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Beaver in Western North America: An Annotated Bibliography, 1966 to 1986

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RESEARCH SUMMARY

This annotated bibliography of published literature on the beaver (*Castor canadensis*) contains 206 references to both technical and popular articles and covers a period from 1966 to 1986. Emphasis is on the Western United States and Canada. A subject index is keyed to an alphabetical list of authors. The purpose of the bibliography is to provide a working tool for natural resource specialists, land-use planners, and others charged with managing beavers and their habitats.

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INTRODUCTION

Of the wild mammals associated with riparian-aquatic habitats, beavers (Castor canadensis) bring about the most extensive changes in their environment. Their activities have pronounced effects upon the ecology and management of not only the immediate area but of downstream habitats as well. In some cases the status of the beaver is unclear; activities may at the same time be both beneficial and detrimental. Because of this duality, the beaver in some areas presents difficult management challenges.

This annotated bibliography is a review of literature on the beaver in Western North America published from 1966 to 1986. Emphasis is on the Western United States and Canada in recognition of regional differences in beaver habitats and regional problems in beaver management. Inclusion of references solely on the basis of geography was somewhat arbitrary. This bibliography was compiled to provide a working tool for use by natural resource specialists, land-use planners, and others charged with managing beavers and their habitats.

Only published information that is generally available is included in this bibliography. References range from technical reports to popular articles and include both methodological and substantive papers. The annotations provide a general idea of the information and results contained in each publication. Some annotations provide only that information contained in broad-based articles that are relevant to this bibliography. The annotations are not intended to be abstracts.

The organization of the bibliography was purposely kept simple. It is arranged alphabetically by author with a number assigned to each entry. To make the bibliography more useful, a subject index is provided. The alphabetical subject index lists the numbers of references, keyed to author, for each subject heading.

The method of citation is in general accordance with the style recommended by the American National Standards Institute (ANSI Z39.29-1977). Preface pages and references to illustrative materials have been omitted. Authors' names are listed as they appear on the original copy of the reference.

Several abstracting publications, books, periodicals, monographs, and bibliographies were useful in locating reference material. Some of these and other important sources for locating additional or earlier references on beavers are listed below.


Amherst, MA: University of Massachusetts, Agricultural Experiment Station. 128 p.


BIBLIOGRAPHY


After observations on the Mackenzie Delta, Northwest Territories, Canada, Aleksiuk hypothesized that scent mound systems function as a means of communication among beaver from adjacent colonies and between established colonies and the floating population. The system appears to be a mechanism of self-regulation that limits the population before food becomes a major limiting factor.

The author discusses the seasonal pattern of tail fat and its role as a storage of energy reserves on specimens collected on the Mackenzie Delta, Northwest Territories, Canada.

This study on the Mackenzie Delta, Northwest Territories, Canada, examined the seasonal variation in food of the beaver. Leaves and growing tips of willows were the main food items in July and August. The remainder of the year beaver preferred a diet of willow bark, poplar, and alder. The northern beaver has adapted to seasonal variation in protein availability by utilizing high-protein willow leaves almost exclusively when they are available.

The study in the Mackenzie Delta, Northwest Territories, showed that a winter weight loss characterized immature animals. Fat was deposited in the autumn, maintained during the winter, and mobilized in the spring. Thyroid gland weights were high in the summer and low in the winter. Metabolic energy expenditure was high during the summer and low during the winter. This annual pattern is an inherent property of northern beavers.

No major seasonal changes occurred in California beavers kept under Vancouver climatic conditions, but arctic beavers kept under the same conditions showed a growth cessation, a 40 percent reduction in food intake, and a depression in the 131PBI conversion ratio during the winter. The authors concluded that northern beavers possess a winter metabolic depression induced by decreasing light intensity in the autumn.

Habitat preferences are described along with a mathematical model designed to provide information for use in impact assessment and habitat management activities. This updates the model in the original publication dated September 1982.

The author looked at sedimentation, storage of water, and increased diversity of beaver ponds and communities on three tributaries of the South Fork of the Snake River near the Idaho-Wyoming border. Water impoundments by beavers provided increased surface area, water current deceleration, regulation of stream flow, a water reservoir, filter for low density particulates, and a greater diversity of wildlife habitat.

Allred discusses the ratio of transient to resident beavers, mortality within populations, and effects of high water on their movement on two tributaries of the South Fork Snake River in western Wyoming.

The author discusses beaver history, physical characteristics, life history, behavior, and management.

This study sought to use "natural" systems and beaver reintroduction to restore riparian habitat on two perennial streams in southwestern Wyoming. The newly built dams were trapping sediment, reducing stream velocity, and locally elevating the water table, thus allowing reestablishment of willow and other riparian plants.

Study areas in overgrazed areas in the Rock Springs, WY, district helped determine if beaver could assist the riparian recovery process. Beaver activity reduced the ability of the stream to transport sediment by reducing the effective slope of the stream channel.

This study in southwestern Wyoming sought to determine if both materials and beaver could be supplied or relocated into marginal habitats with resulting habitat improvement. At the end of 3 years, results showed promise.

February 8-10; Logan, UT. [Publisher and city unknown]: 123-130.

