

Allen, S. G., Ainley, D. G., Page, G. W. & Ribic, C. A. 1984. The effect of disturbance on harbor seal haul-out patterns at Bolinas Lagoon, California. *Fish. Bull.* 82, 493-500.

Abstract

We studied harbor seals at Bolinas Lagoon, California, from May 1978 to June 1979. Field observation and two time lapse motion picture cameras were used to monitor the numbers of seals and of disturbances, and to provide information on tidal height. Peak numbers occurred during the summer. During nonbreeding seasons, high numbers occurred at low tides, and during the breeding season they occurred in early afternoon except when haul out areas were flooded. Seals were disturbed by humans on 71% of days monitored; people in canoes were the primary source of disturbance. Human activities closer than 100 m caused seals to leave haul out sites more than activities at greater distances. Several studies exist on the haul out patterns of harbor seals, *Phoca vitulina*, in undisturbed locations (Scheffer and Slip 1944; Venables and Venables 1955; Richardson 1975; Pitcher 1975; Loughlin 1978), but the effects of human activities on haul out patterns have been examined infrequently (Newby 1971; Paulbitsky 1975; Chapman 1979). We report here how daily and seasonal haul out patterns of harbor seals can be modified by human activity in a small estuary, Bolinas Lagoon, Calif. The data also provide a baseline against which the effects of pending increased levels of human activity could be compared. Since 1970, a state quarantine has reduced human activities in the contaminated waters of Bolinas Lagoon. Human use has been confined to bird watching, some boating, illegal clam digging, beach combing, and recreational bait fishing. When the quarantine is lifted, many of these activities will increase. Increased human activity could also result from provisions included in the General Management Plan of the Golden Gate

Ashwell-Erickson, S., F. H. Fay and R. Elsner. 1986. Metabolic and hormonal correlates of molting and regeneration of pelage in Alaskan harbor and spotted seals *Phoca vitulina* and *Phoca largha*. *Canadian Journal of Zoology* 64:1086-1094.

Abstract

Cellular, hormonal, and metabolic changes during annual molts and regeneration of the pelage were studied in two harbor and five spotted seals of different ages. Seals were maintained in an appropriate photoperiod and monitored biweekly to monthly by measuring their serum cortisol, thyroxine, and triiodothyronine and their standardized resting metabolic rate. Concurrently, external signs of their molt (shedding of hair) were recorded, and samples of skin were collected from the midback for histological determination of the duration of the regenerative phase of the pelage cycle. Timing of the molts coincided with those of free-ranging seals in the natural environment. The overall duration of the period of shedding and regeneration, from first descent of the hair bulbs on the face and flippers to full emergence of new hair on the back, was estimated as 120–170 days. During the period of descent of the hair bulbs and initial growth of new hair on the back, the resting metabolic rate declined an average of 18.6% below premolt values, generally reaching its minimum when shedding of the old hair and rapid growth of new hair began. Serum Cortisol generally reached a maximum just before or during the main shedding of hair from the torso, then decreased abruptly to its premolt level or lower during the main period of rapid growth of new hair. Although corticosteroids appear to inhibit protein anabolism, they favor fat catabolism and may in this way help to maintain the slow growth of new hair before and during the first part of the molt. Serum concentrations of thyroid hormones declined to minima early in the molt, then increased to maxima toward the end, when growth of new hair was most rapid.

Blundell, G.M., and G. W. Pendleton.2015. Factors affecting haul-out behavior of harbor seals *Phoca vitulina* in tidewater glacier inlets in Alaska: can tourism vessels and seals coexist? *PLoS ONE* 105:e012486.

Abstract

Large numbers of harbor seals (*Phoca vitulina*) use habitat in tidewater glaciers in Alaska for pupping, breeding, and molting. Glacial fjords are also popular tourist destinations; however, visitation by numerous vessels can result in disturbance of seals during critical life-history phases. We explored factors affecting haul-out behavior of harbor seals at a glacial site frequented by tourism vessels. In 2008-10, we deployed VHF transmitters on 107 seals in Endicott Arm, Alaska. We remotely monitored presence and haul-out behavior of tagged seals and documented vessel presence with time-lapse cameras. We evaluated the influence of environmental and physical factors on the probability of being hauled out, duration of haul-out bouts, and as factors associated with the start and end of a haulout. Location, season, hour, and interactions of location by year, season, hour, and sex significantly influenced haul-out probability, as did ice, weather, and vessels. Seals were more likely to be hauled out with greater ice availability during the middle of the day, and less likely to be hauled out if vessels were present. Cruise ships had the strongest negative effect; however, most vessel types negatively affected haul-out probability. Haul-out duration was longest in association with starting on incoming tides, clear skies, no precipitation, occurring in the middle of the day, and ending in the late afternoon or evening. End of haulouts was associated with increasing cloud cover, low ice availability, and vessel presence; large-sized tourism vessels or all-vessel-types combined were significant predictors of ending a haul-out bout. Probability of being hauled out was highest in June, during pupping season. Potential disturbances of harbor seals could be reduced, enabling longer resting times for seals and fewer interruptions for nursing pups, if vessels focused the majority of visits to glacial habitat to before or after the hours of 08:00-17:00 or, less optimally, 09:00-16:00.

Boren LJ, Gemmell NJ and Barton KJ. 2002. Tourist disturbance on New Zealand fur seals *Arctocephalus forsteri*. *Australian Mammalogy* 24: 85-95.

Abstract

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.

Born, E.W., Riget, F.F., Dietz, R., Andriashek, D., 1999. Escape responses of hauled out ringed seals *Phoca hispida* to aircraft disturbance. *Polar Biology* 21, 171-178.

Abstract

Arctic marine mammals may be subject to human-induced disturbance from various air traffic, mostly in connection with exploration and exploitation of non-renewable resources. The escape responses (i.e. leaving the ice) of hauled out ringed seals (*Phoca hispida*) to a low-flying (150 m) fixed-wing twin-engine aircraft (Partenavia PN68 Observer) during strip censuses in eastern Greenland (June 1984) and to a low-flying (150 m) helicopter (Bell 206 III) during reconnaissance in northwestern Greenland (May 1992) were recorded. Overall, 6.0% of the seals ($N_{\text{tot}} = 5040$) escaped as a reaction to the fixed-wing aircraft. Seals escaped less than about 600 m in front of the aircraft. The overall probability of escaping was 0.21 within a 200-m-wide centre zone, 0.06 on the side of the aircraft (100–300 m from the flight track), and 0.02 between 300 and 500 m from the track. The probability of escaping was found to be influenced by the time of day, relative wind direction and wind chill. Overall, about 49% of all seals ($N_{\text{tot}} = 227$ cases) escaped as a response to the helicopter. Seals entered the water a maximum of about 1250 m in front of the aircraft. At wind chill values below 1100 kcal/m² h, the probability of escaping was 0.79 in the 200-m-wide centre zone. On the sides the probability of escaping decreased up to about 500 m from the flight track whereafter it remained constant at about 0.30 up to about 1450 m. During the helicopter surveys wind chill was the only environmental factor found to have an additional effect on the probability of escaping. The study indicated that the risk of scaring ringed seals into the water can be substantially reduced if small-type helicopters do not approach them closer than about 1500 m, and small fixed-winged aircraft not closer than about 500 m.

Brasseur S, Aarts G, Kirkwood R 2014. Habitat quality for grey seals in the Dutch Wadden Sea. *Rep No C090/14, IMARES Wageningen UR*

Abstract

Growth in numbers has seen the Netherlands become a strong-hold for grey seals in continental Europe. This report has the following subjects (questions posed by the Dutch Ministry): “Is a favourable status of the habitat quality of the grey seal in the Netherlands dependant on the presence of undisturbed, permanently dry breeding sites, or do the current sites, which are considered sub optimal, suffice for a long term survival of the species in the Netherlands?” and "How is the growth influenced by immigration from other areas (i.e. the UK)?”

Bekkby, T. , A. Bjørge 2000. Diving behaviour of harbour seal *Phoca vitulina* pups from nursing to independent feeding. [*Journal of Sea Research* 44, 3–4, 2000, 267-275](#)

Abstract

To study the diving activity of harbour seal (*Phoca vitulina*) from nursing to independent feeding, we VHF radio tagged and tracked seven pups. The pups gradually developed the diving skills necessary to obtain enough food after weaning and to avoid natural and man-made dangers. The maximum dive duration remained unchanged with pup age, indicating that pups have considerable breath-holding capacity already from an early age. However, mean dive duration increased with age, from 0.92 min in pups ≤ 25 days old to 2.55 min in 1–2 month olds, and 3.09 min in 2–3 month olds. The increase continued for weeks after the assumed weaning, and indicates that the capacity to perform long-lasting dives steadily increases as the pups grow older. Mean and maximum surface duration remained unchanged with pup age. Mean surface duration was 0.32 min with a maximum value of 6.10 min. An increase in mean surface duration with mean dive duration was found when the pups were ≤ 25 days old, but not when they were older. This may indicate that young pups need to rest more after diving than older ones. No relationship was found between dive duration and the subsequent surface interval. The proportion of time spent submerged increased with age, from 71% when the pups were ≤ 25 days old to 86% when they were older. The pups hauled-out less frequently as they grew older. The pups were never recorded outside the study area (defined by the 30-km station range). Time of day, tidal height and weather conditions seemed not to influence the diving behaviour of the pups.

Calambokidis, J., B. L. Taylor, S. D. Carter, G. H. Steiger, P. K. Dawson and L. D. Antrim. 1987. Distribution and haul-out behavior of harbor seals in Glacier Bay, *Alaska*. *Canadian Journal of Zoology* 65:1391-1396.

Abstract

Over 5000 harbor seals haul out on icebergs calved from tidewater glaciers in Muir and Johns Hopkins inlets in Glacier Bay, Alaska. During June, these sites are used primarily by parous females and pups, and in August, by molting seals. The number of mothers and pups was higher than expected for the total number of seals in Glacier Bay, indicating an immigration of some parturient females from outside Glacier Bay. The number of seals counted varied throughout the day with greatest numbers around midday. In Muir Inlet the number of seals hauled out was positively correlated with percent ice cover. Ice that is suitable for hauling out may presently limit the abundance of seals in this area. The retreat of Muir Glacier has dramatically reduced the ice available to seals and, if it continues, will likely result in the elimination of drift-ice habitat in the near future. Seals from both inside and outside Glacier Bay apparently use ice habitat in Muir and Johns Hopkins inlets when giving birth, when nursing pups, and when moulting for protection from terrestrial and marine predators, and because it is relatively abundant and easily accessible at all tides and times

Calambokidis, J., G.H. Steiger, B.D. McLaughlin, and J.R. Evenson. 1990. Harbor seal haul-out habitat and the feasibility of shifting haul-out locations at Dosewallips State Park, Washington. *Report to the Washington State Parks and Recreation Commission, Olympia, Washington. 70pp.*

Executive summary

High fecal coliform concentrations that have been found at the Dosewallips River delta on the Hood Canal appear to originate from harbor seals that use the sloughs and marsh on the southern portion of the delta to haul out (Calambokidis *et al.* 1989, Calambokidis and McLaughlin 1988, DSHS 1988). In other areas in Puget Sound, harbor seals regularly haul out on human-made platforms, such as recreational floats and log booms (Calambokidis *et al.* 1978, 1985, Johnson and Jeffries 1977). Harbor seals used to haul-out on a log boom that existed at the north end of the Dosewallips River Delta through the mid 1970s. Because seal-related contamination is closely associated with haul-out locations, it may be possible to alter the affected areas by shifting the areas used by seals to haul out.

This study examines the feasibility of shifting the seal haul-out habitat at Dosewallips delta from the salt marsh areas used currently to human-made structures that would be located just off the delta. We summarize relevant findings about the biology of harbor seals at this location, harbor seal haul-out requirements, what steps would need to be taken to shift the location of haul-out, and limitations of trying to conduct such a project. This study was funded by the Washington State Parks and Recreation Commission.

Counts made on 49 days from December 1989 to August 1990 at Dosewallips Delta ranged from 11 to 390 harbor seals and averaged 140 ($n=49$, $s.d.=85$). A number of factors were identified that were statistically associated with the variations in the number of seals counted at the Dosewallips Delta. These included time of day, temperature, and tide height and time to high tide.

A major surprise in the results of this study were the significant decrease in seal numbers at the Dosewallips River Delta in recent years. This trend data should be viewed with caution, especially because it does not cover some critical seasons. There were not significant increases or decreases in seal numbers observed at Duckabush River Delta or Quilcene Bay.

