Best practice techniques for monitoring the fur seal haul-out site at Steamers Head, NSW, Australia

Alex Burleigh[1], Tim Lynch[2*] & Tracey Rogers[1]

[1]Australian Marine Mammal Research Centre, PO Box 20, Mosman, NSW 2088, Australia.

[2]Jervis Bay Marine Park. Huskisson, 2540, NSW, Australia.

*__Corresponding author__

CSIRO, GPO Box 1538, HOBART TAS 7001

tim.lynch@csiro.au

ABSTRACT

Several techniques were trialed for monitoring the newly-established fur seal haul-out site at Steamers Head, NSW. In order to minimise our impact, we also monitored for any disturbance to seals from our sampling. The site is unusual as while it can only be observed by boat seals perch on a steep collection of ledges, which means that regardless of their thigmotatic nature, counts can be made of seals from a distance on the horizontal plain. Counts were performed using three methods and at four distances. The three methods trialed were direct counts through binoculars, counts from video footage and counts from projected photographs. Originally, four distances from the haul-out were determined with a laser rangefinder as 150 metres, 100 metres, 75 metres and 50 metres. Disturbance was ranked and recorded, which led us to quickly abandon our 50 metre observation distance. Both binoculars and video techniques were reliable methods for counts of all seals, however; only the binocular technique was reliable for identification of different species and age groups. Counts from photographs were unreliable. Counts through binocular are recommended for long term monitoring as they provide, overall, the most accurate counts of different age classes and a precise repeatable measure. Also, unlike the other methods, binocular counts do not require post-field processing. Monitoring of our disturbance to the seals tentatively found that hauled seals were more easily disturbed when the boat was closer to the haul-out. Disturbance occurred at greater distances as the haul-out seasonally expanded in numbers. We recommend, for this haul-out, that to perform counts unbiased by the impact of observations, researchers must remain at least 75 metres from the haul-out when there are fewer than 50 seals, and at least 100 metres when there are 50 or more seals.

Key words: fur seal, sampling methods, disturbance

Introduction

Australian fur seals *Arctocephalus pusillus doriferus*, and New Zealand fur seals *Arctocephalus forsteri*, are found around the southern coast of Australia. Due to exploitation throughout the 19th and 20th centuries, fur seal numbers in Australia declined, colonies were abandoned and the population retreated south. As a result of legislation for their protection, fur seals numbers have increased over the last sixty years and seals are now found further north along Australia's east coast. One recently occupied non-breeding seasonal haul-out is at Steamers Head south of Jervis Bay.

Steamers Head is the most northern haul-out regularly used by fur seals on the Australian East Coast (see Burleigh *et al.* 2008). In this paper we report on the census techniques developed to describe and monitor the haul-out. The environment at Steamers Head is not conducive to seal monitoring. Located at the base of a massive overhanging sea cliff, the haul-out is inaccessible from the shore. The overhang develops into a cave, which makes commonly used aerial surveys (e.g. Baker and Johanos 2004) impossible. Also, as the overhang faces south, the haul-out is not visible from any land vantage point. This means that the only practical method for monitoring is from a boat.

To track seal numbers through time, which is a long-term objective of our funding bodies, we needed to develop a precise and standardised technique. There are many different established techniques for monitoring seal colonies. These include both total counts and various forms of sampling such as line and strip transects, indices and mark-recapture (Shaughnessy 1999). All census techniques are, however, thought to produce underestimates of numbers, irrespective of how careful the observations (González *et al.* 1997).

We rejected: a total count of population, capture-mark-recapture techniques (e.g. Pemberton and Kirkwood 1994; Shaughnessy 1999) or extrapolation from sample, strip and line counts (e.g. Southwell 2005). This was because seals were hidden in a cave and the survey area was small and discrete, making it difficult to define from the boat whether an animal was within the strip. As well, there was a high risk of disturbing the haul-out if capture was attempted. Capture-mark-recapture can also be inaccurate due to unequal mixing (Pemberton and Kirkwood 1994), which had implications for the Steamers Head haul-out as it is for non-breeding seals (Burleigh *et al.* 2008) and close to another seasonal

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haul-out at Montague Island (Shaughnessy 1999), meaning immigrations and emigrations of fur seals would probably occur. We also rejected this technique due to the danger presented - both to seals and researchers - by the steepness of the site. Rather, after careful consideration, we chose index counts, where a sample count of a proportion of the population is undertaken. Index counts can be used to create a time-series of the population for spatial and temporal comparisons or as a measure of minimum numbers (González *et al.* 1997) and have been used on a number of species such as: Australian and New Zealand fur seals (Brothers and Pemberton 1990; Shaughnessy *et al.* 1994; Stamation *et al.* 1997), monk seals (González *et al.* 1997), sea lions (Dennis and Shaughnessy 1996) and Weddell seals (Lake *et al.* 1997).

Index counts of New Zealand fur seals showed that counts can vary due to weather, sea state, visibility, terrain, time of day, season, and the distance between the observer and the subject being observed (Bradshaw *et al.* 1999). As precision is needed for temporal comparisons, index counts need to be standardised, i.e. counts are undertaken under the same conditions and at the same time (see Burleigh *et al.* 2008 in this volume for a discussion of environmental variables). The two most common procedures are counts from photographs and direct binocular counts. Photographic counts are usually performed from aircraft or a high vantage point (Pearse 1978; Pemberton and Kirkwood 1994; Stamation *et al.* 1997) and generally give lower counts and higher standard errors than direct binocular counts (Pemberton and Kirkwood 1994). The main disadvantages of photographic counts are when animals are hidden in caves and cracks or when they are clumped, as this makes identification of individuals difficult. In comparison, the main problem encountered with direct binocular counts is that they are usually conducted horizontal to the haul-out, hence animals can block the observer from viewing other animals. As the Steamers head haul-out is located on a steep, stepped, cliff, counts from a horizontal position do not suffer from the same blocking issues that occur at flat sites. We also trialed another, less well-established technique; digital video photography.

When determining which technique was most useful, we were also aware that our observations could affect the study species. Australian fur seals are known to stampede in response to novel visual or odour stimulus (Kirkwood *et al.* 2002). Additional to animal welfare issues, an understanding of a minimum approach distance is vital for the integrity of the technique as our index counts only included those animals that had hauled out. However, we would like to stress that our study was not specifically designed to investigate disturbance to seals, rather we monitored our impact as part of our permitting requirement, taking advantage of recent technological advances in the availability and ease of use of cheap, laser range finders to accurately and precisely determine our distance from the haul-out. The primary aim of our disturbance monitoring was to minimise negative interactions with the seals while undertaking our main task of developing an appropriate census technique.

