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Differences Between the Beaked Whales *Mesoplodon mirus* and *Mesoplodon gervaisi*

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When F. W. True (1913) described *Mesoplodon mirus* as a new species, he had only one specimen, and one specimen of the most nearly related species, *M. gervaisi* Deslongchamps, for both are rare. The location of the single pair of teeth at the apex of the mandible in *mirus* seemed sufficiently different from the location of the mandibular teeth in *gervaisi* to justify his describing it as a separate species, however, and he mentioned a number of other lesser differences between the two skulls which he felt might further distinguish the two species.

Recently F. C. Fraser (1955) received a skull without mandibles of *Mesoplodon* from Trinidad in the West Indies. Having but a single skull of *mirus* and none of *gervaisi* with which to compare it, he nevertheless concluded, after very careful reassessment of the differentiating characteristics proffered by True, that the Trinidad specimen was *gervaisi*. A number of reports of individuals of these two species had appeared between 1913 and 1955, but with one exception these reports have treated no comparative material, and no one previous to Fraser made a serious effort to consider which of the skull differences noted by True were actually diagnostic for subsequently available material.

The discovery and identification of a stranded specimen of *Mesoplodon mirus* by one of us (Wood) led to his preserving the skull, hyoids,

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and mandible, and depositing these in the American Museum of Natural History. The other (Moore), in checking the identification, made a reassessment of the value of proposed diagnostic characters, prepared the maps and the comments on distribution, and made the comparisons of measurements presented here.

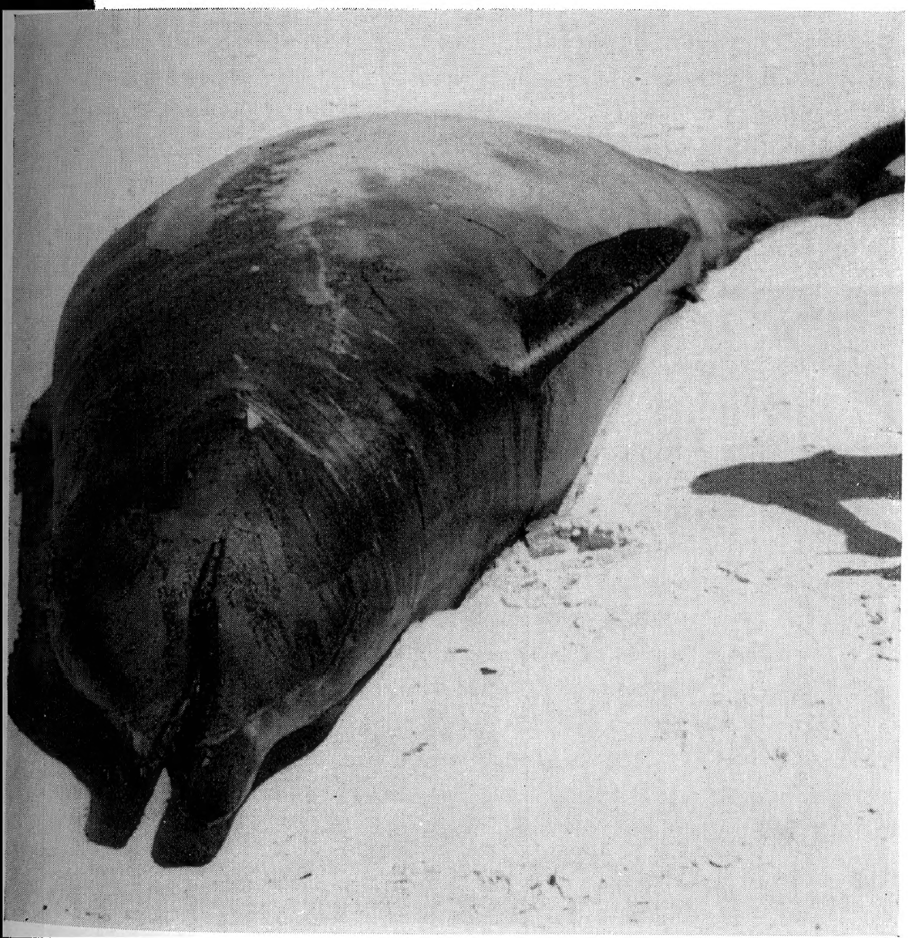
The specimens referred to in the following account are sometimes distinguished by their catalogue numbers in the museums in which they were deposited, and the names of museums are abbreviated as follows:

A.M.N.H., the American Museum of Natural History
A.N.S.P., Academy of Natural Sciences of Philadelphia
B.M., British Museum (Natural History)
C. M., Caen Museum, Normandy, France
M.Q.C., Museum of Queens College, Galway, Ireland
N.C.S.M., North Carolina State Museum, Raleigh
U.S.N.M., United States National Museum
Y.P.M., Yale Peabody Museum, New Haven, Connecticut

On the evening of July 11, 1955, what appeared to be a large delphinid washed up on the sand was observed on Flagler Beach, Florida. Examination revealed the absence of a median notch in the posterior margin of the tail and the presence of two short, converging throat grooves characteristic of the beaked whale family Ziphiidae. Furthermore, the mouth appeared to be entirely toothless, which is characteristic of the females and young males of some species in this family. The locality of this stranding is latitude 29° 28′ N., longitude 81° 07′ W. Local residents said that the whale had been on the beach three or four days. Some swelling of the body had taken place and extruded the penis, observation of which, as Harmer (1924, p. 559) pointed out in relation to the specimen of *Mesoplodon mirus* from Liscannor, Ireland, "placed the sex beyond doubt." Except where abraded, the skin of the animal was entirely black, although, of course, it may not have been so when fresh. (See fig. 1.)

The following morning Wood secured photographs and body measurements, and took the entire head of the animal for examination and the preservation of the skull. When the skull was clean of flesh, the location of the single pair of vestigial teeth was found to be in alveoli at the tip of the mandible. This, and the additional fact that the length of the mandibular symphysis was one-fourth of the length of the mandible, established the identity of our little beaked whale as *Mesoplodon mirus* True.

xternal appearance of this species is very poorly known, phs having been previously published of only four individuals, e. The two gular grooves were sharply incised in our specimen, r ends were abrupt, so that it is possible to determine in one of tographs (not reproduced here) that the left gular groove is the length of the right. Brimley's (1943, pl. 1) specimen seems a similar relationship, although the type (True, 1913, pl. 53, does not. Both of their specimens were less fresh than ours hotographed, however, and the type specimen was particularly en.



