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Effects of Even-Aged Timber Management on Survivorship in Sitka Black-Tailed Deer, Southeast Alaska

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STUDY TITLE: Effects of Even-Aged Timber Management on Survivorship in Sitka Black-Tailed Deer, Southeast Alaska.

PERIOD: 1 July 1996–30 June 1997

SUMMARY

The primary objectives of this study are to determine the influences of even-aged timber management on survivorship in Sitka black-tailed deer and interactions between deer and Alexander Archipelago wolves (*Canis lupus ligoni*). During this reporting period we completed construction of year-round camp facilities on Heceta Island, sampled 120 vegetation plots for habitat classification and successfully captured and radio-collared 23 deer and 1 wolf. Preliminary cluster analysis of the vegetation data indicates 8 logical habitat types differentiated primarily by age (postlogging) and productivity (high and low). This classification differs slightly from recognized classifications by the US Forest Service (FS). Deer use of FS habitat types, as assessed by pellet-group counts, showed high use of high-volume old growth, young clearcuts, and noncommercial forest. Relatively low use was observed in young sawtimber and nonforest habitats. During winter, track counts revealed higher than expected use by deer in high-volume old growth. A variety of techniques were used to capture deer during the year. The use of neck snares was discontinued because of high associated mortality. Transmitter-equipped darts were also unsuccessful because of limited range and accuracy when fired at velocities slow enough not to cause injury to the deer. The most successful capture techniques involved the use of drop nets, although this technique does not include age or sex selection. Another promising technique involves the use of smaller (3 cc) darts loaded with a concentrated mixture of Ketamine and Xylazine. These darts could be fired accurately and yielded relatively short induction times with no mortalities. Of the 23 deer captured, none has died of natural causes. The wolf captured dispersed off Heceta Island to northeast Prince of Wales Island, a travel distance of >100 km. All animals on Heceta are being relocated weekly on a randomized schedule and their locations plotted on low-level color aerial photographs. These relocations will be used to identify home range characteristics and habitat preferences in the next report period. Work planned for next year includes increasing by 2 times the number of vegetation plots sampled and increasing both the number of deer and wolves radiocollared. Increased emphasis will be placed on capturing animals in the unroaded, unlogged areas of the island.

Key Words: clearcuts, *Odocoileus hemionus sitkensis,* old growth, Sitka black-tailed deer, Southeast Alaska, survivorship.

CONTENTS

BACKGROUND

Previous research on Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) -habitat relationships in Southeast Alaska has focused on patterns of habitat use (Wallmo & Schoen 1980, Rose 1982, Schoen & Kirchhoff 1985, Yeo & Peek 1992). These studies have found higher densities of deer in old-growth forest than in even-aged second growth stands, particularly during winter. The reason for these differences in habitat selection has been attributed to forage abundance and availability (Wallmo and Schoen 1980), nutritional quality (Hanley et al. 1989), snow (Kirchhoff and Schoen 1987), and predation risk (Kirchhoff 1994).

Measures of habitat use alone are generally not valid for characterizing the value of habitats to a population (VanHorne 1983, Hobbs & Hanley 1990). VanHorne (1983) proposed a measure of habitat quality that included terms for population density, survivorship, and reproduction; yet admitted that such data could not be feasibly collected in many wildlife studies. VanHorne (1983) and others have noted that source-sink population dynamics can generate high population densities in poor habitats and, conversely, habitats with a low annual population density may be seasonally important to the population. Hobbs & Hanley (1990) concluded there was a need for habitat use studies to examine causal relationships between resources and wildlife populations and that simple measures of use and availability of habitats were likely to obscure important habitat value information.

To resolve questions of habitat quality for deer in logged landscapes, it is necessary to go beyond the earlier examinations of use and availability of specific habitat types (e.g., Wallmo & Schoen 1980, Schoen & Kirchhoff 1990). This study examines how deer survival varies as a function of landscape condition and predation risk. Landscape condition is described in terms of the composition, biomass, and quality of understory vegetation, forage quality, and snow interception ability in various habitats. Predation risk varies as a function of distance to wolf activity centers or den sites.

OBJECTIVES

To determine influences of even-aged timber management on survivorship in Sitka black-tailed deer and interactions between deer and Alexander Archipelago wolves (*Canis lupus ligoni*).