Our study therefore had two aims, 1) identifying the most appropriate procedures to make index counts of the fur seal haul-out, taking into account approach distance, data collection method, and inter-observer variation, and 2) to provide guidelines for approach distance to the Steamers haul-out by boats when undertaking these surveys to avoid seal stampedes and to provide unbiased estimates.

Materials and methods

Study site

Steamers Head is located approximately 6 km south of Jervis Bay on the NSW south coast (see Figure 1 Burleigh *et al.* 2008). Seals hauled out at this site onto three rock platforms and an adjacent cave. The site is unusual as seals perch on a steep collection of ledges (Plate 1-7). This means that regardless of their thigmotatic nature, counts can be made of seals from a distance on the horizontal plain. Seals enter the water at the site where the water depth quickly drops to below 30 m.

Sampling Schedule

Three data collection methods were trailed: on site counts through binoculars, 35 mm slide photos and video footage – in the last two cases counts occurred back at the laboratory. All methods were undertaken at four approach distances: 150 m, 100 m, 75 m and 50 m from the main rock platform (Figure 1 Burleigh *et al.* 2008). When approaching the haul-out, the boat moved at a speed of 4 knots and the distance was continually measured using a laser range finder (Ranging Bushnell Lytespeed 400). The effect of environmental variables on seal counts was considered by Burleigh *et al.* (2008). Though we note that, because of the steepness and depth off the site, some variables, such as tides, had little impact on either the availability of haul-out positions for seals or the distance from the site by observers.

Observers were trained in the identification of the fur seals by species and age groups (see Table 1 Burleigh *et al.* 2008) by viewing photographs, video footage and observation of live fur seals at Taronga Zoo, Mosman, NSW. During counts, observers had access to information sheets for reference.

Three observers made counts through 7x50 power Tasco binoculars. One observer with an SLR camera and a 50 mm lens took two 35 mm photographs (200 ASA slide film) at each of the four distances from the haul-out. We used slides rather than digital photography as, for a reasonable price at the time of the study, slides provided much higher relative pixilation and hence higher clarity when enlarged than did digital photographs. In the laboratory, we projected and enlarged the photographs onto a screen. Three observers made counts from the clearer of the two enlarged images. Video footage was recorded at each of the four distances from the haul-out using a Digital Sony super steady shot video Hi8 Handycam with 210 x digital zoom, 21 x optical zoom and Hi-Fi Stereo (model CCD-TR3400E). The camera operator slowly panned across the haul-out at full zoom spending approximately 10 seconds per group of fur seals. In the lab, counts were made by three observers, from footage replayed on a television. In all cases care was taken so that observer counts were independent of each other.

Comparisons were made among and within the three data collection methods and the four distances for counts of all seals, the number of New Zealand fur seals, the number of Australian fur seals and the number in each age class, which included adults, sub-adults and juveniles.

Disturbance Levels

Disturbance to the haul-out from our observations was monitored to minimise our impact on the seals and to establish our approach limits to the haul-out. Disturbance was ranked by a change in the seals' behaviour, i.e. degree of movement, change in specific behaviours or seals leaving the cliff to enter the water. Disturbance was categorised into three ranks (Table 1) and measured at each distance: 150, 100, 75 and 50 metres.

If disturbance rank 1 occurred, the distance from the haul-out was measured and the boat moved away. If disturbance rank 2 occurred, the distance was measured, the boat moved away and all subsequent counts for that day were cancelled. Counts with disturbance rank 2 were not included in our census analyses.

Table 1. Categorisation of disturbance levels for hauled out seals

Rank	Disturbance Level
0	No change in general behaviour
1	Groups (>3) of seals lift heads
2	Groups (>3) of seals enter water at the one time

Statistical Analyses

Repeatability

Repeatability (see Equation 1), also known as the Intraclass Correlation Coefficient, is a measure between 0 and 1 that shows how alike repeated measurements are of the same counts (Krebs 1999). If the measurements are perfectly repeatable, the value will be 1.

Equation 1.

$$R = \frac{S_A^2}{S_E^2 + S_A^2}$$

where R = Repeatability
S_A^2 = Variance among counts
S_E^2 = Variance within counts

The variance components were obtained by Equations 2 and 3.

Equations 2 and 3.

$$S_E^2 = MS_E$$

$$S_A^2 = \frac{MS_A - MS_E}{n_0}$$

MS_A = Mean square amoung counts (from one-way ANOVA)
MS_E = Mean square between counts (from one-way ANOVA)
n_0 = Effective average number of replicates per count

The effective average number of replicates (n_0) was obtained using equation 4.

Equations 4.

$$n_0 = \frac{1}{a-1}\left(\sum n_i - \frac{\sum n_i^2}{\sum n_i}\right)$$

where a = Number of counts being measured repeatedly
n_i = Number of repeated measurements made on i

Confidence intervals were obtained using Equation 5.

Equations 5.

$$RCI = 1.0 - \frac{n_0 MS_E F}{MS_A + MS_E (n_0 - 1)(F)}$$

where F upper limits = Value from F-table for $\alpha/2$ level of confidence
F lower limits = Value from F-table for $(1-\alpha/2)$ level of confidence

Agreement

A method may be repeatable, but may not necessarily agree with the true value. As the true number of seals can never be determined with methods available to us, it is important to see which methods internally agree the best. Agreement tests how well two methods correspond with each other. Agreement between each method and distance was determined by plotting the differences between the counts against the average of the counts (Bland and Altman 1986). If the scatter of the differences did not increase as the mean increased, the limits of agreement were able to be determined. If the range of the limits of agreement (Equation 6) was less than 40, the methods sufficiently agreed.

Equations 6.

Limit of agreement = $\bar{d} \pm 1.96s$

where $\bar{d}$ = mean difference between methods
s = standard deviation of differences

Alternatively, if the scatter of differences increased as the means increased, then the differences of the logs of the counts were plotted against their means. The antilog of the mean difference and limits of agreement of the logged methods was taken. This represented the multiple of the count of the second method needed to arrive at the value of the first method. In this case the range of the limits of agreement was less than 0.4, the methods agreed sufficiently.

We plotted counts of disturbance by number of samples against time of day, and distance to the haul-out. We divided these measures into three groups of <50 seals, 50-90 seals and >90 seals. The three-dimensional maps we produced are probability distributions for all sampling undertaken with the darkest red indicating a significant likelihood (>95%) that seals will be disturbed.

Results

Haul-out Censuses

A total of 59 counts were performed between January and October 1999. After our approaches in the research boat disturbed (to level 2) seals at the haul-out on several occasions during counts at 50 metres, data collection at this distance was abandoned. Seal numbers were variable over the months studied, and peaked in September with 135 animals observed to haul-out (see Burleigh *et al*., 2008 for more detail on seasonal variation in haul-out numbers).

