TOURIST DISTURBANCE ON NEW ZEALAND FUR SEALS *ARCTOCEPHALUS FORSTERI*

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Marine mammals are significant tourist attractions around New Zealand, however, the impact of eco-tourism on these species is poorly documented. Effective management to mitigate any negative effects requires an understanding of target species' reactions to tourist activities. We have studied the effects of tourist activities on New Zealand fur seals (*Arctocephalus forsteri*) using a novel combination of observations and controlled approaches. Three study areas were selected reflecting a range of visitor density, type of tourism, and the anticipated sensitivity of fur seals to disturbance. Behaviour was observed using instantaneous scan sampling and attributes of tourist approaches were tested experimentally by controlled approaches. Approaches were made on land, by kayak, and motorboat. Fur seal responses and the distance at which the seal responded were recorded. Our results indicate that *A. forsteri* behaviour was being modified by tourist activities. Habituation was occurring at study areas with high levels of tourist activity. Approachers following current minimum approach distances still caused some animals to modify their behaviour and new minimum approach distances are recommended based on controlled approaches to seals at all study areas. Our work demonstrated that controlled approaches can be a useful tool to develop effective management guidelines to lessen impacts from eco-tourism activities.

Key words*:* pinnipeds, controlled approaches, approach distance, tourism management.

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NEW Zealand's extensive coastline and variety of marine life has led to an increase in popularity of marine-based tourism. Five species of dolphins, six species of whales and two species of pinnipeds are encountered regularly in New Zealand. About four other cetaceans and two other pinnipeds may be encountered on rare occasions (Constantine 1999). Robertson (1992) estimated that over 300,000 tourists visit marine attractions annually in New Zealand. Tourist operators have capitalised on the popularity of marine mammals and a range of tourist activities (including swim-with-dolphins and -fur seals, as well as whale, dolphin, and seal viewing from land, sea, and air) are available in New Zealand, where tourists can interact with marine mammals in their natural environment (Constantine 1999). Although marine mammal based tourism can have many benefits including educational, emotional, and financial, tourism may have a cost for the focal animal or animals or their environment (Edington and Edington 1986). Within many countries tourism is not well regulated, with few or no regulations, while in others nature-based tourism is often heavily restricted. For example, swim-with-wild-dolphin, -whale, and -seal programmes are illegal in the USA, and many land-based viewing opportunities elsewhere are restricted to guided walks only (Constantine 1999).

New Zealand fur seals (*Arctocephalus forsteri*) are the only marine mammal found regularly ashore in New Zealand. They are found year round in significant numbers around much of the South Island, and they are the focus of both shore- and sea-based tourism. There is some concern, however, that this species may be especially vulnerable to the effects of tourist pressure. The peak tourist season is in the New Zealand summer, November to February, which coincides with the *A. forsteri* breeding season. *A. forsteri* come ashore annually in November to February to give birth, nurse their young, and to mate (Taylor *et al*. 1995). Time ashore is also important for body maintenance as it is the primary period for rest, recovery after foraging, thermoregulation, and moulting (Barton *et al.* 1998).

In New Zealand, marine mammals are protected under Marine Mammal Protection Act 1978, and its regulations determine how humans may interact with the mammals. This legislation aims to "make provision for the protection, conservation and

management of marine mammals" and "to regulate human contact or behaviour with marine mammals, either by commercial operators or other persons, in order to prevent adverse effects on and interference with marine mammals." Under the Marine Mammal Protection Regulations (1992, Regulation No. 322) it is illegal to harass marine mammals - harassment being defined as actions that disrupt significantly, or are likely to disrupt significantly, the normal behaviour patterns of an animal.

It is the responsibility of the Department of Conservation (DOC) to develop guidelines governing tourist activities and ensure that tourist activities do not adversely affect marine mammals, yet of the 14 DOC conservancies, 10 have permitted marine mammal viewing ventures (Constantine 1999) and the impacts of such activities are still poorly known. *A. forsteri* can be viewed by land and boat in the Wellington, Otago and Nelson-Marlborough conservancies and by land in the West Coast, Canterbury, and Southland (which includes Fiordland). The Nelson-Marlborough conservancy has the most commercial operators specifically targeting *A. forsteri* (n = 33) and the area is a popular tourist destination, with the Abel Tasman National Park (~200,000 visitors/annum; S. Houston pers. comm. 1999) and Kaikoura coastline (~365,000 visitors / annum; Simmons *et al*. 2000) standing out as two key tourist destinations. With these numbers of tourists visiting these areas and potentially interacting with *A. forsteri*, it is important to understand the implications of these interactions.

The majority of past tourism studies on seals are based on species of Phocidae (Kovacs and Innes 1990; Lidgard 1996). Although the principles of the seals' responses may be the same, responses may vary greatly between species (Boness and Bowen 1996). Although there are a few studies of the impact of tourism on otariids (eared seals) in New Zealand, most of these have been on small, non-breeding, mainland populations of Hooker's sea lions (*Phocarctos hookeri*) (Heinrich 1995; Wright 1998).

