

Crazy About Cryptids!

An Ecological Hunt for Nessie and Other Legendary Creatures

by

Matthew P. Rowe

Department of Integrative Biology

Michigan State University, East Lansing, MI

Part I – Introduction

Victoria adored her older brother Travis. She had good reason: their father had died when they were kids, leaving them and their younger twin sisters to be raised by their mother and grandmother. Growing up was tough; their mother's salary as a social worker was meager, and their grandmother suffered from a chronic medical condition that took much of the family's income. As the oldest, Travis started working early to help support the family, a sacrifice not lost on Victoria and her sisters. Victoria so respected her brother that she couldn't help comparing her high school and now her college suitors to Travis, and the admirers always fell short. Travis was kind, courageous, generous to a fault, and oh so smart—he even, while helping raise his siblings, put himself through law school and was now working as a public defender in Chicago. But he had a weakness that worried Victoria. Outside of the courtroom, Travis was gullible. He had a fondness for all things extraordinary—from ghosts to alien abductions to new-age therapies. His true passion, however, was cryptids. He was simply crazy about cryptids.

Victoria was majoring in Integrative Biology at Michigan State. Her training, including courses in ecology, wildlife biology, and the philosophy of science, made her appropriately skeptical of chupacabras, yetis, bigfoot, the Loch Ness monster, and other storied beasts. The fact that her brother, a lawyer whose career depended on the critical examination of evidence, could be so credulous was unsettling to her. While sensitive to his feelings, she hoped she could use her growing understanding of science in general, and ecology in particular, to empower her brother. A “just touching base” phone call from Travis presented Victoria with an opportunity.

“Hi sis, how are classes?” Travis asked supportively when Victoria picked up the phone.

“Great,” she replied, “in my wildlife techniques course, we're studying all the cool things you can learn about an animal just by analyzing a tiny drop of its feces, or a hair or two snagged on a scratching post. It's pretty amazing.”

“Yeah,” Travis replied with unrestrained enthusiasm, “did you hear about the recent study of hair samples collected from a bunch of different sites in the U.S. and Canada that proved the existence of bigfoot, and showed they were interbreeding with humans?”

Victoria, remembering one of the principles she learned in her philosophy course, responded: “Travis, science isn't about ‘proving’ an idea or explanation, it's about marshaling all of the evidence you can to determine which of various competing explanations is best supported.” She continued, “I don't mean to sound scientifically snobbish or anything, but the study you mention by Melba Ketchum and her coauthors lacks credibility. A team led by Bryan Sykes published a more rigorous analysis of hair sent in by bigfoot and yeti enthusiasts from around the world; the results showed that the hair belonged to bears and raccoons and other mammals one would expect to be wandering around in the woods, not to bigfoot or a bigfoot-human hybrid.”

“You’re breaking my heart here kiddo, you know I’m a true believer in Sasquatch,” Travis replied with feigned sadness. “Besides, isn’t it possible that a species of giant man-ape unknown to science exists somewhere on the planet?”

“Sure,” Victoria chimed encouragingly, “species unknown to science are occasionally discovered, like the mega-mouth shark or the saola. And creatures that scientists thought went extinct millions of years ago like the coelacanth are rediscovered. So I’m not saying that bigfoot doesn’t exist, only that the evidence presented so far is insufficient for me to accept that it does.”

After a short pause, Travis responded thoughtfully, “Ok, little sister, I think I see where you are coming from; in a jury trial, which is something I know about, the guilt or innocence of a suspect is determined by the preponderance of the evidence. The jury has to determine whether the accused is guilty beyond a reasonable doubt, not beyond any shadow of a doubt. Absolute certainty is unlikely. What matters is that the jurists, before reaching a verdict, carefully examine each of the explanations and all of the evidence offered by both the prosecution and the defense. I guess it’s the same thing in science.”

Sensing an opening, Victoria slyly suggested, “Didn’t you say you wanted to see a Spartan football game? Well, homecoming is in two weeks; why don’t you come for a visit. We can catch the game, and then afterwards we’ll go hunting for the Loch Ness Monster.”

Nessie was Travis’s favorite cryptid, so his sister’s offer aroused his curiosity. “How can we go hunting for a population of aquatic monsters in Scotland from your apartment in the middle of Michigan?” Travis asked inquisitively.

