

Northwest Science, 1989, Volume 63

Allen, B. H. and J. W. Bartolome (1989). "Cattle Grazing Effects on Understory Cover and Tree Growth in Mixed Conifer Clearcuts." Northwest Science.

A long-term study of cattle grazing effects on shrub and herbaceous cover and tree growth in mixed conifer clearcuts began at Blodgett Forest Research Station on the west slope of the Sierra Nevada (California, USA) in 1977. Until that time, no studies had quantified the relationships between cattle grazing and reduction in non-tree vegetation, and grazing damage to tree regeneration. Yet, with the ban on use of herbicides in Federal forest management, alternative tools for reducing unwanted vegetation were needed. Cattle grazing reduced shrub and herbaceous canopy cover to 8 percent six years after harvesting, and 31 percent eight years after harvesting on two mixed conifer clearcuts. These cover levels were within timber management objectives for tree growth. No significant trampling damage occurred and browsing damage to white and Douglas-fir seedlings was primarily caused by deer. Tree seedlings showed no significant differences in height or basal diameter growth under any treatment. Thus, cattle grazing appears to be a viable tool for meeting brush/grass objectives in forest plantations.

Atkinson, D. B. (1989). "Seasonal Distribution of Sharp-Beaked Redfish *Sebastes*-Spp in Northeastern Grand Bank Atlantic Ocean." Journal of Northwest Atlantic Fishery Science.

Sharp-beaked redfish (*Sebastes* spp.) are distributed widely in northeastern Grand Bank, NAFO Div. 3L, during all of the year. There appears to be a partial separation between northern and southern distribution in the vicinity of 47.degree.15N' for all but the third quarter of the year. They move westward along and up the continental slope between the second and third quarters then back easterly during the fourth and first. There may also be some movement between northern part of the Division and more northern waters (Div. 3K) during the year. The redfish are distributed deepest during the second quarter, then they move into shallower waters in the third quarter before beginning to move deeper again in the fourth and first quarters. Females predominate at depths of 400-449 m during the first quarter and 250-349 m during the third. There is very little geographic separation of the sexes in the second and fourth quarters. The largest fish are generally found in intermediate depths, associated with bottom temperatures of about 2.0.degree. to 4.9.degree.C.

Barnhurst, D. and F. G. Lindzey (1989). "Detecting Female Mountain Lions with Kittens." Northwest Science.

Mountain lion (*Felis concolor*) hunting programs typically include prohibitions against killing females with kittens. It may be difficult, however, for hunters to differentiate females with kittens from other mountain lions because young are often not with their mothers. We investigated the association between females mountain lions and their kittens in southern Utah, [USA] using radiotelemetry locations and examinations of tracks of females known to have kittens. Females were with their kittens on 67 percent of the occasions radio-collared families were located, but kitten tracks were found with their mother's only 25 percent of the time. Because tracks are the sign most available to hunters, 75 percent of females with kittens would not be recognized. The effectiveness of regulations designed to protect female mountain lions with young is limited by the ability of hunters to identify these individuals.

Bull, E. L., M. G. Henjum, et al. (1989). "Reproduction and Mortality of Great Gray Owls in Oregon USA." Northwest Science.

We observed population characteristics of great gray owls (*Strix nebulosa*) in northeastern Oregon from 1982 to 1986 for information needed to manage this species. Of 64 nesting attempts, 77 percent of the pairs raised young. Mean brood size was 2.3 (SD = 0.87, range - 1.5). Annual probability of survival of adult nesting females and males was 0.84 (CL = 0.70-1.00) and 0.91 (CL = 0.78-1.00), respectively. Probabilities of young owls surviving their first 12, 18, and 24 months of life were 0.53 (CL = 0.44-0.75), 0.39 (CL = 0.24-0.65), and 0.31 (CL = 0.16-0.57), respectively. This baseline information on reproduction and survival is essential to the management of populations of great gray owls.

Clay, D., W. T. Stobo, et al. (1989). "Growth of Juvenile Pollock *Pollachius-Virens* L. Along the Atlantic Coast of Canada with Inferences of Inshore-Offshore Movements." Journal of Northwest Atlantic Fishery Science.

Data collected from tagging studies along the coast of Nova Scotia and offshore ichthyoplankton surveys were used to investigate growth and inshore-offshore migrations of juvenile pollock. Age zero pollock from 0.3 to 4.2 cm in length were found in the offshore plankton between November and June and small pollock at lengths of 7-11 cm were caught inshore in July. These small pollock appear to have moved inshore after leaving the offshore pelagic community at 3-6 months of age. They remain inshore until they reach approximately 30+ cm during their second year. Tagged inshore pollock were observed to growth 17-18 cm during their first year of life, an annual instantaneous growth rate (G) of 4.1, and 27-30 cm by the end of their second year (G = 1.8). Seasonal variability in growth was also observed in juvenile pollock. Mean absolute growth from May until August was 1.75 cm per month, from August until October 1.50 cm per month, and from November until April about 0.5 cm per month.

Cox, G. W. (1989). "Early Summer Diet and Food Preferences of Northern Pocket Gophers in North Central Oregon USA." Northwest Science.

Studies of food habits and food plant preferences of the northern pocket gopher, *Thomomys talpoides*, were conducted in a Mima-mound habitat at the Lawrence Memorial Grassland Preserve, north-central Oregon, in early June, 1987. Stomach contents of 15 pocket gophers trapped in early June showed a predominance of forb shoots, particularly those of *Lupinus*, although roots dominated in two individuals, and were present in small amounts in most individuals. Preferences were determined by in-tunnel, cafeteria-style tests. Pocket gophers showed strong preferences for several plant species that were limited to the intermound scabland or stone bed habitats. Strong preference was also shown for certain mound species, such as *Lupinus caudatus*. These observations, together with those of other workers, indicate that members of the genus *Thomomys* feed primarily on herbaceous shoots, especially in summer, and that forb shoots are often much more heavily used than the shoots of grasses.

