

FROM BARBARA —
"UNDONE...."

ABANDONMENT

On Beaver Ecology and Recovery

From my house, a ten-minute walk takes me through a young pine woods to the crest of a high, open meadow, then down

into a valley that supports the most extensive beaver ponds within the range of my wanderings. Two large ponds form the heart of the area, the bigger pond lying farther back at the base of the rugged, aptly named Rocky Ridge. Beavers have inhabited this once forested valley for over three decades, moving alternately from one pond to the other. Because of its wild appearance, created by hundreds of standing dead snags, the area is an all-season magnet for my explorations.

Although only a few minutes from my home, the ponds, particularly the farther one, create the strongest sense of wilderness that I have encountered in the region. Standing on skis at midnight, alone under a January full moon, surrounded by large spruce and pine snags, my feeling of seclusion is as great as any I've ever experienced. Yet this is far from an untouched environment. It is a highly manipulated ecosystem, one that has been dramatically altered to suit the needs of a single species—

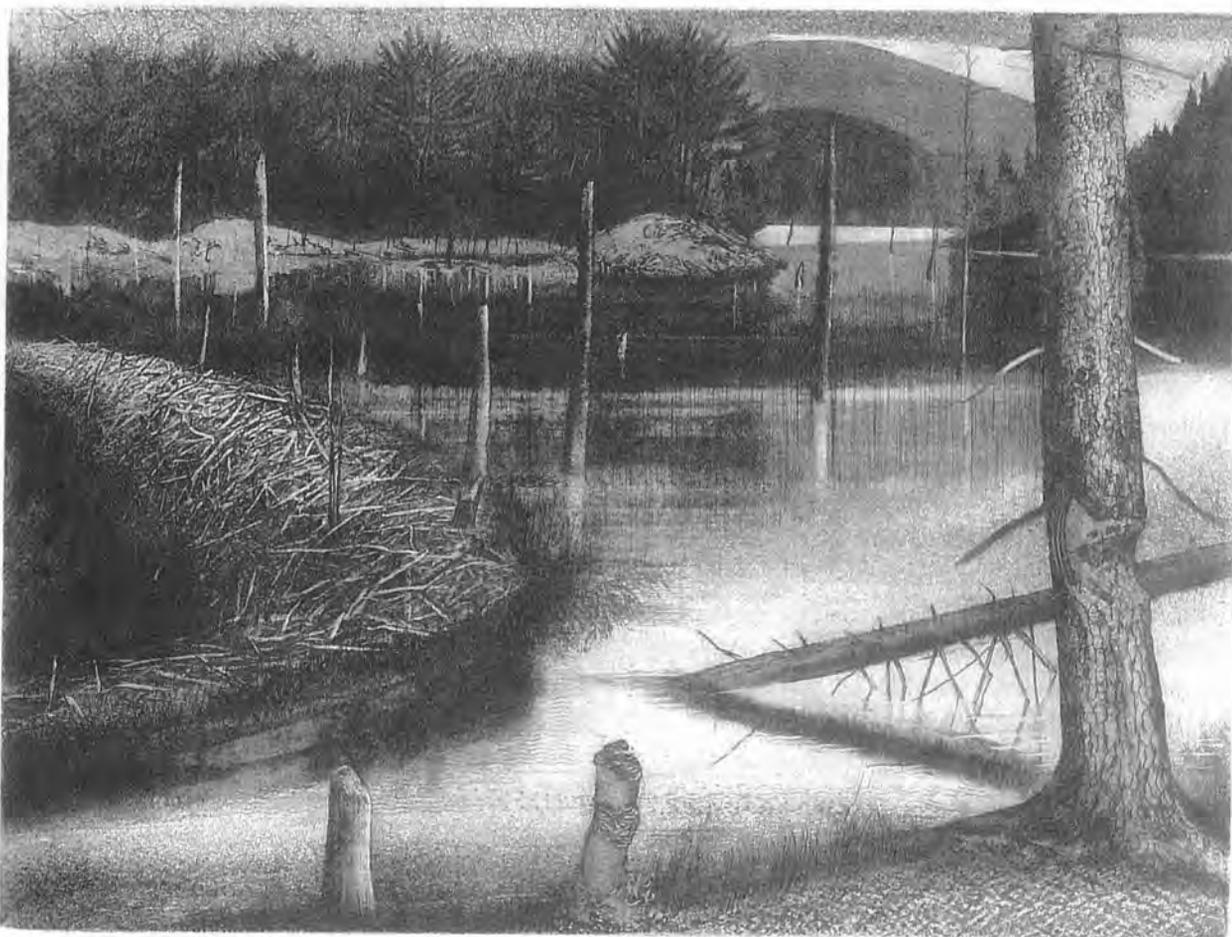
by Tom Wessels

the beaver. Beavers are the only animals, other than humans, that will create entirely new ecosystems for their own use. And often, like humans, once they have depleted an area's resources, they will abandon their holdings and move on.

The etching shown here does not depict one of the ponds near my home, but it does show an abandoned beaver pond, a common sight in central New England. How can we tell that this pond is abandoned? How long ago did the beaver leave this pond? What was the quality of the habitat for the beavers when they created the pond? These questions are the focus of this essay; however, before we attempt to find the answers, we need more information on the life history of the beaver.

Beavers flood forests and create ponds for two reasons. The first is safety. Slow on land, especially in snow, beavers are easy prey for large predators, but in the sanctity of a pond, they are almost completely free from predation. The second is that ponds foster the development of their summertime food supply. Aquatic plants like water lilies, pickerelweed, and cattails are

