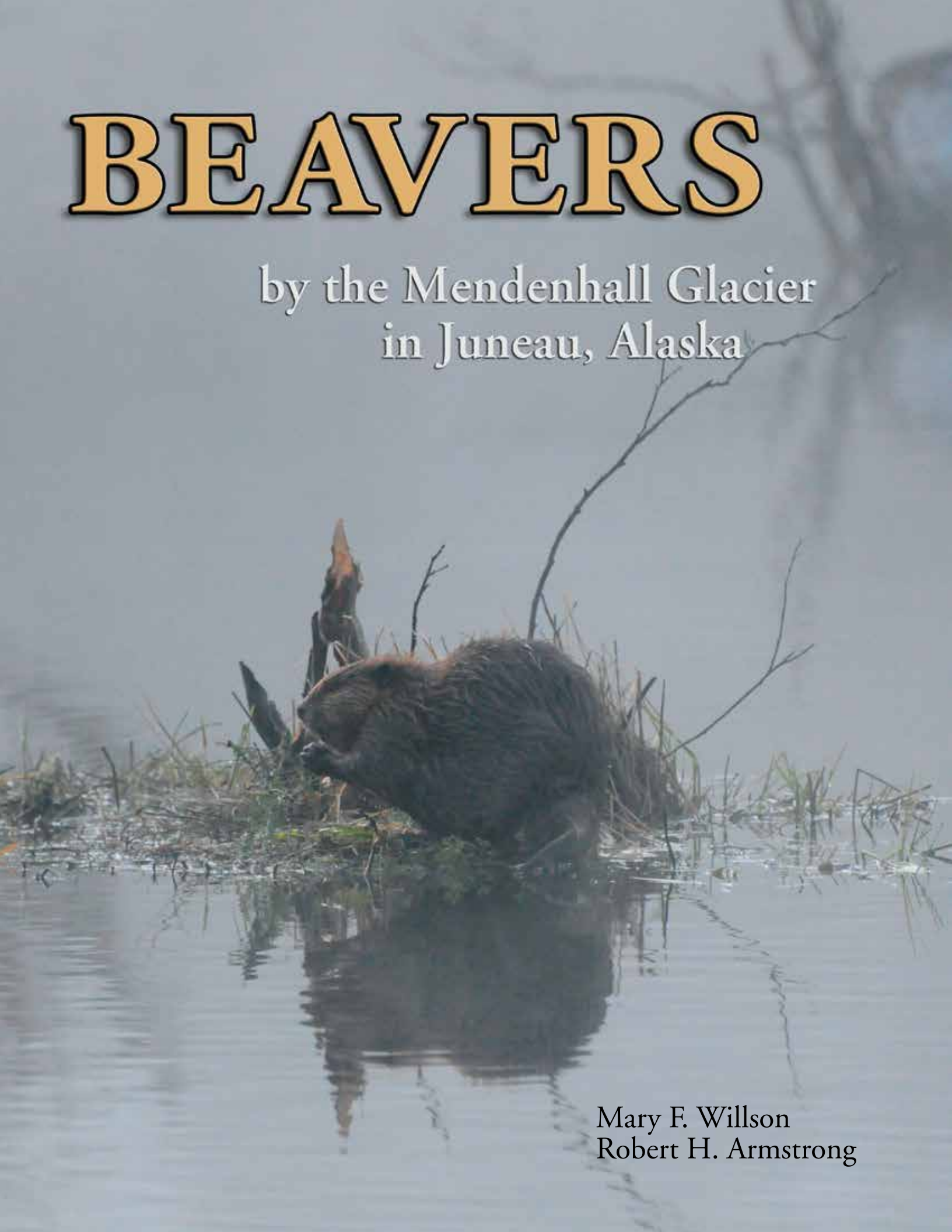
BEAVERS

by the Mendenhall Glacier in Juneau, Alaska

Mary F. Willson
Robert H. Armstrong



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Acknowledgements

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Pete Griffin (District Ranger, U.S. Forest Service, Juneau Ranger District) gave us permission to help alleviate some of the problems created by beavers in the Mendenhall Glacier Recreation Area. Keeping the culverts open on Steep Creek for migrating fish initially prompted our interest in beavers of this area.

Carol Mahera and Robbie Piehl of the U.S. Forest Service graciously shared with us their GPS data and maps of the beaver lodges and dams within the Mendenhall Glacier Recreation Area. Carol also provided her field expertise while we searched for some of the hard-to-find ponds and lodges.

Karen Maher (Education Specialist) and Lindsey Edgar (Information Assistant) allowed us to watch while they told children about the habits of beavers during a U.S. Forest Service day-camp session at Crystal Lake.

Amy Nye (Naturalist for Discovery Southeast) let us tag along and participate in a discussion with children about the habits of beavers in the Moose Lake area.

The main spark that caused us to write this book was the help and encouragement of the many people that volunteered labor and/or money to purchase tools in order to alleviate some of the flooding and fish passage problems caused by beavers in the Mendenhall area. Lorraine Murray, Pat O'Brien, Jenny Purcell, and Pauline Strong were always available to help. Many others contributed their time and expertise for work parties or from time to time. These included: Megan Ahleman, David and Pam Bergeson, Cheryl Cook, George Danner, DeeAnn Grummett, Arnie Hanger, Kathy Hocker, Juneau Youth Services, Juneau High School football team, Linda Mancuso, KJ Metcalfe, Linda Mills, Sue Oliphant, Tom Osborn, Marge Hermans/Osborn, Carrol Rafferty, Mike Tobin, Evelyn Sargent, Linda and Bob Shaw, Geraldine Straty, Marc Scholten, Steve Stoddard, Cher Stone, Sukey Pfirman, Tim Strand, Dave Willson, Don Abel Lumber, Valley Lumber, and any we may have missed.

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Cover: Beaver resting on a rock in Mendenhall Lake with the glacier in the background

Photographing Beavers

The beaver photos used in this book were relatively easy to obtain. However, it required being on site at the crack of dawn, sitting still, and using a certain type of camera and lens.

The beavers of this area appeared to be mostly active at night, but often remained outside their lodges for about 2 hours after daybreak. In early summer this meant from about 5 a.m. to 7 a.m. They also were out and about in the late evening but photography was more difficult then due to failing light and more human activity.

In the beginning I watched them through binoculars to get some sense of their habits. They usually had certain places where they groomed, gathered food, ate, and played. Then I would position myself close enough to these areas to obtain photos. On the first day they were initially upset at my presence and would swim back and forth in front of me slapping their tails. However, after about 30 minutes they resumed their normal activities. Eventually, on subsequent days, they completely ignored me and would eat, gather wood, groom, and play sometimes within a few feet of where I was sitting. Once they became used to my presence slow movements and shutter noise did not seem to bother them.

I used a Nikon D-300 camera with a AF-S Nikkor 70-300mm lens. Most photographs of beavers were taken at ISO 3200. The high ISO was needed because of the low light early in the morning. This was compounded by one of our rainiest summers on record. The camera was hand-held, which allowed me to slowly change positions without disturbing the beavers.

I was very pleased at how accepting the beavers were of my presence. Some, especially the yearlings, would swim right up to me and sit and stare. The young beavers seemed very curious.

Beavers are fun to watch and we are so fortunate to have them living in the upper Mendenhall Valley.

– Bob Armstrong

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Introduction

The upper Mendenhall Valley is excellent habitat for beavers. There are numerous ponds, several creeks, and plenty of willows and cottonwoods to eat. Beaver families live all over this area, including along the Mendenhall River and in Mendenhall Lake.

Beavers have lived in this area for decades, but there are no records of their arrival and spread. The area by the glacier is surrounded by mountains, so it seems likely that beavers arrived via the Mendenhall River, which provides the best access route to the area from other habitats downstream. It may have been the 1950s before beavers moved into the area, as vegetation became established on the ground exposed by the retreating glacier.

Some of the fine beaver habitat in the Mendenhall Valley was created by the glacier itself. Meltwater created channels and ponds. Stranded icebergs, left by the receding glacier, melted, creating kettle ponds. Meltwater from the glacier coursed over the land, making outwash channels that shifted as the glacier retreated.

Human activity created more beaver habitat. Some of the outwash channels were excavated by humans in the mid 1900s, making several more ponds and ditches that are now used by beavers.

Glacial retreat left bare ground in its wake and a succession of plants colonized the area. The first to appear were lichens and mosses, of no particular use to beavers. Later, a few herbaceous species, such as sedges, fireweed, and lupine began to grow. Seeds of willow, cottonwood, and alder arrived by wind. Seedlings of these shrubs and trees can grow quickly, sometimes over a foot a year. However, it probably took at least 20 years after bare ground was exposed for these woody plants to reach a size usable by beavers.

The beaver population grew, but it endured many setbacks from intensive trapping and probably from wolf predation. Nevertheless, by 2008, beavers occupied almost every possible corner of this area.

Beavers may have come to the Mendenhall Valley initially by overland routes near the coast and even by crossing saltwater channels.

What are beavers?

Rodents. Within the taxonomic order Rodentia, beavers belong to the family Castoridae, along with the Eurasian beaver and some extinct forms. The scientific name of the North American beaver is *Castor canadensis*.

Beavers are the largest rodents in North America and the second largest in the world after the capybara of South America. Adults generally weigh between 40 and 80 pounds, but occasionally reach 100-110 pounds. They are about 48″ long, including a 15-16″ tail. The fur is usually dark brown, consisting of an undercoat of short, soft, paler fur and an overcoat of longer, coarser guard hairs. The tail is broad, flat, and scaled, and is used for many purposes. Males and females look alike.

Beavers seem to be immensely strong for their size. They haul heavy stones and logs to build their dams and lodges. Their leg bones are short and heavy—built for strength, not speed. Nevertheless, they can run for short distances.

Semi-aquatic. Beavers depend on bodies of water for protection, transportation and travel, and food storage, but they do much of their foraging on land. Because they use both water and land, they are not as highly adapted to aquatic life as seals or whales, but they do have many adaptations that suit them to their semi-aquatic existence. They are strong swimmers, propelled by their enormous, webbed hind feet. They groom their fur with water-repellent oils from special anal glands. They can close their nostrils, ears, and throat when underwater. And they have special physiological adaptations for diving.

Herbivores. Beavers are herbivores, eating leaves, roots, and bark. They have sharp incisor teeth for cutting stems and branches, strong, ridged molar teeth for chewing up foliage and bark, and strong muscles to work their powerful jaws. They also have a specialized pouch on the digestive tract that helps them digest cellulose from their plant diet.

Construction artists. Beavers build structures that modify their living environment. Their dams create the ponds they need for the aquatic part of their lives. Lodges provide shelter, protection from predators, and a place to raise the newborn kits. These structures are built of tree branches, mud, stones, grasses, and moss, and can reach impressive sizes.

Landscape engineers. Beaver dams, timber-cutting, and trail-building modify stream systems and the surrounding areas. These modifications provide habitat for many other organisms. They also change patterns of sedimentation, nutrient deposition, oxygen availability, and vegetation succession.

Evolution of Beavers

The ancestors of beavers were burrowing rodents that may have used their sharp, cutting incisor teeth to chop roots out of their burrows, or possibly to carve away chunks of hard soil. The earliest castorid fossils are known from the late Eocene period, over 34 million years ago. It is not entirely clear if castorids originated in North America or Eurasia.

During the Miocene period, about 20 million years ago or a bit earlier, a branch of wood-cutting castorids split off from the earlier type. There were about eight genera of wood-cutters, including the *Castor* that includes present-day *Castor canadensis* in North America and *C. fiber* in Eurasia. Some of the eight genera were apparently semi-aquatic, like *Castor*. Of all the wood-cutters, *Castor* is the most specialized for cutting wood. It is thought that *Castor* arose in Eurasia and migrated to North America 2-5 million years ago, during the Pliocene period, probably over the Bering land bridge.

During the Pleistocene ice ages there were several species of beaver, some much larger than *Castor*, living in Europe and North America. One of the giant beavers in North America probably weighed about 220 lb—about the size of a small bear. They apparently built lodges of cut trees but may not have built dams, perhaps living in existing lakes and ponds. All the giants became extinct near the end of the last major glaciation about 10,000 years ago.

Giant beavers were about three times heavier than present-day beavers. They also had larger heads and longer incisor teeth, in proportion to their body size.

Beavers do not have a great capacity to deal with cold in metabolic ways. So some researchers suggest that beavers can establish populations in the cold Far North because of their ability to build protective lodges, dams that impound water, and underwater caches of branches for winter food.

Present-day populations of *Castor canadensis* in North America exhibit different characteristics that reflect the different environments they inhabit. Beavers in the north cache a lot of branches under the ice for winter feeding, but southern beavers cache little or none, because they can forage anywhere all year long. The difference in caching behavior seems to be triggered by cold weather: a southern beaver placed in the north is likely to build a cache. Northern beavers also exhibit seasonal metabolic and behavioral changes that southern beavers lack. The metabolic differences appear to be under genetic control, and therefore the differences indicate that beavers continue to evolve adaptations for differing environments.

This rare white beaver, on display at the Anchorage airport, was captured on the Kenai Peninsula.

Family Life and Reproduction

Beavers are socially monogamous, and pairs commonly stay together for several years unless one of the pair dies. In at least some populations, however, matings occur outside the social pair bond, and some young ones are fathered by neighboring males instead of the male paired with the mother.

Beaver families range in size from four to eight animals, but a typical family consists of two adults, two or three yearlings, and two or three kits of the year. The frequency of pregnancy and the number of kits in a litter are generally higher in good habitat, with abundant deciduous trees, than in poor habitat with conifer forest. Young beavers usually stay with their parents until age 2, when they move out to search for their own mates. If the available habitat is full of beavers, however, they may stay at home for three or even more years, or if the available habitat has a lot of unoccupied space, they may leave home when they are only one year old.

Young females are able to become pregnant and bear litters as soon as they've left their natal family and found their own home-site. Early-breeding females are smaller than older ones, they suffer higher mortality, their litter size is typically small, and their kits may not survive as well. Fully adult females usually produce a litter every year and may do so for several years. Most beavers live only 10-12 years in the wild, although longevity would obviously be less in populations heavily exploited by humans.

Female beavers come into estrus (mating readiness) and mating occurs in late winter. If a copulation does not result in pregnancy, the female may come into estrus, at irregular intervals, several more times that year. The kits are typically born in spring, about 3.5 or 4 months after copulation. They stay in the lodge for four or five weeks, tended by adults and yearlings.