Dellasala, D. A., C. L. Thomas, et al. (1989). "Use of Domestic Sheep Carrion by Bald Eagles Wintering in the Willamette Valley Oregon USA." Northwest Science.

Bald eagles (*Haliaeetus leucocephalus*) wintering in the Willamette Valley, Oregon, are known to feed on live domestic sheep, and have been shot or poisoned while feeding in sheep pastures. Our purpose was to help resolve some of the land-use conflicts surrounding wintering eagles in this area by documenting eagle use of domestic sheep. We conducted weekly (December 1986 through March 1987) counts of foraging eagles at primary foraging locations, made observations of eagle-sheep interactions, and examined eagle castings found at night roosts. Bald eagles fed almost exclusively on sheep carrion and afterbirth that were available throughout the study area but were never observed feeding on live sheep. Eagle numbers peaked at 20 birds with subadults outnumbering adults (68.2% vs. 31.8%) and this peak coincided with the lambing period. Primary feeding locations were pastures bordered by tall (> 20 m) cottonwoods (*Populus trichocarpa*) and most were within 7 km of night roosts. Adult eagles were observed feeding in pastures at greater distances from roads than subadults. Landowners should be encouraged to place sheep carcasses in remote areas away from nearby roads to allow feeding by eagles of all ages and divert eagle use from areas where they may be killed. This would also provide winter food in an area that once supported a much larger and diverse prey base for this threatened species.

Doescher, P. S., S. D. Tesch, et al. (1989). "Water Relations and Growth of Conifer Seedlings during 3 Years of Cattle Grazing on a Southwest Oregon Plantation." Northwest Science **63**(5): 232-240.

Doescher, P. S., S. D. Tesch, et al. (1989). "Water Relations and Growth of Conifer Seedlings During Three Years of Cattle Grazing on a Southwest Oregon USA Plantation." Northwest Science.

Cattle grazing, beginning one year after planting, was found to enhance water relations and growth of conifer seedlings on a young plantation in southwest Oregon. During 1984, because of the rocky nature of soils on the study area, availability of soil moisture to seedlings was assessed using the pressure chamber. Predawn xylem potentials of Douglas-fir (*Pseudotsuga menziesii*)

(Mirb.) Franco) and ponderosa pine (*Pinus ponderosa* Laws.) seedlings were evaluated within three levels of competing vegetation that included ungrazed, grazed, and no competition environments. For ponderosa pine, little difference in predawn xylem potentials during 1984 were detected among the three levels of competition. For Douglas-fir, seedlings on the ungrazed plots exhibited significantly more negative predawn xylem potentials earlier in the growing season in comparison to the grazed and no competition treatments. Comparison of both ponderosa pine and Douglas-fir in 1986 between grazed and ungrazed treatments revealed significantly less negative predawn potentials and significantly greater stomatal conductance on grazed plots early in the growing season. Improved water relations was one factor felt to increase growth and vigor of conifer seedlings on the grazed area. After 3 years, significantly greater seedling volume was found for both ponderosa pine and Douglas-fir on the grazed plots. Controlled cattle grazing improved plant water relations and enhanced the growth performance of young conifer seedlings.

Filip, G. M., L. D. Bryant, et al. (1989). "Mass Movement of River Ice Causes Severe Tree Wounds Along the Grande-Ronde River in Northeastern Oregon." Northwest Science **63**(5): 211-213.

Filip, G. M., L. D. Bryant, et al. (1989). "Mass Movement of River Ice Causes Severe Tree Wounds Along the Grande Ronde River in Northeastern Oregon USA." Northwest Science.

In eastern Oregon and Washington, ice forms in streams and rivers during prolonged periods of freezing temperatures. When rapid thawing occurs, large pieces of ice detach, move down waterways, strike trees, and cause damage. Tree wounds caused by ice movement were categorized on black cottonwood (*Populus trichocarpa* Torr. and Gray), willows (*Salix* spp.), ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.), and Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.)Franco). Tree wound ranged from 63 to 14,066 cm² which resulted in 3 to 100 percent bark removal at about 1.4 m above the ground. Wounded conifers did not have appreciable decay. Ice movement caused either direct mortality of important shrub species, such as mountain alder (*Alnus incana* (L.) Moench), or indirect mortality through wounding and subsequent infection by canker fungi. This indicates that such damage may seriously alter these riparian zones and thus affect the many associated resources.

Fraley, J. J. and B. B. Shepard (1989). "Life History Ecology and Population Status of Migratory Bull Trout *Salvelinus-Confluentus* in the Flathead Lake and River System Montana USA." Northwest Science.

Life history, ecology, and population trends of migratory bull trout (*Salvelinus confluentus*) were investigated in the Flathead Lake and River system of northwest Montana and southeast British Columbia [Canada]. We conducted these studies to obtain information to manage the species in light of threats posed by timber harvest, hydropower development, and a proposed coal mine. We estimated that about half of the adult bull trout in Flathead and Lake embarked on a spawning migration from May through July, swimming 88-250 km to reach tributaries of the North and Middle Forks of the flathead River. Bull trout entered the tributaries when water temperatures dropped below 12.degree.C, and spawned from late August through early October after water temperatures were below 9.degree.C. They spawned in areas of tributaries with low gradient, loosely compacted gravel, groundwater influence, and cover. After spawning, females left the tributaries and returned to the lake sooner than males. Most spawners were six or seven years old and they averaged 628 mm in length. Juveniles were found close to the substrate in streams with summer maximum temperatures less than 15.degree.C. Juveniles migrated out of the tributaries to the river system from June through August, at age I (18%), II (49%), III (32%), and IV (1%). Population status was monitored through redd counts and estimates of juvenile abundance in natal tributaries. The population may be limited by quantity and quality of rearing and spawning habitat, and spawning escapement. Specific requirements for spawning and rearing habitat, and general sensitivity of each life stage, make the bull trout an excellent indicator of environmental disturbance.

