DET NORSKE VIDENSKAPS-AKADEMI I OSLO

SCIENTIFIC RESULTS OF THE NORWEGIAN ANTARCTIC EXPEDITIONS 1927—1928 ET SQQ., INSTITUTED AND FINANCED BY CONSUL LARS CHRISTENSEN. — No. 36.

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A SURVEY OF THE EARED SEALS (FAMILY *Otariidae*) WITH REMARKS ON THE ANTARCTIC SEALS COLLECTED BY M/K «NORVEGIA» IN 1928—1929

With 46 Figures in the Text and 10 Plates

OSLO
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Contents.

Abstract.

A more general reference to the taxonomy of the family *Otariidae* with its two main groups Fur Seals and Sea Lions is given, and different methods of age determination in seal discussed. The present author finds that the suture-age method (table 1, figs. 1–3) gives the best results. Certainly, this method does not give absolute values expressed in years, but only comparative values within a chosen scale (here from 9 to 36). Nevertheless, the method has proved to be very practicable in the comparative studies undertaken, evident from table A (p. 69) where the age grouping is determined according to the degree of suture closure in the skulls examined. The connection between the absolute age determination (numbers of years) which Hamilton (1934) carried out in the case of the Southern Sea-Lion[1], and the comparative determination of suture age undertaken in the same skulls by the present author is found in table 3. (p. 17).

Earlier authors in their descriptions of otarian skulls have given a series of measurements, often without statements as to their value as specific or generic characters. A review of such skull measurements is given on pp. 20-21, and the most interesting of them have been entered in figs. 5-7.

In chapter 4 the practicability of different cranial measurements to distinguish between the individual genera is discussed. The variability of these measurements in relation to the size of the skulls within the group of adult males is also shown in the graphic figures 9–19.

A further examination of the different data concerning sea lions from Australia–New Zealand (pp. 28-31) implies that only one species, *Neophoca cinerea*, is harboured here. Statements that this species should also have been found in Japan, seem to be erroneous and founded on confusion with *Zalophus californianus*. A species from the Galapagos I. earlier mentioned under the name of *Arctocephalus philippii*, also belongs to the genus *Zalophus* and, in fact, represents a new species, *Zalophus wollebæki* (pp. 36-40, figs. 20–30) endemic to the Galapagos I. Otherwise the skull measurements suggest that the Japanese Sea Lion, *Zalophus japonicus*, is synonymous with the Californian Sea Lion, *Zalophus californianus*.

In chapter 7 the systematic position of *Arctophoca philippii* Peters from Juan Fernandez is discussed. This species was classed with the genus *Arctocephalus* by J. A. Allen. However, more detailed studies show that although the species is a fur seal, the pelt consisting of two layers of hairs, its skull is nevertheless so aberrant from that of the other *Arcto-*

[1] New methods for age determination of seals, based upon formation of zones in the permanent canine teeth, has later on been worked out by Scheffer (1950) and Laws (1952).

cephalus species, in some features recalling a *Zalophus* skull, that the species doubtless must be transferred to a genus of its own retaining the original generic name, *Arctophoca*.

As far as it is possible to infer from the material at hand, the three species of fur seals described from Australian and New Zealand waters (*Arctocephalus forsteri*, *A. doriferus*, and *A. tasmanicus*) probably should be referred to one species, *Arctocephalus forsteri*. Thus the genus *Arctocephalus* would comprise 5 different species with well separated habitats (Map, p. 45). Size of skulls of adult males and females of the different species of *Arctocephalus* is given in fig. 32 (p. 48), and the application of different cranial measurements to distinguish the adult males of the various species is found in the figs. 33—45.

Accordingly the family *Otariidae* comprises the following 13 species:

1. Northern Sea Lion, *Eumetopias jubata* (Schreber). Plate I. — Northern Pacific.
2. Southern Sea Lion, *Otaria byronia* (De Blainville). Plate II. — Western and South Eastern coast of South America.
3. Californian Sea Lion, *Zalophus californianus* (Lesson). — Northern Pacific.
4. Galapagos Sea Lion, *Zalophus wollebæki* Sivertsen. Plates III–IV. — Galapagos I.
5. Australian Sea Lion, *Neophoca cinera* Peron and Lesueur. Plate V. — Australian and New Zealand region.
6. Northern Fur Seal, *Callorhinus ursinus* Linnaeus. Plate VI. — Northern Pacific.
7. Chilean Fur Seal, *Arctophoca philippii* Peters. Plate VII. — Juan Fernandez–Mas a Fuera.
8. Lower Californian Fur Seal, *Arctophoca townsendi* (Merriam). — Guadelupe I.
9. Galapagos Fur Seal, *Arctocephalus galapagoensis* Heller. — Galapagos I.
10. Southern Fur Seal, *Arctocephalus australis* (Zimmermann). — Southern part of South America, incl. Falkland I.
11. South African Fur Seal, *Arctocephalus pusillus* (Schreber). — South Africa.
12. Kerguelen Fur Seal, *Arctocephalus gazella* (Peters). Plate VIII. — Bouvet, Kerguelen. Amsterdam I. ?
13. Australian Fur Seal, *Arctocephalus forsteri* (Lesson). — Australian–New Zealand region.

The following five species of seals collected by the «Norvegia» expeditions are dealt with in the special part of the paper: The Leopard Seal, The Wedell Seal, The Crabeater Seal, The Elephant Seal, and The Kerguelen Fur Seal. Here also the observations Dr. Olstad made during the voyages have been entered, and his measurements and weighings of the animals are compared with certain measurements of the corresponding skulls (Fig. 46, tables 12–16, F and G). The demonstration of a population of the Kerguelen Fur Seal at Bouvet I. is of special interest as this species has earlier not been met with west of Kerguelen I. The «Norvegia» collection of this fur seal consists of as many as 37 animals comprising cubs, young ones, and adults of both sexes, and means a valuable accession, as very few specimens had been recorded earlier.

Introduction.

The original aim of this investigation was to examine a material of seals from the Antarctic, collected by Dr. O. Olstad during the cruises of M/k «Norvegia» in the years 1928/1929. All the species except one, a fur seal from the Bouvet Island, were easy to identify. In the last case ,however, it proved to be very desirable to have more material for comparison, a subject not so easy to carry out as a couple of fur seal skulls were the only ones present in Norwegian museums.

However, by grants given for the purpose I fortunately found an opportunity to study Otarid skulls in the collections of various museums in Europe as well as in U.S.A. This study revealed so many interesting problems in the systematics of the Otarids, e.g. an unknown species of a sea lion earlier referred to the fur seals, that the main stress of the work was changed to a comparative study of the Otarid skulls with a shorter treatment of the «Norvegia» collection.

Due to the large sex dimorphismus of the Otarid skulls, it was found most convenient here mainly to deal with one group, the male skulls. Later on I intend to give corresponding dates for the female skulls examined, with a more thoroughly statistical treatment of the whole material in question.

I beg to express my best thanks to the staff of the more than 20 Museums and Institutions I had the pleasure to visit in Europe and America, all of which kindly placed all their Otarid skulls available at my disposal. Furthermore, I which to express my gratitude to Professor Dr. Hj. Broch who, in taking care of the publication of the «Norvegia» material, secured the grant for my first study of the Otarid skulls at Riksmuseet, Stockholm, and later on gave me valuable advice and assistance during the preparation of my manuscript. I am, moreover, indebted to the Norwegian Government, Church- and School Department, which granted me the means for half a years study in U.S.A. in 1948, and to the Department of Fisheries for facilitating my study at the British Museum in 1949. I am also very grateful to Dr. O. Olstad and Director Alf Wollebæk who entrusted me with the working up of the seal collection from the «Norvegia» expeditions, to Professor Dr. Per Ottestad for carrying out the Student's t tests, and last

but not least to my wife for her valuable assistance in the tiresome work of taking all the skull measurements.

In this paper Otarian skulls from collections of the following institutions have been used:

1) U.S. Nat. Mus., Washington, 2) Amer. Mus. Nat. Hist., New York, 3) Mus. Comp. Zool., Boston, 4) Chicago Nat. Hist. Mus., 5) Calif. Acad. Sci., San Francisco, 6) Univ. of Calif., Berkely, 7) Stanford Univ., Palo Alto, 8) Los Angeles County Museum, 9) Scripps Inst., La Jolla, 10) Brit. Mus., London, 11) Anat. Mus. Univ., Edinburgh, 12) Musee d'Hist. Nat., Paris, 13) Rijksmus. Nat. Hist., Leiden, 14) Zool. Mus., København, 15) Riksmuseet, Stockholm, 16) Zool. Mus., Oslo 17) Vidensk. Mus., Trondheim.

Valuable help and information was also received from Dr. Victor B. Scheffer, Fish and Wildlife Service, Seattle, and Mrs. Belle J. Benchley, Director, Balboa Park, San Diego.

General Part.

1. On the Classification of Seals.

The sub-order *Pinnipedia* is divided into three families, one of which, the *Odobaenidae* (walruses), is outside the scope of this paper. It may easily be separated from the other two families by the upper canines which grow into long, powerful tusks.

The second family, *Otariidae*, is generally called Eared Seals, due to their having an ear with a small pointed pinna while the last family, *Phocidae*, in contrast to that, is called Earless Seals as they are said to have no external ears. Even if this definition in most cases holds good it is not of general significance, as pointed out by Pocock (1933) and Mathews (1936), who state that in the Gray Seal (*Halichoerus grypus*) viz., the common seal (*Phoca vitulina*) a short but distinct pinna is present. Of the many characters typical to the Otarids (Fur Seals and Sea Lions) may be mentioned that they are capable of rotating the hind limbs forward to support the body, they have long fore flippers, testes in a scrotum, the skull has a distinct supraorbital process and a small, shrunkenlooking auditory bulla. In the Phocids (Hair Seals) the hind limbs are incapable of forward rotation, the fore flippers are short, there is no scrotum, no distinct supraorbital process in the skull, and the auditory bulla is much larger, globose.

From a systematical point of view the family *Otariidæ* certainly is the most complicated one. Up to the year 1816 two species only were known. Later on, however, lots of new species were described, the number at one time exceeding more than fifty. Most of them, however, proved to be synonyms, and Allen (1870 p. 39) suggests that the number of distinct species is probably not more than ten, the same as given by Bertram (1940, Addendum I), the most recent paper I know on the subject in question.

The main difficulty when working with classification of Otarids is the lack of sufficient material. Even species of which hundreds of thousands of specimens were killed during the nineteenth century, are generally very rare in the collections of the Museums and it is difficult to get what should be needed for scientific purposes. The wanton hunting has reduced e.g. the previous enormous herds of the southern fur seals to a few scattered individuals (Kellog 1942, p. 461), and some species even seem to be quite or nearly exterminated (*Arctocephalus galapagoensis*, *Arctophoca townsendi*).

Another problem in dealing with the systematics of the Otarids is the enormous sex differences and the very large individual variation. Thus a character as colouration of the coat, so commonly used in the systematics of mammals, is of little value when dealing with Otarids. Truly, the coat might be useful for separating larger groups as: Fur Seals (with a thick underfur besides long outer hair) from Hair Seals and Sea Lions (with a short coat and lacking underfur) but it fails when turning to smaller systematical units as genera or species.

For this reason skull characters are generally used for separating the genera and species. As the appearance of the skull, however, varies greatly with sex and age of the animal, both in the shape of the different bones and in its general form, a comparison should be made only of specimens of the same sex and at the same stage of development.

Bertram (1940) has for the Weddell Seal and the Crabeater Seal carried out extensive and interesting investigations on these lines. According to his Addendum the family *Otariidae* should be divided into 6 genera comprising the following 10 species:

Steller's Sea Lion	(*Eumetopias stelleri*)
Falkland » »	(*Otaria byronia*)
Californian » »	(*Zalophus californianus*)
Australian » »	(*Zalophus lobatus*)
Hooker's » »	(*Phocarctos hookeri*)
Northern Fur Seal	(*Callorhinus ursinus-alascanus*)
Lower Californian Fur Seal	(*Arctocephalus townsendi*)
Southern Fur Seal	(*Arctocephalus australis*)
Cape Fur Seal	(*Arctocephalus antarcticus*)
Australian Fur Seal	(*Arctocephalus doriferus*)

I shall later on return to this list which, according to my opinion, should be altered somewhat.

2. Age Determination of Seals.

In estimating the age of seals special attention has been paid to the size of the animal, the size and general ossification of the skull, as well as to the suture closure and wear of teeth. As most of the seal materials in museum collections generally are restricted to skulls only, often without any information about the size of the animals, a suitable method for age determination based upon skull characters only, would be very useful. However, no really good such method had been worked out until Doutt (1942) in his «Review of the Genus Phoca» gave a very valuable contribution to solve this question. After discussing the various methods Doutt finds that of the suture closure to be the most reliable one. He selects eight

sutures in the skull as being applicable for the purpose, and, as the suture closure is a gradual process he gives each suture the certain values according to degree of closure: 1 for open, 2 for less than half-closed, 3 for more than half-closed, and 4 for completely closed. By adding the figures assigned to the various sutures of a skull, the sum will give the «sutural age» of the specimen, which will be high in old specimens where many sutures are closed, lower in younger ones.