Several study projects in the Rock Springs, WY, district resulted in development of techniques for restoring and reestablishing degraded riparian and aquatic habitats. Beaver were reintroduced to fenced study areas and returned on their own to unfenced areas. The newly built beaver dams are trapping sediment, reducing stream velocity, locally elevating the water table, and reducing the effects of seasonally fluctuating water table levels.


Emphasis is on the Midwestern and Eastern United States, but other important references are included.


Questionnaires given to persons wishing to trap on Alaska's Kenai Peninsula asked about their experience, techniques and views of trapping on the refuge, and any impacts it might have. Outdoor experience was the main reason for trapping, and most trappers trapped for land as well as aquatic furbearers. The majority of trappers indicated they would support additional regulations or closed areas to protect furbearers.


Discusses the impact that natural factors have on furbearers, such as the 1964 earthquake, wildfires, overbrowsing of aspen by moose, and increased lynx harvest. Two methods were used to document changes in population levels and harvest rates: comparison of annual furbearer harvests and success rates per trapping permit holder; and comparison of beaver population estimates for different periods and habitats. Factors affecting beaver harvest on the refuge include fur prices, local economic conditions, and trapper experience and technique. Predation on beaver does not appear to be significant.


A husband-and-wife team studied beaver habits on Granite Creek in Wyoming. They discuss beaver life history.


Beaver fossils were one of many small vertebrates found in middle Pliocene sediments from White Cone, Navajo County, AZ.


Baxter covers morphology and physical and chemical limnology of artificial lakes, biology of reservoir ecosystems, and downstream effects of impoundments.


Researchers and land managers are looking at the beneficial role of beavers in regulating water movement, sediment, and streamside vegetation within watersheds in the Pacific Northwest.


The removal of large organic debris resulted in accelerated downcutting of previously stored sediments. As a result, turbidity and suspended sediment levels increased during several storms. Streamflow eroded more than 5,000 m$^3$ of sediment along a 250-m reach the first winter after debris removal.


Two beaver skulls were collected in Union County, NM, in March 1967. This was the first record of occurrence in the Cimarron River of New Mexico.


In an experimental approach, all organic debris dams were removed from a 15-m section of second-order stream, just above a gauging weir. Dam removal brought about a 6 percent increase in the export of dissolved matter and a 500 percent increase in the export of both fine particulate and coarse particulate matter.


Organic debris dams are extremely important components of the small-stream ecosystem. They retain organic matter within the system, thereby allowing it to be processed into finer size fractions in headwater tributaries rather than transported downstream in a coarse particulate form.

beaver
Boyce
The correlation.
(Yukon drainage.
Wyoming. banks
Management, Beaver Colorado.
Boddicker, Boddicker,
32-35.
The author discusses trapping techniques he uses.
The author relates what happened to his trapping grounds and the beaver lodges after 3 months of drought and cold.
Boyce studied an exploited beaver population along the Chena River near Fairbanks, AK, and an unexploited beaver population on Birch Creek in the Yukon River drainage. He was testing the theory on the evolution of life histories that optimal reproductive effort varies with changing survivorship schedules. He compared the demographic structure and life history characteristics of these two populations.
The spacing pattern of beaver colonies along Birch Creek (Yukon River drainage) was studied relative to the habitat surrounding each colony site. The author used discriminant analysis, multiple regression, and canonical correlation.
Beaver were introduced to two severely eroded streams in southwestern Wyoming to help restore riparian habitat, stabilize streambanks, and collect sediment. The results after 3 years were proving favorable.
A survey in 1976 examined current abundance and distribution of beaver in the park and the use beaver made of tamarisk (Tamarix pentandra). No evidence of tamarisk use was found. Beaver do not appear to be threatened by the tamarisk invasion of willow (Salix spp.)
Reviews the natural history of beaver, their habitat requirements, the problems they cause in impoundments, and why those problems occur. The author offers some potential solutions.
Beaver transplants have occurred since 1925, usually resulting in harvestable populations.
Beaver collected in east-central Alberta were infected with a species of Travassosius. One suggestion is that T. americanus in Castor canadensis is the ancestral stock and that T. rufus has evolved following allopatric evolution of C. fiber.
An examination of 86 beaver from Alberta, Canada, for helminth fauna was compared to that of beaver from other Nearctic (C. fiber) and Palearctic regions.
Dominant-submissive and neutral interactions between members of a beaver population in the central Sierra Nevada were studied between 1977 and 1980. Kits had the highest frequency of interactions, while adults had the
lowest. Older animals of both sexes received more interaction than they initiated. Interaction was generally directed from younger animals toward older.


Behavioral patterns of beavers were studied at Sagehen Creek, Nevada County, CA, from 1977 to 1979. A cluster analysis revealed age class, sex, and seasonal differences in behavior between individual family members.


Beaver were trapped from May through September 1974 and 1975 at Little Valley and from May through September at Sagehen Creek, CA. The authors demonstrate that social organization of beavers may be more variable than is often assumed.


The author presents findings on the effects of beaver on water storage, trout habitat, and the water table on the Pole Mountain District of the Medicine Bow National Forest in southeastern Wyoming. Field investigations conducted between 1960 and 1964 show that beaver are of prime importance to the brook trout fishery.


The maximum impounding effect of beaver dams in September is one of the important phenological events of the three ice-free seasons in a brown-water stream in west-central Alberta.