Two studies have focused on the effects of tourism on *A. forsteri* (Barton *et al.* 1998; Shaughnessy *et al.* 1999). The first was a study on land-based tourism at Kaikoura, New Zealand. This study investigated seal responses to tourists and the importance of various sociological factors on people's perceptions of seals. The second investigated the impact of boats on *A. forsteri* at Montague Is., Australia. Our study followed on from this work by focusing on the seals' responses to tourists at popular tourist sites within New Zealand, and encompassed sea and land-based tourism. This paper focuses on the use of controlled approaches as an indicator of tourist disturbance and as a means by which to develop new guidelines for fur seal tourism.

MATERIALS AND METHODS

Three populations of *A. forsteri* were studied: two with high levels of tourist activity, (Abel Tasman National Park and the Kaikoura coastline), and one with no tourist activity, (Whakamoa, Banks Peninsula) over two austral summer seasons (1999 - 2001). We assessed the effects of tourist behaviour on these populations using behavioural observations (focal animal and scan sampling) and experimental approaches (Altmann 1974; Barton et al. 1998).

Study populations

Abel Tasman National Park

The park, located on the north-west coast of the South Island of New Zealand, attracts around 200,000 people annually, many of whom participate in a nature-based tour focusing on *A. forsteri*. Fifteen tour operators are licensed to operate in the park (eight kayak companies, four water taxis, one ferry, one charter boat, and one seal swim) and include viewing or swimming with *A. forsteri* as one of their highlights. There are no regulations to limit the number of trips these groups can make per day. Scenic flights also view *A. forsteri*. *A. forsteri* breed on Tonga Is. (40˚ 53' 25" S 173˚ 04' 05" E), a small triangular shaped island ~800 m off the north-eastern coast of the park, and haul out at several points along the mainland coast along which is a popular tourist walking track. Two sites on the eastern and western sides of Tonga Is. were used for the observations and experiments. The current DOC guidelines operating on Tonga Is. prevent landing and require kayaks to remain at least 10 m from the island, while motor boats must remain 15 m away.

Kaikoura

The Kaikoura coastline, including the Kaikoura Peninsula (42˚ 25' 25" S 173˚ 43' 13" E) runs along the northern portion of the east coast of the South Island, and attracts a large number of tourists for viewing a variety of marine life. Five licensed nature-based tour operators (three swim-with-seals, one guided walk, one kayak-based viewing) specifically target *A. forsteri*. These operators together can potentially make a maximum of 114 trips / week to view and interact with fur seals, although actual visits are more often in the range of 68 - 82 trips / week. There are also several tour operators that primarily target cetaceans, but they often fall back on viewing seals if their primary targets, sperm whales (*Physeter macrocephalus*) and dusky dolphins (*Lagenorhynchus obscurus*), are not

found. From interviews with these operators it was calculated that 133 more visits per week could possibly be made to the seals by boat. Helicopter and fixed-wing viewing trips are not limited and can potentially run a trip every half hour (J. Macphail pers. comm. 1999; D. Armstrong pers. comm. 1999). Although the maximum trip allotments are not always reached, it is possible that commercial operators visit many fur seal concentrations in the Kaikoura region more than a hundred times a week. Tourists can also view fur seals from land without being part of an organised tour.

Arctocephalus forsteri breed at Ohau Point, Lynch's Reef, and Barney's Rock and haul-out along most of the coastline where the terrain is suitable. Five sites were used for the observations and experiments: Ohau Point, Barney's Rock and Lynch's Reef, Shark's Tooth, and the Kaikoura Peninsula car park. At Kaikoura minimum approach distances recommended by DOC are: 10 m by land, 10 m to non-breeding sites by kayak and 20 m to breeding sites by kayak and by motor boat. At both Kaikoura and Abel Tasman National Park aeroplanes and helicopters must maintain an altitude of at least 500 feet above seals; and no more than three vessels are to be within 300 m of a marine mammal at any one point in time; this regulation includes motorboats, aeroplanes, and helicopters, but excludes kayaks.

Whakamoa, Banks Peninsula

Arctocephalus forsteri breeding and haul-out colonies in Whakamoa Bay and Island Bay (43˚ 52' 50" S 172˚ 51' 19" E) were used as control sites. These bays are located on the southern coast of the Banks Peninsula, half way down the east coast of the South Island. No tourist groups visit these areas. Four sub-sites were used for the observations and experiments, three of which were breeding sites while the other was a haul-out.

Baseline data for calculating minimum approach distances

In 85 hr of instantaneous scan sampling data that covered the full daytime cycle and tidal cycles without outside disturbances, fur seals spent about 16.6% ± 1% of their time engaged in active behaviour (Boren 2001). Therefore, if the level of activity increased above the baseline level an external factor may be influencing the fur seals' behaviour. The response distances to controlled and tourist approaches by kayak, boat, and foot were used to calculate minimum response distances, using a baseline of 17% active behaviour. The value was a conservative estimate because that included two sites where the seals were habituated and activity was not likely to change dramatically as a result of a disturbance. Approaches closer than the minimum distances could result in the fur seals modifying their behaviour. Controlled approaches were analysed by type, (land, kayak and motorboat) and by site. Tourist approach data were also analysed by approach type and site. Behaviour responses of seals varied slightly between seasons and appear to depend on the animals' condition and differences in food availability (Boren *et al.* 2001). However, to develop consistent guidelines to account for the levels of natural variability encountered, data from both seasons were pooled.

