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POST-WEANING DISPERSION
OF SOUTHERN ELEPHANT SEAL *MIROUNGA LEONINA*
UNDERYEARLINGS AT KERGUELEN

P.Y. LENGART * and M.N. BESTER **

Pup development and behaviour of the southern elephant seal *Mirounga leonina* have been described by Angot (1954), Laws (1953, 1956), Carrick *et al.* (1962 a), and Condry (1977), and a post-weaning dispersion phase prior to desertion of an island reported for e.g. Macquarie (Carrick *et al.*, 1962 b) and Gough Islands (Bester, 1980). However, no details were given of this post-weaning dispersion phase or the timing of events during its course, which precedes dispersal and dispersion of older age/sex categories. This phase may also influence the indirect estimation of annual pup yields as indicators of breeding success/breeding population size. Furthermore, the pattern and extent of dispersion may differ between islands with physical environmental factors e.g. wind direction, coastal currents, coastline configuration and physiognomy, probably being determining factors. As southern elephant seals wean at ± 22 days after birth at Kerguelen (Van Aarde, 1980 a), their transition to life at sea and nutritional independence is of particular interest.

STUDY AREA

The Kerguelen archipelago (49° 15'S, 69° 30'E) lies on the Antarctic Convergence in the South Indian Ocean, with a mean annual temperature of 4.4° C and with westerly winds predominating. *Mirounga leonina* were studied along the southern and eastern coastlines of the Courbet Peninsula where most of them breed (Angot, 1954) on easily accessible sandy or pebble and cobble beaches, as well as on vegetated areas behind the beach line (Van Aarde, 1980 b).

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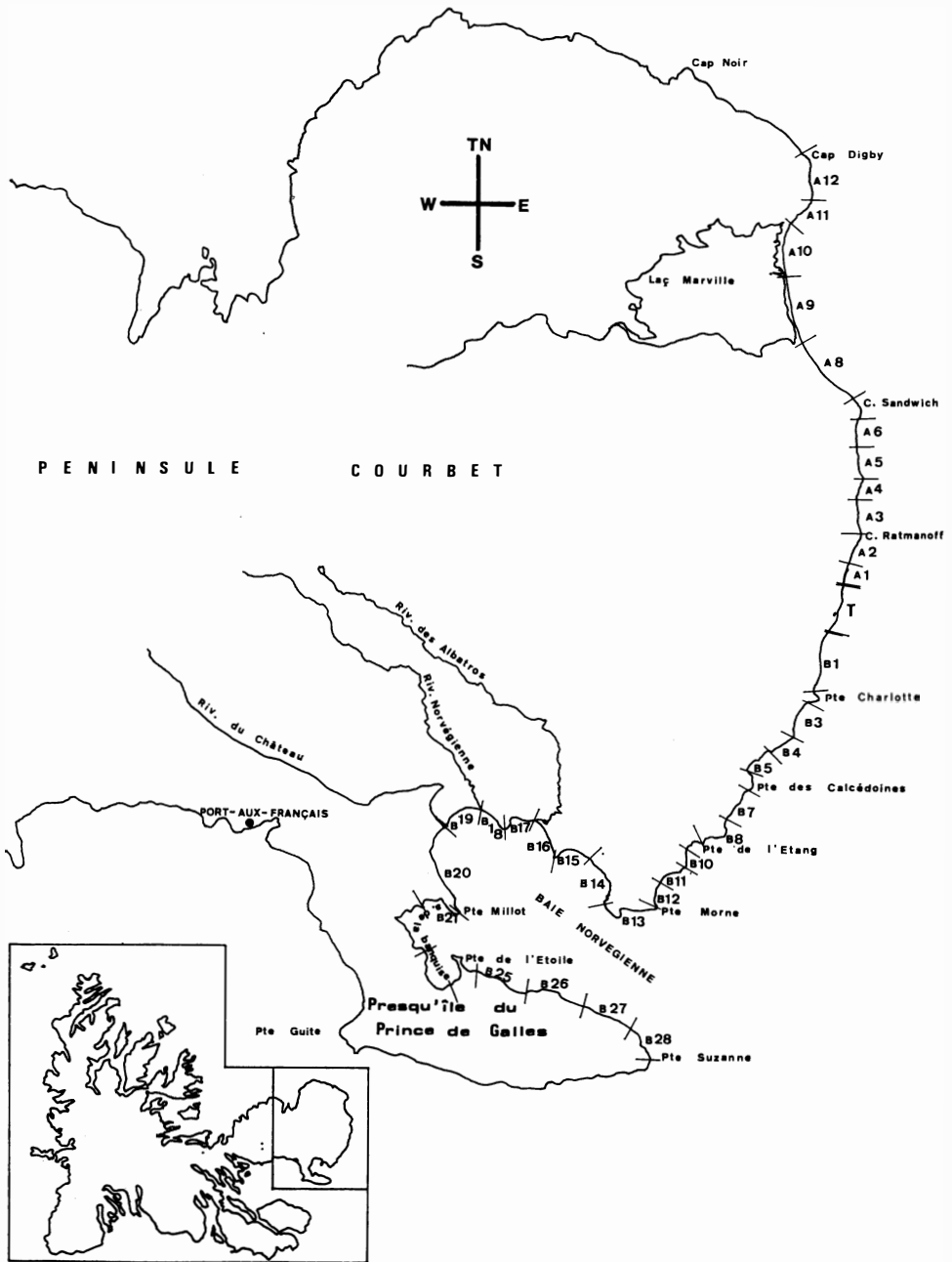


