A Perspective on **Lake Monsters**

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There's a monster in Lake Champlain. Actually, that's not unusual. As you read in the previous article, a surprising number of lakes have monsters, and they run the gamut geographically and descriptively – Bessie in Lake Erie, the Lake Van monster in Turkey, Inkanyamba in South Africa, Nahuelito in Patagonia, Myoso in Columbia, Manipogo in Manitoba, Bunyip in Australia, Gryttie in Sweden, Issie in Japan – the list goes on and on. The most notorious of them all is Nessie in Loch Ness, Scotland, whose fame overshadows the presence of similar monsters in a dozen other Scottish lochs. Even Champ, in Lake Champlain, has a lesser-known cousin, "Memphre," in nearby Lake Memphremagog.

Why are there so many lakes with monsters? Are they all members of an as-yet unidentified species? Or are they remnants of prehistoric marine creatures that became trapped in lakes after the lakes became isolated from the oceans? Perhaps many are simply the product of a desire to attract attention and tourists to a local lake.

With a scientist's eye

Let's look at these monsters objectively, through a scientific lens. What do they have in common? First, they are all large and are seen very rarely – otherwise they would not be frightening or particularly mysterious, which are both necessary features of a "monster." Many descriptions of lake monsters, including Champ in Lake Champlain and Nessie in Loch Ness, suggest the creatures resemble a plesiosaur, with a long neck, horse-like head, a long serpent-like or humped body, and large fins that enable it to crawl onto land.

They are also always singular – there is apparently only one in each lake. But herein lies the problem; there cannot be just one. If the creatures in each lake are the last surviving individuals of a nearly extinct prehistoric species, then they must be VERY old – plesiosaurs, for example, died out at the end of Jurassic period, about 150 million years ago. Given that the oldest known species (other than colonies of single-celled organisms) is approximately 5,000 years old – and it's a tree (http://www.rmtrr.org/oldlist.htm) – the existence of a single animal 150 million years old is well beyond the bounds of credibility.

The alternative is that each lake actually contains a breeding population of some unknown animal that has existed since the lakes were formed. Both Lake Champlain and Loch Ness were once connected to oceans, and a marine species could have been trapped in the lakes when the connections closed (let's ignore, for the sake of brevity, the challenging issue of a marine species adapting to an osmotically different freshwater environment).

To sustain a population over many, many generations and avoid problems due to inbreeding and loss of genetic variation, there cannot be only a few individuals in each generation. In fact, a basic principle of conservation genetics research indicates that at least 5,000-50,000 individuals would be necessary to sustain a population over hundreds of generations.

This raises a simple question – what does a population of so many large animals eat in these relatively small bodies of water, compared to oceans? The smallest of the Scottish lakes that is reputed to contain a monster is Loch Oich, a mere 6.5 km long and 47 m deep, with barely enough room to house 5,000 monsters, let alone generate enough biomass to sustain them for millennia. Limnologists and modelers have made considerable progress in creating food web models for lakes, incorporating biomass estimates of all the components of aquatic communities from plankton to piscivorous fishes and their linkages. Such models would not balance if there was a significant unidentified population of large organisms present in a system.

The second essential feature shared by most lake monsters is their long neck. This characteristic defines them as air-breathers. With the exception of sea horses and eels, fishes do not have a neck. A neck interferes with streamlining and swimming efficiency, and more importantly is not needed by a gill-breathing aquatic animal. A neck is required to move the head upwards to breathe air above the water surface, unless, as in cetaceans, the nostrils are located at the top of the head. But there is another problem: The animals known to dive for the longest periods, whales, need to take a breath about once an hour, and at most can hold their breath up to two to three hours. Using a generous average of two hours, this means that each member of a (minimal) population of 5,000 creatures must surface to breathe 12 times per day, including during daylight hours. Quite simply, wouldn't they be seen more often than once every few years, or decades?

The real monster?

So if the numerous lake monsters are not a bona fide but as-yet unknown aquatic species, what are they? First, consider the observers and the conditions under which the creatures have been observed. Barring experienced sailors and boaters, most people are not familiar with either lake phenomena or aquatic life. People love the thrill of a mystery and have a willingness to suspend disbelief; they do not often stop, question, and analyze the evidence of their eyes when they encounter something unknown. Witness the regular appearance of thousands of tiny, transparent dead fish at the surface of many lakes in spring; a surprising proportion of observers, those who end up reporting them to fish and wildlife agencies, did not look closely enough to notice the legs and hollow bodies that identify these "fish" as exuviae of hatching mayflies.

At a larger scale, add potentially adverse conditions such as fog, dusk, distance, and possibly the effects of alcohol, and even common objects become mysterious. It is worth emphasizing how rarely any photographs have been taken of lake monsters, and those that do exist are invariably of poor resolution (Figure 1) and usually lack perspective that would give an idea of the size of the animal in the image (Figure 2). The famous "surgeon's photograph" of the Loch Ness monster is usually shown as a close-up, whereas the entire photo suggests the animal may only be one or two feet long (Figure 2).

A few years ago a short video was taken on a cell phone of a large animal swimming toward shore in Lake Champlain; a horse-like head and part of its back were visible, and to the credulous it could certainly be interpreted as a monster. Without a background it could have appeared huge, but in fact, with the shoreline visible, it was likely only four to five feet long. As it swam it began to sink; significantly, it kept tilting its head so that the nose pointed upwards. In general, people responding to an internet posting of the video concluded it was evidence of Champ; biologists viewing the footage invariably said "oh, that's really sad," recognizing the behavior of a drowning mammal struggling to breathe (probably a small moose). An aquatic animal would not strive to avoid submerging. Scale, context, and perception are vital for unbiased identification.