The mother nurses them for 6–10 weeks. Beaver milk is very rich, containing 19% fat. Protein content is also high (11.2%), higher than that of most other rodents' milk. The energy content is about 92.5 kcal/g, higher than that of most other mammals' milk.

The kits begin to eat plant material when

At Dredge Lake two adult beavers touch noses while a yearling beaver looks on.

only 2.5 weeks old, while they are still drinking milk.

Kits weigh about one pound when born, but develop rather rapidly. They may weigh 6-9 pounds several weeks after birth, when they start to leave the lodge regularly. A newborn kit can defend itself by hissing and clacking its teeth and can even groom its own face. A kit can dive when only 1.5 week old, and then it needs water-repellent fur. The older members of the family groom a kit's fur with oil from their anal glands, until the kit can oil its own fur, at age 1.5-2 months. Kits only 3-4 weeks old can slap their tails in the characteristic warning signal, but they need practice to do it well.

Yearlings may weigh 19-23 pounds or so. Their growth rate depends on the abundance and quality of food resources. In a poor area, yearling may weigh half as much as a yearling in a good area. Growth rate slows down with age, and body weight fluctuates with the seasons.

This beaver was the largest beaver we have seen in the Mendenhall area. We photographed it at the small pond on the rock peninsula in front of the glacier.

An adult beaver and one of its yearlings interact with each other at Dredge Lake.

Two kits play together, wrestling and diving, at Dredge Lake.

Young beavers seem to be very curious. This Dredge Lake yearling would sometimes sit and stare at Bob for several minutes while he was taking photographs.

Throughout most of the spring and summer we had not observed the yearlings helping with dam building. However, by fall they began helping their parents. This youngster is bringing material for the dam at the outlet of Dredge Lake.

Swimming and Diving

Beavers are well-adapted to their aquatic life-style. Their fur is dense (77,000-148,000 hairs/sq. in., compared to about 1,200 for human head hair), with long guard hairs over a soft, thick undercoat. Oil from a pair of anal glands is used to 'dress' the fur and make it water-repellent.

Large, webbed hind feet help to propel beavers through the water remarkably fast.

The compact body shape helps reduce heat loss in cold water. The shape is somewhat streamlined, but less so than that of many other active aquatic animals. The legs are short, and the front legs are held next to the chest when a beaver is swimming. Powerful muscles in the hindquarters provide drive to the large, webbed hind feet that propel the animal through the water.

When a beaver swims, most of its body is submerged. But its eyes, ears, and nostrils are located near the top of the skull, so that it can breathe and monitor its surroundings. During a dive, special valves close the nostrils and ears. A protective transparent membrane slides over the eyes. Part of the tongue and throat block water from entering the trachea.

As in all rodents, there is a wide gap between the incisors (the cutting teeth) and the molars (the chewing teeth), and beavers can close their lips behind their incisors.

When a beaver swims, most of its body is submerged. But its eyes, ears, and nostrils are located near the top of the skull, so that it can breathe and monitor its surroundings.

This allows them to gnaw branches under water without swallowing wood chips and water.

Beavers can stay under water for several minutes (often up to 5 or 6, seldom as much as 10 or 12). During a dive, the heart rate slows, conserving oxygen. Circulation to brain and heart increases, while the blood supply to the rest of the body decreases, thus redirecting oxygen to vital organs. Beavers have a great capacity to store carbon dioxide in their tissues. When a diving beaver comes to the surface, as much as 75% of the air in the lungs can be exchanged, dumping the accumulated carbon dioxide (five times more air exchange than humans). The heart rate accelerates again when the animal surfaces, which helps restore the resting levels of oxygen and carbon dioxide.

Beavers show their terrestrial origins in their relatively poor ability to conserve body heat when immersed in water. Thick fur and body fat are insulators, but beavers in cold water lose body heat much faster than seals do.

An adult beaver doesn't lose heat as fast as a smaller one does. A kit's body temperature can drop about 13° F in just 20 minutes when immersed in water near freezing.

The broad, flat, scaly tail of beavers is their most diagnostic characteristic, and one of its most important functions is thermoregulation. Tails (and the hind feet) are heat-exchangers, losing heat in warm weather but conserving heat in winter. At the base of the tail is a complex network of blood vessels in which arteries, carrying warm blood from the body core, pass close to veins, carrying cool blood from the tail back to the body. Heat is transferred from the warm arteries to the cooler veins and carried back into the body. This counter-current mechanism conserves heat. In addition, because the tail is kept cooler than the body, it loses heat more slowly to the surrounding cold water.

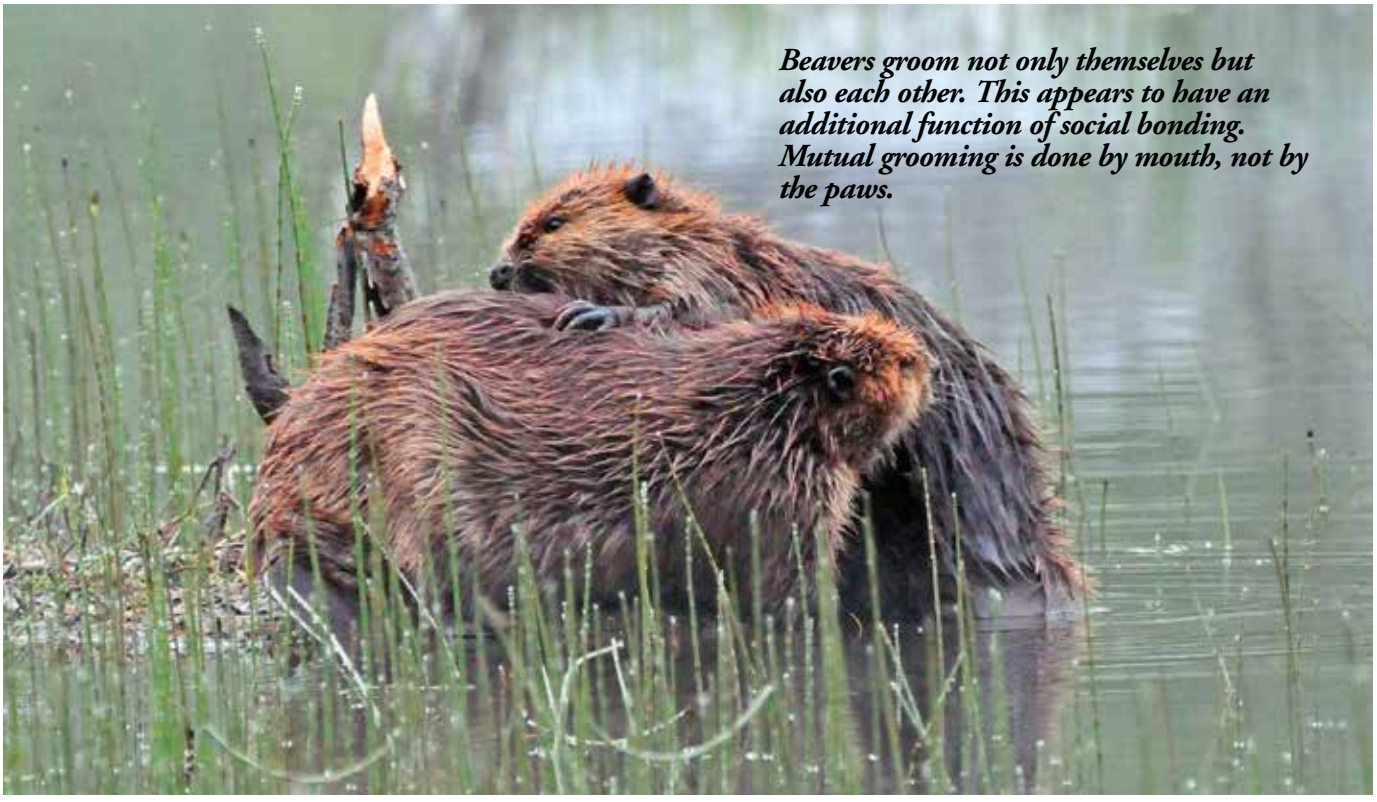
Beaver tails are multi-purpose tools that serve their owners in an astonishing array of functions. They serve as props for beavers standing on their hind legs while walking on land and cutting trees. Swimming beavers use their tails as a rudder to help steer their forward progress. Tails are also used for alarm signals, fat storage in winter, and for regulating body temperature. Female beavers give birth to their kits onto their tails, which are folded forward under the sitting mother.

Contrary to some popular notions, beaver tails are not used to pack mud into the dams.

However, insulation and heat exchangers are not sufficient for beavers to stay warm in cold conditions. Beavers also have to use behavior to thermoregulate if they are exposed to cold water: so they must leave the water periodically in order to maintain body core temperature. Large beavers, with a relatively small surface/volume ratio, can stay in the water 2-3 times as long as kits, which have a relatively large surface area for their volume.

Grooming

Beavers spend a lot of time grooming their fur. They rub the oily secretion of the anal glands over the fur to increase water-repellency. On the second toe of the hind foot is a special, split nail that is used to comb the fur.



Beavers groom not only themselves but also each other. This appears to have an additional function of social bonding. Mutual grooming is done by mouth, not by the paws.

Communication

The principal modes of beaver communication involve scent and sound.

Chemical communication by scent marking is very important in beaver society. Beavers build scent mounds of mud and vegetation along the shore of their home area, especially in spring, when young beavers are wandering in search of homes of their own. The mounds notify the wanderers that the place is occupied, and encourage them to move on. The home area of a beaver family may contain up to several dozen scent mounds.

Each scent mound is anointed by members of a beaver family, especially the male, with chemical signals. Beavers have large (up to about 4˝) internal pouches, called castor sacs, associated with the urinary tract. These contain castoreum, an aromatic liquid that contains many (45 or more) compounds derived from the beaver's diet. Such compounds are commonly produced by plants to defend themselves from various plant-eaters, and beavers seem to have found a way to both use the plants and recycle the compounds in concentrated form for their own use. Once a scent mound is built, the builder and other members of the family deposit castoreum on it, often repeatedly.

Each beaver family can recognize its own 'perfume' of castoreum and distinguish it from that of neighbors and strangers.

The anal glands comprise a second set of scent organs. These are smaller than the castor sacs and can be everted. The oily secretions of the anal glands are chemically complex, containing dozens of compounds. Beavers mark scent mounds with these secretions too. Each animal produces a distinctive scent, like a chemical fingerprint. Beavers can identify gender, family membership, and individual identity by the odor of the anal gland secretion.

Beavers produce a rich variety of vocalizations, many of which are not well understood. A whining call is used especially by kits begging for food, and sometimes by one- and two-year-olds if adults force them to leave the lodge. Beavers also hiss defensively, when frightened or annoyed; even tiny kits can hiss.

By far the best known sound signal produced by beavers is the tail slap. It is an alarm signal, given in response to disturbances or perceived threat. Beavers of all ages slap their tails, but young ones do so with less discrimination than adults and are more often ignored.

Beaver scent mound at Moraine Lake.

Often the tail slap is accompanied by a dive.

This young beaver is giving a whining call to its parent who is eating.

This beaver has raised its tail in preparation for slapping the water.

Cutting Wood

Beavers have large incisor teeth with chisel-like cutting edges. These teeth grow continuously, so beavers need to gnaw on wood to prevent them from growing too long. The roots of incisors are very long: the lower incisors extend well back in the lower jaw, almost to the back of the jaw. The front layer of each incisor is exceptionally hard and wears down more slowly than the back part of the tooth, maintaining the chisel edge.

The jaw muscles are very powerful, and beavers can exert great force when biting. Large muscles attach broadly to the short muzzle, running from there to the lower jaw. These muscles not only close the jaws but also move the lower jaw forward, for biting. Other large muscles, attaching to the skull, help control jaw movement.

One study showed that beavers tend to cut wood with incisors on one side at a time, using the upper tooth as an anchor and the lower one as the cutter. When felling a tree, beavers often make an upper cut a few inches above a lower one, and then bite out the intervening chip (presumably using both sets of teeth).

Trees smaller than about 6 inches can be cut in less than 50 minutes, very small ones in less than one minute. Time to cut a tree increases rapidly with tree diameter, so a tree that is more than 10 inches in diameter may take over 4 hours to fell.

Sometimes beavers cut down very large trees, more than 36 inches in diameter. They commonly do this task over several days, working at it only periodically. Very large tree trunks are typically left on the ground, although some of the bark may be chewed off, but the beavers cut off the branches and twigs and carry them home. Very strong ligaments, running between head and shoulders, reinforce the neck, allowing a beaver to pull and carry heavy branches.

Beavers don't always judge accurately the direction a cut tree will fall. Depending on the density of the stand, 10% or more of the cut trees may get hung up on adjacent standing trees. Very rarely, a timber-cutting beaver is directly in the path of a falling tree.

Beavers can fell large trees. This one near Moose Lake measured 15 inches in diameter.

One of the best places to see the variety and sizes of cottonwood trees that have been felled by beavers is near the outlet of Crystal Lake.

Food and Feeding

This beaver in Moose Lake is eating alder leaves.

Beavers are herbivores, consuming a wide variety of plant species. They need a mixed diet, because no single food item supplies every nutritional need. Across North America, beavers are known to eat parts of many dozen plant species, and the diet in any region depends partly on availability.

The available mixture changes with the seasons. Nutritional values may also change seasonally. Summer foods include tree leaves, pond weeds of several types, and the underground parts of sedges and pond lilies. Cottonwood and willow leaves contain more protein than tree bark and are available only in summer. Aquatic plants, another summer source of food, provide more essential sodium and iodine than other plants.

Tree bark is the principal food in winter, although it is less digestible than the leafy foods of summer. Over all of North America, the favored trees of beavers include aspens or cottonwoods, willows, and sometimes alder, but many other species are also eaten, especially where the favorites are rare.

In addition, many plants defend themselves against plant-eaters by means of defensive chemicals that make the plant distasteful or difficult to digest. So any herbivore must make its food choices by assessing not only energy and nutrient content but also edibility.

Some trees increase production of defensive compounds, and thus reduce their palatability or digestibility, after they've been attacked by an herbivore. Cottonwood trees produce sucker shoots from roots and stumps after a beaver has felled the tree. These young shoots contain more of certain defensive compounds than the original tree. Beavers avoid them, switching to other foods or traveling farther from the home pond to find more desirable cottonwoods.