Repeatability

Counts of all seals observed

For counts of all seals at 150 metres, video was the most repeatable method, followed by counts through binoculars, and then photographs (Figure 1). At 100 metres, the binocular and video methods had equal repeatability, and photographs had lower repeatability, while at 75 metres, the binocular and video counts were the most repeatable, with slide photography counts less repeatable than binocular counts. Similar results were found for Australian fur seals, although in this case there was no significant difference between the repeatability of binocular and slide counts at 150 m (Figure 2a). Results were markedly different for New Zealand fur seals (Figure 2b) with the binocular counts being the most repeatable method only.

For adult Australian fur seals (Figure 3a), binocular counts at both 75 and 150 metres were the most repeatable method. The repeatability of the slide method was low, and declined to zero with increasing distance from the haul out. For sub-adults, repeatability was generally high for all methods over each distance, though binocular counts had higher repeatability than video counts at both 75 m and 100 m (Figure 3b). For juveniles, binocular and slide counts had the best repeatability though this was lower than for other age classes, slides were again of low repeatability (Figure 3c).

Agreement

As binocular counts at 75 m had the highest repeatability (R=0.96) (Fig 1-3), all methods were compared to this technique and distance to test for agreement (Table 2). Binocular counts at 100 m, and video counts at 100 m and 75 m best agreed with binocular counts at 75 m. Counts from slides at 150 m, 75 m and 50 m and counts from binocular observations or from video at 150 m did not agree well with binocular counts at 75 m.

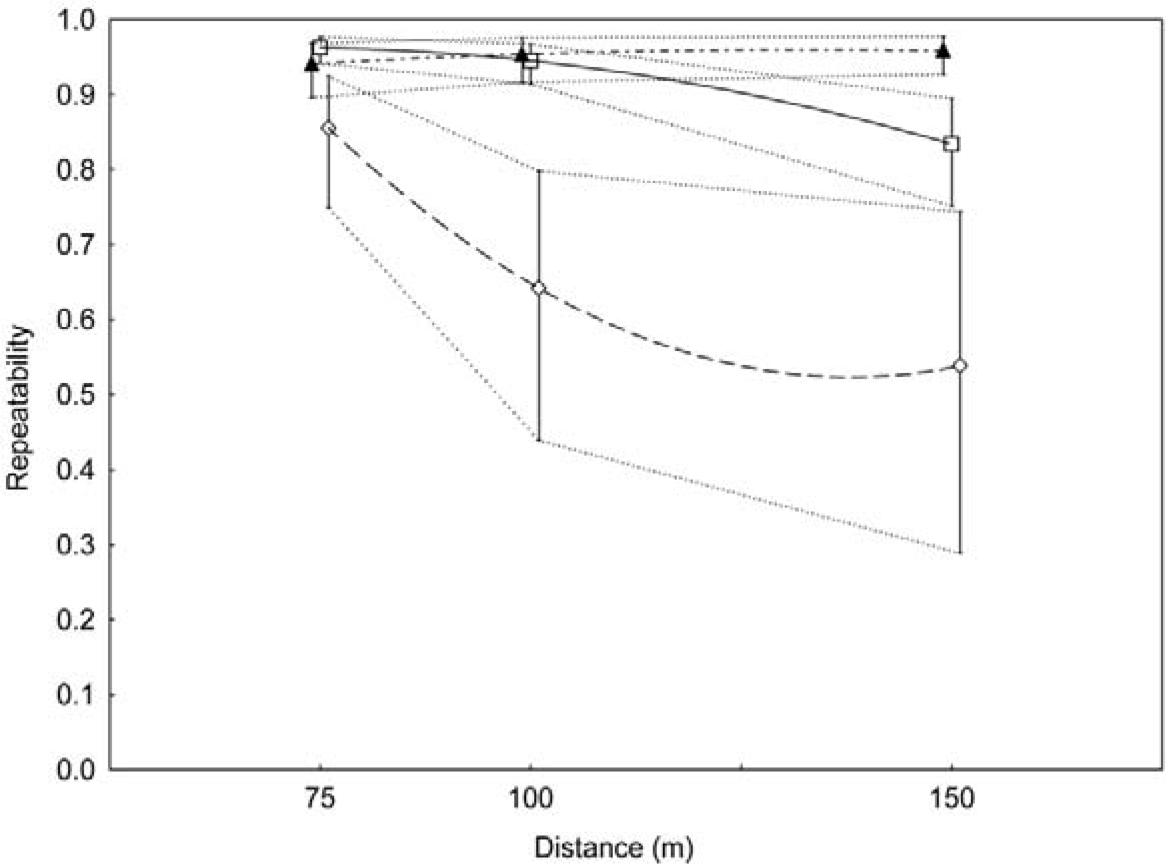
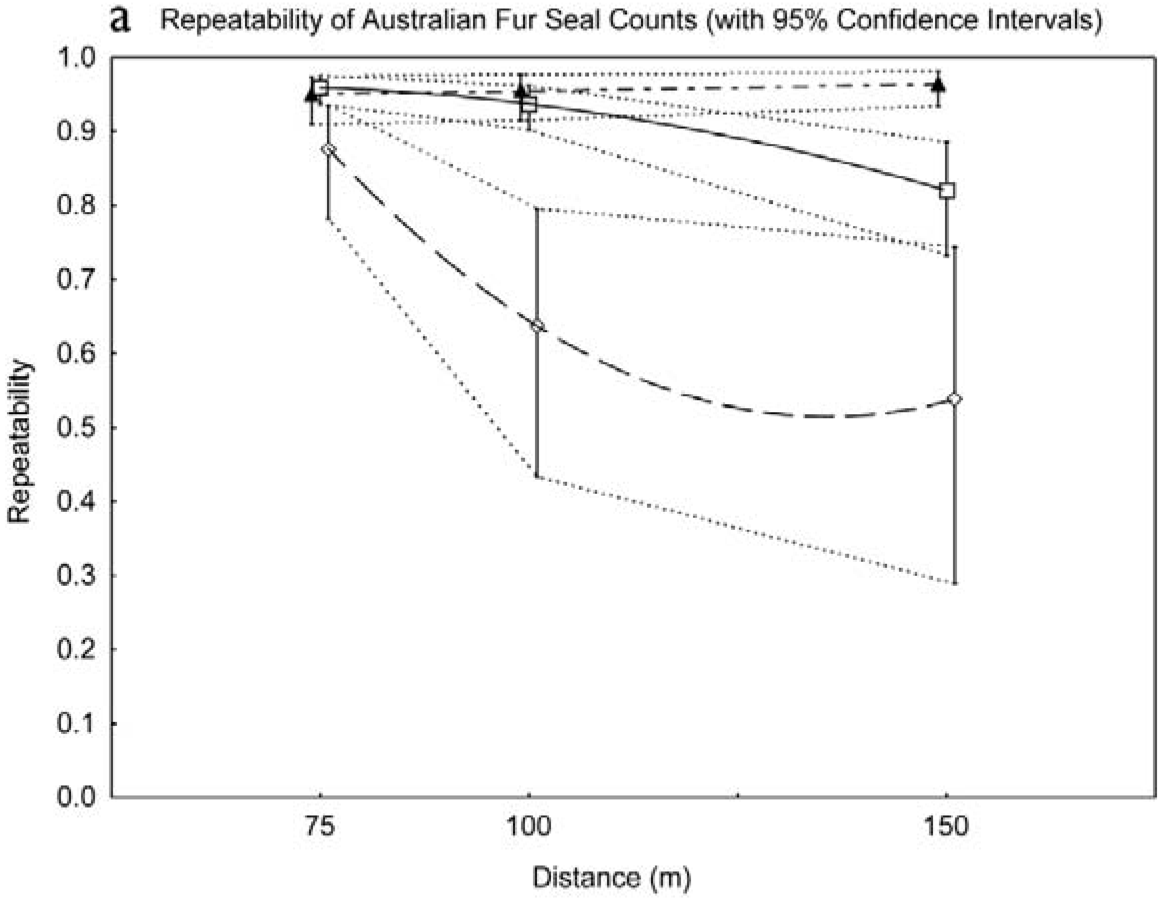


