

RESEARCH

**A Baby Sea-Serpent No More:
Reinterpreting Hagelund’s Juvenile “Cadborosaur” Report**

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Abstract—Eyewitness reports and cultural representations have been interpreted by some researchers to suggest the existence of a large, long-bodied marine vertebrate in the northeast Pacific. Dubbed “Caddy” or “Cadborosaurus” (after Cadboro Bay, British Columbia), it was formally named and described as *Cadborosaurus willsi* by Bousfield and LeBlond in 1995. Among the supposedly most informative accounts is the alleged 1968 capture of a juvenile by William Hagelund, detailed in his 1987 book *Whalers No More*. Reportedly morphologically similar to adult “Cadborosaurs,” the specimen was comparatively tiny, and apparently precocial. Bousfield and LeBlond argue that this strongly supports their contention that “Caddy” is reptilian (juvenile reptiles are typically precocial, recalling “miniature adults” in both behavior and morphology). Anomalous traits suggest some degree of misrecollection in Hagelund’s account, furthermore a quantitative analysis of the similarity of 14 candidate identities with the specimen indicates that it most strongly resembles the bay pipefish (*Syngnathus leptorhynchus*)—far more so than a cryptid or reptile. While this detracts from the plausibility of the cryptid, the re-identification of this particular specimen does not discount the data as a whole nor does it suggest that all “Caddy” reports are necessarily of known fish. We contend that the “reptilian hypothesis” does, however, need to be seriously re-examined in light of the removal of a strong piece of evidence.

Keywords: bay pipefish—*Syngnathus leptorhynchus*—sturgeon poacher—*Podothecus accipenserinus*—Cryptozoology—*Cadborosaurus willsi*—reptile—William Hagelund

Introduction

It is not accurate to presuppose that technically qualified scientists are uninterested in examining cryptozoological evidence. Several workers have assessed such data and reported their findings in the peer-reviewed technical literature (e.g., Scott and Rines, 1975, Raynal & Sylvestre, 1991, Paxton et al., 2005, Paxton & Holland, 2005, Paxton, 2009). Critical discussions of large undescribed species are not necessarily outlandish, as numerous marine vertebrate megafaunal species (>45 kg) have been discovered and described in recent years (e.g., Megamouth shark *Megachasma pelagios* Taylor et al., 1983, Bandolero beaked whale *Mesoplodon peruvianus* Reyes et al., 1991, West African skate *Bathyraja hesperaficana* Stehmann, 1995, Indonesian coelacanth *Latimeria menadoensis* Pouyaud et al., 1999), and statistical work suggests that several such species remain to be documented (Paxton, 1998, 2001, Raynal, 2001, Solow & Smith, 2005, Woodley et al., 2008). Large marine vertebrates can be surprisingly cryptic due to rarity, habitat, and/or avoidance of vessels (Heyning, 1989); *Megachasma pelagios* was not recorded from the Atlantic until 1995 (Amorim et al., 2000); the family Ziphiidae (“beaked whales”) includes numerous poorly known species, including *Mesoplodon traversii*, which is known from three partial skulls and has no live records (van Helden et al., 2002).

Between the early 1990s and the present (see also LeBlond & Sibert, 1973), Edward L. Bousfield and Paul H. LeBlond have collected and analyzed aquatic cryptid reports from the northeast Pacific Ocean (Bousfield & LeBlond, 1992, 1995, LeBlond & Bousfield, 1995, LeBlond, 2001). These authors have speculated on the existence of a large, long-bodied marine vertebrate species in the northeast Pacific Ocean based on their interpretations of eyewitness reports and local cultural representations. Purportedly, the anecdotal evidence generally describes an animal with a length of 5–15 meters, a serpentine body, undulatory locomotion, sheep/horse/giraffe/camel-like head, a neck 1–4 meters in length, anterior flippers, posterior flippers either absent or fused with the body, top of the tail “toothed” or spiny, and a tail which is horizontally split or fluke-like; less frequently reported characteristics include whiskers, large eyes, “colored” eyes, ears, and/or horns; the color is variously described as orange, green, brown, grey, black, and “gun metal” blue; the skin has been described as smooth, although sometimes fur/fuzz/hair on the neck or body is reported; the back has been variably described as serrated and smooth (LeBlond & Bousfield 1995). This cryptid was informally dubbed “Cadborosaurus” (after Cadboro Bay, British Columbia) by journalist Archie H. Wills in 1933 and was formally, albeit controversially, described as *Cadborosaurus willsi* by Bousfield and LeBlond in 1995.

