Visible supernumerary teeth in pinnipeds

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ABSTRACT. Additional, or supernumerary, teeth occur in most mammalian taxa, although they are better recorded in some species than in others. As part of a larger biometric study, incidence of visible supernumerary teeth was recorded in the skulls of 1228 pinnipeds (seals, sea lions, and fur seals). Results showed that supernumerary teeth only occurred in the postcanine (molars and premolars) tooth row. It was also found that 3.3% of otariids (sea lions and fur seals) and 4.7% of phocids ('true' seals) possessed supernumerary postcanines. Out of a total of 52 supernumererary teeth recorded, only six were morphologically abberant; all the others played a functional role in the normal tooth row.

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Introduction

Incidence of supernumerary teeth (a phenomenon also called 'polydontia' or 'polygenesis') occurs in most mammalian taxa, although it is more frequent in some than in others. Teeth that are additional to the usual dental formula frequently occur in a morphologically aberrant form, and are often positioned lingual to the normal tooth row (Hillson 1996). Such teeth are invariably functionally redundant. In humans, supernumerary teeth occur more often in the form of incisors, than in molars or premolars (Lavelle and Moore 1973).

Dental variation in general was considered by Bateson (1894) in a classic, early evolutionary text. He noted the existence of supernumerary teeth in several species of seal, and used the frequency of such teeth to argue against the idea that higher incidences of supernumerary teeth indicated a history of domestication. He documented 'four cases of reduplication of the first premolar' – of which two were in the hooded seal (*Cystophora cristata*) – and noted that variation in tooth number is frequently asymmetric, citing harbour seals (*Phoca vitulina*), harp seals (*Phoca groenlandicus*), and Ross seals (*Ommatophoca rossi*), among the phocids ('true' or 'hair' seals). Bateson suggested that, at least in some cases, a tooth germ had divided to give rise to a supernumerary tooth (citing *Phoca groenlandicus* and *Ommatophoca rossi*, as examples), although his distinction between such 'divided' teeth and those he referred to as 'duplicate' teeth is not clear from his text (page 268).

More recent work on seal populations has suggested that some species are known to have a more variable dentition than others. For example, the Californian sea lion (*Zalophus californianus*) is known to have a higher incidence of supernumerary teeth than the southern elephant seal (*Mirounga leonina*) (see King 1983). Few wider-ranging comparative studies of numerical variation of the teeth in pinnipeds (seals, fur seals, sea lions, and walruses) have been conducted to date, although a study by Kubota and Togawa (1964) documented aspects of numerical variation in the dentitions of 'northern sea lions, fur seals and seals.' The authors considered some of the issues raised in Bateson's (1894) book, and concluded, for example, that the pattern of supernumerary teeth observed in some adult fur seals was consistent with the division of the second premolar tooth germ. Kubota and Togawa interpreted some instances of supernumerary teeth as 'recession towards the full mammalian dentition' (page 487).

The permanent dentition of otariids (sea lions and fur seals) is less variable than those of the phocids (King 1983). The usual dental formula for otariids is:

$$\text{Incisors } \frac{3}{2} \text{ Canines } \frac{1}{1} \text{ Postcanines } \frac{5 \text{ or } 6}{5}$$
(molars and premolars)

(that is, they have three upper and two lower incisors per side; one upper and one lower canine per side; and five or six upper postcanine teeth per side, as compared to five lower ones).

During the last 15 million years, otariid postcanines have evolved towards single roots, with the distal teeth being the last to change (King 1983). Postcanines in otariids are generally cone shaped and flattened in an antero-posterior direction. Repenning and others (1971) noted that many postcanines in sea lions and in the South African fur seal (*Arctocephalus pusillus*) have remained double rooted. This indicates that evolution operates on the mesial teeth first, and may suggest that supernumerary teeth occurring in a distal position constitute a primitive state. King (1983) noted that while the genera *Otaria*, *Phocarctos*, *Callorhinus*, and *Arctocephalus* usually have five lower and six upper postcanines, the formula is more often five upper and five lower in *Eumentopias* and *Neophoca*. As noted, the genus *Zalophus* is variable.

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Table 1. Supernumerary teeth in otariids and phocids.