Figure 1. Repeatability for counts of all fur seals with 95% confidence limits. Squares are counts through binoculars, triangles from video footage and diamonds from slide photography.



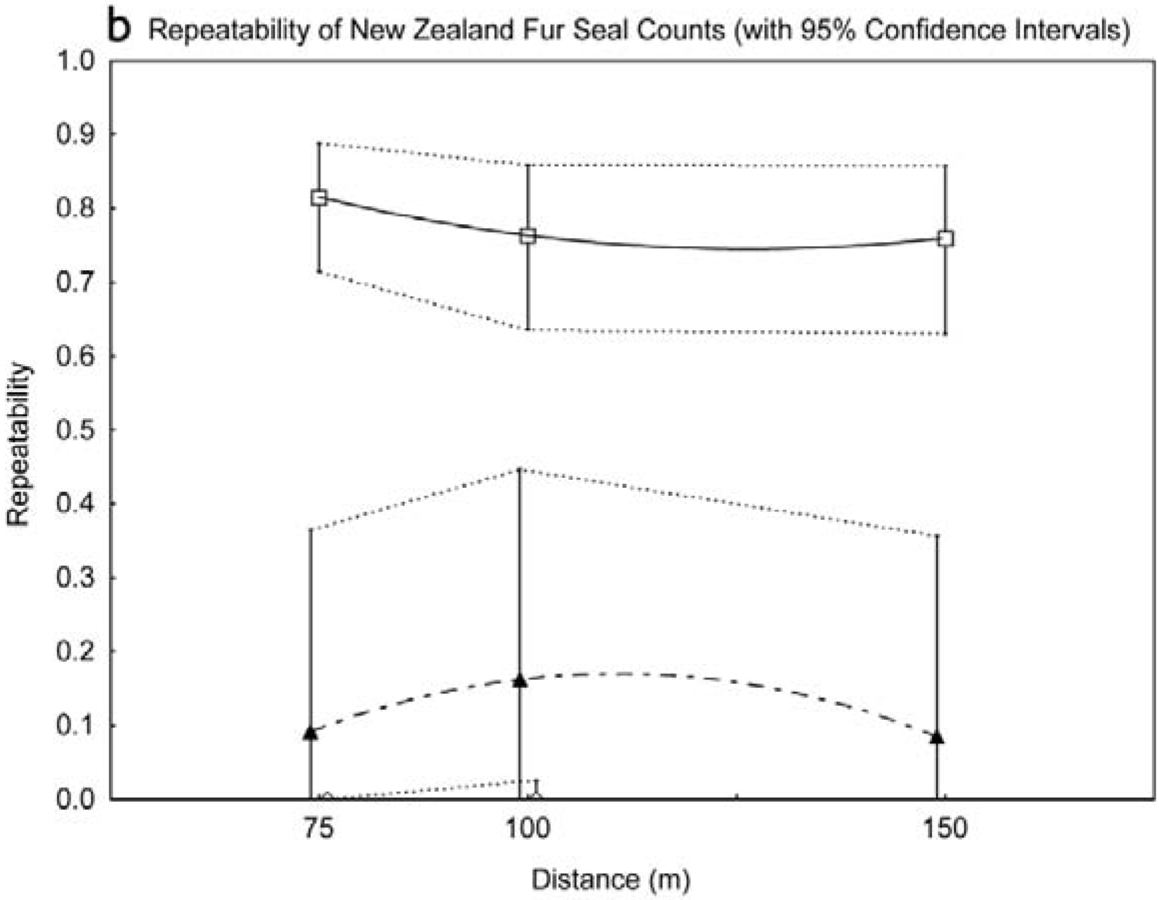
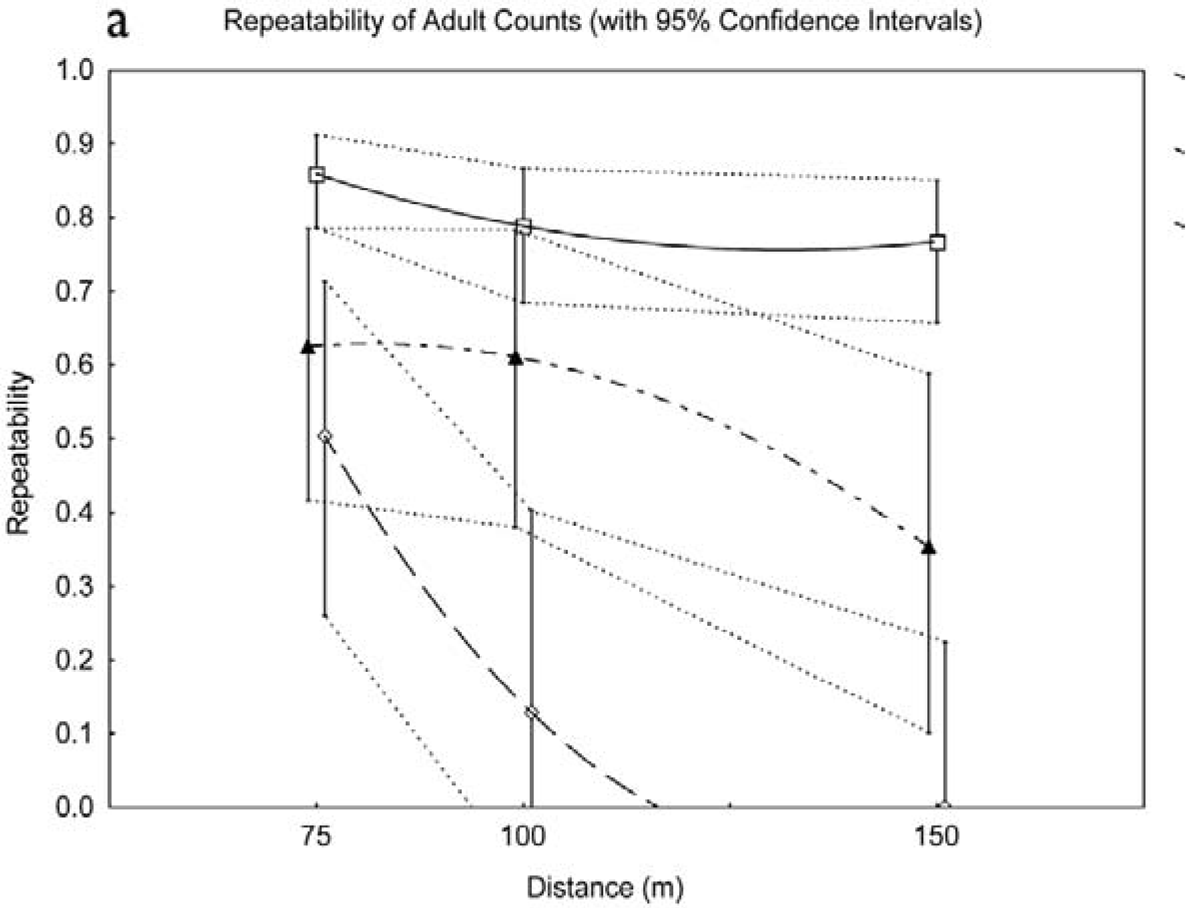
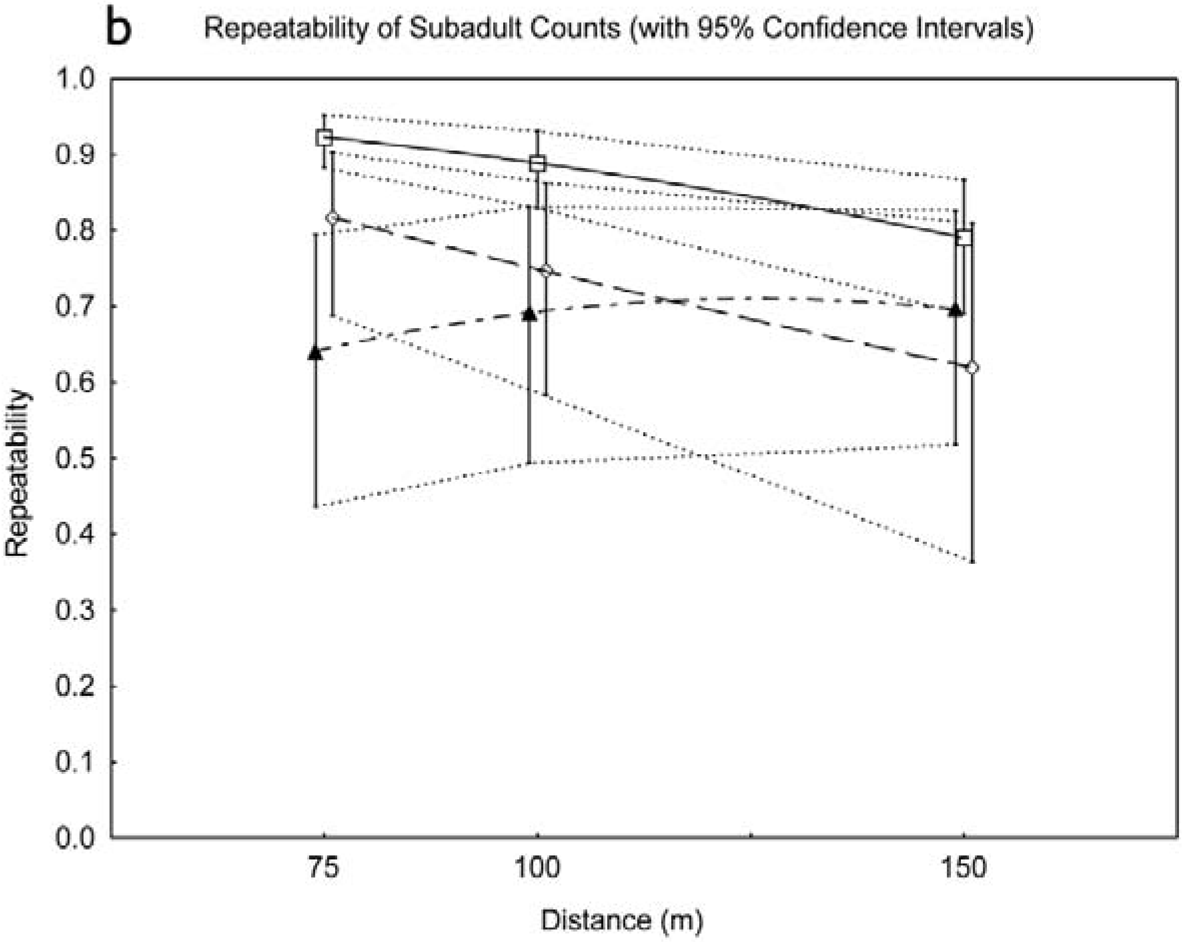


Figure 2. Repeatability for counts of a) Australian and b) New Zealand fur seals with 95% confidence limits. Squares are counts through binoculars, triangles from video footage and diamonds from slides.

a


Repeatability of Adult Counts (with 95% Confidence Intervals)
Repeatability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
75
100
150
Distance (m)

b


Repeatability of Subadult Counts (with 95% Confidence Intervals)
Repeatability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
75
100
150
Distance (m)