The objectives of this study (part of a larger investigation) were to assess the influence of stream flow regimes on beaver population abundance, distribution, and movement. Dramatic population movements occurred at low water levels. Dwelling abandonment at high water was not uncommon.


In areas underlain by carbonate bedrock such as limestone or dolomite, surface waters may be captured by underground stream channels creating special problems for the beaver.


Beavers may have been the source of a Giardia spp. outbreak in the Uinta Mountains of Utah. Three beavers were found to be infected with Giardia cysts at an outbreak in Camas, WA.


The author observed a beaver family preparing for winter in a remote area of Mount McKinley National Park, AK.


Numbers of cottonwood trees declined between 1961 and 1978. Water management, grazing by livestock and deer, plant competition on the ungrazed area, and beaver-felling of young trees all contributed to the lack of regeneration that appears responsible for the general decline in overstory vegetation.


The lake has experienced major changes in productivity in the past 350 years due to disturbance in the watershed from lumbering, road construction, and probably periodic use by beaver colonies.


The vascular anatomy of five beavers was studied by dissection and the injection of vinyl acetate into arteries and veins.


The author includes Canadian mammal literature from the past 40 years. Journals referenced, dates of publication, authors, region of study, means of funding, and subject matter are presented in tables.


Beaver activity affects the cycling of nutrients in streams by increasing the deposit and retention of organic material and by creating zones of anaerobiosis in the sediments.
This increase in overall ecosystem productivity, coupled to the increased and more diverse aquatic habitat, helps make streams with beaver highly productive areas for the rearing of fish.


The authors cite a few Western United States repopulation programs and discuss the beaver's life history and importance as a much-sought-after furbearer during the mid-1800's.


During 1975 to 1977, a survey of people and wild and free-ranging domestic animals for Giardia was completed in several areas of Colorado. Fecal samples were examined by a zinc sulfate centrifugation technique. Of 744 samples from 33 species of vertebrates, 44 of 244 beavers (18 percent) were found to be positive for Giardia.


Caution should be exercised in introducing beavers to enhance riparian habitat. In some cases, beaver can be detrimental to meeting specific objectives.


Beaver affect aspen stands from cutting and dam building behavior. Sucker regrowth of aspen in flooded areas around beaver dams is not fast enough to sustain beaver populations for long.


This report details the general status of 27 of North America's major terrestrial and semiaquatic furbearers.


The author reviews the history of Oregon's furbearer management and harvest.


In determining if there were specific areas or habitat components that would be altered, to the detriment of beaver populations, through construction of a pipeline, the authors concluded that if care was exercised to maintain water regimes, beaver populations or near the proposed pipeline route should not be adversely affected.


Included are estimates of timber volumes lost, those animals chiefly responsible, and how land managers assess the damage. Animal damage within California, Oregon, and Washington is probably costing the timber industry several million dollars each year.


Rodents and insectivores near Bozeman, MT, were tested for the prevalence of Toxoplasma gondii. The disease was isolated in mice inoculated with tissues of one of 27 beavers. The six mice inoculated with pooled tissues of infected beaver developed an antibody titer of >1:256, and T. gondii cysts were found in the brains of three of six mice killed.


Stresses the role of the beaver "as a regulator rather than a passive inhabitant of streams; an innovator and modifier of riparian vegetation rather than a mere consumer."


Beavers were implicated as the most probable source of Giardia organisms that produced an epidemic in March 1976 in Camas, WA. Laboratory and epidemiologic evidence is provided, although somewhat incomplete.


A new fossil species of beaver (Agnotocastor galushai) was found in early Oligocene deposits of the Flagstaff Rim area, Natrona County, WY.


At Willow Creek, ID, beaver were introduced to a severely eroded stream, resulting in stabilization and lushness surrounding their dam site.
Large beaver populations lead to amplification of contamination of surface waters with *Giardia* cysts.


Folliott, Peter F.; Clary, Warren P.; Larson, Frederic R. 1976. Observations of beaver activity in an extreme environment. Southwestern Naturalist. 21(1): 131-133. Beaver were observed adjacent to small perennial pools formed in normally dry drainages dissecting desert scrub and riparian hardwood vegetation types on Dry Beaver drainage in north-central Arizona. Climatic conditions associated with these pools are often semi-arid, which may be considered severe in terms of beaver habitat.

Fidler, Vera. 1972. Grey Owl: a man ahead of his time. Canadian Geographic Journal. 84(5): 152-157. This is a personal history of Grey Owl who, in his later years, resided in Prince Albert National Park, Saskatchewan. Grey Owl was one of the first to carry out an experiment to restore beaver to an area.


Fletcher, Colin. 1966. Un-eager beaver. Field and Stream. 71: 53, 100-109. This life history of beavers includes observations by the author and others who have had contact with them.

Foreyt, W. J.; Leathers, C. W. 1984. Mite (Schizocarpus mingaudi) infestations of ranch-raised beavers. Journal of the American Veterinary Medical Association. 185(11): 1414-1415. In April and May 1981, at a commercial ranch near Kimberly, ID, approximately 50 beavers of all ages and both sexes died. Investigators found numerous adult mites attached to hair shafts on the preserved skin. Treatment of nest boxes was carried out using 50 percent wettable diazinon powder.

