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Numbers and activity of Weddell seal (*Leptonychotes weddelli* Lesson) in the Admiralty Bay (King George Island, South Shetland Islands) in summer 1978/1979

ABSTRACT: On the basis of observations and markings of Weddell seals in the region of the Admiralty Bay it was estimated that numbers of this species decreased systematically from about 500 to about 100 individuals from December to February. The sex structure of the local population also changed, showing a growing domination of females. Males were observed more often on coastal snow patches, females prevailed on rocky beaches close to the sea. A thesis of an increased nocturnal activity of Weddell seal was confirmed, indicating also a possibility of a two days activity cycle of this species. Synchronized among the individuals of local populations by atmoshperic conditionds.

Key words: Antarctic, *Leptonychotes weddelli*, *Pinnipedia*, daily activity, density

1. Introduction

Numbers of the Weddell seal (*Leptonychotes weddelli* Lesson) in Antarctic is estimated as 200 000 to 500 000 (Sheffer 1958) or 730 000 individuals (BIOMASS 1977). These results, although similar to each other, seem not the final ones. The precise censuses of the seals are carried out for obvious reasons on small areas, frequently observations from air are made (Stirling 1969a, Erickson et al. 1974) at certain time of a day — New Zeland Standard Time, when the expected number of seals leaving the sea is the largest. More precise results are obtained on the basis of observations lasting several years (Siniff et al. 1977).

Countings of the seals in region of South Shetland Islands were already made during the australian summer of 1966/1967 and 1967/1968 (Aguyao 1970). It seams that australian summer, although a short one, is the best period for regular large scale observations, due to the better atmospheric conditions in that period than during the rest of the year. Weddell seals start moulting after giving the young and after the mating period, in the middle of summer (Lindsay 1937, Lug 1966). No specific behaviour was

observed during the moulting period, although it is common for many other species of antarctic seals (Øritsland 1970).

Daily activity of Weddell seals is frequently related to atmospheric conditions (Müller-Schwarze 1965, Stirling 1969b, Siniff, Teaster and Kuechle 1971, Siniff et al. 1977). This conclusion, although it seems right, is neither finaly explained nor fully supported by available data, but its confirmation can be essential when conducting the census.

2. Study area and methods

Observations of Weddell seals were carried out from 30 December 1978 till 8 February 1979 in region of South Shetland Islands, on King George Islands in the Admiralty Bay. The Admiralty Bay is a typical fiord with surface area of 131 km^2. Its shore line is 85 km long, 77% of it is formed by glaciers fronts and cliffs (Marsz, unpublished data). The remaining 23% of shores are the only part formed by wave action, thus accessible for resting seals.

Studies of activity were based on the results of counts of individuals resting on the shores. The censuses as were made during 22 days. Counts were done while walking, about 4 km long several times a day, a stretch of the Keller Peninsula (Fig. 1). One walk took about 1 h. On 30 December and 3 January seals were counted only once, about noon time. From 13 to 16 January observations were done five times a day, from 17 to 19 and from 23 to 27 January six times a day, on even intervals. However, from 1 to 8 February, seals were already counted only two times a day, at 10.00 and 14.00 h. During previous periods of observations at these times of a day the maximum number of seals was noted on the shores. All met individuals of Weddell seal were marked with paint during the last eight days long observations. The marks, visible for several days, although they did not allow to identify particular individuals, allowed to evaluate the numbers of local seals population with Zippin's method and Lincoln Index (Southwood 1966). With the Zippin's method the numbers of population N is evaluated on the basis of number of marked animals Y_i in consequent observations — i:

$$N = \frac{Y_i}{Q}$$

Value of Q is the probability with which an animal was not marked in respective number of observations. This value can be obtained from graphs, as a depending on the number of done observations, done calculating an auxiliary value of R (Southwood 1966):

$$R = \frac{\Sigma\,(i-1)\,Y_i}{\Sigma\,Y_i}$$

The marking of seals was caried out also on 12 and 17 January. However, number of animals marked in these days was too low to give a basis for estimation of the population size.