This essay and accompanying illustrations are excerpted from Reading the Forested Landscape: A Natural History of New England by Tom Wessels (©1997) with etchings and illustrations by Brian D. Cohen (©1997), and are reprinted by permission of the publisher, The Countryman Press/W.W. Norton & Company, Inc.



common summer staples. During the winter their diet shifts to the bark of trees. If they are successful in storing a large enough supply of limbs in their pond during the fall, they may never need to leave the protected confines of their watery home for an entire winter season.

The dams beavers construct to create their ponds are composed of a combination of sticks and mud. Although they can deplete the trees around their ponds, these animals are true conservationists when it comes to recycling. All of the sticks, whose bark supported the beavers through the winter, are reused to build the dam and lodge. A truly impressive dam can reach a height of over ten feet. At this dimension the dam often takes on a concave form, bowing into the pond and gaining added strength from its horizontal, archlike structure. When I first moved to Vermont, I came upon an impressive dam like this one in the town of Dummerston. The downstream side was a vaulted nest of smooth gray sticks that rose to meet the pond's surface at the very top of the dam. The dam spanned forty feet, and from its base—in the former streambed—it rose eleven feet.

Odds are that if you encounter a beaver pond, it will be abandoned like the one in the etching. Most beavers will inhabit a pond for only five to twenty years, but abandoned ponds can

last for many decades. Because beavers invest both time and energy in the construction of their dam and lodge, why would they choose to leave the pond? The chief reason for abandonment is a depleted winter food supply. Because beavers are more susceptible to predation on land, they rarely travel more than two hundred feet from their pond margin. In marshy areas they dig canals that radiate from the pond's perimeter to gain access to more distant woodlands. But once all their preferred species of trees have been cut and consumed within a couple hundred feet of the pond margin or canal terminus, beavers will abandon the pond in favor of a new home.