Figure 1. — Zonation of the Courbet Peninsula study area.

METHODS

From 29 October to 6 November 1979, Axaflex Chevillot plastic tags (male component yellow, female component white), each with an exclusive three-digit number (in the KL, KM, KN & KP series), were applied to a hind-flipper of 3 497 recently weaned pups (underyearlings) following Van Aarde and Pascal (1980). In addition, on 24 November a further 100 underyearlings were double-tagged with monel-metal tags stamped with the letters KER and identification numbers 51 to 150 (following Condy and Bester, 1975). Tagging was confined to a 2.5 km stretch of coastline at Cabane de l'Estacade (Fig. 1) and resightings of tagged underyearlings on 75.4 km of coastline, from Cap Digby to Pointe Suzanne, subsequently recorded up to 23 December (Fig. 2). In addition, the area Pointe Guite to Port-aux-Français

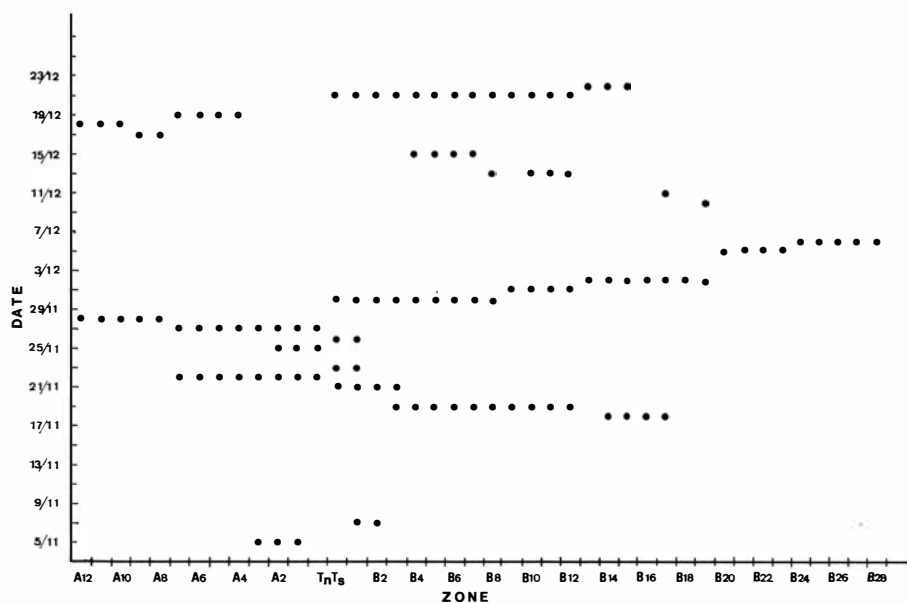


Figure 2. — Timing of searches of the different zones.