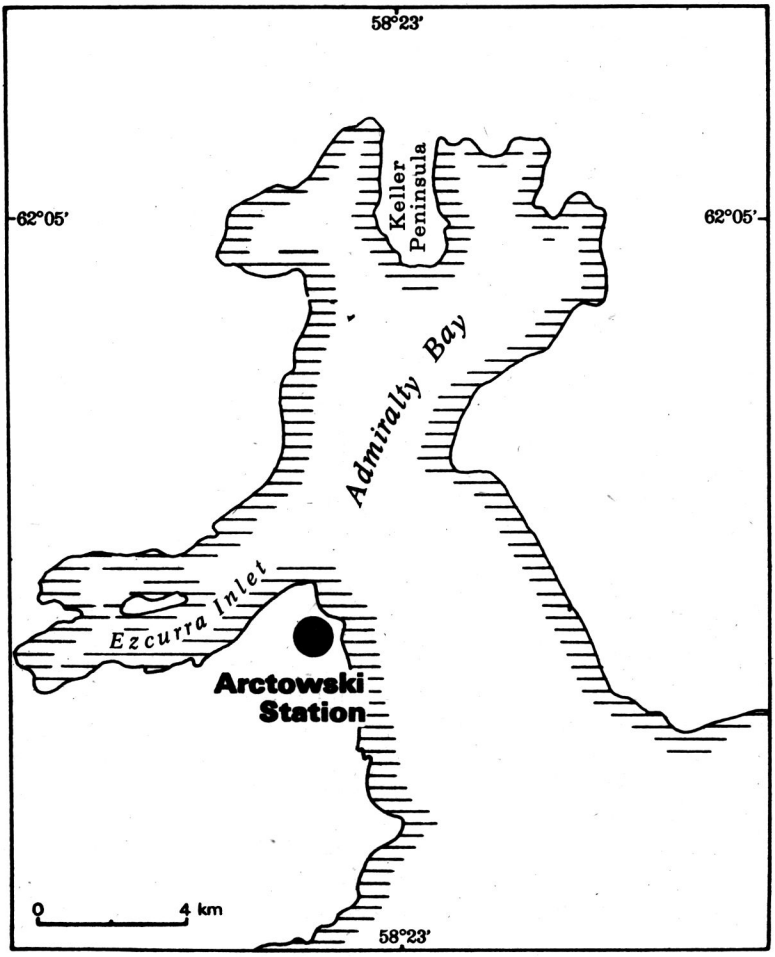

Fig. 1. The region of the Admiralty Bay on King George Island (South Shetland Islands)

Atmospheric conditions (temperature, cloud cover, and falls) were noted before every census. The sex seals was noted during observations, as well as place of their rest — a rocky beach or a patch of snow.

A χ^2 test was used for the comparison of frequency of observations of both sexes and of their preference to the type of a resting place.

3. Results

The distribution of the number of seals on the shores was shown taking as an example three days during which regular observations were conducted (Fig. 2). As the time the Weddell seals spends on the shore is almost entirely devoted for their rest, the results obtained here confirm the common thesis of an increased nocturnal activity of this species

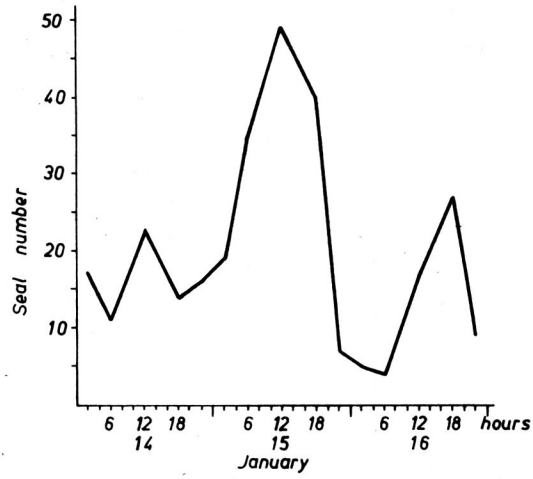

Fig. 2. Number of Weddell seals observed on the shores of the Keller Peninsula from 14 to 16 January 1979

(Stirling 1969b, Øristland 1970, Kaufman, Siniff and Reichle 1975). The majority of individuals was already in water at 18.00 h, and stayed there to 6.00 h of the next day, while the highest counts were noted between 10.00 and 16.00 h.