Beavers have a distinct hierarchy among the species of trees they harvest for winter food. Most preferred in central New England are members of the willow family, including aspens and the cottonwood, all of which have bark that is easily digestible and high in protein. Next come the oaks and ashes, followed by sugar maple and speckled alder. Members of the rose family, such as apples and cherries, are also important. Of moderate interest are members of the birch family, especially muscledwood, black birch, and paper birch. Gray birch, yellow birch, hop hornbeam, beech, and red maple are low on the beaver's food preference list, and conifers like pine and hemlock lie at

the very bottom. When we see conifers being cut and their bark consumed, it is a sign that the beavers will likely be abandoning the pond within a year's passing. (This, however, should not be confused with girdling activity. To encourage the growth of their preferred trees, beavers often girdle and kill young pines and hemlock. Girdled trees are never felled; they have their bark removed all the way around the base with little evidence that the wood has been chewed.)

Beavers have preferences not only for certain species, but for trees of certain sizes, as well. Imagine yourself a beaver: What size trees would you seek to fell, cut up into manageable lengths, and haul back to the pond? From the perspective of a beaver, pole-sized trees, those four to six inches in diameter, provide a better food supply than either larger or smaller trees. This is because the amount of bark offered by a pole-sized tree, relative to the beaver's energy expenditure in cutting and hauling it, makes it the best choice. A beaver's dreamscape would be a forest of pole-sized aspens; its nightmare, a stand of mature hemlocks.

The composition of the surrounding forest will determine how long a beaver pond will be active, but the pond's topographic setting is important, too. Given two ponds surrounded by similar forests, which type of topographic setting will support an active beaver pond for a longer period of time, one sited in a broad, flat valley or one that lies in a narrow ravine? Each year, as beavers cut more trees, they use the debarked limbs to increase the height of their dam. This causes the pond to expand the area of its coverage. In a broad valley, as trees are depleted around the pond, increasing the dam height by only a foot may flood the denuded forest and extend the two-hundred-foot zone to new harvestable trees. Increasing dam height in a ravine, on the other hand, will do little to enlarge the pond and thus will not increase access to new trees. All things being the same, beaver ponds in broad, flat valleys are active for longer periods of time.

As previously mentioned, the pond in the etching (on the previous page) is abandoned. From the evidence at hand, how can this be surmised? Can we tell how many years ago the beaver left? Is it possible to assess the quality of the pond's original beaver habitat to develop a rough estimate of how long the pond was inhabited? The etching holds the answers to all these questions.

DATING ABANDONMENT

The very first sign that beavers are no longer in residence can be observed about two weeks after their leaving. The water level in the pond will drop

one-half to one foot. Without the beavers' daily attention to the dam, numerous leaks develop. Unless there is a drought, an active pond maintains its water level right at the top of the dam.

When beavers emerge from their lodge to begin their nocturnal activities, the first order of business is to examine the dam. Their inspection is auditory in nature. If the noise of running water is low, a little bit of mudding on the pond side of the dam may be in order. Beavers scoop mud from the pond bottom and carry it between their chin and forelegs to be used to patch small leaks. (Contrary to cartoon impersonations, their tails play no role in mudding. The major use of the tail is for fat storage, which helps carry beavers through long winters.) But if beavers hear the sound of rushing water, dam-building activity is stimulated. It is such a strong stimulus that researchers have been able to get beavers to build dams on dry land in response to the sound of rushing water on a tape recorder. Without this nightly repair work, the pond's water level begins to drop.

The lowered water exposes the rich moist mud on the pond side of the dam. During the growing season it takes only about one to two months for this area to become vegetated with herbaceous plants. Since the stream side of the dam is not mudded, little herbaceous growth will occur on an active dam; however, this side may support shrubs on older, maintained dams. The pond in the etching displays a lowered water level and herbaceous growth on the pond side of the dam. Does this suggest that it has been abandoned only for a couple of months?

There is other evidence that points to a longer period of vacancy. The stumps left by beaver activity are the next detail to examine when dating beaver pond abandonment. A tree that has been cut within one year's time leaves a stump with blond-colored wood. Numerous blond-colored stumps surrounding an abandoned pond date the beavers' departure at less than a year. If there are just a couple of these stumps, it is most likely the result of another beaver wandering through in search of suitable habitat following the pond's abandonment. The foreground of the etching shows two stumps, neither of which is blond.