This method was prepared for the genus *Phoca*. When turning to other genera of seals it seemed likely to believe that perhaps some other sutures should be taken into consideration as being more applicable. A thorough examination of a large series of skulls from each genus or species may certainly prove that so it is, and, in fact, I met with some difficulties when using the very same sutures in the various genera of Otarids. For example, in the genera *Eumetopias* and *Otaria* the temporal ridges seem to converge and form the sagittal crest at a much slower rate than is the case in *Arctocephalus*. However, for lack of sufficient material,

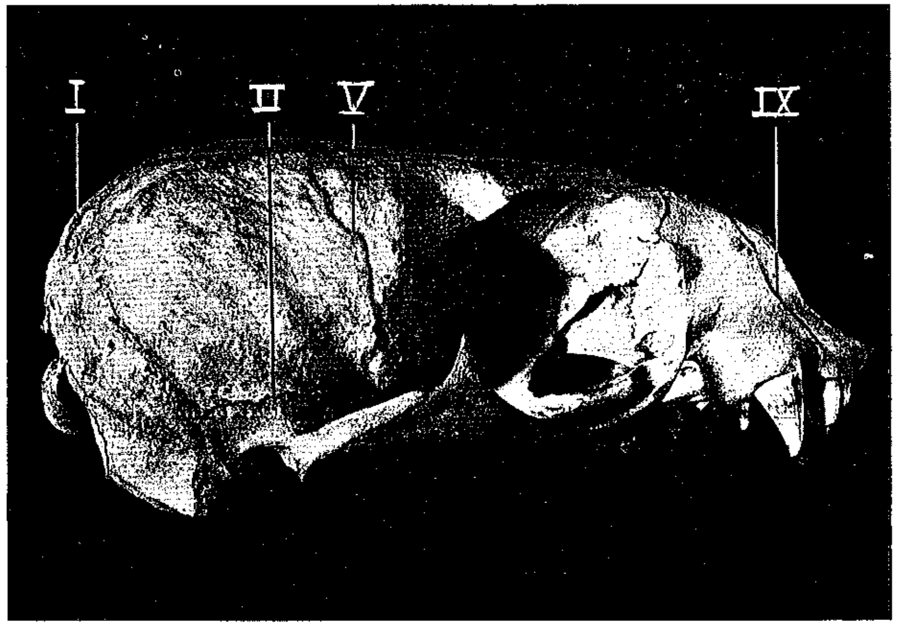


Fig. 1. Skull of young fur seal, lateral view. The sutures used for age determination, in the figures 1–3 indicated by Roman numerals, are as follows:

I. Occipito-parietal	VI. Basioccipito-basisphenoid
II. Squamoso-parietal	VII. Maxillary
III. Interparietal	VIII. Basisphenoid-presphenoid
IV. Interfrontal	IX. Premaxillary-maxillary
V. Coronal	

(Some of the sutures strengthend to make them more distinctly visible).

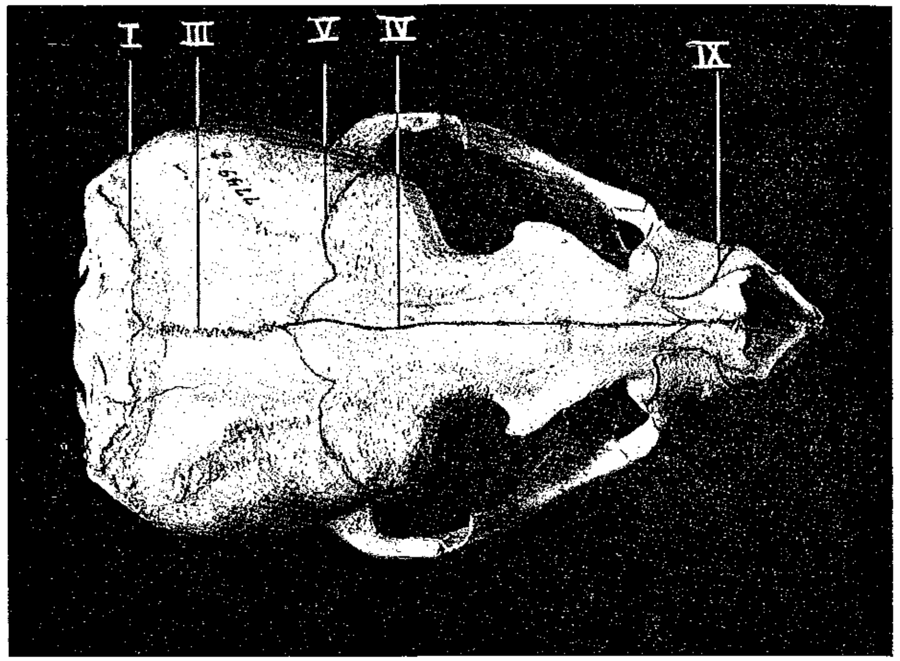


Fig. 2 Skull of young fur seal, dorsal view. Explanation of numerals see fig. 1.

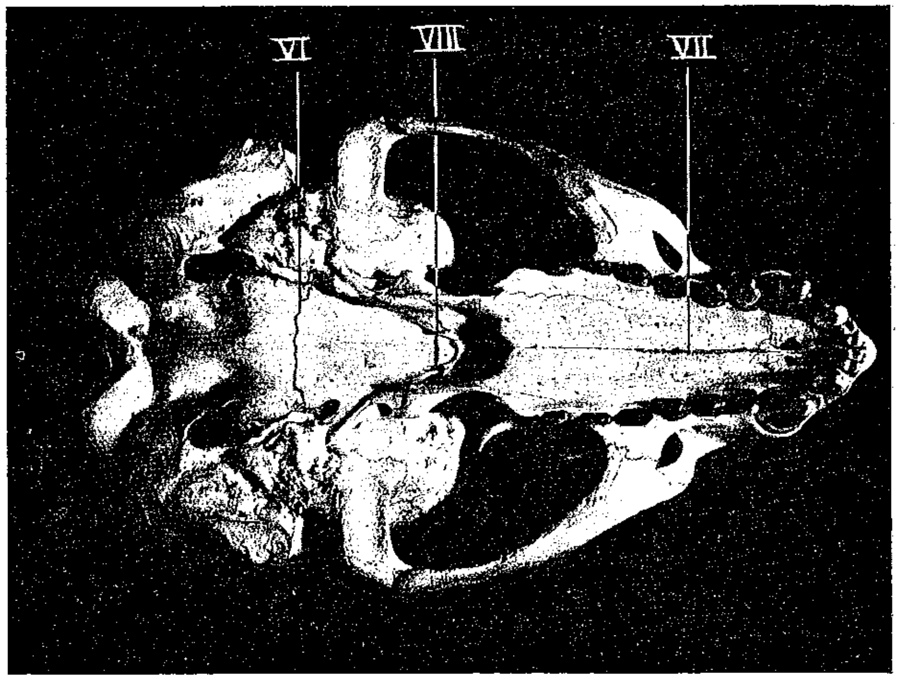


Fig. 3. Skull of young fur seal, ventral view. Explanation of numerals see fig. 1.

and because the genera *Eumetopias* and *Otaria* are only briefly mentioned in the paper at hand, this qustion has not been further studied. The aim was only to get a rough relative age-grouping which could be useful when discussing various problems in the classification of the Otarids based upon skull measurements.

In the genus *Arctocephalus*, which is more closely treated here, the eight skull sutures used by Doutt for the genus *Phoca* fitted very well, and I have only added as a ninth character the maxillary-premaxillary suture (figs. 1–3). For further information of the method used I may refer the reader to Doutt's paper earlier mentioned. Here I shall give only one example (table 1) taken from skulls of *Arctocephalus gazella* in the «Norvegia» collection.

I have found it conveniant when working with Otarid skulls, to separate the following three groups: I) Adults, II) Young ones, and III) Cubs. — For the male skulls this grouping is characterized as follows: Group I includes all skulls which have a more or less pronounced sagittal crest, group II skulls without sagittal crest[1] and without milk teeth, while group III comprises all skulls without sagittal crest which have some of their milk teeth still retained.

A determination of the suture age of the male skulls within each of these groups gives the following values: I) suture age 19–36, II) suture age 10–18, III) suture age 9–10.

This same range of variation in suture age is accepted for separating the corresponding three groups of female skulls, where a real sagittal crest does not occur.

In table A (p. 69) are compiled the measurements of skull length from one species of each of the seven genera of Otarids[2]. Even if the material is small, and some groups are lacking, we may get an impression of how useful a method of relative age determination is for comparison of skulls from different species of Otarids.

To get a better general view of the table, the dates for group I, adult males and females, are graphically represented in fig. 4. The height of each column indicate the degree of variation in condylobasal length of the skull, the figures above and below each column states the suture age of the oldest resp. the youngest skulls examined.

Concerning the male skulls, we find that the three species of fur seals are all of a fairly small size, with an average skull length of some 240 mm. The sea lions are distinctly larger, showing gradually increasing size from *Z. californianus* (with an average skull length of 294 mm) to *E. jubata*

[1] A small sagittal crest may occur in young specimens of *Otaria byronia*, where the formation of a sagittal crest seems to start at a somewhat lower suture age.

[2] Most of the genera are monotypic. In the genus *Arctocephalus*, where 5 species are known, *A. gazella* is selected as representing a medium sized species. The largest species of fur seals, *A. pusillus*, might reach the same size as small sea lions (*Zalophus*) (see p. 22).

Table 1. *Determination of suture age in skulls of Arctocephalus gazella from Bouvet.*

Ref. no.	Sex	Stage	Skull sutures considered: I	II	III	IV	V	VI	VII	VIII	IX	Suture age	Skull length (mm)
7741	Male	Cub.	1	1	1	1	1	1	1	1	1	9	128
—34	»	Young	2	1	1	1	1	4	1	1	1	13	197
—27	»	»	4	1	1	1	2	4	1	1	1	16	218
—37	»	Adult	4	4	4	1	4	4	1	1	1	24	231
—44	»	»	4	4	4	2	4	4	4	4	3	33	244
7755	Female	Cub.	1	1	1	1	1	1	1	1	1	9	118
—50	»	Young	3	1	1	1	1	4	1	1	1	14	183
—54	»	Adult	4	2	2	2	2	4	1	1	1	19	186
—46	»	»	4	4	4	1	4	4	1	4	1	27	197

The gradual closure of the various sutures, in skulls from cubs up to adults of both sexes, is clearly demonstrated in the vertical columns. The sex dimorphismus is well marked e.g. when comparing the two skulls No. 7734 and 7746 which reveal that a male already at a suture age of 13 attains the same size (skull length 197 mm) as an adult female of a suture age as high as 27.

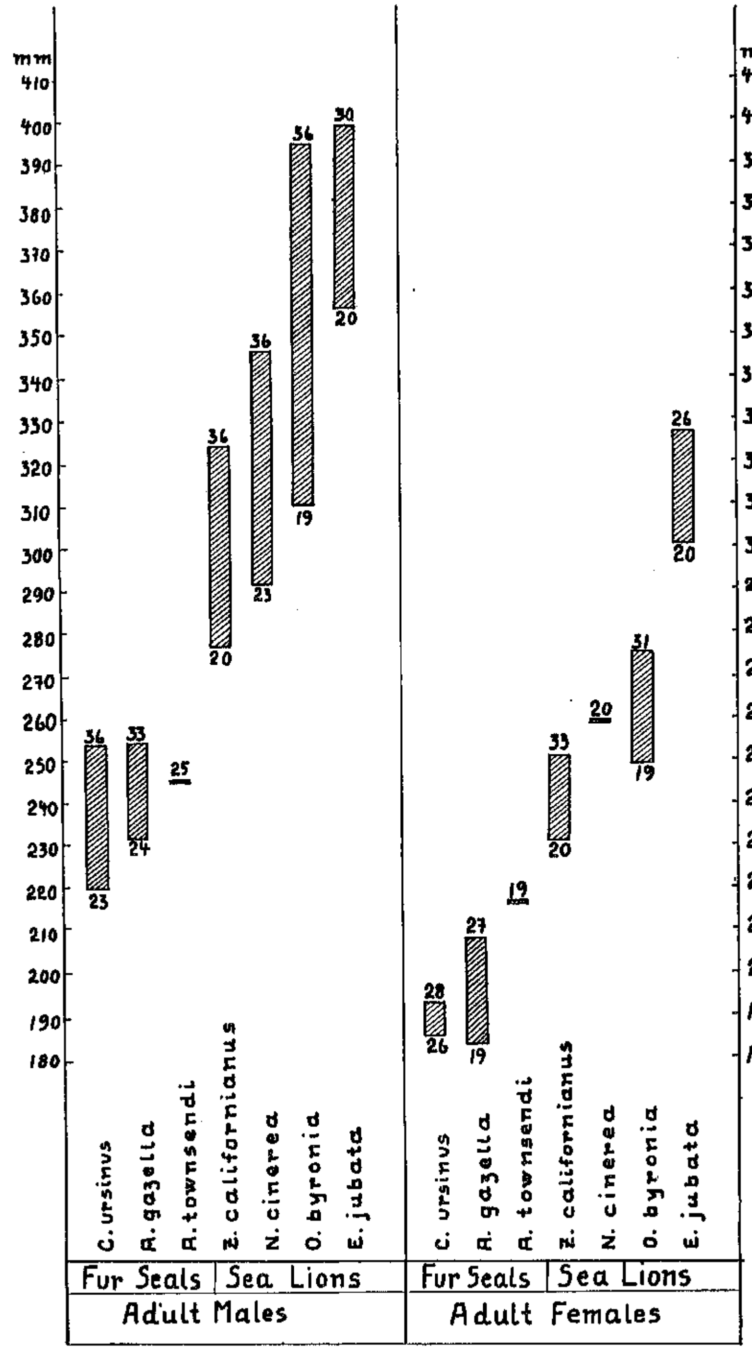


Fig. 4. Length of Otarid skulls, adult males and females. Figures below and above each column indicate suture age of youngest resp. oldest specimen examined.

