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Mesoplodon europaeus.

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Mesoplodon europaeus (Gervais, 1855)

Gervais' Beaked Whale

Dioplodon europaeus Gervais, 1855:320. Type locality "dans la Manche" (English Channel).

Dioplodon gervaisi Deslongchamps, 1866:176. Renaming of *D. europaeus* Gervais.

M[*esoplodon*] *europaeus* Flower, 1878:416. First use of current name combination.

CONTEXT AND CONTENT. Order Cetacea, suborder Odontoceti, superfamily Delphinoidea, family Ziphiidae. *Mesoplodon* has 14 described species, with 1 awaiting formal description; *M. europaeus* is monotypic (Mead and Brownell 1993).

DIAGNOSIS. *Mesoplodon europaeus* (Fig. 1) is distinguished from nonmesoplodont whales by its relatively small head; long, well-defined rostrum; small, triangular, dorsal fin two-thirds of the way down the dorsum; and the presence of 2 erupted mandibular teeth in adult males (Fig. 2). Females and juvenile males may be confused with other beaked whales within their range. *M. europaeus* closely resembles *M. mirus*, but has smaller pectoral flippers than *M. mirus* when measured in proportion to the total body length (Moore and Wood 1957). In contrast to *M. europaeus*, *M. mirus* has teeth at the mandibular apex (teeth of *M. europaeus* are one-third the distance posteriorly from beak tip to mouth corners), lacks lateral rostral flattening, and has a more dolphin-like beak and rounded melon (Leatherwood et al. 1976). At sea, *M. mirus* appears to have a dark dorsal fin contrasting with a paler gray back and a dark narrow blaze along the upper back from head to dorsal fin (Tove 1995). *M. europaeus* differs from *M. densirostris* by an arched contour of the mouth line, and adult males of *M. densirostris* have more massive teeth (Leatherwood et al. 1983). In contrast to *M. europaeus*, the head shape of Cuvier's beaked whale, *Ziphius cavirostris*, is blunter and paler in color, and *Z. cavirostris* has conical teeth at the tip of the lower jaw (Leatherwood et al. 1983).

Skull characters distinguish *M. europaeus* from *M. mirus* (Moore and Wood 1957). In *M. europaeus* the lateral rostral margin curves smoothly around both right and left maxillary prominences without an angular break, but in *M. mirus* the anterior margin of left (and sometimes right) maxillary prominence protrudes into the lateral rostral outline, intersecting it to form a notch. Ventral rostral profile is convex proximally and concave distally in *M. europaeus*, but straight in *M. mirus*. As described by its margin, the shape of the temporal fossa is more elongated in *M. europaeus* than in *M. mirus*. In *M. europaeus* the dorsal surface of the maxilla at about midlength of the rostrum remains level the entire length or gradually slopes outward, but in *M. mirus* it changes sharply from being level to a downward and outward slope. Vomer is shorter and widest at its anterior end, or absent, in *M. europaeus*, but in *M. mirus* it is visible as an extended fusiform ridge, ca. one-third the length of the beak when viewed sagittally on its ventral surface.

GENERAL CHARACTERS. Color is dark gray-black dorsally, on sides and flanks, becoming lighter gray ventrally, with some pink hues ventrally in a few specimens (Mead 1989; Minasian et al. 1984; Rankin 1953). Pectoral fins and flukes are uniformly dark gray above and below. Belly is white in juveniles. In females a white to light gray color occurs at the mammary folds and around the genital slit (Mead 1989; Rankin 1953). Color of *M. europaeus* can change rapidly at the time of death with exposure to air and light, causing the skin to darken (Mead 1989). Melon of *M. europaeus* rises to form a bump and an indentation at the blowhole (Minasian et al. 1984). Gervais' beaked whale has 2 long, ventrally placed throat grooves between the mandibles (Mead 1989; Rankin 1953). *M. europaeus* lacks a notch on its wide, pointed flukes, but a projection was visible on the tail instead of a notch in 1 individual (Mead 1989).

Dorsal fin is falcate and occurs in midlumbar region (Mead 1989; Minasian et al. 1984; Rankin 1953). Pectoral flipper has a short, phalangeal portion and a longer, propodial part (Mead 1989). Depressions on sides of thorax may receive pectoral flippers when the animal is swimming (Mead 1989; True 1910).