Analysing the maximum numbers of individuals staying on the shores of the Keller Peninsula on each subsequent day (Fig. 3), repeatable two days long cycle of their number was noticed. In general, after noting a high number of Weddell seals one day much less of them were observed the next day. These cycles are so distinct, that no statistical confirmation in necessary. It can be assumed, that they occurred also between 20 and 22 January, when observations were not made. This two days long cycle was disturbed only in period 28—31 January, when observation were also not made, and

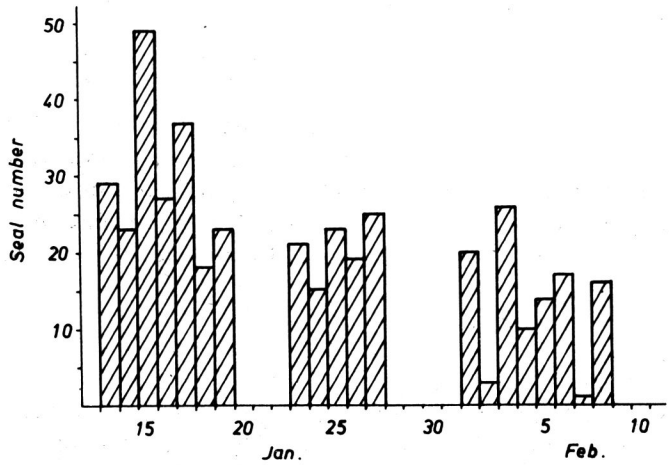

Fig. 3. The maximum number of Weddell seals occurring on the shores of the Keller Peninsula on studied days of January and February 1979

on 6 February (Fig. 3). It should be pointed out that on 6 February the temperature was the highest during the whole season, and the sky was nearly cloudless, which is a rarity in the studied region.

The eight days long February observations allowed an estimation of the total number of Weddell seals in the Admiralty Bay. All individuals met during two rounds made each day in hours of the lowest seals activity of seals in this period were marked. The numbers of seals observed on consequent days can not be, as shown above, considered as undependent values, thus to fulfill the requirements of the Zippin's method (Southwood 1966), the results of marking utilized in calculations were obtained by adding the number of individuals marked during two consequent days. In this way on the basis of four values: 29, 29, 15 and 9 the total number of the local population of Weddell seal was calculated as 105 individuals. The result of this evaluation was confirmed by additional calculations by Lincoln Index (Southwood 1966). A total of 73 individuals marked during the six days long observations, 9 of which were observed again in a group of 13 individuals on the eighth day, made the basis for the numbers evaluation. The result obtained by Lincoln Index was identical with the one obtained by Zippin's method, being 105 individuals.

As the census of Weddell seals on the Keller Peninsula indicated 60 (Birkenmajer, personal communications) and 76 individuals (own data) on 30 December and 3 January, respectively, and as more seals was noted few days later in January than in February (Fig. 3), when a total number of the local population was estimated, it can be assumed that the numbers of Weddell seals decreased systematically in the Admiralty Bay during the discussed period of summer.

The discussion on differences in the behaviour of both sexes is based on the highest count for each day, for censuses done in January and February. Among the 477 seals resting on the snow patches the sex of which was determined, more than half (243 individuals) were males. Of the total of 454 individuals observed on rocky beaches, located usually closer to the sea, the females decisively prevailed (260 individuals). This difference is stastically significant ($\chi^2 = 5.953$, d.f. = 1, $0.02 > P > 0.01$). Apart from the shown different resting place preference, no difference was found in the time or lenght of daily activity between sexes.

At the time of diminishing of near shore snow patches during the summer, and with a decreasing total number of Weddell seals in the Bay a change of the population sex structure was observed. Significant differences were observed in January, when the participation of males decreased from 51% during 13—19 January, to 39% during 23—27 January ($\chi^2 = 3.966$, d.f. = 1, $0.05 > P > 0.02$). This evaluation is based on 178 and 96 individuals, respectively, with sex determined for both discussed periods. In February the participation of males was 46%.

4. Discussion

Conducting the observations of seals in many regions of the Admiralty Bay carried out during australian summer of 1978/1979 it was found that

a grouping of Weddell seals on the Keller Peninsula was the largest. Besides, the seals marked there were met in many regions of the Bay. This justified an application of the Lincoln Index to estimate the total number of the local population. The applied method of marking the selas with paint seems adequate, although it did not allow to recognise particular individuals. The painted marks were visible from quite a distance, and marked seals surely undergone less stress than animals marked with number plates inserted in their flippers (Siniff et al. 1977). While studying the activity, there is a must for frequent contacts with animals, and the resulting stress of animals can be of basic importance. Also, individual marking, with so large dispersion of individuals which had place in the Bay, would yield additional information after a long time. It should be assumed that during the two days long cycle about 30% of the local population was observed.

