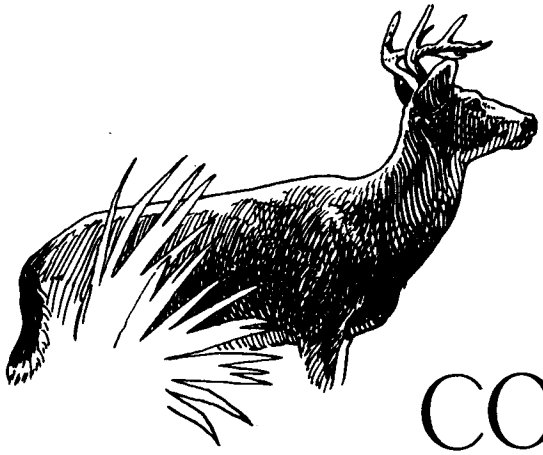

COLUMBIAN WHITE-TAILED DEER RECOVERY PLAN

REVISED

COLUMBIAN WHITE-TAILED DEER

RECOVERY PLAN

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THIS IS THE COMPLETED REVISED COLUMBIAN WHITE-TAILED DEER RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL RECOVERY TEAM MEMBERS/INDIVIDUALS, WHO PLAYED THE KEY ROLE IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

ACKNOWLEDGEMENTS SHOULD READ AS FOLLOWS:

THE REVISED COLUMBIAN WHITE-TAILED DEER RECOVERY PLAN, DATED JUNE 14, 1983, PREPARED BY THE U.S. FISH AND WILDLIFE SERVICE IN COOPERATION WITH THE COLUMBIAN WHITE-TAILED DEER RECOVERY TEAM.

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RECOVERY PLAN EXECUTIVE SUMMARY

There are two populations of Columbian white-tailed deer, Odocoileus virginianus leucurus, (CWTD), in North America, each of which is treated separately in this Recovery Plan. The Columbia River population of CWTD numbers approximately 300 to 400 animals, most of which occur along the lower river in Oregon and Washington from Wallace Island [River Mile (RM) 50] downstream to Karlson Island (RM 32). Four main subpopulations (Washington mainland, Tenasillahe Island, Puget Island, Wallace Island-Westport) of CWTD and one minor one (Karlson Island) occur within this area, each separated from the next by a main river channel or patches of unfavorable habitat which limit consistent interchange.

The Roseburg population of CWTD numbers approximately 2,000 to 2,500 animals located in Douglas County, southwestern Oregon. The present range of the Roseburg population encompasses 1,200 square kilometers (463 square miles); most animals are found in or near riparian lowlands. The highest CWTD densities occur between Glide and Winchester, north of Buckhorn Road and south of the North Umpqua River.

The Prime Objective for the Columbian White-tailed Deer Recovery Plan is to secure the species within its historical range, protect its habitat, and delist the species by accomplishing the following two subobjectives.

A. The Columbia River population may be downlisted to Threatened if

a minimum of 400 CWTD can be maintained in at least three viable subpopulations, two of which must be located on secured habitat. The population may be delisted and considered recovered if a minimum of 400 CWTD can be maintained in at least three viable subpopulations distributed in suitable secure habitat. Presently, one subpopulation is considered viable and secure - Washington mainland on CWTD National Wildlife Refuge (NWR). Thus recovery of this population will require: (1) maintaining overall viability of 400 deer; (2) increasing the subpopulation on Tenasillahe Island to a minimum viable herd of 50 deer; and (3) securing the habitat of one additional subpopulation. Habitat can be secured and/or protected through a variety of methods including landowner incentives, local planning and zoning ordinances, and the active involvement of private organizations and public agencies. After recovery, the Columbia River population of CWTD will require implementation of a long-range management plan to maintain its secure status.

B. The Roseburg population of CWTD may be downlisted to Threatened if:

(1) 1,000 CWTD can be maintained viable on lands within the Umpqua Basin of Douglas County; and (2) the relative proportions of CWTD habitat within the known range of the species in Douglas County are not deteriorated from current conditions. The population may be delisted and considered "recovered" if a minimum viable population can be maintained at 500 deer distributed in 5,500 acres of suitable, secure habitat within the Umpqua Basin of Douglas County, Oregon on lands owned, con-

trolled, protected, or otherwise dedicated to the conservation of CWTD. Landowner incentives, local planning and zoning ordinances, and the active involvement of private organizations and public agencies are primary methods available to secure habitat. After "recovery" the Roseburg population will require on-going maintanance and management to continue the secure status.

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COLUMBIAN WHITE-TAILED DEER RECOVERY PLAN

PART I. INTRODUCTION

The Columbian white-tailed deer (CWTD) (Odocoileus virginianus leucurus) is one of 38 recognized subspecies of virginianus, a species with a continuous geographic distribution that extends from southern Canada to South America, including most of the continental United States (G. Whitehead 1972). The Key deer (O. v. clavium) of Florida is the only other subspecies within the complex that has been listed as Endangered. Federal recognition of CWTD as Endangered in 1968 and its re-classification as a non-game animal by the Washington Department of Game (WDG) a few years later offered limited protection to CWTD, which were found almost entirely on private land. In the spring of 1978 the Oregon Department of Fish and Wildlife (ODFW) recognized Douglas County white-tailed deer as CWTD and in the fall of 1978 prohibited the hunting of CWTD in the Roseburg area.

Prior to establishment of the Columbian White-tailed Deer National Wildlife Refuge (CWTD NWR) and implementation of a research program by Oregon State University in 1972, little information was available concerning the life history, behavior, population dynamics and habitat utilization of CWTD. The Recovery Plan attempts to identify the minimal requirements for recovery of CWTD as a subspecies and proposes a realistic approach to ensure these requirements will be met. This assessment, based on information currently available, will adopt the population as the unit of management and discussion.

Throughout the Plan, a population will be taken to mean "a set of organisms belonging to the same species and occupying a clearly delimited space at the same time" (Wilson 1975).

Lewis and Clark observed and killed white-tailed deer in 1806 along the Columbia River from the approximate locations of the Dalles, Oregon to Astoria, Oregon on the coast (Thwaites 1905). In 1829 David Douglas, the Scottish botanist and naturalist, reported whitetails along the Columbia River as well as along the Cowlitz and Willamette rivers in Wahington and Oregon, respectively (Douglas 1914). Bailey (1936) believed the original range of CWTD extended from Roseburg, Oregon north to the south end of Puget Sound in Washington, but Cowan (pers. comm.) doubted that they ever occurred that far north (Figure 1). The foothills of the Willamette Valley were most likely the eastern extent of former CWTD range. It is also likely that CWTD range extended west from the Willamette Valley to the coast as narrow borders along the major river drainages which flow through the coastal mountains (W. Smith, pers. comm.).

CWTD were extirpated throughout most of their original range by 1900 (Jewett 1914; Bailey 1936), and by 1934 Stanley Jewett believed that the only remnant of this subspecies occurred in Douglas County, Oregon (Cowan 1936). However, Scheffer (1940) investigated reports of whitetails along the Columbia River in late 1939 and concluded that 500 to 700 CWTD were still found in diked areas along the river and on islands in the vicinity of Cathlamet, Washington and Westport, Oregon.

FIGURE 1. HISTORICAL AND CURRENT RANGE OF THE COLUMBIAN WHITE-TAILED DEER (Davison, 1979).

Gavin (1978) suggested several reasons for the decline in total number of CWTD in the Pacific Northwest and the disjunct distribution that resulted. White settlers cleared woody cover adjacent to rivers and intensively farmed these areas. Beaver ponds, which were fertile areas for growth of herbaceous vegetation possibly utilized by CWTD, were drained. Suppression of fires altered the open, savannah-like structure of the Willamette Valley adjacent to riparian zones, resulting in a higher density of oak (Quercus garryanna), and movement of Douglas fir (Pseudotsuga menziesii) down the sides of the valley. Non-native grasses and forbs were introduced and replaced much of the native vegetation. Although it is not clear how these changes in vegetation may have affected CWTD survival or reproduction, the changes occurred at the time that CWTD were thought to be decreasing late in the 19th century. Unregulated shooting of CWTD for sport, food and the commercial market cannot be disregarded as contributory to their decline, since CWTD were probably concentrated in narrow strips of habitat adjacent to major rivers and streams. This distribution would have facilitated their exploitation by humans.

Today, there are only two CWTD populations of any consequence west of the Cascades. One is located along the lower Columbia River and the other 320 kilometers south in Douglas County, Oregon, near Roseburg. These two populations, known as the Columbia River and Roseburg populations, are apparently the remnants of a Columbian whitetail population that once occurred continuously throughout the lower Columbia River in Washington and Oregon, the Cowlitz River in Washington, and the Willamette Valley in Oregon (Figure 1). The Recovery Plan recognizes these

remnants of CWTD as two distinct populations and, because of major differences in location, habitats, threats, land use, etc., the Plan will address the natural history and recovery of each separately.

The taxonomic description of this subspecies by David Douglas was based on two specimens he collected in Oregon (Douglas 1829), originally interpreted as taken in Douglas County (Cowan 1936). A reappraisal of Douglas' account of the type locality for this taxon and correspondence with both the Zoological Society of London and the British Museum of Natural History, where the two specimens are curated, failed to substantiate the specific collection location of the type specimens (Gavin, pers. comm.).

Columbia River Population

Current Status

The Columbia River population of CWTD numbers approximately 300 to 400 animals, most of which occur along the lower river in Oregon and Washington from Wallace Island (RM 50) downstream to Karlson Island (RM 32). Four main subpopulations of CWTD and one minor one occur within this area, each separated from the next by a main river channel or patches of unfavorable habitat which limit consistent interchange (Table 1; Figure 2).

The largest subpopulation occurs on the Washington mainland near Cathlamet (Figure 2). A comparison of Scheffer's rough estimates of CWTD numbers in the vicinity of Cathlamet, Washington in 1939 with those for recent years is indicated in Table 2. Establishment of the CWTD

for recent years is indicated in Table 2. Establishment of the CWTD NWR in 1972 secured about 4,800 acres of this prime CWTD habitat along the Columbia River (Figure 2). The refuge population on the Washington mainland has been declining since 1977 (Clark, pers. comm.).

The Tenasillahe Island subpopulation occurs in Clatsop County, Oregon, and numbers from 30 to 40 animals. The 2,050-acre island is part of the CWTD NWR. CWTD numbers in this subpopulation are presently stable (Clark, pers. comm.). CWTD from this subpopulation frequent adjacent Welch Island which is part of the Lewis and Clark NWR.

The Puget Island subpopulation occurs in Wahkiakum County, Washington, and numbers from 50 to 75 animals (Davison 1979; Clark, pers. comm.). The status of this subpopulation is unknown, but there has been no apparent change in deer numbers in recent years. CWTD in this subpopulation also occur on the adjacent Little, Ryan, Jackson, Brown, and White islands.

Table 1. Estimated numbers of CWTD in the Columbia River population.

