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MULTIPLE - USE  
NATURAL RESOURCES  
MANAGEMENT PLAN

CAMP LEJEUNE, NORTH CAROLINA

PREPARED BY  
CAMP LEJEUNE, NORTH CAROLINA

ASSISTED BY  
SOIL CONSERVATION SERVICE  
U.S. DEPARTMENT OF AGRICULTURE

COOPERATING WITH  
ONslow SOIL AND WATER CONSERVATION DISTRICT

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# TABLE OF CONTENTS

	<u>Page</u>
PREFACE . . . . .	1
A. Purpose . . . . .	2
B. Planning Methodology . . . . .	4
I. INTRODUCTION . . . . .	7
A. Location . . . . .	7
B. Governmental Jurisdictions . . . . .	7
C. Land Use and Population Trends of Onslow County . . . . .	8
D. Weather and Climate . . . . .	9
E. Geology of Camp Lejeune Area . . . . .	9
F. History and Mission of Camp Lejeune/Marine Corps Air Station New River Complex . . . . .	11
II. INVENTORY OF NATURAL RESOURCES . . . . .	17
A. Land and Water Resources . . . . .	17
1. Topography and Soils . . . . .	17
2. Water Areas and Wetlands . . . . .	21
3. Beach and Barrier Islands . . . . .	37
4. Archeological and Historical Resources . . . . .	44
5. Scenic and Natural Areas . . . . .	46
B. Plant and Vegetative Communities . . . . .	50
1. Major Plant Communities . . . . .	50
2. Major Managed Species . . . . .	54
C. Fish and Wildlife Resources . . . . .	70
1. Featured Wildlife Species . . . . .	70
2. Non-Game Species . . . . .	87
3. Threatened and Endangered Species . . . . .	89
4. Freshwater Fish . . . . .	96
III. LONG RANGE NATURAL RESOURCES MANAGEMENT . . . . .	98
A. Land Use Management Concept, Policies and Long Range Management Goals and Objectives . . . . .	98
B. Forestry, Fish and Wildlife and Outdoor Recreation Management Policies and Long Range Goals and Objectives . . . . .	105
C. Soil and Water Conservation Policies and Long Range Goals and Objectives . . . . .	118
D. Natural Resources Management Coordination and Organizational Structure . . . . .	126
IV. APPENDIX	
A. Forest Resource Management Plan	
B. Fish and Wildlife Management Plan	
C. Cooperative Agreements	
D. Directives and Orders	
E. Technical Guide for Soil and Water Conservation and Grounds Maintenance	
F. Biological Opinions	
G. Maps	

## PREFACE

This Multiple-Use Natural Resources Management Plan revises the previous plan published in 1974. It gives the management concept to be carried out within the Camp Lejeune complex on the use and protection of land, water, and related natural resources following the requirements outlined in Marine Corps Order P11000.8B. The term "Camp Lejeune complex" will be used to mean land and waters within and controlled by Marine Corps Base, Camp Lejeune, and Marine Corps Air Station, New River. This plan was developed by the USDA, Soil Conservation Service, in cooperation with the Director, Natural Resources and Environmental Affairs Division, Marine Corps Base, Camp Lejeune, under the overall cognizance of the Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune.

The plan is organized into a text supported by six appendixes and is bound in a looseleaf notebook to allow continuous updating. Each section has specific purposes and can be used separately. The plan's text provides the following:

1. A brief physical description of the Camp Lejeune complex and the historical perspective of the Marine Corps' use of the land and water areas covered by the plan.
2. A basic assessment and inventory of the renewable and non-renewable natural resources and environmental assets of the Camp Lejeune complex.
3. A summary of the natural resources and environmental protection and management goals and objectives to be implemented by this plan.

4. A definition of the multiple-use concept for natural resources management to be used in the Camp Lejeune complex on the primary use of providing training and support facilities essential to the military mission.
5. The organizational structure to be developed to ensure proper management and protection of natural resources and the efficient coordination of all land management activities within the Camp Lejeune complex.
6. Appendixes A and B provide ten-year management plans for the development, protection, and enhancement of forest and wildlife resources within the Camp Lejeune complex. These plans also address outdoor recreational activities such as hunting, camping, picnicking, etc. Appendix C provides copies of all existing cooperative agreements with federal, state and local natural resources management agencies. Appendix D is a brief summary of significant orders and directives affecting the day-to-day implementation of this plan. Appendix E gives locally adapted technical guides for soil and water conservation and grounds maintenance. Appendix F provides aerial photographic-based planning maps.

#### A. PURPOSE

This plan has been developed to assist both natural resource managers and military land use managers. There are five general objectives which guided the development of this plan:



1. To provide consolidated guidance for the local implementation of the management concept and operational requirements of Marine Corps Order P11000.8B and to establish command objectives and goals for natural resources management and environmental protection.
2. To improve capabilities for providing and updating scientific natural resources data required to properly plan, design, construct, operate, and maintain military training areas and supporting facilities.
3. To identify land use and other natural resources and environmental management issues to be addressed during the period 1987-1997 relative to the development and utilization of military training areas and supporting facilities.
4. To provide guidance for programming and budgeting for pollution abatement; natural resources management; and archeological and historical resources protection by establishing specific goals in these areas for the period 1987-1997.
5. To promote the enhancement and utilization of natural resources through implementation of the multiple-use concept of land use management within the constraints of the military mission.

A more specific objective of the program outlined in this plan is to assist with planning and decisionmaking in the area of natural resources management. Many phases of natural resource management, involve decisionmaking which can be very subjective due to the difficulty in presenting and evaluating

applicable data. Also, decisionmakers are often not directly involved or trained in natural resources management. The establishment of clear command objectives in the area of natural resources and environmental management and protection will provide continuity to the program. These objectives also become standards for use in evaluating the impact of proposed actions on the human environment and ensuring compliance with public policy on natural resources management. Decisionmakers must have access to accurate, up-to-date natural resources data regarding issues they must address. Formally identifying issues and goals to be addressed by the command will further aid all decisionmakers to understand the relationship between the primary land use of military training and support, and the following types of secondary uses prescribed by the multiple use concepts outlined in MCO P11000.8:

- (a) Production of timber products
- (b) Fish and wildlife management
- (c) Outdoor recreation

#### B. PLANNING METHODOLOGY

The most important planning factor affecting the development of this plan was insuring maximum coordination with the current base master plan. Since revision of the master plan was in progress, flexibility in scheduling the revision of this Multiple-Use Natural Resources Management Plan was required. This revision was delayed almost 18 months to insure that the master plan development was sufficiently complete to serve as a basic planning guide/reference. (A decision was made to revise

this plan utilizing assistance of the USDA, Soil Conservation Service.) There were five phases of the planning process used to develop this Natural Resources Management Plan as follows:

Base natural resources managers and SCS specialists inventoried existing natural resources, evaluated existing natural resources management programs, and identified natural resources management issues and problems.

A joint review was conducted involving SCS specialists, Base Facilities and military training managers. Military training managers briefed and provided comprehensive guidance to planners involved in revision of this plan on the existing and proposed changes in military mission relative to impact on land use planning.

SCS specialists and Base natural resources managers evaluated available information and developed a mutually agreed to list of natural resources issues and problem areas which required attention during the period covered by this plan. Additionally, a mutually agreed to outline/table of contents was developed for this plan along with how information should be presented.

SCS specialists prepared and compiled a rough draft of the plan, including appendixes.

A second review in progress was conducted, during which cognizant facilities and military training managers reviewed and commented on the draft plan.

Based on the above, SCS prepared a final draft for review and approval by the command and natural resources managers at Headquarters Marine Corps.

## MULTIPLE-USE NATURAL RESOURCES MANAGEMENT PLAN

### I. INTRODUCTION

#### A. LOCATION

The Camp Lejeune military complex is located in southeastern North Carolina approximately 300 miles south of Washington, D. C. The complex is located within Onslow County and has approximately 14 miles of Atlantic Ocean shoreline. Bordered on the northwest by the City of Jacksonville, Camp Lejeune is centered in a rapidly growing region approximately 50 miles from the cities of Wilmington, New Bern and Morehead City. See figure 1.

#### B. GOVERNMENTAL JURISDICTIONS

The planning environment is relatively simple because the complex is located wholly within Onslow County, with sufficient buffer between adjacent counties. Jacksonville is the only incorporated city routinely affected by land-based military activities. Traffic generated by military training affects port facilities in Morehead City and Wilmington, and Carteret, Pender and New Hanover Counties. Air space utilization is of regional concern. However, for the purposes of this plan, only Onslow County, the City of Jacksonville and the State of North Carolina are significantly affected by actions taken within the scope of this plan.

### C. LAND USE AND POPULATION TRENDS OF ONSLOW COUNTY

During the past 10-year period, urbanization has rapidly increased in Onslow County. Residential development has flourished adjacent to all Base boundaries, except where both adverse soil conditions limited the use of septic tank and central sewage treatment facilities were unavailable. Present military population of Camp Lejeune is approximately 40,928 active duty personnel. The military dependent community is in excess of 32,081 (see Note #1). About 36,086 of these personnel and dependents reside in Base housing units. The remaining personnel and dependents live off base and have had dramatic effects on the surrounding area. An additional 4,412 civilian employees perform facilities management and support functions. The population of Onslow County has grown from 17,739 in 1940 (see Note #2), prior to the formation of the Base, to its present population of 121,350 (see Note #3).

The Base, its personnel and its related activities are an integral part of the local area and its social, economic and political climate.

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Note #1: Monthly Camp Lejeune Area Population Report, 30 Nov. 1985.

Note #2: Federal Census, 1940.

Note #3: Office of State Budget and Management Report, 27 Sept. 1985.

#### D. WEATHER AND CLIMATE

Climate and Weather - Camp Lejeune has a mild climate. Typically, summers are hot and humid and winters are cool with some subfreezing cold spells. An occasional accumulation of snow occurs, but rarely persists for more than a few hours. The annual average precipitation is 55.96 inches with the mean temperature being about 60.9°F. The prevailing wind direction is from the southwest; however, sea breezes are a regular occurrence along the coastline. The mild climate and moderating effects of ocean currents provide a long growing season typically in excess of 230 days. Figure 2 gives data on temperature and precipitation.

#### E. GEOLOGY OF THE CAMP LEJEUNE AREA

The Camp Lejeune land area originated in a marine or coastal environment similar to that along the present Atlantic Coast. Changes in sea level due to glacial fluctuations and/or slight crustal movements have caused the alternating emergence and submergence of portions of this surface at irregular intervals. When submerged, the area collected deposits of continental and marine sediments. Each successive emergence resulted in shoreline modifications upon the newly emerged coastal area. The Coastal Sand Ridge that approximately parallels the present shoreline is a beach deposit that formed during these cycles of emergence (see Figure 3).

This area of the Coastal Plain is underlain by hundreds of feet of unconsolidated to weakly consolidated sediments

ranging from Cretaceous to Miocene age. Generally, these formations are covered with a 5 to 30 foot thick layer of Pleistocene sediments. The sediments are mostly clean sand and clayey sand, interlayered with deposits of clay and marine shells. Outcroppings of the Miocene Yorktown Formation occur on the banks of large streams. The Yorktown Formation consists of clay, sand, and shell marl beds similar to the younger surficial deposits (see Note #4).

The mainland area of the complex is made up of three geomorphic surfaces. These surfaces represent three periods of geologically recent land emergence. The Pamlico surface lies at elevations of 0 to 25 feet in a two-mile wide strip near the Intracoastal Waterway and narrower strips along New River and its tributaries. The Wicomico surface, represented by a few areas south of Jacksonville, lies at elevations of 45 to 75 feet. The majority of the complex lies within the Talbot surface at elevations of 25 to 45 feet. Much of this surface is nearly level with wide, dissected divides having soils which are often poorly to very poorly drained due to lack of relief.

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Note #4: Soil Survey Camp Lejeune, NC December 1984.



The Outer Banks makes up the rest of the land area and is a small but very important natural resource area. It is a relatively uniform sand ridge ranging from 200 to 500 feet wide along the entire ocean front. The area consists of two islands caused by three inlets which have cut through the Outer Banks within the complex. Bordered on the east by the Atlantic Ocean and on the west by large areas of salt marsh and open water, this dynamic area is a focal point for natural resources management and environmental protection. The 5 to 15 foot high sand ridges are continuously battered by wind and wave action.

F. HISTORY AND MISSION OF CAMP LEJEUNE/MARINE CORPS AIR STATION  
NEW RIVER COMPLEX

Historians and archeologists indicate the existence of Paleo-Indians during the 10,000 to 11,000 B.C. along the White Oak River and in the area now known as Camp Lejeune.

The coming of age of a new nation saw eastern North Carolina grow slowly. Jacksonville and the surrounding area was a rather quiet community until 1940, when the storm clouds of Europe began spreading over this nation.

With World War II imminent, the coastal carolina site with its 14 miles of ocean front was selected as the East Coast location best suited for an expanded Marine Corps with its amphibious mission.

The development of Camp Lejeune occurred in three major phases of construction. Early in 1941, the first phase of Base development was begun and included the construction of

temporary troop quarters and temporary administrative facilities in the Camp Geiger and Montford Point areas, as well as CCC Camp for civilian workers at Camp Knox. These areas were selected for the original development due to their proximity to Jacksonville, which provided a major source of labor and materials and access to existing roads and rail lines.

In April of 1941, the second phase of construction began at Hadnot Point. A development plan was prepared which sited the major Marine Corps organizational units along the shores of the New River and sited support and industrial facilities inland.

The third phase occurred with changing requirements and involved additional construction of barracks and support facilities in the outlying areas of Montford Point, Camp Geiger and Courthouse Bay.

During the early development of the Camp Lejeune complex, operational and training activities were limited to various types of amphibious warfare. When Camp Lejeune was founded, amphibious training was envisioned as the major Base function. The remaining Base area was acquired for general infantry training and was underutilized for many years.

Since World War II, Marine Corps tactical theories have evolved from extensive beach operations to a concept of vertical envelopment warfare. This evolution combined with the development of new weapons systems and vehicles with greater range and destructive capabilities has resulted in

the inland areas of Camp Lejeune and the accompanying airspaces now being filled with new training ranges and facilities.

From the initial days of development through the projected future, training programs have always considered the underlying thought, "keep training and the environment in balance."

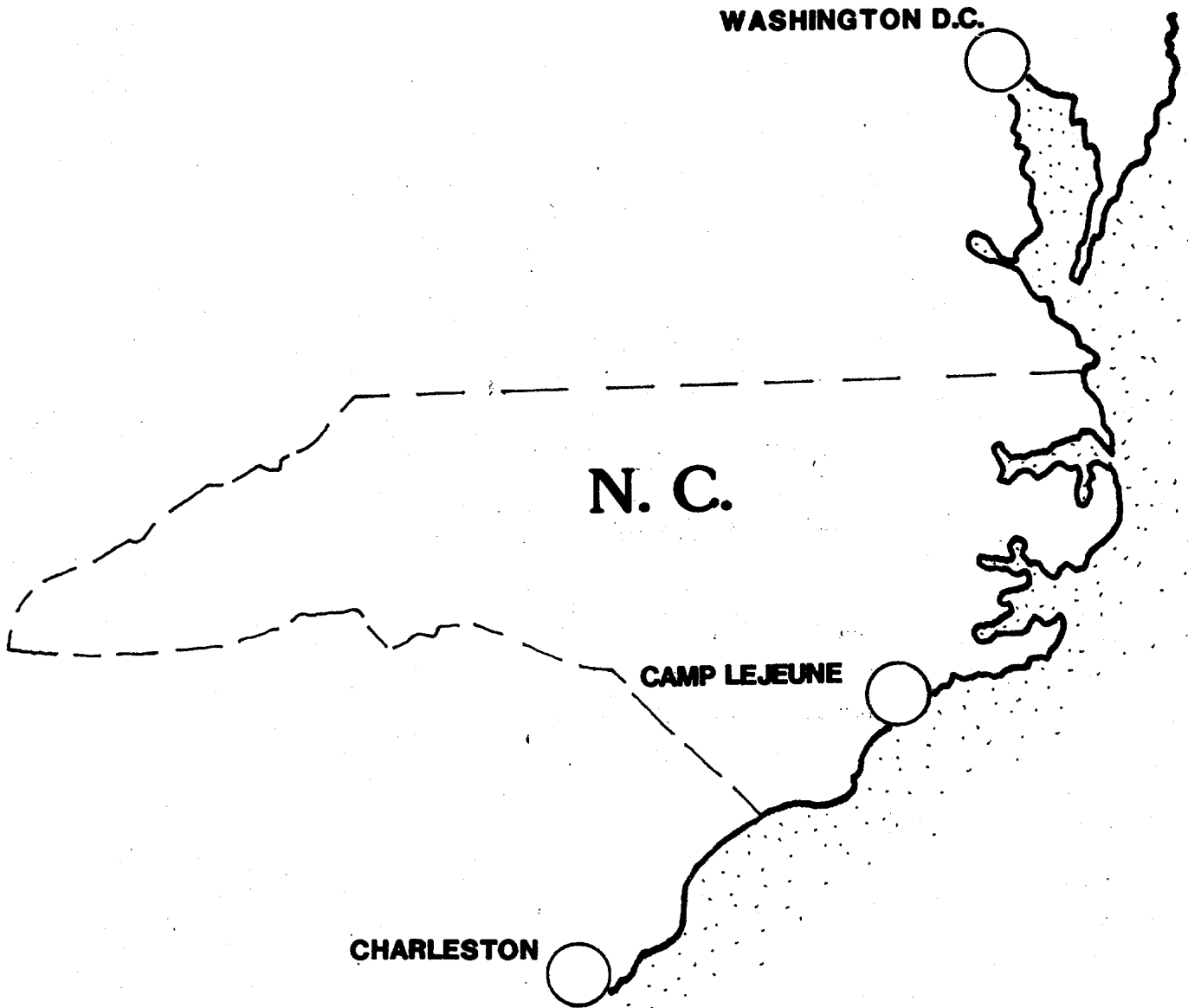


FIGURE 2  
TEMPERATURE AND PRECIPITATION DATA

(Data were recorded in the period 1951-79 at Maysville, NC)

Month	Temperature						Precipitation					
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days	Average	2 years in 10 will have--		Average number of days with snowfall 0.10 inch or more	Average	
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--			
°F	°F	°F	°F	°F	Units	In	In	In	In			
January----	56.3	31.0	43.7	78	9	69	4.10	2.36	5.64	8	1.2	
February---	58.3	32.2	45.3	79	9	55	4.01	2.38	5.46	7	.8	
March-----	65.5	38.3	51.9	85	18	155	3.96	2.37	5.38	8	.5	
April-----	74.7	46.0	60.4	90	25	312	3.11	1.66	4.36	5	.0	
May-----	80.8	54.5	67.7	95	32	549	4.80	3.23	6.24	8	.0	
June-----	85.5	61.7	73.6	97	42	708	6.00	3.18	8.47	8	.0	
July-----	88.6	66.4	77.5	97	51	853	7.01	4.64	9.17	10	.0	
August-----	87.9	65.7	76.8	97	50	831	6.87	4.03	9.39	9	.0	
September--	83.8	59.9	71.9	93	39	657	5.96	2.80	8.67	7	.0	
October----	75.2	48.9	62.1	88	23	381	3.34	1.30	5.04	5	.0	
November---	67.4	39.3	53.4	83	17	147	3.11	1.58	4.43	5	.0	
December---	59.1	32.8	46.0	78	10	85	3.69	1.91	5.23	6	.4	
Yearly:												
Average--	73.6	48.1	60.9	---	---	---	---	---	---	---	---	
Extreme--	---	---	---	98	6	---	---	---	---	---	---	
Total----	---	---	---	---	---	4,802	55.96	47.23	64.30	86	2.9	

<sup>1</sup> A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

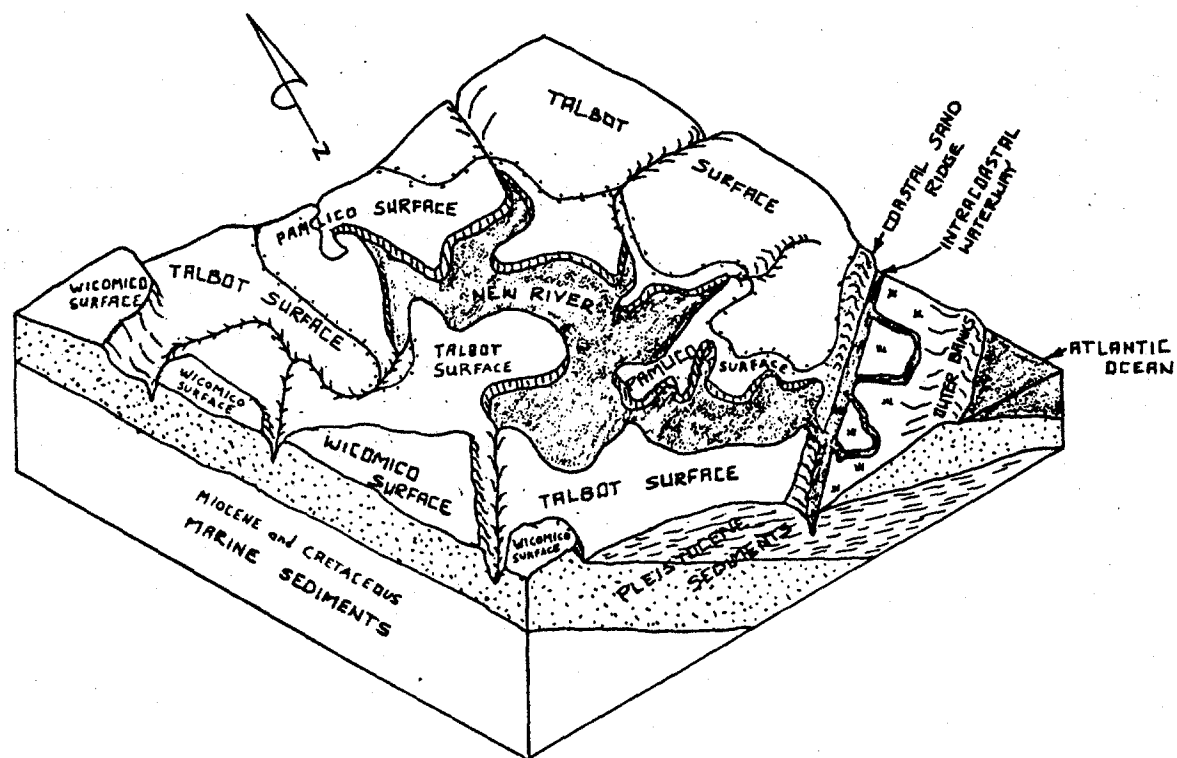


FIGURE 3: Elevations of geomorphic surfaces of the Camp Lejeune area: Pamlico 0-25 feet, Talbot 25-45 feet, Wicomico 45-70 feet.

## II. INVENTORY OF NATURAL RESOURCES

### A. LAND AND WATER RESOURCES

#### 1. Topography and soils

The surface configuration of the inland portion of the Camp Lejeune is related to (1) undissected, nearly level marine sediments which comprise the interstream areas, (2) short convex slopes and narrow valleys made by streams, and (3) low ridges formed by wind deposits of coastal sand. The Outer Banks portion is related to wind deposits of coastal sand on ridges and tidal marsh that flood daily. The elevation of Camp Lejeune ranges from sea level to about 72 feet.

The inland valley bottoms range from 5 to 30 feet below the uplands. The sides of valleys range from 5 to 60 percent slopes and length of slopes range from 20 to about 250 feet. The valley bottoms or flood plains range from a few feet to several hundred feet wide.

The soils on the flood plains are poorly drained Muckalee loam, very poorly drained Dorovan muck, and poorly drained Bohicket silty clay loam which are on wide estuarial flood plains of coastal creeks.

The soils on valley sides are well drained Marvyn loamy fine sand, 6 to 15 percent slopes, (also the steeper valley side slopes are included in mapping with this map unit), and moderately well drained Craven fine sandy loam, 4 to 8 percent slope soils.

The soils joining side slopes to valleys and extending a short distance away from the valley sides are convex areas of well drained Baymeade fine sand, 0 to 6 percent slopes, Norfolk loamy fine sand, 0 to 2 percent slopes and Norfolk loamy fine sand, 2 to 6 percent slope soils.

Adjacent to the more convex areas are slightly convex areas of moderately well drained Foreston loamy fine sand, 0 to 2 percent slopes, Goldsboro fine sandy loam, 0 to 2 percent slopes and Onslow loamy fine sandy soils.

The soils on undulating and low ridges near the edge of the mainland and near coastal creeks are excessively drained Alpin fine sand, 1 to 6 percent slopes, Kureb fine sand, 1 to 6 percent slopes and Wando fine sand, 1 to 6 percent slope soils. In depressions of this area is moderately well and somewhat poorly drained Pactolus fine sand, poorly drained Leon fine sand, and very poorly drained Murville fine sand soils.

The soils on broad, nearly level interstream areas are somewhat poorly drained Lenoir loam, Lynchburg fine sandy loam and Stallings loamy fine sand soils joining the slightly convex areas. Near the center part of the interstream areas are poorly drained Leon fine sand, Rains fine sandy loam, and Woodington loamy fine sand soils. In the center and in depressions are very



poorly drained Croatan muck, Murville fine sand, Pantego mucky loam, and Torhunta fine sandy loam soils.

The soils of the Outer Banks' portion are excessively drained Newhan fine sand, 0 to 30 percent slopes on ridges and dunes, and moderately well drained Corolla fine sand and poorly drained Duckston fine sand soils in depressions. Poorly drained Bohicket silty clay loam and very poorly drained Lafitte muck soils are on tidal marshes, and somewhat poorly to moderately well drained Yaupon fine sandy loam, 0 to 3 percent slope soils, are on dredge spoil.

## ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map Symbol	Soil Name	Acres	Percent
AnB	Alpin fine sand, 1 to 6 percent slopes	1,090	1.3
BmB	Baymeade fine sand, 0 to 6 percent slopes	21,295	24.7
BaB	Baymead-Urban land complex, 0 to 6 percent slopes	4,783	5.6
Bo	Bohicket silty clay loam	1,998	2.3
Co	Corolla fine sand	121	0.1
CrB	Craven fine sandy loam, 1 to 4 percent slopes	182	0.2
CrC	Craven fine sandy loam, 4 to 8 percent slopes	202	0.2
Ct	Crotan muck	747	0.9
Da	Dorovan muck	1,150	1.3
Dc	Duckston fine sand	202	0.2
FoA	Foreston loamy fine sand, 0 to 2 percent slopes	908	1.0
GoA	Goldsboro fine sandy loam, 0 to 2 percent slopes	545	0.6
GpB	Goldsboro-Urban land complex, 0 to 5 percent slopes	969	1.0
KuB	Kureb fine sand, 1 to 6 percent slopes	4,360	5.1
La	Lafitte muck	40	0.05
Le	Lenoir loam	40	0.05
Ln	Leon fine sand	7,650	8.9
Ly	Lunchburg fine sandy loam	141	0.2
MaC	Marvyn loamy fine sand, 6 to 15 percent slopes	8,820	10.3
Mk	Muckalee loam	4,400	5.2
Mu	Murville fine sand	3,472	4.0
NeE	Newhan fine sand, 0 to 30 percent slopes	1,433	1.6
NfC	Newhan fine sand, dredged, 2 to 6 percent slopes	606	0.7
NoA	Norfolk loamy fine sand, 0 to 2 percent slopes	101	0.1
NoB	Norfolk loamy fine sand, 2 to 6 percent slopes	868	1.0
On	Onslow loamy fine sand	6,903	8.0
Pa	Pactolus fine sand	1,776	2.1
Pn	Pantego mucky loam	161	0.2
Pt	Pits	363	0.4
Ra	Rains fine sandy loam	686	0.8
St	Stallings loamy fine sand	1,211	1.4
To	Torhunta fine sandy loam	1,655	1.9
Ud	Udorthents, loam	654	0.7
Ur	Urban land	969	1.1
WaB	Wando fine sand, 1 to 6 percent slopes	4,622	5.4
Wo	Woodington loamy fine sand	989	1.1
YaA	Yaupon fine sandy loam, 0 to 3 percent slopes-	61	0.1
	Total Land Area	86,173	100.0
	Water	75	
	Total Area	86,248	

## 2. Water Areas and Wetlands

The water areas and wetlands on the Base were inventoried and mapped in 1985. This was done by personnel from the North Carolina Department of Natural Resources and Community Development using wetland definitions contained in the document "Classification of Wetlands and Deepwater Habitats of the United States" by Cowardin, et. al. published by the U.S. Fish and Wildlife Service in December 1979.

A summary of the acres of wetlands, by type, is shown in table 1. Maps depicting the location of these wetlands are available for review at the Base library.

Additional information on water areas, wetlands, and the beach and barrier islands, was obtained from a document prepared in 1982 by Thomas C. Loftfield entitled "Archeological and Historical Reconnaissance of U.S. Marine Corps Base, Camp Lejeune -- Part One -- The Prehistoric Archaeological Record". This document describes the interrelationships within the biotic communities. Information presented on pages 23 through 48 was taken from Loftfield's report.

TABLE 1  
CAMP LEJEUNE

QUAD NAME	M2US	E1OW	E2US	E2EM	E2SS	PUB	PAB	PEM	PSS	PF01	PF04	PF06	PFO()	POW	TOTAL WET	TOTAL NONWET
J'ville South		3820		51	36			251	175	1614	899	619	972	21	8458	20486
Sneads Ferry		5124		163	188			18	61	545	211	41	261	2	6614	6352
Camp Lejeune		2123	7	14	3	1	17	305	1133	1005	730	1107	1259	91	7795	29928
New River Inlet	147	1312	10	1844	20		2	142	934	1514	1183	174	717	76	8075	11871
Hubert		39	28	62				18	63	210	341	72	141	5	979	1893
Browns Inlet	164	317	230	935	66			4	13	2	292				2023	3820
<b>TOTAL</b>	<b>311</b>	<b>12735</b>	<b>275</b>	<b>3069</b>	<b>313</b>	<b>1</b>	<b>19</b>	<b>738</b>	<b>2379</b>	<b>4890</b>	<b>3656</b>	<b>2013</b>	<b>3350</b>	<b>195</b>	<b>33944</b>	<b>74350</b>

MAP UNIT DESIGNATIONS

1. M2US Marine, intertidal, unconsolidated shore
2. E1OW Estuarine, subtidal, open water
3. E2US Estuarine, intertidal, unconsolidated shore
4. E2EM Estuarine, intertidal, emergent
5. E2SS Estuarine, intertidal, scrub-shrub
6. PUB Palustrine, unconsolidated bottom
7. PAB Palustrine, aquatic bed
8. PEM Palustrine, emergent
9. PSS Palustrine, scrub-shrub
10. PF01 Palustrine, forested, broad-leaved deciduous
11. PF04 Palustrine, forested, needled-leaved evergreen
12. PF06 Palustrine, forested, deciduous
13. PFO() Palustrine, forested, (mixed community)
14. POW Palustrine, open water

Pocosins. These are the most common lowland forest communities along the coast from Dare County southward. They develop on highly organic soils that are seasonally flooded. Pocosins are commonly found in three situations: in shallow peat and muck filled Carolina Bays, on flat upland areas underlain by impermeable humic and peat substratum, and between sand ridges in low depressional areas containing shallow peat deposits underlain by sands.

Many plants which inhabit pocosins are adapted to substrata with low nutrients, drought, and low pH conditions. Thus, they are physiologically similar to those species found in and associated with peat bogs of boreal forest biomes. Pond pine (Pinus serotina) is the dominant tree species in the pocosin communities but seldom forms a closed upper tree canopy. A dense shrub layer is usually present beneath the pines, and most species are characteristically sclerophyllous evergreens. Species include red bay, sweet bay, swamp ironwood (Cyrilla racemiflora), zenobia (Zenobia pulverulenta), fetterbush (Lyonia lucida), sweet gallberry (Ilex coriacea), dahoon holly (Ilex cassine), and pepperbush (Clethra alnifolia). Few herbaceous plants occur under the shrub zone because little sunlight is able to reach the ground surface. Where openings in the shrub occur, yellow-eyed grasses (Xyris spp.), pipewort (Eriocaulon decanquale), sphagnum

mosses (Sphagnum spp.), haircap mosses (Polytrichum spp.), running pine (Lycopodium alopecuroides), chain ferns (Woodwardia areolata, W. virginica), cinnamon fern (Osmunda cinnamomea), venus fly trap (Dionaea muscipula) and switchcane (Arundinaria gigantea) may be present.

Pocosins, like many other pine communities, are variable in appearance and are strongly influenced by fire. Under the conditions of a long hydroperiod and frequent fire, zenobia and pond pine tend to dominate in a low type of pocosin. With fire withheld, swamp ironwood tends to overtop zenobia and develops a swamp ironwood-pond pine dominated community. On somewhat drier sites with shorter hydroperiods, switchcane dominates frequently on recently burned sites; whereas sweet bay, red bay, loblollybay (Gordonia lasiantha), and pepperbush become common when fires are absent for lengthy time intervals.

These densely vegetated communities are not generally inhabited by a large variety of animals, although they do serve as a shelter refuge for many animals living in the surrounding area.

Inland Bogs and Marshes. These biotic communities occur a short distance inland from the search at several locations. The percentage of landscape which they cover in the project vicinity is considerably less

than that covered by other coastal plain communities described previously.

Bogs are frequently interspersed among pocosin communities in areas where drainage of surface water is severely restricted or blocked. These communities are characterized by a semi-floating mat or cushion-like vegetation that develops on soils which are thoroughly waterlogged throughout the year. Sphagnum mosses (Sphagnum spp.) are the dominant plant species present, but sundews (Drosera spp.), and pitcher plants may also be common. The low mat growth is occasionally interrupted by small shrubs that are capable of growing in wet habitats. Many of these are the same species found in pocosins.

The dense, congested growth of plants and poor circulation of water which typify these communities prevent rapid decomposition of organic debris. As a result, thick layers of organic peat often accumulate beneath the floating mat. Bog waters are often brown in color and strongly acidic. Anaerobic substrate conditions are common.

Marshes occur in low, poorly drained areas and along the shallow water margins of ponds and lakes. Standing water is present throughout the growing season with water levels ranging from 6 inches to 3 feet. Vegetation is dense and often dominated by emergent herbaceous grasses, rushes, and sedges.

Species composition varies depending on salinity of the water. In freshwater situations, species include maidencane (Panicum hemitomon), carexes (Carex spp.), common reed (Phragmites communis), sawgrass (Cladium jamaicensis), big cordgrass (Spartina cynosuroides), spike sedge (Eleocharis spp.), threesquares (Scirpus spp.), smartweeds (Polygonum spp.), cattails (Typha spp.), arrowheads (Sagittaria spp.), pickerelweed (Pontederia cordata), lizardtail (Saururus cernuus), pennywort (Hydrocotyle umbellata), and wild rice (Zizania aquatica). In brackish situations, saltmeadow cordgrass, saltgrass (Distichlis spicata), black needlerush (Juncus roemerianus), olney threesquare (Scirpus olneyi), and marsh fleabanes (Pluchea spp.) are often common. Substrates in the marshes consist of soft mush which is rich in partially decomposed organic matter and mixed with mineral soils.

Inland bogs and marshes serve many of the same ecological functions as tidal marshes. They are a source of valuable nutrients and detritus, much of which is either consumed insitu by small animals or is eventually washed into deeper water where it contributes to the food supply of larger pelagic and benthic animals. These communities are often closely associated with the swamp forest, and like the forest, are rich in animal life.



Ponds and Lakes. Several sites on Camp Lejeune are occupied by these aquatic habitats. Ponds and lakes occur in low, depressional areas where the water table reaches the surface or where the ground substrate is underlain by impermeable materials. Distinction between the two water body types is often difficult to make especially since most of the natural lakes on Camp Lejeune are not very expansive. In general, though, ponds have shallow enough waters to permit growth of rooted plants over most of their bottoms while lakes have a central profundal zone that is devoid of rooted vegetation. The failure of rooted plants to become established in the lake profundal zone is attributable to the deeper water depths which prevent sufficient sunlight from reaching the lake bottom. Lakes in the study area are filled with water throughout the year, whereas many of the ponds dry up during periods of drought. Salinities in these water bodies range from freshwater to brackish. Both ponds and lakes occasionally have outlet streams and both trap sediments brought in by runoff. The accretion of sediments eventually causes these water bodies to succeed to an upland terrestrial community.

The vascular flora which is present in ponds and lakes can be divided into three zones: submerged, floating, and emergent. The submerged zone is found farthest from the shoreline. The plants in this region

are rooted in the bottom and are completely immersed. They are characteristically thin and delicate, lack supportive tissue, and depend on the water to keep them buoyant. Common species in this zone include bladderworts (Utricularia spp.), waterweeds (Elodea spp.), water nymphs (Najas spp.), proserpinacea (Proserpinaca palustris), egeria (Egeria densa), and pondweeds (Potamogeton diversifolius, P. pulcher), in fresh water to mildly brackish situations, and widgeon grass (Ruppia maritima), and pondweeds (Potamogeton perfoliatus var. burpleuroides, P. pectinatus) in more saline waters. The floating plant zone occurs shoreward of the submerged plants. The plants in this zone have little supportive tissue, poorly developed root systems, and often two leaf types: broader, heavily waxed leaves which float on the water surface, and small, highly dissected leaves that occur submerged. These plants' stems and floating leaves frequently contain substantial quantities of spongy tissue which are filled with large air sacs. Typically found in the floating plant zone are waterlilies (Nymphaea spp.), spatterdocks (Nuphar spp.), watershield (Brasenia schreberi), waterstarwort (Callitriche heterophylla), duckweeds (Lemna spp.), and alligator weed (Alternanthera philoxeroides). Many of these are more commonly found in or restricted to fresh water. The floating plant zone is succeeded by a marsh

region dominated by emergent rushes, sedges, and grasses. The species composition has been described previously.

Water and abundant plant growth in many ponds and lakes (around Onslow County) provide attractive habitat for a variety of fish, waterfowl, and other aquatic and semi-aquatic vertebrate species.

Communities Associated With Open Water. Sounds, bays, drowned river valleys, and channels form the open water habitat. Salinities vary from 1.2 to 38.4 ppt, and depths range from mean low water to less than 25 feet. As defined here, open water includes all marine and estuarine waters together with all underlying bottoms below the intertidal zone. Intertidal habitats are considered separately as salt marsh and tidal flat habitats.

The open water biota includes plankton and nekton inhabiting the water column and the benthos living on or in the various types of substrata. The plankton is composed of many types of unicellular algae, various protistan groups (of which the protozoans are most important), larval stages of many invertebrates and fish, and the adult stages of several microscopic invertebrates. Larger animals, such as jellyfish and comb jellies that are carried passively by currents and tides because of their weak swimming ability, are also included in the plankton.

Fish are the principal nekton, but some crustaceans such as portunic crabs, amphipods, and isopods, and some mollusks such as squid, spend at least part of their life as nekton. The open waters of the sound are important nursery areas for fish and shrimp. The sounds are important fishing grounds for shrimp and spot.

The benthic environment includes some communities correlated largely with substratum type. Multicellular green, red, and brown algae, unicellular algae (especially diatoms), and a few aquatic angiosperms, such as widgeon grass and eelgrass, are the primary producers within the photic zone of the benthic environment. The submerged aquatics are an important source of detritus which provide shelter for larval and juvenile animals and serve as bottom stabilizers. Eelgrass is highly productive and provides food and cover for many estuarine organisms. Eelgrass is the primary food source for bay scallops.

The benthic fauna is divided into two groups: epifauna, living on the substratum; and infauna, living within the substratum. Infaunal communities are dominated by a great diversity of burrowing and tube dwelling crustaceans (e.g., amphipods), polychaete worms, and by burrowing bivalve mollusks. Some infaunal invertebrates, especially among the crustaceans, are capable of a high degree of lateral

mobility, but the majority can be regarded as essentially sedentary. The infauna is, with rare exception, comprised of filter and detritus feeding invertebrates.

The epifauna contains a diversity of animal groups associated with a diverse flora. Hard substrata such as rocks, shell and gravel surfaces; and artificial surfaces such as pilings, wrecks, and weirs, support a rich assortment of attached plants and invertebrates. Typically, these communities contain red, green and brown algae, barnacles, attached bivalves, anemones, corals, sea fans, bryozoans, tunicates, sponges, and foraminifera. The communities formed by these attached organisms host a number of both transient and permanent fish species, and motile invertebrates, including gastropods, star fish, sea urchins, crabs, and shrimp. Attached epifaunal invertebrates are principally filter and detritus feeders, but some motile organisms are carnivores.

The epifauna and flora of muddy and sandy bottoms tend to be much lower in diversity, and most inhabitants are microscopic. These surfaces are unsuitable for attachment by sessile invertebrates. In addition, many sand and mud bottoms are depositional, and a continual rain of sediment would quickly bury attached animals. Thus, these substrata support diatoms, other unicellular algae, protistans, and attached

multicellular algae where turbidity is low.

Invertebrates primarily include motile deposit feeders, such as polychaete worms, sea cucumbers, and some sand dollars. Some fish and crabs also graze on the bottom. Attached organisms are restricted largely to the occasional bit of shell or small rock lying on the surface. The development of oyster reefs on muddy intertidal bottoms, for example, is dependent on the presence of bits of shell or rock for initial larval attachment.

Some open water organisms can tolerate wide ranges of temperature and alkalinity, but the majority cannot. Tolerances to environmental parameters also change during the life cycle. Larval or juvenile stages may have environmental requirements dissimilar from those of adult stages within the same species. Anadromous fish and many sedentary invertebrates exhibit this trait. Because of the geologically ephemeral nature of estuaries, fewer organisms are adapted to habitats in brackish waters than to comparable habitats in marine waters. Hence, estuarine communities are less diverse and have shorter food chains than their marine counterparts (Carriker 1967).

Seasonal changes in the open water hydroclimate are reflected in the seasonality of occurrence and abundance of organisms. Many plants and animals are present in a given community for only part of their

life cycle. For example, shrimp and several larval and juvenile fish utilize nutrient-rich coastal open water environments as nursery areas prior to migration to ocean habitats.

The open water community is also utilized by waterfowl and shorebirds particularly during the winter months. A considerable portion of the waterfowl are surface feeders and dabblers, and are commonly found along the shallow water zones where they feed on submerged or emergent vegetation. Species of birds which are found in the deep sounds are principally diving or fish-eating species. Other vertebrates (i.e., mammals, reptiles, and amphibians) are poorly represented in the open water community except where mildly brackish conditions exist. Many of these are semiaquatic and, thus, are temporary residents of the community.

Tidal Marshes. Tidal marshes are discontinuously present in the littoral zones along the (coast). They represent a transitional zone between open water and upland terrestrial habitats. Vegetation in the tidal marshes is dominated by emergent, narrow-leaved rushes, sedges, and grasses. Soils are composed of poorly drained peats and mucks, and anaerobic conditions are usually present beneath the ground surface. Meandering throughout many of these communities are numerous tidal

creeks laden with suspended silts and particulate organic matter.

The tidal marshes south of Beaufort are somewhat vegetationally different from those found north of this point. To the south, the waters are more saline because of their closer proximity to the ocean. Tidal marsh vegetation in this area is composed of highly salt tolerant species and is generally arranged in four recognizable zones. The topographically lowest and first emergent zone occurs from mean sea level (msl) to about mean high water (mhw). This marsh region is regularly flooded by semidiurnal lunar tides and is dominated by smooth cordgrass (Spartina alterniflora). This species usually grows in dense stands and attains its greatest height where inundation is most frequent. A belt of glasswort (Salicornia sp.) is sometimes present along the upper fringes of this low marsh zone. The second vegetational zone occurs beyond mhw and includes that portion of the marsh that is inundated by spring or wind driven tides. Black needlerush is the dominant plant species in this region and usually occurs in relatively pure, dense stands. Beyond the black needlerush region, the marsh is vegetated by a zone of saltmeadow cordgrass and saltgrass which, in turn, is bordered by a mixed herbshrub association along the upper edge of the marsh. Species present in this highest zone include sea oxeye (Borrichia



frutescens), marsh elder, silvering, wax myrtle, and marsh fleabane. Evening primrose (Denothera humifusa) and *Heterotheca graminifolia* are sometimes common where dry, sandy areas are present in this zone.

Tidal marshes are important wildlife habitats. The dense plant growth in these areas provides excellent cover for many species of nesting birds, aquatic and semi-aquatic mammals, reptiles, and amphibians. Energy fixed in the low salt marsh is considered the primary energy source for the detritus based food chains in the estuary. Substrates in these communities are inhabited by a myriad of foraminiferans, nematodes, annelids, arthropods, and mollusks. The importance of these tidal marshes to some commercially important marine species should be noted. It is generally accepted that over 75 percent of the commercially important finfish species are estuarine dependent during some part of their life cycle.

Tidal marshes function as shoreline stabilizers, and they protect the adjacent upland terrestrial communities from storm erosion. The marsh communities also serve to purify water and act as sediment traps for materials brought in by tidal overwash. As the sediments accumulate around the marsh, and subsequently the biotic communities adjacent to it, they encroach upon the estuarine waters. Additionally, tidal marshes are important sources of detritus. The detrital matter

is partially used and recycled by the marsh system itself, but a substantial portion is ultimately flushed into the nearby open water habitats and eventually into the ocean by tidal action. Once transported, the detritus enters a multitude of faunal food webs, many of which include commercially important fish and shellfish species.

Tidal Flats. Composed of soft sand or mud, these biotic communities occur along the shallow water areas of the (sound) and tidal creeks. Though they sometimes create navigational hazards, they are important as wildlife habitats.

Tidal flats are typically devoid of vascular plants but are frequently inhabited by species of diatoms and bacteria. Tidal flats are alternately covered and exposed by wind driven or lunar tides. The tidal action provides a constant influx of particulate organic matter to these habitats, creating a rich nutrient supply for filter-feeding benthic invertebrates. When the tidal flats are covered by water, these animals and nutrients constitute an important food source for a variety of fish species. When the flats are exposed, the nutrients and benthic animals are fed upon by numerous wading birds and shorebirds.

### 3. Beach and Barrier Islands

Beaches occur along the emergent shorelines that are present on the seaward side of barrier islands. Occasionally they extend along the littoral zones of ocean inlets. Beach communities are comprised of a dry berm zone that is located beyond the high tide line, an intertidal zone that is alternately covered and exposed by tidal action, and a subtidal zone that occurs below the low tide line and extends seaward, merging with the ocean surf. Beaches, in general, are gently-sloping communities that serve as transitional areas between open water and upland terrestrial communities.

The beach community is a harsh environment characterized by steep gradients, extremes, and rapid changes in most of its physical environmental parameters. This is particularly true of the upper surface layers. Vascular plants are typically absent from these communities primarily because of instability of the substrata, high salinity, and extreme fluctuation of moisture. Seaweeds and seeds of Caribbean and European plants carried by the Gulf Stream are sometimes tossed up on the beach following the passage of storms. Sediments on the beach are stratified by wind and wave energy regimes according to particle size. Sediment composition consists of coarse to fine grained quartz sands, shells and shell

fragments, fine pebble gravel, and varying amounts of mica.

Micro-invertebrates are the predominant faunal organisms inhabiting the beach region, and most live beneath the sand surface where salinities and temperatures are more constant. A considerable portion of these benthic organisms are filter or deposit feeders, and a great diversity occurs in the intertidal zones where there is a concentration of particulate organic matter brought in by the tides or supplied by the decomposition of animals on the beach. Typical beach inhabitants are beach fleas (Orchestia agilis) and ghost crabs (Ocyroide albicans) in the beach berm, Florida coquinas (Donax variables), mole crabs (Emerita talpoides) and various burrowing worms in the beach intertidal zone, blue crabs (Limulus ployphemus), sand dollars (Mellita Testudinata), and numerous clams and gastropods in the beach subtidal areas. Countless shorebirds, such as terns, gulls, sandpipers, and loons, rest and feed at the water's edge. Atlantic loggerhead sea turtles occasionally utilize the North Carolina beaches for nesting purposes during June and July.

Although the beach is important as habitat for birds and sand-burrowing animals, it also absorbs wave energy and thus protects biotic communities which occur

inland. The greater its width, the greater its energy-absorbing capacity.

Dunes are located landward and run parallel to beach communities. "Dunes are essentially waves of drifting sand whose height and direction of movement are determined by wind direction and intensity" (Frankenburg et al. 1971). Although annual prevailing wind directions are southwesterly, it is the strong northeasterly winds that occur during the fall and winter that are responsible for maximum sand movement.

Few species of plants are capable of inhabiting the dune community due to the inhibitory effect on plant growth by air-borne salt, sediment instability, and frequency of salt overwash. Vegetative coverage is usually sparse and consists predominately of salt tolerant perennial grasses. Typical species include American beach grass (Ammophila breviligulata), bitter panic grass (Panicum amarum), salt-meadow cordgrass (Spartina patens), sea oats (Uniola paniculata), and broomsedges (Andropogon spp.). All of these plants depend on the constant influx of nutrients because leaching in the dune community is very rapid. Likewise, all of the above species derive nutrients from particulate matter attached to the sands and precipitation. As they accumulate sand at their bases, the plants increase the vertical height of the dunes, and their creeping rhizome systems act as sand binders

thus stabilizing the dunes to some degree. Occasionally, interspersed among the dune grasses are scattered individuals of sea rocket (Cakile edentula), sandspur (Cenchrus tribuloides), seaside croton (Croton punctatus), beach spurge (Euphorbia polygonifolia), evening primrose (Oenothera humifusa), seaside elder (Iva imbricata), beach pea (Strophostyles helvola), and purple sandgrass (Triplasis purpurea).

"While the fragile network of dune vegetation is adapted to withstanding the rigors of wind, sand, and salt, the region is easily disrupted by human and vehicular traffic and grazing livestock. Destruction of foredune vegetation by these agents causes the dune to be subject to severe wind erosion. In some areas, the rate of sand movement may be accelerated to such a degree that rapid plant recolonization is virtually prohibited" (Frankenburg et al. 1971).

The lack of vegetative cover and insufficient food supply limit the dune community as an important wildlife habitat. Ghost crabs, tiger beetles, dragonflies, Song Sparrows, Savannah Sparrows, Barn Swallows, six-lined racerunners, Eastern glass lizards and Eastern slender glass lizards are characteristic faunal inhabitants. Black Skimmers and species of terns occasionally utilize the dune communities for nesting purposes during the spring and summer.

The dune community, like the beach, sometimes serves as a protective barrier against storm erosion and damage for the inland environment. Although the initial stress of such storms is sustained by the beaches, those waves that do enter the dune community have their energy rapidly exhausted because of the dune's movable and penetrable landform. Natural dune systems are subject to at least temporary destruction from severe storms, as are the controversial, artificially maintained dunes along the coast.

Maritime Shrub Thicket. Shrub thickets are typically found landward of the dune communities. They may extend continuously to the edge of the tidal marshes along the western fringe of the barrier islands or blend into a maritime forest.

As the name implies, these communities are characterized by a dense growth of low shrubs that are usually entangled with numerous vines. The community usually begins abruptly on the dune side. The first shrubs are commonly prostrate but they become progressively taller with increasing distant inland. The tops of the shrubs are often closely sheared by windborne salt spray and form a smooth, compact, canopy surface. Salt-spray shearing is most evident on the community's seaward side. Substrates in these habitats consist of unconsolidated sands which are intermittently flooded in low swale areas and well

drained on topographically higher elevations. Typical shrub inhabitants are wax myrtle (Myrica cerifera), bayberry (Myrica pensylvanica), silvering (Baccharis halimifolia), seaside elder, winged sumac (Rhus copalina), yaupon (Ilex vomitoria), Carolina laurel-cherry (Prunus caroliniana), live oak (Quercus virginiana), red cedar (Juniperus virginiana), and hercules club (Zanthoxylum clavaherculis). Shrub species distribution and frequency of occurrence in any given area, however, vary according to substratum moisture and degree of salt spary influence. Common vine species in these communities are Virginia creeper (Parthenocissus quinquefolia), and hercules club (Zanthoxylum clavaherculis). Shrub species distribution and frequency of occurrence in any given area, however, vary according to substratum moisture and degree of salt spary influence. Common vine species in these communities are Virginia creeper (Parthenocissus quinquefolis), poison ivy (Rhus radicans), greenbriars (Smilax spp.), and wild grapes (Vitis spp.). Few herbaceous plants are present on the ground surface due to the shading effect created by the dense shrub and evergreenness of most shrub species.

Maritime shrub thickets do not provide a significant year-round source for wildlife and, because of this, are not heavily utilized.



Maritime forest occur landward of maritime shrub communities. Trees in the maritime forest are closely and usually dominated by live oak. Many shrub species occur here as well but are less densely distributed than in the shrub thicket because of shading effects produced by continuous canopy coverage. The maritime forest is subject to the shearing effect of wind-borne salt spray, and the canopy bears a direct relationship to the intensity of salt spray as dominant on the wettest sites with the longest hydroperiod, whereas tupelo gum becomes more abundant on sites with shorter hydroperiods. Both species generally require bare, unflooded mineral soil for seed germination and establishment to occur. Other tree species found in these associations are red maple (Acer rubrum), black gum (Nyssa sylvatica), sweetgum (Liquidambar styraciflua), sweetbay (Magnolia virginiana), redbay (Persea borbonia), water oak (Quercus nigra) and water ash (Fraxinus carolinana). Few shrubs and herbaceous plants occur beneath the tree canopy. A mixed forest often develops where hydroperiods are of intermediate duration.

The white cedar association develops on peaty or semi-sandy soils that are subject to very long hydroperiods. White cedar is usually the only tree species present and often grows in very dense stands. Shrub and herbaceous plants are not common.

Swamp forests are typically very rich in animal life. Of all wooded communities, on the outer coastal plains, these will generally have the greatest diversity of animal species.

#### 4. Archeological and Historical Resources

The Marine Corps Base (MCB) is obligated to protect archeological and historical resources in accordance with the National Environmental Policy Act of 1969, the National Historic Preservation Act (NHPA) of 1966 as amended and Executive Order 11593 of 1971. Section 106, NHPA requires MCB to take into account the effects of its actions on historic properties. Further, MCB must provide the Advisory Council on Historic Preservation and opportunity to comment on any MCB undertakings that could affect historic properties.

Assistance in locating, identifying and documenting existing sites for protection and preservation was first established in 1977. The Department of Sociology/Anthropology at the University of North Carolina at Wilmington and the Onslow County Historian assisted in initiating the program.

Further assistance was obtained in 1980-81 through a contract with the U.S. Department of the Navy and the University of North Carolina at Wilmington to provide an archeological and historical reconnaissance of the Base. The contract involved a search of previous work and a survey of selected disturbed areas. Surface

collections were made at numerous sites and analysis of this material has been completed. The results of the reconnaissance indicated several important sites on MCB need additional study to determine NRHP eligibility. Interim protective measures were recommended on these sites.

In (1985) approximately 10-12 skeletal remains were removed from an Indian Ossuary at Jarrett's Point. The ossuary was located at the edge of a borrow pit by an employee of a construction firm who was working on a military construction project. Marine Corps funding was transferred to the U. S. Park Service to excavate the remains and compile data in accordance with instructions provided by the N. C. State Historic Preservation Officer. The U. S. Park Service awarded a contract to the Department of Archeology and Anthropology, University of North Carolina at Wilmington, NC for this work. A draft report of findings states that association of these remains with any known cultural group cannot be definitely proven.

Camp Lejeune developed in 1986 a draft Historic Protection Plan (HPP) which addresses NHPA compliance and presents management recommendations and priorities for historic properties. The HPP was prepared by Water and Air Research, Inc., Gainesville, Florida under contract with the U. S. Park Service, Atlanta Regional Office.

The draft HPP assessed the effects of Marine Corps military training on historic resources and reviewed 145 sites. Twenty-four (24) sites are described as Potentially Eligible for NRHP listing, primarily based upon significance to local history. Additional testing is required at these sites to determine NRHP eligibility. One hundred and two sites (102) are described as "undetermined eligibility" due to lack of data or unknown site location. Nineteen (19) sites are described as not eligible.

Priority recommendations of the draft HPP are:

- (1) Complete microfilming of historic WWII records of MCB acquisition,
- (2) Testing/data recovery of Jarrett's Point archeological site,
- (3) Testing or eroding areas of New River shoreline affecting historic properties.

#### 5. Scenic and Natural Areas

There are two areas on the Base that are designated natural areas and are listed on the North Carolina Registry of Natural Heritage Areas. They are the Longleaf Pine Natural Area and the Wallace Creek Natural Area. A description of each is contained in a document entitled "Memorandum of Understanding Between the Department of Natural Resources and Community Development, State of North Carolina and the Marine Corps Base, Camp Lejeune, United States Marine Corps

for Designation and Management of Highly Significant Natural Areas on Camp Lejeune, and recognition of those areas on the North Carolina Registry of Natural Heritage Areas". These descriptions are as follows:

- a. Longleaf Pine Natural Area - The 26 acre longleaf pine stand represents one of the few old-growth, natural regenerating longleaf pine forests remaining in the Coastal Plain region. The longleaf pine (Pinus palustris) stand occupies a dry sand ridge. The old flat-topped pine trees with trunk scars from box-faces remain as historic artifacts of the naval stores industry that was once an economic mainstay of eastern North Carolina. There is no evidence that any trees have been cut or stumps removed since before the turn of the twentieth century. Other than fire breaks around the border of the pine stand and a few shallow fire breaks extending into the stand, there are no signs of recent human manipulation. The preserve serves as an historic and natural interpretation and research area. A variety of biological processes are depicted, especially the life history of a natural reproducing longleaf pine forest and the effects of fire management on a fire dependent natural community. An active colony of the red-cockaded woodpecker, a federally listed endangered species, is found in this old longleaf pine stand. Other wildlife

species using this habitat include black bear, deer, and wild turkey. To the east and south of the pine-dominated ridge is a high pocosin natural community dominated by widely scattered pond pine and evergreen shrub species. The creeks on the north and west side of the pine ridge drain the pocosin areas and are vegetated by a swamp forest natural community. The pocosin and swamp wetlands surrounding the pine forest serve as an effective natural buffer and isolate the pine stand from disturbance.

- b. Wallace Creek Natural Area - This 115 acre area of old-growth bald cypress stands survives as a remnant of the historic millpond that was impounded on Wallace Creek by the old Montford Dam, which was destroyed by Hurricane Hazel in 1954. Most such cypress stand have previously been cut elsewhere in the Coastal Plain. Massive, beautiful cypress trees tower over a subcanopy of hardwoods and an open understory with scattered redbays and palmetto palms. The swamp forest above the old impoundment is a high quality example of a blackwater swamp system due to its undisturbed hydrologic condition and maturity of the forest. The cypress-gum swamp grades into a small blackwater stream subtype dominated by black gums and other mixed hardwoods along the three upper tributaries of Wallace Creek.

The swamp forest provides important habitat for a diversity of wildlife and connects with the marshes along the New River.

## B. PLANT AND VEGETATIVE COMMUNITIES

### 1. Major Plant Communities Present

The major plant communities found on the Base are pine forests, mixed pine-hardwood forests, hardwood forests and the estuarine marshes. A detailed summary of these plant communities by forest compartment is contained in Table 2. Data in this table was summarized from the forest type code information contained in the forest compartment prescription field data sheets.

Review of the data indicates that approximately 29.4 percent of the Base land area is comprised of loblolly pine, 10.7 percent is in longleaf pine and 5 percent is in pond pine. The mixed pine-hardwood component is about 22 percent and the pure hardwood forest comprises about 16.8 percent

Figure 3 gives an overview of total land use on the Base. As can be noted, loblolly pine forest comprises the major land use based on acreage comparisons. Mixed stands of loblolly-hardwoods and pure hardwood forests are the second and third largest forest components.

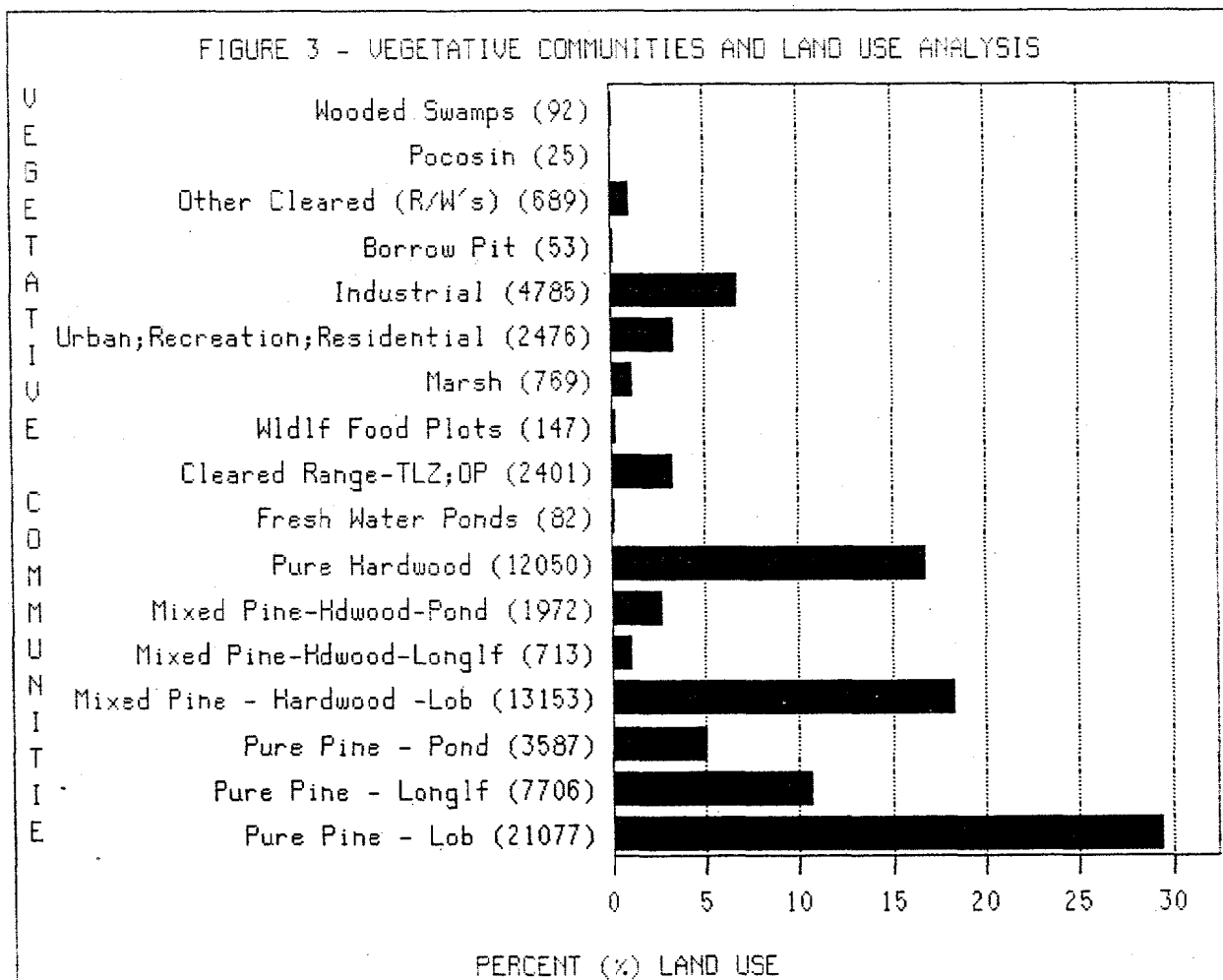
Those vegetative communities typed as pure pond pine, mixed pond pine-hardwood, marshes, pocosins, and wooded swamps comprise the major acreages of wetland present on the Base. This is approximately 3587 acres or 9 percent of the total land area.



Red-cockaded woodpecker habitat would largely be associated with the pure pine-longleaf vegetative community. This species would also occur in selected older stands of loblolly and pond pines, especially in those areas with mixed pine types, including longleaf.

TABLE 2. VEGETATIVE COMMUNITY DATA

Forest Department Number	Pure Pine			Mixed Pine Hardwood			Pure Hardwood	Fresh Water Ponds	Cleared Range, TLZ, OP	Wildlife Food Plots	Marsh Land	Urban: Recreational Residential	Industrial	Borrow Pits	Other Cleared R/W, etc. Intersection Cemetery	Pocosins	Wooded Swamp Cypress- TSC Gum	Total
	Loblolly	Longleaf	Pond	Loblolly Hardwood	Longleaf Hardwood	Pond Hardwood												
1	964 (10)	0	0	401 (3)	0	0	0	0	0	0	0	584	126	0	0	0	0	2,075
2	423 (12)	0	0	102 (3)	0	0	217 (7)	0	0	0	0	0	112	5	10	0	0	849
3	452 (11)	0	0	233 (6)	0	131 (2)	426 (6)	0	1	0	0	9	115	5	143	0	0	1,505
4	270 (8)	0	0	209 (5)	0	0	128 (4)	0	0	0	0	326	154	0	28	0	0	1,115
5	556 (9)	85 (3)	0	262 (4)	103 (1)	0	333 (3)	8	24	0	0	0	0	0	0	0	0	1,137
6	171 (3)	291 (5)	439 (3)	10 (1)	29 (1)	0	115 (1)	0	5	0	0	0	0	0	0	0	0	1,040
7	115 (3)	665 (5)	0	251 (4)	0	15 (1)	227 (2)	0	147	0	0	0	0	0	0	0	0	1,470
8	349 (5)	38 (1)	0	125 (1)	34 (1)	26 (1)	127 (3)	0	19	0	0	0	0	2	8	0	0	773
9	661 (6)	0	0	237 (10)	0	0	71 (3)	25	0	0	0	387	40	0	20	0	0	1,441
10	232 (8)	0	0	313 (4)	0	0	234 (5)	0	0	0	12 (1)	649	0	0	38	0	0	1,478
11	437 (8)	0	0	468 (4)	0	0	27 (1)	0	0	4	0	515	0	1	9	0	0	1,451
12	361 (9)	0	0	227 (3)	0	0	419 (2)	0	5	0	0	0	4	0	0	0	0	1,616
13	443 (5)	0	0	189 (5)	0	0	626 (5)	0	105	8	0	0	0	0	0	0	0	1,341
14	380 (6)	0	0	414 (6)	0	0	391 (5)	0	141	0	0	0	0	0	0	0	0	1,326
15	341 (12)	0	0	207 (8)	0	0	202 (4)	0	0	10	5 (1)	0	0	0	0	0	0	765
16	302 (6)	0	0	327 (5)	0	0	248 (3)	0	0	0	0	0	0	0	0	0	0	877
17	305 (7)	0	0	559 (6)	0	0	307 (4)	0	88	3	0	0	496	11	79	0	0	1,854
18	556 (10)	0	0	71 (2)	0	0	220 (5)	0	147	0	0	0	141	0	0	0	0	1,135
19	270 (5)	292 (9)	410 (2)	23 (1)	107 (2)	36 (2)	0	24	0	0	0	0	0	0	20	0	0	1,207
20	666 (16)	10 (1)	76 (10)	93 (3)	12 (1)	0	212 (2)	0	0	11	0	0	0	12	0	0	0	1,092
21	483 (5)	184 (1)	26 (1)	22 (1)	0	0	0	0	0	6	0	0	0	0	0	0	92 (1)	813
22	625 (17)	99 (2)	14 (1)	34 (2)	0	0	149 (2)	0	42	3	0	0	0	0	6	0	0	972
23	1062 (8)	240 (4)	0	24 (1)	18 (1)	98 (3)	0	134	0	0	0	0	0	0	0	0	0	1,576
24	182 (3)	143 (2)	8 (1)	464 (6)	0	0	149 (6)	21	24	0	0	0	28	0	82	0	0	1,181
25	556 (6)	241 (2)	54 (1)	121 (4)	0	47 (1)	247 (8)	0	0	4	0	0	0	0	0	0	0	1,270
26	383 (3)	80 (2)	0	695 (10)	0	0	23 (2)	0	0	12	0	0	0	0	0	0	0	1,193
27	520 (6)	506 (6)	0	116 (1)	0	0	328 (3)	0	0	4	0	0	0	0	5	0	0	1,479
28	217 (9)	350 (6)	217 (4)	0	20 (2)	72 (3)	0	20	0	0	0	0	0	0	0	0	0	836
29	281 (10)	225 (7)	39 (1)	216 (4)	90 (1)	70 (1)	327 (4)	0	48	8	0	0	0	0	0	0	0	1,304
30	683 (9)	0	21 (1)	408 (2)	0	0	52 (2)	0	19	0	0	0	0	0	0	0	0	1,183
31	222 (3)	0	0	718 (9)	0	0	414 (5)	0	239	0	0	0	0	0	0	0	0	3,082
32	457 (19)	550 (9)	20 (1)	316 (10)	0	0	84 (4)	0	163	5	0	0	1478	11	0	0	0	1,599
33	0	651 (6)	22 (1)	0	215 (1)	0	0	10	98	0	0	0	0	2	0	0	0	998
34	40 (4)	46 (1)	0	586 (7)	17 (1)	187 (1)	133 (5)	0	0	0	0	0	0	0	0	0	0	1,089
35	317 (7)	89 (1)	20 (1)	481 (5)	0	0	162 (1)	3	0	1	16 (1)	0	0	0	0	0	0	1,089
36	378 (10)	0	0	363 (11)	0	0	124 (2)	0	0	3	9 (1)	0	0	0	0	0	0	877
37	700 (9)	0	0	464 (4)	0	8 (1)	227 (3)	0	0	8	0	0	0	0	0	0	0	1,407
38	556 (12)	174 (1)	0	282 (3)	0	0	246 (4)	0	6	3	54 (2)	0	0	0	0	0	0	1,266
39	349 (8)	254 (7)	172 (2)	300 (5)	72 (1)	148 (2)	279 (5)	0	0	6	0	0	0	0	0	0	0	1,580
40	140 (5)	258 (6)	258 (3)	145 (2)	0	0	319 (2)	0	50	0	0	0	0	2	0	0	0	1,172
41	139 (6)	0	0	334 (3)	0	0	699 (5)	0	24	0	0	0	40	0	0	0	0	1,236
42	456 (7)	0	0	234 (4)	0	0	308 (6)	0	1	10	73 (2)	0	0	0	128	0	0	1,219
43	484 (13)	67 (1)	114 (3)	50 (4)	0	331 (1)	88 (3)	0	0	4	0	0	0	0	10	0	0	1,148
44	10 (1)	403 (11)	654 (3)	29 (1)	0	37 (1)	29 (1)	0	31	0	0	0	0	0	0	0	0	1,193
45	128 (4)	359 (10)	326 (3)	0	0	268 (2)	84 (1)	10	48	0	0	0	0	0	20	0	0	1,243
46	497 (12)	102 (2)	0	309 (5)	0	0	367 (6)	2	328	14	175 (2)	0	0	0	0	0	0	1,793
47	235 (8)	382 (6)	628 (3)	28 (1)	0	0	284 (2)	0	0	8	0	0	0	0	0	0	0	1,565
48	334 (10)	0	0	217 (5)	0	0	207 (5)	2	222	0	0	0	304	0	29	0	0	1,385
49	328 (10)	0	0	153 (2)	0	0	366 (8)	0	0	0	69 (1)	0	46	0	29	0	0	990
50	253 (5)	284 (1)	0	0	0	0	182 (4)	0	2	0	0	0	0	0	6	0	0	727
51	364 (11)	44 (1)	0	360 (4)	0	0	234 (7)	0	0	0	92 (1)	0	15	0	9	0	0	1,108
52	258 (7)	0	0	599 (10)	227 (1)	0	160 (3)	1	83	1	101 (1)	0	0	0	0	0	0	1,340
53	583 (10)	0	0	73 (2)	0	0	250 (3)	0	21	9 (2)	98 (1)	0	0	0	0	0	0	1,034
54	211 (7)	0	0	246 (5)	0	0	744 (5)	0	0	0	65 (1)	0	0	0	0	0	0	2,240
55	348 (9)	595 (6)	69 (4)	240 (4)	109 (1)	364 (3)	0	0	92	2	0	0	1675	0	10	0	0	1,843
TOTAL	21,077	7,706	3,587	13,153	713	1,972	12,050	82	2,401	147	769	2,476	4,786	53	689	25	92	71,777



## 2. Major Managed Species

### a. Timber Species

#### (1) Loblolly Pine - SAF 81<sup>1</sup>

Loblolly pine is an abundant timber species on the Base. This type accounts for 62% of the total growing stock of all merchantable saw timber and 25% of all pulpwood.

The type is comprised of pure stands of which the species makes up at least 70% of the stocking. Associated species are many and sweetgum is one of the most common. On well drained sites, longleaf pine, southern red, white, post, and blackjack oaks, hickories, sassafras, and persimmon also are frequently found. On sites moderately to poorly drained, common associates are red maple, blackgum, willow oak, water oak, cherrybark oak, yellow-poplar and pond pine.

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<sup>1</sup> SAF stands for Society of American Foresters

The type occurs on a variety of soils, both on uplands with good drainage and on somewhat poorly drained mineral soils, where it often replaced longleaf pine after the latter was cut. Loblolly pine has colonized the cropland which was abandoned when Camp Lejeune was established.

Abundant, but not excessive, soil moisture is required for good growth of loblolly pine. Best growth is on deep soils with poor surface drainage but without long-standing water. Here, site indexes range from 70 to over 100 feet at 50 years and occasionally to 115 feet.

Because loblolly pine is only moderately tolerant of shade and suffers from hardwood root competition, the type tends to be successional temporary. Sweetgum and red maple may seed in under pines as young as 10 years; blackgum, elm, sassafras, oaks, hickories, and others soon follow. In old fields where hardwood roots have been eliminated, succession is slower (Wahlenberg 1960). In the absence of repeated fire or other severe disturbances, hardwood trees and an undergrowth of woody plants replace the pine. Succession on drier sites is towards upland oaks. On wetter sites loblolly pine is

succeeded by sweetgum, water oak, and other hardwoods.

Loblolly pine often forms a transition with the loblolly pine-hardwood type. Since the type is mostly found where soil moisture is favorable, the associated undergrowth is rich in species and in numbers. Understory trees include black cherry, flowering dogwood, American holly, sassafras, hawthorn, sourwood, fringetree, redbay, sweetbay, and sweetleaf. Characteristic shrubs are beautyberry, yaupon, southern bayberry, gallberry, blackberries, and pepperbush. Common woody vines are Alabama supplejack, yellow jessamine, poison ivy, grape, and greenbriers.

(2) Loblolly Pine-Hardwood - SAF 82

Loblolly pine is not dominant but comprises 30 to 70% of the stocking in mixture with hardwoods. Component hardwood species reflect the spectrum of moisture regimes and sites. On moist to wet sites the type contains broadleaf evergreens, such as sweetbay, southern magnolia and redbay, along with swamp tupelo, red maple and pond pine. On moist sites hardwood components are sweetgum, water oak, cherrybark oak, swamp chestnut oak, white ash, yellow-poplar, American elm, red maple, and swamp

(pignut) hickory. On drier sites, component hardwoods are oaks (southern red, white, post, northern red, and scarlet), hickories (shagbark, pignut, and mockernut), and blackgum. Longleaf pine may also be present.

Soils on which the type occurs are derived primarily from unconsolidated sedimentary deposits of sand, silt, clay and peat.

Succession is strongly towards the hardwoods, and the type can be considered transitional to various hardwood types. When harvested, loblolly pine stands, old-field stands in particular, are replaced by the loblolly pine-hardwood type or by hardwoods. Where soil moisture favors the pine or prescribed fires are frequent, loblolly-hardwood will persist.

The understories reflect the diversity of the moisture regimes and associated trees include gallberry (inkberry), blueberries, blackberries southern bayberry, yaupon, rusty black-haw, possum-haw, American holly, American beautyberry, tree sparkleberry, flowering dogwood, hawthorns and sourwood. Common vines are greenbriers, grapes, yellow jessamine, Japanese honeysuckle and Alabama supplejack.

(3) Longleaf Pine - SAF 70

Longleaf pine is found in pure stands where the species makes up at least 70% of the stocking. Principal hardwood associates vary with site but those most closely associated include dogwood, southern red oak, blackjack oak, turkey oak, water oak, blackgum, sassafras, persimmon, and sweetgum.

The longleaf pine type is considered to be a fire subclimax that has developed as a result of periodic surface fires. It is limited to areas that can and do burn. The longleaf pine type is self perpetuating on sites where fires can burn. Needle litter from overstory pines supports hot ground fires that limit encroachment of hardwoods and brush, and provide favorable conditions for seedling establishment. Longleaf seedlings are fire resistant, and well-developed, healthy, grass-stage seedlings can tolerate fires even during the growing season. Hot fires, fueled by heavy needle litter accumulations, however, are too much for most small seedlings to withstand. Reducing the overstory in stages promotes establishment and survival of longleaf seedlings.



Poor, dry soils, where the site index at age 50 for longleaf pine is commonly less than 60 feet, will not support a full pine overstory. The ground cover is sparse and litter cast is light; consequently, fires are less frequent and severe, permitting development of a scrub hardwood understory. On deep, sandy soils the common scrub hardwoods are turkey, bluejack, sand post, and dwarf live oak.

(4) Longleaf Pine - Scrub Oak - SAF 71

Longleaf pine and scrub oaks - primarily turkey, bluejack, blackjack, and sand post oak - comprise the type. Other scrub oaks are common in some areas.

The type can be characterized as a community of little species diversity, having a structure determined by water deficiency, low fertility and periodic fires. With ability to grow on droughty, infertile, and coarse-textured soils, and with the aid of frequent surface fire to control the more shade tolerant understory hardwoods, longleaf pine once formed pure open stands.

Given a seed source, longleaf pine regenerates and often persists in the grass stage for a number of years on these dry sites.

Frequent surface fires top kill the hardwoods and consume the needles of longleaf seedlings infected with brown spot disease.

In many of its occurrences, however, the type is moderately open with a scattered upper canopy; in such situations a dense, complex undergrowth exists. Common components are laurel-leaf greenbrier, gallberry (inkberry), sweet gallberry, swamp cyrilla, southern bayberry, and evergreen bayberry.

(5) Pond Pine - SAF 98

Pond pine is found in pure stands where the species makes up at least 70% of the stocking. Loblolly pine, pond cypress, baldcypress, swamp tupelo, red maple, sweetgum, sweetbay, loblollybay, and redbay are common associates. The type occurs in areas that have a history of wildfire.

Pond pine has, in the past, been most readily identified by its ability to exist under conditions that effectively eliminate other pines. Thus, on better sites that have escaped destructive wildfires, pond pine often passes for loblolly pine and is harvested and used with no distinction made between the two.

Pond pine seems to be able to endure poor aeration, high soil acidity, slow nitrogen

fixation and nitrification, and wildfires - and still regenerate and grow.

The species is unusual among conifers in possessing both serotinous cones and the ability to re-form a crown by sprouting following wildfires. Through these characteristics, the type has been maintained under conditions that are extremely adverse for other species.

(6) Baldcypress - Tupelo - SAF 102

Baldcypress, together with water tupelo or swamp tupelo, comprises the majority of the stocking. The common associates are red maple, black willow, Carolina ash, pumpkin ash, swamp cottonwood, planertree (water-elm), and water locust. In the shallower margins, overcup oak, water hickory, pond cypress, American elm, green ash, nuttall oak, laurel oak, sweetgum, persimmon, Atlantic white cedar, loblolly and pond pine, red bay and sweetbay are also present.

The type is always found on very wet sites where, in years of normal rainfall, surface water stands well into or throughout the growing season. Water tupelo cannot survive where soil acidity is high or surface water brackish. It is almost completely restricted

to alluvial floodplains and is replaced by swamp tupelo on colluvial soils. Swamp tupelo also occurs in mixture with baldcypress and water tupelo around the edges of alluvial swamps where maximum water depth is less than 0.6 m (about 2 ft.). Baldcypress and water tupelo are most tolerant of complete inundation and advance into the deepest sites when water depth is reduced during periodic droughts.

(7) Water Tupelo - Swamp Tupelo - SAF 103

On certain more limited sites, however, swamp tupelo tends to take the place of water tupelo. On some sites the two type species mix. Common associates of water tupelo where flooding is deep are baldcypress, red maple, black willow, Carolina ash, pumpkin ash, swamp cottonwood, planertree (water-elm), and waterlocust. In shallow water, swamp tupelo, overcup oak, water hickory, American elm, green ash, nuttall oak, laurel oak, sweetgum, persimmon and sweetbay are also present. White cedar and pond pine are also associates. The type is always found on very wet sites where, in years of normal rainfall, surface water stands well into or throughout the growing season.

## (8) Sweetbay - Swamp Tupelo - SAF 104

Combinations of sweetbay with swamp tupelo, redbay, or both, provide a majority of the stocking and locally any one of the three may possess a plurality. A great many species that grow on moist to wet sites may be associated with this type, depending upon geographic location, site and stand history. Common hardwoods include red maple, black tupelo, loblollybay, sweetgum, water oak, laurel oak, yellow-poplar, American holly, Carolina ash, southern magnolia and flowering dogwood. Associated conifers include baldcypress, pond cypress, longleaf pine, loblolly pine, pond pine, and Atlantic whitecedar.

The type occurs on sites where soil is normally saturated, or at least moist, throughout the growing season. Surface flooding also occurs on some sites, but it does not persist through the growing season. Sites include branch heads, the narrow bottoms of small perennial or intermittent streams or branches, pocosins, and poorly drained upland depressions such as small ponds, peat bogs, and borders of swamps.

(9) Swamp Chestnut Oak - Cherrybark Oak - SAF 91

Swamp chestnut oak and cherrybark oak together usually constitute a majority of the stocking, but when many species are mixed, they may comprise only a plurality. Prominent hardwood associates are the ashes (green and white) and the hickories (shagbark, shellbark, mockernut, and bitternut), as well as white oak, post oak, shumard oak, and blackgum. Sweetgum may occasionally be of high importance. Minor associates include willow oak, water oak, southern red oak, post oak, American elm, winged elm, water hickory, southern magnolia, yellow-poplar, beech, and occasionally loblolly pine. The type most commonly occurs adjacent to the sycamore-sweetgum-American elm type and to beech-southern magnolia stands.

(10) Sweetgum - Willow Oak - SAF 92

Sweetgum and willow oak comprise a plurality of the stocking, with sweetgum essentially the key species. Willow oak may be superseded by water oak, sugarberry, green ash, American elm, and nuttall oak which are the major associates. Minor associates are overcup oak, water hickory, cedar elm, laurel oak, red

maple, honeylocust, persimmon and rarely, baldcypress.

(11) Sweetgum - Yellow-Poplar - SAF 87

The type is a part of the mixed bottomland forest in which sweetgum and yellow-poplar comprise a majority of the overstory stocking. A mature stand may commonly contain one or more of the following species: red maple, loblolly pine, sycamore, river birch, ash, willow oak, blackgum, and American elm.

(12) White Oak - Black Oak - Northern Red Oak - SAF 52

White oak, black oak, and northern red oak together comprise a majority of the stocking. Other oaks usually present in this forest cover type include scarlet, southern red, chinkapin, post, and blackjack oaks farther south. One or more species of hickory (bitternut, mockernut, pignut, and shagbark) are a consistent component of the type. Other tree associates occur, the most common being yellow-poplar, blackgum, sugar and red maples, white and green ash, American and red (slippery) elm, basswood, cucumbertree, sweetgum and loblolly pines. Black cherry and American beech may also be present.

### Summary - Hardwoods

The merchantable hardwood growing stock pose special problems in timber management. High water tables, accessibility and equipment operability limitations make harvesting operations difficult in most of hardwood timber types. These types are rarely harvested unless affected by construction or other land clearing projects. The hardwoods are usually associated with well drained side slopes, secondary drainages and transitional fringes. They also generate the majority of income from hardwood sales, due to accessibility. Hardwood timber markets in this locality result in these being under-utilized.