Controlled approaches

A series of controlled approaches were made varying the approach style (land, kayak or motorboat), while recording the seal's response and the distance at which the seal responded. A total of 3,538 single controlled approaches were carried out (by land, kayak, and boat).

Land-based approaches

A fur seal (target) was selected randomly and may have been single or part of a group. No preference was given to seals in a particular behaviour, although swimming seals were not accessible for the purpose of land approaches. The animal had to be easily accessible, to minimise researcher disturbance at the site, and not have been disturbed by tourists for at least 10 min prior to selection. One person quietly approached the target on foot until it responded or until they felt it was not safe to continue, occasionally these went within the recommended minimum approach distances. Once the seal had responded the approacher moved out of sight.

Before the controlled approach, the age class, sex, and behaviour (using the behavioural categories as defined in Table 1) of the target was recorded. The recorder was positioned as far from the seal as possible while still able to have a clear view of both the approacher and the seal. The distance between the target and approaching person when the seal exhibited signs of being aware of the person (seal first followed the approacher with their eyes), and the distance between the two when the fur seal responded were both estimated. The final response was recorded and ranked according to Table 2. Definitions for ranks were developed based on work by Constantine and Baker (1999). The time the seal took to return to its previous behaviour after the approacher left, and any other factors such as the behaviour of other seals, or any tourist disturbance that may have affected the response of the target were recorded.

Behaviour	Definition
Resting	Lying down with eyes closed or open.
Comfort	Grooming, scratching, shifting position, active thermoregulation including lying in a shallow pool or shade.
Mother/pup interaction	Cow lying on side, pup in oral contact with nipples, also includes body contact i.e., sniffing, caressing etc.
Swimming	Seal mostly submerged in water, diving, loafing included.
Active	Sitting up aware, alert or moving, also included vertical territory display of neck.
Interaction	Interaction with other animal

Table 1. Ethogram used for recording *A. forsteri* behaviour prior to controlled approaches

Response rank	Definition of response rank
Interaction	Non-aggressive movement towards stimulus
Neutral	No apparent response
Change behaviour	Change in behaviour including looking up, becoming alert
Avoidance/aggression	Vocalise, threat, enter water, flee

Table 2. Response ranks used for controlled approaches

Landing is not permitted at Tonga Is. without a permit, for this reason coupled with the high level of tourist activity around the island, only a few seals were approached at this site. Due to the low number of approaches here, the data is not included in Figs 1 and 2, however, data from the site could be statistically analysed in comparison to the other sites using a Chi-squared test of independence.

Sea-based approaches

One person in a kayak approached a target animal until it responded or until the person felt it was not safe to continue. The selection of the target and data recorded during the approach were the same as for land approaches. Boat approaches were carried out with the assistance of the Department of Conservation field offices at Kaikoura, Motueka, and Akaroa. Boat approaches were made by slowly (~5 knots) passing as close (5 - 100 m) as safely possible to the colonies. The criteria for selecting a target and the data recorded during the approach were the same as for land approaches.

Tourist approaches

Observations of any effects of 'tourist traffic' (human or vehicle encounters) on *A. forsteri* behaviour were recorded in the same way as controlled approaches. The type of traffic, distance between traffic and the closest seal, and the response of the animals were recorded and ranked according to the criteria in Table 2.

Data analysis

Data for controlled approaches were analysed using the Chi-square test of independence to test for differences in responses of seals between sites and approach types. A significance probability of $P < 0.005$ was used to reduce the possibility of Type 1 errors due to multiple tests. Minimum approach distances, based on fur seals' responses to distances recorded during the controlled approaches, were calculated by comparing fur seal responses to the average activity level calculated from averaging the activity level of scans from all sites in which there were no extraneous disturbances.

RESULTS

Controlled approaches

Overall, fur seals altered their behaviour most during land approaches (76.6%, $n = 334$ [including Tonga Is.]) and less for boat (36.9%, $n = 935$) and kayak approaches (31.0%, $n = 2,269$). The proportion of seals which changed their behaviour also varied by site, with 70.3% of seals approached ($n = 808$) responding at Whakamoa. In contrast 44.1% ($n = 737$) on the Kaikoura coastline, and only 20.7% of animals ($n = 1,993$) responded at Tonga Is. Chi-squared tests of independence results confirmed that the responses to the different approach types differed significantly between sites ($P < 0.001$ for kayak and boat approaches and $P < 0.005$ for land approaches). There was also a significant difference in response patterns between the three approach types ($P < 0.001$). Responses to different approaches varied between sites. Seals at Whakamoa showed more 'behavioural changes' and 'avoidance/aggression' responses than Kaikoura and Tonga Is. (Figs 1 - 3). No 'interaction' responses were observed during land approaches at any sites. At all sites seals exhibited an 'interaction' response to kayaks, but *A. forsteri* at Tonga Is. were the only seals to exhibit an 'interaction' to boats.