Subpopulation	Number of CWTD
Puget Island	50 to 75
Tenasillahe Island	30 to 40
Mainland Washington	150 to 200
Wallace Island-Westport	70 to 80
Karkson Island	8 to 12
	300 to 395

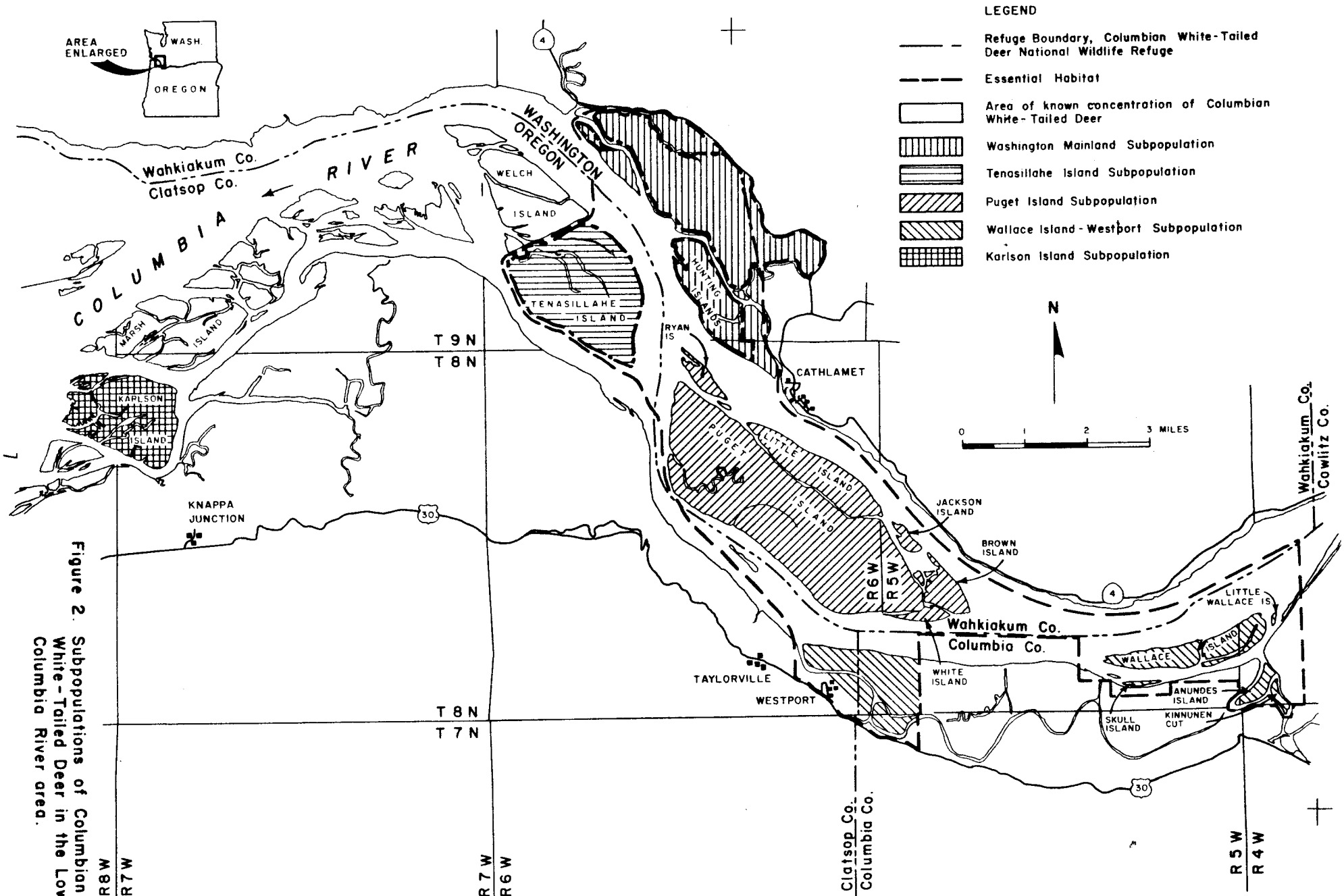


Figure 2. Subpopulations of Columbian White-Tailed Deer in the Lower Columbia River area.

Table 2. Population estimates of white-tailed deer on the CWTD NWR (Washington mainland).

Year	Estimate*	Technique	Source
1939	250-350	Interviews	Scheffer (1940)
1939	200	Interviews	Lauckhart (1940)
1972-73	200-230	Spotlight-evening counts	Suring (1974)
1974 (Nov)	214 (127-370)	Schnabel	Gavin (1979)
1975 (Nov)	180 (124-265)	Schnabel	Gavin (1979)
1976 (Nov.)	164 (92-306)	Schnabel	Gavin (1979)
1977 (Nov.)	202 (126-333)	Schnabel	Gavin (1979)
1978 (Nov-Dec)	212 (145-338)	Schnabel	Clark (pers. comm.)
1979 (Nov-Dec)	191	Evening counts (% change from 1978)	Clark (pers. comm.)
1980 (Nov-Dec)	159	Evening counts (% change from 1978)	Clark (pers. comm.)

*Confidence intervals (95%) are in parentheses.

The Wallace Island-Westport subpopulation occurs in Clatsop and Columbia counties of Oregon and numbers from 70 to 80 CWTD (Davison 1979). This subpopulation includes CWTD on the Oregon mainland between Westport, Woodson, and Clatskanie, as well as on Wallace, Little Wallace, Anundes, Kinnunen Cut, and Skull islands. Current status of this subpopulation is unknown.

The Karlson Island subpopulation occurs in Clatsop County, Oregon and numbers from 8 to 12 CWTD. Karlson Island is part of the Lewis and Clark NWR. Current status of this subpopulation is unknown.

The existence of CWTD on the above areas has been verified by the U.S. Fish and Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Game (WDG). There have been reports of occasional sightings of CWTD in other areas along the lower Columbia River, (E.G., Reed Island near Washougal, Washington), but the locations listed above are believed to contain the only populations of any consequence (Davison 1979).

The Habitat

Certain islands and bottomlands within an 18-mile stretch of the lower Columbia River contain most of the known range of CWTD for this population. Other lands provide potential habitat along the Columbia River, but there have been no recent documented sightings of white-tailed deer in these areas.

There is essentially no elevational relief to the lower Columbia River bottomlands, and whitetails are restricted to these flatlands which

have an elevation of about 3 meters above sea level. Most of these bottomlands have been diked and are crisscrossed with numerous sloughs and drainage ditches.

Native vegetation of the Columbia River "tidelands" consists of a dense, tall shrub or tree community containing Sitka spruce (Picea sitchensis), dogwood (Cornus stolonifera), cottonwood (Populus trichocarpa), red alder (Alnus rubra), and willow (Salix spp.). Most of the bottomlands have been cleared of trees and brush and seeded to grasses and forbs that provide hay, silage and grazing for beef and dairy cattle. Plants commonly found in these grass/forb fields include fescue (Festuca sp.), orchardgrass (Dactylis glomerata), clover (Trifolium sp.), bluegrass (Poa sp.), velvetgrass (Holcus lanatus), buttercup (Ranunculus repens) and ryegrass (Lolium multiflorum). Reed canary grass (Phalaris arundinacea) and water foxtail (Alopecurus geniculatus) are common "invaders" on wet sites. Species of Rubus, Juncus, Carex, Rosa, Sambucus and Symphoricarpos are common, and are utilized as food or cover by deer on the refuge.

The climate of the lower Columbia River is moderate. Mean monthly maximum temperature is 17.7°C in August and the mean monthly minimum is 4.0°C in January near the CWTD NWR (R.B. Webb, pers. comm.). The 15-year mean annual rainfall is 270 centimeters, with an average of 211 centimeters falling from October to March. Snow cover on the refuge is rare and of short duration.

Natural History

The information contained in this section is taken primarily from the thesis of Suring (1974) and Gavin (1979) as well as from their personal observations of CWTD and the recent field work by Clark (pers. comm.). Since the data were collected from the mainland portion of the CWTD NWR, conclusions apply only to that subpopulation.

Reproduction and Sex Ratio. Rutting activity begins the first week of November and probably reaches a peak during the second week. By the end of the month, reproductive behavior by males decreases noticeably, although some deer are apparently capable of breeding as late as March. This conclusion is based on an observation of twins born sometime in late September-early October in 1974, assuming the gestation period of CWTD approximates that of eastern white-tailed deer (210 days).

Observations (spring 1975) indicate that the peak of fawning was the second week in June. This correlates well with the observed rutting period of the second week of November, and corroborates a gestation of about 7 months. Available data indicate that nearly all adult females become pregnant and give birth to one or two fawns. However, recruitment into the population, based on fawn:doe ratios of marked females in November, is relatively low. Fawns comprised 21 percent to 33 percent of the November population from 1972 to 1977 (no data for 1973), while yearling and adult females comprised 52 percent to 60 percent and yearling and adult males 18 percent to 21 percent. There was no evidence that female fawns were fecund.

Recent work by Clark (pers. comm.) indicates herd composition has changed since Gavin's original estimates for the mainland refuge population of CWTD. From 1978 to 1980 fawns comprised only 4 percent to 18 percent of the November population, while yearling and adult females comprised 53 percent to 61 percent and yearling and adult males 31 percent to 36 percent. The decline in the fall fawn population is attributable to a noticeable increase in coyote predation on the refuge since 1978 (Clark, pers. comm.).

The sex ratio did not differ significantly from 1:1 among a combined sample of 134 CWTD fawns captured or found dead from 1972 to 1980 (Gavin 1979; Clark, pers. comm.). Yearling and adult females, however, consistently outnumbered yearling and adult males about 3 to 1 (Gavin 1979). Since 1978 this ratio has dropped to less than 2 to 1 (Clark, pers. comm.).

Density. Estimates of population size in November of each year from 1972 to 1980 (1973 excluded) ranged from 159 to 215, a density of 1 deer per 3.6 ha to 4.8 ha (Gavin 1979; Clark, pers. comm.). Deer were not uniformly dispersed on the refuge, so that local densities on the 1,900-acre area were significantly higher or lower than indicated by these mean density estimates.

Mortality. Proximate causes of mortality in this non-hunted population were diverse and the effect of each type of mortality on population growth and stability was not clear. CWTD died from collisions with vehicles, coyote predation, dogs, drowning, nutritional stress, para-

sitic infection, poaching, capture attempts, and a bacterial infection known as necrobacillosis (foot rot). Nearly one-third of 155 carcasses recovered during the period from 1974 to 1977 exhibited symptoms of necrobacillosis; it was probably a major debilitating factor contributing to mortality of adult deer.

Virtually every deer that was thoroughly examined contained internal parasites which further debilitated some individuals. Cause of death was attributed to stomach worms (Haemonchus sp.) in three deer examined by a veterinary pathologist (T.P. Kistner, pers. comm.). A complete list of all parasites identified from these deer is found in Gavin (in press). Coyote predation was implicated in the deaths of at least 32 percent of 22 fawn carcasses examined in 1975. Coyotes took 23 of 40 radio-collared fawns during the summers of 1978, 1979 and 1980 (Clark, pers. comm.).

By using data on reproduction and population structure, estimates of fawn mortality from all causes were derived for the period of 1975 to 1977. Estimates for these 3 years ranged from 52 percent to 83 percent for fawns from birth to 5 months of age. Annual mortality rates for yearling and adult males and yearling and adult females were estimated to be 35 percent and 18 percent, respectively.