#### b. Plant Materials for Camp Lejeune

Camp Lejeune occupies part of two Major Land Resource Areas (MLRA), MLRA 153A and MLRA 153B. MLRA 153A is the Atlantic Coast Flatwood and is characterized by soils having restricted drainage, a thermic temperature regime and an aquic moisture regime. This area supports a pine-oak climax plant community which changes as elevations go from 82 to 164 feet.

MLRA 153B is the Tidewater Area with elevations from sea level to less than 82 feet. The plant community in this area is similar to that found in MLRA 153A but also has those salt tolerant species



commonly found near the beach like wax myrtle, sea oats, bitter panicgrass, and many others.

The environment created by variations in soil, moisture, temperature, salt, and wind limit the selection and restrict the location of many plants. Although there are many plants which can be used in the area, the following are highly recommended for wildlife, beautification and conservation purposes.

### Grasses

<u>Name</u>	<u>Use</u>
Sea Oats ( <u>Uniola paniculata</u> )	Dune stabilization
American Beachgrass 'Cape' ( <u>Ammophila breviligulata</u> )	Dune stabilization
Bitter panicgrass ( <u>Panicum amarum</u> )	Dune stabilization
Coastal panicgrass 'Atlantic' ( <u>Panicum amarum</u> v. <u>amarulum</u> )	Dune stabilization, wildlife, critical area stabilization
Weeping Lovegrass ( <u>Eragrostis curvula</u> )	Critical area stabilization
Smooth cordgrass ( <u>Spartina alterniflora</u> )	Tidal area stabilization
Marshhay cordgrass ( <u>Spartina patens</u> )	Tidal area stabilization
Pampasgrass ( <u>Cortaderia selloana</u> )	Beautification
Centipedegrass ( <u>Eremochola ophiuroides</u> )	Lawn
Bahiagrass 'Pensacola' ( <u>Paspalum notatum</u> )	Lawn, roadsides, critical area stabilization

Trees and shrubs

American Holly ( <u>Ilex opaca</u> )	Beautification, wildlife
Yaupon Holly ( <u>Ilex vomitoria</u> )	Beautification, wildlife
Red Ceder ( <u>Juniperus virginiana</u> )	Beautification, wildlife
Carolina Cherrylaurel ( <u>Prunus caroliniana</u> )	Beautification, wildlife
Live Oak ( <u>Quercus virginiana</u> )	Beautification, wildlife
Sawtooth Oak ( <u>Quercus acutissima</u> )	Beautification, wildlife
Wax myrtle ( <u>Myrica cerifera</u> )	Beautification, wildlife
Thorny elaeagnus ( <u>Elaeagnus pungens</u> )	Wildlife
Shrub lespedeza 'VA-70' ( <u>Lespedeza thumbergii</u> )	Wildlife
Southern Magnolia ( <u>Magnolia grandiflora</u> )	Beautification
Shore juniper 'Emerald' ( <u>Juniperus conferta</u> )	Beautification

Forbs

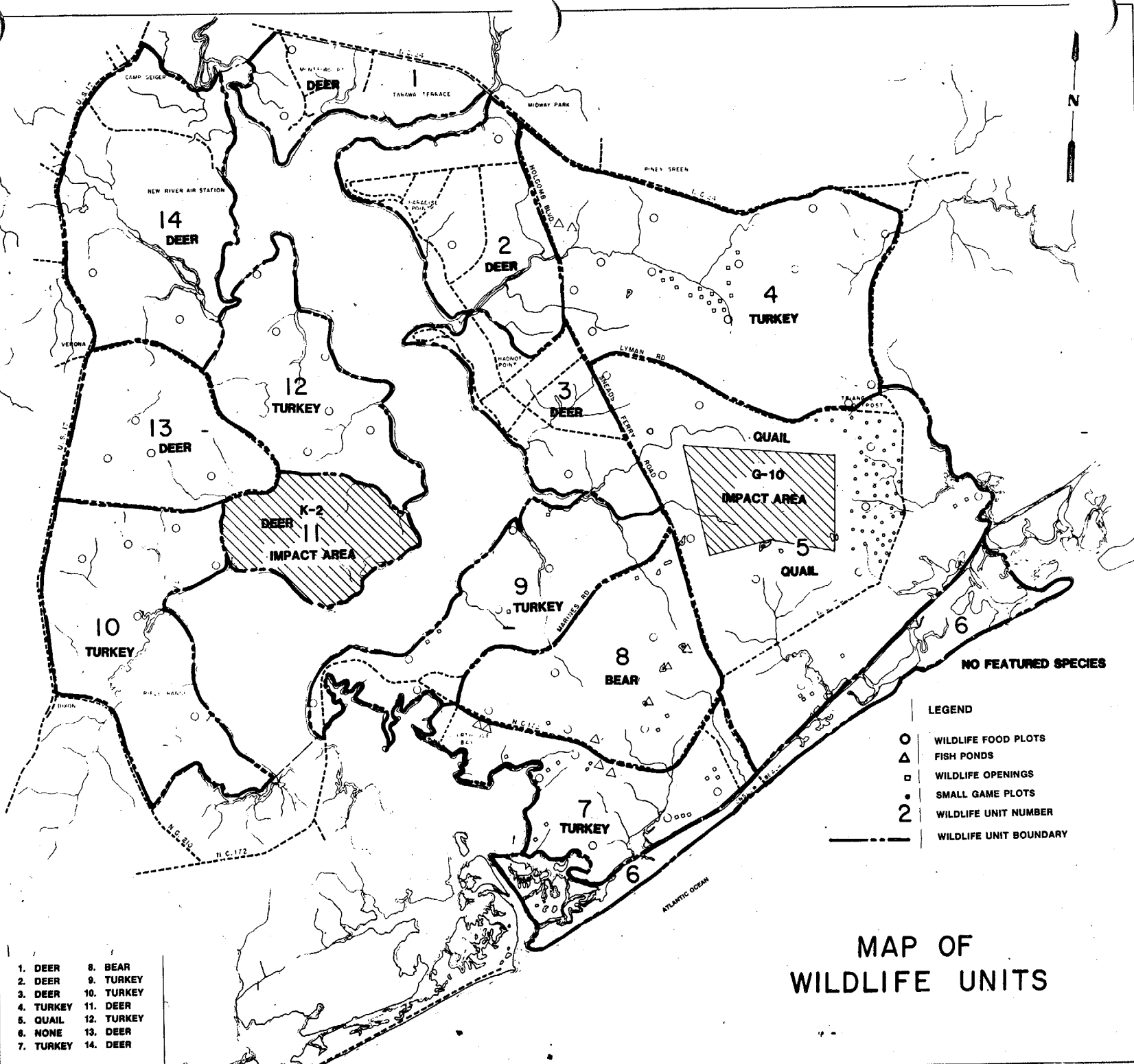
Daylily ( <u>Hemerocallis fulva</u> )	Beautification
Lavender cotton ( <u>Santolina chamaecyparissus</u> )	Beautification
Green santolina ( <u>Santolina virens</u> )	Beautification
Lanced-leaved Coreopsis ( <u>Coreopsis lanceolata</u> )	Beautification
Gallardia ( <u>Gallardia pulchello</u> )	Beautification
Rugosa rose ( <u>Rosa rugosa</u> )	Beautification

Information pertaining to sources, planting and cultivation of these and other plants may be obtained by contacting your local SCS office or the SCS Plant Materials Specialist in Raleigh.

## C. FISH AND WILDLIFE RESOURCES

### 1. Featured Wildlife Species

Featured Game Species Management: This system consists of selecting game species for wildlife units as shown in Figure 1 on the Marine Corps Base, Camp Lejeune, North Carolina and then adapting habitat management activities to meet the habitat requirements of that species. Management adaptation of the featured species concept will be compatible with military training and forest management. Other wildlife species with overlapping or similar habitat requirements will benefit under the featured species system. This system will not be applied to maximize a particular species over all others, or to greatly reduce or even eliminate a given species. The system will feature a species and concurrently consider the existence and habitat requirements of all other present species accordingly. Selected game species are wild turkey, white-tailed deer, black bear, squirrels, bobwhite quail, rabbits, raccoons and wood ducks.



- 1. DEER
- 2. DEER
- 3. DEER
- 4. TURKEY
- 5. QUAIL
- 6. NONE
- 7. TURKEY
- 8. BEAR
- 9. TURKEY
- 10. TURKEY
- 11. DEER
- 12. TURKEY
- 13. DEER
- 14. DEER

## MAP OF WILDLIFE UNITS

EASTERN WILD TURKEY: There are four groups of management practices employed here for the wild turkey: Protecting natural habitat, correcting habitat deficiencies, controlling environmental influences other than habitat, and procedures that deal with the wild turkey itself. The practice of protecting turkey habitat is aimed at maintaining habitat where the population is good by guarding against degrading influences and assisting the natural process to continue. Certain timber management practices can be a serious threat to wild turkey habitat. The most detrimental practices are clear cutting in blocks larger than 50 acres and converting natural turkey woods to short rotation planted pulpwood plantations. Clear cuts or seed tree cuts more than 20 acres in size should not be made in prime hardwoods and mixed stands should not be converted to pine monoculture if soils are capable of growing mast producing hardwoods. Clear cuts should not be square or round but should follow the general contour of the land.

The second management practice is to eliminate habitat deficiencies. Several management practices are utilized to make up for habitat problems where turkeys are absent, where they persist in low numbers, or where at some time in their life cycle they face a particular problem in maintaining their numbers. These mainly take the form of providing supplemental food plantings,

creating and maintaining forest openings and controlled burning. The most popular planted crops for turkeys, in approximate order of popularity, are chufas, wheat, rye, oats, various perennial grasses, millets and clovers.

One of the most important ingredients of prime turkey habitat is well-dispersed grassy openings. Turkeys use such places for strutting, nesting, brood foraging on berries and insects, and feeding on succulent greens. Both clearings and food plantings should be located off public access roads.

Controlled burning as a requirement in the maintenance of natural pine woods is also important in planted pine, certain kinds of scrub woods and savannahs. Plant communities that require fire for their continuance are predominant here. Controlled burning prevents accumulations of fuel that would permit wild fires to damage even fire tolerant vegetation. Fire has a pruning effect on all stems and the ashes have a fertilizing effect that promotes fast growth of leaves, which are food for turkeys and encourages insect life, which is also eaten by turkeys. The open effect produced by prescribed burning is preferred by turkeys, especially when scheduled at 3-5 year intervals.

The third category is other environmental influences which affect wild turkeys. The most

important of these limiting factors is hunting by man. Nothing else has ever been known to eliminate the turkey from good habitat. Therefore, public hunting regulations properly enforced, are essential in maintaining a good turkey population. Spring gobbler hunting only is allowed, and the season is set to coincide with peak gobbling. This season is after peak mating has occurred and prior to the time hatching occurs.

The fourth management aspect is handling the turkey itself. This includes live-trapping for restocking, research and population monitoring. From 20-40 turkeys are live-trapped annually from here in a cooperative effort with the North Carolina Wildlife Resources Commission. The birds are transported and released on selected restoration areas in eastern North Carolina. Blood samples are taken and forwarded to the Southeastern Wildlife Disease Study Center, University of Georgia, where they are analyzed for the purpose of monitoring the annual physical characteristics of the populations. A cooperative research study is also being conducted for determining the genetic variability of wild turkey populations.

Without Marine Corps assistance, the wild turkey program in North Carolina would not have moved forward as rapidly as has been the case. The Base wild turkey population has steadily increased, as has the harvest.



Control of the wild turkey population is exercised through spring gobbler hunting and the live trap removal of approximately 40 birds annually.

**WHITE-TAILED DEER:** Deer are the most popular game animals here and can be found using all kinds of habitat. They will use a variety of habitats where food, cover and water are available. Bottomland hardwoods and mixed pine-hardwood types are generally preferred over salt marshes, pocosins and many upland pine types. Deer generally prefer to bed down in the pine uplands during the day and forage in the bottomland areas at night.

The diet of deer is extremely varied and the feeding habits of white-tails of coastal habitat change seasonally. Seeds of the oaks, dwarf palmetto, hawthorns, American beautyberry and common persimmon are important during late fall and early winter when they are available. During late winter and early spring, grasses and winter rosettes are important. In spring and summer, the leaves and twigs of trees, tender shoots and herbaceous plants afford major portions of deer diets.

Generally, the soils of Coastal Plain habitat are low in fertility and require fertilizer to produce supplemental food crops for deer. Both lime and fertilizer applications are necessary for good plant production. All available data indicate that the

highest quality deer foods are produced in bottomlands, and hardwoods and the upland pine forests produce the lowest quality foods.

Regeneration of timber stands usually provides excellent feeding areas for deer and other wildlife during the early years of development. Once the young trees grow beyond the height suitable for feeding, they provide excellent cover for deer. Partial cuttings and frequent cutting cycle intervals that are well dispersed are needed to maintain high quality, continuous habitat conditions.

Prescribed burning for deer in pine forests is a highly recommended program for management. Used properly, it is an important technique in managing our wildlife resources. Considering all the data, there seems to be little chance of damage to deer range in pine forests by prescribed fire. Fire reduces the understory and increases the availability of succulent browse.

A burning interval of about three to five years is ideal for deer food and cover. This interval permits an excellent response from legumes, keeps most browse plants low, and seldom kills plants or injures game. Palatable species of fleshy fungi occur abundantly following a fire. Protein and phosphorous contents of plants are increased by burning. Increased nutritional benefits are apparent for about two years. Burning

promotes prolific resprouting, thereby providing increased cover for deer. Fire is an excellent, inexpensive method of providing increased deer food and cover in pine uplands.

Deer hunting regulations here are quite liberal. The open season in the Coastal Plain of North Carolina begins in early September when the bow season opens. Firearms season begins in mid-October and continues to January. Each licensed hunter is allowed two deer per day and five per season. Either-sex hunting is authorized by the State on a limited or area-of-need-basis as established by the Base. The deer herd has been biologically monitored here since 1959 when the first either-sex hunts were conducted (see Appendix B for more information). From 1959 through 1975, either-sex hunts were conducted at two-three year intervals during which the deer population exceeded the carrying capacity of the range.

Beginning in 1976, either-sex hunts have been conducted on an annual basis resulting in a better managed herd which is now being maintained within carrying capacity. The health of the herd has greatly improved and the rate of fawn productivity has increased significantly.

**BLACK BEAR:** Black bear occur primarily in the forested wetlands. The major habitat need for bear is large tracts of relatively undisturbed habitat.

Natural pocosins and gum-cypress swamp forests provide preferred habitat for these reclusive animals. Mast and fruits compose the bulk of the diet for black bear. Oaks and black gum provide major food with other plants such as huckleberry, pokeberry, gallberry and blackberry preferred when available. Grubs, insects, mice, lizards, snakes, frogs and fish are also eaten. Bear will feed on trash and garbage at times.

Bears require dens for semi-hibernation cover and for raising their cubs. Large tree cavities are used for this purpose during the winter season. Bear prefer the dens because of the added protection from weather, high water, man and hunting dogs. Large den trees should always be left during timber operations.

Bears use upland habitat near pocosins and bottomland areas for feeding, particularly during the summer. Timber management practices largely determine food quality and supply in upland areas. Favorable practices for bear in regeneration areas include site preparation, thinnings and wide spacing of pine to encourage fruit and mast production by stimulating understory plant growth. Prescribed burning at three to five year intervals also increases the availability of berry and mast producing plants for bear.

Camp Lejeune was established as a bear sanctuary from 1970-1980 in cooperation with the North Carolina Wildlife Resources Commission and there was no open

hunting season during that period. As the bear population expanded, contacts between humans and bear increased to the point that open season was established in 1981 to harvest a limited number of animals. From two to six animals are harvested annually by hunting. Another five or six are killed each year in accidents involving motor vehicles. Open hunting seasons are delayed until mid to late December to reduce the harvest of adult females by hunters.

SQUIRRELS: Both the gray squirrel and fox squirrel are widely dispersed through most habitat types. Both species have a high productive potential, with litters averaging from three to five in the fox, two to six in the gray. <sup>1</sup>Given an average of three per litter and a history of raising two litters a year when food is plentiful, the two squirrels can do an excellent job of perpetuating their species even in the face of high hunting mortality.

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<sup>1</sup> Wildlife Management on Your Land, Author Charles L. Cadieux

Squirrels have population peaks and crashes, so when population numbers are high during hunting seasons, hunters should harvest the legal limit. Hunting has little effect on either species of squirrel here. There is a significant relationship between the productivity of the annual seed crop and subsequent squirrel densities. Fruits, floral parts, buds, bark, roots, fungi and animal matter are seasonally important foods for squirrels. Mast is the principle food during winter, with hickory, pecan, beech and all the oak being the most important seed producers.

Gray squirrel prefer tracts of unbroken hardwood types which are located along the slopes and in the bottomland areas of streams. The fox squirrel prefers more upland forest types where there are openings interspersed through the habitat. Longleaf pine-turkey oak stands are preferred habitat of the fox squirrel here. One of the most important habitat requirements for squirrels is the availability of tree cavities for winter cover and litter rearing. Mature and overmature hardwood trees usually contain enough tree cavities to meet the cover requirements for squirrels.

Both the pines and hardwoods are managed on long rotations which provide ideal habitat conditions for fox and gray squirrels. Probably, the most limiting factor existing relative to the squirrel resource is that it is not effectively harvested by humans at

present. This resource should continue to provide a high level of recreational opportunity for hunters.

**BOBWHITE QUAIL:** Perhaps the most responsive species in the management of pine uplands is the Bobwhite Quail. The key to good quail production is longleaf and loblolly pine types. Properly maintained understories have abundant supplies of annual weeds and a good mixture of food and cover conditions. Pines and naturally occurring vegetation, especially legumes, produce desirable quail foods. Quail prefer habitat where there is about an equal division between exposed ground cover because they cannot travel through thick vegetation. Open forest growth is good habitat where sunlight can reach the ground to produce weeds, grasses and legumes. Water must be available. Dew on vegetation is beneficial but is not a substitute for free water.

Best habitat conditions for quail are one-third in open cultivated clearings; one-third in transitional edge, nesting cover and some food which is easily traveled through; and one-third in open forest canopy. The management practices used for developing understory food for quail are fire, timber harvesting and harrowing in open areas. Annual and perennial planting are useful in supplementing natural foods during certain seasons. Prescribed burning is the best method for maintaining an open understory in pine stands;

however, great care must be exercised in both the timing and the extent of prescribed burning.

Areas which are managed extensively for quail will be prescribed burned annually. A one-quarter acre strip of bicolor lespedeza will be established and maintained for each 10 acres of land area. Prior to annual prescribed burning, a transition band will be disked around a leave area of sparse cover where surface drainage is adequate with a heavy ten-foot disk to prevent burning. A leave area will be installed that is at least 75 feet in diameter and shaped in the form of a figure eight. Leave areas will be located within 30 yards of bicolor lespedeza plantings. The leave areas will be rotated annually for maintaining vegetation in desirable conditions.

**RABBITS:** The two species of rabbits at Camp Lejeune are the Eastern Cottontail and the Marsh Rabbit. These rabbits use a diversity of herbaceous and woody vegetation for food and cover through the year. Herbaceous vegetation provides food during the spring, summer and early fall. Herbaceous vegetation of sufficient height and density also provides shelter and escape cover during these seasons. In the winter, rabbits become almost completely dependent upon buds, stems, twigs and bark of woody vegetation for food. Essentially, since rabbits eat a wide variety of vegetative matter, food availability is not the most



important consideration, as rabbits will select suitable cover over an abundant food supply.

The cover requirements of rabbits can be characterized as being composed of feeding, resting and escape cover. Open cover is used for feeding at night and dense escape cover is used for shelter during the day. Basic cover requirements are generally provided by the same vegetation during summer. Cover becomes more restrictive in late fall and winter, due to loss of woody foliage and desiccation of herbaceous vegetation.

Therefore, habitat diversity and interspersion are the key elements in managing for rabbits. An interspersion of clearings, creation of edge in the clearings, small regeneration cuts in woodlands and establishment of logging slash are effective in habitat improvements for rabbits. The practice of removing overstory trees around the immediate edge of wildlife clearings will improve resting and escape cover. A more abundant food supply adjacent to the escape cover will be provided by seeding and leaving a ten-foot strip of perennial grasses around the edge of wildlife clearings. Well dispersed timber operations including thinning, seed-tree cuts and clear-cuts will benefit rabbits by providing better escape cover and improving the availability of herbaceous vegetation.

RACCOONS: It is difficult to classify the raccoon, for he is a fur-bearer, predator, game animal and nuisance. In North Carolina, the raccoon is classed as a fur-bearing animal when the trapping season is open and a game animal when the hunting season is open. Wonderfully adapted to live in close proximity to man, the raccoon has increased greatly in numbers during the past two centuries.

From 1941 through 1972, raccoons could only be taken at Camp Lejeune during the open hunting season or with live-traps throughout the year. Raccoons became a serious problem as the population continued to expand. Numerous complaints of nuisance raccoons in the housing/industrial complex were common place. Massive die-offs occurred from year to year but the population continued to expand. Live-trapping operations were initiated in cooperation with the North Carolina Wildlife Resources Commission for relocating raccoons to selected restoration areas in the western portion of the State.

This effort was not successful in reducing the population significantly. A trapping season was initiated in 1973 authorizing the use of leg hold traps and has continued each year since that time for most of the Base. Leg hold traps were restricted in the Paradise Point housing area during the 1984-1985 trapping season. A live-trapping and relocation

project was again initiated in cooperation with the Wildlife Resources Commission during 1984-1985. Increased problems with nuisance raccoons in this housing area again increased. Leg hold trapping was again authorized in the Paradise Point housing area to control over-population.

Raccoons eat frogs, crawfish, minnows, shellfish, small birds, bird eggs of any size, mice, corn, garden vegetables, fruits, berries, acorns and garbage. They especially like fish. Raccoons also feed on sea turtle eggs deposited at Onslow Beach if the nests are not protected with wire cages.

Management and control of raccoons is essential, especially around housing/industrial areas, through the use of leg hold trapping by State and Base licensed trappers. Individual trappers are also receiving fair prices for raccoon pelts which helps in population control measures. Wildlife management personnel respond to nuisance raccoon complaints in Base housing/industrial areas by live-trapping animals with box traps, and relocating them away from housing areas. The retention and long rotation for managing bottomland hardwoods will provide prime habitat for raccoons in the future.

**WOOD DUCKS:** Wood ducks inhabit creeks, natural ponds, swamps and beaver ponds of the Base throughout the year. Although they have been referred to in the

past as being primarily herbaceous, recent studies have indicated that invertebrates make up a significant portion of their annual diets. Wood ducks feed on the ground or in water up to depths of 18 inches. Acorns and other mast are important foods during fall and winter. Bald cypress, hickories, buttonbush, arrowarum and burreed are important foods when acorns are lacking. Important foods during breeding season include persistent overwintering fruits and seeds from bottomland hardwood trees, shrubs, and aquatic herbaceous plants, early spring plants and invertebrates.

Suitable cover requirements for wood ducks are provided by trees and shrubs overhanging the water, woody vegetation that is flooded or a combination of these two types. An abundance of downed timber provides suitable year-round cover. Shrubs and clumped herbaceous vegetation provides cover in areas where downed timber is not available in wetlands. Beaver ponds contain both shrubby and herbaceous cover that provides excellent brood habitat. Shrubs provide cover for loafing and security while herbaceous vegetation provides cover and habitat for invertebrates that supply the major part of the diet of broods.

Green-tree impoundments can also provide excellent habitat for broods. These impoundments are flooded in mid September and drawn down in early March to enhance

wood duck populations. Where natural cavities are lacking, artificial nesting boxes are used to minimize the effects of predation on the eggs and broods. Nesting boxes erected in the future will be placed in clusters of five to ten, and spaced from 50 to 100 feet apart.

## 2. Non-Game Species

Nongame species directly benefit from many of the practices that are implemented in managing for certain game species. Songbirds, birds of prey and small mammals frequent wildlife openings which are primarily established for game species. Amphibians, reptiles and other nongame utilize freshwater ponds established for production of game fish. Every possible consideration is made to enhance nongame species and is an integral part of the overall wildlife program.

Longer rotations for both hardwood and pine stands benefit cavity nesting species. Small clear-cuts and seedtree cuts well dispersed through the forestlands enhances both avian and terrestrial species of nongame. Predators benefit from the insect and rodent population increases in these regenerated areas. Nongame species benefit from the forb, fruit and seed production produced in the early succession stages of regenerated areas. The forest prescription - wildlife habitat appraisal system is the primary process for insuring compability for managing nongame species.

Over 30 species of birds use southern forests for nesting and roosting. Many other vertebrate and invertebrates also use cavities. Woodpeckers are the primary cavity nesters and they provide the bulk of cavities used by all other cavity nesters. Fire, wind and tree growth form some cavities, but woodpeckers excavate most of the cavities which other species require. Cavity trees selected by woodpeckers typically have some decayed heartwood and often some decayed sapwood as well. Consequently, the importance of their species to other cavity nesters cannot be over emphasized. The longer rotations for hardwood and pine trees greatly effects all cavity nesting species.

A special project was implemented here in 1973 for the eastern bluebird population due to low population levels which existed at that time. The eastern bluebird population may have plummeted as much as 90% due to shortage of natural cavities for nesting, competition from house sparrows, starlings and pesticides. Over 500 nesting boxes have been erected at selected locations and maintained annually to supplement natural cavities. A special research study involving the bluebird population has been conducted here by a graduate student from the Department of Zoology at North Carolina State University. The research was directed towards determining the nesting preference of habitat types. Preferred nesting habitat

was defined as being open-park-like stands of longleaf pine followed by wildlife clearings and regenerated areas.

### 3. Threatened and Endangered Species

**RED-COCKADED WOODPECKER:** The red-cockaded woodpecker, which is found at Camp Lejeune was listed as an endangered species in 1970. It has the same protection given the better known bald eagle and whooping crane. Unlike other woodpeckers, the red-cockaded roosts and nests in the cavities of living pine trees. The bird needs older pine trees for its cavities, and extensive pine forests to meet its foraging requirements. Marine Corps Base has completed formal consultation with the U.S. Fish and Wildlife Service and has implemented a program designed to protect the red-cockaded and its habitat, as required by Federal Law. The focus of the program is to protect the tree root systems, soils and surrounding habitat of the woodpecker.

Approximately 2512 acres of woodpecker habitat has been marked for protection and habitat protection measures have been implemented through an order applicable to military training. Forest management practices carry out the provisions of biological opinions for managing the birds habitat.

Marine Corps Base initiated a research study for the bird in 1985 which was contracted to North Carolina

State University. The research is aimed at determining home range, population size and composition, reproductive success and habitat use of respective family groups. Thirty-six colony sites have been located, of which 32 were occupied by at least one woodpecker during the 1986 nesting season. Ninety-six adults and 49 nestlings have been banded during the first year of this study. There are 18 known unbanded birds making a likely breeding population total of 104 birds. Fifty-two fledglings have been banded. Of the 32 active colonies, 8 had only 2 adult birds, 21 supported 3-7 adults, and 3 sites had only a single adult bird. A total of 260 cavity trees have been located and description data has been recorded for these trees.

An annual roost survey at each woodpecker colony was initiated in the late summer of 1980, after fledgling had recurred and is continuing on an annual basis.

**AMERICAN ALLIGATOR:** The American alligator ranges throughout the southeast and federal protection has improved the species status until most alligator populations are only threatened. The species, however, is considered endangered in its northern most range, which includes all of North Carolina. Alligators inhabit the wetland acres of Camp Lejeune, including fresh, estuarine and salt waters.



Nesting occurs above the tidal zone just within the tree line and in close proximity to fresh water streams. Nests are constructed from the most readily available material in the immediate vicinity of the site. Nests are constructed from surface litter including loose peat, twigs, leaves, and sphagnums. The nests average approximately 4 feet wide and 2 feet high that are conical in shape.

Egg laying occurs in early July in the upper portion of the mound where from 20-60 eggs are laid. Vegetation is deposited over the eggs. Nests, eggs, and the young are often protected by the mother. Hatching occurs in early September. Young alligators feed on invertebrates, aquatic insects and terrestrial insects. Yearling and adult alligators feed on snakes, turtles, frogs, birds, raccoons, muskrats and opossum.

Long range management for the alligator includes the maintenance and protection of wetlands, protection of the species, and the development of a high level of tolerance by those individuals directly affected by alligators. Annual surveys were initiated on selected creeks during 1977 to record the occurrence of alligators. The surveys are conducted at night with high beam lights to observe individual alligators. Data is recorded on the frequency of sightings, number of alligators and the size of each individual. Signs are maintained at boat landings, bridges and fishing

areas to make the public aware of the presence of alligators. The signs also provide information relative to the requirement for protecting alligators as provided by the Endangered Species Act.

**ATLANTIC LOGGERHEAD TURTLE:** The Atlantic loggerhead turtle is a large sea turtle with a reddish brown to brown carapace (upper shell) and yellowish plastron (lower shell). The forelimbs are paddle-shaped with two claws. Mature males have a longer tail than the hind flipper, while the tail of the female is shorter. Maximum known size for the species is around 1,000 pounds, but 300 pounds and a carapace length of 30 inches is more usual. Loggerheads attain weights up to 430 pounds in North Carolina.

Loggerhead turtles range from Nova Scotia to Argentina, through the Caribbean and the Gulf of Mexico. In North Carolina, they are found along the entire coast April-November, vacating estuaries and rivers as temperatures drop in early winter. It frequents the open ocean, estuaries, mouths of rivers and barrier islands where the females come ashore to lay eggs. The turtle feeds on fish, mollusks, sponges, jellyfish, squid, other animals, and some marine plants.

Mating takes place in the water near nesting beaches. Nesting occurs just above high water on open beaches, usually seaward of the dunes, from late May to

mid August at Onslow Beach. There were 141 known nests at Onslow Beach during the 1983-85 nesting season in which 17,079 eggs were laid for an average clutch size of 121 eggs per nest. The incubation period is 55 to 70 days, with an average of 57-89% hatching success. Eggs, under natural conditions, are subject to erosion and predation from a variety of creatures including raccoons, feral cats, dogs and even humans. Nests are protected from all these elements at Camp Lejeune. Hatchlings fall prey to a wide variety of creatures both on the beach and in the water.

Accelerated destruction of beach nesting sites and heavy nest predation, especially by raccoons, have taken their toll of this species. Human use of meat and eggs in some countries have also contributed significantly to its decline. The loggerhead turtle is listed as threatened and is protected under the Endangered Species Act.

**ATLANTIC GREEN TURTLE:** The green turtle is a medium to large sized turtle with a light to dark brown carapace having darker mottling. The plastron is yellowish. The carapace of the young is black to gray, with some brown on the margin of the shell and flippers, and the plastron is dusky to white. The tail of mature males is equal to or longer than the hind flipper, while shorter in females. The species is known to attain weights of 850 pounds and lengths of 60

inches, but the usual weight is 300 pounds and approximately 43 inches in length.

Essentially, the range of the green turtle is the tropical waters from Massachusetts to Argentina. The species was once abundant in the waters at Beaufort but is now only occasional along the entire coast and in the sounds. The green turtle frequents the ocean and estuarine habitats, entering sounds and rivers in summer. It feeds in shallow water on algae, other vegetation, fish, shrimp, and a variety of other foods, and adults prefer vegetation, especially roots. Its carapace is usually encrusted with barnacles.

This species was not known to nest north of the Georgia coastline prior to 1980 when a green was found nesting at Onslow Beach. This turtle was tagged on both front flippers and she returned to nest 3 more times that year during which she laid a total of 819 eggs. This same turtle returned to nest 5 times in 1985, laying a total of 892 eggs for an average of 190 eggs per nest. The hatching rate was 79% in 1985 or 786 of the 992 eggs successfully hatched. Incubation usually takes from 55-65 days. Both the eggs and young are subject to high mortality under natural conditions.

Green turtle breeding sites in the Caribbean have been decimated by man and predators. This turtle is widely used as a source of meat, eggs, and shell for ornaments in some parts of its range. The green turtle

is undoubtedly, one of the most valuable reptiles known to man. The green turtle receives the same protection as the loggerhead turtle under the Endangered Species Act.

**ATLANTIC RIGHT WHALE:** The right whale is a critically endangered species. It is a moderately large baleen whale up to 53 feet in length. It has a black body with callosity tissue on the head and lower jaw; no dorsal fin; underside of flukes are dark, raises flukes when it dives; has a v-shaped blow. A remnant population remains in the western north Atlantic and scientists believe that the population winters off the southeastern states from Cap Hatteras to northern Florida. In the winter, sightings have been made of mothers with calves close to shore. Scientists estimate that 1-2 herds exist numbering up to 100 individuals.

**FINBACK WHALE:** Endangered finback whales are large, flat-headed baleen whales that may attain a length of 79 feet in length. The body of the finback is gray, with a white patch on the lower lip; v-shaped chevron just behind the blowhole; dorsal fin 1/3 forward from tail; flukes rarely raised on dive; with a tall slender blow. Finbacks travel in close groups of three within loose herds of up to 200 animals feeding on plankton and small fish.

SEI WHALE: Also endangered, the sei whale is a moderately large baleen whale ranging to 62 feet in length. Its body appears shiny; dark gray on back, often with an ovoid grayish white scare; white on front of belly; with dark underside of flippers and flukes; and a dark, medium blow. Sei whales are not very common in cold waters and may have a greater tendency than finback whales to enter tropical waters.

SPERM WHALE: Endangered sperm whales range to 69 feet in length and males grow significantly larger than females. The body of this species is dark brown; wrinkled in appearance; large bulbous head; rounded hump on back followed by knuckles, flukes raised on longer dives; with single oblique blow projected to the left of head.

Consultation with the National Marine Fisheries Service has been conducted for whales as required under Section 7 of the Endangered Species Act. The consultation centered around live firing exercises into offshore waters within the Browns Island Target and Bombing area. A non-jeopardy biological opinion was rendered under the provision that aerial flights would be conducted prior to live firing into offshore water during the fall and spring migration periods.

#### 4. Freshwater Fish

The basic management program for freshwater fish is carried out in 11 ponds on the Base. These ponds

contain 35.5 acres of water. Management activities include good pond construction, proper stocking ratio, good fertilization programs and proper harvest of annual fish production.

Fish species utilized are largemouth bass, bluegill, redear sunfish, and channel catfish. Ponds are sampled periodically to assure that a balanced fish population is maintained.

Pond management for freshwater fishes is a dynamic process that requires constant review of fishing pressure, population trends, and problem areas such as aquatic weed infestations, oxygen deficiencies, and trash fish contamination. Base management programs are designed and administered to recognize those needs.

### III. LONG RANGE NATURAL RESOURCES MANAGEMENT

#### A. LAND USE MANAGEMENT CONCEPT, POLICIES AND LONG RANGE MANAGEMENT GOALS AND OBJECTIVES

While effecting change in the primary military land use patterns within the complex is not within the scope of this plan, land use management is a critical area of concern for improving the natural resources management program. There are many alternatives available for the protection and utilization of the natural resources of Camp Lejeune. There are a large number of officials constantly making decisions which affect what happens to any given acre of land. As a minimum, natural resource managers must ensure that these officials are provided adequate, up-to-date scientific information on how their decisions both impact on or impacted by natural resources management goals and objectives. Because this plan constitutes a revision of a guide to an existing program, widely recognized as sound and effective, there are not any major changes in program objectives and direction. However, improved coordination between various land managers within the Camp Lejeune complex is an obvious area where major inputs of management time and energy are required. Specifically, emphasis should be placed on improvement of programs related to the utilization and maintenance of unimproved grounds, most of which are committed to military training ranges and maneuver areas. It should be noted, that while the existing plan does not emphasize this requirement,



program review indicates that in fact, this emphasis and direction are already developing. However, it is important that these program changes and existing formal and informal lines of communication, coordination and cooperation among land managers be documented and subjected to review, evaluation and improvement. This section will describe the land use management concept in use at Camp Lejeune and its interrelationship with natural resources management. Section III D will outline the land and natural resources management organization within the Camp Lejeune complex.

#### 1. Land Use and Natural Resource Management

Relationships: Natural Resource Management within the Camp Lejeune complex is carried out under a multiple-use concept best described as a system of primary and secondary land uses. The primary use of any given land or water area is with minor exception, directly related to the military mission. The current revision of Base Master Plan, by Harland Bartholomew and Associated, Inc. May 1986, divides military land use into the following categories:

- a. Military Training and Maneuver Areas. Over 90% of the complex is used for various types of training by infantry, mechanized units, amphibious units and air support units. Approximately 52,000 acres is categorized by military training managers as usable land. Remaining area in this category

consists of water, marsh, and other areas with severe physical limitations for mechanized training. However, even these areas provide space required for military training such as the use of artillery.

- b. Operational Uses. Approximately 580 acres of land are devoted to tactical landing zones, administrative landing zones, and aircraft and helicopter operating areas and apron parking at MCAS, New River.
- c. Training Classrooms. Approximately 165 acres are used for formal classrooms, with the majority of this use located at the Marine Corps Service Support Schools, Montford Point and the Marine Corps Engineering School, Courthouse Bay.
- d. Administrative Uses. Approximately 220 acres are used for various types of offices.
- e. Troop Housing. Approximately 620 acres are used for barracks for unaccompanied personnel. Ranging from World War II vintage facilities to modern dormitory style, troop housing facilities are concentrated in the Hadnot Point, French Creek, Camp Geiger and Air Station areas.
- f. Family Housing. Over 1700 acres of land are committed to family housing. Family housing consists almost entirely of low density single family houses and duplexes.

- g. Community Uses. Community uses include all types of noncommercial personnel support facilities such as dining facilities, schools, child care centers, libraries and other public service type facilities. Over 400 acres are devoted to this use.
- h. Commercial Uses. Commissaries, exchanges and other commercial services are located in reasonably close proximity to housing areas. Approximately 90 acres of land is committed to these uses.
- i. Maintenance Uses. Almost 400 acres of land are committed to facilities housing vehicle, equipment and other maintenance functions. Industrial wastes, wastewater and other environmental pollutants generated by maintenance facilities are of significant importance to natural resources protection.
- j. Research. With only one acre committed to this use, this is not a significant planning factor.
- k. Supply and Storage Uses. Approximately 660 acres are in this use, not including safety zones around ammunition and other hazardous materials storage areas, which includes warehouses and open lots.
- l. Medical/Dental Uses. The new Naval Hospital makes up the majority of 90 acres of various medical and dental facilities, located throughout the complex.

- m. Recreational Uses. Approximately 1175 acres are committed to both indoor and outdoor recreational facilities. Included are ball fields, tennis and basketball courts, amphitheater, swimming pools, gymnasiums, etc.
- n. Utilities. Approximately 140 acres of land are devoted to facilities required to provide steam generation, electricity, drinking water, and treatment of wastewater.

The nature of military training carried out within the complex generally does not require the exclusive use of land areas. Historically, the secondary land uses of forest management, wildlife management and outdoor recreation have been practiced and promoted within the complex. Additionally, natural resources related concepts such as open space, aesthetics/beautification, natural areas and environmental protection have been applied throughout the complex.

The balance between military mission priorities on land use and implementation of multiple-use goals for natural resources management appears to be consistent with national goals and standards applicable to federal land management. However, review of documentation developed during the current revision of the Base Master Plan indicates recent and proposed changes in military training requirements and weapon systems will significantly increase land area requirements for

military training. Headquarters, Marine Corps, recently moved forward with the procurement of approximately 39,000 acres of land adjacent to Camp Lejeune as additional training and maneuver area. Until such time as additional lands are obtained, it is not likely that significant increases in either forest productivity or the present level of hunting, fishing and other outdoor recreation related uses will occur. Improved communications and coordinations between military training lands managers, facilities managers and Base natural resources managers are extremely important to maximize the net level of productivity in terms of volume of forest products, number of recreational use days, etc.

Additionally, rapid increases in the retired military population in Camp Lejeune vicinity is placing increased pressures on existing outdoor recreational resources and land use management decision making.

Dealing with this changing planning environment will be the most challenging aspect of the implementation of this long range natural resources management plan.

2. Natural Resources Management Related Goals and Objectives for Land Use Planning. This Long Range Natural Resources Management Plan was developed under the assumption that primary land uses, as established in the Base Master Plan, were established only after

adequate review of their impact on the natural environment. Change of primary land uses was not within the scope of this plan. The following goals have been established to enhance land use management functions within the Camp Lejeune complex in major areas involving interaction or impact on achievement of basic objectives of Marine Corps Order P11000.8B:

Goal 1. To develop a computerized geographic information system with capability to store, evaluate and interpret comprehensive natural resources data and make the system accessible to all major land managers.

Goal 2. To make briefings on all significant areas of natural resources management readily available to newly assigned military training area managers, commanding officers and key staff personnel of tenant commands.

Goal 3. To conduct an annual coordination and review workshop under the authority and control of the Chairman of the Base Environmental Enhancement Committee to identify problems and issues related to encroachment, land use management and natural resources management and protection.

Goal 4. Improve coordination between NREAD and tenant commands on routine matters dealing with natural resources protection and environmental

compliance associated with the conducting of military training in the field environment.

Goal 5. To improve the scheduling, control and related law enforcement required to manage access to hunting, fishing, trapping and other outdoor recreation in a manner which protects public safety and minimizes adverse impact on the military training mission.

Goal 6. To improve the effectiveness of signs, boundary markings and other mechanisms for advising recreational land users such as hunters, fishermen, etc., of the location and nature of restricted use land areas such as impact areas, and other pertinent hazards.

B. FORESTRY, FISH AND WILDLIFE AND OUTDOOR RECREATION  
MANAGEMENT POLICIES AND LONG RANGE GOALS AND OBJECTIVES

FORESTRY

Forest management operations shall provide for the development and maintenance of a desirable balance between the production of timber products and related natural resources values, such as natural beauty, watershed protection, wildlife habitat enhancement and outdoor recreation, but military training will be the primary consideration.

1. Coordination with the Military Mission.

Objective. Forest resources management and treatment decisions will be designed and/or modified within the guidelines of sound silvicultural practice

to improve and protect troop training capability and enhance the military mission.

Goal 1. Improve coordination and communication between Base Range Control and Base Forestry through the continuing education of both parties by periodic one-on-one contact and formal meetings. Changes in mission requirements, planned military activity and forest management and protection activities will be scheduled in advance whenever possible to prevent serious conflicts.

Goal 2. Establish a system whereby the deficiencies in training area maintenance can be identified by NREAD personnel and communicated to the Training Facilities Officer.

Training and other Marine Corps mission requirements will receive priority over forest management activities. Training and mission requirements will be identified, to the greatest extent possible, during the natural resources planning process. Modification of timber sale specifications will be made to accomplish the requirements. Forest fire suppression activity will receive priority in order to prevent damage to training areas, reduce the possibility of catastrophic fires, keep financial loss to facilities and natural resources to a minimum, and reduce the



hazard to suppression forces and other personnel in the immediate vicinity of the wildfire.

2. Inventory of Timber Resources.

Objective. Carry out periodic forest data inventories necessary to support scientific management of the forest resources.

Goal. In FY 1994 enter into an agreement with the Forest Inventory Analysis Unit of the U.S. Forest Service, Southeastern Forest Experiment Station, to conduct a second Multiple-Use Inventory, with particular emphasis on stand volume, growth and mortality rates.

During FY-84, Camp Lejeune entered into a contract with the Southeastern Forest Experiment Station, (Forest Service, U. S. Department of Agriculture), to establish 333 multiple use inventory plots at a cost of \$71,800. Camp Lejeune is gridded every 1,000 meters with each grid intersect representing 247 acres. This corresponds to a selected intensity of 250 acres per plot. Before the sample was made, non-commercial forestland was delineated. Camp Lejeune provided men and vehicles to assist the Forest Inventory Analysis personnel. Potential red-cockaded woodpecker habitat was identified during the survey. Forest inventories on Camp Lejeune have been done on a ten year cycle. In 1964, the U.S. Forest Service conducted the inventory

on the Base. In 1974, the Navy conducted the survey using 3-P sampling and in 1984 the Forest Inventory Analysis Unit of U. S. Forest Service, Southeastern Forest Experiment Station, conducted the first multiple use inventory. See Forest Resource Management Plan (Appendix A) for specific details of Multiple Use Inventory.

3. Establish the Allowable Annual Timber Harvest.

Objective. Establish an allowable harvest of merchantable timber on a periodic basis which will maintain a sustained yield and provide for the optimum utilization of timber resources as well as the reduction in mortality by insects and disease.

Goal 1. Harvest the allowable annual harvest and improve the quality of residual pine and hardwood timber through commercial sale, fuelwood marketing and multiple-use stand improvement work.

Goal 2. Increase the regeneration harvests in the 31-60 year age classes to achieve greater wildlife habitat diversity and a more equal distribution of age classes in all timber types.

Goal 3. Maximize use of LUMS to adjust allowable annual harvests following land use changes or other significant events, such as damage from major wildfires and insect or disease infestation, during the course of the plan.

Goal 4. Achieve an even flow of financial return to the government and to Onslow County from net proceeds from the sale of forest products.

During the last 10 year period the average annual harvest for pine sawtimber was 4,689 MBF, with an approximate value of \$567,000, and 8734 cords of pine pulpwood with an approximate value of \$70,600. During the same period an average of 15 MBF of hardwood sawtimber was harvested and valued at \$6,000 and 130 cords of hardwood pulpwood was harvested at a value of \$400. It is important to note that there has been near full utilization of the pine timber, but the hardwood timber resources has been greatly under utilized because of lack of markets.

Specific information concerning volume per species, size and age class distribution can be found in the Forest Resource Management Plan. (Appendix A)

4. Apply Timely Timber Management Practices, Appendix A.

Objective. To apply timely management practices that promote optimum utilization and improve quality of the timber resources and reduce mortality by fire, insects and disease.

Goal 1. Utilize all available natural resources training to increase productivity, scientific management and protection of the forest resources, such as silvicultural training for timber management forester and personnel involved with compartment

prescription. Fire management training will be provided for all personnel involved in any phase of fire management, with additional training for all employees subject to act as Incident Commander. Training in identification and suppression of insect and disease infestations for all forestry personnel.

The reduction of forest resources mortality by fire will be accomplished by maintaining a strong, aggressive fire suppression capability through periodic training in pre-suppression and suppression techniques, safety and prevention. A major element to reduce wildfire losses is a continued aggressive prescribed burning program to reduce fuel loading.

Goal 2. Work jointly with Public Works Officer to improve communication concerning timely harvest of construction sites and improve response time when dealing with short term salvage contracts.

Goal 3. Continue aerial and ground, insect and disease reconnaissance and an active suppression program in cooperation with the U. S. Forest Service, Pest Management Field Office. Reduction of mortality from insects and diseases will be accomplished by silvicultural treatments to improve the vigor of residual trees. Detect infestations as early as possible and take action to suppress insect or disease before reaching epidemic proportions.

5. Wildlife Habitat and Timber Management Coordination.

Objective. Improve wildlife habitat through silvicultural practices.

Goal 1. Evaluate wildlife habitat conditions during the compartment prescription process in accordance with the wildlife habitat analysis.

Goal 2. Apply even-aged management silvicultural treatments to improve habitat diversity, species composition and habitat productivity, while accomplishing timber management objectives.

Goal 3. Make the compartment the basic natural resources planning unit.

6. Open Space and Forest Recreation.

Objective. Give consideration to open space and forest recreational activities.

Goal. Silvicultural treatment activities will be modified to improve and protect the aesthetic and recreational areas. For example, silvicultural treatment will be modified in conjunction with bridal trails, scouting areas and road side zones where recreational and aesthetics values predominate.

7. Soil, Stream Crossings and Wetlands.

Objective. Prevent and control soil damage, damage to stream crossings, stream side zones and wetlands.

Goal 1. Apply forestry management practices to protect watershed values. Potential for soil erosion, soil damage, and water quality degradation

will be identified during the compartment prescription process and prescribed burning planning.

Goal 2. Make wetland considerations and soil interpretations an integral part of the prescription process.

Goal 3. Continue to enforce timber sale contract specifications which specifically require prevention of damage to the watershed and soil during all phases of the timber harvesting operation.

#### 8. Fire Management.

Objective. Develop and maintain a highly trained, effective and efficient fire management team within guidelines established by the National Wildfire Coordinating Group.

Goal 1. Develop a comprehensive wildfire suppression and pre-suppression plan, which develops guidelines and training needs for suppression, pre-suppression, prevention, detection, preparation, cooperation, communication, fire weather and equipment. The plan will include a prescribed burning plan for the Base.

The suppression of wildfires is given priority over other activities except those involving the safeguard of human life. The highest priority will be given to the prevention of disasterous fires by aggressive pre-suppression and suppression actions.

Goal 2. Only trained and qualified personnel will be assigned to fire suppression duties. All assigned personnel will be issued, wear and be trained in the use of safety clothing and equipment.

Goal 3. Training will be in conjunction with the fire plan to be developed as stated in 1 above. Training, pre-suppression and suppression activities will be in cooperation with the Camp LeJeune Fire Department and under the guidelines established in cooperative forest fire fighting agreements with the U. S. and North Carolina Forest Services, (Appendix C).

9. Firewood Utilization.

Objective. Improve the management and control of firewood collection.

Goal. Encourage utilization of firewood in regeneration cuts and other previously harvested areas and the feasibility of using commercial firewood contractors to accomplish management objectives in non-merchantable hardwood stands.

10. LUMS.

Objective. Establish LUMS as a viable resource management tool aboard Camp Lejeune.

Goal. Implement LUMS capability for compartment prescription, timber management and protection activities.

## FISH AND WILDLIFE MANAGEMENT

The Wildlife Natural Resource Management Plan shall include provisions for multiple-use and ecological development through management, restoration, improvement, preservation, and wise use of fish and wildlife resources. Land and water areas suitable for management under the Fish and Wildlife Program, or under a general environmental enhancement program, shall be identified. Indigenous wildlife species to be protected by habitat protection or improvement shall be identified. Endangered wildlife and plant species and requirements for their protection shall be identified in accordance with the provisions of the current edition of MCO 11015.4. All water areas shall be evaluated with primary and secondary uses identified.

Wildlife resources, and to a more limited extent, fishery resources, are directly related to the soil resources base. Soil properties such as texture, wetness, solum thickness, flood hazard, and slope affect the type of plant community present on a given site. Wildlife populations are directly related to plants and plant communities, as these provide food and cover requirements necessary for species survival. Consequently, long range management plans for fish and wildlife resources must basically consider the manipulation alternatives for plant communities.



Objectives developed in this section reflect this critical plant-animal relationship.

Objective. Maintain an active program to control and improve aquatic habitats as a basic means of perpetuating and improving Base fishery resources.

Goal 1. Manage waters within ecological limits to produce the most desirable game species in optimum size and numbers.

Goal 2. Expand opportunities for utilization of Base fishery resources. Emphasis will be given to utilization of fresh, estuarine, and marine species.

Objective. Maintain quality wildlife habitat for game, non-game, and threatened and endangered species through a program of habitat protection and improvement.

Goal 1. Develop long range species management plans for selected native game, non-game, and threatened and endangered species.

Goal 2. Continue to provide public access to hunting and trapping resources on the Base.

Goal 3. Develop annual harvest projections for game species to ensure adequate harvest required to balance animal populations with habitat productivity.

Objective. Analyze effectiveness of fish and wildlife enforcement activities as it relates to fish and wildlife population harvest.

Goal 1. Review enforcement and protection program responsibilities in cooperation with other sections as appropriate.

Goal 2. Develop a program to facilitate public awareness of Base and State regulations regarding the harvest of fish and wildlife resources.

Objective. Manage Base hardwood resources for native wildlife species.

Goal 1. Maintain or improve existing balance between Base forest types as listed in Figure 3.

Goal 2. Practice scheduled prescribed burning in hardwood and mixed pine hardwood stands in accordance with best management practices to reduce danger of wildfire and to benefit wildlife. Prescribed burning in these habitat types must be planned so as not to be detrimental to existing hardwood forest components.

Goal 3. Manage forest transition zones so that they are improved, protected and managed to favor hardwood species for wildlife resources in accordance with Appendix B 4b.

Goal 4. Develop coordinated program with Base Forester to improve plant species diversity and stand age class diversity in the Base forests.

Goal 5. Develop program in cooperation with Base Forester to utilize marked firewood cuts for thinning hardwood stands and for hardwood release.

Objective. Integrate Wildlife Habitat Appraisal Guides, by species, into the compartment prescription process.

Goal 1. Develop habitat appraisal guide for seven indicator species, as follows:

1. Red-cockaded woodpecker
2. Turkey
3. Bear
4. Deer
5. Fox squirrel
6. Gray squirrel
7. Quail

Goal 2. Provide personnel input into all compartment prescription data accumulations and treatment alternative formulations.

Objective. Implement a data base program for fish and wildlife resource habitat and populations through the use of the LUMS computer system.

Goal 1. Determine data bases applicable for inclusion into LUMS.

Goal 2. Evaluate software programs available for use in management of fish and wildlife resources and provide leadership in developing new programs as needed.

Goal 3. Develop display systems, utilizing LUMS, to project habitat needs, population trends, etc., to facilitate and enhance a long term management plan for Base Fish and Wildlife Resources.

### OUTDOOR RECREATION

Continue to support and assist wherever possible Camp Lejeune Special Services varied recreation programs for military personnel, their dependents and guests so they can enjoy the many recreational facilities and national resources available at Camp Lejeune.

### C. SOIL AND WATER CONSERVATION MANAGEMENT POLICY AND LONG RANGE GOALS AND OBJECTIVES.

Soil and water conservation is used within this plan to mean the local initiative to protect the basic land and water resources of the Camp Lejeune complex. Soil and water conservation is not a function which is centrally managed and controlled such as forestry management and fish and wildlife management. Rather, soil and water conservation goals and objectives are achieved through proper application of soil and water conservation principles and practices by numerous officials involved in the development, use, and maintenance of real property. The following functions are routinely involved:

- Land use planning and environmental impact assessment
- Execution of military training
- Facilities design and construction
- Maintenance and repair of real property
- Pollution control and abatement

Except to the extent that this plan promotes the development and utilization of up-to-date, accurate, natural resources data by all land use planners and managers, effecting major land use changes is not within its scope.

Rather, the land use patterns established by the Base Master Plan will be assumed to be the primary land use of any given area. The objectives and goals set for soil and water conservation will be limited in scope to those which are within local capability to implement during the next ten year planning and programming cycle. The various organizations within the cognizance of the Assistant Chief of Staff, Facilities, and the Assistant Chief of Staff, Training and Operations, have primary responsibility for implementation of soil and water conservation initiatives. The plan of action contained herein has been closely coordinated with each of these two department heads. Day-to-day coordination of the implementation of the soil and water conservation program is the responsibility of the Director, Natural Resources and Environmental Affairs Division, Facilities Department, Marine Corps Base, Camp Lejeune.

1. Current Soil and Water Conservation Issues and Problems

Areas: Camp Lejeune has over 100 miles of streams which have associated with them some 7000-8000 acres of environmentally sensitive flood plains and marshes.

Additionally, the primary source of drinking water is the relatively shallow Castle Hayne groundwater aquifer. This unconfined surface aquifer is subject to contamination from many types of releases of hazardous substances onto or into the soil. In addition to floodplains and marshes, the Camp Lejeune complex contains extensive areas of upland wetlands such as bays and pocosins. Consequently,

soil and water related constraints contribute to a relatively complex planning environment within which military training and facilities managers must operate. Following are important soil and water conservation areas of concern:

- a. Reduction of erosion and related stream sedimentation through more effective maintenance of and application of sound soil erosion control measures to unpaved roads and trails.
- b. Improving procedures for the preparation and implementation of erosion and sedimentation control plans for new construction and related land disturbing activities regulated by State environmental regulations need to be improved.
- c. Improving methodology for controlling the extensive beach and shoreline erosion aboard the complex should be developed. Especially important is the development of a mutually acceptable approach with outside regulatory and planning agencies for addressing the natural phenomenon.
- d. Improving the overall quality of the environment through better utilization of soils information and other available technical data in the areas of soil fertility management, drainage and plant selection.
- e. Reducing maintenance cost and improving trafficability of unpaved roads and trails by proper drainage and surface

water management. Addressing this area of concern involves the constraints of wetland regulations.

- f. Improving the availability of properly interpreted soil, wetlands and water resources data has potential for improving all phases of land use planning. Mechanisms for providing this information and for providing related training in use and interpretation needs to be developed.
- g. Developing a new sanitary landfill site or alternative solid waste disposal method within six to eight years.

Please note that while the previous Natural Resources Management Plan focused on numerous relatively minor, specific sites which required treatment, this plan focuses on improving internal controls and management techniques. There are few significant sites other than naturally eroding shorelines where one time projects will effect permanent solutions to existing problems. Rather, the primary solution appears to lie in upgrading the facilities maintenance program in the areas of improved inspection of roads and grounds, prompt accurate reporting of potential and existing problems/deficiencies to cognizant officials, and effective planning, programming and application of sound soil and water conservation practices. Specialized training of key facilities planners and managers in how to obtain and interpret natural resources data and in the application

of soil and water management techniques appears to have significant potential for improving this program.

2. Soil and Water Conservation Objectives and Goals:

Objective A. To minimize damage to unpaved roads and trails and unimproved grounds by erosion, sedimentation and inadequate drainage by improving inhouse capability to plan, install and maintain conservation measures outlined in Appendix E.

Goal 1. To provide annual training on drainage, erosion control and sediment pollution prevention to key personnel involved in the construction, maintenance and repair of roads, trails and unimproved grounds.

Goal 2. To establish and implement a formal system for utilizing NREAD field personnel to identify, evaluate and report unimproved grounds maintenance problems related to erosion control and drainage per concept outline in Appendix E.

Goal 3. To develop a comprehensive plan for the maintenance and repair of unpaved roads which is consistent with the technical guides and standards contained in Appendix E.

Goal 4. To obtain specialized equipment including, hydroseeder and mulch applicator to improve efficiency and reduce labor requirements of installing erosion and sediment control measures.

Goal 5. To improve inhouse capability to design and lay out simple drainage and erosion control measures and



to develop internal controls to ensure adequate quality control on installation of these measures.

Goal 6. To promote the protection and improvement of vegetative buffer strips along streams and surface water to reduce sediment pollution.

Objective B. To develop a systematic methodology for addressing beach and shoreline erosion problems within the Camp Lejeune complex.

Goal 1. To update shoreline erosion inventory to include establishing priorities for addressing those sections of eroding shoreline which are impacting on the mission or pose risk of damage to facilities.

Goal 2. To, in cooperation with cognizant outside regulatory and planning agencies, develop a mutually acceptable site with specific standards and guidelines for shoreline stabilization measures.

Goal 3. To design and install access ramps and stream crossings with adequate erosion and sedimentation control features to provide river entry and stream crossings by tactical vehicles and equipment.

Goal 4. To improve supervision and maintenance of beach areas to the extent required to prevent excessive damage by foot and vehicular traffic to the sand dunes and to perform timely, effective maintenance and repair to damaged vegetation.

Objective C. Improve internal mechanisms for implementation of erosion, sedimentation and storm water runoff control standards and regulations.

Goal 1. Ensure that effective, technically sound erosion control plans are developed and implemented for all projects with significant potential to cause excessive erosion and sedimentation pollution.

Goal 2. Ensure that storm water runoff is controlled and released to the environment in a manner which minimizes damage to stream channels and which does not violate water quality standards.

Goal 3. To implement a water quality monitoring program to identify changes in water quality which may require corrective action.

Goal 4. Increase awareness of facilities planners and managers and military engineering organizations of the opportunity for economically reducing the impact of erosion and sedimentation on the environment, and by promoting proper timing of the protection of natural vegetative filter strips when conducting any land disturbing activity.

Objective D. Improve Base landscaping and beautification program through improved soil fertility, irrigation, and plant materials management.

Goal 1. To establish a technical advisory committee of concerned staff specialists throughout the complex to coordinate management and related personnel training

activities. Training is required to ensure that the best available technology and techniques are incorporated into all aspects of ground maintenance and repair and into new construction projects.

Goal 2. Conduct periodic workshops on soil fertility management, irrigation water management and plant materials selection and management.

Goal 3. To promote the implementation of technical guidelines and standards contained in Appendix E, and to make maximum use of available technical assistance of state and federal technical agencies such as the Soil Conservation Service, USDA, North Carolina State University, North Carolina Agricultural Extension Service, etc.

Goal 4. To conduct periodic soil sampling and other spot checking to ensure adequate quality control of soil fertilizer and plant materials management activities.

Objective E. To promote the wise use and protection of wetlands, surface waters and groundwater resources.

Goal 1. To develop a Base water conservation program addressing groundwater and treated water supplies.

Goal 2. To develop and implement alternatives for solid waste disposal which addresses the problem of limited useful life of the Base sanitary landfill and which minimizes the utilization of land disposal of wastes.

Goal 3. To conduct a comprehensive study and evaluation of the quality, quantity and distribution of groundwater resources.

Goal 4. To improve the availability of wetlands and soil and water resource data through utilization of the Land Use Management Systems computerized data base management program.

Goal 5. To strengthen education programs and enforcement programs in the areas of hazardous and toxic substance management and disposal, and to aggressively promote the upgrading of equipment and facilities required for safe handling and storage of any chemical with potential to contaminate water resources.

#### D. NATURAL RESOURCE MANAGEMENT COORDINATION AND ORGANIZATIONAL STRUCTURE

By comparing the organizational structure in 1975 (see Figure III.D. 1) with the current structure (see Figure III.D. 2), it is apparent that increased command attention has been given to natural resources management and environmental protection. The number of officials involved on a daily basis in the program has increased. Three specific changes are noteworthy: (1) Establishing the Director, Natural Resources and Environmental Affairs Division, as a special staff officer under the overall cognizance of the Assistant Chief of Staff Facilities (AC/S); (2) establishing a permanent environmental engineer/planner to serve as staff advisor to the Assistant Chief of Staff Facilities and the Environmental

Impact Review Board (EIRB), and (3) transfer of the Game Warden function to the Base Provost Marshall's office from NREAD. The remainder of this section will outline organizational responsibilities and management objectives for implementation of this plan.

1. Organization. The natural resources management organization is outlined in Figure IIID. 2. Appendix D summarizes higher headquarters directives and external regulatory requirements. The AC/S Facilities has overall cognizance for natural resources planning and management. This role is further strengthened by the AC/S Facilities responsibility to serve as Chairman of the Base Environmental Impact Review Board and the Environmental Enhancement Committee. Day-to-day operational control of the Base natural resources program is assigned to the Director, NREAD. NREAD is organized into three branches based on the following areas of concern and disciplines:

Environmental Management and Protection

Fish and Wildlife Management

Forestry Management and Protection

The role of the Forestry Branch, NREAD, has remained relatively unchanged. There will be increased emphasis on the Forestry Branch's role in maintenance of the dirt road system in forested areas. The Fish and Wildlife Branch's role did undergo significant change during the

past ten years. Implementation of state and federal endangered species regulatory requirements has detracted from traditional wildlife management functions. The resulting affects on existing programs appears to have lead to the transfer of the game law enforcement function to the Base Provost Marshall. The most significant increase/change has occured in the Soil, Water and Environmental Branch. Implementation of the Safe Drinking Water Act, Clean Water Act and the Resource Conservation and Recovery Act (i.e., hazardous waste management) has had major impact on the program.

While the transfer of the Base Game Warden to the Base Provost Marshall is not inconsistent with the requirement of Marine Corps Order P11000.8B, previous proposals to civilianize the head Game Warden billet are still valid. The Game Warden plays a key role in managing public access for hunting, fishing, trapping and recreation. Additionally, the Game Warden enforces permits required for collection of firewood. The law enforcement aspects of the function should be staffed by civilians, trained in wildlife law enforcement. The need for close, long-term working relationship with state and federal wildlife agencies and the extent of dealings with the general public tend to favor supervision and location within NREAD.

While the current head of the Soil, Water and Environmental Branch has a natural resources background,

it is likely that given the direction the branch is moving, that an environmental specialist, (i.e., chemist, engineer, etc.) will eventually be required were the position to become vacant. This change is also consistent with recommendation to move the soil conservation function.

It is further recommended that the role of the EIRB/EI Committee continue to be strengthened. The makeup of the board/committee is outstanding and provides a strong mechanism for planning and coordination. The board meetings appear to be the appropriate forum for addressing the broader issues of natural resources and environmental planning. The meetings are conducive to problem solving in that broad representation by all commands and departments creates a relatively neutral environment where managers and staff specialists can interact.

2. Natural Resources Planning and Programming. Day-to-day planning and programming required to achieve natural resources and related environmental protection objectives is somewhat decentralized. However, there are no major problems in this area. The existing organizational structure discussed above is relatively new, and the organizations involved seem to be steadily improving their working relationships with each other. While all areas of natural resources management could benefit from additional personnel, these functions appear to be

getting their proper share of manpower resources in view of overall manpower constraints. There is a serious need to automate natural resource data management systems. Fortunately, the current headquarters Marine Corps project to develop a geographical information system (GIS) will provide a timely solution to this problem. This GIS concept should be implemented as rapidly as possible.

It is recommended that the Director, NREAD, have primary responsibility for identification of natural resources management and protection funding requirement, both long term and short term. The Environmental Engineer should continue to handle long range environmental protection planning and programming. The Environmental Engineer should submit a separate listing of projects and funding requirements via AC/S Facilities for incorporation into the annual NREAD operational plan submitted to HQMC.

The Environmental Engineer should manage environmental projects and related programming and funding which are beyond the scope and purpose of the Annual Operational Plan. Close coordination among the Public Works Officer, Base Maintenance Officer, Director, NREAD, and Environmental Engineer is required to ensure that all requirements are identified and appropriate priorities assigned.



3. Interagency Coordination. The complexity and diversity of uses and changing uses of land is impacting on all natural resources at Camp Lejeune. While military training has priority on most undeveloped areas, these same areas may be managed for one or more other uses such as roads, timber harvest, camping, hunting, fishing, etc. Various agencies have some degree of jurisdiction over natural resources management activities within the Camp Lejeune complex.

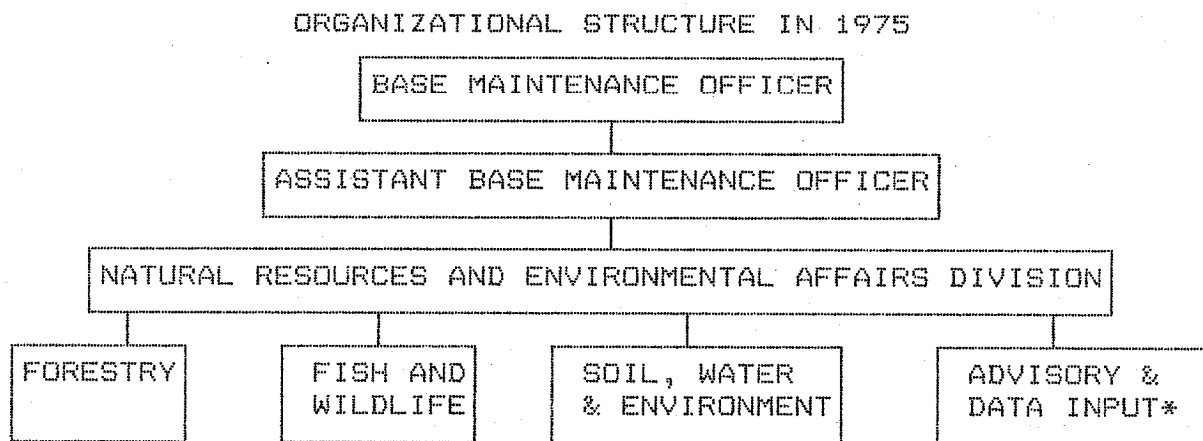
The North Carolina Department of Natural Resources has three programs that regulate land use. They are (1) The Mining Act, (2) Coastal Area Management Act, and (3) Sediment and Erosion Control on Developed Areas. The National Clean Water Act (33 USC 1934) - Section 404 (b) is administered by the United States Army Corps of Engineers. Plans and construction requiring review by one or both of the agencies will be coordinated by Base Environmental Engineer.

In addition to these two regulatory agencies, Camp Lejeune receives assistance from or must coordinate with the following agencies in carrying out its Long Range Natural Resources Management Plan and related environmental protection programs.

- a. NC Division of Health Services
- b. NC Marine Fisheries Department
- c. Environmental Protection Agency
- d. Onslow Soil and Water Conservation District

- e. US Department of Agriculture, Soil Conservation Service
- f. NC Forest Service
- g. US Forest Service
- h. NC Wildlife Resources Commission
- i. US Fish and Wildlife Service
- j. State and Federal Historical/Archaeological Resources Agencies
- k. Federal Aviation Administration
- l. US Coast Guard
- m. Coastal Zone Management Commission

The Commanding General has policy and procedures to assure that present land use and changes in land use will have the minimum adverse impact that is practical on natural resources. Base Orders 11017.1B, 11015.2G, 6240.5, 11090.1B, 11015,3A and 11017.1B have been developed to assist in achieving compliance with related local, state and federal regulations.



\* This section consists of advisory and coordination personnel from Basic Public Works Department and other divisions of Base Maintenance Department on a collateral duty basis.

FIGURE IIID 1

CURRENT ORGANIZATIONAL STRUCTURE

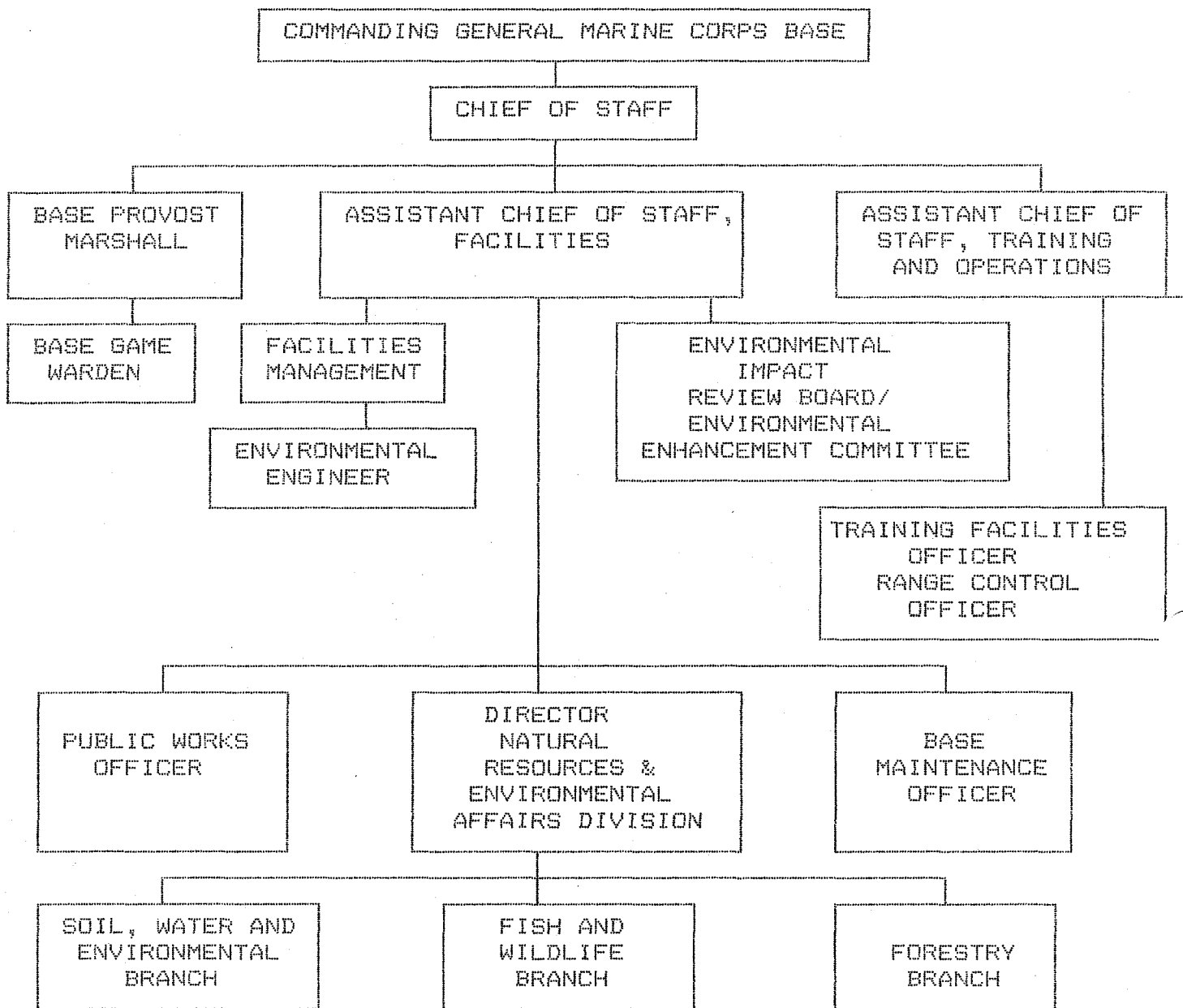


FIGURE IIID 2

## APPENDIX A. FOREST RESOURCE MANAGEMENT PLAN

1. INTRODUCTION . . . . .	A-1
2. FOREST MANAGEMENT HISTORY . . . . .	A-3
3. FOREST SUPERVISION AND MANAGEMENT . . . . .	A-5
a. Silvicultural Systems . . . . .	A-6
b. Inventory . . . . .	A-10
c. Compartment Prescription . . . . .	A-21
4. REFORESTATION AND TIMBER STAND IMPROVEMENT . . . . .	A-26
5. TIMBER SALES . . . . .	A-29
a. Timber Marking . . . . .	A-29
b. Contracting . . . . .	A-36
6. TIMBER ACCESS ROADS . . . . .	A-41
7. FOREST PROTECTION . . . . .	A-41
a. Insect and Disease . . . . .	A-41
b. Wildfire Suppression . . . . .	A-42
c. Prescribed Burning . . . . .	A-42
8. FORESTRY PROJECT WORK SCHEDULING . . . . .	A-44

## A. FOREST RESOURCE MANAGEMENT PLAN

### 1. INTRODUCTION

The Forest Resource Management Plan serves as a guide for the professional multiple-use management of the timber resources aboard Camp Lejeune, and as a reference for other land managers in the assessment of the impact of their actions on the forest resources. As a multiple-use planning document, the plan has the flexibility necessary to meet military training requirements and to cope with unforeseeable events such as insect infestations, catastrophic forest fires, changes in land use and military training requirements.

During the period covered by the 1974 Long Range Plan, the following items were accomplished:

- (a) Gross proceeds from the sale of forest products totaled more than \$6.44 million. The volume of products harvested is listed below:

Pine Sawtimber	46,885 MBF (Scribner FC-78)
Pine Pulpwood	87,338 Cords
Hardwood Sawtimber	151 MBF (Doyle FC-76)
Hardwood Pulpwood	1,303 Cords

- (b) More than 3,000 acres were regenerated and timber stand improvement was performed on 1,900 acres, primarily with a drum chopper used to precommercially thin young pine stands.
- (c) Prescribed or controlled burning to reduce wildfire hazard and improve wildlife habitat was accomplished on an estimated 15,200 acres annually.

- (d) Nine hundred and fifty wildfires burned approximately 9,300 acres.
- (e) One hundred and seventy-two miles of forest access roads were repaired, maintained and seeded with perennials to benefit wildlife and to prevent soil erosion.

Management of forestland used extensively for military operations presents unique management opportunities. Portions of Camp Lejeune, such as the G-10, K-2 and BT-3 impact areas are used exclusively for military training, and controlled burning to reduce wildfire hazard is the only forest management activity carried out in these areas. The surface danger zones (SDZ), used as a safety buffer around the impact areas, are controlled burned for wildfire hazard reduction, but other forest management activity may be permitted by the Command on a case-by-case basis. Live-fire ranges, ammunition storage areas, tactical landing zones and other unique military requirements present imaginative foresters with many opportunities to individualize forest management practices to accomplish both natural resources management objectives and the military mission.

Forest management activities effect the forest environment, so close coordination with other natural resources and land managers is important. Wildlife habitat can be greatly improved by forest management and wildlife habitat appraisal guidelines are used to help plan forest

management activities. Forest management is scheduled to prevent interference with planned military activities.

## 2. FOREST MANAGEMENT HISTORY

Camp Lejeune came into existence in the late 1930s when the Marine Corps realized that its training facilities must be expanded. This area of Onslow County was selected after considering areas from Maine to Florida for the purpose of establishing a Marine Corps Base. Procurement of the land began in 1940.

Prior to 1940, the land was privately owned. Tracts ranged in size from less than an acre to several thousand acres. There were about 6,000 acres of open farmland. Much of the merchantable timber had been harvested from the forestland. There was little or no fire protection and the wildlife populations were generally low.

During the construction period of Camp Lejeune, nine million board feet of timber was harvested from the reservation by portable sawmills operated by Navy construction battalions with the lumber used in local construction projects and the construction of Camp Lejeune-Cherry Point Railroad. In 1944, a sawmill with a daily capacity of 10,000 board feet was put into operation by Base Maintenance with the lumber being used in routine maintenance and minor construction. Timber sales for pulpwood were initiated in 1946, and sawtimber sales were begun when the Base sawmill was closed in 1954.



Camp Lejeune has been under a forest resource management plan since 1946 when the first management plan was implemented with subsequent plans prepared in 1954, 1964 and 1974. During the period covered by the 1974 Long Range Management Plan, the following events occurred which had a significant effect on forest management practices.

- a. During the early and middle 1970's, a severe southern pine beetle epidemic required a clearcut salvage operation totaling approximately 1,800 acres and required an equally large reforestation effort.
- b. An extensive effort was undertaken to determine the age class distribution of the existing forest. It was determined that the vast majority of the acres of pure pine, pine hardwood mixture and pure hardwood were between 30 and 60 years of age. An aggressive program was implemented to thin high quality overstocked pine stands in these age classes and regenerate the poorer quality stands.
- c. The Endangered Species Act of 1973 has had a drastic effect on timber management. The U. S. Fish and Wildlife Service rendered a jeopardy opinion of the forest management program in early 1979. The biological opinion recommended the pine rotation age to increase from 60 years to 100 years for all pines or 80 years for loblolly and 100 years for longleaf and pond pine. For the period covered by this plan an 80-year rotation for

loblolly and a 100-year rotation for longleaf and pond pine will be implemented.

- d. In the summer of 1981, the Forestry Branch received delivery of two low ground pressure crawler tractors and two hauling units purchased with Forestry funds. These tractors and hauling units were purchased to enable site preparation, timber stand improvement and other forest management and protection activities to be accomplished on poorly drained soils.
- e. The spring fire seasons of 1980 and 1981 were the most severe on record for eastern North Carolina. This situation led to the purchase of two additional low ground pressure tractors by Marine Corps Base. Four low ground pressure tractors are now available for wildfire suppression. The severe fire season also led to increased training and communication capability for personnel involved in fire suppression.
- f. In 1982, Public Law 97-99 (Title No. U. S. Code 2665) was implemented to return 25% of the net forestry proceeds from the installation to the county school system in which the installation is located. In 1984, Public Law 97-99 was amended to return 40% of the net forestry proceeds to the county school system. The sale of pine sawtimber has been the major source of proceeds.

### 3. FOREST SUPERVISION AND MANAGEMENT

- a. Silvicultural System.

A good silvicultural system is not chosen but formulated as a solution to a specific set of circumstances, and is subject to evolutionary development as circumstances change and knowledge of them improves. The objectives of the Camp Lejeune silvicultural system are:

- (1) Achieve the objectives of the land owner.
- (2) Help reduce losses from wildfires, insects and diseases.
- (3) Provide for sustained yields of forest products, wildlife habitat and all other forest resources by making efficient use of growing space and site productivity.

An even-aged stand silvicultural system was initiated in the 1946 management plan. This system has been proven by research to be the system best suited for the multiple-use management of Camp Lejeune's forestland. Management of the forest is done by timber stands, normally 10 acres or larger which are delineated by timber type, age, size and stocking.

The even-aged forest management system used at Camp Lejeune is a sustained yield, multiple-use management system. Foresters strive to manage the resources to yield an even flow of forest products plus a sustained flow of diverse wildlife habitat, clean water, aesthetics and recreational opportunity. For management purposes the forest aboard Camp Lejeune can be divided

into four major forest types. Pure pine, (SAF 81 and 70) found on upland drier sites, and pond pine (SAF-98) found on wet sites. Pine-hardwood and upland hardwood (SAF-71, 82, 87, and 52) are found on stream side and more productive sites and bottomland hardwood (SAF-102, 103, 104, 91, and 92) found in the stream bottoms and floodplains of major creeks. (See Section II.B.2.a. for a detailed explanation of S.A.F timber types). The characteristics of the major tree species, such as tolerance to shade, susceptibility to windthrow, adaptability to soil and moisture conditions, ability to withstand flooding and vulnerability to insects, disease and fire, determine the type of silvicultural treatments.

The pure pine, pine-hardwood, upland hardwood and bottomland hardwood forest types are well suited to even-aged forest management. Timber harvesting is done by either regeneration or intermediate harvests. Regeneration harvests are designed to regenerate a new stand by using the following regeneration systems: (1) clearcut, (2) seedtree and (3) shelterwood. These systems produce trees that are approximately the same age, even though they may or may not be equal in size. A brief description of these regeneration systems follows:

- (1) Clearcut: Clearcutting is the harvesting in one operation of all merchantable trees in a stand,

with the expectation that a new even-aged stand will become established. In a clearcut hardwood stand, regeneration develops naturally from seeds stored in the forest floor, from young regeneration already established or from stump or root sprouts from the harvested trees. In a clearcut pine stand, regeneration is established by either planting pine seedlings or direct seeding. In pine clearcuts, site preparation is accomplished by KG blade, root rake, windrowing, drum chopping and/or a prescribed burn. It is often necessary to remove logging debris and undesirable competing vegetation before a new pine stand can be established.

- (2) Seedtree: The seedtree system requires leaving high quality seed producing trees when the mature stand is logged to provide the seed that is needed to regenerate a new even-aged stand. The seedtrees are removed after a stand of young trees are established. This system is well suited to the light seeded species such as loblolly pine. Site preparation after a seedtree harvest, usually consist of drum chopping followed by prescribed burning to expose mineral soil.
- (3) Shelterwood: The shelterwood system used to regenerate longleaf pine and hardwood species, requires a series of partial cuts, leaving more trees per acre than a seedtree cut. Over a period

of years the system will improve the vigor and seed production of the remaining trees. This system is particularly well suited for the heavier seeded species such as longleaf pine, oaks and hickories.

Intermediate treatments are silvicultural treatments made in the timber stand during the rotation prior to regeneration.

- (1) Thinning: A thinning is a harvest designed to reduce competition and to accelerate growth on the residual trees. The thinning can be commercial, with the timber being sold, or pre-commercial, accomplished by hand removal or by a drum chopper when the trees are too small to be economically harvested.
- (2) Improvement Cuttings: Improvement cuttings are made in stands where the stand is a mixture of desirable and undesirable trees. The undesirable trees are removed to improve the stand for timber growth, wildlife habitat improvement, aesthetic appeal, recreation benefit or other forest uses.
- (3) Salvage Cutting: Man-caused and natural catastrophes such as windstorms, ice storms, insect and disease attacks, construction sites and wildfires cause damage in forest stands. Salvage cuttings are made to utilize damaged timber, to reduce the economic loss, improve the aesthetics in

the area and prevent the spread of insects and diseases.

b. Forest Inventories

(1) Allowable Annual Timber Harvest

The allowable annual harvest is the estimated volume of timber products that may be harvested annually to achieve sustained yield of timber products. Table 1 and 2 show total standing volumes aboard Camp Lejeune. The annual allowable harvest is calculated using the volumes of standing timber on commercial forestland as shown in Table 3 and 4, and applying Van Mantel's formula<sup>1</sup> as follows:

$$\text{ALLOWABLE HARVEST} = \frac{\text{Growing stock Volume}}{\text{Rotation Age}/2}$$

Growing stock volume was determined from inventory data gathered in FY-1984 by the U. S. Forest Service, Southeastern Forest Experiment Station, Forest Inventory Analysis Unit, in cooperation with Camp Lejeune. For the purpose of this plan, rotation ages were determined to be 100 years for longleaf and pond pine, 80 years for loblolly pine and 120 years for hardwood species.