Species	Number of seals studied	Number with supernumerary teeth	Upper or lower jaw
Otariids			
Antarctic fur seal (*Arctocephalus gazella*)	81	1	upper
Australian fur seal (*Arctocephalus doriferus*)	19	–	
South African fur seal (*Arctocephalus pusillus*)	22	1	upper
New Zealand fur seal (*Arctocephalus forsteri*)	13	1	upper
South American fur seal (*Arctocephalus australis*)	36	–	
Subantarctic fur seal (*Arctocephalus tropicalis*)	33	1	upper
Galapagos fur seal (*Arctocephalus galapagoensis*)	3	–	
Northern fur seal (*Callorhinus ursinus*)	33	–	
Australian sea lion (*Neophoca cinerea*)	16	2	upper
Steller's sea lion (*Eumentopias jubatus*)	23	–	
Southern sea lion (*Otaria byronia*)	117	1	lower
New Zealand sea lion (*Phocarctos hookeri*)	14	–	
Californian sea lion (*Zalophus californianus*)	13	7	upper (6); lower (1)
Phocids			
Crabeater seal (*Lobodon carcinophagus*)	51	4	upper (3); lower (1)
Ross seal (*Ommatophoca rossi*)	21	–	
Weddell seal (*Leptonychoetes weddelli*)	138	6	upper
Leopard seal (*Hydrurga leptonyx*)	42	2	upper
Mediterranean monk seal (*Monachus monacus*)	12	–	
Southern elephant seal (*Mirounga leonina*)	88	–	
Hooded seal (*Cystophora cristata*)	25	2	upper
Bearded seal (*Erignathus barbatus*)	12	1	upper
Grey seal (*Halichoerus grypus*)	174	17	upper (11); lower (6)
Harbour seal (*Phoca vitulina*)	140	3	upper (1); lower (2)
Largha seal (*Phoca largha)*	10	–	
Harp seal (*Phoca groenlandica*)	33	2	upper
Ribbon seal (*Phoca fasciata*)	10	–	
Ringed seal (*Phoca hispida*)	31	1	lower
Baikal seal (*Phoca sibirica*)	6	–	
Caspian seal (*Phoca caspica*)	12	–	

The phocid dental formula is:

$$\text{Incisors } \frac{3}{2} \text{ Canines } \frac{1}{1} \text{ Postcanines } \frac{5}{5}$$

(that is, similar to the otariids, with the exception of the upper postcanines).

The exceptions are that the hooded seal and both species of elephant seal (*M. leonina* and *M. angustirostris*) have two upper and one lower incisors, and monk seals (genus *Monacus)* have two upper and two lower incisors. The morphology of the phocid postcanine dentition is highly variable, ranging from the large lobed teeth of the leopard seal (*Hydrurga leptonyx*) to the small and shallow-rooted molars of the hooded seal and the Ross seal.

Materials and methods

As part of a larger biometric study, incidence of supernumerary teeth was recorded in 1228 otariid and phocid skulls held at the Natural History Museum, London, the British Antarctic Survey, and the University Museum of Zoology, Cambridge. Because additional teeth are often aberrant in form, many do not erupt and so a detailed study requires careful radiography (Hillson 1996). However, it was observed in the present study that most of the supernumerary teeth surveyed were not aberrant, but tended to take the form of the neighbouring teeth and therefore formed part of the functional tooth row. These were assessed and recorded.

Results

Table 1 shows the number of supernumerary teeth recorded for each species, along with whether they occurred in the upper or the lower jaw. No supernumerary incisors or canines were recorded in any species; all were postcanines.

Of 423 otariids, 14 individuals possessed supernumerary teeth (3.3%). All were upper teeth with the exception of those of two individuals. The Californian sea lion showed the greatest variation, with seven individuals out of 13 possessing additional teeth (53.8%).

In 805 phocids, 38 individuals had additional teeth (4.7%). The grey seal (*Halichoerus grypus*) showed the greatest variation, with 17 individuals out of a population of 174 possessing additional teeth (9.8%). One individual had eight teeth on both the left and the right sides of its upper jaw.

Of the 52 supernumerary teeth found, only six were morphologically aberrant. All the others took the form

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of the neighbouring tooth and were functional in the tooth row. With the exception of the six morphologically aberrant teeth, all supernumerary molars occurred at the distal end of the tooth row.

Discussion and conclusions

The results indicate that supernumerary teeth in both phocids and otariids are comparatively rare in most species. The Californian sea lion showed the greatest variation, as predicted by King (1983), although the sample size was small and further research is needed.

Forty-six of the supernumerary teeth occurred at the distal end of the tooth row and formed part of the functional dentition. This follows a trend noted in other species that evolutionary change tends to occur first in the anterior teeth in a given field (Dahlberg 1945; Butler 1982). It is possible that these supernumerary teeth represent a primitive state, and that the condition does not confer a selective advantage on the individual — that is, that six upper teeth are not significantly more beneficial than five. This would imply that incidence of supernumerary teeth will decline in future populations (compare, Kubota and Togawa 1964).

Most of the additional teeth observed in this study occurred in the upper jaw (43 of 52 individuals). The reasons for this are uncertain, although it has been noted in other studies (for example, Repenning and others 1971) that there can be greater morphological variation in the structure and form of the upper teeth than the lower. It is possible that the upper dentition is more prone to variability in various ways, one of which is the presence of additional teeth.

Finally, a recent paper by Kangas and others (2004) strongly suggested that mammalian dental characters are not (as generations of investigators have hoped) independent. The authors varied the levels of the cell signalling protein ectodysplasin and found clear evidence of correlated changes involving the numbers of cusps, the cusp shapes, and, importantly, the number of teeth. Previous work by Goodwin (1998) had shown that, in ground squirrels (*Spermoplhilus*), supernumerary teeth are more prevalent in hybrids between two species, and Kangas and others suggested that this indicates 'a finely tuned role for genetic background in normal suppression of extra tooth development.'

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