Habitat Preference. The relative preference of vegetative communities by CWTD on the refuge mainland was documented by Suring (1974) and Suring and Vohs (1979) in 1972-73. The study identified 12 different plant communities and concluded that CWTD use was greatest in communi-

ties by CWTD on the refuge mainland was documented by Suring (1974) and Vohs (1979) in 1972-73. The study identified 12 different plant communities and concluded that CWTD use was greatest in communities that provided both forage and cover. Presence of vegetation over 70 centimeters high in the vicinity of forage species attracted deer. Deer showed a preference for the park forest community especially in the fall, winter, and spring. The primary activity in the park forest was feeding (66 percent of the observations), followed by resting (22 percent) and movement (12 percent). Other plant communities that received high CWTD use were open canopy forest, sparse rush, dense thistle. Higher percentages of deer were observed resting and moving in the forest than in non-forest communities. The high freqnency of resting behavior in forest communities is probably related to the thermal protection of woody cover.

Utilization of improved pasture was relatively low even though this plant type covered nearly 40 percent of the study area. Deer fed in maintained pastures, but rarely more than 250 meters from woodlands. The lack of woody cover interspersed in large pasture areas probably accounts for the low CWTD use.

Closed canopy forest, hydric rush, and dogwood communities received low overall deer use. These communities provided deer with cover but the vegetative structure reduced forage and use by deer was low.

Davison (1979) found that CWTD on Wallace and adjacent islands utilize a habitat type which significantly contrasts with habitat conditions on

the refuge. The islands are vegetated with the "tidal spruce" community - dense forested swamps covered with tall shrubs and scattered with spruce, alder, cottonwood, and willow. Less than 5 percent of Wallace Island is in pasture with the remainder in woody cover. Davison considers the tidal spruce community to be the historical habitat of CWTD for forbs and grass in open pastures, as observed by Suring (1974) and Gavin (1979), may actually be an adaptation to available habitat rather than an actual feeding preference.

Observations by Suring (1974) and Gavin (1979) indicate that CWTD on the refuge are primarily grazers. Recent studies by Dublin (1980), however, indicate that food preferences of CWTD are seasonal and that browse is a more important food item than previously suspected by earlier researchers. Dublin's study attempted to expand on earlier observational data by using a quantitative comparison of deer diets to characteristics of available forage. This, along with a broad view of ruminant foraging strategies in general, has offered an understanding of the options open to and taken by these deer. Through fecal analyses of diet composition and quality, combined with vegetational availability estimates, a seasonal scheme of forage preferences was demonstrated. In general, browse is chosen in summer, fall, and winter while forbs are most heavily utilized in spring, summer, and early fall. Grasses are not preferred at any time of the year but are eaten in proportion to their availability only in the early spring (Dublin 1980).

A clear example of discrimination on the part of the deer was demonstrated for grasses, browse, and forbs. Use of individual species

of grass almost invariably coincided with the period of rapid growth, just prior to flowering. At that time, most grasses consist of leaves and sheaths, with very little stem material present. This is the period of high plant palatability when protein levels are, on the average, at their highest values and silica content at their lowest. Grass use in the diet peaked in March and April, yet total grass consumption was always less than availability. Such under-utilization by CWTD suggests either that grasses were uneconomical for consumption or there were better items available.

Similar correlations of increased use are seen among browse species. They are heavily utilized just prior to flowering and again just after fruiting begins. Here, deer may be capitalizing on high carbohydrate levels to increase body reserves as they go into winter. They may be relying on other species to meet their protein requirements. In the late fall and early winter relative availability of protein is higher in browse species than in grasses and forbs which may be more directly affected by severe weather conditions. At these times, the protein levels of many browse species, as well as of cured grasses, may be attractive to deer. Even though their absolute quality is low, their availability may be high and nothing better may be accessible. Browse was preferred in late summer, early fall, and winter with peak use occurring in November and December.

Heavy use of forbs occurs as they emerge in the spring and throughout the summer. Forb species are generally eaten just as they are emerging. At these times, when they are at the height of their growth

phase, protein levels are highest. CWTD showed a heavy preference for forbs in the spring, summer and fall, with peak use occurring from May through August.

Haying, grazing and green chopping are important management practices conducted on the refuge to maintain pastures as CWTD feeding areas. During 1975, an experiment was conducted to determine whether CWTD preferred to graze in pastures that were kept short by cattle grazing or those kept short by haying. Although there was no significant preference exhibited for either pasture treatment relative to the other during spring and summer, deer preferred to feed in late fall and winter in those pastures that had been grazed by cattle (Gavin 1979). This may reflect avoidance of cattle by deer during the summer since few CWTD were observed within 30 meters of cattle (Suring and Vohs 1979). Cattle were removed from the refuge in late October.

In addition to cattle, elk (which are now year-round residents on the refuge) and flocks of wintering waterfowl could possibly conflict with CWTD feeding patterns. Conflicts could arise through direct competition for available food sources or through avoidance on the part of CWTD. Neither possibility has been studied.

Land use practices since 1972 via an interim management plan have encouraged the regrowth and reestablishment of permanent cover on many areas of the refuge with a history of heavy grazing. Continuous evaluation of deer responses to land use changes is necessary so that the proper balance between short grass/forb pastures and dense cover is

maintained.

Threats. The integrity of the Columbia River population of CWTD and their habitat is threatened by a variety of factors, including both natural and man-caused phenomena.

Perhaps the greatest single man-caused threat to CWTD is the continued degradation of riparian habitats through logging and brush removal (Crews 1939; Scheffer 1940; Gavin 1978). Suring (1974) documented that woodlots on CWTD NWR decreased from 70 percent of the refuge in 1939 to 17 percent in 1972. Davison (1979) documents a similar decline on Puget Island, with woodlots decreasing from 43 percent of the island in 1938 to 1 percent in 1977. In both cases, woodlots were cleared for agriculture. Davison and Spencer (1979) found that 22 of 32 islands on the lower Columbia River have undergone some form of development. Recent interviews with island landowners indicate growing interest in development of riparian zones for beef production, cottonwood and alder harvest, and for marina development (Davison and Spencer 1979). Such activities would either diminish existing CWTD habitat or eliminate areas for future CWTD transplants.

Lesser man-caused threats include automobile collisions, poaching, entanglement in barbed wire fences, and competition with livestock. The newest potential livestock problem is the introduction of feral swine on Wallace Island in 1980. The impact of swine on CWTD and their habitat is unknown, but the potential exists for problems to develop which could seriously jeopardize the Wallace Island-Westport subpopulation

(Clark, pers. comm.).

Natural threats to the CWTD are varied. The potential for a major flood is always present and is compounded by the fact that much of the Key CWTD habitat is protected by levees which are subject to erosion and failure. The greatest danger would arise if a flood coincided with a very high tide, thus placing additional stress on dikes and levees. A dike failure resulted in the inundation of over 1,400 acres for nearly 1½ years. The overall impact of the dike failure on CWTD is unknown; however, long-standing water did kill trees and shrubs on the island and such wet conditions are a major contributing factor to foot rot (Necrobacillosis), a chronic problem in the Columbia River population.

High tides are a limiting factor on undiked islands of the lower river. High water restricts CWTD distribution and woody vegetation, and probably contributes to foot rot. High tides are particularly threatening to the small subpopulation of CWTD that inhabit undiked Karlson Island.

Disease (foot rot) and parasites (stomach worms) are two threats common in the Columbia River population. The high incidence of parasites indicates the possibility of overcrowding. The potential for a major dieoff is particularly acute if infected CWTD should be subjected to additional stress, such as a flood or a prolonged freeze.

Black-tailed deer are a potential threat to CWTD by direct competition for available food sources and by hybridization. The extent of either

threat by blacktails is unknown.

A recent wildlife-related threat is the presence of Roosevelt elk on the mainland portion of CWTD NWR. The elk were first observed on the refuge in the late 1970s and are now year-round residents, competing with CWTD for pastures and damaging or destroying tree planting intended to improve CWTD habitat (Clark, pers. comm.). The overall impact of elk on the mainland subpopulation of CWTD is unknown.

Conservation Efforts. The columbian white-tailed deer was Federally listed as an Endangered Species in 1968. In 1972 the Service acquired approximately 4,800 acres of CWTD habitat and established the CWTD NWR with headquarters near Cathlamet, Washington. The primary objective of the refuge is to protect CWTD and their habitat. Refuge objectives for CWTD management are carried out through a variety of activities including research, area closures, hunting prohibitions, law enforcement, grazing, haying, shrub and tree plantings, and public information and education.

In addition to direct land management, the Service is also involved in CWTD conservation by providing planning guidance, project review, consultations, and technical expertise to developers, local governments, public land management agencies, and others. These activities are conducted by Ecological Services in Portland and by the Endangered Species Team in Olympia and include Section 7 consultation (see Endangered Species Act of 1973, as amended), recommendations resulting from permit application reviews, and comments on environmental assessments

and impact statements.

State wildlife agencies (WDG and ODFW) are also directly involved in CWTD conservation through law enforcement, hunting closures, and public education. Local representatives of each state agency are called upon to alleviate CWTD crop depredation problems. The environmental planning branches of each agency are also involved in the review and comment of permits, environmental documents, etc. WDG and ODFW have also been cooperators in CWTD research projects conducted through the University of Washington and Oregon State University.

The USFWS, WDG, and ODFW are jointly involved in CWTD conservation as participants in the CWTD Recovery Team. The Recovery Team was formed in 1974, and was responsible for drafting the CWTD Recovery Plan approved in 1976.