JOBS

1. Characterize the habitat types available to deer in terms of forage composition and abundance, seasonal forage availability, and hiding cover.
2. Measure the amount of deer use each habitat type receives, diurnally and seasonally, by radio-collared individuals.
3. Measure adult survivorship, reproduction, recruitment, and home range composition of adult deer using different habitat types or landscapes.
4. Measure predation risk associated with individual habitat types as a function of vegetative structure and proximity to wolf den sites or wolf activity centers.

STUDY AREA

The study area is located on Heceta Island (55°45' N, 133°45' W), in Game Management Unit (GMU) 2 in southern Southeast Alaska. Heceta Island is approximately 180 km^2 in area with 100 km of coastline. The island is underlain with extensive karst limestone deposits and supports productive forest growth, dominated by Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*), with lesser amounts of western red cedar (*Thuja plicata*), Alaska yellow cedar (*Chamaecyparis nootkatensis*), and shore pine (*Pinus contorta contorta*). Common shrubs include several species of blueberry (*Vaccinium* spp.), rusty menziesia (*Menziesia ferruginea*), salmonberry (*Rubus spectabilis*), and devil's club (*Oplopanax horridus*). Ground vegetation is dominated by evergreen forbs (*Cornus canadensis, Coptis asplendifolia, Rubus pedatus, Tiarella trifoliata*), ferns (*Dryopteris expansa, Gymnocarpium dryopteris, Blechnum spicant, Polystichum munitum*), and bryophytes (*Sphagnum* spp., *Hylocomium* spp., *Rhytidiadelphus* spp.).

Timber harvest on the island began about 1926 and peaked between 1970 and 1985. As of 1996, 42% of the productive forest land had been cut (USFS 1996). Of that 65% was in a young clearcut stage (i.e., less than 26 years old), while 35% is in a closed second growth stage (26–150 years old). An estimated 83% of the island is road-accessible due to logging activities (USFS 1996).

METHODS

HABITAT CHARACTERIZATION

To obtain a representative sample of all habitats available to deer on Heceta Island, we used a randomized sampling design. Using the USFS geographic information system (GIS) database, we overlaid a 1km x 1km grid of sample points on a map of the island. This approach provided us with 178 points (each with an associated UTM coordinate) from which to start vegetation-sampling transects. We selected a random subset of 50 of these points to sample and assigned a random transect azimuth to each. Along each transect line, we established six 0.2 ha circular plots at 100-m intervals. For each 0.2 ha plot, we recorded stand age, mapped stand age, mapped volume class, tree height, basal area, hiding cover (Griffith and Youttie 1988), elevation, aspect, and percent ground cover of large, contagiously distributed understory plants, including devil's club, rusty menzesia, and skunk cabbage (*Lysichiton americanum).* Nested within each 0.2 ha plot were six 4-m^2 subplots at 10-m intervals along the transect line. For each subplot, we recorded the percent cover of total shrubs, *V. parvifolium* and *V. alaskaense/ovalifolium*, and the modal shrub height. In each subplot, we positioned a 1-m x 1-m forb plot from which we estimated percent cover of evergreen and deciduous forbs.

Statistical analysis

Less than 50% of the planned sample points were visited in the first field season. Initial analysis based on this partial sample is mostly exploratory and may change as additional points are sampled. To identify natural groupings of habitat types, we performed a cluster analysis (Manly 1986) using forest understory and overstory characteristics believed to be important for deer. These included mean tree height, basal area, timber volume, modal shrub height, and percent coverage of *Lysichiton americanum*, *Vaccinium parvifolium*, other shrubs, evergreen forbs, and deciduous forbs. We clustered age classes of habitats based on Euclidean distances calculated for the selected variable set. To determine the stability of the clusters, we used 3 linkage algorithms: complete linkage, unweighted pair-group average linkage, and Ward's linkage (Johnson and Wichern 1992). To determine which of the many possible clustering schemes were appropriate to the data set, we relied on field knowledge of the sample plots, the stability of clustering schemes using different linkage algorithms, and plots of linkage distance as a function of amalgamation step.

Additional winter habitat characterization planned for future years consists of establishing a network of snow depth measurement stakes on the island to determine effects of elevation and aspect on snowfall, effects of overstory on snow interception, and effects of snow throughfall on shrub and forb burial.