(average length 374 mm). The latter species may certainly grow even larger than indicated in the graph as the oldest male skull examined has a suture age of only 30, while in all the other species of sea lions full-grown male specimens with all the nine skull sutures closed (suture age 36)are ascertained.

In the female skulls a corresponding difference in size of the various species is found. Furthermore, the graph distinctly shows the marked sex dimorphismus.

Concerning the absolute age of fur seals and sea lions, I have not been able to locate any skull of known age in the collections of the Museums visited. The only exception is a few sea lion skulls from zoological gardens. The ossification in such animals kept in captivity is however so anomalous that they have to be left out in this connection. However, Osgood, Preble and Parker (1914 p. 65-70) have succeeded in separating various year classes of the Northern Fur Seal, mainly based upon differences in the total length of the animals, partly on skull characters too. A summary of their measurements is given in table 2.

Table 2. *Age determination and skull measurements of Callorhinus ursinus (from Osgood, Preble and Parker 1914 p. 70).*

Males	Number of specimens examined	Length of skull in mm		
		min.	mean	max.
2-year-olds	13	170	175,3	181
3-year-olds	35	182	192	198
4-year-olds	5	202	205,2	208

When comparing these dates with my measurements of skulls from the same species (table A, p. 69), we find that all the three year-classes mentioned by Osgood *et alia* fall within the size limits given for my group II, young ones. The term of this group thus seems to fit well, as Osgood *et alia* further states that the males of *Callorhinus ursinus* normally do not breed until an age of 6 or 7 years.

Hamilton (1934 and 1939), who has carried out thorough investigations on the biology of the Southern Sea Lion (*Otaria byronia*) at the Falkland Islands, succeeded in separating age groups of this species. The following characters were considered in determining the age: 1) Length of the animal and bodily development, 2) coat colour, 3) length of skull, 4) proportion of the skull length to the total length of the body, 5) proportions of various skull measurements to the length of the skull, 6) osteological development, 7) dental development, and 8) condition of the reproductive glands.

When all these characters are considered and combined with elaborate observations in the field, they certainly give a very reliable basis for age determinations. As I had the opportunity at the British Museum to study Hamilton's large collection of Southern Sea Lion skulls, I found it interesting to compare the suture-age found by myself with the age-determination of the same skulls carried out by Hamilton. The results of this study are compiled in table 3.

Table 3. *Size, age, and suture-age of the skulls of Otaria byronia in the Hamilton collection.*

Age determination (Hamilton det.)	Males			Females		
	Number of skulls examined	Average length of skull	Average suture-age (Sivertsen det.)	Number of skull examined	Average length of skull	Average suture-age (Sivertsen det.)
1st year	14	185	9,4	6	174	9,1
2nd	11	225	10,6	3	198	10,7
3rd »	5	238	13,2	4	210	12,5
4th »	5	269	15,0	14	227	14,3
5th »	5	308	17,2	22	237	15,0
6th » and over	22	327	24,6	57	258	20,6

As we may see from the table there is a fairly even rise in the values of suture age from year to year until the fifth year of age. Between the 5th and 6th year, however, there is a distinctly marked jump in the average suture age, rising from 17.2–24.6 in the males, from 15–20.6 in the females. And as earlier mentioned, just within this suture-interval (at a suture age of about 18–19) the demarcation between our Group II (Young ones) and our Group I (Adults) has been fixed.

How well this demarcation line between young and adult specimens agrees with the results obtained by Hamilton, may emerge from his statement (1943 p. 297) that even if specimens of *Otaria byronia* may become sexually active earlier (the female about the end of the fourth year, the male in its fifth year), neither of the sexes shows the facies of the fully adult until the sixth year.

These examples may show that an age-grouping based upon suture closure, agree with other methods of age determination and might be useful for comparison of skulls from different species of Otarids.

3. Skull Measurements in Otarids.

To identify fur seals or sea lions from skull characters only is sometimes a quite difficult task. In some species (*Arctophoca philipii, Arctocephalus gazella*) the original description is based upon juvenile specimens only, and very little is known about the exact skull proportions in adult specimens. This fact, and the extreme sex dimorphismus and high degree of individual variation in the Otarid skulls, might explain the many systematical errors made during time, and the partial obscurity which still exists in the systematics of some of the Otarian groups, e.g. the Australian fur seals. As an object lesson may further be mentioned a case some fifty years ago where the most eminent seal investigator J. A. Allen identified some skulls from the Galapagos Islands as belonging to a fur seal (*Arctocephalus philippii*) while it now proves to be a sea lion (*Zalophus wollebœki*) endemic to these islands.

For these reasons I felt the necessity of trying to find out which skull characters might be reliable for a comparative study of the various species of Otarids. Some 80 different measurements from each skull were taken, most of them mentioned in descriptions of Otarid skulls by earlier authors. As should to be expected, the larger number of these measurements proved to be of little value due to the high degree of individual variation. However, to save later workers on the subject from such timewasting and tiring

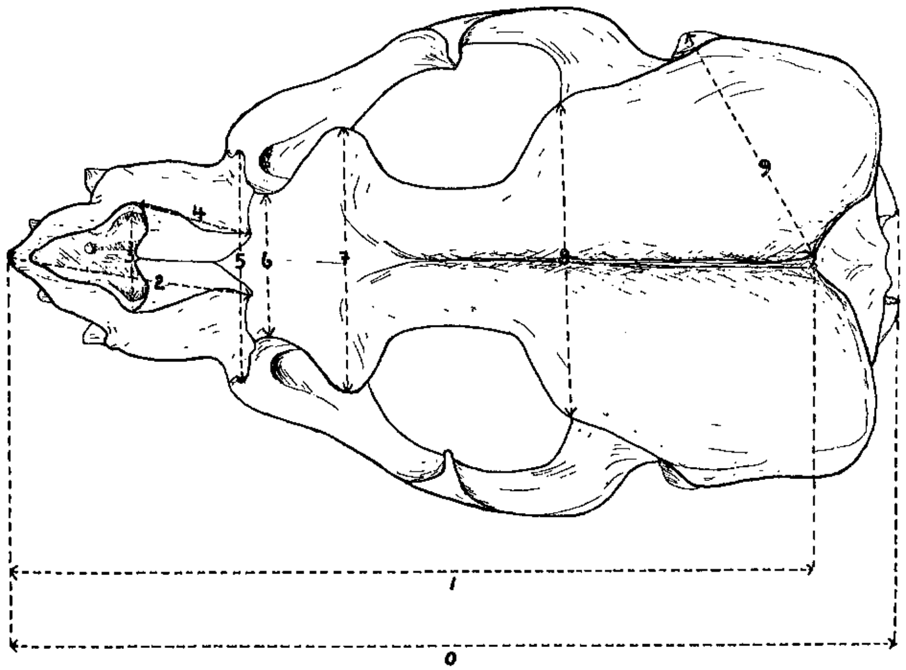


Fig. 5. Dorsal view of skull (*Arctocephalus gazella* ad ♂) to show points of measurement (cf. pp. 20-21).

work, I give a list of all the skull measurements taken, showing which were found to be unfitted and which were more or less serviceable for comparative studies in this connection (see pp. 20-21 and figs. 5–7).

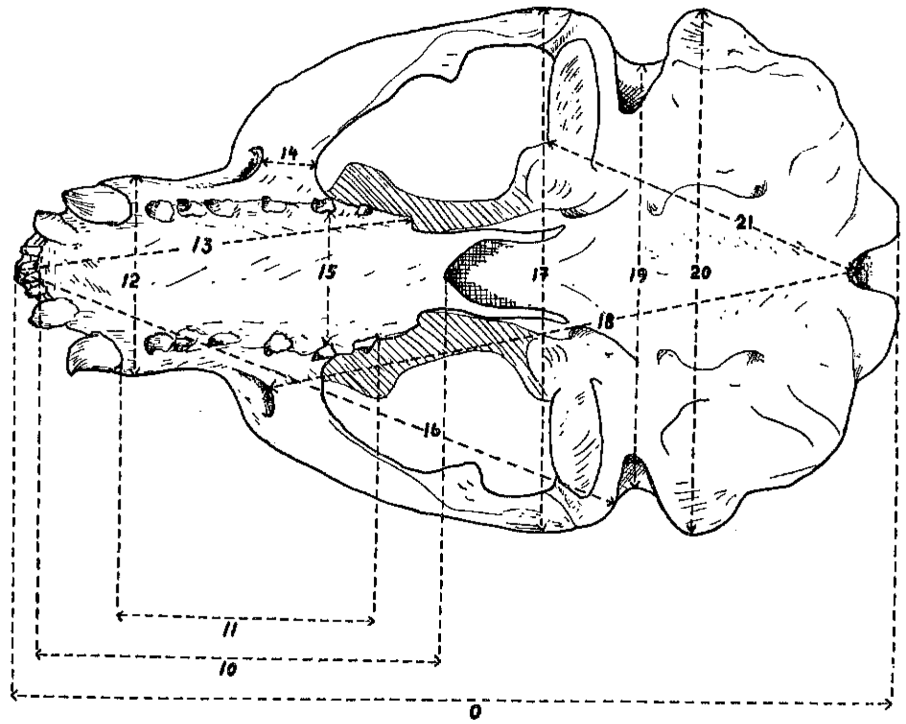


Fig. 6. Palatal view of skull (*Arctocephalus gazella* ad ♂) to show points of measurement (cf. pp. 20-21).

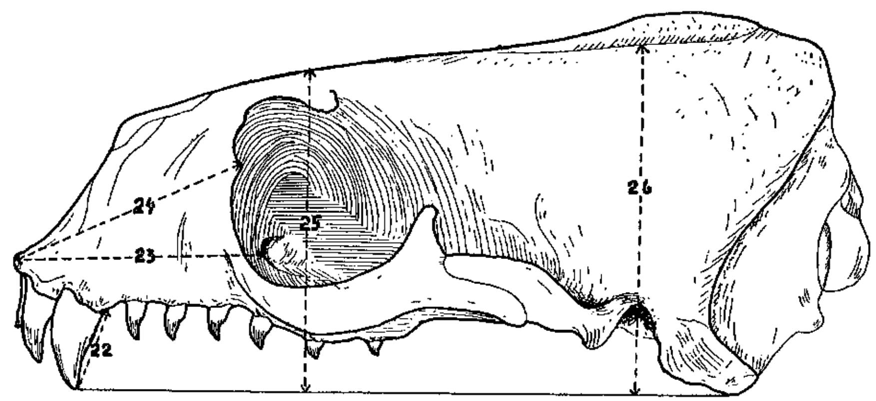


Fig. 7. Lateral view of skull (*Arctocephalus gazella* ad ♂) to show points of measurement (cf. pp. 20-21).

Skull measurements used.

(see figs. 5–7).

0. Skull length (= condylobasal length)
1. Gnathion – middle of occipital crest
2. Gnathion – upper end of nasals
3. Greatest width of anterior nares
4. Greatest length of nasals
5. Breadth at preorbital processes
6. Interorbital constriction .
7. Breadth at supraorbital processes
8. Breadth of brain case
9. Occipital crest – mastoid
10. Palatal notch – incisors
11. Distance hind border canini – hind border 6th cheek tooth, upper jaw
12. Breadth of skull at canines
13. Gnathion – posterior end of maxilla (palatal)
14. Breadth of zygomatic root of maxilla
15. Breadth of palate at 5th cheek teeth
16. Gnathion - hind border of postglenoid process
17. Zygomatic breadth
18. Basion – zygomatic root (anterior)
19. Auditory breadth
20. Mastoid breadth
21. Basion-bend of pterygoid
22. Height of canines above alveol
23. Gnathion –foramen infraorbitale
24. Gnathion –hind border of preorbital process
25. Height of skull at supraorbital process
26. Height of skull at auditory meatus
27. Height of sagittal crest
28. Anteroposterior diameter of the cheek teeth
29. Breadth of condyles, lower jaw
30. Distance 3rd–4th upper cheek tooth
31. Distance 4th–5th upper cheek tooth.