A number of speculative inferences and suggestions led Bousfield and LeBlond (1995) to promote a hypothesis of the putative taxon's phylogenetic affinities. The long, slender body reported for *C. willsi* was argued by Bousfield and LeBlond (1995) to be most compatible with a poikilothermic physiology, and hence with a reptilian identity (Bousfield & LeBlond, 1995:9). It was also suggested that the existence of small, precocial "*Cadborosaurus*" juveniles evidenced reptilian identity since the juveniles of mammals generally undergo an extended period of parental care in which they are incapable of surviving by themselves. By comparing the inferred morphology of an enigmatic carcass from Naden Harbour, British Columbia, with that of various extinct and extant vertebrates, they concluded that the closest similarities were with the extinct reptiles of the clade Sauropterygia, and specifically with plesiosaurs. Sauropterygians are otherwise known only from the Mesozoic, and there is no evidence from the fossil record that they survived beyond the end of the Late Cretaceous (Lucas & Reynolds, 1993). Bousfield and LeBlond's hypothesis has been criticized on the grounds that eyewitness evidence used to support the reality of *C. willsi* is more compatible with a mammalian identity than a reptilian one, as the putative animal inhabits cold water, exhibits maximum flexibility in its vertical plane, and is sometimes described as possessing hair (Saggese, 2006, Woodley, 2008, Woodley et al., 2008). Now, further analysis has demonstrated that one of the best-described juvenile "*cadborosaurs*" cannot be considered reptilian and most likely represents a known, albeit unfamiliar, species of fish.

Captain William Hagelund's Account

In August 1968 while at Pirate's Cove, De Courcy Island, British Columbia, former whaler Captain William Hagelund gave the following description of an animal he could not identify; the account is taken from Hagelund (1987:177–180):

With my two sons and their grandfather aboard our centre cockpit sloop, we spotted a small surface disturbance in the calm anchorage where we had dropped the hook for the night. Lowering the dinghy, my youngest son Gerry and I rowed out to investigate. We found a small, eel-like, sea creature swimming along with its head held completely out of the water, the undulation of its long, slender body causing portions of its spine to break the surface. My first thought that it was a sea snake was quickly discarded when, on drawing closer, I noticed the dark limpid eyes, large in proportion to the slender head, which had given it a seal-like appearance when viewed from the front. When it turned away, a long, slightly hooked snout could be discerned.

As the evening's darkness made observation difficult, and the swiftness of the creature's progress warned that he could quickly disappear, I decided to attempt a capture and bring it aboard the sloop for closer examination. Reaching

out with a small dip net as Gerry swung the stern of our dinghy into the path of the small vee of wavelets that were the only indication of the creature's position, I was pleased to find him twisting angrily in the net when I lifted it up.

Under the bright lights aboard the sloop, we examined our catch and found he was approximately sixteen inches long, and just over an inch in diameter. His lower jaw had a set of sharp tiny teeth and his back was protected by plate-like scales, while his undersides were covered in a soft yellow fuzz. A pair of small, flipper-like feet protruded from his shoulder area, and a spade-shaped tail proved to be two tiny flipper-like fins that overlapped each other.

I felt the biological people at Departure Bay would be interested in this find, but without a radiophone to contact them, the next best thing was to sail up there in the morning. Agreeing on this, we filled a large plastic bucket with seawater and dumped our creature into it. We retired early, for I intended to leave at first light, but sleep would not come to me. Instead, I lay awake, acutely aware of the little creature trapped in our bucket. In the stillness of the anchorage I could hear the splashes made by his tail, and the scratching of his little teeth and flippers as he attempted to grasp the smooth surface of the bucket. Such exertion, I began to realize, could cause him to perish before morning.

My uneasiness grew until I finally climbed back on deck and shone my flashlight down into the bucket. He stopped swimming immediately, and faced the light as though it were an enemy, his mouth opened slightly, the lips drawn back exposing his teeth, and the tufts of whiskers standing stiffly out from each side of his snout, while his large eyes reflected the glare of my flashlight. I felt a strong compassion for that little face staring up at me, so bravely awaiting its fate.

Just as strongly came the feeling that, if he was as rare a creature as my limited knowledge led me to believe, then the miracle of his being in Pirate's Cove at all should not be undone by my impulsive capture. He should be allowed to go free, to survive, if possible, and to fulfill his purpose. If he were successful, we could possibly see more of his kind, not less.

If he perished in my hands, he would only be a forgotten curiosity. I lowered the bucket over the side and watched him swim quickly away into the darkness, then returning to my bunk for a peaceful rest, my mind untroubled by the encounter.

Hagelund included an illustration of his creature (reproduced in Figure 1) with the following notes: hooked upper jaw, 3 inches (brackets include head), large eyes, plate scales, black on top and brown on sides, ragged ends (arrow pointing to tail), yellow tail, approximately 1 to 1½ inches in diameter, yellow fuzz (pointing to belly), tiny teeth on both jaws, 16 inches (brackets including head, body, and tail).

Analysis

Hagelund's account includes 24 reported traits: an eel-like appearance (= sea snake-like; long, slender body), head held out of the water while swimming,

undulatory movement, dark eyes, limpid eyes, large eyes, seal-like face, slender head, slightly hooked snout, long snout, length of 16 inches (40 cm), diameter of 1 to 1.5 inches (2.5–3.8 cm), tiny teeth in both jaws, plate-like scales on the back, undersides with a soft yellow fuzz, flipper-like feet near the shoulder, spade-shaped tail, tail composed of two overlapping flipper-like fins, lips, whiskers, coloration of black on top and brown on the sides, yellow tail, and a head length of 3 inches (7.6 cm). It is likely the ragged ends of the tail mentioned in the illustration's text represent damage rather than an actual trait, which raises the possibility that "overlapping flipper-like fins" are also the result of damage.