DEER HABITAT USE AND DENSITY

We measured relative density of deer in each of 6 habitat types (nonforest, young clearcut, second-growth, low- medium- and high-volume old growth) using a variable area transect (VAT; Parker 1979). Starting at the edge of each 0.2 ha plot, we measured the distance to the center of the first, second, and third pellet groups encountered within 0.5 m of the transect line, up to a maximum distance of 50 m. Pellet-group density was calculated following Parker (1979).

Because pellet-group persistence rates vary with season and habitat type, correct interpretation of pellet-group densities requires knowledge of persistence times. In May 1997 we established one pellet persistence plot (Fisch 1978; Kirchhoff 1990) in each habitat type. Each plot contained 5 pellet-groups (10 pellets per group) arranged 2 m apart in an X pattern. These will be monitored monthly throughout the year until they are no longer visible. New plots will be established at quarterly intervals throughout the year to determine how persistence times vary seasonally.

During the winter months, we also used deer track counts to assess winter habitat use. We established an approximately 16 km-long transect along a roadway. The transect traversed habitats between 15 and 305 m in elevation. After each fresh snowfall, this transect was driven slowly, and all instances in which deer tracks crossed the centerline of the road were recorded as a track set. We calculated the linear length of road passing through each habitat type and converted this to a proportion of the total transect. Tracks were counted only in areas where the habitat type was the same on both sides of the road. We also calculated the proportion of total transect track sets within each habitat type. The mean observed proportions of track sets per habitat type were then compared using a chi-square statistic. These measures will be repeated each winter.

DEER HOME RANGE COMPOSITION, SURVIVORSHIP, AND REPRODUCTION

Habitat use at the individual level will be assessed via radio telemetry. We will relocate animals weekly by triangulating on their telemetry collar frequencies. This will allow us to determine both first order (home range choice) and second order (habitat within the home range) habitat selection using compositional analysis (Aebischer et al.1993).

All radios were equipped with mortality sensors (Telonics, Mesa, Az.). We will monitor the radio signals of deer daily, allowing us to identify the time of mortality within one day. We will visually locate all carcasses, determine the cause of mortality, and identify the habitat type in which the mortality occurred. We will use the mortality data in a staggered entry Kaplan-Meier series approximation (Pollock et al. 1989) to compute daily, interval, and annual survival rates.

To estimate deer reproductive success we will attempt to capture the fawns of radiocollared female deer. Captured fawns will be fitted with breakaway radio telemetry collars (Telonics, Mesa, Az). Daily monitoring will allow us to determine the mortality rates of these fawns and probable cause of death. We will follow fawns until approximately December (collars break away after about 6 months). Deer will be considered recruited if they are alive at 6 months of age.

DEER CAPTURE

To capture deer for the deployment of radio telemetry collars, we tried several techniques (Table 1). Between October 1996 and January 1997, we placed cable neck snares (light wolf; Alaska Range Supply, Wasilla, Ak.) fitted with deer stops along heavily used deer trails. We made a daily check of all snares in October and November 1996. In December 1996 and January 1997, we padded the snares and placed trapsite telemetry transmitters on all snares and monitored the signals at 4-hour intervals. We immobilized deer captured in neck snares, using a mixture of ketamine hydrochloride and xylazine hydrochloride delivered by a jab pole per ADF&G protocol (Taylor 1996).

In November 1996 we also began attempts to chemically immobilize deer using a dart gun. Due to the heavy cover, we selected 6cc darts composed of a 3cc drug chamber and a 3cc chamber holding a small telemetry transmitter (Pneu-Dart, Inc., Williamsport, Pa.). This dart package allowed us to follow darted deer moving through heavy undergrowth, even in darkness. We used a mixture of ketamine hydrochloride and xylazine hydrochloride (3mg/lb:0.3mg/lb) in the darts. These darting efforts were made from a blind using various commercial deer calls during daylight hours. In February 1997 we began use of nighttime spotlighting to increase our deer encounter rate for darting attempts (e.g., Progulske and Duerre 1964, Harestad and Jones 1981, McCullough 1982).