Godo, O. R. and A. Engas (1989). "Swept Area Variation with Depth and Its Influence on Abundance Indices of Groundfish from Trawl Surveys." Journal of Northwest Atlantic Fishery Science.

Norwegian stratified-random bottom trawl surveys are carried out under the assumption that a constant area is swept by the trawl during a standard haul to generate abundance indices.

Results from measurements of trawl geometry during a trawl survey in the Svalbard area, showed that there was a considerable depth dependency, and to a lesser extent, area/bottom stratum dependency of wingspread. Assuming that the swept area was linearly related to the wingspread, it was found that the currently applied method relatively underestimates the younger ages of cod (1-3 years) in the Svalbard area. The use of instruments for monitoring trawl geometry during all tows is one way to diminish variability in bottom trawl survey indices.

Hall, J. A. (1989). "Aspects of Forster's Tern *Sterna forsteri* Reproduction on Cobblestone Islands in Southcentral Washington USA." Northwest Science.

Reproductive variables of the Forster's tern (*Sterna forsteri*), a species normally found nesting in marshes, were studied during the 1985 breeding season on cobblestone islands on the Hanford Reach of the Columbia River in southcentral Washington. In a colony of 81 active nests, average clutch size was 2.9 (\pm 0.39; 1 S.D.). Nesting success, based on successful chick hatchings (at least 1 chick per nest), was 71.6 percent and exceeded that reported for marsh studies.

Halse, R. R., B. A. Rottink, et al. (1989). "Studies in *Sidalcea* Taxonomy." Northwest Science.

The objectives of this study were to investigate taxonomic relationships among the four species of *Sidalcea* [*S. cusickii*, *S. campestris*, *S. virgata*, and *S. nelsoniana*] growing in Oregon's Willamette Valley, [USA] and among various populations of *Sidalcea nelsoniana*. These relationships were assessed by examining pollen with the scanning electron microscope, and performing principal component analysis (PCA) on gross morphological features of the plants. Pollen morphology was of limited use in making intra- and inter-specific comparisons. Chromosome number was determined for six populations of *S. nelsoniana*; it was identical for all populations ($n = 10$). PCA was useful in segregating the four *Sidalcea* species. However, a PCA of 73 specimens of *S. nelsoniana* revealed no distinct sub-taxa; this information is useful in making management decisions for this Category 2 candidate species.

Hard, J. S. (1989). "Sequence of Trees Attacked by Spruce Beetles in a Mature Even-Aged Spruce Stand in South-Central Alaska USA." Northwest Science.

Spruce beetles (*Dendroctonus rufipennis*) concentrate early attacks on an initial tree, the "focus" tree, but later attacks occur on adjacent trees, "recipient" trees. The pattern of these initial and following attacks may provide a key for management approaches to deal with spruce beetle outbreaks. Thus, this study was done to determine timing and distribution of spruce beetle attacks among trees in an unmanaged even-aged spruce stand. Repeated observations on 9 plots, each containing 10 formerly uninfested spruce, revealed that the initially attacked trees ("focus" trees) were apparently moisture-stressed due to extensively frozen soils and rapidly warming air temperatures. Continued warm weather caused many more spruce beetles to emerge from hibernation and soils to thaw. Some newly emerged beetles attracted by odors from beetles already established in focus trees attacked the focus trees, but many attacked nearby unstressed trees ("recipient" trees). As a result, all focus trees and many recipient trees within 10 m of focus trees were killed. Furthermore, many recipient trees weakened by unsuccessful attacks were reattacked the following season. Knowledge of spruce beetle behavior that enables them to overwhelm the natural defense of apparently unstressed trees in unmanaged stands should be useful to forest managers. Perhaps opportunities for spruce beetles to concentrate their attacks and kill clusters of trees could be reduced by partial forest harvesting to increase residual tree spacing. This should reduce competition among trees for soil moisture and should minimize stress at the beginning of the annual growth cycle when trees first become exposed to spruce beetle attack.

Hollabaugh, C. L., B. D. Robertson, et al. (1989). "The Petrology and Vapor-Phase Mineralogy of Rhyolite and Tuffs from Garnet Hill, White-Pine County, Nevada." Northwest Science **63**(5): 201-210.

Klinka, K., R. E. Carter, et al. (1989). "Relations between Site Index Salal Plant Communities and Sites in Coastal Douglas-Fir Ecosystems British Columbia Canada." Northwest Science.

Salal is often considered an undesirable forest plant in coastal British Columbia and is thought to have adverse effects on tree growth. To assess the relationship between salal cover the tree

growth in southwestern British Columbia, vegetation data from 101 sample plots in disturbed immature Douglas-fir [*Pseudotsuga mensiesii* (Mirb.) Franco] plantations were analyzed. This analysis indicated that the plots could be placed into one of five vegetation units. To eliminate non-plant influences on Douglas-fir growth, plots with the same climatic, soil moisture, and soil nutrient regimes in two vegetation units where salal was most and least abundant, were selected for detailed analysis. This analysis indicated that there were no significant differences between the two sets of plots in Douglas-fir foliar nutrients despite the fact that one set had high cover and the other low cover of salal. Furthermore, regression analyses indicated a poor relationship between site index and salal cover suggesting that salal cover had no major adverse effect on Douglas-fir height growth. When data from all the study plots were analyzed, it was found that variables representing the soil moisture or nutrient regimes were better predictors of site index than were various vegetation variables, not involving salal cover. Salal cover was a poorer predictor of site index than any of these variables. It is concluded that salal may not necessarily significantly influence tree growth in the ecosystems studied.

Kozel, S. J., W. A. Hubert, et al. (1989). "Habitat Features and Trout Abundance Relative to Gradient in Some Wyoming Streams USA." Northwest Science.