Minimum approach distances

Land approaches

Fur seal response distances to land-based approached in relation to the 17% activity level are shown in Figs

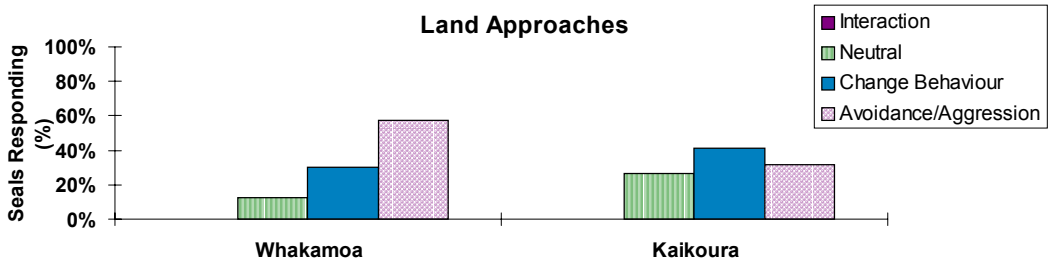

Fig. 1. Response of *A. forsteri* to controlled approaches by land at two study areas from the 1999/00 and 2000/01 summer seasons, Whakamoa $n = 56$ and Kaikoura $n = 265$

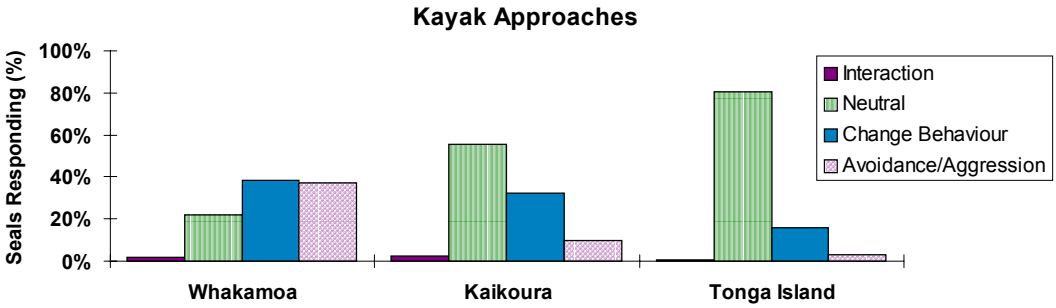

Fig. 2. Response of *A. forsteri* to controlled approaches by kayak at three study areas from 1999/00 and 2000/01 summer seasons, Whakamoa $n = 429$, Kaikoura $n = 131$, Tonga Island $n = 1709$.

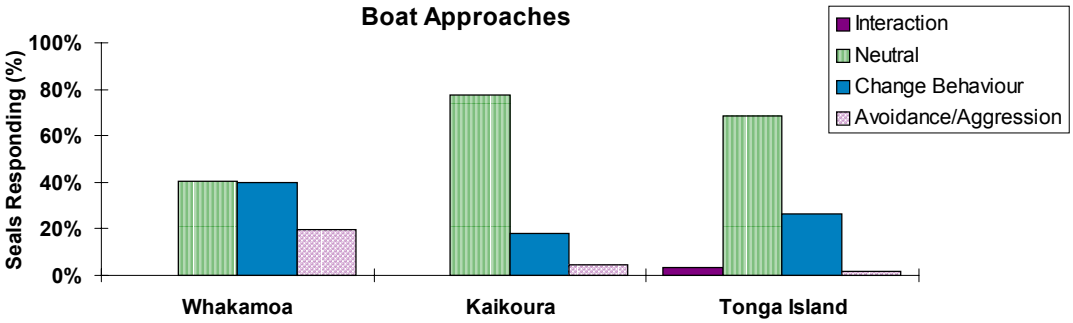

Fig. 3. Response of *A. forsteri* to controlled approaches by motorboat at Whakamoa $n = 323$, Kaikoura $n = 341$, and Tonga Is. $n = 271$.

4 and 5. Data for Tonga Is. and Whakamoa are not included in these figures as there were not enough tourist approaches to make a reliable comparison. Results are shown for Kaikoura coastline sites and are compared with the 'Average Population Activity Level' (APAL) of 17%. The response of *A. forsteri* to controlled approaches on land in both field seasons (1999/00; 2000/01) is shown in Fig. 4. The proportion of active seals went above 17% at 20 - 30 m (29.8%, $n = 265$). In comparison, around 60% of *A. forsteri* responded to controlled approaches at a distance of 10 m, the current DOC guidelines. Traffic data showed that activity levels increased above 17% around 10 - 20 m (26.8%, $n = 1,171$) in comparison with approximately 35% of *A. forsteri* responding at 10 m (Fig. 5)

Kayak approaches

Fur seals' responses from the three study areas to various distances of controlled approaches by kayaks for both seasons are shown in Fig. 6. The proportion of seals that responded went above 17% at 10 - 20 m

(24.2%, *n* = 2,269). Nearly 30% of fur seals, responded to approaches at 10 m, the current minimum approach distance. However, Fig. 7 shows that the percentage of *A. forsteri* that responded to tourist approaches by kayak increased over 17% at 0 - 10 m (26.3%, *n* = 847).

