



Invited reply

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Serendipity in research—investigation into illegal wildlife trade discovers a new population of Steller’s sea cows: a reply to Pyenson *et al.* (2016)

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According to Stejneger [1], it is most likely that the last of the great northern sea cows went extinct around 1768. Many Steller’s sea cow (*Hydrodamalis gigas*) bones have been located on the Commander and Aleutian Islands to date [2,3]. However, no verified *H. gigas* bones have ever been located that come from farther north. Crerar *et al.* [4] described a trophically distinct population of Steller’s sea cows from St Lawrence Island using bones obtained by LD Crerar from Jerry Kochheiser of Alaskan Fossil Ivory. Mr Kochheiser obtained several hundred pounds of bone by travelling to St Lawrence Island and purchasing them from local residents who had excavated them.

Pyenson *et al.* [5] stated that studies of this type should be conducted using museum voucher specimens. However, the bones were not collected as part of a typical palaeontological study, but as the by-product of a very different kind of study (unpublished). Crerar [6] found bone purported to be Steller’s sea cow being sold at knife shows (for carving purposes) and on Ebay. This material is commonly known as ‘mermaid ivory’. As Steller’s sea cows are extinct, sale of such material is legal and does not violate the US Endangered Species Act, the US Marine Mammal Protection Act or the Convention for the International Trade in Endangered Species (CITES). However, we noted that morphologically some of this ‘mermaid ivory’ did not resemble sirenian bone, but was perhaps some other sort of marine mammal bone. This hypothesis was verified using DNA typing [7]. Thus, the samples in Crerar *et al.* [4] were collected for an analysis of bone that was suspected of being traded illegally, and the identification of a new population of *H. gigas* at St Lawrence Island was a serendipitous and beneficial by-product of a study with entirely different aims. (Investigation is also recommended to examine purported mammoth ivory being sold in the same venues. The sale of ‘mammoth ivory’ could hide illegal trade in elephant ivory, which is similar. According to Burrigato *et al.* [8], a very small quantity of ivory is required to make the differentiation.)

The analysis of *H. gigas* bone acquired from Ebay sellers and knife dealers provided the first tangible evidence in support of the claim by Murie [9], who, when reporting on an Eskimo description of an animal formerly found at St Lawrence Island, stated that this “would indicate Steller’s sea cow and is most interesting information. However, no bones have been obtained as yet. . . . [Y]et [this tradition] deserves special attention in future work on the island” (p. 345). Using DNA typing from the published Steller’s sea cow sequence generated by Ozawa *et al.* [10], the identity of a large number of commercially traded bone samples was established, revealing several that did not derive from Steller’s sea cows (and were potentially illegal marine mammal bone).

We initially thought that the bones might have come from carcasses (e.g. from Bering Island) stranded on St Lawrence Island (although that was unlikely

considering the large distance from Bering Island), or had been brought there by natives who make decorative carvings of the bone. However, when nitrogen-15 ($\delta^{15}\text{N}$)/carbon-13 ($\delta^{13}\text{C}$) values were obtained for the bones, it became clear that these bones were not from the population that lived around Bering Island, but from some other location—a finding consistent with their claimed origin from St Lawrence Island.

At the time of publication of Crerar *et al.* [4], these sea cow bones were not yet in a museum collection, but were and are still being used in ongoing genetic analyses. They are not complete bones, but merely sections or fragments of ribs. In a study of the population ecology of a recently extinct species, it would have been preferable to use museum specimens. However, as explained above, the samples were not initially intended for genetic and isotope comparisons between museum specimens from different locations. Indeed, there are no known museum specimens of Steller's sea cows from St Lawrence Island, so data solely from museum specimens would never have revealed this previously unknown population.

This was a significant discovery in the field of sirenian research. It extends the known range of *H. gigas* northward by over 1600 km and 8° of latitude. The discovery of illicit trade in the bone of threatened species under the guise of Steller's sea cow bone was also a significant discovery for conservation science. Museum specimens are very useful, but these discoveries would not have been made if our

Table 1. Assigned collection numbers for bones used in Crerar *et al.* [4].

GMU collection number	original <i>Biology Letters</i> article identifier
GMU 00001	Crerar003
GMU 00002	Crerar005
GMU 00003	Crerar001
GMU 00004	Crerar004
GMU 00005	Crerar002
USNM 593920	Crerar006

research had relied solely on museum specimens. However, we acknowledge the importance of depositing voucher specimens in a public collection, so bone fragments used in the Crerar *et al.* analysis were deposited in the George Mason University Collection in December 2015 (collection numbers in table 1). The genetic sequences of the samples analysed in Crerar *et al.* [4] are already on deposit at GenBank (accession nos. KP134338–KP134342) and in Dryad (doi:10.5061/dryad.vf86p).

Competing interests. We have no competing interests.

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