The following are the allowable annual harvests  
for this planning period:

Pine Sawtimber (Scribner FC-78)	. . . . .	6,733 MBF
Loblolly Pine	. . . . .	5,818.8 MBF
Longleaf & Pond Pine	. . . . .	914.2 MBF
Pine Pulpwood	. . . . .	2,668 CORDS
Loblolly Pine	. . . . .	1,848 CORDS
Longleaf & Pond Pine	. . . . .	820 CORDS
Hardwood Sawtimber (Doyle FC-76)	. . . . .	1,537 MBF
Hardwood Pulpwood	. . . . .	2,928 CORDS

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<sup>1</sup> Forestry Handbook - Society of American Foresters.



TABLE 1  
 VOLUME SAWTIMBER ON CAMP LEJEUNE BY SPECIES AND DIAMETER CLASS  
 Pine - SCRIBNER FC-78 Log Rule (Hundred Board Feet)  
 Hardwood - DOYLE FC-76 Log Rule (Hundred Board Feet)

SOFTWOOD	ALL CLASSED	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 28.9	29.0 and larger
Longleaf Pine	467524	81711	129045	91511	144877	14634	2743	2931	4649
Loblolly Pine	2821266	152026	276453	448677	513406	548020	391326	486664	
Pond Pine	143815	33980	40159	35496	17604	8422	8143		
Cypress	19803		3524	5724	2613	1442	6482		
Cedar	5320	2524		1545		1321			
Total	3457656	270171	449181	582953	678500	573850	408694	489595	4649

HARDWOOD	ALL CLASSED	11.0 - 12.9	13.0 - 14.9	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 28.9	29.0 and larger
White Oaks	144719	20422	14436	218161	13225	15109	42704	16872
Red Oaks	213043	39424	46509	28768	28872	20822	43640	5008
Hickory	47883	4021	15627	6060	4056	2399	8479	7241
Maple	66421	17077	14165	18441	5252	2132	5596	2758
Beech	5964		1259	3432			1273	
Sweetgum	177787	42965	38223	28030	26606	18953	20510	2500
Tuplo/Blackgum	215349	38132	49880	40097	33583	28221	25436	
Ash	36266	4645	7132	4067	6067	13346		
Yellow Poplar	216445	21318	27225	32097	18111	44664	60905	12095
Bay/Magnolia	1169	1179						
Black Cherry								
Elm	14230	4176	4539		1990	3525		
Other Hardwood	11423	2603	2910	3692		2218		
Total	1150709	195962	223905	382845	137762	149171	210761	46474

TABLE 2  
 VOLUME PULPWOOD (ROUNDWOOD AND TOPWOOD) ON CAMP LEJEUNE BY SPECIES AND DIAMETER CLASS  
 (Hundred Cubic Feet)

<u>SOFTWOOD</u>	All CLASSES	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 26.9	29.0 and larger
Longleaf Pine	22802	4494	11161	3152	2437	950	466	113	21	8	
Loblolly Pine	95877	22170	29818	10452	8977	8478	7579	4706	2479	1190	28
Pond Pine	25197	9535	11384	1899	1225	700	245	117	92		
Cypress	1283	234	218		236	321	98	44		132	
Cedar	2218	1168	838	154		22		36			
Total	147377	37601	53419	15657	12875	10471	8388	5016	2592	1330	28
 <u>HARDWOOD</u>											
White Oaks	17099	2801	3828	3292	2142	1148	1197	648	448	1362	233
Red Oaks	36039	6559	10842	8102	2996	2924	1457	1053	672	1377	57
Hickory	5674	413	1416	1233	446	1130	374	160	65	287	150
Maple	28808	5911	8515	9079	1967	1254	1348	285	90	260	99
Beech	741	201				111	310			119	
Sweetgum	33115	5024	7637	11752	3967	2272	1205	649	285	305	19
Tupelo/Blackgum	32258	3670	4182	11279	4052	3704	2384	1476	717	794	
Ash	4595	880	739	667	487	720	283	326	493		
Bay/Magnolia	5508	1703	1887	1757	161						
Yellow Poplar	14597	1235	3677	2952	2005	1598	1261	407	648	766	48
Black Cherry	154	154									
Elm	3105	479	559	857	387	355	159	100	209		
Other Hardwood	6772	2125	2327	1783	238	198				101	
Total	188465	31155	45609	52753	18848	15414	9978	5104	3627	5370	606

TABLE 3  
VOLUME SAWTIMBER ON COMMERCIAL FORESTLAND BY SPECIES AND DIAMETER CLASS  
Pine - SCRIBNER FC-78 Log Rule (Hundred Board Feet)  
Hardwood - DOYLE FC-76 Log Rule (Hundred Board Feet)

SOFTWOOD	ALL CLASSES	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 28.9	29.0 and larger
Lonleaf Pine	334545	73208	108425	79960	54495	12783	2743	2931	
Loblolly Pine	2327534	119052	229194	366847	467411	479037	303136	358163	4694
Pond Pine	122550	28489	30949	33147	17604	7072	5289		
Cypress	15529		3542	5724	2613	1442		2208	
Cedar	1196	1196							
Total	2801354	221945	372110	485678	542123	500334	311168	363302	4694

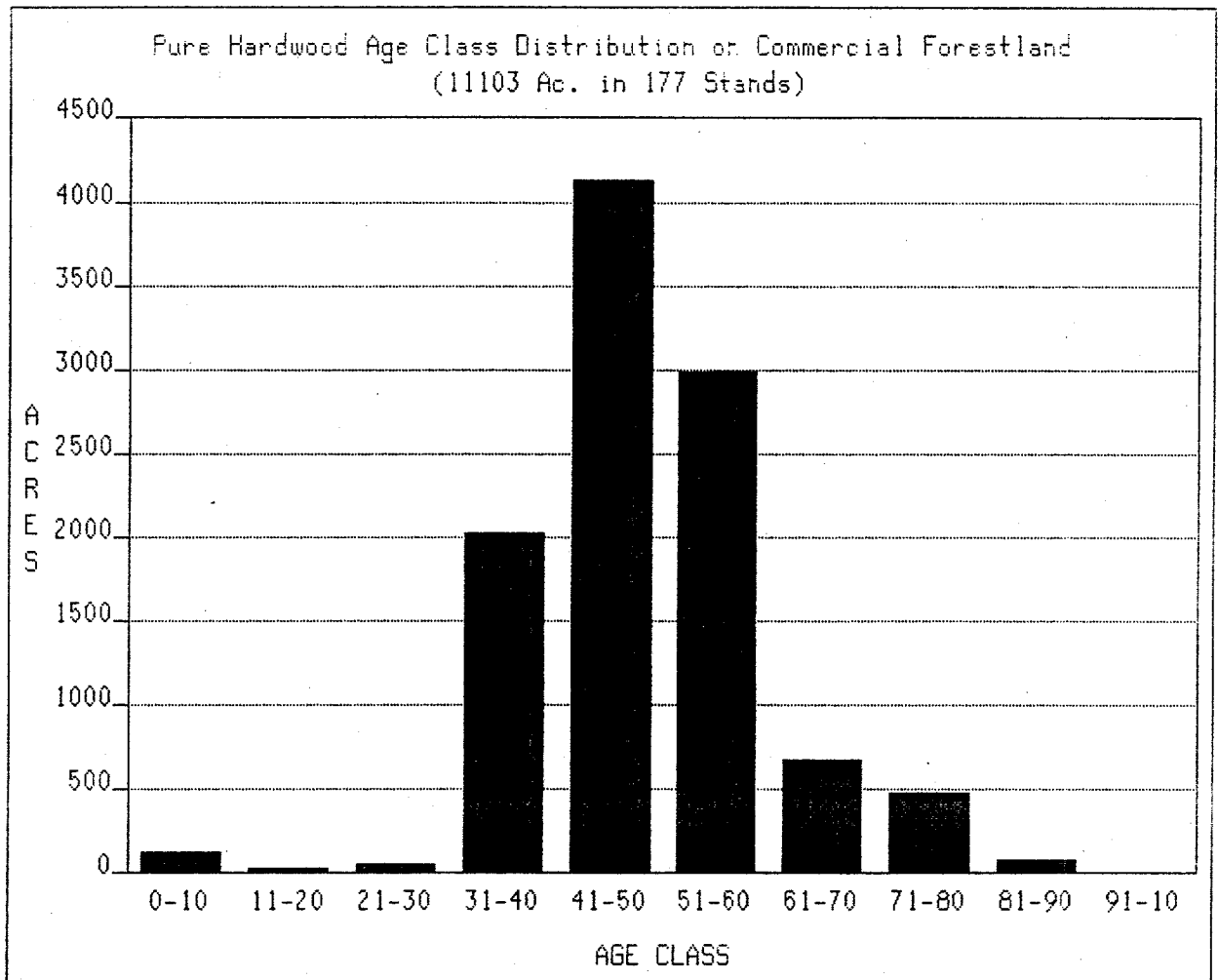
HARDWOOD	ALL CLASSES	11.0 - 12.9	13.0 - 14.9	15.0 - 16.9	17.0 - 18.9	19.0 - 20.9	21.0 - 28.9	29.0 and larger
White Oak	92827	17643	8753	17474	2274	8859	25107	12717
Red Oak	163185	36496	31418	24103	27103	13207	30858	
Hickory	31638	2789	6674	4622	4056	2399	8479	2619
Maple	58554	17077	15165	10574	5252	2132	5596	2758
Beech	5964		1259	3432			1273	
Sweetgum	162037	42965	35786	28030	21782	15880	15094	2500
Tupelo/Sweetgum	181471	34005	43639	37571	19074	28221	18961	
Ash	28428	4645	8132	4067	2399	9185		
Yellow Poplar	179681	17435	21845	32097	13753	25606	56850	12095
Bay/Magnolia	1179	1179						
Black Cherry								
Elm	10705	4176	4539		1990			
Other Hardwood	6480	2603	2910	967				
Total	922149	181013	180120	162937	97683	105489	162218	32689

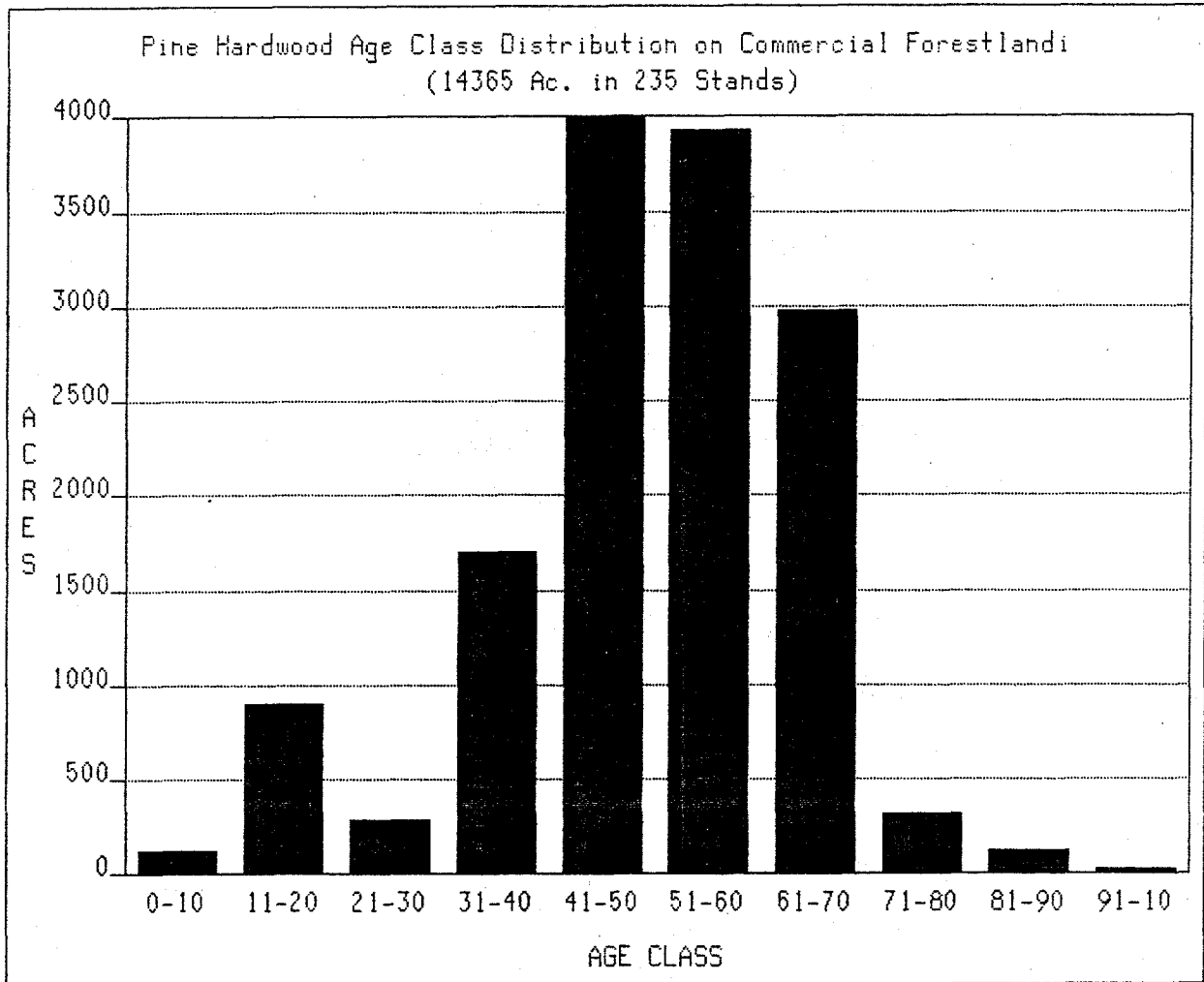
TABLE 4  
 VOLUME PULPWOOD (ROUNDWOOD AND TOPWOOD) ON COMMERCIAL FORESTLAND BY SPECIES AND DIAMETER CLASS  
 (Hundred Cubic Feet)

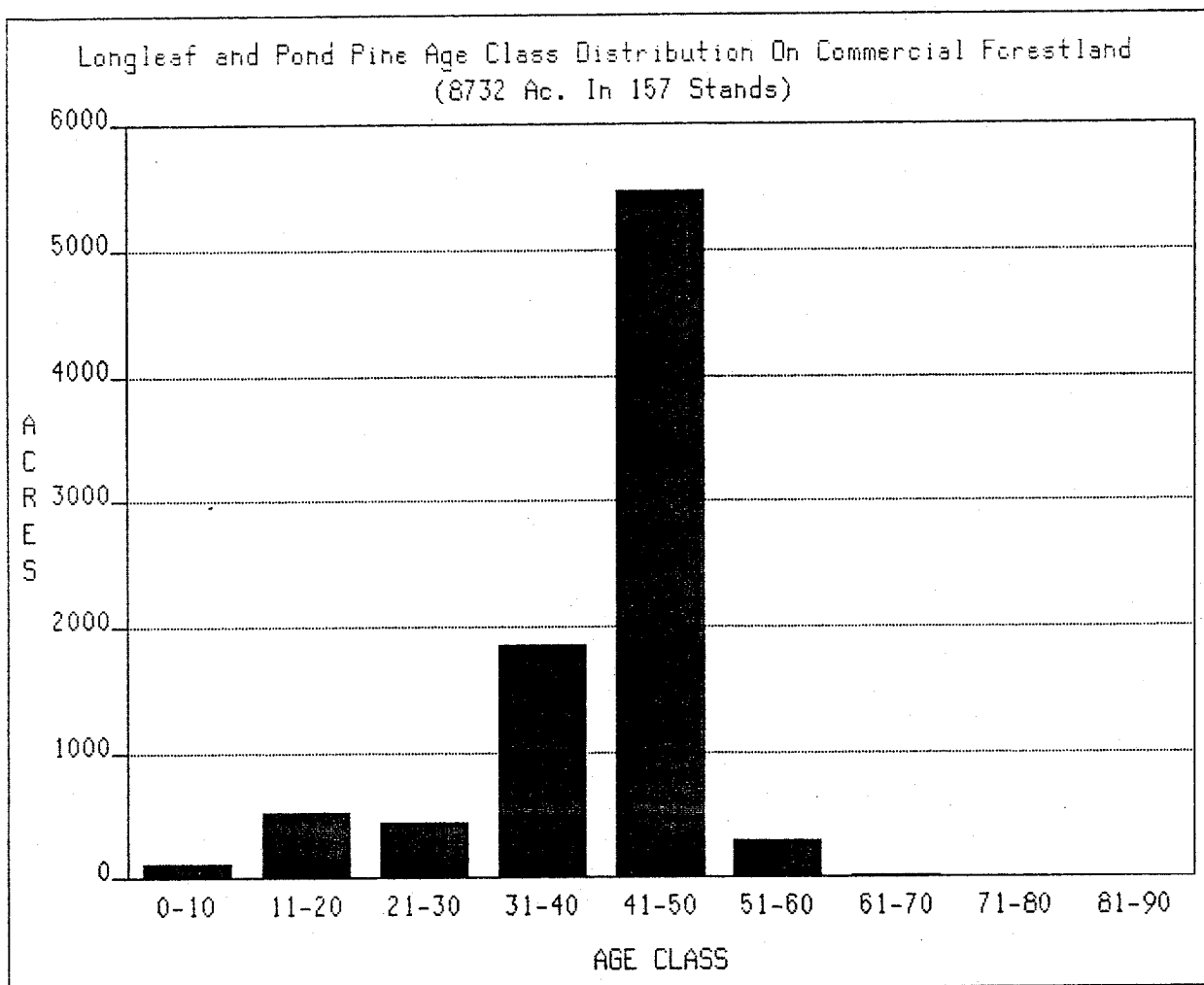
<u>SOFTWOOD</u>	<u>ALL</u> <u>CLASSES</u>	<u>5.0 -</u> <u>6.9</u>	<u>7.0 -</u> <u>8.9</u>	<u>9.0 -</u> <u>10.9</u>	<u>11.0 -</u> <u>12.9</u>	<u>13.0 -</u> <u>14.9</u>	<u>15.0 -</u> <u>16.9</u>	<u>17.0 -</u> <u>18.9</u>	<u>19.0 -</u> <u>20.9</u>	<u>21.0 -</u> <u>28.9</u>	<u>29.0 and</u> <u>larger</u>
Longleaf Pine	20638	4256	10042	2830	2155	822	422	82	21	8	
Loblolly Pine	66522	11614	20214	8031	7574	7028	5943	3760	1811	449	28
Pond Pine	16134	5599	7092	1551	894	639	245	84	70		
Cypress	1193	234	218		236	321	98	44		42	
Cedar	1750	1168	504	78							
<b>Total</b>	<b>106237</b>	<b>22871</b>	<b>38070</b>	<b>12490</b>	<b>10859</b>	<b>8810</b>	<b>6708</b>	<b>3970</b>	<b>1902</b>	<b>499</b>	<b>28</b>
 <u>HARDWOOD</u>											
White Oak	12847	2801	2582	2751	1823	711	957	114	217	749	142
Red Oak	28792	5950	8384	6380	2717	1807	1259	995	266	934	
Hickory	4353	413	1085	1233	297	477	279	160	65	287	57
Maple	23471	5911	5557	7261	1967	1254	787	285	90	260	99
Beech	741	201				111	310			119	
Sweetgum	28804	4362	6317	9870	3967	2122	1205	520	193	229	19
Tupelo/Blackgum	28089	3256	3468	10101	3700	3230	2240	773	717	604	
Ash	3554	603	739	295	487	720	283	115	312		
Yellow Poplar	13439	1235	3677	2952	1711	1316	1216	291	240	708	48
Bay/Magnolia	4839	1552	1887	1239	161						
Black Cherry	154	154									
Elm	2372	479	559	439	387	355	53	100			
Other Hardwood	6671	2125	2327	1783	238	198					
<b>Total</b>	<b>158126</b>	<b>29042</b>	<b>36582</b>	<b>44304</b>	<b>17455</b>	<b>12301</b>	<b>8634</b>	<b>3353</b>	<b>2200</b>	<b>3890</b>	<b>365</b>

(2) Age-Class Distribution:

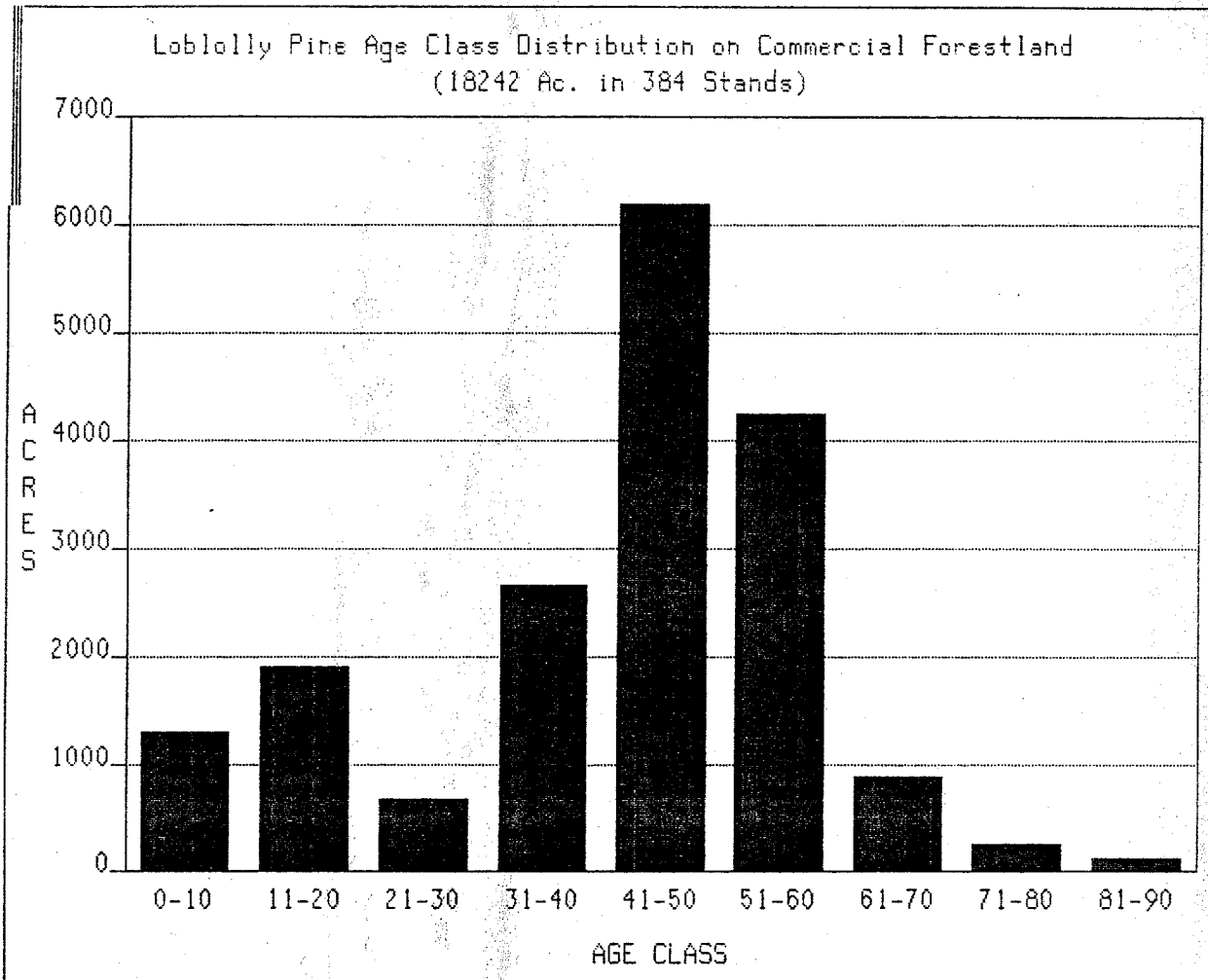
The unbalanced distribution of forest age classes, as shown in Charts 1, 2, 3, and 4, make it necessary that regeneration harvests be made from the 31 to 60 year age classes. Regeneration will be planned in these mid-rotation age classes to avoid having this extremely large amount of acreage requiring silvicultural treatment at rotation age. The regeneration of mid-rotation timber is consistent with the biological opinion rendered by the U. S. Fish and Wildlife Service. The resulting improvement in age class distribution would not only lead to a fully regulated forest, but also will greatly increase the diversity needed to provide a sustained yield of quality wildlife habitat.











c. Compartment Prescription.

General

- (1) The prescription process is the basis for making forest and wildlife management decisions to fulfill long range goals and objectives set forth in the Long Range Natural Resources Management Plan (Section III. A). The purpose of a compartment prescription is to:
  - (a) Determine site productivity, forest type, age, stocking density, operability and forest condition class.
  - (b) Determine the silvicultural treatment, if any, required on a stand-by-stand basis.
  - (c) Determine modifications to standard silvicultural practices required to achieve multiple use objectives and special land-use requirements.
  - (d) Develop road access and maintenance plan.
  - (e) Collect data necessary to establish volume estimates for sales program.
  - (f) Collect data used to develop annual operational plans.
  - (g) Insure coordination of forest and wildlife management objectives.
- (2) The steps of compartment examination are:
  - (a) In the office prepare a compartment stand map using aerial photographs, wetland and soils

maps and determine the appropriate travel routes for sampling stands.

(b) In the field, check type map accuracy, collect timber data; such as forest type, stand condition class, method of cut, operability, site index, productivity class, stand age, and basal area; and assist in conducting the wildlife species habitat appraisal. The collection of prescription data will be performed by a professional forester accompanied by a member of the wildlife staff to collect the data required to accomplish the wildlife species habitat appraisal.

(3) Assembly of the Compartment Prescription Report for review by Natural Resources Environmental Affairs Staff.

This report summarizes the data collected, management decisions made and translates this information into an action plan. The report will include:

(a) Compartment Composition Map - This map will designate forest cover types grouped by pure pine, pine-hardwood, pure hardwood and modified management zones, such as wetlands and endangered species habitat.

Classifications will include acreage and percentages for each timber type.

- (b) Wildlife Habitat Analysis Transect Data and Recommendations - Wildlife habitat analysis will be conducted by a wildlife biologist during the prescription process, and will be used to adjust forest management practices to achieve wildlife habitat improvement whenever possible.
- (c) Proposed Treatment Map - This map will show all silvicultural treatment, other proposed actions, and total acreages for each treatment.
- (d) Regeneration Map - This map will show all existing regeneration for age class 0-10 years and proposed regeneration with acreages and percentage.
- (e) Logging Plan and Road Access Map - This map will show proposed deck sites, truck routes and any road construction or repair work required. Road construction and repair will include description of work and mileage.
- (f) Sampling Route Map - Forest cover type will be plotted along the sample routes at previously determined plot locations. The maps will show corrections in stand boundaries as required.

- (g) Wildlife Featured Species Map - This map will show the location of the compartment prescribed on a base featured species map.
- (h) Compartment Summary - This chart summarizes all stand data recorded on prescription tally sheets.
- (i) Proposed marking, harvesting and silviculture treatment summary - Only stands to receive treatment will be listed in this summary. Each stand is listed by number, forest type, year of treatment, acres involved, type of treatment proposed. A brief narrative description of the stand, including basal area, stocking density, site index, age, soil type, timber quality and estimated volume to be harvested is also included. Any special features, stand inclusions or areas requiring modified management are also described in this section.
- Estimating timber volumes is done by consulting the comparables chart developed from previous harvests. This chart shows harvest type, species composition, site index, basal area, operability and stand condition class. The estimate is made by matching the stand and its proposed harvest to an average of similar stands with known yields/acre.

The estimated volumes are calculated by product and entered on the Marking, Harvesting, and Silvicultural Treatment Summary. The summary is used to make adjustments in stand treatments to meet the long range objectives in harvesting the allowable annual cut.

(4) Review And Approval Of Prescription:

- (a) Field review of the report - Copies of the prescription package are given to the Wildlife Manager, Ecologist, Base Forester and the Natural Resources and Environmental Affairs Director. Each individual is responsible for field review of the proposed prescription and will make notations and comments. This procedure reduces the risk of misinterpretations of proposals and possible duplication of efforts.
- (b) Compartment Prescription Review Board - After field review, a formal meeting between the Wildlife Manager, Base Ecologist, Base Forester, Natural Resources and Environmental Affairs Director and the prescriber is conducted. The prescriber presents the report and management alternatives and proposals are discussed. If required, modifications are noted prior to approval by each department

head and the director. An approved prescription is then scheduled for timber marking and implementation. A modified marking map will be made if necessary.

#### 4. REFORESTATION AND TIMBER STAND IMPROVEMENT

Both artificial and natural regeneration techniques are used for pine regeneration. Natural regeneration techniques are used for regenerating hardwood stands and where possible, are the preferred method for pine. These techniques are less labor intensive and although they don't allow planting of superior growing stock, they often produce healthier stands that are better matched to the site. The table "Woodland Management, and Productivity" in the published soil survey for Camp Lejeune should be used as a guide to fit artificial regeneration to site quality.

The use of heavy equipment for management practices such as pre-commercial thinning and site preparation will be carried after the seasonal effect on wildlife habitat has been considered.

Timber stand improvement (TSI) projects are initiated to improve vigor and productivity of the residual trees, reduce volume of fuels, and create browse and wildlife habitat. TSI work can be accomplished by sanitation and salvage timber harvests where practical, or pre-commercial thinning.

Pre-commercial thinning using heavy equipment and a drum chopper, is used in naturally regenerated pine stands

to reduce overstocking. This work will be accomplished while the seedlings/saplings are four to five foot height or less. If regeneration becomes taller, or in the case of hardwood regeneration, where species selection is needed, this work may require hand crews.

a. Site Preparation.

(1) Site preparation will normally be accomplished during the period October through March or August and September. Site preparation during April through July may occur but will be judged in conjunction with wildlife nesting requirements on a case by case basis. Special consideration will be given to snag retention if it is felt that snag availability is a limiting factor.

(2) Natural regeneration:

(a) Pine Type: Site preparation for natural pine regeneration will be accomplished by drum chopper, heavy disc, and/or prescribed burning during August and September prior to seed fall, or by KG blade and root rake where heavy logging slash exists. Windrows created by site preparation will not be prescribed burned.

(b) Hardwood Type: Site preparation for natural regeneration of hardwood will be accomplished by hand removal of undesirable trees. Heavy equipment will be used only when removal of



undesirable timber by hand will be too dangerous.

- (3) Artificial Regeneration: Site preparation for artificial pine regeneration will be accomplished by either KG blade, root rake and bedding when required, or by drum chopping followed by site preparation burning. Windrows created by site preparation will not be prescribed burned.

b. Mixed Pine-Hardwood Stand Management.

- (1) When mixed pine-hardwood is growing on a suitable soil (site index 90 or better for loblolly pine) and 50 square feet of basal area of desirable mast producing, intermediate, co-dominant or dominant hardwood trees are evenly distributed throughout the stand, or portion of the stand, convert the stand to hardwood type if less than 30% of the commercial forestland within the compartment is in mast producing hardwood.
- (2) Where mast producing hardwoods occur in stand size on soils with a site index of less than 90 feet for pine they may be managed for hardwood if less than 30% of the commercial forestland within the compartment is in mast producing hardwood and if a basal area of 50 square feet of mast producers may be obtained by rotation age to allow adequate regeneration.

## 5. TIMBER SALES

### a. Timber Marking Guidelines.

Timber marking at Camp Lejeune is conducted by Base Forestry personnel. Salvage or construction site marking is performed shortly before harvesting operations, generally clearcuts, because of the need to remove timber quickly and completely. Regularly planned compartment timber marking is done one or two years prior to harvesting so timely budget and sale preparation can be accomplished. The type of harvest, either intermedate or regeneration, is determined during the compartment prescription process.

#### (1) Intermediate Harvest:

(a) Leave Tree Marking in Pine Stands. Research shows using the leave tree method of thinning overstocked pine stands, helps prevent loss from southern pine beetle, improves the quality of residual timber and prepares the stand for natural regeneration to pine. Procedural steps in applying the leave tree method follow:

Run cruise line through individual stand selected for leave tree marking which will adequately sample d.b.h. of acceptable dominant and co-dominant trees. At each sample point, select nearest dominant or co-dominant tree which is acceptable as a leave

tree and record its d.b.h. Summarize by d.b.h. classes and determine estimated average d.b.h. of leave trees.

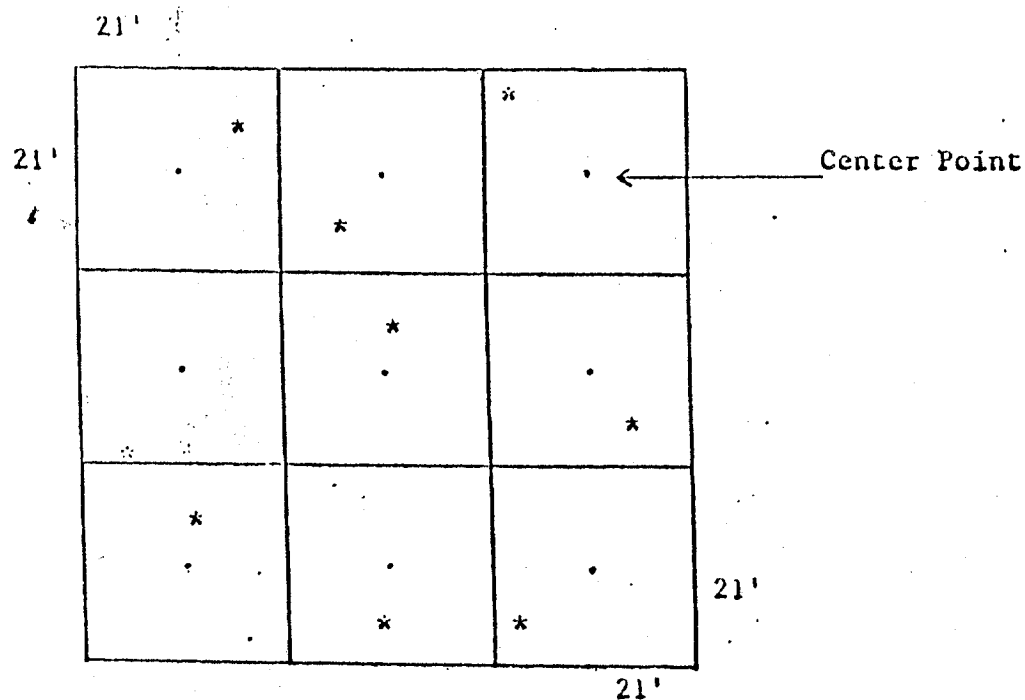
Leave tree spacing is determined by using the following chart.

SOUTHERN PINE

Spacing by Aveage Leave Tree DBH

<u>Aveage DBH</u>	<u>Grid Square Spacing Ft.</u>	<u>No. of Trees Per Acre</u>	<u>BA</u>
6	12 x 12	302	58
7	12 x 12	302	61
8	13 x 13	258	90
9	15 x 15	194	86
10	17 x 17	151	82
11	19 x 19	121	60
12	21 x 21	99	78
13	22 x 22	90	83
14	24 x 24	76	82
15	25 x 25	70	86
16	26 x 26	65	91
17	27 x 27	60	95

Select leave trees on grid basis using hand compass and pacing. Use intermediates only where there are not acceptable dominant or co-dominant trees. Mark leave trees with blue paint below stump height and at breast height so as to be visible from 360°. Based on the predetermined spacing, the marker will then select the best tree based on species, dominance and genetic quality in the grid square shown below.



For example, a stand is to be thinned to 21- x 21-foot spacing. This will mean a grid square of 21-foot square per leave tree. The timber marker will mark the center of the 21-foot

square. He will then select the best leave tree in the square. The tree selected can be anywhere in the square. However, if two or more dominant or co-dominant trees are equally acceptable, select the tree closest to the center point. After selecting the tree and marking it, the marker must go back to the center point and pace 21 feet in the selected compass direction to the next grid square center. He then repeats the procedure and selects a tree from the next 21 x 21-foot square.

After leave trees are marked with blue paint, mark and determine volume of merchantable trees to be removed using red, yellow or orange paint. For trees to be cut 360° visibility is not required.

- (b) Leave tree thinning with hardwood consideration. This system is applied in the same manner used for thinning pure pine except a desirable dominant or co-dominant mast producing hardwood is marked as the leave trees. This system was designed to improve wildlife habitat by leaving the best mast producing tree whenever they exist in the grid square. Refer to 4.b. 1 and 2.

- (c) Pine only thinning or removal. This intermediate harvest is conducted for wildlife habitat improvement, to improve hardwood mast production in mixed pine hardwood stands and to increase the hardwood component in the compartment. The areas where more than 50 square feet of desirable mast producing hardwood basal area per acre is available and the site index is 90 feet or better for loblolly pine, all pine is marked for removal. Where less than 50 square feet desirable mast producing hardwood basal area per acre is present a dominant or co-dominant pine should be left in grid square to give a total residual BA of 80 square feet. Refer to 4.b. 1 and 2.
- (d) Overstory removal. In naturally regenerated stands with an understocked mature overstory there are often two or more age classes. The older mature overstory should be marked for removal if the understory is adequately stocked.

## (2) Regeneration Harvest:

## (a) Pine.

Seed Tree - The highest quality, vigorous, dominant or co-dominant loblolly pine on a 60 x 60 feet spacing will be marked as a seedtree.

These seed trees will be marked at breast height to be visible from 360° and once on the butt with blue paint.

Shelterwood for Longleaf Pine - Heavier seeded pine species, such as longleaf pine, require more seed source than is left in a seed tree system. The residual seed source in a shelterwood cut should be left to a basal area of 30 square feet/acre of the best dominant or co-dominant longleaf pine. These residual trees will be marked blue as in the seedtree system. The marking crew will determine seed source stocking using a 10 BAF prism. All other merchantable pine and hardwood will be marked for removal.

MINIMUM RECOMMENDED NUMBER  
OF SHELTERWOOD TREE/ACRE

<u>DBH</u>	<u>Longleaf</u>
10	55
12	38
14	28
16+	21

Clearcut - When rotation age is reached all merchantable pine and hardwood will be marked for removal with site preparation and artificial regeneration to follow.

Seedtree or Shelterwood Removal - When adequate regeneration has become established, the overstory should be removed to prevent overstocking.

(b) Hardwood.

Shelterwood - Hardwood stands can be regenerated using the shelterwood system. In selecting the shelterwood seed source, preference should be given to hard mast producing trees, leaving approximately 50 square feet basal area per acre. The residual seed source should be marked using the same technique as used in the pine seedtree system. All remaining merchantable pine and hardwood will be marked for removal.

Clearcut - Many desirable hardwood species will stump sprout particularly when harvested in the winter months. In this system, all merchantable pine and hardwood are removed in a single cutting, with all trees greater than 1 inch dbh cut for site preparation. Clearcutting not only uses stump sprouting but



also utilizes advanced reproduction and viable seed in the forest duff.

Shelterwood Removal - When adequate regeneration is present the overstory should be removed to prevent overstocking and the suppression of regeneration.

b. Contracting.

The timber sale contracting program is the dual responsibility of the Forestry Branch and the Public Works Office. The Forestry Branch is charged with compiling timber volume estimates, writing the timber harvesting section of the specifications, showing sale sites to prospective bidders, conducting pre-work conferences, inspecting sale area to ensure contract compliance and recommending contract closure upon completion of all contract requirements.

The Public Works Office administers contract assembly, advertisement, bid opening, collection of monies, and conducts all official correspondence with the bidders and contractors.

There are three types of timber sales conducted at Camp Lejeune:

- (1) Regularly planned compartment sales. There are four to six of these sales conducted each fiscal year. These sales must have been approved by the Environmental Impact Review Board. Each sale may encompass a number of timber stands in a

compartment and various harvesting techniques. Compartment size sales generally close one year after award with extensions granted for adverse weather conditions or military training activity.

(2) Construction sales. These sales are formal, greater than \$25,000, or informal, less than \$25,000, and allow the removal of merchantable timber from planned or on-going construction sites. They are conducted as needed throughout the year and the contract duration is usually 30 to 60 days and generally no extension is allowed.

(3) Salvage Sale. This type of sale, generally informal, is used whenever the immediate removal of timber is required. The salvage sale is generally used to remove merchantable timber from areas where timber has been damaged from wildfire, southern pine beetle infestation or grounds maintenance. The completion time varies with the quantities of forest products to be removed, but the harvesting must begin immediately.

(a) Volume Computation.

Timber volume estimates are calculated using the data gathered by the timber marking crew. The estimated quantity and quality of the forest products to be harvested determine the intensity of the cruise. Diameter class breakdowns are developed for each stand by

product (i.e., sound sawtimber, defective sawtimber and pulpwood). After the volumes from each stand have been recorded on diameter class breakdown forms, the total volume for each stand is consolidated by product onto a payment unit summary. The payment unit summary lists total tree counts and volumes for each stand by product, acres to harvest by stand, and average sawtimber tree size by stand. If more than one payment unit is required (typically they should not exceed \$100,000 estimated value), each payment unit summary sheet is consolidated on a timber sale summary. These volumes, both quality and quantity, are not guaranteed but government volume and tree count information is provided solely for the convenience of the bidders.

(b) Contract Writing.

The Forestry Branch develops the guidelines and constraints for each sale specification. The timber sale specification along with timber sale summary sheets, payment unit summary sheets, diameter class breakdown sheets and maps showing the sale area are sent to the Contracts and Specifications Branch of the Public Works Office. Here the contract is assembled, reviewed and printed.

(c) Contract Advertisement, Bidding and Award.

The Contracts Division of the Public Works Office is responsible for advertising sales and conducting bid openings for timber sale contracts. A timber sale showing date is set and Forestry Branch personnel show prospective bidders the sale area and discuss contract specifications. A bid opening date, normally 30 days after advertisement, is set by the Contracts Division and all bids must be received by 1400 on that date. A security deposit equal to 25% of the bid must accompany the bid. The successful bidder's deposit is kept in an escrow account while all other deposits are returned to the bidders. Informal sales, which must be under \$25,000, do not require security deposits. A government estimate prepared by the Forestry Branch is also provided to the Public Works Office. There is no minimum bid required, and all bids, regardless of whether above or below the government estimate, may be rejected. If the high bid is accepted, the government has 60 days to award the contract.

(d) Timber Sale Compliance.

After a contract has been awarded, the payment unit must be paid in full before any

timber harvesting activities can commence. A Forestry Branch representative, a Public Works representative, and the contractor must hold a pre-work conference at least three days prior to initiation of harvesting operations. The contract specifications and any special multiple-use management or military training requirements are discussed at this meeting.

Once harvesting operations have begun, the Forestry Branch inspects the harvesting operation and notifies the Contracting Officer officially when the contractor fails to comply with contract specification. As inspector, the Forestry Branch can, within the constraints spelled out in the contract, make any recommendations regarding the disposition of the contract.

(e) Contract Closure and Follow-up.

It is the responsibility of the Forestry Branch to notify, in writing, the Contracting Officer when all work required by the contract has been completed. In this correspondence all final timber additions, deletions and any monetary adjustments are documented. It is the task of the Public Works Office to conclude all financial transactions with the contractor. Once all legal obligations have

been met and the contract has been closed by Public Works, the area is opened to the Firewood Program if suitable quantities of firewood are available.

## 6. TIMBER ACCESS ROADS

The building and maintenance of roads on Camp Lejeune is the responsibility of Base Maintenance Division. However, forestry funds and equipment are used for road construction and maintenance whenever access to a timber stand is required for management or logging activities. If possible old existing roads are repaired and utilized as logging roads. During timber harvesting activities, the logging contractor is responsible for the upkeep of the road and is required to return the road to its pre-logging condition upon completion of the timber harvest. If spur roads are required to facilitate the timber harvesting operations, the contractor is responsible for the construction of these roads under the direction of NREAD.

Refer to Appendix E Technical Guide for Soil and Water Conservation and Ground Maintenance, for a detailed description and typical road cross section.

## 7. FOREST PROTECTION

- a. Insect and Disease. There has been little or no problem with forest tree disease other than an endemic stage of root rot in old field loblolly pine stands. In the event that disease or insects become a problem and identification or methods of control cannot be

determined by Base Forestry, the North Carolina Forest Service, and the U. S. Forest Service, Forest Pest Management Field Office, will be asked to assist.

Historically, Southern Pine Beetle has been extremely destructive to the forest at Camp Lejeune. Southern Pine Beetle are always present aboard the Base but cause major problems only when population levels reach epidemic proportions. When increased beetle activity is documented by field crews, detection flights are scheduled to determine the extent of the infestation. Guidelines for suppression techniques are outlined in the Forest Pest Management Fieldbook developed by the U.S. Forest Service.

In recent years another forest pest, the gypsy moth, has caused concern as it spread into formerly uninfested areas. The Base Forestry Branch, in cooperation with the U. S. Forest Service, Forest Pest Management Field Office, is currently monitoring 21 gypsy moth traps distributed throughout Camp Lejeune. No evidence of gypsy moth defoliation has occurred thus far; however, four male moths have been trapped on the Base.

- b. Wildfire Suppression. Wildfire has been a significant part of the forest environment in the southeast coastal plain. Although prescribed burning effectively reduces the fuel available to a wildfire, the problem of uncontrolled fires during adverse

weather is always present. Properly trained and equipped wildfire suppression crews, along with properly equipped low ground pressure tractors and plow units and trained operators, are essential to protect and conserve not only our natural resources, but personnel and physical facilities. Personnel safety is always the first concern of any wildfire suppression effort.

The periods between the middle of March through the first of June and September through October are the two major wildfire seasons. The spring season, mid-March to the first of June, is by far the most critical. Wildfires that occur during periods other than spring can normally be suppressed by resources available at the Base. Cooperative agreements between the Base, the North Carolina Forest Service and the U. S. Forest Service allow assistance to be rendered by the other agencies during a wildfire emergency.

The Forestry Section coordinates wildfire suppression activity with the Base Fire Department and the Range Facilities Officer as covered by Base Order 11320.1F.

- c. Prescribed Burning. Both pine and hardwood forestland is prescribed burned on a five year cycle between 1 December and 15 March, with all precautions being taken to prevent damage to both species. Ranges, impact areas, and the quail management area are burned



annually and red-cockaded woodpecker habitat is burned on a three year cycle. The primary benefits derived from prescribed or controlled burning are:

1. Wildfire hazard reduction
2. Wildlife habitat improvement
3. Control of undesirable species
4. Maintenance of open understory
5. Seedbed preparation

Prescribed burning for seedbed preparation occurs late August and early September before pine seed fall in October. All phases of burning are coordinated with the Range Facilities Officer so as not to conflict with planned training requirements.

Planning for prescribed and controlled burning begins in early summer with a Preliminary Environmental Assessment being presented to the Base Environmental Impact Review Board by late summer. If containment lines are required to exclude fire from specific areas, such as pine and hardwood regenerated areas, they will be flagged in September. Following leaf fall, containment lines are plowed in October and November, with burning to begin after the first killing frost, usually in late November or December.

## 8. FORESTRY PROJECT WORK SCHEDULING





V. REFORESTATION (SITE PREPARED FY- 86)

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
7				
19				
25				
28				
46				

VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
1	2,075				
4	1,115				
7	1,470				
19	1,207				
25	1,270				
28	896				
37	1,407				
46	1,793				
54	2,940				
55	1,839				

VII. CONTROL BURNING

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2, 4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
GMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 1	Acres	Date Completed	Remarks
1-1	80		
1-2	62		
1-3	68		
1-4	134		
1-5	32		
TOTAL	376		











## V. REFORESTATION (SITE PREPARED FY-87 )

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
27				
38				
44				
49				
51				
53				

## VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
6	1,060				
10	1,478				
17	1,854				
27	1,479				
38	1,266				
42	1,219				
43	1,148				
44	1,193				
49	990				
51	1,108				
52	1,340				
53	1,034				

VII. CONTROL BURNING

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2,4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 3	Acres	Date Completed	Remarks
3-1	134		
3-2	105		
3-3	104		
3-4	104		
TOTAL	447		









## V. REFORESTATION (SITE PREPARED FY- 88)

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
2				
8				
14				
31				
32				

## VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
2	925				
8	773				
11	1,451				
12	1,016				
14	1,326				
21	813				
26	1,193				
31	3,082				
32	1,599				
34	1,009				



## VII. CONTROL BURNING

## A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2,4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

## B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 2	Acres	Date Completed	Remarks
2-1	185		
2-2	77		
2-3	65		
2-4	62		
2-5	157		
2-6	69		
2-7	15		
2-8	48		
2-9	110		
2-10	56		
TOTAL	844		









## V. REFORESTATION (SITE PREPARED FY-89)

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
15				
18				
22				
29				
33				
50				

## VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Flow Lines	Date Completed	Remarks
5	1,371				
9	1,441				
15	765				
16	877				
18	1,135				
22	972				
24	1,101				
29	1,304				
33	998				
36	877				
40	727				
41	1,236				

VII. CONTROL BURNING

A-66

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2,4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 1	Acres	Date Completed	Remarks
1-1	80		
1-2	62		
1-3	68		
1-4	134		
1-5	32		
TOTAL	376		











V. REFORESTATION (SITE PREPARED FY-90 )

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
1				
4				
37				
54				
55				

VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
1	2,075				
3	1,505				
4	1,115				
13	1,342				
35	1,089				
37	1,407				
40	1,172				
48	1,315				
54	2,940				
55	1,839				

VII. CONTROL BURNING

A-72

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2,4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
EO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 2	Acres	Date Completed	Remarks
2-1	185		
2-2	77		
2-3	65		
2-4	62		
2-5	157		
2-6	69		
2-7	15		
2-8	48		
2-9	110		
2-10	56		
TOTAL	844		











V. REFORESTATION (SITE PREPARED FY- 91 )

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
6				
10				
17				
42				
43				
52				

VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
6	1,060				
10	1,478				
17	1,854				
20	1,092				
23	1,576				
30	1,183				
39	1,580				
42	1,219				
43	1,148				
45	1,243				
47	1,565				
52	1,340				

VII. CONTROL BURNING

A-78

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2,4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
<del>14</del> -14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 3	Acres	Date Completed	Remarks
3-1	134		
3-2	105		
3-3	104		
<del>3</del> -4	104		
TOTAL	447		









V. REFORESTATION (SITE PREPARED FY- 92 )

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
11				
12				
21				
26				
34				

VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
7	1,470				
11	1,451				
12	1,016				
19	1,207				
21	813				
25	1,270				
26	1,193				
28	896				
34	1,009				
46	1,793				



VII. CONTROL BURNING

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2, 4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 2	Acres	Date Completed	Remarks
2-1	185		
2-2	77		
2-3	65		
2-4	62		
2-5	157		
2-6	69		
2-7	15		
2-8	48		
2-9	110		
2-10	56		
TOTAL	844		









V. REFORESTATION (SITE PREPARED FY- 93)

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
5				
9				
16				
24				
36				
41				

VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
5	1,371				
9	1,441				
16	877				
24	1,101				
27	1,479				
36	877				
38	1,266				
41	1,236				
44	1,193				
49	990				
51	1,108				
53	1,034				

VII. CONTROL BURNING

A-90

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2, 4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BQ-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 1	Acres	Date Completed	Remarks
1-1	80		
1-2	62		
1-3	68		
1-4	134		
1-5	32		
TOTAL	376		











## V. REFORESTATION (SITE PREPARED FY- 94 )

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
3				
13				
35				
40				
48				

## VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
2	925				
3	1,505				
8	773				
13	1,341				
14	1,326				
31	3,082				
32	1,599				
35	1,089				
40	1,172				
48	1,315				

VII. CONTROL BURNING

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2, 4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 2	Acres	Date Completed	Remarks
2-1	185		
2-2	77		
2-3	65		
2-4	62		
2-5	157		
2-6	69		
2-7	15		
2-8	48		
2-9	110		
2-10	56		
TOTAL	844		











## V. REFORESTATION (SITE PREPARED FY- 95)

Compt. Number	Acres Artificial	Species Planted	Acres Natural	Remarks
20				
23				
30				
39				
45				
47				

## VI. PRESCRIBED BURNING

Compt. Number	Gross Acres	Acres To Burn	Miles Of Plow Lines	Date Completed	Remarks
15	765				
18	1,135				
20	1,092				
22	972				
23	1,576				
29	1,304				
30	1,183				
33	998				
39	1,580				
45	1,243				
47	1,565				
50	727				

VII. CONTROL BURNING

A. RANGES AND QUAIL MANAGEMENT AREA (ANNUAL)

Range Number	Acres	Date Completed	Remarks
F-2, 4&5	151		
F-3	326		
F-12	333		
F-18	61		
G-10	5,779		
BT-3	1,321		
K-2	3,472		
L-5	136		
BO-14	9		
QMA	952		
TOTAL	12,540		

B. RED-COCKADED WOODPECKER HABITAT (3 YR CYCLE)

Area 3	Acres	Date Completed	Remarks
3-1	134		
3-2	105		
3-3	104		
3-4	104		
TOTAL	447		

military training. Headquarters, Marine Corps, recently moved forward with the procurement of approximately 39,000 acres of land adjacent to Camp Lejeune as additional training and maneuver area. Until such time as additional lands are obtained, it is not likely that significant increases in either forest productivity or the present level of hunting, fishing and other outdoor recreation related uses will occur. Improved communications and coordinations between military training lands managers, facilities managers and Base natural resources managers are extremely important to maximize the net level of productivity in terms of volume of forest products, number of recreational use days, etc.

Additionally, rapid increases in the retired military population in Camp Lejeune vicinity is placing increased pressures on existing outdoor recreational resources and land use management decision making.

Dealing with this changing planning environment will be the most challenging aspect of the implementation of this long range natural resources management plan.

2. Natural Resources Management Related Goals and Objectives for Land Use Planning. This Long Range Natural Resources Management Plan was developed under the assumption that primary land uses, as established in the Base Master Plan, were established only after



APPENDIX B. FISH AND WILDLIFE MANAGEMENT PLAN

1. PURPOSE OF PLAN . . . . .	B-1
2. MANAGEMENT GOALS AND OBJECTIVES . . . . .	B-2
3. LIFE HISTORY DESCRIPTIONS FOR IMPORTANT GAME, NON-GAME, THREATENED AND ENDANGERED SPECIES, AND FRESHWATER FISH SPECIES FOUND ON THE BASE. . . . .	B-4
4. WILDLIFE MANAGEMENT PRACTICES . . . . .	B-47
a. Streams and Freshwater Ponds . . . . .	B-47
b. Management of Forestlands for Wildlife . . . . .	B-48
c. Managing Wildlife Openings . . . . .	B-51
d. Supplemental Food Plantings . . . . .	B-54
e. Game Species Management . . . . .	B-54
f. Nongame Species Management . . . . .	B-57
g. Endangered and Threatened Species Management . . . . .	B-58
h. Managing Nongame Birds . . . . .	B-61
5. REFERENCES . . . . .	B-64
6. TABLES AND CHARTS . . . . .	B-66

## B. FISH AND WILDLIFE MANAGEMENT PLAN

### 1. PURPOSE OF PLAN

Wildlife management is the science and art of the interrelationships between wild animals, their habitat and humans. Therefore, the maintenance or manipulation of habitat is a major component of responsible management emphasis. Wildlife is a product of the land and the species produced are usually a result of the uses of the land. Management of wildlife at Camp Lejeune is basically concerned with maintaining quality habitat as it exists in the natural ecosystem and in providing quality habitat where it has deteriorated or where a specific habitat component is lacking. The long range management effort is aimed at managing forest-wildlife species for human use while maintaining substantial populations of game, nongame, endangered and threatened species. The following basic principles will be included in planning and implementing wildlife management on the land:

- a. Projects will be justified according to biological needs, as determined, utilizing wildlife habitat appraisal guidelines during the compartment prescription process.
- b. Proposed practices will be evaluated for their effect on other natural resources and land uses.
- c. Native flora and fauna will generally be perpetuated by implementing improvements that simulate natural conditions.

- d. Manipulation projects will be designed to follow natural topographical features.
- e. Projects will be economically practical and will be planned for maintaining or improving the existing character of the habitat.
- f. Projects will be evaluated at intervals to determine if objectives have been achieved.
- g. New management techniques for game, nongame, endangered and threatened species are continuously being modified and improved by researchers throughout the country. As new techniques are developed they will be implemented, when applicable, into the Base Wildlife Management Program.

## 2. MANAGEMENT GOALS AND OBJECTIVES

A description of the goals and objectives which will be met by the manipulation of habitat and populations is included. The goals and objectives are considered as being attainable by normal standards during the duration of this plan. Essentially, these goals and objectives are intended to guide personnel in carrying out a practical program that is compatible with other uses of the land.

Goals and objectives are as follows:

- a. Improve the productivity of existing freshwater ponds for recreational fishing opportunity.
- b. Expand family recreational fishing opportunity at the Henderson-Hickory Pond complex.



- c. Increase the diversity and long/term productivity of wildlife habitat.
- d. Increase the number, total acreage and distribution of openings for wildlife until the long range goal of 10% of the total land area is in some type of opening. Wildlife openings, tactical landing zones, gun positions and powerline acreages will be included in reaching the long range goal.
- e. Evaluate the management and control programs for deer and wild turkey populations.
- f. Maintain program for control of nuisance wildlife.
- g. Develop job sheets to assist field workers in implementing management practices, collecting data and conducting surveys.
- h. Formalize systems for collection of wildlife data and establish a computerized data storage system.
- i. Apply wildlife habitat appraisal guidelines during the forest compartment prescription planning process to formulate habitat management objectives for selected species.
- j. Manage nuisance wildlife in base housing/industrial areas through the use of legal and humane methods of control.
- k. Maintain and keep current the Cooperative Plan Agreement between the North Carolina Wildlife Resource Commission, U. S. Fish and Wildlife Service and Marine Corps Base (Appendix C).

3. LIFE HISTORY DESCRIPTIONS FOR IMPORTANT GAME, NON-GAME, THREATENED AND ENDANGERED SPECIES, AND FRESHWATER FISH SPECIES FOUND ON THE BASE

a. DEER (Odocoileus virginianus)

Life History:

- (1) Usually breed for first time at 1.5 years of age.
- (2) Mating occurs in fall.
- (3) Gestation period is 195-212 days with fawns born in late May or June.
- (4) Goal of good management is to produce twins from does in the 2.5-7.5 year classes.

Food: Deer are very adaptable and will take a wide variety of foods including twigs, leaves, buds, fruits, herbaceous plants, grasses, vines and agricultural plants. Fertilization improves plant nutritive values for deer. Control burn areas are also preferred food sites.

Choice natural foods include the fruit and/or foliage of grapes, honeysuckle, greenbriar, oaks, blueberries, titi, red bay, sumac and gallberry.

Cover: Good cover consists of about equal parts of mature hardwoods or mixed-pine hardwoods, open areas (cropland, pastureland, etc.) and brushland. Good woodland cover consists of a mixed-aged hardwood forest stand, especially bottomland hardwoods with scattered openings.

b. BEAVER (Castor canadensis)

Range: Beaver were re-introduced into North Carolina in 1938. Since that time, and with subsequent stockings, beaver have spread and are now found in most areas of the state. The beaver is the largest North American rodent reaching an average size of 60-70 lbs. Some have been trapped that weighed 100 lbs.

Habitat: These rodents are found associated with varied aquatic habitats and will thrive in ponds, streams, and the margins of large lakes. In general, beaver do not range over 300 feet from water. Most of their activity is at sunset and at night.

Dams are built on streams to impound water for beaver ponds. These dams are constructed of sticks, small logs and mud, and are usually found on perennial streams. Dens or bank burrows are constructed in the ponds for safety and for over-winter use. Food is stored in the lodges and the young are born there.

The dens or lodges have under-water entrances to protect the den from predators.

Colony territories are distinct and do not overlap. A colony may contain several ponds of varying age, size and depth. Generally, a colony consists of a pair of adults, young of the previous year (sub-adults) and young of the year. The home range of the colony will range from .3-.5 mile radius of the lodge or den.

Life History: Beavers are monogamous and will mate for life. Mating occurs January through March with a peak in February. Young are born in April or May. Four young or "kits" is the average litter size. Young stay in the colony usually until late winter or early spring of their second year.

Food: These animals are vegetarians and eat leaves, twigs and bark of woody plants. Preferred foods are poplar, willow, birch, cottonwood and alder. They will, however, eat almost any type of tree or shrub available around the colony site. Aquatic vegetation such as duckweed, arrowhead and pondweeds are preferred foods when available. White and yellow waterlily and watershield are also readily taken.

Natural Enemies: Bear and bobcat will both take an adult beaver. The young are preyed upon by fox and mink and occasionally by large snapping turtles. Drought is also a strong natural enemy of a beaver population. Since water and a pond type habitat are critical year round habitat elements, a lack of water can severely damage a colony.

Man was at one time considered a primary enemy of the beaver. However, since beaver fur is no longer of value, trapping of these animals has almost ceased.

c. BLACK BEAR (*Ursus americanus*)

Range: These mammals are found throughout coastal North Carolina although their numbers are low.

Harvest is carefully regulated in all areas. Bear do not co-exist well with humans so populations are highest in counties (or portions of counties) where the human population is relatively low.

Habitat: Bear populations are associated primarily with large woodland tracts. These provide the "sanctuary" requirement of the bear and tend to prevent contact with human populations. Pocosins, large swamps, etc., provide prime habitat.

Life History: Bear do not breed until they reach age 3-1/2 years. Females breed every two years until age 18-20. Young are born in mid-winter and are not fully weaned until late summer or early fall. They then stay with the mother through the winter.

Food: These animals are omnivorous and will take both plant and animal food. Plant foods taken include acorns, beechnuts, dogwood berries, crabapples, grapes, persimmons, blueberries, etc.. Oak mast is a very important diet component and consequently management plans to maximize acorn production are important to bear management.

Animal foods include bees, honey, wasps, grubs, lizards, frogs, snakes, etc.. They consume carrion also.

Bear have tremendous appetites and consume large amounts of food. This is especially true during the fall months before the on-set of cold weather.

Predators: The primary predator or enemy of the bear is man. This is manifested in two ways: (1) direct threat to the population through hunting, and (2) indirect threat through loss of habitat by land clearing, reforestation practices, road building, etc.. Careful management and an awareness of the bear's habitat requirements will be mandatory to maintain this species in North Carolina.

d. BOBCAT (Lynx rufus)

General: The bobcat has long been a central figure in folklore and hunting tales of North Carolina. Hunters occasionally see a bobcat, but in general, few people ever see this animal. It's secretive, nocturnal habits prevent good population estimates. Large bobcats will weight between 20-25 pounds.

Range: In our state, this animal is largely confined to the eastern and western parts of the state, with few to none in the Central Piedmont region. Larger numbers are known to occur in large swamps and mountainous woodlands.

Life History: Bobcats will den under fallen logs, tree tops, in hollows, or in dense thickets. Mating usually occurs in February and March, with the young being born in April and May. There are 2-4 kittens per litter and these young stay with the mother for several months. During this period, no "guests" are

welcome, and this includes other bobcats, especially males.

Food: The bobcat is a major predator of the forest and edge habitats. Small animals such as mice, rats, squirrels, and rabbits make up a large part of its diet. It will also take young deer, wild turkey, and grouse.

Enemies: This animal probably has few enemies, other than man. It is a highly skilled hunter and fighter and the mother fiercely protects her young.

e. FOXES

Red Fox (Vulpes vulpes)

Gray Fox (Urocyon cinereoargenteus)

Range: The red fox is found across North Carolina, although it is generally considered to be more common in the Upper Coastal Plain, Piedmont and Mountains. Its population has increased in the eastern part of the state in recent years largely as a result of increased land clearing and agricultural activity. The gray fox is found throughout the state, being especially prevalent in the eastern section.

Habitat: The "red" is associated with "edge" or open habitat conditions. It prefers broken habitat types typified by small farms and woodlands. This fox will run long distances and is generally preferred by hunters. "Grays" prefer woodlands and inhabits large woodlands common in the Coastal Plain. When hunted,

this fox will often go quickly to a tree for escape. This habit makes him less popular with hunters since the "chase" often ends quickly.

Life History: The adults reach a size of 9-12 pounds. "Reds" are reddish-yellow in color, while "grays" have a gray face, white throat, and a rusty colored body. Mating occurs in February or March and the young are born in April or May. Litter size ranges from 4-9. The young stay in the den for about 5 weeks and with the parents until late summer.

Food: Foxes are primarily meat eaters and consume large numbers of rats, mice, birds, snakes, and insects. During the spring months when they are hunting with the young, they will occasionally raid a chicken yard, but this practice is uncommon. Generally, the fox will pursue those species which are most common at a given time of year. Game animals such as rabbits and quail are taken, especially the young.

Enemies: Man would be the foxes primary enemy. Hunting and/or trapping activity is common in most states, and populations are generally kept in check by these activities. There is no open season with weapons or by trapping for taking foxes in Onslow County, Camp Lejeune.



f. MINK (Mustela vison)

General: The mink has long been a prized animal among trappers in our state. This secretive animal is difficult to trap and relatively few trappers are consistently successful in capturing them. In recent years, wild mink have been in less demand in the fur industry due to the increase in popularity of the "ranch" mink or mink raised in captivity.

Range: The mink is found across the entire state. Population densities fluctuate widely, but good populations are found in most areas with the possible exception of the outer Coastal Plains.

Habitat: Rivers, creeks, and to a lesser degree, ponds and lakes, are primary habitats of this furbearer. Males have large territories, traveling great distances, while females generally stay close to the den. Dens are found on high stream banks, under roots of large trees along stream banks, or in hollow logs in swamps.

Life History: Mink are most active at night. Males are slightly larger than females with average weights of 1 1/2 to 3 pounds to 1 to 2 pounds respectively. Mating occurs in February and the young are born in about six weeks. Litter size is normally 4 and these are blind, naked and entirely helpless. After about six weeks, however, the young are active around the den. Families stay together until fall at which time

the young are self-sufficient and able to take care of themselves.

Food: Mink are carnivorous and are considered excellent, fierce hunters. Crayfish, small mammals, fish, frogs, snakes, and the eggs and young of snapping turtles comprise the bulk of this animals diet.

Enemies: This animal has few natural enemies. The great horned owl is a native species that will occasionally take a mink, especially a young animal. Man, however, is probably the only true enemy of the mink.

g. OTTER (Lutra canadensis)

Range: Historically, the otter was found throughout the state. In recent years, however, it has been found primarily in the lower Piedmont and Coastal Plain. Numbers are largest in the canals, rivers, and creeks of the coastal region where food is abundant and cover or sanctuary habitat is most abundant.

Habitat: This is an aquatic animal found along creeks, rivers and their tributaries, and adjacent wetlands. Canals around the larger Coastal Plain lakes are favorite areas and families are often seen feeding and playing in these water systems. In some areas, otter have a large home range and the male will travel long distances. In areas of good habitat,

however, a small home range of 3-5 miles radius appears to be adequate.

Life History: Adult otters reach large sizes, with average weights of 16-20 pounds. Males generally are larger than females. Mating occurs in late January or early February and the young are born in March and early April. The young are born in dens under the roots of large trees along a stream bank, in a hollow log, or in an abandoned muskrat or beaver lodge. Litter size is usually 3 or 4 and the young are blind and helpless. In 6-7 weeks the young are weaned and begin to take food such as small fish provided by the mother. After learning to swim, the young and mother are rejoined by the father, and these family groups are often seen together during the fall months.

Food: Fish, crayfish, birds, muskrats, and blue crabs are the main components of the otters diet. They are excellent hunters, fast swimmers, and can easily outmaneuver and capture prey animals, including fish.

Enemies: Otters do not have any natural enemies other than man. Trapping pressure and habitat deterioration are primary activities of man that adversely impact on otter populations.

h. RABBITS

Cottontail (Sylvilagus floridanus)

Marsh Rabbit (Sylvilagus palustris)

There are two species of rabbits found in North Carolina, the cottontail rabbit and the marsh rabbit or "bluetail" as it is commonly called. The cottontail is probably the more popular of the two with North Carolina hunters. Like the bobwhite quail, it is considered an "edge" species and can usually be found in honeysuckle or "brier" patches around field edges or along brushy ditch banks. Conversely, the marsh rabbit, as its name implies, prefers swampy areas of the Coastal Plains region of the state. Rabbits are a primary prey species, having many natural enemies such as foxes, hawks, etc.. Their only defense from these enemies is speed, good cover conditions, and a high reproduction capability.

Life History: Rabbits usually breed from February through September although in some years breeding may occur all year. Typically, three or four litters are produced per year with an average litter size of about five young. Nests are usually made in shallow depressions dug in the ground and lined with leaves, grass, and their own fur. The gestation period is about one month and maternal care lasts 15-18 days. After that time, the young rabbits must care for themselves. Mortality among rabbits is high. Life expectancy in North Carolina is probably less than one year with fall populations containing as high as 70 percent young-of-the-year.

Food: The year-round diet of the rabbit includes a large number of plant species. Its summer foods consist of grasses, low broadleafed weeds and many agricultural crops, especially the legumes. Winter foods will consist of available greens, buds, twigs, and bark. Choice foods for the rabbit are clovers and tender pasture grasses.

Cover: Rabbits utilize a wide range of natural cover types, from open grassland to dense swamps, but prefer the dense cover of herbaceous plants, tall grasses or brush. Honeysuckle thickets and blackberry and greenbrier patches are also favorite spots, especially during the hard winter months.

i. RACCOON (Procyon lotor)

Range: Raccoons are present throughout North Carolina. They are most numerous, however, in Eastern Carolina in the swamps, pocosins, and overflow bottomlands. Restocking efforts have been on-going to increase populations in the western piedmont and mountains, and these efforts have been successful.

Habitat: The raccoon is a very adaptable wild animal and can be found in habitats ranging from the deep swamp, to a campsite, to a suburban backyard. They are "visible" to humans and are often seen around garbage sites or in crop fields foraging for food.

Life History: These animals are active mostly at night. The "coon" is at home on land, in the water,

or in a tree. Hollow trees are most often used as dens.

They mate in February and March and the young are born in April and May. Litter size will range from 2-6 and the young will weigh about 2-3 ounces and are born with full markings. The mother will nurse the young for at least 30 days. After that time, the family usually stays together for prolonged periods. The young accompany the adults on feedings and exploring trips, often raiding corn fields.

Food: Raccoons are omnivorous and will readily take both plant and animal food. Most feeding activity is at night. Vegetable items in the diet include corn, acorns, persimmons, grapes, and other fruits. Animal matter includes fish, frogs, crayfish, mussels, eggs, and occasionally, a snake or bird.

The feeding activity of raccoons makes him an enemy of other wildlife species such as the wood duck, sea turtle, quail, young muskrat, and wild turkey. This trait often gives him a bad name with hunters.

Enemies: Man would probably be considered as the primary enemy of the raccoon. Trapping and hunting are primary population control measures. Other than man, alligators, bobcats, and owls are considered as predators, although they probably do not take large numbers in North Carolina.

## J. SQUIRRELS

Gray Squirrel (Sciurus carolinensis)

Fox Squirrel (S. niger)

All species of squirrel found in the Eastern United States are present in North Carolina, but only two are of special significance - the gray and the fox squirrels. Of these two, the gray squirrel is the most widespread, and hence, the most important from a management standpoint. The gray squirrel competes with rabbits for the title of the most popular game animal. In the past, the gray or, as he is sometimes called, "cat" squirrel, was so numerous as to be a menace to agriculture, but with the widespread woodland harvesting of today, his numbers have been drastically reduced. However, the gray squirrel is adaptable and relatively easy to manage. Fox squirrels are more specific as to habitat requirements and are not nearly as abundant as are the "grays".

Life History: The squirrel has two primary breeding seasons. These are January through March and June through August with peak activity occurring in February and July, respectively. The gestation period is about six weeks, and females produce two litters per year. Litter size varies but will average about three. The young squirrels receive maternal care for about 12 weeks after which they are capable of taking care of themselves.

The potential life span of squirrels is five to seven years. Most, however, do not attain that age with average fall populations containing as high as fifty to sixty percent young-of-the-year.

Food: Favored fall and winter foods of the squirrel are acorns, hickory nuts, corn, dogwood berries, pecans, walnuts and beech nuts. Choice spring and summer foods are black cherry, elm (seed and buds), grape, maple (seed and buds) and pine seed.

Cover: Gray squirrels are relatively adaptable in their cover requirements. However, a preference is shown for hardwood and mixed pine-hardwood forests. Fox squirrels prefer an open, park-like understory and are more often found in longleaf pine stands and are associated more closely with sandy soils. Nests (dens) may be found in hollow trees or may be observed as leaf nests. Leaf nests are temporary in nature and are more predominate in pine areas. Den trees have holes with openings three to five inches in diameter and usually 20 feet or more from the ground. Preferred dens are comprised of holes six or seven inches wide and one to three feet deep.

k. WHALES

(1) Sei Whales (Balaenoptera borealis)

These whales grow to a size of approximately 62 feet. They are considered skimmer feeders with



primary foods consisting of copepods, krill, and a variety of small schooling fish.

These animals travel in small groups of from 2-5 individuals. Large groups may be seen on the feeding grounds. Sei whales can be seen both inshore and offshore but they prefer open offshore water areas. Their distribution and migration patterns are poorly known at the present time. However, they apparently avoid the colder regions near the ice pack even during the summer months. Research indicates that the summer range extends from New England to the southern arctic water. Migration south to the winter range begins in October. This migration carries the whales to the northeast Venezuelan coast and the northeast and southwest Gulf of Mexico.

(2) Humpback Whales (Megaptera novaengliae)

These animals grow to a length of approximately 53 feet. Food is primarily krill (planktonic crustaceans and larva) and schooling fish. Humpback whales are widely distributed in the north Atlantic. Their preferred habitat is along coastal or inshore waters. The summer range of this species is from New England north to the ice pack. During the winter they migrate southward to the shallow borderland waters off Bermuda, to the Bahamas and to the West Indies. It is in these

tropical waters that they over winter, calve and mate.

(3) Right Whales (Euvalaena glacialis)

Historically, these whales were preferred and heavily sought after by hunters for whalebone and oil. Right whales are considered slow swimmers and usually are not wary of boats. Also, as contrasted with many other species of whales, the carcasses of this species floats when killed so hunters were better able to handle and process the carcasses.

Food of the right whale is primarily copepods. The animals are found in shallow waters near the coastline and occasionally may even be seen in large bays.

The range of this species includes the waters from Iceland south to Florida. Summer range is from New England north to at least Nova Scotia. Winter range is along the coast of Florida. In fact, these animals may be seen along the Atlantic coastline in January through late March during their migration northward to their summer range.

1. AMERICAN WOODCOCK (Philohela minor)

Range: The woodcock is a year-round resident of the Piedmont and Coastal Plains region of our state.

Breeding populations probably occur state-wide, but

winter populations are largely confined to the Piedmont and Coastal Plains.

Habitat: The woodcock has three primary habitat requirements as follows: (1) forest openings for singing grounds and roost sites; (2) poorly to very poorly drained soils that provide an abundance of earthworms; and (3) shrubby vegetational stages that provide cover. Wet abandoned fields, flood plains with a shrubby understory, and other similar wet, swampy, and shrubby areas provide excellent homes for this bird.

Life History: The male woodcock establishes his territory ranging in size from one to several acres. He then selects his "singing ground" and begins his ritual to attract females. This ritual consists of aerial flights, acrobatics, twittering of his wings, and vocal chirps, and is performed in early morning and late afternoon. Males are polygamous and mating occurs on the singing ground during the ritual display.

Woodcock are ground nesters, building a "cup-type" nest. Four eggs are usually laid by the female who incubates them for 21 days. Eggs hatch in April or May and the chicks are fully feathered, can fly some by 2 weeks, and are fully independent by 4 weeks of age.

If a nest is destroyed, the female may re-nest, but multiple nesting is not believed to occur.

Food: These birds are primarily carnivorous.

Earthworms comprise 60-90 percent of their diet.

Other insects such as beetles and fly larvae are also taken. Plant foods comprise a small percent of the diet.

Enemies: Animals such as raccoons and snakes are the primary predators on these ground nesting birds and their eggs. Hunting pressure is also increasing significantly throughout much of the wintering range.

m. QUAIL (Colinus virginianus)

Life History: Quail pair off in late March and early April and nest from May through August. Peak nesting activity occurs in May and June. A pair of quail will nest once per year with an average clutch size of 14. Incubation time is 23 days. Young quail are capable of flight at about two weeks old and are fully grown at 14-16 weeks. The young may remain with the parents as a covey or join other young to form new coveys. If nests are disturbed or destroyed, a pair of quail will make numerous attempts at re-nesting. Quail have a life expectancy of about eight years but few survive past one year. It is estimated that about 70-80 percent of fall populations are young-of-the-year.

Food: Quail consume about 15 percent animal matter and 85 percent vegetable matter in their total diet. The animal food is primarily insects such as crickets, beetles and grasshoppers. The vegetable portion of the diet is primarily seed and fruits with a small percentage of green matter being taken. Native seeds of primary importance are beggarweeds, partridge pea, panic and paspalum grass seed, pine seed, ragweed and vetch. Fruits such as blackberries and dogwood berries are important. Several agricultural crops such as corn, soybeans, wheat, browntop millet and peanuts are also favorite foods of the bobwhite quail.

Cover: There are three types of cover - nesting, escape and loafing - which are essential components of good quail habitat. The proximity of each cover type to another and to a reliable food source is vitally important. Preferred nesting cover is provided by grassy or herbaceous areas. These areas should be planned and managed to ensure minimum disturbance during the May through June peak nesting season. Escape cover is provided in areas of dense vegetative thickets. Blackberry thickets and honeysuckle patches normally provide good escape cover. Loafing cover will be associated with good "edge" areas. Young pine stands, honeysuckle patches, broomsedge and patches of seresia lespedeza will provide good areas of loafing cover.

n. EASTERN WILD TURKEY (Meleagris gallopavo silvestris)

Life History: Turkeys are polygamous with a mature gobbler having a harem of four to ten hens. Young gobblers seldom breed until they are two years of age. The breeding season extends from late winter to May or June with the peak activity in April. Turkeys are ground nesters, usually selecting a nest site near an opening and relatively close to water. Average clutch size is ten eggs with an incubation period of 28 days. Turkeys are especially susceptible to nest disturbance and nests are often abandoned if disturbed. When this happens, the hen usually does not attempt to reneest. Young turkeys learn to fly when they are between four and eight weeks of age and can fly reasonably well at six weeks. The young will remain with the hen in a flock until the following spring, and are often joined in late summer by other broods and by hens that were unsuccessful in producing a brood. Following the breeding season, old gobblers often live alone or in small flocks. Young gobblers live and travel together, often maintaining this relationship until the next spring mating season. The potential life span for turkeys is 12 to 15 years, but few reach this age. Adults 2.5 years of age or older make up but a small part of the population.

Food: During their first few months, young turkeys depend largely on insects and grass seeds for food, with insects being a very important diet component. Summer and early fall foods are obtained from plants such as blackberries, bahiagrass, millets, corn, grain sorghum and wheat. Insects are also important during this period.

Late fall, winter and spring foods are acorns, beechnuts, dogwoods, grapes, sweetgum seeds and pine seeds. Planted crops such as small grains and winter clovers also provide winter forage areas.

Cover: Turkeys normally have a home range of about 1,000 acres. Therefore, cover requirements include large areas of relatively undisturbed habitat. Cover types must be comprised primarily of woodlands of which at least half should be mature hardwoods. Species diversity is important for this hardwood habitat component, and ideally, both upland and bottomland hardwoods would be present. Pine stands, particularly sawtimber size trees, are also an important habitat component. Ideally, the forest understory should be open. A minimum of 10% of the range should be in grassy openings and this can range upwards to 30-40 percent.

o. WOOD DUCK (Aix sponsa)

General: This duck is a "home grown" resident of North Carolina. It is one of the most brightly

colored birds of North America and the male plumage is widely recognized by all bird watchers. The "woodie" is heavily sought after by duck hunters and during most years, averages between 25-40 percent of all ducks taken in North Carolina.

Range: The wood duck is found throughout the state. Populations are prevalent year-round in all sections.

Habitat: Wooded swamps, bottomlands, ponds, lakes, and streams are all utilized by the "woodie". It adapts to human intrusion and often utilizes man-made ponds for nesting and brood rearing.

Life History: Wood ducks are hole nesters utilizing natural cavities or man-made nest boxes. Cavity selection starts in February and nesting begins in early March and lasts into June. About 15 creamy-colored eggs are laid per nest. The incubation period is 27-30 days. Due to predation and competition, however, mortality is high and brood success often averages less than 50 percent.

Food: A wide variety of plant foods are taken, but fruits and nuts are preferred. Mast from oak and beech trees are the primary diet components of adults. Young, up to 8-10 weeks of age, consume mostly animal matter, primarily aquatic insects. Other plants of importance as food are buttonbush, gum and duckweed.

Predators: These are a primary limiting factor on wood duck populations. Research indicates that



mortality rates on nests in natural cavities ranges as high as 50-70 percent. Raccoon, snakes, squirrels, mink, starlings, and woodpeckers are probably the most important predators on these birds. Some of these animals compete for nesting holes while others eat either the eggs, young, or adults.

p. AMERICAN OSPREY (Pandion haliaetus)

General: While this bird is quite common in North Carolina, it is listed on the State Threatened and Endangered Species List. This large bird has a wing span of 54-72 inches and is known as the fish hawk.

Range: The osprey is found throughout North Carolina, but it is much more common in the Coastal Plains region. In the Piedmont and Mountains, it is primarily associated with large lakes and streams.

Habitat: This bird is associated with aquatic habitats. Large lakes, rivers, and estuarine areas are prime sites for nesting and feeding activity.

Life History: Ospreys build large nests usually in solitary sites around water. Large trees such as cypress, gum, and pine are often chosen. Nests are also common in estuarine areas on navigational markers. These birds will utilize the same nests over a period of years, often enlarging it each year. One brood is produced per year.

Food: As the name "fish hawk" implies, this birds diet consists almost entirely of fish. Suckers such as carp and mullet are primary prey species.

q. CARDINAL (Richmondena cardinalis)

General: The cardinal was adopted as the State Bird of North Carolina on March 4, 1943. It was chosen because it was well known throughout the state, is easily recognized and is a permanent resident. This is the only red bird that has a crest.

Range: This bird is found state-wide. It generally remains in the same vicinity year after year.

Habitat: Cardinals are generally considered an "edge" species frequently found in residential and urban areas. Farmsteads, small communities, or anywhere there is an abundance of food and good cover, is home to this bird.

Life History: Nests are built in the spring usually in thickets or low bushes. The nest is constructed of twigs, roots, etc., and is lined with grass. Three or four bluish-white marked with brown or purple eggs are laid. These hatch in about 12-13 days and the young are gone from the nest in 9-10 days. A pair of cardinals will raise two broods per year.