In cases where bilateral measurements are possible, the average values have been used.

Unserviceable skull measurements.

Basion – gnathion
Basion – incisors
Palatal length (gnathion-postpalatal notch)
Postpalatal length (postpalatal notch –basion)
Length of lateral series of teeth (canini-molars incl.)
Distance between canines (alveol)
Distance between 3rd molars (alveol)
Basion –optic foramen
Distance between outer sides of upper canines (alveol)
Breadth at postorbital constriction
Breadth of nasals
Breadth of rostrum

Gnathion – postorbital process
Distance between outer sides of lateral incisors (alveol)
Basion – middle of occipital crest
Height of occipital crest
Breadth across condyles
Height of lateral incisors above alveol
Frontal – palate, at supraorbital process
Height of skull at nasals
Gnathion – hamular process
Gnathion – hind border of supraorbital process
Gnathion – hind border of occipital crest
Gnathion – lower end of nasals
Gnathion – maxillar, in the bend up to jugal
Length of molar teeth row, at crone
Mesethmoid – nasale
Nasals – maxillare
Least breadth of palate
Height of postorbital process, jugal
Shape of palatal notch

Lower jaw.

Length of ramus
Length of mandibular teeth row (incisivi-molars incl.)
Width between outer sides of canines (alveols)
Width between outer sides of condyles
Length of cheek teeth row, at crone
Height at meatus
Angularis – coronoideus
Length of coronoideus.

Many of the characters mentioned are difficult to measure with the desirable accuracy. This is also the case in a few of the characters used by me (e.g. Nos. 25–28), but the differences between skulls compared are here so large as to eliminate the inaccuracy. (See e. g. height of sagittal crest in *Zalophus wollebæki* Pl. III and *Arctocephalus gazella*, Pl. VII).

4. Skull Characters Distinguishing the genera of Otarids.

From the skull measurements just mentioned I have selected twelve as being the most suitable ones for this purpose. They are to be found

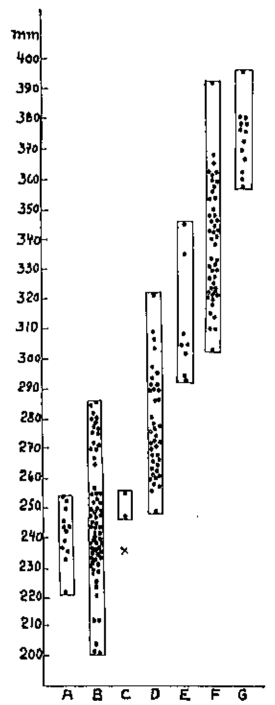


Fig. 8. Skull length.

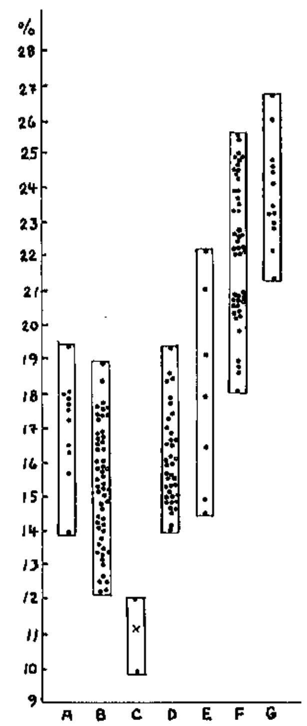


Fig. 9. Interorbital constriction as percentage of skull length.

Figs. 8—19. Skull proportions in the 7 genera of Otarids.
The letters A—G signify:

A. Genus Callorhinus (1 species)
B. » Arctocephalus (5 »
C. » Arctophoca (2 »)
D. » Zalophus (2 »)
E. » Neophoca (1 »)
F. » Otaria (1 »)
G. » Eumetopias (1 »)

Each · (or x) indicate one specimen. (Concerning x see explanation p. 43).

in table B (p. 70) and figures 8–19. To simplify the problem I have here confined myself to adult male skulls only[1].

In table B the absolute measurements are given. Here all the measured skulls are included, even those where the suture age were not recorded[2]. The number of specimens examined here is therefore much larger (188 skulls) than what is the case in table A earlier mentioned (82 skulls) where only the age-determined skulls were dealt with.

Furthermore in table A only one species from each genus was taken into consideration; in table B all species are included. This fact explains the much wider range of size-variation e.g. in the genus *Arctocephalus* of table B (resp. fig. 8) compared with table A (resp. fig. 4).

When about to compare skulls varying so much in size within each genus as they do here, I have found it most expedient not to use the absolute but the relative measurements, calculated in relation to the length

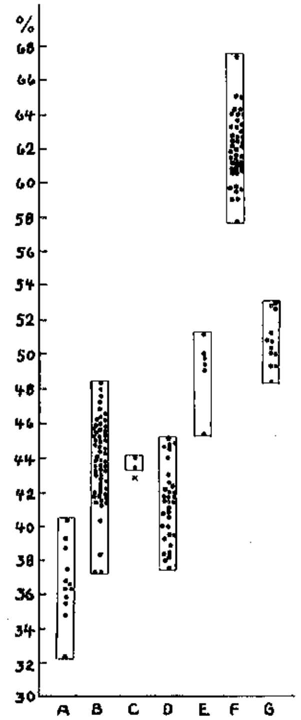


Fig. 10. Palatal notch-incissors as percentage of skull length.

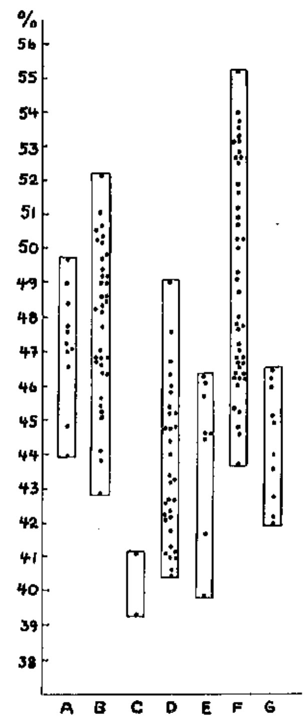


Fig. 11. Occipital crest-mastoid as percentage of skull length.

Explanation of letters A–G, see figs. 8–9.

[1] For a closer study of the general features I may refer the reader to J. A. Allen's detailed and comprehensive papers on the subject (1870, 1880 and 1905).

[2] They were measured before the suture-age method was tried out in the Otarid skulls.

of each skull. According to that the 11 skull proportions in question are graphically represented in the figs. 9–19.

The figures might speak for themselves, but a few remarks on typical features should be made.

Even if the various characters show a fairly high degree of overlapping we may for each genus find a combination of skull proportions characteristic for just that genus. Thus in the monotypic genus *Eumetopias* we find that *E. jubata* is characterized by the large skull (fig. 8 G), the broad interorbital constriction (fig. 9, G), the fairly large palatal length (fig. 10 G), and especially by the large space between fourth and fifth cheek teeth (fig. 17 G and Pl. I).

Otaria byronia, the second largest of the Otarids (fig. 8 F) is easily distinguished from all the others in the diverging shape of the hard palate,

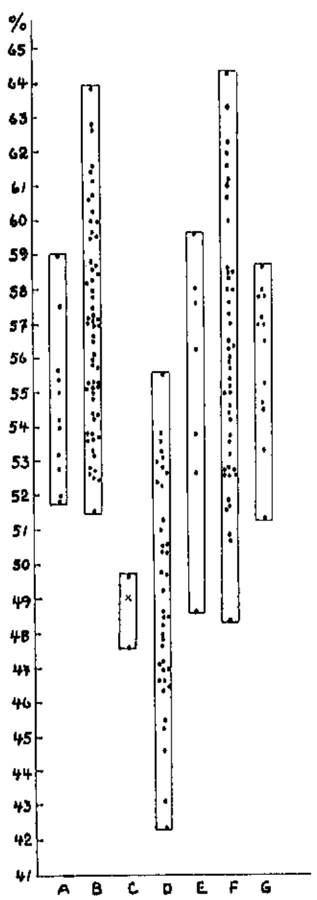


Fig. 12. Mastoid breadth as percentage of skull length.

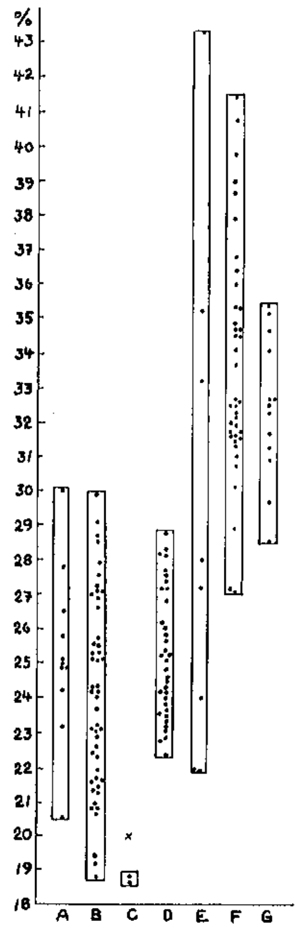


Fig. 13. Breadth at supraorbital processes as percentage skull length.

Explanation of letters A–G see figs. 8–9.

the lateral borders of which is vertically raised making the surface deeply concave. The depth of the concavity in the adult males varies from 35–40 mm, while in other Otarids it never exceeds the depth of 10 mm. The hard palate is exceptionally long too (fig. 10 F and Pl. II), almost reaching the hamular pterygoids. Furthermore, the long maxilla (fig. 14 F) and the broad snout (fig. 15 F) are useful characters.

The third genus of the American sea lions, *Zalophus*, is distinctly smaller (fig. 8 D), has a shorter palate (fig. 10 D), a more narrow supraorbital region (figs. 9 D and 13 D), narrow anterior nares (fig. 18 D) and a fairly narrow zygomatic root of maxilla (fig. 19 D). The skull of *Zalophus* thus has a more slender and elongated shape, compared with the broader and stouter skulls of the other genera, both of sea lions and fur seals (except *Arctophoca*).

The character most typical of adult males of *Zalophus* is, however, the size and shape of the sagittal crest. As seen from Plate III, the sagittal crest rises quite steeply from the frontal in the supraorbital region, reaching its largest height before the middle and sloping evenly down to the much lower occipital crest at the rear of the skull. In all the other Otarids the sagittal crest is more of an *Arctocephalus*-like type (Pl. VII) comparatively small and mainly restricted to the rear part of the skull in the parietal-

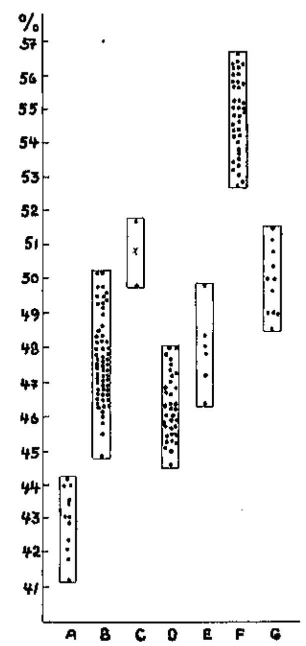


Fig. 14. Gnathion—posterior palatal end of maxilla as percentage of skull length.

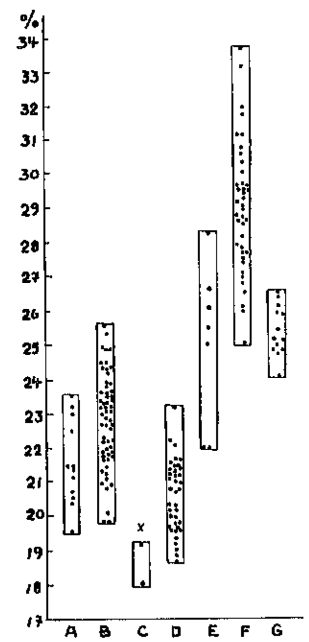


Fig. 15. Breadth of skull at canines as percentage of skull length.

Explanation of letters A–G see figs. 8–9.

occipital region. Even the skulls from old females of *Zalophus*, where an indication of a sagittal crest sometimes may occur, are easily identified by the typical shape of the crest.

The Australian Sea Lion (*Neophoca cinerea*) has some resemblance to *Zalophus*, and has also been referred to that genus (Allen, Bertram). It differs, however, besides in the shape of the sagittal crest (Pl. IV), in the broader snout (fig. 15 E), the greater width of anterior nares (fig. 18 E) and the greater mastoid breadth (12 E). — It remains to be said that *Neophoca*, both in the characters mentioned (see also fig. 13 E) and in a lot of other skull characters, reveals an extremely high degree of variation compared with what is found in other Otarid skulls.

A closer treatment of the genus *Neophoca* (including *Phocarctos*) is given later on (pp. 28–31).

