

Short Communication

Abundance, seasonal haul-out patterns and conservation of spotted seals *Phoca largha* along the coast of Bak-ryoung Island, South Korea

Changman Won and Byoung-Ho Yoo

Abstract The spotted seal *Phoca largha*, which is found in the Okhotsk, Bering, Chukchi, Beaufort and Yellow seas, is Critically Endangered in the Yellow Sea of China and Korea because of habitat destruction and human harassment in the region. Shipboard surveys were conducted in the inshore waters of Bak-ryoung Island off western South Korea from March 2000 to October 2002 to investigate the distribution, abundance and seasonal haul-out patterns of spotted seals and thereby to lay a foundation for developing conservation measures. Seals were seen on every survey during the study period, hauled out on offshore rocks rather than on beaches. The highest concentration of spotted seals occurred on Mul-Beum Rock, probably because of the relatively lower exposure of this site to waves and spray. There was a

seasonal pattern in the total number of seals hauled out, with the highest numbers seen from late spring to late summer. Spotted seals arrived as early as 15 March and left the area by late December. We suggest that spotted seals spend the spring, summer and autumn feeding along the coast of Bak-ryoung Island and return to their breeding grounds in Liaodong Bay, China, in October. Because the spotted seal populations of China and South Korea are small and seasonally dispersed, the establishment of an international protected areas network and research cooperation between China and South Korea is urgently required.

Keywords China, haul-out patterns, marine mammals, *Phoca largha*, South Korea, spotted seal, Yellow Sea.

Introduction

Spotted seals *Phoca largha* occur mainly in coastal waters and on ice floes in the Okhotsk, Bering, Chukchi and Beaufort Seas (Shaughnessy & Fay, 1977; Lowry *et al.*, 1998), and also in Chinese coastal waters from the Yellow and Bohae Seas to the north of the East China Sea (Wang, 1986; Rice, 1998; Wang, 1998). The spotted seal is categorized as Critically Endangered in the Yellow Sea of China and Korea because of habitat destruction and human harassment in the region (Wang, 1998). Its breeding ground in the Yellow Sea is on ice floes in Liaodong Bay in the Bohae Sea (Wang, 1986). Pups are born on ice floes from January to mid February (Wang, 1986). After the breeding season, the seals remain on the ice to moult. During the non-breeding season the spotted seals of this region are known to migrate as far south as the Yangtze River and Fujian in China (Rice, 1998; Wang, 1998; Nowak, 1999).

Although the distribution, abundance, movements and behaviour of spotted seals in the Okhotsk, Bering and Chukchi Seas have been described (Tikhomirov, 1966; Ostroumov, 1967; Chugunkov, 1970; Naito & Konno, 1979; Burkanov, 1983; Burns *et al.*, 1985; Frost *et al.*, 1993; Lowry, *et al.*, 1998, 2000), populations of north-eastern China and South Korea have not been as intensively studied. Most of the information available for the species in this region has come from studies in the Bohae Sea, where pupping, breeding and moulting occur (Wang, 1986). More recently Dong & Shen (1991) estimated changes in population size in Liaodong Bay over the last century and showed that *c.* 8,000 animals were present in the early 1940s, falling to 2,300 in the 1980s.

Spotted seals occur along the coast of the Chil-San and Bak-ryoung islands and the Tae-An Peninsula of western South Korea. We began studies along the coast of Bak-ryoung Island, South Korea, in 1998 after conversations with residents and our observations indicated that at least several hundred spotted seals occurred in the area each year. A survey on 15 May 1998 indicated that 120 spotted seals occurred along the coast of the Bak-ryoung Island (FRI, 1998), since which there have been no other published reports on spotted seals in this region.

The 45.6 km² Bak-ryoung Island lies 191.4 km off the coast of Incheon, western South Korea (Fig. 1). Lunar tides

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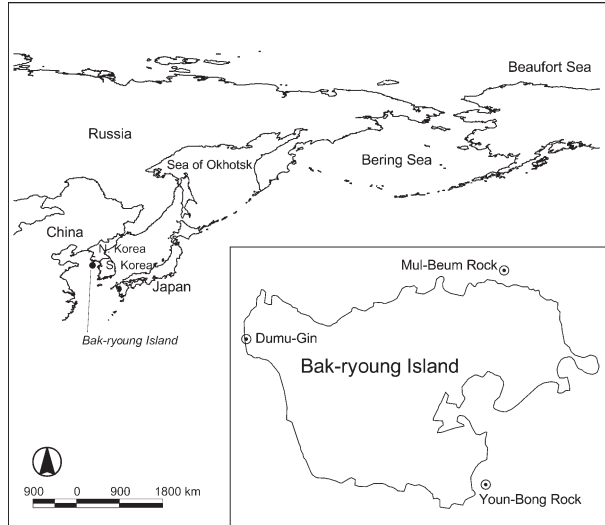


Fig. 1 Map of the region in which the spotted seal occurs, with the location of Bak-ryoung Island. The inset indicates the location of the three haul-out sites on the Island.

are strong along the coast of the Island, with a daily tidal range of >2 m. There are three areas that appear to be regularly used by spotted seals: Mul-Beum Rock (Plate 1), Dumu-Gin and Young-Bong Rock. Mul-Beum Rock, 1.2 km off the north-east coast of the island, consists of three rocks, two that are washed at high tide and a third that is dry even at high tide. The Dumu-Gin area on the north-west of the island is characterized by rugged exposed offshore rocks subjected to continuous turbulent wave action. Youn-Bong Rock, 3 km off the south-west of the island, consists of exposed offshore rocks.