Channel gradient has been shown to have a negative relation to trout standing stocks indicating that separation of stream channels into gradient classes may provide a better understanding of the relationships between habitat and trout abundance. Our major objective was to determine if there are significant differences in habitat features and standing stocks of trout > 100 mm between two classes of channel gradient, low (0.1-1.4% channel slope) and moderate (1.5-4.0%). We also determined statistical relations between habitat features and trout standing stocks in each class of channel for unaltered streams on the Medicine Bow National Forest, Wyoming. Low-gradient reaches were found to have deeper nearshore water depths, more undercut banks, and more trench pools than moderate-gradient reaches, while moderate-gradient reaches had more cobble substrate, dammed pools formed by woody debris, and plunged pools. The mean standing stock was 267 kg/ha in low-gradient reaches and 102 kg/ha in moderate-gradient reaches. Habitat features correlated with trout standing stocks differed between the two gradient classes. Our results demonstrate that separation of stream segments into reaches of similar gradient are important in identifying features of trout habitat that are otherwise obscured by variation over a wider gradient range.

Krohn, W. B. and E. G. Bizeau (1989). "An Estimate of Bias in Tail-Fan Surveys of Rocky Mountain USA Canada Geese." Northwest Science.

Tail fans from Canada geese (*Branta canadensis*) shot by hunters are examined annually to estimate age ratios (immature/adult). Some immatures completely replace immature (notched) tail feathers with adult (unnotched) feathers before the end of hunting season. To analyze the significance of this molt, two fall estimates of the numbers of immatures and adults in the Rocky Mountain Canada goose population (RMP) were used to calculate expected tail-fan age ratios. The accuracy of these ratios was assessed by estimating the percentage of immatures completing the tail molt to adjust the numbers of immatures (birds with at least one notched tail feather) and apparent adults (adults plus immatures with adult-looking tail feathers) available for sampling in tail-fan surveys. Comparison for the estimated observed ratios to a mean age ratio from the survey indicated reasonable results. Expected tail-fan age ratios were from 0.9 to 1.1 versus an observed ratio of 0.2. Tail-fan ratios across North America were examined in relation to latitude of nesting and suggested that nesting phenology, as it influences the time of molt, is a critical factor affecting the degree of bias in Canada goose tail-fan surveys.

Larson, L. L. and M. L. McInnis (1989). "Impact of Grass Seedings on Establishment and Density of Diffuse Knapweed and Yellow Star Thistle." Northwest Science.

Knapweeds (*Centaurea* spp.) are major weed pests of northwestern rangelands, reducing productivity and accelerating erosion. Heavily infested rangelands need to be revegetated with forage species that can compete with knapweed, if they are to be returned to former levels of productivity. We conducted a two-year study to evaluate the survival of diffuse knapweed (*C. diffusa* Lam.) and yellow starthistle (*C. solstitialis* L.) during the establishment period of four

rangeland grass species. 'Covar' sheep fescue (*Festuca ovina* L.) was the slowest grass to become established in the study. The biomass and early growth of 'Covar' controlled knapweed establishment during the second growing season. 'Ephraim' crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.) provided an effective control of knapweed during the first growing season, but did not compete well with knapweed during the second growing season. 'Paiute' orchardgrass (*Dactylis glomerata* L.) and 'Critana' thickspike wheatgrass (*A. dasystachyum* (Hook.) Scribn.) controlled knapweed during both years of the study. The proximity of knapweed seeds to grass plants increased knapweed survival. These results indicate that the rate of reestablishment of knapweed on newly seeded range can be reduced by selecting grass species with competitive biomass and early growth characteristics.

Leininger, W. C., S. H. Sharrow, et al. (1989). "Sheep Production in Coastal Oregon Douglas-Fir Plantations." Northwest Science **63**(5): 195-200.

Leininger, W. C., S. H. Sharrow, et al. (1989). "Sheep Production in Coastal Oregon USA Douglas-Fir Plantations." Northwest Science.

The recent interest in using biological tools in resource management, together with a desire to use energy sources more efficiently, has increased interest in employing sheep grazing as a silvicultural tool to suppress competing vegetation in commercial conifer plantations. Widespread use of sheep as a biological control agent in forests is currently limited by insufficient numbers of sheep available to forest managers. Few data exist concerning livestock performance in Coastal Oregon Douglas-fir plantations. Without such information, livestock producers are reluctant to commit their current flocks to a silvicultural program or to purchase additional sheep in order to take advantage of this new forage source. The purpose of our study was to document sheep weight gains, death losses, and forage quality (crude protein and digestibility) during the spring-summer grazing season. Deata were collected during 1981, 1982, 1984, and 1985 from flocks of 250-900 sheep which grazed coastal Douglas-fir plantations near Alsea, Oregon. Average daily gains of lambs ranged from 95 to 175 g/head/day, while yearling ewes gained 78 g/head/day. Ewes lost an average of 4.5 kg/head in liveweight during the grazing season. Sheep had highest daily gains in spring when forage plants were most nutritious. Livestock death loss, 3 to 5 percent of the flock, was no higher than that reported for flocks grazing in pastures. Our data suggest that incrazed death loss of herded sheep in coastal forests is not much of a problems. A bigger issue is weight gains, which tended to be lower than those achievable on nearby improved pastures.

Loeng, H. (1989). "The Influence of Temperature on Some Fish Population Parameters in the Barents Sea Arctic Ocean." Journal of Northwest Atlantic Fishery Science.

At the beginning of this century it was clear that in the Barents Sea, variations in the physical conditions have a great influence on the biological conditions of fish. The cold period during 1977-82 initiated new investigations on the influence of oceanographic conditions on recruitment, distribution and growth of commercial fish species in the Barents Sea, both by Norwegian and USSR scientists. A review of some of the most important results achieved so far is presented. Rich year-classes of cod occur only in years with relatively high temperature on the spawning grounds and the areas of their distribution during the first half-year of their lives. Feeding distributions of cod, haddock and capelin depend on the climatic conditions in the Barents Sea with more easterly and northerly distributions noted in warm years than in cold ones. The growth of fish also seems to depend on the environmental temperature, but the temperature-growth relationships are probably not simple. The climatic fluctuations also influence the plankton production and thereby the food conditions for all plankton feeders. Temperature effects linked to the variability of food may therefore be as important as the direct effect of temperature on the biological conditions of fish.

