Double-faced monster in the bottlenosed dolphin (*Tursiops truncatus*) found in the Mediterranean sea

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and Madbouly 1981, Buttiker and Zumpt 1982) concerning myiasis did not record *W nuba* larvae as causative agents.

Although this study recorded few cases of traumatic myiasis, it identified the important causative fly species and indicated their geographical and seasonal distribution in Saudi Arabia. It seems certain that more screwworm myiasis occurred but was not reported, owing to the failure of veterinarians to submit samples and the lack of awareness on the part of animal owners of the need to bring their livestock for treatment. Further intensive studies are needed to provide more detailed data on the geographical distribution and the pest status of the Old World screwworm fly in Saudi Arabia. Successful control should be based on the identification of infested areas and complete involvement of owners and veterinarians in a well organised campaign of prevention and treatment.

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Double-faced monster in the bottlenosed dolphin (*Tursiops truncatus*) found in the Mediterranean sea

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TERATOLOGY is the study of abnormal development. In particular, it is the study of the causes, mechanisms and manifestations of abnormal development, whether genetically, gestationally, or postnatally induced, and is expressed as mortality, malformation, growth retardation or functional aberrations (Wilson 1986). Abnormal development produces monsters which are defined as a fetus or neonate with such pronounced developmental anomalies as to be grotesque and usually non-viable. Analysis of these cases can provide more information on embryological processes due to either genetic or chromosomal factors, and the effect of mutagenetic factors operating after fertilisation, or infectious, chemical or physical factors operating during embryogenesis and fetal development (Briard and Le Merrer 1989, Shepard and others 2000). This knowledge is important in human and veterinary medicine (Brent and others 2000), can be related to possible environmental causes like contaminants (Bjerkedal 1989, Inouve 1989, Yasuda 1994) and can provide useful insight into phylogenetic relationships (Slaïpka 1994). Many types of teratological specimens have been found among mammals including man. Comparatively, such records in cetaceans remain scarce. This short communication describes a case of a double-faced monster in a bottlenosed dolphin (*Tursiops truncatus*) found stranded on the French Mediterranean coast.

The specimen was collected on June 24, 2001, at Borgo beach, Corsica, in the western Mediterranean Sea. It was a partially decomposed female bottlenosed dolphin calf, 119 cm in length, weighing 22 kg with an 80 cm lone, single umbilical cord still attached. These measurements were close to standard values for newborn bottlenosed dolphin calves, whose lengths at birth are approximately 0·9 to 1·3 m (Mead and Potter 1990) and suggested that the specimen had completed its fetal development and probably died at delivery. This was confirmed by examination of the lungs, which showed that the animal had never breathed. The teratological nature of the specimen was externally revealed by the presence of two visible beaks.

The carcase was kept frozen for further examination. The animal was x-rayed and a postmortem examination was carried out at the University of Luminy, Marseille, on July 2. The malformation mostly affected the face of the animal and to a lesser extent the brain case (Figs 1, 2). The skull was abnormally wide and had a single occipital hole. There was a single brain case with two tympanic bullae, but two beaks, two blow holes, two eyes located laterally and two others inserted between the two beaks. There was a single hyoid apparatus, but the tongue was bifid, each part corresponding to one of the two beaks. Teeth formation in the upper and lower jaws was normal for such a young animal, with well-developed teeth barely erupting from the gum. The rest of the external structures located further backward showed no difference from a normal dolphin calf in either shape or size. For example, there were a pair of flippers, a normal-shaped tail fluke

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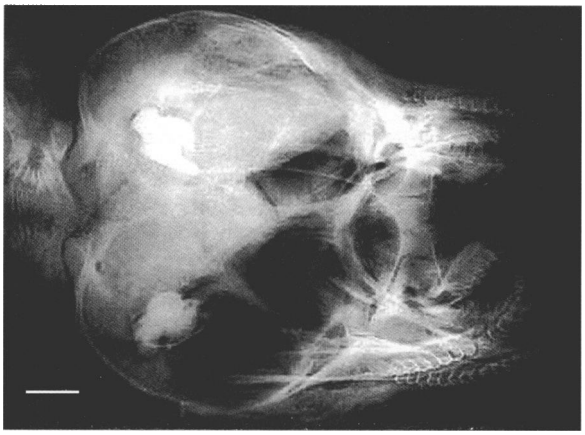