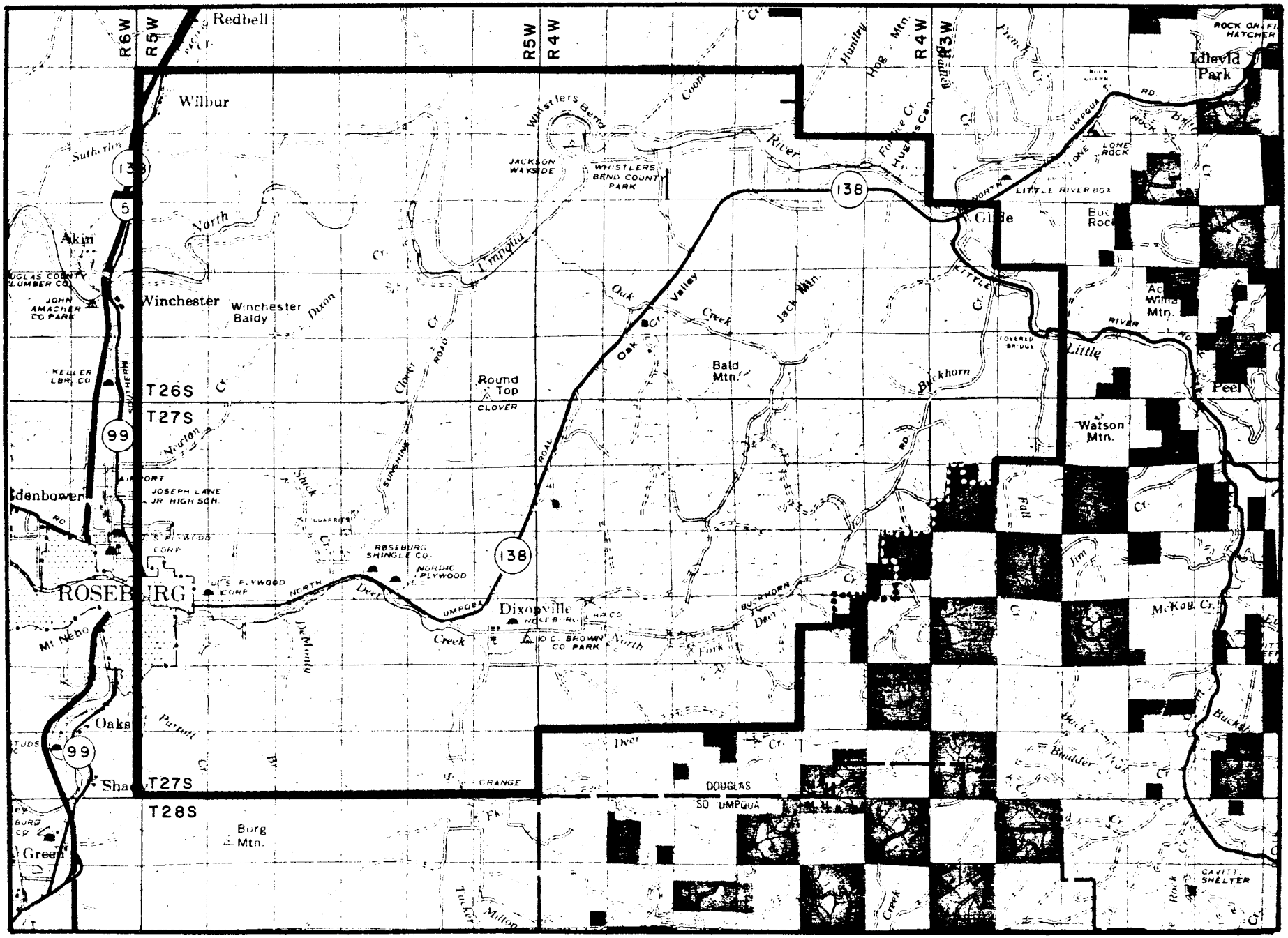
Roseburg Population

Current Status

The Roseburg population of CWTD numbers approximately 2,000 to 2,500 animals located in Douglas County, southwestern Oregon (Smith, pers. comm.).

The present geographic range of CWTD in Douglas County extends from Oldham Creek, 8.0 km northeast of Oakland, south to Cow Creek, 4,8 km southwest of Riddle. Morgan Creek, 1.5 km north of its intersection with the South Umpqua River, is the southeastern-most extent of known CWTD range, whereas the northwest boundary extends to the town of Umpqua. The eastern and western boundaries are Fall Creek, 0.5 km south of Little River, and Hawkins Lake (BLM), respectively. The present range of the Roseburg population encompasses 1,199 square kilometers (463 square miles) (Smith 1981).

CWTD distribution in Douglas County is not contiguous throughout their range but, rather, most animals are found in or near riparian lowlands. The highest CWTD densities occur between Glide and Winchester, north of Buckhorn Road and south of the North Umpqua River (Figure 3). Recent surveys (Smith 1981) estimate 628 to 740 CWTD on a 2,745 ha study area within this core area northeast of Roseburg. Comparisons of Smith's estimates (Crews 1939; ODFW annual spotlight trend counts) indicate the Roseburg population has expanded in the past 30 years, both geographically and numerically, with riparian zones serving as avenues for dispersal (Smith 1981).



= Federal O & C Lands

Figure 3. Essential Habitat for Columbian White-Tailed Deer in Douglas County, Oregon.

The Habitat

The Roseburg area is characterized by low grassland valleys and pastures interspersed with riparian zones along rivers and creeks surrounded by low rolling hills covered primarily with oaks. Elevations range from 140 to 183 m in the river valleys and from 457 to 1,067 m in the surrounding hills.

The Roseburg climate is moderate. Average annual temperature is 53.1°F and average annual precipitation is 77.5 cm. Most precipitation comes as fall/winter rains with snow being uncommon. The region experiences semi-drought conditions in the summer with only 5.8 percent of the annual precipitation occurring from July to September.

Smith (1981) delineated ten distinct habitats within his CWTD study area northeast of Roseburg - grassland, grass-shrub, oak-savannah, open oak, closed oak, oak-conifer, oak-madrone, madrone, riparian, and conifer.

The dominant tree is Oregon white oak (*Quercus garryana*), with madrone (*Arbutus menziesii*), and California black oak (*Quercus kelloggii*) also present. Douglas Fir (*Pseudotsuga menziesii*) predominates at higher elevations and northern slopes. Poison oak (*Rhus diversiloba*) and wild rose (*Rosa eglanteria*) are the dominant shrubs. Orchard grass (*Dactylis glomerata*) and velvet grass (*Holcus lanatus*) are generally found in wetter woodland sites.

Riparian zones are dominated by red alder (*Alnus rubra*), with big-leaf

maple (Acer macrophyllum) are also present. Riparian areas with standing water are commonly vegetated with sedges (Carex spp.) and rushes (Juncus spp.).

Grasslands are vegetated with a variety of herbaceous species with hedgehog dogtail (Cynosurus echinatus) and ripgut grass (Bromus rigidus) the dominant species in unimproved pastures. In improved pastures, perennial ryegrass (Lolium perenne), tall fescue (Festuca arundinacea), and subterranean clover (Trifolium subterranean) were common species.

Natural History

The information contained in this section is taken from the thesis of Smith (1981) and from personal communication with him.

Reproduction and Sex Ratio. The rut begins in early November and lasts until mid-January with the peak breeding activity occurring from mid-November to mid-December. Peak fawning occurs during the first two weeks of June, although minor fawning peaks were observed in July and August.

Sex and age ratio counts conducted in the fall of 1979 estimated 52 fawns:100 does and 30 bucks:100 does.

Fawn recruitment, measured as the number of fawns entering the breeding population on June 1 varied from a low of 27 fawns:100 does in 1978-79 to 75-79 fawns:100 does in 1980-81.

Density. CWTD in the Roseburg area exhibit a discontinuous distribution pattern with widely varying densities. A region of high CWTD density occurs northeast of Roseburg between Glide and Winchester along the North Umpqua River.

Overall density for the study area (2,745 ha) was 22.9 CWTD per km^2 and ranged from 18.0 to 35.2 CWTD per km^2. CWTD exhibited a strong affinity to the North Umpqua River. Ninety percent of all CWTD observations were made within 1 km of the river, a portion of the study area representing about 50 percent of the total area.

CWTD densities generally increased with increasing woodland cover. However, as percent of woodland cover approached 50 percent, there were corresponding increases in CWTD density. The maximum density observed in the study area was 35.2 CWTD per km^2 in a wooded area adjacent to the North Umpqua River.

Mortality. Five major proximate causes of mortality were identified by Smith (1981): malnutrition, vehicle collisions, fence entanglements, predation, and disease. The relative importance of each mortality factor varied annually; however, malnutrition and vehicle collisions were the primary mortality factors, each accounting for 25 percent of the 120 carcasses for which cause of death could be determined. CWTD experienced almost 50 percent of their road-kill mortality from July to September, apparently caused by seasonal movement patterns associated with decreasing availability of water and palatable forage.

Several parasites were collected from CWTD in the Roseburg population (see Smith 1981 for complete list); however, all parasite loads were not considered a major problem. Disease was also a minor mortality factor. Autopsies of some CWTD carcasses indicated viral pneumonia to be the cause of death; however, this was primarily limited to fawns born late in the season (September-October).

Most fawn mortality occurred during the first 10 weeks of life, the magnitude of loss varying yearly and seasonally. In 1978, only 40 percent of the fawns survived to the fall season; survival was 87 percent in 1980. The severe winter in 1978-79 meted additional loss when one-half of the fawns surviving to fall (20 percent) had died by the spring season. The 1980-81 figure for a similar period of time, but with milder winter weather, was 73 percent.

Habitat Preference. CWTD demonstrated a significant preference for grass-shrub, oak-savannah, open oak, closed oak, riparian, and conifer habitats. The oak woodland/grassland ecotone was very important. CWTD occurred in grasslands habitats 20.2 percent of the time, but use of grassland was restricted to within 25 meters of escape cover. Also, oak-savannah habitats (a part of the oak woodland/grassland complex) received the most frequent use among all the habitats (20.2 percent), yet represented only 13.2 percent of the study area.

CWTD exhibited seasonal trends in habitat use that correspond with seasonal climatic and phenological patterns. The most apparent pattern occurred among grassland habitats. Percent use of grasslands in-

creased throughout the spring in proportion to increases in biomass production of grasses and forbs, while frequency of grassland use during the fall varied with respect to mean monthly precipitation (i.e., fall green-up). CWTD exhibited a similar pattern of forage utilization - grasses and forbs were consumed most often during late spring and autumn. An increase in grazing accompanied a significantly greater frequency of grassland habitat use during autumn and suggests that CWTD relied more heavily on herbaceous forage during the fall.

There were apparent differences in habitat use among the age classes. Fawns utilized woodland and brushland habitats more often and occurred in grasslands less frequently than yearlings and adults. Typical fawning habitat (during the first week postpartum) represented areas experiencing little or no livestock use, averaged 146.2 m from water, supported an Oregon white oak canopy and occurred on sites with little or no incline and a northern exposure. Fawns were captured an average of 3.95 m from the base of a tree in herbaceous vegetation that averaged 38.2 cm in height. Seasonal patterns of habitat use exhibited by CWTD fawns were apparently associated with a need for escape and thermal stress, particularly during late spring and summer.

CWTD generally utilized upland oak woodland/grassland regions during late winter and spring, but moved to lowland areas with associated riparian systems during the summer. During late summer accessibility to water is crucial; CWTD significantly alter their movement patterns and must suffer increased susceptibility to vehicle-inflicted injuries in regions where a permanent water source is not available or natural

corridors are interrupted.

Threats

The primary threat to the Roseburg population of CWTD is the subdivision and residential development of native riparian habitats, particularly along the North Umpqua River. These farmlands are under continuing pressure to be developed for rural residential homesites of one to several acres each. The major attraction of the area is the scenic view and water-based recreational opportunities available on the North Umpqua River.

Additional threats to CWTD come from the continued livestock development activities in the lowland river valleys. Brush clearing aimed at creating and improving pastures removes vital CWTD habitat and reduces the overall woodland/grassland ecotone. Large blocks of grassland are not significantly utilized by CWTD except within 25 m of escape cover. In addition, CWTD in the Roseburg area have exhibited a negative association with livestock. Thus, as bottomlands are improved and livestock use increases, CWTD are displaced.

Conservation Efforts

The Roseburg population of CWTD was formally recognized by the ODFW as an Endangered Species in 1978. The ODFW closed the Roseburg area to CWTD hunting in the fall of 1978. The Roseburg population is now protected by the Endangered Species Act of 1973, as amended, and all the laws, regulations, and penalties at the disposal of both the FWS and the ODFW.

In the spring of 1981 the FWS, Ecological Services, began a Protection Strategy Study of the Roseburg CWTD population to assess threats and to determine possible opportunities at the local level to protect CWTD habitat. The plan was completed in the fall of 1981.

The Nature Conservancy is currently contacting landowners in the North Umpqua River area northeast of Roseburg regarding conservation easements for CWTD habitats. The results of these contacts will influence the future direction of the CWTD recovery effort.