“We’ll track her down using the science of ecology,” Victoria answered.

Questions

1. Two articles were mentioned in the story. The first, titled “Novel North American Hominins, Next Generation Sequencing of Three Whole Genomes and Associated Studies” by lead author Melba Ketchum and her co-authors, was published in the journal *DeNovo*. The second, titled “Genetic Analysis of Hair Samples Attributed To Yeti, Bigfoot, and Other Anomalous Primates” by Bryan Sykes and his team, was published in the journal *Proceedings of the Royal Society B: Biological Sciences*. The two reports apply similar techniques using similarly obtained samples but reach different conclusions. Summarize the main conclusions of each.
2. Credibility is an important concept both in science and in courts-of-law. Which of the two publications is more credible, and why?
3. Occam’s Razor, also known as the Principle of Parsimony, can be useful when trying to determine which explanation, among two or more, is most likely to be correct. What is the Principle of Parsimony? Apply the principle to the different explanations offered by Ketchum’s team and Syke’s team. Which of the competing explanations best passes the razor test, and why?

Part II – Hunting for Nessie

Victoria was a bit of a cyptozoologist herself, and she knew there was more evidence for the Loch Ness monster than for all the other legendary creatures combined. By one estimate, there have been more than 4,000 sightings of Nessie over the last 80 years, along with sonar tracings, video records, and some incredible photographs. But her Philosophy of Science professor had the class read Carl Sagan's book *The Demon Haunted World*, so she was familiar with Sagan's "Baloney Detection Kit." One of the tools Sagan recommended was to "spin more than one hypothesis"; that is, consider all reasonable explanations of a phenomenon, weigh the evidence for and against each, then let the evidence tell you which explanation is most likely correct. While her brother was stuck on a single idea—namely that monsters were living in a lake in northern Scotland—Victoria understood the limitations of eyewitness accounts, sonar tracings, and fuzzy photographs. She would introduce her alternative hypotheses to Travis later. Now she was going to take him on a mental quest using what she had learned in her ecology course.

"That was a great game sis, too bad your team lost to the Irish, and on homecoming weekend to boot."

"No worries," she responded. "I've just poured each of us a big glass of fresh lemonade; want to go on that hunt for Nessie?"

"Sure. Where, or should I ask 'how,' do we start?"

"Well, to begin with, tell me what you know about the monster," Victoria prodded, "but keep it brief."

Travis had read every positive report about Nessie, but Victoria requested the "elevator-pitch version," so he strained to keep his account short and sweet. "Well, some saint back in the 6th century was the first to encounter it, but it wasn't seen again until an elderly couple reported it crossing the road, heading towards the lake, with a lamb in its mouth, in 1933. The next year, a fantastic photo was taken of the beast. Called "The Surgeon's Photo," it is probably the most widely recognized photograph of any cryptid anywhere."

"I know the one you're talking about, this big animal in the middle of a lake, with its head raised out of the water, looking around, the one that resembles a plesiosaur," Victoria added.

"That's the one," Travis continued. "And it spawned a huge public interest. People flocked to the loch, and many saw the monster. Numerous scientific expeditions followed, generating some interesting sonar tracings. Then, in 1975, a paper was published in the journal *Nature* that not only assigned a scientific name to the beast, but also printed several underwater pictures of Nessie; two of the photos clearly revealed her plesiosaur-like fins, while two others, with less resolution, showed her body, long neck, and head. More expeditions followed, and a set of vertebrae were found, but there hasn't been much recently."

"So the general consensus is that Nessie is a plesiosaur, or something like that?"

"Yep, and she's big!" Travis blurted, eager to show his kid sister how much he knew. "Based on the photos and sonar records published back in 1975, she's around 15 meters long, about the length of a gray whale, and would weigh approximately 8 tons, although another report suggested she may only be half that long with a mass of only 1.5 tons."

"Wow, that is big" Victoria responded. "And what do they eat?"



Figure 1. The "Surgeon's Photo" of the Loch Ness Monster. Provided by the Fortean Picture Library.

“Well, we don’t know for sure, as no one has ever found a carcass or skeleton of the monster. But based on the skulls and teeth of fossil plesiosaurs, they were top-level predators and ate big fish like salmon.”