Our objective was to use these and other traits in comparing Hagelund's specimen with other plausible candidate species. In order for some of the traits to be usable in comparison with known animals and proposed cryptids, some needed to be more strictly defined or modified. Body diameter and head length were not used directly, but were rather modified into proportions relative to the total length (i.e. including the tail appendage), giving a depth:TL of 1:16 to 1:10.7, and a head:TL of 1:5.33. "Eel-like" was taken to mean an elongate and cylindrical body, and is not necessarily redundant in conjunction with the aforementioned proportions, as eel-like animals may not be proportionally similar and animals with similar head:TL proportions may not be eel-like. For the given traits of "eel-like," "large eyes," "slightly hooked snout," "long snout," and "slender head," the illustrated morphology was used to determine the threshold of these traits, e.g., if the eyes are at least the same size in proportion they were considered "large." While the account suggests that only the back had plate-like scales, the illustration shows them covering most of the animal's side; due to this apparent contradiction, the trait was simplified to the presence of plate-like scales. Since several of the candidates lack teeth entirely, it was decided that the simple presence or absence of teeth would be a more worthwhile trait rather than attempting to determine the threshold for "tiny" teeth; specifying teeth in both jaws is unnecessary in this analysis as none of the candidates, and few animals in general, have teeth in only one jaw. The trait of "undulatory" movement unfortunately does not specify a plane, so was interpreted as eel- or snake-like locomotion occurring either horizontally or laterally. It is not clear if "slender head" refers to head depth or width, so the illustrated depth was used as a guide but given low weight (see below).

For comparisons with fish candidates, the traits of dorsal fin(s), pelvic fins, and anal fin were added to determine which candidates are the closest fit. The description of "flipper-like feet" near the shoulder is confusing since Hagelund's illustration appears to show fin rays typical for actinopterygian fish; accordingly, this trait is regarded as synonymous with pectoral appendages of any type.

Hagelund's illustration does not clarify how dark the eyes are, so this trait was assumed to indicate that the eyes were somewhat darker than the surrounding body. It is hard to objectively define how eyes could be described as "limpid," although this trait was retained since it still has comparative value with one aberrant report.

Due to the uncertainty of eyewitness observations, multiple character states were used in our analysis. While a certain trait may be present (e.g., poacher pelvic fins), there may be a plausible reason why it could be overlooked (e.g., the fin could be folded and/or is small and transparent enough to be easily overlooked). Additionally, a trait may not be present (e.g., tail composed of two separate flippers in cutlassfishes) but could be explained by the misinterpretation of another trait (e.g., a strongly forked tail). This does not mean that overlooking or inventing a trait is impossible; it is merely less likely than the suggestion that these may be flawed descriptions of real character states.

It is apparent that not every trait should carry the same comparative weight due to both occasional nebulous descriptions and the potential for eyewitness confusion: We therefore argue that traits should be sorted into different categories based on their importance. Traits regarded as having high importance are clearly described and difficult to misinterpret: They involved such obvious morphological traits as plate-like scales, eel-like appearance, teeth, head held out of the water while swimming, black dorsal coloration, brown lateral coloration, and yellow tail.

In total 29 morphological characters were used. A simple coding system was developed to determine whether a particular trait was present or not. When a trait is unambiguously present, it is coded with P (for present), when a trait is occasionally present due to individual variability, it is coded with an O (for occasionally present). The use of A indicates the absence of a particular trait, whereas a question mark indicates that it is not known whether or not this trait or something that could be mistaken for it is present. As there is an element of subjectivity to the inference of a particular trait, the addition of * next to a trait indicates that the presence of the trait may be open to eyewitness interpretation. Each character was ranked as either similar (s), in that it co-occurs (is either simultaneously present or absent) in both the Hagelund specimen and candidate, somewhat similar (ss), in that it or something that could be mistaken for it could co-occur, or dissimilar (d) indicating no co-occurrence. Co-occurrent (similar) traits were awarded a whole point. An occasionally present (somewhat similar) trait was given half a point in all cases as the trait must be either present or absent at least some of the time in the candidate. Stand-alone question marks (indicating unknown presence or absence) were awarded zero points, and a co-occurrent score followed by * (suggesting uncertainty) incurred a "subjectivity penalty" of a quarter of a point. This gives rise to a simple formula with which the overall similarity with respect to the Hagelund specimen could be ascertained for a given candidate:

Similar scores (1 point) + Somewhat similar scores (0.5 point) – Subjectivity penalty (0.25 point)
= Candidate's overall similarity score.

It was decided not to include a separate penalty for dissimilarity, as this would have further complicated the measure. For example, calculating separate dissimilarity scores and then subtracting them from the similarity score resulted in negative scores in the case of some candidate identities. Furthermore, dissimilarity scores were deemed to be less informative in instances where there were large numbers of “unknown” character states which couldn't be honestly described as dissimilar (for example in the case of the Finn John description there were 21 “uncertain” character states vs. 8 character states that were unambiguously present, i.e. were “similar” with respect to the Hagelund specimen and no unambiguously dissimilar characters—in this instance similarity scores are simply more informative). Therefore, while not perfect, the similarity measure developed here should serve as an adequate metric allowing for candidate identities to be easily compared.