G. 1. *Mesoplodon mirus* True on Flagler Beach, Florida, July 12, 1955. A e shell placed on the eye marks its location on a slight prominence. Three our days of near tropical sun have stimulated swelling of the body, which resulted in the erection of the left flipper.

TABLE 1

COMPARISON OF EXTERNAL MEASUREMENTS OF *Mesoplodon mirus* AND *Mesoplodon gervaisi*

(The measurements in roman are in millimeters; those in italics are in thousandths of the former. Sources of data on the specimens are, from left to right: True, 1913; present report; Raven, 1937; Allen, 1939; Ulmer, 1941; Brimley, 1943; True, 1910; Raven, 1937; Rankin, 1953.)

	Mesoplodon mirus						*Mesoplodon gervaisi*		
	Type ♀	Fla. ♂	N.Y. ♀	N.S. ♀?	N.J. ♀	N.C. ♀	N.J. ♂	N.Y. ♀	W.I. ♀
Tip of snout to center of posterior margin of tail	4870	4394	4870	5106	4870	5180	3810	4670	4267
Tip of snout to corner of mouth	*.079*	*.075*	—	—	—	—	*.065*	—	*.077*
Tip of snout to blowhole	*.125*	*.127*	—	—	—	—	*.123*	*.121*	*.133*
Tip of snout to center of eye	*.133*	*.136*	*.132*	*.116*	*.128*	*.123*	—	*.124*	*.133*
Tip of snout to origin of flipper	*.239*	*.237*	*.233*	*.227*	*.245*	—	*.233*	—	—
Tip of snout to origin of dorsal fin	*.587*	*.647*	*.616*	—	*.584*	—	*.604*	—	—
Tip of snout to genital orifice	—	*.618*	—	—	—	—	—	—	—
Length of flipper	*.109*	*.095*	—	*.091*	*.097*	*.069*	*.073*	*.077*	—
Greatest width of left flipper	—	*.029*	—	*.030*	*.029*	*.029*	*.025*	*.027*	—
Width of blowhole	*.023*	*.026*	—	—	—	—	*.027*	*.019*	—
Width of tail	*.239*	—	—	*.252*	*.214*	*.206*	*.233*	*.300*	—
Tip of snout to vent	*.717*	—	—	—	*.704*	—	—	—	—
Length of dorsal fin (basal)	—	—	*.057*	*.077*	*.076*	*.075*	*.094*	—	—
Height of dorsal fin	—	—	—	*.056*	*.042*	*.047*	*.040*	—	—

Table 1 reveals the extremely few comparative data available on external measurements of *Mesoplodon mirus* and *M. gervaisi,* and virtually the only real difference that can be seen is that *gervaisi* appears to have proportionally smaller flippers than *mirus*. Table 1 also shows that, in the excitement of examining a rare animal or a failure to realize how fleeting is the opportunity to obtain a good set of measurements of a dead whale, a number of investigators have provided less information than they might. The external measurements of the *Mesoplodon mirus* on Flagler Beach were taken in a straight line and to the nearest half inch.

The teeth of the young male Flagler Beach whale are somewhat larger than those reported by True (1913) and Thorpe (1938) for adult female whales of this species and are shaped like those shown in Thorpe's figures, but proportionally longer. The teeth of the Flagler Beach specimen, right and left, respectively, measure (in millimeters): greatest length from tip to root, 44.7, 44.8; greatest anteroposterior width, 16.7, 17.4; greatest transverse breadth, 9.3, 9.1. The wider tooth is presumed to be the left, because True (1913) seems to imply that their curvature should face concave side outward. The teeth in an older adult male from Liscannor, Ireland (Harmer, 1924, pl. 4), are evidently much longer, projecting above the gum as functional teeth, and are also proportionally much broader transversely.

GEOGRAPHICAL DISTRIBUTION

This latest stranding of *Mesoplodon mirus* provides a southwestward extension of its known range some 500 miles. This is the first time that the "range" of this animal has been discussed, which is not surprising, for there are but 14 specimens known. The pattern of distribution of the recorded occurrences of *mirus* seems to have particular significance, however, in relation to the still scantier distribution records of *gervaisi*.

Both of these whales are known only from the North Atlantic Ocean and predominantly from the west side. Only one of the nine recorded occurrences of *gervaisi* has been on the eastern side of the North Atlantic, evidently an exceedingly rare stray, possibly carried by the Gulf Stream. Figure 2 shows the distribution of recorded occurrences of *gervaisi* to be notably southern. Emphasis is lent by the fact that during the century that *gervaisi* has been known to science, strandings of unusual cetaceans in the northern United States and Canada have been much more likely to reach the attention of someone who would study and report them than such strandings farther south. The evidence presented in figure 2, therefore, leads one to anticipate that further reporting of *gervaisi* will very likely come from the Antillean area as study of marine organisms increases there. The strandings of *gervaisi* in New Jersey and New York may best be regarded not quite like the extraordinary English Channel occurrence but as fairly rare driftings on the Gulf Stream to a relatively well-watched coast.

Comparison of the distribution of *gervaisi* in the southwestern North Atlantic with that of *mirus*, shown in figure 3, reveals evidence of some segregation between these species, although there is also con-