As a general rule, the farther a foraging beaver has to go from its home pond, the more selectively it forages. The value of the food to be obtained must be balanced against the cost of traveling farther and the increased risk of predation to a beaver on land. Beavers seldom travel more than a couple hundred yards from their home waterways.

This beaver in Moose Lake is carrying a cottonwood branch. Cottonwood is one of the preferred foods of beavers.

Cottonwood stumps produce sucker shoots. Curiously, the juvenile leaves of these shoots resemble willow leaves. These shoots have more chemical defenses than the original tree and are avoided by beavers.

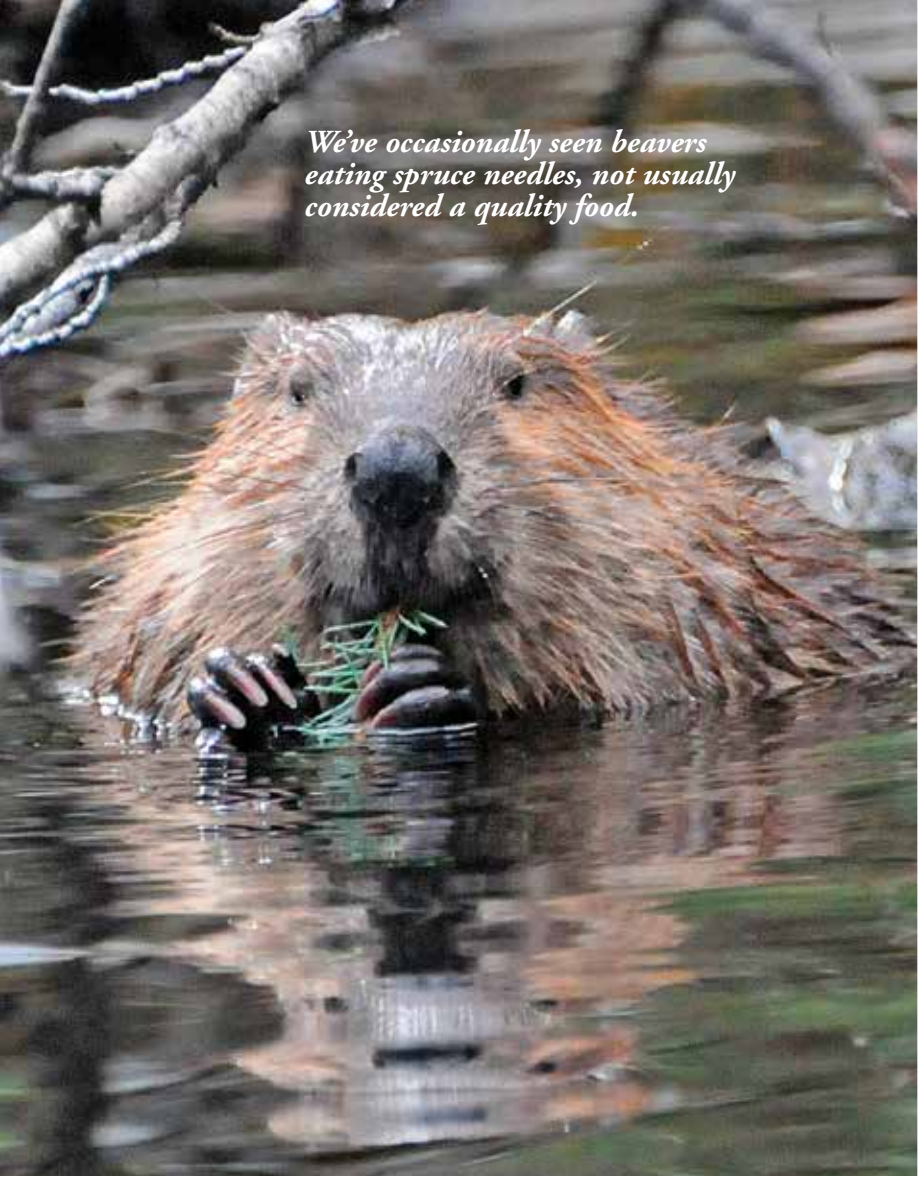
Far right: Beaver Lunch Spot. You can often see areas where beavers have eaten the bark off branches. This well-used spot was on the bank of Mendenhall Lake.

This beaver, photographed at the Holding Pond, is eating horsetail. This is one of the most common plants of summer and can be found along the margins of most lakes and ponds in the glacier area.

Another summer food of beavers in the Mendenhall Glacier area is pondweed. To get this food the beaver dove underwater in Dredge Lake and brought it to the shore to eat.

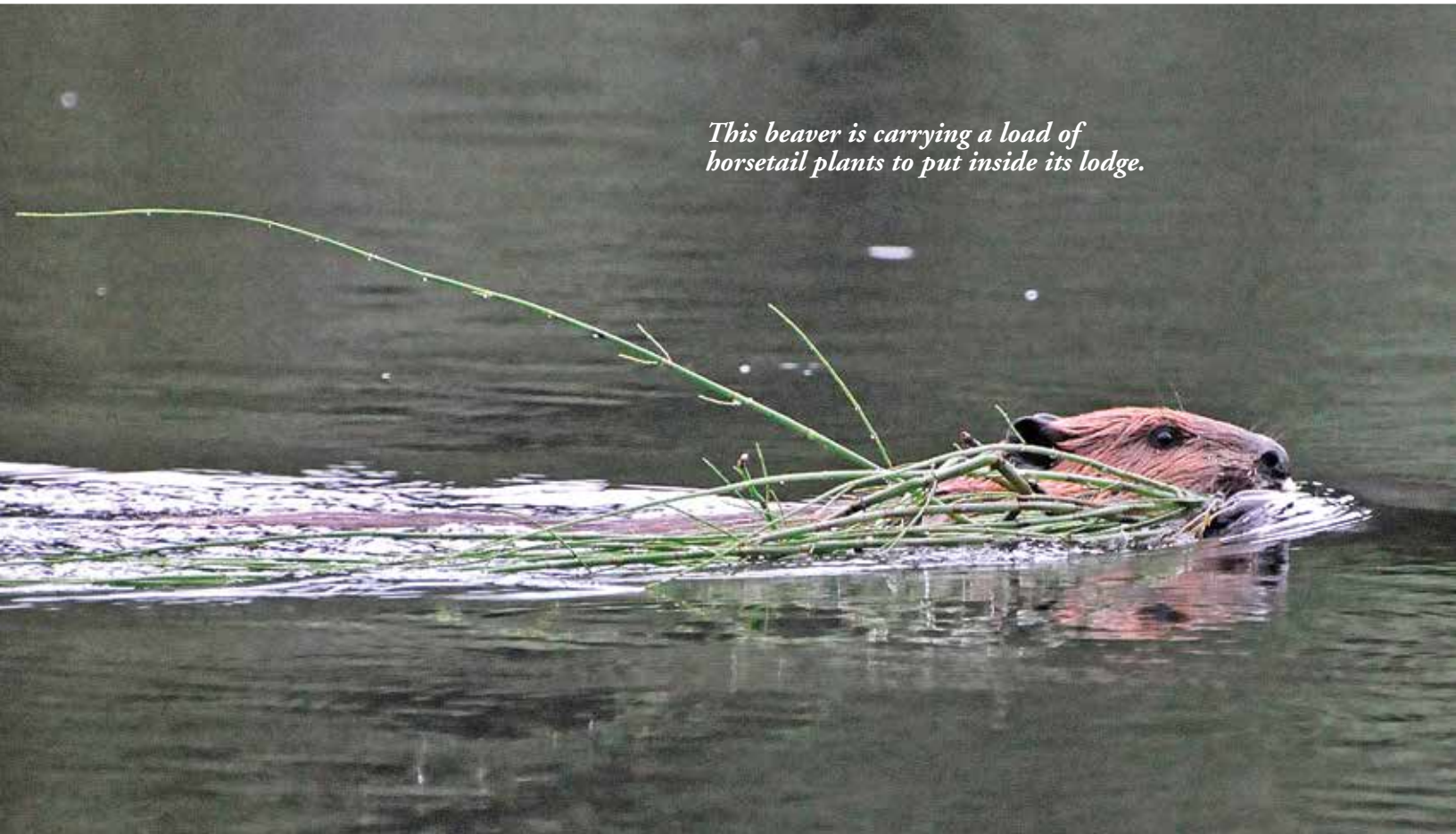
Willows are one of the most common shrubs in the emerging landscape near the glacier. They are also one of the foods we most frequently see beavers harvesting.

This beaver is eating willow leaves at a small pond near one of the salmon-viewing platforms at the glacier.



We've occasionally seen beavers eating spruce needles, not usually considered a quality food.

This beaver repeatedly leaped out of the water to get this cottonwood branch overhanging the shore of Moose Lake, but he was unsuccessful at dragging it down to where he could bite it off. Finally, he slapped his tail on the water and swam away.



This beaver is carrying a load of horsetail plants to put inside its lodge.

This beaver is eating the bark off a cottonwood branch. Holding it in his front paws, he twirls the branch while scraping the bark off with his teeth.

This beaver is eating a chip of wood from a cottonwood tree. We could hear it crunching away and it sounded like someone chomping on a potato chip.

If a cottonwood tree falls in or near water, the beavers often eat the bark. Note that the branches of this tree have been eaten by the beavers.

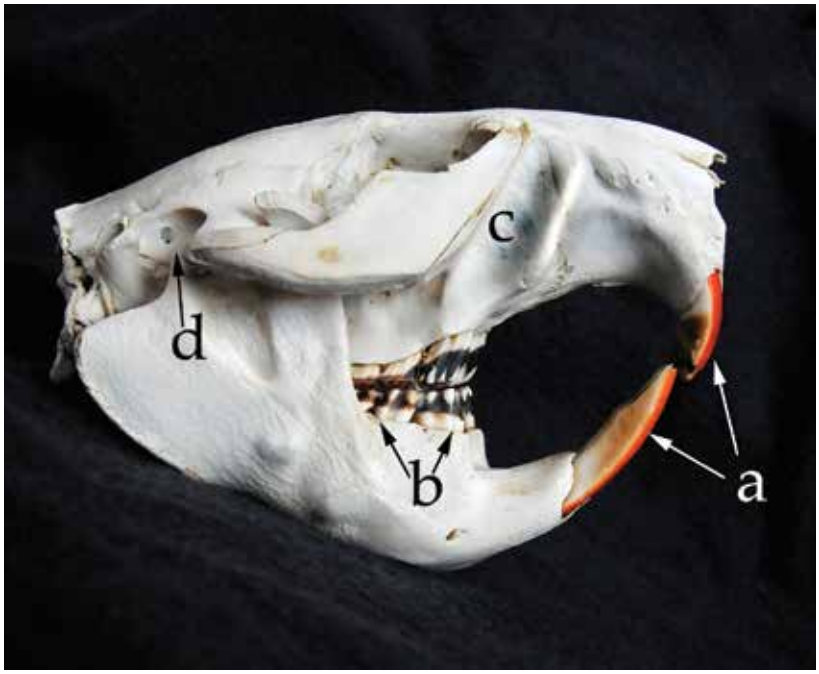
Digestion

The first step in digestion is cutting off bits of food and chewing it into smaller bits. Beavers have compact skulls, with short muzzles. The jaw joint is fairly high on the skull, which allows the cheek teeth (molars) of upper and lower jaws to meet in parallel, for grinding up food. The molars have broad, ridged crowns that shred and crush plant material. In contrast, the jaw joint of carnivores is low on the skull, the teeth typically have sharp cutting edges, and the jaws have a scissors-like, shearing motion.

Green and woody vegetation contains a lot of cellulose, which is typically difficult to digest. Herbivores have to consume much more material than similar-sized carnivores, whose food is more easily digested.

Beavers deal with cellulose in several ways. Attached to the digestive tract, near the junction of the small and large intestines, is a large pouch, called the cecum. It is filled with bacteria that break down cellulose into smaller, more usable molecules. This material is excreted as a special kind of feces, which is dark and soft. Beavers eat this material, passing it through the gut a second time and extracting more of the nutrients and vitamins. Beavers share with rabbits and some other small plant-eaters this curious habit of eating the products of cecal digestion. Digested material that has not been processed by the cecum is lighter and firmer; it is excreted but not eaten.

Beavers can deal with a variety of plant defensive compounds. Tannins are one of the chemical defenses of plants, and beaver saliva can tie up certain tannins, which prevents them from affecting digestion. They sequester many kinds of plant-defensive compounds into their castor sacs, and their castoreum is 'flavored' with an array of such compounds.



For cutting wood, beavers have large incisor teeth (a) with chisel-like cutting edges. The molars (b) are used to shred and crush plant material. The deep groove (c) houses a large muscle for jaw closing. The jaw joint (d) is high on the skull, well above the tooth rows, which then can meet in parallel.

How much does a beaver need to eat? This depends on size, growth rate, seasonal metabolic rates, and the characteristics of the available foods. For example, a 33 lb beaver can process about 7.5 lbs per day, at least when eating summer foods. The digestive tract can't hold all this material at once, and the tract has to be emptied 2-3 times a day.

Lodges

The center of beaver family life is the lodge. Lodges come in all sizes, from casual-looking piles of sticks just a few feet in diameter to massive accumulations of sticks and mud 30-50' wide and 10' above the water line. Some lodges are built on the bank of a pond, lake or river, and others are little islands surrounded by water.

When beavers build a bank lodge, they tunnel from below the pond surface into the bank, with an opening on the surface of the bank. Then they pile sticks on top of the opening and pack the sides of the pile with mud, grass, and moss. The very top of the pile is usually not plastered, thus leaving space between the sticks for ventilation. After piling up all those sticks, the beavers bite off branches inside the pile and excavate more dirt to make a living chamber.