PART II. RECOVERY

Prime Objective: To secure the Columbian white-tailed deer within its historical range, protect its habitat, and delist the species by accomplishment of the sub-objectives for the Columbia River population (page 31) and the Roseburg population (page 45).

Columbia River CWTD Population Sub-Objective: To downlist to Threatened the Columbia River population by maintaining a minimum of 400 CWTD in at least three viable subpopulations, two of which must be located on secured habitat; to restore the Columbia River population to a minimum of 400 CWTD (see Appendix A) distributed in suitable secure habitat in at least three viable subpopulations, one subpopulation being Tenasillahe Island with a viable herd of at least 50 deer; and delist the species.

1. Annually assess viability of each extant subpopulation of CWTD: (1) Washington mainland; (2) Tenasillahe Island; (3) Puget Island; (4) Westport-Wallace Island; and (5) others as determined necessary.

2. Ensure viability of extant populations of CWTD.
   21. Enforce current Federal and State regulations.
      211. Maintain closed hunting season in Oregon and Washington on CWTD.
      212. Maintain CWTD NWR as closed to all hunting.

213. Enforce Endangered Species Act of 1973, as amended.

22. Protect habitat of viable populations of CWTD

221. Provide and manage habitat on CWTD NWR in accordance with long-term management plan.

2211. Complete food habits study on CWTD. (Completed 1980)

2212. Incorporate results of earlier studies in long-term management plan.

222. Secure off-refuge habitat in areas that contain viable CWTD populations.

2221. Use landowner incentives to secure habitat on lower Columbia River.

2222. Use local planning, zoning, easements, agreements, etc., to secure habitat.

2223. Encourage private organizations to secure habitat.

2224. Delineate essential habitat.

23. Assess possible hybridization with black-tailed deer.

3. Establish necessary new populations of CWTD on existing habitat.

31. Capture and transport CWTD for transplant purposes.

32. Select areas within historical range for potential transplantation.

321. Resolve bio-political problems associated with moving CWTD to new areas.

322. Evaluate present habitat conditions of transplant areas.

4. Encourage public support for CWTD restoration program.

41. Provide expertise on prevention of CWTD habitat loss.

42. Provide public with conservation information on the CWTD restoration effort.

421. Provide news media with timely results on recovery activities.

422. Publish informational bulletin.

423. Provide lectures and slide series programs.

43. Provide CWTD observation opportunities for on-refuge visitors.

NARRATIVE

The primary objective for the restoration of the Columbia River population of CWTD is to delist the species by maintaining a minimum of 400 deer, distributed in suitable, secure habitat in at least three viable subpopulations. The strength of the objective is dependent on two words that need clarification: "secure" and "viable."

Habitat is considered to be secure only if it is free from adverse human activities (e.g., unregulated heavy grazing by domestic animals, clearing of woody plants, etc.) in the foreseeable future and is relatively safe from natural phenomena that would destroy its value to CWTD. An undiked island located at the mouth of the Columbia River would not contain CWTD habitat secure from flooding, even though the island may have habitat suitable for CWTD from time to time.

Definition of what constitutes a viable subpopulation is more difficult and less precise than defining "secure." A viable population is one whose intrinsic probability of extinction is relatively low (i.e., independent of major environmental perturbations), as determined from annual estimates of population size (Gavin 1978), and whose population is large enough to minimize deleterious effects of inbreeding. It is

now impossible to determine exactly what size of (sub)population will satisfy both of these requirements, but some approximations can be made to arrive at a reasonable answer (See Appendix A).

Assuming a sex and age ratio similar to that of the CWTD NWR mainland subpopulation, a minimum November population of 50 will be defined as viable for practical purposes here (See Appendix A). A subpopulation that periodically receives immigrants from other subpopulations would be more viable than a population of the same size that is totally closed to immigration, due to the periodic addition of "non-identical" genes to the gene pool of that former population.

It is possible for a population to be "secure-not viable"; secure-viable"; "not secure-not viable"; or "not secure-viable." Only CWTD subpopulations that are both secure and viable, based on the best available data, will be counted toward the requirement of three in the prime objective. As of autumn 1981, the following subpopulation of CWTD was considered to be viable and in secure habitat:

- CWTD NWR mainland, Wahkiakum County, Washington (CWTD=150 to 200 animals)

One subpopulation is considered secure but not viable:

- CWTD NWR, Tenasillahe Island, Clatsop County, Oregon (CWTD=30 to 40 animals)

The security of both the Washington mainland and Tenasillahe Island subpopulations is dependent upon continued maintenance of peripheral dikes. If either dike is breeched the affected subpopulation will no longer be considered secure and relisting may need to be considered. A possible action which could enhance security is the use of dredge spoil to raise the elevation of portions of CWTD habitat above the floodplain, thus providing "islands" of escape cover during a period of flood.

Two subpopulations are thought to be viable, but are not secure in habitat:

- Puget Island, Wahkiakum County, Washington (CWTD=50 to 75 animals)

- Wallace Island-Westport area, Clatsop and Columbia counties, Oregon (CWTD=70 to 80 animals)

The subpopulation on Karlson Island, Clatsop County, Oregon is probably neither secure nor viable. The island, which is subject to occasional flooding, may have a population of 8 to 12 CWTD.

If a population of 400 animals can be maintained, if habitat can be secured for one additional subpopulation in the "not secure-viable" category, and if the subpopulation on Tenasillahe Island becomes viable (minimum of 50 deer), the prime objective for recovering this population of CWTD will be met and it may be considered for delisting. If this cannot be done, then the best alternative is to establish new

subpopulations on existing habitat within CWTD historical range. However, reintroduction is costly, time-consuming and subject to failure; every effort should be made to secure habitat for subpopulations that are currently viable.

The following narratives describe in some detail how the secondary objectives will be accomplished. Numbers correspond to those of the outline.

1. All extant subpopulations of CWTD should be censused annually for population size, sex ratios, and doe:fawn ratios. The definition of viability requires that a reliable estimate of population size be obtained; minimum population size must remain above 50 in November if that subpopulation is to remain classified as viable. Since the prime objective requires three viable subpopulations, this objective of assessing populations is very important, even though it does not contribute directly to increasing the size or number of CWTD populations.
2. In addition to annually assessing viability of existing CWTD populations, management must be applied to assure that their viability does not decrease, better that it increase. This encompasses direct management of these populations as well as management of their habitat.
   21. Current federal and state regulations should be enforced to protect the viability of extant subpopulations of CWTD.
      211. Clark, Cowlitz, Pacific and Wahkiakum counties in Washington, and Saddle Mountain and Scappoose Game Manage-

ment units in Oregon should remain closed to the hunting of CWTD.

212. Closed areas on CWTD NWR should be maintained.

213. The Endangered Species Act of 1973, as amended, should be enforced to protect CWTD subpopulations and their habitat.

22. The protection of habitat for currently viable populations of CWTD is necessary to obtain the required number of subpopulations (3) with secure habitat. For refuge lands, this process entails habitat management that is attentive to CWTD requirements. For off-refuge habitat, protection and enhancement can be secured through local land use planning, zoning, easement, leases, agreements, and/or memorandums of understanding. Acquisition by either public or private organizations should be considered the least preferred option since funding is required for maintenance of the area(s).

221. A long-range management plan for the CWTD NWR should be drafted based on existing knowledge of CWTD-habitat relationships, patterns of plant succession, and results of completed research projects (e.g., Suring 1974; Suring and Vohs 1979; Gavin 1979; Dublin 1980). This plan should detail intensity and seasonal distribution of cattle grazing, haying, pasture renovation, and water management (dikes, tide gates, and drainage ditches, etc.).

2211. A CWTD food habits study was completed in 1980

by Holly T. Dublin in partial fulfillment of the requirements for the degree of Master of Science, University of Washington, Seattle.

2212. The results of Dublin's 1980 food habits study should be incorporated into the refuge management plan for CWTD NWR along with pertinent findings from earlier studies.

222. There are two known viable subpopulations of CWTD on private land in the lower Columbia River (Puget Island and Wallace Island-Westport). To meet the prime objective, the habitat for one of these subpopulations must be secured. This could be accomplished in several ways. These recommendations are based on a knowledge of land ownership in these areas and the feasibility of obtaining concessions from the owners.

2221. The CWTD-habitat-owner relationships on Puget Island, Washington are probably the most difficult to improve. CWTD have been responsible for crop damage on Puget Island, which resulted in compensation paid by the State of Washington to one landowner in 1975. CWTD grazing has caused continued complaints of crop depredation which further polarizes relations between local wildlife agencies and landowners. In addition, the amount of all-season cover on Puget Island proper has been dwindling for many years and this is expected to continue. Landowners that live in the area

of Puget Island should be encouraged to participate in land-use practices beneficial to CWTD, particularly in the saving of remaining woody cover.

Based on recent observations by Mike Davison (1979), CWTD on Wallace Island and the adjacent area near Westport, Oregon belong to a single subpopulation. The island has a nearly impenetrable thicket that provided excellent cover for these deer until logged in January 1980. The more open mainland area consists of private ranches; it may be possible to reach an agreement with some of the owners of these ranches. The owner of the Magruder ranch, for example, was at one time amenable to following refuge recommendations for CWTD habitat management on his land in exchange for grazing rights on Tenasillahe Island. A similar approach might be initiated with landowners near Westport who control lands used by CWTD.

2222. Contacts should be initiated with all local governmental entities (e.g., counties, cities, farm bureaus, port districts, etc.), to secure privately-owned CWTD habitat through local land use plans, zoning, easements, agreements, tax incentives, etc.

2223. Private conservation organizations such as The

Nature Conservancy, Trust for Public Lands, 1,000 Friends of Oregon, Audubon Society, etc., should be contacted and encouraged to secure habitat within their respective programs through easements, leases, acquisition, donations, or trusts.

2224. Section 7 of the Endangered Species Act, as amended, instructs the Secretary of Interior to take appropriate action to prevent destruction or modification of habitat considered essential to the survival of any Endangered or Threatened species. General legal descriptions of lands considered essential for the recovery of CWTD are given in the Appendix. (See 213)

23. CWTD hybridization with black-tailed deer is presently not a significant threat to the Columbia River population. However, this situation should be annually monitored during routine CWTD census work. If trend counts indicate hybridization frequency is increasing, management practices should be initiated to alleviate the problem.

3. If the prime objective (page 31) cannot be met through other means, then trapping CWTD from existing secure populations and transplanting them to areas containing suitable habitat, but within the historical range, may be considered.

31. Plans for transplanting CWTD must include consideration of potential animal loss following initial releases into pre-

determined sites. Losses may result from predation, illegal hunting, accidents, etc. The ramifications of breeding stock losses include 1) insufficient recruitment (fawns) to result in the desired population increases, and 2) poor quality and/or inadequate gene pool and flow. Biologically, a release ratio of 2 does;1 buck is suggested, with a minimum release totalling 6 animals. However, subject to the considerations noted above, a larger number is recommended to significantly increase the probability of success.

The transplantation should be done in April when green vegetation is abundant and actively growing. This is a few weeks before parturition; females that give birth to fawns in the new location may be less likely to emigrate from the transplant area. Puget Island and the mainland of the CWTD NWR are the preferred areas from which to obtain deer for transplanting, since the populations are concentrated and large enough that their viability would not be affected by the removal of a few individuals.