At the Dosewallips River delta, harbor seals haul out along the three main southern sloughs and along or on logs along the river. We found significant seasonal and annual changes in the use of different portions of the Dosewallips River Delta.

A trial float placed at Dosewallips River delta on 16 May 1990 was not used by seals until 15 June 1990 and not regularly until late July. Females with pups occasionally hauled-out on the float in late August, towards the end of the pupping season. Exploratory behavior by seals in the water of the trial float was seen frequently.

The amount of haul-out space required per seal was similar among locations and habitats and averaged about $2 \text{ m}^2/\text{seal}$. The area used by seals at human-made habitats tended to be slightly larger than natural habitats, though this difference was small. The mean shoreline distance per seal (the distance of shoreline or water access for a group of seals) was generally under 1 m/seal at natural habitats and greater than 1 m/seal at other human-made habitat.

Human-made haul-out areas appear to provide some advantages over natural habitats, especially in their accessibility at all tides and their rapid access to deep water. The height above water for human-made structures used by seals, including log booms, floats, and a fish net pen, ranged from 12 to 54 cm with log booms lowest in the water. The height above the water of many floats used by seals appear to prevent newborn seal pups from getting out on the float for the first 1-2 weeks.

An alternate haul-out structure able to accommodate the maximum seals seen using the current haul-out area (470) would need to be $1,175 \text{ m}^2$ using 2.5 m^2 per seal. Shoreline space would need to be at least 1 m per seal or about 500 m in total. This is less of a limiting factor since the haul-out area designs discussed below and human-made haul-out areas in general, easily meet this requirement.

Two human-made structures, log booms and floats, represent the best choices for alternate habitat at Dosewallips and a combination of both structures would provide the best alternative habitat for harbor seals. To allow segregation between groups we recommend use of multiple small structures as opposed to one or two large structures.

The ideal log-boom structure consists of three logs secured together by crosspieces with total width of 1.5 m. For the float design, the most suitable and compact structure would be a series of open-celled concrete floats. A fairly compact 12 x 17 m structure would be suitable for up to 60 harbor seals. A marked barrier around the structures would be necessary to keep boaters away from hauled seals and restrict them from using the structures for recreational purposes. The best location for an alternate haul-out site is along the steep slope marking the edge of the delta just north of the main river channel.

Seals may not readily adapt to new structures, as indicated by the delay in the use of the trial float. We propose actions that can be taken to encourage use of an alternate location. Additionally, options to discourage seal use of current areas include: 1) changes that elicit a behavioral avoidance by seals such as placement of a 'scarecrow' type object, 2) placement of physical barriers on marsh areas that restrict seal access to some or all haul-out areas, 3) placement of physical barriers at slough entrances to restrict access of seals but not smaller animals, and 4) disturbance of seals using haul-out areas. We recommend only the first two of these options be considered and only after seal use of alternate structures has begun, indicating these structures can meet seal haul-out requirements.

To evaluate the success of the project, we developed (in cooperation with personnel from the Department of Wildlife and Department of Health) a recommended monitoring program to be conducted if the relocation project is undertaken. The primary goals of the monitoring program would be to evaluate the success of the project to shift seal haul-out locations from marsh areas to new structures and to monitor trends in water quality for improvements as a result of the relocation activities.

A number of legal requirements exist for conducting this type of project. Discussion with personnel at the National Marine Fisheries Service, indicated that the information we have provided appear to be adequate to justify shifting haul-out locations as long as the method was non-lethal and alternate habitat were provided. A number of other permits are required, however, these all seem obtainable if public support of this project continues.

We do not expect significant impacts of seals at a new structure because they will be in deep, well-circulated water that is away from the intertidal zone where there would be more impacts. The large size of the proposed structures and their relative proximity to shore could pose an aesthetic impact, though this did not appear to be a concern expressed by residents of the area. Harbor seal predation on fish species would not likely be altered by the relatively minor shift in haul-out locations.

The experimental nature of this action makes it impossible to provide assurance of success even if all the procedures identified here are followed. The change in fecal coliform levels will probably be a slow process that may take years. The increased visibility of seals on a structure would make them susceptible to those who want to harm them. Additionally, the initial cost estimates for the artificial structures are high (over \$100,000).

The project would have little chance for success should there be strong opposition from groups oriented towards protecting marine mammals or the local residents concerned about seal population increases. It is essential to maintain cooperation with these groups by including them in project evaluation.

Identified alternatives to the relocation option include no action (continue to prohibit shellfish harvesting in the state park), re-evaluation of the water quality standards, or elimination or reduction of the seal population. These alternatives are not feasible or would maintain the status quo.

We recommend that alternate structures be phased in gradually. This would allow evaluation of the success of the project prior to a full financial commitment and better identification of successful and unsuccessful approaches for shifting seal use. A series of steps are proposed for how to proceed on the project should State Parks decide to do so. The initial steps recommended before a final decision on implementation of the full project include:

- Experimental closing of one slough (#1) to seals to examine effects on water quality
- Evaluation of engineering questions related to structures and water currents in area of planned float placement
- Obtain more precise cost estimates on construction and installation of haul-out structures
- The experimental closing of one slough would allow evaluation of how quickly seal relocation would result in improvements in water quality.

Cassini MH. 2001. Behavioural responses of South American fur seals to approach by tourists . a brief report. *Appl. Anim. Behav. Sci.* 714: 341.346.

Abstract

I studied the responses (retreats, threats, attacks or leaving the rookery) of South American fur seals *Arctocephalus australis* to tourist approaches at a non-reproductive, continental colony of located in Cabo Polonio, Uruguay (34 degrees 24'S, 53 degrees 46'W). Fur seals tolerated relatively close distances to humans, but a strong response of the animals was elicited when tourists crossed a threshold of 10m. The attitude of the tourist was also important. Calm people were able to approach the colony without almost any disturbance. These results suggested that, with a minimal control of visitor's behaviour, the impact of tourism on this colony would be low.

Cordes, L. & Thompson, P. 2015 Mark-resight estimates of seasonal variation in harbor seal abundance and site fidelity. *Population Ecology*, 1-6.

Abstract

Monitoring trends in abundance of pinnipeds typically involves counting seals at terrestrial haul-out sites during the breeding season. Counts of seals made at other times of the year are typically lower; however, it is often unknown whether this is because fewer animals are present or whether lower counts simply reflect a reduction in haul-out probability. Here we illustrate how photo-identification data from an individual-based study of harbor seals (*Phoca vitulina*) can be used to estimate seasonal variation in abundance and site fidelity. Monthly data collected over a two-year period were analyzed using a mark-recapture mark-resight model accounting for individuals transitioning between observable and unobservable states. Levels of site fidelity were high throughout the year and abundance estimates showed no seasonal pattern. This suggests that individual seals used haul-out sites to the same extent throughout the year, and that peaks in counts during the breeding season are a result of seasonal changes in haul-out probability. The results of this study have implications for understanding population sub-structuring, gene flow and disease spread.

Cordes, L. S., C. D. Duck, B. L. Mackey, A. J. Hall and P. M. Thompson. 2011. Long-term patterns in harbour seal site-use and the consequences for managing protected areas. *Animal Conservation* 14:430-438.

Abstract

There have been marked declines of UK harbour seal populations over at least the last decade. Protected areas, such as Special Areas of Conservation (SACs), provide one tool to improve the conservation status of these populations. However, the design and management of SACs is often limited by a lack of information on long-term patterns in the use of seal haul-out sites and foraging areas. The Moray Firth is the only UK region where long-term harbour seal population studies have been conducted in parallel with detailed studies of foraging ecology. We used this opportunity to investigate changes in the use of haul-out sites and foraging areas within two adjacent estuaries, where annual haul-out counts were made over a 20-year period. In 1988, >99% of seals and all mother-pup pairs were located at haul-out sites within an area that was subsequently designated as a SAC to protect harbour seals. In addition to previously reported declines in this area, we detected a shift in haul-out distribution resulting from the development of a new pupping site that, by 2008, held 37% of mother pup pairs in the area. Foraging areas of breeding females were compared in 1989 and 2009 using a combination of VHF and GPS–GSM telemetry, confirming that females foraged in broadly similar areas in both periods. This suggests that the development of this new pupping site was not driven by the need to forage further offshore, but instead was more likely due to local variation in haul-out site characteristics. These results are discussed in relation to potential drivers of haul-out site choice and the need to develop a broader suite of measures for managing habitat quality within this and other SACs for harbour seals.

Coulson JC 1981 A study of the factors influencing the timing of breeding in the grey seal *Halichoerus grypus*. *Journal of Zoology* 194:553-571

Abstract

The Grey seal has a restricted distribution in the North Atlantic and Baltic but within this area there are differences of almost six months in the breeding dates in individual colonies, although there is little variation between years in the same colony. The date of breeding shows an irregular geographical distribution which excludes photoperiod as being the main factor determining the time of breeding. The timing of breeding is most likely to be determined by the factors which terminate the period of suspended embryonic development ("delayed implantation") and studies of both the year to year variation in the mean date of births on the Farne Islands, Northumberland, and also the geographical differences in the date of breeding are correlated with the sea-surface temperature in the period just prior to the end of the suspended development. On average, a one degree Celsius lower sea-surface temperature between colonies at this time results in the date of pupping being 13 days later. Evidence is also presented that the size of the seal colony has an influence on the date of breeding and there is reason to believe that the breeding season on the Farne Islands in the 1930s, when the colony was much smaller than it is now, was at least 10 days later than in recent years. It is suggested that this influence of numbers is possibly a social facilitation effect which slightly modifies the date of termination of the period of suspended embryonic development. It is also suggested that the two days later mean birth date of female pups is caused by a minor alteration to the restart of embryonic development caused by the sex of the embryo. A model of the manner in which the breeding season is determined in the Grey seal is presented and attention is drawn to possible selective advantages stemming from synchronized breeding rather than pupping at a particular time of year.

Coulson, J.C. and G. Hickling. 1964. The breeding biology of the grey seals, *Halichoerus grypus*, on the Farne Islands, Northumberland. *Journal of Animal Ecology* 44 33:485-512.

Abstract

1. A study has been made on the grey seals (*Halichoerus grypus*) breeding on four of the Farne Islands, Northumberland, between 1956 and 1962 and information from earlier observations have been included where relevant. Particular attention has been given to a comparative study of the seals breeding under differing degrees of crowding. 2. A well-defined annual movement has been detected within the Farne Islands; the seals showing a marked seasonal change in the islands used for haul-outs. 3. The young calves show an explosive dispersion from their birthplace and the maximum distances are reached within the first 3 months of life, after which there is a progressive contraction of their range towards their natal colony. The dispersion is apparently radial, but there is a marked bias of recoveries owing to uneven distributions of salmon fisheries. 4. The change in population has been followed by using the number of calves born each year. The population was low in early 1930s, there being probably less than 100 calves born each year. There was a marked increase in numbers by 1951, averaging about 11% increase per year. During the period 1952-62, the average rate of increase was 6% per year. This reduction in the rate of increase is probably related to an increase in calf mortality associated with crowding. 5. It is suggested that the initial selection of the breeding islands each year by the first cows to calve determines the choice of many of the later breeding cows. 6. The breeding season on a particular island approximates closely to a normal distribution with a standard deviation of 8.5 days. 7. The breeding season on the Farne Islands spreads from mid-October until late December which is later than any other large colony around the British Isles. No instances of spring births have been recorded. About 30% of the total births occur in the week 3-10 November. 8. Breeding occurs about 10 days later on Brownsman and South Wamses than on Staple and North Wamses. Since smaller numbers are born on the first two mentioned islands, the overall breeding is skewed with a distinct 'tail' after the peak of births. 9. Early calves are born near the tide line and later ones are found progressively further from the shore. 10. The sex-ratio of the calves is very close to equality, but there is a marked change in the sex-ratio as the breeding season progresses; more males are born early in the breeding season and more females towards the end of the season. 11. On average, a calf remains 32 days on the islands before finally leaving for the sea, but a minority remain for over 40 days. 12. A well-fed calf puts on about 4 lb/day (1.8 kg/day) while suckling, but there is considerable variation in individual growth-rates. A close inverse correlation occurs between the numbers of calves on the island and their growth-rate. This lower growth-rate is apparently induced by the crowded conditions. 13. The survival of calves after leaving their natal island is closely correlated with their growth-rate during their suckling period. 14. Much of the calf mortality is induced by crowded conditions on the breeding islands. The mortality is higher on crowded islands and is associated with the amount of accessible shore-line available to the seal in relation to the numbers using the island. When the breeding seals are well spread out, it is expected that about 9% of the calves will die. Mortality in excess of this amount is probably induced by crowding effects and about 40% of all the calf mortality on the Farne Islands is caused by density-dependent effects. 15. It is clear that the grey seal is choosing to breed under the crowded conditions which occur on the Farne Islands as other suitable islands are available. The situation is not comparable with the over-crowding which occurs in some herbivores. It is suggested that the self-induced calf mortality may be a mechanism to prevent the numbers increasing beyond the limits of the food resources.

