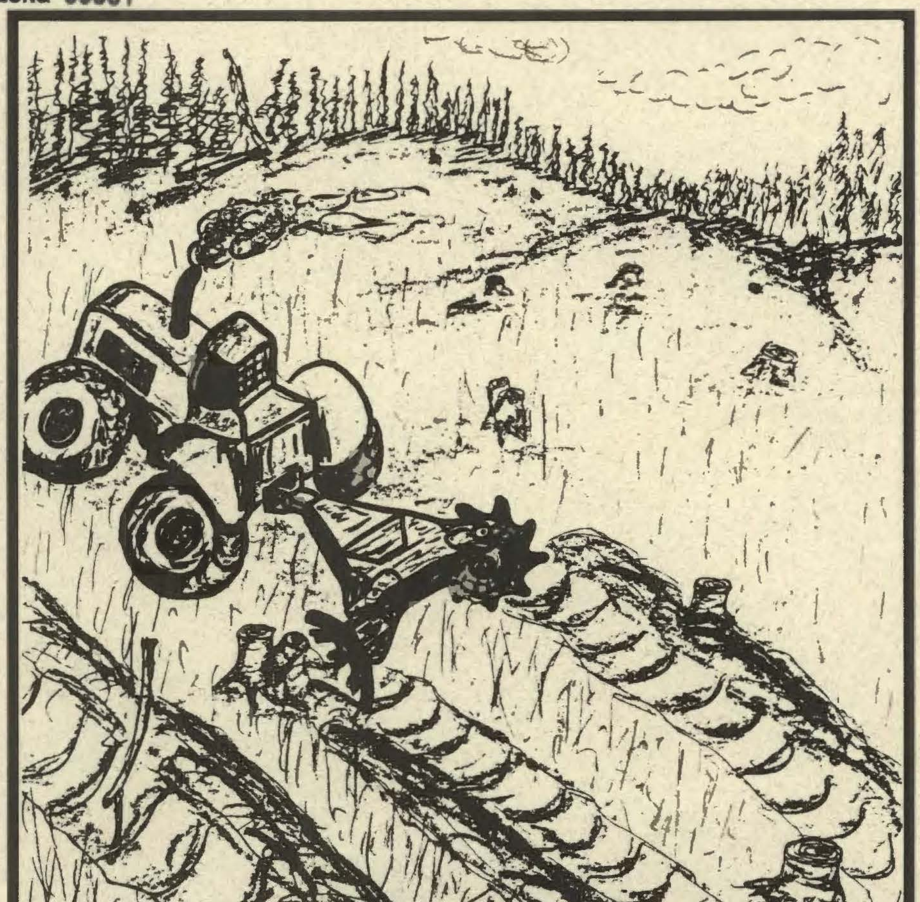
Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Wildlife Habitat Enhancement in the Spruce-Hardwood Forest of the Matanuska and Susitna Valleys

by

William B. Collins



Project W-24-1
Study No. 1.44
December 1993

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STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
Carl L. Rosier, Commissioner

DIVISION OF WILDLIFE CONSERVATION
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PROGRESS REPORT (RESEARCH)

State: Alaska

Project No.: W-24-1 Project Title: Wildlife Research and Management

Study No.: 1.44 Study Title: Wildlife Habitat Enhancement in the Spruce-Hardwood Forest of the Matanuska and Susitna River Valleys

Period Covered: 1 July 1992-30 June 1993

SUMMARY

Several jobs were active during this report period. We are testing techniques for enhancing wildlife habitat through timber harvest activities and various direct methods.

A disk trencher purchased jointly by the Alaska Department of Fish and Game (ADF&G) and Division of Forestry (DOF) was tested under various conditions in southcentral Alaska. It has become the preferred tool for scarification of most sites requiring post-logging site preparation. Most of the backlog of untreated clearcuts on state land in the Matanuska and Susitna valleys have now been scarified with it. Its use is now being extended to the Kenai Peninsula.

Tree planters have concluded they prefer planting on sites which have been disk trenched. This preference increases the probability that even those sites which are scheduled only for spruce planting will be scarified in a way which will promote browse production.

We developed a prescription for a controlled burn in cooperation with the Division of Forestry for approximately 900 acres of upland black spruce in an important moose wintering area near Willow, Alaska. Dozers were used to create fuel breaks, and a gridwork of 200 stations was established to monitor fire intensity relative to fuel loads, fire characteristics and eventual vegetation responses.