Machutchon, A. G. (1989). "Spring and Summer Food Habits of Black Bears in the Pelly River Valley Yukon Canada." Northwest Science.

Food habits of black bears (*Ursus americanus*) from the Pelly River Valley, Yukon, were examined to determine the seasonal importance of various foods for bears inhabiting a northern environment. Food habits were determined by analysis of 59 scats and one stomach.

Herbaceous material and berries accounted for 95 percent of the scat volume during spring and summer. Horsetail (*Equisetum* spp.), bearberry (*Arctostaphylos uva-ursi*), soapberry (*Shepherdia canadensis*), and graminoids were the most important foods. Overwintered berries were eaten early in spring until herbaceous vegetation became available. New berries were important from mid to late-summer. Insects, particularly ants, were frequent in scats from May to August, but were only two percent of the total diet volume. Seasonal food habit information is important because it reflects seasonal trends in black bear habitat use. Food habit preferences of bears in northern environments are generally similar to those in southern areas; however the restricted availability of different foods limits diversity in northern diets.

Mahon, R. and R. W. Smith (1989). "Comparison of Species Composition in a Bottom Trawl Calibration Experiment." Journal of Northwest Atlantic Fishery Science.

The species composition in a comparative trawl fishing experiment on the Scotian Shelf [North Atlantic Ocean] was analysed to determine if two ships using different gear resulted in different pictures of assemblage structure. A multiple regression technique was used with an index of biological dissimilarity as the dependent variable, and dummy variables to control day-night differences, sampling stratum and location. The analysis showed that the dissimilarity index values between vessels were not significantly larger than those within vessels. Pairs of tows by the different vessels and gear at the same location, were significantly less dissimilar than pairs of tows by the same vessel in the same sampling stratum (i.e. nearby). The study shows that it is valid to compare assemblage structure on the basis of surveys by these two vessels. The results also suggest that there are spatial patterns in the demersal fish assemblages on the Scotian Shelf at a scale between the area covered by a trawl tow and the area of a stratum.

Mayo, R. K., J. M. McGlade, et al. (1989). "Patterns of Exploitation and Biological Status of Pollock *Pollachius-Virens* L. in the Scotian Shelf Atlantic Ocean Georges Bank Atlantic Ocean and Gulf of Maine Area." Journal of Northwest Atlantic Fishery Science.

Commercial exploitation of pollock in NAFO Divisions 4VWX and Subareas 5 and 6 has increased considerably over the past two decades as abundance of traditional groundfish species has declined. Total pollock landings from this area increased from less than 30,000 (metric) tons per year during the late-1960s to over 60,000 tons since 1985; USA recreational catches have contributed between 1,000 and 2,000 tons to the annual totals. Since 1977, when both the USA and Canada extended uni-lateral jurisdiction over their fishery resources to 200 miles, domestic management programs for pollock have been either non-existent or ineffective in restricting total landings. Assessment and management advice for pollock has traditionally been predicated on the assumption of a single unit stock within the region. Tagging studies and morphometric and meristic measurements, however, suggest a possible separation of Gulf of Maine pollock from those on Browns Bank and Emerald Basin on the Scotian Shelf. The distribution of pollock eggs and larvae also indicates the presence of several spawning sites on the Scotian Shelf in addition to previously documented locations in the western Gulf of Maine. Sexual maturation and growth rates for pollock are similar throughout the region. Growth rates of males and females do not differ significantly, although the median size at maturity is slightly larger for males. The majority of pollock of both sexes become sexually mature during their third year. Recruitment has been consistent since the late-1960s with one or more relatively strong year-classes appearing throughout the region every 3-4 years. Pollock become fully recruited to the fishery between ages 6 and 7, although partial recruitment declines again after age 7. Estimates of total stock size (age 2+), derived from virtual population analysis (VPA), increased from 102 million fish in 1974 to 145 million in 1977, but declined to 97 million in 1980. Following recruitment of the 1979 year-class age 2 in 1981, stock size increased to 168 million before declining to 113 million in 1988. Instantaneous fishing mortality (F) has exceeded $F_{0.1}$ (0.29) but remained at or below F_{max} (0.57) throughout the 1970s. Fishing mortality has been close to F_{max} , however, in 4 of the 6 years since 1982. Analyses of research vessel survey data generally agree with results obtained from the VPA, indicating a recent decline in stock abundance and biomass, and an increase in instantaneous total mortality. Equilibrium calculations suggest that fishing at $F_{0.1}$ would provide a long-term yield of 53,600 tons from a stock biomass of 317,700 tons, while fishing at F_{max} would provide a yield of 58,100 tons from a stock biomass of 204,600 tons. Corresponding spawning

stock biomass levels at $F_{0.1}$ and F_{max} are 260,400 and 149,800 tons respectively. Although long-term yields are approximately 8% greater at the F_{max} level, fishing at $F_{0.1}$ provides for a 55% increase in total stock and 74% increase in spawning stock biomass over those allowed under F_{max} .

McCorquodale, S. M., K. J. Raedeke, et al. (1989). "Home Ranges of Elk in an Arid Environment." Northwest Science.