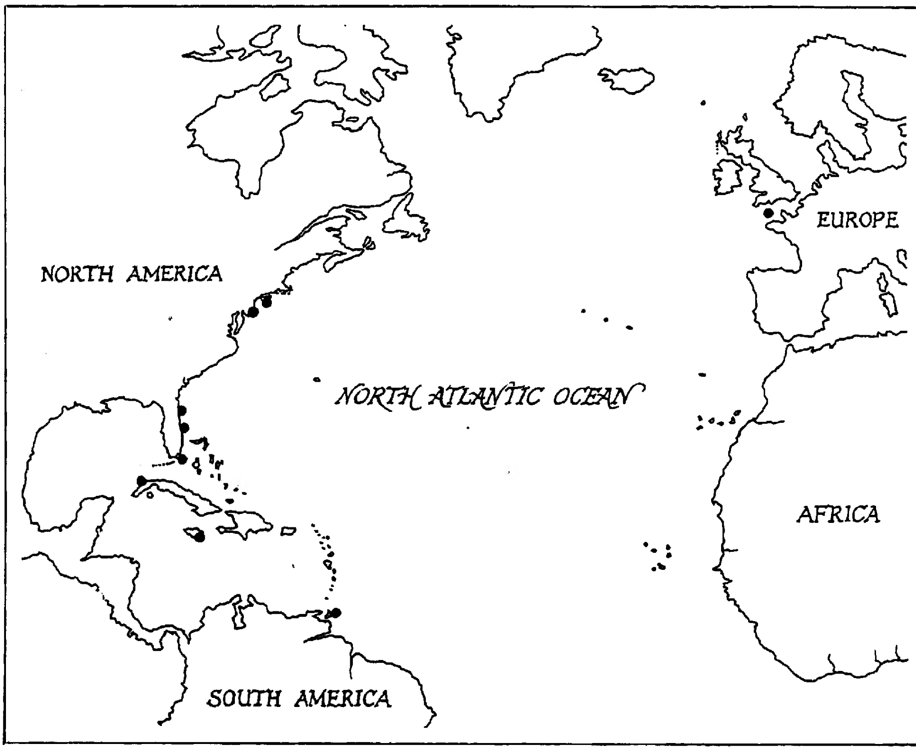


FIG. 2. Distribution of *Mesoplodon gervaisi* Deslongchamps based on the following authorities (south to north): male, Trinidad, Fraser (1955); female, Bull Bay, Jamaica, Rankin (1953); Cayo Alacranes, Cuba, Aguayo (1954); female, Key Largo, Florida, Moore (1953); female, Melbourne, Florida, Moore (1953); St. Augustine Beach, Florida, Ulmer (1947); male, Atlantic City, New Jersey, True (1910); female, Rockaway Beach, New York, Raven (1937); male, English Channel, True (1910).

The sex of the fourth, fifth, and ninth individuals listed here is as deduced from skull characters described in the present paper.

siderable overlap. Because in terrestrial mammals very closely related species are most often found to have allopatric ranges, the degree of geographic segregation evident in these two poorly known but exceedingly similar species of beaked whales is especially interesting. In considering the known distribution of *mirus*, one should bear in mind that the four strandings in the British Isles represent a far greater scarcity of *mirus* in those waters than this share of the entire record of *mirus* suggests. Whales and dolphins are traditionally Crown property in Britain and have been reported dutifully by the Coast Guard since 1913, a fact that has enabled the British Museum to publish a great store of knowledge of these animals, which includes some indication

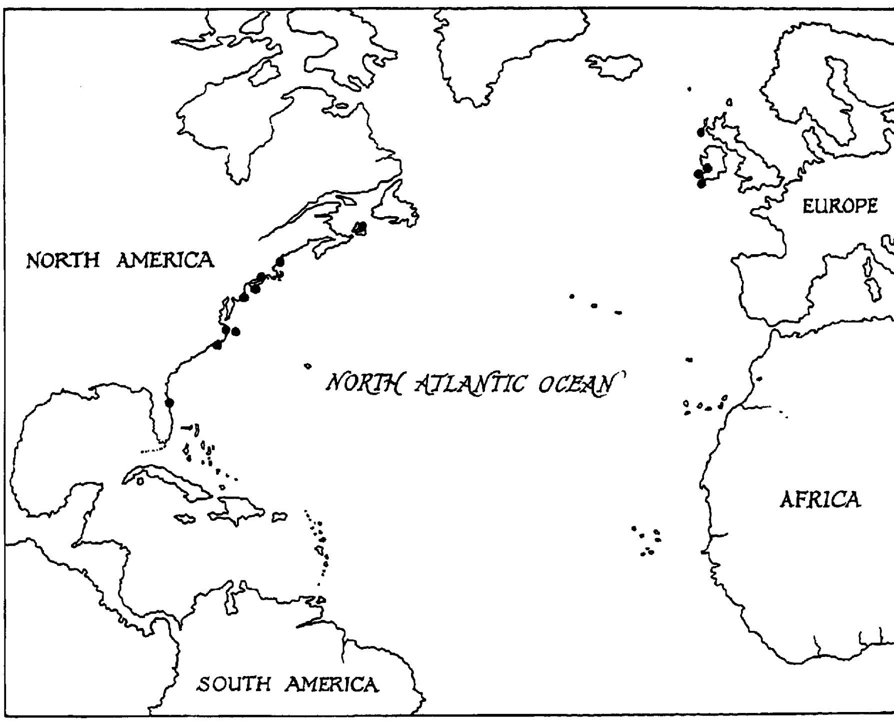


FIG. 3. Distribution of *Mesoplodon mirus* True based on the following authorities (south to north): male, Flagler Beach, Florida, present report; female, Beaufort Harbor, North Carolina, True (1913); female, Oregon Inlet, North Carolina, Brimley (1943); Oregon Inlet, North Carolina, Brimley (1945); female, Island Beach, New Jersey, Ulmer (1941); female, Edgemere, Long Island, New York, Raven (1937); female, Mason Island, Connecticut, Thorpe (1938); male, Wells Beach, Maine, Raven (1937); female?, Cape Breton Island, Nova Scotia, Allen (1939); male, Valentia, Ireland, Fraser (1946); male, Liscannor, Ireland, Harmer (1927); Galway, Ireland, Harmer (1927); female?, Geirnish, South Uist, Outer Hebrides, Fraser (1934).

of relative abundance in those waters. The almost entirely haphazard reporting of such strandings on the western side of the Atlantic gives support to recognition of the nine records as representing a proportionally greater concentration of the animals and, one may infer, a greater proximity to the part of the ocean that they ordinarily inhabit. Our Florida record of *mirus* should, perhaps, be looked upon as that of a stray which may have ridden the inshore coastal current a little south of its ordinary range.

In a species in which the males have a greater geographic range, as they appear to have in the sperm whale, the geographic range of the female may be the more critical to compare with that of a potentially competitive species, for it would be the range in which the species maintains itself by reproduction. Differences in the geographic ranges of the sexes of *Mesoplodon mirus* and *gervaisi* are not known to exist, but it seems advisable to account for the known distribution of the sexes. Five American occurrences of *mirus* and two of *gervaisi* are reported as definitely females. (See figs. 2 and 3.) Two American occurrences of *mirus* (Wells Beach, Maine, and Flagler Beach, Florida) have been reported as males, but the sex of the former has been questioned (Ulmer, 1941). Only one American occurrence of *gervaisi*, at Atlantic City, New Jersey, has definitely been reported to be a male. Localities of the known breeding records of the two species may also be noted. The one record of a female *mirus* with young is from Oregon Inlet, North Carolina, about latitude 35° 46′ N., in March, 1940 (Brimley, 1943). The 17-foot adult had a term fetus 7 feet 2 inches long. The one record of a female *gervaisi* with young is from Bull Bay, Jamaica, about latitude 17° 48′ N., on February 21, 1953 (Rankin, 1953). This 14-foot lactating female was accompanied by a 7-foot young one (Rankin, 1955). What data there are on strandings of females, and of females with young, support reasonably well the suggestion that the two species may have generally allopatric ranges in the western North Atlantic Ocean.