Assuming that the maximum daily number of Weddell seals on the shores of the Keller Peninsula (Fig. 3) is proportional to the total number of this species in the Bay, an expected dynamics of the local population can be presented. Taking 105 individuals as a real number of Weddell selas in the first days of February and calculating the average number of the most numerous catches in the following four periods (3 December — 1 January, 13—19 January, 23—27 January and 1—8 February) it can be concluded that the population numbers was about 500 individuals in December 1978 (Fig. 4). These conclusion, although correct from mathematical point of view can bear a large error.

On the turn of 1966/1967 and 1967/1968 Øritsland (1970) estimated the number of Weddell seals on the whole King George Island as 249 to 254 individuals. This result, although difficult to compare with data for the Admiralty Bay alone (Fig. 4), seems to low.

A joint analyse of the whole population without a divission to age or sex groups probably did not significantly change the result of the numbers evaluation. The young individuals were met rarely on the coast, and different behaviour of both sexes was found only as far as a selection of resting places was concerned. The males prevailed on patches of diminishing snow, while females on rocky beaches closer to the sea. Nearly half of the animals was observed on dark rocky surface, and this can be of basic importance while making a census on the basis of aerial photographs. This could be the reason for lowering the results of counting done from air in the region of South Shetland Islands (Øritsland 1970).

The sex structure of population, changing in January, and resulting in the growing dominance of females (Fig. 4), is the most probably related to the earlier ending of the males moulting period, similarly as in the case of the elephant seal.

The higher nocturnal activity of Weddell seals was already reported by Prévost (1964), Müller-Schwarze (1965), Øritsland (1979) and others, the results of the present paper (Fig. 2) confirm this, too. However, a two days long cycle of the number of individuals resting on the shore needs an explanation (Fig. 3). If in the discussed period the individuals of Weddell seals would have a two days long activity pattern, this could explain the

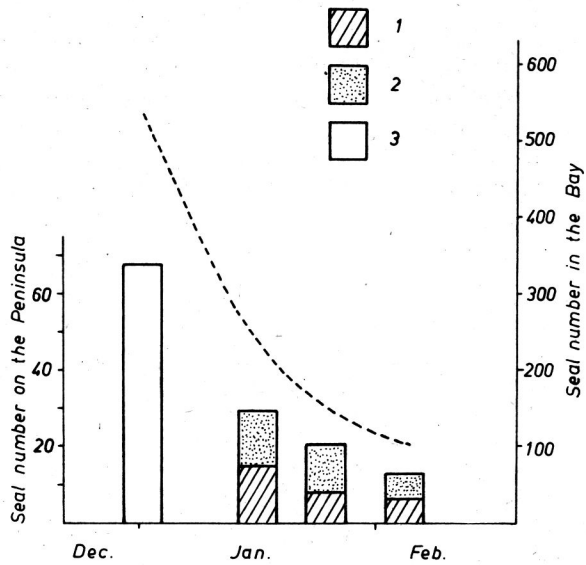

Fig. 4. Number of Weddell seals on the Keller Peninsula and their expected number in the Admiralty Bay from December 1978 to February 1979

Number of seals on Keller Peninsula is presented as a mean of the most numerous counts for each day during four periods: 30 December — 3 January, 13—19 January, 23—27 January and 1—8 February

1 — males, 2 — females, 3 — males and females

observed cyclicity of their number. It could be expected then, that an average individual spends about a day and a half at the fishery and on his way there. During the remaining hours of the two days cycle the seals probably rest. Such behaviour can be explained by its ecological aspects. Jabłoński (1980) while observing numerous penguins colonies on the shores of the Bay stated that the food resources of the Bay are not sufficient for these birds. Probably becouse of this fact, penguin colonies are situated not further than 5 km from the Bays opening to the sea. This guaranties a shorter distance to the fishery. It can be assummed also, that the stocks of fish and cephalopodes, which feed mainly on krill, do not supply enough of food for the local population of seals. Even assuming that there are only 100 Weddell seals in the Bay, their yearly food demand for and cephalopodes would be about 577 tones (BIOMASS 1977). Such values of fish production occur in the most productive seas of the world (Odum 1977). As the fish are the main food of the Weddell seal, and the whole production of prey can not be consumed by the predator, these seals have to leave waters of the Bay and feed in the open sea. Economics of using such a distant food source needs a relatively long time necessary for travel and feed, and it may cause a prolonged activity cycle.