Home ranges of elk (*Cervus elaphus nelsoni*) inhabiting montane and coastal forests have been previously documented, but few estimates have been reported for elk occupying non-forested habitats. We analyzed the home ranges of elk inhabiting the treeless shrub-steppe of Washington [USA] using 782 relocations of eight radio-collared individuals during 1983 and 1984. Annual minimum convex polygon estimates averaged 161.4 km² for female elk and 163.1 km² for male elk. Annual ninety-five percent confidence ellipses averaged 305.1 km² for female elk and 284.6 km² for male elk. Seasonal home ranges of female elk decreased significantly each season from spring through fall. Large home ranges of elk in the shrub-steppe relative to elk in more mesic environments are hypothesized to be a strategy to compensate for low forage density in the arid shrub-steppe. These elk maintained large home ranges yet were reproductively successful, indicating that large home ranges can be an effective strategy for large herbivores faced with low food densities. We hypothesize that the success of these elk was mediated by the quantity rather than the quality of foraging areas in a prairie-like environment. Home range shapes appeared to be related to the availability of disturbance-free areas. A review of the literature suggested annual precipitation may be a relatively good predictor of home range sizes of elk.

McNabb, D. H. and S. D. Hobbs (1989). "Shallow Tillage Fails to Increase 5-Year Growth of Ponderosa Pine-Seedlings." Northwest Science **63**(5): 241-245.

McNabb, D. H. and S. D. Hobbs (1989). "Shallow Tillage Fails to Increase 5-Year Growth of Ponderosa Pine Seedlings." Northwest Science.

Forest soils can be compacted by rubber-tired skidders and crawler tractors during timber harvesting and site preparation. Compacted soils are often tilled with machines pulling rock rippers to reduce detrimental effects on seedling performance. In southwest Oregon (USA), soil compaction during intensive site preparation by machines increased the naturally high bulk density of the soil by 9 percent at the 10- to 20-cm depth. Subsequent tillage with machine-mounted rock rippers, spaced 1.68 m apart, to a depth of 30 cm significantly reduced the bulk density of approximately six percent of the soil to that depth. Through year five, tillage did not increase growth of 2-0 bareroot seedlings of ponderosa pine (*Pinus ponderosa* Laws.) planted in the rip-furrow compared to those planted midway between furrows. Survival was at least 96 percent for both planting locations. These results suggest that shallow tillage of soil is ineffective at improving the performance of well-planted seedlings.

Meyer, S. E. (1989). "Warm Pretreatment Effects on Antelope Bitterbrush *Purshia-Tridentata* Germination Response to Chilling." Northwest Science.

Antelope bitterbrush occurs over a wide range of habitats in the West [USA], yet laboratory germination requirements for fresh seed collections are remarkably similar. The seeds are dormant when dispersed in midsummer and require four to six weeks of moist chilling to become germinable. Laboratory experiments were conducted to test the hypothesis that warm dry summer conditions at low elevation sites would tend to make seeds less dormant at the beginning of winter chill, while warm moist conditions at higher elevation sites would tend to lengthen the winter chill required to break dormancy. Warm-dry seed pretreatments for short periods (4-8 weeks) at moderate temperature (15 and 30.degree.C) significantly increased germination response to an otherwise inadequate (2-week) chill. Warm-moist seed pretreatments (2 weeks at 15 or 30.degree.C) significantly decreased germination response to an otherwise adequate (4-week) chill. These results suggest that conditions experienced during summer and fall by rodent-cached antelope bitterbrush seeds in the field may change their chill requirements. The resulting increased dormancy at sites with longer winters and decreased dormancy at sites with shorter winters would increase the changes for correctly timed emergence and thus for seedling survival.

in different habitats. These findings have implications for artificial seeding of antelope bitterbush, since conditions experienced in dry storage prior to fall seeding may be different from postdispersal conditions in the field.

Milne, D. G., A. S. Harestad, et al. (1989). "Diets of Wolves on Northern Vancouver Island Canada." Northwest Science.

The purpose of our study was to determine the occurrence and seasonal variation of prey species in the diets of wolves on northern Vancouver Island. Columbian black-tailed deer were found to be the most frequent prey and comprised the greatest relative weight in the diet of wolves. Roosevelt elk comprised the next greatest component by relative weight in the diet. Hairs of fawns occurred with greater frequency in summer scats than did those of adult deer. Beaver hair was frequent in winter scats than in summer scats. The proportion of beaver in the diet varied among years and was greatest when deer populations were low. On Vancouver Island, young ungulates were important prey of wolves during summer. Use of alternative prey by wolves increased when deer abundance was low.

Monda, M. J. and J. D. Reichel (1989). "Avian Community Changes Following Lower Granite Dam Construction on the Snake River Washington USA." Northwest Science.

The reservoir behind the Lower Granite Dam on the Snake River inundated 210 ha of riparian habitat and 1109 ha of flood plain habitat. Loss of these habitats was associated with the change from free-flowing river to reservoir. Our objective was to evaluate response of the avian community to habitat change. We compared numbers of birds and species observed during monthly road counts in 1973 (preimpoundment) and 1981 (postimpoundment). More individual birds and species per survey were observed in 1981. Of 37 species classified as riparian, 18 had a larger number of individuals observed in 1981. Our data suggest that some riparian species shifted habitat-use patterns after impoundment, and/or that nonriparian upland habitats were not adequately surveyed prior to impoundment. Riparian passerines decreased after impoundment in number of individuals and species per survey, and may not have been dependent on riparian habitat. More individuals and eight new species of aquatic birds were recorded in 1981. Migrant ducks during spring contributed heavily to the increase in aquatic birds. The proportion of total birds observed increased for aquatic and upland birds and decreased for riparian birds. These changes paralleled changes in habitat behind the dam. This study may aid in evaluating environmental impacts caused by impoundments.

Mountain, D. G., M. Pastuszak, et al. (1989). "Slope Water Intrusion to the Great South Channel Atlantic Ocean During Autumn 1977-85." Journal of Northwest Atlantic Fishery Science.