was searched on 6 December, and almost the entire coastline of the Courbet Peninsula from 2 to 13 January 1980 (Bester, *in press*). Two observers on foot recorded those tags directly visible without handling the underyearlings' flippers. This method was adopted since approximately 38 951 live underyearlings occurred in the study area (Cap Digby to Pointe Suzanne) which precluded the handling of all individuals during searches. Prior to the searches for tagged underyearlings a test involving one person noting visible tags, followed by another spreading flippers of under-

yearlings, was undertaken and showed that 60 % (n = 60) of tagged underyearlings (n = 100) were detected in this way. The identification number and locality of resighted underyearlings were recorded. To this end, the study area was arbitrarily divided into 41 zones according to distinguishable landmarks, each zone averaging 1.84 ± 0.87 km in length ($\bar{x} \pm S.D.$). To calculate displacements of underyearlings, resightings were assumed to be made in the middle of a zone. Since the whole study area could not be covered within a day, the distribution of tagged underyearlings along the coast was assumed to remain unchanged during approximately a week, the departure of one from a given zone being matched by an arrival on that zone. Furthermore, a uniform density in each particular zone was assumed.

With the major part of the study area lying north to south, onshore (easterly) and offshore (westerly) winds were not considered to have an influence on surface water movement along the coast. Wind direction was allocated to a northern sector (blowing from WNW - ENE) and southern sector (WSW - ESE), and together with windspeed data were obtained from readings taken at the Port-aux-Français Meteorological Station.

RESULTS

1. Resightings

Table I gives the data of tagged underyearlings resighted between Cap Digby and Pointe Suzanne. A total of 2 077 resightings were recorded with 37.9 % (n = 1 365) of the tagged total (n = 3 597) resighted at least once, and none being resighted more than six times. No tagged underyearlings occurred south

TABLE I

Resighting data of tagged underyearlings at the Péninsule Courbet, between Cap Digby and Pointe Suzanne.

Number of underyearlings tagged	Frequency of underyearling resights					
	X1	X2	X3	X4	X5	X6
3597	1365	585	107	17	2	1

of the study area on 6 December, and very few (if any) north of Cap Digby (see Section 3). One reached Port-aux-Français, 79 km distant from the tagging area, on 11 December.