Physically mature adults range from 4.5 to 4.8 m (Leatherwood et al. 1983). Maximum length is 520 cm for females (mean, 4.5 m) and 480 cm for males, whereas the longest fetus is 218 cm (Mead 1989). In adult males dentition consists of 2 teeth in the anterior mandible. Most of the erupted tooth is covered by gum tissue, and only the tooth tip is exposed, fitting into grooves in the skin of the upper jaw (Leatherwood et al. 1983). External measurements (in cm) for a single, mature male that stranded in Curaçao, Netherlands Antilles, are: total length, 425; tip of upper jaw to angle of gape, 25; tip of upper jaw to center of eye, 53; tip of upper jaw to midblowhole, 48; length of throat grooves, 22; tip of upper jaw to midpoint of genital opening, 292; tip of upper jaw to anus, 319; height of dorsal fin, 20; length of pectoral flipper, insertion to tip, 42; width of flukes, 116 (Debrot and Barros 1992). Selected measurements (in cm) for an adult female that stranded in Jamaica are: total length, 426.7; tip of snout to blowhole, 57; tip of snout to eye, 57; tip of snout to angle of mouth, 33; tip of snout to posterior border of base of pectoral fin, 119.4 (Rankin 1953).

Skull (Fig. 2) of *M. europaeus* is distinctive. When viewed laterally in an upright position with the long axis of the beak horizontal, premaxillary foramina are below or straddling a horizontal plane transecting the centers of maxillary foramina. Vomer almost fills the entire mesorostral canal length in adult males, proximally surpassing the premaxillary edges (Moore 1966). Mandibular teeth are laterally compressed and situated opposite and near the posterior half of symphysis (Raven 1937). In adults of both sexes the greatest right nasal length on vertex of skull is 40–50 mm (Moore 1966). Palatine vomer length is typically <80 mm (Moore 1966), and mandibular symphysis is very short and deep (Raven 1937).

DISTRIBUTION. Although the holotype is from the English Channel, the geographic distribution of *M. europaeus* is concentrated in the western North Atlantic (Fig. 3). Gervais' beaked whale is the most common mesoplodont to strand along the Atlantic coast of the United States (Mead 1989). Northernmost records from the

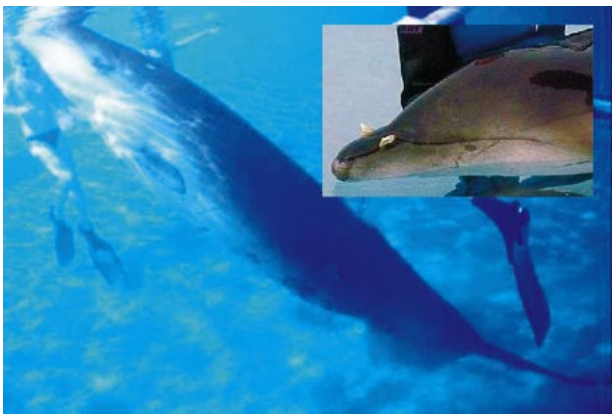

FIG. 1. Photograph of a male *Mesoplodon europaeus* stranded on the Gulf Coast of Florida, and held at Mote Marine Laboratory, Sarasota, Florida. Inset is a close-up of the head showing mandibular teeth. Photograph by C. Manire; used with permission.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Mesoplodon europaeus* (USNM 504738, male, Cape Hatteras, North Carolina). Greatest length of skull is 744 mm. Photographs used with permission of the National Museum of Natural History.

western North Atlantic are from New York (Moore 1966; Raven 1937) and New Jersey (Allen 1906; Turner 1891), but most strandings occur along the southeastern coast, notably Florida (Moore 1953; Ulmer 1941) and North Carolina. Specimens have also been recorded in Texas (Moore 1958, 1960), Cuba (Rankin 1956; Varona 1970), Jamaica (Caldwell 1964; Lewis 1954; Rankin 1953), and Trinidad (Fraser 1955), and on the South Atlantic island of Ascension (Mead 1989). In the eastern Atlantic the Gervais' beaked whale has been found in the English Channel, the Atlantic coast of France (Van Canneyt et al. 1999), Spain (Valverde and Galán 1996), Canary Islands (Martin et al. 1990), Republica Popular da Guine-Bissau (Reiner 1980), and Mauritania on Africa's west coast (Robineau and Vely 1993).