The Northern Fur Seal (*Callorhinus ursinus*) which is one of the smallest Otarids (fig. 8 A) is characterized by the short palate (fig. 10 A), the very short maxilla (fig. 14 A), and the broad anterior nares (fig. 18 A). Furthermore, the general appearance of the skull is very typical (Pl. V): the great height in the supraorbital region, the nearly vertical, almost terminal anterior nares, and the nasals situated so far in front gives the skull of *Callorhinus* a much more abrupt declination of the facial profile than any other Otarid skull.

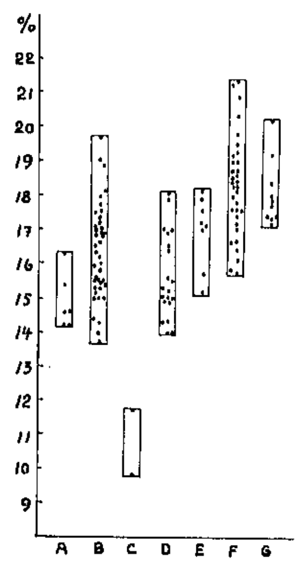


Fig. 16. Breadth of condyles of lower jaw as percentage of skull length.

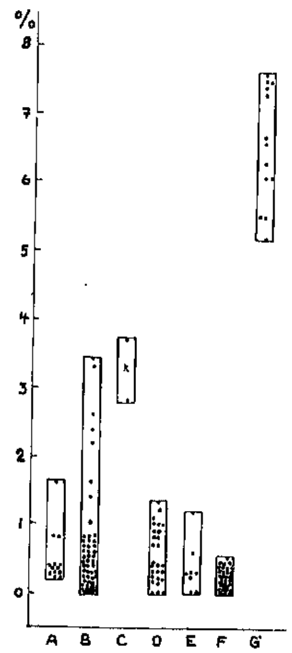


Fig. 17. Distance 4th–5th cheek tooth as percentage of skull length.

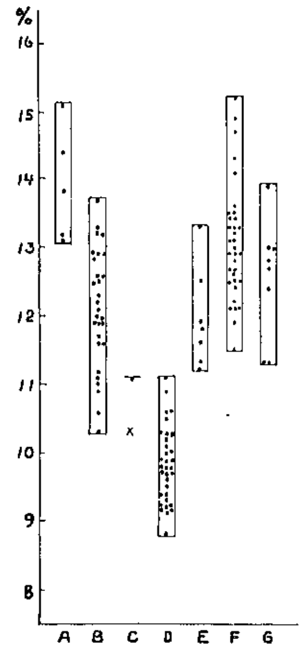


Fig. 18. Width of anterior nares as percentage of skull length.

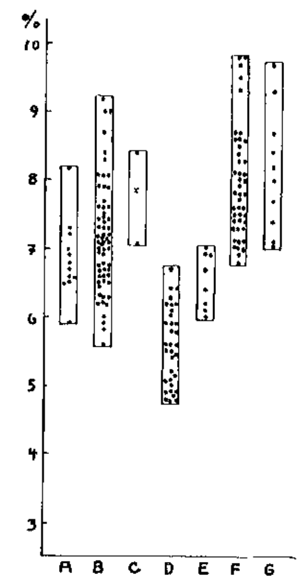


Fig. 19. Zygomatic root of maxilla as percentage of skull length.

Explanation of letters A–G see figs. 8–9.

The two last genera of fur seals, *Arctophoca* and *Arctocephalus* are treated more thoroughly later on. Here need only be mentioned that the skull of *Arctophoca* (Pl. VI) in some characters agrees with *Zalophus* (Pl. III), in others with *Arctocephalus* (Pl. VII). From the latter it differs in the narrower and more slender shape of the skull (figs. 9, 11, 12 and 15 B, C) and in the exceptionally narrow condyles of the mandible (fig. 16), from the former in the different shape of the sagittal crest (Pls. III and VI) and in various other skull proportions (figs. 9, 14, 16 and 17 C, D).

5. Sea Lions from Australian and New Zealand Waters.

From these regions two species are recorded: 1) The Australian Sea Lion (*Neophoca cinerea* Peron and Lesueur 1816) from South Australian waters and 2) Hooker's Sea Lion (*Phocarctos hookeri* Gray 1844) from Auckland and other islands in the New Zealand region[1].

Concerning the generic name of *Neophoca cinerea*, there has been some confusion. Gray (1866) erected the genus *Neophoca*, McCoy (1879) referred the species to *Euotaria*, Allen (1880 and 1905) to *Zalophus*, Wood Jones (1925) to *Arctocephalus*, Bertram (1940) to *Zalophus*, and Carter, Hill and Tate (1945) again to *Neophoca*.

As the species in question has no under fur, it should certainly not be referred either to *Euotaria* or to *Arctocephalus*. It has some resemblance to *Zalophus californianus* but differs in the shape of the sagittal crest, as well as in so many other skull characters (see p. 26) that I find it most correct to refer these two, also geographically so widely separated species of sea lions, to their respective genera. For the Australian Sea Lion the generic name *Neophoca* would then have priority[2].

As far as I know no thorough comparison of the two sea lions, *Neophoca cinerea* and *Phocarctos hookeri* has been carried out, certainly due to lack of sufficient material. It seems, however, to be generally accepted (Allen 1880 and 1905) that one of the most important characters distinguishing the two species is the number of cheeck teeth in the upper jaw, stated to be five in *Neophoca cinerea*, six in *Phocarctos hookeri*.

[1] The record of the type specimen, a female, as being from the Falkland Islands (Gray 1866a, p. 54) is certainly wrong (see Clark 1873, p. 754). I had the opportunity of examining the type skull of the species in the collection of the British Museum. It was labelled Falkland Island, but with a distinct question mark. This skull apparently was collected during the voyage of «Erebus» and «Terror» (1839–1843), and is the only one ever recorded from the Falkland region. As «Erebus» and «Terror» in the same voyage visited the New Zealand region too, where the species is well known, it can hardly be doubted that a confusion of labels has occurred. — The two stuffed skins of *P. hookeri* in the British Museum collection, mentioned by Allen as being from the Falklands, was labelled «Antarctic Exped. Admirality», and might as well have come from the Auckland region.

[2] Ellerman and Morrison-Scott (1951) have arrived at the same conclusion.

When estimating the value of this character it is of interest to see how the number of cheek teeth varies in the Otarid species as a whole. In the 354 skulls from 14 different species of Otarids which I had the opportunity of examining the following number of cheek teeth was recorded:

Table 4. *Variation in number of cheek teeth in Otarid skulls.*

Species:	Number of specimens with the following cheek teeth formulas:		
	$\frac{5-5}{5-5}$	$\frac{5-6}{5-5}$	$\frac{6-6}{5-5}$
Eumetopias jubata	25	1	—
Otaria byronia	—	—	68
Zalophus californianus	60	11	5
» wollebæki	8	—	24
Phocarctos hookeri	—	1	12
Neophoca cinerea	3	—	6
Callorhinus ursinus	1	—	22
Arctophoca philippii	—	—	3
» townsendi	—	—	1
Arctocephalus australis	—	—	30
» pusillus	1	*	27
» gazella	2	—	27
» galapagoensis	1	—	4
» forsteri	—	1	8

* Two specimens with the formula $\frac{6-7}{5-5}$

As seem from the table, the number of cheek teeth in the lower jaw is constantly 5–5, in the upper, however, it varies from 5–5 to 6–7, with the largest degree of variation in the two species of *Zalophus*, and in *Neophoca cinerea*.

Concerning the latter species Jones (1925 p. 14) states, without referring to the number of observations: «Cheek teeth variably $\frac{5\text{-}5}{5\text{-}5}$ or $\frac{6\text{-}6}{5\text{-}5}$ the smaller formula being most frequently met with». This statement is in contrast to my own observations where the larger formula was most frequently met with. Even if my material is very small it decidedly points in the direction that the number of cheek teeth is of little value for separating *Neophoca cinerea* from *Phocarctos hookeri*, as in both these species the larger formula is found to be the most frequent one (see table).

The only reference in literature to an adult male skull of *Phocarctos hookeri* which I am aware of is that given by Clark (1873 pp. 754-755) from Auckland Islands. The figures of the skull which he gives there show a marked resemblance to the skull of *Neophoca cinerea*.

In a later paper Clark (1884) gives some figures of a female skull of *Neophoca cinerea* from the east coast of Australia. This skull has 6–6 upper cheek teeth, and in other characters too it is strikingly more like the female skulls identified as *Phocarctos hookeri* in the collection of the British Museum, than the single female skull of *Neophoca cinerea* in the same collection.

However, keeping to the skulls from adult males, the following eight specimens have been examined by me (table 5).

Table 5. *Adult male skulls of Neophoca cinerea and Phocarctos hookeri.*

Species	Locality	Collection	Skull length	Suture age	Height sagittal crest
Neophoca cinera	Pearson Id. S. Australia	British Museum No. 25.10.8.32	294 mm	23	16 mm
»	Neptun Id. S. Australia	British Museum No. 97.10.10.5	308 »	33	16 »
»	Port Stephens, E. Australia	British Museum No. 89.2.20.1.	292 »	36	30 »
»	N.W. Australia	British Museum No. 334.1	304 »	36	18 »
»	Westernpoint, Victoria	British Museum No. 87.5.6.2.	304 »	35	14 »
»	Victoria	Anatom. Museum Edinburgh. No. 1.	302 »	28	10 »
Phocarctos hookeri	Campbell Id.	Musee d'Hist. Nat. Paris No. A. 585.	335 »	28	23 »
»	—»—	Musée d'Hist. Nat. Paris No. A. 12990.	346 »	34	23 »

Concerning the geographical distribution of the two species we find that while *Phocarctos hookeri* is restricted to the Campbell-Auckland Islands, *Neophoca cinerea* is recorded from various localities all the way from N.W. Australia around the south coast to New South Wales in the east. Compared with this wide range of distribution the distance from S.E. Australia to Campbell-Auckland, the home of *Phocarctos hookeri*, is fairly short.

According to Turner (1912 p. 173) the skull of *P. hookeri* «is distinguished by its great length in relation to both the zygomatic and cranial breadth». — The two skulls of *P. hookeri* which I have measured both have a zygomatic and auditory breadth falling within the limits of variation found in the skulls of *Neophoca cinerea*.

The same features were ascertained for other skull characters measured, e.g. those of figs. 9–19. In a few cases the *Phocarctos* skulls differ somewhat more from those of *Neophoca*[1], but as these exceptions apply to characters which generally are subject to a high degree of individual variation (occipital crest, mastoid process), too much attention should not be pay to these discrepancies.

As seen from table 5, the two specimens from Campbell Islands are considerably larger than the six specimens from Australia, without any corresponding difference in suture age, and the development of the sagittal crest is quite irregular as well, with the largest crest occurring at the smallest, though oldest skull. Probably these differences might be explained by divergent conditions of living through the wide area of distribution.

Furthermore, I may mention the curiosity that in the collection at the British Museum all the 5 male skulls identified as *Neophoca cinera* are adult specimens (suture age 23–36), while the 3 male skulls identified as *Phocarctos hookeri* are young ones (suture age only 14–17) and therefore not included in table 5. And as far as I could decide no important skull differences were to be observed except those due to age variation.

More material is of course badly needed to settle the question definitely, but the skull-material available certainly indicates that *Phocarctos hookeri* and *Neophoca cinerea* are conspecific, and the latter name should then take precedense over the former.

Ellerman and Morrison-Scott (1951 p. 334) give the approximate distribution of *Neophoca cinerea* Peron & Lesueur to be Australia and Japan, the latter locality based upon the statement of Temminck & Schlegel (Fauna Japonica 1844). However, during a visit to the Museum of Natural History in Leiden I fortunately found an opportunity to examine the skulls in question from the Temminck collection. Among the six skulls of the collection four were juveniles (suture age 10–13) while two were adult males (suture age 23–33). These last two skulls could easily, due to the very typical shape of the sagittal crest, at once be picked out as being not a *Neophoca* but a *Zalophus*. In fact, these skulls from Japan show such a high degree of conformity to the skulls of *Zalophus californianus* that they certainly have to be referred to one and the same species (see p. 35).

The distribution of *Neophoca cinerae* should thus be restricted to Australian–New Zealand waters only.

[1] See fig. 11 E where the two lowermost points represent the *Phocarctos* skulls, and fig. 12 E where the one at the bottom is *Phocarctos* (the other skull defect).

6. The genera Arctocephalus-Zalophus.

As already mentioned there seems to have been some confusion of species belonging to these two genera, even if the first is a fur seal, the second a sea lion. I made first contact with this problem when at Riksmuseet in Stockholm I examined some skulls from the Galapagos Islands which were identified as *Arctocephalus philippii* Petres. There were no skins in the collection to give further information, but the general appearance of the skulls had much more resemblance to the skull of the Californian Sea Lion than to any fur seal skull.