2. *Aquatic phase*

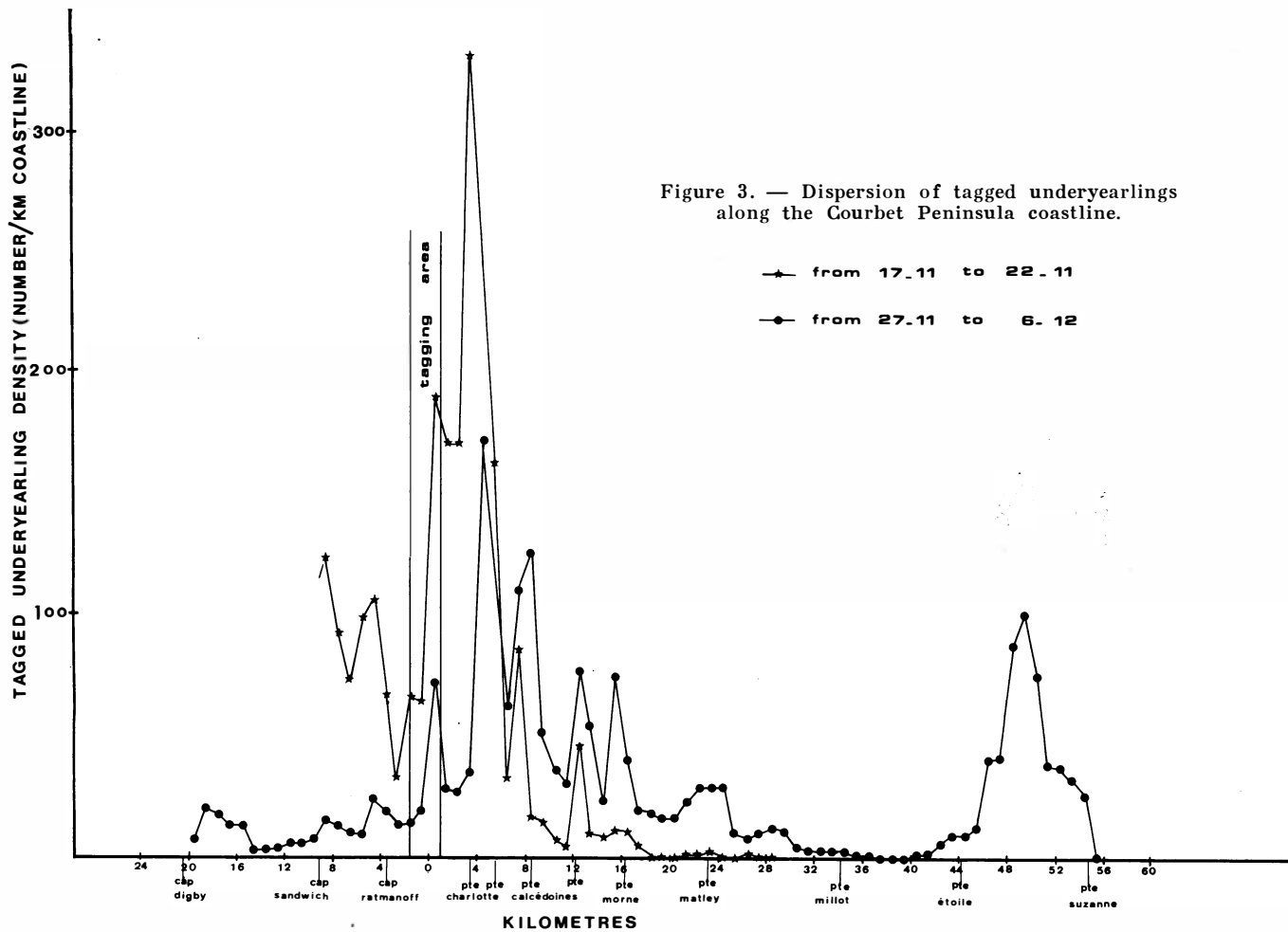
Underyearlings (weaned pups) congregated in pods behind the harems and their numbers increased as the breeding season progressed. Towards the end of October they encountered fresh water drainage lines and pools, and by the onset of November ventured into shallow sea water, but stayed close to the waterline in small groups. At this time a land/sea and vice versa crepuscular movement became evident, with most underyearlings hauled out on the back of the beaches, and usually well away from the sea, during mid-day. Throughout November they gradually ventured into deeper water but still stayed near the shore. By the end of November underyearlings ceased proceeding to the upper parts of beaches during the day, but remained close to the waterline.

3. *Dispersion phase*

From 3 to 5 November the tagging zone (T) was flooded with newly-arrived underyearlings. A search north of the tagging zone on 5 November showed tagged underyearlings dispersed to the boundary of zones A_2/A_3 , the most adventurous one 4.15 km distant, but the majority adjacent to T ($A_1 = 108/\text{km}$, $A_2 = 25/\text{km}$). To the south, on 7 November, large numbers occurred. Many were not inspected yet 71.1 % of all tagged underyearlings recorded outside T on the two days ($n = 461$ adjusted) occurred here at higher densities ($B_1 = 140/\text{km}$, $B_2 = 73/\text{km}$) and had covered a greater distance (± 5 km and probably more, B_3 being only partly searched) than to the north. The majority, however, were still confined to the T zone.

