

Supplementary paper

Aggressive behaviour of an adult male Cape fur seal (*Arctocephalus pusillus pusillus*) towards a great white shark (*Carcharodon carcharias*)

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This is a report of a marine predator (the white shark) being threatened by a member of the species on which it preys (a male Cape fur seal). Although these events may be rarely observed or occur infrequently, they may have important implications for the predator and its prey. We suggest that shark mobbing by adult male Cape fur seals is adaptive for the reduction of risk of predation by sharks. Mobbing of sharks is likely to alert conspecifics to the presence of a predator, and/or reduce the shark's hunting motivation near the mobbing site.

Key words: *Arctocephalus pusillus pusillus*, *Carcharodon carcharias*, predator, mobbing

Aggressive behaviour of an adult male Cape fur seal (*Arctocephalus pusillus pusillus*) towards a medium-large great white shark (*Carcharodon carcharias*) was observed on 7 December 1994 at the Robberg Nature and Marine Reserve, Plettenberg Bay, on the south east coast of South Africa (34°03'S; 23°24'E). Observations were made from a cliff face about 6 m directly above the Rondeklippe fur seal colony, which at the time comprised 11 animals: eight adult males, one subadult male, one adult female and one unsexed juvenile.

At 10:47 on 7 December 1994, we sighted a 3.5–4.0 m great white shark, just beneath the water surface, about 8 m northwest of the seal colony. The shark moved steadily towards the cliff line, and then veered eastward towards the colony where nine resident seals were lying on the rocks. The dominant¹ male and another adult male were at sea and had not been sighted since their departure earlier that morning (08:49).

As the shark approached to within several metres of the main landing-area, the dominant male seal, estimated to be at least 2 m in length and 300 kg in weight, suddenly appeared. The seal turned to face the shark, and swam directly towards the intruder in a threatening charge, forcing the shark to divert in a northeasterly direction. The charge was continuous, orientated and at the water surface (Fig. 14(b).1). No direct contact was made. The attacking fur seal then chased the shark at a distance of less than a body length until it was at least 15 m from the colony. At no time during the encounter did the shark show obvious signs of aggression. The dominant male returned to the colony but remained in the water; he appeared calm, occasionally rolling in a 360° lateral turn, presumably keeping a look-out for ascending sharks (see McCosker 1985). At 10:54 he hauled out onto the rocks and joined the other seals.

At 11:14, the same male accompanied six of the seals (five males and the female) into the water, and they departed as a pod in a westerly direction. This gregarious behaviour may be at least partly

¹ For the purpose of this report, the term 'dominant' is used loosely to describe the rank of one of the two largest male seals [i.e., Rondeklippe seals were submissive to this male; a large non-resident male seal feeding near the colony was attacked (frontal-strike) and chased by this male (Stewardson, pers.obs.)].

associated with predator avoidance, i.e., if a shark were sighted by at least one of the seven seals then the entire pod would be alerted (Ainley *et al.*, 1985; McCosker 1985).

Similar attacks on large sharks have been reported in other species of pinnipeds, otariids and phocids, e.g., Galàpagos sea lions (*Zalophus californianus*), Galàpagos fur seals (*Arctocephalus galapagoensis*) and Hawaiian monk seals (*Monachus schauinslandi*) (Nelson 1968; Barlow 1972, 1974; Alcorn & Kam 1986; Johanos & Kam 1986; Trillmich 1996). Although these events may be rarely observed or occur infrequently, they may have important implications for the predator and its prey. It is not known why seals attack sharks; however several possibilities are suggested below.

Aggressive tendencies during the breeding season

The Cape fur seal breeding season extends from late October to late December, and during this time large breeding males exhibit aggressive territorial maintenance behaviour and fight for control of harems (Rand 1967). Vocal threats and threatening charges are commonly observed at the breeding rookeries. This change in male behaviour appears to be associated with functional gonads and their products, androgens (Bester 1990; Stewardson *et al.*, 1998). Large males show aggression on land and in stretches of water adjoining the rookeries. Narrow inlets and channels near the main landing-areas are often subdivided among breeding males; these 'aquatic territories' are vigorously defended (Rand 1967). It is likely that breeding males will attack any object that roughly resembles an intruding rival male (Miller 1974), including large sharks.