We also deployed two 5-by-10-foot drop net deer traps designed by an ADF&G employee (L. Beier, Douglas, Ak.) in February 1997. We deployed these along heavily used deer trails as we did with snares. The traps were modified, and their number increased to 5 in April 1997 and 10 in June 1997. Chemical immobilization was not required to handle and process deer caught in drop nets.

In May 1997 we tested smaller (3cc) darts without transmitters (Pneu-dart, Williamsport, Pa.) in combination with a more concentrated mixture of ketamine and xylazine (6mg/lb:1.2mg/lb). This concentration, known as Capture-all 5, was designed to decrease drug induction time.

Fawn capture attempts focused on intensive searches for the fawns of known pregnant radio-collared females ($N = 2$) and opportunistic sightings of females with fawns. In each case, if a fawn was located, we restrained it by hand while deploying the radio collar and making physical measurements.

PREDATION RISK

To monitor predation risk across the island, we attempted to capture wolves in the fall and winter. We used No. 14 Newhouse traps in scent post sets along roadways and trails, as well as blind sets along some trails. The wolf traps were modified before deployment by placing cable clamps on the jaws (Person and Ingle, 1995) to prevent the trap teeth from overlapping fully. We attached the traps securely to small log drags, allowing animals to get off the road system and into thick cover before being stopped. These wolf traps were deployed for a total of 1294 trap days in September–November 1996 and January–March 1997.

We placed radio telemetry collars on captured wolves and obtained weekly relocations from the ground. Due to the wide-ranging movements of wolves, we also obtained one aerial relocation per month. When wolves were not in areas accessible from the road system, we obtained only the monthly aerial relocations. Telemetry data were augmented by mapping all scat and track locations encountered on the road system. Since we traversed all major roadways on a biweekly rotation, all areas of the road system were equally represented in this sample.

We will use wolf relocations to identify the home range of the island's wolves. Within this home range, we will identify seasonal core areas and travel routes. Predation risk of habitats will be assessed as a function of distance from the nearest core area and proximity to travel routes. Predation risk will be assessed for general habitat types by measuring the predation mortality rate in each of the habitat types and by measuring escape cover in those habitat types.

RESULTS

FACILITIES

A major portion of the effort expended on the project in 1996 was devoted to construction of a research support cabin. We constructed a wood frame 16-by-16-foot, 1.5-story cabin on state land, approximately 1.5 km SW of the Camp Island dock. The cabin is fully insulated and wired for 110 volts (inverter and battery bank). Water is plumbed into the cabin from a cistern (roof catchment) and filtered through Katadyn ceramic filters. The cabin is equipped with a cellular telephone, wood stove, propane cook top, and bunks for 3 people. Two wall tents were also erected for summer field crew quarters and equipment storage. Transportation on and around the island is provided by an Isuzu Trooper, 2 all-terrain vehicles, and 2 outboard powered skiffs. Fuel is transported by landing craft in 55 gallon drums and stored on-site. We also built a 1000 m^2 enclosure and covered stalls adjacent to the cabin to house 2 tame deer for the project.

HABITAT CHARACTERIZATION

During July and August 1996 we completed 120 vegetation plots. We will add to this sample as available time and labor permit, with a goal of sampling >300 plots. Cluster analysis using complete linkage produced 8 habitat clusters based on vegetative parameters (Table 2). These clusters represent groups of timber stand age classes similar to those that are functionally significant to foraging deer. The dendrograms produced by unweighted pair-group average and Ward's linkage methods were similar in overall structure, but each produced 6 clusters by combining some clusters identified by the complete linkage method.

The linkage distance at which clusters were identified was set at 2.4 based on the plot of linkage distance as a function of amalgamation step. We chose this distance based on the observation of a significant plateau in the plot at linkage distances of 2.2–2.4. Such plateaus indicate that little further information is added by considering larger clusters (Statsoft 1995). This information was combined with an examination of the variable means by age class in determining a reasonable clustering scheme.