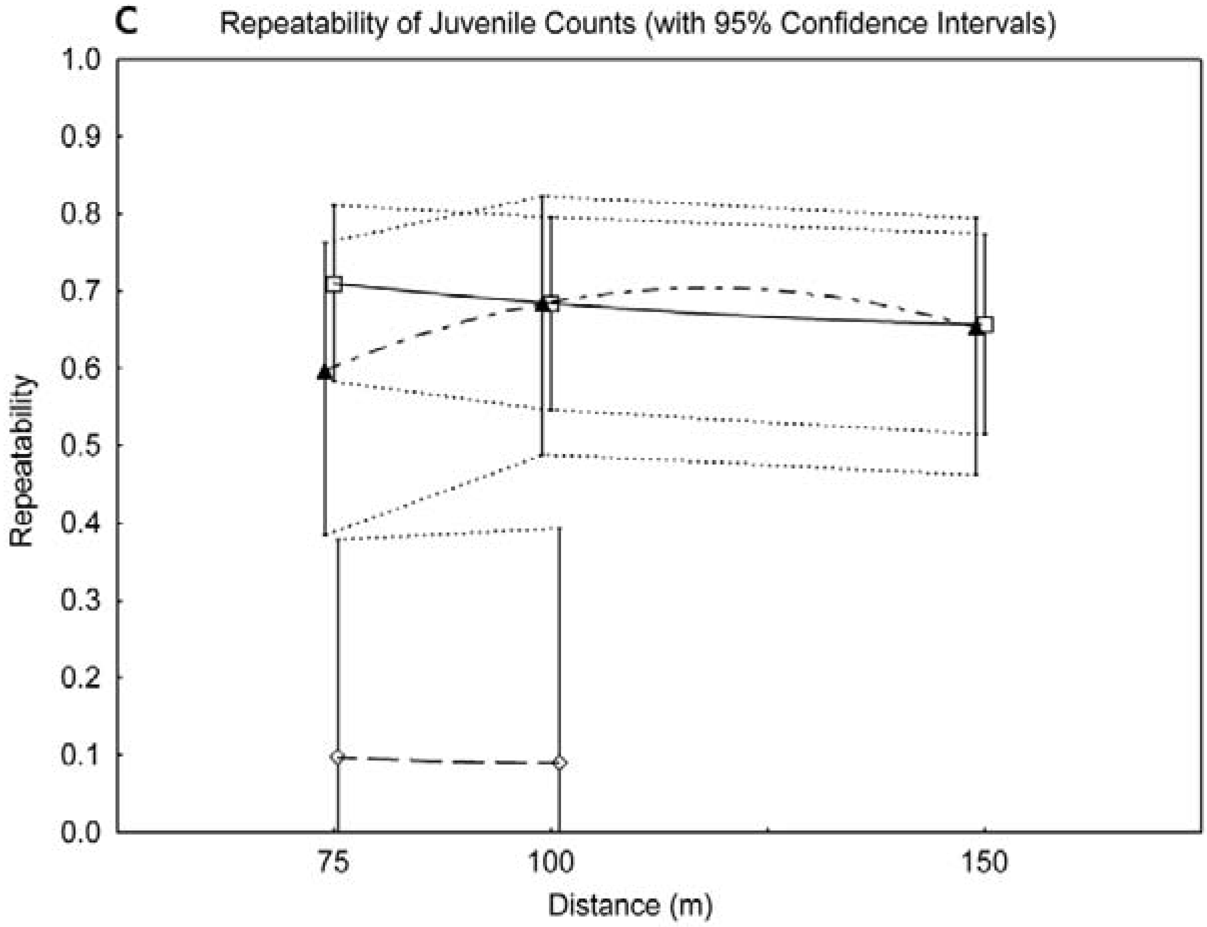


Figure 3. Repeatability of counts of a) adult b) sub-adult and c) juvenile Australian fur seals, with 95% confidence intervals. Squares are counts through binoculars, triangles from video footage and diamonds from slide photography.

Disturbance

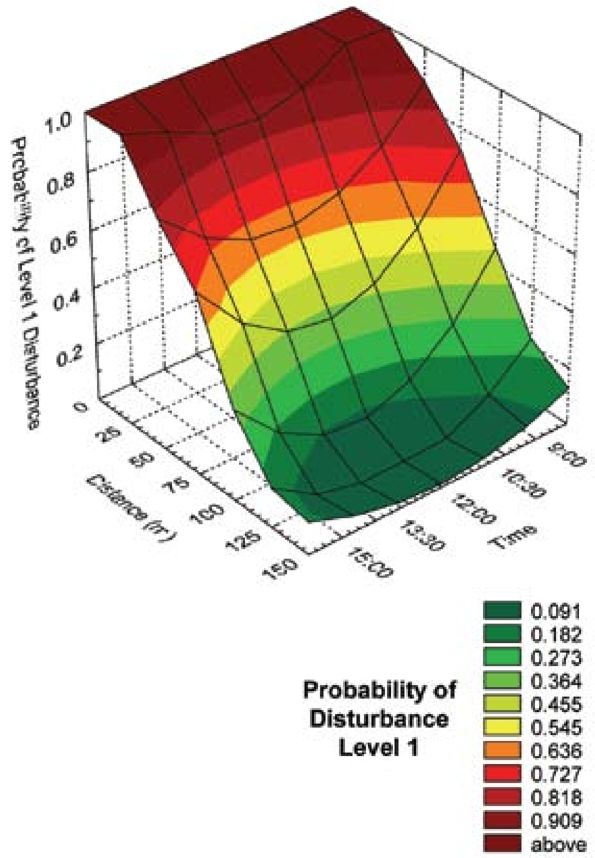
Disturbance to seals (rank 1), when plotted against distance and time (Figure 4), was found to increase when we approached the haul out. When the data were categorised into three different amounts of seals hauled out, <50 seals, 50-90 seals, >90 seals (Figure 5), we found that disturbance occurred at a greater distance from the haul-out. The 95% confidence likelihood increased from one matrix square for <50 seals to 9 for 50-90 seals to 13 for >90 seals.

Disturbance rank 2, where several seals entered the water at the one time, occurred on six occasions. Early in our investigations this occurred twice at our 50 m sampling point, after which we abandoned counts at this distance. Rank 2 disturbances also occurred on three occasions in August and September at 75 m, which was around the peak occupation of the haul-out (see Burleigh *et al.* 2008). Only once, in July, were the seals disturbed at 100 m. Notably, of all six rank 2 disturbances that occurred, five occurred during the 0900 h count, with one occurring during the 1030 h count.

Table 2. Antilog of the mean and limits of agreement for each monitoring method compared to binocular counts at 75 m.

Method	Mean	Upper Limit of Agreement	Lower Limit of Agreement
Binocular 150 m	1.20	1.49	0.96
Binocular 100 m*	1.07	1.20	0.95
Video 150 m	1.11	1.34	0.92
Video 100 m*	1.01	1.15	0.90
Video 75 m*	1.00	1.13	0.89
Slide 150 m	2.94	6.66	1.30
Slide 100 m	1.99	3.65	1.08
Slide 75 m	1.67	2.74	1.02

* Method showed good agreement with binocular counts at 75 m.