Boat approaches

Seal response distances to boat approaches in relation to the 17% APAL are shown in Figs 8 and 9. Controlled boat approaches (Fig. 8) show 17% or more of *A. forsteri* at the three study areas becoming active at 20 - 30 m (27.6%, *n* = 935). A range of minimum approach distances for boats are currently operating around the South Island; and at least 30% of fur seals are responding to controlled approaches at the most conservative of current minimum approach distances (20 m). No tour boat traffic triggered the 17% cut off (12.2%, *n* = 1,928) (Fig. 9).

DISCUSSION

Analyses of our experimental data indicate that *A. forsteri* responses to tourist disturbance are highly variable. This agrees with previous studies on phocid (Kovacs and Innes 1990; Lidgard 1996; Young 1998; Born *et al.* 1999; Suryan and Harvey 1999) and otariid seals (Barton *et al*. 1998), as well as cetaceans (Richardson and Würsig 1997; Constantine and Baker 1999) and some bird species (Kazmeirow 1996). Within this natural variation, characteristics

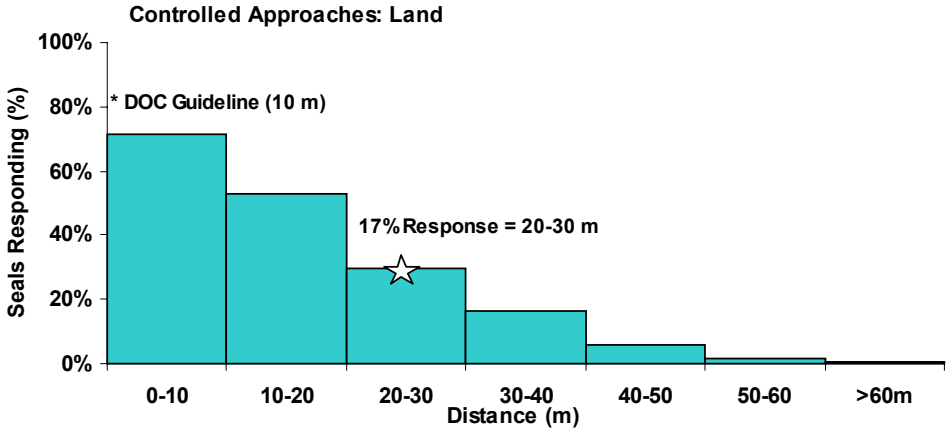

Fig. 4. Cumulative response of *A. forsteri* on the Kaikoura coast to controlled approaches by land in comparison with the Average Population Activity Level (APAL). The distance at which the response of fur seals increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, *n* = 256.

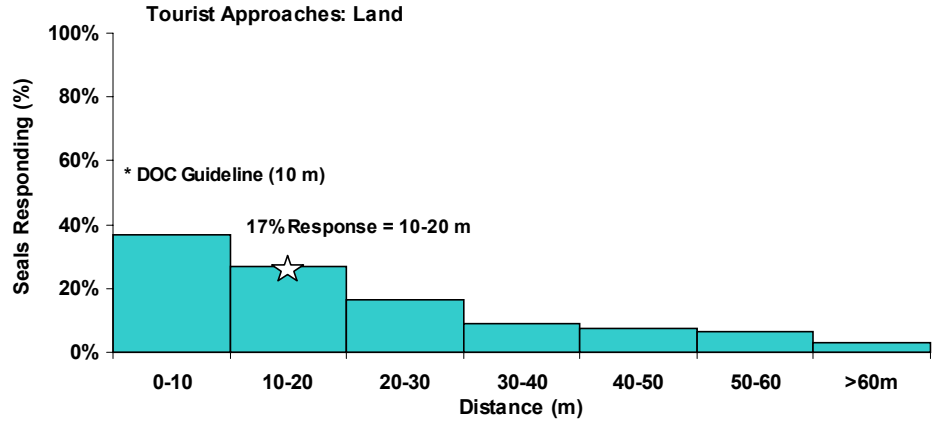

Fig. 5. Cumulative response of *A. forsteri* on the Kaikoura coast to tourist approaches by land in comparison with the Average Population Activity Level (APAL). The distance at which the response of *A. forsteri* increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, *n* = 1,171.