We chose the complete linkage clustering method over both the unweighted pair-group average and Ward's methods because it kept separate 2 additional clusters that merged with others quite late in all 3 amalgamation schedules. Each of the clustering methods relies on a slightly different evaluation of Euclidean distances among cases (Johnson & Wichern 1992). Despite the differences among clustering methods, it is significant that all 3 produced the same general dendrogram, with differences occurring primarily not in cluster membership but only in the relative distance at which clusters were formed. This stability of clustering is a good indication the clusters represent real groupings for the measured variables. Also, if we look at larger linkage distances on any of the dendrograms, we can see distinct clustering of shrub/sapling and poletimber types, low-volume forest/nonforest, young sawtimber, and high-volume old-growth habitat types. This argues against the traditional scheme of lumping low- and high-volume old growth as "productive forestland." Although young sawtimber was clustered with high-volume old growth on all 3 dendrograms, this was based primarily on similarities in basal area and tree height. Although these habitat types have certain overstory characteristics in common, they are still quite distinct in terms of understory composition and biomass. Finally, this clustering scheme should be viewed as preliminary, since many of the measured stand ages are represented by only a small number of plots. Further sampling should provide better estimates of within group variance and may alter the current clusters.

Deer Habitat Use

Due to the provisional nature of the habitat clusters listed previously, we computed mean pellet densities for each of 6 habitat types identified *a priori* on the basis of U.S. Forest Service timber type designations. Because sample sizes for some of the habitat types were very small, we did not perform statistical tests on these data. However, from qualitative inspection of the data, pellet densities are highest in high-volume old growth, noncommercial forest, and shrub-sapling habitat types; intermediate in nonforest and poletimber types; and lowest in young sawtimber types. It is important to note the density of 83 pellet groups/ha calculated for young sawtimber habitat is derived from application of a 50-m maximum distance to the VATs. In fact, no pellet-groups were found in this habitat type.

Winter track counts yielded relative use estimates for the same 6 habitat categories as above (Table 3). We counted tracks on January 22 and 28, and on March 2 , 7, and 17, 1997. These were the only days on which snow cover was sufficient to allow counts in all habitat types along the transect. We found a significant difference (chi square = 28.53, df = 4, $P < 0.001$) between observed and expected distribution of tracks, with particularly high use in high-volume old growth.

Deer Capture, Reproduction, Survivorship, and Home Range Composition

We evaluated several methods of capturing deer for our sample throughout Fall 1996 and Winter 1997. A summary of capture results shows the methods tried to date are quite variable in terms of capture success, mortality rate, and labor (Table 5). As of 12 June, 1997, we captured 23 deer. Of these, 15 were successfully collared and released and 8 died during or within 1 week of capture (i.e., 35% capture-related mortality). The current sample consists of 3 adult males, 5 yearling males, 3 adult females, and 3 yearling females. One yearling female shed her collar and was censored from the data set. No radiocollared deer have died of natural causes, including starvation or predation.

Deer captured in stopped neck snares (N = 7) suffered a high mortality rate (71%). Causes of deaths for deer captured in snares were as follows:
1 snare stop failure (strangulation), 1 trapsite transmitter installation error (exposure), 1 drug overdose (on a buck in rut), and 2 broken necks. We discontinued use of snares due to the high mortality rate.

Both transmitter-equipped darts (Kilpatrick et al. 1996) and darts without transmitters were used to capture deer. Of 2 deer struck with transmitter-equipped darts, both died due to dart wounds. We discontinued use of telemetry darts because of the large mass of the dart, inconsistent flight trajectories, and low chance of hitting the deer with proper force and placement. Of 10 non-transmitter–equipped darts fired, 2 struck deer; both deer were captured and none died. Despite the higher time per capture for this method, we could be more selective of deer being added to the sample. Induction times using 200 mg ketamine/ml averaged 4 minutes for the 2 deer captured. We will continue evaluating this technique in the coming year.

Drop net traps produced the greatest number of captures (12) accompanied by a low mortality rate (8%). They also required the lowest labor expenditure of capture method, with each trap requiring 4 hours to set up, 1 hour per week maintenance, and approximately 1 hour per week total telemetry monitoring time.

Three pregnant female deer were captured before June 1, 1997. In late May and early June, we attempted to locate the fawns of these animals based on intensive telemetry relocation efforts. These attempts were unsuccessful. Additional attempts to locate fawns along the road system have also failed. Thus far, only 1 fawn has been seen on the road system, and it was old enough to flee rapidly with its mother when approached.