Cronin, M.A., Zuur, A.F., Rogan, E. & McConnell, B.J. 2010 Using mobile phone telemetry to investigate the haul-out behaviour of harbour seals *Phoca vitulina vitulina*. *Endangered Species Research*, 10, 255-267.

Abstract

Information on the haul-out behaviour of pinnipeds is essential for increasing the accuracy of population estimates necessary for the effective conservation of protected species, as well as improving survey design. The haul-out behaviour of 10 harbour seals *Phoca vitulina* L. in southwest Ireland was examined using a novel telemetry system based on global systems for mobile communications technology. The data on the haul-out patterns of tagged individuals were examined using generalised additive modelling to determine potential factors of influence, such as the tide, the time of day and the time of year. The behaviour varied among seals, with time ashore reaching a maximum during post-moult in October and decreasing to a minimum in February. A strong tidal influence on haul-out behaviour was evident. Tagged seals hauled out more frequently at low tide. There was variation between individuals in the influence of time of day on haul-out behaviour. A cyclic pattern with lunar periodicity was evident in seals tagged in October, and the pattern varied between tidal periods. There was an overall large variation in patterns of behaviour over the tagging period, both between individuals and between tidal periods for each individual. This cautions against making inferences on the haul-out behaviour of the 'population' based on the behaviour of a small number of tagged individuals. The present study provides detailed information, heretofore unavailable, on the haul-out behaviour of individual harbour seals and on the behaviour of the species in Ireland, and it has important implications for population assessment for conservation purposes across the species' entire geographical range.

Daryl J. Boness, , Don Bowen, , Sara J. Iverson, and , Olav T. Oftedal. 1992. Influence of storms and maternal size on mother–pup separations and fostering in the harbor seal, *Phoca vitulina*. *Canadian Journal of Zoology*, 1992, 70(8): 1640-1644, <https://doi.org/10.1139/z92-228>

Abstract

Fostering behavior has been documented in a large number of mammals and birds, but its frequency of occurrence and proximate causes are poorly understood in most species. Ten percent of a sample of 76 paint-marked female harbor seals (*Phoca vitulina*) fostered pups for some portion of the lactation period. Fostering appears to be associated with females having lost their own pup. In a subsample of 30 pairs that were followed closely, 3 of 16 females that lost their pups fostered, but none of 14 females that maintained continuous association with their pups throughout lactation did so. Smaller, and presumably younger, females were significantly more likely to become separated from their pups than were larger, and presumably older, females (73 vs. 33%). A high proportion (68%) of 35 separations observed occurred during the same day as, or within 1 day following, a storm. In 7 of 8 instances where we relocated pups after they were separated from their mothers during a storm, we found them in the direction of the surface current, 4.9 km from their previous location, on average. These data suggest that storms were the primary cause of separation of harbor seal mothers from their pups, and that younger mothers may be more likely to become separated from their pups. As fostering only occurs after a mother has lost her pup, we suggest that fostering, too, may be more likely among younger females.

Dendrinos P, Karamanlidis AA, Kotomatas S, Legakis A, Tounta E, et al. 2007
Pupping habitat use in the Mediterranean monk seal: a long-term study. *Mar Mamm Sci*
23: 615-628.

Abstract

The Mediterranean monk seal gives birth almost exclusively in coastal caves. Given its critical conservation status, the identification and protection of such sites is important for the survival of the species. From 1990 to 2004 we collected data on physical and environmental variables and monitored pupping events in thirty-four coastal caves in Greece. We modeled the probability of cave occupancy as a function of the properties of each cave. Model selection and model averaging enabled us to rank the variables that influenced use of potential pupping sites. Environmental variables related to cave seclusion, substrate, and degree of protection from wind and wave action were the most important among them. The relative importance and directions of these relationships confirm the long-standing assumption that Mediterranean monk seals require sheltered pupping sites, far from sources of human disturbance and thus are progressively limited to isolated parts of the country's coastline. We used cross-validation to examine the predictive ability of our analysis and quantified the sensitivity of our predictions to the degree of extrapolation. We conclude that, although more data are required, the model is capable of predicting occupancy for caves close to the middle of the environmental space examined in this study.

Engelhard GH, Baarspul ANJ, Broekman M, Creuwels JCS and Reijnders PJH.
2002. Human disturbance, nursing behaviour and lactational pup growth in a declining southern elephant seal *Mirounga leonina* population. *Can. J. Zool.* 80: 1876.1886.

Abstract

We studied lactation behaviour in relation to pup growth in southern elephant seals (*Mirounga leonina*) at Macquarie Island, and compared harems in areas of high and low human presence to determine if there is an effect attributable to human activities, including scientific research. Pup weaning mass, a known correlate of first-year survival, was positively influenced by suckle bout durations during early and middle lactation and by maternal aggression during late lactation; no other behavioural variables were associated with weaning mass. In the area of high human presence, we observed from a distance the behaviour of mother–pup pairs directly before, during, and after visits to harems by other researchers. Alertness was raised threefold in the presence of people but quickly returned to predisturbance levels after their departure; there were no significant short-term effects on other behavioural variables. In the areas of high and low human presence, we observed the undisturbed behaviour of the seals in the absence of other people. No significant differences in any behavioural variables examined were found, indicating no long-term changes in behaviour resulting from human presence. Human disturbance therefore appears not to have significantly contributed to the population decline observed at Macquarie Island, but the conclusion requires caution given the fairly low power of our analyses.

Fogden, S.C.L, 1971. Mother-young behaviour at grey seal breeding beaches. *Journ. Zool., Lond.* 164 - 6 1-92.

Abstract

A comparative study of mother-young relations at Grey seal breeding beaches was made and results from two sites in Orkney are described to illustrate the different situations. It was found that at the minimally disturbed beach the cows consistently and exclusively suckled their own pups. To achieve this a bond is formed between the mother and pup immediately after parturition. The cow uses a combination of senses to locate and identify her pup; she recognises and responds to her pup's call, she returns to where she last suckled and she identifies the pup by smell. The pup remains on the beach where it was last suckled, it probably does not recognise its mother and does not discriminate between cows when soliciting suckling. These results are considered to be representative of completely undisturbed behaviour in the wild. At the other beach there were many examples of inconsistent suckling; these are described and attributed to disturbed conditions created by the method of study which led to a break-down of the mother-young bond between many of the seals present. The situation was accentuated by the topography of the beach and the density of seals present.

Fox, KS. 2008. Harbor seal behavioural response to boaters at Bair Island refuge. Master's theses, paper 3591, *San Jose State University*.

Conclusions

Bair Island Refuge protects prime haul-out habitat for harbor seals in the South San Francisco Bay, supporting a population of at least 60 harbor seals during the pupping/molting season. While the existing historical data are too scant for population trend analysis, it is clear that seals have been hauling out in Corkscrew Slough for the past 60 years, demonstrating the type of site fidelity they have shown in other locations. Seals rarely encounter recreational boaters at the remote Outer Bair haul-out, but they do encounter a variety of boats within Corkscrew Slough on a year round basis. Current traffic levels average 0.55 boats per hour through Corkscrew Slough. Such levels are considerably lower than those at some other haul-out sites in the San Francisco Bay, although they are higher than levels at the very sequestered Mowry Slough haul-out. Recreational boaters used Corkscrew Slough on a year round basis, mostly as solo boaters or in small groups of 2 - 6 boats. On occasion, large organized events bring significantly more traffic through the slough for a short period of time.

Thirty seven kayak and outriggers and a supporting group of two motor boats moved by the Corkscrew haul-out area within a 30 - 45 minute period during an organized race in February 2007. Seals appear tolerant of recreational boaters at current traffic levels. They remained at the haul-out without flushing during 70% of boating events and when seals did flush they almost always recovered within the large Corkscrew Slough haul-out area. The bathymetry, length, winding nature and sloping shoreline at Corkscrew Slough may contribute to the seals' ability to cope with boats that pass. When seals become alarmed, escape to the water is easy; the wide body of water allows for extended periods of swimming, and the long expanse of the slough allows many alternatives for hauling out.

Humans walking on the marsh plain near the haul-out site cause severe disruption to the seals as do extremely loud and fast boats that create an extreme wake as they pass. While seals appear generally tolerant of boaters at current traffic levels, total seal numbers at the haul-out were lower during multiple boat sessions than the baseline observed during no boat sessions. These data demonstrate a longer term impact from multiple boat events than for a single boat event, suggesting that more boat traffic may reduce the number of seals using Corkscrew Slough. Currently, multiple event sessions are not common enough to result in statistically lower numbers on days with boats versus days without. Increases in boating at Corkscrew Slough and seal responses should be monitored regularly in order to assess the potential impact.

French, et al. 2011. Human Disturbance Influences Reproductive Success and Growth Rate in California Sea Lions (*Zalophus californianus*). *Plos one* March 16, 2011

Abstract

The environment is currently undergoing changes at both global (e.g., climate change) and local (e.g., tourism, pollution, habitat modification) scales that have the capacity to affect the viability of animal and plant populations. Many of these changes, such as human disturbance, have an anthropogenic origin and therefore may be mitigated by management action. To do so requires an understanding of the impact of human activities and changing environmental conditions on population dynamics. We investigated the influence of human activity on important life history parameters (reproductive rate, and body condition, and growth rate of neonate pups) for California sea lions (*Zalophus californianus*) in the Gulf of California, Mexico. Increased human presence was associated with lower reproductive rates, which translated into reduced long-term population growth rates and suggested that human activities are a disturbance that could lead to population declines. We also observed higher body growth rates in pups with increased exposure to humans. Increased growth rates in pups may reflect a density dependent response to declining reproductive rates (e.g., decreased competition for resources). Our results highlight the potentially complex changes in life history parameters that may result from human disturbance, and their implication for population dynamics. We recommend careful monitoring of human activities in the Gulf of California and emphasize the importance of management strategies that explicitly consider the potential impact of human activities such as ecotourism on vertebrate populations.

Grigg, E. K., D. E. Green, S. G. Allen and H. Markowitz. 2002. Nocturnal and diurnal haulout patterns of harbor seals *Phoca vitulina richardsi* at Castro Rocks, San Francisco Bay, California. *California Fish and Game* 88:15-27.

Abstract

Surveys of harbor seals, *Phoca vitulina richardsi*, at Castro Rocks, San Francisco Bay (SFB), California, were conducted from May 1998 through April 2001. Surveys were conducted at all hours of the day and disturbance data and seal responses were recorded continuously during these surveys. Harbor seals hauled out at Castro Rocks during the daytime and nighttime throughout the year. Over the course of the study period, mean nighttime counts were significantly higher than mean daytime counts. Maximum daytime and nighttime seal counts were recorded during the fall season. Tidal dependence alone was not a clear predictor of fluctuations in seal numbers hauling out during the daytime compared to the nighttime. Seals at this site experienced high levels of disturbance from a variety of sources during the daytime and significantly lower levels of disturbance at night. We believe that, in this highly urbanized environment, high levels of daytime disturbance contribute to the higher use of this haul-out site at nighttime, versus daytime. Given projected increases in the number of people living and working around SFB, protecting the integrity of haul-out sites in SFB is an important facet of protecting the harbor seal population.

Groothedde, J. 2011. Mother-pup interaction and the impact of anthropogenic disturbance in wild harbour seals *Phoca vitulina*. Masters Thesis, *Linköpings University, Sweden*.

Abstract

This study investigated the abundance of harbour seals (*Phoca vitulina*) on inter-tidal sandbanks, mother-pup interactions as well as the impact of anthropogenic disturbance during breeding season. The abundance was a composite picture of harbour seals of different age and sex, and increased gradually towards peaks in June.