Later on, when I was able to examine the Otarid skulls in the collection of U. S. National Museum in Washington, the same kind of skulls were found there, also named *Arctocephalus philippii.* Dr. Kellogg, the director of the Museum, however, informed me that according to his opinion these skulls, which were identified by Allen (1905 p. 131–135) *A. philippii,* should very likely be referred to the genus *Zalophus.*

Further, from the last paper on the subject (Osgood 1943 p. 103) I quote: «The conclusion that *Zalophus* occurs in chilean waters as well as those of the Galapagos is perhaps not justified without examination of specimens, but it is evident that Allen's recognition of *philippii* is not to be relied upon, and when conditions are favorable the whole subject should be reinvestigated».

As I now had the opportunity to examine the 4 original skulls from the Galapagos Islands which Allen had identified as *Arctocephalus philippii* (U. S. Nat. Mus. collection), as well as 19 more adult male skulls from the same locality[1], I found the material large enough for trying to carry out such a reinvestigation.

From the west coast of America only one species of *Zalophus* (*Z. californianus* Lesson) and two species of *Arctocephalus* (*A. australus* (Zimmermann), and *A. galapagoensis* Heller) have been recorded. Below we compare specimens of these three species with the dubious specimens of *A. philippii* Peters from Galapagos.

As Allen himself (1880 p. 283) points out that «The skulls in *Zalophus californianus,* as compared with the skull in allied genera, is remarkable for the narrowness . . .», we are choosing just that character for our purpose.

[1] In the collection of Museums in: Stockholm (10 skulls), San Francisco (4), New York (2), Washington (1), Chicago (1), Oslo (1).

Two measurements are selected as well fitted to show this feature of the skull, viz., 1) zygomatic breadth and 2) mastoid breadth, both of which are mentioned in the tables of skull measurements given by Allen (1880 p. 285 and 1905 p. 128).

In the foolowing fig. 20 the results of these measurements, calculated as percentage of skull length, are graphically represented. For each species (except *A. galapagoensis*) two columns are figured; the first refers to Allen's measurements (columns A.C.E.), the second to measurements carried out y me (columns B, D, F, G.).

We may at once ascertain that the figure shows full conformity with Allen's statement of the narrow skull in *Zalophus californianus* (columns C, D) compared with the specimens of *Arctocephalus* from Magellan and Galapagos (columns E, F, G.). In *Arctocephalus philippii* from Galapagos the skulls, however, are extremely narrow (columns A, B), distinctly narrower than the skulls of *Zalophus californianus,* and thus even more typical to the genus *Zalophus* than the type species itself.

A lot of other skull characters all prove the close relation of the Galapagos skulls to *Zalophus,* and a glance at the shape and large size of the sagittal crest in the skulls of adult males from Galapagos (Pl. III) does not leave any doubt that they have to be referred to *Zalophus* and not to *Arctocephalus* (Pl. VII).

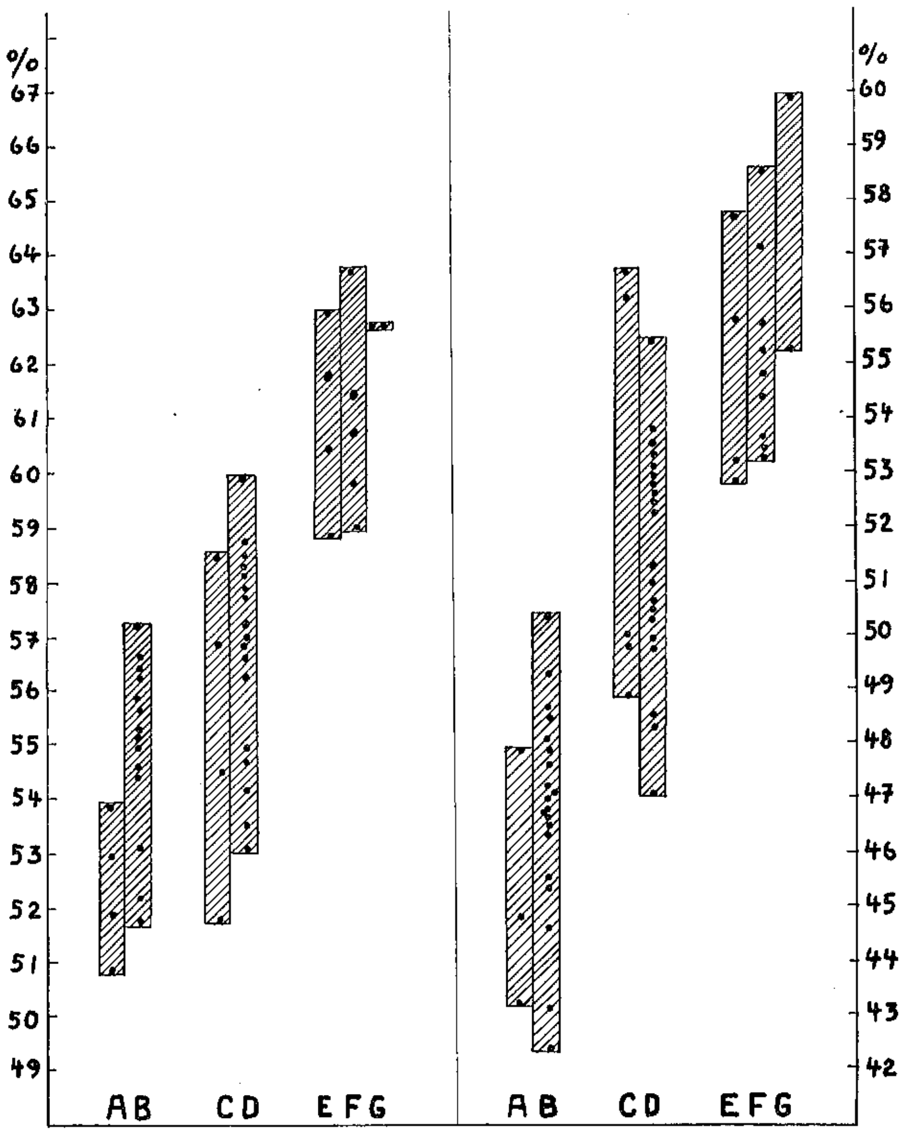
The skull of *Arctocephalus* is also much more compact than the narrow and slender skull of *Zalophus.* This difference is distinctly manifested in the weight of the skulls, as seen from the examples below.

Table 6. *Length and weight of adult male skulls in Arctocephalus and Zalophus.*

	Number of specimens examined	Skull length (mm)			Skull weight (g)		
		max.	mean	min.	max.	mean	min.
Arctocephalus pusillus	11	285	274	256	1000	756	525
—„— gazella	6	254	242	231	575	531	438
Zalophus californianus	4	296	293	287	780	687	596
—„— wollebæki	14	276	265	256	486	410	341

A study of the ground material of the table reveal that the skulls of *Arctocephalus* is 40-70 % heavier than the skulls of *Zalophus* of the same mean size.

The main reason why the specimens of sea lions from Galapagos were wrongly identified as fur seals, was, of course, that no skins had been examined. However, after I had finished the skull examinations mentioned, I became aware that Alf Wollebæk, the former Director of the Zoological Museum, Oslo, when returning from an expedition to the Galapagos Islands in 1925, brought home two skulls of the Southern Sea Lion (*Otaria byronia*), one of them with skin too. A closer examination now disclosed that they did not belong to the Southern Sea Lion, the only sea lion earlier recorded



Ratio of zygomatic breadth to length of skull **Ratio of mastoid breadth to length of skull**

Fig. 20. The relative skull width in adult males of *Zalophus* and *Arctocephalus* from Galapagos, California and Magellan. Each . indicate one specimen.

A.	A. philippii,	Galapagos,	(Allen's measurements)
B.	»	»	(Sivertsen's »)
C.	Z. californianus,	California,	(Allen's »)
D.	»	»	(Sivertsen's »)
E.	A. australis,	Magellan,	(Allen's »)
F.	»	»	(Sivertsen's »)
G.	A. galapagoensis,	Galapagos,	(» »)

from Galapagos, but were specimens of *Zalophus* identical with those by Allen formerly referred to *Arctocephalus philippii*. And the coat was typically that of a sea lion, without any trace of under fur.

a. The genus Zalophus Gill.

The type specimen of this genus is *Zalophus californianus* Lesson which, according to Bonnot (1928 p. 2), occurs along the coast of California from Farallon Islands southwards to central Mexico. Bertram (1940, Addendum I) includes in this genus the Australian Sea Lion (*Zalophus lobatus*), but this species should, as mentioned before, more properly be referred to its own genus under the name *Neophoca cinerea* Peron and Lesueur.

The so-called Japanese Sea Lion is by some authors considered as a distinct species (*Zalophus japonicus*), by others (see Ellerman and Morrison-Scott 1951) referred to *Neophoca cinerea* or *Zalophus californianus*.

The only known specimens available from Japanese waters are a single skull in the British Museum and the 6 skulls of the Temminck collection in the Museum of Nat. Hist., Leiden. As I had an opportunity to study all these skulls, my observations might throw some light on the problem in question.

Three of the skulls were adult males (2 in Leiden Nos. 13443, 13447, 1 in the British Museum No. 73.3.12.1), all with the high, curved sagittal crest typical of *Zalophus californianus*. The skull from the British Museum was exceptionally large, with a condylobasal length of even 323 mm against 309 mm in the largest I have measured from Californian waters. The two others were smaller with skull lengths of 307 and 277 mm respectively. As regards all the other skull characters considered, including those mentioned in figs. 9-19, the skulls from Japanese waters all fall within or so close to the limit of variation found in skulls of *Zalophus* from California, that no distinction has been possible. These detailed skull comparisons thus suggest that the Japanese Sea Lion has to be referred to *Zalophus californianus*. Furthermore, I suppose that the record of *Neophoca cinerea* from Japan must be due to confusion, as it sometimes might be quite difficult to separate young specimens or females of *Neophoca cinerea* from those of *Zalophus californianus*. In adult males, however, the task is very easy (Pls. III and IV).

A problem of special interest is whether the specimens of *Zalophus* from the Galapagos Islands should be referred to *Z. californianus* or be separated as a new species. There is a large gap of some 1400 miles from Galapagos to the southernmost locality of *Z. californianus*, i.e., the same distance as the hitherto known range of distribution of the species along the west coast of America. Furthermore, the *Zalophus*-specimens from Galapagos differ, as I am trying to show, in so many skull characters from the californian specimens, that I have found it justifiable to describe it as a new species. In honour of Director Wollebæk, the only collector as far as I know who brought home skull as well as skin of this species, I have proposed the name *Zalophus wollebæki*. A short preliminary description has already been given (Sivertsen 1953).

b. Zalophus californianus (Lesson) and Zalophus wollebæki Sivertsen.

The first impression one gets when comparing *Zalophus*-skulls from Galapagos with those from the northern localities is that the Galapagos skulls are of much more slender build and by far fail to reach the large size of the others. This divergence can hardly be ascribed to differences in age, as the Galapagos skulls have an average suture age larger than that of the other skulls examined. In table 7 I have compiled all skulls of the two species in question of which the suture age could be determined with a high degree of accuracy. Furthermore, the height of the sagittal crest is included, as this character is so very typical of the skulls of adult males.

As seen from the table, the only adult male of *Z. californianus* with all skull sutures closed (suture age 36) has a skull length of 323 mm, while the male skulls of *Z. wollebæki* of the same age never exceed a length of 276 mm. A corresponding difference in skull size of the two species is found in the average values (at the bottom of the table), as well as in the other age-groups (see below). Among the adult males the 17 skulls of *Z. wollebæki* have an average suture age of 33 with an average skull length of 265 mm, while in *Z. californianus* the average skull length is up to 296 mm even if the average suture age is not more than 32.

Further the sagittal crest is higher in *Z. californianus*, both absolutely and in relation to the size of the skull.

Among the adult females only a single skull of *Z. wollebæki* is at hand. The size and age of this skull indicates, however, when compared with the 11 female skulls of *Z. californianus*, that a similar well marked difference in size of the two species is found in this sex too.

The collection of skulls from younger specimens is very small, but the few samples available point in the same direction as recorded for the adult ones.

Z. californianus

4 young males,	average suture-age 15,	average skull length	229 mm.
4 young females	» » » 14,	» » »	212 »
3 cubs	» » » 9,	» » »	165 »

Z. wollebæki

2 young females	» » » 14,5	» » »	195 »
1 cub	» » » 9,	» » »	160 »

Table 7. *Size, suture age, and height of sagittal crest in skulls of Zalophus californianus and Zalophus wollebæki.*

	Adult males						Adult females			
	Z. wollebæki			Z. californianus			Z. wollebæki		Z. californianus	
	Condylo-basal length	Height sagittal crest	Suture age	Condylo-basal length	Height sagittal crest	Suture age	Condylo-basal length	Suture age	Condylo-basal length	Suture age
	mm	mm		mm	mm		mm		mm	
	276	30	36	323	40	36	214	32	251	27
	274	34	36	309	30	35			249	28
	272	30	36	307	40	33			242	25
	272	26	36	296	30	35			239	33
	271	—	29	287	25	35			237	33
	269	29	36	286	—	34			235	34
	268	22	35	280	24	27			235	20
	268	22	33	277	12	21			234	30
	266	24	33						232	28
	265	20	31						232	27
	264	18	36						231	30
	261	16	30							
	260	25	32							
	258	20	36							
	258	17	30							
	256	20	35							
	248	11	20							
Average	265	22.8	33	296	28.7	32	214	32	238	28.6

These facts indicate that *Z. wollebæki*, living in tropical conditions around the Galapagos Islands, never reach the large size of the nearly related northern species *Z. californianus*.