Francis, Margaret M.; Naiman, Robert J.; Melillo, Jerry M. 1985. Nitrogen fixation in subarctic streams influenced by beaver (*Castor canadensis*). Hydrobiologia. 121(3): 193-202. The authors measured nitrogen fixation in four subarctic streams substantially modified by beaver in Quebec, Canada. The authors estimated that total nitrogen accumulation in sediment, per unit area, is enhanced nine to 44 times by beaver damming a section of stream.

Frost, Floyd; Plan, Byron; Liechty, Bill. 1980. *Giardia* prevalence in commercially trapped mammals. Journal of Environmental Health. 42(5): 245-249. A *Giardia* outbreak in Camas, WA, prompted the Washington State Health Services Division to survey wild beaver and muskrat for prevalence of *Giardia* infection to determine if animal contamination of other water supplies could occur. Surveys were conducted in 1976-77, 1977-78, and 1978-79. Annual percentages of beaver contaminated were 6.3, 6.8, and 19, respectively.

Fuller, Todd K.; Keith, Lloyd B. 1980. Wolf population dynamics and prey relationships in northeastern Alberta. Journal of Wildlife Management. 44(3): 583-602. Wolf population studies from October 1975 through June 1978 on two study areas in northern Alberta showed that beaver populations were directly related to beaver occurrence in wolf scat. Consumption of beaver varied greatly between packs.

Gainer, Robert; Smith, Kirby. 1985. Mineralization of subcutaneous tissue in beaver, *Castor canadensis*. The Canadian Field-Naturalist. 99(4): 535-536. The subcutaneous surface of the hides of two yearling kits, shot by a local trapper in the central Alberta foothills, had a white, 0.5 to 2 mm thick, meshlike layer of a stiff and fibrous material that covered most of the anterior dorsal portion of the hide.

Gerhart, Bill. 1979. The land along the water: riparian zones are critical for wildlife survival. Wyoming Wildlife. 43(11): 20-23. The beaver is one of many mammals dependent on riparian habitat for all or part of their life cycle.

Gill, Don. 1972. The evolution of a discrete beaver habitat in the Mackenzie River Delta, Northwest Territories. The Canadian Field-Naturalist. 86(3): 233-239. This study traced through time the sequence of physical and biological events that create a discrete beaver habitat, conducive to the colonization of a poplar (*Populus balsamifera*) seral community.

Gill, Don. 1978. Some ecological and human consequences of hydroelectric projects in the Mackenzie

This paper called attention to the ecological alteration that can and has already occurred below large hydroelectric projects on northern rivers. Northern floodplains and deltas are most subject to downstream regulation-caused damage. Beaver use floodplains and deltas as their primary habitat. If flooding and siltation were to no longer take place, the riparian community would be replaced by a white spruce (Picea glauca) climax forest, virtually unusable by beaver.


This paper deals with the Columbia River to the confluence of the Snake River and the latter stream to the point where it flows around the north end of the Blue Mountains, and considers these streams as they were before dams were built. The Columbia River is a barrier for many mammals, and the gorge lets many mammals breach the Cascade Mountain barrier that cannot go over an unbroken range. Beaver are one of 14 members found in the Columbia River vicinity that have transgressed the stream.


Beaver are involved in the transmission of Giardia spp. Their aquatic habits ensure a steady supply of the parasite to the water. Giardia lamblia is probably the most common intestinal parasite in the United States.


The authors review the relationship of regularly occurring vertebrates to plant communities and their successional stages, and dependency upon and use of aquatic and special and unique habitats. They include a checklist with relative abundance, residence status, and classification by State for all vertebrates found in Oregon and Washington.


Larvae of the crane fly living in abandoned beaver ponds in the Kananskis Forest Reserve, AB, ingest diatoms, filamentous algae, mineral particles, and detritus from the benthic sediments.


A young beaver was selected for observation and experimentation and for evaluating the bases of water-regulation behavior. Rates and timing of activities were examined against variation in water flow, temperature, level, time of day, and ambient as well as water-specific sounds.


Hawkes describes the "valuable ecological consequences" that beaver have on elk and moose habitat by their swamp-building ability and resultant growth of food-producing shrubs and small trees.


Hawley summarizes part of Michael Aleksiu's 1968 thesis on how the energy regime of northern beavers fluctuates. Information also includes the composition, distribution, and density of beaver populations in the study area.


Herb discusses the importance of wetlands as wildlife habitat and the need to protect them. Large numbers of wildlife use the areas because of the abundance of water, food, cover, and nesting areas. Beaver depend upon wetlands for survival.


The author discusses the distribution, physiology, reproduction, ecology, behavior, mortality, economic status, and management of beaver throughout its present range in North America.


The authors discuss management (season, traps, damage) and economics (markets, supply and demand, prices, harvest trends) of beaver in North America.


The authors attempt to synthesize data on North American beaver into a general scheme. Discussion is limited to intensive studies of individually marked animals of known sex and age class.


The authors have supplemented and updated earlier bibliographies on beaver.

Subjects of the study were the feeding biology, distribution relative to substrate type, and adult phenology of benthic insects associated with a shallow, abandoned beaver pond in Kananaskis Valley, AB, Canada. The insect fauna of beaver ponds differ markedly from streams, rivers, and lakes. Larvae of Diptera, especially Tipulidae, are the major faunal components.