CRITIQUE OF SKULL CHARACTERS

The three skulls of *Mesoplodon gervaisi* at the American Museum of Natural History probably constitute the largest collection in the world at the present time, and here also are now two skulls of *mirus*. Because we are reporting on the occurrence of the two species, it seems appropriate to reconsider, following Fraser's (1955) lead, the validity of skull characters that have been offered as means by which to distinguish them. Eighteen proposed differences are given under headings that indicate the aspect of the skull to which each applies, and usually in our own words to make clear what we understand the original propositions to mean. Following each of these is a statement of whether, and sometimes in what way, each of the five available specimens conforms to the proposition, and in what way other specimens reported in the literature conform, if it is stated, or if we can determine a conformity satisfactorily from the published photographs. The validity of the proposition in the making of identifications is commented on in each case.

The citations of specimens are from southwest to northeast in each species and can be identified as follows:

Mesoplodon mirus

"Florida": Skull, male, A.M.N.H. No. 147293, from Flagler Beach, herein reported

"North Carolina": Type, female, U.S.N.M. No. 175019 (True, 1913), Beaufort

"New York": Female, A.M.N.H. No. 90053, from Edgemere, Long Island

"Connecticut": Female, Y.P.M. No. 02430, from Mason Island (Thorpe, 1938)

"Ireland": Male, B.M. No. 1920.5.20.1, from Liscannor (Harmer, 1924)

Mesoplodon gervaisi

"Trinidad": Skull, B.M. No. 1953.10.6.1, found on the east coast

"Florida 1": Skull, A.M.N.H. No. 121894, from Key Largo

"Florida 2": Skull, A.M.N.H. No. 135639, from the beach at Melbourne

"New Jersey": Young male, U.S.N.M. No. 23346, from Atlantic City

"New York": Female, A.M.N.H. No. 90051, from Rockaway Beach

"English Channel": Skull, type, in the Caen Museum (Brasil, 1909)

Dorsal Aspect

1. Maxillary Prominences: The maxillary prominences that flank the base of the rostrum are longer, lower, and more nearly parallel to the long axis of the skull in *gervaisi*.

Mesoplodon mirus: Florida conforms, the prominences being high, short, and angling away from the long axis of the skull (left, 22°; right, 25°); North Carolina conforms; New York conforms (left, about 5°; right, 24°); Connecticut conforms in shortness and height, but not very closely in angle of divergence; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms, the prominences being virtually parallel; Florida 2 conforms, the prominences being rather high, but the total divergence only 18 degrees; New Jersey conforms; New York conforms, with a divergence of 16 degrees left and 9 degrees right; English Channel differs in that the left appears to diverge about 22 degrees.

The above proposition is of dubious value.

2. MAXILLARY PROMINENCE: The anterior margin of each maxillary

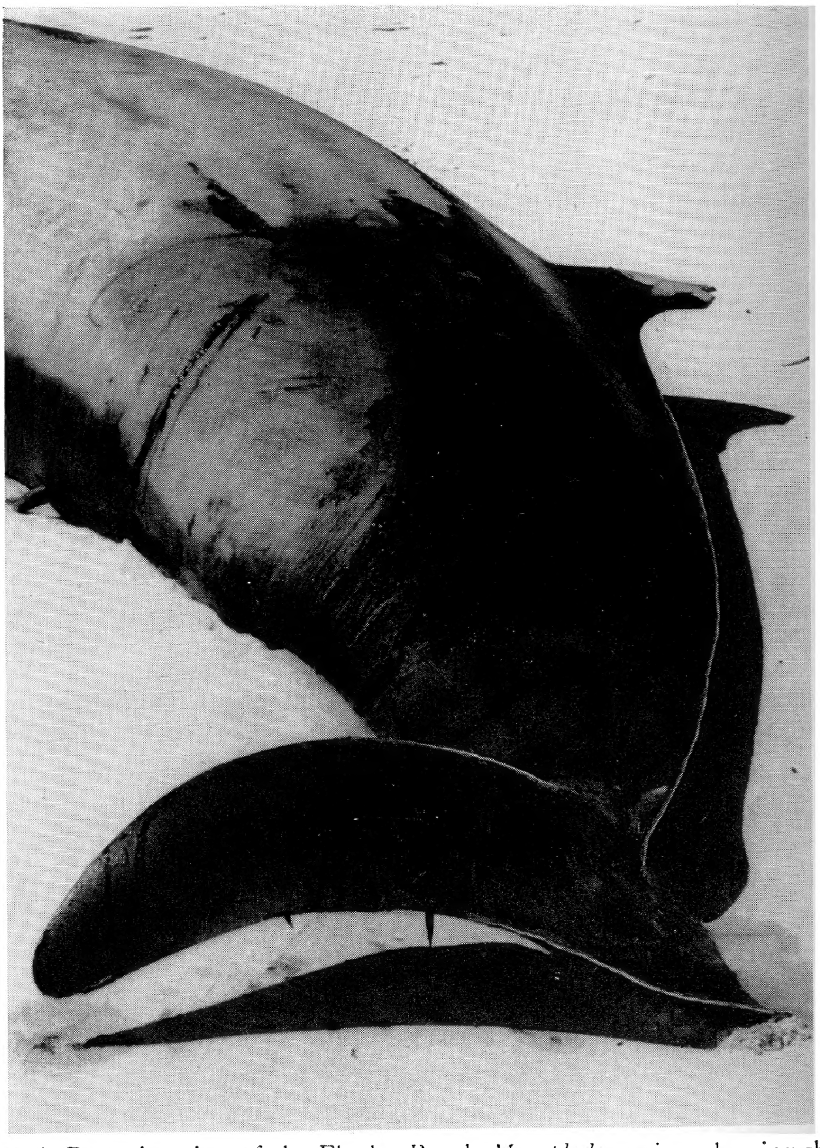


FIG. 4. Posterior view of the Flagler Beach *Mesoplodon mirus* showing shape of tail and dorsal fin and extrusion of penis. The shape of the tail appears to be very different from that of the *M. gervaisi* illustrated by Raven (1937, fig. 1) but not unlike that of *gervaisi* shown by Rankin (1955, fig. 2). Margins of tail and back accented.