“But aren’t plesiosaurs a group of marine reptiles that went extinct when a meteor exploded near the tip of the Yucatán Peninsula 65 million years ago, wiping out the dinosaurs, ichthyosaurs, pterosaurs, and a whole bunch of other stuff?” Victoria probed.

“Sure,” Travis snapped defensively, “but scientists thought the coelacanth died out back then too, and look how wrong they were!”



Figure 2. Plesiosaur skeleton, Denver Museum of Nature and Science. Used with permission from Mike Everhart.

Questions

1. Prior to the meteor-driven extinction at the end of the Cretaceous, the seas teemed with a diversity of large reptiles, including voracious predators like plesiosaurs, ichthyosaurs, and mosasaurs. What is left of this diversity of marine reptiles? If you wanted to snorkel with our few remnants of this past reptilian glory, where would you go? Could any of today’s marine reptiles survive and breed in Loch Ness? Why or why not?
2. Is Loch Ness old enough, geologically, to have been a refuge for plesiosaurs that may have escaped the mass extinction of 65mya?
3. What is Net Primary Productivity, or NPP? Are all ecosystems equally productive? Where, on the range of NPP values for different systems/biomes, would Loch Ness fall?
4. What is the 10% rule in ecology? A generous appraisal of the mass of fish in Loch Ness is 15,675 kg. Based on Travis’s estimates of the size of Nessie, how many monsters might the lake contain?
5. What is the 50/500 rule, and why is it relevant?
6. Your sleuthing likely revealed additional ecological inconsistencies regarding the plesiosaur hypothesis. Provide a short list.
7. Imagine that, as a good friend of both Travis and Victoria, you’ve joined them in their lemonade-fueled quest for Nessie. Using your answers to the questions above, summarize the results of your investigation. What do your results suggest regarding Travis’s hypothesis that a population of large, predatory monsters (plesiosaur or otherwise) prowls the murky depths of Loch Ness?

Part III – Spinning Additional Hypotheses

Travis felt a bit deflated following their hunt for Nessie. “Alright sis, I’ll grant that ecology makes a strong case against the monster.”

As a good defense attorney, however, he wasn’t conceding defeat, not yet. “But what about all the evidence in her favor?” he added.

“Such as...?” responded Victoria, knowing full well the nature of the evidence—and its limitations.

“To begin with, there are the eyewitness accounts, and the positive sonar recordings! Have you seen Tim Dinsdale’s film? And that set of fossil plesiosaur vertebrae found at the edge of the lake? What about those amazing underwater photos, especially of Nessie’s flippers? How do you explain those if Nessie isn’t real?”

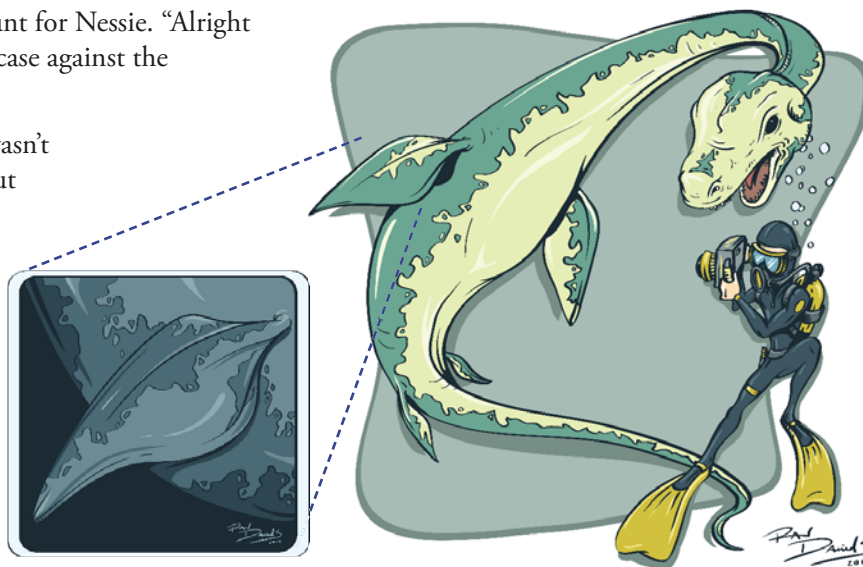


Figure 3. Is this how the infamous “flipper photo” was taken? Illustration by Ryan Daniels; used with permission.

