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Short Note
Haul-out behaviour of two Ross seals off eastern Antarctica

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Accurate assessment of the abundance of pinnipeds from visual surveys requires estimation of both the available (hauled-out) and unavailable (in-water) components of the population (Eberhardt *et al.* 1979). Continental estimates of the abundance of the four Antarctic seals are based on limited information on haul-out behaviour. In developing continental estimates, Erickson & Hanson (1990) corrected visual surveys of the hauled-out component of the species' populations using data from observational studies of haul-out behaviour by Erickson *et al.* (1989). Erickson & Hanson (1990) point out that, because the observational studies did not account for an unknown fraction of seals that remained in the water during the peak haul-out period, their abundance estimates are minimum values. Further, Erickson & Hanson (1990) corrected the visual surveys for all four species using haul-out data for the crabeater seal only, as observational data for the other species were not available. This assumes that haul-out patterns are constant across species, which is largely untested. Consequently, there is potential for bias, in both a relative and absolute sense, in the estimated abundance of Antarctic seals. .

As an alternative to observation, several investigators have attempted to determine the diel haul-out pattern of Antarctic seals indirectly by *post-hoc* analysis of visual survey data in relation to time of day. However, interpretion is difficult because the effects of location (and hence possibly local abundance) and time are confounded.

The development of dive recorders has allowed direct, potentially unbiased assessment of haul-out behaviour. This note reports on haul-out behaviour determined from dive recorders attached to two Ross seals in eastern Antarctica in early summer. With virtually no previous direct information available on Ross seal haul-out behaviour, these data provide limited but valuable information for improved assessment of the abundance of this species.

Methods

ARGOS satellite-linked dive recorders (SDRs) were deployed on two Ross seals (1 male on 11 December 1999; 1 female on 16 December 1999) at locations < 50 km north of the shelf break and > 100 km from the Antarctic continent (male: 64°44'S, 131°08'E; female: 64°37'S, 110°35'E). The SDRs measured conductivity (wet/dry) at 10 s intervals, and summarized the data into 20 min wet or dry intervals.

Results and discussion

Although transmissions were received from both SDRs from the time of capture through to mid-March 2000 (male 90 d; female 97 d) data are presented only for days prior to an apparent cessation of diving (for the male 29 d, and the female 10 d, after capture), which I consider to have resulted from the SDRs being shed onto the ice as the seals moulted.

Haul-out bouts, defined as a continuous sequence of dry 20 min intervals, ranged from 0.3–34.6 h for the male and 10.6–40.3 h for the female. The chronological sequence of haul-out bouts (Fig. 1) shows them centring over or close to midday on all days for the female, and on most days prior to 28 December for the male. After that date, haul-out bouts by the male tended to centre around 06h00 (Fig. 1). Figure 2 summarises raw data within hourly bins across days, with data for the male split into two time periods to illustrate his changing haul-out behaviour. The two seals exhibited a consistent pattern of haul-out from the commencement of data recording until 27 December. During this time the proportion of time on the ice increased from a low point at midnight to a peak near 07h00, and remained relatively constant at this peak until the mid- to late-afternoon before declining. At peak haul-out the male spent *c.* 80% of his time on the ice, and the female her entire time. After 27 December the peak in haul-out for the male occurred earlier in the day and was of shorter duration, lasting from approximately 04h00–08h00.

Direct data on Ross seal haul-out behaviour from other studies is limited to a single animal over a two day period in

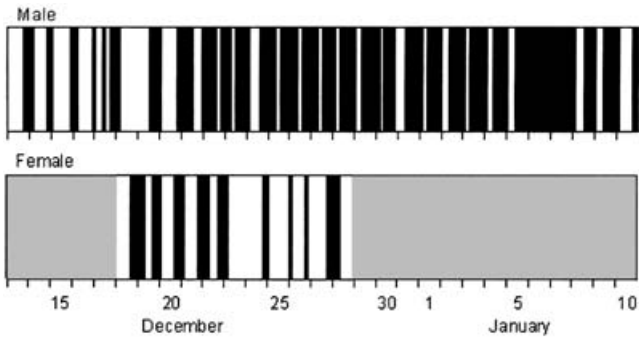

Fig. 1. Chronological sequence of haul-out classification in 20 min intervals for two Ross seals in eastern Antarctica; white = dry, black = wet; grey = no data. Tick marks on the time axis indicate midnight local time.