PREDATION RISK

We captured 1 wolf in October 1996 and followed its movements via weekly telemetry relocations until December 1996. In December the wolf dispersed from the island, and we were unable to find it on nearby islands, including the closest portions of Prince of Wales Island. In May 1997 workers on another ADF&G project detected the wolf's telemetry signal in the Salmon Bay Lake area of Prince of Wales Island (C. Flatten, ADF&G, pers. commun.). This area is approximately 60 km by air from Heceta Island and represents a minimum travel distance of 100 km, involving 1 or 2 ocean swims.

Our traps contacted 2 other wolves during 1996 but failed to capture them due to the half inch jaw offset. A local trapper removed 9 wolves from the island in 1995, and we believe the 3 wolves we contacted in 1996 were all that remained on the island. Extensive tracking during the winter supported this conclusion.

Without a collared wolf on the island, we relied on the biweekly scat location surveys to map wolf locations along the road system. Although this method primarily provides information on road use, it is a gauge of predation risk for adjacent habitats and has provided relocations without error. We located and mapped a total of 53 scats between September 1996 and June 1997. Two patterns appeared in the resulting map: wolves on the island used small areas for 10–14 days at a time, then moved to new areas; wolf activity was concentrated west of Warm Chuck Inlet (87% of scats) with little activity on the eastern portion of the island.

DISCUSSION

Experience with 6cc telemetry darts has provided useful insight into dart performance. Using a cartridge-actuated dart gun, it is possible to project the 6cc transmitter-equipped darts accurately. However, in thin-skinned animals such as deer, the power required to shoot accurately results in excessive tissue damage. One of our capture mortalities occurred in a deer struck in the upper buttock from a distance of 20 m. The dart penetrated 7–10 cm and ruptured the animal's bowel. In contrast, a similar hit on another animal using a 3cc dart produced only a small puncture wound with no apparent tissue damage (this deer is still in our sample). We found use of a low enough charge to prevent over penetration by the 6cc dart reduced accuracy to the point of futility. A compounding factor was the high variability in the strength of individual cartridge charges.

Although drop nets were our most productive method of capture during the past year, several caveats apply to their use. Because the capture team is not present at the moment of capture, drop nets do not provide selectivity in capture. This is important in projects that require only 1 age or sex class of animal. Also, animals are fully conscious during handling, which increases the risk of capture myopathy. For this reason, handling of animals captured in drop nets must be minimized, which precludes invasive procedures such as tooth-based age estimation, ear tag application, and blood sampling. Finally, use of drop nets during the spring and early summer may potentially cause damage to growing antlers on male deer.

The capture method with the most promise for future use in Southeast Alaska is probably the use of small, nontelemetry darts in combination with more potent immobilizing agents. In this respect, lyophilized and reconstituted Capture-all 5 at the highest possible concentration seems both safe for human handlers and effective for capturing deer.

Our future efforts on the project will focus upon completion of capture efforts using both drop nets and darting, with possible additional use of a net gun. Vegetation studies will be completed during summer 1997, and a more exhaustive habitat description combined with hypothesis testing will be undertaken. Finalization of the functional groupings of habitats will allow us to modify the deer habitat use indices to reflect these groupings.

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Table 1. Comparison of deer capture methods on Heceta Island, Alaska, 1996–97.

Method	Trap Days/Man Hrs	Contacts/Darts fired	Total Captures	Mortalities
Neck Snare	974d	33	7	5
Telemetry Dart	160h	28	2	2
Regular Dart	50h	10	2	0
Drop Net	413d	30	12	1

Table 2 Habitat Types identified by a complete cluster analysis on 120 random vegetation plots, Heceta Island, 1996–97.

Habitat Types:

- High volume old growth (VC 5-7);
- Low volume old growth (VC 4 and NCF);
- Young Sawtimber (stand ages 75 & 46);
- Productive sapling/shrub (ages 31, 29, & 26);
- Productive clearcut (ages 16 & 11);
- Unproductive sapling/shrub (ages 44 & 15);
- Unproductive clearcut (ages 20, 13,10), and
- Nonforest (NF);

Table 3 Deer track and mean pellet-group density by USFS habitat designation, Heceta Island, 1996–97.