FIG. 5. Head of *Mesoplodon mirus* from Flagler Beach. The eye, throat groove, and blowhole have been accented.

prominence protrudes so that it intersects the lateral margin of the rostrum and forms a notch there in *mirus*, at least on the left side if not on both. In *gervaisi* the lateral margin of the rostrum curves gently out around the maxillary prominence, with no angular break.

Mesoplodon mirus: Florida conforms; North Carolina conforms, notch only on left side; New York conforms; Connecticut conforms, notch on left side only; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms; Florida 2 conforms; New Jersey conforms; New York conforms; English Channel conforms.

The above proposition is considered useful as a means of differentiating these species.

3. ROSTRUM, LATERAL MARGIN: Anterior to the concave basal curve the external free margin of the rostrum proceeds towards the tip in a straight line in *mirus*, but describes a further long, gentle, convex curve in *gervaisi*.

Mesoplodon mirus: Florida conforms; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms but poorly, the left side having a long, gently convex curve.

Mesoplodon gervaisi: Trinidad conforms but not closely; Florida 1 conforms, with the slight convexity farther forward than usual; Florida 2 conforms; New Jersey conforms; New York conforms; English Channel conforms but not closely.

The above proposition is considered useful only in support of other evidence of identity.

4. ANTORBITAL TUBERCLE: The lacrimal extends conspicuously forward to form the apex of the antorbital tubercle in *mirus*, but in *gervaisi* the maxilla extends forward over the lacrimal to form the apex.

Mesoplodon mirus: Florida conforms, the left lacrimal extending 16 mm. forward of the maxilla, the right one, 20 mm.; North Carolina conforms; New York conforms, 12 mm. left, and 16 mm. right; Connecticut conforms on right side; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 differs, both left and right lacrimals protruding 5 mm. to form apices; Florida 2 differs, the left lacrimal protruding 3 mm. and the right 2 mm.; New Jersey conforms; New York differs, the left lacrimal protruding 6 mm., the right, 7 mm.; English Channel conforms.

The above proposition can be modified as follows, to be used in support of other evidence of identity: The lacrimal extends beyond the maxilla 10 mm. or more in *mirus* to form the apex of the antorbital tubercle. In *gervaisi* it extends less than 10 mm. (sometimes not at all).

Posterior Aspect

5. Supraoccipital: The dorsolateral slope of the margin of the supraoccipital is rather flat in outline in *mirus* but arched in *gervaisi*.

Mesoplodon mirus: Florida differs, the right side being arched about 20 mm. in its 160-mm. length, the left about 15 mm. in 140 mm.; North Carolina conforms; New York conforms, both sides being nearly flat; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms somewhat, the right side being arched about 30 mm. in 160 mm., the left about 15 mm. in 140 mm.; Florida 2 conforms to the same extent as Florida 1; New Jersey conforms; New York conforms to the same extent as Florida 1 and Florida 2; English Channel conforms.

The above proposition is of uncertain value.

Lateral Aspect

6. Rostral Profile: Both dorsal and ventral outlines of the rostrum are straight lines in *mirus*. In *gervaisi* the dorsal profile is slightly concave proximally and more convex distally, and the ventral profile is more convex proximally and concave distally.

Mesoplodon mirus: Florida conforms; North Carolina conforms; New York conforms, except for a slight distal down curve in the upper profile; Connecticut conforms, except for a slight distal down curve in the upper profile; Ireland conforms, except for a slight distal down curve in the upper profile.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 differs in that the upper profile is straight; Florida 2 conforms; New Jersey conforms but for the lack of dorsal concavity; New York conforms; English Channel conforms but for the lack of dorsal concavity.

The above proposition can be modified as follows for use in a determination of the species. The ventral outline of the rostrum is straight in *mirus*, but in *gervaisi* it is convex proximally and concave distally.

7. Rostrum-Pterygoid Profile: In *gervaisi* the ventral profile of the rostrum is intersected sharply by that of the pterygoids, whereas in *mirus* the ventral outlines of these two come together in a gentle curve.

Mesoplodon mirus: Florida conforms; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms (Fraser, 1955).

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms; Florida 2 conforms; New Jersey conforms; New York conforms; English Channel differs, as the outlines meet in a gentle curve.

The above proposition is of uncertain value.

8. TEMPORAL FOSSA: The shape of the temporal fossa as described by its margin is more elongate in *gervaisi* than in *mirus*. (The figures provided are ratios of greatest width by greatest length.)

Mesoplodon mirus: Florida conforms, 0.54; New York conforms, 0.53.

Mesoplodon gervaisi: Florida 1 conforms, 0.44; Florida 2 conforms, 0.40; New York conforms, 0.48.

The above proposition may be of value as a means of differentiating the species.

9. ZYGOMATIC PROCESS: The zygomatic process of *mirus* is more robust than that of *gervaisi.*

Mesoplodon mirus: Florida, 65 mm. by 84, conforms; New York, 42 mm. by 86, conforms.

Mesoplodon gervaisi: Florida 1, 64 mm. by 75, conforms; Florida 2, 74 mm. by 92, differs; New York, 72 mm. by 87, differs.

The above proposition is of no value.

10. POSTORBITAL PROCESS: The postorbital process of the frontal tapers to a point in *gervaisi,* but in *mirus* it thickens and becomes truncated at the end.

Mesoplodon mirus: Florida conforms, thickening on left to 15.5 mm., on right to 17; North Carolina conforms; New York conforms, left to 16 mm., right to 16.5; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms, both sides reaching 11 mm. in thickness; Florida 2 conforms, thickening on left to 11.5 mm., on right to 11; New Jersey differs somewhat; New York differs, by reaching 14.5 mm. on the left and 15.5 on the right, and by coming to a disc-shaped edge instead of a point; English Channel conforms.

The above proposition is of uncertain value.

11. PTERYGOID NOTCH: The notch in the posterior margin of the pterygoid is longer and narrower in *mirus* than in *gervaisi.* (Ratios given are greatest width divided by greatest length.)

Mesoplodon mirus: Florida conforms, 0.21; North Carolina differs, 0.46; New York conforms, 0.35; Connecticut conforms, 0.30; Ireland conforms, 0.37.

Mesoplodon gervaisi: Trinidad differs; Florida 1 conforms, 0.61; Florida 2 conforms, 0.53; New Jersey conforms, 0.47; New York differs, 0.46.

The above proposition is of no value.

12. ANTORBITAL TUBERCLE: The extension of the frontal forward from the orbit into the antorbital tubercle is greater in *mirus,* and the lacrimal (in this side view) appears reduced to a thin layer wrapped around the protrusion of the frontal. In *gervaisi* the frontal contributes no more than half of the tubercle.