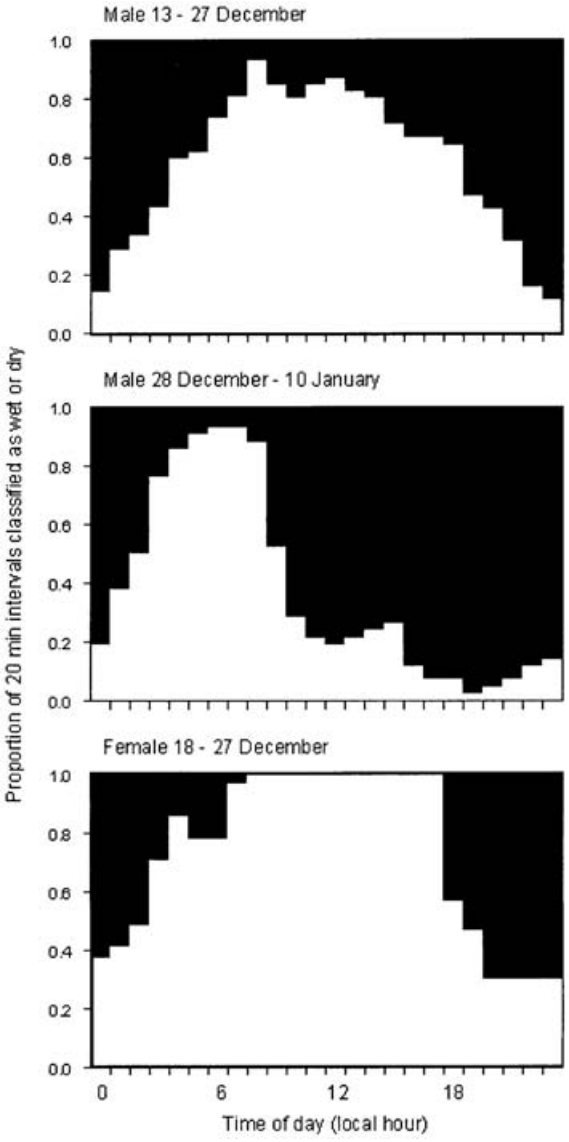

Fig. 2. Hourly proportion of 20 min intervals classified as dry (white) and wet (black) for two Ross seals in eastern Antarctica.

early January near the Antarctic Peninsula (Bengtson & Stewart 1997). This seal hauled out at 05h30, returned to the water at 22h30, and hauled out again at 02h30, a pattern generally consistent with the two seals of this study prior to 28 December. The haul-out patterns for the two seals of this study in December are also similar to the haul-out behaviour of crabeater seals fitted with SDRs in March (Bengtson & Stewart 1992, Norday *et al.* 1995).

However, care should be exercised in generalizing haul-out behaviour across all species and times. Norday *et al.* (1995) found seasonal variation in the haul-out behaviour of crabeater seals, and in this study the relatively consistent haul-out behaviour of the male Ross seal during December changed in early January. The apparent shedding of SDRs in late December and early January is consistent with the time of year when Ross seals are thought to moult (Skinner & Westlin-van Aarde 1989). While there is no direct information on haul-out behaviour of moulting Ross seals, the finding that a high proportion of Ross seals sampled in January have empty stomachs (Skinner & Klages 1994) suggests they fast during this time, and consequently that haul-out behaviour during the moult may be considerably different from that observed by me just prior to the moult.

The utility of the observational method for correcting visual counts of hauled-out seals to minimise or eliminate bias in abundance estimates rests on the assumption that the peak in diel haul-out equates to a time of complete haul-out for the population. My limited data suggests that, if the two seals of this study are representative of Ross seals in general, this assumption would not be grossly violated for this species, provided any shift in peak haul-out, such as that exhibited by the male, is synchronized across the entire population. Clearly, data are required from more animals before such generalisations can be made.

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