Food: Cardinals consume both plant and animal foods. Animal food utilization is highest in spring (60 percent of diet), with ants, beetles, caterpillars, grasshoppers, and weevils being readily taken. Choice

plant food are blackberry, cantaloupe seed, corn, dogwood, grapes, panic grasses, ragweed, and pokeberry. Cardinals will readily utilize the backyard feeder, especially those filled with sunflower seed, millets, and nuts.

r. CAROLINA CHICKADEE (Parus carolinensis)

General: This is a small bird about 4 1/2 inches long with a black crown, chin, and throat. The rest of its body is white to slate gray. The chickadee is very active and can be seen in our state year-round.

Habitat: This is an "edge" species and is abundant around farmsteads and homesites in rural, suburban, and urban areas. These birds do not like open, treeless habitats.

Life History: These birds are "hole" nesters utilizing abandoned woodpecker holes, birdboxes, and odd sites around houses, barns, etc. Two broods are raised each year. Four or five eggs are laid per nest. These are white with reddish-brown spots. Incubation lasts for 11-13 days and the young leave the nest in 12-16 days.

Food: In spring and summer, animal foods comprise about 90 percent of their diet. In winter months, when insects are scarce, animal food intake drops to about 50 percent. Preferred animal foods are ants, beetles, leafhoppers, moths, spiders, and wasps. During winter months, insect eggs or pupae are taken.

Plant foods of preference are peanuts, pecans, pineseed, and sunflower seed. Chickadees will come to bird feeders in search of suet, cracked nuts, peanut butter, and sunflower seed.

s. CAROLINA WREN (Thryothorus ludovicianus)

General: This is the largest of the wrens averaging about 5 1/2 inches long. It is rusty-red above and buffy below, and has a very characteristic white strip over the eye. It is a permanent resident of North Carolina.

Habitat: The wren inhabits farmsteads, preferring areas around barns and outbuildings. They are "edge" birds, but prefer wooded edge and rarely frequent open habitats.

Life History: Nests are built in stumps, brushpiles, and fallen tree tops. Nests also are often found under shelters, in shops and in mailboxes. Two or three broods per year are normal. Eggs are white or cream with brown or lavender markings and there are normally 4-6 per nest. Incubation lasts 12 days and the young remain in the nest 12-14 days.

Food: The diet of the wren is composed of about 95 percent animal matter. Insects such as ants, beetles, crickets, flies, grasshoppers, moths, and weevils are the primary food components. These birds do not readily come to feeding stations.

t. EASTERN BLUEBIRD (Sialia sialis)

General: This is the only bluebird with a red breast. It is 7 inches in length and nests throughout much of our state. The bluebird experienced a population decline during the 1950's and 1960's, but populations appear to be increasing at the present time and, in fact, this bird is becoming quite common.

Habitat: The bluebird is commonly found around farmsteads. It occasionally frequents suburban areas, but does not prefer truly wooded or open habitats. As is the case with many non-game bird species, it is most often associated with "edge" habitats.

Life History: Nests are found in abandoned woodpecker holes or other such cavities. They will readily utilize nest boxes if properly constructed and erected. Bluebirds normally return to the same nest location year after year. Two to three broods are raised each year. Three to five eggs are laid per nest and these eggs are bluish-white. Incubation takes 13-15 days and the young stay in the nest about 15-18 days.

Food: Bluebirds prefer animal foods when available. Insects comprise about 90 and 60 percent of their diet in summer and winter, respectively. Beetles, caterpillars, crickets, weevils, and grasshoppers are favorite foods. Plant foods include blackberry,

blueberry, cherry, Virginia creeper, dogwood berries, and pokeberries. Bluebirds are not normally attracted to feeding stations.

u. HAWKS

Red-Tailed (Buteo jamaicensis)

Red-Shouldered (Buteo lineatus)

Eastern Sparrow (Falco sparverius sparverius)

Range: These birds are common throughout the state.

A general population decline occurred during the 1950's and 1960's. This decline apparently reversed during the late 1970's and, at the present time, populations appear to be increasing.

Habitat: These birds are found in all habitat types. All three utilize woodlands for nesting, but feed in either openland or edge areas.

Life History: The large red-tailed and red-shouldered hawks build nests in large, high trees, while the small sparrow hawk is a cavity nester. One brood is produced per year.

Food: Hawks are carnivorous and are often seen soaring over a pasture or field looking for prey. Although they occasionally take game animals such as rabbits and quail, their diet consists primarily of non-game species.

The diet of the large red-tailed and red-shouldered hawks consists primarily of rodents, amphibians, and reptiles. They will also occasionally take ducks,

chickens, blackbirds, squirrels, crows, etc. Sparrow hawks, on the other hand, primarily consume grasshoppers and other larger insects such as locusts, crickets, etc. They will also readily take mice, rats, and lizards. As its name indicates, this hawk will also take small birds such as the common English sparrow.

v. OWLS

Barred Owl (Strix varia)

Great Horned Owl (Bubo virginianus)

Screech Owl (Otus asio)

Range: These owls are common throughout North Carolina. They are permanent residents and are often seen or heard in late afternoon, at night, and occasionally, during daylight hours.

Habitat: Owls are generally considered birds of the woods preferring swamps or bottomland habitat types. They range readily into other habitat types, however, and the great horned may even be a "night raider" on a farmers chicken yard.

Life History: These birds are cavity nesters. Abandoned woodpecker cavities or other suitable cavities are readily utilized. They raise one brood per year. Eggs are white and incubation takes from 21 to 28 days. The young remain in the nest for at least five weeks.

Food: Owls are carnivorous and feed almost entirely at night. The principle diet components are mice and rats. They will also take rabbits, small birds, and frogs.

#### W. WOODPECKERS

##### (1) Pileated Woodpecker (Dryocopus pileatus)

Habitat: This large woodpecker inhabits mature stands of both coniferous and deciduous woodlands and is found throughout eastern North Carolina. Key habitat components are large snags, large mature trees, and timber stands with high snag densities. In our area, they are particularly associated with hardwood corridors, floodplains, and swamps. Territorial size for a pair of these woodpeckers appears to be from 150-200 acres. Good habitat for this species would be an indicator of good habitat for most other hole nesters.

Life History: Pileated woodpeckers are cavity nesters. Nests are found in large snag trees and a new nest is excavated each spring. The male and female stay together year-round and studies indicate that they occupy the same territory for a number of years.

Snags used for nesting and roosting are usually from 60-70 feet tall. Nests are located high up



in the snag and will usually be in the upper one-third of the tree.

The exact number of snags necessary to support a pair of these birds is not precisely known. However, studies have been made that indicate that from 14-20 sound snags per territorial area are required.

Timber stand management plans that include rotations or cutting cycles of greater than 80 years would be a requirement to provide good habitat for the pileated woodpecker.

Food: Carpenter ants and other wood boring insects are the primary food source for this bird. Forage areas include snags, logs and live trees. Wild fruits comprise a small percentage, less than 30 percent, of the diet.

(2) Red-cockaded Woodpecker (Picoides borealis)

Habitat: This bird is an endangered species that inhabits mature, old growth pine stands. Sparse or open understory is an essential habitat component. The red-cockaded woodpecker will utilize any of the native pines found in North Carolina if other habitat components are unavailable. Generally, however, colonies are associated more closely with longleaf pine stands in our state.

Life History: These birds are found in colonies with each colony normally having a territory of

about 150-200 acres. Each colony will have from 3 to 7 nest trees. These nest trees will be live pines and are usually not more than 150-200 feet apart. The trees are readily identified by a whitish appearance resulting from a continuous flow of resin from the live tree. Each nest tree may have from one to seven cavities but only one is normally utilized for nesting. Other cavities are utilized for roosting. Cavity formation takes from a few months to, in some cases, several years.

Food: The diet of the red-cockaded woodpecker consists primarily of insects, although some fruits are taken with a general ratio of 80 percent to 20 percent respectively. Insects such as beetles, beetle larvae, caterpillars, moths and spiders are readily taken. Fruits such as grapes, blueberries, holly, etc. are utilized when available.

These birds will rarely feed on the ground and most of the feeding activity is done above the understory or shrub community. Forage habitat may include tree stands as young as 20 years old and may include as many as 200 acres in a radius around the colony area.

Predators: The brown rat snake and an occasional raccoon would be considered as the primary threats to the nesting woodpecker.

Management: Habitat loss or degradation through timber management practices such as clear-cutting or short term timber rotation pose the most severe threat to red-cockaded populations. Other activities by man such as highway construction, urban or suburban development also encroach on their habitat, and as a general result, in overall population reductions.

Beneficial woodland management practices include stand management goals of 80-100 years and a regular prescribed burning program to control understory vegetation.

x. BROWN PELICAN (Pelecanus occidentalis)

Range: This bird ranges along the coastal area of North Carolina and is especially prevalent in the southern coastal counties. Flocks of from 5-30 individuals can readily be observed gliding overhead or feeding along the coastal waters.

Life History: This bird nests in colonies on the ground or in low trees. Nests usually contain from 1 to 4 eggs. During the 1950's and 1960's the hatching success of these birds became extremely low. Due to this, it was placed on the endangered species list by the U.S. Fish and Wildlife Service. Since that time,

however, populations have recovered significantly and it is no longer listed as endangered.

Food: Pelicans have large appetites and consume large quantities of fish. Their characteristic "dive" to capture food is well known and often entertains visitors to the coastal region. Young, newly hatched birds feed on partly digested food obtained by putting their head deep into the parents' pouch.

y. BLUEGILL (Lepomis macrochirus)

General: The bluegill is probably the most widely recognized fish in North Carolina. It is sought after by people of all ages in ponds, lakes and streams from the mountains to the coast. During the late spring, mid-April through June, people get out the cane poles, flyrods, and even the rod and reel, and head for their favorite "bream" holes.

Range: This fish was originally considered native to waters east of the Mississippi. However, due to its adaptability to a wide range of habitat conditions and its suitability to production in fish hatcheries, it is now widely distributed throughout the United States. The bluegill is also now found in many other countries throughout the world.

Life History: Bluegill are nest builders and spawn after the water temperature reaches about 70 degrees. Spawning in our state usually begins in late April to early May and often continues into October. Many

nests are often congregated in a small area. Water depth over the nest will range from 6" to 24". Females may spawn two times per summer but the long spawning period is mostly associated with various age class distribution within a population. Number of eggs per female varies greatly, 2,000 - 50,000, depending on factors such as age, size, condition factor, etc. After the eggs are laid by the female, the male guards the nest and fans the eggs to circulate water and prevent siltation of the nest. Bluegill, or bream, as they are often called are a primary forage species. The small fish are taken readily by bass, pickerel, and many other predator species. The average size bluegill caught by fishermen is probably 6-8 ounces, although they will attain sizes up to 3-4 pounds.

Food: The food of this fish is highly variable. They will feed on aquatic insects, eggs of other fish (including their own), and on terrestrial insects and worms if they happen to fall into the water. Plankton and aquatic insects are the primary diet components, however.

z. CHANNEL CATFISH (Ictalurus punctatus)

General: The channel catfish is found throughout the waters of North Carolina and is generally considered as a large lake or river species. It has been utilized as a pond species in pond management programs

throughout the Southeast for several years, however. In streams, channel catfish reproduce effectively and maintain stable populations, but in ponds they generally do not successfully reproduce and are considered a "put and take" species.

Range: This species was originally native to the Mississippi River system and to the Great Lakes area. Through stocking programs, however, it has been widely distributed over the entire United States. It is found in all North Carolina waters with the possible exception of the higher mountain streams.

Life History: Channel catfish prefer to spawn in well protected areas such as hollow logs, underneath tree stumps or roots, or in holes of undercut banks. Spawning occurs at a water temperature of about 75°. Depending on age and size of the female, from 2,000 - 20,000 eggs are laid. The male guards the nest to protect the eggs from predation by other fish and provides agitation for the eggs by fanning the water with his tail. Hatching of the eggs usually takes 7 - 10 days and the fry stay together in dense schools for varying periods of time from a few days to 2 - 3 weeks.

Predation by other fish species is heavy on both the eggs and the young. Fry and fingerlings are considered favorite food for large bluegill, crappie and especially the largemouth bass.

Food: These fish are considered omnivorous although their primary diet component is animal matter. Worms, insects, other fish, and fish eggs are readily taken. Small channels are not generally recognized as strong predators on other fishes but larger individuals do serve as primary predators in aquatic systems.

aa. LARGEMOUTH BASS (Micropterus salmoides)

General: This fish is in the sunfish family and is considered by most people to be the most important game fish in North Carolina. It is found in most aquatic habitats throughout the state and is the primary predatory species in farm pond management programs.

Range: The largemouth was originally native to the Eastern United States. It has been propagated in private, state, and federal fish hatcheries, however, and is now stocked across the entire United States.

Life History: This fish species is a "nest builder", fanning a nest with its tail, in water from 2 - 5 feet deep. Coves, stream cut-offs or other quiet water areas are preferred for nesting sites. Nesting occurs when the water temperature is between 60-70° usually in April and early May in North Carolina. The number of eggs per nest is highly variable ranging from 2,000 - 10,000 or more. Males usually guard the nest and fan the eggs to circulate water to prevent siltation.

After hatching, large "swarms" or schools of fry are often observed.

Food: As fry and small fingerlings (less than 2"), the diet of largemouth bass is largely aquatic plankton and small insect larva. After they attain a length of about 1.5 - 2.0 inches, however, they become highly carnivorous and are fierce predators. The primary diet is other fish but they will take almost anything that can be captured and swallowed. Crayfish, tadpoles, frogs, etc., are readily taken.

bb. REDEAR SUNFISH (Lepomis Microlophus)

General: The redear, or shellcracker as it is more commonly called, is now being utilized widely for stocking ponds and lakes. In appearance it is very similar to the pumpkinseed (Lepomis gibbosus) and the two species are difficult to distinguish when small. However, shellcrackers are considered to be much more manageable and adaptable to ponds and lakes than are the smaller pumpkinseed.

Range: The shellcracker is native to the Mississippi River system and to most of the Southeastern United States. However, in recent years it has been produced in fish hatcheries and widely stocked in most areas of the country.

Life History: The spawning habits of the shellcracker are very similar to those of the bluegill.

Shellcracker, in stream habitats, may spawn earlier



than bluegill, but this probably does not occur in ponds and lakes.

Food: The food of the shellcracker also consists of plankton and aquatic insects. Additionally, they will consume aquatic mollusks when available.

cc. AMERICAN ALLIGATOR (Alligator mississippiensis)

Range: The alligator is found throughout much of the central and eastern coastal portion of North Carolina. Good populations are found in most coastal counties from Craven south through Brunswick County. Smaller, more isolated populations are also found northward to the Albemarle Sound region.

Habitat: Prime habitat in North Carolina is in inland lakes, ponds and streams and along coastal marshes and sloughs. Preferred habitat is in water with a good mix of open water and aquatic vegetative bed habitat. Areas with good vegetative cover such as sedges, rushes and other marsh grasses are prime habitat. This vegetation provides nesting materials and protections, and sanctuary for both the immature and mature animals.

Life History: Nesting occurs in spring and early summer. Nests are built in decaying vegetation relatively close to water and usually contain from 35-45 eggs. After hatching the young move to water and have a small home range. As they mature the sub-adults become much more mobile and may have a home

range of up to 1/2 to 3/4 miles. Mature alligators have a larger home range, up to several hundred acres, and both sexes travel great distances during the mating season.

Food: Young alligators prefer food such as crayfish, frogs, fish and snakes. They consume large amounts of food and are considered strong predators in the marsh ecosystem. Adults will consume similar animals but also prey on higher vertebrate animals.

Enemies: Raccoons are considered a major enemy of alligators since they prey heavily on their eggs. Humans are the primary enemy of adults. Alligator skins and meat have been heavily sought after in the past.

dd. SEA TURTLES

(1) Green Sea Turtles (Chelonia mydas)

Habitat: These are animals of the open ocean as well as the coastal estuarine areas. During the summer months they will enter the coastal sounds and rivers.

Food: These are omnivorous animals that eat marine grasses such as *Zostera*, *Gymnodocea*, *Thalassia* and *Halophila*, with plant roots being preferred. Animals such as oysters and other small mollusks and crustacean are also readily taken.

Breeding: Nesting occurs from June through August. Female green turtles may nest several times in the same season. Eggs laid per nesting varies but will normally vary from 160 to 180 eggs. The incubation period ranges from 45-60 days with the average time in recorded North Carolina nestings at 58 days. Hatching success is approximately 80%. These turtles prefer a medium textured sand for nesting. Schwartz, 1981 reported best hatching success of sea turtles in sands retained in a 60-120 mesh seive.

The first reported successful nesting of a green sea turtle on the U. S. Atlantic Coast North of Florida occurred in 1980 (Schwartz, et.al 1981). A second nesting by the same turtle was reported in 1985 (Peterson et.al 1985). Both of these nests were located on Onslow Beach and were found in the same approximate area. In 1980 the female produced 4 successful nestings with a total of 819 eggs. In 1985, she had 5 successful nestings and a total of 893 eggs. There was a 5 year inter-nesting period.

Enemies: These include sharks and killer whales on the adult turtles. During and immediately after nesting, the eggs and young are preyed upon by ghost crabs, racoons and foxes. Once the young reach the ocean waters they are preyed upon

by both birds and fish. Nest destruction is generally considered to be a major factor in the decline of sea turtles. Control of natural predators, as well as the control of man's activities, are critical factors on the future survival of these animals.

(2) Loggerhead Turtles (Caretta caretta)

Habitat: These are animals of the open ocean and estuarine areas. They will also be found at the mouths of large coastal rivers.

Food: While these turtles will consume some grasses, they are primarily carnivorous. The adults are vicious, feeding primarily on conchs, shellfish and barnacles. They will also readily eat fish, sponges and jellyfish.

Breeding: Female turtles come ashore to nest along most areas of the North Carolina coastline. Nests have been reported from Sunset Beach north to the Virginia line on Currituck Beach. Most nesting activity however, occurs in the mid-coastal section of the state.

Females come ashore to nest during the period from late May to late August. The average number of eggs per nest is approximately 126.

Incubation will normally be about 60-70 days.

Hatching success is generally good, ranging about 85%.

Enemies: These would be the same as those listed above for the green sea turtles.

#### 4. WILDLIFE MANAGEMENT PRACTICES

##### a. STREAMS AND FRESHWATER PONDS

Camp Lejeune contains approximately 80 miles of tidal streams and 21 miles of marine shoreline within its boundaries. Most of the water is salt or brackish in nature and represents approximately 26,000 acres of surface area. There are 11 fresh water ponds on Marine Corps Base and one at Marine Corps Air Station, New River, with a total surface area of 35.5 acres. The ponds are managed to provide recreational fishing opportunity for freshwater anglers. Fish populations managed in these ponds include redear, bluegill, largemouth bass and channel catfish.

##### PLANNED PRACTICES:

- (1) Control the invasion of aquatic weeds.
- (2) Develop the shorelines of all ponds by removing brush and debris to provide fishing access.
- (3) Initiate a liming and fertilization program for maximum fish production.
- (4) Manage fish populations to maximize standing crops and sustained annual harvest.
- (5) Consider a cyclic renovation project for older ponds by draining one pond each year as needed for the purpose of renovating the shoreline.

- (6) Select a good site with a reliable water supply and good access when constructing any new pond.
- (7) Implement engineering design and construction practices that will make management practices efficient and productive when a new pond is constructed.
- (8) Select the fish species best adapted to the ponds seasonal temperatures.
- (9) Select the desired number and size of fish to be stocked.
- (10) Harvest the annual fish crop to provide the most recreational return from the investment and management of the pond.

b. MANAGEMENT OF FORESTLANDS FOR WILDLIFE

The basic consideration for present and future wildlife populations is how the Base forest is managed. Planned woodland and wildlife management practices must be compatible to ensure total resource management on the Base. When properly planned, timber harvests can be commercially profitable, and benefit wildlife resources. The following are guidelines for woodland management to maintain or improve the diversity and long term productivity of wildlife habitat in woodlands:

(1) General Considerations

- (a) Favor old growth longleaf and flat-top pines during timber harvesting operations.

- (b) Manage the Base forests to maintain the balance between forest community types, i.e. pure pine, mixed pine-hardwoods, pure hardwoods.

Consideration should be given to acreage, stand quality, stand composition and soil type.

- (c) On timber stand improvement and site preparation, establish a framework time of April through July where decisions on performing work will be made on individual stands. These decisions will be made by the prescription biologist and forestry team based on wildlife species, reproductive needs and capabilities.
- (d) Key areas such as old home sites and unique habitat will be protected.
- (e) All precautions will be taken to protect hardwoods during prescribed burning activities.

(2) Stand Management

- (a) Seedling or Open Stage

This stage provides nesting and brood range. Plant pines at 5' x 12' spacing to aid rapid stand development and chop between the rows every 5 years to lengthen grass and forb production. Manage for sawtimber rotation in both pine and hardwood stands. Thirty percent of each compartment will be managed for mast producing species, consistent with (1)(b) above.

(b) Sapling Stage

In hardwood stands, thin to favor oaks, beech and other mast producing trees. In older sapling pine, burn December through mid-March to encourage grass and forb production.

(c) Pole Stage

Thin to release mast producers in hardwood and pine-hardwood stands. Prescribe burn portions of the stand up to 3 to 5 year intervals in December through mid-March.

(d) Young Sawtimber

Cut to improve and maintain a variety of mast bearing trees and fruit bearing shrubs in hardwood stands. Break up large stands as stated in (f) and (g) below. Use fire or logging to keep pine stands open. Remove all products in same operation to reduce disturbance.

(e) Mature Sawtimber

Apply 80 to 100 year rotation for pine sawtimber and 120 year rotation for hardwoods. Maintain pine in medium to fully stocked stands to prevent a heavy midstory. Burn pine stands in December to mid-March on a 3 to 5 year cycle. Consider surrounding stands in selecting regeneration areas to maintain diversity. Distribute cuts to minimize disturbance, other



impacts, and maintain stands necessary for optimum habitat diversity.

(f) Regeneration of Pine Uplands

Limit regeneration of pine stands through clear-cutting, shelterwood, and seed tree cutting methods to 10 - 100 acres in size with an average of 40 acres.

(g) Regeneration of Hardwood Stands

Begin the regeneration of hardwood stands by clear-cut or shelterwood cuts with a 10 - 25 acre stand size goal with an average of 15 acres.

(h) Mixed Pine-Hardwood Stand Management

For mixed pine-hardwood stand management, see Appendix (A) (4) b.

(i) Mixed longleaf pine - turkey oak stand management.

(1) Management longleaf - turkey oak stands by keeping the understory as clear as possible.

(2) Favor turkey oaks as most important hardwood component in the understory of longleaf pine.

(3) Plan for an eventual stocking of mature longleaf trees not exceeding 100 stems per acre at maturity.

- (4) Emphasize retention of mature and over mature hardwood to loggers during timber harvesting operations.
- (5) Prescribe burn at 5 year intervals beginning when oaks reach a d.b.h. of 4 inches and when there is sufficient moisture to prevent damage to the base of individual hardwood.

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Above recommendations provided by Dr. Gene Wood, Professor and Wildlife Ecologist, Bell W. Baruch Forest Science Institute of Clemson University, Georgetown, South Carolina.

c. MANAGING WILDLIFE OPENINGS

Many wildlife species need open areas to feed on green vegetation, seeds and insects. Openings are especially important to young animals such as quail, turkey, and rabbit. The insect population is highest in grassy openings and provide an available food source for both game and nongame species. Openings may include plantings or fallow areas, powerlines, gun positions, tactical landing zones, access roads and other areas which provide breaks from the continuous woodlands. Approximately 10 percent of the woodlands should be maintained in some type of opening for wildlife species.

Diversity of vegetative cover is correlated with forest wildlife abundance; therefore, openings are a

necessary component of forest-wildlife habitat. Where openings do not exist in sufficient number, they should be created to supplement the food base of forest-wildlife through the introduction of additional plant species. Plantings or encouraging selected plants which will tend to maintain the open character of an opening, is a valid effort as long as the least expense guides the selection of the technique. The term "wildlife openings" is selected for reference purpose.

#### PLANNED PRACTICES

- (1) Establish 25 acres of additional wildlife openings 2-4 acres in size on an annual basis.
- (2) Correlate soil conditions including soil type, fertility, drainage and cover diversity in selecting site locations.
- (3) Select and mark locations for new wildlife clearings prior to timber sales so that any merchantable trees can be removed.
- (4) Plan project for establishing new clearings soon after the timber sale contract has been completed.
- (5) Maintain present wildlife clearings as grassy openings in various stages of succession.
- (6) Plan treatments of openings to maintain the most desired effect for optimum wildlife usage through mowing, discing, overseeding or periodically allowing to remain fallow.

- (7) Utilize both annual and perennial seed mixtures for establishing wildlife clearings.
- (8) The important attributes of the crop selected for wildlife plantings must adhere to the following guidelines:
  - (a) It must be adapted to the local soil and climate.
  - (b) It should provide food when natural foods are not abundant.
  - (c) It should be preferred by principal game species.
  - (d) It must not be completely eaten by other animals before being used by the targeted game species.
  - (e) It should not be too difficult or too costly to plant or cultivate.
  - (f) A crop that produces winter greens, as well as seed in spring and good insect habitat, is ideal.

d. SUPPLEMENTAL FOOD PLANTINGS

Wildlife species feed by various methods such as grazing, picking, scratching, clipping, stripping or ingesting food material whole. A combination of these methods is often used. Green grasses and leaves are ingested in large quantities in the spring and summer. During the summer and early fall, picking and stripping methods are used to get at ripened seed heads.

A wide range of natural foods including insects, seeds, grasses, berries, legumes, acorns, chinquapins, dogwood berries, hickory nuts, wild cherries and grapes are available in the woodland edge around wildlife clearings. Supplemental plantings can be established in summer and fall to provide additional food through the winter until early spring.

Bicolor shrub lespedeza and autumn olive seedlings will be planted for both game and nongame species. These plant materials will be planted at appropriate locations in or adjacent to established wildlife openings. Periodic maintenance will be performed as necessary for good seed and fruit production of these plantings.

e. GAME SPECIES MANAGEMENT

Camp Lejeune has a variety of game species present including upland game birds, small game animals, big game animals, fur bearing animals and migratory waterfowl. Open hunting or open trapping seasons are established in accordance with Base, State and Federal regulations for the recreational taking of the various game species. Upland game birds here include wild turkey and bobwhite quail. Small game animals include fox squirrels, gray squirrels, cottontail rabbit, and marsh rabbit. Big game animals include white-tailed deer and black bear. Fur bearing animals include raccoon, opossum, mink, otter, beaver, bobcat, gray fox, red fox and skunk. Both hunting and trapping seasons are established for raccoon and

opossum while hunting season only is established for other game. White-tailed deer are the most popular game species with local sportsmen. The most popular upland gamebird is wild turkey and the most popular small game species is gray squirrel. More raccoon are harvested than any other fur bearing animal. The taking of red and gray fox is prohibited by state regulations.

#### PLANNED PRACTICES

- (1) Control deer populations by establishing either-sex hunting seasons, as necessary, to maintain the herd within the range carrying capacity.
- (2) Conduct special either-sex hunts in the surface danger areas, adjacent to impact areas as necessary, for herd control within the constraints of established safety procedures.
- (3) At least one special either-sex hunt will be conducted annually in Base housing areas for control of the deer population. The special hunt(s) will be well publicized to occupants of Base housing and other interests for safe coordination of the hunts.
- (4) Conduct biological sampling of the deer herd by accomplishing abomasal parasite studies, reproduction studies, age-sex ratio, weight and harvest analysis.
- (5) Maintain the wild turkey population by harvesting males only during spring season and by live-trapping birds for relocation to selected restoration areas.

- (6) Conduct spring gobbler counts prior to the spring hunting season along three permanently established routes.
- (7) Intensively manage the quail management area outside surface danger areas for the development of food, cover, nesting and brood range for bobwhite quail.
- (8) Maintain well dispersed wildlife openings for wild turkey, white-tailed deer, quail, rabbit and morning dove.
- (9) Establish seed producing bicolor lespedeza and plantings of sawtooth oak for game species.
- (10) Establish and annually maintain artificial nesting boxes for wood ducks in selected wetland areas.

f. NONGAME SPECIES MANAGEMENT

Hundreds of different nongame species occur in the upland forest, pocosin, swamp, beach and estuarine habitats of Camp Lejeune. Nongame birds are very valuable assets to the general environment here. Many birds serve in a beneficial manner as controllers of weeds, and invertebrate and vertebrate pests detrimental to humans. Their insect control capabilities greatly benefit personnel who are in the field at all seasons of the year conducting military training exercises. In addition, the hobby of bird watching has stimulated many persons who use the outdoors to locate, observe and record with binoculars, cameras and notebook, the species found there. Some nongame birds can cause problems around industrial

areas and housing areas at various times. Most nongame species, however, cause few problems to the human environment.

#### PLANNED PRACTICES

- (1) Consider habitat requirements for nongame species when reviewing timber management prescriptions.
- (2) Schedule prescribed burning at 3-5 year intervals to improve the general forest habitat for nongame species.
- (3) Protect cull trees and snags where possible during thinning of timber stands for providing cavities, potential cavities and future cavities for nongame species.
- (4) Establish and maintain plantings of fruit producing trees and shrubs for songbirds.
- (5) Develop a diversity of edge around wildlife clearings and openings to enhance nesting and feeding areas for nongame species.
- (6) Establish artificial nesting boxes for species that will use them.
- (7) Develop measures for controlling nuisance nongame species around industrial and housing areas.

#### g. ENDANGERED AND THREATENED SPECIES MANAGEMENT

Protection of endangered and threatened species is in accordance with the National Environmental Policy Act of 1968 and the Endangered Species Act of 1973 as amended. Nationally listed endangered and threatened species found



here are the red-cockaded woodpecker, American alligator, loggerhead sea turtle, green sea turtle, sei whale, humpback whale, finback whale, Atlantic right whale and sperm whale. Formal consultation has been conducted with the Fish and Wildlife Service and the National Marine Fisheries Service for all listed species as required by Section 7 of the Endangered Species Act. Biological opinions have been rendered for all the listed endangered and threatened species present at Camp Lejeune and are on file in the Natural Resources and Environmental Affairs Division. These biological opinions contain management guidelines for protecting all listed species and their respective habitats. Existing endangered species permits issued by the USFWS are also on file in the NREAD. The guidelines are implemented by Base orders which are designed to carry out habitat protection measures during military training exercises and other land use operations.

#### PLANNED PRACTICES

- (1) Coordinate a two year red-cockaded woodpecker research study with the contractor, N. C. State University.
- (2) Annually, clear woody debris, shrubby vegetation, and prescribe burn a twelve foot buffer around all red-cockaded woodpecker cavity trees.
- (3) Prescribe burn all woodpecker colony and support stands at 1-3 year intervals.

- (4) Locate, map and mark new starts, roost and cavity trees utilized by red-cockaded woodpeckers.
- (5) Conduct annual roost surveys in August at all red-cockaded woodpecker colony sites.
- (6) Assist the Training Facilities Officer in conducting weekly inspections of red-cockaded woodpecker habitat in the Tank Mechanized Training Area and at Tactical Landing Zone Penguin.
- (7) Conduct periodic inspections of all remaining red-cockaded woodpecker habitat on the Base.
- (8) Annually, survey American alligator populations in July on Wallace, Southwest, French, Duck, Mill and Stone Creeks.
- (9) Contract aerial surveys over Onslow Beach, Browns Island and Bear Island to monitor nesting activities on the beach and in offshore waters.
- (10) Monitor green sea turtle and loggerhead sea turtle nesting activity at Onslow Beach May through August.
- (11) Double tag nesting females by placing one tag on each front flipper, and measure and collect pertinent data from each turtle tagged.
- (12) Relocate nests threatened by erosion, tides, extreme predation or military training operations to safe beach sites within 12 hours after laying.
- (13) Excavate each nest within 12 hours after laying for the purpose of carefully counting and recovering the eggs.

- (14) Place a 4'X4'X2' electric welded wire cage with 2"X4" mesh over each nest, positioned approximately six inches in the soil, to protect nest from raccoon, opossum and fox predation.
- (15) After hatching occurs, excavate each nest and count unhatched eggs and dead hatchlings for determining nesting success.
- (16) Publish an annual report of sea turtle nesting activities and forward to the U. S. Wildlife Service Permit Office and the N. C. Wildlife Resources Commission Permit Office, as required by 31 January of each year under the respective endangered species permits.
- (17) Annually, coordinate with the Assistant Chief of Staff, Training and Operations, the implementing of daily flights over offshore waters to ensure that whales are not present during migration periods.

#### h. MANAGING NONGAME BIRDS

There is much enjoyment in the very fact that our closest neighbors are birds and we are refreshed daily by their presence. Some of them sing beautifully like the robin, the wood thrush, the mockingbird, and a hundred others. One of the most beautiful sounds in the forest is the pileated woodpecker on a quiet, clear morning sounding as if he wants the entire world to hear his song. Other birds afford us countless hours of enjoyment just watching their antics. House wrens, flycatchers and kingbirds fall

into this category as do many others. Hummingbirds are probably the greatest flyers of all, able to fly backwards, hover in stationary flight, zip straight up or down, shift to top speed from a standstill start and amaze us in many other ways with their agility. Many birds perform miracles in controlling insect populations. Martins residing in built-up areas in spring and summer will do much to clear the air of mosquitoes. All the swallows are excellent flying insect traps. The night hawk is an expert acrobat of the skies and eats his own weight in insects every three days. Woodpeckers searching for worms in dead trees hollow out cavities that are used by many other species from small birds to large wood ducks, and from flying squirrels to tree frogs. Hawks and owls do an excellent job of controlling small rodents. Ospreys are fish hawks and are able to expertly grab fish from the water. Public attitudes toward the conservation of nongame species has taken a more positive approach in recent years. Provision for undisturbed nesting cover is perhaps the most important aspect considered here in managing for nongame species. Long timber rotations, clear cuts and seed-tree cuts less than 50 acres in size, wildlife plantings and the maintenance of openings benefit nongame.

Other management practices for maintaining populations of nongame birds will be:

- (1) Providing nest boxes for species that will use them.

- (14) Place a 4'X4'X2' electric welded wire cage with 2"X4" mesh over each nest, positioned approximately six inches in the soil, to protect nest from raccoon, opossum and fox predation.
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Other management practices for maintaining populations of nongame birds will be:

- (1) Providing nest boxes for species that will use them.

- (2) Improving nesting cover by planting preferred trees and shrubs.
- (3) Choosing trees and shrubs that provide food for songbirds.
- (4) Maintaining supplemental food plantings and grass openings.
- (5) Protecting nongame species by enforcement of applicable local, state and federal regulations.

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TABLE 1  
A REPRESENTATIVE LIST OF VASCULAR  
PLANTS OF WETLAND HABITATS

	<u>Common Name</u>	<u>Scientific Name</u>
3	American holly	<u>Ilex opaca</u>
1	Atlantic white cedar	<u>Chamaecyparis thyoides</u>
1	Slender Fimbristylis	<u>Fimbristylis autumnalis</u>
1	Bladcypress	<u>Taxodium distichum</u>
1	Short-Beaked Baldrush	<u>Psilocarya nitens</u>
4	Bamboo-briar	<u>Smilax laurifolia</u>
1	White Bartonnia	<u>Bartonia verna</u>
1	Whitebeaked rush	<u>Rhynchospora alba</u>
1	Capitate Beaked-rush	<u>Rhynchospora cephalantha</u>
1	Loose-headed beaked-rush	<u>Rhynchospora chalarocephala</u>
1	Fasciculate beaked-rush	<u>Rhynchospora fascicularis</u>
1	Slender beaked-rush	<u>Rhynchospora gracilentia</u>
1	Horned-rush	<u>Rhynchospora macrostachya</u>
2	Bitter gallberry	<u>Ilex glabra</u>
3	Black gum	<u>Nyssa sylvatica</u>
1	Two-flowered bladderwort	<u>Utricularia biflora</u>
1	Floating bladderwort	<u>Utricularia inflata</u>
1	Purple bladderwort	<u>Utricularia purpurea</u>
1	Southern blue flag	<u>Iris virginica</u>
1	Hairy pipewort	<u>Lachnocaulon anceps</u>
4	Brackenfern	<u>Pteridium aquilinum</u>
3	Broomsedge	<u>Andropogon virginicus</u>
4	Rough buttonweed	<u>Diodia teres</u>
2	Coinwort	<u>Centella asiatica</u>
2	Cinnamon fern	<u>Osmunda cinnamomea</u>
2	Climbing hempweed	<u>Mikania scandens</u>
2	Colley's meadowrue	<u>Thalictrum colleyi</u>
1	Common cattail	<u>Typha latifolia</u>
3	Creeping blueberry	<u>Vaccinium crassifolium</u>
1	Creeping rush	<u>Juncus repens</u>
2	Myrtle dahoon	<u>Ilex myrtifolia</u>
1	Early whitetop fleabane	<u>Erigeron vernus</u>
3	Dangleberry	<u>Gaylussacia frondosa</u>
2	Sand swamp white topsedge	<u>Dichromena latifolia</u>
3	Dwarf huckleberry	<u>Gaylussacia dumosa</u>
2	American elder	<u>Sambucus canadensis</u>
1	Hoary ludwigia	<u>Ludwigia pilosa</u>
2	Sweetbells leucothoe	<u>Leucothoe racemosa</u>
2	Fetterbush	<u>Lyonia lucida</u>
1	Foxtail clubmoss	<u>Lycopodium alopecuroides</u>
1	Golden club	<u>Orontium aquaticum</u>
4	Wild bamboo	<u>Smilax auriculata</u>
3	Cat greenbriar	<u>Smilax glauca</u>
3	Long-stalked greenbriar	<u>Smilax pseudochina</u>
1	Coral greenbriar	<u>Smilax walteri</u>
3	Arum wild ginger	<u>Asarum arifolium</u>
2	Shaggy hedge hyssop	<u>Gratiola pilosa</u>
2	Highbush blueberry	<u>Vaccinium corymbosum</u>

2	Leafless cowbane	<u>Oxypolis filiformis</u>
1	Hog-fennel	<u>Oxypolis ternata</u>
1	Honeycup	<u>Zenobia pulverulenta</u>
1	Hooded pitcherplant	<u>Sarracenia minor</u>
3	Horse sugar (sweetleaf)	<u>Symplocos tinctoria</u>
3	Field horsetail	<u>Equisetum arvense</u>
1	Bay iris	<u>Iris tridentata</u>
2	Carolina kalmia	<u>Kalmia carolina</u>
1	Leatherleaf	<u>Chamaedaphne calyculata</u>
2	Downy leucothoe	<u>Leucothoe axillaris</u>
2	Nuttall's lobelia	<u>Lobelia nuttallii</u>
2	Loblolly bay	<u>Gordonia lasianthus</u>
3	Loblolly pine	<u>Pinus taeda</u>
4	Longleaf pine	<u>Pinus palustris</u>
1	Threadleaf sundew	<u>Drosera filiformis</u>
2	Male-blueberry	<u>Lyonia ligustrina</u>
1	Many-headed rush	<u>Juncus polycephalus</u>
2	Shore rush	<u>Juncus marginatus</u>
1	Sminking fleabane	<u>Pluchae foetida</u>
1	Cutleaf mermaidweed	<u>Proserpinaca pectinata</u>
1	Awn-petaled meadow beauty	<u>Rhexia aristosa</u>
3	Muscadine grape	<u>Vitis rotundifolia</u>
1	Netted chain-fern	<u>Woodwardia areolata</u>
2	One-flowered oldenlandia	<u>Oldenlandia uniflora</u>
2	Fall panicum	<u>Panicum dichotomiflorum</u>
3	Slender rush	<u>Juncus tenuis</u>
1	Whorled pennywort	<u>Hydrocotyle verticillata</u>
1	Pickernelweed	<u>Pontederia cordata</u>
2	Pinebarren gentain	<u>Gentiana autumnalis</u>
3	Pinxter flower	<u>Rhododendron periclymenoides</u>
1	Flattened pipewort	<u>Eriocaulon compressum</u>
1	Pitcherplant	<u>Sarracenia purpurea</u>
1	Bald cypress	<u>Taxodium distichum</u>
1	Pond pine	<u>Pinus serotina</u>
3	Pyxie moss	<u>Pyxidantha barbulata</u>
2	Red bay	<u>Persea borbonia</u>
2	Red chokecherry	<u>Aronia arbutifolia</u>
3	Red maple	<u>Acer rubrum</u>
1	Redroot	<u>Lachnanthes caroliniana</u>
1	Rough-leaf lossestrife	<u>Lysimachia asperulifolia</u>
1	Royal fern	<u>Osmunda regalis</u>
1	Tapertip rush	<u>Juncus acuminatus</u>
1	Rush-featherling	<u>Pleea tenuifolia</u>
1	Lanceleaved sabatia	<u>Sabatia difformis</u>
1	Elliott's sedge	<u>Carex elliotii</u>
1	Sedge	<u>Carex walterana</u>
1	Mild water pepper	<u>Polygonum hydropiperoides</u>
2	Water smartweed	<u>Polygonum punctatum</u>
2	Smooth winterberry	<u>Ilex laevigata</u>
4	Farkleberry	<u>Vaccinium arboreum</u>
1	Spatterdock	<u>Nuphar luteum</u>
1	Northern jointed spikerush	<u>Eleocharis equisetoides</u>
1	Torrey's spikerush	<u>Eleocharis microcarpa</u>

2	Large tuberculad spikerush	<u>Eleocharis tuberculosa</u>
2	Canada St. Johnswort	<u>Hypericum canadense</u>
2	Round-podded St. Johnswort	<u>Hypericum oistifolium</u>
1	Purple St. Johnswort	<u>Triadenum virginicum</u>
1	Pink sundew	<u>Drosera capillaris</u>
1	Spatulate-leaved sundew	<u>Drosera intermedia</u>
1	Carolina ash	<u>Fraxinus caroliniana</u>
2	Swamp honeysuckle	<u>Rhododendron viscosum</u>
2	Possumhaw viburnum	<u>Viburnum nudum</u>
2	Sweet gallberry	<u>Ilex coriacea</u>
2	Sweet pepperbush	<u>Clethra alnifolia</u>
1	Sweet pitcherplant	<u>Sarracenia rubra</u>
2	Sweetbay	<u>Magnolia virginiana</u>
3	Sweetgum	<u>Liquidambar styraciflua</u>
2	Giant cane	<u>Arundinaria gigantea</u>
2	Bantom buttons	<u>Synqonanthus flavidulus</u>
1	Tenangled pipewort	<u>Eriocaulon decanquulare</u>
1	Three-way sedge	<u>Dulichium arundinaceum</u>
2	Titi	<u>Cyrilla racemiflora</u>
1	Trumpets	<u>Sarracenia flava</u>
1	Water tupelo	<u>Nyssa aquatica</u>
1	Two-flowered burmannia	<u>Burmannia biflora</u>
1	Turnflower rush	<u>Juncus biflorus</u>
2	Forked rush	<u>Juncus dichotomus</u>
1	Umbrella grass	<u>Fuirena squarrosa</u>
2	Venus' fly trap	<u>Dionaea muscipula</u>
2	Virginia buttonweed	<u>Diodia virginiana</u>
1	Virginia chain-fern	<u>Woodwardia virginica</u>
2	Virginia sweetspire	<u>Itea virginica</u>
1	White waterlily	<u>Nymphaea odorata</u>
3	Southern waxmyrtle	<u>Myrica cerifera</u>
3	Pixi moss	<u>Pyxidantha barbulata</u>
1	White arum	<u>Peltandra sagittifolia</u>
2	Whitewicky kalmia	<u>Kalmia cuneata</u>
4	Teaberry	<u>Gaultheria procumbens</u>
2	Witch-alder	<u>Fothergilla gardenii</u>
3	Yellow jassamine	<u>Gelsemium sempervirens</u>
1	Yellow-eyed grass	<u>Xyris ambigua</u>
1	St. Mary's grass	<u>Xyris baldwiniana</u>
1	Carolina yellow-eyed grass	<u>Xyris caroliniana</u>
1	Funged yellow-eyed grass	<u>Xyris fimbriata</u>

Sources for this list are: Kologiski (1977), Snyder (1977), Ashton and Ashton (1979), McDonald and Ash (1981), McDonald et al. (1981). Scientific plant names in tables conform to the National List of Scientific Plant Names (Soil Conservation Service 1982). Common names conform to Radford et al. (1968).

#### Wetland Indicator Status

1. Obligate - Frequency greater than 99% in wetlands.
2. Facultative wet - 67-99% found in wetlands.
3. Facultative - 34-66% found in wetlands.
4. Facultative upland - 1-33% found in wetlands.
5. Nonwetland - less than 1% in wetlands.

TABLE 2  
 VASCULAR PLANTS OF POCOSINS AND RELATED FRESHWATER  
 WETLANDS THAT ARE THREATENED OR ENDANGERED<sup>a</sup>

<u>Common Name</u>	<u>Scientific Name</u>
Colley's meadowrue	<u>Thalictrum colleyi</u>
Loose watermilfoil	<u>Myriophyllum laxum</u>
Rough-leaf loosesstrife*	<u>Lysimachia asperulifolia</u>
Saruis holly*	<u>Ilex amelanchier</u>
Tuberclad orchid	<u>Platanthera flava</u>
Southern spicebush*	<u>Lindera melissifolia</u>
Spring-flowering goldenrod	<u>Solidago verna</u>
Sweet pitcher-plant	<u>Sarracenia rubra</u>
Venus' fly-trap	<u>Dionaea muscipula</u>
Pixi moss	<u>Pyxidantha barbulata</u>
Whitewicky kalmia*	<u>Kalmia cuneata</u>
Wireleaf dropseed	<u>Sporobolus teretifolius</u>
Yellow fringeless-orchid	<u>Platanthera integra</u>

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<sup>a</sup> Species marked with an asterisk are legally protected in North Carolina under the North Carolina Protection and Conservation Act of 1979. Other species are listed in Endangered and Threatened Plants and Animals of North Carolina (J. E. Cooper, et al., 1977).

TABLE 3  
 A REPRESENTATIVE LIST OF VERTEBRATE FAUNA  
 OF POCOSINS, POCOSIN ECOTONES  
 AND ADJACENT WATERS<sup>a</sup>

## FISH

<u>Common Name</u>	<u>Scientific Name</u>
Alewife	<u>Alosa pseudoharengus</u>
American eel	<u>Anquilla rostrata</u>
American shad	<u>Alosa sapidissima</u>
Atlantic croaker	<u>Micropogonias undulatus</u>
Atlantic menhaden	<u>Brevoortia tyrannus</u>
Atlantic needlefish	<u>Strongylura marina</u>
Atlantic spadefish	<u>Chatodipterus faber</u>
Atlantic thread herring	<u>Opisthonema oglinum</u>
Banded killfish	<u>Fundulus diaphanus</u>
Banded sunfish	<u>Enneacanthus obesus</u>
Bay anchovy	<u>Anchoa mitchilli</u>
Blackcreek tonguefish	<u>Symphurus plagiosa</u>
Black crappie	<u>Pomoxis nigromaculatus</u>
Blackbanded sunfish	<u>Enneacanthus chaetodon</u>
Blueback herring	<u>Alosa aestivalis</u>
Bluefish	<u>Pomatomus salatrix</u>
Bluegill	<u>Lepomis macrochirus</u>
Bluespotted sunfish	<u>Enneacanthus gloriosus</u>
Bowfin	<u>Amia calva</u>
Brown bullhead	<u>Ictalurus nebulosus</u>
Bullnose ray	<u>Myliobatis freminvillei</u>
Carp	<u>Cyprinus carpio</u>
Chain pickerel	<u>Esox niger</u>
Channel catfish	<u>Ictalurus punctatus</u>
Cownose ray	<u>Rhinoptera bonasus</u>
Crevalle jack	<u>Caranx hippos</u>
Dusky pipefish	<u>Syngnathus floridae</u>
Dusky shiner	<u>Notropis cummingsae</u>
Eastern mudminnow	<u>Umbra pygmaea</u>
Feather blenny	<u>Hypsoblennius hentzi</u>
Flier	<u>Centrarchus macropterus</u>
Gizzard shad	<u>Dorosoma cepedianum</u>
Golden shiner	<u>Notemigonus crysoleucas</u>
Green goby	<u>Microgobius thalassinus</u>
Hogchoker	<u>Trinectes maculatus</u>
Ironcolor shiner	<u>Notropis chalybaeus</u>
Johnny darter	<u>Etheostoma nigrum</u>
Ladyfish	<u>Elops saurus</u>
Lake chubsucker	<u>Erimyzon sucetta</u>
Largemouth bass	<u>Micropterus salmoides</u>
Longnose gar	<u>Lepisosteus osseus</u>
Marked goby	<u>Bogionellus stigmaticus</u>
Mosquitofish	<u>Gambusia affinis</u>
Mud sunfish	<u>Acantharchus pomotis</u>

Mummichog	<u>Gundulus heteroclitus</u>
Naked goby	<u>Gobiosoma boscii</u>
Northern pipefish	<u>Syngnathus fuscus</u>
Pinfish	<u>Lagodon rhomboides</u>
Pirate perch	<u>Aphredoderus sayanus</u>
Pumpkinseed	<u>Lepomis gibbosus</u>
Pygmy killfish	<u>Leptolucaania ommata</u>
Rainwater killfish	<u>Lucania parva</u>
Redbreast sunfish	<u>Lepomis auritus</u>
Red drum	<u>Sciaenops ocellatus</u>
Redear sunfish	<u>Lepomis macrolophus</u>
Redfin pickerel	<u>Esox americanus</u>
Rough silverside	<u>Membras martinica</u>
Satinfin shiner	<u>Notropis analostanus</u>
Sawcheek darter	<u>Etheostoma serriferum</u>
Silver jenny	<u>Eucinostomus gula</u>
Silver perch	<u>Bairdiella chrysoura</u>
Silvery minnow	<u>Hybognathus nuchalis</u>
Skilletfish	<u>Gobiesox strumosus</u>
Southern flounder	<u>Paralichthys lethostigma</u>
Southern studfish	<u>Fundulus stellifer</u>
Spanish mackerel	<u>Scomberomorus maculatus</u>
Speckled worm eel	<u>Myrophis punctatus</u>
Spot	<u>Leiostomus xanthurus</u>
Spottail shiner	<u>Notropis hudsonius</u>
Spotted seatrout	<u>Cynoscion nebulosus</u>
Starhead topminnow	<u>Fundulus notti</u>
Striped bass	<u>Morone saxatilis</u>
Striped killifish	<u>Fundulus majalis</u>
Striped mullet	<u>Mugil cephalus</u>
Summer flounder	<u>Paralichthys dentatus</u>
Swamp darter	<u>Etheostoma fusiforme</u>
Swampfish	<u>Chologaster cornuta</u>
Tadpole madtom	<u>Noturus gyrinus</u>
Tessellated darter	<u>Etheostoma olmstedii</u>
Threadfin shad	<u>Dorosoma petenense</u>
Tidewater silverside	<u>Menidia peninsulae</u>
Warmouth	<u>Lepomis gulosus</u>
Weakfish	<u>Cynoscion regalis</u>
White catfish	<u>Ictalurus catus</u>
White perch	<u>Morone americana</u>
Yellow bullhead	<u>Ictalurus natalis</u>
Yellow perch	<u>Perca flavescens</u>

## REPTILES AND AMPHIBIANS

American alligator	<u>Alligator mississippiensis</u>
Banded water snake	<u>Nerodia fasciata fasciata</u>
Barking treefrog	<u>Hyla gratiosa</u>
Racer	<u>Coluber constrictor</u>
Marbled salamander	<u>Ambystoma opacum</u>



Northern fence lizard  
undulatushyacinthinus  
 Northern redbelly snake

Northern scarlet snake  
 Northern spring peeper  
 Northern water snake  
 Oak toad  
 Pickerel frog  
 Pine woods snake  
 Pine woods treefrog  
 Rainbow snake  
erytrogramma

Redback salamander  
 Redbelly turtle

Redbelly water snake

Red-spotted newt

Rough earth snake  
 Rough green snake  
 Scarlet kingsnake

Six-lined racerunner

Slimy salamander

Southeastern five-lined skink  
 Southern cricket frog  
 Southern leopard frog  
 Southern ringneck snake

Southern toad  
 Spotted turtle  
 Squirrel treefrog  
 Stinkpot  
 Timber rattlesnake  
 Two-toed amphiuma  
 Yellowbelly slider

### Sceloporus

Storepria occopitomaculata  
occopitomaculata

Cemophora coccinea copei

Hyla crucifer crucifer

Nerodia sipedon sipedon

Bufo quercicus

Rana palustris

Rhadinaea flavilata

Hyal femoralis

Farancia erytrogramma

Plethodon cinereus

Pseudemys rubriventris  
rubriventris

Nerodai erythrogaster  
erthrogaster

Notophthalmus viridescens  
viridescens

Virginia striatula

Opheodrys aestivus

Lampropeltis triangulum  
elapsoides

Cnemidophorus sexlineatus  
sexlineatus

Plethodon glutinosus  
glutinosus

Eumeces inexpectatus

Acris gryllus gryllus

Rana sphenocephala

Diadophis punctatus  
punctatus

Bufo terrestris

Clemmys guttata

Hyal squirella

Sternotherus odoratus

Crotalus horridus

Amphiuma means

Pseudemys scripta scripta

### BIRDS

Acadian flycatcher  
 American bittern  
 Black duck  
 American coot  
 American crow  
 American goldfinch  
 Flamingo  
 Routh-winged swallow  
 Northern saw-whet owl  
 Northern shoveler

Empidonax virescens

Botaurus lentiginosus

Anas rubripes

Fulica americana

Corvus brachyrhynchos

Spinus tristis

Phoenicopterus ruber

Stelgidopteryx ruficollis

Aegolius acadicus

Anas clypeata

Orange-crowned warbler	<u>Vermivora celata</u>
Orchard oriole	<u>Icterus spurius</u>
Osprey	<u>Pandion haliaetus</u>
Ovenbird	<u>Seiurus aurocapillus</u>
Palm warbler	<u>Dendroica palmarum</u>
Pied-billed grebe	<u>Podilymbus podiceps</u>
Pileated woodpecker	<u>Dryocopus pileatus</u>
Pine siskin	<u>Spinus pinus</u>
Pine warbler	<u>Dendroica pinus</u>
Prairier warbler	<u>Dendroica discolor</u>
Prothonotary warbler	<u>Protonotaria citrea</u>
Purple martin	<u>Progne subis</u>
Red-bellied woodpecker	<u>Melanerpes carolinus</u>
Red-breasted merganser	<u>Mergus serrator</u>
Red-breasted nuthatch	<u>Sitta canadensis</u>
Red-cockaded woodpecker	<u>Picoides borealis</u>
Red-eyed vireo	<u>Vireo olivaceus</u>
Redhead	<u>Aythya americana</u>
Red-headed woodpecker	<u>Melanerpes erythrocephalus</u>
Red-shouldered hawk	<u>Buteo lineatus</u>
Red-tailed hawk	<u>Buteo jamaicensis</u>
Red-winged blackbird	<u>Agelaius phoeniceus</u>
Ring-billed gull	<u>Larus delawarensis</u>
Rock dove	<u>Columba livia</u>
Royal tern	<u>Thalasseus maximus</u>
Ruby-crowned kinglet	<u>Regulus calendula</u>
Ruby-throated hummingbird	<u>Archilochus colubris</u>
Ruddy duck	<u>Oxyura jamaicensis</u>
Rufous-sided towhee	<u>Pipilo erythrophthalmus</u>
Rusty blackbird	<u>Euphagus carolinus</u>
Savannah sparrow	<u>Passerculus sandwichensis</u>
Short-billed marsh wren	<u>Cistothorus platensis</u>
Snow goose	<u>Chen hyperborea</u>
Solitary sandpiper	<u>Tringa solitaria</u>
Solitary vireo	<u>Vireo solitarius</u>
Song sparrow	<u>Melospiza melodia</u>
Summer tanager	<u>Piranga rubra</u>
Swainson's warbler	<u>Limnithlypis swainsonii</u>
Swamp sparrow	<u>Melospiza georgiana</u>
Tree swallow	<u>Iridoprocne bicolor</u>
Tufted titmouse	<u>Parus bicolor</u>
Whistling swan	<u>Olor columbianus</u>
Turkey vulture	<u>Cathartes aura</u>
Virginia rail	<u>Rallus limicola</u>
Whip-poor-will	<u>Caprimulgus vociferus</u>
White-breasted nuthatch	<u>Sitta carolinensis</u>
American kestrel	<u>Falco sparverius</u>
American redstart	<u>Setophaga ruticilla</u>
American robin	<u>Turdus migratorius</u>
American wigeon	<u>Mareca americana</u>
American woodcock	<u>Philohela minor</u>
Anhinga	<u>Anhinga anhinga</u>
Bald eagle	<u>Haliaeetus leucocephalus</u>

Beachman's sparrow	<u>Aimophila aestivalis</u>
Barn swallow	<u>Hirundo rustica</u>
Barred owl	<u>Strix varia</u>
Belted kingfisher	<u>Megasceryle alcyon</u>
Black-and-white warbler	<u>Mniotilta varia</u>
Black-crowned night-heron	<u>Nycticorax nycticorax</u>
Black rail	<u>Laterallus jamaicensis</u>
Black skimmer	<u>Rynchops niger</u>
Black-throated green warbler	<u>Dendroica virens</u>
Blue-gray gnatcatcher	<u>Polioptila caerulea</u>
Blue grosbeak	<u>Guiraca caerulea</u>
Blue Jay	<u>Cyanocitta cristata</u>
Blue-winged teal	<u>Anas discors</u>
Boar-tailed grackle	<u>Cassidix mexicanus</u>
Bobolink	<u>Dolichonyx oryzivorus</u>
Brown-headed cowbird	<u>Molothrus ater</u>
Brown-headed nuthatch	<u>Sitta pusilla</u>
Brown Thrasher	<u>Toxostoma rufum</u>
Bufflehead	<u>Bucephala albeola</u>
Canada goose	<u>Branta canadensis</u>
Canvasback	<u>Aythya valisineria</u>
Carolina chickadee	<u>Parus carolinensis</u>
Carolina wren	<u>Thryothorus ludovicianus</u>
Caspian tern	<u>Hydroprogne caspia</u>
Cattle egret	<u>Bubulcus ibis</u>
Cedar waxwing	<u>Bombycilla cedrorum</u>
Chimney swift	<u>Chaetura pelagica</u>
Chipping sparrow	<u>Spizella passerina</u>
Chuck-will's-widow	<u>Caprimulgus carolinensis</u>
Common goldeneye	<u>Bucephala clangula</u>
Common grackle	<u>Quiscalus quiscula</u>
Common merganser	<u>Mergus merganser</u>
Common gallinule	<u>Gallinula chloropus</u>
Common highhawk	<u>Chordeiles minor</u>
Common tern	<u>Sterna hirundo</u>
Yellowthroat	<u>Geothlypis trichas</u>
Cooper's hawk	<u>Accipiter cooperii</u>
Slate-colored junco	<u>Junco hyemalis</u>
Double-crested cormorant	<u>Phalacrocorax auritus</u>
Downey woodpecker	<u>Dendrocopos pubescens</u>
Eastern bluebird	<u>Sialia sialis</u>
Eastern kingbird	<u>Tyrannus tyrannus</u>
Eastern meadowlark	<u>Sturnella magna</u>
Eastern phoebe	<u>Sayornis phoebe</u>
Eastern screech owl	<u>Otus asio</u>
Eastern sparrow hawk	<u>Falco Sparverius sparverius</u>
Eastern wild turkey	<u>Meleagris gallopava</u>
<u>silverstris</u>	
Eastern wood-pewee	<u>Contopus virens</u>
European starling	<u>Sturnus vulgaris</u>
Evening grosbeak	<u>Hesperiphona vespertina</u>
Field sparrow	<u>Spizella pusilla</u>
Fish crow	<u>Corvus ossifragus</u>

Fox sparrow	<u>Passerella iliaca</u>
Gadwall	<u>Anas strepera</u>
Golden-crowned kinglet	<u>Regulus satrapa</u>
Catbird	<u>Dumitella carolinensis</u>
Great black-backed gull	<u>Larus marinus</u>
Great blue heron	<u>Ardea herodias</u>
Great crested flycatcher	<u>Myiarchus crinitus</u>
Common egret	<u>Casmerodius albus</u>
Great horned owl	<u>Bubo virginianus</u>
Greater Scaup	<u>Aythya marila</u>
Green heron	<u>Butorides virescens</u>
Green-winged teal	<u>Anas crecca</u>
Gull-billed tern	<u>Gelochelidon nilotica</u>
Hairy woodpecker	<u>Dendrocopos villosus</u>
Hermit thrust	<u>Hylocichla guttata</u>
Herring gull	<u>Larus argentatus</u>
Hooded merganser	<u>Lophodytes cucullatus</u>
Hooded warbler	<u>Wilsonia citrina</u>
Horned lark	<u>Eremophila alpestris</u>
House sparrow	<u>Passer domesticus</u>
House wren	<u>Troglodytes aedon</u>
Indigo bunting	<u>Passerina cyanea</u>
Kentucky warbler	<u>Oporornis formosus</u>
Killdeer	<u>Charadrius vociferus</u>
King rail	<u>Rallus elegans</u>
Laughing gull	<u>Larus atricilla</u>
Least bittern	<u>Ixobrychus exilis</u>
Least tern	<u>Sterna albitrons</u>
Lesser scaup	<u>Aythya affinis</u>
Louisiana waterthrush	<u>Seiurus motacilla</u>
Mallard	<u>Anas platyrhynchos</u>
Long-billed marsh wren	<u>Telmatodytes palustris</u>
Mourning dove	<u>Zenaida macroura</u>
Northern bobwhite	<u>Colinus virginianus</u>
Cardinal	<u>Richmondia cardinalis</u>
Northern flicker	<u>Colaptes auratus</u>
Marsh hawk	<u>Circus cyaneus</u>
Mockingbird	<u>Nimus polyglottos</u>
Parula warbler	<u>Parula americana</u>
Northern pintail	<u>Anas acuta</u>
White-eyed vireo	<u>Vireo griseus</u>
White-throated sparrow	<u>Zonotrichia albicollis</u>
Wood duck	<u>Aix sponsa</u>
Worm-eating warbler	<u>Helminthos vermivorus</u>
Yellow-bellied sapsucker	<u>Sphyrapicus varius</u>
Yellow-billed cuckoo	<u>Coccyzus americanus</u>
Yellow-breasted chat	<u>Icteria virens</u>
Myrtle warbler	<u>Dendroica coronata</u>
Yellow-throated warbler	<u>Dendroica dominica</u>
Yellow warbler	<u>Dendroica petechia</u>

## MAMMALS

Beaver	<u>Castor canadensis</u>
Big brown bat	<u>Eptesicus fuscus</u>
Black bear	<u>Ursus americanus</u>
Black rat	<u>Rattus rattus</u>
Bobcat	<u>Lynx rufus</u>
Cotton mouse	<u>Peromyscus gossypinus</u>
Eastern big-eared bat	<u>Plecotus rafinesqueii</u>
Eastern cottontail	<u>Sylvilagus floridanus</u>
Eastern fox squirrel	<u>Sciurus niger</u>
Eastern gray squirrel	<u>Sciurus carolinensis</u>
Eastern harvest mouse	<u>Reithrodontomys humulis</u>
Eastern mole	<u>Scalopus aquaticus</u>
Eastern pipistrelle	<u>Pipistrellus subflavus</u>
Evening bat	<u>Nycticeius humeralis</u>
Golden mouse	<u>Peromyscus nuttalli</u>
Gray fox	<u>Urocyon cinereoargenteus</u>
Hispid cotton rat	<u>Sigmodon hispidus</u>
Hoary bat	<u>Lasiurus cinereus</u>
House mouse	<u>Mus musculus</u>
Kenn's myotis	<u>Myotis keenii</u>
Least shrew	<u>Cryptotis parva</u>
Little brown myotis	<u>Myotis lucifugus</u>
Long-tailed weasel	<u>Mustela frenata</u>
Marsh rabbit	<u>Sylvilagus palustris</u>
Marsh rice rat	<u>Oryzomys palustris</u>
Meadow jumping mouse	<u>Zapus hudsonius</u>
Meadow vole	<u>Microtus pennsylvanicus</u>
Mink	<u>Mustela vison</u>
Muskrat	<u>Ondatra zibethicus</u>
Eastern yellow bat	<u>Lasiurus intermedius</u>
Norway rat	<u>Rattus norvegicus</u>
Nutria	<u>Myocastor coypus</u>
Opossum	<u>Didelphis marsupialis</u>
Raccoon	<u>Procyon lotor</u>
Red bat	<u>Lasiurus borealis</u>
Red fox	<u>Vulpes vulpes</u>
River otter	<u>Lutra canadensis</u>
Seminole bat	<u>Lasiurus seminolus</u>
Short-tailed shrew	<u>Blarina brevicauda</u>
Silver-haired bat	<u>Lasionycteris noctivagans</u>
Southeastern shrew	<u>Sorex longirostris</u>
Southern bog lemming	<u>Synaptomys cooperi</u>
Southern flying squirrel	<u>Glaucomys volans</u>
Star-nosed mole	<u>Condylura cristata</u>
Striped skunk	<u>Mephitis mephitis</u>
White-footed mouse	<u>Peromyscus leucopus</u>
White-tailed deer	<u>Odocoileus virginianus</u>
Pine vole	<u>Microtus pinetorum</u>

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<sup>a</sup>Sources for this list are: Coastal Zone Resources Corporation (1976), Allen et al. (1979), Potter (1982), and U. S. Fish and Wildlife Service (in prep.). Nomenclature in all animal lists follows Robins et al. (1980), fish: Collins et al. (1982), amphibians and reptiles: American Ornithologists' Union (1981), birds; Jones et al. (1979), Mammals.

TABLE 4  
 TERRESTRIAL VERTEBRATES OF POCOSINS AND RELATED  
 FRESHWATER WETLANDS THAT ARE ENDANGERED  
 OR OF SPECIAL CONCERN<sup>a</sup>

<u>Common Name</u>	<u>Scientific Name</u>
Alligator*	<u>Alligator mississippiensis</u>
American black duck	<u>Anas rubripes</u>
Anhinga	<u>Anhinga anhinga</u>
Bald eagle	<u>Haliaeetus leucocephalus</u>
Beaver	<u>Castor canadensis</u>
Black-and-white warbler	<u>Minotilta varia</u>
Black bear	<u>Ursus americanus</u>
Black-throated green warbler	<u>Dendroica virens</u>
Carolina gopher frog	<u>Rana areolata capito</u>
Dismal Swamp meadow vole	<u>Microtus pennsylvanicus</u> <u>nigrans</u>
Double-crested cormorant	<u>Phalacrocorax auritus</u>
Eastern diamondback rattlesnake	<u>Crotalus adamanteus</u>
Least bittern	<u>Ixobrychus exilis</u>
Osprey	<u>Pandion haliaetus</u>
Prothonotary warbler	<u>Protonotaria citrea</u>
Red-cockaded woodpecker	<u>Dendrocopos borealis</u>
Red-shouldered hawk	<u>Buteo lineatus</u>
Swainson's warbler	<u>Limnithlypis swainsonii</u>
Worm-eating warbler	<u>Helmitheros vermivorus</u>

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<sup>a</sup> Species that are marked with an asterisk receive Federal protection under the Endangered Species Act of 1973. All other species are listed in Cooper et al. (1977).

TABLE 5  
 GAME SPECIES INDIGENOUS TO POCOSINS  
 OR RELATED FRESHWATER  
 WETLANDS

<u>Common Name</u>	<u>Scientific Name</u>
American woodcock	<u>Philohela minor</u>
Black bear	<u>Ursus americanus</u>
Beaver	<u>Castor canadensis</u>
Bobcat	<u>Lynx rufus</u>
Clapper rail	<u>Rallus longirostris</u>
Gray fox	<u>Urocyon cinereoargenteus</u>
Longtail weasel	<u>Mustela frenata</u>
Marsh rabbit	<u>Sylvilagus palustris</u>
Mink	<u>Mustela vison</u>
Muskrat	<u>Ondatra zibethicus</u>
Opossum	<u>Didelphis marsupialis</u>
Raccoon	<u>Procyon lotor</u>
River otter	<u>Lutra canadensis</u>
Waterfowl	<u>Anatidae</u>







	Upland Game Birds					Fur & Game Animals					Water Birds					Marsh & Shorebirds					Songbirds																	
	Ruffed Grouse	Bobwhite Quail	Wild Turkey	American Woodcock	Mourning Dove	Deer	Black Bear	Raccoon	Eastern Gray Squirrel	Cottontail Rabbit	Canada Goose	Mallard	Gadwall	Baldpate	Greenwing Teal	Wood Duck	Clapper Rail	Virginia Rail	Yellow Rail	Purple Gallinule	Wilson Snipe	Yellow-Bellied Sapsucker	Hairy Woodpecker	Eastern Kingbird	Eastern Phoebe	Common Crow	White-Breasted Nuthatch	Mockingbird	Catbird	Brown Thrasher	Eastern Bluebird	Pine Warbler	Eastern Meadowlark	Redwing blackbird	Cardinal	Eastern Towhee	Field Sparrow	
Ferns	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fescue	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bluegrass	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass	-	1	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Paspalums	-	2	1	-	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	
Panicgrasses	-	1	1	1	2	-	-	-	-	1	1	1	2	4	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	1	1	4	2	3	-	-	
Bristlegrasses	-	1	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	2	4	4	-	-	-	
Broomsedge	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sedges	1	-	1	1	-	2	1	-	1	-	-	-	-	-	-	-	1	1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	
Sheepsorrel & Dock	2	1	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Knotweed	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pokeweed	1	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	3	2	1	2	-	-	-	1	-	-	
Chickweed	-	1	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buttercups	-	-	2	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strawberries	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Partridgepeas	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clovers	1	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beggarweeds	1	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lespedezas	1	5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vetches	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Woodsorrels	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Doveweeds (crotons)	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	
Spurges	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nightshades	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plaintains	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	
Poorjoe	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goldenrods	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ragweed	-	3	1	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	
Sunflowers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spanishneedles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wild lettuce	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Marsh and Aquatic Plants	Upland Game Birds		Water Birds														Marsh and Shorebirds					Songbirds						
	Wild Turkey	Mourning Dove	Whistling Swan	Canada Goose	Brant	Snow Goose	Mallard	Black Duck	Gadwall	Baldpate	Pintail	Greenwing Teal	Wood Duck	Redhead	Canvasback	Lesser Scaup Duck	Ruddy Duck	Common Coot	King Rail	Clapper Rail	Virginia Rail	Yellow Rail	Purple Gallinule	Wilson Snipe	Redwing Blackbird	Cardinal	Slate-colored Junco	
Algae	-	-	-	-	6	-	-	3	3	1	-	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-
Muskgrasses	-	-	1	-	-	-	-	-	-	2	3	1	2	1	1	2	2	4	-	-	-	-	-	-	-	-	-	-
Burreeds	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eelgrass	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pondweeds	-	-	4	-	-	3	4	2	3	2	2	-	4	-	2	4	3	1	-	-	-	-	-	1	-	-	-	-
Wigeongrass	-	-	-	4	4	-	2	3	4	4	3	1	-	4	1	4	2	4	1	-	-	-	1	-	-	-	-	-
Horned Pondweed	-	-	-	-	-	1	-	-	2	1	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Naiads	-	-	-	1	-	2	3	3	3	1	-	-	2	1	-	2	3	1	-	-	-	-	-	-	-	-	-	-
Arrowheads	-	-	3	-	-	2	-	3	-	2	-	-	-	4	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Wild Celery	-	-	4	-	-	-	1	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Saltgrasses	-	-	-	1	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Cordgrasses	-	-	-	5	1	4	1	2	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-
Rice Cutgrass	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wild Rice	-	-	-	-	2	1	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wild Millets	-	1	-	1	-	3	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Chufa	2	-	-	1	-	2	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Bullrushes	-	-	1	1	-	3	2	4	3	3	4	-	1	4	1	3	1	1	1	1	1	1	-	2	-	-	-	-
Spikerushes	-	-	3	4	-	3	3	1	1	1	1	-	1	-	-	-	2	2	-	1	1	2	1	-	-	-	-	-
Sawgrass	-	-	-	-	-	1	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
Duckweed	-	-	-	-	-	2	-	-	-	3	3	2	-	-	-	-	5	-	-	-	-	-	3	-	-	-	-	-
Smartweed	-	-	3	-	-	3	3	-	-	-	-	1	-	-	2	1	-	1	1	1	1	3	-	1	2	1	2	-
Glasswort	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Watershield	-	-	-	-	-	1	-	-	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Waterlilies	-	-	-	-	-	-	-	-	-	1	-	-	3	3	4	2	-	-	-	-	-	-	1	-	-	-	-	-
Cowlilies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Coontail	-	-	-	-	-	2	-	3	1	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Watermilfoils	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note 1 - Interpretation of the numerical rating system is as follows:

- 1 = Comprises 1/2 to 2 percent of the diet
- 2 = Comprises 2 to 5 percent of the diet
- 3 = Comprises 5 to 10 percent of the diet
- 4 = Comprises 10 to 25 percent of the diet
- 5 = Comprises 25 to 50 percent of the diet
- 6 = Comprises 50 percent or more of the diet

Note 2 - The plant list is not intended to be all-inclusive of the plants utilized by wildlife in North Carolina. It does, however, provide a listing of those plants most commonly used.

APPENDIX C. COOPERATIVE AGREEMENTS

1. USDA FOREST SERVICE . . . . .	C-1
2. NORTH CAROLINA FOREST SERVICE . . . . .	C-5
3. ONSLOW SOIL AND WATER CONSERVATION DISTRICT . . . . .	C-8
4. DEPARTMENT OF INTERIOR, US FISH AND WILDLIFE SERVICE AND NORTH CAROLINA WILDLIFE RESOURCES COMMISSION . . . . .	C-9

ATTACHMENT I  
MUTUAL FIRE FIGHTING ASSISTANCE AGREEMENT

This Agreement, made and entered into, by and between the U. S. Department of Agriculture-Forest Service, (National Forests in North Carolina) hereinafter referred to as the Forest Service, and the Commanding General, Marine Corps Base, Camp Lejeune, North Carolina, hereinafter referred to as the Commanding General, will become effective on the date the Support Agreement (block 14, 14a., and 14b. of the DD Form 1144) is approved by the Forest Service.

WITNESSETH;

WHEREAS, each of the parties hereto maintains equipment and personnel for the suppression of fires within its own jurisdiction and areas, and

WHEREAS, the parties hereto desire to augment the fire protection available in their various establishment, districts, agencies and municipalities in the event of large fires or conflagrations, and

WHEREAS, the lands or districts of the parties hereto are adjacent or contiguous so that mutual assistance in fire emergency is deemed feasible, and

WHEREAS, it is the policy of the U. S. Marine Corps and of the municipalities or other districts and of their governing bodies to conclude such agreements wherever practicable, and

WHEREAS, it is mutually deemed sound, desirable, practicable, and beneficial for the parties to this Agreement to render assistance to one another in accordance with these terms;

## THEREFORE BE IT AGREED THAT:

1. Upon request of the designated official of the Forest Service, the Commanding General will furnish such fire fighting service to the extent deemed available at the time of the fire, for the purpose of assisting the Forest service in combating fires occurring within the latter's fire protection district.
  - a. The following officials of the Forest Service are hereby designated to request fire fighting assistance from the Commanding General:  
District Ranger or Acting District Ranger, Croatan National Forest
  - b. Request for assistance will be made to the Camp Lejeune Fire Dispatcher (Phone: 541-3333)
2. Upon request of the Commanding General or his designated representative, the Forest Service will furnish such fire fighting service, to the extent they deem available at the time of the fire, for the purpose of assisting the Camp Lejeune Fire Protection Division in combating fires occurring on the Marine Corps Base.
  - a. The following officials are designated representatives of the Commanding General to request fire fighting assistance from the Forest Service:  
Chief of Staff, Marine Corps Base  
Fire Chief, Marine Corps Base  
Command Duty Officer, Marine Corps Base

- b. Request for assistance will be made to the District Ranger, Croatan National Forest (Phone 638-5628)
3. Upon arrival at the scene of the fire, assisting personnel and equipment shall report to the technical head of the Fire Department furnishing assistance to assume command, he shall not, by relinquishing command, be relieved of his responsibility for the operation; provided that the apparatus, personnel and equipment of the agency rendering assistance shall be under the immediate responsibility of the senior officer of the fire department rendering assistance.
  4. The rendering of assistance under the terms of the Agreement shall not be mandatory, but the party receiving the request for assistance should immediately inform the requesting service, if, for any reason, assistance cannot be rendered.
  5. Services rendered under the terms of this Agreement shall be rendered without reimbursement of either party therefore.
  6. Each party to this Agreement hereby expressly waives all claims against the other party or parties for compensation for any loss, damage, personal injury, or death occurring in consequence of the performance of this Agreement.
  7. The Chief Fire Officer and personnel of the fire department of both parties to this Agreement are invited and encouraged, on a reciprocal basis, to frequently visit each other's activities for guided familiarization tours consistent with local security requirements and, as feasible, to jointly conduct pre-fire planning inspections and drills.



8. The technical heads of the fire departments of the parties to this Agreement are authorized and directed to meet and draft any detailed plans and procedures of operation necessary to effectively implement this Agreement. Such plans and procedures of operations shall become effective upon ratification by the signatory parties.
9. The terms of this Agreement will abrogate all previous agreements between the parties hereto with respect to the subject matter contained herein and will remain in effect until such time as either of the parties shall notify, in writing, the other party of an intention to rescind the agreement.

Raleigh 27611

ROBERT W. SCOTT  
GOVERNOR

A. BRADSHAW, JR.

1972

Office of Forest Resources

RALPH C. WINKWORTH, DIRECTOR  
TELEPHONE 829-4141

November 20, 1972

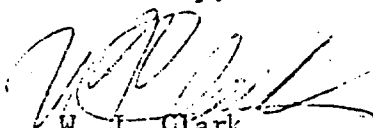
Commanding General  
Attention: J. F. Mader  
Colonel, U. S. Marine Corps  
Assistant Chief of Staff, Facilities  
United States Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Re: 4C/RLB/mkc P-11320/4 dated 31 October 1972

Dear Colonel Mader:

Enclosed is the executed original copy of the Mutual Fire Fighting Assistance Agreement between Marine Corps Base, Camp Lejeune, North Carolina, and the North Carolina Forest Service.

Sincerely,



W. J. Clark  
Staff Forester, Plans

WJC:ljk

Enclosure

This Agreement, made and entered into this 22 day of November, 1977, by and between the North Carolina Department of Natural and Economic Resources (State Forest Service) hereinafter referred to as the State Forest Service, and the Commanding General, Marine Corps Base, Camp Lejeune, North Carolina, hereinafter referred to as the Commanding General.

WITNESSETH :

WHEREAS, each of the parties hereto maintains equipment and personnel for the suppression of fires within its own jurisdiction and areas, and

WHEREAS, the parties hereto desire to augment the fire protection available in their various establishment, districts, agencies and municipalities in the event of large fires or conflagrations, and

WHEREAS, the lands or districts of the parties hereto are adjacent or contiguous so that mutual assistance in a fire emergency is deemed feasible, and

WHEREAS, it is the policy of the U. S. Marine Corps and of the municipalities or other districts and of their governing bodies to conclude such agreements wherever practicable, and

WHEREAS, it is mutually deemed sound, desirable, practicable, and beneficial for the parties to this Agreement to render assistance to one another in accordance with these terms;

THEREFORE BE IT AGREED THAT:

1. Upon request of the designated official of the State Forest Service, the Commanding General will furnish such fire fighting service, to the extent deemed available at the time of the fire, for the purpose of assisting the State Forest Service in combating fires occurring within the latter's fire protection district.

a. The following officials of State Forest Service are hereby designated to request fire fighting assistance from the Commanding General:

State Forest Director  
Onslow County Forest Ranger.

b. Requests for assistance will be made to the Camp Lejeune Fire Dispatcher (phone: 451-3004 or 451-5856).

2. Upon request of the Commanding General or his designated representative, the State Forest Service will furnish such fire fighting service, to the extent they deem available at the time of the fire, for the purpose of assisting the Camp Lejeune Fire Department in combating fires occurring on the Marine Corps Base.

a. The following officials are designated representatives of the Commanding General to request fire fighting assistance from the State Forest Service:

Chief of Staff, Marine Corps Base  
Fire Chief, Marine Corps Base  
Staff Duty Officer, Marine Corps Base.

b. Requests for assistance will be made to the Onslow County Forest Ranger (phone: 324-3431).

3. Upon arrival at the scene of the fire, assisting personnel and equipment shall report to the technical head of the Fire Department of the requesting party who shall assume full charge of the operations, but if he specifically requests a senior officer of a fire department furnishing assistance to assume command, he shall not, by relinquishing command, be relieved of his responsibility for the operation; provided that the

apparatus, personal and equipment of the agency rendering assistance shall be under the immediate responsibility of the senior officer of the fire department rendering assistance.

\*. The rendering of assistance under the terms of the Agreement shall not be mandatory, but the party receiving the request for assistance should immediately inform the requesting service if, for any reason, assistance cannot be rendered.

5. Services rendered under the terms of this Agreement shall be rendered without reimbursement of either party therefor.

6. Each party to this Agreement hereby expressly waives all claims against the other party or parties for compensation for any loss, damage, personal injury, or death occurring in consequence of the performance of this Agreement.

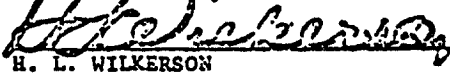
7. The Chief Fire Officer and personnel of the fire department of both parties to this Agreement are invited and encouraged, on a reciprocal basis, to frequently visit each other's activities for guided familiarization tours consistent with local security requirements and, as feasible, to jointly conduct pre-fire planning inspections and drills.

8. The technical heads of the fire departments of the parties to this Agreement are authorized and directed to meet and draft any detailed plans and procedures of operation necessary to effectively implement this Agreement. Such plans and procedures of operations shall become effective upon ratification by the signatory parties.

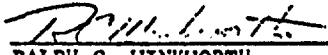
9. The terms of this Agreement will abrogate all previous agreements between the parties hereto with respect to the subject matter contained herein and will remain in effect until such time as either of the parties shall notify, in writing, the other party of an intention to rescind the agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement at Camp Lejeune, North Carolina, on the day and year first above written.

FOR MARINE CORPS BASE

  
H. L. WILKERSON  
Brigadier General, U. S. Marine Corps  
Commanding, Marine Corps Base  
Camp Lejeune, North Carolina

FOR NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES (STATE FOREST SERVICE)

  
RALPH C. WINKWORTH  
State Forest Director  
North Carolina Department of Natural and  
Economic Resources (State Forest Service)  
Raleigh, North Carolina

# CONSERVATION APPLICATION AND AGREEMENT

*Between*

Onslow Soil and Water Conservation District, Onslow County

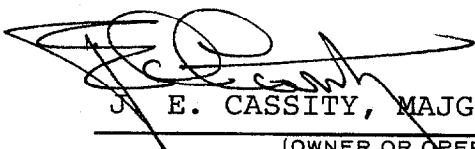
*And*

Marine Corps Base Camp Lejeune, N.C. 111,336  
(OWNER OR OPERATOR) (ADDRESS) (AGREEMENT NUMBER) (ACRES)

I request help from my Soil and Water Conservation District in developing a soil and water conservation plan for my land. I intend to use my land within its capabilities and treat it according to its needs, and will cooperate in making the land use adjustments and in applying and maintaining the conservation practices that I plan. I will use any materials furnished by the District as indicated in my conservation plan.

We, the Supervisors of the District, will furnish technical assistance, materials and supplies as available to help plan, apply, and maintain the needed soil and water conservation measures.