32. Davison (1979) and Davison and Spencer (1979) identified Cottonwood Island, Cowlitz County, Washington and Crim's Island, Columbia County, Oregon (Figure 4) as having potential as transplant sites for CWTD. The islands compare favorably to the CWTD NWR mainland in all categories (e.g., cover habitat/pasture ratios and nutrient analyses of pasture samples) except for plant species diversity, where the refuge excels. However, except for 148 acres of State-owned land on

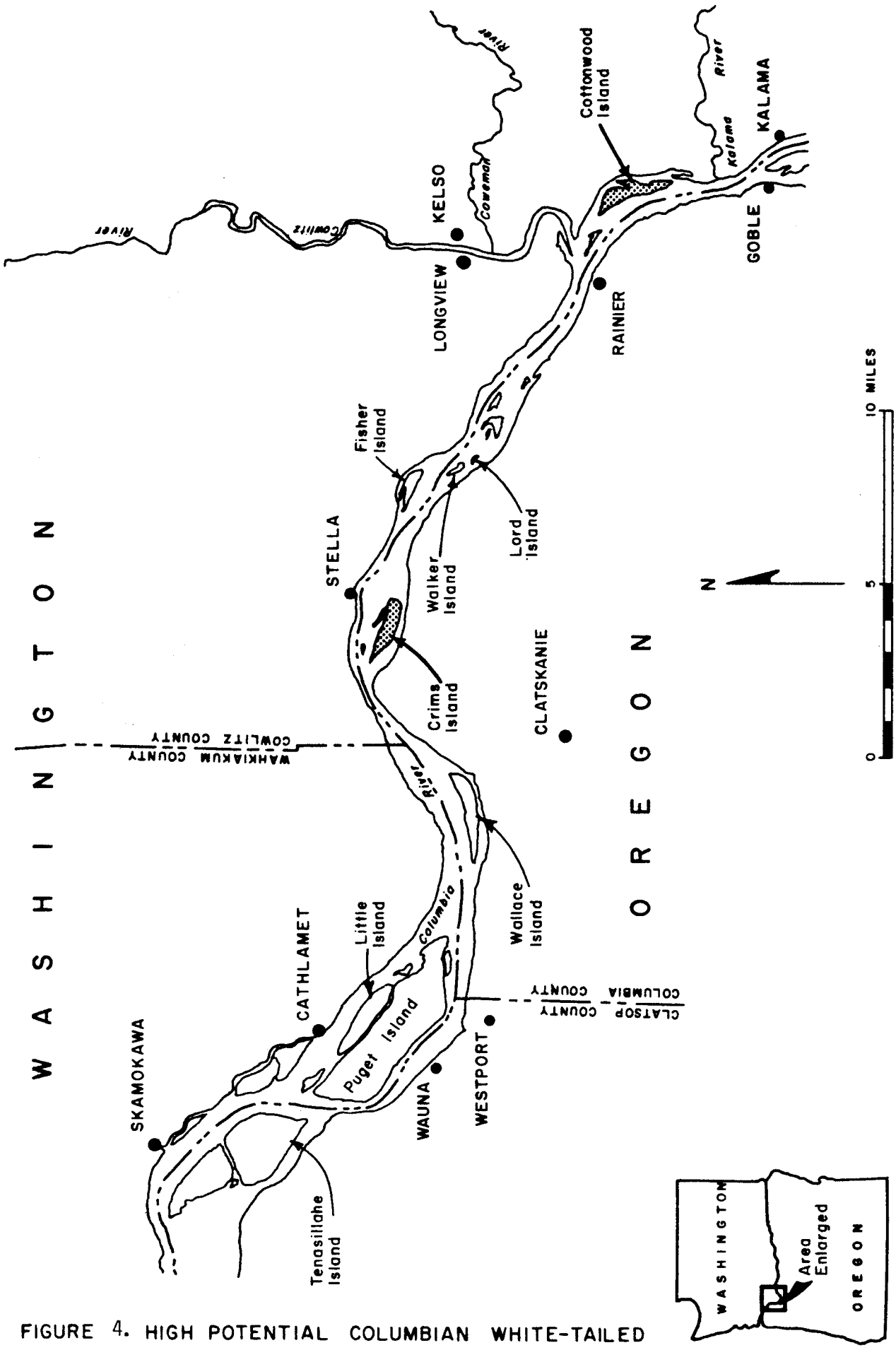


FIGURE 4. HIGH POTENTIAL COLUMBIAN WHITE-TAILED DEER TRANSPLANT SITES ON THE LOWER COLUMBIA RIVER.

Crim's Island, both islands are privately owned. Ridgefield NWR, Clark County, Washington may also have potential as a transplant site, although the existing habitat has not been evaluated for CWTD suitability.

321. If transplanting were conducted, major biopolitical problems would need to be resolved. These include coordination with State management plans, landowner contacts and negotiations, county approvals, and may also require public meetings and hearings, environmental assessments, etc. Contingencies should be developed in the long range recovery planning for CWTD to accommodate the lengthy process involved if transplanting is considered.

322. Habitat conditions for potential transplant areas have been evaluated by Davison (1979). Land use and ownerships frequently change and an updated habitat evaluation would be required prior to initiating any transplanting efforts.

4. Public support for the CWTD restoration program is necessary to encourage private landowners to adopt recommended management practices to enhance or protect CWTD habitat on their lands (see 2221). In addition, the public ultimately determines or influences how public monies are spent and can have an impact on funding for CWTD research and habitat protection programs. Therefore, the public should be kept informed of the status of CWTD and its progress toward recovery. This positive reinforcement is necessary, since

it alleviates the questionable attitude that complete restoration of the species is not possible.

41. Requests are received by the CWTD Recovery Team to comment on proposed projects within the geographic range of CWTD. Such requests may come from county, state or federal agencies. Biologists associated with the Recovery Team can enhance the species' recovery by encouraging cooperation between agencies consistent with Recovery Plan objectives.

42. Several outlets are available for informing the public of progress on CWTD restoration efforts. Each outlet should be utilized freely and frequently to inform the public and to encourage support for restoration efforts.

    421. News stories that detail estimates of annual population and heard composition, results of research, and status of off-refuge populations should be released regularly to provide a consistent picture of trends.

    422. An informational bulletin should be developed which summarizes current knowledge of CWTD ecology, behavior, population dynamics, and management. This bulletin should be available for distribution at CWTD NWR, local offices of ODFW and WDG and any other appropriate visitor contact point.

    423. A slide-tape series complementing the informational bulletin should be prepared. Local representatives of FWS, ODFW, and WDG should utilize the series as one means of informing interested groups and individuals about CWTD restoration activities.

43. Observations by the public of CWTD on the refuge mainland should be encouraged, but in such a way as to minimize impacts to the deer.

Roseburg CWTD Population Sub-Objective: To downlist to Threatened the Roseburg population by maintaining 1,000 CWTD in a viable status on lands within the Umpqua Basin of Douglas County, Oregon, and keeping the relative proportions of CWTD habitat within the known range of the species from further deterioration of current conditions; to restore the Roseburg population by maintaining a minimum population of 500 animals distributed in 5,500 acres (see Appendix A) of suitable, secure habitat within the Umpqua Basin of Douglas County on lands owned, controlled, protected or otherwise dedicated to the conservation of the species, and delist the species.

1. Annually assess viability of extant populations of CWTD.

2. Ensure viability of extant populations of CWTD.
   21. Enforce current Federal and State regulations.
      211. Maintain closed hunting season for CWTD in Dixon, Indigo, and Melrose management units.
      212. Enforce Endangered Species Act of 1973, as amended.
   22. Protect habitat of viable CWTD population.
      221. Develop long-term management plan for Roseburg population.
      222. Incorporate results of CWTD studies in long-term management plan.

223. Complete ecological study of CWTD in Douglas County, Oregon. (Completed September 1981)

23. Secure habitat in areas that contain viable CWTD populations.

231. Use landowner incentives to secure habitat.

232. Use local zoning ordinances, land use planning, county parks, etc., to secure habitat.

233. Encourage private organizations to secure habitat.

234. Complete Protection Strategy Study. (Completed 1981)

235. Delineate essential habitat.

24. Assess possible hybridization of CWTD with black-tailed deer.

3. Encourage public support for CWTD restoration program.

31. Provide expertise on prevention of CWTD habitat loss.

32. Provide public with conservation information on the CWTD restoration effort.

321. Provide news media with information on recovery activities.

322. Publish informational bulletin.

323. Provide talks and slide series programs.

NARRATIVE

The primary objective for the restoration of the Roseburg population of CWTD is to delist the species by maintaining a viable minimum herd of 500 deer distributed in a minimum of 5,500 acres of secure habitat within the Umpqua Basin, Douglas County, Oregon. Habitat is considered to be secure only if it is protected from adverse human activities (e.g., heavy unregulated grazing by domestic animals, clearing of woody plants, etc.) in the foreseeable future, and is relatively safe from

natural phenomena that would destroy its value to CWTD.

Definition of what constitutes a viable population is more difficult and less precise than defining "secure". A viable population is one whose intrinsic probability of extinction is relatively low (i.e., independent of major environmental perturbations), as determined from annual estimates of population size (Gavin 1978), and whose population is large enough to minimize deleterious effects of inbreeding. It is now possible to determine exactly what size of population satisfies both these requirements, but some approximations can be made to arrive at a reasonable answer (see Appendix A).

Assuming a sex and age ratio similar to that reported by Smith (1981), a minimum November population of 500 will be defined as viable for the Roseburg population of CWTD. As of autumn 1981 the Roseburg population is considered viable but not secure.

Given the present status of extant populations of CWTD in Douglas county, if viability can be maintained and 5,500 acres of habitat secured, the prime objective for recovering this population of CWTD will be met and it may be considered for delisting. If this cannot be done, then the best alternative is to establish by reintroduction new subpopulations on existing habitat within the species historical range in the Umpqua Basin. This alternative is costly, time/consuming, and total success can not be assured; every effort should be made to secure habitat already inhabited by CWTD. Since it appears that the Umpqua Basin has enough habitat to support a viable, delisted population of

CWTD, transplanting outside the Basin is not considered feasible or biologically necessary at this time.

Short of attaining the prime objective, the interim objective of this recovery action will be the downlisting of the Roseburg population of CWTD from Endangered to Threatened. The Roseburg population will be considered Threatened if a viable population of 1,000 deer is maintained and the relative proportions of CWTD habitat within the known range of CWTD in Douglas County is not changed.

The following narratives describe how secondary objectives will be accomplished. Numbers correspond to those of the previous recovery outline.

1. All extant populations of CWTD should be monitored at least annually for population size and composition. The definition of viability we have adopted requires that a reliable estimate of population size be obtained; minimum population size must remain above 500 CWTD in November if the population is to remain classified as viable. This objective is very important, even though it does not contribute directly to increasing the number of CWTD.

   The area designated as essential habitat (Figure 3) contains the largest group of CWTD in Douglas County and has served as the basis for most biological understanding of the Roseburg population (i.e., studies by Winston Smith from 1978 to 1981) Continued monitoring of deer within this core high density area should be em-

phasized. Reliable estimates of population size should be obtained each fall for the essential habitat area. Population estimates are absolutely necessary to develop and evaluate long-term management plans per 221. Sex ratios and doe:fawn ratios can be obtained from the same data used to estimate population size, so that 1 to 2 weeks of intensive data collection in November of each year shculd suffice. If marked animals are required for the population estimation technique used, additional effort will be required throughout the year to keep a sample of deer marked.