From March 2000 to October 2002 we made periodic surveys, from a boat, of seals in these three areas. Each



Plate 1 Spotted seals hauled out on part of Mul-Beum Rock off Bak-ryoung Island.

survey lasted 2–4 days, depending on weather conditions. All seals at each of the haul-out sites were recorded at least once every 5 minutes for at least 2 hours each day, and all groups were videotaped. The number of seals at each haul-out site on each survey was determined by using both the counts and analysis of the videotapes. There was a seasonal pattern in the total number of seals hauled out (Fig. 2), with >100 seals counted from late June to early October; similar counts have been reported as early as 15 May (FRI, 1998). In 2000, 2001 and 2002 the lowest and highest counts were, respectively, 18 in March and 307 in July, 6 in December and 205 in August, and 98 in October and 343 in August (Fig. 2). During these surveys the earliest arrival date of seals on the three rocks was 15 March, and they had all departed by late December. This suggests that spotted seals spend spring, summer and autumn feeding along the coast of Bak-ryoung Island, and move to their breeding area in Liaodong Bay, China, in October. The highest concentration of spotted seals occurred, during the summer months, on Mul-Beum Rock (Fig. 2), probably because of the lower exposure of this site to waves and spray. We found that disturbance from ships, including both the survey boat and local fishing boats, commonly caused all the seals to move into the water. The importance of the lack of disturbance for seal haul-out sites has been discussed by Sullivan (1982) and Frost *et al.* (1993).

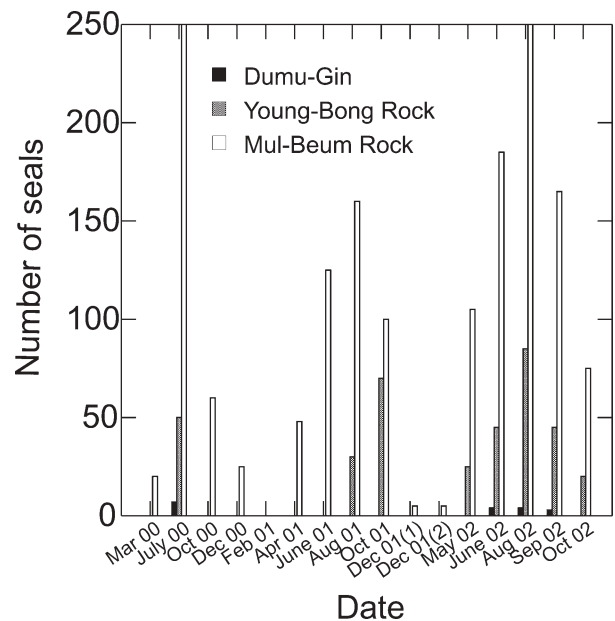


Fig. 2 Number of seals at the three haul-out areas along the coast of Bak-ryoung Island, South Korea (see Fig. 1), based on boat surveys conducted from March 2000 to October 2002. There were two surveys in December 2001. Numbers are the maximum number of seals found in each survey.

Various studies (Naito & Konno, 1979; Burkanov, 1983; Frost *et al.*, 1993; Lowry *et al.*, 1998) have indicated that spotted seals haul out along the coasts of the Bering, Chukchi, and Okhotsk Seas and the Kamchatka Peninsula during the ice-free summer period. This was not the case with the spotted seals on Bak-ryoung Island, which hauled out only on exposed offshore rocks, suggesting that the seals might have changed their haul-out behaviour in response to disturbance. Absence of the seals from beaches was probably due to human disturbance such as the military training that occurs in the area, and oyster and barnacle collection along the coast.

Information that we have obtained from elsewhere off the west coast of South Korea indicates that the number of spotted seals is low, with <10 seals at other haul-out sites (unpub. data). Bak-ryoung Island therefore appears to be one of the most important sites for spotted seals in the Yellow Sea, and the seasonal occurrence of hundreds of seals on specific rocks suggests that they are of particular biological significance for the species. Spotted seals in the Bering and Chukchi seas haul out on land during summer and early autumn, but leave their haul-out sites and spend many days at sea, returning for periods of several days between feeding trips (Lowry *et al.*, 1998). Similar detailed studies have not yet been carried out in the Yellow Sea, but would provide valuable information on the biology of spotted seals in the region.