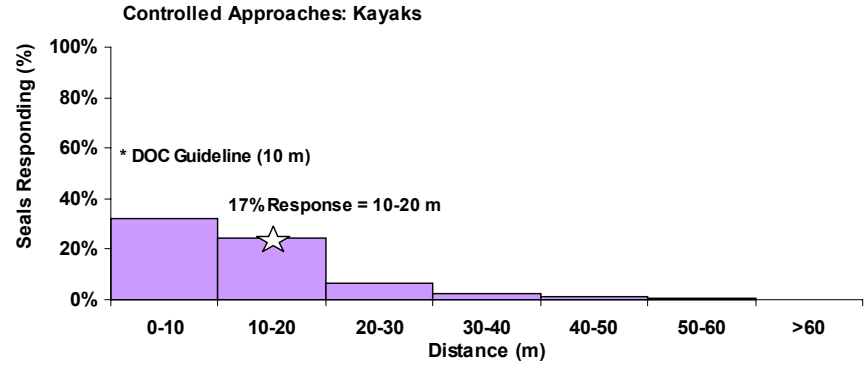

Fig. 6. Cumulative response of *A. forsteri* at all study areas to controlled approaches by kayak in comparison with the Average Population Activity Level (APAL). The distance at which the response of *A. forsteri* increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, $n = 2{,}269$.

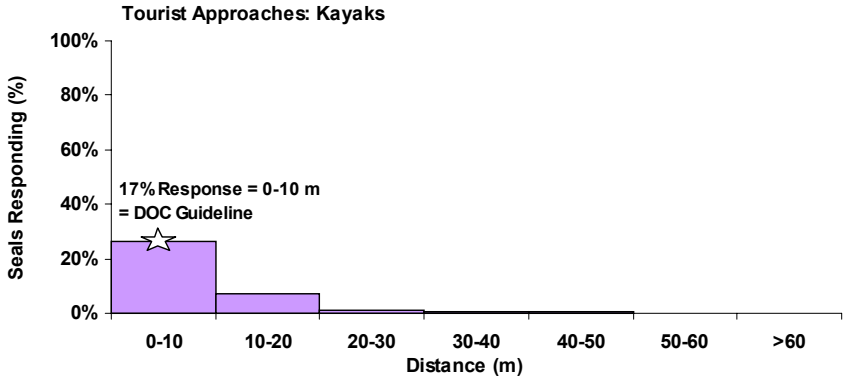

Fig. 7. Cumulative response of *A. forsteri* at Tonga Island and the Kaikoura coastline to tourist approaches by kayak in comparison with the Average Population Activity Level (APAL). The distance at which the response of *A. forsteri* increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, $n = 847$.

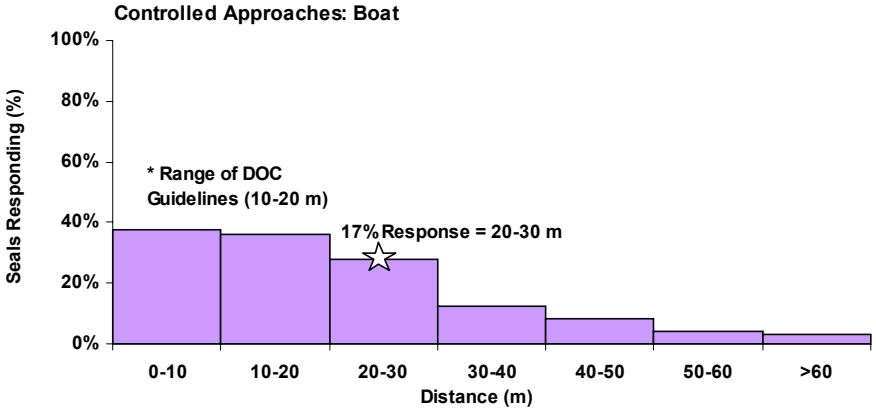

Fig. 8. Cumulative response of *A. forsteri* at all study areas to controlled approaches by motor boat in comparison with the Average Population Activity Level (APAL). The distance at which the response of *A. forsteri* increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, $n = 935$.

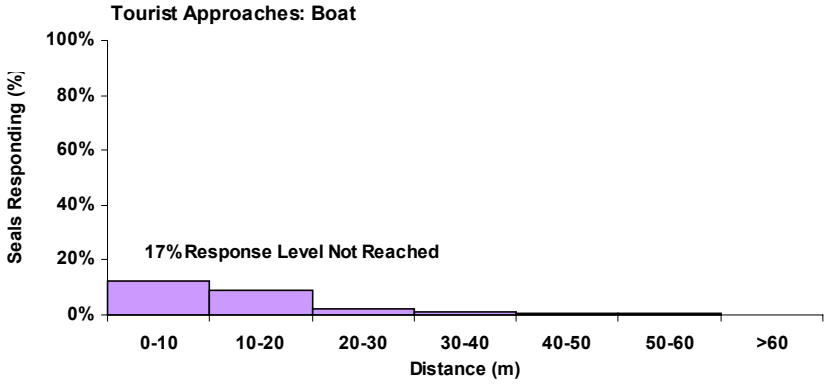

Fig. 9. Cumulative response of *A. forsteri* at Tonga Island and the Kaikoura coastline to tourist approaches by motor boat in comparison with the Average Population Activity Level (APAL). The distance at which the response of *A. forsteri* increases above the APAL is shown with a star, and the response of *A. forsteri* to approaches at the current minimum approach distance is included for reference, n = 1,928.

specific to an animal and factors specific to a site will influence how a fur seal responds to human activity. The four most important factors being; function of the site (breeding vs. haul-out), gender, previous exposure to the stimulus and approach type.