Mechanically cleared upland black spruce stands had 2.1 million birch seedlings per hectare one year after clearing. Microsites where A-horizon was exposed were most productive and had the best overwinter survival of seedlings. Dense growth of horsetail (*Equisetum sylvaticum*) appeared to serve as a nurse crop for new birch seedlings.

High intensity, short duration grazing by livestock was begun to determine its value for controlling bluejoint grass competition and for stimulating natural regeneration of birch and willows. Bluejoint carbohydrate reserves, important to spring greenup and indicated by etiolated growth, were reduced 63% by one season of intense grazing. Reduction in litter and exposure of mineral soil by hoof action has produced numerous microsites for hardwood seed germination. However, potential competition from bluejoint has not yet been adequately reduced for new hardwood seedlings to survive. Water quality downstream from grazing paddocks remained unaffected.

Studies of browsing influences on reforestation, browse stand maintenance and control of right-of-way browse by steam were continued.

Key words: habitat, forest succession, logging, grazing, boreal forest, browse, *Alces alces*.

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BACKGROUND

Most wildlife in the boreal forest benefit from hardwood species and associated early successional vegetation. Since boreal forest succession leads toward domination by spruce, presence of hardwood species largely depends upon retrogressive disturbances.

Historically, the two principal forces responsible for retrogression of forests and maintenance of habitat diversity have been fire and erosion by rivers and streams (Rowe 1961). Both of these remove overstories and expose mineral soil, creating ideal conditions for hardwood seedling establishment (Viereck and Schandelmeier 1980, Zasada et. al 1983, Perala 1987).

One significant problem faced by managers of moose populations is maintenance of adequate habitat (Franzmann 1978). Traditional winter range is the most likely portion of moose range to be encroached upon by man.

Of much greater significance than loss of habitat to development are the far-reaching effects of land management policies which unwittingly cause extensive, yet insidious, disruptions in ecosystem ability to maintain the diversity and productivity of habitats and their wildlife. Fire suppression to protect scattered, remote inholdings established by State land disposals is a case in point.

Loss of early successional habitat is aggravated by the fact that clearing and road building often stimulate development of early successional species in and near areas of greatest human presence. Such situations are highly attractive to moose experiencing browse shortages where forest succession has progressed beyond browse-productive early stages. This results in unnecessarily high numbers of moose/vehicle collisions, property damage, and dangerous moose/human confrontations.

Principal hardwood species--birch, balsam poplar and most willows--require full sunlight and exposure to mineral soil to regenerate from seed (Rowe 1961, Argus 1973, Viereck and Schandelmeier 1980, Perala 1987). Density of root and/or stump sprouts by these species is often marginal or insufficient for hardwood forest regeneration. By contrast, aspen regenerates well by root sprouting, if apical dominance for the clone is eliminated by total removal of standing trees.

Complete removal of forest canopy by logging provides the same full-light conditions and elimination of apical dominance as does overstory removal by fire. However, with the exception of aspen, it is critical that soils be scarified following logging, so that hardwood seeds will be exposed to mineral soil. It also appears that timing of scarification relative to seed availabilities of various species has considerable effect on which species dominate early succession.

Competition from bluejoint grass represents a major problem for hardwood reestablishment in cutover areas in southcentral Alaska. Bluejoint readily monopolizes cutover areas of the boreal forest (Mitchell and Evans 1966, Collins 1992a) and greatly limits opportunities for successful hardwood germination. Bluejoint not only competes for soil nutrients, but reduces their availability by insulating soil and limiting soil microbial activity. It also competes for light and is primarily responsible for snow press damage or mortality where it lies over the top of new hardwood seedlings (Kabzems 1992).

Although logging may be a useful tool for maintaining diversity and productivity of boreal forest where fire is excluded, little attention has been given to regeneration of hardwood species. Most commercial timber operations have not had any concern for the future of sites harvested. From observation of the few sites where some form of scarification occurred, it is apparent that proper site preparation can make at least a 100-fold difference in density of hardwood establishment. However, incorrect methods of scarification can also devastate a site by disrupting its nutrient, moisture and temperature relationships too severely.

Bluejoint is intolerant of intensive cropping, particularly if grazing begins in early spring and the grass is completely cropped 3 times or more during the growing season (Mitchell 1979, Rieger and Wunderlich 1960). Intensive grazing should open the community to entry by other species, including browse. In fact, overgrazed pastures in the Matanuska and Susitna valleys represent some of the area's best moose winter range. Potential for livestock competition with other foragers in bluejoint-fireweed disclimax communities is extremely limited, since bluejoint is essentially the only livestock forage species present (Mitchell and Evans 1966) and is excessively abundant throughout the region.