To determine the possible identification of the Hagelund specimen, the reported characteristics were compared with those of the cryptid *C. willsi* proposed by LeBlond and Bousfield and with those of an unusual “caddy” report from one Finn John reported by Hagelund. Crocodylians and elasmosaurids were also included in the analysis following LeBlond and Bousfield's proposal of reptilian affinities for *C. willsi*. The traits of ear and/or horn presence, long neck (quantified as more than twice the length of head), and presence of a “toothed” or spiny tail were also included in our comparative analysis. A generic pinniped was also included as a candidate owing to Hagelund's description of his specimen possessing a “seal-like face.” One of us (McCormick) noted a strong similarity between the Hagelund specimen and pipefish; the hypothesis that the specimen represents a known fish rather than a reptilian cryptid is significant, so a number of fish from the northeast Pacific (all morphologically reminiscent of the specimen) were incorporated as well: bay pipefish (Syngnathidae; *Syngnathus leptorhynchus*), poachers (Agonidae; *Podotheucus accipenserinus*, *Pallasina barbata*, *Sarritor frenatus*), tube-snout (Aulorhynchidae; *Aulorhynchus flavidus*), green sturgeon (Acipenseridae; *Acipenser medirostris*), and cutlassfishes (Trichiuridae; *Aphanopus arigato*, *Lepidopus fitchi*). A decapod candidate (*Pandalus platyceros*) was also included due to Staude and Lambert's (1995) suggestion that a representative of this order might have been the culprit behind Hagelund's specimen.

For a listing of the traits ascribed to “caddy” by LeBlond and Bousfield (1995), refer to the Introduction above. A review of the reports utilized by LeBlond and Bousfield (1995) shows that no one individual account possesses

the full complement of traits present in the Hagelund description, furthermore contradictions are frequent (as discussed above), and singular traits such as “fins all over the body,” “turtle-like,” “cat-like head,” “like a huge diver wearing a helmet,” et cetera, are not uncommon. Clearly, the establishment of *C. willsi* by LeBlond and Bousfield was subjective, and conclusions drawn from comparisons with the set of traits have to be limited.

Table 1 presents an analysis of the similarity of 14 candidate identities to Hagelund’s specimen with respect to 29 different characters. Based on this analysis it is evident that conflating LeBlond and Bousfield’s *C. willsi* with the Hagelund specimen is problematic for a number of reasons: most strikingly, the plate-like scales of the latter. While the traits of a serrated crest and toothed/spiny tail are reportedly present in *C. willsi*, the former does not necessarily imply armor (it could be a soft structure or even hair), and the latter appears to have occurred exclusively in the enigmatic Naden Harbour carcass. Also conspicuously absent in the Hagelund specimen is a long neck. While the Hagelund specimen and *C. willsi* share the traits of large eyes and whiskers, the rarity of the traits in “caddy” reports, coupled with their fairly generic nature, suggests they have little diagnostic value. Overall, *C. willsi* exhibited a relatively low similarity to the Hagelund specimen (8.25 points out of a possible 29). The Finn John “caddy” report shares a number of specific traits with Hagelund’s encounter such as a spade-shaped tail, large limpid eyes, whiskers, fur, and plates on the back, although its overall similarity was low (8 points out of a possible 29); this unusual report was in fact recalled by Hagelund, and its dissimilarity to other reports aside from traits specific to Hagelund’s specimen is no doubt significant (see below).

Interestingly, the Hagelund specimen shares more traits in common with the generalized crocodylians (plate-like scales, sometimes coloration) (scoring 13 points out of 29); however, significantly with respect to LeBlond and Bousfield’s thesis, it seems to share no more traits in common with the elasmosaurids than it does with *C. willsi* (8 points out of 29). A generic pinniped was included for comparison owing to Hagelund’s reference to his specimen possessing a “seal-like face.” There are five seal species native to British Columbia belonging to both the Otariidae family (northern fur seal *Callorhinus ursinus*, Steller sea lion *Eumetopias jubatus*, and California sea-lion *Zalophus californianus*), and the Phocidae family (northern elephant seal *Mirounga angustirostris* and harbor seal *Phoca vitulina*) (Allen, 1974). While the pinnipeds as a whole scored a respectable 14.75 out of 29, no single species possesses all of the traits present in Hagelund’s specimen. The fact that Hagelund’s specimen was small (33cm) is also grounds to rule out pinnipeds as plausible candidates, as this size falls far below that of any pinniped species. One point of similarity between these candidates and the Hagelund specimen is swimming with the head out of the

TABLE 1
Analysis of the Similarity of 14 Candidate Identities to Hagelund's Specimen with Respect to 29 Different Characters