Mesoplodon mirus: Florida conforms; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms; Florida 2 conforms; New Jersey differs, the frontal being large and the lacrimal reduced; New York conforms; English Channel differs in that the lacrimal is especially reduced.

The above proposition is of no value.

13. MAXILLARY BEVEL: On the dorsal surface about at the midlength of the rostrum in *mirus* a sharp change in slope of the maxilla begins at the outside edge and angles forward to the inside edge. Posterior to this the surface of the maxilla is level or slopes gently towards the sagittal plane; anterior to it the outward slope is steep. In *gervaisi* there is no such sharp change in the slope of the dorsal maxillary surface; its surface may be completely level or gradually slope outward.

Mesoplodon mirus: Florida conforms; New York conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms, gradually sloping out; Florida 2 conforms, being entirely level; New York conforms, gradually sloping out.

The above proposition may be of value in identifications.

14. LACRIMAL: The external free border of the lacrimal bone is about one-half of the length of the orbit in *mirus;* less in *gervaisi.*

Mesoplodon mirus: Florida conforms, 53 mm. to 98; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad differs; Florida 1 differs, 52 mm. to 95; Florida 2 differs, 45 mm. to 95; New Jersey conforms; New York differs, 49 mm. to 100; English Channel conforms.

The above proposition is of no value.

VENTRAL ASPECT

15. PTERYGOID RIDGE: On the inferior surface of the pterygoid in *gervaisi* there is an oblique ridge beginning at or near the posterior edge of the pterygoid at or near the sagittal plane, which extends obliquely laterad nearly the length of the ventral surface of the pterygoid. This

ridge is absent in *mirus,* although a change in the texture of the bone may make a corresponding line visible.

Mesoplodon mirus: Florida conforms; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 conforms; Florida 2 conforms; New Jersey conforms; New York conforms; English Channel differs, the ridge being absent in the drawing (Van Beneden and Gervais, 1880).

The above proposition is of value only if it be established that the type of *gervaisi* has such a ridge which was omitted from the drawing.

16. PALATINES: The maxillae of *mirus* extend posteriorly between the pterygoids, separating the palatines and preventing their meeting in the sagittal plane, but the palatines meet in *gervaisi.*

Mesoplodon mirus: Florida differs, the palatines meeting for a distance of 30 mm.; North Carolina conforms; New York conforms; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad differs, the palatines not meeting; Florida 1 conforms; Florida 2 differs, palatines much reduced and not meeting; New Jersey conforms; New York conforms; English Channel differs clearly.

The above proposition is of no value.

17. ROSTRAL KEEL: The ventral surface of the rostrum just forward of the pterygoids in *gervaisi* has a sagittal keel, but in *mirus* it is smoothly rounded.

Mesoplodon mirus: Florida conforms; New York conforms; Connecticut apparently conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms; Florida 1 differs, being just as round as in *mirus;* Florida 2 conforms, but not closely, having a slight keel; New York conforms, with a keel about 130 mm. long; English Channel appears to conform.

The above proposition is of no value.

18. VOMER: The vomer appears in the sagittal plane on the ventral surface of the beak in *mirus* as an elongate fusiform ridge with a visible length about one-third of that of the beak. In *gervaisi* it is shorter and has its greatest width at the anterior end, or it may be absent from the surface.

Mesoplodon mirus: Florida conforms, length 160 mm.; North Carolina conforms; New York conforms, 125 mm.; Connecticut conforms; Ireland conforms.

Mesoplodon gervaisi: Trinidad conforms, being short; Florida 1 conforms, 70 mm. visible; Florida 2 conforms, not visible; New Jersey conforms, being short; New York conforms, 80 mm. visible; English Channel conforms, not visible.

The above proposition is apparently useful in the determination of species.

DISCUSSION

From the foregoing it appears that a number of diagnostic differences have in the past been proposed without due regard for the illustrated characters of the type of *gervaisi*.[1] Especially impressive is the number of propositions (1, 7, and 15) that apply quite well to all examples of *gervaisi* but the type. Because these characters distinguish all the other *gervaisi* material from all the *mirus* material, a question is raised about the relationship of the type specimen of *gervaisi* to the other specimens referred to the same species. One explanation of the differences in skull characters between the type and all other *gervaisi* may be that the differences are those between an old male and females and young males.

Parenthetically one may note the importance of explicitly stating the observed evidence as to the sex of a specimen. The genital apertures of male cetaceans are so similar to those of females that, unless mention is made at least of the mammary slits or the penis, future reviewers of the characters of the species are justified, if not compelled, to eliminate data on such specimens from any comparisons made to demonstrate sexual dimorphism or to differentiate species by the characters of the males.

There is a specimen of *gervaisi* found on the beach near Melbourne, Florida, the skull characters of which are here reported for the first time, although its occurrence has been previously noted (Moore, 1953). This skull, Florida 2, is of interest in comparison to the type of *gervaisi*, for it is like the type in having the mesirostral groove completely filled by dorsal proliferation of the presphenoid and the vomer, which is believed to be a condition of advanced age (Raven, 1937). As with the type also, its sex is unknown, but in this respect it is more enigmatic than the type, for its mandible is not available for an inference regarding its sex to be made from the size of the teeth. Because there is evidence that the type skull may be that of an old male, it should be interesting to note how this skull of an old individual from Melbourne, Florida, compares with it. This specimen agrees with the type in only a moderate number (four) of

[1] Similarly, a diagnostic character proposed while the present paper was in press (Rankin, 1956, p. 355) does not apply to the type of *mirus*.

TABLE 2

Comparative Skull Measurements of Six *Mesoplodon gervaisi* and Eight *Mesoplodon mirus*

(The measurements in roman are in millimeters; those in italics are in thousandths of the former. Sources of data on the specimens, from left to right, are: True, 1910; True, 1910; present report; present report; present report; Fraser, 1955; Harmer, 1924; True, 1913; Harmer, 1924; present report; Thorpe, 1938; Ulmer, 1941; Brimley, 1943; present report.)