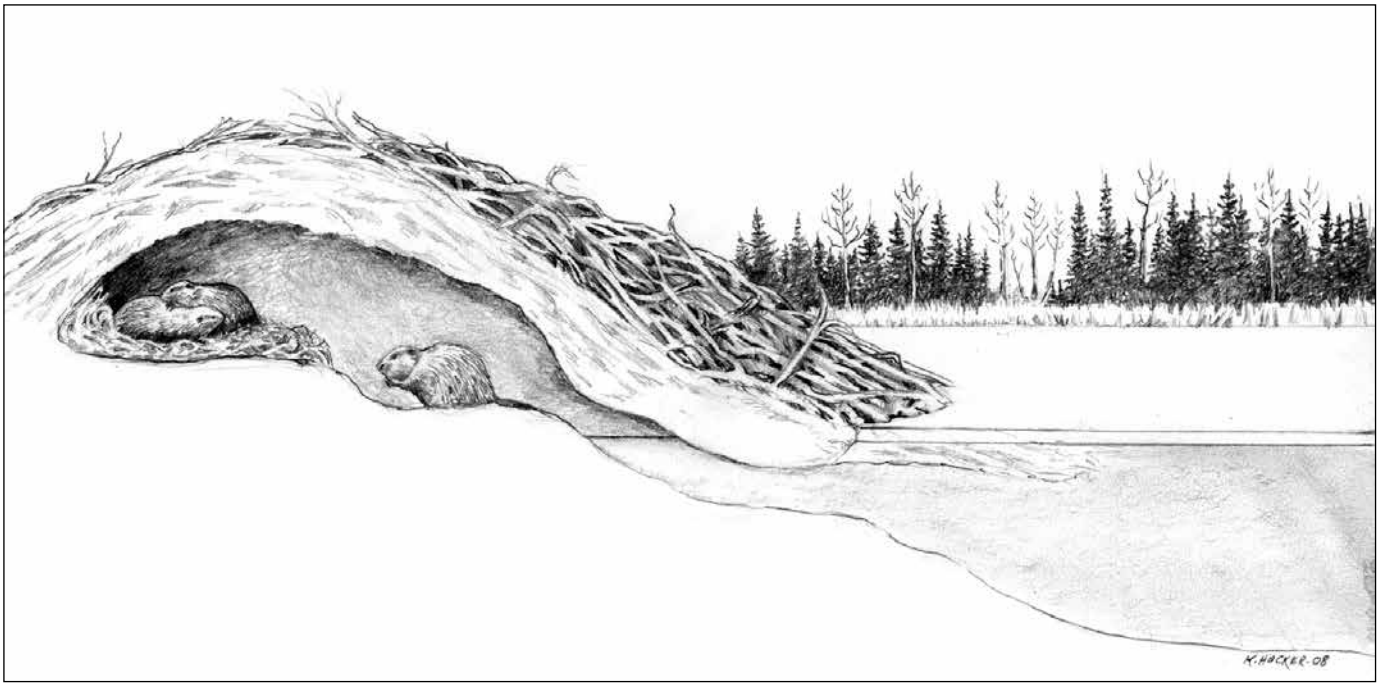
In some cases, lodges are constructed on top of a platform of sticks in shallow water. Beavers pile up more sticks on this platform and then chew entrances and living chambers inside the pile.

A beaver family may have several lodges. A main lodge is the center of activity. Smaller lodges may be used for short times, or as retreats from danger, or as sources of air for beavers swimming under winter ice. There may also be simple burrows in earthen banks for occasional use.

Beavers also make dens deep inside earthen banks, sometimes as much as 20-30' from the water, and reached by a tunnel from the pond. The living chamber is carved out of the soil at the end of the tunnel. Bank dens are used where it is not feasible to construct lodges because trees are scarce or the river is too large.

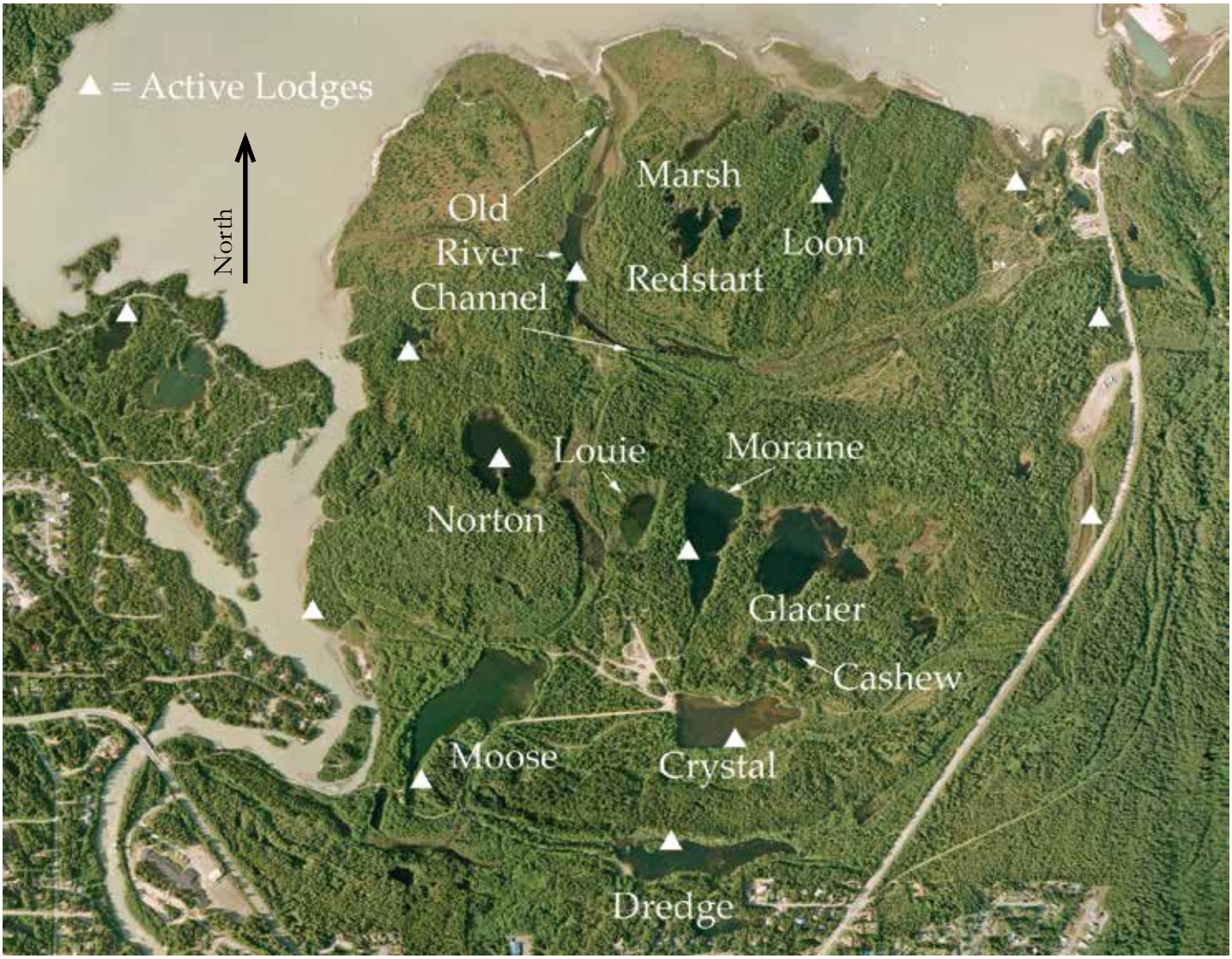
All lodges have underwater entrances, usually two or even three of them. When a beaver swims through the tunnel into its lodge, it emerges on a low platform. This area is used for drying off and for eating. A raised area beside the low platform is the family bed, usually covered with a carpet of wood chips. Here they groom each other and sleep, and here the kits are born.

This beaver lodge is located on the old river channel. It is completely surrounded by water and is the largest one we have seen in the Mendenhall Glacier area.



This cutaway illustration of a typical beaver lodge shows the underwater entrance and low platform that they use for drying off and eating. The raised area above is used for sleeping and grooming.

The beaver lodge at Dredge Lake (center of photo). In 2008 this lodge housed 6 beavers: 2 adults, 2 yearlings and 2 kits.



The beaver lodges that we believe were active in summer of 2008 are indicated with white triangles. In addition, there were two active lodges near the rock peninsula in front of the glacier. If we assume 15 active lodges for the entire upper Mendenhall Valley and 6 beavers per lodge, the area could have supported about 90 beavers in 2008. However, two lodges were apparently abandoned before winter.

This lodge is located along the shore at the northwest end of Mendenhall Lake. It is the only lodge that borders the lake itself.

Dams

Beaver dams range in size from tiny sills of mud and grass a few inches high to gigantic structures hundreds of yards long and up to 20 feet high, composed of logs, branches, stones, mud, and soft vegetation. In the upper Mendenhall Valley even large dams are not more than about 6 feet high because of the relatively flat terrain.

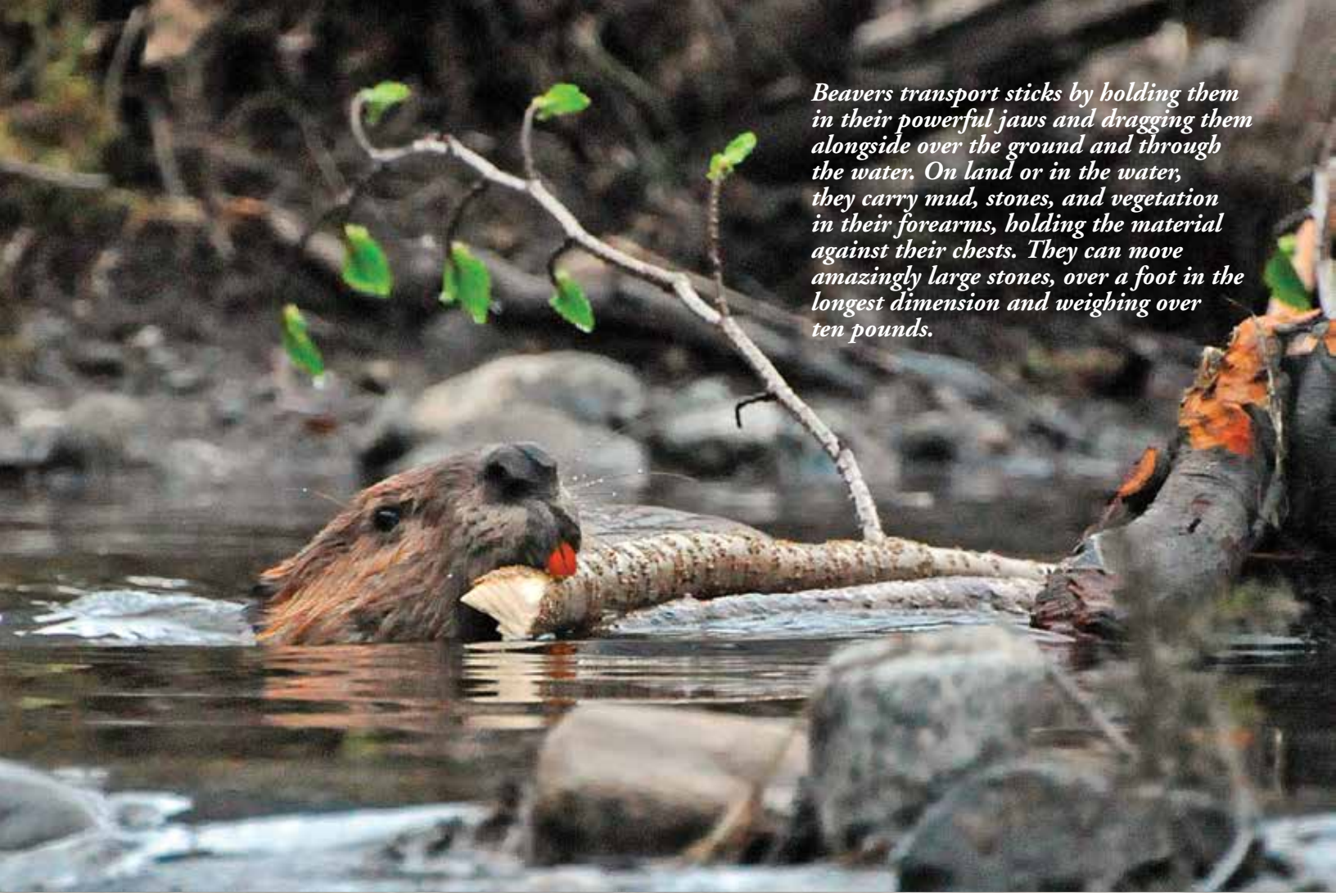
When beavers colonize a stream system, a top priority usually is building a dam to create a pond or to enlarge a pond already present. There are two main ways to start a dam. On large streams with strong waterflow, beavers may start with sticks wedged into the streamside banks and angled into the flow. Later sticks are poked into the collection of starter sticks and aligned with the flow. Gradually the structure is extended into the stream and eventually the gaps are closed. Then the beavers may work to increase the height of the whole structure and seal the spaces with mud, moss, and grass.

In small streams, beavers may first raise a ridge of mud, gravel, twigs, and leaves across the stream. Later, larger branches may be added. Most of the added branches are placed with the butt end downstream and the twigs and leaves at the upstream end. Into the upstream-facing network of twigs the beavers place more mud, stones, and wadded up grasses, sedges, and moss. This both anchors the branches and seals up crevices among the branches. Other sticks may then be added to the base layer, with some of them placed crosswise to solidify the whole array.

In addition to the main dam on the home pond, a family of beavers commonly constructs any number of subsidiary dams along the stream. This creates small impoundments used for safe travel and easy transport of branches. Exploring farther and farther upstream above a beaver pond, a hiker is likely to encounter a branching network of ever smaller ponds on ever smaller streams, used by the resident beavers to reach ever more distant food sources.