FOSSIL RECORD. Fossilized specimens of *Mesoplodon* (Glaessner 1947; Miyazaki and Hasegawa 1992; Robineau 1973; Whitmore et al. 1986) differ from living *Mesoplodon* species, but the exact relationship is unclear. Mesoplodonts as well as other beaked whales first appeared in the lower Miocene and went through their greatest evolution by the upper Miocene when ziphiids similar to modern beaked whales were becoming more numerous. *Mesoplodon* was derived by the late Miocene (Kulu 1972) and is probably related to the Miocene genera *Proroziphius* and *Belemnoziphius* (Mead 1975).

Of the ziphiid genera, *Tasmacetus* is the most primitive and *Mesoplodon* more advanced than other genera, according to some skull characteristics and tooth alveolar shape, number, and position (Gaskin 1982; Mead 1975; Moore 1968). In the genus *Mesoplodon* the position of the single pair of mandibular teeth corresponds to a species' placement on a scale from primitive to derivative, with apical teeth being the most primitive and more posteriorly placed teeth the most derivative (Heyning 1984; Moore 1968). *M. europaeus* would be the 3rd most primitive, behind *M. hectori* and *M. mirus* (Moore 1968).

FORM AND FUNCTION. Variation in color may be because of dilation of blood vessels near the skin (Mead 1989). Color may be lighter in an active animal that is dissipating deep body heat to the environment, whereas an inactive animal may appear dark gray to black. Scars on the skin of *M. europaeus* are often readily visible (Heyning 1984; McCann 1974). Scarring appears to be more prevalent in adult males and can occur in round, oval, or linear (singularly or parallel) patterns. Oval scars may result from cookie cutter sharks (Jones 1971). Given the placement of the mandibular teeth, the scars from conspecifics are single linear lines (Heyning 1984).

Sexually mature ovaries had a mean mass of 14 g (range, 12–19 g; $n = 7$—Mead 1984). A "bursa ovarica" occurs in *M. europaeus* (Rankin 1961). A single mature testis had a maximum weight of 160 g. Brain mass of 4 *M. europaeus* and 6 other mesoplodonts together averaged 1,603 g ($SD = 331$ g—Mead 1989).

Vertebral formula of *M. europaeus* is 7 C, 9–11 T, 8–11 L, 17–21 Ca, total 45–51 (Mead 1989). Fusion of the vertebral epiphysis center indicates physical maturity. In 1 *M. europaeus* the first 4 cervical vertebrae were fused, with the 5th and the 6th fused together but separate from the first 4. The 7th cervical vertebra was not fused to the other vertebrae (Debrot and Barros 1992). Ribs consist of 9–11 pairs, of which the first 7 pairs are double-headed; 8–10 chevron bones are present. Manus has a proximal row of carpal bones that includes ulna, intermedium, and radiale. Bones in the distal row are 1st carpal, fused 2nd and 3rd carpals, and fused 4th and 5th carpals (Mead 1989). Distal carpals 4 and 5 are distinct in *M. europaeus* (Raven 1937). The mesorostral groove appears to ossify slowly, or not at all, in adult *M. europaeus* females (McCann 1965; Moore 1960).

Maxillary teeth are generally absent in *M. europaeus* (Mead 1989). The remaining dentition consists of a pair of laterally compressed mandibular teeth, present in both sexes but erupting only in adult males (Heyning 1984). One *M. europaeus* had 2 small vertical grooves in the dentine, which gradually disappeared toward the tip because of wear. Toward the base the grooves may also disappear because of cementum covering them (Moore 1960). Characteristics of the skull which distinguish the sexes include eruption of mandibular teeth in adult males, but not in females and juveniles of both sexes, and a vomer that completely fills the mesorostral canal in adult males, but does not surpass the level of maxillary in females or juveniles (Varona 1985).

Mesoplodon europaeus has no forestomach but has >2 pyloric stomach compartments. A distal main stomach compartment opens to a cul-de-sac off the proximal compartment. Connecting chambers join the proximal compartment. Mean number of chambers is 7 in *M. europaeus* (Mead 1993).

ONTOGENY AND REPRODUCTION. Estimated mean length at birth (2.10 m) is ca. 40–48% of the maximum length of females of *M. europaeus* (Mead 1989). In a female *M. europaeus* dentine deposition stopped, or became irregular, at 6 years, an early age (Perrin and Myrick 1980). In 1 specimen of *M. europaeus* the number of cement growth layer groups was >48, suggesting an age of 48 years (Perrin and Myrick 1980).