Of these two stumps, one has gray wood, which dates its cutting to more than a year ago; the other supports the growth of turkey tails, a species of shelf fungus that grows on decaying wood and is never visible on stumps less than three years old. Without any other evidence at hand, we would need to walk around the pond examining stumps and age the pond's abandon-



girdled hemlock



stumps in foreground



turkey tails



hemlock showing wound and bark growth rings

concave form of beaver dam

ment based on the proportion of blond to gray to turkey tailed. If few blond stumps were found and most were gray and turkey tail-free, we'd guess one to three years had passed since the beavers' departure. If few stumps were free of turkey tails, we'd guess more than three years had passed. Luckily, there is one more piece of evidence in the etching that will allow us to put a more definitive date on abandonment.

The bark that forms on hemlock wounds shows visible annual growth rings. Any wound on a hemlock, whether from the rubbing of a stag's antlers during rutting season or from the gnawing of a beaver whose preferred winter food supply has been exhausted, can be accurately dated. The hemlock on the right-hand side of the etching clearly displays three growth rings in the bark surrounding a beaver gnawing. This hemlock was not girdled, but sampled as a possible food tree. We can surmise this because the bark was not cut all the way around the hemlock and some of the wood was gnawed. When beavers start sampling hemlocks in this fashion, it is a sure sign that they are having a difficult time finding enough trees to supply their winter needs. In this case, it is also strong evidence that this pond was abandoned two to three years ago due to a depleted supply of winter trees.

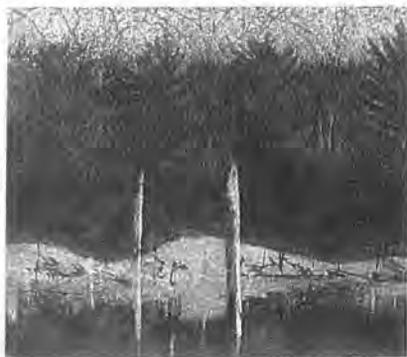
Now that we have a sense of when the pond was abandoned, let's turn our questions to the quality of habitat when the beavers arrived. The pond is surrounded by conifers. Does this suggest that the original quality of habitat for the beavers was poor, since their preferred species of trees are missing? Not necessarily, for a coniferous border, like the one in the etching, is a fairly common feature of old or abandoned ponds. The cutting of hardwoods and the recutting of their stump-sprouts eventually leave the residual pines and hemlocks and their seedlings to flourish in openings, free from

hardwood competition, creating a band of conifers that surrounds the pond. So how can we assess the quality of habitat at the time when beavers first invaded the area? The answer lies in the pond's standing dead snags.

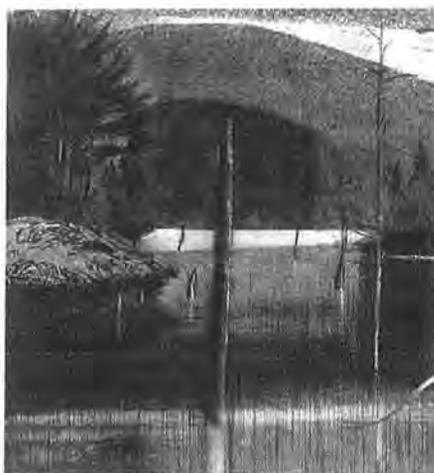
Because flooding, and the associated lack of oxygen, keeps the roots of dead trees from rotting, beaver pond snags will stand for decades following abandonment. The etching shows few snags emerging from the pond. If the area was originally forest, what does this suggest? It indicates that most of the trees were cut by the beavers and that, therefore, the original forest was probably composed of preferred species. This, in turn, suggests that the beavers inhabited this pond for a good number of years, as the area supported an ample winter food supply. A pond with numerous standing dead snags suggests that the original forest was dominated by conifers or yellow birch, trees rarely felled by beavers.