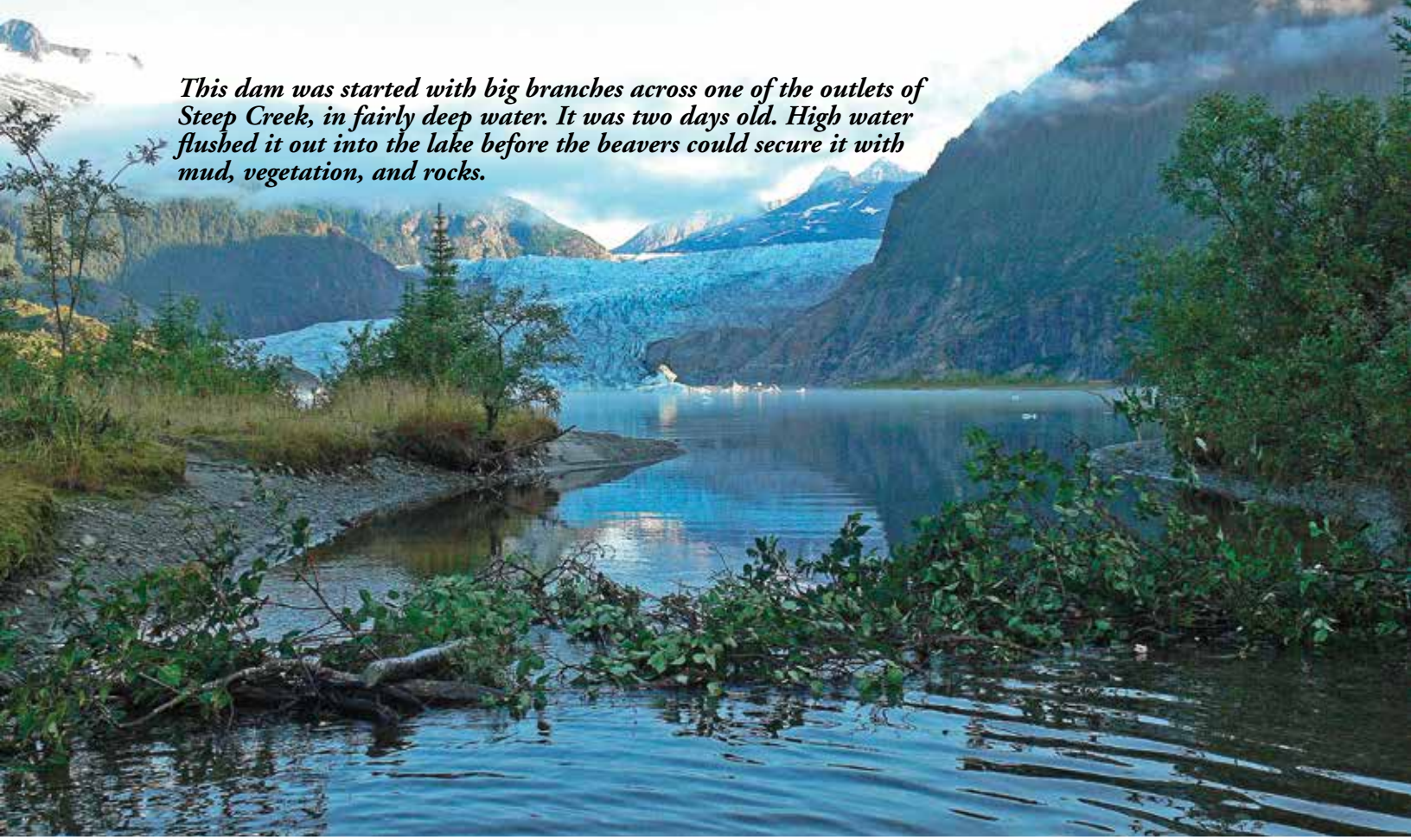
The highest and longest dams that we have seen in the Mendenhall Glacier area are across the old river channel.

This dam is across one of the outlets of Steep Creek.



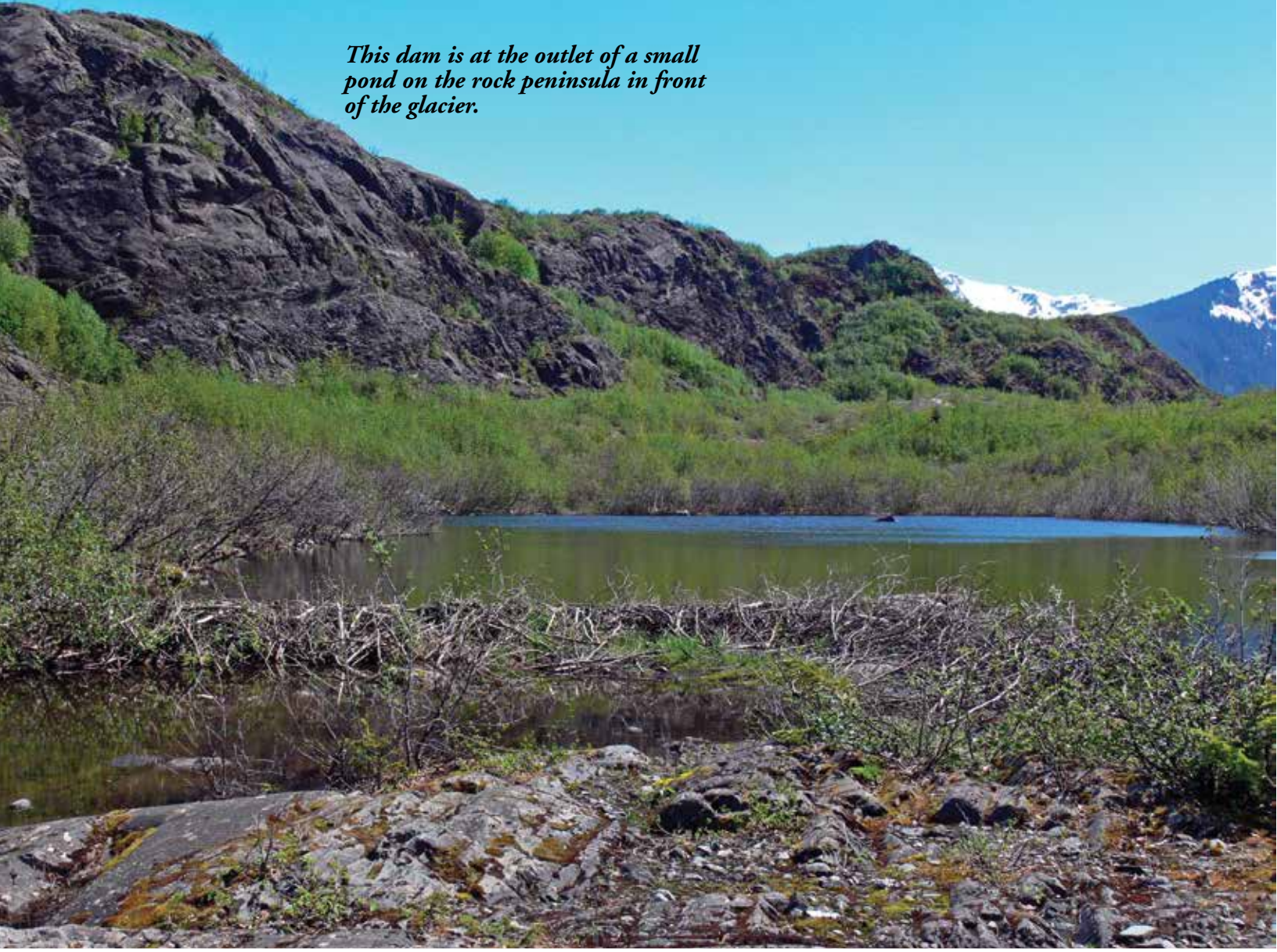
Beavers transport sticks by holding them in their powerful jaws and dragging them alongside over the ground and through the water. On land or in the water, they carry mud, stones, and vegetation in their forearms, holding the material against their chests. They can move amazingly large stones, over a foot in the longest dimension and weighing over ten pounds.

This beaver is carrying mud to put on the dam at the outlet of Dredge Lake.



This dam was started with big branches across one of the outlets of Steep Creek, in fairly deep water. It was two days old. High water flushed it out into the lake before the beavers could secure it with mud, vegetation, and rocks.

To the dam at the outlet of Dredge Lake, the beavers added smaller sticks, vegetation, mud and rocks, after the larger branches were in place.



This dam is at the outlet of a small pond on the rock peninsula in front of the glacier.

Beaver dams are often used by animals for crossing over water and as a place to look for food. This black bear is looking for salmon carcasses at the mouth of Steep Creek.

This great blue heron is using a beaver dam at the outlet of Steep Creek to look for fish.

Beaver dams can remain intact for many years even after the beavers have left the area. Vegetation eventually grows on the dam and helps anchor it in place. This dam is at the outlet of a small pond near the Mendenhall Lake shore.


North
North Shore Trail
Moraine Ecology Trail
Old River Trail
Moose Lake Trail
Moraine Lake Trail
River Trail
Dike Trail
Moose Lake
Crystal Lk Trail
Crystal Lake
Back Loop Bridge Trail
Dredge Lake

Dams and Trails

On this aerial photograph of a portion of the Mendenhall Glacier Recreation Area are shown the main trails and the approximate locations of most of the beaver dams (as of fall 2008).

Many of the main trails run along old outwash areas, where flat, gravelly stretches offer easy travel. A number of these are former roadways, used for many years by vehicles of hunters and other visitors.

Because so many trails are on flat, low-lying land, they are subject to flooding. Melting snows in spring raise the water levels of ponds and lakes. The melting glacier increases summer water levels along the Mendenhall River and the shore of Mendenhall Lake. Juneau's high rainfall adds lots of water, especially in the fall. Almost all that water drains eventually into Mendenhall Lake and its river. But the drainage is often slowed and some trails can be flooded.

Several factors contribute to slowed drainage and flooded trails. In some places, the trails were so worn by previous vehicular use that pits were created. Water often accumulates in the pits and only slowly drains or evaporates away. In a few places, inadequate culverts can back up the water over the trails at times.

The largest, longest-lasting floods are created by beaver dams. Parts of the Moose Lake Trail and the Old River Trail have been under water for years. Parts of other trails are flooded intermittently, especially after very heavy rains, when the dams slow the release of water. Because culverts constrict water flow, they attract the attention of beavers, which respond inherently to the sound and feel of running water by damming the culverts themselves.

Clearly, a combination of natural and human factors have contributed to the flooding of trails in the Mendenhall Glacier Recreation Area.

Trails and Canals

Beavers make both land and water trails to facilitate access to food sources and transportation of sticks back to the home pond. Land trails, just a bit wider than a beaver's body, lead from the home waterways up into stands of trees suitable for cutting or into adjacent ponds. Beavers also dig canals, and sometimes tunnels, from pond-side into marshy or low-lying ground, for the same reasons. Channels also pass along the pond bottom from the lodge to dams, caches, and scent-marking stations. They provide deep-water passage under winter ice and may also serve as landmarks.

Some beaver trails are quite obvious, like this one near Crystal Lake. You can easily find beaver trails leading from and to most area lakes and ponds that have active beaver lodges. But look carefully and you can also notice beaver trails leading over the paved highway along Steep Creek and over some of the gravel roads and human trails in the area.

This beaver canal leads from a pond near Mendenhall Lake to the lakeshore. It gives beavers that live in the area relatively safe access between the pond and Mendenhall Lake. Like most of the many beaver canals in the area, it leads through vegetated, marshy terrain.

Predators and Parasites

Humans have long been the main predators of beavers. Heavy commercial trapping from the 1500s to the early 1900s nearly exterminated beavers from North America. Present-day trapping and shooting is the major source of beaver mortality in many areas. (Note: the U.S.F.S. Mendenhall Glacier Recreation Area is closed to trapping except by permit.)

Where human exploitation is low, wolves are probably the main predators, but bears, wolverines, and coyotes may also capture some. The farther away from water a beaver is, the more vulnerable it is to these predators. Beavers become especially subject to predation by wolves when the beavers' food supply is scarce and they have to venture farther and farther from water, and/or the wolves' main food supply (deer, moose) is scarce and they turn to beavers instead. Mortality of young beavers (less than 3 years old) tends to be much higher than that of adults. In water, adult beavers are quite safe, but kits can be eaten occasionally by otters or even by large fish such as northern pike.

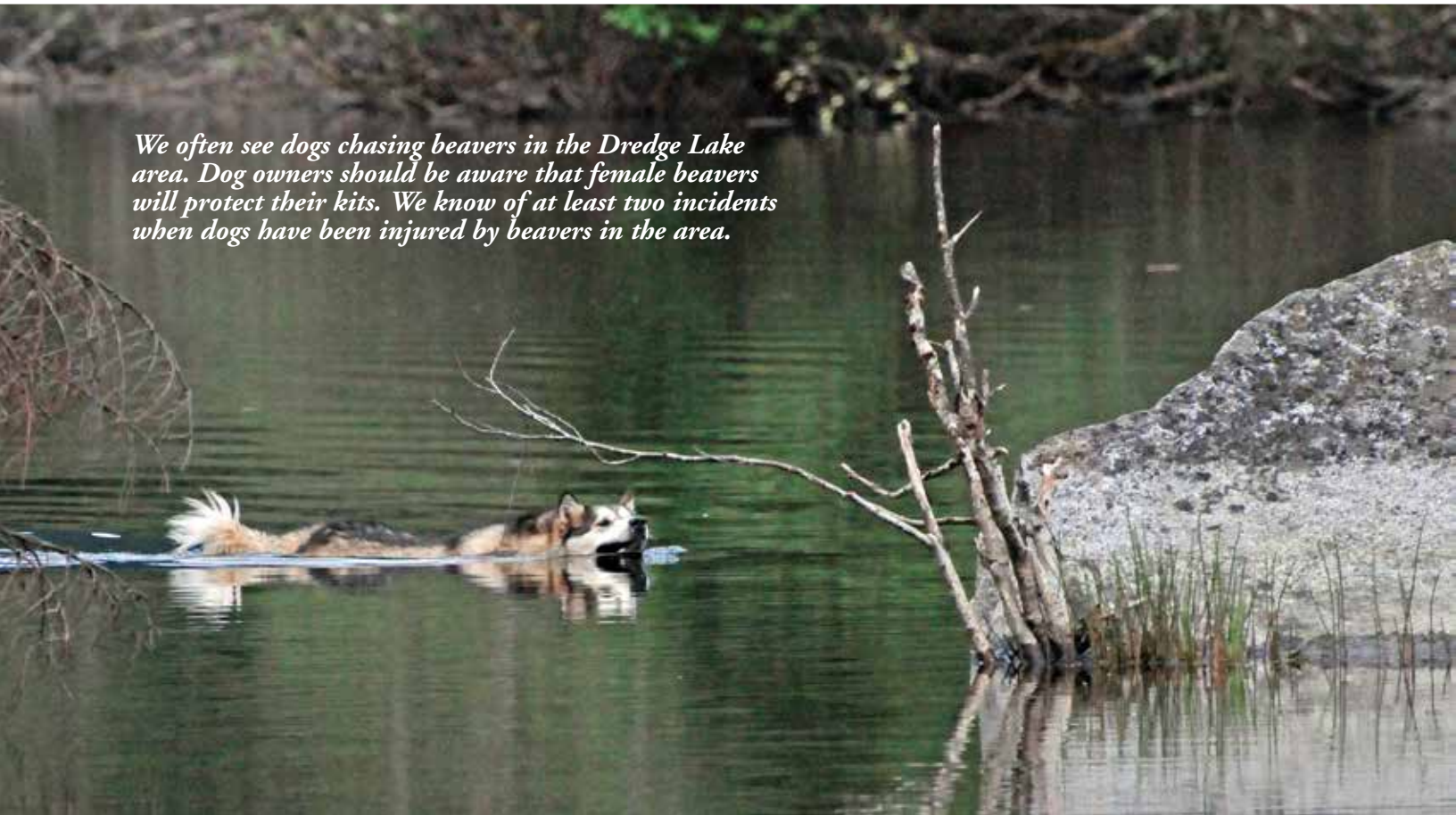
Other sources of mortality may include catastrophic floods, which may drive beavers onto land, and accidents, such as road-kill. Starvation takes a toll in hard winters, or when suitable food trees are depleted near the lodge, or if a dispersing beaver fails to find suitable forage along the way.