This study, part of a larger project, assessed the role of allochthonous detritus in an abandoned beaver pond ecosystem in the Kananaskis Valley, AB, Canada. All five litter types (Salix sp., Pinus contorta, Juncus tracyi, Deschampsia cespitosa, Picea glauca) differed significantly in their rate of breakdown over the 18-month study.


During 1973 inflow and outflow of energy were measured independently for one spring-fed pond in the Kananaskis Valley, AB, Canada. Of the total yearly energy inflow, 18 percent was exported, 26 percent was respired, and 56 percent accumulated in the sediments. The author concluded that the beaver pond is a highly accretive heterotrophic ecosystem.


Levels of dry matter, acid detergent fiber, lignin, protein, and volatile fatty acids were determined in the ingesta at several locations in the gastrointestinal tract. Average cellulose digestion was estimated at 30 percent and protein at 44 percent. Total volatile fatty acids were highest in the cecum and upper colon.


This study evaluated the characteristics and economic loss resulting from beaver predation and the cost and effectiveness of beaver control programs.


Documentation over 28 years of beaver (Castor canadensis) habitat use on the Prescott Peninsula, New Salem, MA, permitted development and testing of two models to predict maximum density of active beaver colonies on streams. In mixed coniferous-deciduous forest habitat, the percentage of hardwood vegetation, watershed size, and stream width had significant positive effects on active colony density. Increasing stream gradient and progressively well-drained soils had negative effects. The models were 80 and 75 percent reliable in predicting active colony density.


In May 1976, researchers collected 1,362 mosquitoes (Anopheles earli) from a beaver lodge near George Lake, AB; 39.2 percent were blood-fed and 3.1 percent were gravid.


Beavers may be more important to aquatic ecology and to the formation of prairies and wetlands than biologists had realized. When the animals dam streams they begin a process that causes ponds to spread and later evolve into watery meadows.


Beavers were planted in many parts of Nevada primarily as a means of creating upstream water storage and improving the fisheries resources, rather than for the monetary value of the furs.


From September 1972 through April 1974, beavers exhibited seasonal and year-to-year differences in preference for certain genera of trees in central Massachusetts.


Jenkins found that for most tree genera, beaver cut a smaller range of sizes far from shore than close to shore and more smaller trees and fewer large trees at greater distances. His study was conducted in a deciduous forest of central Massachusetts.


Beavers exhibit strong selection for particular types of plants under certain circumstances. If herbaceous vegetation is available, beavers appear to prefer it to woody vegetation during all seasons.


The authors summarize information on the life history and ecology of the North American beaver.


Johannsen has written a brief life history of the North American beaver.
The author summarizes beaver harvest by counties, fur sales, harvest summary, statewide trend of harvest, population status, and nuisance complaints.

This study looked at beaver population fluctuations between 1835 and 1850 as shown in fur harvest reports.

The author looks at the techniques that beavers use in coping with the dangers and difficulties of winter in Alaska's Mt. McKinley National Park.

Johnson reviews some of the current studies done on eroded trout streams in Montana and Wyoming using beaver for habitat recovery.

Vertebrate samples were collected in 1937-38 by the National Park Service. Castor kit fossils suggest they may have been deposited in the backwater of a beaver dam.

A look-in lodge display was built for beaver at the Calgary Zoo. In 1978 the first reproduction and successful raising of young occurred.

Changing trends in the world of fashion strongly influence the cropping of fur animals. Therefore, in fur-bearer management, two main variables must be considered: the population status and demand for the fur of each species.

Oregon's fur trapping industry shows signs of continuing for many years. This article discusses the 1974-75 fur take by trappers.

The authors concluded that fire is the most important factor influencing the ecology of the northern boreal forest. The beaver is best adapted to early stages of forest succession because it depends primarily on deciduous trees for food and building supplies.

Kindschy documents the effect of beaver use on red willow (Salix lasiandra) in an area unused by domestic livestock.

Beaver harvest of mature trees, along with overgrazing by cattle, has contributed to some of the historical avifaunal changes that have been observed since 1868.

117. LaBastille, Anne. 1979. The best dam builder around.
The author briefly reviews beaver life history, nuisance complaints, and management.

Various mammalian hosts were infected with Fasciola hepatica, beaver among them. Of 53 hosts checked from 1968 through 1975, three of 12 beaver had mature worms in the hepatic and common bile ducts. Ten mature flukes were recovered from infected beaver.

Langford reported 20 incidents of infection with Pasteurella pseudotuberculosis over a 14-year period in western Alberta and British Columbia. One beaver was infected with the organism.

Mail surveys of biologists in North America and reports and contacts with Canadian biologists provided the information for this report. Figures and tables present beaver harvest trends for the United States and selected areas of Canada.

Beaver were live trapped and tagged from National Forest lands adjacent to problem areas of southeastern Idaho during the summers of 1962 and 1963. Movements were then recorded for those tagged animals that were retrapped.

Data from 192 live trapped and tagged beaver helped determine the origin of troublesome beaver on private lands. The yearling age class and males of all groups migrate the most frequently.


The authors gathered data on sex and age ratios, litter size, and rate of pregnancy from live-trapping and fur-trapping operations in 1953-56 and 1962-64. Males consistently outnumbered females in kit and yearling age classes, while females were more abundant among the adults. The sex ratio of 352 beavers examined was 113 males per 100 females. A disturbed population had a lower percentage of kit and yearling beavers than did an undisturbed population.