A closer study of the rate of growth of these species would be of interest. In the collection of e.g., the Academy of Sciences, San Francisco, there is a very nice collection of various stages of skulls both of *Z. californianus* and *Z. wollebæki*, some of the former even with statements of age. Unfortunately, at the time I had the pleasure to work there in 1948 I did not have the method of suture age quite worked out besides which Doutt's paper on the subject was unknown to me. As a few skull-sutures only were noticed, I am unable to utilize my measurements of these skulls in this connection.

Among other skull characters distinguishing the two species, I may mention the disagreement in number of upper sheek teeth. As seen from table 4 (p. 29) the number of teeth in both species reveals some degree of variation. In spite of this we may find that there is a certain distinction between them as in *Z. wollebæki* the larger formula (6–6) is most common (75 % of the skulls examined) while in *Z. californianus* the smaller formula (5–5) dominates strongly (79 %).

The impression of a more slender and narrow skull-type in *Z. wollebæki* is further confirmed when comparing various skull measurements of the two species. In the description of *Z. wollebæki* (Sivertsen 1953 pp. 2–3) besides the size of the skull and the height of the sagittal crest, 8 cranial characters are pointed out as typical of the species. The degree of variation in these characters, based upon measurements of the 43 available skulls from the two species in question, is given in table C (p. 71), and in the figs. 21–30 the calculated relative values of these characters are graphically represented.

The first four figures (21–24) indicate the marked narrowness of the skull in *Z. wollebæki* in the anterior as well as the posterior part of the skull, while at the same time fig. 25 indicates a fairly short snout in the same species.

Characteristic of *Z. wollebæki* is, further, the large breadth of the brain case at jugal (fig. 27), as well as the low values in the skull proportions represented in the figs. 29–30, compared with those of *Z. californianus*. Even in the lower jaw the more slender skull-type in *Z. wollebæki* is marked by the less breadth of condyles (fig. 28).

For each of these characters a Student's t test has been carried out, which proves a significant t for all of them. The exact dates are given in table 8.

It seems to be quite commonly accepted that the Southern Sea Lion, *Otaria byronia*, does occur at the Galapagos Islands (Carter et alia 1945 p. 100). However, I should like to call attention to the fact that of the numerous skull collections I have seen in various museums

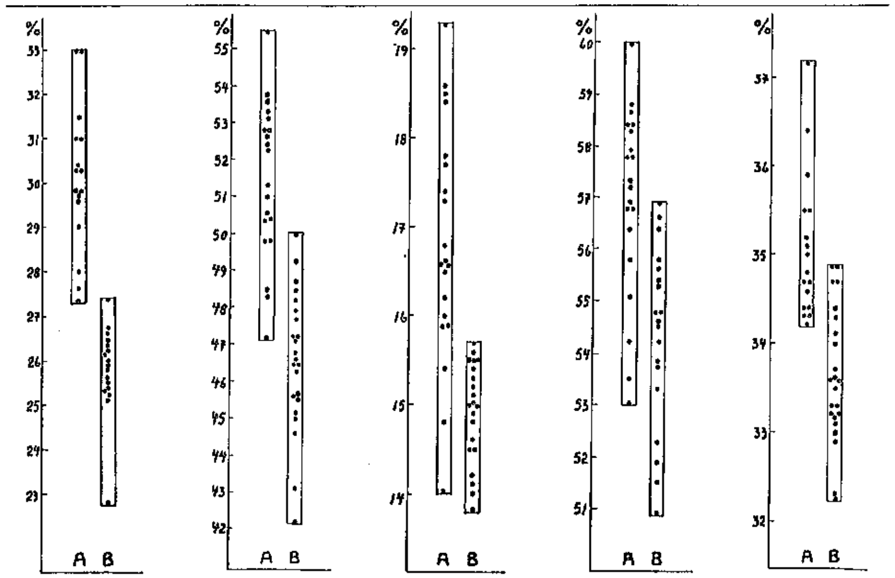


Fig. 21. Br.at preorb. proc.
Fig. 22. Interorb. constr.
Fig. 23. Zygomatic br.
Fig. 24. Mastoid br.
Fig. 25. Gnathion-preorb. proc.

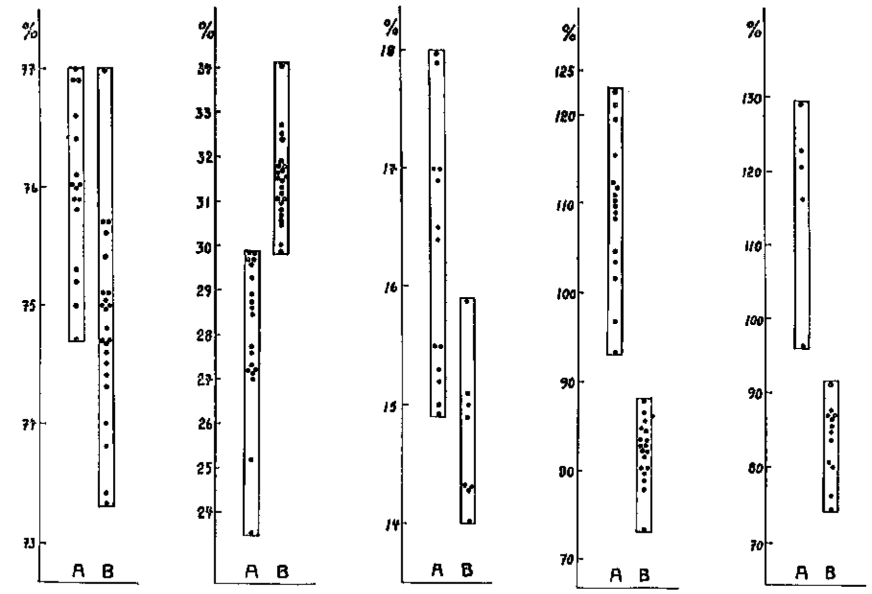


Fig. 26. Gnathion–post-glenoid proc.
Fig. 27. Br. of brain case.
Fig. 28. Br. of. condyles of lower jaw.
Fig. 29. Explanation see below.
Fig. 30. Explanation see below.

Figs. 21-30. Various skull proportions distinguishing A) *Zalophus californianus*, from B) *Zalophus wollebæki*.

Figs. 21-28. Values calculated as percentage of skull length.

Fig. 29. $\dfrac{\text{Breadth at preorb. proc.}}{\text{Breadth of brain case}} \cdot 100$

Fig. 30. $\dfrac{\text{(Br. at preorb. proc.)} \cdot \text{(gnathion - preorb. proc.)}}{\text{(Basion - bend pterygoid)} \cdot \text{(br. of brain case)}} \cdot 100$

Table 8. *Student's t test for the skull proportions given in the figures 21–30.*

Figures	21	22	23	24	25	26	27	28	29	30
t	9,41	5,99	4,54	8,03	5,69	4,74	8,27	12,70	7,89	3,59
f	32	39	37	41	38	37	40	32	15	19

f — degrees of freedom. Aignificant t for the figs. 21-29 was found on the 1 ‰ level, for fig. 30 on the 1 % level.

both in Europe and U.S.A., not a single skull of this species from the Galapagos Islands has been detected. Generally, the skulls of *Zalophus wollebœki* were identified as *Arctocephalus philippii*, but in a few cases (California Academy of Sciences and Oslo Museum) they were labelled *Otaria byronia*.

There might thus be a possibility that *Zalophus wollebœki* is the only sea lion of this island-group, together with the Galapagos Fur Seal, *Arctocephalus galapagoensis*, which also is endemic to that locality.[1]

7. The genus Arctophoca Peters 1866.

The description of this genus (originally subgenus of *Otaria*) was based upon the skull and skin from an adult but not very old male from Juan Fernandez, Chile (Peters 1866 p. 276). The original decsription is as follows: «Ohren länger, Behaarung mit dichter Unterwolle; Backzähne 5-5/5-5, gelappt, die drei letzten unter der breiten untern Wurzel des Ober kieferjochfortsatzes stehend; Gaumen vorn schmal und tief concav, hinten breiter und abgeflacht, am hintern Rande tief winklig (oder bogenförmig) eingebuchtet. Unterkiefer ohne Winkel, mit dem hintern Fortsatz nach innen gebogen».

At first one species only (*Arctophoca philippii* Peters) was referred to this subgenus, but later on Peters (1866 p. 671) included the fur seal from the Falkland Islands (*A. falklandica* Shaw, Burmeister, and *A. nigrescens* Gray).

Gray (1869 p. 269) raised the subgenus *Arctophoca* to generic rank, and placed it with the genus *Eumetopias* in the tribe *Eumetopiina*. This tribe was distinguished from the other tribes of the family *Otariidae* in having grinders 5–5/5–5 where the last upper ones were separated from the other grinders by a concave space.

As may be seen from the original description of *Arctophoca*, the most important character distinguishing it from the other genera of fur seal is the number of upper cheek teeth being five only, instead of six. However, as pointed out by Gray (1872), Philippi (1892) and Allen (1905)

1) This assumption has now been confirmed by Dr. I. Eibl-Eibesfeldt who visited the Galapagos Islands in 1954. Dr. Eibl-Eibesfeldt has informed me that no specimens of *Otaria byronia* were observed at the Archipelago, while *Zalophus* was very common. Moreover he kindly has placed at my disposal the nice photographs of the Galapagos Sea Lion (Pl. IX, figs. 1—2) which clearly show the high sagittal crest and narrow snout typical to adult males of *Zalophus*.

this may be due to one of the cheek teeth having fallen out, an abnormality which occurs with some frequency in various species of Otarids. Allen (1905 p. 120) therefore includes the *Arctophoca* in the synonymy of the genus *Arctocephalus* Cuvier, finding some Otarian skulls from the Galapagos Islands (and one from Magellan[1]) to be identical with the fur seal skull of *Arctophoca philippii* Peters from Juan Fernandez.

However, as already mentioned this has proved not to be correct as the skulls from Galapagos originate in a new species of sea lions, *Zalophus wollebœki*, endemic to these islands. Furthermore, Peters' excellent drawings of the skull of *Arctophoca philippii* from Juan Fernandez clearly show that this species in many important characters differs from the common Southern Fur Seal, *Arctocephalus australis*, e.g., in the distinctly narrower shape of the skull, the longer nasals and the longer and more slender rostral portion of the skull. In these characters the skull of *Arctophoca philippii* from Juan Fernandez reminds one much of a *Zalophus*-skull, especially that of young specimens where the sagittal crest has not yet occurred. This fact might explain Allen's confusion of fur seals and sea lions.

In this connection I may mention another species of fur seal, *Arctocephalus townsendi* Merriam, from Guadalupe Island, Lower California, the systematical position of which has been subject to some discussion. Two adult specimens of this rare species are available, a male in the Museum of Natural History, New York (No. 76844), and a female skull in the U. S. National Museum, Washington (No. 83618). As a closer examination of these skulls disclosed a combination of skull characters from both *Arctocephalus* and *Zalophus*, and the general feature of these skulls was very like that of *Arctophoca philippii* Peters as far as can be decided from Peters' drawings, it would be quite natural to refer this species, too, to *Arctophoca*. However, as the genotype (in Berlin) was not available to me I deeply felt the lack of other skulls of the type species for comparison.

But finally, in the collection of the British Museum I succeeded in examining both skin and skull of a specimen of *Arctophoca philippii* Peters. The skull of this specimen, which was labelled: No. 83.11.8.1, *Arctocephalus nigrescens*, Juan Fernandez, Chilian Government, agrees so well with Peters' description and figures of *Arctophoca philippii*, and the skin, moreover, in having abundant underfur, that there can hardly be any doubt about referring it to the same species.

The two skulls further agree in having only five upper cheek teeth. However, the specimen in the British Museum shows distinct empty alveoli which proves that there have been six upper cheek teeth on both sides of the jaw, the last having fallen out (see Pl. VI.). The same seems to have happened to the type skull too, as the drawings (Peters 1866 Taf. 2 C) show a faint indication of a nearly obliterated sixth alveolus

1 This skull (U. S. Nat. Mus. No. 23332) is certainly wrongly labelled Magellan instead of Galapagos Islands.

on the left side of the upper jaw. Allen (1905 p. 133) suggests that the ante-penultimate tooth has fallen out in the type specimen, but that does not seem to be the case as the fairly long space between fourth and fifth cheek tooth seems to be a normal feature of this species.