Diseases such as tularemia (a bacterial disease transmitted by ticks and flies) can wipe out whole populations of beavers. Beavers are also hosts for several kinds of intestinal parasites, including flukes and roundworms. Beavers and other aquatic mammals can carry giardia, a protozoan parasite that causes intestinal disturbances in humans. Although beavers can harbor the giardia cysts, they apparently do not get sick. It turns out that human contamination of water is by far the main source of human infections.

Externally, beavers host a blind, flightless, very specialized beetle that eats fur and epidermis, and another beetle that preys on parasitic mites. Beavers may carry thousands of mites in their fur, with different kinds of mites on different parts of the body.

Probably the main predator of beavers in the Mendenhall area is a lone black wolf that has lived there for the last few years. He has been observed stalking and taking a beaver on land, and one resident who lives along the river has reported seeing the wolf carry a beaver. In addition, beaver fur and bones have been seen in wolf scat in the area.

We have no evidence of black bears preying on beavers in the Mendenhall Glacier area. However, we once watched a bear digging into a beaver lodge on Steep Creek. After about 10 minutes, the bear emerged with a dead salmon.



We often see dogs chasing beavers in the Dredge Lake area. Dog owners should be aware that female beavers will protect their kits. We know of at least two incidents when dogs have been injured by beavers in the area.

Seasonal Adaptations

Beavers in northern North America have to cope with marked seasonal changes. Winter, especially, brings challenging conditions. Cold temperatures cover ponds and lakes with ice. Deciduous trees are leafless and aquatic plants die back. Northern beavers have developed several ways of dealing with winter.

In the fall, beavers build food caches in the water near the lodge. They cut small trees and branches of deciduous species. Some of these sticks are pushed into the mud at the bottom of the pond, and others are woven into the uprights. More and more sticks are added to the pile, which eventually sinks below the surface, with just a few twigs emerging.

Bark on the branches of the food cache is the winter food supply for the beaver family. During the winter, northern beavers stay in the lodge most of the time, emerging periodically to cut branches from the cache and take them back to the lodge to eat. As ice begins to form in late fall, and as it begins to thin and break up in early spring, beavers may break the ice in front of the lodge and near the dam, thus temporarily keeping open their access to food on shore. They break it with their front paws, or stand on it until it breaks, or butt it with head and shoulders.

Beavers do not cope very well with environmental temperatures much below freezing, although they live in northern areas with extreme winter cold. They cannot maintain their body temperatures efficiently below about 27° F. So they become relatively inactive and spend most of the time in the lodge, where the body heat of the family maintains a more moderate temperature, usually near 32° F, even when external air temperatures are much lower.

Beavers also reduce their metabolic rate in winter, thus saving some energy. Average body temperature of adults drops about 3°F. Adult food intake is reduced and growth stops until spring. In contrast, kits maintain the same body temperature year round, do not lose weight, have a higher metabolic rate, and keep on growing.

To the right of this lodge on Steep Creek, the beavers have cached willow branches they will use for food in the winter.

Beavers store body fat around the internal organs, under the skin, and especially in the tail. Adults may become quite obese in late fall. The volume of the tail may double in fall, and its fat content grows from about 7% to as much as 64%. Adults commonly lose weight during the winter and early spring, metabolizing the stored fat. Some researchers suggest that adults in winter rely primarily on energy conservation (lower metabolism, low activity, and stored fat), and eat relatively less (for their body size) of the food cache than kits.

A beaver lodge along the edge of Mendenhall River.

Beaver footprints in the snow along Mendenhall River.

A beaver lodge on the old river channel showing the winter cache of food on the left (a). Photo taken on October 8, 2008.

This photo taken on July 15, 2008 shows no cache of food near the same lodge.

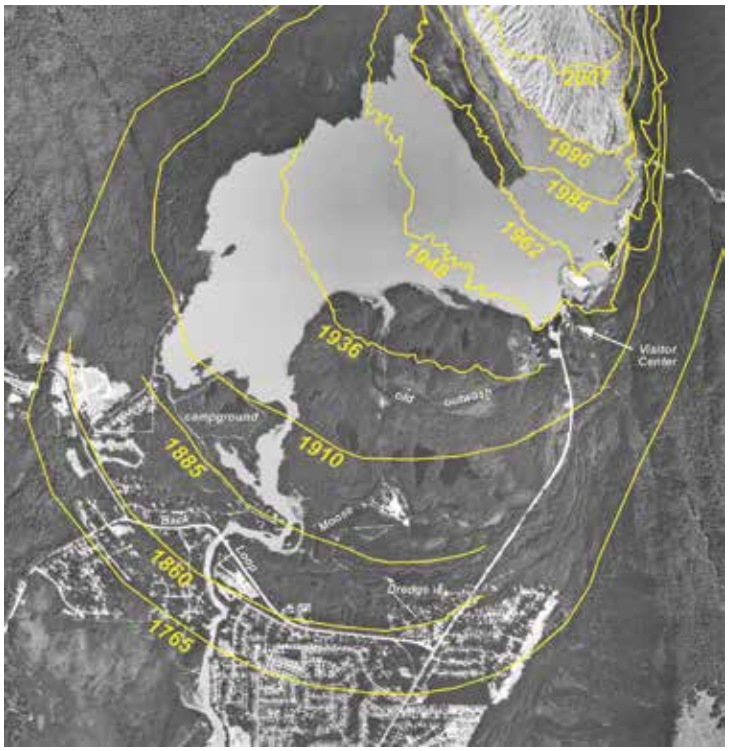
Creating a Landscape

When beavers arrived in the upper Mendenhall Valley, they found fine beaver habitat: a well-watered landscape of ponds, wetlands, and streams, where their preferred trees (willow and cottonwood) grew well. This landscape had been shaped by ice and water and, later, by human activity.

Ice and Water

The Mendenhall Valley was once a deep glacial fjord, carved by the passage of Ice Age glaciers. While it was flooded by sea water, about 12,000 to 6500 years ago, hundreds of feet of marine sediments were deposited, making the fjord shallower. Then, the last major Ice Age glacier retreated, removing the prodigious weight of ice that had depressed the land. The land rebounded, rising above the reach of sea water. Glacier meltwaters deposited outwash stream sediments over the newly exposed marine material, and vegetation began to grow.

Around 6000 to 5000 years ago, the climate became colder and glaciers advanced again. The Mendenhall Glacier moved down-valley, knocking down the forest that had grown in the upper valley, and depositing rubble on top of the earlier sediments. During a Little Ice Age from about 1300 to 1850 or so, the Mendenhall reached just past what is now the Back Loop Road. It then receded in fits and starts, leaving small moraines in concentric arcs that stretch across the upper valley.

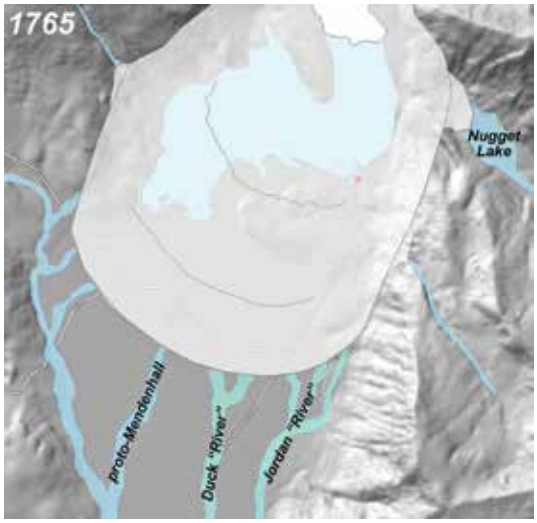


Aerial photo of upper valley, showing glacier recession lines with dates.

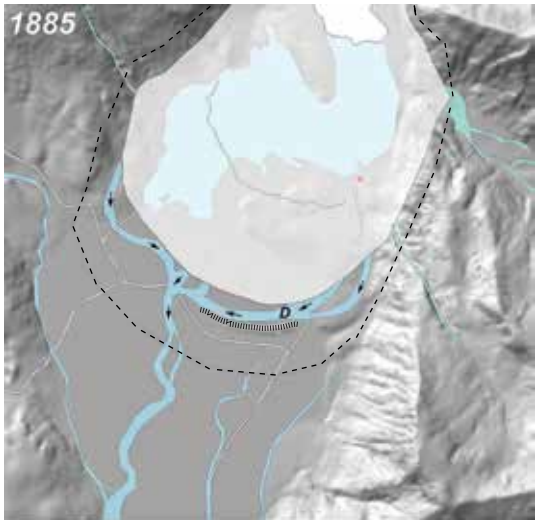
As the Mendenhall Glacier of the Little Ice Age receded, outwash from its melting poured over the valley floor, shifting its course, sometimes dammed by the curved moraines, sometimes abandoning former channels. Stranded icebergs melted, leaving water-filled kettle ponds.

Vegetation has recolonized almost the entire area, with lichens and mosses on the most recently exposed land close to the glacier and young spruce forest near the Back Loop. Willows, alders, and cottonwoods grow around ponds and outwash areas.

Moraine Lake is probably a kettle pond formed when the glacier retreated, leaving stranded icebergs that melted in place. In 2008 this lake had an active beaver lodge. These beavers foraged for food in nearby Louie and Glacier Lakes.

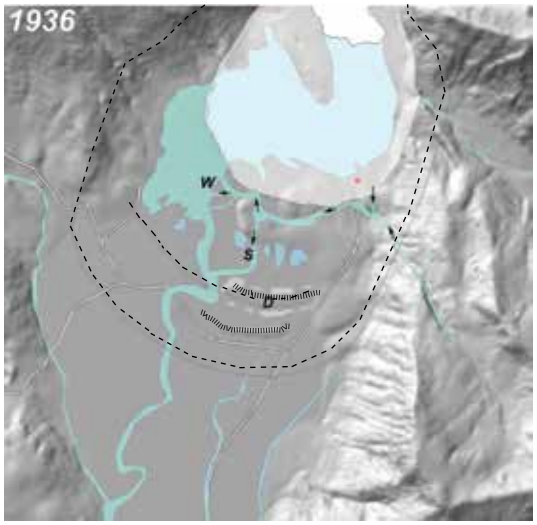


Maximum extent of the Mendenhall Glacier in the Little Ice Age. Several channels drained meltwater over the gravelly outwash in front of the glacier.

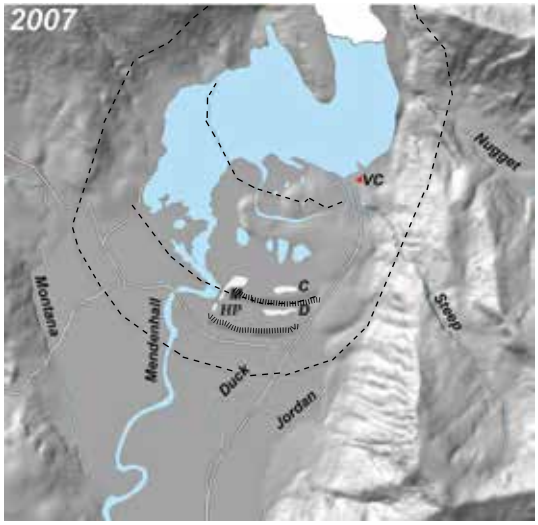


As the glacier retreated in fits and starts, it left curved recessional moraines, which formed barriers to down-valley movement of water. At "D", the eventual location of Dredge Lake, these moraines shunted water from the east side of the valley toward the west. There the water entered the channel of what was becoming today's Mendenhall River.

Historical changes in the Mendenhall Glacier Recreation Area associated with recession of the Mendenhall Glacier. On each map, the Visitor Center (red dot), outlines of glacier extent at certain times during its retreat (dashed lines), and today's main roads are shown for reference points. Curved recessional moraines are indicated by vertical hatching.



As the glacier continued to recede, meltwater, now joined directly by Steep Creek, found new routes westward over a broad delta (W), with part of the water swinging south (S) between the newly exposed natural ponds, shown in blue. Pale ovals at "D" show the abandoned outwash channels near the 1885 position of the ice and the future man-made ponds, shown in the next map. Mendenhall Lake was emerging.



The glacier has retreated rapidly, Mendenhall Lake is almost entirely ice-free, and Steep Creek now meets the lake near the Visitor Center. Ponds shown in white (C = Crystal, D = Dredge, M = Moose, HP = Holding Pond) were dredged for gravel or fish-rearing in the 1940s and 1970s.

Creating a Landscape

Humans

Before vegetation grew thickly in the upper valley, people created roadways over much of the area, following the old outwash channels. During the mid-1900s, four ponds were created by dredging some of the outwash channels. Dredge Lake and Crystal Lake were created in the 1940s, by scooping up the gravels for road-building. The present Moose Lake and the Holding Pond were dug out about 1973, as part of an experimental fish-stocking project.

Thus, human alterations to the landscape created more ponds suitable for beavers. Human activity also made ditches and constrained flowages that are much easier than the broad glacial outwash channels for beavers to dam up. Together, human and glacial forces made very nice beaver habitat.

Moose Lake was dug out around 1973, as part of an experimental fish-stocking project. In 2008 the beaver lodge on this lake was the home for a family of seven beavers.

In addition, natural drainages were altered. A ditch was dug from Dredge Lake to the Holding Pond, by-passing the natural drainage route. Another ditch drained Crystal Lake. Moraine Lake naturally drained to the north, but a new outlet was dug at the south end in the 1970s. Yet another ditch was dug from Norton Lake southward, toward Moose Lake.

Several dikes have been constructed in the area to constrain flowing water to preferred channels. There is a long dike between the Mendenhall River and Moose Lake, and another one just northeast of Norton Lake, both built in the 1970s. Steep Creek near the glacier was diked in the late 1990s.