Although the sandbank water inlet was the longest time emerged, mother-pup pairs and other seals hauled out more abundant on the other sandbanks, probably due to space availability, differences in sandbank structure and distance to human activity. Mothers and their offspring were found to be mostly inactive during haul out. Mothers initiated significantly more frequently interactions i.e. hauling out, entering water and suckling. Seals hauled out at sandbanks close to the dyke were most frequently disturbed by pedestrians. Important regarding the impact on the seals seemed to be the group size of pedestrians and the distance to the seals (on dyke or seaside of it), i.e. pedestrians seaside disturbed more seals. This applies also to the disturbance by marine activity, e.g. distance of seals to the engine boat. Jet fighters were shown to affect the highest mean number of seals per event. After anthropogenic disturbances separations of mother and offspring were not recorded, e.g. due to seals being in the water; however, the steep edges as result of the culvert at water inlet lead to a few separations. The most frequent behavioural response towards anthropogenic disturbance was commotion with a probably lower level of energy costs during the energy consuming lactation period.

Härkönen, T., and K. C. Harding. 2001. Spatial structure of harbour seal populations and the implications thereof. *Canadian Journal of Zoology* 79:2115-2127.

Abstract

A long-term study of freeze-branded harbour seals (*Phoca vitulina*) revealed explicit site fidelity. Individuals were followed up to 14 years of age and none of the 163 branded animals were observed to haul out beyond a 32-km distance from the site where they were branded as pups. Within this range, striking spatial segregation by age and sex prevailed. While females' site fidelity increased with age, males spent less time at their natal site with increasing age. These findings have consequences for understanding the population dynamics of harbour seals, since single "colonies" will act as partly isolated "subpopulations" in some contexts but not in others. The differing migration tendencies of the population segments lead to spatially segregated sex and age ratios of subpopulations and create a complex pattern of connectivity among these subpopulations. Ignoring the spatial scale will lead to severe misinterpretations of analyses of basic population-dynamic processes, especially rates of population increase, rates of gene flow, and the dynamics of the spread of diseases. We suggest that when studies have different aims, these should be addressed by encompassing different numbers of subpopulations

Härkönen,, T. J. 1987. Seasonal and regional variations in the feeding habits of the harbour seal, *Phoca vitulina*, in the Skagerrak and the Kattegat. *Journal of Zoology London*, 213: 535.543.

Abstract

Studies of the feeding of harbour seals have been carried out at the Tjärnö Marine Biological Laboratory since 1977. The studies are based on fish otoliths found in faeces at seal haulouts. The present paper compares feeding habitats at two different localities. Three families of fish, gadoids, pleuronectids and clupeoids were predominant in the seals' diet at a rocky shore habitat. Pleuronectids made up 75% of the diet at a sandy shore habitat. Temporal variations in feeding habits are also examined. The results indicate that harbour seals are opportunists in their choice of prey species, but some locally abundant species do not appear in their diet.

Hayward, J. L., S. M. Henson, C. J. Logan, C. R. Parris, M. W. Meyer and B. Dennis.
2005. Predicting numbers of hauled-out harbour seals: A mathematical model. *Journal of Applied Ecology* 2005 42 , 108–117

Summary.

1. It was once assumed that commercially important fish make up significant portions of seal diets. As a consequence, prior to the 1970s many seal populations were dramatically reduced by rampant slaughtering. Today, seals and other marine mammals are valued components of marine ecosystems and their numbers are carefully managed. To facilitate management, government statutes mandate the systematic monitoring of seal populations. Population estimates are based on counts of hauled-out seals obtained by aerial survey and radio and satellite telemetry; hence, considerable effort has been devoted to finding optimal times for such counts. We have developed a predictive mathematical model of seal haul-out to assist resource managers in the selection of optimal census times.

2. Haul-out depends on a number of environmental variables. Some of these variables, such as wind speed, can be obtained only as historical data or short-range predictions. Others, such as tide height, are deterministic and can be obtained as long-range predictions.

3. We used deterministic environmental variables to develop mathematical models that describe haul-out dynamics of harbour seals *Phoca vitulina* during the pupping season at a site in Washington, USA. A list of alternative hypotheses for environmental cues gave rise to a suite of competing models. We used information-theoretic model selection techniques to choose the best model. The selected model was a function of tide height and current direction, and explained 40% of the variability in hourly census data.

4. An assumption that the system recovers rapidly after disturbance introduced two timescales. This allowed the differential equation model to be reduced to an algebraic equation.

5. Synthesis and applications.

This study demonstrates that resource managers can use a simple algebraic equation based on deterministic environmental variables to predict times at which to census maximal haul-out in harbour seals. At the Washington site, maximal daily haul-outs during pupping season are predicted to occur during receding tides, approximately midway between high and low tides. The largest maximal daily haul-outs during the pupping season are predicted to occur in the last week of July. The environmental factors correlated with haul-out are, however, site-specific; therefore the model developed for the Washington site will not necessarily hold for other haul-out areas. Managers should carry out the model selection procedure separately for each monitored haul-out site. The general methodology employed in this study can be used to make long-range predictions of diurnal movements for a variety of marine birds and mammals.

Jansen JK, Bengtson JL, Dahle SP, Ver Hoef JM. 2006. Disturbance of harbor seals by cruise ships in Disenchantment Bay, Alaska: an investigation at three spatial and temporal scales. AFSC Processed Report 2006-02. 7600 Sand Point Way NE, Seattle, WA 98115: *National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service*; 2006. p. 75.

Abstract

Cruise tourism in Alaska has been growing rapidly since the early 1970s. Over the last decade there has been increasing concern about possible impacts on sensitive coastal ecosystems. Attention has focused most recently on the possible effects of tour vessels, particularly cruise ships, on subsistence resources that have been critically important to Alaska Natives for many generations. Harbor seals that haul out year-round on floating ice near tidewater glaciers are one such resource of concern because their habitat is a popular destination for tourism. This study examined the potential effects of cruise ships on the behavior, abundance, and distribution of harbor seals in Disenchantment Bay, Alaska, from early May 2002, at the onset of seal pupping, to mid-August 2002, during the molting season. Analyses presented here of the behavioral observations – conducted from cruise ships – indicate that the likelihood of harbor seals vacating ice floes rose steeply when ships approached to less than 500 m; seals approached by a ship at 100 m were 25 times more likely to enter the water than seals approached at 500 m. Seals were also four times more prone to enter the water when ships approached them directly rather than passing abeam. The proportion of seals that entered the water when ships passed within 200 m was nearly 75% compared to less than 10% entering the water at distances where seals showed no apparent overt response to vessels (i.e., > 600 m). Analysis of aerial strip-transect sampling (by video playback) showed pronounced shifts in seal abundance, with a decline of 75% in mid-May during early pup-rearing. Abundance rebounded to peak levels in late June, as cruise ship traffic reached maximum levels. Sightings of mother-pup pairs also peaked in late June. Seal abundance then stabilized at near-peak levels from late June until the end of the study in early August. The decline in seal abundance in mid-May was already underway at the first cruise ship entry. Seal abundance then steadily increased in concert with increasing ship traffic, suggesting that changes in overall abundance were influenced by factors other than ship presence, such as constraints related to pupping and breeding, or other environmental variables. Space-time statistical models of the effect of environmental and cruise ship covariates on seal abundance and distribution were conducted in two stages: one model to assess effects on the distribution of seals (i.e., absence-presence in a grid); the other to assess effects on seal abundance in grid cells where seals occurred. The two models showed that ice cover was a dominant factor with seals tending to occur at the highest frequency and in higher numbers in intermediate ice cover (i.e., 50-70% coverage by area). Mother-pup pairs showed similar patterns with regard to the type of ice cover. Other natural variables, such as precipitation, wind speed, and the area of ice habitat available to seals, did not have a measurable effect on the abundance or distribution of the pooled seals or mother-pup pairs. Measures of ship traffic, including time spent at closest approach and number of ship visits occurring on the 3 days prior to a survey, did not have a statistically measurable effect on the abundance of all seals or mother-pup pairs. A negative relationship between ships' closest approach distance and both seal abundance and distribution (i.e., more seals at shorter distances) is likely the result of close spatial overlap between ships and seals in conjunction with no obvious avoidance by seals of areas used by ships. However, increased time that ships spent at their closest approach coincided with tighter distributions of harbor seals with no detectable change in abundance. This suggests that seals aggregated more closely with increasing ship presence. Such findings are consistent with other studies of marine mammals that show denser aggregations during periods of disturbance. Coupled with no

apparent negative effect of ship distance on seal abundance (e.g., no short-term avoidance of areas used by ships), these findings suggest the seals' aggregation response is independent of proximity to ship areas and thus appears to occur at distances greater than the 500 m threshold suggested by the shipboard observations. The seasonal comparison of seal abundance between Disenchantment Bay and nearby Icy Bay, where cruise ships are reportedly rare, showed some pronounced differences. The maximum total count at Icy Bay was reached in August (5435) during molting, with numbers having steadily increased from lower counts in May (1011) and June (2543) during early to mid-pupping. In contrast, the peak count at Disenchantment Bay (2149) occurred in June at mid-pupping with numbers falling slightly through July (1786) and August (1778). The different seasonal patterns suggest that comparable numbers of seals use the two sites during pupping but that only a third to half the number of seals use Disenchantment Bay during the molting period. Information about the actual movement of seals, possibly between the two sites, in relation to natural and anthropogenic factors would aid in interpreting these patterns.

Jezierski, C. 2009. The impact of sea kayak tourism and recreation on harbor seal behavior in Kenai Fjords National Park: integrating research with outreach, education, and tourism. M.S. thesis, 69 p. *Univ. Alaska Fairbanks, Fairbanks, AK.*

Increasing numbers of sea kayakers in Kenai Fjords National Park, Alaska prompted a study to evaluate human disturbance on harbor seals. Harbor seal behavior recorded during the molt from 2004- 2006 via remotely controlled cameras and direct field observations were used to evaluate effects of human activities. Behaviors of the seals observed in the presence and absence of kayakers walkers were contrasted by method of collection, year, presence of humans, presence of a guide, and guide training. Results demonstrated that harbor seals abandoned the ice and were more alert when kayakers were present than when humans were absent. Harbor seals became progressively sensitive to the presence of walkers. Sea kayak guides were advised to observe seal behavior and minimize contact by avoiding areas with high concentrations of hauledout seals. Educational training provided to sea kayak guides effectively reduced the impact of human disturbance on harbor seals.

Johnson W.M. and Lavigne DM. 1999. Mass tourism and the Mediterranean monk seal. *The Monachus Guardian* 22: 1.30.

Mass tourism has been implicated in the decline of the Mediterranean monk seal (*Monachus monachus*) since the 1970s, when scientists first began reviewing the global status of the species. Since then, the scientific literature, recognising the inexorable process of disturbance and loss of habitat that this economic and social activity has produced along extensive stretches of Mediterranean coastline, has consistently identified tourism as among the most significant causes of decline affecting this critically-endangered species. Despite apparent consensus on this point, no serious attempt has been made to assess the tourist industry's role, or to acknowledge and discuss its moral and Financial responsibility, in the continuing decline and possible future extinction of *M. monachus*. In view of this, we undertook a review of existing literature to identify specific areas in which tourism has impacted the Mediterranean monk seal. Our results provide compelling evidence that mass tourism has indeed played a major role in the extirpation of the monk seal in several European countries, that it continues to act as a significant force of extinction in the last Mediterranean strongholds of the species, and that the industry exerts a generally negative influence on the design and operation of protected areas in coastal marine habitats. There are compelling reasons to conclude that unless the tourist industry can be persuaded to become an active and constructive partner in monk seal conservation initiatives, it will eventually ensure the extinction of the remaining monk seals in the Mediterranean.

Kovacs KM and Innes S. 1990. The impact of tourism on harp seals *Phoca groenlandica* in the Gulf of St. Lawrence, Canada. *Appl. Anim. Behav. Sci.* 26:15.26.

Abstract

This study investigated the impact of tourism on the behaviour of female harp seals (*Phoca groenlandica*) and their pups during the whelping seasons of 1986 and 1987 in the Gulf of St. Lawrence, Canada. The seals' behaviour during and after visits by tourists was compared with behaviour observed at undisturbed sites. Virtually all aspects of the behaviour of mothers and pups were significantly affected by the presence of tourists. Female attendance was significantly reduced and those females that remained with their pups when tourists were present spent significantly more time alert and less time nursing their pups. Pups were more active with tourists present, resting less and changing location more frequently. Pups also spent significantly more time alert and engaged in agonistic behaviour. When tourists approached to within 3 m or touched pups, the young seals frequently exhibited a freeze response which was observed only in this context. Pup age and tourist behaviour affected the degree of disturbance. After the tourists departed, most females returned to their pups promptly and behaviour characteristic of undisturbed situations usually resumed within 1 h.

Kriebler, M. & Barette, C. 1984. Aggregation behaviour of Harbour seals at Forillon national park, Canada. *Journal of Animal Ecology* 53: 913-928.