Site function is determined by the population structure: mainly cows and young animals at breeding colonies; and mainly bulls and SAM's on haul-outs. The age and sex of an animal was a good predictor of how a seal would respond to a stimulus it perceived as threatening. Cows typically enter the sea, males typically stay and fight, while pups run and hide. The differences result mainly from seal social organisation and the different mating strategies of males and females (Riedman 1990). Within a typical *A. forsteri* breeding colony, dominant bulls stake out territories where they defend either females or resources that females depend on (Riedman 1990). Bulls expend considerable time and energy in obtaining and defending a territory and typically hold territories for only a very small part of their reproductive life. With more at stake, bulls are likely to stand their ground when disturbed by an intruder. In contrast, cows and pups are smaller and submissive, have no specific investment in any given site, and are more likely to flee. If they can avoid danger, they are more likely to survive and reproduce. Therefore, the impact of disturbance at a breeding colony is predicted to be greater than that on a haul-out as a result of this age-sex difference in behaviour.

The stage in the breeding cycle can also influence the response to disturbance. While a bull is actively guarding his territory, especially during pupping and mating (late November to mid-January), he will react faster and more aggressively to disturbance. Cows are also more sensitive at this time, they are under stress from pupping, from the attention of the bull, and from competing with other cows for the best breeding and haul-out spots. Disturbance on a colony during the pupping-mating season has greater consequences for the breeding population than at any other time of the year. *A. forsteri* fleeing from disturbance in a breeding colony have been known to cause mortality to young through trampling (Mattlin 1978).

A seal's response to disturbance was also influenced by its behaviour prior to the disturbance. If seals were sleeping prior to the approach, the chances of them not responding were higher, many stayed asleep. The animals that did wake and become aware of the approacher typically responded instantly with avoidance behaviour. Where an individual was active prior to the approach it would watch the approacher for longer before responding.

While the age/gender of *A. forsteri*, the type of colony and time in breeding season will affect how an individual responds, previous exposure to tourist activity appeared to be the most important factor in determining whether or not a seal was likely to respond at all. *A. forsteri* at study areas experiencing high levels of tourism (Tonga Is. and Kaikoura coastline) respond less, often respond less dramatically and respond at closer distances than seals at the control site (Whakamoa, Banks Peninsula), which is rarely visited by people (Figs 1 - 3). Our controlled approaches indicated that previous exposure to a specific type of approach was the major factor regulating how *A. forsteri* responded. For example the high number of neutral responses (~80%) exhibited at Tonga Is. to kayaks in comparison to other sites is most likely explained by

a degree of habituation due to a high level of exposure to kayaks.

Some variability in the level of habituation within a site was detected and this may relate to the fact that some animals are more habituated than others. At some of the study sites at Kaikoura and at Tonga Is. during approaches 'non-residents' (transient animals) moved into the sea when the approach was detected whereas, recognisable 'resident' animals remained unmoved. Presumably, the non-resident animals were not used to human disturbance. This phenomenon was also observed in a study on sperm whales (*Physeter macrocephalus*) off the coast of Kaikoura, where the animals fell into two distinct groups of 'residents' and 'non-residents' (Gordon *et al*. 1992)

Habituation can reduce the stress of an individual and therefore the animal can conserve energy by not responding to stimuli perceived as non-threatening (Groves and Thompson 1970). Habituation is, however, a behavioural modification and in the long-term habituation may degrade the long-term survival of the species. Habituation to human activity may result in *A. forsteri* becoming too trusting of humans and not responding appropriately when necessary (Edington and Edington 1986) and where habituation has been documented in a number of eco-tourism studies new or unnatural behaviours have been observed, for example biting and begging in bottlenose dolphins (*Tursiops truncatus)* (Connor and Smolker 1985). Only long-term monitoring will indicate the biological effect of habituation on a species.

Land approaches appeared to affect *A. forsteri* more than other approach types. Only a few seals exhibited 'neutral' responses at Whakamoa, none exhibited 'neutral' responses at Tonga Is. 'Behavioural changes' and 'avoidance/aggression' responses were lowest at Kaikoura (Figs 1- 3), most likely because the seals present had become habituated by the large amount of land traffic that they are exposed to at this location. Tonga Is. is also a high density breeding colony. Both factors result in a large disturbance when someone does land, as was seen from the behaviour of the few individuals approached, the traffic observations, and the response of *A. forsteri* during the mark-recapture experiment (Boren 2001). 'Avoidance/aggression' responses were highest at the control site, which has few visitors (Figs 1 - 3).