Beavers begin their search for new ponds in the spring. Not only do adults abandon old ponds at this time, but also all two-year-old kits are chased out of their family ponds by their parents to search for their own places of residence. Because beavers have annual broods, forcing out the two-year-olds is necessary to make room for the young. A two-year apprenticeship is enough for a young beaver to learn all the skills involved in tree felling, hauling, dam and lodge construction, and canal making. Beavers don't reach reproductive age until their third year, which slows population growth rates for the species. This is an unusual strategy in the rodent family, but one that makes sense for an animal with such large resource needs and complex skills development.

Beavers begin their search for a new home by moving up or down the watershed. Ponds already established by beavers have scent posts—piles of leaves, mud, and small sticks—on



coniferous border of pond



pond with snags

which the animals leave their scent to alert newcomers that the pond is inhabited. If one of the pond's mated pair has died, the scent post announces the vacancy through the absence of one gender's scent. If the newcomer happens to be of the "vacant" gender, he or she will move in to complete the monogamous pairing.

If beavers find no suitable habitat in their own watershed, they migrate to new watersheds. This usually involves some significant travel on land, making this the most dangerous period of a beaver's life. More dead beavers are seen on roadsides in April and May than at any other time of year—the majority of them two-year-olds in search of new homes.

CHANGES IN OLD PONDS

Once a pond is abandoned, it undergoes changes in vegetation. The condition of the dam is primarily responsible for influencing the successional outcomes. If the dam is strong and continues to hold water, the pond will evolve—as it continues to fill with stream-borne sediment—toward a marsh or "beaver meadow," a wetland dominated by sedges, rushes, and cattails. In time, as decaying plant material builds up in the marsh, wetland shrubs like willows, alders, dogwoods, and viburnums find acceptable sites for germination and convert the marsh into a shrubby swamp. Through the annual decay of their leaves, shrubs add to the buildup of organic matter in the wetland, eventually creating conditions dry enough for trees to establish themselves. Red maple is very tolerant of saturated substrates and often dominates wetlands that have developed to this stage. Given enough



beaver scent post

time, the swamp may fill and dry to the point that a wet-sited forest develops.

If the dam is breached and the pond drains, a forest can develop much more quickly. Grasses and other herbaceous plants will first colonize the rich, exposed sediments of the pond bottom. But trees may move in quickly. Depending on the seed source from surrounding trees or a coinciding mast year for a particular species, the composition of the drained pond's future forest could be almost anything. Whichever route succession takes, either through a progression of wetlands or through

more direct forest establishment, in some period of time a winter food supply for beavers will be regenerated, and the process of beaver impoundment will start all over again, in some cases with a new dam being built directly on the site of an old one.

This cyclic pattern of successional change created by beaver activity adds a wonderfully diverse mosaic to any landscape in which these creatures are found. Without beaver impoundments—in all states of activity and abandonment—our regional ecosystem would be impoverished. Although beavers do deplete their local resources and move on, the depletion is temporary and results in a parade of varied ecosystems that create critical habitat for numerous species of plants and wildlife. So the next time you encounter an abandoned beaver meadow, don't be afraid to get your feet wet. Walk in and contemplate the fact that beneath you lie deposits, layer upon layer, from the beaver ponds that have cycled there through the millennia.

A LOOK BACK

Although beavers have been an important component of the central New England landscape for thousands of years, less than a century ago it was impossible to find one active impoundment in the region. Trapping to provide furs for European hat markets led to the beavers' extermination by the early 1800s. With the exception of northern Maine, where some were spared, all of New England's beavers were eliminated in less than two centuries.