Describes the fossil remains of the family Castoridae collected from the Barstow formation.


Lulman described what early explorers and trappers might have seen on a journey of the Athabasca River before human pressures changed the face of the land through fire, clearing, and mining.


The author summarizes descriptions and distributions of the various furbearing mammals found in Oregon.


Major flow reductions of the Yellowstone Basin could encourage beaver to build more dams, thus triggering the following: reduced food supply because of extensive additional cuttings of cottonwood and willow; banks with weakened resistance to erosion during peak flows; and habitat loss for other wildlife species that use cottonwoods and willows for nesting, perching, and protective cover.


Martin discusses the potential physical, biological, and water use impacts of water withdrawals and water development on the middle and lower reaches of the Yellowstone River Basin on migratory birds, furbearers, recreation, and existing water users. Increased winter flows could wash away food caches, forcing beaver to constantly expose themselves to the elements and predators. Low flows in early fall would stimulate dam building, thus decreasing available food supply, weakening bank resistance to erosion, and reducing habitat for other wildlife species.


The author shares his actions, problems, and thoughts as he goes about, alone, trapping beaver in the wilderness of Alaska.


The waters of concern in the Pole Mountain area are almost entirely composed of beaver ponds that are not static and therefore are subject to change. Consequently, the fishery is in constant flux. McDowell concluded that high beaver population densities result in short-term, unstable pond conditions due to rapid habitat losses. Balanced management for beaver in relation to available food supply will provide continued aquatic habitat for trout.


In testing theories of central place foraging among beavers along the San Juan River in southern Utah, the authors found that large branches were favored at all distances. This differed from patterns observed in previous studies.


Grizzlies and wolves succeeded in killing or forcing a beaver colony to abandon its lodge in Denali National Park. This eventually led to the death of the pond and its replacement by a huge mud flat and meandering stream.


Beavers were anesthetized and prepared for monitoring (by immersion in 15-20 °C water for 4 minutes) of regional distribution of blood flow; cardiac output, oxygen consumption, arterial and venous blood gases, and pH. Rate of decline of oxygen stores during diving decreased by 93 percent, regional blood flow decreased to all organs except the adrenals, heart, and lungs, and blood flow to the brain increased during dives.

Ten wild beavers were live trapped and taken to the laboratory at the University of Idaho, Moscow. They were anesthetized with pentobarbital, and then the researchers determined total lung capacity, hemoglobin, blood volume, and myoglobin. These measured values were used to calculate total oxygen storage capacity.


The presence of a breeding population of trumpeter swans was established from previous summer records of swans and by data from extensive aerial surveys. Beaver activity is an important influence in the development of ponds used by swans.


The Wildlife Working Group (composed of various fish and game personnel from Oregon, Washington, and Idaho) assessed the impact of controlled water level fluctuations on riparian and associated upland habitat, vertebrate species using these habitats, and proposed river regulation impacts upon these habitats.


Beavers were used to help restore severely eroded trout streams of southwestern Wyoming.


The author focuses primarily on damage prevention and control methods, such as repellents, traps, and shooting.


Temperatures measured in the walls and living chambers of four beaver lodges near Fairbanks, AK, over 1 year, showed that body heat was a significant factor in maintaining inner lodge temperatures.


This study compared peripheral nerve function at low temperature in a variety of mammals, including beaver, from interior Alaska.


In beavers from the vicinity of Fairbanks, AK, nerves accustomed to tissue temperatures approaching 0 °C were compared with nerves that encounter less severe cooling and nerves that are accustomed only to deep body temperature. Conduction velocity-temperature slopes of the three nerves were different, and absolute refractory periods in the cold-adapted nerves were significantly shorter at low temperatures.


The researchers developed a mathematical model of the growth phase of an unexploited beaver (Castor canadensis) population in Massachusetts. The rate of pair formation between dispersed individuals varied as a function of the number of occupied colony sites within an area containing a fixed number of suitable sites.


This is intended as an aid in ecological and food habitat studies and in law enforcement investigations.


Muchmore reviews beaver life history, trapping, reintro-duction, management, and habitat preference in Wyoming.


Stream reach evaluations were conducted on 20 livestock allotments within the Deerlodge and Lolo National Forests of Montana to assess compatibility of cattle with riparian resources.


Munther discusses the impacts of beaver on wildlife, water quality and quantity, fish habitat and populations, recreation, livestock, forest vegetation, and condition of transportation facilities.


The authors constructed a nitrogen budget for a section of a second order stream in eastern Quebec and a beaver dam in that stream. The beaver-modified section accumulated approximately 1,000 times more nitrogen than before
alteration. The ecosystem implications of beaver activity suggest that current concepts of patterns and processes in running waters require modification.


Effects of beaver activity were considered on several major ecosystem components and processes in boreal forest drainage networks in Quebec, Canada. Results suggest that current concepts of the organization and diversity of unaltered stream ecosystems in North America should recognize the key role of beaver because drainage networks with beaver are substantially different in their biogeochemical economies from those without beaver.


An outbreak of Giardia lamblia gastroenteritis occurred in Reno, NV, in 1982. Giardia cysts were recovered from the water supply and a beaver infected with Giardia was found in one of the reservoirs. Corrective measures included the removal of the infested beaver.