The adjusted number of tagged underyearlings (an 40 % increase) resighted during mid-November ($n = 2\,270$) and November/December ($n = 2\,060$) in the different zones are shown in Fig. 3. During mid-November underyearlings were concentrated on the southern part of the tagging area (T_s), in B_2 to B_3 , B_5 and B_9 , with very few occurring past Pointe Morne (B_{12}), the furthest being approximately 28 km distant. The northern section showed a reduction in numbers on the northern part of the tagging area (T_N), and peaks in A_3 and A_7 (the zones further north were not visited).

During the latter part of November the concentration of underyearlings in the southern areas persisted but at a lower density, except south of B_3 where underyearlings numbers increased, Pointe Morne (B_{12}) showing a definite peak. Tagged underyearlings occurred on the entire Baie Norvégienne coast-



line, very few, however, were present in the shallow Anse de la Banquise (B₂₂ and B₂₃). A large peak in numbers occurred in B₂₆ to B₂₈, and none managed to disperse past the southern cliffs of the Presqu'île du Prince de Galles onto the beaches from Pointe Guite to Port-aux-Français (Fig. 1 & 3). North of T, numbers progressively decreased except for a small peak at Cap Digby (A₁₁ and A₁₂).

The sex ratio of tagged underyearlings at the boundaries of the dispersion area, i.e., Cap Digby (female:male ratio of 1:1.38, n = 60) and Pointe Suzanne (female:male ratio of 1:1.13, n = 223) did not differ significantly ($\chi^2 =$ respectively 1.27 & 0.31, df = 2) from the sex ratio (1:1.04, n = 3 591) of the tagged sample at T.

After mid-December practically no underyearlings, tagged or otherwise, occurred north of B₂, the T zone also being vacated with a small number remaining at Cap Digby (Fig. 1).

4. Individual movements

Underyearlings did not consistently move in the same direction (Fig. 4), as Fig. 3 seems to depict. Of 127 underyearlings resighted at least three times, 30.7 % (n = 39) moved north at