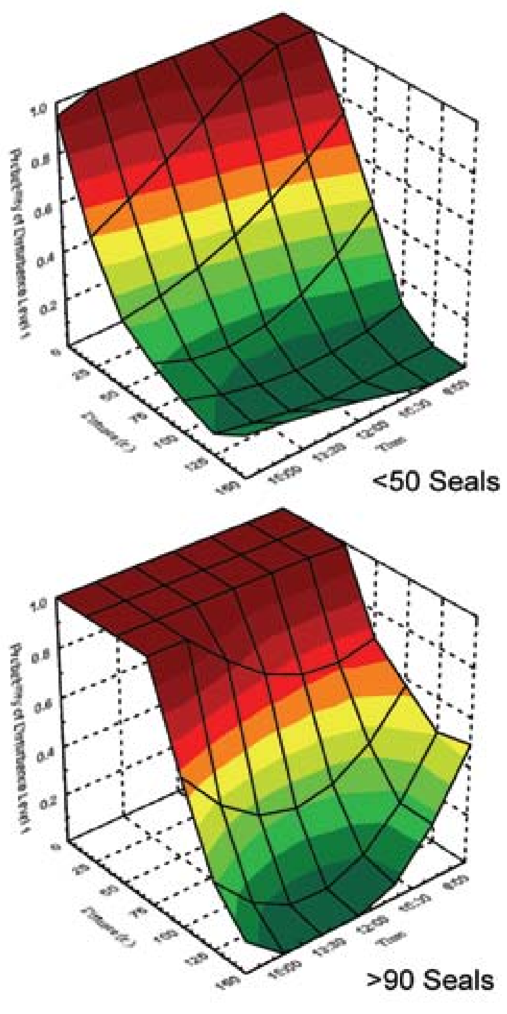
Discussion

Due to the presence of a cave, overhanging sea cliff and southerly aspect at the Steamers Head haul-out, the only practical method for monitoring the seals was by boat-based index counts. By trialing and comparing a variety of techniques and distances for undertaking index counts, our study examined which method is best for ongoing monitoring of the Steamers Head fur seal haul-out. All techniques, with the exception of slide photographs at 150 m and 100 m, showed good repeatability in identifying Australian fur seals, possibly because this was the dominant species. However, various techniques displayed pros and cons for describing inter-age class and species data.

Binoculars – pros and cons

We established that binocular counts showed good overall repeatability. Movement alerted the observer to groups of seals, and behavioural cues – such as vocalisations – also aided identification. In particular binocular counts allowed for good comparisons between the 'gizz' of individuals. This is an ornithological term to describe an animal's or group of animals' general behaviour and movements which aids identification.

Figure 4. A 3-dimensional surface plot of probability of disturbance against time of day and distance for all observations. Probability of disturbance is indicated by colour with deep red indicating a significant likelihood of disturbance.



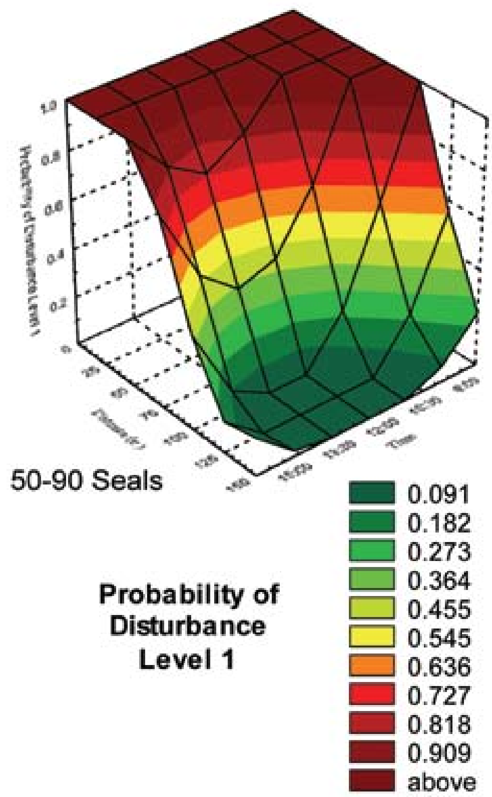


Figure 5. A 3-dimensional surface plot of probability of disturbance against time of day and distance categorised according to number of seals hauled out. Probability of disturbance is indicated by colour with deep red indicating a significant likelihood of disturbance.

Binocular counts were the only technique that showed good repeatability in the identification of New Zealand fur seals. We suspect that this was due to easier comparisons between differences in gizz and size between the species and because observers could easily identify the direction of seal calls and could thus link the high-pitched bark of a New Zealand fur seal with the location of the actual animal. In binocular counts, comparison of body size was also easily accomplished for both species and age class.

One disadvantage of the binocular technique was that due to their thigmotactic nature, groups of juvenile fur seals were occasionally mistaken as a sub-adult when observed at 150 m from the haul-out, resulting in greater variability between observers and reduced repeatability.

Video – pros and cons

The video camera had a powerful digital zoom that allowed for clear images of the haul-out to be sourced from a distance. The image was also clear when paused due to the "steady shot" video technology, thus eliminating the effect of the rocking boat. Using the zoom and digital pause, juveniles that were clumped could easily be distinguished. However, comparison between body size and hence repeatability in terms of other inter-age comparisons was low. As the image was on full zoom and thus tightly clipped, relative comparison was difficult. Also, perspective was lost as a consequence of the digital zoom. Besides this problem with detecting differences between some age-classes, video counts also did not show good repeatability for counts of New Zealand fur seals. In addition to the size comparison issues already mentioned we suspect that this was for two reasons, first there was greater difficultly in the observer being able to orient themselves to the areas where New Zealand fur seals were known to have hauled out and second it was not possible to identify the direction of their peculiar vocalisations to a position in the haul-out.

Although video footage has not been previously used as a general census method for fur seals, video techniques have been used at Cape Bridgewater for counting seals as they abandoned a cave (Stamation *et al.* 1997). This lack of other examples may be due to the low quality of images produced by earlier analogue video cameras. With the advent of cheap, digital, video cameras, which give clear and steady images, the technology for video censuses is now available. At Steamers Head the main problems with this technique were misidentification of the minority species and for single species colonies this technique may be more useful.

Slides – pros and cons

Due to the poor quality of the slide photographs the repeatability of this method was low. Colouring and body size of seals lacked clarity, and therefore juveniles and adults were missed. Due to the inability to adequately identify adults and juveniles, most seals were assumed to be sub-adults. Photographs also had the disadvantage of only being static without audio so there was no ability to detect particular gizz or vocalisations of individual species or age classes.

The reason for the poor repeatability and agreement for slide photographs is primarily due to poor lighting for photography, at the haul-out, as the site faces south and was permanently in shade. Also, at the more distant counting positions, the sun was in view of the photographer, making glare another factor that decreased the technique's usefulness. In other studies that used photography as a census method, the technique was quite reliable for counts of all seals (Pemberton and Kirkwood 1994; Southwell 2005); however this was probably due to seals being in full sun and an aerial perspective resulting in shots that were both clear and sharp.

Disturbance

The Steamers Head haul-out is the subject of not only research but also sight-seeing and commercial dive tourism that operates out of the port of Huskisson. Human disturbance to seal colonies often results in movement of the animals into the water. This may impact on the energy budget of individual seals and consequently on their ability to thrive. Habitat with minimal human access, such as Steamers Head, may be especially important for seals in small populations in which individuals may perceive themselves as more vulnerable because of decreased vigilance and dilution effects (Stevens and Boness 2003).