Measurements of water properties in the Great South Channel (GSC) made on 35 surveys between 1977 and 1985 indicate an intrusion of high salinity water in the autumn of most years. The intrusion represents an influx of slope water. It is most evident near bottom, but high salinity values are found throughout the water column. In some years the intrusion can be traced through the channel to the north side of Georges Bank. Larvae of offshore, warm-water fish species found in the high salinity intrusion support reports that the presence of these larvae is associated with an influx of slope water through the channel. The influx is likely to be associated with the seasonal shelfward movement of the shelf/slope front during the autumn. While the extent of the influx may be modified by Gulf Stream rings located south of the channel region, the phenomenon does not appear to be caused by rings. The influx of slope water across the shelf and to GSC suggests a seasonal reduction in the transport of Georges Bank water westward past Nantucket Shoals, [Massachusetts, USA].

Overholtz, W. J. (1989). "Density-Dependent Growth in the Northwest Atlantic Stock of Atlantic Mackerel *Scomber scombrus*." Journal of Northwest Atlantic Fishery Science.

Density-dependent growth relationships in the Northwest Atlantic stock of Atlantic mackerel (*Scomber scombrus*) were investigated with regression and non-parametric statistical procedures. Mean weight at ages 1-3 for research survey caught and ages 2-4 for commercially caught fish were found to be significantly and negatively correlated with stock density. Weight-at-age of fish from the 1978-82, and 1984 cohorts were significantly different at ages 1, 2 and 3. The 1982

cohort was found to be one of the slowest growing on record; it is also one of the largest recruiting year-classes that has been observed. Results suggested that a two stage growth model that accounts for different distribution of juvenile and adult fish may be appropriate for this stock. Early growth may be related to year-class size, whereas stock size may be more influential after juvenile fish join the adult stock further offshore.

Palsson, O. K., E. Jonsson, et al. (1989). "Icelandic Groundfish Survey Data Used to Improved Precision in Stock Assessments." Journal of Northwest Atlantic Fishery Science.

The main objective of this study was to improve the precision of stock assessment of demersal fish in Icelandic waters, with particular emphasis on cod. Sampling was carried out on approximately 600 stations in the Iceland shelf area in March 1985 and again in March 1986. Stations were distributed in the survey area through a semi-randomly stratified process. A standardized bottom trawl was designed for the sampling and the data collected included length measurements, otolith samples and sex determination, as well as information on the environment and fishing gear. Results are presented for cod, haddock, saithe, redfish, catfish and long rough dab. The distributions of the different species indicate common nursery grounds in the northern part of the survey area. The youngest age-groups were generally not fully represented in the survey. Pronounced diurnal catch variations were observed for catfish and redfish. Age disaggregated stock indices of the gadoid species are well correlated with virtual population analysis (VPA) values. However, the total stock indices differ in their proportion of the VPA stock size. In comparison with previous surveys, the precision of stock indices has been increased markedly through this survey for all species except saithe. This is basically the result of an increased number of stations. Skipper-selected stations (non-random) generally gave higher aggregated indices than random ones, although statistically significant differences are exceptional. On a length disaggregated basis, however, a highly significant difference was observed for all species.

Parsons, D. G., V. L. Mercer, et al. (1989). "Comparison of the Growth of Northern Shrimp *Pandalus borealis* from Four Regions of the Northwest Atlantic." Journal of Northwest Atlantic Fishery Science.

Modal analyses of carapace length frequencies and interpretation of biological data for the northern shrimp (*Pandalus borealis*) indicate variation in both age at sex change and growth rate for some Northwest Atlantic populations. The first female age (the species is protandrous) varied from 6 in the southernmost area to 7 and possibly 8 in more northerly areas. The observed differences could not be related to differences in environmental temperature. Overlapping of modes in the length frequency data was severe in many cases, possibly obscuring an additional mode (age group) in the Davis Strait data. The assumption that sex change occurs at a specific age and the choice of appropriate models and statistical analyses to describe growth require further study.

Rickard, W. H. (1989). "Response of Round-Headed Buckwheat to Summer Burning." Northwest Science.

Wildfires are common in the shrubsteppe region of the western United States, but there is little information concerning the response of shrubs that grow on rock outcrops to burning. We thus examined the response of an isolated stand of round-headed buckwheat to two August wildfires. The pre-burn stand density of round-headed buckwheat plants averaged 133 plants per 100 m². In the first growing season following a wildfire in August 1984, density was reduced to 47 plants per 100 m². In the second growing season after the initial burning, almost all of the surviving burn-damaged plants produced flowers. Following a second wildfire in August 1987, density was reduced to 7 plants per 100 m². Despite the fact that the buckwheat plants were widely spaced and past the flowering stage, and that the shallow, stony soil supported only a sparse stand of herbaceous plants with low fuel potential, rounded-headed buckwheat plants were vulnerable to late summer burning.

Rickard, W. H. and K. R. Price (1989). "Uptake of Tritiated Groundwater by Black Locust Trees." Northwest Science.

Artificially planted trees have survived for four decades in the very dry climate of south-central Washington [USA] without irrigation. It is generally believed that long-time tree survival depends

on root contact with groundwater but this assumption had not been critically evaluated. Leafwater from trees growing at a location where groundwater was 7.7 m below the surface had elevated levels of tritium. The well water also had elevated levels of tritium indicating that some of the tritium measured in tree leaf water was obtained from root contact with tritiated groundwater. Tritium concentrations in leaf water were greatest in August when sources of tritium other than groundwater are least abundant, indicating that the trees relied most heavily on groundwater during the hottest and driest season of the year.

Roche, C. T. and B. F. Roche (1989). "Introductory Notes on Squarrose Knapweed (*Centaurea-Virgata* Lam Ssp *Squarrosa* Gugl)." Northwest Science **63**(5): 246-252.

Roche, C. T. and B. F. J. Roche (1989). "Introductory Notes on Squarrose Knapweed *Centaurea-Virgata*-Ssp-*Squarrosa* Gugl." Northwest Science.