If adult male Cape fur seals were shown to attack only during the breeding season, then high androgen levels might partially explain our observation. However, Trillmich (1996) described mobbing behaviour of sharks by male, female and juvenile Galàpagos sea lions and Galàpagos fur seals, indicating that high androgen levels are not necessary for aggressive behaviour to be exhibited towards large sharks.

Paternal role

Barlow (1972) found that large Galàpagos sharks (*Carcharhinus galapagensis*), which swim near the territories of breeding male Galàpagos sea lions, are usually chased away by one or several adult males ('mobbors'). The adult males appear to protect the young seals by escorting the sharks away, i.e., the pups dash shoreward as the shark is being intercepted. This may be interpreted as paternal behaviour of territorial males, which promotes the survival of related pups and hence improves the inclusive fitness of the males (Barlow 1972, 1974; but see Miller 1974). The argument is proposed that a bull is likely to be protecting his genetic investment by repelling sharks from anywhere around the rookery,



Fig. 14(b).1 A marine predator (the white shark) being threatened by a member of the species on which it preys (a male Cape fur seal).

Top: at 08:49, 7 December 1994, the dominant male seal in the group departs from the colony. (Note the very large body size of the dominant male compared to the two adult males at the water's edge. There is an old shark-bite wound across the chest and foreflippers of the dominant male indicating previous encounters with sharks).

Middle: at 10:48, a medium-large great white shark, about 3.5–4.0 m in length approaches the Rondeklippe seal colony.

Bottom: as the shark approaches to within several metres of the main landing-area, the dominant male suddenly appears and swims directly towards the shark in a threatening charge. The intruding shark was forced to divert from the oncoming seal, and was chased in a northeastly direction, about 15 m from the fur seal colony.

(The images were taken from video footage).

because pups carrying his genes may move about through any territory (Barlow, 1974).

However, in the present study, mobbing of the shark by the dominant male did not have a paternal role. At the time Rondeklipe was a non-breeding colony. There were no pups at the colony when the attack occurred.

Mobbing of predators

Studies suggest that mobbing of predators may benefit the 'mobber' and conspecifics, including the blood relatives of the 'mobber' (Kobayashi 1994). For example: (1) the mobber may acquire information about a predator, and relay this information to conspecifics, alerting them to potential danger (i.e., mobbing has a signal effect, alerting conspecifics of the presence of a predator, thus reducing the likelihood of predation); (2) mobbing behaviour threatens and/or confuses the predator, which may reduce the predator's hunting effectiveness and motivation near the mobbing site; (3) mobbing may make other conspecifics who have no innate recognition of the predator know that the mobbed animal is dangerous (Curio *et al.*, 1978).

Trillmich (1996) found that shark mobbing by male Galàpagos sea lions and male Galàpagos fur seals presumably serves to move sharks away from preferred seal resting places, or to chase them from feeding sites. Because territorial males are more prone to shark predation (e.g., spend more time at the water's edge), males can benefit greatly from mobbing if mobbing keeps sharks away (Trillmich 1996).

Based on limited observational data, we suggest that aggressive behaviour of adult male Cape fur seals towards large white sharks is adaptive for the reduction of the risk of shark predation. This behaviour is likely to alert conspecifics to the presence of a predator, and/or reduce the shark's hunting motivation near the mobbing site. Further studies are required to determine the prevalence of mobbing of sharks by Cape fur seals, and to investigate the benefits and risks of mobbing behaviour. Depending on the 'motivational state' of the shark, mobbing may be an option or not: fleeing may be more adaptive if the shark does not retreat, i.e., the mobber may be bitten or even killed (L. Compagno. pers. obs.).

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