Visually-detectable attributes of spinal malformations in free-ranging bottlenose dolphin calves in northeast Scotland

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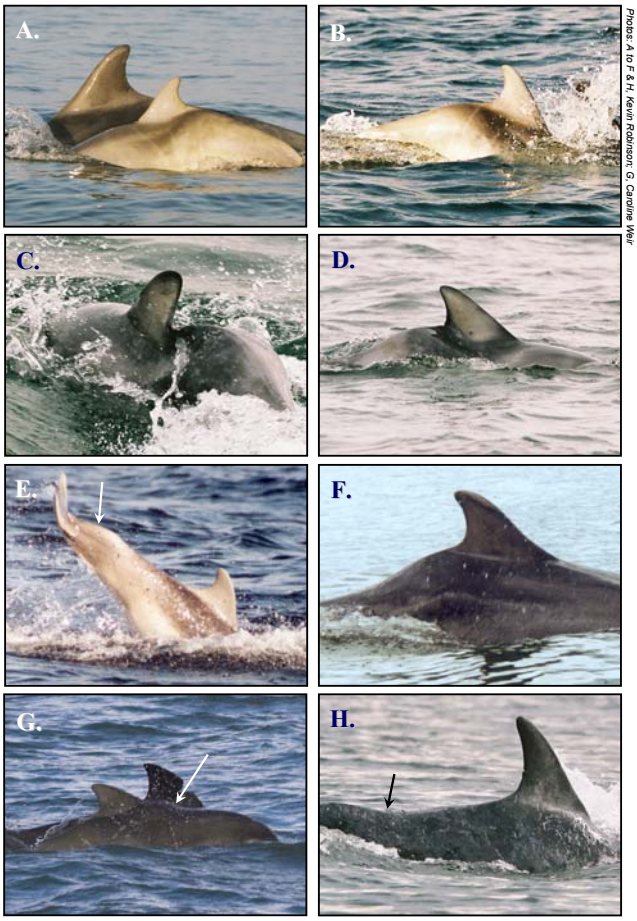
Introduction: In free-ranging vertebrates, deformities or deviations of the spinal column may be either congenital or acquired (Turek 1984). In most models studied, congenital conditions are associated with a high incidence of both spinal and extra-spinal defects, whereas acquired conditions may result from neurological disease, environmental contamination, or may be idiopathic (Cowell et al. 1972, Couch et al. 1977, Giddens et al. 1984). In aquatic mammals such as cetaceans, however, vertebral malformations may additionally result from traumatic injury (Watson et al. 2004), and boat strikes, inter-specific aggression, and the agonistic behaviour of con-specifics have all been implicated in this respect. In the present paper, six cases of mild to severe spinal malformations are detailed from visually-detectable attributes of afflicted animals within a small bottlenose dolphin (*Tursiops truncatus*) community in northeast Scotland.

Methods: Photographs taken during the course of a 10-year photo-identification study in the outer Moray Firth, were used to distinguish the visual details of spinal malformations observed in six individual bottlenoses (4 calves, a sub-adult and an adult). The animals were sexed from direct observations of their genital area and/or, in the case of females, by known associations with calves. Malformations were assigned using the terminology applied by Berghan & Visser (2000).

Results: The details of the case report no.'s I to VI are described below and illustrated in the accompanying plates.

Case Report No.	Condition Observed
I) **"Natalia"** (ID.390) – first year calf of female sex. Sighted as a neonate in Aug 2006, and encountered twice thereafter in Oct 2006.	**Kyphosis** – increased convexity of the vertebral column with a prominent kyphotic hump in the thoracic region directly caudal to the dorsal fin (Plates A & B).
II) **"Fitri"** (ID.377) - a second year calf (2006) of unknown sex. First sighted with this condition (although not as severe) as a neonate in Jul 2005, and sighted a further 18 times since to Oct 2006.	**Kyphoscoliosis** – lateral indentation and severe backward curvature of the spine with concavity on the left hand side and a prominent kyphotic hump (Plates C & D). When first seen, there was no lateral curvature.
III) **"Pine"** (ID.328) – born in the late summer of 2002. Sex unknown. Last seen in Aug 2005 shortly before it separated from its mother at age 3 years.	**Kyphosis** – increased convexity and a slight kyphotic hump in the caudal region anterior to the tail flukes (Plate E).
IV) **"Humpy"** (ID.43) – sub-adult female when first recorded in 1997, although earlier records show that this deformity was incurred when in calf hood. Sighted on 8 occasions in 1997 but not recorded thereafter.	**Kyphoscoliosis** – slight lateral deviation to the left then back to the right and a pronounced kyphotic hump in the thoracic region, directly posterior to the dorsal fin (Plate F).
V) **"Bump"** (ID.417) – First seen in Oct 2006 as a newborn calf. Sex unknown. Condition first seen in 2007 and therefore acquired after birth.	**Kyphosis** – increased convexity of the thoracic region anterior to the dorsal fin with a prominent kyphotic hump (Plate G).
VI) **"Grans"** (ID.138) – ageing adult female, first sighted in 1998. Seen again in 2004 and throughout 2005. Produced calves in 1998 and 2004.	**Lordosis** – horizontal displacement with a shallow concavity of the lumbar-caudal region giving the appearance of a sway back (Plate H).



Photos: A to F & H: Kevin Robinson; G: Caroline Weir

Discussion: In the present study, a surprisingly high number of bottlenose calves showing vertebral deformations were observed. Whilst the longevity of delphinids displaying such conformational deformities is largely unknown, it seems from the present study and from other case examples in delphinids (e.g. Wilson et al. 1997, Berghan & Visser 2000, Watson et al. 2004), that some animals survive well into adulthood. In the cases of the free-ranging calves presented here, neither the durability of the malformations nor the fate of the animals could be determined, but longevity is likely to be dependant upon the extent and resulting complications of the malformations observed. Pathological and congenital causes are suggested as possible explanations for the relatively high incidence in animals observed in this study. However, the trauma-inducing capability of intra-specific attacks by males on calves in this location (Patterson et al. 1988, Deaville et al. 2006) might conceivably explain the large number of cases reported here in first and second year animals. The survivability of compromised calves nevertheless underscores an extraordinary ability for functional adaptation of the species to such gross structural deformation.

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