traits	Hagelund	C. willisi Finn	John	Thalatto-	Elasmosaur-	Pinnipedia	S. leptos-	P. accipetr-	Pa. barb-	Sa. Tresh-	Alc. Flab-	A. angatio-	L. Mami	Ac. Mead-	Pan. Flaby-	
				suchia spp.	idae spp.	spp.	rhynchus	seirinus	bata	atus	idus			rostris	ceros	
Teeth	P	?	?	P (s)	P (s)	P (s)	A (d)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A (d)	A (d)
Lips	P	?	?	A (d)	A (d)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A (d)
Head held out of water	P	P (s)	?	P (s)	P (s)	P (s)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)
Ears and/or horns	A	O (ss)	?	A (s)	A (s)	O (ss)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)
Tail dorsally toothed, spiny	A	P (d)	?	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)
Black dorsally, brown laterally	P	A (d)	?	?	?	O (ss)	O (ss)	P (s)	A (d)	P (s)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)
Yellow tail	P	A (d)	?	?	?	A (d)	A (d)	P (s)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)
Plate-like scales	P	?	P (s)	O (ss)	A (d)	A (d)	P (s)	P (s)	P (s)	P (s)	A* (d)	A (d)	A (d)	O (ss)	A* (d)	A* (d)
Eel-like	P	P (s)	P (s)	A (d)	A (d)	A* (d)	P (s)	A* (d)	P (s)	A* (d)	P (s)	P (s)	P (s)	P (s)	A (d)	A (d)
Long snout	P	P (s)	P (s)	P (s)	A (d)	O (ss)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A* (d)
Large eyes	P	O (ss)	P (s)	O (ss)	O (ss)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)
Long neck	A	P (d)	?	A (s)	P (d)	A* (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)	A (s)
Snout slightly hooked	P	A (d)	?	A (d)	A (d)	A* (d)	A* (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)	A (d)
40 cm approximate total length	P	A (d)	?	P (s)	?	A (d)	O* (ss)	A* (d)	A (d)	A* (d)	A (d)	P (s)	P (s)	P (s)	P (s)	A (d)
Diameter: TL ~ 1:16 to 1:10.7	P	A (d)	?	O (ss)	O (ss)	A* (d)	P (s)	P (s)	P (s)	A* (d)	P (s)	P (s)	P (s)	P (s)	A* (d)	P (s)
Head: TL ~ 1:5.33	P	A (d)	?	O (ss)	A (d)	A (d)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A (d)
Undulatory movement	P	P (s)	?	P (s)	A (d)	O (ss)	P (s)	A* (d)	A* (d)	A* (d)	A (d)	O (ss)	O (ss)	A* (d)	A (d)	A (d)
Flipper-like feet near shoulder	P	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A (d)
Dorsal fin(s)	A	A (s)	?	A (s)	A (s)	A (s)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P (d)	A (s)
Pelvic fins	A	O* (ss)	?	P (d)	P (d)	P* (d)	A (s)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P (d)	A (s)
Anal fin	A	A (s)	?	A (s)	A (s)	A (s)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P* (d)	P (d)	A (s)
Dark eyes	P	A (d)	?	?	?	P (s)	P (s)	A* (d)	A* (d)	P (s)	P (s)	P (s)	P (s)	P (s)	P (s)	A (s)
Tail composed of separate flippers	P	A* (d)	?	A (d)	A (d)	P (s)	A (d)	A (d)	A (d)	A (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)
Whiskers	P	O (ss)	P (s)	A (d)	A (d)	P (s)	A (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)
Underbelly w/ soft yellow fuzz	P	A* (d)	?	A (d)	A (d)	A (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)	A* (d)
Slender head	P	?	?	?	?	?	P (s)	?	P (s)	?	P (d)	?	?	?	?	?
Seal-like face	P	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Limpid eyes	P	?	P (s)	?	?	?	?	?	?	?	?	?	?	?	?	?
Spade-shaped tail	P	?	P (s)	?	?	?	O* (ss)	?	?	?	?	?	?	?	?	?
Total similar (out of 29)	29	8.25	8	13	8	14.75	16	13	13	12	12	13.5	13.5	10.5	9	9

* open to eyewitness interpretation; ? unknown presence; 0 occasionally present due to variability; P present; A absent; s co-occurs as present or absent in the Hagelund specimen; ss somewhat similar in that it or something that could be mistaken for it sometimes co-occurs; d dissimilar indicating no co-occurrence

water, which as air breathers these candidates must do at least some of the time. This trait would seemingly imply that the Hagelund specimen was also an air-breather; however, Hagelund never mentioned breathing. Rather than dismiss the local fish species that superficially resemble the Hagelund specimen on the basis of surface activity, the possibility of aberrant behavior in those fish must be considered: After all, this is in no way less likely than the identification of Hagelund's animal as a cryptid. Another possibility is that Hagelund added "caddy"-like behavior during his recollection of the encounter, although it would still require the animal to be at or near the surface.

The bay pipefish is common to the bays and sloughs of the west coast of Canada, the US, and Mexico, where it lives among common eelgrass, feeding on small invertebrates (Eschmeyer & Herald, 1983). Data suggest that this species does venture into more open water (Hart, 1973), so the location of Hagelund's encounter is not necessarily problematic. The presence of plate-like scales, pectoral fins (= "fore flippers"), large eyes, a long snout, and lips all strongly agree with traits reported from the Hagelund specimen. In Hagelund's illustration (reproduced in Figure 1), the specimen was described as having a black dorsum, brown flanks, and yellow ventral fur; this appears to fall within the known color variation of *S. leptorhynchus* which has been described as varying from green to mottled brown with streaks of black on the dorsal portion, coupled with a yellowish ventrum (Filisky & Peterson, 1998, Girard, 1858). The reported head length of 7.62 cm (3") for the Hagelund specimen gives a head:TL (TL = total length) proportion of 1:5.3, which is similar to the head:SL (Standard Length = tip of snout to end of caudal peduncle) proportion of 1:6.5 reported for *S. leptorhynchus* (Girard, 1858). Since the individual measured by Girard (1858) was 15 cm in length, it might be possible that positive allometric growth of the pipefish's head would yield an even closer proportion for a large individual.