“Travis,” Victoria admonished, “as a defense attorney you know the limitations of eyewitness testimony. The Innocence Project has used DNA evidence to free hundreds of people wrongly convicted of crimes based solely on eyewitness identifications. People’s accounts of events are notoriously fallible, especially when they have expectations about what they are likely to see. The majority of ‘Nessie sightings’ are by tourists visiting the loch in the hopes of encountering the monster. As you yourself have argued in defense of a client, ‘without corroborating hard evidence, eye-witness accounts cannot be used to reach a verdict.’”

“Ok, I’ll grant you that. But what explains the sonar contacts?”

“Remember that trip we took out to New Mexico, with mom and dad before the twins were born, to visit the Roswell UFO Museum?” While Victoria didn’t share her brother’s fascination with aliens, this family vacation just prior to their father’s death was a cherished memory. “And do you remember how, when driving through the desert, we thought we saw a huge lake, but it was only a mirage? Well, mirages are the product of ‘layered’ air. When a colder layer of air sits above a warmer layer, as it often does on a hot summer day in the desert, light can be bent at the boundary. So what we think is a lake is just a reflection of the sky. There are several things that can cause layering of the water in a lake. And, like light, sound can be bent by the boundaries, leading to ‘false positives’ in sonar tracings.”

Having set the trap, Victoria moved in for the kill, “But that doesn’t mean all sonar tracings are false. As you said, juries need to base their decision on the preponderance of the evidence. There have been numerous scientific expeditions to Loch Ness in search of the monster, and many have used sonar to scan the depths of the lake. The most ambitious of these was the BBC expedition back in 2003. They used an array of 600 sonar machines, positioned by satellites, to probe every inch of the loch. Do you know what they found?”

“No,” Travis demurred.

“Nothing. Nada. Zip. Other than the submerged target buoy they used to test their equipment. No monsters.”

“Bummer,” whimpered Travis. “But that set of fossil vertebrae?”

“Millions of years old, and taken from somewhere else” Victoria quipped, “possibly planted to keep the Nessie-based tourism industry alive.”

“And the flipper photos?” her brother asked quietly, sensing the case slipping away from him.

“Airbrushed. The lead scientist on the expedition that took those photos was both a credible scientist and a successful lawyer, but he was passionate about Nessie. Passion, as we all know, can cloud judgment. The un-retouched photos show a fuzzy blur, nothing resembling a flipper. And the underwater photos of Nessie’s head turned out to be a tree stump.”

Travis suspected Victoria had another shoe to drop, “Any other bad news?”

“Sorry bro,” Victoria added, “but even the Surgeon’s photo appears to have been faked.”

Questions

1. Science, law, and critical thinking share a common approach. When presented with a claim, the surest way to the truth (or as close as we can come to it) is to work up a list of alternative explanations (referred to as “multiple working hypotheses” in scientific jargon). The next step is to gather all the evidence you can find that challenges or supports the various explanations. The most likely explanation is the one that best survives this thorough and impartial examination. Travis was trapped because he chose not to consider explanations challenging his belief in Nessie. He failed to develop a set of “multiple working hypotheses.” This is a skill that benefits from practice.

Start with the 1960 Dinsdale film (<https://www.youtube.com/watch?v=GdQUbLKwCvQ>), which many claim represents the best cinematic evidence for the monster. The footage, shot by Tim Dinsdale from over a mile away, purportedly shows Nessie swimming at high speed, leaving a wake. What hypotheses other than “I’ve filmed Nessie!” could explain what you observe in the video? Which explanation would best survive Occam’s Razor?

2. Your hunt for Nessie probably uncovered additional types of evidence that “true believers” have offered in her support. Pick one, something different from the “mysterious wakes” reported by Dinsdale and others. Develop a complete list of alternative hypotheses that could account for the type of evidence/observation(s) you selected.
3. Nessie isn’t alone; she comes from a large and diverse family of cryptids. Apply what you’ve learned during this investigation to the claims made in favor of a different legendary creature.



Case copyright held by the **National Center for Case Study Teaching in Science**, University at Buffalo, State University of New York. Originally published June 16, 2015. Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this work. Licensed photograph of Urquhart Castle on Loch Ness in title block ©Merlindo | Fotolia, ID#21216098.