We did not set out to investigate disturbance of the Steamers Head seals, but we decided to monitor our effects on the animals to account for any bias we may have unintentionally introduced to our census results, and as a requirement to limit our impact on animals at the haul-out site for our scientific permit. Our initial results and sensitivity to minimising disturbance to the haul-out resulted in our abandonment of the 50 m sampling distance. Also, it must be reinforced that we defined disturbance to the haul-out, where we would modify our behaviour, as seals lifting their heads rather than more vigorous movements.

At the Steamers Head haul-out we found that disturbance increased as we approached the haul-out with disturbance greatest at distances less than 75 m. We also discovered that disturbance occurred at greater distances as numbers of seals increased over the seasonal occupation of the haul-out and that juveniles were usually the first animals to be disturbed. When disturbance rank 2 occurred, it usually consisted of three to four juveniles entering the water. Interestingly, the one time when our approaching research vessel disturbed seals at a distance of 100 m was immediately prior to a landslip, which, on the following day, resulted in many tonnes of rock crashing onto the haul-out and killing at least one seal (see Burleigh *et al.* 2008).

We observed that other boats approached the haul-out more closely than our vessel. When boats came close to the haul-out, the number of seals that entered the water rose rapidly, and occasionally a stampede took place and numerous animals entered the water. In one instance in September, approximately 100 animals abandoned the site when a dive boat was anchored 20 m away from the haul-out. In this stampede, an adult male Australian fur seal was observed falling from the top of the platform, and bounced off several rocks before hitting the water. The strong response by seals may indicate that the site has a high proportion of juveniles, the haul-out is relatively new, and/or the eco-tours approaching are relatively new such that the seals have yet to habituate to boats. However, it must be noted that our data were collected opportunistically and our study was not a designed series of controlled approaches (e.g. Boren *et al.* 2002).We tentatively suggested that risk of disturbance was also higher in the morning. This may have been due to the fact that not all animals were sleeping at 0900 h compared to later in the day.

Our research vessel measured 6 m in length, but larger boats visiting the site may cause disturbance at distances further from the haul-out. Also, when there were multiple boats in the area there may be cumulative effects. Further investigation should be undertaken to determine the effects of boat size and abundance on disturbance especially as, like the Montague Island haul-out (Shaughnessy *et al*. 1999), the haul-out is regularly visited by tourists.

Conclusion

Our preferred monitoring technique eventually came down to a choice between counts made on site through binoculars or counts made *post hoc* from digital video footage. Projected photographs showed poor repeatability and agreement, and are not considered a worthwhile technique for monitoring this particular haul-out site.

Both binocular and video methods could be used to perform index counts of the Steamers Head haul-out. The advantage of the video technique is that a permanent record is obtained and, in counts of all seals hauled out, was more accurate at a greater distance. The advantage of binocular counts is that a more accurate age classing and ratio of species is possible and there is less post-field processing. For these reasons it is recommended that binocular counts should be the basis for monitoring these seals, supplemented with video footage.

The NSW National Parks and Wildlife Service (NPWS), now the Department of Environment and Climate Change NSW (DECC) has recently legislated that a person must not approach a hauled seal closer than 40 m and a hauled pup (which is defined as a seal equal or less than half the length of an adult) no closer than 80 m. At the Steamers Head haul-out we found that disturbance increased as we approached the haul-out. This presented somewhat of a dilemma as the repeatability of our counts also increased as we approached the colony. However, to collect unbiased data we recommend that when there are less than 50 seals at the haul-out, a maximum approach distance of 80 m, in line with DECC guidelines, is necessary to minimise disturbance but this will need to be extended to 100 m when numbers hauled out are greater than 50 seals. To minimise disturbance to seals, it is also recommended that the best time of day to perform census counts is when the seals are least active, between 1000 h and 1500 h.

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APPENDIX I

Australian fur seals.

Photo, Jervis Bay Marine Park

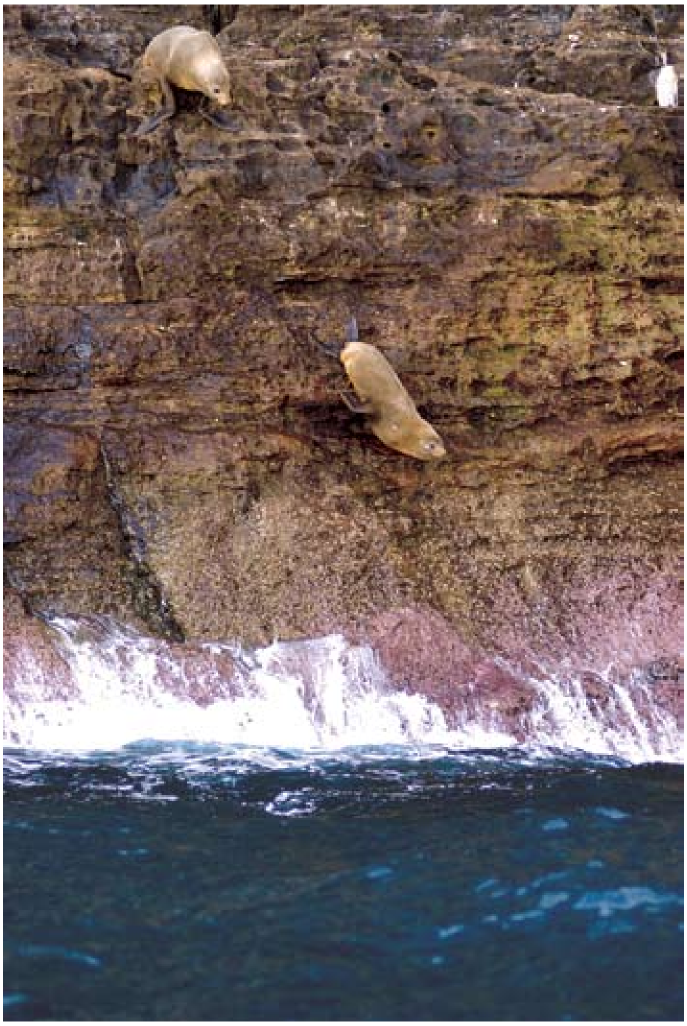
APPENDIX I

Adult Australian fur seals.
Photo, Jervis Bay Marine Park

Platform 1.
Photo, Jervis Bay Marine Park

Platform 2.
Photo, Jervis Bay Marine Park

Entrance to the Steamers Head cave.
Photo, Jervis Bay Marine Park



The steepness of the site made stampedes an animal welfare issue.

Photo, Jervis Bay Marine Park