The Weddell seals leave water more frequently on sunny and warm days (Müller-Schwarze 1965, Smith and Burton 1970, Siniff, Tester and Kuechle 1971). The same was found during the observations in region of the Admiralty Bay. It seems that atmospheric conditions synchronize activity

of individuals of the local population. The result of observations of 6 February (Fig. 3), with the sun shining the whole day, seems to confirm this assumption. Probably the weather conditions stable during several days or competition in the case of a large number of feeding individuals can lead to a decay of the two days cyclic variations of the number of resting seals.

The presented suggestions can be verified with the aid of teletransmitters or on the basis of data obtained by permanent individual marking of Weddell seals.

I am grateful to W. Krzemiński, M. Sc. for help in field observations and to professor K. Birkenmajer and docent S. Rakusa-Suszczewski for the information on distribution of seals in the region of the Admiralty Bay. Professor K. Kowalski and docent A. Łomnicki are acknowledged for valuable remarks while elaborating the data.

5. Summary

The numbers of Weddell seals on the Keller Peninsula in the Admiralty Bay was estimated in australian summer 1978/1979 on the basis of several days long observations and marking (Fig. 1). The numbers of this species in the Bay was estimates by Zippin's method and Lincoln's Index as 105 individuals for February. This result and earlier observations allowed to present a probable dynamics of the local population size of Weddell seal during the summer (Fig. 4). These data were supplemented by presenting the sex structure of the population (Fig. 4), and by observations of preferences of both sexes in the selection of resting places. The Weddell seals were met as often on shore rocky beaches, where females prevailed, as on snow patches, usually further from the sea, where males prevailed.

The known thesis of higher nocturnal activity of Weddell seal was confirmed (Fig. 2). A two days long cycles of the maximum of seals resting on the shores (Fig. 3) was explained by two days activity pattern of the individuals. The activity cycle, prolonged to two days and synchronized with atmospheric conditions, can result from inadequate food resources of the Bay, pressing the individuals to make regular trips to the further fishery on an open sea.

6. Резюме

На основе многосуточных наблюдений и мечения тюленей Ведделла проживающих на полуострове Келлер в Адмиральты Бей (рис. 1) летом 1978/79 методом Зиппина и индексом Линкольна оценено количество этого вида в Заливе. В феврале оно достигло 105 особей. Этот итог так как и более ранние наблюдения дали возможность представить вероятную динамику локальной популяции тюленя Ведделла в период антарктического лета (рис. 4). Эти данные дополнено представляя половую структуру популяции (рис. 4), а также наблюдениями свидетельствующими о разной у обоих полов преференции в выборе мест отдыха. Тюлени Ведделла можно было встретить на каменистых плажах, где преобладали самки, а также на полосах снега обычно подальше воды, где преобладали самцы.

Подтвердился тезис о усилённой ночной активности тюленя Ведделла (рис. 2). Двусуточную цикличность количества проживающих на берегу тюленей (рис. 3) объясняло двусуточным циклом активности отдельных особей. Удлинённый на две сутки цикл активности отдельных особей синхронизированный у особей из локальной популяции атмосферическими условиями, может быть вызван недостаточными запасами Залива, что принуждает особей к регулярным миграциям на более отдалённые места ловли в район открытого моря.

7. Streszczenie

Na podstawie wielodobowych obserwacji i znakowania fok Weddella przebywających na Półwyspie Keller w Zatoce Admiralicji (rys. 1) latem 1978/79, metodami Zippina i indeksem Lincolna oceniono liczebność tego gatunku w Zatoce, wynoszącą w lutym 105 osobników. Wynik ten, jak i wcześniejsze obserwacje umożliwiły przedstawienie prawdopodobnej dynamiki lokalnej populacji fok Weddella w okresie antarktycznego lata (rys. 4). Dane te uzupełniono płciową strukturą populacji (rys. 4) oraz obserwacjami świadczącymi o różnej u obu płci preferencji w wyborze miejsc spoczynku. Foki Weddella równie często spotykano na nadbrzeżnych kamienistych plażach, gdzie przeważały samice, jak i na płatach śniegu znajdujących się zwykle dalej od wody, gdzie przeważały samce.

Potwierdzono dotychczas przyjęte twierdzenie o wzmożonej nocnej aktywności foki Weddella (rys. 2). Dwudobowa cykliczność liczby przebywających na brzegu fok jest tłumaczona dwudobową aktywnością osobników (rys. 3). Przedłużony na dwie doby cykl aktywności, synchronizowany u osobników z lokalnej populacji warunkami atmosferycznymi, może być wywołany niewystarczającymi zasobami Zatoki, co zmusza osobniki do regularnych wędrówek na dalsze łowiska, w rejon otwartego morza.

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