	Mesoplodon gervaisi						*Mesoplodon mirus*							
	English Channel Type, C.M.	Atlantic City, N. J. U.S.N.M. No. 23346, ♂	Rockaway Beach, N. Y. A.M.N.H. No. 90051, ♀	Key Largo, Florida A.M.N.H. No. 121894	Melbourne, Fla. A.M.N.H. No. 135639	Trinidad, W. I. B.M. No. 1953.10.6.1	Galway, Ireland M.Q.C.	Beaufort, N. C. U.S.N.M. No. 175019	Liscannor, Ireland B.M. No. 1920.5.20.1	Edgemere, N. Y. A.M.N.H. No. 90053, ♀	Mason I., Conn. Y.P.M. No. 02430	Island Beach, N. J. A.N.S.P. No. 20484	Oregon Inlet, N. C. N.C.S.M.	Flagler Beach, Fla. A.M.N.H. No. 147293, ♂
1	762	675	780	761	700	733	762	810	814	805	805	800	832	777
2	*.616*	*.633*	*.636*	*.610*	*.603*	*.644*	—	*.613*	*.639*	*.648*	*.597*	*.608*	*.649*	*.640*
3	*.736*	*.778*	*.791*	*.764*	*.783*	*.780*	—	*.763*	*.774*	*.774*	*.767*	—	—	*.796*
4	—	—	*.818*	*.799*	*.826*	*.812*	—	—	—	*.817*	—	—	*.809*	*.840*
5	—	—	*.099*	*.095*	*.000*	—	—	*.200*	*.166*	*.139*	*.192*	*.225*	*.184*	*.212*
6	—	—	*.136*	*.124*	*.136*	—	—	—	—	*.122*	—	—	—	*.129*
7	*.134*	*.150*	*.167*	*.174*	*.193*	*.153*	—	—	—	*.160*	—	—	—	*.158*
8	—	—	*.064*	*.066*	*.071*	—	—	—	—	*.070*	—	—	*.090*	*.077*

TABLE 2–(*Continued*)

9	—	—	.459	.460	.500	.453	—	—	—	.436	—	—	.449	.448
10	.472	.447	.452	.453	.496	.435	.433	.426	.438	.423	.431	.455	.429	.431
11	.429	.425	.421	.428	.463	.409	—	.401	.414	.416	.425	.442	.419	.426
12	—	—	.374	.389	.407	—	—	—	—	.369	—	—	.370	.363
13	.299	.308	.299	.286	.310	.293	—	—	—	.273	—	—	—	.272
14	—	—	.140	.141	.146	.149	—	.154	.144	.139	.149	.160	.159	.148
15	.055	.050	.051	.059	.059	.057	—	—	—	.048	—	—	—	.053
16	.220	.210	.220	.198	.214	.199	.197	.175	.203	.182	.194	.184	.195	.192
17	—	—	.133	.127	.139	—	—	.146	.148	.139	.142	.136	.138	.136
18	.146	.154	.136	.131	.144	—	—	—	—	.148	—	—	—	.137
19	—	—	.090	.070	.083	.076	—	.084	.092	.096	.078	.091	.080	.080
20	.276	.270	.254	.258	.284	.252	—	.259	.246	.257	.261	.272	.249	.273
21	—	—	—	—	—	—	.191	—	.184	.193	—	—	—	.206
22	.087	.089	.094	.072	.113	.083	—	.074	.082	.081	.076	.074	.084	.095
23	.071	.059	.068	.063	.073	.064	—	—	—	.058	—	—	—	.062
24	.067	.062	.064	.067	.064	.067	—	.069	.072	.066	.065	.079	.067	.064
25	—	—	.080	.076	.077	—	—	—	—	.845	—	—	.093	.085
26	—	—	.109	.105	.119	—	—	.114	.112	.124	.112	.114	.111	.116
27	—	—	.090	.104	.100	—	—	.078	.075	.080	.087	.086	.083	.082
28	—	.379	.384	.381	.419	.374	.358	.371	.387	.379	.380	.385	.385	.372
29	.858	.837	.837	.855	—	—	.800	.825	.860	.859	.878	.860	.809	.834
30	.177	.172	.201	.218	—	—	.199	.238	.234	.264	.231	.230	.223	.242
31	.158	.150	.145	.148	—	—	.150	.144	.150	.147	.139	.156	.148	.142
32	—	—	9	70	13	—	—	—	—	0	—	—	30	20

1. Greatest length of skull.
2. Greatest length of rostrum, from line across bases of antorbital notches.
3. Tip of rostrum to posterior margin of pterygoids, in sagittal plane.

TABLE 2–(*Continued*)

4. Tip of rostrum to most ventral point on anterior margin of pterygoid notch.
5. Greatest length of portion of vomer visible on palate.
6. Greatest length of orbit.
7. Greatest length of temporal fossa.
8. Greatest length of right nasal on the vertex.
9. Greatest width across postorbital processes of frontals.
10. Greatest width across zygomatic processes.
11. Greatest width across centers of orbits.
12. Greatest breadth of skull across exoccipitals.
13. Least width across the posterior margins of the temporal fossae.
14. Greatest width across occipital condyles.
15. Greatest inside width of foramen magnum.
16. Greatest width of premaxillae at their proximal expansion.
17. Least width of premaxillae opposite the anterior nares.
18. Greatest width of premaxillae anterior to the anterior nares.
19. Width of premaxillae opposite premaxillary foramina.
20. Greatest width of rostrum in antorbital notches.
21. Greatest width of rostrum in notches (if any) formed by maxillary prominences.
22. Greatest width of rostrum at midlength of rostrum.
23. Greatest depth of rostrum at midlength.
24. Greatest inside width of anterior nares (at right angles to sagittal plane).
25. Greatest width of temporal fossa without regard to orientation of skull.
26 Least distance between maxillary foramina.
27. Distance from posterior border of maxillary foramen and anterior end of maxillary prominence.
28. Height of skull, vertex to inferior border of maxillaries.
29. Greatest length of mandible.
30. Greatest length of mandibular symphysis.
31. Greatest height of mandible at coronoid process.
32. Amount added for missing portion of beak tip, to measurements involving tip of beak.

14 skull-character propositions, and in none of these four are the two different from the remaining specimens of *gervaisi*. Sharing of advanced age, therefore, does not alone appear important in the expression of these skull characters. As the Melbourne, Florida, skull does not exclusively share any of these 18 skull characters with the young male of Atlantic City, New Jersey, either, then it cannot by any means be construed to be a male. We find that on the other hand it agrees with the known female New York (as also with Florida 1) in 14 of the 18 propositions. For these reasons we are disposed to regard the skull from Melbourne, Florida, as that of an old female.