During the 1980s, increasing concern about losses of wildlife habitat to human encroachment and by vegetation succession and potential impacts of commercial timber harvests led to the initiation of this project.

This report contains information collected from 1 July 1992 through 30 June 1993. Jobs include (1) mechanical and chemical methods of site preparation for forest regeneration, (2) black spruce type conversion, (3) moose browsing influences on reforestation, (4) livestock grazing to stimulate hardwood establishment, (5) browse stand maintenance, and (6) steam killing of browse along rights-of-way.

OBJECTIVES

Study Objective

1. To test and evaluate techniques that are potentially useful for enhancing or maintaining wildlife habitat in the boreal forest of southcentral Alaska.

Job Objectives

2. To test the effectiveness of different mechanical and chemical means for enhancing the establishment of hardwoods on logged sites.

3. To determine methods of converting upland black spruce forest to productive stands of browse.

4. To assess the impacts of moose browsing on development of hardwood forests.

5. To evaluate livestock grazing as a means of stimulating hardwood regeneration in cutover forest.

6. To determine the effectiveness of hydroaxing and burning to maintain the availability and productivity of browse within hardwood stands.

7. To determine the effectiveness of steam in killing hardwood species along rights-of-way.

METHODS

Mechanical and Chemical Site Preparation (Job 2)

I monitored hardwood seedling density, and herbaceous plant recovery on different hardwood-spruce stands which had been scarified to enhance hardwood regeneration. Summer skidding, flat blading, root raking (clearing blade), disk trenching, and whole-tree clearing were the scarification methods used. A disk trencher is a tool developed in Finland for creating planting sites for conifers. Its use for preparation of planting sites in the boreal forest in Canada became popular in the early 1980s (Coates and Haeussler 1987). Whole-tree clearing involves uprooting the entire tree by a dozer, bunching, and removal of the stump and limbs. The process of whole-tree clearing results in a relatively high degree of scarification, with minimal displacement of nutrient rich soil into piles.

Hardwood seedling densities, bluejoint grass height and productivity were monitored on three clearcuts which had been treated with glyphosate in 1991 and 1992 (Collins 1992b).

Black Spruce Type Conversion (Job 3)

In cooperation with the Division of Forestry, I prepared and obtained approval for a burn prescription for 900 acres of upland black spruce adjacent to prime moose winter range west of Willow, Alaska. Fuel breaks were cleared with dozers to prepare for the burn.

To monitor this burn, I established a grid of 200 sensors to monitor fire intensity relative to fuel accumulations, vegetation and soil moisture and atmospheric conditions. I applied fire sensitive paints (developed for foundry uses) to aluminum tags for recording temperature at 100°C increments 1 m above ground (Cole et al. 1992) and to thermal insulative boards and tiles for measuring heat penetration into ground cover/soil.

I continued monitoring hardwood establishment and herbaceous recovery in upland black spruce stands which were mechanically cleared in 1991.

Browsing Impacts on Forest Development (Job 4)

One moose exclosure (0.2 acre) was constructed in an aspen habitat enhancement in the Matanuska Valley Moose Range (MVMR) to document the effects of what appears to be unusually heavy utilization of aspen by moose. Hardwood densities and current annual growth are being monitored annually in this and other exclosures established in 1991.

Livestock Grazing to Stimulate Browse Establishment (Job 5)

Two grazing paddocks were fenced within wet, clearcut stands of birch-spruce. Both sites are on poorly drained soils overlying glacial till. All reforestation efforts have failed because of extreme competition from bluejoint grass. Efforts included intense scarification with a root rake, followed by burning, followed by planting of 2-foot-tall seedlings of spruce and balsam poplar.

High intensity, short duration grazing by cattle and/or horses is being used to heavily and uniformly utilize bluejoint repeatedly through the growing season. The grazing treatments will be maintained at least 3 years in order to radically deplete grass carbohydrate reserves and competitive vigor. Grazing was begun on one paddock in spring 1992, the other in spring 1993.

Grass productivity and phenology are being documented between each grazing period. Carbohydrate reserves of bluejoint grass are being indexed by measurement of etiolated growth each spring. Forage quality (crude protein, digestibility, and crude fiber) are being determined biweekly through the growing season. Water upstream and downstream of both paddocks is being monitored for total nitrogen and *E. coli.*

I measure hardwood seedling density and development at the end of each grazing season.