Knowledge of distribution and population size of disjunct groups of CWTD within Douglas County will help assess overall viability of the population. Areas outside the essential habitat zone which are frequented by CWTD (e.g., Driver Valley, Coles Valley, and Riddle) should be censused annually. Reports of CWTD in new areas should be confirmed and distribution maps updated as appropriate.

2. Management must be applied to guarantee or increase the viability of the Roseburg population. This encompasses direct management of CWTD as well as their habitat.

   21. Current federal and state regulations should be enforced to protect the viability of extant populations of CWTD.

      211. Until the Roseburg population is downlisted to Threatened, the Melrose, Dixon an Indigo game management units in Oregon should remain closed to the hunting of CWTD. A Threatened classification could include provisions for "controlled take" for management purposes.

      212. All protective stipulations of the Endangered Species

Act should be exercised to afford maximum protection under the law until the species is delisted. This would include law enforcement, issuance of permits, and planning guidance through the Section 7 consultation process.

22. The protection of habitat for currently viable populations of CWTD is necessary for maintaining population size and for delisting the species. Since most CWTD habitat is privately owned, the process entails the development of strategies and techniques which encourage landowners to conduct land use practices attentive to CWTD requirements.

    221. A long-term management plan for the Roseburg population should be developed based on current knowledge of CWTD-habitat relationships, patterns of plant succession, and results of completed research projects. The plan would provide landowners with guidelines on grazing, haying, pasture renovation, water management, brush control, timber removal, and various other activities in riparian zones which are least disruptive to CWTD. Methods for encouraging landowners to participate in such activities (e.g., cost-sharing through the county Agriculture Stabilization and Conservation Service) would be included in the document. The plan would also provide guidelines and recommendations for protecting crops and gardens from deer depredations. Management practices for keeping the species off the Endangered Species list once removed should be outlined and discussed, concluding with recommendations for species management.

222. Data, results, and management recommendations from Smith (1981) should be reviewed and incorporated into the management plan as appropriate. Needs for further studies should be identified and appended to the management plan.

223. The doctoral dissertation of Winston P. Smith on the ecology of the Roseburg population of CWTD was completed September, 1981.

23. The Roseburg population is currently considered viable but its habitat is not secure. Securing habitat by removing adverse human activities is thus crucial if classification to Threatened or delisting is to become a reality.

231. Since most CWTD habitat is privately owned, the most expedient means of rapidly securing a large amount of habitat is with the cooperation of private landowners. Incentives such as land trusts and perpetual conservation easements may be employed which can result in securing key areas with minimal inconvenience to the landowner. This is particularly timely since most public agency land acquisition efforts are becoming increasingly more difficult to implement due to lack of funds and changing public sentiments concerning Federal government land ownership. Landowners within the essential habitat zone with key parcels of CWTD habitat should be contacted and encouraged to participate in habitat protection efforts.

232. Contacts should be initiated with local entities includ-

ing planning commissions, county parks department, farm bureaus, etc. Such groups should be encouraged to secure habitat through zoning ordinances, land use planning, parks and greenbelts, agreements, memorandums of understanding, etc.

233. Private conservation organizations such as The Nature Conservancy, Trust for Public Lands, 1,000 Friends of Oregon, and the Audubon Society, etc., should be contacted and encouraged to explore securing habitat within their respective programs through easements, leases, acquisition, donations, or trusts.

234. In 1981 the FWS completed a Protection Strategy Study (PSS) for the Roseburg population. The plan identifies opportunities to secure CWTD habitat. Recommendations from the PSS should be explored for implementing tasks 231 through 233.

235. Data from Winston Smith's study should be utilized to update the essential habitat zone (Figure 3). Key parcels within the zone should be identified and ranked based on the needs of CWTD and threats to the habitat. A land status review and ownership determination would be especially useful when habitat protection/management programs are implemented. This review will determine the minimum acreages and locations necessary for: (1) downlisting to Threatened, and (2) completely delisting the Roseburg population. A list of general legal descriptions of essential habitat is given in the

Appendix.

24. CWTD hydridization with black-tailed deer is presently not a significant threat to the Roseburg population. However, this situation should be annually monitored during routine CWTD census work. If assessment of the information collected indicate hybridization frequency is increasing, management practices should be initiated to alleviate the problem.

3. The ultimate success of any CWTD restoration program is dependent upon the support of the Roseburg populace, particularly landowners within the essential habitat zone. This is particularly true in Douglas County, where CWTD often occur in moderately dense rural residential areas up to and including some fringe areas within the city limits of Roseburg.

31. Wildlife agency personnel should provide continuing expertise to local governments, developers, etc., on how to prevent CWTD habitat loss. This should be accomplished through continuing review of planning documents, environmental assessments and impact statements, and permits. In cases where habitat is lost or altered, mitigation and/or compensation should be sought.

32. Public support is dependent upon an informed public who know and understand the problems and issues in the local area. Every effort should be made to cultivate support through education and information.

321. Annual census information, findings of new studies, or any significant new developments in the Roseburg population of CWTD should be released to the news media in a

timely manner.

322. An informational brochure should be developed describing the history, location, and present status of CWTD in Douglas County. Similar information can be incorporated into bulletin boards and installed at county parks, boat launching facilities or any other location which would receive wide public exposure.

323. Every worthwhile opportunity should be taken to inform the public on CWTD matters in Douglas County. Personal presentations should be made to key groups, such as planning commissions, farm bureaus, and sportsmens groups. Slide-tape series should be developed and made available for loan to schools, civic and environmental organizations, scouts, etc.

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PART III. IMPLEMENTATION SCHEDULE

The table which follows is a summary of scheduled actions and costs for the Columbian white-tailed deer recovery program. It is a guide to meet the objectives of the recovery plan, as elaborated upon in Part II, Narrative section. This table indicates the priority in scheduling tasks to meet the objective, which agencies are responsible to perform these tasks, a time-table for accomplishing these task, and lastly, the estimated costs to perform them. Implementing Paart III is the action of the recovery plan, that when accomplished, will bring about the recovery of this endangered species.

Note that the Schedule is divided into two sections - Columbia River Population and Roseburg Population.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or Research (R)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

1 = All actions that are absolutely essential to prevent extinction of the species.
2 = All actions necessary to maintain species' current population status.
3 = All other actions necessary to provide for full recovery of the species.

Abbreviations

FWS	U.S. Fish and Wildlife Service
WDG	Washington Department of Game
ODFW	Oregon Department of Fish and Wildlife
CWTD	Columbian White-tailed Deer
CWTD NWR	Columbian White-tailed Deer National Wildlife Refuge
LE	Law Enforcement
SE	Endangered Species
OSU	Oregon State University
UW	University of Washington
OCWRU	Oregon Cooperative Wildlife Research Unit

Ongoing = Continuous after once being initiated.

III. IMPLEMENTATION SCHEDULE

A. Columbia River Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency			Fiscal Year Costs ($1,000s)			Comments/Notes
					F W S						
					Region	Program	Other	FY 83	FY 84	FY 85	
I-1	Annual population estimates for each subpopulation	1	2	ongoing	I	refuges	ODFW WDG	refuge costs 2.0 2.0	refuge costs 2.2 2.2	refuge costs 2.4 2.4	WDG funding through non-game program
O-3	Maintain closed hunting season in Ore. and Wash.	211	1	ongoing			ODFW WDG	existing budget	existing budget	existing budget	No additional funds required. Task accomplished within existing agency budget
O-3	Maintain closed areas on CWTD NWR	212	1	ongoing	I	refuges		refuge costs	refuge costs	refuge costs	
O-4	Enforce Endangered Species Act, 1973 as amended	213	1	ongoing	I	refuges LE SE		existing budgets	existing budgets	existing budgets	Includes 2224
M-3	Manage CWTD NWR according to longterm mgmt. plan	221	1	ongoing	I	refuges		275.0BLHP 156,000	172,000*	190,000*	* Estimated Budget increases

III. IMPLEMENTATION SCHEDULE

A. Columbia River Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency			Fiscal Year Costs ($1,000s)			Comments/Notes
					F W S						
					Region	Program	Other	FY 83	FY 84	FY 85	
A-7	Use landowner incentives to secure habitat	2221	1	ongoing	I	refuges	ODFW WDG	existing budgets	existing budgets	existing budgets	
A-7	Use local planning, zoning,etc. to secure habitat	2222	1	ongoing	I	refuges	ODGW WDG	existing budgets	existing budgets	existing budgets	
A-7	Use private organizations to secure habitat	2223	1	ongoing	I	refuges	ODFW WDG	existing	existing	existing	No additional funds required. Task accomplished within existing agency budgets.
I-1	Monitor BTD-CWTD hybrid frequency during annual surveys	23	2	ongoing	I	refuges	ODFW	Done in conjunction w/ Task #1	Done in conjunction w/ Task #1	Done in conjunction w/ Task #1	
O-4	Provide expertise on prevention of CWTD habitat loss	41	1	ongoing	I	refuges	ODFW WDG	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budgets

III. IMPLEMENTATION SCHEDULE

A. Columbia River Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency F W S Region	Responsible Agency F W S Program	Responsible Agency Other	Fiscal Year Costs ($1,000s) FY 83	Fiscal Year Costs ($1,000s) FY 84	Fiscal Year Costs ($1,000s) FY 85	Comments/Notes
0-1	Provide news media with results of recovery activity	421	3	ongoing	I	refuges SE		existing budgets	existing budgets	existing budgets	
0-1	Publish informational brochure/ scientific studies	422	2	complete by FY-84		refuges SE OCWRU	ODGW	existing budgets	1.0 1.0 2.0 1.0	1.0 2.0 1.0	Additional funds required to print brochures & scientific monographs on CWTD
0-1	Provide lectures and slide series programs	423	3	ongoing	I	refuges SE		existing budgets	existing budgets	existing budgets	
0-1	Provide observation opportunities	43	3	ongoing	I	refuges		existing budget	existing budget	existing budget	

III. IMPLEMENTATION SCHEDULE

B. Roseburg Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency			Fiscal Year Costs ($1,000s)			Comments/Notes
					F W S						
					Region	Program	Other	FY 83	FY 84	FY 85	
I-1	Annual population estimates in essential habitat	1	2	ongoing			ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget
O-3	Maintain closed hunting seasons	211	1	ongoing			ODFW	existing	existing	existing	No additional funds required. Task accomplished within existing agency budget
O-4	Enforce Endangered Species Act,1973, as amended	212	1	ongoing	I	refuges LE SE		existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget*
M-3	Develop long-term mgmt. plan	221	1	FY-82	I	SE	ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget
M-3	Incorporate results of Smith 1981 into mgmt plan	222	1	FY-82			ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget

III. IMPLEMENTATION SCHEDULE

B. Roseburg Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency			Fiscal Year Costs ($1,000s)			Comments/Notes
					F W S						
					Region	Program	Other	FY 83	FY 84	FY 85	
A-7	Use landowner incentives to secure habitat	231	1	ongoing	I	refuges	ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget
A-7	Secure habitat through local government	232	1	ongoing	I	refuges	ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within exist-
I-2	Secure habitat through private organizations	233	1	ongoing	I	refuges	ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget.
I-2	Update essential habitat maps	235	2	ongoing	I	SE	ODFW	existing budgets	existing budgets	existing budgets	
I-1	Monitor BTD-CWTD hybrid frequency during annual surveys	24	2	ongoing			ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budget

III. IMPLEMENTATION SCHEDULE

B. Roseburg Population

General Category	Plan Task	Task#	Priority	Task Duration	Responsible Agency F W S Region	Program	Other	Fiscal Year Costs ($1,000s) FY 83	FY 84	FY 85	Comments/Notes
O-4	Provide expertise on prevention of habitat loss	31	1	ongoing	I	refuges SE	ODFW	existing budgets	existing budgets	existing budgets	No additional funds required. Task accomplished within existing agency budgets
O-1	Provide news media with information	321	3	ongoing	I	SE	ODFW	existing budgets	existing budgets	existing budgets	
O-1	Publish informational leaflet/ scientific studies	322	2	FY-83	I	SE	ODFW	existing budgets	5.0 2.0		Leaflet developed w/ existing budget. 5.0 needed to publish leaflet/monograph
O-1	Provide talks and slide series programs	323	3	ongoing	I	SE	ODFW	existing budgets	existing budgets	existing budgets	

General Legal Description of Lands Classified as Essential for the Survival and Recovery of the Columbian White-tailed Deer (All descriptions associated with Willamette Meridian.)