Our observations have important conservation and management implications for spotted seals in the Yellow Sea. The species is designated a protected species under the Nature Conservation Act of South Korea (ME, 2000), and is listed as a Nature Monument no. 331 and also as a vulnerable species under the Wildlife Conservation Act of China (Wang, 1998). However, so far no conservation action, public awareness or education programmes have been carried out for the species in this region. Residents of Bak-ryoung Island indicated to us that the seals come into conflict with commercial fishing and have therefore been persecuted. Bycatch of spotted seals in fishing nets occurs but has not been monitored. Local residents and fishermen frequently stated that the number of seals in the region has declined since the 1970s because of habitat disturbance and persecution by humans. In this regard, restrictions on human activities associated with commercial fisheries and tourism in certain seasons and areas are needed to provide mitigation measures (Frost *et al.*, 1993).

Wang (1998) reported that poaching pressure on spotted seals of the Bohai Sea is high because of demands for fur, meat and oil, and with the male genitalia being used for traditional medicine. In the 1950s hunting pressure was high, with >1,000 seals being taken in a single year (Wang, 1998). In the 1960s and 1970s 400–500 seals

were killed annually (Wang, 1998). As a result of excessive harvesting and destruction of its breeding habitat, the spotted seal has declined in numbers and range (Wang, 1986; Dong & Shen, 1991; Wang, 1998).

Spotted seals are Critically Endangered because of direct killing, human encroachment, persecution and disturbance in the region (Wang, 1986; Dong & Shen, 1991; Wang, 1998). The protection of their habitats should be the overriding priority for the conservation of the species (Wang, 1986; Dong & Shen, 1991; Wang, 1998). Because the spotted seal populations of China and South Korea are small and highly dispersed seasonally, the establishment of an international protected areas network and research cooperation between China and South Korea is urgently needed.

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References

- Burkanov, V.N. (1983) Results of aerial observation of the coastal haulouts of spotted seals on the Kamchatka Peninsula in 1982. *Biological Problems of the North*, **2**, 45–49.
- Burns, J.J., Frost, K.J. & Lowry, L.F. (1985) In *Marine Mammals Species Accounts* (eds J.J. Burns, K.J. Frost & L.F. Lowry), pp. 87–96. Alaska Department of Fish and Game, Alaska, USA.
- Chugunkov, D.I. (1970) Observations of spotted seals on the Utkinskii haulout. *Izvestiia TINRO*, **70**, 25–34.
- Dong, J. & Shen, F. (1991) Estimates of the historical population size of the harbour seal (*Phoca largha*) in Liaodong Bay. *Marine Sciences*, **3**, 26–31 [in Chinese with English summary]. Forestry Research Institute (FRI) (1998) *Ecological Survey of the Demilitarized Zone (DMZ) and Adjacent Areas*. FRI Research Report No. 4, Seoul, South Korea [in Korean with English summary].
- Frost, K.J., Lowry, L.F. & Carroll, G. (1993) Beluga whale and spotted seal use of a coastal lagoon system in the northeastern Chukchi Sea. *Arctic*, **46**, 8–16.
- Lowry, L.F., Burkanov, V.N., Frost, K.J., Simpkins, M.A., Davis, R., DeMaster, D.P., Suydam, R. & Springer, A. (2000) Habitat use and habitat selection by spotted seals (*Phoca largha*) in the Bering Sea. *Canadian Journal of Zoology*, **78**, 1–13.
- Lowry, L.F., Frost, K.J., Davis, R., DeMaster, D.P. & Suydam, R.S. (1998) Movements and behavior of satellite-tagged spotted seals (*Phoca largha*) in the Bering and Chukchi Seas. *Polar Biology*, **19**, 221–230.
- Naito, Y. & Konno, S. (1979) The post-breeding distribution of ice-breeding harbour seal (*Phoca largha*) and ribbon seal (*Phoca fasciata*) in the southern Sea of Okhotsk. *Science Report Whales Research Institute Tokyo*, **31**, 105–119.

- Nowak, R.M. (1999) *Walker's Mammals of the World. Vol. II*. Johns Hopkins University Press, Baltimore, USA.
- Ostroumov, A.G. (1967) Some information on the number of pinnipeds – spotted and ringed seals – in the coastal waters of Kamchatka. In *Questions of the Geography of Kamchatka*, Russian Academy of Science, Kamchatka, Russia.
- Rice, D.W. (1998) *Marine mammals of the World: Systematics and Distribution*. The Society for Marine Mammalogy, Special Publication No. 4. Allen Press, Lawrence, USA.
- Shaughnessy, P.D. & Fay, F.H. (1977) A review of the taxonomy and nomenclature of North Pacific harbour seals. *Journal of Zoology*, **182**, 385–419.
- Sullivan, R.M. (1982) Agonistic behavior and dominance relationships in the harbor seal, *Phoca vitulina*. *Journal of Mammalogy*, **63**, 554–569.
- Tikhomirov, E.A. (1966) Some data concerning the distribution and biology of the spotted seal in the Okhotsk Sea in the summer-autumn period and the organization of its harvest. *Izvestiia TINRO*, **58**, 73–77.
- Wang, P.C. (1986) Distribution, ecology and resource conservation of the spotted seal in the Huanghae and Bohae Seas. *Acta Oceanologica Sinica*, **5**, 126–133 [in Chinese with English summary].
- Wang, S. (1998) *China Red Data Book of Endangered Animals: Mammalia*. Science Press, Beijing, China [in Chinese with English summary].

Biographical sketches

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