The authors discuss the value, history, management, and future of California's furbearers.


In a study in Wood Buffalo National Park of Alberta and the Northwest Territories, Novakowski found that energy deficits are a product of the winter behavior of the animals and that energy conservation and an increase in fur insulation and fat deposition provide the necessary mechanisms for survival.


This is an analysis of a group of sounds made by 14 beaver kept in confinement on the University of Saskatchewan campus. The study related sound production to age in beaver and also to behavior and survival. Because beavers are an herbivore and a prey species, vocalization while foraging would seem to have no survival value. Vocalization primarily occurs within the lodge.


This study examined the potential protein of wildlife as a protein source. Beavers have been a source of protein for many years.


Oertli describes his various methods of observation along with the behavioral patterns of beaver in the Rocky Mountains of Alberta, Canada.


This current record of collections containing beaver and other mammals from Oregon lists the numbers of each species on deposit in each collection.


Furtaking is Oregon's oldest industry. Furs taken in 1977 brought nearly $1.2 million to approximately 1,500 licensed furtakers.


This study, conducted in the bottomland and mixed pine-hardwood forests of Bradley, Clark, Cleveland, and Dallas Counties, AR, evaluated the effectiveness of Magic Circle as a potential beaver repellent. Contrary to previous reports, Magic Circle did not discourage beavers from repairing dams.


A complex of beaver dams can improve the quality of water flowing through them, according to studies on a section of Currant Creek in southwestern Wyoming during May-August 1984 and April-June 1985.


A simple model is proposed to measure the potential of beaver to resist perturbations of lower order streams.


Payne looked at density, colony size, reproduction, and mortality of beaver populations in North America.
This study aims to identify, delineate, and describe the riparian and associated upland habitats; to identify wild vertebrates, excluding fish, using these habitats; to establish indices and population estimates where possible; and to make preliminary assessments of river regulation impacts upon these habitats and their associated populations.

Adult waterfowl preferred beaver ponds larger than 0.4 ha over natural catchment basins of the same size.

Conducted in the Kananaskis Valley of Alberta, this study examined the role of crane flies in energy and nutrient turnover and tested certain ideas concerning life history strategies in aquatic insects.

The authors describe five beaver ponds that were abandoned for about 10 years in an area of white spruce-lodgepole pine forest in the Kananaskis Forest Reserve in the eastern foothills of the Rocky Mountains in Alberta. They also describe the life cycle of the cranefly. Craneflies are clearly important in terms of energy flow, and there are some interesting relationships between their distribution and abundance and habitat conditions.

Alderflies were studied in abandoned beaver ponds in the Kananaskis Forest Reserve of Alberta.

Habitat inventory and evaluation of brook trout populations from 57 beaver ponds in Colorado permitted comparisons of stunted and nonstunted populations of fish and the environmental conditions under which the populations occurred.

Hudson’s Bay Company tried to introduce beaver conservation schemes in western Canada between 1821 and 1850. This study looks at the lands that lie within the company’s northern department.

Overtrapping of beaver and subsequent loss of their dams is one of the multiple causes for watershed deterioration of the Gila River and its tributaries in New Mexico.

The Canadian Wildlife Service was involved in the development and testing of traps. Results showed that a trap, if it is to kill humanely, should be designed to avoid impacts in the abdominal region.

Beavers have the power to change both the history and the topography of the land by their way of life.

Fires in some parts of the boreal forest have proven to be beneficial to beaver populations by replacing the coniferous forest with aspen and willow.

For 6 years beavers helped the U.S. Department of the Interior, Bureau of Land Management to combat soil erosion in southwestern Wyoming. Projects are now under way to help curb erosion near Salt Lake City, UT.

The introduction of beaver by the U.S. Department of the Interior, Bureau of Land Management on Wyoming’s Currant Creek to help control erosion has succeeded in slowing stream flow and reducing sediment transport. Rye grass and willow have returned to the banks and spring flooding has been regulated.

The author makes an effort to establish some basic information on the economic value of sustained harvest of California’s beaver, mink, and muskrat.

The authors evaluated the role of coarse woody debris in the geomorphology of streams, specifically: longitudinal profiles, channel patterns and positions, channel geometry, sediment and organic matter storage, and channel dynamics. They also examined the fisheries implications of coarse woody debris, including blockage to migration, water quality, and summer and winter rearing habitat.


Shay relates the history of beaver trapping in Oregon.


Wildlife and their preferred habitats were inventoried on the Suislaw National Forest of the Oregon coast in 1973 and 1974 to determine general changes in wildlife habitats resulting from timber management. Timber management activities were not expected to have a serious impact upon beaver.


During the summers of 1979 and 1980 on a mountain rangeland near Laramie, WY, streams were tested for bacteria as indicators of pollution, and were studied for differences between grazing treatments and streams. Variation in counts of fecal coliform and streptococci could not be fully accounted for by differences in grazing management, but the variation is partially explained by beaver damming of stream flow.


The authors provide a model of the relationship of beaver to their habitat, a means of beaver inventory, a basis for beaver management, a land capability methodology, and the development of a land capability classification system for beaver.


Observations were made at 115 colony sites within a 100-km radius in the northern interior of British Columbia, May through August 1974 and 1975 and October 1974. Raft constituents are selected both for their availability and their ability to submerge and secure the cache. Because preferred foods are frequently used for this purpose, the beaver does not attempt to conserve the food resource by using nonfood and low preference food species in the raft.