It is mutually agreed that: (1) Neither the District, its representatives, nor the owner or operator will be liable for any damage to the other's property or personal injury resulting from the planning or carrying out of the soil and water conservation plan, unless such damages are caused by negligence or misconduct. (2) This agreement will remain in effect until terminated by change of ownership or operator or by either party giving sixty (60) days written notice to the other.



J. E. CASSITY, MAJGEN USMC, Commanding  
(OWNER OR OPERATOR)

18 Jun 87

(DATE)

ONSLOW

SOIL AND WATER CONSERVATION DISTRICT

BY Rames W Caraway  
(SUPERVISOR)

June 29 1987  
(DATE)

COOPERATIVE MANAGEMENT PLAN  
CONSERVATION OF FISH AND WILDLIFE RESOURCES  
U.S. MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

1. PURPOSE. To provide a cooperative fish and wildlife management plan through a tripartite agreement between the Department of Defense, State of North Carolina, and the Department of the Interior for the conservation and development of fish and wildlife resources on the Camp Lejeune complex.

2. AUTHORITY. In accordance with the authority contained in Title 10, U.S. Code, Section 2671, and Title 16, U.S. Code, Section 670, the Department of Defense, the Department of Interior, and the State of North Carolina, through their duly designated representatives whose signatures appear below, approve the following cooperative management plan for the protection, development, and management of fish and wildlife resources at Camp Lejeune.

3. LIMITATIONS. This agreement covers Marine Corps Base lands for the management of fish, game, nongame, endangered and threatened species only. The military mission at Camp Lejeune supersedes fish and wildlife management and associated recreational activities, and such activities must in all instances be compatible with the military mission. However, where there is conflict between the military mission and the provisions of the Endangered Species Act or other applicable statutes, such conflicts will be resolved by statutory requirements.

4. FISH AND WILDLIFE INVENTORY. As specified by the Real Property Facilities Manual, Volume V, a multi-resource inventory of vegetative profiles of fish and wildlife habitat has been completed. The inventory was conducted through contractual procedures with the U.S. Forest Service, Asheville, North Carolina. The inventory will be used for the next 10 years in the management of vegetative communities for producing sustained populations of wildlife and forest products. A list of the present plant and animal species occurring at Camp Lejeune will be included in the updated wildlife management plan being completed in cooperation with the U.S. Soil Conservation Service.

5. WILDLIFE MANAGEMENT PLAN. The long-range wildlife management plan is currently being updated and when completed will be in effect for the next 10 years. Development of the plan is being accomplished with assistance through the U.S. Soil Conservation Service Office in Raleigh, North Carolina. This plan will provide long-range guidance for implementation of the program that will be compatible with the military mission. The following will be specifically addressed:

a. Long-range plan of work for fish and wildlife habitat development and maintenance.

b. Integration of fish and wildlife management practices with forestry, outdoor recreation, and other natural resources management work.

c. Development and preservation of wetland habitats where feasible, for waterfowl, other wildlife, and water quality.

d. Protection and management of existing fish and wildlife species.

e. Protection and preservation of endangered and threatened species and their respective habitats.

f. Improvement and enhancement of natural beauty associated with fish and wildlife management programs.

g. Additional recreational benefits for both installation personnel and the general public.

The plan will be attached to this agreement upon completion and approval.

#### 6. INTERAGENCY COOPERATION.

a. Law Enforcement: The enforcement of Base, State, and Federal Laws is the responsibility of the Base Game Warden under the cognizance of the Provost Marshal. Consistent with its primary objectives and responsibilities, the Fish and Wildlife Service will provide law enforcement assistance on a nonreimbursable basis when requested.

#### b. Technical Assistance:

(1) Wildlife Management. The participating agencies will provide technical assistance for the wildlife management program, with the understanding that the Fish and Wildlife Service may provide assistance only when the North Carolina Wildlife Resources Commission cannot accommodate the requested assistance. Subject to availability of funds and personnel, visits to Camp Lejeune will be made by personnel as requested or as necessary to maintain a sound wildlife program. Visiting personnel may provide advice and assistance on all aspects of wildlife management. It is understood, however, that wildlife assistance provided by the Fish and Wildlife Service shall be on a cost-reimbursable basis, except for the following:

(a) Activities required of the Service by the Endangered Species Act, in particular Section 7 consultations, or reviews associated with the National Environmental Policy Act and other Federal laws; and

(b) The coordination of assistance from the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, for the purpose of reducing animal damage control problems. The State ADC Director is located in Raleigh, North Carolina, and may be reached at (919)856-4132.

(2) Fish Management. The participating agencies will provide technical assistance on the fishery management program, with the understanding that the Fish and Wildlife Service may provide assistance only if the North Carolina Wildlife Resources Commission cannot accommodate the requested assistance. Subject to availability of funds and personnel, visits to Camp Lejeune will be made by personnel as requested or as necessary to maintain a sound fishery management program. Visiting personnel may provide advice and assistance in all phases of the program, to include inventory, renovation, stocking, weed control, and the manipulation of aquatic habitat as required. It is understood, however, that fisheries assistance and fish provided by the Fish and Wildlife Service shall be on a cost-reimbursable basis.

(3) Research and Development. Marine Corps Base, Camp Lejeune recognizes that continuing research and development in game and fish management are vital programs. It shall be the policy of the Commanding General, Marine Corps Base, Camp Lejeune to encourage and support research conducted by the participating agencies. To this end, suitable land areas, animals, facilities, and personnel may be made available at the Commanding General's discretion, when permitted by Department of the Navy regulations and requested by participating agencies, providing the proposed studies are compatible with and in no way limit accomplishment of the military training mission.

(4) Exotic Species. No exotic species of fish or wildlife shall be introduced on Camp Lejeune without prior written approval of the Marine Corps, North Carolina Wildlife Resources Commission, and the Fish and Wildlife Service.

(5) Periodic Meetings. Representatives of Camp Lejeune and the North Carolina Wildlife Resources Commission will meet as necessary to discuss, plan, update, and schedule management activities to enhance the fish and wildlife program. The Natural Resources and Environmental Affairs Division, Assistant Chief of Staff, Facilities Department, Marine Corps Base, Camp Lejeune, North Carolina 28542, (FTS 676-5003 or commercial (919) 451-2195) will be the office of contact with regard to the fish and wildlife program. When requested, the Fish and Wildlife Service shall provide limited participation in fish and wildlife management planning meetings on a nonreimbursable basis.

(6) Wild Turkey Restoration. It is the continuing policy of the Commanding General, Marine Corps Base to cooperate with the North Carolina Wildlife Resources Commission in the wild turkey restoration program in the State. Written requests for live trapping will be approved when excess birds are available relative to the population.

7. HARVESTING FISH AND WILDLIFE. All hunting, fishing, and trapping will be in accordance with Federal and State fish and wildlife laws. The general public will be allowed to participate



in the harvest of fish and game within manageable quotas, on a first-come, first-served basis. Civilians will be considered on an equal basis with military and civilian employees for permits and access to hunting and fishing areas when they are accompanied by a civilian or military host for reasons of safety. Hunting and fishing will be allowed only on those areas where there is no conflict with military training activities and no unreasonable safety hazard to participants, military personnel and dependents, or civilian employees. Certain areas will be closed to hunting and fishing permanently, including but not limited to impact areas containing unexploded ordnance, housing, industrial, ammunition, and storage areas. Such areas will be marked as permanently closed on the installation hunting maps. Training areas will be open on a daily basis when not scheduled for military training operations. All hunters must check in and check out on a daily basis when still or stalk hunting. When organized hunting for deer, the huntsmaster serves as host for hunters in the party. Installation hunting maps indicating open or closed areas will be posted and updated daily, or as required by the Game Warden.

8. PERMITS. An annual or daily permit will be required for all hunting, trapping, and fishing activities on the installation except for fishing in navigable waters. All persons hunting, trapping, or fishing on Marine Corps lands must also meet applicable licensing requirements of State laws and of the Migratory Bird Treaty Act, as amended. Annual or daily hunting permits will be issued by the Base Game Warden at Building PT-4. Permit holders must also meet the daily check-in/check-out requirements of self clearing daily passes. Each hunter receives two daily passes for his annual or daily permit when checking in to hunt, one of which must be placed on the dashboard of the vehicle and the other kept on the individual. When the hunter checks out, the daily passes are returned and the hunter's daily or annual permit is returned. Game harvested, recreational participation, and other pertinent information is recorded from each hunter.

9. FEES. There will be nominal fees charged for hunting, fishing, and trapping in support of fish and wildlife habitat development projects. Fees charges are as follows effective for the 1987-1988 hunting seasons:

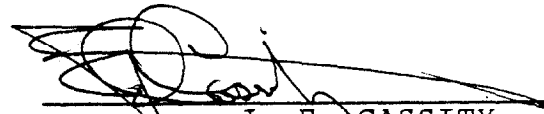
<u>TYPE</u>	<u>FEE</u>
Hunting-Fishing (military).....	\$15
Hunting-Fishing (civilian employee).....	15
Hunting-Fishing (civilian guest).....	15
Daily Hunting-Fishing (civilian guest).....	5
Fishing (military-civilian employee).....	5
Fishing (civilian guest).....	5
Daily hunting/fishing (military-civilian employee).....	5
Trapping (military-civilian employee).....	25

10. OFF-ROAD RECREATIONAL VEHICLES (ORRV'S). There will be no restrictions on the use of off-road vehicles for hunting, fishing and trapping with the following exception:

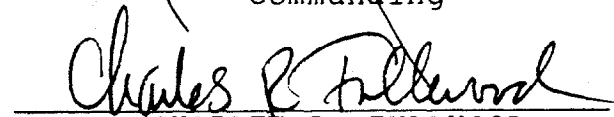
a. Saltwater fishermen may use ORRV's on the beach strand from the waters edge to the seaward side of the sand dunes from Riseley Pier to New River Inlet except during sea turtle nesting season. Onslow Beach is closed to ORRV travel from sunset to sunrise for protection of sea turtles from June - October. The main access road from the North Tower to the South Tower is open for use by fishermen during the nesting season and throughout the year. Riseley Pier and South Tower are the only two egress routes used to gain access to the beach strand. ORRV's are not permitted at any time to be on any portion of Onslow Beach north of Riseley Pier.

11. ADOPTION. This agreement will become effective upon the date subscribed by the last signature and shall continue in full force for a period of five years or until terminated by written notice to the other parties by any of the parties signing this agreement. This agreement may be amended or revised by agreement between the parties hereto. Action to amend or revise may originate with any one of the participating agencies.


DATE: 10/6/87

  
 J. E. CASSITY  
 Major General, USMC  
 Commanding

DATE: 2-26-87

  
 CHARLES R. FULLWOOD  
 Director  
 North Carolina Wildlife  
 Resources Commission

DATE: May 11, 1987

  
 JAMES W. PULLIAM, JR.  
 Regional Director  
 U.S. Fish and Wildlife Service  
 Region 4, Atlanta, GA

APPENDIX D. DIRECTIVES AND ORDERS

1. MARINE CORPS ORDER P1100.8 EXCERPTS	
A. LONG RANGE PLAN . . . . .	D-1
B. FOREST RESOURCE MANAGEMENT PLAN . . . . .	D-2
C. FISH AND WILDLIFE MANAGEMENT PLAN . . . . .	D-6
D. LANDSCAPING . . . . .	D-9
E. OUTDOOR RECREATION . . . . .	D-10
F. OTHER . . . . .	D-10
G. ADMINISTRATION OF ARCHEOLOGICAL/HISTORICAL RESOURCES . . . . .	D-13
H. SUBMISSION REQUIREMENTS . . . . .	D-12
2. OTHER ORDERS AND DIRECTIVES . . . . .	D-14

## A. LONG RANGE PLAN

The Multiple-Use Natural Resources Management Plan will identify the activity's natural resources and other environmental assets, as determined by the basic assessment, and establish the goals to be achieved under the program. The plan shall be based on detailed site investigations describing existing land and water resources, public domain land under Marine Corps control, potential for future development, existing and recommended land uses, existing vegetative cover and its condition (including landscape quality), applicable data on the capability and limitations of soils, and the assessment of the natural environment. The plan shall contain the management concept and operational requirements for the restoration, protection, scenic enhancement, beneficial use, and sustained yield of all resources. The plan should also identify staffing and funds required to carry out and support the program with a brief description of each organizational function and its relationship to the activity's program. The Multiple-Use Natural Resources Management Plan shall contain:

- a. General description of the activity, location, size, topography, and climate.
- b. Description of land and water areas identifying potential resources, military land use requirements, and secondary land use. Full agreement in future management operations under each of the resource disciplines should be made during the planning process.

- c. Suitable maps (aerial or current general development maps), identifying land classification, land use (including multiple-use), primary tidal and fresh water streams, woodlands, desert, beach, training field numbers, boundaries, and primary vegetative cover types.
- d. Routine and recurring grounds maintenance practices and routine agronomic and engineering practices to be included in construction, maintenance, repair, and activities necessary to protect land and water areas by correcting or treating erosion, runoff, sediment damage, vegetative cover, and landscape plant materials.
- e. A narrative description of intended accomplishments stated in terms of goals, objectives, and alternatives with target dates.
- f. Botanical listing of locally adaptable ground cover and landscape plants.
- g. A copy of cooperative agreements with assisting federal and state agencies.

Figure 2-2 is a graphic illustration showing the various stages of resources planning and the sequence for development of the Multiple-Use Natural Resources Management Plan.

#### B. FOREST RESOURCE MANAGEMENT PLAN

- a. Woodlands, which have been identified in the Multiple-Use Natural Resources Management Plan as suitable for the production of timber products, shall be managed in accordance with a Forest Resource Management Plan, prepared by the activity as herein prescribed and included in the

appendix of the Multiple-Use Natural Resources Management Plan. Forest management operations shall provide for the development and maintenance of a desirable balance in the forest community through the production of timber products and related natural resources values, such as natural beauty, watershed protection, wildlife enhancement, and outdoor recreation. Careful consideration shall be given to all multiple-use potentials, with particular consideration given to wildlife, military and public use of resources. In addition, the development of a comprehensive Forest Resource Management Program will require:

- (1) The accumulation of forest resource data necessary to support scientific management of the forest area.
- (2) The establishment of an allowable cut of merchantable timber on a periodic basis which will maintain a sustained yield and provide for the optimum utilization of timber resources as well as the reduction in mortality by fire, insects, and disease.
- (3) The timely application of woodland management practices that promote the favorable composition and growth of forests. Such practices shall provide for optimum utilization of timber resources; reduction in mortality by fire, insects, and disease; and timber products quality.
- (4) The inclusion of game enhancement practices is in conjunction with silviculture treatment. Treatment, such as fire lane seeding, establishment of small

- woodland openings, and edge development, shall be considered as woodland management practices.
- (5) Consideration of open space values and woodland recreational activities.
  - (6) The application of woodland management techniques and practices to protect the watershed.
  - (7) Use of harvesting or treatment specifications designed, as appropriate, to improve troop training areas, storage areas, shorelines, recreational areas, wildlife habitat, and watersheds.
  - (8) A fire protection plan to address organizational responsibility for fire danger prediction and presuppression and suppression operations. Normally, forest fire protection operations eligible for reimbursement will be restricted to the reduction of hazardous fuels, fire break construction, and limited fire lane construction and maintenance.
  - (9) Attainment of a sustained yield management program through scheduled treatment designed to achieve optimum use of timber markets and desirable composition of residual stands.
  - (10) Special treatment in buffer or maintained sites which preserves natural beauty values along scenic corridors, such as highways, railroads, shorelines, and built-up and recreational areas.
  - (11) Emergency harvesting to salvage timber which is infested by insects or plant disease, or the

modification of forest cover to meet changing requirements of the military mission.

(12) Management and control of firewood collection.

b. The activity's Forest Resource Management Plan shall be developed and implemented with the aid and assistance of federal or state forestry agencies, as appropriate. All forestry management operations and related funding requests shall be based on the Forest Resource Management Plan. The Forest Resource Management Plan shall be prepared based on a projected 10-year operational program and shall be reviewed and revised annually, as appropriate, with the assistance of a professional forester to update the plan and reflect the change in conditions. The Forest Resource Management Plan shall contain:

- (1) Forest stand-type map with merchantability and volume by stand, class, and age. This map shall also identify reserved woodland areas required for military operations.
- (2) Compartment map delineating manageable areas and acreage, and showing planned or existing access roads and fire lanes which shall be suitably numbered to correspond with a table on the map indicating linear feet of each.
- (3) Total and merchantable volumes.
- (4) Annual rate of growth based on the soil survey report.



- (5) Type of silvicultural systems needed to improve productivity for a projected 10-year period, by compartment.
  - (6) Timber harvest cutting schedule and estimated volumes to be removed over the 10-year period, by compartment and by year.
  - (7) Location and discussion of planned reforestation operations.
  - (8) Planned forest wildlife habitat management, including the introduction of plant variations and discussion of the impact of forestry operations on open land game, or wildlife habitat.
  - (9) Methods of implementing the plan.
- c. The activity commander, in accordance with MCO P11000.11, Chapter 9 and Appendix D thereto, may execute a cooperative agreement with the state forestry department for the exchange of assistance for forest fire suppression where not covered by an existing agreement. A copy of the agreement should be included in the management plan.

#### C. FISH AND WILDLIFE MANAGEMENT PLAN

Marine Corps activities having land and water resources suitable for development, conservation, management, and harvesting of fish and wildlife shall have an active and progressive management program and shall prepare a comprehensive Fish and Wildlife Management Plan to be included as an appendix to the Multiple-Use Natural Resources Management Plan. The suitability of resources for management

## G. ADMINISTRATION OF ARCHEOLOGICAL/HISTORICAL RESOURCES

Administration of archeological/historical resources will be accomplished in accordance with the applicable provisions of the current edition of MCO P5750.1 and the Archeological Resources Protection Act (Publ. L. No. 96-95).

## H. SUBMISSION REQUIREMENTS

### a. Activity's Long-Range Multiple-Use Natural Resources

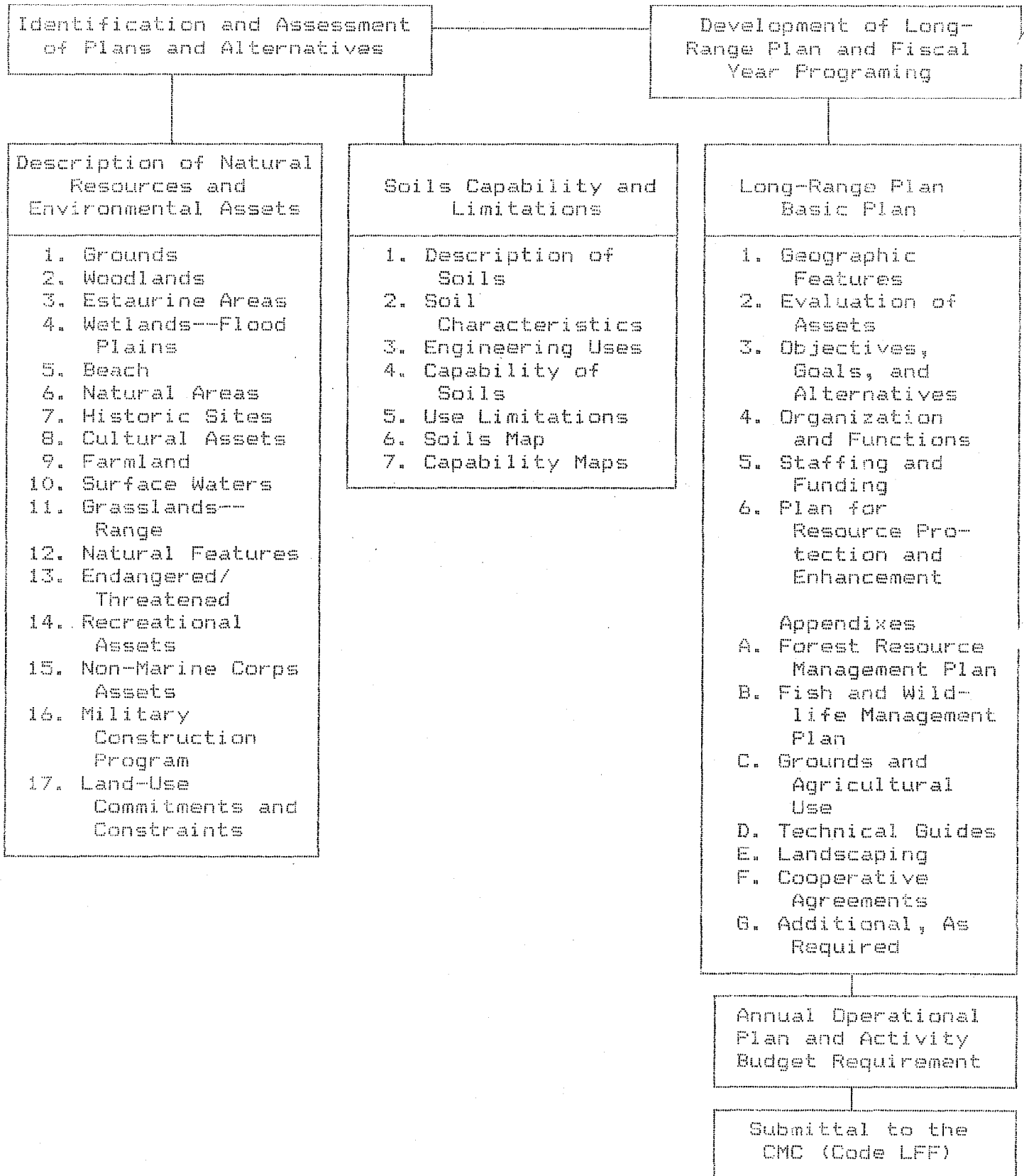
Management Plans are submitted to the CMC (Code LFF) in final draft prior to command approval. Plans received are reviewed or referred back to the activity for completion in accordance with the provisions of this Manual.

b. Activity commanders shall submit the completed plan to the CMC (Code LFF).

c. Approved activity plans shall be reviewed annually.

Proposed changes or modifications of the plan shall be submitted to the CMC (Code LFF), concurrently with the activity's Annual Operational Plan submission required by paragraph 2300, following.

Figure 2-2 Development of the Multiple-Use Natural Resources Management Plan



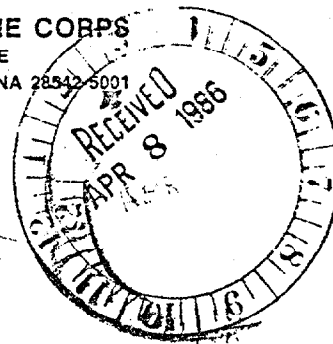


UNITED STATES MARINE CORPS  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA 28542-5001

D-13

FILE

BO 11015.6A  
RCTL/kae  
31 Mar 1986



BASE ORDER 11015.6A

From: Commanding General  
To: Distribution List

Subj: Red-Cockaded Woodpecker (*Picoides borealis*) Protection Program/Measures

Ref: (a) Public Law 93-205, Endangered Species Act of 1973 (NOTAL)  
(b) MCO 11015.4  
(c) BO 11015.3

Encl: (1) Map of Red-Cockaded Woodpecker Restricted Areas  
(2) Example of Tree Markings Depicting Contiguous Habitat Boundary and Colony Buffer Zone Boundary

1. Purpose. To set forth regulations and establish responsibilities to ensure the conservation of the red-cockaded woodpecker aboard Camp Lejeune.

2. Cancellation. Base Order 11015.6.

3. Background

a. The red-cockaded woodpecker is an endangered species listed in the Federal Register of Endangered Species and is present in Camp Lejeune locations as shown on enclosure (1).

b. In accordance with reference (a), it is unlawful for any person(s) subject to the jurisdiction of the United States to harass, harm, or capture any endangered species within the United States. Further, it is unlawful for any person(s) to violate any regulation promulgated for the protection of any such species.

c. The following actions violate reference (a) and guidelines concerning the red-cockaded woodpecker and its habitat:

(1) The use of any vehicle off designated trails in either the contiguous habitat of the red-cockaded woodpecker or the buffer zones is prohibited.

(2) The cutting or damaging of pine trees of any size within either the contiguous habitat or buffer zones is prohibited.

(3) Any excavating or digging which may damage the root structures of pine trees within either the contiguous habitat or buffer zones is prohibited.

(4) Bivouacking and the establishment of command posts is prohibited within the contiguous habitat or buffer zones.

(5) "Tree topping" of antennas, girdling of pine trees with comm wire, burying of assault cable, and the climbing of pine trees with tree gaffs are prohibited.

(6) The firing of artillery near buffer zones is prohibited.

(7) The removal or destruction of signs marking restricted area is prohibited.

d. References (b) and (c) promulgate Marine Corps and Marine Corps Base policy for the conservation of endangered and threatened species in compliance with reference (a).

4. Definitions of Terms

a. Cavity Tree - A tree containing one or more red-cockaded woodpecker cavities.

BO. 11015, 6A  
31 Mar 1986

b. Buffer Zone - Area extending 200 feet outward from each nesting/cavity tree. Examples of marking are shown on enclosure (2).

c. Contiguous Habitat - Contiguous acres of pine forest including the colony, support stands, breeding territory, seasonal foraging area or other definable units (approximately 100 contiguous acres).

5. Action. Commanders and officers-in-charge will ensure strict compliance with the following regulations:

a. Within the contiguous habitats of the red-cockaded woodpecker (marked by one white stripe painted on trees with signs stating "Restricted Area Endangered Species" and within the red-cockaded woodpecker colony buffer zone (marked by two white stripes painted on trees and signs depicting a woodpecker and stating "Endangered Species Buffer Zone" (enclosure (2)):

AUTHORIZED ACTIVITIES

(1) Use of wheeled or tracked vehicles on existing, well-defined, main roads/trails.

(2) Movement on foot.

(3) Blank small arms firing.

b. Weekly inspections will be conducted under the cognizance of the Base Training Facilities Officer and supported by a Natural Resources and Environmental Affairs Division representative to determine if violations have occurred and, if so, to report them to the Assistant Chief of Staff, Training and Operations.

c. Commanders will conduct a continuous education/information program to ensure all personnel are aware of the contents of this Order.

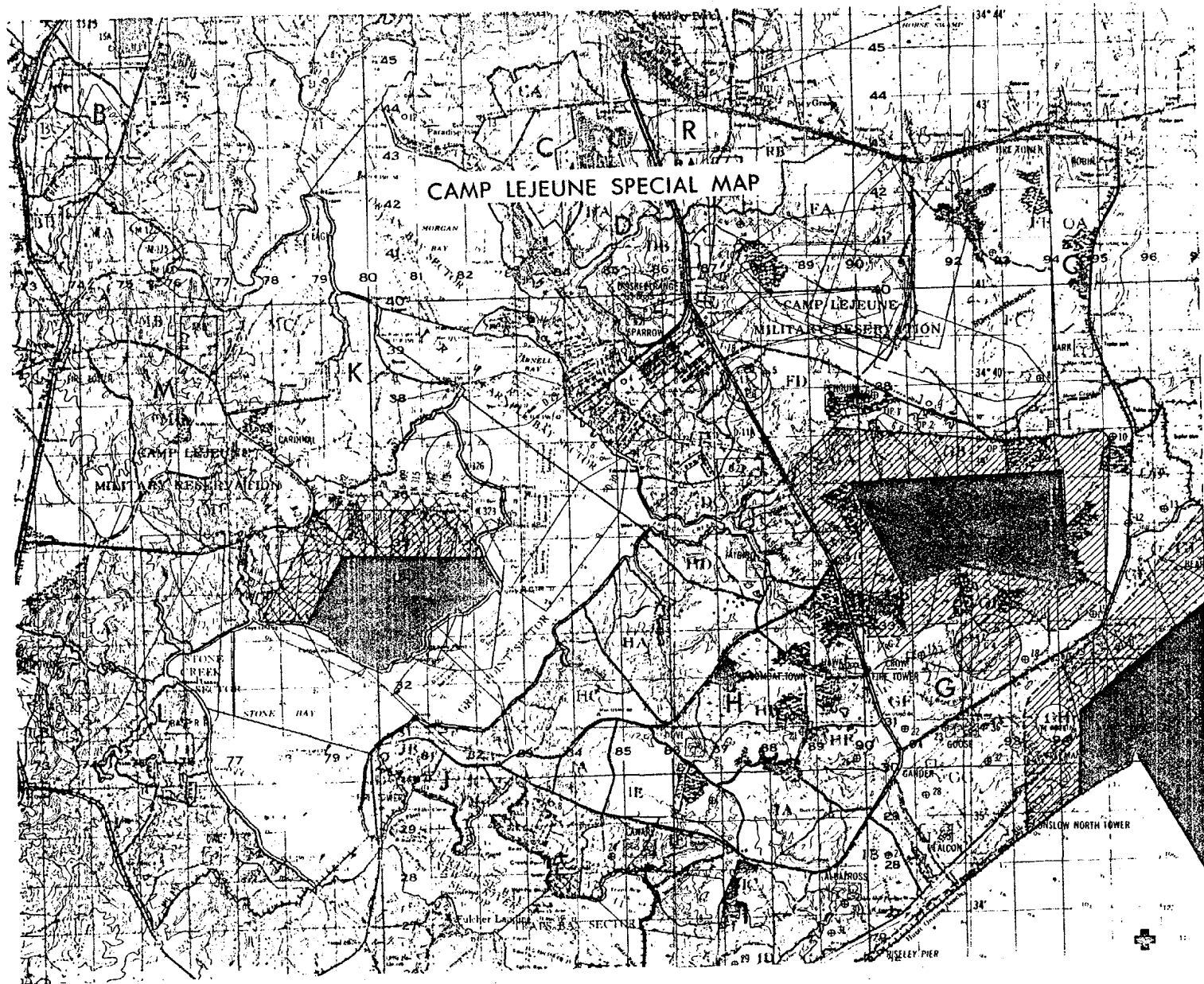
6. Violations. Violations of this Order that are observed or noted should be reported to Assistant Chief of Staff, Training and Operations, Marine Corps Base. In accordance with section II of reference (a), such violations are prosecutable under Article 92, Uniform Code of Military Justice, and reports of the violations will be forwarded to the appropriate commanding officer for disposition.

7. Notice. A copy of this Order shall be made available to commanding officers or officers-in-charge of units who use areas inhabited by the red-cockaded woodpecker. The contents of this Order shall also be made known to the military member using such areas.

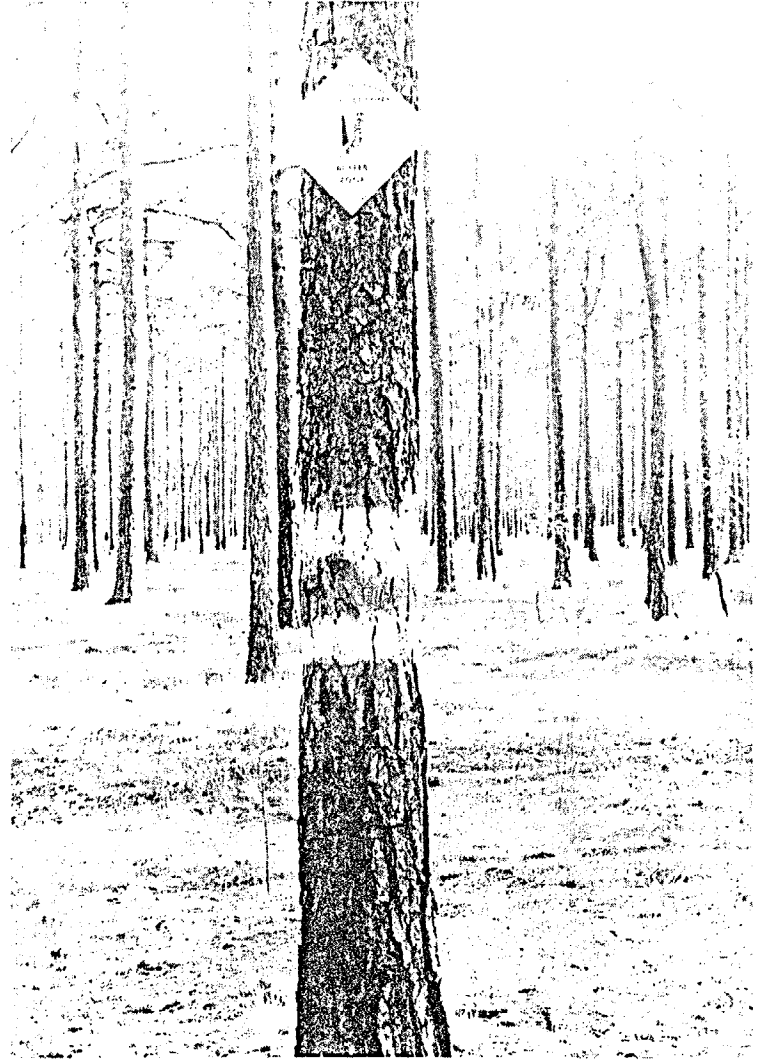
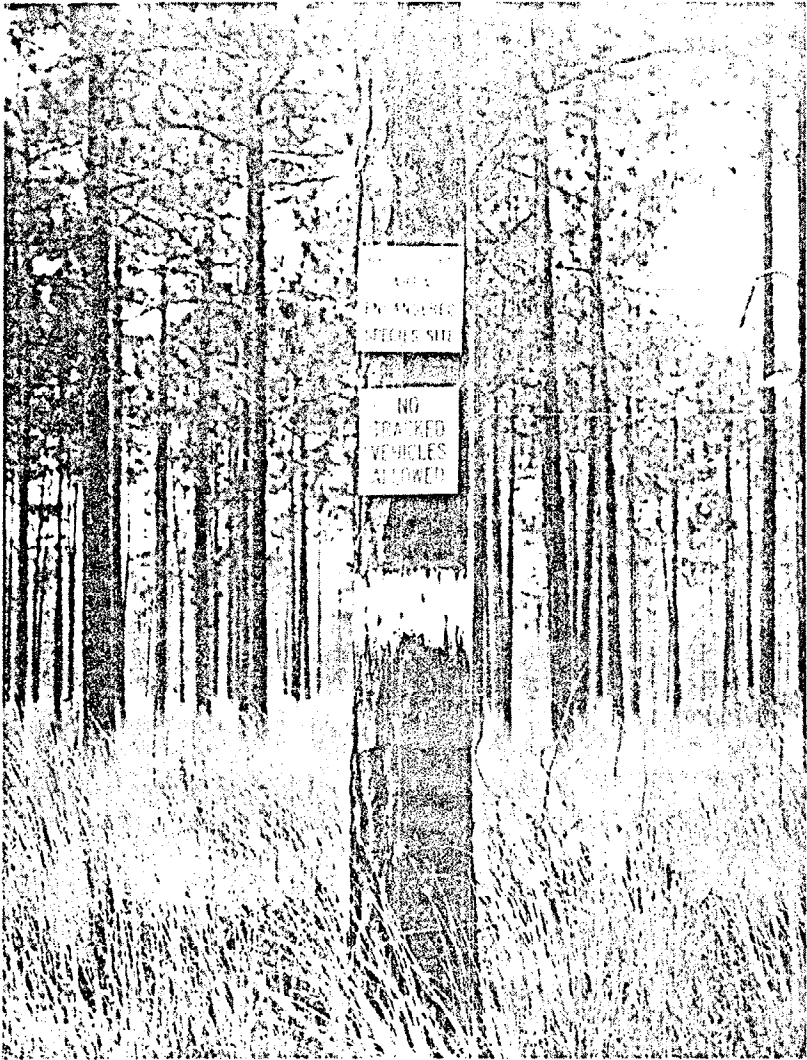
8. Concurrence. This Order has been coordinated with and concurred in by the Commanding Generals, II Marine Amphibious Force, 2d Marine Division, FMF, COMCABEAST, Cherry Point, 2d Force Service Support Group (Rein), FMF, 6th Marine Amphibious Brigade, FMF, and the Commanding Officer, Marine Corps Air Station, New River.

  
M. C. HARRINGTON  
Chief of Staff

DISTRIBUTION: A



D-15  
BO 11015.6A  
31 Mar 1986



BO 11015.6A  
31 Mar 1986

APPENDIX E. TECHNICAL GUIDE FOR SOIL AND WATER CONSERVATION AND  
GROUND MAINTENANCE

1. EROSION AND SEDIMENT CONTROL . . . . .	E-1
a. Critical Area Stabilization . . . . .	E-1
b. Temporary Cover For Construction Sites And Other Disturbed Areas . . . . .	E-9
c. Buffer Zones . . . . .	E-12
d. Grade Stabilization Structures . . . . .	E-14
e. Sediment Basins . . . . .	E-19
2. DRAINAGE . . . . .	E-21
a. Open Channels . . . . .	E-21
b. Subsurface Drains . . . . .	E-33
c. Surface Drains . . . . .	E-37
3. ROAD CONSTRUCTION AND MAINTENANCE . . . . .	E-41
4. RIVERSHORE STABILIZATION . . . . .	E-45
5. DUNE STABILIZATION WITH GRASSES . . . . .	E-57
6. STANDARDS AND SPECIFICATIONS . . . . .	E-61
a. Establishing and Maintaining Lawn Grasses . . . . .	E-61
b. Using Shrubs in the Landscape . . . . .	E-73
c. Flowering Annuals . . . . .	E-90
d. Ground Cover . . . . .	E-102
e. Trees . . . . .	E-107
f. Mulches . . . . .	E-119



## E. TECHNICAL GUIDE FOR SOIL AND WATER CONSERVATION GROUND MAINTENANCE

### 1. EROSION AND SEDIMENT CONTROL

#### a. Critical Area Stabilization

A critical erosion area is any erodible, sediment-producing area such as excessively eroding cuts, fills, streambanks, landfills, roadbanks, dams, spillways, borrow areas, and denuded or gullied areas where vegetative stabilization is difficult by ordinary methods. Stabilizing these areas will reduce damage from sediment and runoff to downstream areas, and improve wildlife habitat and visual resources.

Soils: Usually, the soil material on which seeding or planting is to be done is infertile, poor in structure and aggregation, low in organic matter and may be highly acid. This material is highly susceptible to erosion due to slow water intake and rapid runoff. To help overcome these conditions, organic matter can be applied in the form of mulch, lime can be applied where needed, and appropriate commercial fertilizers can be added. On most eroded sites, four inches of loamy topsoil applied to the site before seeding enhances establishment of ground cover and minimizes maintenance.

Site Preparation: Where equipment will travel over the site during planting and/or for maintenance after establishment, slopes should be no steeper than 3:1. Where practical, fill and shape gullied areas. Install

necessary water control measures such as diversions, waterways or outlets, and subsurface (tile) drainage. Remove all debris such as stones and tree stumps that may interfere with seeding and maintenance operations.

Seedbed Preparation: Scarify ground surfaces to a depth of at least four inches with a disk or other suitable method. In some situations such as drainage ditch banks and spoil banks scarification can be excluded if lime, fertilizer, and seed are applied to the roughened surface within one or two days after earth moving. Apply lime and fertilizer according to soil test or based upon known needs of the soil. Mix them into the surface soil. If lime and fertilizer are to be applied by hydroseeder, soil mixing is not required. In the absence of soil test results or knowledge of the needs, suggested per acre application rates are two tons of limestone, 500 to 800 pounds of 20% superphosphate (or equivalent) and at least 80 pounds each of nitrogen, phosphorus, and potassium (800 lbs. of 10-10-10 or equivalent). Nitrogen can be reduced by one-half if legumes are seeded alone or with grasses.

Plant Selection and Specifications: Select plants which are best suited to site conditions. In making the selection, keep in mind the plants' characteristics, climatic adaptation, the intended use, and level of maintenance required. Suggested time of seeding, rates

of seed, and mixtures for specific use should be obtained from Table 1. Certified seed tested within six months before seeding should be used. Legumes should be scarified and inoculated with the proper strain of nitrogen fixing bacteria before seeding. When grass is established vegetatively (sprigs or runners), use precaution to make certain only fresh, moist planting material is used.

Seeding or Planting: Uniformly apply seed with a drill, cultipacker seeder, or hydroseeder. Seed may also be broadcast by using a whirlwind or cyclone seeder or by hand. Cover the seed 1/4 to 1 inch deep, depending on the size of the seed, and firm the soil with a cultipacker except where a hydroseeder is used.

Mulching: Mulching is a very important step in establishing vegetation on critical areas. Mulch will help hold moisture, protect soils from erosion, hold seed in place, and keep soil temperatures more constant. It should be applied uniformly by mechanical means or by hand. Some bare soil should still be visible through the mulch. Hay, straw, or other fibrous mulches are best for mulching newly seeded areas. Most mulch materials are subject to blowing and must be tied down by anchoring or pressing into the soil, netting, or asphalt spray.

Maintenance: Lime and fertilizer should be applied based on a soil fertility test and the use and general appearance of the vegetative cover. In the absence of a soil test, the following are suggested lime and fertilizer rates: one to two tons of limestone per acre every three to five years, and at least 40 pounds each of nitrogen, phosphorus, and potassium (400 lbs. of 10-10-10 or equivalent) per acre annually. Nitrogen may be reduced one-half or more if legumes are established alone or with grasses. Care should be taken not to damage the vegetation mechanically through use of improper mowing equipment or by too frequent and/or too close mowing.

TABLE 1 PLANTS AND MIXTURES OF PLANTS FOR CRITICAL AREAS

PLANTS AND MIXTURES	PLANTING RATES/ACRE	PLANTING DATES	NOTES
Pensacola Bahiagrass	30-40 lbs	Mar 15 - June 15	
Wilmington Bahiagrass	30-40 lbs	Mar 15 - June 15	
Common Bermudagrass (Hulled)	8-12 lbs	April - July	
Common Bermudagrass (Unhulled)	15-20 lbs	Jan - March	
Common or Tufcote Bermudagrass sprigs	Sprigs 2'x2' 30 cu ft or Broadcast 50-80 cu ft	Mar - April 15	Tiflawn lower-growing & finer turf than common. Requires sunny sites.
Tiflawn Bermudagrass sprigs	Sprigs 2'x2' 30 cu ft or Broadcast 40-60 cu ft	Mar - April 15	
Coastal Bermudagrass sprigs	Sprigs 2'x2' 30 cu ft or Broadcast 50-80 cu ft	Mar - April 15	Suited to well-drained sites, required high level of management.
Kudzu (plants)	Space 4'x5' 2,200 plants	Late winter/ early spring	Well adapted to large and very steep cuts and high fills-not suited to soils with poor internal drainage. Excellent for gullies.
Weeping Lovegrass	4-5 lbs	Mar 15 - June	Gives quick summer cover-well adapted to droughty sites. Best in mixture with Sericea Lespedeza-tends to become clumpy with age.
Maiden cane (plants)	Space 2'x'2' 11,000 plants dig native plants	Late winter/ spring	Good on stream & channel banks, not for small laterals & small stream channels with low velocity.
Sericea Lespedeza (Scarified)	40-50 lbs	March - May	Avoid wet sites-will persist & furnish cover on eroded droughty sites and subsoil material.
Sericea Lespedeza (Unscarified)	50-60 lbs	Oct - Feb	Tolerates low level of management. May be seeded alone or overseeded on Fescue, Lovegrass small-grain & other compatible plants during fall & winter months
Sericea Lespedeza (Scarified) and Pensacola Bahiagrass	25-35 lbs 20-30 lbs	March - May	Tolerates low level of management.
Sericea Lespedeza (Scarified) and Wilmington Bahiagrass	25-35 lbs 20-30 lbs	March - May	Tolerates low level of management.
Sericea Lespedeza (Scarified) and Weeping Lovegrass	40-50 lbs 4-5 lbs	March - May	Lovegrass provides quick protective cover.

TABLE 1 (Continued)

PLANTS AND MIXTURES	PLANTING RATES/ACRE	PLANTING DATES	NOTES
Sericea Lespedeza (Scarified) and Common Bermudagrass (Hulled)	40-50 lbs 6-8 lbs	March - May	Bermuda provides quick land cover, spreads & heals in open areas. Bermudagrass usually disappears where Sericea established a canopy.
Sericea Lespedeza (Scarified) and Tall Fescue	40-50 lbs 25-30 lbs	March - April	Scarified Sericea may be sprig seeded on Fescue seeded the previous fall.
Sericea Lespedeza (Unscarified) and Tall Fescue	50-60 lbs 25-30 lbs	Sep - Nov	If Sericea seed is available at planting time, it may be overseeded on Fescue later in the winter.
Tall Fescue	40-60 lbs	Sep - Nov	Not well suited to infertile, droughty, sandy soils. Requires good maintenance.
Tall Fescue and White Clover	30-50 lbs 3-4 lbs	Sep - Nov	Can be used where mowing is desired & high level of maintenance will be provided.
Tall Fescue and Browntop Millet or Sorghum-Sudan Hybrids	40-60 lbs 25-35 lbs 25-30 lbs	Aug - Sep	Keep annuals cut back to 10-12 inches. Mulching is desirable.
Tall Fescue and Rye	40-60 lbs 25-30 lbs	Dec - Jan	Use only when necessary to complete a job. Mulching will be necessary to provide erosion control. Keep annuals cut back to 10-12 inches.

There will be conditions and interest that will warrant the use of other plants or mixtures not listed in the above table. Their use should be evaluated for each site.

Some rules of thumb for conversions:

Lbs/Ac x .367	= Oz/1,000 sq ft
Lbs/Ac x .0023	= Lbs/100 sq ft
Lbs/Ac x .023	= Lbs/1,000 sq ft
Lbs/Ac x .000207	= Lbs/100 sq ft
Lbs/Ac x .207	= Lbs/1,000 sq yds
Sq ft of area x .000023	= Acres (valid up to 10 acres)
Lbs/Ac x .0207	= Lbs/100 sq yds

Small Grain Mulch With Mulch Netting: Mulch is needed to conserve moisture, prevent surface compaction and crusting, reduce runoff and erosion, control weeds, and help establish plant cover.

Generally, wheat straw is preferred over oat straw or hay. Oat straw frequently contains more viable seeds and there is a greater chance of noxious weeds in hay than in straw.

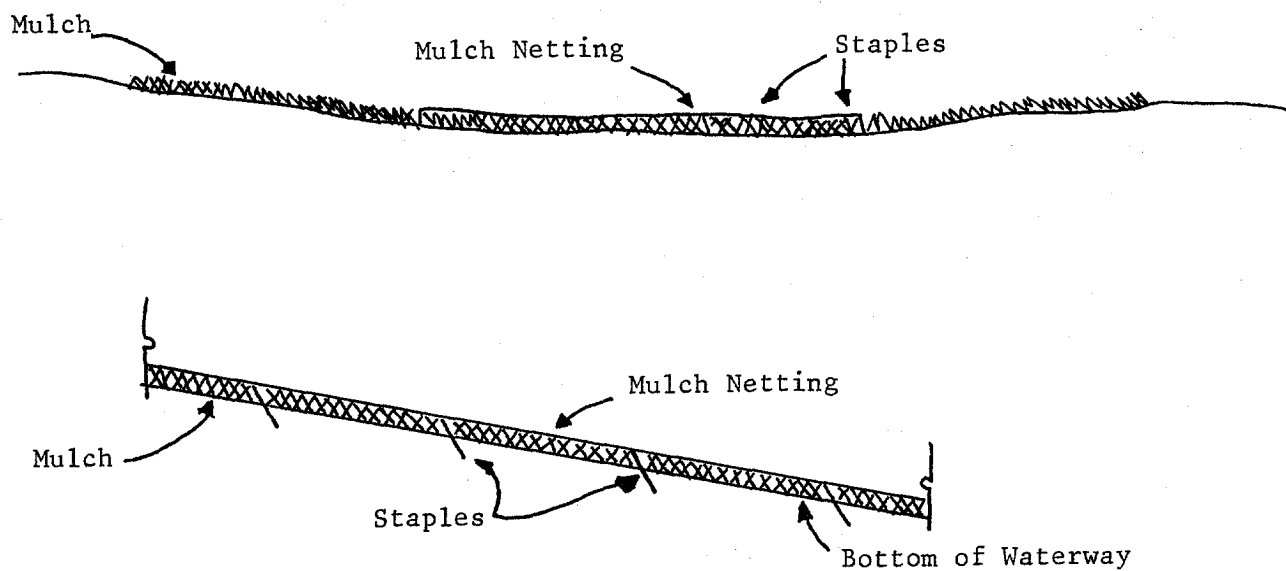
Spread mulch at the rate of 1 to 2 tons per acre, depending on the site conditions. Gently sloping and fertile sites planted at the best time for the species may only need the lower rate. Mulch may be spread by hand or blower-type spreading equipment. Apply mulch uniformly so about 25 percent of the ground surface is visible. This will allow young seedlings to emerge.

Mulch Netting: A commercially available mulch netting which comes in 7.5, 10, 12 and 15 foot widths is widely used. This plastic biodegradable netting is anchored by steel staples.

Netting should be placed tightly on top of the mulch on a smooth surface to prevent water flow under the netting and mulch.

Cover at least the critical flow area of waterways. Successful anchoring of mulch netting with steel staples can be accomplished by the following method:

1. Space staples on each edge and 2 to 3 feet apart across width of netting.
2. Each succeeding row of staples should be spaced from 5 to 6 feet apart along the length of netting. Staples may be offset in every other row to improve anchoring.
3. Angle into soil so the top of the staple leans upstream. This helps to stabilize staple anchoring against water force.
4. Staples need to be placed in all low areas.



MULCH NETTING PLACEMENT



b. Temporary Cover For Construction Sites And Other Distrubed Areas

Temporary vegetative cover is established by planting annual grasses or small grain. Its purpose is to provide short-term (less than 12 months) cover for the control of surface runoff and erosion to reduce damages from sediment to downstream areas until permanent vegetation or other stabilization measures can be established.

The temporary measures should be coordinated with the permanent measures planned to assure economical and effective control.

Site Preparation:

- (1) Install needed erosion control practices, either temporary or permanent, such as dikes, ditches, diversions, drains, and desilting basins.
- (2) Grade, as needed, to permit the use of planned seeding equipment. Shaping may not be required if hand seeding or hydraulic seeding equipment is to be used.

Seedbed Preparation:

- (1) Chisel or loosen compacted areas. Spread available topsoil over unfavorable soil conditions for successful establishment of plants.
- (2) When hydraulic seeder is to be used, seedbed preparation is not required.

- (3) When conventional seeding equipment is to be used, no preparation is required if the soil material is loose and has not been sealed by rainfall. On smooth undisturbed cut slopes, the surface will require pitting, trenching, or scarifying to provide a place for seed to lodge and germinate.
- (4) See recommended seeding rates in the following table.

TABLE 2 SPECIES OR MIXTURES AND SEEDING RATES FOR TEMPORARY SEEDINGS <sup>1/</sup>

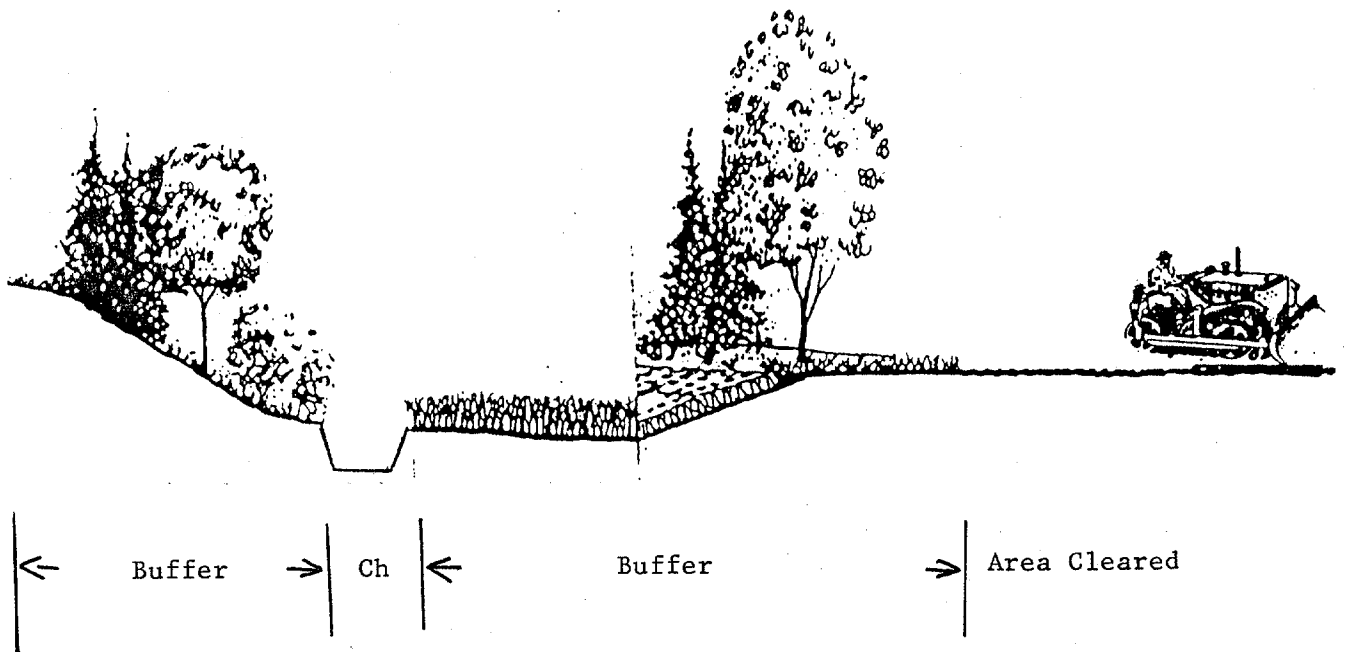
Seeding Period (Month)	Seeding Rate Pounds Per <sup>3/</sup>		Plant Suitability For			
	Acre	1,000 sq. ft.	Sandy	Loamy	Clayey	Somewhat Poorly Drained
Late Winter-Spring (Feb. to May)						
Annual Ryegrass	40-50	1	x	x	x	x
Rye	110-150	3	x	x	x	x
Spring Oats	95-125	3	x	x	x	x
Small grain and Annual lespedeza	60-110 25	2 1/2				
Summer (May to Aug. 15)						
Sudan or Sorghum hybrids	40-50	1	x	x	x	
Millet (Brown top)	40	1	x	x		x
Weeping Lovegrass <sup>2/</sup>	4-6	.2	x	x	x	
Late Summer-Late Fall (Aug. 15 to Nov.)						
Annual Ryegrass	35-45	1	x	x	x	x
Rye	100-150	3	x	x	x	x
Oats	95-125	2 1/2	x	x	x	
Wheat	100-180	3		x	x	
Small grain and Ryegrass	75-135 20	2 1/2				

- <sup>1/</sup> Determine and use local seeding dates. To provide cover during winter, seedings must be made in time to produce needed growth before cold weather. Seedings not made at optimum time may be successful if mulching and/or irrigation are used.
- <sup>2/</sup> A warm season perennial with strong seedling vigor. Due to its wide adaption, it may be used for temporary cover.
- <sup>3/</sup> Unusual site conditions may require heavier seeding rates.

### c. Buffer Zones

Buffer zones are areas or strips of perennial vegetation (sometimes referred to as filter strips) along roads, streams, or ponds which can remove sediment and other pollutants from runoff water. Although these strips can be established by seeding, the most effective and practical are zones of natural vegetation retained along a stream perimeter during land clearing operations. Natural buffer zones should include the floodplain and side slopes on each side of stream or constructed channels (see illustration).

With the many streams and channels throughout Camp Lejeune, this practice has broad application and should be a part of any plan involving land disturbing activities. When roads or other improvements have to cross natural drains or channels, runoff should be diverted from disturbed area to buffer zone before reaching steep slopes or drains. If buffer zones are established by seeding use the Critical Area Stabilization Guide.



BUFFER ZONE

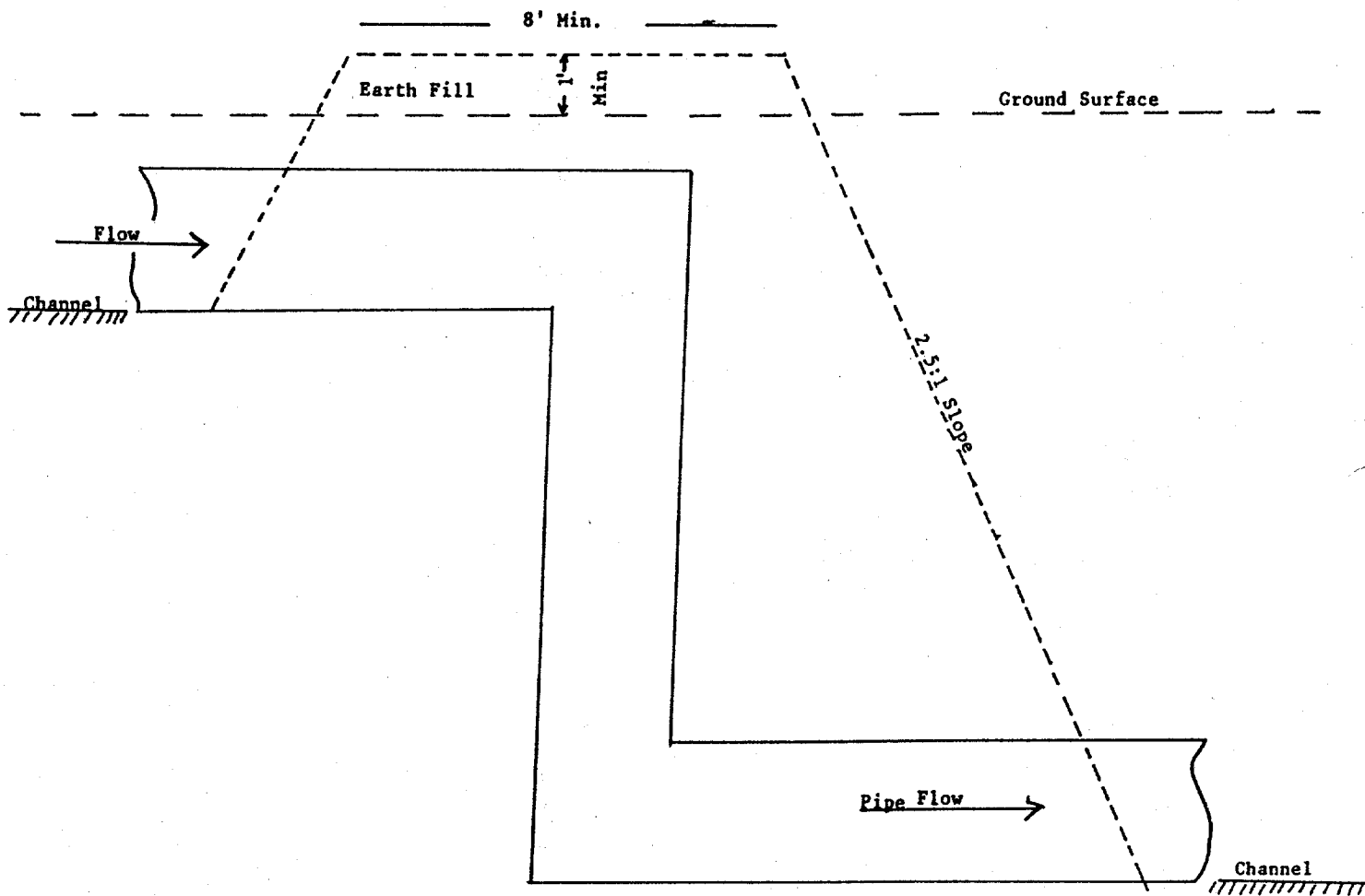
#### d. Grade Stabilization Structure

Description: A structure to stabilize the grade or to control head cutting in natural or artificial channels. Overfall structures may be designed using materials such as concrete, rock, masonry, steel, aluminum, or treated wood to lower water from one elevation to another without erosion (see attached sketches). Pipe drops of metal pipe with suitable inlet and outlet structures may also be used. Channel linings may be of concrete, asphalt, rock riprap, half-round metal pipe, or other suitable lining materials.

Purpose: Grade stabilization structures are used to reduce or prevent excessive erosion by reduction of velocities in the watercourse or by providing structures that can withstand the higher velocities.

Where Applicable: These structures should generally be planned and installed along with or as a part of other conservation practices in an overall surface water disposal system. This practice applies to sites where the capability of earth and vegetative measures is exceeded in the handling of water at permissible velocities, where excessive grades or overfall conditions are encountered, or where water is to be lowered structurally from one elevation to another. Channel linings should generally be used where channel velocities exceed safe velocities for vegetated channels

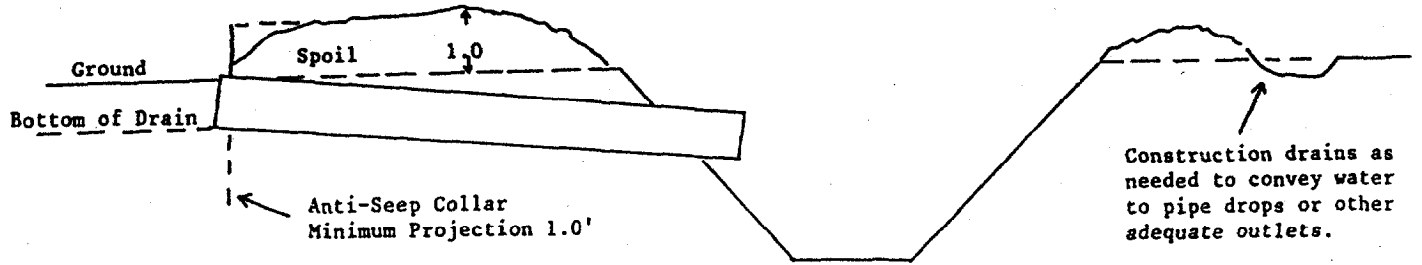
due to high stream channel gradient, or a change in channel cross section, or where durability of vegetative lining is adversely affected by seasonal changes.



GRADE CONTROL STRUCTURE



PIPE DROP STRUCTURE



MATERIALS

<u>TYPE</u>	<u>DIAMETER</u>	<u>LENGTH</u>
-------------	-----------------	---------------

Pipe

Anti-Seep Collar  
(Optional)

INSTALLATION GUIDES

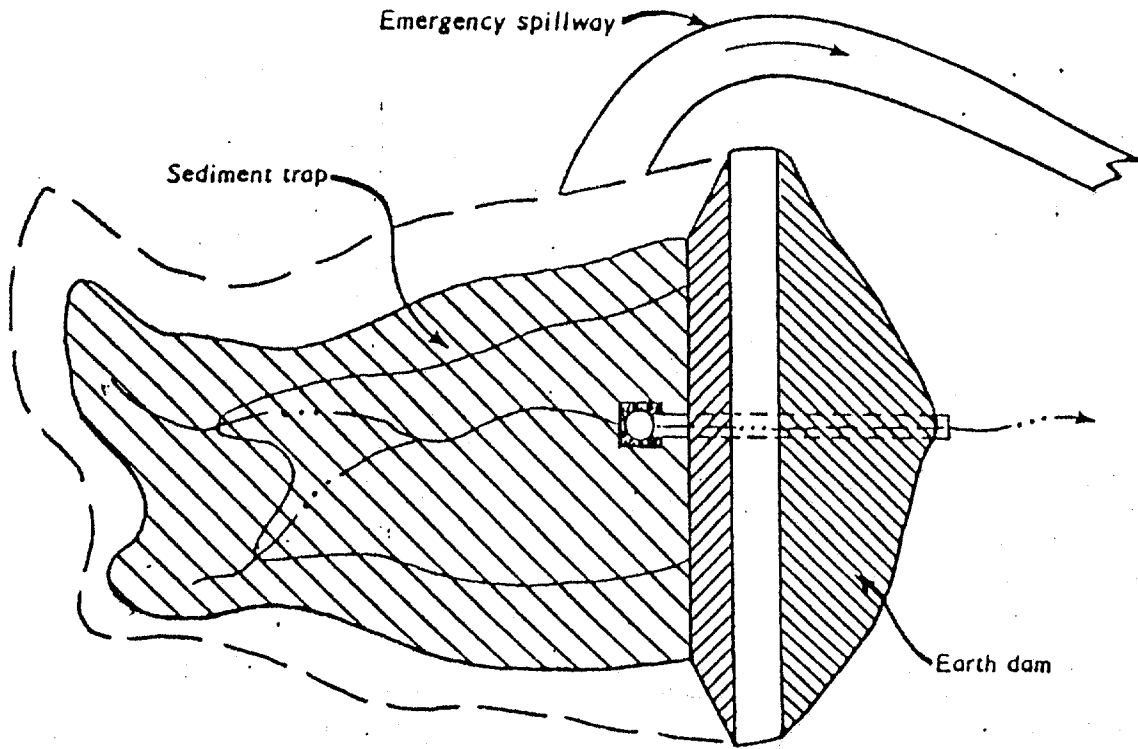
1. Excavate trench so that back fill can be compacted around pipe (especially along lower half of pipe).
2. Remove all vegetation, roots, and debris from trench.
3. Place pipe on undisturbed or compacted soil free of debris. If anti-seep collar is used, install lower half prior to pipe placement.
4. The top of the pipe at inlet shall be at or below ground surface.
5. The bottom of the pipe at inlet shall be placed at constructed bottom of drain.
6. Pipe grade should be suited to site conditions (0.5' to 1.0' drop is recommended).
7. Compact soil around pipe as back filling progresses.
8. Completed back fill should be 1.0' (minimum) above ground and shaped for adequate seeding and maintenance (3:1 minimum slope is recommended).
9. Plan vegetation establishment in accordance with Soil Conservation Service Technical Guide.

#### e. Sediment Basin

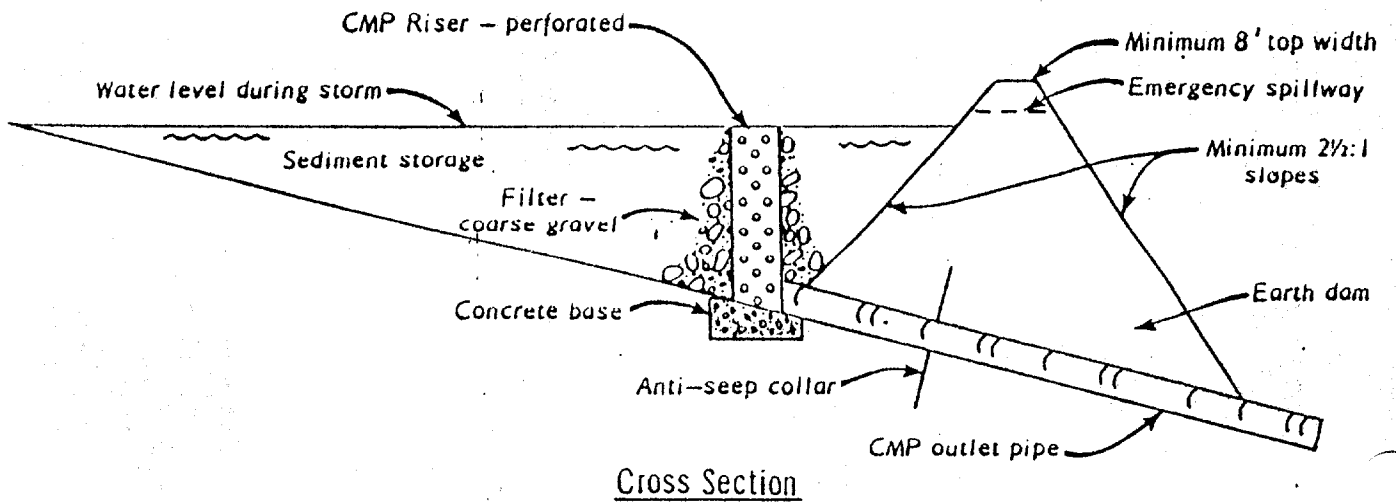
A sediment basin is a barrier or dam constructed across a waterway or at another suitable location to retard runoff and trap sediment. These structures may be temporary or permanent. Provisions must be made to remove trapped sediment periodically if the capacity of the basin is inadequate. The spillways must be designed to safely accommodate the normal flow and the maximum flood flow from a storm of selected frequency. If the structure is to be permanent, it should be designed as a water impoundment structure. (See design criteria in North Carolina Guide for Sediment Control.)

Purpose: To preserve the capacity of reservoirs, ditches, canals, diversions, waterways, and streams; to prevent undesirable deposition on floodplains and/or other developed areas by providing basins for the deposition and storage of silt, sand, gravel, and other non-toxic debris.

Conditions Where Practice Applies: This standard applies where physical conditions preclude the treatment of the sediment source by the installation of erosion control measures to keep soil and other material in place, or where a sediment basin offers the most practical solution to the problem.



SEDIMENT BASIN



Cross Section

## 2. DRAINAGE

Artificial drainage (manmade) should be planned, designed, constructed, and maintained to supplement natural drainage systems for wise use of natural resources. Inadequate designs or construction can result in unsatisfactory drainage and increases erosion and sediment.

This guide is intended to provide general standards for planning, design, construction, operation, and maintenance of drainage systems on Camp Lejeune USMC.

### a. Open Channels

Definition: Constructing a channel to a designed size and grade, or improving a channel in which water flows with a free surface.

Purpose: To provide discharge capacity required for flood prevention, remove excess surface or subsurface water, control ground water levels, or a combination of these objectives.

Conditions Where Practice Applies: All lands to be drained shall be suitable for the intended use after installation of planned drainage and other planned measures. In areas where an adequate outlet for the drainage system is available, either by gravity flow or by pumping, and where excavation or other channel work does not cause excessive erosion, or sedimentation.

Plan: Channel construction or modification shall be according to an approved plan prepared for the site,

and in keeping with this standard. All drainage plans should comply with appropriate national and state regulations. (See section III.C.)

In selecting the location and the design of channels, careful consideration shall be given to minimizing water pollution, damage to fish and wildlife habitat, and the quality of the landscape. In considering requirements for construction, operation, and maintenance, selected woody plants should be preserved when practical. Buffer zones of natural vegetation or seeded vegetation should be included in plans. (See buffer zone guides.) The overall landscape character, prominent views, and fish and wildlife habitat requirements must be considered.

Measures necessary to mitigate unavoidable losses to fish or wildlife habitat shall be included in the plan. The quality of the landscape shall be maintained by both the location of channel works and plantings, as appropriate.

The alignment of channels undergoing modification shall not be changed to the extent that the stability of the channel or laterals is endangered. When practical, constructed channels will be located in natural low areas to provide for more storm runoff, and prevent excessive excavation.

Through developed areas or areas to be developed, the channel flow, out of bank flow, and surface storage (detention storage), shall be adequate to pass the peak discharge of the 100-year storm without damage to structures.

#### Drainage Right-Of-Way

Drainage right-of-way will be designated for all channels, and widths will be shown on designs. The right-of-way shall include top width of channel, disposal area for cleared material, disposal areas for excavated spoil, and a minimum 15 foot travelway for channel maintenance (see page 32).

Design Criteria: The design and installation shall be based on adequate surveys and investigations.

#### (1) Design Storm Runoff

The minimum design for channels and related structures shall be that required to remove runoff in twenty-four (24) hours the five year-one day storm. The Soil Conservation Service method of estimating runoff or an equivalent method will be used to determine design storm runoff. (See SCS Engineering Field Manual, Chapter 2, Estimating Runoff or North Carolina Guide for Sediment Control on Construction Sites.)

## EXAMPLE:

COVER	SOILS	HYDROLOGIC GROUP	CURVE NUMBER	ACRES	ACRES X CURVE NUMBER
Woods (fair)	Rains	D	79	40	3160
Recreational area (grass)	Rains	B	69	40	2760
Apartments	Rains	B	85	20	1700
Shopping Center (Roofs & Paved)	Onslow	B	98	20	1960
Residential Lots ( $\frac{1}{4}$ ac.)	Craven	C	83	15	1245
Residential Lots ( $\frac{1}{2}$ ac.)	Murville	D	85	10	850
Road Surfaces	Murville	D	92	50	460
Residential Lots ( $\frac{1}{4}$ ac.)	Baymeade	A	61	50	3050
				<u>200</u>	<u>15,185</u>



Weighted Curve Number (CN) =  $15,185/200 = 75.9$   
Use CN = 75 (nearest multiple of 5)  
5 year - 1 day rainfall is 5.8 inches.  
Peak flow (Q5) = 180 cubic feet second.  
With curve number 75 the runoff is 3.11 inches.

To remove 3.11 inches from 200 acres in 24 hours, the average discharge is 26 cubic feet per second (Ft<sup>3</sup>/sec).

(2) Detention Storage

Detention Storage is recommended for areas that are being developed intensively such as large paved areas and roofs. The design peak flow is the estimated discharge (cubic feet per second), for cover conditions before development. The detention storage is the difference in estimated discharge before and after development.

(3) Depth

Channels shall be designed deep enough to allow for normal siltation. An additional 0.5 foot is adequate for most site conditions. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage. The increase shall be based on an evaluation of site conditions. Channels that serve as outlets for subsurface drains shall be designed for a normal water surface at or below

the invert of the outlet end of the drain. The clearance between a drain invert and the channel bottom shall be at least one foot for new channels that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow. The minimum channel depth will be sufficient for the hydraulic gradient to be at or below the ground surface profile, including any hydraulic head losses caused by structures in the channel.

(4) Velocity

Manning's Formula shall be used to determine the design velocity, and the value of "n" shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of "n", based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula when determining the design for required capacity.

Hydraulic radius	"n"
Less than 2.5 . . . . .	0.040 - 0.045
2.5 to 4.0 . . . . .	.035 - .040
4.1 to 5.0 . . . . .	.030 - .035
More than 5.0 . . . . .	.025 - .030

Recommended maximum design velocities for soil conditions are:

Sands and sandy loams (non-plastic)	2.5 ft/sec
Unified classification SP, SP-SM, SM	
Silt loams (ML, CL, MH)	3.0 ft/sec
Sandy clay loam (SC)	3.5 ft/sec
Clay loam (CL, CH)	4.0 ft/sec.

See Camp Lejeune soil survey, Table 5 - Soil Classification.

All channel designs will show the design velocity and the bankfull flow velocity.

(5) Cross Section

The design channel cross section shall meet the combined requirements of capacity, velocity, depth, side slopes, and bottom width. Side slopes shall be based on site conditions. The minimum recommended side slope is 1:1.

(6) Appurtenant Structures

The channel design shall include all structures required for proper functioning of the channel and its laterals, as well as travelways for operation and maintenance.

Inlets and structures needed for entry of surface and subsurface flow into channels, without significant erosion or degradation, shall be included in the channel design. The design also shall provide for necessary flood gates, water level control devices, bays used in connection with pumping plants, and any other appurtenances essential to the functioning of channels and contributing to attainment of the purposes for which they are built. If needed, protective structures or treatment shall be used at junctions of channels to insure stability at these critical locations.

The effect of channel work on existing culverts, bridges, buried cables, pipelines, and structures for surface and subsurface drainage on the channel shall be evaluated to determine the need for modification or replacement. The hydraulic grade line should be below bridge stringers. The allowable head loss through culverts should not exceed 0.5 foot. Culverts and bridges that are modified or added as part of channel projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the channel design discharge or

state agency design requirements, whichever is greater.

When design discharge from culverts or other structures causes the velocity in the receiving channel to exceed the maximum recommended velocity for channel conditions, outlet protection will be provided. The design outlet protection will be shown in the plan and shall be sufficient to reduce velocities to allowable channel velocities.

The procedure in Appendix C of the North Carolina Guide For Sediment Control on Construction Sites may be used.

(7) Disposal of Spoil

Spoil material from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

- (a) Not confine or direct flows so as to cause instability of channel or spoil when the discharge is greater than the bank-full flow.
- (b) Provide for the free flow of water between the channel and floodplain unless the valley routing and water surface profile are based on continuous dikes being installed.
- (c) Not hinder the installation of travelways for maintenance.

- (d) Leave the right-of-way in the best condition feasible, consistent with the project purposes and adjacent land uses.
  - (e) Direct water accumulating on or behind spoil areas to protected outlets.
  - (f) Maintain or improve the visual quality of the site to the extent feasible.
- (8) Vegetation of Channel

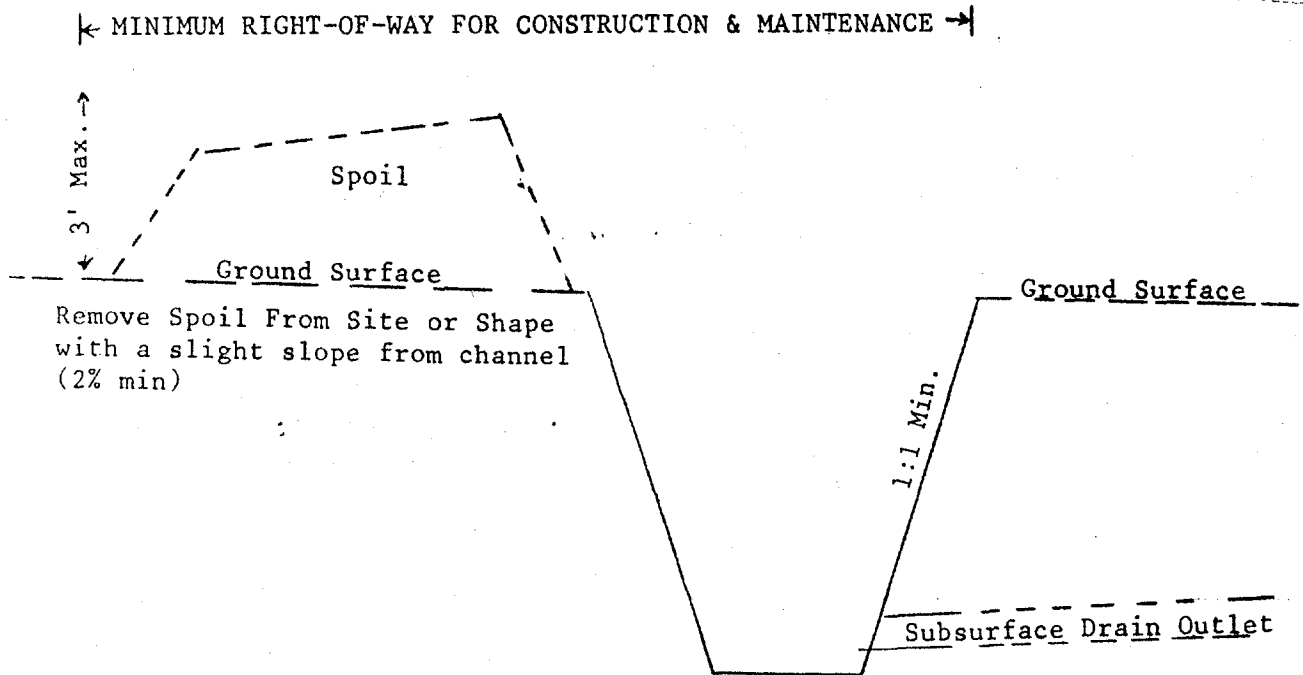
Vegetation will be established on all channel slopes, berms, spoil, and other disturbed areas according to critical area seeding specifications.

#### Operation And Maintenance

Plan: An operation and maintenance plan must be prepared for each channel system. Minimum requirements for operation, maintenance, and replacement shall be consistent with the design objectives. This includes consideration of fish and wildlife habitat, quality of the landscape, water quality, methods, equipment, costs, stability, function for design life, frequency, and time of year for accomplishing the work. Detailed provisions for operation and maintenance must be made if complex features such as water level control structures and pumping plants are required.

Maintenance Access: Travelways for maintenance shall be provided as part of all channel work. This requirement may be met by providing ready access points to sections of the channel if this will permit adequate maintenance in conformance with the operation and maintenance plan.

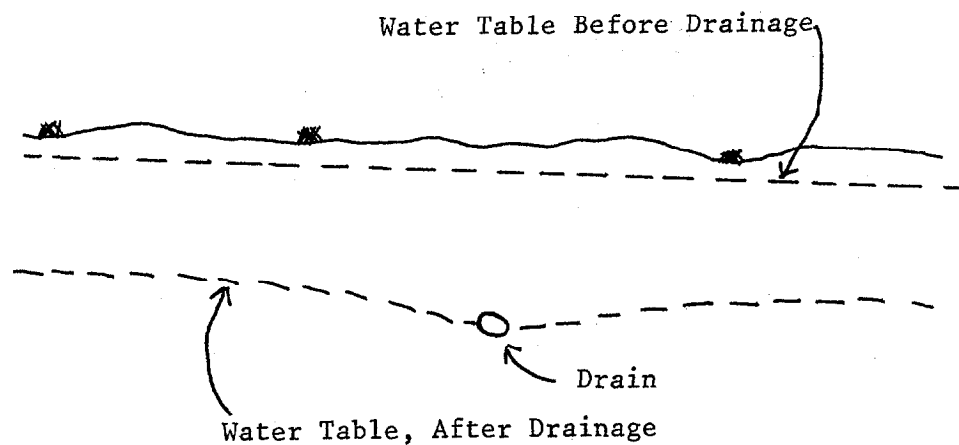
A travelway shall be provided on each side of large channels if necessary for use of maintenance equipment. Travelways must be adequate for movement and operation of equipment required for maintenance of the channel. The travelway may be located adjacent to the channel on a berm or on the spread spoil. The travelway, including access points, should blend into the topography and the landscape.





## b. Subsurface Drainage

Subsurface drainage removes free water from the soil and lowers the water table for (1) better vegetative growth, (2) waste disposal areas, (3) buildings sites, (4) roads, and (5) play areas. Subsurface drainage also intercepts and prevents water movement into a wet area and aids in removing excessive water on the surface from rainfall, thus preventing long periods of ponding or flooding and surface erosion. Subsurface drainage is achieved with tile and/or open ditch (See Camp Lejeune Soil Survey, Table 17 - Water Table).