The Florida 1 specimen agrees with both the known female *gervaisi*, New York, and the old presumed female, Florida 2, in 12 of the 18 skull-character propositions, the closest agreement than any of the *gervaisi* show. It should not, therefore, test our credulity too greatly to consider these conservative three to be all females. Furthermore, these three together differ uniformly in propositions 4, 5, 12, and 14 from both the one known male, New Jersey, and the type, English Channel, which is presumed to be an old male because of its large teeth. This, therefore, logically sorts out these five specimens as three females and two males. The Trinidad specimen is less certain than these others in its associations, consorting with the New Jersey and English Channel males in only two of the four supposedly male diagnostic characters. On the other hand, it associates with the females with quite equal indifference. Our suggestion on this is that, as there is greater likelihood that males in a ziphiid species vary individually more than do females (already somewhat demonstrated by agreement of two males in only four of the skull-character propositions, when three females agree in 14), this Trinidad skull represents a male animal. It would perhaps be over-optimistic in the face of so much individual variation to hope that the two skull-character propositions in which these three males agree may correctly distinguish the maleness of future material, but they are numbers 4 and 5.

The most difficult to reconcile of the relationships shown in this reassessment of skull characters proposed for the differentiation of *mirus* from *gervaisi* is that two perfectly good specimens, Florida 1 from Key Largo and the female from New York, agree only three times each with the type of their species in the 14 unamended propositions in which the type is treated. The type, English Channel, agrees in these 14 propositions with Trinidad eight times; with Florida 1, three times; with Florida 2, four times; with New Jersey, six times; and with New York, three times. Florida 2, by way of comparison, agrees in 18 propositions with the other specimens in *gervaisi*, respectively, 14, 14, 8, 14, and 4 times. While some of the divergence of the type of *gervaisi* may be ascribed to sexual dimorphism as suggested, the divergence also of the Trinidad specimen and that of the Melbourne, Florida, specimen which shows in table 2 (measurements 2, 3, 4, 5, 15, 20) indicates that there is greater individual variation in the available sample of *gervaisi* than there is in that of *mirus*. Individual variation may also, therefore, be invoked to account for the peculiarities of the *gervaisi* type specimen.

MEASUREMENTS OF THE SKULL

It is customary in reporting a new specimen of a rare whale to present a series of straight-line measurements of the skull, and the tacit implication is that these data will to some extent show the taxonomic relationships of the individual being reported. To be able to compare these measurements meaningfully with those presented for other specimens by earlier authors, one must take measurements that correspond. That may seem obvious enough, but one author (Raven, 1937), in a paper dealing primarily with one new specimen each of *Mesoplodon mirus* and *Mesoplodon gervaisi*, not only neglected to present a set of measurements fully comparable to those of earlier authors reporting on these species, but did not even present the same measurements for the two skulls he was reporting so that they could be fully compared.

Although early authors had little comparative material on which to select measurements that might prove to have taxonomic value, and in the present species we still have very little material, succeeding authors have occasionally introduced additional measurements that they apparently thought might prove diagnostic. With a view to determine whether the data and material now available to us[1] has yet begun to show taxonomic value at the species level, we compare skull measurements of *mirus* and *gervaisi* in table 2. The measurements used are taken from early treatments of the species (True, 1910, 1913; Harmer, 1924), and some of the newer ones offered by later authors have been included. This comparison reveals that measurements numbered 1, 5, 8, 9, 12, 13, 16, 25, and 27 individually show a tendency to separate the two species. While it would be unwise to depend solely on any one of these measurements to identify a specimen, collectively used they should separate adult material of these two species very well.

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[1] These regrettably did not include Rankin's paper (1956) which was published after the present paper had gone to press. Rankin reports skull measurements for the Jamaica adult and young and for the Cuban specimen.

ACCEPTED SKULL DIFFERENCES

It seems evident that the skull characters that have been proposed for differentiating *mirus* and *gervaisi* that have survived the tests of the present study are:

2. In *mirus* the anterior margin of the left (and sometimes the right) maxillary prominence protrudes into the lateral outline of the rostrum, intersecting it so as to form a notch with it. In *gervaisi* the lateral margin of the rostrum curves around either prominence without forming a notch.

6. The ventral outline of the rostrum in *mirus* is straight, but in *gervaisi* it is convex proximally and concave distally. This is true in five skulls examined, and in the published photographs of six more.

8. The shape of the temporal fossa as described by its outside margin is more elongate in *gervaisi* than in *mirus* as determined by the ratio of greatest length to greatest width (without reference to the orientation of the skull).

13. The dorsal surface of the maxillary in *mirus* about at midlength of the rostrum changes from being level to a downward and outward slope over an oblique bevel. In *gervaisi* it is level for the entire length or declines gradually. This is observed in the five skulls examined.

18. The vomer appears in the sagittal plane on the ventral surface of the beak in *mirus* as an elongate fusiform ridge visible for about a third of the length of the beak. In *gervaisi* it may not appear at all or is shorter and has its greatest width at the anterior end. The five skulls examined, and illustrations of five others, conformed to this proposition.

In addition to the above five characters, two others seem to be of value as supporting evidence:

3. The external free margin of the rostrum, anterior to its basal concave curve, proceeds towards the tip in a straight line in *mirus* but describes a further long, gentle, convex curve in *gervaisi*.

4. In *mirus* the lacrimal extends forward of the maxilla 10 mm. or more to form the apex of the antorbital tubercle. In *gervaisi* it extends less than 10 mm. (or not at all).

SUMMARY

A stranding of a young male *Mesoplodon mirus* True is reported from Flagler Beach, Florida—the most southern record for the species. The distribution of occurrences of *Mesoplodon mirus* and *Mesoplodon gervaisi* Deslongchamps are charted, and evidence of geographic segregation

of the two species is noted and discussed. *Mesoplodon mirus* apparently occupies the temperate western North Atlantic, and *gervaisi* the tropical and near tropical western North Atlantic.

Eighteen proposed skull differences between *Mesoplodon mirus* and *M. gervaisi* are tested on the two specimens of the former and three of the latter in the American Museum of Natural History, and to some extent on published photographs of other specimens. Five of these propositions are found to be good, or modifiable so that they distinguish this material, and two others are found to be useful as supporting evidence.

In addition to the interspecific differences concurred in by this testing of the 18 skull characters, some intraspecific differences are observed in *gervaisi*. Part of this variation is shown to be sexual dimorphism, and the studied *gervaisi* material is sorted by it into three females and three males. Individual variation is evidently greater in the males.

Comparison of external body measurements suggests that the length of the flipper of *mirus* generally exceeds that of *gervaisi* in proportion to total body length. Comparison of 31 skull measurements of the two species reveals nine measurements which, used collectively, will separate skulls of these two species.

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