Abstract

(1) In order to explain the aggregation behaviour of harbour seals (*Phoca vitulina*) at their landing sites, two possibilities were investigated: grouping in response to resting site distribution, or in response to changes in individual time-energy budget. (2) To verify if seals aggregated according to the distribution of their landing sites, we studied their site selection. Although seals select sites with distinctive features, they frequented only those whose area was sufficient or that were close enough to other suitable sites to hold a tight resting group. Hence, the distribution of landing sites was ruled out as the sole factor explaining aggregation. (3) By a closer look into time budgeting, we found that membership in a group generated an individual benefit. This takes the form of an increased time allocation to sleep in larger and tighter groups. While individual scanning rate decreased with group size and proximity, overall vigilance increased with group size and decreased with proximity. Although evidently desiring to join larger and tighter groups, seals saw their density regulated on each site by aggressive interactions. Rate of aggressive interaction did not vary with density, but the proportion leading to departures increased with density. No fighting advantage was found in larger size, but the first animal to land on the site was generally the winner. (4) Changes in the landing behaviour in relation to weather were consistent with other studies. However, seasonal weather trends could not fully explain the increase in group size from spring to autumn, during which time the proportion of used space remained roughly constant

McConnell, B. J., M. A. Fedak, P. Lovell and P. S. Hammond. 1999. Movements and foraging areas of grey seals in the North Sea. *Journal of Applied Ecology* 36:573-590.

Summary

1. Grey seals *Halichoerus grypus* Fab. are large, numerous marine top predators. Fears concerning competition with fisheries have prompted calls for control measures. However, little is known about the areas where grey seals forage or the distances they may travel.
2. The movements of 14 grey seals caught at the Farnes in north-east England (12) and Abertay in eastern Scotland (2) between August 1991 and July 1993 were investigated using Argos Satellite Relay Data Loggers (SRDLs). A total of 1461 seal days of location and behavioural data (mean 104.3 days per seal) covered all months of the year except February and March.
3. The seal movements were on two geographical scales: long and distant travel (up to 2100 km away); and local, repeated trips from the Farnes, Abertay and other haul-out sites to discrete offshore areas.
4. Long distance travel included visits to Orkney, Shetland, the Faroes, and far offshore into the Eastern Atlantic and the North Sea. During travel the seals moved at speeds of between 75 and 100 km day⁻¹ (0.87 and 1.16 m s⁻¹). Most of the time, long distance travel was directed to known haul-out sites. The large distances travelled indicate that grey seals that haul out at the Farnes are not ecologically isolated from those at Orkney, Shetland and the Faroes.
5. In 88% of trips to sea, individual seals returned to the same haul-out site from which they departed. The durations of these trips were short (mean 2.33 days) and their destinations at sea were often localized areas characterized by a gravel/sand seabed sediment. This is the preferred burrowing habitat of sandeels, an important part of grey seal diet. This, and the fact that dives in these areas were primarily to the seabed, leads us to conclude that these were foraging areas. The limited extents of return-trips from a haul-out site (mean 39.8 km) suggest that the direct impact of seal predation may be greater on fisheries within this coastal zone, especially those near seal haul-out sites, rather than on fisheries further offshore.
6. An average of 43% of all the seals' time was spent within 10 km of a haul-out site, although localized foraging areas were identified considerably further offshore. Proximity to a haul-out may provide safety from predation. Alternatively, these periods may be used for rest or social interaction, or we may be underestimating foraging activity near haul-out sites.
7. We suggest that the movement patterns observed in this study may persist through time and across the grey seals which haul-out at the Farnes. We also suggest that a study such as this could be combined with diet studies and haul-out censuses to map foraging intensity. Such information is an essential component of seal–fishery interaction models, upon which management decisions should be based.

Miller K and Irving L. 1975. Metabolism and temperature regulation in young harbour seals *Phoca vitulina richardi*. *Am. J. Physiol.* 229: 506-511.

Abstract

Metabolism and the ability to regulate core and peripheral temperatures under a variety of ambient conditions were studied in five unrestrained pups (less than 5 wk old) and four 3- to 5-mo-old harbor seals. Pups born with nonlanugo (adultlike) hair and little fat were able to swim in 5 degrees C water for several hours without becoming hypothermic. They were also found to tolerate 5 degrees C air temperature with the fur wet and exposed to a 35-knot wind. Basal metabolism in pups averaged 0.8 ml O₂ g⁻¹ h⁻¹, which is 2.6 times the predicted value for an adult mammal of the same weight. Lower critical temperature in air was about 3 degrees C. Oxygen uptake in 3- to 5-mo-old seals under basal conditions was 0.5 ml g⁻¹ h⁻¹. Minimal thermal conductance values were .02 and .015 ml O₂ g⁻¹ h⁻¹ degrees C⁻¹ in pups and 3- to 5-month-old seals, respectively. Appendages, and to a lesser extent the skin on the torso, cooled appreciably at lower air temperatures, and the flippers were kept just above freezing in subzero air. Tissue insulation provided by low peripheral temperatures and a high resting metabolic rate enable newborn and developing harbor seals to tolerate the low temperatures encountered in their natural environment.

Paterson W, Sparling CE, Thompson D, Pomeroy PP, Currie JI and McCafferty DJ. 2012. Seals like it hot: changes in surface temperature of harbour seals *Phoca vitulina* from late pregnancy to moult. *J. Thermal Biol.* 37: 454.461.

Abstract

The annual moult in [harbour seals](#) (*Phoca vitulina* L.) follows a few weeks after the end of [lactation](#) and is characterised by a progressive loss and regrowth of hair which is apparent over a 4–6 week period. It is thought that during the moult harbour seals increase the time spent ashore as an adaptation to avoid additional energy costs associated with blood flow to the skin surface. The aim of this study was to determine the extent to which harbour seals regulated their surface temperature in order to maximise hair regrowth during the moult. The surface temperatures of two female harbour seals were recorded in captivity from late pregnancy to completion of the moult using infrared [thermography](#). In this study, animals hauled out (exited the water onto land) more frequently during lactation and throughout the moult. Compared to the premoult period the temperature difference between body surface and air temperature (dT) showed a ~ 10 °C elevation at the peak of the moult. Also, during the moult reached a higher maximum at a faster rate over a two hour haul-out period. Heat loss was estimated to increase during the moult and was equivalent to an approximate doubling of [resting metabolic rate](#). It was therefore evident that harbour seals minimise the energetic cost of the moult by hauling out so that they can maintain optimal high skin surface temperature for hair growth. Human disturbance at haul-out sites that causes animals to enter the water during the moult may have consequences for harbour seals for two reasons. Firstly, reduced time spent ashore in optimal conditions for hair regeneration may prolong the duration of the moult and secondly, repeatedly forcing animals into the water when their skin temperature is high will incur an energetic cost.

Highlights

► We model heat loss from female harbour seals during pregnancy and the moult. ► A peak in body surface temperature during the moult shows energetic cost. ► Animals showed an increased tendency to haul out during lactation and the moult. ► Body surface temperature reached a higher maximum at a faster rate during the moult.

Pauli, B.D. & J.M. Terhune 1987. Tidal and temporal interactions on harbour seal haul out patterns. *Aq. Mamm. 13*: 93-95.

Abstract

The numbers of harbour seals (*Phoca vitulina*) on haul-out site, in an area of large tidal amplitude, were examined for 2 summers. Daily, pre- and post-pupping, and between year differences occurred in the numbers of seals present and their hauling patterns. When the numbers were analyzed as a proportion of the maximum daily count, a temporal variation superimposed on the tidal patterns was observed. In the morning, seals hauled-out earlier in the tidal cycle, and in the greater numbers, when low tide occurred in the afternoon. Censuses for harbour seals on haul-out sites should be conducted during afternoon low tides.

Tidal and temporal interactions on harbour seal haul-out patterns. Available from: https://www.researchgate.net/publication/317349314_Tidal_and_temporal_interactions_on_harbour_seal_haul-out_patterns [accessed Oct 24 2017].

London JM, Ver Hoef JM, Jeffries SJ, Lance MM, Boveng PL (2012) Haul-Out Behavior of Harbor Seals (*Phoca vitulina*) in Hood Canal, Washington. *PLoS ONE* 7(6): e38180. doi:10.1371/journal.pone.0038180

Abstract

The goal of this study was to model haul-out behavior of harbor seals (*Phoca vitulina*) in the Hood Canal region of Washington State with respect to changes in physiological, environmental, and temporal covariates. Previous research has provided a solid understanding of seal haul-out behavior. Here, we expand on that work using a generalized linear mixed model (GLMM) with temporal autocorrelation and a large dataset. Our dataset included behavioral haul-out records from archival and VHF radio tag deployments on 25 individual seals representing 61,430 seal hours. A novel application for increased computational efficiency allowed us to examine this large dataset with a GLMM that appropriately accounts for temporal autocorrelation. We found significant relationships with the covariates hour of day, day of year, minutes from high tide and year. Additionally, there was a significant effect of the interaction term hour of day : day of year. This interaction term demonstrated that seals are more likely to haul out during nighttime hours in August and September, but then switch to predominantly daylight haul-out patterns in October and November. We attribute this change in behavior to an effect of human disturbance levels. This study also examined a unique ecological event to determine the role of increased killer whale (*Orcinus orca*) predation on haul-out behavior. In 2003 and 2005 these harbor seals were exposed to unprecedented levels of killer whale predation and results show an overall increase in haul-out probability after exposure to killer whales. The outcome of this study will be integral to understanding any changes in population abundance as a result of increased killer whale predation.

Perry EA and Renouf D. 1987. Further studies of the role of harbour seal *Phoca vitulina* pup vocalizations in preventing separation of mother-pup pairs. *Can. J. Zool.* 66: 934.938.

Abstract

Calls of harbour seal (*Phoca vitulina*) pups, propagated simultaneously in air and underwater while the pups' heads were above the surface of the water, were recorded to examine in detail the differences between them and to determine if both versions are individually distinct. Although the airborne and underwater versions of the calls were different from one another, they were distinct for each pup on the basis of several physical parameters, primarily the frequency of the major harmonic. Interactions between the mothers and pups at the time of calling were observed to assess the role of the cries in maintaining mother-pup contact. Analysis of the variations in vocalizations and contextual data supported the hypothesis that the mothers use these vocalizations for individual recognition of their offspring and for ensuring that contact with them is maintained. It is postulated that differences between the aerial and underwater versions of calls increase the accuracy with which the mothers can locate their pups

Pitcher KW, McAllister DC. 1981 Movements and haulout behavior of radio-tagged harbor seals, *Phoca vitulina*. *Canadian Field-Naturalist*. 1981

Abstract:

Movements, haulout area fidelity and haulout frequency of harbor seals (*Phoca vitulina*) were studied in the Kodiak Island area, Alaska by relocating radio-tagged animals captured on a large hauling area.

Eight of 35 radio-tagged seals were found on hauling areas other than the capture site. The longest movement was 194 km.

One seal crossed 74 km of open ocean. Movement rates up to 27 km/day were recorded.

There appeared to be considerable fidelity to one or two specific Haulout locations by individual radio-tagged animals. "Resident," radio-tagged seals of a large hauling area were hauled out during 50% of the daily radio checks in June and 41% from 1 August to 5 September. On an individual basis, frequency of haulout ranged from 16% to 80% of the days.

Pomeroy PP, Twiss SD, Duck CD 2000 Expansion of a grey seal *Halichoerus grypus* breeding colony: changes in pupping site use at the Isle of May, Scotland. *Journal of Zoology* 250:1-12

Abstract

Until the mid 1970s only a few grey seal *Halichoerus grypus* pups were born each year on the Isle of May, Scotland, but 1408 pups were born there in 1994. We examined changes in overall site use, individual pupping site fidelity and success in relation to local population density and topography. The area of the island used by seals for breeding has increased as the population increased. Between 1988 and 1994 an index of the proportion of the island's northern area occupied by seals increased from 0.48 to 0.65, while the average population density in these occupied areas decreased over the same period. Although seals have begun to breed in southern parts of the island that were unused previously, other apparently suitable breeding areas on the island remain vacant. Fine scale digital elevation models were constructed using a GIS to evaluate the topographic characteristics of occupied areas and assign topographic 'costs' to areas used by seals for breeding on the Isle of May. Seals were associated generally with areas close to the numerous access points from the sea. New areas occupied in the later years of the study had a higher topographical 'cost' than the traditional sites. Thus, in an expanding colony such as the Isle of May, areas colonized early in the colony's history were those close to access points and/or standing water and at low elevations. Subsequent expansion resulted in an increase in the areas occupied by seals, but these newly colonized areas were less suitable, and their occupiers were subject to increased topographic 'costs'. Pup mortality rates were similar in areas of high and low breeding density. Aggressive behaviour between breeding females is the likely mechanism which acts to limit local animal density. Mothers marked at the Isle of May since 1987 returned there to breed with few exceptions, and most females that returned were faithful to their previous pupping sites (median distance between sites used in consecutive breeding seasons = 25 m). Site fidelity persisted even when a previous pupping was unsuccessful and most individuals' pupping locations did not change gradually with time. Comparison with other colonies suggests that the spatial scale of site fidelity is related to the scale of topographic variation within the breeding site.