Browse Stand Maintenance (Job 6)

Old stands of feltleaf willow (*Salix alexensis*) along the Gulkana River north of Paxson, Alaska were hydroaxed in early spring prior to leafout. Even though this area was heavily used by wintering moose, most willows had grown beyond the reach of browsing moose. Current annual growth will be measured in fall 1993 for this and previously hydroaxed stands. I will measure winter utilization in spring 1994.

Steam Kill of Browse (Job 7)

Mortality of paper birch, balsam poplar, willow, and alder were determined for plots treated with steam in mid July 1991 and again in mid July 1992 (Collins 1992b).

RESULTS AND DISCUSSION

Mechanical Post-logging Site Preparation (Job 2)

Before 1991, forest clearcuts in southcentral Alaska were scarified by flat-blading, root-raking, and skidding, or were not treated at all (Collins 1992b). Results of scarification I completed with a leased disk trencher in 1990 and 1991 convinced DOF to purchase a trencher in partnership with ADF&G. Since then, we have disk trenched most of the remaining untreated forest clearcuts in the Matanuska and Susitna valleys and have begun loaning it to DOF personnel in the Kenai Peninsula for site preparations on their clearcuts.

The disk trencher produces more ideal scarification than other tools because it is easy to control the depth of its penetration and prevent substantial displacement of nutrient-rich O- and A-horizon soils. Potential acreage treated per hour also makes it more cost effective than other means of scarification. Root rakes are still the preferred tool for scarification of steep sites where pulling of a trencher is too difficult or dangerous.

From subsequent observations of sites scarified in 1990 and 1992 we have concluded that single passes of the implement over a site are not sufficient to control bluejoint competition where heavy stands are established. The above-ground parts of robust bluejoint bend and lay completely across single scarification strips and eventually result in snow press and hardwood seedling death. Only those treatments receiving two or three crisscrossing passes have retained open, exposed soil where seedlings can develop.

We have also found that disk trenched sites are preferred by tree planting crews, because such sites provide a well distributed variety of planting microsites. This finding will increase the probability that all clearcut sites will be scarified, regardless of whether the objective is to obtain natural regeneration or to plant spruce. As such, even those sites which are planted to spruce will have received scarification conducive to hardwood establishment. Hardwoods on those sites will have 15 - 20 years of dominance before planted spruce can begin to dominate the site.

I continue to monitor plots treated with glyphosate in 1990 and 1992 for hardwood density and growth rates and bluejoint productivity. At this time, glyphosate appears most beneficial for control of bluejoint competition with planted tree seedlings, if the resultant grass aftermath is left undisturbed to serve as a mulch for retarding germination of bluejoint. Reestablishment of bluejoint and other herbaceous plants is much more rapid on sites where aftermath is burned or scarified following herbicide kill. On highly productive wet sites, dense bluejoint aftermath is still blocking reestablishment of all plant species 3 years after treatment.

While dense accumulation of killed bluejoint is effective in reducing competition with planted trees, it does not support natural regeneration by hardwoods. At this time, I cannot conclude that there is an advantage to scarification being preceded by a single glyphosate kill of bluejoint, since bluejoint recovery from seeds is rapid and profuse where soil has been disturbed. However, there does appear to be a distinct advantage for natural hardwood establishment where secondary treatment by glyphosate is used to kill new bluejoint established from seeds following kill of the original bluejoint stand.

<u>Black Spruce Type Conversion (Job 3)</u>

By late August 1992, I estimated an almost unbelievable 2.12 million birch seedlings per hectare from plot samples of black spruce stands which were cleared with dozers the previous year. Most seedlings were of the year, while less than 1% were seedlings from the year of clearing (1991). Mean height of the latter had already reached 20 cm.

Seedling density ($11370/m^2$) was significantly greater ($P < 0.01$) on microsites of exposed A-horizon than on O-horizon ($3030/m^2$) or B-horizon ($2870/m^2$). Seedling establishment on O-horizon sites was primarily limited to sphagnum which had been sheared to a fraction of its depth without disrupting the mat's contact with mineral soil; these conditions were found where moss was frozen at the time of clearing. Moss mats which had broken free from the soil were too prone to drying to allow seedling establishment.