COLUMBIA RIVER POPULATION (Figure 2)

a. Columbian White-tailed Deer NWR

Clatsop County, Oregon

All of Tennasillahe Island (2,050 acres), situated in T8N R6W, Sections 4 and 5, and in T9N R6W, Sections 28 through 33.

Wahkiakum County, Washington

748 acres of Hunting Islands, situated in T8N R6W, Section 3 and in T9N R6W, Sections 27, 28, 34 and 35; and 59 acres of Price Island, situated in T9N R6W, Section 17.

Approximately 1,900 acres on the Washington mainland, as follows:
T9N R6W -

Section 16, that part lying south of Brooks Slough; Section 17, Lots 7 and 8, and that part of the NE¼ lying south of Brooks Slough and southeasterly of the dike road;

Section 21, that part lying south of Brooks Slough.

Section 22, that part lying south of Brooks Slough and the county road and southwesterly of State Highway 4;

Section 23, that part lying westerly of State Highway 4;

Section 26, that part lying westerly of State Highway 4 and northerly of Elochoman Slough;

Section 27, Lots 1, 2, 5, 6, 10 and the N½ NE¼, and the SE¼ NE¼;

and Lot 1 of each - Section 28, Section 34, and Section 35.

Federal ownership - 4,645 acres; State of Washington ownership - 155; total acreage - 4,800 acres.

b. Land Adjacent to CWTD NWR

Wahkiakum County, Washington

T8N R6W -

Section 2, that part of Hunting Islands in the W½.

T9N R6W -

Section 15, that part lying southwesterly of State Highway 4;

Section 6, that part lying south of State Highway 4 and east of the access road to Washington Department of Game (WDG) boat launch ramp;

Section 20, Lots 1 and 2 (Price Island);

Section 21, Lots 2, 3 and 5 (Price Island);

Section 23 and 26, that land bordered on three sides by State Highway 4, Risk Road, and Nelson Creek Road;

Section 26, that part of SW¼ lying west of State Highway 4 and east of the boundary of CWTD NWR;

Section 27, that part of Hunting Islands in the W½ and SE¼;

Section 34, NE¼; and

Section 35, NW¼ west of State Highway 4, and that land on Hunting Islands in the SW¼.

Public ownership - 173 acres; Private ownership - 917 acres; total acreage - 1,090 acres.

c. Puget Islands and Adjacent Islands

Wahkiakum County, Washington

T8N R5W -

Sections 18 (SW¼), 19, 20 (SW¼), 29 (NW¼), and 30 (N½).

T8N R6W -

Sections 3 (W½), 4 (E½), 9 (E½), 10, 11 (NW¼ and S¼), 12 (SW¼), 13, 14, 15, 16 (NE¼), 22 (NE¼), 23, 24, 25 (N½), and 26 (NE¼).

State of Washington ownership - 497 acres; Private ownership - 7,503; total acreage - 8,000 acres.

d. Westport Area (Kerry Island, Magruder Ranch)

Clatsop County, Oregon

T7N R6W -

Section 1, NE¼, that part lying north of U.S. Highway 30;

T8N R6W -

Section 25 (S½); and

Section 36, that part lying north and east of U.S. Highway 30.

Columbia County, Oregon

T7N R5W -

Section 6, that part lying north of U.S. Highway 30.

T8N R5W -

Sections 30 (S½) and 31.

Private ownership - 1,500 acres.

e. Wallace Island, Anundes Island Area, Kinnunen Cut, and Adjacent Shorelines.

Columbia County, Oregon

T8N R5W -

Sections 25, 31, 34 (NE¼), 35 (N¼ and N½ S½, including Skull Island), and 36 (N½ and that part of Anundes Island within Section).

T8N R4W-

Sections 30 and 31.

T7N R4W -

Section 6 and that part of Kinnunen Cut in NE¼.

State of Oregon ownership - 23 acres (Skull Island); Private ownership - 1,777 acres; total acres - 1,800 acres.

Total acres of essential habitat for the Columbia River population of CWTD:

Public ownership - 5,493 acres; Private ownership - 11,697 acres; total acreage - 17,190 acres.

ROSEBURG POPULATION (Figure 3)

Douglas County, Oregon. (Lands located east of Roseburg.)

T26S R3W - Sections 19, 29, 30, 31 and 32;

T26S R4W - Sections 7, 8, 9, 10, and 13 through 36;

T26S R5W - Sections 7 through 36:

T27S R5W - Sections 1 through 36;

T27S R4W - Sections 1 through 12, 13 (W½ NW¼ and SE¼), 14 through 22, 23 (NW¼), and 27 through 30.

T27S R3W - Sections 5, 6 and 7 (W½ NW¼ and N½ NE¼).

Public ownership - 160 acres; Private ownership - 80,560 acres; total acreage - 80,720 acres.

Grand Total of Essential Habitat for the two populations of Columbian White-tailed Deer:

Public ownership - 5,653 acres; Private ownership - 92,257 acres; total acreage - 97,910 acres.

Determination of Minimum Desirable Population

The minimum population size of CWTD theoretically required to cancel the deleterious genetic effects of inbreeding (inbreeding depression) can be calculated (Senner 1980). The degree of inbreeding is a function of population size and is measured by the inbreeding coefficient, F. F is equal to $\frac{1}{2}N_e$ per generation (Franklin 1980), where N_e is the effective population size, i.e., the number of breeding individuals necessary to provide an ideal exchange of genetic material.

An effective population of 10, for example, would have an inbreeding coefficient (F) of 1/20 or 5% per generation. F would equal 100% and the effects of inbreeding would be maximized in just 20 generations. A model developed by Senner (1980) predicts this population would begin a sharp decline at the 15th generation and become extinct at about the 25 generation.

Natural selection and mutation can counteract some effects of inbreeding but they act very slowly (Bunnell 1978, Franklin 1980). What rate of inbreeding can be considered as acceptable, then? Soule (1980) recommended a maximum rate of 1% for short term survival (less than about 75 generations). For the CWTD, we must be concerned with long term survival. We feel that 0.25% is a reasonable inbreeding coefficient. The 100% level of inbreeding would be reached at 400 generations, or approximately 1,000 to 1,400 years, assuming a generation time of 2.5 to 3.5 years. This should be sufficient time for selection and mutation to counterbalance inbreeding. An additional margin of safety is

provided by the fact that we are dealing with two disjunct populations - Roseburg and Lower Columbia. If inbreeding effects are noted in one or both populations, the situation can be improved by transplants.

Substituting .0025 for F in the formula $F=\frac{1}{2}N_e$ gives an effective population size of 200. However, this number assumes an equal sex ratio. To compensate for the fact that the actual sex ratios are not equal, the formula $N_e=4N_mN_f/(N_m+N_f)$ is used (Hartl 1980), where N_m is the number of breeding males and N_f the number of breeding females.

The ratio of breeding adults (two years and older) in the Roseburg herd is about 4 females to 1 male (Smith 1981). Therefore, $N_f=4N$ and substituting in the formula gives $200=16N_m^2/5N_m$ and $N_m=62$. $N_f=(4)(62)=248$. The effective population is thus 62+248=310 individuals. Fawns and yearlings do not contribute to the Roseburg breeding population, yet they comprise about 40% of the herd. Therefore, the total minimum population compatible with a 0.25% rate of inbreeding is 310/0.6 or 516, given the existing sex and age ratios.

The same basic procedure is used to calculate the desirable population size for the Lower Columbia area. However, there are some differences in herd composition (Gavin 1979), Clark unpubl. data). The ratio of adult females to adult males is more nearly 3 to 1, therefore $N_f=3N_m$. Substituting in the equation, $N_m=67$ and $N_f=201$ for an effective population of 268. Approximately 65% of the herd are of breeding age, thus the total necessary population is 268/.65 or 412.

There is a further complication in the Lower Columbia area in that the herd is split into discrete subpopulations which are separated by formidable, but not impassable, water barriers (channels of the Columbia River). It is likely that some exchange between subpopulations occurs, but there is no evidence of frequent migration. It is therefore necessary to define a viable subpopulation.

We feel that an inbreeding coefficient of 2% is the maximum acceptable for a subpopulation, given the present geographic distribution. The 100% level of inbreeding would be reached in 50 generations if there was no migration; however, just one migrant per generation entering the breeding population would offset this. With F=0.02, N_e=25, N_m=8 and N_f=24. The effective population is 32, and the total population is 32/0.65 or 49.

Rounding off the numbers, the minimum acceptable population sizes for continued viability of CWTD are: Roseburg - 500; Lower Columbia (total) - 400; Lower Columbia (subpopulation) - 50. It is important to remember that these numbers are based on the existing sex ratios. A shift in the sex ratio toward males would do no harm providing it does not go beyond 1:1. A significant decline in the proportion of males would be unfavorable. If, for example, the sex ratio increased to 6:1 (favoring females) the inbreeding coefficient would nearly double. An effective population of 464 (Lower Columbia) and a total population in excess of 700 would be required to maintain the coefficient at .25%. It is imperative that management plans for CWTD consider sex ratios.

The foregoing discussion is a relatively superficial overview of an exceedingly complex subject and is not intended to be the final word. The calculations are based on some assumptions that are not strictly true for CWTD. For example, the method of determining effective population size assumes that breeding is completely random and there are no age-specific differences in genetic contributions. Deer are not purely random breeders and the older, stronger males probably breed more than the younger ones. These factors will tend to increase the actual inbreeding coefficient. We cannot predict the extent of this increase but it should not be excessively large. Nonetheless, the calculated population sizes should be regarded as minimums - the larger the population, the lower the genetic risk.

With population sizes in the 400 to 500 range, there is an extremely low probability (barring a major environmental catastrophe) of CWTD becoming extinct, simply because of year-to-year fluctuations in mortality, reproductive success, etc. Gavin (1978) presents a thorough discussion of this concept. It suffices here to say that the probability for any given year is one in many hundreds of thousands.