FIG 1: Radiograph of the head showing the two complete beaks and the teeth, as well as the single, abnormally wide brain case with two auditory bullae (denser areas). Bar=2 cm

FIG 2: Frontal view of the head of the dolphin during dissection showing the locations of two blow holes (arrows) and two eyes (arrowheads)

and dorsal fin and an umbilical cord attached to the abdomen. Viscera in the thoracic and abdominal cavities were no different to the conformation observed at the same stage of development in a normal dolphin calf. The state of decomposition precluded any further investigation and the possible initial causes of the malformation could not be determined from examination of the carcase.

The skull was kept macerated in fresh water and gradually cleaned by hand in order to preserve bone sutures (Fig 3) and to allow the description and measurements of features on cranial bones (Table 1), as proposed by Rommel (1990) and Perrin (1975) for delphinid skulls. The skull division was complete forward from the frontal bones, located dorsally, and the vomers, located ventrally. The back of the brain case was formed normally with one of each of the following bones: supraoccipital, exoccipital, basioccipital as well as a pair of squamosal and a pair of auditory bullae. In between, a transitional zone was visible in which the parietal and interparietal bones were only partially duplicated. Two interparietals were clearly visible in the axis of each rostrum and the parietals were represented by three bones. Two bones were located laterally and seemed to be shaped normally; the third, probably resulting from the fusion of two other parietals (fused parietals), was located between the duplicate interparietal bones. In terms of relative dimensions, the supraoccipital and the basioccipital

TABLE 1: Skull measurements of the bluenosed dolphin*

Measurement	Left skull (mm)	Right skull (mm)
Condylobasal length	284	296
Length of rostrum	135	147
Rostrum width at base	74	70
Width of rostrum at quarter length	58	54
Width of rostrum at half length	52	51
Width of rostrum at three-quarter length	41	40
Width of premaxillaries at half length	24	24
Tip of rostrum to external nares	158	163
Tip of rostrum to external nares	159	182
Preorbital width	113	110
Postorbital width	137	142
Zygomatic width	116	114
Width of external nares	35	33
Maximum width across premaxillaries	64	74
Parietal width	184	
Brain case height	107	
Brain case length	124	122
Length of temporal fossa	61	66
Height of temporal fossa	43	42
Length of orbit (left [L]/right [R] length of orbit for each skull)†	46/24	26/47
Length of antorbital process	59	61
Width of internal nares	31	32
Length of upper toothrow (R/L)†	124/101	114/119
Number of upper left teeth	21	21
Number of upper right teeth	18	21
Number of lower left teeth	20	20
Number of lower right teeth	18	20
Length of lower tooth row	NA	NA
Length of ramus	NA	NA
Height of ramus (L/R)†	49/38	37/53
Width of tooth at alveolus ([R/L]: mm and 10ths)†	124/104	123/111
Maximum bicephale cranial breath	189	
Distance between the two rostrums at tip	88	
Distance between the two rostrums at mid-length	91	
Distance between the two rostrum ends	102	

* Based on standards measurements in Perrin (1975)
† Duplicate measurements of the two beaks
NA Unavailable data