This photo, taken in 2008, shows the outlet of the Holding Pond. The dike that was constructed in the 1970s shows in the background.

Creating a Landscape

Beavers

This Hudsonian whiteface dragonfly is emerging from its larval exoskeleton at Dredge Lake. Within a couple of hours it had expanded its wings and flown away.

More than any other vertebrate except humans, beavers deliberately modify their habitat to suit their needs. In addition, some of their activities modify habitat in incidental ways that don't directly benefit themselves but can have major consequences for other organisms. Beavers are often called 'ecosystem engineers' or 'ecological engineers' because of their remarkable ability to alter the landscape.

Dams and Ponds. The principal engineering accomplishment is the building of dams. Dams impound water, sometimes creating very large ponds, flood low-lying land, and may kill terrestrial vegetation. Beavers apparently have an inherent response to the sound and feel of running water that stimulates dam-building. Beaver ponds directly benefit their builders by providing deep water to protect the lodge entrances, providing shelter from terrestrial predators, and providing water routes for transporting building material and food.

Eleven species of dragonflies have been identified near the ponds and lakes in the Mendenhall Glacier area, including this zigzag darner photographed at Dredge Lake.

In addition to the branches used for the framework of a dam, beavers also dredge up mud from the bottom of the pond to help seal the dam. Dredging serves to deepen the pond still more. Some of the dredging activity creates channels along the pond bottom, which are useful for travel under ice in winter and as known routes to feeding areas. Canals are also built into adjacent marsh areas, to extend travel routes to additional feeding areas.

Beaver dams create habitat for many other animals. Populations of many insects (a different array than would be found in running water) thrive in the ponds and associated marshes and in shrubby pond margins.

Threespine stickleback are common throughout the Mendenhall area. This photo shows a dragonfly larva attempting to catch a stickleback.

These insects in turn provide good foraging for many insect-feeders, including birds, toads, predatory insects such as dragonflies and damselflies, and fish. Dolly Varden, and coho and sockeye salmon fry, as well as non-game species such as sticklebacks, make good use of the insect prey in beaver ponds.

Beaver ponds also provide overwintering sites for Dolly Varden and salmon fry. In times of little

precipitation, the impounded waters may offer the only available fish habitat along a drainage.

Studies have shown that coho salmon, sockeye salmon, cutthroat trout, and Dolly Varden make substantial use of beaver ponds. For coho salmon, in particular, several studies have shown that the numbers, growth rate, and survival rate of the juveniles are much higher in areas impounded by beaver dams than in stream areas without beaver dams. In one study the researchers found juvenile sockeye salmon that reared in areas above beaver dams were larger and grew faster than those that used other instream habitats.

Coho salmon populations in parts of California, Oregon and Washington are now listed as threatened under the U.S. Endangered Species Act. In some watersheds researchers have concluded that the loss of beaver-created habitat, due in part to widespread trapping, is the single most important factor limiting coho salmon production. To restore coho salmon habitat, recommendations have been made to reintroduce beavers. The fish habitat that beavers create is considered to be much better than habitat improvement by humans, and it's free.

If all beaver dams were completely removed from the Steep Creek system, the numbers of coho salmon, sockeye salmon, and Dolly Varden would probably diminish. This would then have a ripple effect on the bears, herons, mergansers and other creatures that depend on these fish for food.

River otters are reported to favor ponds occupied by beavers, perhaps largely because the ponds provide good fish habitat and good feeding opportunities for the otters. In at least some winters, they are able to use ice-free areas near dams and lodges. However, otters may sometimes prey on young beavers.

Fish-eating birds such as kingfishers and herons forage in beaver ponds. Migrating waterfowl may rest and feed there. Songbirds use the shrubby pond margins and associated marshy places. In some regions, other herbivores such as moose benefit from the aquatic vegetation in beaver ponds.

Photo by Jeff Mondragon

The number of coho salmon spawning in Steep Creek has approached 1,000 fish in some years. The juveniles of these fish are known to favor beaver ponds for rearing. Coho young in this area may live in fresh water from 1-4 years before migrating to sea.

Photo by Jeff Mondragon

Steep Creek is well known for its run of sockeye salmon, which often number in the thousands. Juvenile sockeye typically live in fresh water 1-2 years before migrating to sea. These fish may also favor beaver ponds during some part of their fresh water life.

Photo by Jeff Mondragon

Numerous Dolly Varden spawn in the Steep Creek system and elsewhere within the area. The young of these fish typically live for 3-4 years in fresh water before migrating to sea.

Although not numerous, sea-run cutthroat trout are known to occur in some streams and ponds occupied by beavers in the Mendenhall area.

River otters are fairly common in the area, especially in the more remote parts such as around Norton Lake. But we have also occasionally seen them in the beaver pond just below the salmon-viewing platform on Steep Creek.

Ducks of many species often nest near beaver ponds and bring their broods to forage there. Mallards and teal nest near the shores, and some ducks use holes in the standing dead trees. Snipe and red-throated loons sometimes nest on the pond margins. Swans and geese may nest near the ponds.

Beaver ponds are known to offer mating and rearing sites for several species of pond-breeding amphibians. For example, wood frogs (which occur in Alaska) favor older beaver ponds with very open tree canopies and warmer waters, where their tadpoles can grow well. Ponds in the Mendenhall area formerly hosted breeding populations of western toads, which have now vanished from the area except for scattered reports of wandering adults.

Belted Kingfishers nest in the cut-banks of the Mendenhall River and often forage for fish in nearby beaver ponds and lakes. This female kingfisher is holding a juvenile salmon.

Beaver ponds also capture silt (sometimes up to several inches/yr), nutrients, and pollutants. The dams slow the runoff of water during times of heavy precipitation and during droughts. Sometimes dams divert waterflow and help establish alternative channels, which help accommodate flood flows. If a large dam fails, the resulting rush of water downstream can be destructive. However, such catastrophic failures are rare in the low-gradient systems such as those in the upper Mendenhall Valley.

The water in beaver ponds is often warmer than that in the associated streams, although it may stay cold for longer in the spring. In our cool climate, warmer waters in summer allow juvenile fish to forage more actively and grow faster.

This great blue heron captured a Dolly Varden in the roadside beaver pond at Steep Creek.

Even after beavers have abandoned a site, useful habitat is created as the pond gradually drains and fills with sediment. A diverse array of mosses, sedges, and grasses create a meadow, which can support an animal community distinct from that of the forest. After some time, vegetation succession proceeds and forest may be re-established.

Lodges. Beavers also build their own housing. Many animals build temporary nests, dens, or display areas, but beaver lodges may be used for many years by multiple generations.

Other creatures may make use of beaver lodges. Mink, otter, and, in some regions, muskrats may take up residence in an unused chamber or abandoned lodge.

Tree Cutting. Tree cutting, for food and building material, modifies the habitat. The density of trees is reduced, opening the canopy to more sunlight and changing the array of plants that grow there. Consumption of aquatic vegetation alters the composition of that community also, and reduces the amount of litter available for decomposition.

Beaver-killed wood benefits many animals. Dead, standing trees in beaver ponds may be used by nesting woodpeckers, tree swallows, chickadees, and even owls. Larger trees may be used by hole-nesting ducks, such as goldeneyes and hooded mergansers. In addition, flood-killed trees are havens for bark beetles–good woodpecker food.

In some regions, beaver-cut logs and branches of willow and aspen are breeding sites for certain kinds of fruit flies. Cutting cottonwood and aspen trees induces the remaining stump to produce new shoots laden with defensive chemicals, which deter further beaver browsing. But those new shoots are very attractive to certain leaf beetles that recycle the plant's defenses for their own defense against predators, and thus they survive better. These beetles also grow faster on the re-sprouts.

Intensive timber harvesting by beavers eventually leads to a reduction of the supply of suitable beaver food. The site may be abandoned completely, and the population of beavers in that area declines.

Photo by B.E. Small (VIREO)

Photo by R & N Bowers (VIREO)

Several species of songbirds have recently increased in the upper Mendenhall Valley. Birds such as American redstart (above), common yellowthroat (left), and northern waterthrush (below) feed and nest around the ponds and marshy areas created by beavers. The Juneau Audubon Society now leads spring bird walks into the area to look for these species and others.

Some species of birds, such as this Wilson's snipe photographed on its nest at Norton Lake, seem to favor the marshy areas created by beavers.

American dippers frequently forage for insects, small fish, and salmon eggs in one of the beaver ponds on Steep Creek.

Red-throated Loons and their young on Loon Lake.

Several broods of mallards are raised in the ponds and lakes maintained by beavers in the Mendenhall Glacier area.

Common mergansers also raise their young in the ponds and lakes of the Mendenhall Glacier area. This photo was taken at Moose Lake.

We have observed a couple of broods of Barrow's goldeneye ducks in the area. These birds nest in tree cavities and may be using the dead trees that typically occur in the areas flooded by beavers. This brood was photographed at Norton Lake.

Several barn swallows build their nests and raise their young in the various structures at the Mendenhall Glacier Visitor Center. This swallow is gathering mud and vegetation for its nest from the shore of the lower beaver pond on Steep Creek.

Woodpeckers such as this hairy woodpecker commonly build their nests in trees that have been killed by beaver activity. Bird-watchers have generally noted an increase in woodpeckers within the Mendenhall Glacier area.

In the fall trumpeter swans often stop and feed in the lakes and ponds within the upper Mendenhall valley. This swan spent about a month feeding and resting on Moose Lake.

We have noted numerous mink tracks along some of the beaver-maintained lakes in the area. Mink have even been sighted from the "beaver-cam" within a lodge along Steep Creek.

Western toads were once common breeders in the Dredge Lake area. Muskrats were often seen in the Mendenhall ponds and lakes in the early 60's and 70's. Except for a rare toad sighting, both these species seem to have vanished from the area.

Population Growth and Density

Once beavers have colonized an area, the population can grow rather quickly. For example, one study found that two families expanded to 16 families in 17 years, then to 54 families in the following 13 years. Another study showed that, one year after almost all the beavers were removed from an area, there were seven new families. There were 12 families in the second year, and 17 families in the third year. Yet another study showed an increase from 34 families to 93 families in a decade or so.

After a period of rapid growth, beaver populations often decline, as they eat up their food supply. In other cases, when the food supply is not depleted, the population stabilizes for a time because population growth decreases as the population density increases. When the population is very dense, two-year-olds often stay home for an extra year instead of dispersing, and residents feed more often on less preferred tree species and make longer trails to get to food trees.

If beavers are removed from an area, the population is likely to grow rapidly, because reduced population density leaves vacant sites that are available for occupation. Young beavers then find new home-sites readily, endure less mortality in reaching these sites, and can reproduce at younger ages. Early reproduction by more young animals leads to faster population growth, even though the young parents are relatively small and do not breed as successfully as older, larger animals.

We estimated that in 2008 there were 15 active beaver lodges in the entire Mendenhall Glacier Recreation Area. We suspect that the area probably cannot support more than about this number of beaver families, because the food supply is limited.

In the Mendenhall area, the food supply for beavers is diminishing, so the density of beavers is also expected to decline. Several factors contribute to decreasing food supply: vegetation succession, with the continued encroachment of conifer trees over more of the landscape, continuing post-glacial uplift of the land, which creates more areas suitable for conifer trees, and the selective tree-cutting activities of the beavers themselves.

In the area around Redstart Lake most of the trees are conifers and there is very little food left for beavers. The lake does have a lodge but it appears to be unoccupied. There is evidence that beavers visit the area but probably no longer live there.

Beavers: A Mixed Blessing

Beavers are part of the interpretive program for tourists and locals at the salmon-viewing platforms on Steep Creek. Their dams, lodges, and other signs are easy for people to observe in the area.

The presence of beavers in the upper Mendenhall Valley can be beneficial. Their ponds create habitat for many other animals, including fish, birds, dragonflies, other mammals, and some invertebrates (and formerly, toads). Ponds tend to have somewhat higher temperatures than streams, which in our cool climate allows juvenile fish to grow faster. More generally, when beavers move into an area, they make a landscape that is a mosaic of habitats, supporting an increased diversity of species. The mosaic lasts long after beavers eat up their food supply and abandon the pond, because it takes a long time for the pond to fill up, the dam to break open and drain the pond area, and for plants to move in and grow.

The increase in habitat diversity benefits humans who enjoy observing animals in the wild. Residents and tourists like to watch beavers and see their constructions. Bird-watchers enjoy the increased variety of birds found nesting and foraging in the varied landscape. Botanically inclined observers find more kinds of plants to observe.

Another major benefit lies in education and helping kids connect with nature. A real, live, native animal in its own habitat can be a better educational tool than all the creatures in a zoo or on tv. Students on field trips to the Mendenhall Glacier Recreation Area can see for themselves the signs of beaver activity and even sometimes watch the beavers in action. In the early morning or evening, the beavers themselves may be seen, chewing leaves and branches, swimming and diving, and tail-slapping.

Students also can learn at first-hand about other animals that make use of beaver-created habitats. Field trips, and related activities in the classroom, are also opportunities to learn about the importance of wetlands, the ecology of ponds and their surroundings, aspects of animal behavior, and vegetation succession.

There can also be negative impacts of beavers. The backed-up water sometimes covers popular trails used by bird-watchers, hikers, dog-walkers, and cyclists. And beaver-felled trees may lie across some trails, impeding passage by humans. Near the highway, rising water levels may, potentially, weaken the roadbed, long before rising high enough to flood the road.

Beaver dams can affect the movement of sediment in the streambed, which in turn can affect fish and invertebrates that need a gravelly stream bottom. Dams trap fine sediment, which settles in the pond behind the dam. The sediment supports a rich community of invertebrates, different from that of running water, and small fish in the pond have abundant prey. If the dam is destroyed, however, that sediment may wash downstream, potentially smothering salmon

Local teachers say that kids love to see beavers and the signs of their activity. Here Karen Maher (Education Specialist) and Lindsey Edgar (Information Assistant) of the U.S. Forest Service tell a class about beaver lodges during a day camp at Crystal Lake.