Beaver trapping in central New England, a major component of the fur trade with the British, began with the establishment of William Pynchon's

trading post in Springfield, Massachusetts, in 1636. This post served as the major clearinghouse for furs throughout central New England. Ironically, the development of commercial trapping, and the ultimate extirpation of the beaver, was directly related to the decline of another New England population. The epidemics that decimated Native peoples created conditions that made a commercial fur trade viable by tearing great holes in the social fabric of tribal culture.

Prior to the introduction of European diseases, tribal leadership developed in orderly ways, often through lineage. The epidemics changed this orderly progression. Tribes were broken, scattered, and constantly reconfigured as illness wiped out village after village. Ascension to leadership positions was no longer based solely on an individual's record of service to the tribe. Individuals who were ascribed as carrying prestige filled leadership roles, and the British created conditions where prestige did not have to be earned; it could be traded for. It could be gained in the form of *wampum*.

Colored, cylindrical beads fashioned from the shells of whelks and quahogs, wampum were highly revered by Native people, and they were usually worn in very modest amounts, only by people of high status. The use of wampum by the British as currency, during a period of profoundly unstable tribal life, spawned a fur trade of great proportions. Among Native people, what had once been self-reliant trapping of furbearers for indigenous use became market trapping for wampum and the heightened prestige that it brought.

Beavers were the preferred prey due to their sedentary nature and the high value the British placed on their pelts. The ease with which trappers could find their lodges, and the beavers' predictable behavior, made them the most easily trapped of all furbearers. With their low reproductive rates, it is not surprising that the number of beavers trapped in central New England had dropped precipitously by 1670. By 1700, trade in beaver pelts was almost nonexistent. During the eighteenth century, the last remnants of the beaver population were swept from the region, to be found only in the northern reaches of Maine, New Hampshire, and Vermont. Extermination from the latter two states occurred by 1850.

The reintroduction of the beaver to central New England was just as rapid as its extirpation. First occurring in southern Vermont in 1921, by 1940 beavers had established populations in all central New England states. In the last half century, beavers have vigorously reclaimed their territory throughout New England. This is truly a story of success for the well-being of our regional landscape, because beaver activity fosters biodiversity through the array of habitats it creates.

Yet the removal and associated reintroduction of beavers were not free of short-term, negative side effects. By the middle of the nineteenth century, farm abandonment was at record rates. Lowland areas that formerly had been in cultivation, used as mowings or pasture, were let go. Other lowland areas that had not been cleared also underwent successional processes in the absence of beavers. At the point of their reintroduction, beavers found ample forest habitat, much of it the same successional age. With freedom from trapping and the absence of large predators, they quickly expanded their population in the region and began to exploit their regional habitat in a synchronized fashion, meaning that at some time in the future, most of their habitat would be in the same degraded state.

In my explorations of southeastern Vermont and southwestern New Hampshire, beaver habitat with a winter food supply that can support an active colony for many years is hard to find. The vast majority of it has already been utilized by beavers and abandoned, and I have great difficulty finding impoundments that have been active for more than just a few years. I have also seen new ponds being established late in the summer and sometimes even early fall, an indication that beavers are needing to search far longer for future homes. Often these new impoundments are developed in the most marginal areas in terms of winter food supply. It is evidence of a last-ditch stand after a long summer of searching with no success. The residents of such sites rarely make it through the winter before succumbing to starvation. On a positive note, I am convinced that this situation is merely a small blip and that, in time, asynchrony will again develop in the grand cycle of beaver impoundment and abandonment.

The beaver should be revered as the creator of a landscape mosaic—a rich assortment of varied wetland ecosystems. No other creature fashions such an array of habitats on which so many other species are dependent. How poor our countryside would become if this species were again to be lost. Thankfully, unless humans again interfere, beavers are sure to remain an important component of our New England landscape. ☾

Tom Wessels is an ecologist and the director of the *Environmental Biology Program at Antioch New England Graduate School*. His book *Reading the Forested Landscape: A Natural History of New England*, from which this essay is excerpted, traces disturbance patterns in New England forests from precolonial days to the present.