While *S. leptorhynchus* has not been observed to reach 40 cm in length, the maximum reported length of 33 cm is within a reasonable margin of observer error (Eschmeyer & Herald, 1983). The 2.54 cm (1") body depth of the Hagelund specimen (body depth:TL = 1:16) seems excessive for a pipefish, but this could be explained by the possibility that the Hagelunds captured a pregnant male, as pregnancy in pipefish causes considerable swelling. The lack of a dorsal fin and anal fin in Hagelund's description could be explained by their being folded down or being overlooked entirely as they are semi-opaque structures composed of only 32 and 3 soft rays, respectively (Girard, 1858). The presence of a bifurcated caudal appendage reportedly composed of two separate and overlapping fins could be due to a misinterpretation of a folded caudal fin or damage to the fin. Hagelund's description of integumentary structures is curious; hair-like appendages used for camouflage are present in some

syngnathids such as *Urocampus carinirostris*, however these fish are weak swimmers which lack a dispersive egg and larval phase, implying that the entire life cycle occurs in localized areas in the western Pacific (Neira et al., 1998, Chenoweth et al., 2002). While the possibility exists that the Hagelund pipefish represents an undescribed, large, “hairy” syngnathid from the northeast Pacific, we contend that the fur-like growth reported on the specimen’s underside could be a misinterpretation of the ventral coloration, which has been described as yellowish with a mesh work pattern of brown lines (Girard, 1858). Alternately, a covering of algae could create the impression of a fur-like integument.

The most problematic morphological aspect reported by Hagelund is the presence of “whiskers” and of teeth. Since Hagelund already referred to “fore flippers,” it seems very unlikely that he would interpret the pectoral fins again as “whiskers,” and it is also unlikely that the coloration pattern would give the impression of a structure protruding from the head of the fish. Pipefish have very small, toothless mouths quite unlike what Hagelund described. Despite these problematic details, the pipefish is still the strongest candidate for the Hagelund specimen, scoring 16 out of a possible 29. Other local fish species, however, also deserve consideration:

Poachers (*Agonidae spp*) are morphologically distinctive scorpaeniforms with rows of bony armor covering their typically elongated bodies; due to a superficially similar appearance to pipefishes, they are also somewhat plausible candidates for the Hagelund specimen. Large eyes, long snouts, small teeth, and lips are typically present in members of the clade, as are barbel-like structures, which could be interpreted as “whiskers.” The spines associated with the armor of some species could potentially be confused for hairs. The often-large pectoral fins are the primary means of locomotion except for the c-start escape behavior, which utilizes the caudal fin; this appears to be comparable with the behavior that Hagelund observed in his specimen (Nowroozi et al., 2009). Problematically, however, poachers are benthic and strongly negatively buoyant (Nowroozi et al., 2009), which makes the capture of a specimen near the surface in relatively deep water seem rather improbable. The presence of a prominent spiny first dorsal fin (sometimes absent), a soft-rayed second dorsal fin, a prominent anal fin, and a small, thoracic pelvic fin would have to have gone unnoticed in Hagelund’s specimen if an agonid was involved, as such traits go unreported (one possibility is that they were folded). Like pipefish, the caudal fin is rounded and could only be interpreted as bifurcated if it was damaged.

Most of the approximately 50 poacher species occur in the North Pacific, and it is noteworthy that they are not well-known (Jensen, 2005). While at least 17 species are known to occur in the same broad geographical area as Hagelund’s sighting, most of these species fall considerably under 40 cm in length and

some are even fairly stout-bodied (Froese & Pauly, 2009). The superficially sturgeon-like *Podothecus accipenserinus* can reach 30.5 cm in length, has very prominent barbels, and has a coloration which can be roughly similar to that of the Hagelund specimen (Hart, 1973); this species obtained a similarity score of 13 out of 29, however, it is not particularly attenuated since the body depth:total length is approximately 1:7.5 instead of 1:16, which was observed in the Hagelund specimen. This difference falls far outside a comfortable margin of error. Other strong candidate species include *Pallasina barbata* and *Sarritor frenatus*; *P. barbata* has a slender head and similar proportions as the Hagelund specimen, but is small (max. 17 cm) with a prominent stripe on its head (Eschmeyer & Herald, 1983), *Sa. frenatus* is somewhat larger (max. 27 cm) and matches the coloration description as well as the head:total length proportion, but not the body depth:total length, and the known range does not include southern British Columbia (although it is close) (Eschmeyer & Herald, 1983). These candidates both obtained similarity scores of 13 and 12 out of 29, respectively. It does not appear that there is any long-snouted poacher, which matches the size, proportions, and reported coloration of the Hagelund specimen (Tokranov & Orlov, 2005, Miller & Lea, 1976, Froese & Pauly, 2009). While Agonidae as a whole may display almost all of the characters reported in the Hagelund specimen, no one species is more probable as a candidate identity than the bay pipefish, and suggesting an unknown species is outside the applicability of the present data.