By late June 1993 seedlings growing on O-horizon had experienced 39% mortality, versus 6.4% and 13.6% mortality among A-horizon and B-horizon seedlings, respectively. Most mortality appeared to be the result of unusually dry weather in spring 1993 through mid June 1993. All dead seedlings observed in late June 1993 retained dead leaves formed in the spring of the year. Most dead seedlings were located in drier microsites where seedling density was lowest. Nevertheless, intraspecific and interspecific competition should increase later in the 1993 growing season as individual seedlings begin to compete for space and nutrients.

Birch seedlings growing within the protection of horsetail (*E. sylvaticum*) had the lowest mortality, which reduced my concern that horsetail may prevent hardwood seedling establishment. Even though horsetail cover may be as high as 100%, winter die-back is light and friable enough that it does not contribute to snow press damage as does bluejoint.

The 900 acre stand of black spruce originally prepared for burning in 1992 has not yet been burned. The primary obstacle to its being burned is the lack of available DOF fire personnel and equipment during weather periods in which the prescription window can be met. Typically, fire personnel and equipment are most in demand when conditions are best for achieving the biological goals of the prescribed burn. Burning when the probability of wildfires is low (and availability of personnel and equipment is high) essentially guarantees a fire of low intensity which does little more than recycle nutrients to existing ground covers such as bluejoint grass.

Browsing Impacts on Forest Development (Job 4)

Exclosures have been built in each of the principle forest types being logged or cleared for wood and/or wildlife habitat enhancement in the Matanuska and Susitna valleys. The primary purpose of the exclosures is to document effects of moose browsing on reforestation. It appears that small isolated stands of browse, as are typically produced by current logging practices, are so over-utilized by moose that forest development is severely impaired.

One additional exclosure was built this year to document changes occurring in aspen stands cleared with dozers in late winter 1991 for wildlife habitat enhancement. Some local people objected to these clearings, arguing that they would be overtaken by alder. Their arguments may be partially correct, not because clearing by dozers is detrimental to aspen stand rejuvenation, but because relatively small and temporary homestead clearings of aspen in the area have reverted to alder. Not knowing the complete history of the homestead clearings prevents clear appraisal of present vegetation, however, since maintenance of the clearings over 3 or more seasons would have greatly depleted aspen reserves for resprouting.

Even though aspen ranks below willow and birch in terms of moose preference, moose are browsing 100% of aspen stems above 50 - 70 cm height in the wildlife clearings we developed. Moose strip leaves throughout the summer and browse stems in winter, which rapidly depletes aspen vigor and resprouting potential. Meanwhile alders are becoming established and will soon dominate overbrowsed, stunted aspen. This response is one more indication that habitat enhancements should be fairly extensive in areas of moose concentration if they are to avoid being excessively browsed by moose.

Livestock Grazing to Stimulate Hardwood Establishment (Job 5)

Beginning in spring 1992, cattle were grazed in one experimental paddock for short durations (8 days or less) to utilize 90% of bluejoint regrowth occurring during that grazing period. Three periods of grazing were established, the first occurring within the first week of greenup in spring, the second in early July, and the last in late August. The same grazing schedule was initiated in a second paddock beginning in spring 1993, using horses in place of cattle. The entire sequence will be repeated for three or more years in each paddock.

Cattle weights did not vary significantly from beginning to end of any grazing period. Grazing intake appeared to rapidly decline during the last two days of each period as excessive utilization was obtained, which cancelled gains made early in the grazing period.

Cattle consumed much of the previous year's grass litter, and their hoof action accelerated breakdown of remaining litter, resulting in approximately 15% of the site being adequately prepared for hardwood seedling establishment. New birch and spruce seedlings were observed in the first paddock in early September 1992. However, potential competition from bluejoint remains too great for those seedlings to survive.

Etiolated bluejoint growth inside paddock 1 was 37% of that outside the paddock. No significant reduction in etiolated horsetail production occurred, and sample size was not adequate to test for differences in fireweed production. Grass greenup inside the paddock preceded that outside by 8 - 10 days, with no evidence of grass mortality. Early greenup inside the paddock was a result of earlier soil warming enabled by litter reduction.

No increase in total nitrogen has occurred in water downflow from the paddock, and fecal coliform counts have not increased below the paddock.

Steam Kill of Browse (Job 7)

A second defoliation by steam in July 1992 resulted in complete kill of birch and alder which were first steam treated in 1991 (Collins 1992b). Approximately 15% of Bebb willow's basal resprouted following a second treatment.

All balsam poplar basal resprouted in 1993, including "individuals" which appeared completely dead in 1992. I have since determined that basal resprouts from "dead" balsam poplar arose from their roots which were also tied to mature trees living just outside of the right-of-way; what appeared to be individual balsam poplar were actually resprouts from extensive root systems of untreated individuals.