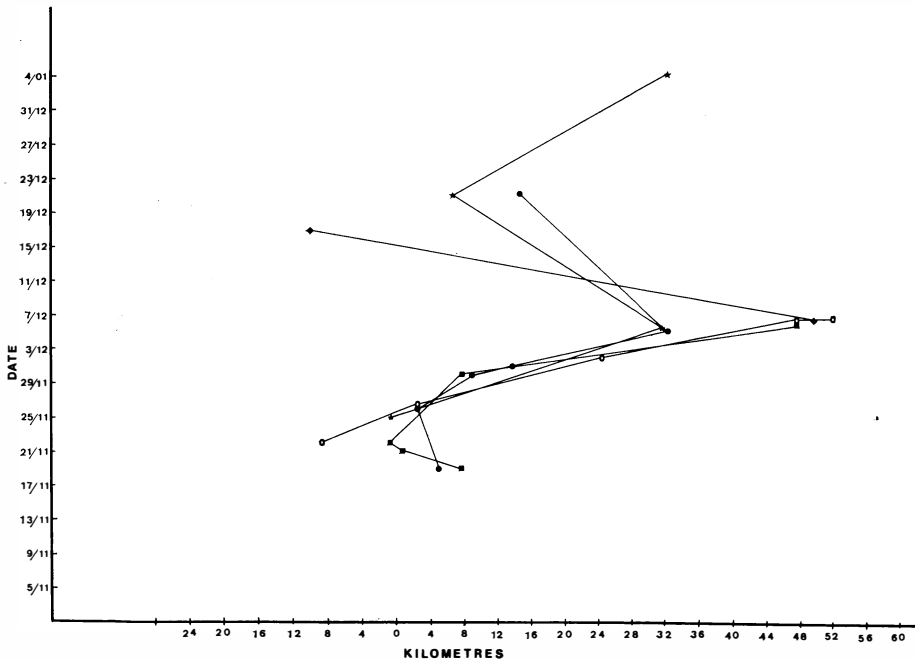


Figure 4. — Individual movement of tagged underyearlings along the Courbet Peninsula coastline.

the onset of November, 94.9 % of these ($n = 37$) subsequently being resighted further south. On the other hand, 69.3 % ($n = 88$) moved south initially, with only 6.8 % ($n = 6$) subsequently resighted north of the T zone. Since a month has elapsed between sightings of some of these, it cannot be assumed that the observed displacements fit the actual distance(s) travelled. However, by 18 November an underyearling had travelled 26.2 km in 15 days ($\bar{x} = 1.7$ km/day), one travelling 12 km in one day (B_2 to B_{12}) after apparently moving only 4.4 km (T to B_2) during the previous month. Two underyearlings tagged on 25 November when dispersion was already widespread, together covered 22.6 km in seven days (3.2 km/day), one of these reaching B_{25} at the most four days later, thus travelling at an overall rate of 4.4 km/day if following the coastline in one direction. At this time (November/December) some underyearlings tagged during late October could still be found on and adjacent to T, either remaining, or after several probable displacements, relocated into the area of birth.

5. Final departure

Underyearlings finally left the island from at least mid-December to early January. None were found between Cap Noir and Rivière du Château from 12 to 13 January.

DISCUSSION

The movement of underyearlings into shallow water at the onset of November corroborates previous observations at Kerguelen (Pascal, 1979). Although they enter the sea at 2 to 3 weeks after weaning (Angot, 1954), pups weaned end-October seemed to follow underyearlings weaned much earlier into the sea as in the northern elephant seal *M. angustirostris* (Reiter, Stinson and Le Boeuf, 1978). *M. angustirostris* weaners move towards the sea during the afternoon, returning when the sun rises with ± 10 % of the total remaining in the sea from noon to 16 h 00. The calculated tagged underyearling density per kilometre of coastline in the present study, therefore, gives an indication of relative abundance and not of absolute numbers, since the same crepuscular movement was observed (Angot, 1954 ; present study) resulting in a fluctuation of numbers ashore.

First acquaintance with the sea facilitates easy dispersion although limited lateral onshore movements may also occur. Since they stay close inshore where shallow bottom gradients exist, strong inshore currents are presumably excluded, wind-speed and wind direction effects on the movement of surface water masses apparently playing the most important role. It

appears that initial dispersion to the north and south is unintentional, as underyearlings drift with primarily wind generated surface water movement whilst playing and swimming clumsily. From 1 to 7 November windspeed averaged ± 5.8 m/s, blowing from the northern and southern sectors respectively for 62.1 and 17.2 % of the time favouring southerly displacement, underyearlings hauling out during the morning a short distance from their point of entry. At this stage (early November) the rate of dispersion is slow. Throughout November, as their expertise in swimming increases, they deliberately move along the coast, covering larger distances and consequently becoming more widely dispersed. Nevertheless, from 8 to 22 November a southerly movement, particularly evident immediately south of T (Fig. 3), was slightly favoured when winds from the north and south blew respectively 31.7 and 28.3 % of the time (averaging 10.1 m/s).

Moreover, until 6 December winds predominated from the north (53.6 % versus 25 % from the south, averaging 9.6 m/s) co-incident with a general decrease in numbers north of T, known northbound individuals reversing the direction of displacement (Fig. 3). This southward movement persisted up to at least 23 December (northerly and southerly winds blowing respectively 68.4 and 31.6 % of the time) and underyearlings became completely pelagic during mid-December to early January as at Macquarie Island (Carrick *et al.*, 1962b) and Marion Island (Condy, 1979).