Ramasco, V. 2008. Habitat Use and Feeding Behaviour of Harbour Seals *Phoca vitulina* in Vesterålen. *Norwegian College of Fishery Science University of Tromsø.*

Abstract

A pilot project was carried out by the Institute of Marine Research (IMR) to test the functionality of GPS phone tags (by SMRU) on harbour seals (*Phoca vitulina*) in the Vesterålen archipelago, Norway. Acoustic surveys were performed to investigate the abundance of fish in these waters and scat sampling was used to assess the diet composition of the seal population inhabiting the area. Five juvenile females were tracked between August 2007 and March 2008 and their diving behaviour and habitat use was studied. The dive profiles recorded from the tags were classified in the attempt to identify the dives connected with feeding behaviour. The tagged seals foraged close to the coast and at relatively shallow depths (50% of the dives between 12-32 m) showing marked individual differences in the choice of feeding grounds. Analysis of scat sampling suggested that gadoids dominated the diet (62%) followed by herring (*Clupea harengus*) (35%). Comparison between the abundance of fish species in the study area and in the diet composition indicated that harbour seals have no prey preference. Harbour seals appeared to prey on small size classes of gadoids. Therefore fish size, rather than species, could be a potential selection criterion in foraging. The local abundance of fish in the area is likely to allow harbour seals to feed on what is available close to the haul out sites. Targeting of small size classes might therefore be a consequence of habitat selection based on accessibility rather than size selection.

Reijnders, P. J. H. 1978. Recruitment in the Harbor Seal *Phoca vitulina* Population in the Dutch Wadden Sea. *Journal of Sea Research* 12:164-179.

Abstract

During 1974 to 1978 population dynamics of the harbour seal population in the Dutch Wadden Sea have been studied. Frequent aerial surveys provided data upon the size of the population. During boat trips information about the age composition was obtained by measuring track widths. These data have been used in a simulation model to calculate the birth rate and the initial juvenile mortality.

It was found (1.) that the initial juvenile mortality in the Dutch population is higher than that in Schleswig Holstein; (2.) that pup production in the Dutch population is low compared to the population in Schleswig Holstein if the ratio adult females to males in the Dutch population is supposed to be equal to that in Schleswig Holstein, or that mortality amongst adult females in the Dutch population is higher than in Schleswig Holstein; (3.) that the number of subadults in the Dutch population is relatively high compared to a stable population (Schleswig Holstein) and that apparently immigration from elsewhere occurs; (4.) that the reproductive rate was higher or the juvenile mortality lower during 1974 to 1978 than in the preceding decennium.

Reijnders, P. J. H. 1980 Management and conservation of the harbour seal, *Phoca vitulina*, population in the international Wadden sea area. *Biol. Conserv.* 19, 213-221.

Abstract

A population assessment of the harbour seal in the international Wadden Sea area was carried out. The results show that the populations in the different areas must be considered as one entity. Therefore management and conservation measurements should be placed in an international context. Because of the low pup production in the Dutch area the survival of a harbour seal population in the Dutch Wadden Sea depends on migration from the adjacent areas as long as adverse environmental factors, i.e. pollution and disturbance, are not under control.

Reijnders, P.J.H., S.M.J.M. Brasseur & A.G. Brinkman 2000. Habitatgebruik en aantalsontwikkelingen van gewone zeehonden in de Oosterschelde en het overige Deltagebied. *Alterra rapport 078, ISSN 1566-7197. Alterra, Wageningen, The Netherlands, 56 pp.*

Conclusies

De eerste vraagstelling van dit onderzoek heeft betrekking op het al dan niet bestaan van een tijdvenster in een bepaald getijde waarbinnen men door de Oliegeulgebied zou kunnen varen zonder dat hierbij de zeehonden beïnvloed worden. Dit onderzoek toont aan dat 20% van de waarnemingen van de gezenderde zeehonden binnen een straal van 1,26-1,91 km van de Oliegeul vallen, en dat 50% van de data binnen een straal van 3,25-3,43 km wordt gelocaliseerd. Dat geldt vrijwel gelijk voor laagwater en hoogwater. Hieruit moet worden geconcludeerd dat het Oliegeulgebied van vitaal belang is voor de dieren en dat er niet zonder meer een tijdvenster voor doorvaart zonder risico's voor effecten op de zeehonden kan worden aangewezen.

Daarnaast is uit de gepresenteerde data gebleken dat de belangrijkste ligplaatsen voor de dieren in de Oosterschelde zich in dit Oliegeulgebied bevinden. De gedragswaarnemingen suggereren dat het huidige niveau van verstoring (nu per vergunning geregeld) al een effect heeft op de dieren wanneer zij gebruikmaken van de ligplaats op de Roggenplaat-werkhaven.

Het duikgedrag van de zeehonden in de Oosterschelde lijkt niet fundamenteel verschillend van die in de Waddenzee hoewel een relatief groter deel van de tijd ondiep (<10 m) gedoken wordt. Dit ondanks het feit dat de Oosterschelde gemiddeld dieper is dan het gebied waar in de Waddenzee en de aangrenzende Noordzee gemeten is.

Als laatste valt op dat ondanks de mogelijkheid om door de kering te zwemmen de dieren niet vaak de Noordzee opgaan. Hieruit kan worden geconcludeerd dat de Oosterschelde voldoende mogelijkheden biedt voor de dieren om te foerageren.

Reijnders, P.J.H., S.M.J.M. Brasseur, and E.H.W. Meesters. 2010 Earlier pupping in harbour seals, *Phoca vitulina*, *Biology letters* 2010. 66: p. 854-857.

Abstract

The annual reproductive cycle of most seal species is characterized by a tight synchrony of births. Typically, timing of birth shows little inter-annual variation. Here, however we show that harbour seals *Phoca vitulina* from the Wadden Sea (southeast North Sea) have shortened their yearly cycle, moving parturition to earlier dates since the early 1970s. Between 1974 and 2009, the birth date of harbour seals shifted on average by -0.71 d yr^{-1} , three and a half weeks (25 days) earlier, in the Dutch part of the Wadden Sea. Pup counts available for other parts of the Wadden Sea were analysed, showing a similar shift. To elucidate potential mechanism(s) for this shift in pupping phenology, possible changes in population demography, changes in maternal life-history traits and variations in environmental conditions were examined. It was deduced that the most likely mechanism was a shortening of embryonic diapause. We hypothesize that this could have been facilitated by an improved forage base, e.g. increase of small fishes, attributable to overfishing of large predator fishes and size-selective fisheries.

Reiman AJ and Terhune JM. 1993. The maximum range of vocal communication in air between a harbour seal *Phoca vitulina* pup and its mother. *Mar. Mamm. Sci.* 92: 182.189.

Abstract: The transmission losses with distance of four pure tones (0.5, 1, 2, 4 kHz) were measured in the air 9 cm above the surface of the coastal waters in the Bay of Fundy. The study was conducted between May and July 1992, on warm days with low winds. The measured transmission losses were as much as 11 dB less than predicted by spherical spreading (6 dB/distance doubled), at 400 m (0.5 kHz). This enhanced sound transmission is probably due to the air temperature profile which increases with height above the water's surface. Such a profile causes sound waves to refract towards the water, thereby reducing spreading losses. High-frequency sound absorption negates enhanced transmission at 4 kHz, at distances over 500 m. On days with low winds and low ambient noise levels, a seal pup calling at 90 dB re 20, μ Pa at 0.5 kHz should be detectable by the mother up to 1 km away, and may be audibly recognizable up to 140 m away.

Renouf D. 1984. The vocalization of the harbour seal pup *Phoca vitulina* and its role in the maintenance of contact with the mother. *J. Zool., Lond.* 202: 583.590.

Abstract

The Harbour seal pup is predisposed to follow its mother's movements which helps to ensure that the pair stays together. The mother monitors her pup's following and it is argued in this paper that she does so primarily by listening to the frequent, individually characteristic vocalization of her pup. This call can be produced in air and water simultaneously and as such could serve as a precise location mechanism.

Renouf, D., J. Lawson, and L. Gaborko. 1983. Attachment between harbour seal *Phoca vitulina* mothers and pups. *J. Zool.* 199:179-187.

Abstract

Behavioural interactions between Harbour seal mothers and pups at Miquelon revealed that the following behaviour of the pup generally ensures that the pair stay together, though the mother takes over this rôle when necessary. This relationship held true when the animals were hauled out on the sandflats, and when they were in the water. Our results imply, contrary to suggestions in the literature, that the pup is able to distinguish its mother from other females. The tendency of the pup to follow its mother is discussed in the context of imprinting as a bonding mechanism.

Shaughnessy PD, Nicholls AO and Briggs SV. 2008. Do tour boats affect fur seals at Montague Island, New South Wales? *Tourism in Marine Environments* 51: 15.27.

Abstract

Interactions between fur seals (*Arctocephalus pusillus doriferus* and *A. forsteri*) and tour boats at Montague Island were investigated between November 1997 and November 1998. The fur seals were in four haul-out sites, which are referred to here as colonies. The study was instigated by the management requirement of the National Parks and Wildlife Service of New South Wales to determine effects of disturbance from tour boats on the fur seal colonies. At each of 84 inspections, distance between the boat and the colony was measured and seal behavior (or response) was recorded 11 times at 15-second intervals as the boat moved toward the seals. This period of 2.5 minutes was approximately the time tour boats stayed at a colony. Behavior of the fur seals ashore was recorded in four categories of increasing disturbance from "Resting" to "Many moving." From analyses using multinomial models, the probability of observing a given response by the fur seals and the pattern of the responses as a function of distance from the colony were both influenced by the colony under observation. In general, fur seals' responses were significantly correlated with distance between the study boat and the colony, and with the size of the colony (i.e., number of fur seals visible ashore). In all cases, the probability of the colony remaining in the "Resting" category decreased as the distance between the colony and the study boat decreased. Similarly the probability of the colony showing the maximum response ("Many moving") increased as the distance decreased. The probability of New Zealand fur seals "Resting" was higher than for Australian fur seals. Tour boats approaching the colonies had a relatively small effect on the fur seals; few or none of them ran to the sea. Based on results from this study, we recommended that the minimum approach distance of tour boats to the fur seal colonies at Montague Island should be 40 m; other recommendations involved how tour boats approach the fur seal colonies. The former has been gazetted as a government regulation and the other recommendations have been incorporated into the license conditions for the tour boats operators.

Do Tour Boats Affect Fur Seals at Montague Island, New South Wales? (PDF Download Available). Available from:

https://www.researchgate.net/publication/233591717_Do_Tour_Boats_Affect_Fur_Seals_at_Montague_Island_New_South_Wales [accessed Oct 24 2017].

Simpkins, M. A., D. E. Withrow, J. C. Cesarone, and P. L. Boveng. 2003. Stability in the proportion of harbor seals hauled out under locally ideal conditions. *Mar. Mamm. Sci.* 19:791-805.

Abstract

We monitored the haul-out behavior of 68 radio-tagged harbor seals (*Phoca vitulina*) during the molt season at two Alaskan haul-out sites (Grand Island, August-September 1994; Nanvak Bay, August-September 2000). For each site, we created a statistical model of the proportion of seals hauled out as a function of date, time of day, tide, and weather covariates. Using these models, we identified the conditions that would result in the greatest proportion of seals hauled out. Although those “ideal conditions” differed between sites, the proportion of seals predicted to be hauled out under those conditions was very similar (81.3% for Grand Island and 85.7% for Nanvak Bay). The similar estimates for both sites suggest that haul-out proportions under locally ideal conditions may be constant between years and geographic regions, at least during the molt season.

Stafford-Bell R, Scarr M and Scarpaci C. 2010. Behavioural responses of the Australian fur seal *Arctocephalus pusillus doriferus* to vessel traffic and presence of swimmers in Port Phillip Bay, Victoria, Australia. *Aquatic mammals* 383: 241.249.