The resprouting phenomena illustrates the difficulty of controlling root sprouters such as balsam poplar and aspen which may retain untreated above-ground portions outside the area of treatment. The same species arising from seed would be expected to respond similarly to the Bebb willow in this treatment, since they are a part of the same taxonomic family and are similar in growth characteristics.

Defoliation by steam is at least as effective as hydroaxing in control of hardwoods.

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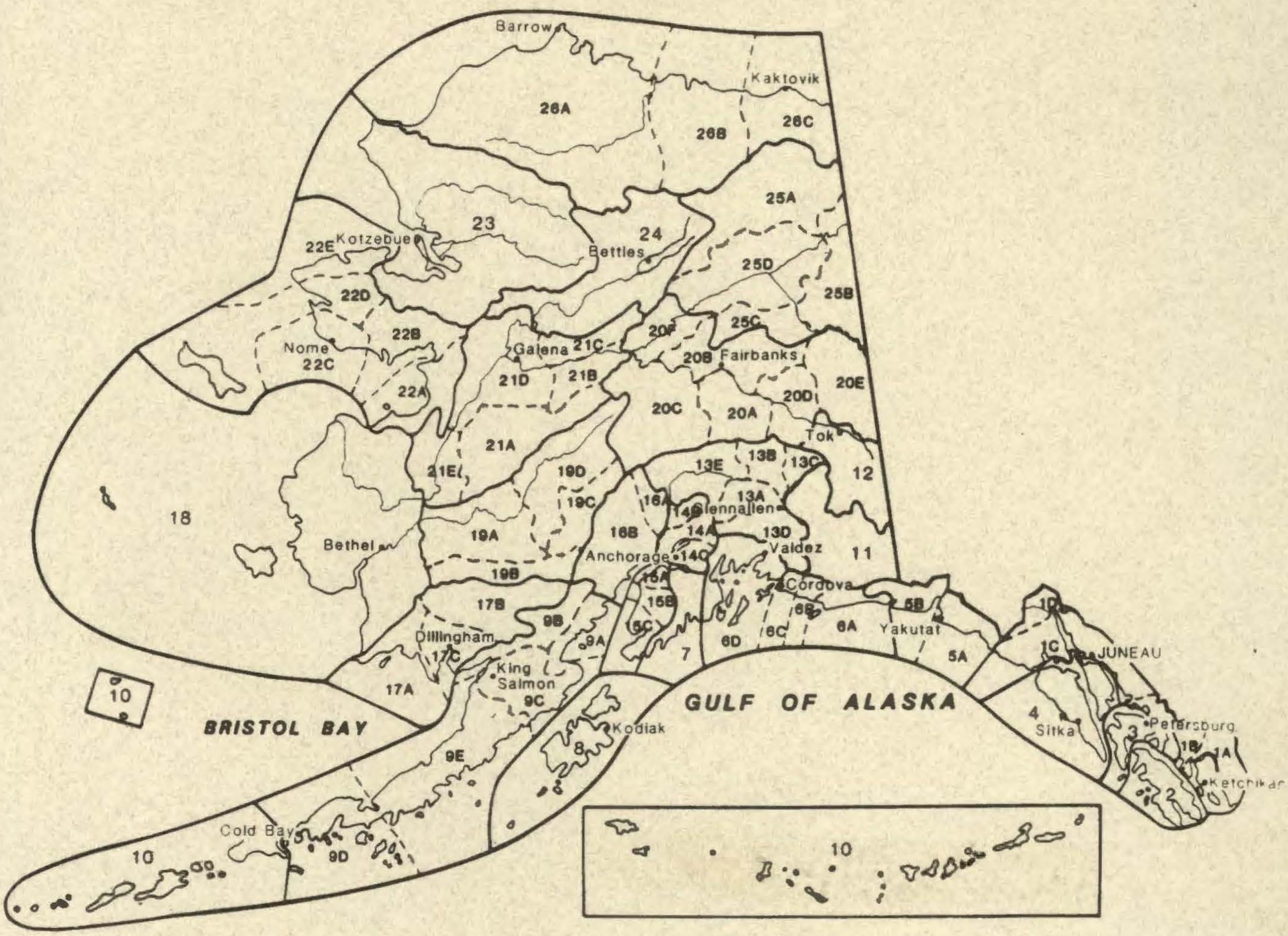

Federal Aid in Wildlife Restoration

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 then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.