ECOLOGY. *Mesoplodon europaeus* may be limited to the deeper waters of the tropical and warm temperate Atlantic. Its southern range overlaps that of *M. densirostris* (Debrot and Barros 1993), whereas the North Atlantic range overlaps considerably with *M. mirus;* however, *M. europaeus* prefers warmer waters (Mead 1989).

A fishery specifically aimed at *Mesoplodon* has never developed, particularly because of lack of certainty regarding *Mesoplodon* distribution (Mead 1989). A few species have been occasionally exploited and incidentally taken in various parts of the world, particularly in the pelagic drift gillnet fishery (Hoyt 1994; Julian and Beeson 1998; Mead 1989; Moore 1965). Observers with the National Marine Fisheries Service and the Northeast Fisheries Science Center Sea Sampling Observer Program have noted by-catch in the pelagic drift gillnet fishery. Total fishery-related mortality cannot be estimated for each species of *Mesoplodon* because of the uncertainty in species identification by fishery observers; instead

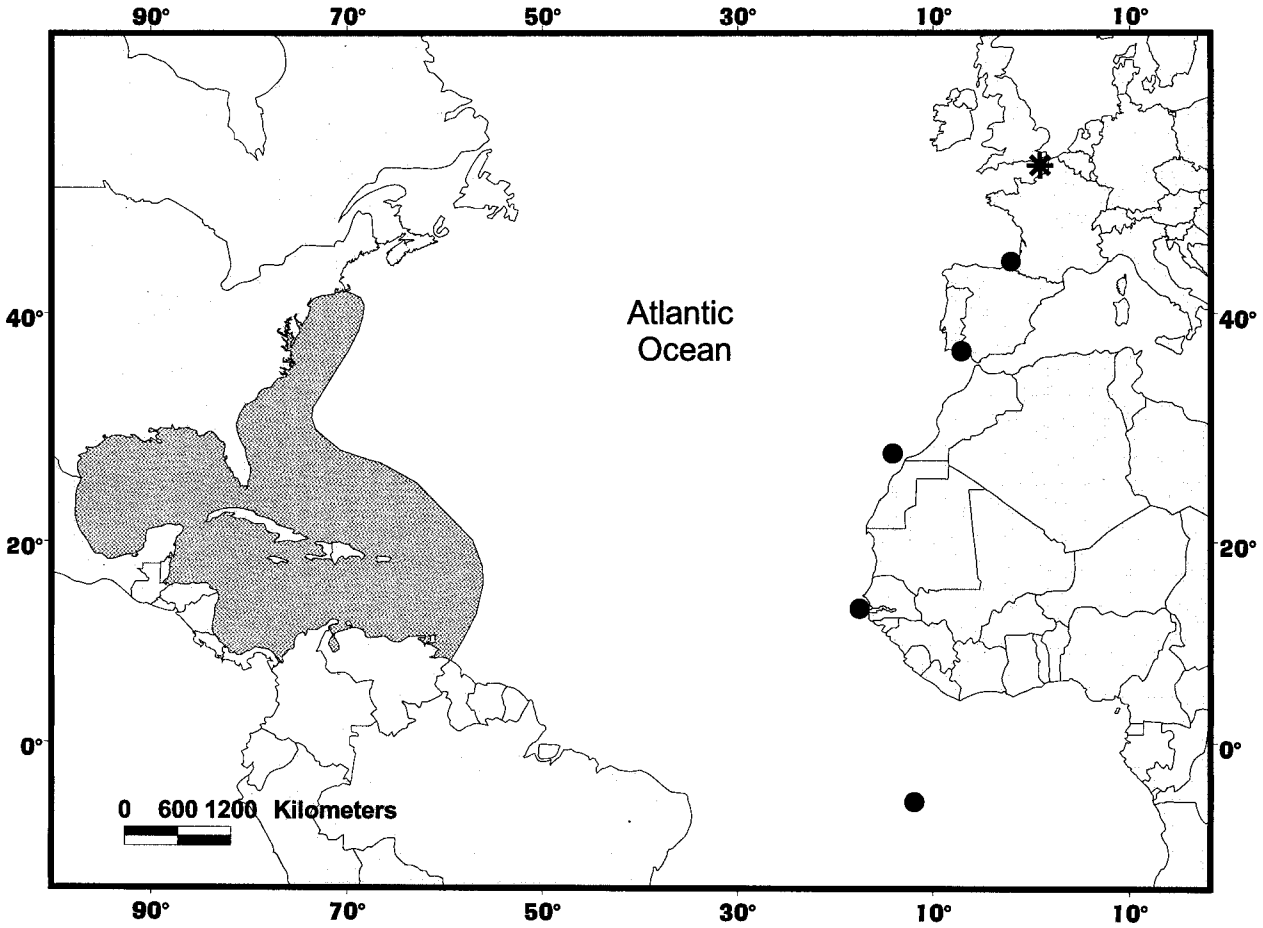

FIG. 3. Distribution of *Mesoplodon europaeus* (Mead 1989) with modifications. Asterisk indicates type locality. Black circles indicate sightings and strandings. Map prepared by J. Waite.

they are combined together as an undifferentiated group (Waring et al. 1999).

A 4.2-m female *M. europaeus,* which stranded on 3 May 1996, had extensive osteomyelitis of rostral skull and abscesses around left flipper (Mead 1989). A juvenile male, which stranded on 13 October 1998 off Reddington Beach, Florida, suffered from heart and kidney problems as well as gastric ulcers (C. Manire, in litt.). Death was most likely caused by sepsis that comprised the respiratory tract. Pulmonary lesions and syncytial cells in pharyngeal and mesenteric lymph nodes suggested a viral etiology. Arteriosclerosis and membranous glomerulonephritis also occurred (C. Manire, in litt.).

Parasites include *Isocyamus delphini* found on a healing flank wound of an adult *M. europaeus. Monorhygma* and *Phyllobothrium* cestode cysticerci are common in *M. europaeus,* with *Monorhygma* occurring typically between peritoneal membrane and body wall in caudal abdomen, and *Phyllobothrium* in flank blubber (Mead 1989). *M. europaeus* hosts trematodes in liver and bile duct, and unidentified nematodes within stomach and intestine. No parasites occur in pterygoid air sinuses (Mead 1989). Commensal barnacles will attach to the teeth.