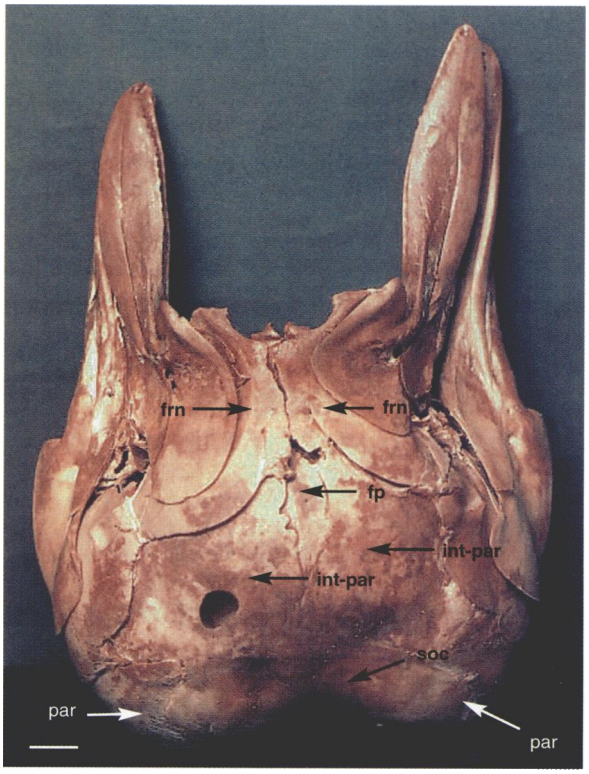

FIG 3: Dorsal view of the skull showing that the facial bones are duplicated. frn Frontal, fused parietals, fp Fused parietals, int-par Interparietals, par Parietals, soc Supraoccipital. Bar=2 cm

were broader than normal, and the outer bones of each beak (left and right premaxillary, maxillary and frontal bones of the left and right rostra, respectively) were notably more elongated than the corresponding inner ones (Table 1).

This short communication describes the second case of a duplicate anterior and the first known case of a double-faced monster in odontocetes. The classification of monster in this case is an atlodymus, that is, a duplicate face with only one atlas. The other case of a duplicate anterior was reported by Kamiya and others (1981) who described the first known case of dicephaly in odontocetes. They described a malformed embryo of a striped dolphin (*Stenella coeruleoalba*), found in Japan in 1981, which was a duplicate anterior characterised by the presence of two distinct heads, not merely two 'faces' as in the present specimen (diproscopy). It had duplicate cervical vertebrae and four eyes (tetraophthalmy), and was classified as a derodymus monster.

Other cases of monstrosity in cetaceans are scarce, but several real double monsters (two individuals more or less completely fused) have been described previously. A case of a double monster in a bottlenosed dolphin with fusion of the thoracic and abdominal cavities was described by Droogleever Fortuyn and Römer (1920) in the Netherlands. Kawamura (1969) described siamese twins in the sei whale (*Balaenoptera borealis*). The twins were two male fetuses that measured 114 and 137 cm in length. This case was considered a typical example of complete fusion of thoracic and abdominal cavities from the throat to a point just posterior to the naval, with one umbilical cord only, in line with the definition of a monophalus monster. Zemsky and Budylenko (1970) reported a seemingly identical case of twin female humpback whale (*Megaptera noveanglia*) fetuses with body lengths of 124 and 120 cm. A striped dolphin double monster was also observed by Kawamura and Kashita (1971) – a case of twin embryos, with body lengths 16·8 and 17·2 cm, fused anteriorly to the flippers along a rostrocaudal axis, like a sycephalus monster.

Finally, a few cases of individuals with one or more anomalies have also been reported. Kamiya and Miyazaki (1974) described the early developmental stage of a 9 mm long striped dolphin embryo showing multiple severe congenital malformations. Perrin and others (1989) reviewed the collection of dolphin embryos held at the Southwest Fisheries Center of the US National Oceanographic and Atmospheric Administration in La Jolla, California, and described five cases of monstrous dolphins of unspecified species, reporting severe caudal regression (genetic atrophy), megalencephaly (due to cerebrospinal fluid expansion), omphalocele (digestive tract developing in the umbilical cord, externally to the abdominal cavity), cleft mandible and hypoplasia of maxilla and monozygote twins.

All of these cases are relatively unusual and their relative prevalence can hardly be discussed in terms of possible causes, either genetic or environmental. However, it is informative to compare them with the prevalence of monstrosity among other mammals. Teratological specimens have long been documented in a diversity of mammals, mostly domestic species and man, and cases of double-faced or double-headed monsters are well known in the order Artiodactyla, the closest relatives to cetaceans among terrestrial mammal fauna.

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