The tubesnout (*Aulorhynchus flavidus*) is a marine gasterosteoid (stickleback relative) with a long snout, large eyes, and body that is both slender and elongate; notably, the caudal fin is forked (Hart, 1973), and sharp teeth are present in the mouth (Jordan & Gilbert, 1882). 24–27 membrane-free dorsal spines are located anterior to the soft rays (Hart, 1973). The skin is naked with the exception of rugose shields near the lateral line and dorsal fin (Jordan & Gilbert, 1882). It could be possible for the shields and/or spines to suggest more extensive plate-like scales to an eyewitness, but this is not very likely. A soft dorsal fin is located far back on the body and mirrors the anal fin (Hart, 1973). The fish is described as pale mottled brown with an olive-brown or yellow-brown dorsum, white ventrum, and a silver patch bordered by a dark band near the head and gills (Hart, 1973). This candidate species obtained a similarity score of 12 out of 29, however the maximum recorded size is 18.8 cm (Bayer, 1980), and coupled with the distinctive coloration, lack of actual armor, and lack of morphology which can be interpreted as whiskers and fuzz, the tubesnout can be ruled out as a strong candidate for Hagelund's specimen.

Cutlassfishes regularly exceed 40 cm in length, and have big eyes, teeth, subtle pelvic fins, and a forked caudal fin. *Aphanopus arigato* (formerly *A. intermedius*) and *Lepidopus fitchi* occur in the northeast Pacific Ocean and

appear to be the strongest candidates for the Hagelund specimen within the group; *A. arigato* is coppery black in color with an iridescent tint, has a body depth:standard length proportion ranging from 1:12 to 1:16.4 and a head length:standard length proportion ranging from 1:4.9 to 1:5.5; *L. fitchi* has a black or brown coloration with a silver abdomen, a body depth:standard length proportion of 1:9.2 to 1:13.3, and a head length:standard length proportion of 1:4.2 to 1:5.5 (Nakamura & Parin, 1993). It is presumed both species use similar locomotion as *A. carbo*, which involves ostraciiform swimming (i.e. caudal fin only) when stalking prey and anguilliform when in striking distance; it is notable that the dorsal and anal fins are retracted when in the former and the median fins are erected in the latter (Bone, 1971). Both candidate species obtained similarity scores of 13.5 out of 29, however the absence of plate-like scales, structures which may explain “yellow fuzz” (the anal fin occurs only in the far posterior of the body), and strikingly different coloration compared with Hagelund’s specimen provides substantive grounds upon which this group can be ruled out as a strong candidate identity.

All sturgeon species (Acipenseridae) can exceed 40 cm in length and have five rows of dorsal, lateral, and ventrolateral scutes, which could complement Hagelund’s description of plate-like scales. The Green sturgeon (*Acipenser medirostris*) is present in the northeast Pacific Ocean, has a nearly homocercal tail (i.e. consisting of two equal lobes) which could be regarded as separate “flippers,” lips, pectoral fins, barbels (potential “whiskers”), and a similar head:body length proportion as the Hagelund specimen (Girard, 1858). This candidate obtained a similarity score of 10.5 out of 29, however it is not eel-like and it seems unlikely an observer could overlook a dorsal fin, pelvic fins, an anal fin, strongly ventral mouth, and prominent lateral stripes, which effectively rules out this candidate species as a strong contender.

Staude and Lambert (1995) proposed decapods as a candidate for Hagelund’s specimen, but did not specify a species. Presumably, the authors suggested this crustacean order due to the possibility of an exoskeleton being interpreted as plate-like scales, antennae as whiskers, pereopods and pleopods (swimming and walking legs) as “fuzz,” and uropods as a tail composed of two flippers. The reported presence of lips, teeth, pectoral appendages, and the overall vertebrate-like appearance of the drawing are problematic for any decapod candidate. The Spot prawn (*Pandalus platyceros*) is the largest shrimp in the region, with an eyestalk-telson length that may exceed 20 cm, and coloration that is orange in large individuals with white spots on the first and fifth pleura (Hoffman, 1972). American lobster (*Homarus americanus*) have been introduced to the region (Ray, 2005), and fit the size criterion, but are highly unlikely to be found at the surface and to go unrecognized. While the decapod hypothesis is certainly novel and thought-provoking, the lack of a viable candidate species, coupled

with a low similarity score for *P. platyceros* (9 out of 29), means that it can be ruled out as a plausible candidate.

As can be seen through comparison of the illustrations in Figure 1, Hagelund's drawing bears more than a superficial resemblance to the bay pipefish. Despite the problematic description of whiskers and teeth, given how well the majority of the details reported by Hagelund seem to complement our proposed *S. leptorhynchus* identification, is it therefore possible that Hagelund simply misremembered the details of the specimen in his 1987 description? One piece of evidence supportive of this is the 18-year gap between Hagelund making his observations and recounting them in his book. Memories are hardly infallible and are subject to distortion with the passage of time (Wiseman & Lamont, 1996, Wright & Loftus, 2008). Hagelund claimed that the description of *C. willsi* he heard from Finn John had slipped his mind at Pirate Cove but perhaps there was a subconscious influence upon recollection; Finn John's account shares traits with Hagelund's account that are reported in no other "Caddy" reports (ventral fur, dorsal overlapping plates) and shares several details with little variation (horse-like head, large eyes, whiskers, slender body, flippers, spade-shaped tail). Perhaps as Hagelund became increasingly convinced that what he and his family had caught was a baby sea-serpent, his memory of the specimen correspondingly adapted by taking on the "appropriate" characteristics.