Overall, seals changed their behaviour less in response to kayak and boat approaches than to land approaches. This may again be related to the perception of threat. *A. forsteri* are excellent swimmers, but on land they move less efficiently, so when approached by land they may respond more quickly or at a greater distance from intruders to give themselves a greater safety margin. Unlike land approaches, kayak approaches elicited an 'interactive' response at all sites where the seal followed or approached the kayak, apparently out of curiosity. This was probably related to the previous behaviour of the animal; only seals already swimming would move towards the kayak. The high number of 'neutral' responses exhibited by seals at Tonga Is. to kayaks is probably explained by a degree of habituation. In contrast, kayakers are novel to *A. forsteri* at Whakamoa and approaches at Whakamoa elicited many 'avoidance/aggression' responses. *A. forsteri* at Kaikoura showed an intermediate change in activity level in response to kayaks — 9.9% of the seals avoided the kayak, and 32.1% changed their behaviour when approached. Only one company operates kayak tours in Kaikoura and this has only been running for two years, so for many animals at Kaikoura, kayaks are still novel. These results suggest that previous exposure to a stimulus such as kayaks may eventually lead to habituation.

Arctocephalus forsteri at some sites around the Kaikoura coastline itself are potentially habituated to boats. For example, at Barney's Rock and Lynch's Reef not only tourist boats but also private and fishing boats visit almost daily. *A. forsteri* at Ohau Point, however are visited only sporadically from a few fishing vessels and these seals did not show the levels of habituation seen at other sites (Boren 2001). *A. forsteri* at Tonga Is. also responded little to boat approaches. The results from 'traffic' observations were quite similar to the approach data. This suggests that *A. forsteri* at this site are already habituated and continued tourist traffic will ensure that younger animals and new arrivals become accustomed to the presence of boats.

Minimum approach distances

Our data have demonstrated that while seals display variability in their response, there are some key indicators as to how an animal will respond to disturbance such as, age, sex, stage in breeding cycle, location, degree of exposure, and type of disturbance. It is not practical to devise guidelines that vary depending on the age or gender of the fur seal to be approached, as these would require the public to be able to determine the gender of a seal, or at the very least the type of site (breeding vs. haul-out). More general, precautionary guidelines are required, which allow for variability in *A. forsteri* behaviour and that take into consideration non-habituated/naïve animals, not just for those animals that have developed some degree of tolerance to human disturbance.

Conclusions

Our results suggest that the current minimum approach distances in operation are ineffective (Figs 4 - 9) in that high proportions of *A. forsteri* are still responding to approaches at these distances. Results from tourist traffic showed that *A. forsteri* responded at Kaikoura and Tonga Is. at closer distances than during the controlled approaches. The controlled approach data included three sites with varying degrees of previous exposure to tourists, whereas the 'traffic' results were obtained from only the two sites, Kaikoura and Tonga Is., which receive considerable tourist traffic. This again supports the idea that *A. forsteri* are habituated at these tourist locations. These results reinforce the conclusion that distance must be based on information from sites with differing degrees of tourist activity. There are several coastal areas, where tourists might find *A. forsteri*, where there is no established form of tourism and no way to monitor tourists' behaviour around the seals. Minimum approach distances need to be precautionary in order to encompass all *A. forsteri* colonies that may be exposed to human disturbances. Although distances cannot always be enforced, having precautionary, consistent distances will allow DOC staff to more easily enforce the regulations

The sites at which the controlled approach experiments described here were performed include a site at which seals were non-habituated and therefore better represent *A. forsteri* populations around the country. From these data a minimum approach distance of 30 m is recommended for land approaches, 20 m for kayak approaches and 30 m for boat approaches. Based on the responses of cows and pups, and the importance of the function of a breeding colony, it is important to keep disturbance at breeding colonies to a minimum. Therefore, it is recommended that no land-based tourism activities be permitted in breeding colonies.

As this study is one of the first to investigate the impact of tourism on *A. forsteri*, it has investigated several aspects of tourist approaches rather than focusing on any smaller portion. While data were collected on function of site (breeding vs. haul-out), gender, and previous behaviour of the targets, there is not enough replication to look at each site on its own. To investigate further the effects of these factors on seals' response, sites would need to be combined and the previous exposure to tourists is a confounding factor. Although all factors are important for understanding seal responses to tourists, it is not practical to base guidelines on each of these factors. Prior exposure appears to be the strongest in determining a seals' response and mechanisms that control this factor are the least understood, therefore, this study has chosen to focus on this aspect. Future study could be carried out to further explore the other factors. For the purpose of this study, however, to develop precautionary and more manageable guidelines, certain factors were pooled for general results (age/gender, sub-site function, and prior behaviour), and finally the three major study areas were pooled for calculating minimum approach distances. As only *A. forsteri* was studied, different factors will need to be taken into account for different species. For all seal species the following aspects need to be considered; distance must be based on lack of disturbance of target species and safety of tourists, regulations need to be consistent between tour operators as well as locations, which enables easier enforcement, and minimum approach distances need to be precautionary and therefore encompass all possible variation in approaches; such distances will better protect seals that are easily accessible to humans but not near popular tourist destinations.

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