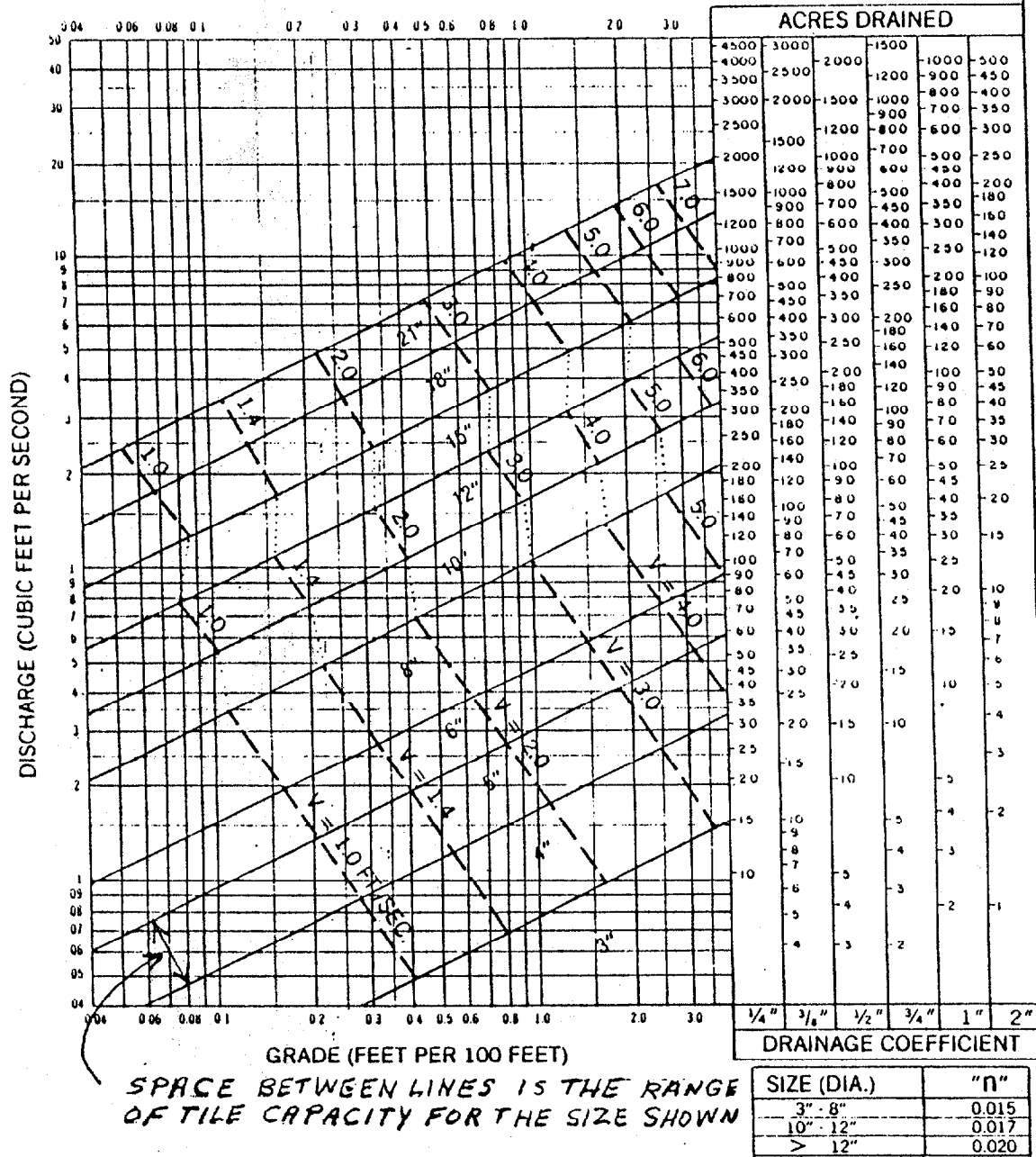
SUBSURFACE DRAIN

### Subsurface Drains

Subsurface drains should be designed to remove from the soil a minimum of 0.5 inch of water every 24 hours (see attached design chart). Drains should be designed and installed on a continuous grade to the outlet with a minimum grade of 0.2 percent. The recommended minimum cover over drains is 2 feet. If subsurface drains are to receive surface water, surface inlets should be installed to prevent trash and sediment from entering the drains. Due to the sandy soils in the Camp Lejeune area, a filter is recommended on all drains installed to reduce sediment accumulation in drains. If practical, no drains should be installed within 50 feet of trees to reduce the chance of roots clogging a drain. Solid (non-perforated) pipe should be considered where trees will be closer than 50 feet. If perforated pipe is installed near trees, (especially hardwoods such as willow, maple, and oak), the performance and life may be reduced and maintenance may increase. A right-of-way 15 feet wide for installation and maintenance is required. All disturbed areas should be seeded in accordance with critical area seeding specifications.

Landscaping of rights-of-way through developed areas is encouraged, but permanent structures should not be permitted over subsurface drains unless drains under structures are re-routed. Permanent records showing the location of all subsurface drains installed should be filed with records of other underground utilities.

## PLASTIC TUBING DRAINAGE CHART



**REFERENCE**

MANNING'S ROUGHNESS  
BASED ON ASAE EP 260.3

U.S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DRAINAGE SECTION

**DRAWING NO.**

5,P-38,023

SHEET 1 OF 1

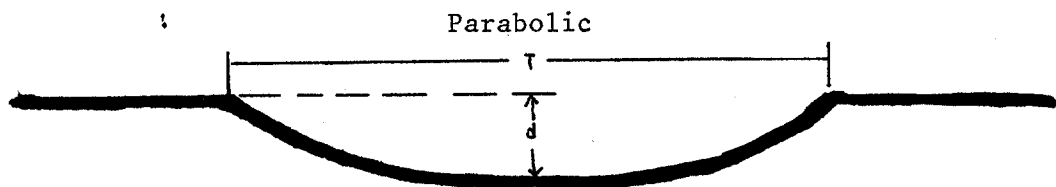
DATE 7-1-81

**CHART FOR DETERMINING REQUIRED SIZE OF  
CORRUGATED PLASTIC DRAINAGE TUBING.**

### c. Surface Drains

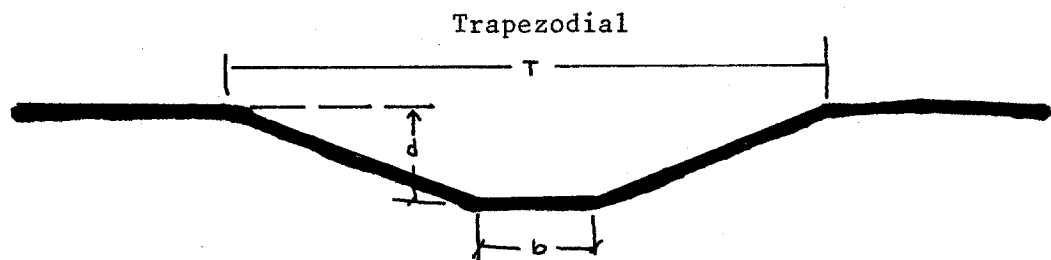
Surface drains are shallow, shaped drains (1 to 2 feet deep) used to control and remove surface water. Usually they have flat side slopes (3:1 or flatter) and can be mowed or crossed with vehicles. The types of surface drains used at Camp Lejeune are:

- (1) Shaped drains through depressions or wet areas to remove surface water. Drains should be designed to remove 5 year 24 hour storm runoff in 24 hours. The channel grade is usually less than 0.5 percent and channel velocities are not erosive (less than 2 feet per second). See design procedure for open channels.
- (2) Shaped, vegetated drains (grassed waterways) to collect and convey surface water runoff. The channel grade is usually greater than 0.5 percent and vegetation is needed to prevent erosion of bare soil. (See North Carolina Sediment Control Guide for design data.)



Cross sectional area (A) -  $\frac{2}{3}Td$

Design top width (T) -  $\frac{1.5A}{d}$

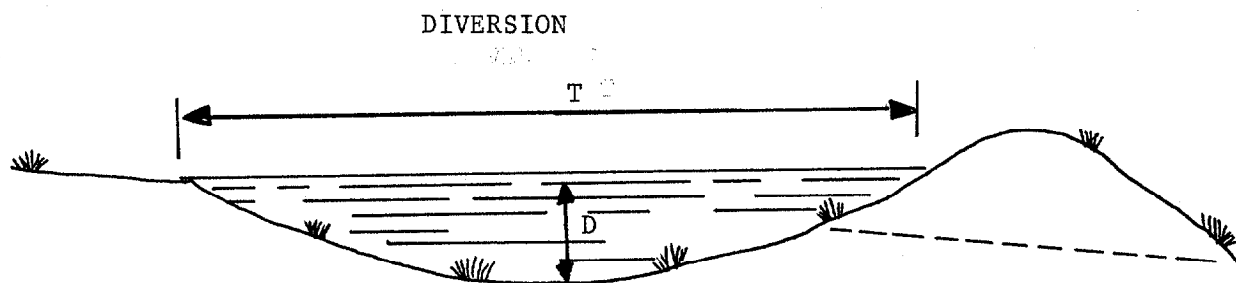


Cross sectional area (A) -  $bd + zd$

Design top width (T) -  $b + 2dz$

SHAPED DRAIN

- (3) Diversions - Diversions are usually constructed across a sloping land surface to intercept surface water runoff from a higher area and divert it from a lower area to a stable outlet. The diversion may be needed to (1) prevent erosion, (2) protect developed areas such as buildings, parking lots and roads, or (3) divert water for use nearby. When the channel grade exceeds 0.5 percent the diversion should be vegetated. (See Sediment Control Guide



T - Top Width

D - Depth

$A = \frac{2}{3} TD$

Where vegetation is needed to stabilize surface drains, critical area seeding specifications should be used. When surface drain outlets into deep ditches or other unstable outlets, pipe drops or grade control structures should be used to prevent

erosion at the outlet and sedimentation down stream  
(see Grade Stabilization Structures).



### 3. ROAD CONSTRUCTION AND MAINTENANCE

Camp Lejeune has over 400 miles of roads consisting of five use categories. They are (a) administrative roads, (b) improved roads, (c) semi-improved roads, (d) tank trails, and (e) temporary access roads.

- a. Administrative roads are paved or graveled and are maintained to provide passage of light trucks and sedans at all times. Generally, track vehicles are not permitted to use these roads. They are usually located in built-up areas but some are located for use as access to improved ranges. The recommended minimum width, including side drains, is 60 feet. Pavement is repaired as needed. Shoulders and parallel side drains are mowed and repaired as needed.
- b. Improved roads are the major access to unimproved grounds and training areas. These graveled roads are maintained to provide passage of light trucks and sedans most of the time, and to provide passage for light 4-wheel-drive vehicles year round. The recommended minimum width is 60 feet. For maintenance these roads are scraped with a motor grader as needed to fill pockets and ruts. This operation moves loose soil and gravel from each side toward the center forming a crown with a slight slope to each side. Side drains are cleaned with a motor grader by removing sediment from drain and spreading over road surface.

- c. Semi-improved roads are designated access extending beyond improved roads. They are maintained to provide passage of 4-wheel-drive light trucks year-round. The recommended minimum width is 40 feet. Maintenance is performed as needed using the same procedure as described for improved roads.
- d. Tank trails are semi-improved trails to permit year-round use by tanks, amtracs, light armored vehicles (LAV's), and other rubber-tired tactical vehicles. They are used primarily for combat engineered military maneuvering and are maintained as needed for that use. Drainage to remove surface water is recommended to reduce maintenance on vehicles and trails, and to reduce need for vehicle to leave trails to go around areas that are not passable. The recommended minimum width for tank trails is 40 feet to allow vehicles to meet without getting in side drains. When maintenance is performed, the procedure used should be the same as for improved road.
- e. Temporary access roads are used for timber harvest and are sometimes abandoned or barricaded when not in use. They are 20 to 25 feet wide, including side drains that are needed in some locations (soils with high water table, or surface depressions that trap water), to remove surface water. These roads should be installed and used so that runoff will not cause any off-site

damage. The timber contractor is responsible for maintenance during harvest.

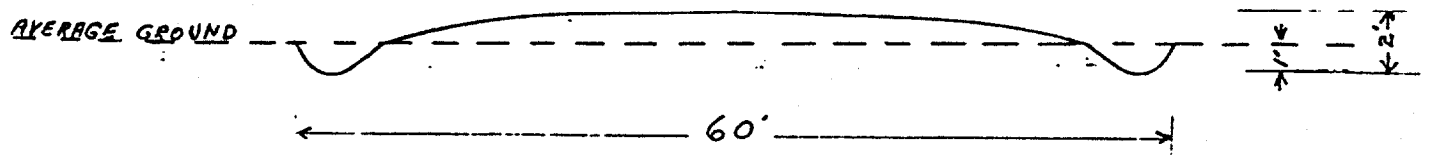
The greatest use of surface drains is along roads and trails. Most roads and trails have drains along one or both sides, and some of these drains are eroding or are not adequate to remove surface water. A road maintenance plan should include drains and related structures along roadways.

When constructing new roads or upgrading existing ones, surveys should be made as needed to assure that roads and drains are constructed with continuous grade to a stable outlet for surface water runoff. (See typical cross-section of roads and drainage guide.)

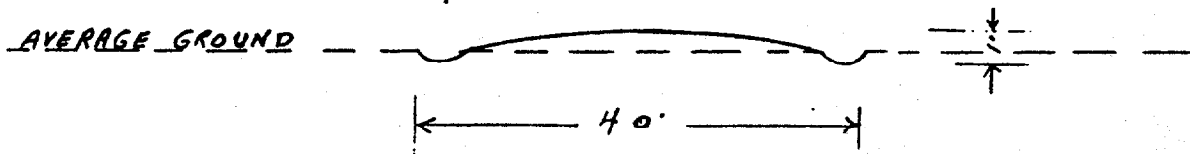
Any job that disturbs one acre or more should have a sediment and erosion control plan reviewed and approved prior to contracting for construction.

When cuts and fills are required for road construction, 2.5 to 1 slopes are recommended and should be less than 1 to 1.

ROAD - TYPICAL CROSS SECTION



TANK TRAIL - TYPICAL CROSS SECTION



#### 4. RIVERSHORE STABILIZATION

There are approximately 47 miles of New River shoreline on Camp Lejeune. From an inventory made by the Soil Conservation Service in 1974, erosion is occurring along 20 miles of this shoreline. The average rate of erosion is 1.4 feet (width) per year, and the area with the highest rate is 7 feet per year.

Most erosion on shores of broad rivers and sounds is caused by wind tides and waves. The two major factors causing erosion by wave action are exposure and fetch. Exposure is the direction from which the wind tide water can attack the bank. Fetch is the distance across open water from the point being considered until land is encountered (the theoretical distance a wave could travel before striking the shore). These factors are one reason there was no measurable erosion on some of the shoreline. Another is the bulkheads that had been installed several years before the inventory was made.

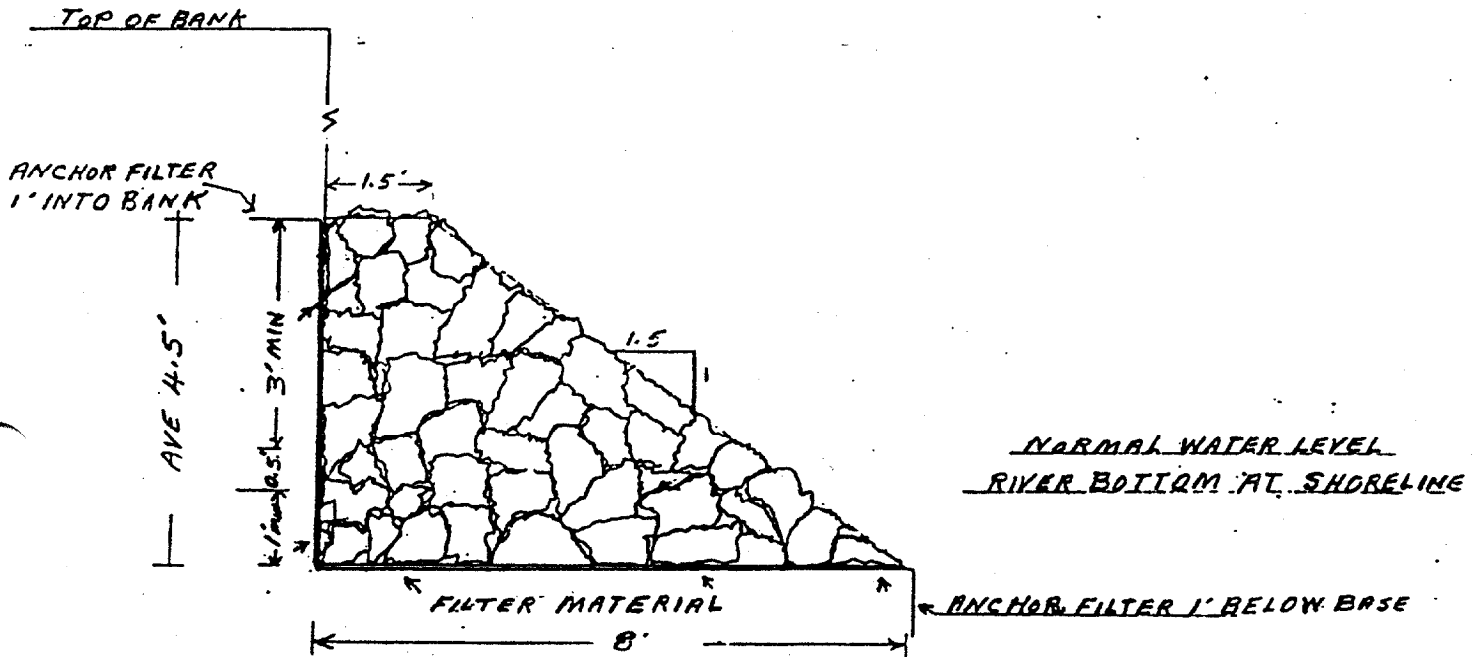
Shore erosion is a result of direct wave action on the exposed banks. The lower face of the bank is cut back by the force of the waves. The area cut usually extends from the low water level to three feet above the low water level. The bank above the eroded section will collapse or break off when no longer supported by the lower portion. When the lower portion is protected from wave action the high portion can be stabilized with vegetation.

The most often used structure to control shore erosion is a bulkhead and is the most effective when properly installed. Two materials used in bulkheads are treated wood and rock riprap. Jetties (groins) are sometimes used but are not as effective against wave action. They are most effective in protecting banks from water currents and in trapping sand during normal tide and wind conditions. Storm tides and strong winds usually remove trapped sand and erode banks where utilities are located.

Camp Lejeune has used rock riprap or rubble bulkheads to prevent shore erosion at critical locations for several years, and continues this practice as rubble becomes available from the repair and replacement of pavements and buildings. Priorities should be established for future installations based on rate of erosion and adjoining land use.

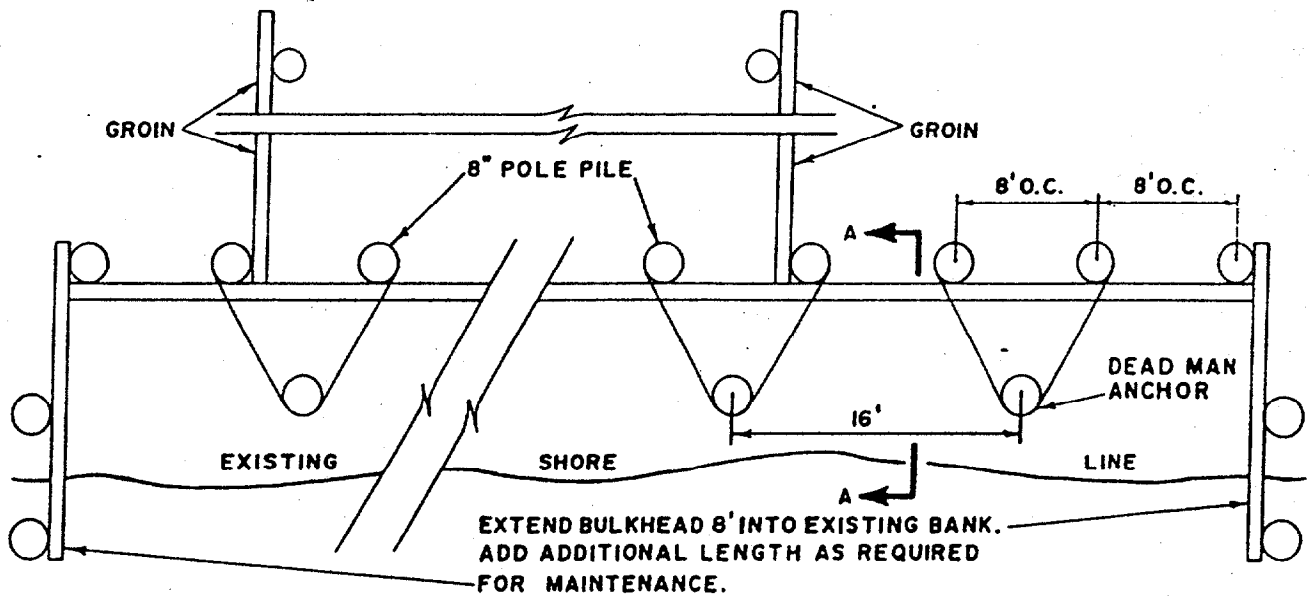
Attached are guides for installing headwall and groins.

EXCAVATE 1' MINIMUM BELOW RIVER BOTTOM  
PLACE AND SECURE FILTER  
MACHINE PLACE RIPRAP IN A MANNER TO PREVENT DAMAGE TO FILTER  
SEE ATTACHED RECOMMENDED MATERIAL SPECIFICATIONS FOR RIPRAP AND FILTER  
CLASS 1 STONE RIPRAP (N.C. DOT) IS RECOMMENDED ON NEW RIVER SHORELINE



ROCK RIPRAP BULKHEAD

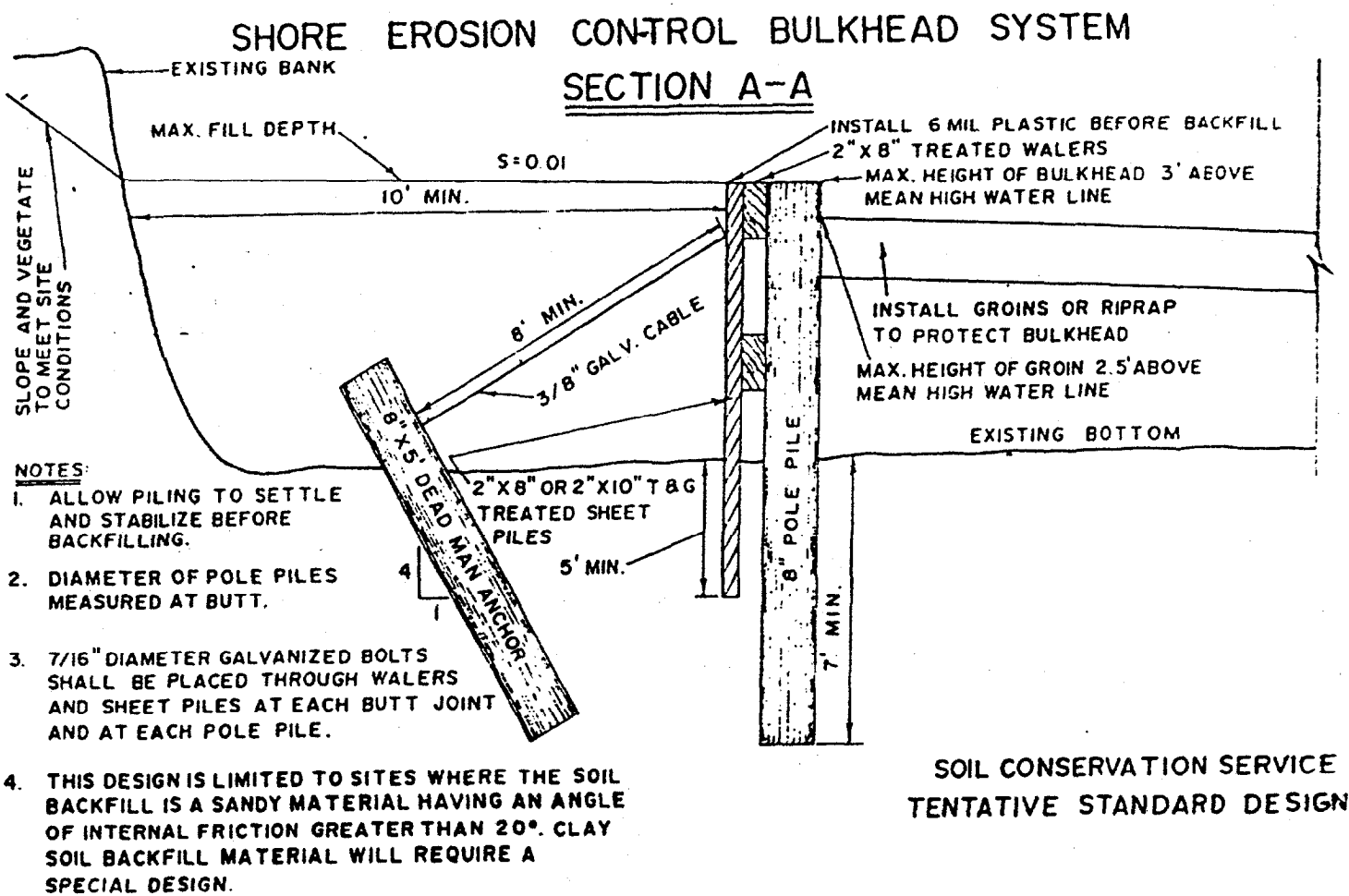
# SHORE EROSION CONTROL BULKHEAD SYSTEM PLAN VIEW



SOIL CONSERVATION SERVICE  
TENTATIVE STANDARD DESIGN

NO SCALE





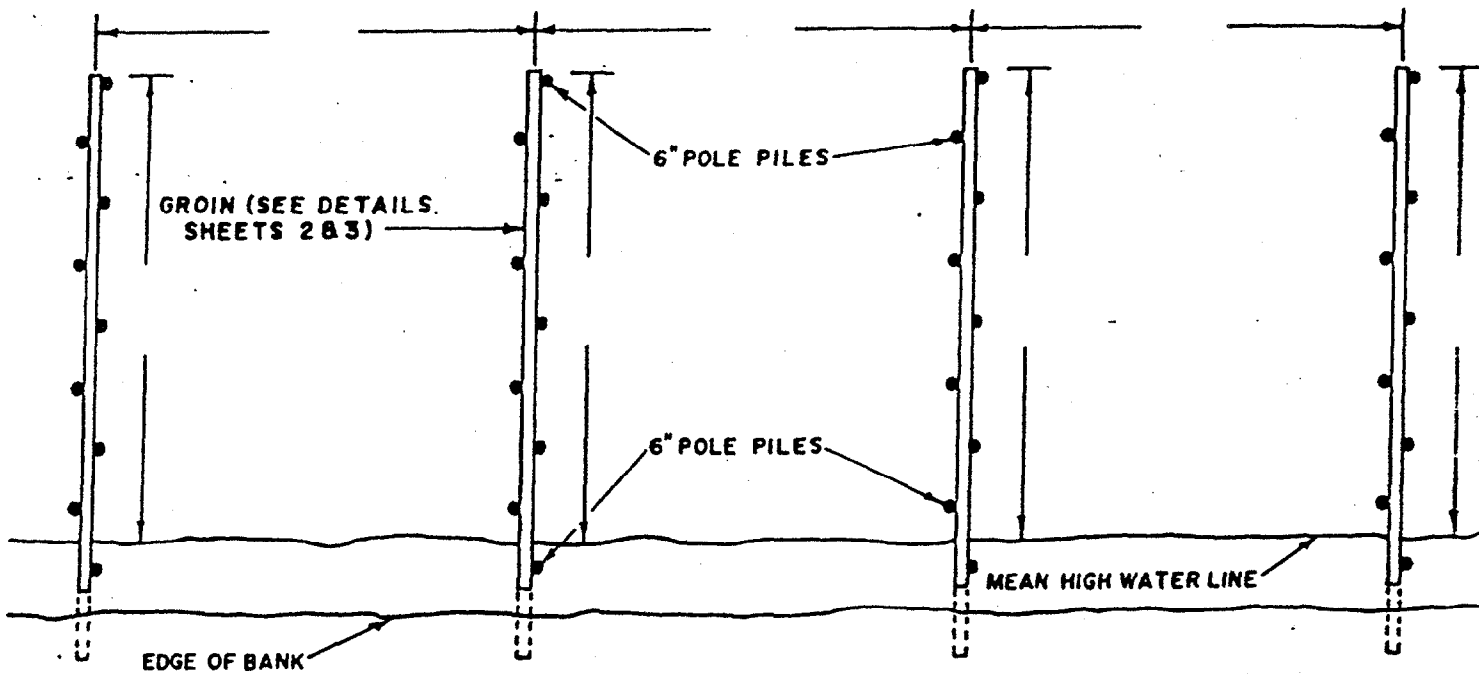
NO SCALE

REQUIREMENTS FOR NONWOVEN ENGINEERING FABRIC  
FOR EROSION CONTROL

Property	Method	Requirements
Equivalent Opening Size (EOS)	US Standard Sieve No.	40-100 (range)
Elongation at Failure - %	ASTM D-1682	50% Min.
Tensile Strength * - lbs	ASTM D-1682 Grab Test Method using 1"x2" jaws & travel rate of 12 in./min.	150 lbs. Min.
Trapezoidal Tear * Strength - lbs.	ASTM D-1117 2"x3" jaws	70 lbs. Min.
Burst Strength * - psi	ASTM D-3786 Diaphragm Bursting Strength Tester Method	320 psi Min.
Permeability Coefficient - cm/sec	K value (Falling head- head 10 in. max head)	0.15 cm/sec. Min.
Puncture Strength * - lbs.	ASTM-751 (Modified) Tension Testing Machine with Ring Clamp	80 lbs. Min.

\*Average roll minimum value - weakest principal direction.

# SHORE EROSION CONTROL GROIN SYSTEM PLAN VIEW



SOIL CONSERVATION SERVICE  
TENTATIVE STANDARD DESIGN

NOTE: DIAMETER OF POLE PILES MEASURED AT BUTT

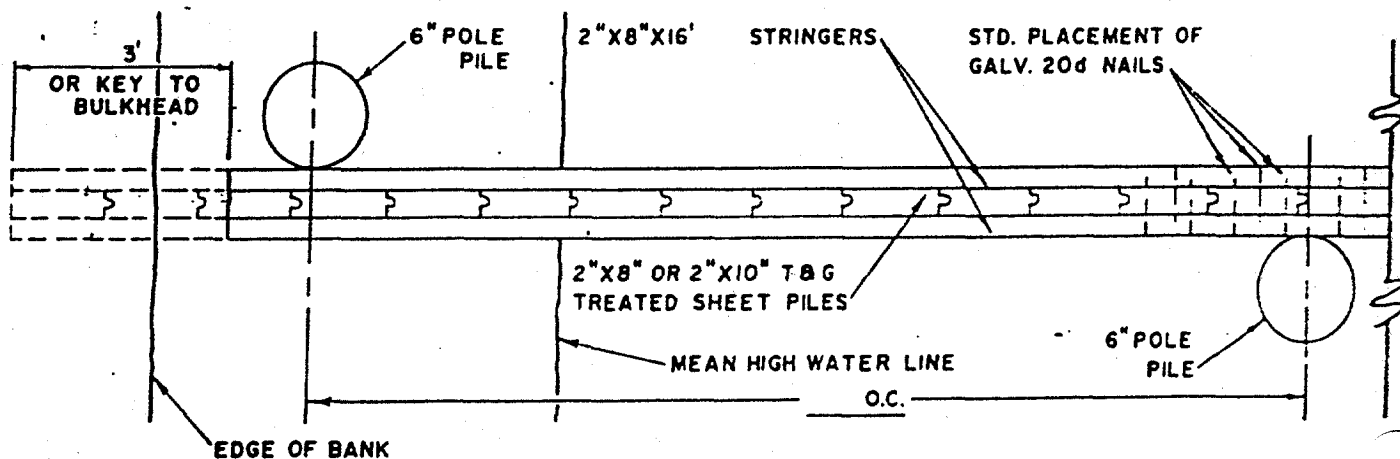
LENGTH OF POLE PILES \_\_\_\_\_

LENGTH OF SHEET PILING \_\_\_\_\_

NO SCALE

NUMBER OF GROINS RECOMMENDED \_\_\_\_\_

## SHORE EROSION CONTROL GROIN SYSTEM TOP VIEW DETAIL

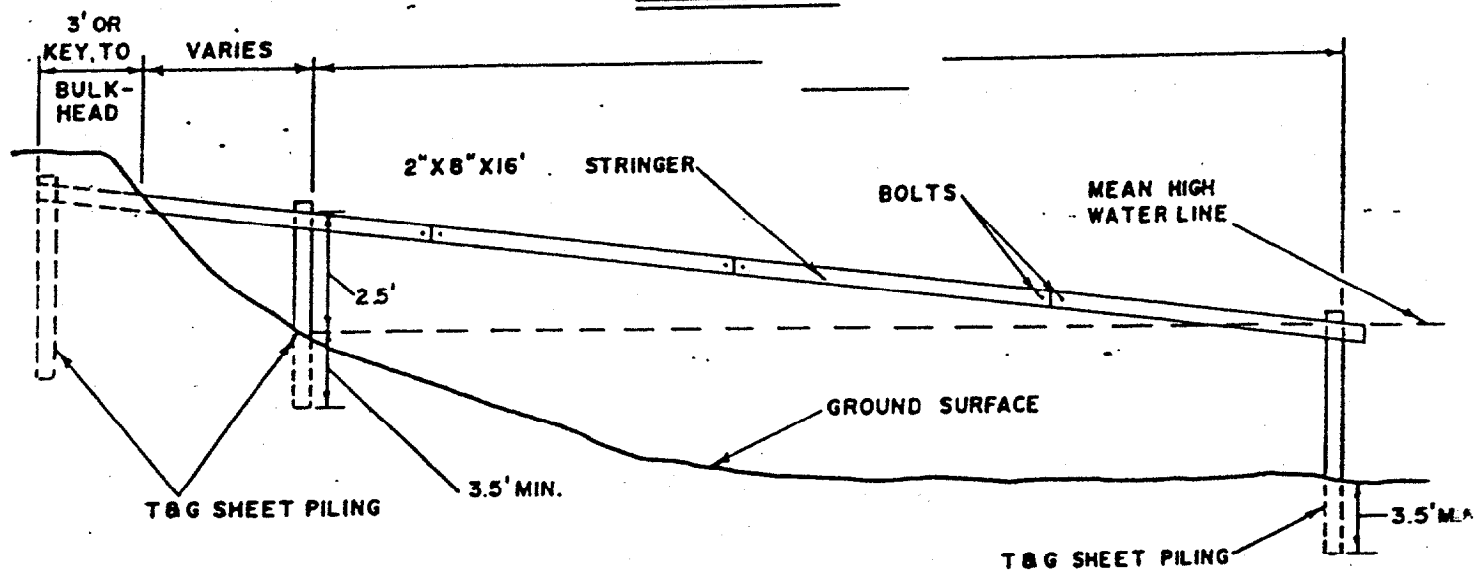


- NOTES: 1.  $7/16$ " DIA. GALV. BOLTS SHALL BE PLACED THROUGH STRINGERS AND SHEET PILES AT EACH BUTT JOINT AND AT EACH POLE PILE. BOLTS SHALL NOT BE PLACED MORE THAN 8 FEET APART.
2. AT NO TIME SHALL POLE PILES BE INSTALLED OPPOSITE BREAK IN STRINGER.

SOIL CONSERVATION SERVICE  
TENTATIVE STANDARD DESIGN

NO SCALE

# SHORE EROSION CONTROL GROIN SYSTEM SIDE VIEW



SOIL CONSERVATION SERVICE  
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### Riprap Materials

Plain Riprap: Stone for plain riprap shall consist of field stone or rough unhewn quarry stone. The stone shall be sound, tough, dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. Where broken concrete from demolished structures or pavement is available, it may be used in place of stone provided that such use meets with the approval of the engineer. Any reinforcing steel protruding from broken concrete will be removed or bent so that it is not a safety hazard. The stone or broken concrete shall be graded to meet the following requirements:

1. For Class 1 Riprap. Stone shall vary in weight from 5 to 200 pounds. At least 30 percent of the total weight of the riprap shall be individual pieces weighing a minimum of 60 pounds each. Not more than 10 percent of the total weight of the riprap may be in individual pieces weighing less than 15 pounds each.
2. For Class 2 Riprap. Stone shall vary in weight from 25 to 250 pounds. At least 60 percent of the total weight of the riprap shall be in individual pieces weighing a minimum of 100 pounds each. Not more than 5 percent of the total weight of the riprap may be in individual pieces weighing less than 50 pounds each.

### Filter Placement

The engineering fabric shall be placed on the approved prepared surface at the locations and in accordance with the details shown on the drawings. The fabric shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when the stone or other material is placed. No cuts will be permitted in the fabric panel unless otherwise specified. The panel may be folded and overlapped to permit proper placement in the designated areas. The fabric shall be rejected at the time of placement if it has defects, rips, holes, flaws, deterioration, or damage which occurred during manufacture, transportation, storage, or installation.

The orientation of the width and length of the fabric panels shall be as shown on the drawings. The overlaps of panels and end-roll details shall be as specified. The minimum overlap shall be 18 inches.

Securing pins shall be placed along the edge of the panel to adequately secure the engineering fabric during placement. The use of securing pins will be held to the minimum necessary. The fabric may be secured with other methods when specified or as approved by the engineer.

The engineering fabric shall not be placed until riprap or other material can be used to cover it within the same working day.

Temporary cover may be used as approved by the engineer. Riprap shall be placed in a manner that prevents damage to the fabric. In no case will riprap be dropped on uncovered fabric from a height greater than three feet.



## 5. DUNE STABILIZATION WITH GRASSES

Dune stabilization is needed where blowing sand is a problem and where there is a need to prevent damaging erosion of established dune areas; prevent accumulation of sand over roads, walks, buildings, and other manmade works; and impede sand encroachment and burying of sites already protected by perennial vegetation.

For an effective first line defense, plants grown on the "grass" or "pioneer" zone (zone closest to the ocean and has direct exposure to the elements) must have the following characteristics:

- a. Be able to tolerate up to several feet of sand accumulation a year;
- b. Withstand sand blast strong enough to take the paint off a car;
- c. Withstand salt spray;
- d. Survive droughtiness, high heat, and low nutrient supply; and
- e. Be able to trap and hold sand against wind and water erosion.

The following four perennial grasses meet these requirements:

- a. American beachgrass - A tough dune starter that transplants easily and rapidly captures sand from the wind. This grass does best on frontal dunes where sand is whipping and drifting around it. After the grass is

dense enough to cut off sand movement, the plants lose vigor, and the sand begins to deteriorate. At this stage, the grass can be maintained only with applications of fertilizer. This grass should be combined with sea oats or bitter panicum for a longer vegetative cover.

Date of planting: November 1 to April 1, with earlier dates preferred.

Depth of planting: 8" to 10"

Spacing: 1" in row and 2' row width

Method of planting: 1 to 3 plants in individual holes made with shovel or dribble. Larger areas may be planted with a tobacco transplanter.

- b. Sea Oats - A plant which spreads from long extended rhizomes with pale green leaves which die back to the ground each winter; beachgrass leaves remain partially green. It grows best where sand is drifting and accumulating. Unlike beachgrass, it persists after the sand has been stilled. It is the perfect replacement for beachgrass in the pioneer zones. Digging is illegal; however, permission from the local county dune protection officer may be given. Dig young healthy plants.

Date of planting: November 1 to April 1

Depth of planting: 10" to 12"

Spacing: 1' in row and 2' row width, or 4' x 4' middles of new beachgrass plantings.

Method of planting: Same as beachgrass. Sea oats are good replacement for dead beachgrass plants.

- c. Bitter Panicum - A very aggressive but scattered system of far-reaching rhizomes. This grass is not as efficient at dune building as sea oats or beachgrass when planted alone. By including this grass in 10 percent of a dune planting, it can help assure a long-term stability of an area. This grass has bluish smooth leaves approximately 12 inches long. The seed head does not produce viable seed.

Date of planting: March 1 to June 1

Depth of planting: 6"

Spacing: Since planting stock is not readily available, a wide spaced interval of 4' x 4' seems practical.

Method of planting: With small plants, use the same method as beachgrass. An 8" to 10" rhizome may be planted with at least two nodes on each piece. Plant 4" deep.

- d. Marshhay Cordgrass or Saltmeadow Cordgrass - This 2-2 1/2' grass is best adapted to moist sites such as sand flats. While this species prefers moist sites, it will also produce and hold a scattered stand in drier sites such as hummocks between dunes. It spreads by slime rhizomes which are often banded in purple. The leaves are rolled inward giving them a rush-like appearance. The perennial persistence of this grass gives it a worthwhile value as one of several species which together will provide the final long-lasting dune protection.

Date of planting: March 1 through May 30. On low flats where drying is not a problem, you can plant through June.

Depth of planting: 4" in moist areas; 5"+ in dryer sites.

Spacing: Same as beachgrass, or for wider spacing, use 2' in row and 4' row widths.

Method of planting: Plant several stems rooted at the base and preferably with a section of rhizome attached. Rootstock is easy to locate in lower lying areas such as you commonly find along the sounds or Intracoastal Waterway.

#### Fertilization

Dune grasses appreciate fertilizer, especially when they are just getting started. Nitrogen and phosphorus

are particularly helpful, with nitrogen the most critical. A general recommendation would be 150-200 pounds/acre of nitrogen and 50-60 pounds/acre of phosphorus, divided into three equal amounts, around March, June, and September. One or two applications of 30-40 pounds/acre of nitrogen and 15-20 pounds/acre of phosphorus are recommended for the second year starting in April. The third year and after, use one application or no application every other year, depending on growth. Do not over fertilize; the plants will grow too tall and fall. It will also increase the risk of disease. Fertilizer is best applied by hand; ground equipment may damage the plants.

#### Helpful Tips

1. A sand fence parallel to the shore and in the middle of the planting will help collect sand.
2. Pure stands may encourage pest and disease. Also, no one grass is good for both immediate and long-term stabilization.
3. Avoid excessive traffic over the dune. Keep dune buggies off.

## 6. STANDARDS AND SPECIFICATIONS

### a. Establishing and Maintaining Lawn Grasses

#### (1) Selection of Grass

There are six species or kinds of lawn grasses that are adapted to the area climate and soil types:

(a) centipedegrass (Eremochloa ophiuroides); (b) bermudagrass (Cynodon dactylon); (c) St. Augustine or Charlestonegrass (Stenotaphrum secundatum); (d) bahiagrass (Paspalum notatum); (e) zoysiagrass (Zoysia matrella), and (f) tall fescue (Festuca arundinacea). Five of these grasses are warm season perennials (green and growing from late spring to mid fall and brown in winter) and one is a cool season perennial (green almost year round but grows most between October and April).

(a) Centipedegrass - This species will take traffic abuse, grow on the poorest of sites, and needs maintenance less than other lawn grasses. It will grow in full sunlight and partial shade. It spreads by above-the-ground runners and can be established by planting the runners (sprigs) or seed. With seed and proper care, a good sod can be established in one growing season. Sprigs are slower and usually require two years to acquire a good turf. Centipede thrives on soils in the pH range of 5.5 to 7.0. High levels of phosphorous are harmful, therefore, and fertilizers which are low in phosphorous should be used. One moderate fertilization of high nitrogen fertilizer per year is sufficient

for mature grass. Mowings will be about three weeks apart to a height of 1 to 1 1/2 inches.

- (b) Bermudagrass has several varieties, but common bermudagrass is the most practical choice for lawns. Growth is very fast and a full cover can be obtained in one growing season from seeds. It spreads by runners above ground and rhizomes below the ground. Bermudagrass has a high resistance to wear and weather damages. It requires sunny locations, high amounts of nitrogen, and liberal fertilization. Mowing should be weekly during the growing season to a height of 1 to 1 1/2 inches.
- (c) St. Augustine or Charlestonegrass is a lush, wide-bladed species which spreads by above ground runners. It is well adapted to shade and is therefore, the best choice for shaded housing locations. The vigorous growth makes a dense mat which chokes out undesirable weeds. It is subject to chinch bug damage and must be checked regularly for their presence. It is best suited to well or somewhat poorly drained sites of moderate fertility. Establishment is by sprigs only and maintenance mowing should not be closer than 1 1/2 inches.

- (d) Bahiagrass is a species native to South America. The two varieties adapted to this area are 'Pensacola' and 'Wilmington'. Wilmington is more cold hardy and makes a tighter sod than pensacola. Bahia will grow on deep sandy soils and somewhat poorly drained sites. Fertility requirements are low and its tolerance to acidity is high. Seeds are born in a "V" shaped seed head. Seed heads appear in late June and reappear soon after mowing throughout the summer. The grass is disease free, traffic resistant, and requires little maintenance other than mowing. Mowing height should be from 1 to 1 1/2 inches.
- (e) Zoysia or Manilagrass has a very fine dark green blade and forms a dense mat. It spreads slowly from above ground runners and rhizomes. It is moderately drought tolerant and must be mowed every seven to ten days. Mowing height should be 1 to 1 1/2 inches. The thatch of dead clippings which accumulates must be removed each spring. The grass is established by sprigging. It grows slowly and takes two to three years to obtain a good cover. It grows in full sunlight or partial shade. All



varieties of zoyzia are resistant to wear and disease.

- (f) Tall fescue is a tall-growing, perennial bunchgrass that is well adapted to the heavy and/or wet soils of the area. Kentucky 31 is the best variety available. Where it is well adapted, tall fescue will come nearest to giving a year-round green lawn of any grass available in North Carolina. But, it will stop growing (go semi-dormant) in the hot part of summer. This must be recognized as normal and the plants should not be forced to grow by applying extra fertilizer and/or water at such times (diseases will kill the grass if forced). Tall fescue grows well in sun or medium shade. It resembles Italian (annual) ryegrass; however, it is coarser and makes a coarser-textured lawn. Thus, it should be considered for use in extensive areas where a tough, wear-resistant, medium-quality turf is wanted. Always use certified seed, since uncertified lots are often contaminated with ryegrass. Heavy seeding helps eliminate the bunchy effect. Mowing height should be about 2-3 inches high. Close cutting will thin stands and allow weed invasion.

## (2) Establishment

A lawn is not difficult to establish if a few key points are remembered: (1) prepare a good seedbed; (2) select a suitable grass variety to the location; (3) use tested seeds or certified sprigs at the recommended rate; and (4) supply adequate fertilizer and water. A soil test should always be taken before an attempt is made to establish a lawn. Table 1 gives the essential management data for each of the adapted lawn grasses.

## (3) Lime and Fertilizer

Lime and fertilizer are important items in producing and maintaining healthy and attractive lawns. Ample lime and the correct analysis fertilizer applied at the correct time and rate is essential for lawn maintenance. This requirement varies with different grass as use and natural fertility of the site.

Most of the soils are too acid to grow good grass unless corrected by liming. Even though some grasses are more tolerant of soil acidity than others, the adverse effects of soil acidity are expensive compared to the simplicity of correction. Lime should be applied during seedbed preparation in accordance with the recommendations of a soil test. After establishment and as regular

maintenance, liming should be done periodically in amounts adequate to forestall serious acidity problems. Making a soil test at least every three years should provide an accurate guide to treatment needs. For warm season grasses, apply lime during the fall for the desired effects during the following growing season and in the spring for cool season grasses.

Either inorganic or organic nitrogen fertilizer may be used for maintaining lawns. Organic nitrogen gives more uniform stimulation to grass over a longer period of time. Cost is higher for organic nitrogen. Nitrogen is the growth regulating element that produces the rich green color in lawn grasses. Since it cannot be stored by the plant or in the soil for any length of time, it must be applied several times annually.

Grasses normally respond favorably to a 4:1:2 to 4:1:3 (N:P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O) ratio fertilizer. Most of these grasses require phosphorous and potash in the spring and fall for healthy growth and minimum cold damage during winter. Centipede and bahia are low-fertility grasses and one application of phosphorous and potash at the start of the growing season is sufficient. The time interval between nitrogen applications depends on the type of

nitrogen fertilizer being used and the quality of turf desired. Large applications of nitrogen during the late growing season should be avoided. The soil test taken every three years on all lawn areas will provide guidance in the proper amounts of plant nutrients to be applied.

(4) Mowing

Scheduling of a mowing program for an area as large as Camp Lejeune is an important part of the maintenance program. The objective of the schedule is that no more than 1/4 to 1/2 of the total leaf surface is removed at one mowing. This can generally be accomplished by setting all mowers to cut at a height of 1 1/2 to 2 inches. Mowing should be done when the grass and soil are dry to prevent lawn diseases. Whenever possible, the removal of clippings is desirable. Proper application of fertilizer and periodically mowing will greatly reduce weed competition and thatch accumulation. Removal of thatch will be done as needed.

(5) Irrigation

Irrigation is not normally required in this region of the state. There are special cases when irrigation is necessary to reduce drought injury and to assure good germination and/or development

of a full cover of grass. In these cases, irrigate with a sprinkler that will not pack the soil or cause erosion of the area from too rapid an application. Apply the water no faster than the soil can take it up, and wet the soil thoroughly to a depth of six inches at each sprinkler setting. Lighter, more frequent waterings will promote the growth of shallow rooted annuals such as crabgrass and annual weeds.

(6) Weed Control

Program emphasis will be on controlling broadleaf weeds. The strategy for weed control consists of two parts. First, promote and manage for a healthy and dense grass sod so that weeds will have difficulty in establishing themselves. Second, conduct an annual spray program. Spraying is to be done in accordance with rates and chemical recommendations made by the School of Agriculture and Life Sciences, North Carolina State University, Raleigh, North Carolina.

(7) Disease and Insect Control

Diseases are not a serious problem in this area of North Carolina if lawns are properly fertilized and maintained. During extremely wet summer periods, mildew or algae may appear in scattered

areas. This can be cleared up with a few weeks of good weather and proper management.

Lawn insects that attack adapted grasses are grubs and ants which act mainly below the ground; sod webworms, armyworms, and cutworms which feed on leaves and stems; and chinch bugs and leaf hoppers which feed by sucking the grass juices.

Chemical control of insects and diseases should be in accordance with recommendations made by the School of Agriculture and Life Sciences, North Carolina State University, Raleigh, North Carolina.

TABLE 1 ADAPTED COOL AND WARM SEASON GRASSES

	Centipedegrass Eremochloa ophiuroides	Common Bermudagrass Cynodon dactylon	St. Augustine Stenotaphrum secundatum	Bahiagrass Pasapalum notatum	Zoyziagrass Zoyzia matrella	Tall Fescue Festuca arundinacea
Tolerance to foot traffic and wear	Medium	High	Low	Medium	High	Medium
Soil Preference	Well drained coarse-medium textured	Well to somewhat poorly drained coarse-medium textured	Well drained medium textured	Well to somewhat poorly drained	Well drained medium-fine textured	Moderately well to somewhat poorly drained medium fine textured
Shade Tolerance	Medium	Low	High	Medium	Medium	Medium
Water Tolerance	Low	Medium	Medium to high	Medium	High	Low
Optimum ph Range	5.5 - 7.0	6.5 - 7.0	6.5 - 7.0	6.5 - 7.0	6.5 - 7.0	5.5 - 8.0
Fertility Requirements	Low	High	Medium	Low	Medium	Medium
Method of Propagation	Seed-vegetative	Seed-vegetative	Vegetative	Seed	Vegetative	Seed
Optimum Propagation Period	May - June	April - May	April - May	April - May	May - June	Sep - Nov, Feb - Mar, Apr - May
Pounds of Seed per 1000 sq. ft.	1/4 lb.	2 lbs.		2 lbs.		3 - 5 lbs.
Bushels of Sprigs per 1000 sq. ft.	1/2 - 3/4 sq.yd.	1/5 - 1/3 sq.yd.	3/4 - 1 sq. yd.		1/6 - 1/4 sq.yd.	

TABLE 1 (Continued)

	Centipedegrass <i>Eremochloa ophiuroides</i>	Common Bermudagrass <i>Cynodon dactylon</i>	St. Augustine <i>Stenotaphrum secundatum</i>	Bahizgrass <i>Paspalum notatum</i>	Zoyziagrass <i>Zoyzia matrella</i>	Tall Fescue <i>Festuca arundinacea</i>
Annual fertiliza- tion, pounds per acre for medium manage- ment	70-70-70	100-25-50	80-20-40	70-70-70	80-20-40	80-20-40
Annual fertiliza- tion, pounds per acre for high manage- ment	100-100-100	160-40-80	120-30-60	100-100-100	120-30-60	100-25-50
No. Fertiliza- tions annually	1	5 - 6	4 - 5	2	4 - 5	2 - 3
Frequency of fertilizing (weeks)		4 - 6	6 - 8	12 - 14	6 - 8	8 - 12
Dat of first annual fertiliza- tion	April 1	April 1	April 1	April 1	April 1	Feb 15, Sep 1
Height of cutting (inches)	1 to 1-1/2	1 to 1-1/2	1-1/2 to 2-1/2	1 to 1-1/2	1 to 1-1/2	2 - 3
Frequency of cutting (days)	14 - 21	5 - 10	10 - 14	5 - 10	7 - 10	5 - 10



## b. Using Shrubs in the Landscape

Of all the plants used in landscaping, the shrubs have the most intimate appeal. Unlike trees and flowers, their size is easily related to man. The wide-ranging beauty of their foliage and flowers makes them attractive to have close at hand. At their best they are used to separate areas and define spaces.

### (1) Basic Sizes and Shapes

There are shrubs of every gradation in heights from shoe-top to above the upraised hand, but for use they can be logically divided into four sizes: knee high, 1 1/2 to 2 feet; waist high, 2 1/2 to 3 1/2 feet; head high, 6 to 6 1/2 feet; and fingertip high, 7 feet and over.

The same is true of shape. There are shrubs of every shape, from narrow to spreading; but if you think of them in the four general groupings, they easily can be related to the spaces you want to fill in the landscape.

(a) Rounded - This is the form with greatest mass.

Some can be pruned to be spreading, upright, or vase-shaped.

- (b) Vase-Shaped - Some of these are graceful and others tend to be leggy and bare at the base. Many of the best-known flowering shrubs are this shape.
- (c) Spreading - Shrubs of this shape are useful for large-scale ground covers and to fill horizontal spaces.
- (d) Upright - Included in this category, to simplify selection, are columnar shrubs as well as upright forms.

## (2) Basic Kinds of Shrubs

Shrubs will be either broad-leaved or needle-leaved, evergreen or deciduous, and are indicated as such in table 2. The broad-leaved evergreens have attractive foliage the year round, and some, such as the rhododendrons and azaleas, also have magnificent flowers in their season. While the foliage is called "green", it does in many cases take on variations in color that slowly change from chartreuse to bronzy green with the seasons. Most of the broad-leaved evergreens are limited to mild climates.

Needle-leaved shrubs are all evergreens, bear seeds in woody cones, and are classed as conifers.

There is great variation in shape, texture and the shade of green in most needle-leaved shrubs.

Deciduous plants are those that lose their leaves in winter. Most deciduous plants are hardy in cold climates and require full sun to flower.

(3) Selecting the Right Shrubs

Table 2 lists shrubs considered to be best suited to the average minimum temperatures at Camp Lejeune. However, the average minimum temperature is not the only factor affecting plant growth. Rainfall, soil composition and characteristics, and the duration and intensity of the sunlight all have their effect upon the growth of shrubs and must also be considered. The temperature, however, is the most useful and dependable single indicator.

(4) Setting Out Shrubs

Choose a healthy shrub from the nursery. Give it the sun, shade, air circulation, and the soil it needs and it should continue to grow well from the day you set it out. For individual plantings, make the planting hole at least a third larger than needed to accommodate the roots or root ball. Mound at the bottom and position the plant so the ground level will be the same as before it was dug. Any shrubs or trees may come with their roots in a ball of earth wrapped in burlap, however, deciduous plants may be handled "bare root" if dug up and replanted during their dormant season. The space

around the roots can be filled with topsoil enriched with fertilizer such as 5-10-10, so the feeder cells at the end of the root system will have a good medium for growth. Firm the soil around each plant and use water to settle the soil around the roots. Always make a watering reservoir by mounding the soil in a circle at the perimeter of the root area or the ground surface. Mulch each plant with sawdust, pine bark mulch, pine straw, or other suitable mulching material. Use guide wires to support taller transplanted shrubs.

Broken or damaged stems should be removed or pruned. The tops of bare-root plants are cut back one-third or more to compensate for the loss of roots. If necessary to induce branching in single stemmed or high-branching shrubs, the stems can be cut back as low as six inches or less from the ground.

(5) Maintenance

(a) Pruning.

On established shrubs corrective measures must often be taken to restore them to attractive form. For deciduous plants that have grown lean and rangy, cut back the stems to inward-facing buds to throw the growth that way. Cut back severely to make the branching start as low as possible. If the growth is too tight, reverse the process and randomly cut out branches to open it up, removing the branches completely or cutting back to buds that face outward. Remove dead stems, as well as tired, old twiggy ones that show little new growth. Prune those plants that bloom in spring on wood of the previous year's growth in late spring, immediately after blooming is over. On later blooming shrubs, blooming on the current year's growth, prune in late winter or early spring before growth starts.

For old deciduous plants which have lost their vigor and have become twiggy, remove whole stems, usually as close to the ground as possible. Normally, take about one third of the oldest stems out the first year, the same number the second, and the rest the third.

Evergreens differ from deciduous plants in that they need less pruning than broad-leaved plants. Also many evergreens do not readily throw out new branches after cutting. For the spruces and pines, pruning should be completed just before new growth starts or is still in its early stages, not because it is necessary for the formation of buds, but so the plants may outgrow their "haircut" appearance as soon as possible.

Flowering and berry-bearing evergreens that go into the dormant period with their flower buds already formed, are cut immediately after blooming. Plants that produce flower buds later on new wood, such as the hollies, may be cut any time during the dormant period, or if berry-bearing, as soon as the fruits are ripe.

(b) Fertilization.

After the first year, plants should be fertilized on a biennial basis in spring or early summer. The following mixtures should be used:

Poor acid tolerating plants such as azaleas, camellias, hollies, and other specialty plants use a mixture of 200 pounds of cottonseed meal,

600 pounds 8-8-8 commercial fertilizer, 100 pounds of ferrous sulphate and 25 pounds of magnesium sulphate. Use 1 to 2 pounds of the mixture for each inch of trunk diameter.

Spread the mixture on the soil around the plant to about 1 1/2 feet beyond the tips of the branch.

For broad-leaved and needle-leaved evergreen shrubs, use a mixture of 100 pounds of cottonseed meal and 200 pounds 6-8-6 or 8-8-8 commercial fertilizer. Use 1 to 2 pounds of mixture for each inch of trunk diameter.

For deciduous plants, use 1 to 2 pounds of 8-8-8 commercial fertilizer per inch of trunk diameter.

(c) Insect and disease.

Several measures may result in prevention of shrub disease. These include:

Remove diseased portions of plants. Use nursery stock that is certified and free of disease.

Remove and destroy diseased plants that cannot be saved to prevent spread of the disease or insect.

Protection - Spraying or dusting plants may prevent growth and entrance of parasitic fungi

and bacteria. It is highly essential that complete coverage of the plants be obtained to prevent infestation repeated applications be made at certain intervals depending on the disease and climatic conditions. Exercise care to avoid mechanical injuries caused by machinery used in landscaping, mowing, etc. This will aid in preventing infestation. Resistant varieties - Use of resistant varieties, when obtainable, is always the best method of control.

Cultural practices - Strong, vigorous, well kept plants usually have a better chance of escaping diseases than poorly cared for plants. This includes proper fertilization, watering during prolonged droughts, and mulching.

- (d) Apply control measures when pests are first observed. To obtain the best control, the spray must be prepared properly, applied promptly, and applied with good equipment to the entire area of the plant; and particular attention will be given to the underneath surface of leaves.



TABLE 2 - SELECTED SHRUBS AND CHARACTERISTICS 1-/

## 1. Knee-high, 1 1/2 to 2 feet

- (A-1-b) Dwarf shrub holly (Ilex crenata). The variety helleri is a dark green mound to 12 inches high and 18 inches wide with tiny rounded leaves. Use it in rows as a front edging or massed as a ground cover.
- (B-1-b) Dwarf bamboo (pleioblastus pumilus). This little bamboo with its handsome wide-bladed leaves creeps by underground roots to make a clump and is an effective low accent. There are several other larger, hardy bamboos. Sun or half shade.
- (B-1-b) Santolina: Gray santolina or lavender-cotton (S. chamaecyparissus). These are evergreens with gray foliage. Green santolina (S. virens) has bright green leaves and all have a pleasantly pungent aroma. Does best in full sun.
- (C-1) Small-leaved cotoneaster (Cotoneaster microphylla). Tiny rounded leaves make a neat evergreen mound. Has small white flowers followed by red fruit.
- (C-1-b) Reeves skimmia (S. reevesiana). The common skimmia (S. japonica) grows to 4 feet or so. Reeves skimmia is half the height but has larger pointed leaves of shiny green. Flowers are white and berries are red. Requires partial or full shade for best performance.
- (C-1-b) Dwarf English box (Buxus sempervirens suffruticosa). The standard dwarf edging boxwood may be used as a continuous line or with spacing between plants. Can be kept to neat globes no more than 3 or 4 inches high. Does well in the sun or part shade.
- (A 1-b) Boxwood (B. sempervirens). Vander valley. A small mounded variety of good green color that grows to about 1 1/2 feet high and slightly wider.

- (B-2-a) Miniature rose (Rosa chinensis minima). Perfect rose plant. Interesting accents but require considerable attention to watering, feeding, and pest control.
- (C-2-a) Coast azalea (Rhododendron atlanticum). This good-looking shrub spreads by underground roots to make a mass. Has fragrant white or light rose flowers to 1 1/2 inches across in spring. Blooms freely and makes a good show. Requires humus soil on the acid side. Keep in mind that this is not an evergreen as are most azaleas.
- (C-2) Chilean pernettya (Pernettya mucronata). A small bushy deciduous shrub with shiny leaves. Although the flowers are minimal, the showy fruit in red, violet, purple, pink, or white is outstanding in the fall and winter. For best fruiting, plant varied kinds, but group the colors together or it can be too gaudy. Does best in full sun.

2. Waist-high, 2 1/2 to 3 1/2 feet.

- (A-1-b) Shrub holly (Ilex crenata) 'Green Island' A perky shrub holly with upward spreading branches. Bright green rounded leaves are about 3/4 inches across. Takes shade.
- (C-1-a) Snow azalea (Rhododendron mucronatum also known as R. ledifolium album). Evergreen leaves to 3 inches long; white fragrant flowers.
- (B-1-a) True lavender (Lavandula officinalis). Interesting and unusual gray-green leaves. Good for dooryard planting or as single plants for accent in a planting of flowers. Flowers of lavender color are born in upright spikes in June. Does well in dry sunny situations. Dried leaves hold the familiar scent.

- (C-1-a) Kurume azaleas (Rhododendron obtusum). These handsome medium-sized azaleas have small shining evergreen leaves on dense branches. They literally cover themselves with flowers. As do all rhododendrons, they require humus soil on the acid side and part shade. The variety 'Amoenum' has purple to magenta flowers. 'Hinodegiri' is a bright magenta red. 'Hinoerinsan' is red. 'Christmas Cheer' is a double red, 'Coral bells', double pink.
- (C-2-a) Abelia (Abelia grandiflora). This plant has small leaves with a reddish tinge are evergreen in warmer climates. A light airy plant with pink flowers over the summer. Sun or half shade.
- (C-1-a) Japanese skimmia (Skimmia japonica). Round-pointed glossy evergreen leaves on a rich full upright to rounded bush. Small whitish flowers in clusters in May, followed by red berries borne on the female plants. Both male and female plants required for production of fruit. A good medium height hedge plant. Takes shade.
- (A-1-c) Bird's nest spruce (Picea abies nidiformis). Needled evergreen of dark green color. Dense form is spreading to vase-shaped. There are many dwarf varieties of spruce. This one is hardy to coldest climates, but is very slow growing there.
- (C-1-b) Sarcococca (S. ruscifolia). The small shiny dark green pointed leaves grow thickly and densely on the spreading plant to make a handsome mass of green. Small fragrant white flowers are followed by red berries. This variety is slightly over 3 feet, while Himalayan Sarcococca (S. hookeriana) is lower and has black berries. Does well in shade.
- (C-1-b) Dwarf Chinese holly (Ilex cornuta rotunda). Makes a good dense rounded mass of dark green leaves. Foliage is much less spiny than the typical holly. May be clipped for a low edging or left unclipped to grow to about five feet. Takes sun or half shade, and does best in moist soil.

(C-1-a) Sage (Salvia). Two plants quite similar except for their coloration: Autumn Sage (S. greggi) has gray-green foliage and reddish-purple flowers that bloom almost all year. Mexican bush sage (S. leucantha) has white woolly leaves and purplish flowers. Both take full sun and are quite drought-resistant.

### 3. Head high, 5 to 6 1/2 feet

(C-1-b) Shrub holly or Japanese holly (Ilex crenata). This is a group of handsome wide-growing evergreens with form and foliage quite like boxwood but faster growing and hardier. Rounded varieties include: Convexleaf (I. c. convexa) with shiny green leaves arched in the middle. The form 'bullata' is excellent. Round leaf (I. c. rotundifolia) has shiny flat rounded leaves on a full rounded plant. Hertz boxleaf (I. c. hetzii) is dense in texture and more hardy than the others listed above.

(A-1-b) Upright shrub holly (Ilex crenata and I. C. microphylla). Small leaves held compactly on an upright form. Good to mark corners and as a vertical background accent. For an evergreen screen, plant in a raised bed to bring above eye level. It makes a good solid hedge and grows well in sun or half shade.

(A-1-c) Cripps Hinoki falsecypress (Chamaecyparis obtusa formosana crippsi). Fluffy textured upright conical shrub with golden yellow branchlets. One of the few good evergreens with colored leaves. Still must be used cautiously in the landscape. In very cold or windy locations, edges tend to turn brown in winter. Sun or half shade.

(B-1-b) Heavenly bamboo (Nandina domestica). Many upright bamboo-like stalks, but the leaves are deeply compounded and held horizontally. Light, open, and airy with creamy flowers in spring; red berries in the fall. In cold climates leaves may turn red and fall. In warmer climates it may reach eight feet. Sun or half shade. In Japan it is traditionally set beside a doorway.

- (C-1-b) Burkwood viburnum (Viburnum burkwoodi). The evergreen leaves are dark above and lighter below. It has a loose, open naturalistic character. The flowers have pinkish white heads with waxy petals and are very fragrant. Berries in fall. An excellent shrub of informal character for sun or half shade.
- (C-1-b) Laurel cherry (Prunus laurocerasus). This dense and vigorous shrub has shiny rich dark green foliage, narrow and pointed to three inches long. Can be clipped as a hedge or left unclipped. Sun or half shade. Two outstanding forms are 'schipkaensis' and 'zabeliana', which have particularly good color and a neat habit of growth.
- (C-1-b) Sasanqua camellia (C. sasanqua). This species has the typical glossy foliage and marvelously symmetrical camellia flower. Some varieties, such as the white flowered 'Mine-no-yuki', with its lovely graceful spreading form, and Tanya, which makes a neat low mound, are more interesting in form than the usual upright varieties. All camellias require a humus soil on the acid side. They do best with light shade and protection from the wind.
- (B-1-b) Leatherleaf mahonia (Mahonia bealei). Upright branches with large bold bluish leaves that stand opposite one another on long stems. An unusual and startling architectural effect. Takes sun or half shade. In warmer climates it reaches 8 to 10 feet in height.
- (B-1-b) Gold dust plant (Aucuba japonica). Slightly toothed leaves with gold flecks are prominently displayed and grow to eight inches in length. Makes an interesting touch of leaf color with a tropical effect. Red berries appear in the fall. Also available in a variety with leaves of solid green. Grows in sun or half shade.

- (C-2-a) Old fashioned roses (for warmer climates). These are typical of the "species" roses that are larger, more vigorous, and more shrub-like than the better known garden varieties. Persian Musk Rose (Rosa moschata nastarana) has single pink flowers to two inches across in June. Tea Rose (R. odorata), also pink, is larger and some of the leaves hold on through the winter. Sun.
- (C-1-a) Yeddo hawthorn (Raphiolepis umbellata). A useful broad leafed evergreen with dark leaves to three inches long. Has small white fragrant flowers in clusters, and small black berries. Can be made smaller by clipping as an informal hedge. Takes sun or half shade. Does well in either dry or moist soil.
- (B-1-b) Bamboo (Sasa senanensis and others). This is a handsome bamboo that grows to a height of about five feet. As do all bamboos, it spreads by underground roots and can be difficult to control. It makes an excellent container plant.
- (B-1-a) Rosemary (Rosmarinus officinalis). A spreading, irregular gray-green shrub with narrow three-quarter to one-inch leaves, dark green above, gray below, and highly scented. Has light blue flowers in early summer. Thrives in sun, tolerates dry soil.
- (C-1-a) Evergreen azaleas. The Glenn Dale hybrids are an excellent group in this category. They have good form and foliage, and a wide range of colors. Indian Hybrids (Rhododendron Simsii) are the famous large-flowered, large-growing azaleas of the south. Two excellent choices are: 'Iveryana', with a white flower and rose stripe; and 'Pride of Mobile', a deep pink. They require humus-acid soil and partial shade.
- (C-1-b) Boxwood (Buxus sempervirens suffruticosa). Box grows for centuries to make magnificent specimens. It is clipped for hedges, edging, or left to make gentle masses reaching six feet. The variety 'Myrtifolia' has smaller pointed leaves. Takes sun or half shade.

(B-1-c) Torulosa juniper (Juniperus chinensis torulosa). An evergreen with interesting irregular form, twisted branches, and a good green color. Where an unusual shape is wanted, this is one of the best. Requires sun, takes dry soil.

4. Finger-high, 7 feet and over

(B-1-b) Willowleaf cotoneaster (C. salicifolia). Narrow willow-like leaves on branches which arch gracefully like willows. Red berries in fall. An evergreen, except in cold climates where some of the leaves drop in winter.

(B-1-b) Upright common boxwood (Buxus sempervirens). In addition to the regular mounded boxwood, there are several good upright forms: 'Handworthi' is upright with drooping tips, attractive singly or as a screen; 'angustifolia' has treelike trunks; 'arborescens' is larger with three treelike branches; 'pendula' has hanging branches.

(B-1-b) English holly (Ilex aquifolium). Rich green spiny leaves on a full upright to rounded evergreen plant. A perfect background or unclipped tall hedge, or to use at building corners. Bright red berries on female plants (male plants are required in planting). Takes sun or part shade. Acid-humus damp soil is best. Burford holly have fewer spines and leaves of different shape.

(D-1-a) Chinese photinia (Photinia serrulata). The large evergreen leaves on an oval bush make the photinia a good accent background plant. The attractive flat heads of white flowers are followed in fall by clusters of bright red berries.

(B-1-a) Camellia (C. japonica, C. sasanqua, C. reticulata). The japonicas have good dark green 4-inch leaves on a full bodied plant. A good foliage plant in addition to its value for the classic flowers. Needs cool nights to bloom. Typical varieties: 'Adolphe Audusson', upright, red; 'Alba plena', double white., 'Raikagura', peony shaped rose color on a spreading plant; 'Bernie Boddy', pink, long blooming.

The Sasanquas have smaller leaves and smaller flowers which are often single instead of the usual double form. They are equally delightful and bloom later.

The reticulatas are larger upright plants with larger flowers.

All camellias require soil with plenty of humus and on the acid side. Give them part shade or sun and remove fallen flowers from under plants to avoid petal blight.

(C-1-b) Evergreen privets (Ligustrum) in variety. These are so similar that there's often confusion as to which is which. They all have dark green glossy leaves and make good hedge or background plants, and can be clipped into almost any required shape or left unclipped. They are listed here in order of size - both plant and leaf: Glossy Privet (L. lucidum) to 20 feet will make a small tree. Japanese Privet (L. japonicum) to 12 feet., Texas Privet (L. texanum) to 12 feet.

(C-1-b) Portugese laurelcherry (Prunus lusitanica). Dark evergreen leaves, stiff and densely held. A good background screen or hedge. May reach tree size and can be shaped by pruning, or kept as a hedge.

(D-1-a) Rogers firethorn (Pyracantha crenulata rogersiana). Long narrow rounded leaves on a twiggy bush that trains easily to interesting shapes on a wall, fence or trellis. Clusters of white flowers and red berries.



- (C-1-a) Rhododendron hybrids. These excellent broad-leaved evergreens do best in mild climates so the best of the hybrids are found on the West Coast, on the rainy mountain slopes of the Southeast, or in southern England. The Catawbiense hybrids are included in the six-foot listing. See your local rhododendron nursery. Others to consider are Fortune hybrids, Griffithianum hybrids, Gills Crimson, a good crimson; and 'Beauty of Littleworth,' a good white.
- (B-1-c) Umbrella pine (Sciadopitys verticillata). Has whorls of needles like a yew, but much heavier and longer, to about 5 inches or so. One of the richest textured of all plants, it is good as a hedge or formal accent or corner piece in a mixed planting because of its definite character. Grows best in sun but will also do quite well in part shade.
- (B-1-b) Osmanthus. A group of evergreens with toothed leaves of shiny green and small flowers which are mostly hidden but very fragrant. Makes a good screen or background. O. Fortunei has rounded leaves to 4 inches long on a full dark green bush to 6 feet high. Holly osmanthus (o. ilicifolius) has spiny leaves like holly, but opposite each other. Grows to 20 feet or so. They tolerate almost any growing conditions and are easy to care for.
- (C-1-a) Lanceleaf phillyrea (phillyrea decora). A mounded to upright broadleaved evergreen shrub. Small white flowers in April followed by showy red fruits changing to purple in the fall.
- (B-1-c) Irish yew (Taxaceae baccata stricta). An impressive long-lived plant that makes a large full column of evergreen color and a strong accent.
- (C-1-c) English yew (Taxaceae baccata). A wide-spreading yew that will become a 30-foot tree in time or can be kept clipped to almost any size. It will live for hundreds of years.

(B-1-b) Sweet bay or laurel (Laurus nobilis). Narrow dark evergreen, "bay" leaves closely held on a full columnar plant that grows to 20 or 25 feet and makes a good background or screen. Can also be clipped to a formal hedge or into almost any topiary shape. This is both the laurel of ancient Greece and the bay leaf used in cooking.

(D-1) Wax myrtle (Myrica cerifera). A wild plant related to bayberry. The full irregular form grows to 15 feet. A good sturdy fullgrowing background plant, but may be shortlived. One of the few shrubs that will tolerate boggy soil.

1/ Each plant is coded to shape, kinds, and outstanding characteristics:

Spreading - A	Outstanding for flowers - a
Upright - B	Outstanding broadleaf - b
Rounded - C	Foliage needle - c
Vase-Shaped - D	
Evergreen - 1	
Deciduous - 2	

#### c. Flowering Annuals

Annuals start from seed, grow to maturity, produce flowers, and return to seed all within one growing season. An annual can produce flowers in a matter of weeks and this can be of great value in the landscape.

An easy and effective way to use annuals is to plant them for splashes of bright accent in a green garden of shrubs and ground covers.

Choose varieties that will be compatible with the site they will occupy. Some of them do well in full sun, others can take the shade. Some thrive on little moisture and many are at home in wet situations.

(1) Selecting Annuals and Design Considerations

Several factors should be considered in selection of annuals. These include color, maturity height, hardiness, use, moisture and fertility requirements, the need for open sunlight or shade to flower best, and whether the seeds will be seeded in place or plants transplanted at the desired location. Table 3 is a list of several locally adapted annuals by various characteristics.

Design is important in obtaining the utmost from annuals. To get effective masses of color and also to avoid a spotty appearance, several plants of each variety should be placed in a group. In a large border these groups may be repeated as often as desired. Never less than three and preferably at least half a dozen plants should be used in each group or unit. Except in very formal beds, the spaces devoted to each variety should be irregular in shape and size. The size of each space will be determined by the size and number of the plants to be placed within it and also by the over-all dimensions of the bed or border; the larger the border, the larger should be the size of the individual units of

color (that is, the number of individual plants in each group) comprising it.

Whether annuals are used by themselves in an all-annual border or as supplementary material in a perennial or shrub border, it is all-important to keep in mind the height to which each species or variety used will grow. Unless this is done, the border will be ragged in appearance and a large proportion of the flowers will be hidden by taller plants in front of them.

On the other hand, any appearance of stiff regimentation is to be avoided. Rank behind rank of flowers of even height should be avoided.

The next step is to consider the period of bloom of the various species, and of individual types and varieties. Although many annuals will continue in flower over very long periods (especially if not allowed to form seeds), there are some which can be counted upon for only short periods. In the all-annual border, care should be taken to avoid having too many short season bloomers next to each other, and also to see that each section of the border contains some early-season, some mid-season, and some late-season kinds near each other. Table 1 will enable you to make selections to accomplish this end.

Two important facts should be kept in mind when selecting color.

- (a) The stronger (purer) a color is, the less likely will it be compatible with neighboring colors. Pastel tints and deep shades will give little trouble.
- (b) The closer two colors are placed in conjunction, the more marked will be their harmony or their discord.

The practical application of these two single principles can make a great difference in the degree of charm and appeal of annuals plantings.

Avoid using strong, aggressive colors such as purple, magenta, scarlet, and orange together, unless they are toned down by nearby white or gray, or by plenty of green foliage or unless combined with the complementary colors.

## (2) Preparing the Soil

Satisfactory results in growing annuals largely depends on thorough preparation of the soil where the plants are to grow. Planting annuals in bulb beds after the bulbs have bloomed or in shrub beds for decoration while the shrubs are small, should require little soil preparation since bulb or shrub

beds should already be prepared. A half-inch of peat moss worked into the soil surface before planting in these beds is usually advantageous. Soil preparation should begin in the fall before planting time for new beds.

Spade the soil to a depth of 8 to 10 inches, turning the soil over completely. Remove boards, large stones, and building trash, but turn under all leaves, grass, stems, roots, and anything else that will decay easily and add organic content.

In spring and just before planting, spade again. Prior to spading, add a complete fertilizer. Use 5-10-5 or its equalivent at a rate of 1 1/2 pounds per 100 square feet. Add ground limestone at a rate of 5 pounds per 100 square feet if needed. Work the fertilizer, lime, and other amenities such as peat into the soil.

Rake the soil surface smooth. After raking, the soil is ready for seeding or planting.

### (3) Planting Times

Delay sowing seed outdoors or setting out seedlings until after the last chance of frost for most plants. Seeds will not germinate well until the soil warms to about 60°, and if sowed in soil that is cooler than this, they will remain dormant until the soil warms or may rot before germination. Many of the annuals can be seeded throughout the growing season to provide for a prolonged display of color. See Table 4 for proper times for seeding most of the common annuals.

### (4) Setting Plants

Use of seedlings or started plants is especially desirable and helpful for annuals that are slow to germinate or that need several months to bloom. When setting, remove the plants from flats by slicing downward in the soil between the plants and lifting out each plant with a block of soil surrounding its roots. Set the soil block in a planting hole. If the plants are in fiber pots, remove the paper from the outside of the root mass and set. For plant in peat pots, set the entire pot in the planting hole.

After setting, water each plant with a starter solution made from one tablespoon of high phosphate fertilizer, grade 10-52-17, in 1 gallon of water.

(5) Sowing Seed in Place

To prevent the soil surface from sealing, sow the seed in vermiculite-filled furrows. Make the furrows in the soil by filling one-half inch deep slots with fine vermiculite, and sprinkling with water. At seeding make a shallow furrow in the vermiculite slot and sow the seed into this furrow. Seed at the recommended rate.

After seeding, cover with a layer of vermiculite and, using a nozzle adjusted to a fine mist, water the areas thoroughly.

(6) Thinning

When the seedlings develop to true leaves, they should be thinned to the recommended spacing. See Table 4.

(7) Maintenance

(a) Mulches help to keep the soil surface from crusting, aid in preventing growth of weeds, and add organic matter to the soil. Grass clippings when available, make a good mulch for annuals.

(b) Cultivate only to break crusts on the surface of the soil. When the plants begin to grow, stop cultivating. Pull weeds by hand. Continued cultivation can cause injury to the



spreading of roots which develop between the plants.

- (c) To maintain plant vigor, remove mature flowers and seed pods.
- (d) Watch for insects such as spider mites, aphids, Japanese beetles, lacebugs and thrips, and treat with insecticides as needed. Normally, you do not need to pretreat for soil insects unless you find large numbers of cutworms, white grubs, or wireworms when preparing the soil for planting.

When using pesticides, be sure to read and follow all directions for use, including precautions shown on the label. If pesticides are handled, applied, or disposed of improperly, they may be injurious to human beings, desirable plants, or flowers and beneficial insects. Use pesticides only when needed and handle them with care.

TABLE 3 CHARACTERISTICS OF SELECTED AND ADAPTED GARDEN ANNUALS

PLANT	HEIGHT Inches	BEST USE	COLOR	REMARKS
Mexican Ageratum	6-20	Edging	Blue, lavender blue, white	They take sun if it is not too hot. Tall varieties grown for cut flowers. Blooms from mid-June to frost.
Babysbreath	12-18	Borders	White	Source of cut flowers and plants for drying. Filler material in arrangements. Grows well on alkaline soils. Give plenty of room and sun.
Balsam	20-28	Beeding	Various	Good window-garden plant. Will not tolerate wet or cold weather.
Calendula	14-18		Yellow	Daisy-like flowers. They tolerate little shade, dislike intense heat. Source of cut flowers.
Calliopsis	18-24	Beeding, edging	Yellow, brown red	Source of cut flowers. Blooms quick, last all summer.
Candytuft	9-12	Edging, bedding	White, pine & lavender	Rock-garden plant. Filler. Select dwarf ones for bedding. Excellent edging in full sun.
China aster	12-24	Beeding	Various	Daisy like or pompom flower. Successive planting will provide flowers for both cutting and garden bloom.
Cockscomb	16-40		Yellow to crimson	Source of cut flowers and plants for drying.
Coleus	20-24		White to crimson	Perennial grown for decorative foliage. Good plant for window gardens.
Cornflower	16-36		Blue, pink, white	Source of cut flowers.
Cosmos	30-48	Screen, bedding	Various	Outstanding flower with large-petalled blossoms. Blooms from July to frost.
Dahlia	18-40	Bedding, edging	Crimson to white	Source of cut flowers. Background
Forget-me-not	8-12	Bedding, borders	Various	Source of cut flowers. Blooms early. Makes good edging plant.
Four-o'clock	20-24	Bedding	Pink, white, yellow	Source of cut flowers. Does not withstand heat.
Gaillardia	12-18	Borders	Various	Source of cut flowers. Does not withstand heat.
Globe amaranth	18-24		Crimson	Source of cut flowers and plants for drying.
Impatiens	10-12	Beeding	Red, pink, white	Dependable in sunny and shady areas. Single blossom varieties best. Water well at first signs of wilting.
Larkspur	18-48	Screen	Various blues	Source of cut flowers.
Lupine	18-24	Borders	Great variety	Long spikes of pea-like flowers. Blooms during May and June. Needs plenty of water.
Marigold	6-30	Beeding	Yellow to red-brown	Source of cut flowers; good window-garden plant
Morning glory		Screen	Various	Vine; grows 8 to 12 feet tall.
Nasturtium	12	Bedding, edging	Scarlet to	Pungent odor; blooms 1 month after sowing. Needs well-drained soil.
Pansy	6-10		Varied purple, blue, yellow, white	Source of cut flowers. Pot plants after bloom, protect for overwinter. Replace with petunia for summer bloom.

TABLE 3 (Continued)

PLANT	HEIGHT Inches	BEST USE	COLOR	REMARKS
Petunia	8-24	Bedding	Various	Good plant for window gardens. Long blooming period.
Phlox	6-12		Various	Withstand heat. More compact than petunias.
Poppy	12-16	Borders	Yellow-orange	Source of cut flowers. Successive sowings. Does well in poor soil or light shade.
Portulaca	6-9	Bedding,	Purplish-crimson, yellow, white	Good plant for rock gardens. Withstands heat.
Rudbeckia	20-24	Borders, bedding	Yellow, black center (Black eyes susan)	Source of cut flowers. Heat loving.
Salpiglossis	20-30	Bedding	Purples and yellow variegated	Source of cut flowers. Does not withstand heat.
Scabiosa	18-36	Borders	Various	Source of cut flowers. Remove dead flowers.
Scarlet sage	14-36	Borders, bedding		Short varieties bloom early; tall varieties bloom late.
Snapdragon	10-36	Bedding	Various	Source of cut flowers, good plant for window gardens (dwarf). Select rust-proof varieties.
Spider plant	30-36	Borders, hedges	White and pastel	Long blooming period.
Stock	24-30	Bedding	Tones of rose, purple	Source of cut flowers; good plant for window gardens. Overwinters in protected areas.
Strawflower	30-40		Red, pink, yellow, white	Source of cut flowers and plants for drying
Sunflower	48-84		Golden	Source of cut flowers.
Sweet alyssum	6-10	Edging, borders	White	Grow in well-drained soil. Damps off easily. Neat and free flowering. Long blooming period.
Sweetpea		Screen	Various	Vine, grows 4 to 8 feet long. Source of cut flowers. Prefers cool growing weather.
Verbena	9-12	Bedding	Magenta to white	Source of cut flowers. Covers spots left by spring-flowering bulbs. Perennial grown as an annual.
Vinca	15-18		White with red eye and pink most popular	Perennial grown as annual. Good plant for window gardens.
Zinnia	18-36		Various	Source of cut flowers. Endures heat. Foliage frequently mildews.