The bay pipefish shares more characteristics in common with Hagelund's specimen than any other candidate species. Although certain observed traits are congruent with similar traits reported in *C. willsi*, Hagelund's "sea-serpent" differs markedly from typical accounts of *C. willsi* and is comparatively far less similar. Based on this analysis it is therefore suggested that the theory that Hagelund (1987) describes a pipefish, most probably *S. leptorhynchus*, is the most probable explanation.

Conclusion

Both cryptozoologists and those skeptical of the field have reinterpreted reports of sea-serpents and lake-monsters as reports of either known animals perhaps engaged in unusual behaviors or as inanimate objects viewed under unusual conditions. Naish (1997) argued that photographs of an alleged *C. willsi* "carcass" taken on the beach at Camp Fircom, British Columbia, in the 1930s, do not represent an animal carcass but are in fact composed of a montage of beach debris. Similarly Naish (2001) and Radford (2003) have both independently suggested that the "lake monster" photographed by Sandra Mansi in 1977 at Lake Champlain might have been a tree stump propelled to the surface by gas generated through bacterial decay. Paxton et al. (2005) suggested that Egede's alleged account of a "most dreadful monster" witnessed off the

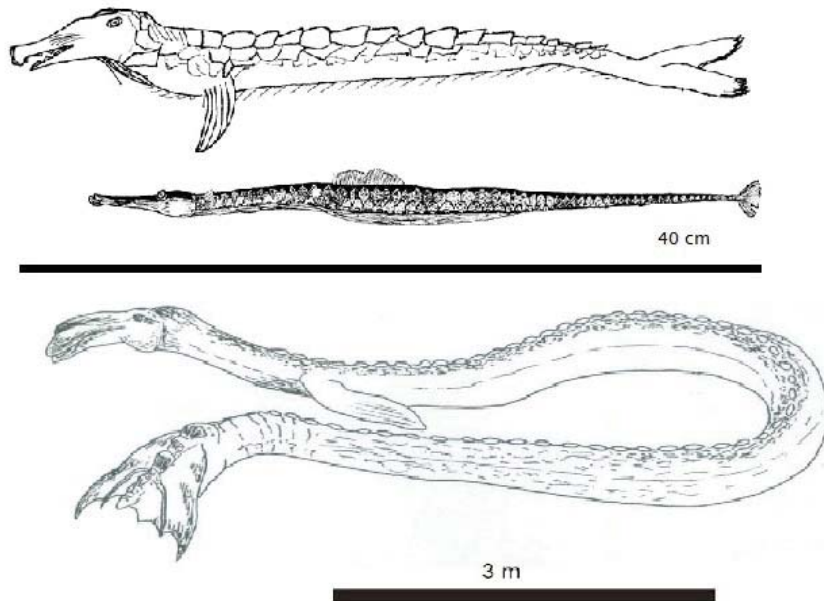


Figure 1. A reproduction of Hagelund's drawing of his "baby sea-serpent" (top) along with an illustration of the bay pipefish *S. leptorhynchus* (middle), and *C. willsi* (bottom) along with scales (40 cm and 3m, respectively).

Note that the maximum girth:total length ratio in Hagelund's illustration is approximately 1:11 while the description gives a significantly more attenuated ratio of 1:16. Pipefish and Hagelund specimen by Cameron A. McCormick, *C. willsi* by Darren Naish.

coast of Greenland in 1734, which was interpreted by Heuvelmans (1968) as a sighting of a "super-otter" (a hypothetical primitive mega-archaeocete), may actually have been of a whale in a state of arousal, owing to morphological similarities between the description of the terminal end of the monster and whale penises (Paxton et al., 2005). Many additional examples represent probable misidentification of this kind; even Heuvelmans (1968) ruled out 52 reports in *In the Wake of the Sea-Serpents* on the grounds that they were likely misidentifications of known species or other more mundane objects.

At this stage it is necessary to make two points. Firstly, in suggesting that Hagelund's 1968 baby sea-serpent was in all likelihood a bay pipefish, we are in no way implying that he deliberately falsified the details of his encounter, although we have reason to suspect that certain details may have

been misremembered subsequently. Similarly, there is no reason to believe that Hagelund (or his family) should have been familiar with pipefish as they are far less well-known than their close relatives the sea horses; even experienced whalers like Hagelund would never normally encounter pipefish in their line of work. It is therefore easy to imagine how a bizarre-looking, long, serpentine, armour-plated sea creature might excite the imaginations of those encountering it for the first time.

Additionally, in suggesting a bay pipefish identity for Hagelund's animal, we are not suggesting that all "Caddy" reports are simply cases of mistaken identity. Since the Hagelund specimen, by far the smallest reported "Caddy," was already at the extreme of bay pipefish size variation, it is highly improbable that pipefish misidentification resulted in any other reports of the cryptid. The possibility that cutlassfishes and sturgeons may have been responsible for some "Caddy" sightings cannot be ruled out, however.

It is our contention that Hagelund's encounter should not be used in support of the existence of "Caddy," let alone form the basis of entirely speculative theories concerning its putative reproductive and life-history characteristics. Although the elimination of this encounter lessens the overall likelihood for the existence of "Caddy," rooting out the probable misidentifications advances enquiry, as researchers can focus their efforts on the more robust and ultimately intriguing data.

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