Squarrose knapweed (*Centaurea virgata* Lam. spp. *squarrosa* Gugl.), previously unrecorded in Oregon (USA), was discovered in August 1988 near Long Creek in Grant County. It has spread from initial infestations in California and Utah (1950 and 1954, respectively) to occupy an estimated 5,000 ha of rangeland and pasture in three states. Two exotic seed head gall forming insects, *Urophora quadrifasciata* and *U. affinis*, were found using the Oregon squarrose knapweed population. *Urophora quadrifasciata* galls were found in 79 percent of the seed heads. Because only 36 percent of the knapweeds heads contained filled seeds and the deciduous heads are disseminated epizocially, the flies may slow spread of the weed. Squarrose knapweed is a relatively new and unknown weed that has the potential to reduce forage production similar to losses due to other knapweeds on rangeland in the western United States. New line drawings illustrate important characteristics of the plant as an aid to identification.

Spencer, P. K. (1989). "A Small Mammal Fauna from the Touchet Beds of Walla Walla County Washington USA Support for the Multiple-Flood Hypothesis." Northwest Science.

Recent work in southeastern Washington has challenged the long-accepted hypothesis that the late Pleistocene Touchet Beds were deposited by one or a few colossal glacial outburst floods from glacial Lake Missoula in western Montana. Work conducted for this study in the northern portion of the Walla Walla Valley has revealed the presence of a diverse and exceedingly well-preserved small-mammal fauna from the middle portion of these flood-related sediments. The remains are preserved with fragile bone elements and dentition intact and virtually no evidence for post-mortem transport or reworking. Biogenic structures interpreted as rodent burrows are prevalent throughout the section. Sedimentary structures and textures preserved at the fossil collection site suggest that the sediments were deposited under conditions of considerable turbulence, and that there were periods of time between depositional episodes characterized by erosion and colonization by small mammals. The data are overwhelmingly supportive of a hypothesis which invokes multiple flood episodes separated in time by decades-long periods of exposure for deposition of the Touchet Beds.

Templeman, W. (1989). "Variation of Vertebral Numbers with Fish Length in Atlantic Cod *Gadus-Morhua* of the Eastern Newfoundland Area Canada 1947-71." Journal of Northwest Atlantic Fishery Science.

In NAFO Div. 2GHJ and 3KL, the northern-type high-vertebral means (usually over or slightly below 55) were usually present at the length-ranges of lesser length, declining toward lower means at greater sizes. The high-vertebral-type mean extended to higher length-ranges northward than southward. In coastal areas of Div. 2GHJ and 3K, the means at the same length-ranges tended to be somewhat lower than offshore. Means at the same length-ranges for the above areas were usually a little higher in the earlier period, 1947-55, than in the later period, 1958-71. Throughout the area (not including Div. 3M) offshore and inshore vertebral means at the same length-range and period were typically lower in the southern than in the adjacent northern area. The vertebral means of the relatively isolated cod stock on Flemish Cap (Div. 3M) were intermediate between the northern- and the southern-types, and on the southern Grand Bank (Div.3NO) the means (usually below 54) were typically the lowest in the eastern Newfoundland area. Within each of these areas (Div.3M and 3NO), means did not differ greatly by length-range and from the earlier to the late period. It appears that stock mixing is the primary mechanism

causing the observed, relatively large, variations in mean vertebral number of the larger compared with those of the smaller fish. The lack of seasonal variation in mean vertebral numbers in offshore northern areas indicates that straying of larger fish from more southern or inshore stocks accounts for decreasing vertebral number with size. However, larval drift and mixing from seasonal migration are important causative factors of differences found in other areas. Differential fishing pressure on stocks could be the cause of temporal trends in vertebral counts in mixing areas.

Wagner, O. E. (1989). "W-Waves and Plant Communication." Northwest Science.

Plants have been found to communicate directly with each other. An ax chop to one tree has been detected in a neighboring tree for example. The basis of this communication has been hypothesized to be W-wave signals.

Winters, G. H. (1989). "Life History Parameters of Sand Lances *Ammodytes*-Spp from the Coastal Waters of Eastern Newfoundland Canada." Journal of Northwest Atlantic Fishery Science.

Estimates of various life history parameters of sympatric populations of *Ammodytes dubius* and *A. americanus* from coastal waters of Newfoundland are presented for the first time. Significant differences between the two species of sand lances were evident for length-weight and age-weight relationships. In addition, *A. americanus* tended to have a slightly earlier spawning season, and matured at a slightly earlier age than *A. dubius*. Similarities in these vital rates were noted between *A. americanus* populations in Newfoundland coastal waters and those in New England [USA] waters. Likewise, populations of *A. dubius* from coastal Newfoundland water had similar vital rates as those published for *A. dubius* populations on the Grand Banks.

Yarie, J. and B. R. Mead (1989). "Biomass Regression Equations for Determination of Vertical Structure of Major Understory Species of Southeast Alaska." Northwest Science **63**(5): 221-231.

Yarie, J. and B. R. Mead (1989). "Biomass Regression Equations for Determination of Vertical Structure of Major Understory Species of Southeast Alaska USA." Northwest Science.

Describing structural aspects of forest vegetation is now routine in forest inventories in Alaska. The biomass structure of understory vegetation is considered a necessary part of the inventory process. In this study twig, foliar and combined (twig plus foliar) biomass were related to percent cover for 48 species common to southeast Alaska. Biomass values calculated with these equations yield estimates of kilograms biomass per hectare for a 10 cm vertical layer. Thus a vertical understory biomass profile can be estimated utilizing these equations and an appropriate set of cover estimates. A destructive sampling technique was used to estimate understory biomass and was compared to an estimate derived from a nondestructive application of the derived regression equations. The nondestructive estimate fell within the 95% confidence limits of the biomass estimate derived from the destructive sample. This indicates that the regression approach will result in estimates of understory biomass in vertical layers with similar accuracy as the more costly and time consuming harvest technique.