TABLE 4 PLANTING AND CULTURE OF SELECTED AND ADAPTED GARDEN ANNUALS

PLANT	WHEN TO PLANT SEED	EXPOSURE	GERMINA-	PLANT	REMARKS
			TION TIME	SPACING	
			Days	Inches	
Mexican Ageratum	After last frost	Semishade or full sun	5	10 to 12	Pinch tips of plants to encourage branching. Remove dead flowers.
Babysbreath	Early spring or summer	Sun	10	10 to 12	Make successive sowings for prolonged blooming period. Shade summer plantings.
Balsam	After last frost		10	12 to 14	
Calendula	Early spring or late fall	Shade or sun	10	8 to 10	
Calliopsis	After last frost		8	10 to 14	
Candytuft	Early spring or late fall		20	8 to 12	
China aster	After last frost		8	10 to 12	For best plants start early, grow in clodframe. Make successive sowings for prolonged bloom.
Cockscomb			10	10 to 12	
Coleus	Sow indoors anytime; outdoors after last frost	Sun or partial shade	10	10 to 12	
Cornflower	Early spring	Partial shade	5	12 to 14	
Cosmos	After last frost	Sun	5	10 to 12	
Dahlia			5	12 to 14	For maximum bloom, sow several weeks before other annuals.
Forget-me-not	Spring or summer; shade in summer	Partial shade	10	10 to 12	
Four-o'clock	After last frost	Sun	5	12 to 14	Store roots, plant next year
Gaillardia	Early spring through summer; shade in summer		20	10 to 12	
Globe amaranth	Early spring		15	10 to 12	
Impatiens	Indoord anytime; Set out after last frost	Partial shade or deep shade	15	10 to 12	
Larkspur	Late fall in South, early spring in North	Sun	20	6 to 8	Difficult to transplant; grow in peat pots.
Lupine	Early spring or late fall		20	6 to 8	Soak seed before planting. Guard against damping-off.

TABLE 4 (Continued)

PLANT	WHEN TO PLANT SEED	EXPOSTURE	GERMINATION TIME Days	PLANT SPACING Inches	REMARKS
Marigold	After last frost		5	10 to 14	High fertility delays bloom.
Morning glory			5	24 to 36	Reseeds itself.
Nasturtium			8	8 to 12	For best flowers, grow in soil of low fertility.
Pansy	Spring or summer; shade in summer	Sun or shade	10	6 to 8	Does best in cool season.
Petunia	Late fall (in South)	Sun	10	12 to 14	Start early in spring indoors. Keep cool.
Phlox	Early spring		10	6 to 8	Make successive plantings for prolonged bloom.
Poppy	Early spring through summer; shade in summer		10	6 to 10	Difficult to transplant; start in peat pots. Make successive plantings.
Portulaca	After last frost or in late fall		10	10 to 12	
Rudbeckia	Spring or summer, shade in summer	Sun or partial shade	20	10 to 14	Perennial grown as annual. Blooms first year.
Salpiglossis	Early spring	Sun	15	10 to 12	Needs support. Avoid cold, heavy soil.
Scabiosa	Spring or summer; shade in summer		10	12 to 14	Keep old flowers removed.
Scarlet sage			15	8 to 12	
Snapdragon	Spring or late fall		15	6 to 10	Start cool, pinch tips to encourage branching.
Spider plant	Early spring; spring, or fall		10	12 to 14	Reseeds freely. Pinch to keep plant short. Water and fertilize freely.
Stock			5	6 to 10	
Strawflower	Early spring		5	10 to 12	
Sunflower	After last frost		5	12 to 14	
Sweet alyssum	Early spring		5	10 to 12	Damps off easily. Sow in hills, do not thin.
Sweetpea	Early spring or late summer through late fall		15	6 to 8	Select heat-resistant types.
Verbena	After last frost		20	18 to 24	Pinch tips often to encourage branching.
Vinca			15	10 to 12	Avoid overwatering.
Zinnia			5	8 to 12	Thin after plants begin to bloom; remove poor flowering plants.

#### d. Ground Covers

Plants included in this group are herbaceous perennials, many evergreen and deciduous shrubs of various heights, and certain vines that creep over the ground. The uses and usefulness of these plants vary considerably according to situations, and many are adapted to grow in problem areas where it is difficult to maintain lawns or other less vigorous plants. Three of the most important uses of ground covers are: (1) to create texture and color contrasts in the landscape; (2) to define special spaces or areas; and (3) to cover the ground and provide soil protection in areas where grass is difficult to grow or maintain.

Ground covers can be used in many ways. They can be planted as a pleasant foreground for the shrub boarder, and are of particular value for use among plantings of broad-leaved evergreens. Ground covers serve much the same purpose as a mulch in that they keep the soil cool and moist. Ground covers may also be used very successfully on narrow or odd-shaped areas that are often difficult to mow or maintain.

##### (1) Selection of Ground Cover

Selection of a suitable ground cover will depend upon the site conditions. There are ground covers that grow well only in partial shade, others that require full sunlight, and others that are

tolerant of both sunlight and shade. Some prefer moist soils, rich in humus, while others are particularly well adapted to dry, shady soils. Some are low and matlike, while others are somewhat tall and spreading. Some are evergreen, whereas others are deciduous. See Table 5 for recommended plants for specific site conditions.

(2) Date of Planting

Ground covers are best planted in early fall or early spring. If erosion is a potential problem, spring planting may be preferred in order to allow for maximum root development and to allow the plant to become established before winter.

(3) Site Preparation

Lime will be required unless the soil is known to have a pH of 6 or above or if the plant requires an acid site.

(a) For close spaced mass plantings apply a commercial granular fertilizer such as 5-10-10 and an organic supplement (such as composted cow manure, peat or well rooted sawdust), and work into the soil prior to planting.

Fertilizer rate - 3 to 5 lbs. per 100 sq. ft.

The amount of organic material needed will depend upon the soil and plant being used.

Plants such as Pachysandra require a high rate

of organic material, about a 2-inch layer worked into the root zone. Depending on the soil type and steepness of slope, the depth of soil working will vary from 4 to 6 inches.

- (b) For mass plantings on steep slopes (3 to 1 or steeper), working up the entire planting area would not be practical and would induce erosion. Instead, work up the soil in contour rows or dig single holes for each plant. Blend the needed lime, fertilizer and organic material with the soil removed from each hole or furrow. Great care must be taken to avoid fertilizer burn. Use it sparingly and mix it thoroughly with the soil before planting. If the soil on the slope is not suitable for plant growth, it is best to batch blend a planting medium, such as a mixture of 1:1 or 2:1 sandy loam soil and peat, composted cow manure or well rotted sawdust, 10 lbs. of 5-10-10 and 20 lbs. of lime per cubic yard of soil mix. (If manure is used, delete the 5-10-10).

The entire planted slope should be covered with a protective mulch, such as shredded hardwood bark, grain or pine straw, or other weed free organic material. This is essential to conserve moisture, control erosion and



suppress weeds. (Note: It requires about a 6-inch layer of mulch to prevent weed growth.)

(4) Maintenance

Some watering, weeding, remulching and feeding may be required for new ground covers during the period of establishment. Cultivation as such is not recommended as this may encourage erosion and might also cause some root injury. Competing weeds should be pulled.

Fertilize the plantings the spring of the second growing season and thereafter, as needed, using 2 to 3 lbs. per 100 sq. ft., a granulated commercial fertilizer such as 5-10-10.

TABLE 5 ADAPTED GROUND COVERS

PLANT SPECIES	GROWTH RAPID MEDIUM SLOW	HEIGHT	SPACING AT PLANTING	ADAPTED FOR SITES*	REMARKS
<b>A. LOW MAT FORMING EVERGREENS</b>					
Bugleflower ( <i>Ajuga reptans</i> )	R	4-8"	8"-12" apart	a, f	Dark green foliage, flowers blue, white, purple. Quickly forms a dense sod.
Lilyturf ( <i>Liriope spicata</i> )	S	8-12"	8"-12" apart	a, f	Some varieties are variegated. Separate clump and set individual plants.
Aaronsbeard ( <i>Hypericum calycinum</i> )	R	10-12"	1' apart	a,b,f	One of best ground covers for mid-summer bloom.
Japanese spruce ( <i>Pachysandra terminalis</i> )	S-M	6-12"	1' apart	f	Spreads by underground stolons. A popular and versatile plant.
Moss pink ( <i>Phlox subulata</i> )	S	6"	19"-12" apart	a, b	Also known as Thrift
Lavender cotton ( <i>Santolina Chamaecyparissus</i> )	M	1-2'	18"-24" apart	a, b	Leaves silvery gray, wooly. Has appearance of "dry look" plant.
Green santolina ( <i>Santolina virens</i> )	M	10-16"	18"-24" apart	a, b	Leaves green and smaller.
Wineleaf cinquefoil ( <i>Potentilla tridentata</i> )	S	4-12"	1' apart	a,b,c	A plant of very refined foliage and texture.
<b>B. HERBACEOUS PLANTS</b>					
Daylily ( <i>Hemerocallis sp.</i> )	M	16-24"	12"-24" apart	a, b	Will thrive indefinitely without any attention.
Iris (bearded) ( <i>Iris sp.</i> )	S	1-2'		a, b	Barely cover the rhizomes with soil. Plant with all rhizomes pointing in same way.
Blue lead wort ( <i>Plumbago larpentiae</i> )	M	6-12"	10"-12" apart	d	Starts to grow late in the Spring.
<b>C. EVERGREEN VINES</b>					
English Ivy ( <i>Hedera Helix</i> )	M	1'	16"-24" apart	a, f	Very dense ground cover about 1' deep.
Wintercreeper ( <i>Euonymus fortunei</i> )	S	10"	1' apart	c, f	
Periwinkle ( <i>Vinca minor</i> )	M	8"	12"-18" apart	f	Forms a dense low mat. One of best ground covers.
<b>D. EVERGREEN SHRUBS WITH NEEDLES</b>					
Creeping juniper ( <i>Juniperus horizontalis</i> )	S	12-16"	3'-4' apart	a, b	Low mass plants, used in lieu of small lawn areas.
Shore juniper ( <i>Juniperus conferta</i> )	M	1-2'	3'-4' apart	a,b	Fast spreading, vigorous grower. Popular substitute for grass in small areas.

## \*Soil &amp; Site Conditions:

- |                    |               |                    |
|--------------------|---------------|--------------------|
| a. Infertile soils | c. Acid soils | e. Steep cuts      |
| b. Dry sites       | d. Wet sites  | f. Shady locations |

## e. Trees

Trees are a very important element in landscape composition and are used for various purposes in design. Groups of them may form the masses in the design as contrast to an open area. Many trees together make a background for the structure and for the more intimate details of design. Individual trees may serve as accents in the overall design or as incidental notes of the picturesque. By their shapes, trees express line as well as mass in the composition.

In a landscape composition the trees native to a region are usually to be preferred to exotic trees that would be alien to the immediate surroundings. This does not mean that foreign trees should not be used, but rather that they should be used with discretion.

For trees to do their intended job satisfactorily, they must be selected carefully, then watched until they become established. Once they are established, carefully selected trees require less attention.

(1) Selection of Trees.

The use for the intended tree and the location should guide the tree selected. In selecting a shade or ornamental tree, points to be considered are:

- (a) Size of the tree at maturity. A six-foot evergreen that is attractive today can

eventually grow to a height of seventy feet and a spread of forty feet. Therefore, the maturity size as well as the rate of growth and longevity after maturity are important considerations.

- (b) Hardiness. Consider the total environment including temperature, moisture, the contaminants in the atmosphere, and competition from the activities of human society.
- (c) Adaptability to soil conditions. Some soils are poorly drained and compacted while others are open and droughty. Select trees that are tolerant to the specific soil condition at the specific site.
- (d) Habit and desirable landscape qualities. When selecting for ornamental reasons, those trees that have outstanding beauty during several seasons of the year should be given preference. A tree that produces a good display of blossoms in spring, displays ornamental fruit in autumn, shows good autumn leaf color, and presents a pleasing growth habit in winter, is thus far more desirable than one that merely blossoms well in the spring and has no outstanding features throughout the rest of the year.

(e) Undesireable characteristics. It is difficult to find a tree that has no undesireable characteristics. Some trees are very susceptible to local disease such as anthracnose Dutch Elm disease, or Mimosa webworm. Some trees have traits that are nuisances but maybe tolerable. Sweet gum fruits are covered with thorny protuberances that make the fruits a nuisance in lawns. Some trees have characteristics that are intolerable in one situation, but not in another. Maples, for example, have a tendency to raise and crack pavement with their roots. If they are planted where there is no nearby pavement, this is no problem

Match the trees' characteristics with its intended use and decide if they are compatible.

(2) Site preparation.

Carefully preparing the soil before trees are transplanted is one of the essentials to success. Rich soil stimulates the vigor of trees and equips them with abundant vitality that will make them less subject to disease and less vulnerable to attack by insects.

(a) In good, textured and deep soil, without drainage problems:

Dig planting holes for bare-root trees large enough to receive the roots when they are spread in a natural position.

Dig planting holes for balled and burlapped trees 2 feet wider than the rootball.

Dig holes deep enough so you can set the trees at the same level at which they grew in the nursery.

(b) In shallow, compacted soils:

Dig holes for all trees as wide and deep as you can conveniently make them.

Replace the poor soil from the hole with good soil when you fill in around the newly set tree.

(c) In soils having poor drainage:

Take all practical measures to improve drainage.

Limit tree selection to species having a mature height less than 50 feet.

Set the rootball in a shallow depression in the soil.

Fill in around the rootball with good soil, forming a slightly concave bed extending out as far from the trunk as you can manage. Topsoil is often removed in building operations.

Subsoil is commonly unfavorable for trees. In

such cases, the best procedure is to use as much topsoil as practical in the planting hole.

(3) Planting the Tree.

Pack soil under the newly set tree until it sets at the level at which it grew in the nursery.

Before filling around the rootball stake or guy the tree. If the trunk diameter of the tree is 3 inches or less, use one or two 6 foot poles or steel fenceposts to stake the tree. Set the poles vertically into the soil next to the rootball. Fasten the trunk to the poles with a loop of wire that is enclosed in a section of garden hose to prevent bark cutting.

If the tree trunk is larger than 3 inches in diameter, support it with three hose-covered guide wires. Loop the wires around the trunk about two-thirds up the main stem or trunk. Stake one guy wire to the ground in the direction of the prevailing wind. Stake the other two wires to the ground to form an equilateral triangle.

After the tree is set and the hole is filled with good soil, settle the soil around the roots by watering thoroughly. Wrap the trunk with burlap or creped kraft paper to prevent sunscald. Start wrapping at the top and wrap toward the ground. Tie the wrapping material with stout cord, knotting

it about every 18 inches. The wrapping should remain for 1 to 2 years.

(4) Fertilization.

Most trees will benefit from an annual application of fertilizer applied properly and in reasonable quantities. Healthy, vigorous trees not only grow better, and more beautifully, and produce better shade, but they are very often much better able to resist the attacks of insects and diseases which may plague poorly kept and weakened trees. Woodland trees do not require artificial feeding since the leaves falling each year remain on the ground and return fertilizing elements to the soil. The leaves from lawn trees, however, are generally raked and burned, thus depriving these trees of their natural annual source of nutrients. Furthermore, shade trees must frequently compete with a heavy grass sod for the elements and water necessary for good growth.

Late fall or early spring applications of fertilizer are preferred for trees. Fall feedings should be delayed until the leaves have fallen from hardwoods or until there is no possibility of further growth in evergreens. Spring applications can be made any time up until about May 1. Feedings after this date will not produce the



maximum response in root and top growth. Summer fertilizing should be avoided, since the growth produced usually is soft and succulent and does not harden properly, thus making it subject to winter injury. If, however, a tree is obviously starving, it should be fed regardless of the season of the year.

While most shade trees will respond to yearly treatments, some trees may require feeding only every two, three, or four years. This will vary somewhat depending on the species and the particular site on which the tree stands.

Refer to the following table for fertilizers to be used and methods of application.

## FERTILIZERS FOR SHADE AND ORNAMENTAL TREES

TYPE OF TREE	FERTILIZER	METHOD OF APPLICATION
1. Under 6' diam. <sup>1</sup>	Commercial-6-8-6 and sodium of ammonium nitrates. Mix at the rate of 30 lbs. of sodium nitrate to 80 lbs. of 6-8-6 or 15 lbs. of ammonium nitrate to 90 lbs. of 6-8-6. Use 1 to 2 lbs. per inch of diam. <sup>1</sup>	In holes <sup>2</sup> or scattered uniformly over soil under tree limbs and hoed and watered thoroughly into soil.
2. Over 6" diam. <sup>1</sup>	Commercial-Mix as above. 2 to 4 lbs. per inch of diam. <sup>1</sup>	In holes <sup>2</sup>
<u>Evergreens</u>		
1. Small, in groups (shrubs)	Tankage <sup>3</sup> or cottonseed meal. Use 5 lbs. per 100 sq. feet of bed area.	Scattered over bed and hoed and watered thoroughly into soil.
2. Large, in groups (large shrubs & trees)	Commercial-Mix as under hardwoods. Use 2 to 4 lbs. per 100 sq. feet of bed areas.	In Holes <sup>2</sup> or scattered uniformly over soil under tree limbs and hoed and watered thoroughly into soil.
3. Large, single	Commercial-Mix as under hardwoods. Use 2 lbs. per inch of diam. <sup>1</sup>	In holes <sup>2</sup> .
<u>Evergreens</u>		
<u>Broadleaved</u> <sup>4</sup> Azalea Rhododendron Laurel Leucothoe, etc.	Acid peat moss & rotted oak leaf mold are best, but other acid humus material may be used. In poor soils, tankage <sup>3</sup> or cottonseed meal may be used, in addition at the rate of 5 lbs. per 100 sq. feet of bed area.	Liberal quantities of the humus material should be used as a mulch and incorporated in the soil by hoeing or turning with a fork. When tankage or cotton seed meal is used it should be thoroughly hoed and watered into the soil.
<ol style="list-style-type: none"> <li>1. Measure diameter of tree about 3 feet above the ground.</li> <li>2. The preferred method for applying commercial fertilizers to trees is by placing it in holes approximately 18 to 24 inches deep. The majority of the feeding roots of most tree species occur within this soil depth. The holes may be made with a soil auger or crowbar and should be about 2 inches in diameter. They should also be slanted toward the tree so that the bottom of each hole is closer to the top to the base of the tree. The holes should be 2 feet apart in a series of circles around the tree, the outer most circle lying just below the tips of the longest branches. Each succeeding circle should be 2 feet closer to the tree base. It is not necessary to make a circle of holes closer than two-thirds of the distance from the branch tips to the trunk, since few, if any, feeding roots will be found that near the base of the tree. <u>Never place commercial fertilizer within one foot of the trunk, inasmuch as injury to the root collar and trunk base may result.</u> The proper amount of fertilizer should be distributed among the holes. After placing the fertilizer in the holes, fill them with superphosphate or bone meal, enough phosphate to last a long time. The holes should then be closed with soil. If the ground is dry, holes may be filled with water to help carry the nutrients into the surrounding soil.</li> <li>3. Tankage - dried animal refuse originating at packing houses.</li> <li>4. Magnolias, live oaks, and other evergreen hardwood tree species should be treated as "Hardwoods".</li> </ol>		

(5) Watering.

Water trees for the first two seasons after planting. Water about once a week and let the water run for several hours. For soils underlain with a hard pan, be careful not to overwater. Excess water will kill some kinds of trees faster than drought.

(6) Pruning.

Inspect shade trees regularly and prune when needed. The appearance, health, and strength of the tree can be improved and maintained through a regular scheduled pruning program. In such a program, try to eliminate undesirable branches or shoots while they are small. Drastic, difficult, or expensive pruning maybe avoided by early corrective pruning.

Things to look for and prune are:

- (a) Dead, dying, or unsightly parts of trees.
- (b) Sprouts growing at or near the base of the tree trunk.
- (c) Branches that grow toward the center of the tree.
- (d) Crossed branches. If branches cross and rub together, disease and decay fungi can enter the tree through the abraded parts.

- (e) V crotches. If it is possible to do so without ruining the appearance of the tree, remove one of the members forming a V crotch. V crotches split easily and their removal helps to prevent storm damage to the tree.
- (f) Multiple leaders. If several leaders develop on a tree that normally has only a single stem and you wish the tree to develop its typical shape, cut out all but one leader. This restores dominance to the remaining stem.
- (g) "Nuisance" growth. Cut out branches that are likely to interfere with electric or telephone wires. Remove branches that shade street lights or block the view in streets so as to constitute a traffic hazard. Prune out branches that shut off breezes. Cut off lower limbs that shade the lawn excessively.

Do not leave stubs when you prune. Stubs usually die. They are points at which decay fungi can enter the tree.

Small pruning cuts heal quickly. Large cuts - more than 1 inch in diameter - should be treated with an antiseptic tree dressing to prevent entrance of decay or disease while the wound is healing.

(7) Insects, Diseases, and Mechanical Injury.

Most insects and diseases can be controlled by spraying. The most recently published North Carolina Agricultural Chemicals Manual, issued by the School of Agricultural and Life Sciences, North Carolina State University, should be used as a guide to design and apply an effective spray program.

Mechanical injury by lawn mowers, bicycles, and foot traffic is reduced when stakes and guide wires are installed. Also, use of ground mulches can reduce close mowing and mower injury.

(8) Grading Around a Tree.

If the grades around a tree are to be altered by filling soil over the original ground level, then special precautions should be taken to prevent the smothering of the roots. A fill of 4 inches of good topsoil over the roots of deciduous trees will usually do no damage, although it might affect evergreens unfavorably. A fill of 12 inches or more would be very harmful. The quantity of air and water in the soil diminishes with the depth. Thus when roots growing at a depth of 18 inches are covered so that they are 36 inches from the surface, they are deprived of their normal oxygen and water rations. To overcome this handicap, it

is advisable to construct some device for maintaining a contact between the air and the root-containing soil. It is important to do this before the fill is made. First, the original soil is loosened by forking. Then a dry stone wall is built up around the tree, if possible, at a distance of several feet from the base of the trunk and to the level of the new grade. Several 4-inch agricultural tile drains are laid in lines radiating from the inner surface of this wall. The entire area is then spread with a course of crushed stone or large gravel. This material is put on to a depth of 6 or to within 12 inches or 15 inches of the final grades. Above this is spread a layer of straw or, preferably, manure to prevent the soil above from sifting down through the stones or slag. Finally, a layer of topsoil is spread to a depth of 6 or 8 inches. This construction should cover the whole area of tree roots. The tile pipes may be used to conduct water to the roots and may be filled by a hose.

If soil has been washed away from the roots of large trees, as sometimes happens on steep slopes, or if the ground is worn down by pedestrian traffic, the damage to the trees may eventually be fatal. Restoration of the natural grade by

applying a layer of topsoil to cover the roots and establishing a turf or a ground cover crop to retain the soil is the only permanent remedy for this situation.

f. Mulches

A good mulch, consisting of suitable material properly applied at the correct time, serves many functions. The most important include:

- (1) Conservation of moisture. It increases infiltration of rainfall and reduces evaporation in dry, hot periods.
- (2) Effective measure of weed control. Few weeds can push up through heavy mulch.
- (3) Maintain more even soil temperatures by serving as an insulating material.
- (4) Organic mulches decompose and add humus to the soil.

(a) Selecting Mulch Materials.

In selecting materials for mulches, there are a number of factors to be considered: the availability of the material; the cost, compared with that of other materials; the appearance, the effect it will have on the soil; its durability; whether it presents a fire hazard; and, whether it decomposes rapidly or slowly. In general, organic mulches are to

be preferred to inorganic mulches because of their benefit to the soil.

(b) Mulch Materials.

Dry, unchopped, unweathered small grain straw or rain-damaged hay free of weed seed may be used as long straw or hay, but for flower beds it should be chopped. Spread 6 to 10 inches deep. Straw or hay rots down into good humus and is beneficial to the soil. Extra nitrogen should be added due to soil bacteria which requires large amounts of nitrogen for breakdown of raw organic material.

Shredded bark or wood are very effective as a mulch and in time, becomes completely decomposed and add humus to the soil. Spread 4 to 8 inches deep and add extra nitrogen.

Pine needles are an airy attractive mulch, light in weight, weed free and pleasant to handle. Apply 4 to 6 inches thick.

Local materials such as sawdust, tobacco stems, leaves and grass clippings may be used. Grass clippings provide a good home-grown mulching material but because they tend to form a dense mat, it is advisable to mix item with coarse materials such as rotted leaves or sawdust.

Sawdust is not always desirable in flower beds



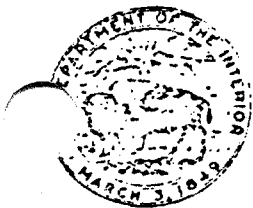
because it is apt to encourage crown rot in plants that are susceptible. Spread these materials 4 to 6 inches thick.

Peat moss is one of the most widely used mulch materials. It makes a mulch that is attractive, clean, easy to handle and weed free. It should be moistened before it is applied and should be kept moist and loose. If it is allowed to dry out, you should check to see if a crust has been formed that will be impervious to water. Spread peat moss 4 to 6 inches thick.

Black polyethylene plastic is used where weeds and moisture are critical. Additionally, being dark, it absorbs the rays of the sun and therefore maintains a higher soil temperature. However, in the summer soil temperatures may become too high for some plants under the polyethylene cover.

APPENDIX F. BIOLOGICAL OPINIONS FOR ENDANGERED AND THREATENED SPECIES AT MARINE CORPS BASE CAMP LEJEUNE

1.	MECHANIZED INFANTRY TRAINING/RED-COCKADED WOODPECKER PROTECTION GUIDELINES (FEBRUARY 1, 1979) . . . . .	F-1
2.	FOREST MANAGEMENT PROGRAM/RED-COCKADED WOODPECKER PROTECTION GUIDELINES (APRIL 3, 1979) . . . . .	F-4
3.	AMPHIBIOUS TRAINING/ATLANTIC LOGGERHEAD SEA TURTLE PROTECTION GUIDELINES (APRIL 19, 1979) . . . . .	F-9
4.	AMMENDED MECHANIZED INFANTRY TRAINING/RED-COCKADED WOODPECKER PROTECTION GUIDELINES (JUNE 12, 1979) . . . . .	F-12
5.	SOUTHERN PINE BEETLE CONTROL PROJECT/RED-COCKADED WOODPECKER PROTECTION GUIDELINES (MARCH 12, 1980) . . . . .	F-19
6.	THREATENED GREEN SEA TURTLE PROTECTION GUIDELINES (FEBRUARY 23, 1981) . . . . .	F-22
7.	ENDANGERED BROWN PELICAN (now delisted), AMERICAN ALLIGATOR AND LOGGERHEAD, AND GREEN SEA TURTLE PROTECTION GUIDELINES (DECEMBER 10, 1981) . . . . .	F-24
8.	GUIDELINES AND PROCEDURES FOR PROTECTING SEA TURTLES AND WHALES IN OFFSHORE WATERS (JUNE 27, 1983) . . . . .	F-29
9.	ENDANGERED AMERICAN ALLIGATOR/CAMP LEJEUNE RAILROAD CONSTRUCTION RECOMMENDATIONS (DECEMBER 4, 1984) . . . . .	F-46
10.	ENDANGERED RED-COCKADED WOODPECKER/K-2 IMPACT AREA IMPROVEMENT GUIDELINES (DECEMBER 6, 1984) . . . . .	F-48
11.	FOREST FIRE SUPPRESSION/ENDANGERED RED-COCKADED WOODPECKER PROTECTION GUIDELINES (JUNE 5, 1985) . . . . .	F-50
12.	THREATENED SEA TURTLE MANAGEMENT GUIDELINES (DECEMBER 13, 1985) . . . . .	F-52
13.	ENDANGERED RED-COCKADED WOODPECKER MANAGEMENT GUIDELINES (MARCH 23, 1987) . . . . .	F-54



## United States Department of the Interior

## FISH AND WILDLIFE SERVICE

P. O. BOX 95067

ATLANTA, GEORGIA 30347

FEB. 1 1979

Brigadier General D. B. Barker  
U.S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Dear General Barker:

This letter presents the Biological Opinion of the Fish and Wildlife Service relative to the effects of mechanized infantry training in the Camp Lejeune Mechanized Infantry Training Area upon the endangered red-cockaded woodpecker (Picoides borealis). Your letter to Regional Director Black, dated September 13, 1978, also requested consultation on the base's management plans for the red-cockaded woodpecker and sea turtles. The Biological Opinions on these two base-wide management programs will be handled separately and will follow at a later date.

This Biological Opinion is based upon field inspections and associated meetings and discussions with base personnel on December 11 and 12, 1978, and January 11 and 12, 1979, review of Fish and Wildlife Service files on past informal consultation concerning the area, review of the Draft Red-Cockaded Woodpecker Recovery Plan and other pertinent literature, and informal communication with researchers currently working with the species.

After a careful review of the findings by Fish and Wildlife personnel in the Asheville Area Office, it is our Biological Opinion that existing activities within the Mechanized Infantry Training Area are likely to jeopardize the continued existence of the red-cockaded woodpecker. This opinion is based upon the following considerations:

Field inspections revealed a commendable program in locating, marking, and designating red-cockaded woodpecker colonies, buffer zones, and support stands within the Mechanized Infantry Training Area. However, the following adverse impacts were found within designated red-cockaded woodpecker habitat: (1) cutting of pine trees for barricades, etc.; (2) mechanical damage to pines by vehicles; (3) mortality of pines, including cavity trees, from root damage by heavy tracked vehicles; (4) girdling of pines by attachment of communication wires, etc.; (5) soil disturbance from digging foxholes, garbage pits, trenches, etc.; (6) soil and plant disturbance by heavy tracked vehicles traversing general forest areas off of established roads and trails; (7) destroyed or removed signs delineating designated areas and; (8) fire damage from

accidental fires. These impacts are thought to be a result of lack of knowledge and/or enforcement of current regulations and poor conservation attitudes regarding endangered species, especially red-cockaded woodpeckers.

The impacts observed have the effect of destruction of the habitat of the red-cockaded woodpecker, including existing nesting and roosting cavity trees, future replacement cavity trees, and foraging trees. Other effects are more subtle but equally important. The whole ecology of the area is being affected, and the habitat is gradually being changed to a type not beneficial to the red-cockaded woodpecker. Disturbance to the bird itself is also occurring and is detrimental to reproductive activities. In fact, some of the activities are considered harrassment, which is included under the definition of "take" in Section 3(14) and is prohibited by Section 9(a) (1) (b) of the Endangered Species Act of 1973 (Public Law 93-205).

There are two identified reasonable and prudent alternatives that would eliminate jeopardy to the species. One alternative is to select another site for a Mechanized Infantry Training Area that does not contain red-cockaded woodpeckers. The second alternative is to prepare guidelines for the use of the Mechanized Infantry Training Area, incorporate these guidelines as base regulations, and stringently enforce the regulations. Because of economics and the adverse impact on other resources from alternative one, alternative two was selected and agreed to as the best alternative in a meeting with base personnel on January 11, 1979. These guidelines and/or regulations must include the following:

(1) Prohibition within the marked boundaries of red-cockaded woodpecker colonies, buffer zones and support stands of (a) all vehicle use except on established designated roads and trails (these should be designated in cooperation with the Base Natural Resources Division personnel); (b) cutting or destruction of woody vegetation; (c) excavation or digging of foxholes, trenches, garbage pits; laying underground communication lines; or other similar significant disturbance of the soil; (d) use of open burning including campfires; and (e) bivouacking or setting up command posts.

(2) Prohibition of all training, forestry activities, and similar activities creating a major disturbance within the colony sites and buffer zones, from March 1 through July 31. (This includes prohibition of firing from Gun Positions 3, 6, 10, and 21 during this time period.)

*for  
RCW  
Timber*

(3) Assignment of responsibility and accountability for ensuring that the use of the Mechanized Infantry Training Area is compatible with the maintenance of designated red-cockaded woodpecker habitat (colonies, buffer zones, and support stands) and that the guidelines are prepared, incorporated into base regulations, brought to the attention of all personnel, and enforced.

(4) Daily inspection of each training area containing marked red-cockaded woodpecker habitat (colonies, buffer zones and support stands) during and after each training assignment and periodically at other times to determine if violations have occurred and corrective actions taken to include disciplinary action and prosecution under the Endangered Species Act, where warranted.

(5) Initiation of an information/education program with full, documented support of the entire Camp Lejeune Staff to effect a change of attitude among Base personnel concerning endangered species in general and the red-cockaded woodpecker in particular.

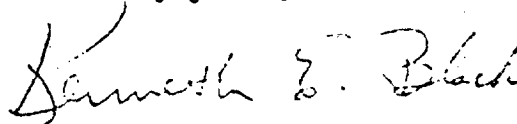
(6) Inspection at periodic (semi-annual) intervals by Fish and Wildlife Service personnel and recommendations made as to the effectiveness of the guidelines and regulations and corrective actions needed.

Please provide the Asheville Area Office with a copy of the guidelines when finalized and a copy of the resulting Base Regulations when promulgated. We would also like to be promptly informed of actions taken regarding violations.

It must be recognized that failure of alternative two to rectify the existing situation leaves only alternative one as a solution to the problem.

We would like to express our appreciation to your entire staff for their hospitality and assistance provided in this consultation process. We hope that the end results are an improvement of an already commendable program and an amicable and cooperative relationship between our agencies.

Sincerely yours,



Regional Director



# United States Department of the Interior

F-4

## FISH AND WILDLIFE SERVICE

P. O. BOX 95067

ATLANTA, GEORGIA 30347

APR 3 1979

Brigadier General D. B. Barker  
U. S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Dear General Barker:

This letter presents the Biological Opinion of the Fish and Wildlife Service relative to the effects of the forestry management program at Camp Lejeune on the endangered red-cockaded woodpecker (Picoides borealis). It is in response to the request dated September 13, 1978, for formal consultation pursuant to Section 7 of the Endangered Species Act of 1973. A Biological Opinion concerning the Mechanized Infantry Training Area and the red-cockaded woodpecker population within the training area was rendered February 1, 1979. A field inspection of the Browns Island Impact Area was conducted February 27, 1979; and an opinion regarding the effects of Marine Corps training activities on Camp Lejeune's beaches upon the threatened loggerhead turtle will be finalized shortly.

This Biological Opinion is based upon field inspections and associated meetings and discussions with Base personnel on December 11-12, 1978, and January 11-12, 1979; review of the Camp Lejeune Natural Resource Management Plan and Habitat Management Guidelines for the Red-Cockaded Woodpecker; review of the draft Red-Cockaded Woodpecker Recovery Plan and other pertinent literature; and communications with researchers and managers currently working with the species. Also, a review of the draft Biological Opinion at the March 22, 1979, meeting (attendee list enclosed) at Camp Lejeune indicated no objections to the findings of this opinion. It was also indicated by the Base Forester that implementation of the opinion would cause very little disruption of the forest management activities on the Base. An administrative record is available in the Asheville Area Office.

After review of the findings by Fish and Wildlife personnel in the Asheville Area Office, it is our Biological Opinion that the present forestry management program at Camp Lejeune is likely to jeopardize the continued existence of the red-cockaded woodpecker unless one of the reasonable and prudent alternatives is implemented. The information supporting this opinion follows.

The present guidelines for habitat management of the red-cockaded woodpecker on Camp Lejeune follow guidelines set forth in an early draft of the recovery plan. These recovery plan guidelines have been changed slightly by the latest recovery plan draft. The major change is an increase in the size of the support stand provided for each colony from 100 to 200 acres. This change is based upon the approximate average home range of the species of 200-250 acres. Actually these new guidelines work out to be the same as present Camp Lejeune guidelines when analyzed. Camp Lejeune guidelines call for 100-acre support stands 40 years old or older. Where rotations are 80 years old this would equal 200 acres with an even distribution of all age classes, i.e., 100 acres over 40 years old and 100 acres under 40 years old. There is presently a conflict in Camp Lejeune guidelines in that rotations are established for the support stands but the support stands must be 40 years old or older; therefore, no regeneration is possible, and rotations are thus meaningless.

The draft recovery plan and Camp Lejeune guidelines call for 80-year rotations for loblolly pine and 100-year rotations for longleaf in support stands, thus recognizing the need for mature stands to provide adequate roosting and nesting habitat. Existing literature is consistent in pointing out this need. Mean cavity tree ages range from 72 to 126 years for longleaf, 71 to 98 years for loblolly, and 62 to 131 years for pond pine. Aging of cavity trees at Camp Lejeune would be expected to be similar. Although stand ages on Camp Lejeune are considerably younger than this, the actual cavities are probably in older relict trees, which is a common characteristic throughout the bird's range.

There are two closely related reasonable and prudent alternatives that would remove jeopardy to the species from the forestry management program at Camp Lejeune. These are:

1. Extend rotations for all pine to 100 years.
2. Extend rotations for loblolly pine to 80 years and for longleaf and pond pine to 100 years.

The difference between these alternatives is rotation for loblolly pine, the most common pine species on Camp Lejeune. At present, pine species are regulated as a group on Camp Lejeune, and this would require implementation of alternative one. However, regulation of loblolly separately would permit implementation of alternative two.

It is recognized in the alternatives presented that stands younger than rotation age must be cut to achieve a balance of age classes. However, this cutting must occur in the age classes containing more acreage than necessary to achieve balance; i.e., predominantly ages

30 to 57 on Camp Lejeune. At present only 2,594 acres are older than 60 years and thus considered suitable for meeting shelter requirement of the red-cockaded woodpecker. Therefore, there should be no cutting in age classes above 60 until 40 percent of the acreage on 100-year rotations and/or 25 percent of the acreage on 80-year rotations are 60 years old or older. Some stands must be carried past rotation age in order to achieve a balance of age classes and provide habitat for the red-cockaded woodpecker.

Management by one of the alternatives eliminates the need for the identification of support stands on the ground and thus simplifies management. This applies to Camp Lejeune with the exception of the Mechanized Infantry Training Area. Because of the potential of tremendous adverse impact on the overall ecology and habitat of the red-cockaded woodpecker by such training activities, support stands and the inherent restrictions addressed in the Biological Opinion of February 1, 1979, are still necessary in the Training Area.

However, even though marked support stands per se are not necessary, the alternatives must include the provision that colonies are not isolated by cutting on all sides but are always connected to a minimum of 200 acres of contiguous pine and/or pine-hardwood stands 20 years old or older. No more than one-third of the compartment, or one-third of the support stand in the Mechanized Infantry Training Area, should be in 0-20 year age classes at any time. To prevent major disruptions to home ranges, regeneration stand sizes immediately surrounding colony sites should not exceed 50 acres, and 30 acres is preferable.

The Camp Lejeune Habitat Management Guidelines for the Red-Cockaded Woodpecker needs some other revisions as discussed with Natural Resources personnel. The buffer zones, as well as the colony sites, should be restricted from road construction. The colonies and buffer zones should be prescribed burned at 2- to 3-year intervals, instead of 5-year intervals. To the extent feasible with available manpower and funds, the support stands in the Mechanized Infantry Training Area and the general pine habitat elsewhere should also be prescribed burned at 2- to 3-year intervals.

Although several management concepts for the species were carefully evaluated, including present Camp Lejeune guidelines, present draft recovery plan guidelines, and U. S. Forest Service existing and proposed guidelines, the alternatives presented are the most certain of all concepts to ensure the conservation of the red-cockaded woodpecker.

As agreed in discussions with Base Natural Resources personnel, we evaluated other alternatives based on modifications of the presented alternatives that would exclude certain acreage from long rotations where habitat is marginal and/or unoccupied and not believed to be



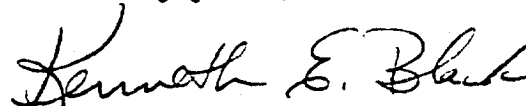
needed in the foreseeable future for expansion of present red-cockaded populations. However, consideration of seven different alternatives resulted in excluded acreages ranging from 4,889 to 6,940 acres. In discussions with the Base Forester, it was agreed that this small acreage would not justify the added effort, difficulty, and cost of regulating separately. Therefore, these alternatives are not presented but are a part of the administrative record on this Biological Opinion filed at the Asheville Area Office.

We certainly recognize that existing management of the red-cockaded woodpecker at Camp Lejeune was based on the best information and recommendations available at the time, and this interest and initiative in conservation of endangered species is commended. Unfortunately, continued analysis of data and new information indicates a necessity to do more. The cumulative effects of shorter rotations than those presented in the alternatives for public lands, which contain approximately 90 percent of present red-cockaded woodpecker populations, is believed extremely detrimental when added to the trend to shorter pulpwood rotations on private lands over which we have no control, the decreasing availability of southern pine sawtimber across the southeast, and the restriction of the species to a very small percent of its original habitat.

Current research on the species should shed more light on essential habitat requirements of the species. Such new information would, of course, be one basis for reinitiating consultation, if Camp Lejeune so desired. Along these lines, we would certainly recommend that data be collected on Camp Lejeune regarding cavity tree ages stratified by species of tree, stand forest type, site index, and start trees versus existing cavities. This would provide input on age of trees selected for cavities on Camp Lejeune, age of trees when cavity excavation begins, and the effect of site index on selection of cavity trees by age.

We appreciate the assistance provided in this consultation by your entire staff, particularly the Natural Resources Division personnel. We hope this assists you in meeting your obligations under the Endangered Species Act of 1973, as this is the spirit in which this Biological Opinion is rendered. We look forward to continuing cooperation between our agencies.

Sincerely yours,



Regional Director

Enclosure



APR 10 1979

Brigadier General D. D. Barker  
U. S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Dear General Barker:

This letter represents the Biological Opinion of the Fish and Wildlife Service on the possible effects of the Marine Corps amphibious training program on Camp Lejeune's beaches as well as the Sea Turtle Habitat Management program at Camp Lejeune for the threatened Atlantic loggerhead turtle (Caretta caretta). This letter responds to your request for consultation dated September 13, 1978.

This Biological Opinion is based upon field inspections, associated meetings and discussions with Base personnel on December 11-12, 1978, January 11-12, 1979, February 27-28, 1979, and on March 22, 1979; review of the Camp Lejeune Habitat Management Guidelines for the Atlantic Loggerhead Turtle; review of pertinent literature, including a draft "Plan for the Recovery and Management of Marine Turtles in the Southeast Region;" and communications with Dr. Frank J. Schwartz of the University of North Carolina Marine Institute, a noted authority on the loggerhead.

On December 12, 1978, the threshold examination concerning this consultation on Camp Lejeune was discussed with Base personnel. An inspection of Onslow Beach revealed heavy use of the beach from Riseley Pier to Onslow South Tower, a distance of about 1.5 miles.

On January 11, 1979, a discussion of the potential impacts to the Atlantic loggerhead turtle was held with the Base personnel. Those specific impacts were: training activities preventing turtles from coming ashore or nesting (false crawls - turtles come ashore but return to sea without nesting), destruction of nests and/or turtles by training activities, young hatchlings prevented from reaching sea by deep ruts caused by tracked and rubber-tired vehicles, lighting on the beach at night disorienting turtles, direct mortality of turtles and/or nests within the Browns Island Impact Area by exploded ordnance, and predation of nests and/or turtles by natural predators and man.

cc: Area Manager, FWS, Asheville, North Carolina (SE)

During this discussion, your training officer stated that: 500 meters along the beach was sufficient for training; use of the rest of the beach area could be restricted as necessary; and these restrictions could be enforced. Actions by the Marine Corps would include marking the areas by signs or some other means, promulgating regulations preventing (1) nighttime use of the beaches during the nesting season (May-August), (2) vehicular traffic parallel to the beach outside tidal zones, and (3) disturbance of turtles or nests. Nests within the area of training use would be relocated by Natural Resource personnel to other areas. It was also agreed that tank traps would be prohibited and the causeways needed to facilitate movement would be coordinated with Base Natural Resources personnel, who will take into account the needs of the turtles.

On February 27, 1979, the training restrictions agreed upon on January 11, 1979, were reviewed. At this time the 500 meters previously agreed upon was determined to be inadequate for training. To accommodate the full scope of amphibious training, your command identified an area of approximately 1 1/2 miles between Riseley Pier and the Onslow South Tower as fully adequate for this purpose. It was agreed that vehicle use could be restricted to the tidal zone except for needed egress routes between the beach and the road behind the dunes. While discussions centered around four major egress routes as important to the training mission, a later inspection revealed an additional eight minor egress routes as important to the training mission. We agreed that only nests found within or adjacent to the egress routes would need relocation, with the possibility of a few exceptions when noted, such as nests found below high tide.

Arrangements were made to inspect the Browns Island impact area on February 27, 1979. No adverse impacts were identified during this inspection.

On March 22, 1979, this consultation and the draft Biological Opinion was reviewed with you and members of your staff. At this meeting it was stated that restricting vehicle use during training exercises to the tidal zone except for egress routes would hamper training and that, since the number of nests occurring in the area was few (approximately six), all nests in the training area would be relocated. We have no objection to this plan of action as long as all nests that occur within the identified exercise area (from Riseley Pier to Onslow South Tower) are relocated to safe areas elsewhere.

After review of the findings by Fish and Wildlife Service personnel in the Asheville Area Office, it is our Biological Opinion that present ongoing activities on Camp Lejeune's beaches are not likely to jeopardize the continued existence of the Atlantic loggerhead sea turtle. However, we offer the following recommendations to enhance your conservation efforts for this species. These efforts should be made to the maximum extent possible consistent with the training mission and objectives of Camp Lejeune.

1. Schedule training exercises during the period May through October outside the peak full moon period of each month. This peak nesting period each month is centered around the peak of the full moon, plus and minus three days, for a total of seven days per month.
2. Confine training exercises, using the minimum amount of the beach necessary to complete training objectives. This area has been identified through consultation as an area approximately 1 1/2-2 miles long running from Riseley Pier to about the Onslow South Tower.
3. Egress routes from the beach to the road behind the dunes should be kept to a minimum. Four major and eight minor passes through the dunes were identified.
4. All vehicular travel on the beaches should be restricted to the tidal zone except within the identified exercise area, providing all turtle nests have been removed from that area prior to any landings.
5. Tank traps on the beaches should be prohibited.
6. During the period May through October, night landings for training purposes should be eliminated or reduced to a minimum level.
7. Night lighting during training exercises (May-October) should be at a minimum level or eliminated.
8. Other nighttime use of the beaches (recreation, etc.) from May through October should be restricted to those uses not requiring artificial lighting or fires.
8. Other activities with potential impacts not addressed in this opinion should be coordinated with the Base Natural Resource personnel and referred to the Fish and Wildlife Service for consultation if adverse or beneficial impacts are perceived as being possible.
9. Close monitoring of nesting activities should be continued to detect any long-term trends. The Fish and Wildlife Service would appreciate receiving this data.

We appreciate the cooperation of your personnel in this consultation and commend Camp Lejeune for its conservation efforts for the Atlantic loggerhead. We hope this will help you fulfill your obligations under the Endangered Species Act.

Sincerely yours,

/s/ Clayton J. Lonkford

Regional Director

Director, FWS, Washington, D. C. (AFA/OES)  
Area Manager, FWS, Asheville, North Carolina (SE)



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
WASHINGTON, D.C. 20240

F-12

In Reply Refer To:  
FWS/OES 375.4

JUN 1 1979

Honorable Mitzi M. Wertheim  
Deputy Under Secretary of the Navy  
Pentagon  
Washington, D.C. 20350

Dear Ms. Werthiem:

This responds to your letter of March 30, 1979, requesting reinitiation of consultation on the impacts of existing use patterns of the Mechanized Infantry Training Area on Camp Lejeune Marine Corps Base on the Endangered red-cockaded woodpecker. A biological opinion on the use of this area was issued by our Regional Director in Atlanta, Georgia, on **February 1, 1979.** A copy of that opinion is a part of the administrative record for this consultation. This correspondence serves as an amendment to the February 1 opinion and, therefore, should be read in conjunction with that earlier opinion.

By letter of April 2, 1979, I agreed to reinitiate consultation at the Washington Office level and appointed a Service consultation team. Your letter of April 3, 1979, acknowledged our reinitiation of consultation and appointed Ms. Mary Margaret Goodwin as your team leader. On April 24, 25, and 26, 1979, meetings were conducted at Camp Lejeune by the consultation teams, including the Commanding Generals of the Camp Lejeune Marine Corps Base and the Second Marine Division and members of their respective staffs.

Field investigations conducted by the teams revealed that red-cockaded woodpecker habitat was being adversely impacted by the training activities previously described in paragraph 4 of the February 1, 1979, opinion, i.e.: (1) cutting of pine trees for barricades, etc.; (2) mechanical damage to pines by vehicles; (3) mortality of pines, including cavity trees, from root damage by heavy tracked vehicles; (4) girdling of pines by attachment of communication wires, etc.; (5) soil disturbance from digging foxholes, garbage pits, trenches, etc.; (6) soil and plant disturbance by heavy tracked vehicles traversing general forest areas off of established roads and trails; (7) destroyed or removed signs delineating designated areas and; (8) fire damage from



accidental fires. It was found that continued use of the Mechanized Training Area at existing levels is likely to result in the complete destruction of the forest habitat.

During the course of the consultation, the team reviewed the literature on the red-cockaded woodpecker and discussed the bird's biology and the training activities on Camp Lejeune with red-cockaded woodpecker Recovery Team members and other authorities knowledgeable of this species. The administrative record for this consultation is maintained in the Office of Endangered Species, U.S. Fish and Wildlife Service, Suite 500, 1000 N. Glebe Road, Arlington, Virginia.

The red-cockaded woodpecker's habitat is mature southern pine forests containing some trees having red heart disease. Red heart disease does not begin to occur naturally until the trees are "over mature," at approximately 60 to 80 years-of-age. Because much of the private timber lands in the South are intensively managed for pulp wood production and the amount of saw timber grown is decreasing rapidly, little suitable red-cockaded woodpecker habitat remains on these private lands. Private timber forests usually are on a 40 to 60-year rotation, which will eventually (perhaps by 2010) result in the nearly complete eradication of this woodpecker on such lands. Only the pine forests managed by Federal and some State agencies can be expected to maintain a longer timber rotation that may preserve forests attractive to the red-cockaded woodpecker. In the last decade no documentation of the establishment of any new woodpecker colony has been found anywhere in the range of the species. With the anticipated loss of all private forest habitat for this woodpecker, and the lack of expansion into now "over mature", — forests, the outlook for the red-cockaded woodpecker is poor. Those habitats found in highway rights-of-way, parks, refuges, game management areas, public forests, and, as in this case, military installations may save this species from extinction.

Public forest lands administered by the Forest Service and the Departments of Defense and Interior now contain stands of mature trees and will ultimately comprise the majority of forested lands with suitable red-cockaded woodpecker habitat. However, current timber practices on these lands are reducing the numbers of mature pine trees upon which the red-cockaded woodpecker depends. The cumulative effects of actions on both private and public forest lands are adversely affecting the species to such an extent that the loss of the colonies found in the Mechanized Training Area is likely to jeopardize the continued existence of the species. Therefore, it is my biological opinion that the present activities conducted within the Mechanized Training Area are likely to jeopardize the continued existence of the red-cockaded woodpecker; however, a prudent and reasonable alternative is available which would avoid such jeopardy.

A review by the Marine Corps of the two alternatives offered in the February 1, 1979, opinion indicated that neither was acceptable to the training requirements of the Marine Corps. In their review of the first alternative (an alternative area for the mechanized training) the Marine Corps indicated that the selection of an alternative site is not practical because of the need for contiguous uninterrupted travel of troops, vehicles, and equipment between the ocean landing beaches and the Mechanized Training Area. Due to the configuration of the land at Camp Lejeune and the existing land use (e.g., ordnance impact areas) there are no alternative sites which meet the specific training requirements associated with both mechanized training and beach assaults.

The Marine Corps felt that the guidelines presented in the second alternative (modify use and management within present training area) would effectively eliminate their use of the Mechanized Training Area. In-depth discussions resulted in a better understanding of training activities and the types of actions which need to be conducted in the Mechanized Training Area. Because this area is essential for meeting the training requirements at Camp Lejeune and contains nine known woodpecker colonies (plus two others on the periphery) the Service's consultation team considered alternative use patterns for the Mechanized Training Area that would allow training activities which would be compatible with the conservation of the woodpecker. Although this was the intended purpose of the second alternative described in the February 1 opinion, discussions with Marine Corps personnel at Camp Lejeune revealed that there was some confusion and misunderstanding of the February 1 guidelines. These in-depth discussions provided a better understanding for all.

It is my opinion that if the guidelines for use of the Mechanized Training Area, enumerated in alternative 2 of the Service's Regional Office opinion of February 1, 1979, are deleted and replaced with the following guidelines, the likelihood of jeopardy would be eliminated. The conclusion (i.e., jeopardy to the species) of the February 1 biological opinion will remain as written.

1. The following restrictions and prohibitions apply only to the marked boundaries of red-cockaded woodpecker buffer zones (200-foot radius around each cavity tree) and support stands:

- a. Restrict all vehicle use to designated roads and trails (any new trails shall be designated by the Base Natural Resources Division in consultation with the Base Training Department and shall be consistent with the conservation of the red-cockaded woodpecker) with the following exceptions: command tracked vehicles



may utilize a single, predesignated, ingress/egress route to each preselected command post site in red-cockaded woodpecker support stands, and wheeled vehicles may be used in the immediate vicinity of the bivouac and preselected command sites in red-cockaded woodpecker support stands. All vehicles operating within the support stands are prohibited from causing destruction or injury to tree roots or bark. No vehicles shall be allowed at any time within the buffer zones except for bona fide emergencies (fire or injured personnel) or on trails already designated as of April 26, 1979.

b. Prohibit indiscriminate cutting or destruction of woody vegetation. Only vegetation that has been specifically marked for cutting within a support stand may be cut for camouflage material, wood fires, barricades, etc. Such trees will be marked in advance only by the Base Natural Resources personnel and in a manner consistent with the conservation of the woodpecker. Should additional woody material be needed, it will be obtained outside the boundaries of the support stands of the Mechanized Training Area and brought into these areas for use.

c. Prohibit any excavating or digging that would result in the destruction of woody vegetation, including damage to root systems. Troops should be encouraged to utilize existing fox holes, trenches, etc.

2. Prohibit the establishment of command posts and bivouacs in any buffer zones.
3. Prohibit the firing of artillery within 200 meters of a red-cockaded woodpecker cavity tree.
4. Increase the prescribed burning program in the Mechanized Training Area to reduce the potential for wildfires.
5. Initiate a program to at least annually survey the Mechanized Training Area and remove wires that are girdling trees.
6. Utilize other areas on the Base outside the Mechanized Training Area for more of the routine training by field units not requiring the specific features (e.g., landing zones, Combat Town) and tracked vehicles in the Mechanized Training Area.
7. The Mechanized Training Area will be inspected at periodic intervals by the U.S. Fish and Wildlife Service. Recommendations will then be made as to the effectiveness of the Base guidelines and regulations.

Inspections will determine if significant violations have occurred and insure that proper actions have been taken to correct any violations. Included in these inspections would be an annual color infrared aerial photo of the Mechanized Training Area. This photograph is to be provided by the Marine Corps at a scale suitable to detect the death of individual large trees (over 1 foot DBH).

In order to greatly facilitate the implementation and effectiveness of the above guidelines, we suggest that the following actions should be taken at Camp Lejeune:

- A. An information/education program should be initiated and maintained to effect a change of attitude among all personnel utilizing Camp Lejeune concerning natural resources management, in general, and the Endangered red-cockaded woodpecker, in particular.
- B. A responsibility and accountability program should be developed at all levels to insure that the use of the Mechanized Training Area is compatible with the maintenance of the red-cockaded woodpecker buffer zones and support stands.
- C. Base regulations and guidelines should be prepared which are brought to the attention of all personnel using Camp Lejeune and these should be effectively enforced.
- D. The Base should also develop a monitoring program to insure that the protective measures instituted from this opinion are having the desired effect of maintaining the support stands and buffer zones as viable habitat for the woodpecker.

In summary, I would like to point out that the major thrust of the February opinion has not been changed. There is an imperative need to protect the habitat of the red-cockaded woodpecker and provide ample replacement vegetation for the future needs of the bird. This can best be accomplished by the implementation of appropriate Base regulations incorporating the above guidelines and, most importantly, the stringent enforcement of these regulations. Implementation of the regulations will not only provide protection for the red-cockaded woodpecker, but will also insure that the natural vegetation cover is maintained for the continued training needs of the Marine Corps.

I would like to thank you, your Special Assistant, and the Commanding Generals and their respective staffs of the Camp Lejeune Marine Corps

Base and the Second Marine Division for cooperating with my consultation team and for the genuine interest shown in natural resources management and the Endangered Species Program. Your assistance made this consultation proceed very smoothly and successfully.

Should this action, as now planned, be modified or altered or should new species be listed that may be affected, you must reinitiate consultation.

Sincerely yours,

Harold J. O'Connor

Acting Director

cc: ~~CG, Camp Lejeune MCB~~  
~~CG, Second Marine Division~~  
Regions 2, 4, and 5  
Mr. Jim Baker, Jacksonville Area Office  
Mr. Wendell Neal, Jackson Area Office



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

75 SPRING STREET, S.W.  
ATLANTA, GEORGIA 30303

F-18

**MAR 12 1980**

Brigadier General D. B. Barker  
U.S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Re: 4-2-80-F-80

Dear General Barker:

This letter presents the Biological Opinion of the Fish and Wildlife Service relative to the effects of Camp Lejeune's proposed southern pine beetle control project on the endangered red-cockaded woodpecker (Picoides borealis), as requested by letter of January 29, 1980. Field inspections and meetings with Camp Lejeune personnel and entomologists of the U.S. Forest Service (State and Private Forestry, Forest Insect and Disease Management) and North Carolina State University were conducted on January 28-30, 1980, following notification of the problem by telephone on January 14, 1980.

It is the Biological Opinion of the Fish and Wildlife Service that control efforts for the southern pine beetle, as discussed and agreed upon January 28-30, 1980, and outlined herein, are not likely to jeopardize the continued existence of the red-cockaded woodpecker.

Assessment of the problem began with a meeting wherein the following was presented:

1. An overview of the current situation on Camp Lejeune - a total of 155 infestation spots have been recorded,
2. Information on the life history of the southern pine beetle and recommended control measures, and
3. Details concerning beetle infestations within the marked boundaries of red-cockaded woodpecker habitat, including a map of the habitat and a description of the number and types of trees involved.

Beetle infestations are currently recorded in eleven red-cockaded woodpecker sites, three of which involve cavity trees. Field inspections of the three sites involving cavity trees with infestations and other infestation sites were made following the meeting.

It was determined that infestations are limited to stressed trees, many of which have been injured. The potential for a major outbreak this summer is evident and, thus, early control efforts are important. Mortality of infested trees is inevitable from either girdling by beetles or prevention of translocation by blue stain fungus introduced by beetles. Normal beetle control measures involve treating infested trees as well as a 70-foot buffer of trees around the head of the infestation. Control is by salvage removal, cut and burn, cut and spray with pesticides, or cut and leave (in the summer only). Trees from which the beetles have emerged usually contain populations of predatory insect species and should not be treated. If not controlled, infestations will destroy red-cockaded woodpecker nesting and foraging habitat and could have a significant adverse impact on the species. In red-cockaded woodpecker habitat, modifications of control measures are necessary. The modifications discussed and agreed upon are as follows:

1. Within colonies and buffer zones, each infested tree will be inspected individually and decisions made as to control measures for that tree; buffers of non-infested trees will not be treated,
2. Active cavity trees will not be cut or sprayed,
3. Dead or apparently live cavity trees from which beetles have emerged will not be cut,
4. Inactive cavities (dead, enlarged by other species, etc.) will not be cut unless a minimum of four cavity trees (active and inactive) per colony remain to provide shelter for a breeding pair of birds and up to two helper birds for the interim period necessary for excavation of new replacement cavities,
5. Spraying with presently approved pesticides (Lindane - a chlorinated hydrocarbon, Dursban - an organophosphate) will not be conducted within colonies and buffers - trees cut within these areas will be removed,
6. Cutting of buffers around the head of infestations in contiguous habitat is acceptable unless doing so would separate the colony completely from suitable foraging territory (doughnutting or isolating colonies). In this case, the Camp Lejeune Wildlife Manager should determine if a buffer should be cut and, if so, the modifications of the buffer that should be made considering:
  - a. the likelihood of preventing the infestation from entering colony sites by cutting or not cutting the buffer,

- b. the distance from the colony to suitable foraging territory if a buffer is cut (short distances would be crossed by the bird without undue impact), and
- c. the probability of the infestation destroying all or a significant portion of the foraging territory if the buffer is cut versus not cut.

These guidelines were developed by inspection and discussions of the three infestation sites involving cavity trees. Specific application to the impacted cavity trees in the three areas is as follows:

- Site 6 - The dead cavity tree should be left because the beetles have emerged. The live cavity tree contains two cavities, one of which has been enlarged by pileated woodpeckers. The other is presently being enlarged. There are presently seven cavity trees within this colony. Therefore, this beetle infested inactive cavity tree should be cut and removed, leaving six healthy uninfested cavity trees within the colony site, which are sufficient for providing shelter and exceed the minimum of four recommended.
- Site 11 - The cavity tree should not be cut because it is active and the infestation is light and confined to the uppermost parts of the tree. In fact, the tree may have been successful in excluding or pitching out the beetles. The beetle infested start tree should be cut and removed because it is not a completed cavity useful for shelter.
- Site 12 - The cavity tree should not be cut because it has an active cavity. Because it was an active cavity tree, it was not checked to see if the beetles were successful in invading the tree or were repelled. Attacking beetle pitch tubes were large and very white in color, which is a good indicator of exclusion by some trees through heavy resin flow.

In addition to the guidelines just presented, implementation of recommendations are offered, which will enhance the conservation of the red-cockaded woodpecker and/or reduce susceptibility of pine trees to future infestations of southern pine beetles. These are as follows:

1. Reduce man-caused injuries to pines. All of the trees infested by beetles were stressed to some degree, most by man-caused physical injuries such as wounds from climbing spikes used in climbing trees, cutting implements such as axes and hatchets, heavy equipment and vehicles, and girdling by communication wire. These injuries should be reduced to the minimum. Designation of certain areas or trees for training needs such as climbing, instead of permitting indiscriminate, haphazard climbing, would reduce the overall injury impact on timber and confine such impacts to exact locations that could be closely monitored for implementation of necessary insect and disease control.

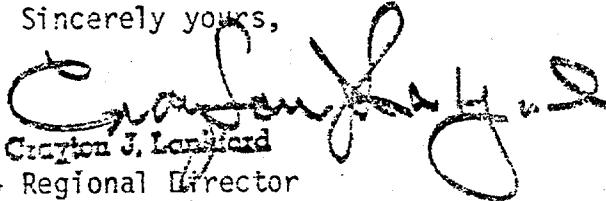
2. For minimum potential adverse impact to red-cockaded woodpeckers, treatment of infested trees in decreasing order of preference are:
  - a. cut and leave,
  - b. cut and remove (salvage),
  - c. cut and burn, and
  - d. cut and spray with pesticides.

The only registered pesticides available for southern pine beetle control are chlorinated hydrocarbons or organophosphates, therefore, use of these materials should be a last resort, especially in red-cockaded woodpecker habitat. We recognize, however, that pesticide treatment may be necessary in order to carry out beetle control in as short a time period as possible. No standing trees should be chemically treated but once trees are cut, chemical treatment is unlikely to affect red-cockaded woodpeckers because they are not ground feeders. However, exceptions do occur and there is an outside possibility that red-cockaded woodpeckers will feed on insects in or on cut trees on the ground.

Individuals with knowledge of the habits of the red-cockaded woodpecker were consulted for advice in this consultation. In addition, the approved recovery plan for the red-cockaded woodpecker and other pertinent literature were reviewed. A complete administrative record of this consultation is maintained and available for review at the Asheville Area Office of the Fish and Wildlife Service.

We appreciate the cooperation of your personnel and the early initiation of consultation in efforts to confront this situation as soon as possible. The cooperation of U.S. Forest Service (State and Private Forestry, Forest Insect and Disease Management) and North Carolina State University personnel was indispensable and also much appreciated. Should beetle control measures be changed from those outlined in this Opinion or should new information regarding control methods or impacts on the red-cockaded woodpecker become available, consultation should be reinitiated. Your efforts in fulfilling your responsibilities regarding endangered species are appreciated. We look forward to future cooperation.

Sincerely yours,

  
Clayton J. Lonliard  
Acting Regional Director

February 23, 1981

Colonel R. W. Kirby  
Acting Chief of Staff  
U.S. Marine Corps  
Marine Corps Base  
Camp Lejeune, NC 28542

Dear Colonel Kirby:

This letter presents the Biological Opinion of the Fish and Wildlife Service regarding the potential effects of Camp Lejeune's sea turtle management program and military training use of Onslow Beach on the Threatened green turtle (*Chelonia mydas*). It responds to your letter of August 4, 1980, received August 20, 1980. Completion of the consultation was delayed pending receipt of additional data and information from Camp Lejeune, Dr. Frank Schwartz, and the Sea Turtle Recovery Team, as per request of October 20, 1980. This Biological Opinion is intended to help you fulfill your obligations under the Endangered Species Act of 1973, as amended.

This Biological Opinion is based upon review and analysis of the data requested from and submitted by Camp Lejeune and Dr. Schwartz; review of the Administrative Record on an earlier consultation concerning like effects on the Threatened loggerhead turtle (*Caretta caretta*) for which a Biological Opinion was rendered April 10, 1979; review of the Sea Turtle Conservation Strategy drafted at the first World Conference on Sea Turtle Conservation held in Washington, D.C., on November 26-30, 1979; input requested and received from the Sea Turtle Recovery Team; and discussions with knowledgeable individuals possessing expertise on the species.

It is our Biological Opinion that the sea turtle management program and military training use, as presented and examined in the earlier consultation on the loggerhead turtle, and cumulative effects associated with these activities, are not likely to jeopardize the continued existence of the green turtle. However, we do offer recommendations to enhance the conservation of the species. The recommendations made in the April 10, 1979, Biological Opinion for the loggerhead turtle should be applied also to the green turtle. Additional recommendations regarding moving nests follow and these recommendations are also intended as an amendment to the April 10, 1979, Biological Opinion and the subsequent April 26, 1979, letter regarding conservation programs for the loggerhead turtle.



1. Only nests threatened by erosion, tides, extreme predation, military activities, etc., should be moved. This includes late (August) nests as well as earlier nests.
2. Nests necessitating movement should be placed in a safe place on the beach and not removed to a laboratory.
3. Nests, especially late (August) nests should be monitored for hatchability.

These recommendations resulted from analysis of hatchability of 1979 and 1980 nests on Camp Lejeune, including natural nests, redeposited nests and nests removed to the laboratory for artificial incubation. An additional concern was the effect upon the imprinting process of turtles from artificial incubation and release. Natural hatchability exceeded artificial hatchability for months with sufficient data. Unfortunately, data on natural hatchability was not available for August. Monitoring of August nests for a couple of years would provide some data for comparison to artificial hatchability of August nests in 1979 and 1980, which was less than 50 percent (20 percent for the green turtle).

Once data is obtained, Camp Lejeune may reinitiate consultation if results warrant reconsideration of artificial incubation for late nests and Camp Lejeune so proposes.

An Administrative Record of this consultation is maintained and available for review at this office. Should new information reveal impacts that may affect the green and/or loggerhead turtle which was not considered in this and the April 10, 1979, Opinions and/or should the activities considered in this consultation be subsequently modified, consultation should be reinitiated. For example, if new or expanded use of the beaches for military activities are proposed, consultation should be reinitiated.

The conservation work with loggerhead and green turtles will require a permit, contrary to the April 26, 1979, letter on loggerheads which is now in error. Permit applications can be obtained from James R. Bailey, Senior Resident Agent, U.S. Fish and Wildlife Service, P.O. Box 1138, Raleigh, NC 27602, telephone 919/755-4786 (commercial) or 672-4786 (FTS) or from the Federal Wildlife Permit Office, U.S. Fish and Wildlife Service, Main Interior Building, 18th and C Streets, NW, Washington, DC 20240, telephone 253-1903 (FTS) or 703/235-1937 (commercial). Copies of the Biological Opinions should accompany the application.

Once more we extend our appreciation to Camp Lejeune and its personnel for your conservation efforts for endangered and threatened species and your cooperation in this consultation. We look forward to future cooperation and consultations between our agencies.

Sincerely yours,

**/s/ William C. Hickling**

William C. Hickling  
Area Manager

cc: Raleigh ES



United States Department of the Interior

FISH AND WILDLIFE SERVICE  
PLATEAU BUILDING, ROOM A-5  
50 SOUTH FRENCH BROAD AVENUE  
ASHEVILLE, NORTH CAROLINA 28801

F-24

December 10, 1981

Major General C. G. Cooper  
Commanding General  
U.S. Marine Corps  
Camp Lejeune, NC 28542

Re: 4-2-81-198 (MAIN/EMA/th 11-15)

Dear General Cooper:

This responds to Colonel Millice's letter of November 30, 1981, concurring with initiation of formal consultation regarding the effects of Marine Corps training activities on the endangered brown pelican (Pelecanus occidentalis) and American alligator (Alligator mississippiensis) and the effects of the establishment and use of a new range (Onslow Beach North Tower Machine Gun Range) on the threatened loggerhead and green sea turtle (Caretta caretta and Chelonia mydas). We have reviewed the November 30, letter and discussed it with Mr. Julian Wooten, Director, Natural Resources and Environmental Affairs Branch, Base Maintenance Division, and Lieutenant Colonel E. M. Asanovich, Training Facilities Officer, on December 8, 1981. We agreed to accept your recommendations outlined in paragraphs c and d and to make some word changes in reference to paragraphs b and e to clarify our intent. These changes were agreed to by Lieutenant Colonel Asanovitch.

Attached is the final Biological Opinion incorporating these recommendations and changes.

Sincerely yours,

/s/ William C. Hickling

William C. Hickling  
Area Manager

cc:

Director, FWS, Washington, DC (OES)  
Regional Director, FWS, Atlanta, GA (ARD-FA/SE)  
Project Leader, FWS, Raleigh, NC



United States Department of the Interior

FISH AND WILDLIFE SERVICE  
PLATEAU BUILDING, ROOM A-5  
50 SOUTH FRENCH BROAD AVENUE  
ASHEVILLE, NORTH CAROLINA 28801

F-25  
WIP

December 10, 1981

Major General C. G. Cooper  
Commanding General  
U.S. Marine Corps  
Camp Lejeune, NC 28542

Re: 4-2-81-198

Dear General Cooper:

This letter represents the Biological Opinion of the Fish and Wildlife Service on (1) the effects of Marine Corps training activities on the endangered brown pelican (Pelecanus occidentalis) and the endangered American alligator (Alligator mississippiensis) and (2) the effects of the establishment and use of a new range (Onslow Beach North Tower Machine Gun Range) on the threatened loggerhead and green sea turtles (Caretta caretta and Chelonia mydas). This responds to General Barker's letter of April 27, 1981; subsequent correspondence of June 19, 1981 (signed by Bill Hickling), July 7, 1981 (signed by Colonel K. P. Mallice, Jr.), and August 3, 1981 (signed by Bill Hickling); and the letter of November 30, 1981, initiating consultation (signed by Colonel K. P. Millice). The effects of Marine Corps training activities on the two sea turtles were the subjects of previous consultations and Biological Opinions were rendered April 10, 1979, and February 23, 1981. The new range represents a deviation from activities considered in past consultations. This Biological Opinion does not supercede these prior Opinions but should be considered as an amendment, in regards to sea turtles, to those Opinions.

This Biological Opinion is based upon field inspections and associated meetings and discussions with Base personnel conducted on July 13-15, 1981; review of the Administrative Records for the earlier consultations on sea turtles referenced above; and review of documents provided by Base personnel on July 13-15, 1981, including: (1) Standing Operating Procedure For Training Facilities and Services (BO P11102.1J), (2) new page inserts B-60 a through c, Chapter 2 to BO P11102.1J, (3) Environmental Impact Assessment (EIA) - Proposed .50 Caliber Machine Gun Range at North Onslow Tower, (4) Minutes of the Environmental Enhancement/Environmental Impact Review Board Meeting of November 25, 1980, and (5) Utilization of Individual Ranges - data for BT-3 and G-7 from October 3, 1980, to July 13, 1981.

Specific activities and effects considered in this consultation are the effects of establishment and use of the Onslow Beach North Tower Machine Gun Range on brown pelicans, loggerhead turtles, and green turtles; the effects of the use of ranges G-5, G-5A, G-7, and BT-3 on brown pelicans and alligators; the effects of other military training activities involving stream crossings; maneuvers of men and vehicles in streamside and marsh habitat; and ordnance explosion in alligator habitat on the American alligator. Reference is made to correspondence from this office of

August 3, 1981, regarding review of activities for identification of those activities requiring formal consultation and the rationale used in evaluating the activities for impact and jeopardy to the continued existence of the species.

It is our Biological Opinion that the activities identified above, and cumulative effects associated with these activities, are not likely to jeopardize the continued existence of the brown pelican, American alligator, loggerhead turtle, or green turtle. However, field inspection and review of the documents referenced in paragraph two of this letter did reveal some inconsistencies and possible impacts that should be clarified, reduced, or corrected. These inconsistencies and impacts will be reviewed followed by recommendations to enhance the conservation of the two sea turtles.

The EIS and Minutes of the Environmental Enhancement/Environmental Review Board Meeting of November 25, 1980, state that avoiding interference with waterborne traffic on the intra-coastal waterway is a justification for the new Onslow Beach North Tower Machine Gun Range. However, Special Instructions a.(1) and i. on pages B-60 b and c, Chapter 2 of EO P11102.J, indicate or authorize use of other ranges during the times the Onslow Beach North Tower Range is used. Use of these other ranges requires control of boat traffic on the intra-coastal waterway and thus negates the justification stated above for the Onslow Beach North Tower Range for those periods of time when other ranges are being used. Because cumulative effects of usurping more beach areas for various uses (military uses, recreation, residences, etc.) throughout the range of nesting of sea turtles serves to continually reduce the amount of suitable nesting areas lacking interferences, we recommend that the necessity of changing or intensifying use of beach areas of Camp Lejeune be evaluated carefully. For example, on Camp Lejeune, the beach area from Risley Pier to Onslow Beach South Tower (1 1/2-2 miles in length) is intensively used for military training, necessitating translocation of turtle nests in the area. At the same time the entire Onslow Beach is utilized for recreation with the approximately two-mile section from Risley Pier north receiving heavy recreational pressure. In addition to the four miles of beach already heavily utilized by humans on Camp Lejeune, the establishment of the Onslow Beach North Tower Range adds one more section of beach to human use for military training. If this cumulative usurping of beach areas for intensive human use continues, sea turtles could eventually reach a threshold from which recovery is impossible. Translocation of nests is not a long range solution because eventually there will be no suitable safe beaches left to which turtle nests can be translocated.

Paragraph c. of the Minutes of the Environmental Enhancement/Environmental Review Board of November 25, 1980, states that to avoid damage to beach areas, the new gun positions at the Onslow Beach North Tower Range and a diagram of the existing vehicular trails authorized for movement to and from the gun positions will have to be incorporated into a change to the Base Order on Range Regulations. The new page inserts (pages B-60a through c, Chapter 2) issued to EO P11102.1J did not diagram authorized access routes and identified gun positions as a 400-meter area forward of the dunes (beach area) and south of grid line 29. This is not adequate to avoid damage to beach areas, as so stated in the above referenced Minutes. A diagram showing the authorized routes of ingress/egress to the Onslow Beach North

Tower Machine Gun Range should be included in the base range regulations. Additionally, the firing point area should be marked by range limit signs to restrict the use of the beach to that amount of space necessary to conduct training.

Paragraph 1.c. of Section I of the EIA states that for safety reasons, no more than three vehicles will be on the firing line at once with a 25 meter interval between firing vehicles, yet page inserts B-60a through c to BO P11102.1J does not place these restrictions on use of the range. Restricting the use to three vehicles would also lessen the impact on the beach. This information should be part of the special instructions for this range.

Recommended conservation enhancement measures follow:

1. Amend or revise pages B-60a through c, Chapter 2 of BO P11102.1J by:
  - a. Restricting use of the range on days that other ranges are being used requiring control of boat traffic on the intra-coastal waterway to overflow that cannot be accommodated on the other ranges. (When other ranges are not being used, the use of the North Tower Range is obviously not so restricted).
  - b. Including identification of authorized gun positions and access routes.
  - c. Restricting personnel and vehicles using the range to an area between Grid 29 and a point where access route (2) in paragraph e. of Section I of the EIA bisects the beach.
  - d. Revise Special Instructions 1. to prohibit firing of weapons at sea mammals, birds, or reptiles or when these animals are visible down range.
2. Follow one of the three following alternatives to reduce or eliminate rutting of the beach area:
  - a. Amend or revise pages B-60a through c, Chapter 2 of BO P11102.1J to authorize use of the Range only during the period of November through April to avoid the turtle nesting season, or
  - b. Amend or revise pages B-60a through c, Chapter 2 of BO P11102.1J to restrict access to the Range to routes 2 and 4 identified in paragraph e of Section I of the EIA and/or to the tidal zone at low tide for routes 1 and 3 and restrict firing vehicles to the tidal zone at low tide, or
  - c. Amend or revise pages B-60a through c, Chapter 2 of BO P11102.1J to restrict access to routes 2 and 4 and translocate turtle nests from the Range area to safe beach locations outside the range.

An Administrative Record of this consultation is maintained and available for review at this office. Please provide us with documentation concerning implementation of recommendations. Should new information reveal impacts

that may affect the four species considered in this consultation and which were not considered in this or earlier consultations and/or should the activities considered in these consultations be subsequently modified, consultation should be reinitiated. For example, should the unexpected happen and any of the four species be directly killed during military training activities, or if new and expanded use of the beaches or other areas for military activities be proposed, consultation should be reinitiated.

As per several times over the past years, we extend our appreciation to Camp Lejeune and its personnel for your initiative and conservation efforts on behalf of endangered and threatened species, as well as other fish and wildlife, and for your cooperation in this consultation. Please contact us if we can be of help in the future. We look forward to continuing cooperation between our agencies.

Sincerely yours,

**/s/ William C. Hickling**

William C. Hickling  
Area Manager

Southeast Region  
9450 Koger Boulevard  
St. Petersburg, FL 33702

June 27, 1983

Colonel J.T. Marshall  
Assistant Chief of Staff, Facilities  
United States Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

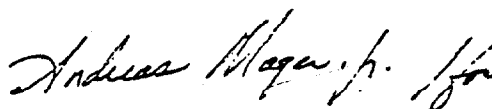
Dear Colonel Marshall:

This responds to your June 3, 1983, and June 16, 1983, letters regarding expansion of the N-1 Impact Area and Brown's Island Target and Bombing Area BT-3 at the Marine Corps Base, Camp Lejeune, North Carolina. Consultation was requested pursuant to Section 7 of the Endangered Species Act of 1973 (ESA).

We have reviewed your biological assessment (BA) and concur with your determination that populations of endangered/threatened species under our purview would not likely be jeopardized by the subject action.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

Sincerely yours,



Charles A. Oravetz, Chief  
Protected Species Management Branch

cc:

FWS - Asheville, NC

OPNAV 5216/144 (REV 6-70)  
S/N 0107-LF-778-8097  
DEPARTMENT OF THE NAVY

# Memorandum

DDS  
CAF

DATE: 18 MAR 83

FROM: A c/s Fae

TO: DIR NRIEA))

SUBJ: Here is TRN's comments on our package. I have talked to them LTCOL SAMS/LTCOL BRUNELLI and COL R AND THEY KNOW that they have to do a flight befo they can fire and the area must be clear.

J J Marshall





UNITED STATES MARINE CORPS  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA 28542

F-31

IN REPLY REFER TO

TRNG/AWR/kak  
1500  
18 Mar 1983

*file*

FIRST ENDORSEMENT on TFACO ltr TRNG/ARB/eks over 1500 dtd 17 Mar 1983

From: Assistant Chief of Staff, Training  
To: Assistant Chief of Staff, Facilities

Subj: Aerial Flights to Protect Endangered Species in Offshore Waters

1. Forwarded as discussed on 17 Mar 1983.
2. You interposed no objection to morning flights and flights only on days when live firing taking place to seaward.

A handwritten signature in cursive script, appearing to read "M. P. Sams".

M. P. SAMS  
By direction



UNITED STATES MARINE CORPS  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA 28542

F-32

IN REPLY REFER TO  
TRNG/ARB/eks  
1500  
17 Mar 1983

From: Training Facilities Officer  
To: Assistant Chief of Staff, Facilities  
Via: Assistant Chief of Staff, Training

Subj: Aerial Flights to Protect Endangered Species in Offshore Waters

Ref: (a) Yr ltr NREAD/DDS/th over 11015 dtd 16 Mar 83; same subject

1. The reference discussed measures believed necessary to provide protection for certain endangered marine species which, periodically/seasonally, frequent the offshore waters of this installation.

2. Notwithstanding the information contained in paragraph 3 which indicates the best time to observe the whales is 1200-1500, the present practice of requiring an aerial reconnaissance of the offshore surface danger area prior to commencing live fire on effected ranges is normally concurrent with units' firing request, most typically 0730-0900. It is believed that flights during the period just prior to the range(s) "going hot" are the better of the periods in that:

a. The aerial visual recon is already a range requirement and, accordingly, this would not generate a totally new wing requirement. It would, however, substantially increase the amount of area searched, with resultant increase in fuel/maintenance/flight hours involved.

b. Under normal weather conditions, both aerial observation and water clarity tend to be optimum in the earlier morning hours, and decrease markedly as the sun causes wind and waves offshore, which would enhance detection of whales if the flights were before the suggested 1200-1500 time period.

c. It is further understood that the clear intent of these reconnaissance flights is to attempt to take all prudent measures to protect these whales from possible firing danger (paragraph 3 of enclosure (5) to reference (a) germane), so these flights would be conducted only in association with live firing on ranges impacting into the offshore danger area.

3. Additional instructions for these flights and specifics relative to tower observers shall be promulgated as soon as practical.

  
A. R. BRUNELLI, Jr.

TRNG/ARB/eks  
1500  
17 Mar 1983

From: Training Facilities Officer  
To: Assistant Chief of Staff, Facilities  
Via: Assistant Chief of Staff, Training

Subj: Aerial Flights to Protect Endangered Species in Offshore Waters

Ref: (a) Yr-ltr NREAD/DDS/th over 11015 dtd 16 Mar 83; same subject

1. The reference discussed measures believed necessary to provide protection for certain endangered marine species which, periodically/seasonally, frequent the offshore waters of this installation.

2. Notwithstanding the information contained in paragraph 3 which indicates the best time to observe the whales is 1200-1500, the present practice of requiring an aerial reconnaissance of the offshore surface danger area prior to commencing live fire on effected ranges is normally concurrent with units' firing request, most typically 0730-0900. It is believed that flights during the period just prior to the range(s) "going hot" are the better of the periods in that:

a. The aerial visual recon is already a range requirement and, accordingly, this would not generate a totally new wing requirement. It would, however, substantially increase the amount of area searched, with resultant increase in fuel/maintenance/flight hours involved.

b. Under normal weather conditions, both aerial observation and water clarity tend to be optimum in the earlier morning hours, and decrease markedly as the sun causes wind and waves offshore, which would enhance detection of whales if the flights were before the suggested 1200-1500 time period.

c. It is further understood that the clear intent of these reconnaissance flights is to attempt to take all prudent measures to protect these whales from possible firing danger (paragraph 3 of enclosure (5) to reference (a) germane), so these flights would be conducted only in association with live firing on ranges impacting into the offshore danger area.