Yukon Department of Renewable Resources conducted an inventory in the Yukon River Basin in 1982 and 1983. Beaver food cache and colony site surveys were analyzed in conjunction with an ongoing trapper questionnaire and historical fur harvest data. The authors discuss the fur resource capability and problems and issues associated with impacts on furbearer populations, habitats, and user groups.


Smith looks at the feasibility of using computer software to help improve stream habitats for beaver.


Species of the virilis group, except the primitive D. virilis, are semibiobialy commensals of the beaver. The decimation of the beaver population during the 18th and 19th centuries resulted in a drastic reduction of the virilis species group populations.


A beaver specimen (Castor canadensis repentinus Goldman) was collected from southwestern Utah, showing an extension of range.


During the summer of 1982 mammalian fecal samples were collected in the Sierra Nevada Mountains in an attempt to clarify the epidemiology of the disease giardiasis by identifying potential host-reservoirs.

The authors provide some basic information on the mammals that occur along the Colorado River in the Grand Canyon and identify locations of materials and related information for use by biologists and others. Float trips to collect the data occurred periodically from September 1970 to September 1976.


The author analyzed data collected between 1974 and 1977 to determine beavers' use of woody and nonwoody vegetation for food and to quantify seasonal changes in use of different types of vegetation.


Aerial surveys proved to be unreliable in indicating beaver population size or trend but were accurate in locating caches and were constant among years and areas.


Taylor, briefly discussing the history of beaver introduction at Sagehen Creek in the Sierra Nevada from 1945 through 1970, shows that periods of rapid growth and high population were dependent upon standing crop of aspen.


Factors that influence harvest levels include the economic success or failure of the commercial salmon fishery in Bristol Bay prior to the trapping season and changes in weather conditions as they affect trapper mobility. The author explains how current trapping practices effectively prevent maximum sustained yield management, and reviews management alternatives.


Beaver moved into part of the Summit Creek study area, thus providing increased habitat for trout and waterfowl. Some of the original brushy species were killed by flooding from beaver dams, but new willows and birch plants appeared at the edges of the marshes about as fast as old plants were destroyed.


Wildlife use riparian zones more than any other plant community. Of the 363 terrestrial species known to occur in the Great Basin of southeastern Oregon, 288, including the beaver, are either directly dependent on riparian zones or use them more than other habitats.


Researchers examined 126 specimens, diseased animals, eggs and tissue samples from July 1983 to June 1984. They found bacterial abscesses in two trapper-killed beaver. One also had extensive muscular fibrosis, and Staphylococcus aureus was recovered from the other.


The author looks at the beaver's dam construction habits.


The author presents arguments for the ecological benefits of maintaining optimal beaver populations versus the disadvantages of overpopulation.


The report includes statistics on fur production and the fur industry in Alberta from 1920-21 to 1977-78. Beaver harvests in Alberta are inadequate today, and beaver are considered overabundant in many agricultural and suburban areas.


Animal and nonanimal items were identified in the digestive tracts of 61 cougars (Felis concolor) collected between 1978 and 1984. Beaver in the diet may have represented opportunistic feeding.


The river otter often depends upon the beaver because the beaver's dam is a haven for fish, the otter's main food. Widespread efforts aimed at restoring beaver populations have also benefited the otter.


In 1974 a well-preserved skull was recovered from north-central Oregon. The cranial morphology was compared to that of other fossil beavers (Eucastor and Castoroides) and to present day Castor skulls.

*Giardia* cysts taken from the rectum and large intestine of a beaver, trapped commercially near Ribbon Creek in the Kananaskis Valley of Alberta, were added to 100 L of untreated stream water and recovered by filtration. Recovery efficiencies averaged 53 percent at cyst concentrations between 0.5 and 45 cysts per liter. Maximum cyst recovery was observed at filtration pressures of 40-60 kPa. This method results in higher recovery efficiencies at low cyst concentrations and simpler, more rapid laboratory procedures.


A survey of potential hosts of *Giardia* spp. was carried out during 1982 and 1983 in the Kananaskis Valley and Banff National Park, AB, Canada. Positive samples were found from two of 58 beavers sampled.


Researchers conducted a survey of animal feces and surface water supplies from 1983 to 1984 to evaluate the potential for zoonotic transmission of giardiasis by surface waters in the Kananaskis-Banff area. Initial results showed that 3.5 percent of beaver fecal samples contained *Giardia* spp. cysts.


The authors seek to place in perspective the kinds of factors associated with beaver populations within the study area. Identification of habitat and descriptions of habitat types provide information for land-use planning programs or for more detailed research.


Beaver fecal samples were tested for giardiasis along Forty-Mile Creek in Banff, AB, Canada in March 1982. All of the fecal samples tested positive for *G. lamblia*.


The report briefly discusses the life history and seasonal activity of the North American beaver.


The author describes the distribution of *Castor canadensis* Kuhl.

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This annotated bibliography of 206 references is provided as a working tool for natural resource specialists, land-use planners, and others charged with managing beavers and their habitats. References include both technical and popular articles. Emphasis is on the Western United States and Canada.

**KEYWORDS:** *Castor canadensis*, management, ecology, life history

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