	Pellet-groups		Track Counts	
Habitat Type	Mean PGs/ha	N Plots	% transect length	% of total tracks
Nonforest	244	5	2.4	0.8
Unproductive Forest	429	10	16.8	9.8
Young Clearcut	422	30	21	23.8
Shrub/sapling	216	30	37.2	24
Young Sawtimber	83	6	0	0
HV old-growth	524	37	22.2	43

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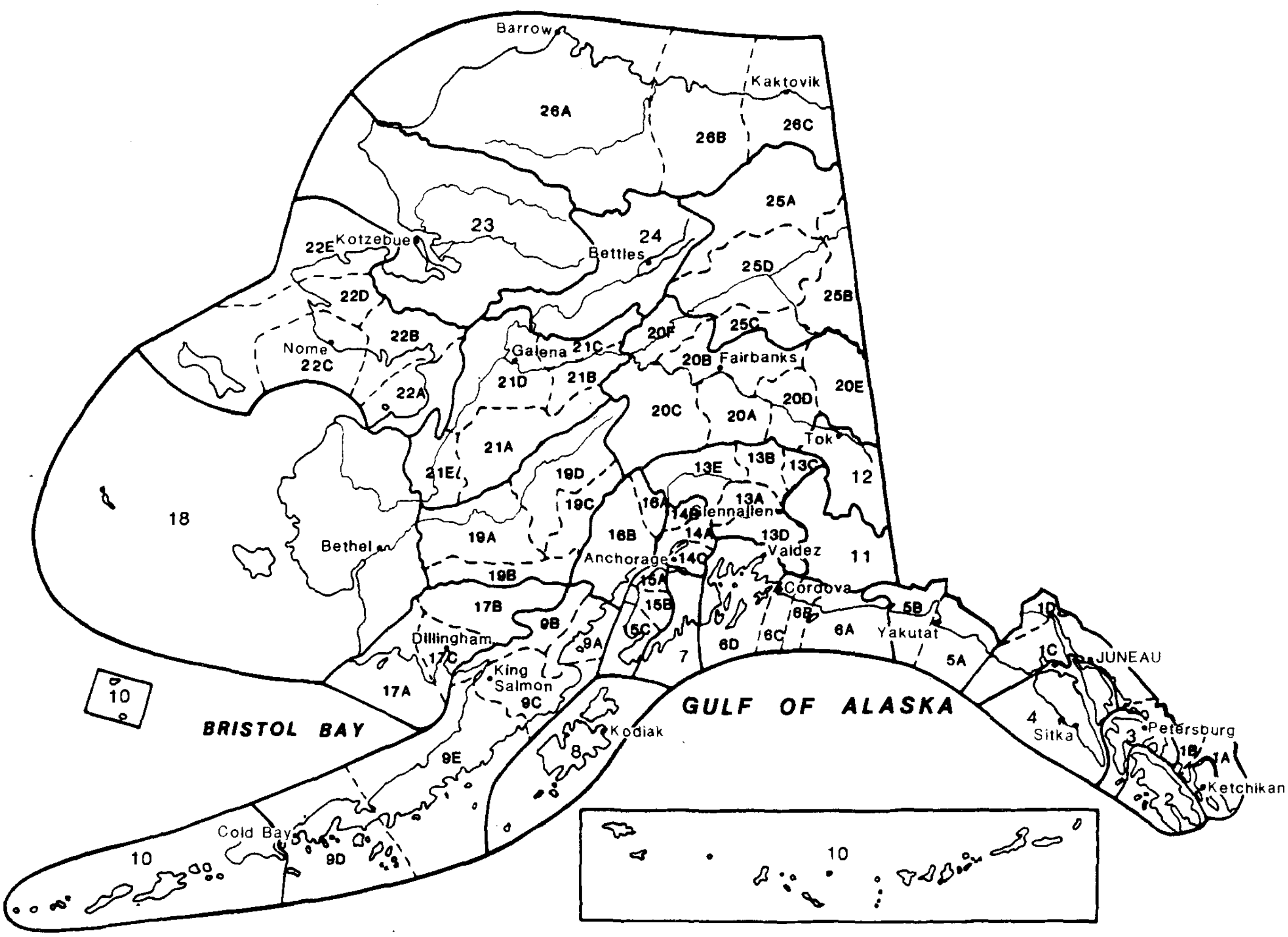
Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

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