3. Additional instructions for these flights and specifics relative to tower observers shall be promulgated as soon as practical.

A. R. BRUNELLI, Jr.

TRNG/ARB/eks  
1500  
17 Mar 1983

From: Training Facilities Officer  
To: Assistant Chief of Staff, Facilities  
Via: Assistant Chief of Staff, Training

Subj: Aerial Flights to Protect Endangered Species in Offshore Waters

Ref: (a) Yr ltr NREAD/DDS/th over 11015 dtd 16 Mar 83; same subject

1. The reference discussed measures believed necessary to provide protection for certain endangered marine species which, periodically/seasonally, frequent the offshore waters of this installation.

2. Notwithstanding the information contained in paragraph 3 which indicates the best time to observe the whales is 1200-1500, the present practice of requiring an aerial reconnaissance of the offshore surface danger area prior to commencing live fire on effected ranges is normally concurrent with units' firing request, most typically 0730-0900. It is believed that flights during the period just prior to the range(s) "going hot" are the better of the periods in that:

a. The aerial visual recon is already a range requirement and, accordingly, this would not generate a totally new wing requirement. It would, however, substantially increase the amount of area searched, with resultant increase in fuel/maintenance/flight hours involved.

b. Under normal weather conditions, both aerial observation and water clarity tend to be optimum in the earlier morning hours, and decrease markedly as the sun causes wind and waves offshore, which would enhance detection of whales if the flights were before the suggested 1200-1500 time period.

c. It is further understood that the clear intent of these reconnaissance flights is to attempt to take all prudent measures to protect these whales from possible firing danger (paragraph 3 of enclosure (5) to reference (a) germane), so these flights would be conducted only in association with live firing on ranges impacting into the offshore danger area.

3. Additional instructions for these flights and specifics relative to tower observers shall be promulgated as soon as practical.

A. R. BRUNELLI, Jr.

UNITED STATES MARINE CORPS  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

F-35

NREAD/DDS/th  
11015

1 6 MAR 1983

From: Assistant Chief of Staff, Facilities  
To: Assistant Chief of Staff, Training

Subj: Protection of Endangered Species in Offshore Waters

Ref: (a) Section 7, Endangered Species Act

Encl: (1) CG MCB ltr MAIN/CDP/th 11015 of 17 Nov 1981  
(2) NMFS ltr of 23 Nov 1981  
(3) CG MCB ltr NREAD/JIW/th 11015 of 4 Nov 1982  
(4) NMFS ltr of 8 Nov 1982  
(5) CG MCB ltr NREAD/JIW/jc 11015 of 12 Jan 1983  
(6) NMFS ltr of 3 Mar 1983  
(7) Whale Identification Packet

1. The purpose of this letter is to advise that formal consultation has been completed with the National Marine Fisheries Service (NMFS) relative to the impact of live-firing into offshore waters on nationally listed endangered and threatened species pursuant to the reference. Enclosures (1) through (6) document the consultation process. Based on the information provided in enclosures (1) through (6), the NMFS has concurred with Base's determination that current live-firing activity into the offshore waters, as described in enclosure (3), would not affect the subject species which are under NMFS purview. As specified in enclosure (6), NMFS concurrence was conditional with a possibility of reentering consultation if changes in circumstances occur. It is requested that any changes or proposed changes in firing into the subject waters be reported to this office so as to permit continued compliance with the reference.

2. Also, note that enclosure (4) required this Command to provide NMFS with a description of actions to be taken to avoid impact on individual members of the protected species which may be present in the subject waters. Enclosure (5) provided the requested information. Therefore, it should be noted that NMFS concurrence is also contingent upon implementation of the protective measures listed in enclosure (5).

3. Dr. Frank Schwartz, an expert on whales with the Institute of Marine Sciences, University of North Carolina at Morehead City, was contacted to determine appropriate methods to follow for detecting any whales in the area so as to avoid possible adverse impact. Dr. Schwartz advised that whales annually move through offshore waters during their spring migration occurring 20 February - 7 April. Females and calves of the right whale migrate very close to the coastline during spring migration. Whales may be in a given area for several days and then suddenly move quite rapidly sometimes traveling to a maximum distance of ten miles within a 24-hour period. The best time to observe whales from the air is from 1200-1500 hours. Enclosure (7) contains material for identifying various species of whales. Dr. Schwartz's recommendations were also based on consultation with Dr. Howard E. Winn, Whale Coordinator, University of Rhode Island, concerning annual whale migration off Onslow

NREAD/DDS/th F-36  
11015  
1 6 MAR 1983

Subj: Protection of Endangered Species in Offshore Waters

Beach and Brown's Island relative to protecting the species.

4. Therefore, in addition to all existing precautionary procedures listed in enclosure (5), the Training Facilities Officer should implement the following procedures immediately and annually hereafter, during the period of 20 February - 7 April:

a. Schedule daily aerial flights covering an area extending four miles seaward from the beach from Bogue Inlet southward to New Topsail Inlet, to determine if any whales are present (See Enclosure (7)).

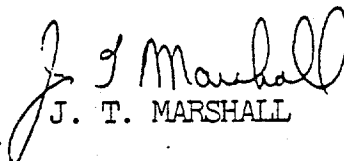
b. Conduct flights between 1200-1500 hours when possible and in a manner which allows the pilot to carefully observe the entire area within boundaries described in paragraph 4a above.

c. Flights should be flown at intervals of 24 hours or less.

d. Discontinue live-firing exercises anytime whales are discovered within 10 miles of the E-1, N-1 and BT-3 Range Areas and contact AC/S, Facilities.

5. Implementation of procedures and methods for protecting sea turtles also involved in this consultation with NMFS will be forwarded by separate correspondence in the near future.

6. Point of contact in this matter is Mr. Julian Wooten, Director, Natural Resources and Environmental Affairs Division, extension 2083.

  
J. T. MARSHALL

Mr. Harold Allen  
Acting Director Southeast Region  
National Marine Fisheries Services  
National Oceanic Atmospheric Administration  
9450 Koger Boulevard  
St. Petersburg, Florida 33702

Dear Mr. Allen:

Marine Corps Base, Camp Lejeune, North Carolina, has conducted formal consultation procedures with the U. S. Fish and Wildlife Service for endangered and threatened species pursuant to the Endangered Species Act of 1973, Title 50, Code of Federal Regulations, Number 402. Biological opinions have been rendered for the Red-Cockaded Woodpecker (Dendrocopos borealis), Atlantic Loggerhead Sea Turtle (Caretta caretta) and Green Sea Turtle (Chelonia mydas).

Formal consultation is now in progress which initially involved the Eastern Brown Pelican (*Pelecanus occidentalis*) and the American Alligator (*Alligator mississippiensis*). Possible impacts to sea turtles at Onslow Beach and in offshore waters from the Onslow Beach North Tower Range were noted during this consultation process. These impacts were listed in a draft biological opinion presently being reviewed by Marine Corps Base. The possible impacts listed include: ruts caused by assault amphibian vehicles in gaining access to the range presenting an obstacle to hatchlings reaching the sea; ruts caused by vehicles on the firing line in setting up and maneuvering also presenting an obstacle to hatchlings reaching the seas; and live service ammunition fired into the ocean causing direct mortality of sea turtles in offshore waters. The first two impacts were addressed in the draft biological opinion.

The U. S. Fish and Wildlife Service advised that the third impact was a basis for initiation of formal consultation with the National Marine Fisheries Service, who has jurisdiction over sea turtles in offshore waters. By this letter, we are, therefore, initiating formal consultation procedures with your agency to resolve any possible conflicts between Marine Corps activities and our responsibilities under the Endangered Species Act.

We look forward to consulting with you on these matters involving established military training requirements and our legal responsibilities concerning sea turtles in offshore waters.

Sincerely,

C. G. COOPER  
Major General, U. S. Marine Corps  
Commanding General

BIOLOGICAL ASSESSMENT OF MARINE HABITAT  
Onslow Beach, Marine Corps Base  
Camp Lejeune, North Carolina

F-38

I. INTRODUCTION

A. This biological assessment provides information concerning threatened and endangered species occurring in offshore waters at Onslow Beach, Marine Corps Base, Camp Lejeune, North Carolina. Endangered whales migrating past Browns Island includes the Fin Whale (*Balaenoptera physalus*), Humpback Whale (*Megaptera novaeangliae*) and Right Whale (*Eubaleana glacialis*). Whales usually migrate one-fourth or more miles off Onslow Beach. Most movement has been recorded in mid-March to mid-May with lesser activities in late November and December. There have been no known strandings of whales on Onslow Beach but there have been recent strandings on nearby Bear Island, Topsail Island and Bogue Banks.

B. Threatened species include the Atlantic Loggerhead (*Caretta caretta*) and Green Turtle (*Chelonia mydas*) which nest on Onslow Beach. A comprehensive program has been conducted for these species since 1972 involving monitoring nesting activities through surveys, tagging and protecting nests from predation. Formal consultation has been conducted with the U. S. Fish and Wildlife Service and a biological opinion has been rendered for these listed species. Both opinions contain guidelines relative to military training activities and management functions for each of these listed species concerning nesting activities on Onslow Beach. Formal consultation concerning these species as well as the Atlantic Ridley (*Lepidochelys kempi*), Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) Sea Turtles which migrate through the area is necessary due to live-firing into marine habitat off Browns Island.

C. The Browns Island N-1 Impact and Target and Bombing Area has been used for live-firing since Camp Lejeune was established in the early 1940's. There has been no noticeable environmental change to the island or marine habitat except for the live ordnance contained there.

D. Aerial surveys have been conducted of Browns Island and surrounding areas to determine the amount of sea turtle nesting activity. Twenty-one flights were made during the 1982 nesting season as contracted by the North Carolina Wildlife Resources Commission. Ninety-one apparent nests were located during the aerial survey on Browns Island in comparison to sixty six active nests which were ground truthed on Onslow Beach.

II. DESCRIPTION OF AREA

A. The Browns Island coastline is a relatively uniform sand ridge about 200 to 500 feet wide and typically about 5 to 15 feet in elevation. Shifting sand dunes on the ridge reach elevations of 25 to 40 feet. The sand ridge protects the mainland from wave action and it impedes tidal action as well as drainage from the mainland. Drainage from the area passes through Browns Inlet and Bear Inlet into the Atlantic Ocean. Tidal flats occupy irregular strips behind the coastal sand ridge, in pockets along the shore at the sound and in lowlands along the estuaries draining into the sounds.



B. This area of the coastal plain is underlain by hundreds of free or unconsolidated and weakly consolidated sediments ranging from cretaceous to miocene in age. Generally these formations are covered with a 5 to 30 feet surface layer of pleistocene sediments. These sediments are mostly clean sand and clayey sand, interlayered with deposits of clay and marine shells. On some of the poorly drained upland areas, thick organic soils have developed since emergence. Locally, on the banks of large streams, outcroppings of the miocene yorktown formation can be found. The yorktown consists of clay, sand and shell marl beds which are similar to the younger surficial deposits. The coastal sand ridge is primarily of wave-washed beach sand, but assorted sediments as described above occurs at shallow depths under the ridge.

C. Browns Island is composed of an intratidal zone, flat beach zone, supratidal zone; pioneer zone, scrub zone, forest zone and marsh zone. Beach vegetation is non-existent in the intratidal and flat beach zones. Plant life in the supratidal zone is marsh cord grass. Plants found in the pioneer zone are American beachgrass, sea oats, panicgrass, bitter panicum and marsh elder. The plants found in the scrub zone are seacoast blue stem, silverleaf croton, sea-side goldenrod, large pennywort, yaupon holly, waxmyrtle, bayberry, Eastern baccharis, shinning sumac and pepperwine. Plants found in the forest zone are Virginia creeper, muscadine grape, American holly, devilwood, flowering dogwood, redbay loblolly pine, red maple, blackcherry, red cedar and live oak. Plants found in the marsh zone inland from the forest zone are marsh cord grass, glasswort, black needle rush, saltmeadow hay, salt grass, marsh elder, sea oxeye and grou

D. Marine life in the supratidal zone are ghost crabs and sand fleas. Ghost shrimp, bristle worms and clams are found in the flat beach zone. In the intratidal zone, clams, lugworms and mole crabs are found. Blue crabs, sand dollars and silversides are found in the subtidal zone.

E. Marine fishes inhabiting offshore waters are barracudas, black sea bass, bluefish, bonitos, cobia, croakers, dolphin, black drum, red drum, flounder, grouper, grunt, jack mackerel, Atlantic mackerel, ling mackerel, spanish mackerel, ocean mullet, whitefish, pigfish, pompanos, porgie, spotted weakfish, sharks, silversides, snapping spot and white sea trout.

### III. ACTION/PROJECT DESCRIPTION

A. This biological assessment does not describe a new facility or project. It provides information on threatened and endangered species located in an existing bombing and artillery range located at Browns Island. Both of these ranges have been in existence since World War II. The range located at Browns Island has been in continuous use since World War II. The range adjacent to, but offshore from, Browns Island was in use until the early 1960's. Since the early 1960's, it has fallen into disuse, except for over-shoots. Due to changes in the Marine Corps weapons inventory, plus increased range capabilities of new weapons, there is a requirement to resume firing in the offshore portion of Browns Island target complex. This assessment addresses these ranges as one since they are adjacent and will be scheduled for utilization as one range. This range is commonly referred to by one of the following names: BT-3, N-1 Impact Area or Browns Island. For clarity's sake this assessment will address the complex as the N-1 Impact Area as it is this agency's intent to formally declare Browns Island the adjoining rectangular ocean sector (see map) as a single target and bombing area. A description of the first range is as follows:

1. Range: N-1 Impact Area

F-40

2. Location: Browns Island grid coordinate 9429 through 0033 and a rectangular oceanic sector approximately 6,000 meters wide, extending approximately 10,000 meters in a southeasterly direction off the coast of Camp Lejeune (see attached map), Appendix A.

3. Description:

a. This range is also referred to as Bombing and Target Range (BT-3) and Browns Island.

b. The Browns Island portion is used for aircraft, artillery and tank weapons firing utilizing improvised targets such as vehicle hulls. It is an impact area for the G-5, G-5A and G-7 Ranges.

c. The offshore portion of the N-1 Impact Area will be used as an impact area for machinegun and other light weapons fire at targets and as an over-shoot safety impact area from firing at land based targets. Targets will be small, improvised, anchored devices towed into place prior to a firing exercise and removed upon completion of the firing exercise.

d. The Browns Island portion of the N-1 Impact Area is adjacent to the Intracoastal Waterway.

4. Authorized Firing:

a. Aircraft - All aircraft armanent is composed of practice rounds not exceeding net explosive weight of 20 pounds TNT equivalent.

b. Ground Weapons - All weapons and ammunition authorized for ranges G-5, G-5A and G-7.

c. Mortars may be used to mark targets (HE, illumination and WP).

d. Artillery - All types of ammunition.

5. Range Limits: This range extends northeast from the Junction of north/south grid line 94 at Onslow Beach, along the beach line to Bear Creek Inlet; north-northwest along Bear Creek to a point 400 yards northwest of the Intracoastal Waterway; west-southwest on a line 400 yards of and parallel to the Intracoastal Waterway to Freeman's Creek then south to the point of origin. This portion of the N-1 Impact Area is bordered by a 1,000 yard buffer zone on the north and west side. A 1,000 yard no fire zone extends inboard from Bear Creek. The water portion of the N-1 Impact Area is a rectangular oceanic sector approximately 6,000 meters wide and extends approximately 10,000 meters in a southeasterly direction seaward, off the coast of Camp Lejeune.

B. A description of the second range is as follows:

1. Range: Onslow Beach North Tower Machinegun Range

2. Location: Onslow Beach North Tower grid coordinate is 9328

3. Description:

b. Floating target platforms seaward within the N-1 Impact Area

4. Authorized Firing:

a. Weapons - M-2, M-85, M-60 and 25 mm machineguns both ground mounted and vehicle mounted.

b. Ammunition - Service

5. Range Limits:

a. Right flank coordinate 935287, azimuth 105°

b. Left flank coordinate 939290, azimuth 80°

C. A description of the third range is as follows:

1. Range: E-1 Onslow Beach Missile Range

2. Location: E-1 Onslow Beach Missile Range extends between Onslow South Tower and grid line 90 on the beach between the frontal dunes and the ocean.

3. Additional Information: The E-1 Range is a missile firing range for Redeye and Hawk missiles. The weapon systems are designed to be used against aerial targets. Firing of these missiles is by Marine Corps and the U. S. Army personnel on the beach. There are no explosives on the practice missiles, but there will be debris from fragmentation and the missiles themselves which impact into the ocean. Normally the missile firing is conducted semi-annually. Twelve missiles were fired from 3 December 1980 through 22 March 1982.

IV. PROBABLE IMPACT TO ENDANGERED/THREATENED SPECIES IN THE MARINE ENVIRONMENT

A. The marine environment in the N-1 Impact/BT-3 Bombing and Target Area has been used for many years for military training exercises. This area contains large quantities of unexploded ordnance. The land area can be entered only by Explosive Ordnance Disposal personnel. The U. S. Fish and Wildlife Service found no adverse impact in the opinion rendered for the Green and Atlantic Loggerhead Sea Turtles relative to impact from live-firing on Browns Island.

B. The offshore portion of the range is primarily used for firing non-exploding projectiles. It is also used as a buffer zone for firing on Browns Island and infrequently receives artillery projectiles or aircraft bombs that are over-shot. There are no permanent structures except for an observation tower on the outer edges of the buffer zone at Onslow Beach and Browns Tower. Range regulations prohibit firing at wildlife species on land, air or water at all times.

C. A dead Loggerhead Turtle was stranded near Browns Inlet in 1978 which appeared to have been shot through the head. Two whales of undetermined species were stranded on Bear Island in April 1982 approximately 24 feet to 30 feet in length. Neither of these incidents were known to have resulted from firing into the N-1 Impact/BT-3 Bombing and Target Areas. A portion of the subject area has been established as a sea turtle sanctuary by the State of North Carolina to prohibit commercial trawling during the nesting seasons.

D. The sea turtle sanctuary is listed as beginning at the northernmost end of Hammocks Beach (Bear Island) and seaward toward the Bogue Inlet bouy for 1,000 feet; southwestward 1,000 feet off Bear Island to the restricted zone designated as part of Camp Lejeune restricted area; seaward along the northern boundary of this zone; on the south side of the restricted zone the sanctuary shall recommence 1,000 feet or one-fourth mile off the beach and pass southwestwardly to the first (northern) observation tower on Onslow Beach; thence the zone shall extend for three-fourths of a mile to  $34^{\circ} 33.5' N-77^{\circ} 13.4' W$ ; the zone shall thence include that portion of the ocean southwestward of the New River Inlet buoy the demarkation line shall pass the southernmost tip of Onslow Beach, no person shall use any commercial fishing equipment between June 1 and August 31, except that the Secretary, North Carolina Department of Natural Resources and Community Development, acting upon the advice of the Director, may by proclamation modify the sea turtle sanctuary within the above described area and vary implementation between these dates for the protection of the sea turtle population. The sea turtle sanctuary is contained in Appendix B.

E. Contracts have been made with recognized experts concerning listed species in the subject area including those with the U. S. Fish and Wildlife Service and the North Carolina Wildlife Resources Commission and the University of North Carolina. The North Carolina Marine Fisheries Division has been contacted relative to commercial fishing operations in offshore waters along Onslow Beach. Names and addresses of those individuals contacted are as follows:

1. Dr. Frank Schwartz, Institute of Marine Sciences, University of North Carolina, Morehead City, North Carolina
2. Mr. Don Harke, State Supervisor Wildlife Assistance, U. S. Fish and Wildlife Service, Raleigh, North Carolina
3. Mr. Otto Florschutz, Sea Turtle Recovery Team Member, U. S. Fish and Wildlife Service, Washington, North Carolina
4. Mr. Stuart Critcher, Endangered Species Coordinator, North Carolina Wildlife Resources Commission, Raleigh, North Carolina
5. Mr. Stephen Polinski, Law Enforcement Plot, North Carolina Marine Fisheries Division, Morehead City, North Carolina
6. Mr. Howard Bogey, Inspector, North Carolina Division of Marine Fisheries, Swansboro, North Carolina

F. Available literature on the listed species has been reviewed.



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE

F-43

Southeast Region  
9450 Koger Boulevard  
St. Petersburg, FL 33702

November 23, 1981

F/SER61:AM

Major General C. G. Cooper  
Commanding General, U. S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Dear Major General Cooper:

This responds to your November 17, 1981, letter requesting consultation for Marine Corps activities at the Marine Corps Base, Camp Lejeune, North Carolina, as required by Section 7 of the Endangered Species Act of 1973.

The attached list provides the threatened and endangered species under National Marine Fisheries Service jurisdiction that may be present in the project area. Upon receipt of this list, the USMC must insure that its actions are not likely to jeopardize the continued existence of the listed species.

For a major Federal action, the agency must conduct a biological assessment to identify any endangered or threatened species which are likely to be affected by such action. The biological assessment shall be completed within 180 days after receipt of the species list, unless it is mutually agreed to extend this period.

The components of a biological assessment are as follows:

- (1) conduct a scientifically sound on-site inspection of the area affected by the action, which must, unless otherwise directed by the Service, include a detailed survey of the area to determine if listed or proposed species are present or occur seasonally and whether suitable habitat exists within the area for either expanding the existing population or potential reintroduction of populations;
- (2) interview recognized experts on the species at issue, including those within the Fish and Wildlife Service, the NMFS, State conservation agencies, universities and others who may have data not yet found in scientific literature;
- (3) review literature and other scientific data to determine the species distribution, habitat needs, and other biological requirements;
- (4) review and analyze the effects of the action on the species, in terms of individuals and population, including consideration of the cumulative effects of the action on the species and habitat;



- (5) analyze alternative actions that may provide conservation measures;
- (6) conduct any studies necessary to fulfill the requirements of (1) through (5) above;
- (7) review any other information.

At the conclusion of the biological assessment, as described above, the Federal agency should prepare a report documenting the results.

If the biological assessment reveals that the proposed project is likely to affect listed species, the formal consultation process shall be initiated by writing to the Regional Director, National Marine Fisheries Service, 9450 Koger Boulevard, Duval Building, St. Petersburg, Florida 33702. If no effect is evident, there is no need for formal consultation. We would, however, appreciate the opportunity to review your biological assessment.

If you have any questions, please contact Andreas Mager, Jr., Fishery Biologist, Southeast Regional Office, FTS 826-3503.

Sincerely yours,

*Charles A. Oravecz*

for D. R. Ekberg  
Chief, Environmental &  
Technical Services Branch

Enclosure

cc: FWS, Atlanta, GA  
FWS, Raleigh, NC

ENDANGERED AND THREATENED SPECIES AND CRITICAL HABITATS UNDER  
NMFS JURISDICTION:

F-45

North Carolina

<u>LISTED SPECIES</u>	<u>SCIENTIFIC NAME</u>	<u>STATUS</u>	<u>DATE LISTED</u>
Fin Whale	<u>Balaenoptera physalus</u>	E	12/2/70
Humpback Whale	<u>Megaptera novaeanglinae</u>	E	12/2/70
Right Whale	<u>Eubaleana glacialis</u>	E	12/2/70
Sei Whale	<u>Balaenoptera borealis</u>	E	12/2/70
Green Sea Turtle	<u>Chelonia mydas</u>	Th	7/28/78
Hawksbill Sea Turtle	<u>Eretmochelys imbricata</u>	E	6/2/70
Kemp's (Atlantic) Ridley Sea Turtle	<u>Lepidochelys kempii</u>	E	12/2/70
Leatherback Sea Turtle	<u>Dermochelys coriacea</u>	E	6/2/70
Loggerhead Sea Turtle	<u>Caretta caretta</u>	Th	7/28/78
Shortnose Sturgeon	<u>Acipenser brevirostrum</u>	E	3/11/67

SPECIES PROPOSED FOR LISTING

None

LISTED CRITICAL HABITAT

None

PROPOSED CRITICAL HABITAT

None

1. Include sperm whale only for deep water projects.
2. Humpback and right whales occur in shallow water.



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
ENDANGERED SPECIES FIELD STATION  
100 OTIS STREET, ROOM 224  
ASHEVILLE, NORTH CAROLINA 28801

F-46

December 4, 1984

Brigadier General L. H. Buehl  
Commanding General  
U. S. Marine Corps Base  
Camp Lejeune, North Carolina 28542

Dear General Buehl:

This letter presents the Biological Opinion of the Fish and Wildlife Service concerning the effects of proposed repairs to the existing railroad (Phase II) from Camp Lejeune to Cherry Point, North Carolina on the endangered American alligator (Alligator mississippiensis). It responds to Colonel M. G. Lilley's request for formal consultation dated November 21, 1984. This opinion does not address requirements of environmental laws other than the Endangered Species Act. Log No. 4-2-85-078 has been assigned to this consultation; this number should be referenced in all future correspondence concerning this project.

## Project Description

The standard gauge railroad between Camp Lejeune and Cherry Point was constructed during the World War II period. It was originally built and owned by the Seaboard Railroad Corporation, but during the past several decades usage dropped substantially and the 27-mile-long reach involved in this consultation was acquired by the Federal government. A significant amount of repair work is needed to bring the system up to full standard and allow the safe transporting of heavy military equipment from Camp Lejeune to port facilities at Morehead City. Contemplated work includes replacement of damaged cross ties, refurbishing of bridges, right-of-way clearing, and the upgrading of the existing road bed. Soil material needed for road bed improvement will come from borrow areas within the right-of-way. Much of the railroad right-of-way crosses the Croatan National Forest.

## Consultation History

Contacts with U. S. Forest Service personnel on the Croatan National Forest during the summer of 1984 indicated that a significant amount of repair work was forthcoming on this railroad bed. These personnel expressed concern over the fate of American alligators that are frequently seen during the warmer months of the year. Informal consultation on this project was requested by letter from Colonel Lilley dated September 24, 1984. On October 26, 1984, I visited Camp Lejeune and was briefed on the project by members of your natural resources and facilities staff. That afternoon I inspected the entire length of railroad. After considerable discussion with biologists knowledgeable of the area and the American alligator, conclusions were drawn and set forth in my letter to you of November 19, 1984. These recommendations indicated that the only area of concern was that portion of the railroad that passed near the Camp Brian-Lake Ellis area. Work within



this particular area, from mile marker 20 to 27, should be scheduled only during the periods October 1 - December 15, and March 15 - June 15. By letter of November 21, 1984, from Colonel M. G. Lilley, formal consultation was requested on this project in view of the may affect situation.

### Biological Opinion

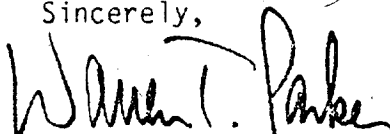
After careful review of all the information available for this project and based on the commitments made in Colonel Lilley's letter of November 21, 1984, concerning the timing of work between mile markers 20 and 27, it is my Biological Opinion that the planned upgrading of the Camp Lejeune to Cherry Point Railroad (Phase II) is not likely to jeopardize the continued existence of the American alligator.

In meeting the provisions of "incidental take" in Section 7(b)(4) of the Endangered Species Act, we have reviewed the biological information and other available information relative to this action. Based upon our review, incidental take is not authorized for the American alligator during implementation of this activity.

If modifications or changes in planned operations for the upgrading of the Camp Lejeune-Cherry Point Railroad are made which were not a part of this consultation, or other information reveals impacts of these actions which may affect listed species or critical habitat in a manner not previously considered, consultation must be reinitiated with this office.

I would like again to thank you and your staff for the hospitality provided in this consultation process, and trust that this opinion will prove useful to you. Your interest in endangered species is certainly appreciated.

Sincerely,

  
Warren T. Parker  
Field Supervisor

CC:  
Director, FWS, OES, Washington, D. C.  
Regional Director, FWS, Atlanta, Georgia (FA)  
Field Supervisor, FWS, ES, Raleigh, N. C.



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
ENDANGERED SPECIES FIELD STATION  
100 OTIS STREET, ROOM 224  
ASHEVILLE, NORTH CAROLINA 28801

F-48

December 6, 1984

Brigadier General L. H. Buehl  
Commanding General  
U. S. Marine Corps Base  
Camp Lejeune, North Carolina 28542

Re: 4-2-85-077

Dear General Buehl:

This letter presents the Biological Opinion of the Fish and Wildlife Service concerning the effects of proposed range improvements at the K-2 Impact Area on the endangered red-cockaded woodpecker (Picoides borealis). It responds to Colonel M. G. Lilley's request for formal consultation dated November 7, 1984. This opinion does not address the requirements of environmental laws other than the Endangered Species Act. Log No. 4-2-85-077 has been assigned to this consultation; this number should be referenced in all future correspondence concerning this project.

## Project Description

The K-2 Impact Area has been operational for many years. That portion of the area actually designated for impact of short range weapon systems as well as long-range artillery fire totals 1,597 acres. This is surrounded by a buffer zone that comprises some 1,181 acres. Predominate timber type throughout is mixed longleaf pine and hardwood and some essentially pure, open stands of longleaf pine.

Range refurbishment is necessitated by reduced visibility of target areas within the K-2 Impact Area. This has occurred due to growth of trees and understory vegetation. Trees and brush will be leveled by heavy equipment to provide visibility of target arrays at distances up to 3,000 meters from observation posts.

## Consultation History

On September 26, 1984, Fish and Wildlife Service personnel accompanied Regional Director James Pulliam for a meeting with you and your staff regarding the G-10 Impact Area and its possible effect on adjacent colonies of red-cockaded woodpeckers. At this meeting we learned of the planned clearing of the K-2 Impact Area. Subsequent discussion revealed that an active colony of red-cockaded woodpeckers had only recently been discovered within the buffer of this impact area. In view of this "may affect" situation, formal consultation was initiated. On October 26, 1984, I visited Camp Lejeune and conducted an on-site inspection of the active woodpecker colony as well as adjacent habitat. By letter of November 19, 1984, I informed you of my findings and recommendations concerning the management of the colony site. Subsequent discussions with Mr. Julian Wooten indicate that

requested helicopter surveys were conducted and no new colonies of birds were located within the project area.

### Biological Opinion

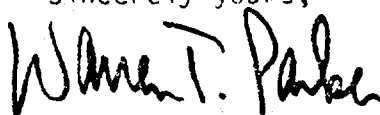
After careful review of all the information available for this project and based on the commitments made in Colonel Lilley's letter of November 7, 1984 concerning the dedication of 125 acres of selected habitat for foraging and colony site protection, it is my biological opinion that the planned clearing of the K-2 Impact Area is not likely to jeopardize the continued existence of the red-cockaded woodpecker.

In meeting the provisions for "incidental take" in Section 7(b)(4) of the Endangered Species Act, we have reviewed the biological information and other available information relative to this action. Based upon our review, ~~incidental take is not~~ authorized for the red-cockaded woodpecker during implementation of this activity.

If modifications or changes in planned operations for the clearing of the K-2 Impact Area are made which were not a part of this consultation, or other information reveals impacts of these actions which may affect listed species or critical habitat in a manner not previously considered, consultation must be reinitiated with this office.

We would like to express our appreciation to you and your entire staff for the assistance provided in this consultation process. I trust that the end results are an improvement of an already commendable program and an amicable and cooperative relationship between our offices.

Sincerely yours,



Warren T. Parker  
Field Supervisor

CC:

Director, FWS, OES, Washington, D.C.  
Regional Director, FWS, Atlanta, Georgia (AFA/SE)  
Field Supervisor, FWS, ES, Raleigh, N. C.



# United States Department of the Interior

FISH AND WILDLIFE SERVICE

F-50

ENDANGERED SPECIES FIELD STATION

100 OTIS STREET, ROOM 224

ASHEVILLE, NORTH CAROLINA 28801

June 5, 1985

Mr. B. W. Elston  
Assistant Chief of Staff, Facilities  
U.S. Marine Corps Base  
Camp Lejeune, North Carolina 28542-5001

Dear Mr. Elston:

RE: Log No. 4-2-78-385

This responds to your letter of May 9, 1985, requesting consultation regarding forest fire suppression in red-cockaded woodpecker (*Picoides borealis*) habitat. Your letter was acknowledged by letter of May 24, 1985, from our Regional Office and forwarded to this office for handling. As pointed out in your letter, the April 3, 1979, biological opinion on the base forestry management program does not address this point. We have informally consulted by telephone with base personnel on this issue in the past.

We will attempt herein to offer guidance on this issue, based on consultation with your personnel as well as our knowledge concerning the biological needs of the species. If this guidance is acceptable, please acknowledge such by return letter and incorporate the guidance as an amendment to the April 3, 1979, biological opinion in terms of further description of your forestry management program. If this guidance is unacceptable, we request that you initiate formal consultation regarding the effects of fire suppression effects at Camp Lejeune on the endangered red-cockaded woodpecker.

The April 3, 1979, biological opinion recommended a two- to three-year prescribed burning cycle in red-cockaded woodpecker habitat and restriction of road construction in colonies and buffer zones. In addition, the June 12, 1979, biological opinion on activities within the Mechanized Infantry Training Area restricted digging and destruction of vegetation. Obviously, if a need to suppress a wildfire within red-cockaded woodpecker habitat exists, some of the restrictions in these biological opinions would hamper these efforts.

However, every case must be handled individually based on the situation existing at that place and time. Therefore, we can only offer general guidance and depend on the case-by-case situations being adequately handled by base Natural Resource personnel, who are located on-site and are most knowledgeable regarding the biological needs of the species, habitat conditions in the area, and the risks involved in suppression versus non-suppression. In general, wildfire suppression within red-cockaded woodpecker habitat is only appropriate if the risks to the species and its

habitat from the wildfire are greater than the risks from the suppression activities themselves in the judgment of your Natural Resource personnel.

If red-cockaded woodpecker habitat has been prescribed burned on two- to three-year cycles, the risks from wildfires should not be great. Therefore, suppression activities should be conducted outside designated support stands, colony sites, and buffer zones. If the fire is outside these areas, suppression activities should be conducted outside of or at the designated habitat boundaries. If the fire is within the designated boundaries, it should be allowed to burn to the boundary and suppressed there, unless fuel build-up is such that the fire would be expected to be more detrimental to the species than the fire suppression measures necessary, by destroying overstory and midstory trees valuable for foraging, roosting, and/or nesting of the species.

At no time should suppression activities (fire lines, etc.) be conducted within colony sites and buffer zones because these areas are so small that possible benefits would not outweigh the possible adverse impacts. Again the fire should be suppressed outside of or at the boundary. If the fire is already within the colony site or buffer zone, it would be expected to traverse the area before suppression could be effective within the area anyway because of its small size. Also, the adverse impacts from fire suppression activities would be much greater in colony site and buffer zones than in support stands. Therefore, we cannot perceive risks from wildfires outweighing risks from fire suppression activities in colony sites and buffer zones.

If it is considered necessary to suppress wildfires in support stands, every effort should be made to avoid or reduce impacts to the most mature trees by placement of fire lines, etc., through the younger stands and/or stems. Within a mixed stand, move the line through younger stems to avoid the older stems.

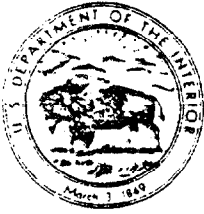
I hope this guidance meets your needs and is acceptable. We appreciate your concern and interest in endangered species, especially the red-cockaded woodpecker, and look forward to future cooperation in this regard between our agencies.

Sincerely yours,



Warren T. Parker  
Field Supervisor

CC:  
Ms. Deborah S. Paul, North Carolina Wildlife Resources Commission,  
Raleigh, NC  
Director, North Carolina Natural Heritage Program, Raleigh, NC  
Field Supervisor, ES, FWS, Raleigh, NC



# United States Department of the Interior

F-52

FISH AND WILDLIFE SERVICE  
ENDANGERED SPECIES FIELD STATION  
100 OTIS STREET, ROOM 224  
ASHEVILLE, NORTH CAROLINA 28801

December 13, 1985

Brigadier General J. B. Knotts  
United States Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Re: 4-2-85-681

Dear General Knotts:

This letter presents the biological opinion of the Fish and Wildlife Service concerning the potential effects of the suspension of the nightly beach monitoring of sea turtle nesting activities, from Onslow Beach North Tower to Browns Inlet, on the threatened loggerhead sea turtle (Caretta caretta) and the threatened green sea turtle (Chelonia mydas). It responds to your request for consultation dated August 5, 1985. This opinion is based upon review of Colonel T. A. Tiebout's September 13, 1985, letter which assessed the increased training use of Onslow Beach and the additional impacts on sea turtles, and other relevant information. It does not address requirements of environmental laws other than the Endangered Species Act.

## Project Description

The G-5 and G-5A ranges fan over the northern end of Onslow Beach. They were designed as a tank range complex allowing firing of all weapons up to the tank main gun. Due to improvements in tank gunnery systems and limited range and maneuver space, this complex was used only periodically. However between 1982 and 1984 the range complex was refurbished and presently receives almost constant use by the tank battalion, amphibian assault vehicle battalion, light armored vehicle battalion, and other units. This increased use has resulted in an increased possibility of unexploded ordnance being present on the northern end of Onslow Beach. The safety of personnel monitoring the turtle nesting activities on this section of the beach cannot now be guaranteed at night.

## Biological Opinion

After careful review of all the information available for this action, it is the biological opinion of the Service that the suspension of the nightly sea turtle monitoring activities on the north end of Onslow Beach will not jeopardize the continued existence of the loggerhead sea turtle or the green sea turtle.

In meeting the provisions for "incidental take" in Section 7(b)(4) of the Endangered Species Act, we have reviewed the biological information and other available information relative to this action. Based upon our review, incidental take is not expected as a result of this action and is not authorized.

If any modifications or changes in this action are made which were not a part of this consultation, or if other information reveals impacts of this action which may affect listed species or critical habitat in a manner not previously considered, consultation must be reinitiated with this office.

#### Conservation Recommendations

For the past 11 years, Camp Lejeune has conducted a highly commendable sea turtle nest monitoring and conservation program. Nest success on Onslow Beach has been relatively high compared to other areas, as indicated by the base's summer sea turtle monitoring reports. This is a direct result of Camp Lejeune's efforts toward nest protection.

We are concerned that suspension of the nightly patrols and nest protection on the northern end of Onslow beach will result in loss of a large percentage of nests to predation and tidal inundation. Nest loss in unprotected habitat often ranges from 80-100 percent. In order to reduce this potential for nest loss, we have the following conservation recommendations:

1. Nightly patrols should be continued on Onslow Beach from the New River Inlet north to the Onslow Beach North Tower.
2. Nightly monitoring should be resumed along the portion of the beach which is designated as a secondary danger zone, since according to the assessment this area should not ordinarily contain unexploded ordnance and could be safely monitored by observing basic safety procedures.
3. Monitoring of the remaining portion of the beach (1400-1500 meters) designated as an impact area should be conducted daily, as early in the morning as safely possible. When it is necessary to relocate nests in this area, relocation should take place within six hours of egg-laying whenever possible; and eggs excavated during daytime should be shaded from the heat of the sun.

We hope this opinion will be useful to you in fulfilling your obligations under the Endangered Species Act. If you have any questions concerning this opinion, contact John Fridell or Nora Murdock at (FTS) 672-0321.

Sincerely yours,

*V. Gary Henry*

V. Gary Henry  
Acting Field Supervisor



# United States Department of the Interior

F-54

FISH AND WILDLIFE SERVICE  
ENDANGERED SPECIES FIELD OFFICE  
100 OTIS STREET, ROOM 224  
ASHEVILLE, NORTH CAROLINA 28801

March 23, 1987

Major General J. E. Cassity  
Commanding General  
U.S. Marine Corps  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

RE: 4-2-86-623

Dear General Cassity:

This letter responds to an informal consultation request received by telephone the week of February 17, 1987, regarding proposed management activities for the endangered red-cockaded woodpecker (Picoides borealis). I also took the opportunity while on the Base to briefly inspect the Tank/Mechanized Infantry Training Area (TMITA) as per the biological opinion of June 12, 1979.

Three specific areas were reviewed on the ground with regard to needed habitat management for the species. I will reference these areas by the red-cockaded woodpecker inventory colony number used by Base and North Carolina State University research personnel.

The first area looked at was colony site number 33 in timber compartment 26 east of Highway 17. This was a newly discovered colony that is in need of understory and midstory control work. The second area was colony site number 36 in timber compartment 47 just east of Highway 17. This site also needed some understory and midstory control work but also included a seed tree area in which the seed trees had not yet been removed and were being utilized by the red-cockaded woodpecker for foraging habitat. The last area evaluated was colony site number 22 in timber compartment 5 just west of Highway 172. This site was believed to be abandoned, but we discovered an active tree in this evaluation and observed one bird. We also discovered an inactive tree infested with southern pine beetles. This stand is in need of thinning, in general, which can provide much of the control of understory and midstory necessary in colony sites.

We discussed needed management and options to accomplish the necessary work. In general, the necessary management can be grouped into the following recommendation headings and are also addressed on page 50 of the recently revised recovery plan for the species:



1. Manage colony sites as stands - In the past, colonies on some lands have been considered as the cavity trees plus a 200-foot buffer, and these colony sites have been managed separately from the adjacent and surrounding stands. While this is a positive approach, it has some pitfalls. In colonies with scattered trees, some parts of the colony can be separated from other parts of the same colony. Also, colonies with few trees encompass such a small area that it is noneconomical, inefficient, and impractical in many cases to conduct needed management activities.

We recommend that the colony sites be stand size of 10 acres or more for management purposes and that they be prescribed for needed treatment during normal compartment prescription entry. Where possible, some of the needed treatments can then be handled by normal timber harvest contract. Noncommercial treatments can also be more efficient and economical because the acreage involved is sufficient to justify expenditures. Of course, treatments must be conducted outside of the nesting and fledging season of March through August. In delineating colony stands, all cavity trees and a 200-foot buffer should be included. The additional acreage should be the oldest and best habitat in terms of species composition and ease of management. In other words, include upland longleaf instead of mixed pine-hardwood or pocosin where possible. This recommendation is currently being implemented on Camp Lejeune, with the exception of colony site 22, and is not a major problem.

2. Control hardwood stocking - Hardwood stocking in colony stands should be kept below 20 feet<sup>2</sup>/acre BA, and all hardwood stems 1 inch and larger within 50 feet of cavity trees should be removed. Pine stems within 25 feet of cavity trees should be removed, and other pines within 50 feet that interfere with open travel lanes to the actual cavities should also be removed. Treatment options include hand treatment, mechanical treatment such as drum chopping, herbicide treatment, and prescribed fire. The treatment(s) needed, or most efficient and economical, will vary by stands and is strictly up to Base Natural Resource and Environmental Affairs Division (NREAD) personnel. Of course, chemical treatment must be with nonpersistent herbicides that are not toxic to vertebrates.

3. Maintain a 20- to 25-foot spacing between trees in sawtimber stands - This is a recommendation to minimize the probability of bark beetle infestation and spread. Where infestations occur, follow the provisions of the March 12, 1980, biological opinion on southern pine beetle control.

Application of these and other recommendations in specific cases reviewed are as follows:

Colony site 33 - Control understory and midstory by provisions in recommendation number 2. This will probably require hand, mechanical, or chemical treatment (or a combination of these), followed by periodic prescribed fire for maintenance.

Colony site 36 - Control understory and midstory by provisions in recommendation number 2. This does not appear to be quite as bad a situation as in colony 33 and will probably not require as much fund

expenditure and manpower. Also, the seed trees should be left for foraging habitat and not be removed, as there is sufficient information to indicate the usage of the area at present by the birds.

Colony site 22 - This should be treated as an active site, because we found an active tree and observed a woodpecker in the area. At least parts of the area need thinning using the provisions of recommendation number 3. This site is an excellent example where the provisions of recommendation number 1 would have been helpful in past activities. The colony site was separated from the surrounding stand and not treated. It would have been better to have designated a stand of 10 acres or more containing the colony site as a separate stand and thinned it along with the rest or other stands. Of course, we cannot manage by hindsight but must manage by foresight by treating the stand as we now recognize the need. The southern pine beetle infestation should be handled as provided in the March 12, 1980, biological opinion. This includes removing the inactive cavity tree if at least four cavity trees (active and inactive) still remain and the beetles have not emerged.

Updated Habitat Management Guidelines for the red-cockaded woodpecker on Camp Lejeune as per the revised recovery plan and the recommendations included therein were also reviewed.

After on-the-ground review of management proposals and needs of the red-cockaded woodpecker at Camp Lejeune through informal consultation, we concur that the proposed actions and management guidelines for managing red-cockaded woodpeckers on Camp Lejeune as detailed in this letter are conservation enhancement actions and are not likely to adversely affect the red-cockaded woodpecker or other listed species or critical habitat. Therefore, the obligations under Section 7(a)(2) of the Endangered Species Act of 1973, as amended, have been fulfilled with regard to these proposed actions.

However, these obligations must be reconsidered and consultation reinitiated if (1) incidental taking occurs as a result of the action, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the proposed action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this consultation, or (4) a new species is listed or critical habitat designated that may be affected by the proposed action.

Inspection of the TMITA revealed no significant problems. The last inspection was conducted December 13, 1983, and the change in the area in the last three years is very conspicuous. At the time of the consultation (1979), the area was rapidly deteriorating into a biological desert as a result of indiscriminate vegetation destruction. Most sites in the area now have a very good herbaceous and woody understory established. A review of photos taken at the time of the consultation and comparison to today's situation should readily reveal the change. A comparison of the TMITA to the immediate site at TLZ Hawk would also reveal the difference, as the entire TMITA was rapidly being changed to a condition present now at TLZ Hawk with just a few scattered trees and little or no additional understory vegetation. The Base is to be commended on their efforts to

protect the red-cockaded woodpecker and the vegetation on which they are dependent in the TMITA.

The understory and midstory control, thinning, etc., recommended in this letter for colonies outside the TMITA may, on the surface, seem to be in conflict with recommendations made and implemented in the TMITA. However, the situation is entirely different. In the TMITA we are dealing with continuous indiscriminate vegetation destruction that left little vegetation for the birds' use. In the general forest area we are dealing with periodic and very specific discriminate vegetation control. Once again, one only has to compare the site at TLZ Hawk to the general forest area to conceive the difference. Vegetation control is sometimes necessary, but the vegetation to be controlled is very specific to create favorable habitat conditions for the species.

We appreciate the cooperation extended by the Base NREAD personnel in this informal consultation and inspection trip. We have complete confidence in the ability of the Natural Resource personnel to manage the red-cockaded woodpecker properly. The stability of the population over some trying times with regard to training activities, southern pine beetle infestations, etc., is a tribute to their efforts. We are available at anytime the Base NREAD personnel want our input and advice, and we look forward to future cooperative relations between our agencies.

Sincerely,

*V. Gary Henry*

V. Gary Henry  
Acting Field Supervisor

*[Faint, illegible text, possibly bleed-through from the reverse side of the page]*

HABITAT MANAGEMENT GUIDELINES  
FOR THE RED-COCKADED WOODPECKER  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA

The purpose of the following guidelines is to comply with the Endangered Species Act of 1973 (Pub. L. No. 93-205) for the perpetuation of red-cockaded woodpeckers. These guidelines are in accordance with the 1985 Revised Red-cockaded Woodpecker Recovery Plan prepared for this species by the U.S. Fish and Wildlife Service. The subject guidelines are considered as immediate requirements to maintain current populations of these woodpeckers. By following these guidelines, areas closely resembling the original pine forests of the coastal plain can be maintained. All species of flora and fauna native to fire-maintained pine forests should benefit from this program.

These guidelines will become an integral part of the Natural Resource Management Plan. All natural resource management activities will be adjusted to maximize the perpetuation of this species throughout the contiguous habitat. Frequent monitoring of all colony areas and contiguous habitat is an ongoing responsibility of natural resource management personnel on the installation. Any land use activities adversely impacting upon woodpecker habitat will be reported to the proper authority for corrective action.

#### GUIDELINES

1. Protection and management of the red-cockaded woodpecker will take precedence over other featured species throughout the range of this bird at Camp Lejeune.
2. Maintain at least 100 acres of contiguous pine forest, including the colony stand and support stands 40 years of age or older, for replacement cavity trees, feeding, or roosting areas. In the event 100 acres are not present, manage available acreage. The following guidelines will be adhered to in management.
3. Locate, conspicuously mark, and map all cavity trees and active colonies and aggregates thereof, including single trees, starts, and relicts. Mark a 400-foot buffer zone around each nesting cavity for exclusion of primary land use during nesting season (March through July).
4. Manage colony sites as stands rather than individual trees and do not isolate colony sites from adjacent forest cover and foraging habitat. Plan no timber rotations for colony stands. Rotations for support stands will be aimed at providing sufficient stands of old growth timber. Rotations will be 100 years for longleaf pines and 80 years for loblolly

pinus for optimum dispersal. Younger stands of pinus will be sufficiently dispersed for future replacement of old growth stands. Rotation of these stands will be the same as previously mentioned for longleaf and loblolly pinus.

5. Maintain the cavity trees and a basal area of 50 to 80 square feet per acre in colony stands. Remove trees which threaten to block the cavity entrances. Conduct thinnings for reduction of dense pine and hardwood reproduction exceeding 1 inch d.b.h. or 15-foot heights within the colony stands. Thin to minimum stocking level acceptable. Understory and midstory stocking will be maintained as recommended in the recovery plan. Leave all dead snags for use by other cavity nesting birds thereby reducing competition of active cavities used by woodpeckers. Schedule logging operations in colony stands from August through February.

6. Prescribe burn colony stands and contiguous habitat for providing open park-like stands required by the woodpecker. Remove vegetation and debris from the area immediately surrounding all cavity trees prior to prescribed burning. Schedule prescribed burning with two- to three-year intervals from December through February.

7. Site preparation within the contiguous habitat will be for natural regeneration of longleaf pine whenever possible.

8. New roads will not be constructed within any colony stands.

9. Maintain a spacing of 20 to 25 feet between trees in sawtimber colony stands to minimize the probability of bark beetle infestation or spread. Control of pine park beetles in red-cockaded woodpecker habitat will follow the provisions of the biological opinion issued March 12, 1980. Problems not covered sufficiently by this opinion will be handled through consultation with the Fish and Wildlife Service.

10. Cavity trees, colony areas, and contiguous habitat will be protected from all actions which will result in the destruction or adverse modification of such habitat.

11. All land use activities will cease within the 400-foot buffer of nesting cavities from March through July except for the following:

- a. Casual human activity such as nature study and photography.
- b. Infrequent field trips by students or public groups.
- c. Management activities associated with site protection, evaluation, or populations studies.

12. Provide a minimum of 125 acres of well-stocked ( $\geq 60 \text{ ft}^2/\text{acre}$  BA) pine and pine hardwood stands ( $\geq 50$  percent BA in pine), 30 years of age and older, with more than 24 pines/acre  $\geq 10$  inches d.b.h. within 0.5 mile of all colonies. Forty percent, or 50 acres, of the 125 acres will be 60 years old or older. In areas of younger, smaller diameter, or sparsely stocked stands, equivalent foraging substrate containing 21,250 pine stems with a total BA of  $8,490 \text{ ft}^2$  and 6,350 pine stems  $\geq 10$  inches d.b.h. will be provided.

## DEFINITION OF TERMS











1. Cavity - An excavation used by red-cockaded woodpeckers for roosting or nesting at some time during the life of the colony.
2. Cavity Tree - A tree containing one or more red-cockaded woodpecker cavities.
3. Nest Tree - A tree containing a nesting cavity.
4. Nest Cavity - A cavity used by a pair of red-cockaded woodpeckers as a place in which to raise their young, usually the roosting cavity of a male.
5. Start Hole - The beginning of a cavity--may never be finished--but if completed, excavation is usually over a period of several months.
6. Roost Cavity - A cavity used by a red-cockaded woodpecker only as a shelter, particularly at night and during inclement weather.
7. Old Cavity - An enlarged cavity with deteriorating glaze receiving little or no current use.
8. Clan - All the red-cockaded woodpeckers that inhabit a colony at a given point in time--generally a mated pair of red-cockaded woodpeckers, their offspring, and their associated helpers.
9. Helper - Any red-cockaded woodpecker in a clan other than the genetic parents of young raised by the clan during the most recent breeding season.
10. Colony - The area prescribed by an aggregation of start holes and roost, nest, and old cavities habitually used by a clan.
11. Range - The area surrounding a nest cavity required by a clan to fulfill their life cycle requirements.
12. Habitat - The place or site where plants or animals naturally or normally live and grow.
13. Contiguous Habitat - Continuous acres of pine forest, including the colony, support stands, breeding territory, seasonal foraging area, or other definable units.
14. Buffer Zone - A 400-foot area around nesting/cavity trees when land uses are restricted during nesting and brooding period.

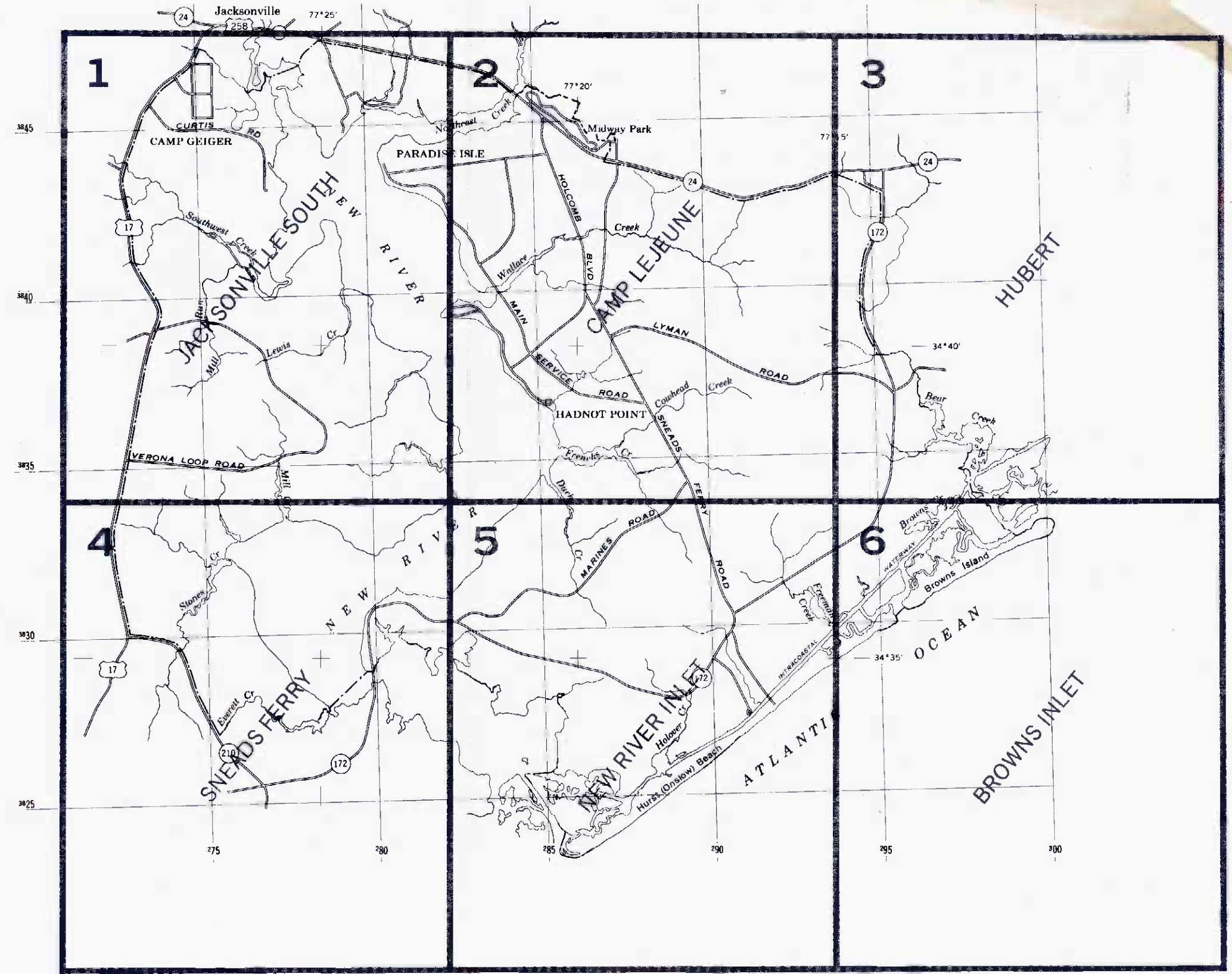
15. **Marked Boundary** - An established line marked along the periphery of contiguous red-cockaded woodpecker habitat.

16. **Resin Well** - A small hole, generally circular, excavated by the bird in the bark of a cavity tree or on a tree adjacent to a cavity tree from which resin exudes.

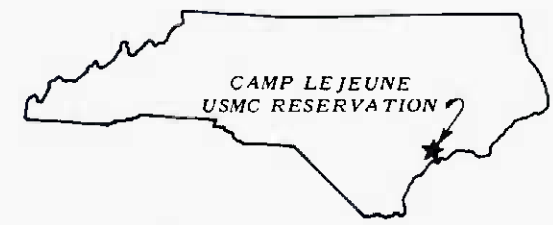


LEGEND

- RESOURCE COMPARTMENT BOUNDARY 
- RESOURCE COMPARTMENT NUMBERS **25**
- RED-COCKADED WOODPECKER CONTIGUOUS HABITAT 
- BOAT RAMPS  Name of Landing
- NATURAL AREAS  Name of Area
- WILDLIFE OPENINGS 
- FOREST FIRE DETECTION TOWERS USMC 
- FOREST FIRE DETECTION TOWERS NCFS 
- DIVIDED HIGHWAY 
- GOOD MOTOR ROAD 
- DRAINAGE 
- MANAGED FISH PONDS **8**



1. Courthouse Bay
2. Powerline
3. Ward
4. Cedar Point
5. Mile Point
6. Oak
7. Prince
8. Hog Pen
9. New River
10. Orde
11. Henderson
12. Hickory



VICINITY MAP

**INDEX TO MAP SHEETS  
CAMP LEJEUNE  
USMC RESERVATION  
ONSLOW COUNTY, NORTH CAROLINA**



02001LLBIX





34° 37' 30"  
77° 30' 00"

365,000 FEET



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1974 photography obtained from U.S. Department of Interior, Geological Survey.



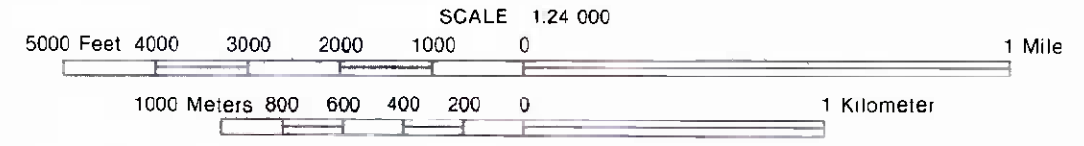


NATURAL RESOURCES MULTI-USE MANAGEMENT PLAN  
**CAMP LEJEUNE USMC RESERVATION**  
 ONSLOW COUNTY, NORTH CAROLINA

SHEET 2  
 CAMP LEJEUNE

REVISED JAN 1988 4-R-39948-2

Base compiled from National High Altitude  
 Photography dated 1983





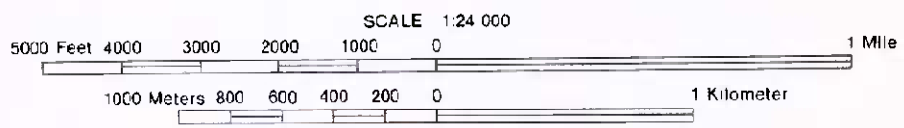


Base compiled from National High Altitude Photography dated 1988

**NATURAL RESOURCES MULTI-USE MANAGEMENT PLAN**  
**CAMP LEJEUNE USMC RESERVATION**  
 ONSLOW COUNTY, NORTH CAROLINA

SHEET 3  
HUBERT

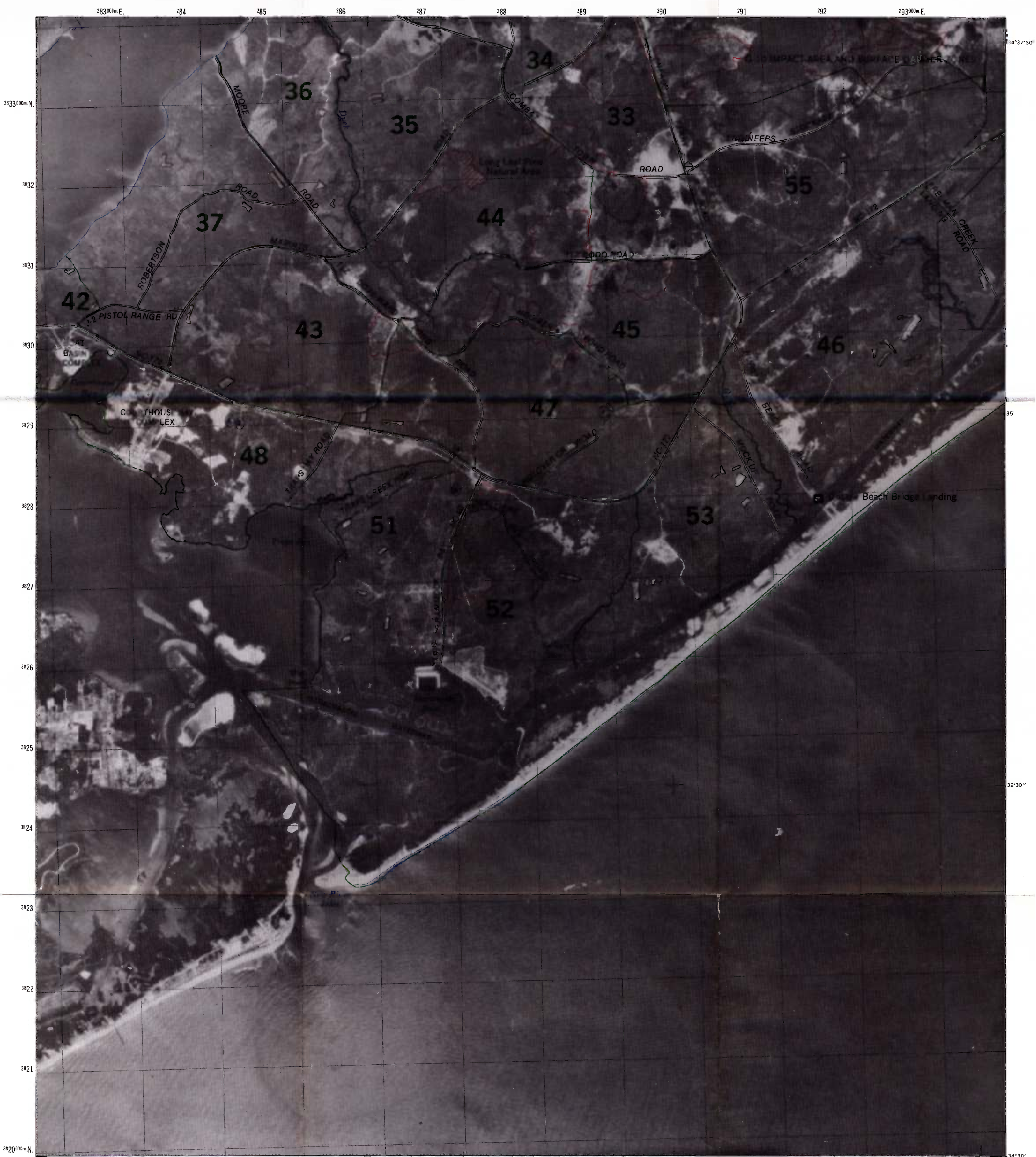
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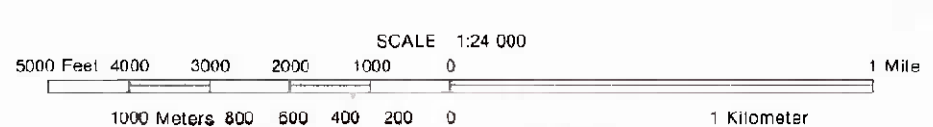


NATURAL RESOURCES MULTI-USE MANAGEMENT PLAN  
**CAMP LEJEUNE USMC RESERVATION**  
 ONSLOW COUNTY, NORTH CAROLINA

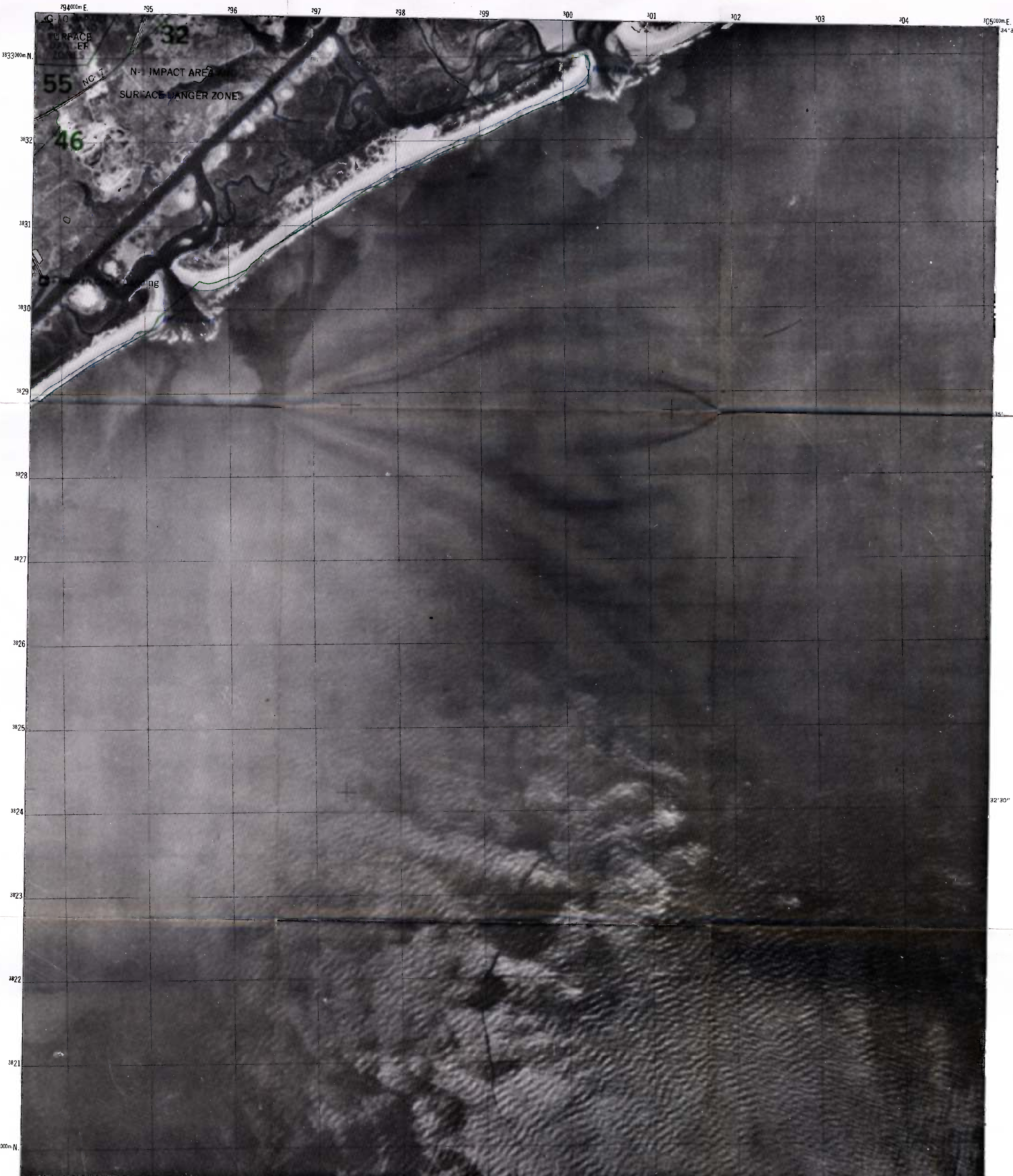
SHEET 5  
 NEW RIVER INLET

REVISED JAN 1988 4-R-39948-5

Base compiled from National High Altitude  
 Photography dated 1983







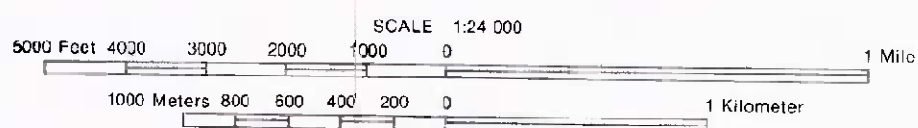
Base compiled from National High Altitude  
Photography dated 1983



NATURAL RESOURCES MULTI-USE MANAGEMENT PLAN  
**CAMP LEJEUNE USMC RESERVATION**  
ONSLow COUNTY, NORTH CAROLINA

SHEET 6  
BROWNS INLET

REVISED JAN 1989 4-R-39948-E





Executive Summary

# Multiple-Use Natural Resources Management Plan

United States Marine Corps  
Camp Lejeune



0200111 B2X





## Mission

**E**stablished in 1941 and named in honor of Lieutenant General John A. Lejeune, Camp Lejeune is the home of the II Marine Amphibious Force; 2nd Marine Division, FMF; 2nd Force Service Support Group (Rein), FMF; 6th Marine Amphibious Brigade, FMF; COMCABEAST, Marine Corps Air Station, New River; Naval Hospital; and Naval Dental Clinic.

Camp Lejeune's mission is to provide housing, training facilities, and logistic and administrative support for the assigned units. Even though amphibious tactics are emphasized, the Base prepares and maintains Marine units for almost all facets of military operations.

As World War II approached, the Marine Corps began to search for a suitable site on the East Coast to conduct amphibious warfare training. In 1939 land was bought in Onslow County, North Carolina, and in 1941 construction of the Base began.

Most of the land was privately owned. The woodlands had been denuded of quality timber. There was no fire protection and the wildlife habitat was generally poor.

Part of the Base Commander's responsibility is to ensure that the Base's facilities, including its natural resources, are maintained at the highest standards. This means the protection and conservation of the Base's soil, water, forest and wildlife resources. It also means using these natural resources to their fullest potential for the benefit of the United States and its people.

Since government ownership was finalized in 1941, the Base implemented a forestry program in 1946, a wildlife management program in 1966, an environmental pro-

gram in 1972, and recently a multi-use natural resources management plan. Environmental conditions for flora, fauna and humans have improved steadily under the Corps' direction.

About 90 percent of the land area within Camp Lejeune is being used for military training. However, the nature of military training carried out within the complex generally does not require the exclusive use of the land area. The secondary use of natural resources management has been practiced and promoted. This balance between military priorities and natural resources management is consistent with national policies and regulations applicable to publicly-owned land.

The Natural Resources and Environmental Affairs Division (NREAD) has the primary responsibility for assisting the Base Commander in carrying out his natural resource management and protection responsibility.

## Resources

**C**amp Lejeune consists of approximately 85,000 acres of land. About 84 percent of the area is covered by forests.

The Base is typical of the Southeastern Coastal Plain with an elevation of sea level to 70 feet above. The topography ranges from flat, savannah-like to gently rolling. Deep wooded forests characterize the better upland sites while most of the water-courses are headed by inaccessible swamps and pocosins.

The principal watershed drainage areas are New River, Northeast Creek, Southwest Creek, Wallace Creek, French Creek, Bear Creek, Freeman Creek, and Duck Creek.



**(Above)** Camp Lejeune has many valuable natural resources including these hardwood stands.

**(Top)** Military exercises and resource management can be compatible as Camp Lejeune has proven for the past 40 years.



**(Above)** Wetlands provide excellent habitat for many species of wildlife. Their protection is closely regulated by both state and federal agencies.

**(Top)** Trees are marked for thinning. Crowded trees are easy prey for disease and insect damage. Thinning helps improve the growth rate and productivity of the forest.

There are 25 different soil series ranging from sandy loams to fine sand and muck. The dominant series is sandy loam. Some of the soils are low in organic matter and fertility, but most produce abundant crops of timber, forage and mast for wildlife.

Vegetation on the unimproved areas of the Base is typical of the Southeastern Coastal Plain. Pure pine stands, consisting of loblolly and longleaf pine, are found on the drier upland soils. Pure pond pine stands are found on the high organic wet soils. Pine-hardwood and pure hardwood stands are found in the streamside zone and on the more productive soils. Bottomland hardwood types are found on the floodplains of the major creeks.

The Base has an abundant population of native game and non-game wildlife species. There are also several endangered and threatened species. Wildlife serves as a natural barometer to the quality of the general environment of Camp Lejeune.

### Forest Management

Camp Lejeune has 72,000 acres of forest land. It is the dominant land use and the Base's primary natural resource. Nearly 60,000 acres of the forest land are considered to have commercial value. Another 11,500 acres are included in impact areas and surface danger zones which prevent the timber from being harvested. The remaining acreage is considered to have no commercial value, or higher non-timber value, such as aesthetics, recreational or historical areas.

The Natural Resources and Environmental Affairs Officer has primary responsibility to the Commanding General for managing this

land in accordance with public law, Department of Defense (DOD) directives, and Marine Corps directives. Camp Lejeune's forestry program meets these requirements through the principles of multiple use, sustained yield, and even-aged management. The objective is to provide an even flow of forest related benefits such as a quality training area, wildlife habitat, outdoor recreation, and aesthetics.

More than 16,000 cords of pine wood and 6,000 cords of hardwood can be harvested under the Base Forestry Program. Proceeds from the sale of forest products are used to fund the annual operational expenses of the forest management program. As required by law, 40 percent of the net proceeds is annually returned to the Onslow County School System. Any remaining proceeds are used to fund forest management programs at other Marine Corps and Navy installations.

For record keeping purposes, the Base is divided into 55 compartments. Each compartment contains approximately 1,050 acres. These are further subdivided into contiguous stands of similar timber type and age. Silvicultural treatments are applied on a stand-by-stand basis. Five to six compartments are analyzed for needed silvicultural treatment annually.

In 1983, a multi-resource inventory was conducted in cooperation with the US Forest Service. It provides basic details for determining allowable annual harvest and general information concerning the condition of the forest resources.

Typical forest management projects carried out by the NREAD staff include:

#### Timber Sales

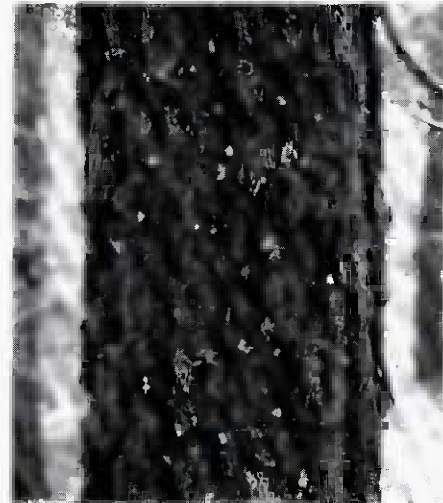
Timber sales are prepared to carry out



**(Above)** Wildfires are a common problem aboard Camp Lejeune. Specialized heavy equipment and properly trained personnel are essential for constructing fire lanes and conducting other fire suppression activities.

**(Left)** Long leaf pine is a preferred species because of its resistance to insects, disease, and fire. Long leaf is particularly suited to the less fertile soils.





**(Above)** Historically the Southern Pine beetle has done considerable damage to pine forests. Thinning has reduced the problem by promoting healthier timber stands.

**(Top)** Timber sales inspections are done as required to ensure the contractor's compliance with the contract specifications.

specific management objectives, and monitored to ensure contractual compliance.

**Prescribed Burning**

Prescribed burning helps reduce wildfire hazards, improve wildlife habitat, and control undesirable species. Camp Lejeune's forest land is normally burned on a five year cycle. Ranges, impact areas, and quail management areas are burned annually — while the Red-Cockaded Woodpecker habitat areas are burned on a two or three-year cycle.

**Insect and Disease Control**

Insect and disease control requires constant monitoring because conditions can vary greatly from month to month. Early detection and a rapid response are essential for preventing losses and limiting the spread of the agent.

**Timber Stand Improvement**

Timber stand improvement maintains the health and productivity of the forest by removing overstocked and unmerchantable trees. This is normally accomplished by mechanical precommercial thinning.

**Reforestation**

Reforestation helps sustain the forest benefits by creating a balanced age distribution. About 400 acres of pine, and 160 acres of hardwood and mixed pine and hardwood should be regenerated annually.

**Wildfire Control**

The incidence of wildfire within Camp Lejeune depends on the severity of the weather and the intensity of military training. Monitoring weather conditions and manning fire towers during periods of high fire danger maintain the Base's ability to respond quickly when wildfires occur.

**Forest Access Road Maintenance**

Multiple-use management of the forest re-

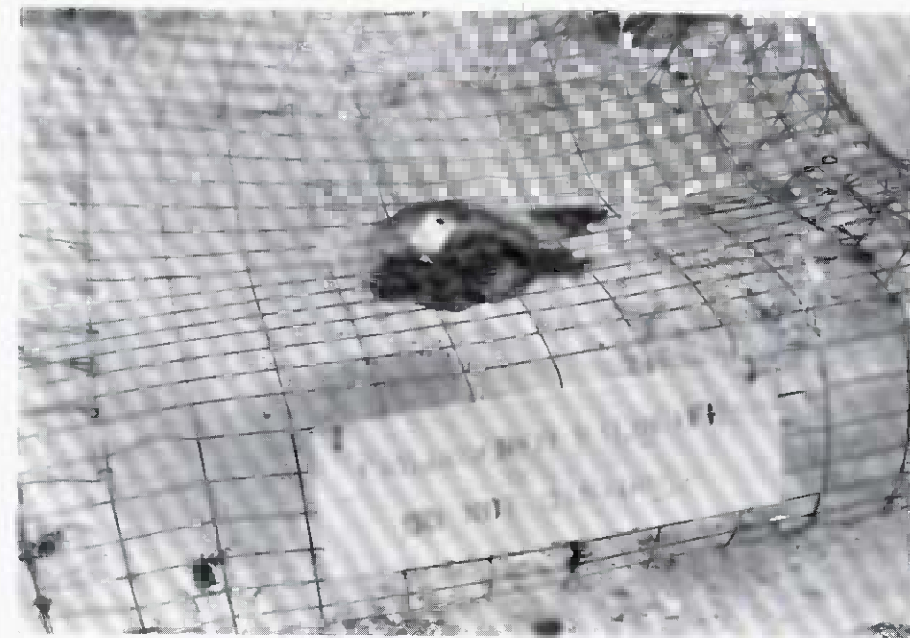


**By consuming the understory, prescribed burning reduces the fuel available to wildfires. Wildlife food and cover are also improved through this practice.**



**(Above)** The Base's wildlife management program has maintained a wide variety of game animals. Deer, wild turkey, bear, quail, dove, rabbit, and squirrel are all available to the sportsman.

**(Right)** Military personnel are briefed on the measures used at Camp Lejeune to protect the Base's natural resources.



source requires an adequately maintained access road system. The access roads are protected from erosion by planting perennial grasses. Once the grass is established the roads also provide wildlife food and cover.

### Wildlife Management

**C**amp Lejeune's wildlife management program provides optimum environmental conditions for all present wildlife, including game, nongame, endangered, and threatened species. It is consistent with the Base's primary land use — military training. The program is also in compliance with all Base, state and federal regulations concerning wildlife management.

An aggressive game management program on the Base, provides quality hunting, fishing, and trapping opportunities for the sportsman. Approximately 850 white-tailed deer, 30 wild turkey, and three black bear are harvested annually. In addition, numerous small game species such as bobwhite quail, morning dove, rabbit and squirrel are hunted. Twelve fresh water ponds offer the angler excellent fishing for bass, bluegill, and channel catfish.

A well dispersed system of wildlife openings have been established at Camp Lejeune. These sites benefit both game and nongame species by enhancing cover and supplementing the natural food supply. Also, the openings provide excellent vantage points for observing wildlife in their natural surroundings.

Protection of endangered and threatened species on Camp Lejeune is done in accordance with the Environmental Policy Act of

1968 and the Endangered Species Act of 1973. Principal endangered and threatened species found here are the Red-Cockaded Woodpecker, American Alligator, Green Sea Turtle, and the Atlantic Loggerhead Sea Turtle. In addition, the Fin Whale, Humpback Whale, Right Whale, and Sei Whale use the waters off the coast in their yearly migration routes.

### Soil and Water Management

**W**henver vegetation is damaged and soil disturbed, a potential for soil erosion and water management problems exists. The movement of troops and heavy equipment can easily create potential erosion. Many of the soil types found within the Base are highly erodible which complicates the situation further.

Controlling soil erosion, however, is not a difficult task if proper management techniques are followed. The NREAD has developed with the help of the USDA Soil Conservation Service a Technical Guide. In the Technical Guide are specific criteria for designing and maintaining erosion control practices.

**(Top)** The nests of the Loggerhead and Green Sea turtles are covered with a wire cage to prevent predation from raccoons and foxes.

**(Above, Right)** When sea turtle nests are located on a portion of beach designated for military training operations the eggs are moved to a safer location.

**(Right)** Boy Scouts from the Base participate in the non-game management program by building and hanging blue bird boxes in selected areas.







For the soil and water conservation goals to be achieved it will take the cooperation of a number of officials involved in the development, use, and maintenance of real property. The control and prevention of water pollution and soil erosion is the single most demanding environmental requirement for the Command.

determine if it can be improved through forest and wildlife management techniques.

## Conclusions

**C**amp Lejeune has long been a leader in Department of Defense natural resource management. In fact, this is the fifth Long Range Management Plan that has been written for Camp Lejeune, though the present addition is by far the most complex and comprehensive ever produced.

Camp Lejeune has been the recipient of the Secretary of Defense Conservation Award in 1968, 1973 and 1975. In 1972, 1974, 1975, 1978, and 1980 Camp Lejeune won the Secretary of the Navy Environmental Protection Award, and in 1980 won the Secretary of Defense Environmental Protection Award.

Camp Lejeune was among the first Department of Defense installations to seek formal consultation with the US Fish and Wildlife Service to establish guidelines for compliance with the Endangered Species Act. It was also the first installation to develop, in cooperation with the US Forest Service, a multiple-use inventory that is the basis for the Multiple-use Natural Resources Management Plan.

The highlights presented in this document are intended to help interested persons understand how the management of natural resources and other environmental management issues will be addressed at Camp Lejeune.

## New Initiatives

**T**he Multiple-use Natural Resources Management Plan represents no radical changes but, rather, a logical progression built on past success. There are two initiatives which will have beneficial effect on natural resources management at Camp Lejeune.

### Land-Use Management System (LUMS)

LUMS is being developed to alleviate deficiencies in current land management and land use planning methodologies. The deployment of new mobile weapons systems has intensified the Base's land use activities. At the same time environmental protection legislation has also increased. These two events occurring simultaneously have greatly increased the need for closer resource management. LUMS will provide it.

### Wildlife Habitat Appraisal Guidelines

This guide is a field evaluation procedure designed to measure the quality of the habitat for a particular species of wildlife. It is designed not only to rate the quality of the existing vegetative cover, but also accounts for the effects of forest management practices on the habitat. The guide identifies weak or missing elements as a basis for making improvements. By using this habitat appraisal system, NREAD can define habitat needs for the featured species and



**(Above)** Areas left bare by the construction of roads are a major source of soil erosion on the Base. Forest access roads are seeded immediately after the construction is completed.

**(Top)** Forest compartment prescriptions and wildlife habitat appraisals, conducted by natural resources specialists, ensure program coordination and the accomplishments of the multiple-use natural resources management objectives.