A typical and frequent monster "sighting" is the observation of two or more dark humps in the water, moving steadily in a line and slowing sinking.

Figure 1. The Lake Champlain monster, Champ. Photo by Sandra Mansi in 1977.

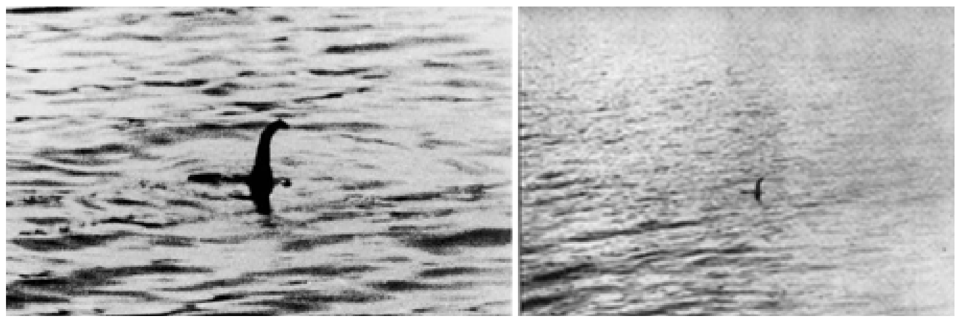


Figure 2. The famous "surgeon's photograph" of the Loch Ness monster (photo by Dr. Robert Kenneth Wilson in 1934), as usually published (left), and in its original form (right) with a better perspective of the scale; 60 years later Dr. Wilson admitted it was a hoax.

This manifestation, usually on a calm lake, is consistent with the remnants of a boat wake, with the boat at a considerable distance or out of sight ahead of the wake. Disturbances at the surface of an otherwise quiet lake can originate from a wide variety of sources: release of gases contained in sediments, subsurface currents, and movement of fishes. On a misty morning when light is low and the opposite shoreline may be obscured, it is difficult to perceive scale – a cormorant or loon with their long neck and humped body behind may be mistaken for something much larger. Similarly, large fish rolling at the surface can be startling, especially sturgeons or congregations of spawning carp. In spring, snowmelt pushes deadwood into rivers and offshore, so that lakes may become minefields of unusually shaped objects (Figure 3). There are less likely explanations that are still within the bounds of possibility, unlike a millennia-old dinosaur. For example, large marine fishes, whales, or seals could accidentally wander into lakes that are connected to the ocean; seal skeletons and the remails of a beluga whale have been found in the Lake Champlain basin (Harington 1977).

Evidence-based monsters

What would it take to convince a scientist that there really is a monster in one or more lakes? Obviously, a physical specimen would be the most exciting and tangible evidence; however, the closest recent candidate for a monster, a large and relative intact body washed ashore near Aberdeen, Scotland in 2020, proved to be the carcass of a minke whale (Figure 4).

Better visual "evidence" of monsters would certainly be useful, and these days nearly everyone consistently carries a cell phone with a high-resolution camera. Images of interesting lake "marvels" are being posted on various internet platforms with increasing frequency – and are more recognizable as identifiable phenomena.

Perhaps the most promising new method with potential to identify monsters is the use of environmental DNA. All

Figure 3. Large woody debris on Lake Champlain in spring. Viewed without focus, or in a mist, it may have a terrifying aspect.

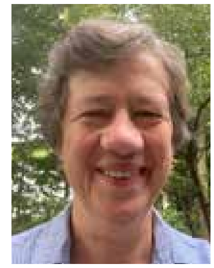
living organisms leave traces of their DNA in the environment, either as shed skin, fecal material, or after death. A geneticist from New Zealand has applied the study of eDNA to categorize the entire species composition of Loch Ness, from plankton to plants to fishes, but has not found any evidence of a previously unidentified species.

Ultimately, all scientific analysis aside, lake monsters are primarily the product of our imagination and our delight in the mysterious. Maybe there really is something out there that remains to be discovered, explored, and studied. Meanwhile, the stories go around the campfires, the tourist industry has fun with the tales, and new sightings crop up each time a new observation of an unidentified object is reported.

Figure 4. A monster that washed ashore near Aberdeen, Scotland, in 2020. Biologists established that it was the carcass of a minke whale. Credit: Fubar News, Scotland.

Reference

Harington, C.R. 1977. Marine mammals in the Champlain Sea and the Great Lakes. Ann. NY Acad. Sci. 288, 508-537.



Ellen Marsden received her master's degree and Ph.D. from Cornell University, and directed the Lake Michigan Biological Station, Illinois Natural History Survey, prior to joining the faculty of the University of Vermont in 1996. Her research is focused in the Great Lakes and Lake Champlain, and includes studies of the behavior and early life history of lake trout, alternative control methods for sea lamprey, ecology of exotic species, population dynamics of lake whitefish, and use of artificial reefs to enhance fish restoration.

UPCOMING IN *LAKELINE*

WINTER ISSUE – URBAN LAKES will be the focus on the winter issue of *LakeLine*. These important resources tend to be highly impacted due to population densities, land uses that are high in impervious surfaces, and runoff with excess nutrients and other contaminants. Please consider sharing articles that relate to the common problems observed in urban systems, partnerships for restoration, rehabilitation of these systems for recreational uses, what urban lakes mean to those who live near them, or other angles related to studying and managing urban lakes. Articles for the winter issue are due by December 15, for publication in January.

SPRING ISSUE – FISHERIES will be the focus of the spring 2022 issue of *LakeLine*. A range of topics related to fisheries is welcome, including biology, ecology, evolution, fish hatcheries, stocking, habitat enhancement, collaboratives, invasive species, and more. Articles for the spring issue are due by March 15, for publication in April.