Mesoplodon europaeus may prefer mesopelagic cephalopods and fish (Mead 1989). Cephalopods constitute the primary food (Clark 1986).

Specimens of *M. europaeus* have only been maintained in captivity after stranding. On 13 October 1998, a 4.3-m male stranded off Reddington Beach, Florida, and was transported to Mote Marine Laboratory in Sarasota, Florida (Fig. 1), but died after 8 days of intensive treatment (C. Manire, in litt.).

Numerous strandings of *M. europaeus* have occurred in the southeastern United States. A mass stranding of 4 *M. europaeus* occurred during the hurricane Bonnie in North Carolina in August and September 1998. Five more unrelated strandings occurred in September 1998, 2 in Florida and 3 in South Carolina (National Marine Fisheries Service, in litt.).

BEHAVIOR. The densely ossified mesorostral canal in mature males may reinforce the rostrum during intraspecific fighting, but evidence of interspecific fighting does not exist (Heyning 1984). *M. europaeus* thrusts its beak prominently from the water when surfacing to breathe.

A stranded male *M. europaeus* produced frequent vocalizations, most commonly at a high amplitude. Slow and fast clicks and "a narrow band sound" were recorded (Caldwell and Caldwell 1991:153).

GENETICS. *Mesoplodon europaeus* and *M. carlhubbsi* differ from all other cetacea, except physeterids, in having a diploid chromosome number of 42 instead of 44 (Arnason et al. 1977). Reference sequences for the mitochondrial deoxyribonucleic acid control region of *M. europaeus* aid identification of stranded specimens or those entangled in fishing gear (Henshaw et al. 1997).

REMARKS. The genus name *Mesoplodon* is derived from the Greek words *mesos* for middle, *hopla* for arm, and *odon* for tooth, signifying an animal "armed" with a "tooth" in the "middle" of the lower jaw (Gervais 1850). The species name *europaeus* refers to Europe where the type specimen was described. *M. gervaisi* (Deslongchamps 1866) is the junior synonym, but it was replaced with its senior synonym, *M. europaeus* (Hershkovitz 1961). *M. europaeus* is also known as the Antillean beaked whale, Gulf-Stream beaked whale, European beaked whale, zifio de Gervais (Spanish), and Baleine à bec de Gervais (French).

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