The observation that the density of tagged underyearlings did not increase regularly from the tagging area to the end of the dispersal area, but showed peaks in concentration, may have a two-fold explanation. Since most of these concentrations are located in small protected bays associated with projecting points or headlands, a preference for calmer sea conditions is indicated. Furthermore, the large stretches of sandy beaches which are less protected and battered by rough seas (Cap Sandwich to Pointe Charlotte) are less popular towards end-November. Also Pointe Morne (mid-November) and Pointe Suzanne (end-November/December) present barriers to the dispersion of underyearlings since both project into deeper water without easily negotiable beaches. In fact, the southern flank of the Presqu'île du Prince de Galles present ± 15 km of cliffs with few hauling-out sites, and was skirted by one underyearling only.

The paucity of underyearlings during late November/early December on the Anse de la Banquise coastline in particular, and the innermost part of the Baie Norvégienne in general, seems to indicate that they do not necessarily disperse following the coastline just prior to becoming completely pelagic. They probably directly cross from Pointe Millot to Pointe de l'Étoile, and possibly directly across the Baie Norvégienne from Pointe Morne to the Presqu'île du Prince de Galles.

As a result of dispersion, tagged underyearlings are randomly mixed with the underyearling class within a well-defined dispersion area at end-November without any relation to their birthsite. This implicates pup yield estimates through mark-recapture experiments, the selection of a northerly tagging zone within the expected dispersion area being a preferable choice in view of the general southward displacement.

SUMMARY

Information obtained during the austral summer of 1979/80 on the post-weaning dispersion of southern elephant seal *Mirounga leonina* underyearlings at the Courbet Peninsula of Kerguelen is presented. Underyearlings dispersed from their birthsite by early November, primarily from dusk to dawn, by way of inshore waters under the influence of wind generated surface water movement. Northerly winds predominated over southerly winds and resulted in a distinct southward displacement of underyearlings along the coast, especially during late November when they were proficient at swimming. The progression of dispersion was also influenced by the coastal configuration and physiognomy, in particular coastal sections that impeded displacement when underyearlings seemed reluctant in negotiating deeper water without available hauling-out sites on the adjacent coastline. As a result of dispersion, tagged underyearlings were randomly mixed with the underyearling class as a whole within a well-defined dispersion area by late November, and before they finally became completely pelagic. This could facilitate mark-recapture experiments to estimate the total number of pups born during the breeding season.

RESUME

Les auteurs présentent les résultats qu'ils ont obtenus pendant l'été austral 1979-1980 sur la dispersion après sevrage des jeunes éléphants de mer *Mirounga leonina* de la Péninsule Courbet, aux îles Kerguelen. Ces jeunes de l'année (« underyearlings ») quittent leurs lieux de naissance début novembre, surtout entre le crépuscule et l'aube, et se déplacent le long de la côte en profitant des courants de surface dus aux vents. Du fait de la prédominance des vents du nord sur ceux du sud, il en est résulté un déplacement de ces animaux en direction du sud, le long de la côte — en particulier à la fin de novembre quand ils furent capables de nager correctement. Cette dispersion des jeunes de l'année est également influencée par la physionomie et la configuration du littoral. Les portions de la côte où les jeunes doivent

s'aventurer en eau profonde sans qu'il y ait une plage à proximité sont rarement franchies. Du fait de leur dispersion massive, les jeunes de l'année qui ont été préalablement marqués se mêlent au hasard, en fin novembre, avec les individus non marqués, dans une zone de dispersion bien définie, avant de prendre définitivement la mer. Ce phénomène peut faciliter la détermination du nombre de jeunes nés pendant la saison de reproduction précédente, en utilisant la méthode de marquage-recapture.

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