Abstract: A largely unregulated seal-swim industry exists in Port Phillip Bay, Victoria, Australia. This study has documented four fur seal behaviours in response to vessel traffic and presence of swimmers in order to determine the impact of tourism activities on Australian fur seals (*Arctocephalus pusillus doriferus*). Behavioural responses of fur seals to the presence of a total of 135 vessels (tour = 61 and recreational = 74) were collected on 42 research trips over the peak austral summer tourist period (November 2007 to February 2008). After considering all studied variables, vessel distance, the number of swimmers undertaking seal-swim activities, and the number of recreational vessels were found to influence seal behaviour. Aggressive behaviour displays by fur seals were influenced by the presence of recreational vessels within close proximity to the study site (< 200 m); haul-out events initially increased as a result of the presence of swimmers undertaking seal-swim activities; and occurrences of fur seals entering the water increased in response to the distance of approaching tourism vessels to the study site. Statistical analyses found no clear indicator influencing the number of threat postures displayed by fur seals. While a weak linear relationship was identified between the indicators (i.e., presence of recreational vessels, presence of swimmers, and the distance of tour vessels) and the three behaviours displayed by fur seals, *post hoc* tests failed to achieve significantly different means for each of the indicators. This preliminary research into the impact of swim-with tourism upon *A. pusillus doriferus* will provide valuable baseline data for the future. The long-term research into the effects of this particular tourism industry on fur seal behaviour may ensure wildlife managers develop appropriate regulations for seal tourism interactions that promote a sustainable marine tourism industry within Port Phillip Bay.

Stein, J.L. 1989. Reproductive parameters and behavior of mother and pup harbor seals, *Phoca vitulina richardsi*, in Grays Harbor, Washington. *M.S. thesis, San Francisco State Univ., San Francisco, CA, 110 p.*

Abstract

The timing of reproductive events and the behavior of mother and pup harbor seals were studied at a nursery site in Grays Harbor, Washington during the 1984-1986 pupping seasons. Pregnant females began arriving during the first week of May. The peak number of births occurred between 13-26 May and the maximum numbers of both total seals and pups were counted during the week of 3-9 June. By the third week of July, all seals had left the study area.

Haulout patterns of mothers and pups were influenced by both diurnal and tidal factors. Maximum numbers of mothers and pups were hauled out during tide heights less than 1.0 ft. in the morning or early afternoon.

Pups spent more time sleeping, in locomotion, and nosing than mothers.

As pups matured, they spent more time comforting and began using agonistic behaviors. Older pups spent a greater percentage of their time nursing while on the hauling grounds and suckled for longer continuous stretches than younger pups. Mothers spent more time resting alert than pups, but the percentage of time in this behavior decreased as pups matured. Once weaned, the amount of time pups spent resting alert increased significantly.

Daily haulout duration of radio-tagged females decreased as pups matured and separations of increased distance and duration were noted for marked pairs as weaning approached. The length of the nursing period varied considerably between pairs (15-18 days to >36-39 days), as did the abruptness of weaning. Movements of radio-tagged females out of Grays Harbor were not documented until after pups were weaned.

Radio-tagged weaned pups appeared to spend more time in the water than adult females. Post-pupping season dispersal of weaned pups to estuaries south of Grays Harbor was similar to that documented for adult females.

Stevens, M.A., and D.J. Boness. 2003. Influences of habitat features and human disturbance on use of breeding sites by a declining population of southern fur seals *Arctocephalus australis*. *Journal of Zoology* 260:145-152.

Abstract

Southern fur seals *Arctocephalus australis* in Peru have declined gradually over the past decade, and declined dramatically (72%) as a result of low food availability during the severe El Niño in 1997–98. In 1999, seals abandoned some historically important breeding sites. This is particularly alarming because new sites were not colonized. Our objective was to examine how habitat features and human disturbance influenced whether sites were currently used, abandoned or apparently not used in the past by fur seals for breeding. Data were collected on 14 variables at 70 potential breeding sites at three guano reserves in Peru. Discriminant analysis revealed significant multivariate differences among sites currently used for breeding, abandoned sites and unused sites ($F=5.97$, $P<0.00001$), and the model classified 74% of sites correctly. Currently used sites were less likely to have human disturbance and more likely to have offshore islands, stacked rocks, tide pools and abundant shade. Separate discriminant analyses for each reserve produced similar results. Habitat associated with thermoregulation (e.g. shade or pools) may be more important to fur seals in Peru, which breed at lower latitudes and are at greater risk of overheating on land than other populations. Habitat with minimized human access may be especially important to seals in small populations in which individuals may perceive themselves as more vulnerable because of decreased vigilance and dilution effects. Seals in our study selected breeding habitat with stacked rocks, which create shade and tide pools for thermoregulation and make human access difficult; but pups might suffer higher mortality in this habitat. We hypothesize that fur seals in Peru may exhibit an Allee effect, whereby suitability of habitat varies with population abundance.

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Terhune JM and Brillant SW. 1996. Harbour seal vigilance decreases over time since haul out. *Anim. Behav.* 51: 757.763.

Abstract

The hypothesis was examined that vigilance of harbour seals, *Phoca vitulina*, on haul-out sites decreases with time since haul out. The study was conducted in the Bay of Fundy, Canada, where the seals haul out onto newly exposed rocky ledges on falling tides. Initial scanning time of newly hauled-out harbour seals during the first 3 min after haul out decreased as group size increased. The scanning times of individual seals significantly decreased over time since haul out. Alternating observations (similar conditions for each pair of seals) showed that newly hauled-out seals scanned significantly longer than seals that were resident for over 30 min. Seals on the periphery of the group scanned significantly longer than those in the centre. Part of the scanning decrease of seals in larger groups was attributed to time since haul out and fewer animals being on the periphery of the group. The seals were 1.4 ± 0.6 (sd) body lengths from the water's edge and 1.6 ± 0.5 body lengths apart; 81% were oriented towards the water; this orientation and spacing allowed for ready access to the water. These behaviour patterns, and the high levels of vigilance, support an anti-predator function of harbour seal grouping on haul-out sites. 1996 The Association for the Study of Animal Behaviour.

Thompson, P. M. 1989. Seasonal changes in the distribution and composition of common seal *Phoca vitulina* haul-out groups. *Journal of Zoology* 217:281-294.

Abstract

Seasonal changes in the distribution and composition of common seal haul-out groups were followed in a study area in Orkney, Scotland. A marking programme was also undertaken, using both conventional and radio-tags, to study individual movements between sites and seasonal changes in site-use. Certain haul-out sites were used only in the breeding season, while others were used during the winter. Seals were seen at one site all year round and at another during only the pre-pupping and moult period. On one island where two sites were used during the summer, there were significant differences in the sex ratio of groups at the two sites: at one site males predominated and few pups were seen; on another, nearby, mothers and pups were regularly seen, although the site was also used by males. There was also evidence for segregation of the sexes outside the breeding season. Repeated observations of marked seals showed that seals used several different haul-out sites throughout the year, and that the seasonal changes in abundance at different sites resulted from individual changes in site-use. These changes in site-use are discussed in relation to feeding movements, breeding requirements and the physical characteristics of different sites.

Thompson, P. M., and Miller, D. 1990. Summer foraging activity and movements of radio-tagged common seals *Phoca vitulina* L. in the Moray Firth, Scotland UK. *Journal of Applied Ecology*, 27:492-501.

Abstract

Seals travelled up to 45 km from their haul-out sites on feeding trips of up to 6 days. Trip duration and foraging range were significantly correlated. At-sea locations were often clumped. Two of the 3 individuals returned regularly to particular feeding areas, apparently associated with habitats such as rocky reefs and offshore sandbanks. Spatial and temporal variations in the distribution of seals are discussed in relation to their breeding activity and to changes in food availability

Summer Foraging Activity and Movements of Radio-Tagged Common Seals (Phoca vitulina. L.) in the Moray Firth, Scotland. Available from:
https://www.researchgate.net/publication/236134188_Summer_Foraging_Activity_and_Movements_of_Radio-Tagged_Common_Seals_Phoca_vitulina_L_in_the_Moray_Firth_Scotland [accessed Oct 24 2017].

Thompson, P.M. 1989. Seasonal changes in the distribution and composition of common seal *Phoca vitulina* haulout groups. *J. Zool. London* 217: 281-294.

Abstract

Seasonal changes in the distribution and composition of common seal haul-out groups were followed in a study area in Orkney, Scotland. A marking programme was also undertaken, using both conventional and radio-tags, to study individual movements between sites and seasonal changes in site-use. Certain haul-out sites were used only in the breeding season, while others were used during the winter. Seals were seen at one site all year round and at another during only the pre-pupping and moult period. On one island where two sites were used during the summer, there were significant differences in the sex ratio of groups at the two sites: at one site males predominated and few pups were seen; on another, nearby, mothers and pups were regularly seen, although the site was also used by males. There was also evidence for segregation of the sexes outside the breeding season. Repeated observations of marked seals showed that seals used several different haul-out sites throughout the year, and that the seasonal changes in abundance at different sites resulted from individual changes in site-use. These changes in site-use are discussed in relation to feeding movements, breeding requirements and the physical characteristics of different sites.

Thompson, P.M., Fedak, M.A., McConnel, B.J. & Nicholas, K.S. 1989. Seasonal and sex-related variation in the activity patterns of common seals, *Phoca vitulina*. *Journal of Applied Ecology* 26: 521-535.

Abstract

Radio-telemetry was used to study common seal activity patterns around Orkney, and to assess the degree of individual, seasonal and sex-related variation in haul-out behaviour in 1984-86. (2) During the summer, both males and females hauled-out regularly, in a marked diurnal pattern, but there were differences in other aspects of their haul-out behaviour. (3) Males showed a marked change in their haul-out behaviour at the beginning of moult. At this time, they hauled-out every day and, consequently, male behaviour became more synchronous. The change in behaviour of the male followed in 1985 was closely related to changes in abundance at the haul-out site that he used over this period. (4) In contrast, females showed no sign of a similar change in behaviour at the beginning of moult, but appeared to spend more of their time at sea after lactation. (5) During the winter, seals appeared to spend more time in offshore waters, although they regularly returned to the inshore study area to haul-out. At this time of year there was no marked diurnal haul-out pattern. (6) There was a high degree of individual variation in the effect of the tidal cycle on activity patterns, which appeared to be related to tide-related changes in food and habitat availability. Overall, however, the tidal cycle had less effect on haul-out behaviour in summer, when strong circadian patterns were more important. (7) The variations in activity patterns found in this study are discussed in relation to seasonal changes in feeding activity and the demands of breeding and moult.

Tollit, D.J., Black, A.D., Thompson, P.M., Mackay, A., Corpe, H.M., Wilson, B., Parijs, S.M., Grellier, K. & Parlane, S. 1998. Variations in harbour seal *Phoca vitulina* diet and dive-depths in relation to foraging habitat. *Journal of Zoology*, 244, 209-222.

Abstract

We use information on the at-sea distribution of radio-tagged seals to identify the summer foraging areas used by 31 harbour seals from two different haul-out sites in the Moray Firth, N.E. Scotland. We then determine whether seals tend to occur over particular sediment types or water depths as hypothesized by Härkönen (1987*b*), and assess whether local geographical variations in diet composition can be related to local differences in available foraging habitat.

The majority of seals foraged within 30 km of their haul-out site, consequently there was broad overlap between the foraging areas used by animals from the same site, but little overlap in the areas used by seals from different sites. Most seals foraged in water depths of 10-50 m with mainly sandy sea-bed sediments. Data on the distribution of dive depths of five seals which were fitted with time-depth-recorders indicated that seals were generally diving on, or close to, the sea-bed. Occasional pelagic dives between the more common benthic dives were also observed. Between-site differences in the seals' use of different water depths and sea-bed sediments suggest that local geographical variations in diet were related to local differences in foraging habitats, but that habitat use also differed between individual seals

Twiss, S., P. P. Pomeroy and S. S. Anderson. 1994. Dispersion and site fidelity of breeding male grey seals *Halichoerus grypus* on North Rona, Scotland. *Journal of Zoology London* 233:683-693.

Abstract

Female grey seals (*Halichoerus grypus*) formed breeding aggregations on the island of North Rona, Scotland. Aggregations of females were associated particularly with gullies leading from the sea, leaving large areas of available space unoccupied. Changes in the degree of aggregation of females during the breeding season were similar in 1987, 1988 and 1989. Pronounced aggregations occurred in the early and late parts of each breeding season.