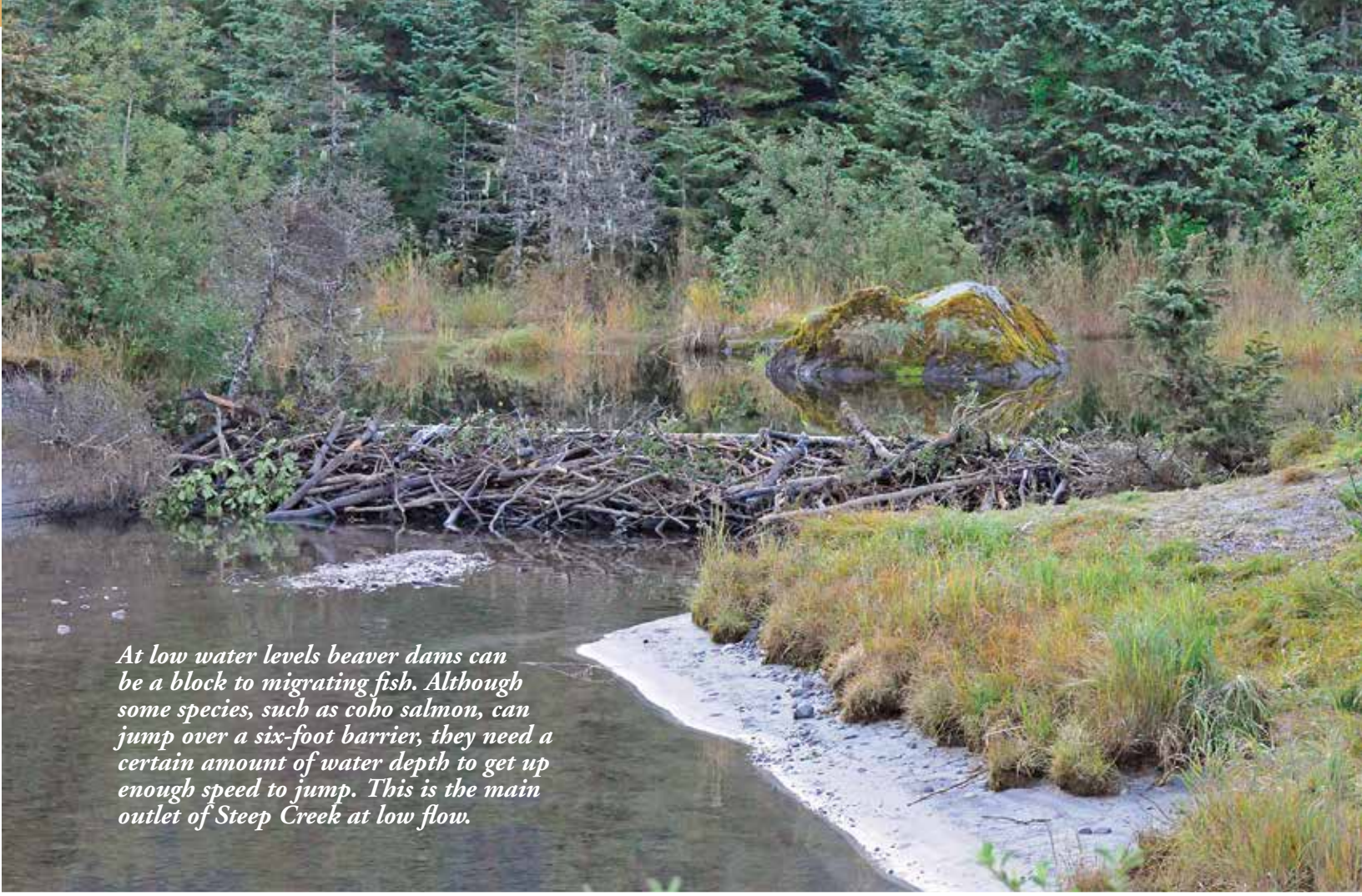
eggs buried in the gravel, filling crevices in the gravels and reducing the living space for many invertebrates.

Well-built dams can block very strong streamflow on steep gradients that might destroy habitat by scouring out all the gravels suitable for invertebrates and salmon eggs or damage fish eggs and young. However, they may sometimes block moderate flows that would create fresh gravelly substrate for spawning fish and for invertebrates.

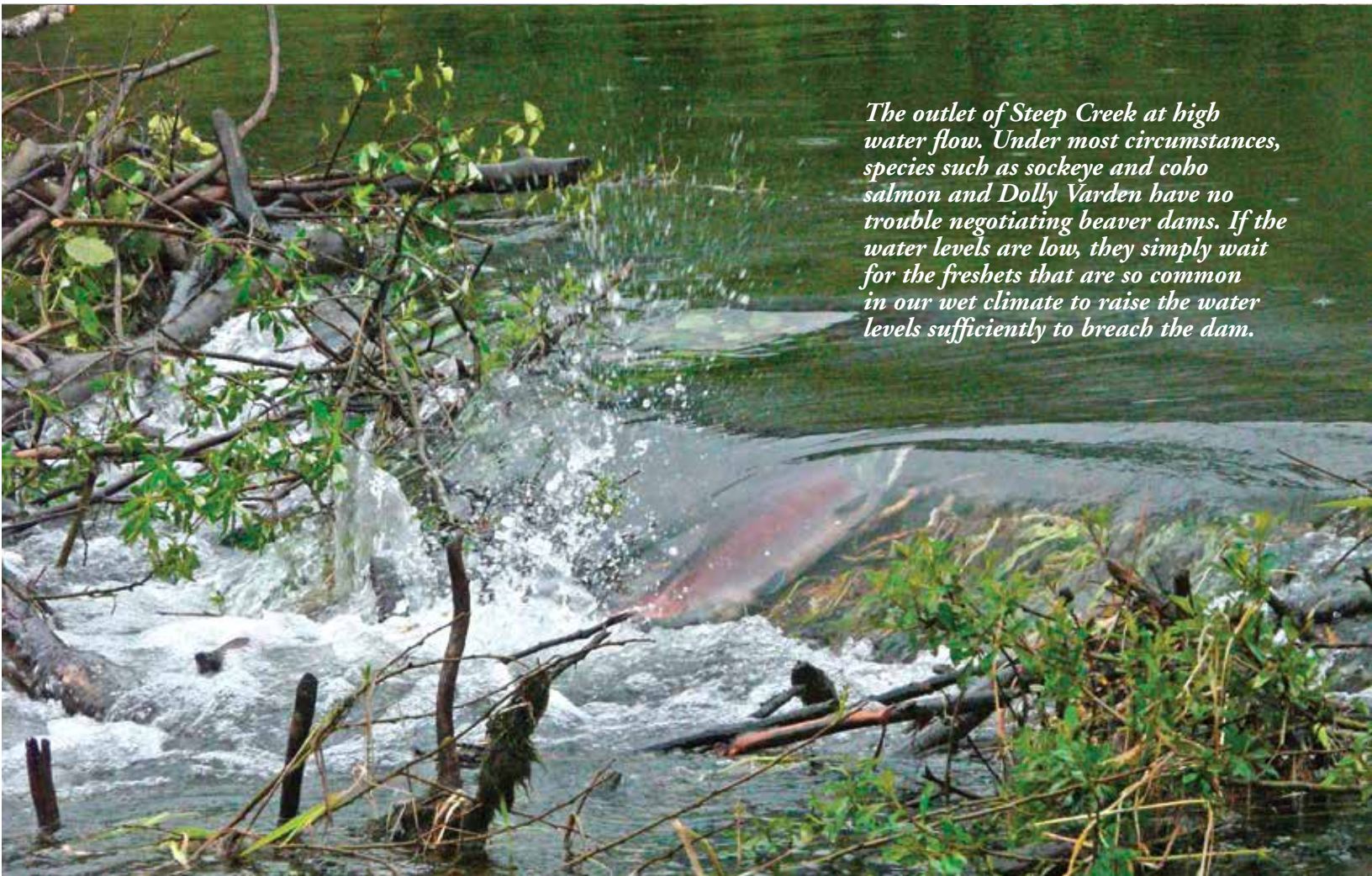
Beaver dams may hinder or block migrating salmon and Dolly Varden, although in most situations fish can get by the dams. Beaver dams in culverts certainly can block fish movement. Although the installation of protective screening around culvert ends can help, maintenance is often required to keep them open enough for fish passage.

During long periods of low rainfall and runoff, the stream levels may be so low that fish cannot get over or around beaver dams. Although most adult salmon are good jumpers, well able to clear a six-foot dam, they need a good pool below the dam to get a 'run' at it. In the relatively flat Mendenhall area, such pools are not always present below the dams. In some years coho salmon are known to migrate into the upper Mendenhall Valley streams quite late in the year. If this occurs as the waters are beginning to ice over and no further flooding or high water occurs, then the coho may be blocked from reaching their spawning area.

Although it is possible that beaver dams, under some circumstances, may be detrimental to fish, the benefits for fish usually far outweigh their potential harm.



At low water levels beaver dams can be a block to migrating fish. Although some species, such as coho salmon, can jump over a six-foot barrier, they need a certain amount of water depth to get up enough speed to jump. This is the main outlet of Steep Creek at low flow.



The outlet of Steep Creek at high water flow. Under most circumstances, species such as sockeye and coho salmon and Dolly Varden have no trouble negotiating beaver dams. If the water levels are low, they simply wait for the freshets that are so common in our wet climate to raise the water levels sufficiently to breach the dam.

Culverts can be a problem because beavers seem to find them fairly easy to block. They were even successful in blocking two 6-foot-high culverts on Steep Creek. In 2007 beavers had completely blocked the upstream-migrant sockeye and coho from reaching a major portion of their spawning area. It took up to 12 volunteers 5 days to completely remove the accumulated logs and sticks and open up the area for salmon. The beavers eventually stopped efforts to block them and abandoned the lodge in the pond above the two opened culverts.

Before cleaning

After cleaning

These two photos illustrate possible solutions to the problems that beavers create. On the near left a wire mesh has been put around the base of a cottonwood tree. This prevents them from cutting this tree next to a popular hiking trail.

The other photo shows a wire mesh called a "beaver baffler" that has been installed at the end of a culvert in the campground. This device helps prevent beavers from clogging culverts.

Resolving the Conflicts

In some cases, the only solution to the conflicts between humans and beavers is thought to be removing the beavers from certain ponds and destroying the dams. This is a temporary 'solution', because young beavers from other colonies will disperse to the vacated ponds and try to establish themselves there with new dams and lodges. Destroying the dams releases sediment, which could cover downstream salmonid nests (depending on timing) and decrease the invertebrate populations that feed young fish, so the timing of dam destruction is critical. Repeated removal would generally be necessary, under this approach.

A more permanent solution to perceived conflicts between humans and beavers is more constructive but also more expensive. It could be possible to both maintain a beaver population and have a fully functional trail system and suitable fish habitats. A plan designed with all the goals in mind would keep the beavers for their education and habitat values while providing access to humans and fish.

For example, some trails could be rerouted to higher ground and improperly functioning culverts could be replaced with better culverts or small bridges. Other trails could be raised above the level occasionally inundated by beaver floods. Protective screening around culvert ends ("beaver bafflers") could help in certain places to slow down culvert clogging by beaver sticks. In this country of heavy rains, some patrolling of trails and monitoring of water levels would also be needed. This approach has been used successfully in other places.

Eventually, beavers eat themselves out of house and home. Furthermore, their favorite trees (willow and cottonwood) are an early part of plant succession. In the upper Mendenhall Valley spruce and hemlock trees are gradually replacing these preferred trees, and beavers are cutting down the remaining deciduous trees for winter food. Thus, with passage of time, there will be less and less beaver food in the area and the beaver population will dwindle.

Amy Nye, a naturalist with Discovery Southeast, teaches children and their parents about why and how beavers build dams at the outlet of Moose Lake.

Further reading

To gather material for this book we reviewed numerous publications. Here are some of the ones we found most useful.

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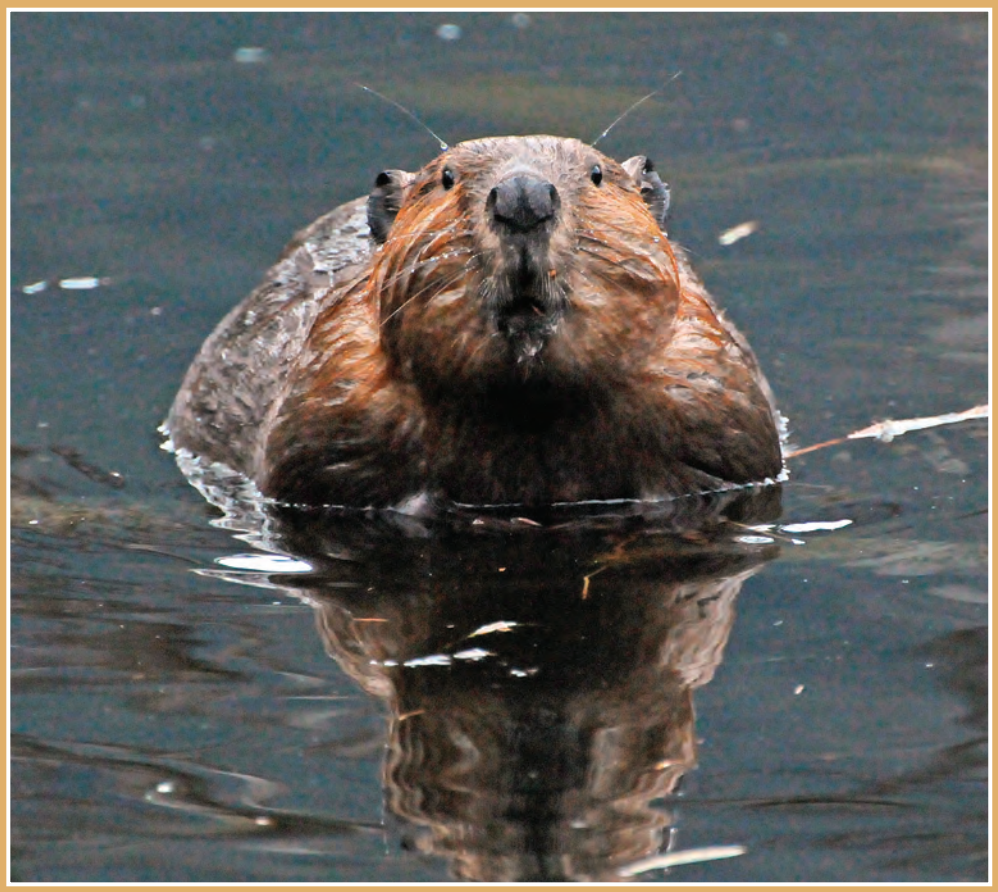

Beavers are fun to watch by the Mendenhall Glacier

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