Of 67 breeding females marked in 1985, 62 (93%) returned to N. Rona to breed in at least one season up to 1989, but 18 (27%) were present in all five years. Females came ashore up to 14 days before giving birth and 82% were observed first in the vicinity of their subsequent pupping site. Between 1985 and 1989, marked females which returned were faithful to their previous pupping sites, even when the previous pup had died. There was no evidence of a gradual change in the location of individual pupping sites over time. This pupping site fidelity may generate aggregations whose location, timing and composition is predictable.

SOFIE M. VAN PARIJS, PAUL M. THOMPSON, DOMINIC J. TOLLIT & ANN MACKAY

Distribution and activity of male harbour seals during the mating season

Anim. Behav. , 1997, 54, 35–43

Abstract.

Little is known about male reproductive strategies in aquatically mating pinnipeds. To study the mating patterns of harbour seals, *Phoca vitulina*, VHF telemetry was used to relate the distribution and behaviour of adult males to the distribution of females during the summer pupping and mating season. Prior to July males occupied large and variable ranges. At the beginning of July, males decreased their mean range size, but continued to spend much of their time in the water where they made characteristic short dives. Acoustic recordings in the presence of several radiotagged males suggested that these short dives were associated with underwater vocal displays. Throughout July, males varied in the geographical areas which they used to perform these displays. Some individuals were found in the water around haul-out sites; others were located on foraging grounds, up to 50 km from pupping sites, and some were consistently located displaying on transit routes between these two areas. This study supports previous suggestions that vocalizations and diving displays may be associated with male mating behaviour, but suggests that males may display over a much wider geographical area than was previously recognized. This system of dispersed but small display territories is suggestive of lekking. However, further research on the distribution of the clumping of displaying males is required to confirm this.

Van Polanen-Petel T, Giese M and Hindel M. A preliminary investigation of the effect of repeated pedestrian approaches to Weddell seals *Leptonychotes weddellii*. *Appl. Anim. Behav. Sci.* 1121: 205.211.

Abstract

Repeated exposure to human activity can change the behavioural response of wildlife, having implications for management. Weddell seals (*Leptonychotes weddellii*) breeding close to Antarctic research stations are easily accessible and regularly visited by people. To investigate the responses of Weddell seals to repeated pedestrian approaches, we tested the effect of regular visitation over a short-time period (<2 h) on the behaviour of lactating seals. Seals showed evidence of rapid habituation, as assessed by the higher proportion of seals that responded, with 67% looking up during the first approach compared to 18% during the 10th approach ($R^2 = 0.398$, $P = 0.050$), and by a decrease in the time spent looking at the approacher with repeated exposure ($P < 0.001$). The effect of irregular pedestrian activity over a long-time period (approximately 3 weeks) was also examined, with results suggesting that such activity did not result in habituation, rather, adult female seals appeared to become sensitised to people (the majority of seals in both colonies looked up $G_1 = 0.027$, $P = 0.870$). Weddell seal pups observed during the same experiment also failed to display signs of habituation to irregular pedestrian activity, with 47% of pups looking up in the colony subjected to pedestrian activity compared to 10% in the control colony ($G_1 = 5.811$, $P = 0.016$). The implications of these results for managing human activity around breeding Weddell seals are discussed.

Summary

- 1 May to September observations on a colony of c. 400 *Phoca vitulina* in Shetland. The limiting factors of the habitat are described.
- 2 Daily 8 a.m. counts showed that numbers hauled out depended chiefly on swell or human disturbance (both erratic), to a lesser degree on the state of the tide and little, if at all, on rain and sun.
- 3 Relations with other species include: practically no overlap with *Halichoerus grypus*, indications that sea-birds may be taken as food, and man as a long-established enemy, mainly in the pupping season, when almost an entire generation may be wiped out.
- 4 In May and early June there was a great deal of play, apparently sexual, with “pairs” rolling together in the water. First pups appeared on June 14th when the play period ceased. The pupping season extended over three weeks.
- 5 Breeding behaviour proved largely aquatic. Pups may be born on tidal rocks or apparently even in the water. They found great difficulty in landing at first and spent most of their time at sea. Mothers guarded them closely for about three weeks and suckled them either in the shallows or ashore. Lactation lasted four weeks.
- 6 After the pups became independent, adults began to moult. Sexual play was not resumed and no coition was seen during this post-pupping season.
- 7 Of the seals present at the beginning of the season c. 15 per cent were yearlings and possibly only 70 per cent. were adult. The number of pups born was c. 18 per cent of the total population. Comparisons are made with a colony in Orkney

Watts, P. 1996. The diel hauling-out cycle of harbour seals in an open marine environment: correlates and constraints. *J. Zool.* 240:175-200.

Abstract

A colony of harbour seals in the Pacific north-west was monitored over two years, concurrent with a variety of environmental variables. Regression models described diel hauling-out activity as: i) a photoperiodic cycle; ii) a function of other environmental factors; or iii) a cycle modified by environmental constraints. Throughout the year, the number of seals on shore followed a diel pattern with a midday peak. Seals hauled-out in lower numbers in winter than in summer, and for a smaller proportion of the day (although for about the same proportion of the photoperiod). During the annual moult, numbers hauled were elevated around the clock, and the midday peak was skewed to late afternoon/early evening. Models that defined hauling-out in terms of environmental factors were significant, but did not fit the data as well as models based on photoperiod. The strongest environmental correlates (such as tidal height) owed much of their explanatory power to artefactual similarities with the photoperiodic cycle. Four general conditions are presented which, if met, should always result in a diel hauling-out cycle with a midday peak. The most fundamental of these involves a proposed 'cost of immersion' which motivates pinnipeds to *haul-out* when not foraging. Two likely candidates for such a cost involve risk from aquatic predators and the energetic expense of sleeping while immersed.

Wilson SC, Corpe HM and Kennedy S. 1999. Radiotelemetry study of a harbour seal pup released after a brief postweaning rehabilitation period. *J. Wildlife Rehabilitation* 223: 12-16.

Abstract

A postweaning harbor seal pup was taken from a haul-out site at Minerstown in County Down, Northern Ireland, for rehabilitation, owing to her small size and emaciated appearance. She was fed a high-fat/high-protein liquid diet for three weeks and then fitted with a head-mounted VHF radio-transmitter and released, weighing 15.5 kg. During the next six weeks, radiotracking found her diving off the County Down coast, moving within the range known to be used by wild weaned pups from Minerstown. Between four and six weeks after release she was sighted on three occasions at the Minerstown haul-out site in the company of other postweaning pups, and each time appeared to be in good health and approximately the same size as the other pups. Two weeks later, however, she stranded with a swollen shoulder and fore-flipper; despite veterinary treatment, she died three days later. Postmortem examination revealed a fracture of the left ulna and parasitic pneumonia. Observations during the week prior to her stranding suggest a gradual deterioration in her condition stemming from the trauma to her shoulder, which was most probably the result of collision with a boat.

Radiotelemetry Study of a Harbor Seal Pup Released after a Brief Postweaning Rehabilitation Period. Available from:

https://www.researchgate.net/publication/290783240_Radiotelemetry_Study_of_a_Harb_or_Seal_Pup_Released_after_a_Brief_Postweaning_Rehabilitation_Period [accessed Oct 24 2017].

Wilson, S. 1973 Mother-young interactions in the common seal, *Phoca vitulina vitulina*. *Behaviour* 48:23-36.

The mother-young relationship of the common seal *Phoca vitulina* in Strangford Lough, N.E. Ireland, lasted about three weeks. Mothers with young were most active during the first two hours of the ebb, and also they spent more time in the water when the ebb occurred towards evening than in the morning. Characteristic behaviour in the water included (i) the mother guiding the pup and maintaining close contact with it (ii) playing, and (iii) the pup sleeping at the surface with the mother close by. Progressive changes in the relationship included a slight decrease in time spent by the mother in guiding the pup, a slight increase in time spent close together, an increase in time spent at a considerable distance apart, and an increase in time spent by the pup sleeping at the surface. Throughout the suckling period the mother controlled the onset of suckling, but rarely terminated it. Throughout, also, the pup broke contact the most, while the mother re-established contact the most. Just before weaning, mothers left their pups for long periods, the separation sometimes terminating a play bout.

Yochem P.K., B.S. Stewart, R.L. Delong & D.P. Demaster 1987. Diel haul-out patterns and site fidelity of harbor seals *Phoca-Vitulina-Richardsi* on San Miguel Island, California, in Autumn *Marine Mammal Science* 3 4: 323-332.

Abstract

We studied the haul-out patterns and movements of harbor seals (*Phoca vitulina richardsi*) on San Miguel Island, California, from 23 October through 6 December 1982 by attaching a radio transmitter to each of 18 seals and monitoring their presence ashore with continuously scanning receivers. Seals hauled out at all hours although, on average, the largest proportion of tagged seals was ashore between 1300 and 1500 h. Median durations of haul-out bouts of individual seals ranged from 4.7 to 21.8 h; 81% of all haul-out bouts were less than 12 h and 3% were longer than 24 h. Eighty-one percent of the seals that were resighted at least twice used only the sites where they were tagged; two seals used two sites and one seal used three. Most seals were hauled out on fewer than 51% of the days sampled. On average, about 41% of tagged seals hauled out each day whereas an average of about 19% was hauled out during peak afternoon hours. Using telemetry data to correct a count of 412 seals made during an aerial survey, we estimated absolute abundance at about 2,168 seals; a modified Peterson mark-recapture model produced an estimate of about 1,445 seals.

Young, C., S. M. Gende, and J. T. Harvey.2014. Effects of vessels on harbor seals in Glacier Bay National Park. *Tourism Mar. Environ.* 10:5-20.

Abstract

We evaluated the effectiveness of harbor seal (*Phoca vitulina*)-related vessel regulations in Glacier Bay National Park. We observed 100% compliance with area closures intended to minimize disturbance to dependent pups, yet dependent pups were still present in the inlet after the area was opened to vessels. Compliance with the 463 meter (m) minimum approach distance regulation by vessels was low (22%), although 33% of vessel–seal encounters resulted in disturbance when vessels were still >463 m from seals. Ice cover was the best predictor of disturbance. Our results indicated that vessel regulations might be variably effective due to biological irrelevance, noncompliance, or environmental factors. MPA regulations should be evaluated to ensure achievement of conservation objectives.

Young, C.2009. Disturbance of harbor seals by vessels in John Hopkins Inlet, Glacier Bay, AK. M.S. thesis, 120 p. *San Jose State Univ., San Jose, CA.*

Abstract

Pacific harbor seal (*Phoca vitulina richardii*) abundance in John Hopkins Inlet (JHI), a glacial fjord in Glacier Bay National Park (GBNP), Alaska, has been decreasing at a concerning rate. Disease, increased predation, emigration, depletion of prey resources, and disturbance by vessels all have been implicated as causal factors of the abundance decrease. This study involved evaluating the role of disturbance by vessels during 2007 and 2008 as a causal factor in the harbor seal abundance decrease by (1) quantifying the vessel disturbance regime experienced by seals in JHI and (2) quantifying behavioral and bioenergetic impacts of vessels on seals in JHI. The presence of vessels altered the haulout patterns and behavioral activity budgets of seals by increasing the rate of flushing (vacating an iceberg and entering the water) and increasing vigilance behavior. According to the bioenergetic model used during this study, all seals flushed by vessels incurred an energetic cost, though that cost was disproportionately greater for pups than non-pups. The overall proportion of the JHI seal aggregation that was impacted by vessel disturbance was relatively low; however, repeated disturbance may be inducing the relocation of seals to other areas, and direct energetic impacts may be decreasing the individual fitness levels of pups. Vessel disturbance, therefore, may be playing direct and indirect roles in the harbor seal abundance decrease in JHI.

Sjöberg, M., M.A. Fedak, B.J. McConnell. 1995. Movements and diurnal behaviour patterns in a Baltic grey seal (*Halichoerus grypus*). [Polar Biology](#), 1995, Volume 15, 8, 593–595

A sub-adult grey seal was caught and tagged with a satellite relay data logger at Tihällan (61°28'00"N, 17°25'40"E), Sweden, on 21 August 1992. We tracked it for 115 days during which time we recorded 841 locations, data on 3556 dives and 80 “haulout” periods. It travelled 730 km in the first 12 days to the southern Archipelago Sea. It stayed most of the remaining time within 25 km of a haulout site, with a major exception of an 8-day trip of 520 km. Dive shape and swimming activity were used to distinguish dive types. Square-shaped “foraging” dives were more common over the midday period. “Haulout” periods were more common during the night.