As earlier mentioned, Peters (1866 p. 671) includes in his subgenus *Arctophoca* both *A. falklandia* Shaw, Burmeister, and *A. nigrescens* Gray from the Falkland Islands. Both these names have to be excluded as being synonyms of *Arctocephalus australis* (Zimmermann). Further Allen (1905 p. 131) in his synonymy list of *Arctocephalus philippii* Peters includes *Arctocephalus galapagoensis* Heller. This name should be excluded, too, as it represents a valid species endemic to the Galapagos Islands; and as stated before, the skulls from the Galapagos Islands identified by Allen as *Arctocephalus philippii* Peters should be referred to *Zalophus wollebæki* Sivertsen.

Besides the two male specimens mentioned (the type specimen and the specimen in the British Museum), another young male and a young female of *Arctophoca philippii* are recorded from the same locality by Philippi (1892). In the same paper Philippi describes two new species, viz., *Otaria* (*Arctophoca*) *argentata* from Juan Fernandez and *Otaria leucosoma* from the adjacent Mas a Fuera; but as pointed out by Allen (1905 p. 31) both these are also young specimens of *Arctophoca philippii* Peters.

All known data thus point in the direction that *Arctophoca philippii* Peters is restricted to the lonely islands Juan Fernandez–Mas a Fuera to the west of Chile. From this same locality might originate a female skull in the Leiden Museum which undoubtedly should be referred to the same species. It was labelled No. 13439 *E. stelleri?*, Brook's collection, Pacific Ocean. — This skull was fairly easy to recognize as originating from *Arctophoca philippii* by the small size (at a suture age of 20), the narrowness of the skull, and the slender unicuspid teeth. The number of upper cheek teeth was 6–6, which certainly is the most usual formula in this species, the same number as recorded in the four skulls mentioned by Philippi (1892).

From what is said above, it appears that two species should be referred to the genus *Arctophoca*, viz. *A. philippii* Peters (the genotype) and *A. townsendi* Merriam. As the description of the genus is quite incomplete we might now, from the new specimens brought to light, be able to give some additional particulars. We are then keeping to the two male skulls mentioned above, *A. philippii* in the British Museum, and *A. townsendi* in the Museum of National History, New York. Various proportions in these skulls have already been discussed and compared with corresponding skull proportions in male skulls from other genera (figs. 9–19), and in the description below I refer to these figures. As the two skulls in question both originate from fairly young males (suture age 20 and 25) we have to make reservations for changes due to older age, as well as for wider individual variation on a larger material.

Additional particulars to the original description of the genus Arctophoca Peters based upon skulls of two young males (suture age 20 and 25):

Condylobasal length of skull 247–256 mm, skull exceptionally narrow compared with the skull of *Arctocephalus* (figs. 9, 12, 15 B,C); distance from middle of occipital crest to mastoid processes very short (fig. 11 B,C); condyles of lower jaw particularly narrow (fig. 16 B,C); space between 4th and 5th upper cheek tooth rather large (fig. 17 B,C); dental formula 3/2.1/1.6–6/5–5.

As the skull of *Arctophoca* has some resemblance to skulls of young specimens of *Zalophus* I may point out that the *Arctophoca* skulls differ in their smaller size (figs. 4 and 8 C, D); the narrow interorbital constriction (fig. 9 C, D); the larger supraorbital processes (fig. 13 C, D); the longer maxilla (fig. 14 C, D); the broader zygomatic root of maxilla (fig. 19, C. D); and other characters mentioned above (figs. 11, 16, 17 C, D).

The two species of *Arctophoca* seem to be closely related and it is difficult to find really good skull characters of distinction. *A. philippii* might be somewhat larger (see table 9) having a skull length of 256 mm at a suture age of 20–21, while the skull of *A. townsendi* has a length of only 247 mm even at a suture age of 25. There are some differences in the skull proportions too, but we do not know their specific value because only one male and one female skull from each species is available. However, as it seems to be very difficult to get more material, some measurements of the skulls examined are given here (table 9, p. 44). The first column of the table is a kind of an experiment because in the original description of *Arctophoca philippii* no skull measurements except the length were given. The particulars thus refer to values calculated from the drawings of the type specimen (Peters 1866 Taf. 2 C), and should therefore be treated with some care. However, it looks as if the skull is rather correctly drawn as all the measurements calculated from the drawings agree very well with the corresponding particulars of the other somewhat larger male skull of the same species (British Museum). This good conformity in skull proportions might very instructively be seen from the figs. 9C–19C (pp. 22-27) which show that the calculated values of the type (marked x) in most cases fall within the corresponding values of the other two skulls, or so close by that all these three skulls quite evidently belong to one and the same genus.

Table 9. *Skull measurements in Arctophoca philippii Peters and A. townsendi. (The particulars for the type specimen are calculated from the drawings of the type skull).*

No.		*Arctophoca philippii* Juan Fernandez Island ad. ♂ Type specimen	ad. ♂ (Brit. Mus.)	ad. ♀ (Leiden)	*Arctophoca townsendi* Guadalupe Island ad. ♂ (New York)	ad. ♀ (Washington)
1.	Condylobasal length (mm)	235	256	197	247	217
2.	Suture age	—	20(21)	20	25	—
3.	Interorbital constriction ....(mm)	26	30,7	21,5	24	22
4.	Palatal notch-incissors »	100	111	82	109	93
5.	Mastoid breadth .... »	115	127	ca. 90	118	105
6.	Breadth across supraorb. proc. ..... »	47	48	41	46	ca. 39
7.	Gnathion-post end. of maxilla .... »	119	132	89,5	123	107
8.	Breadth of skull at canines .... »	46	46	33	47	37
9.	Distance 4th-5th cheek tooth .... »	8	9,5	6,2	7	5
10.	Zygomatic root of maxilla .... »	18	21,5	15	17,7	16,5
11.	Zygomatic breadth .. »	130	140	ca. 107	134	118
12.	Auditory breadth ... »	105	110	82,5	104	96
13.	Breadth of brain case »	87	88	77	83	84
14.	Basion-zygomatic root »	156	173	131	163	144
15.	Length of nasals .... »	40	46	29	38	—
16.	Height of skull at supraorb. proc. ..... »	82	91	71	75	71
17.	Height of canini above alveol............. »	24	29	18	21	21
18.	Breadth of palate at 5th cheek teeth ..... »	34	30	28	34,5	—
19.	Height of sagittal crest »	2	4	0	4	0

8. The genus Arctocephalus Cuvier.

The number of species referred to this genus has been a subject much in dispute. Papers on the subject from this century (Allen 1905, Turner 1912, Jones 1925, Townsend 1934, Bertram 1940, Carter, Hill and Tate 1945) give some different lists, but altogether the following 9 species are mentioned:

1. *Arctocephalus galapagoensis* Heller
2. —»— *australis* (Zimm.)
3. —»— *pusillus* (Schreber)
4. —»— *gazella* (Peters)
5. —»— *doriferus* Jones
6. *Arctocephalus tasmanicus* Scott & Lord
7. —»— *forsteri* (Lesson)
8. —»— *townsendi* Merriam
9. —»— *philippii* (Peters)

The two last species have, according to what has been previously stated, to be excluded from the list as they properly should be referred to the genus *Arctophoca*, partly (the Galapagos specimens) to the genus

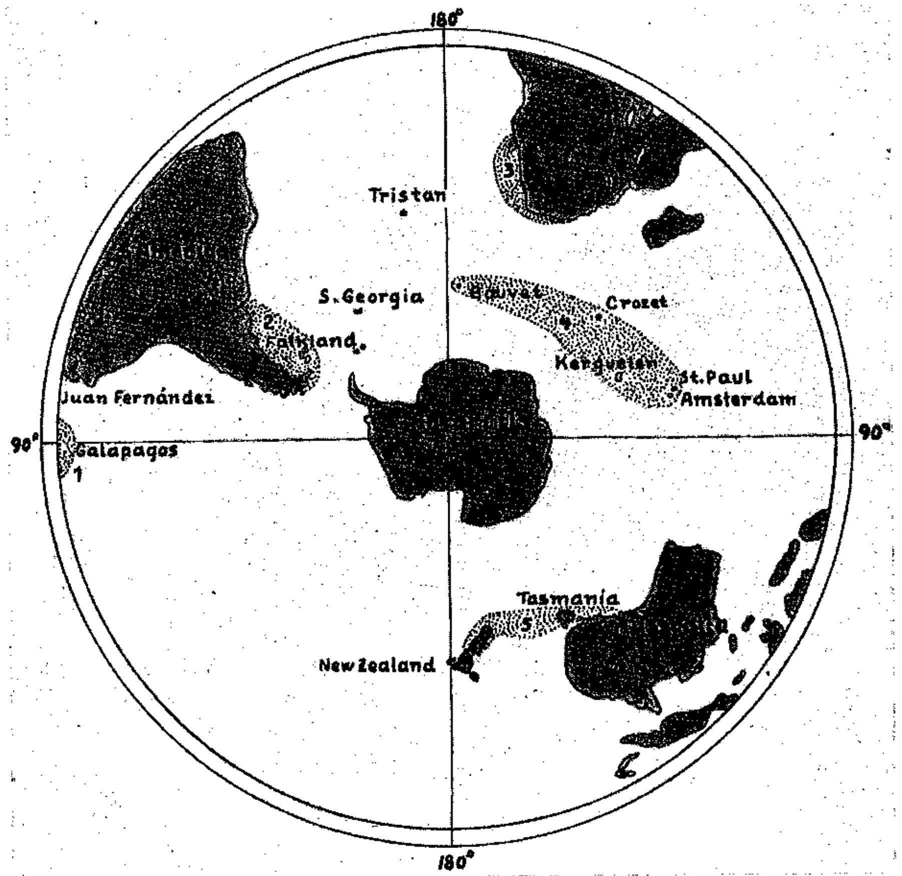


Fig. 31. Dotted areas numbered 1–5 give the approximate distribution of the species of *Arctocephalus*.
1) A. galapagoensis. 2) A. australis. 3) A. pusillus. 4) A. gazella. 5) A. forsteri (doriferus, tasmanicus).

Zalophus. The approximate range of distribution of the remaining 7 species is marked out on the map (fig. 31).

It appears that the four first species of the list are restricted to well separated areas of their own, the last three, however, are all found within a quite small area (South Australia–New Zealand). From this fact the question naturally suggest itself: are these three species of fur seals valid species, and what characters distinguish them from each other? Two papers are of special interest in this connection, Jones (1925) and Scott and Lord (1925).

Jones (1925 p. 9–16) in his list of the Eared Seals of South Australia includes 3 species of *Arctocephalus*, viz. *A. cinereus*, *A. doriferus*, and *A. forsteri*. The first one, however, has to be excluded in this connection as being a hair seal (*Neophoca cinerea*). Further from the same region Scott and Lord (1925 p. 189) describe a new species (*Arctocephalus tasmanicus*) endemic to Tasmania.

Besides differences in the colour of the coat (a character submitted to a considerably high degree of individual variation), and some small differences in the pedal digits, the following skull characters may, according to the authors just mentioned, be selected as the most important ones in distinguishing the adult males of the three species in question (tab. 10).

Table 10. *Skull characters distinguishing the adult males of the three species of Australian-New Zealand fur seals*
(according to Jones, Scott and Lord).

	A. tasmanicus (Tasmania)	*A. doriferus* (South Australia)	*A. forsteri* (New Zealand)
Condylobasal length	280–290 mm	max. 250 mm	max. 230 mm
Sagittal crest	well developed	poorly marked	poorly marked
Post. end of nasals	pass beyond post. margins of maxilla	nearly reach post. margins of maxilla	as *doriferus*
Cheek teeth formula	$\frac{6-6}{5-5}$	$\frac{6-6}{5-5}$ rarely $\frac{5-5}{5-5}$	$\frac{6-6}{5-5}$
Cheek teeth with	well defined anterior and posterior cusps	as *tasmanicus*	only an anterior secondary cusp arising from the cingulum

The two first characters in the table are both of less specific value as the changes in development of these characters with varying age of the specimens are not known. The differences mentioned in the table might as well indicate that those specimens referred to *A. forsteri* may be the youngest, those of *A. doriferus* somewhat older, and those of *A. tasmanicus* the oldest specimens of one and the same species. However, as all the fur seal skulls from the Australian region examined by me belong to the

one species *Arctocephalus forsteri*, a closer treatment of the problem is not possible at present.[1]

The third character mentioned in the table also seems to be of little specific value. Among the eight skulls of *A. forsteri* which I examined at the British Museum, the posterior end of the nasals in four of them reached exactly to the posterior margin of the maxilla, in two they passed beyond, and in two they nearly reached that suture. — And in other species of fur seals, e.g., *Arctocephalus australis*, a corresponding variation in the length of the nasals was observed.

The number of cheek teeth does not form any reliable base for distinguishing the three species in question, nor does the last character in the table. In the eight skulls of *A. forsteri*, mentioned before, one (two) had cheek teeth with anterior cusps only, while the remaining seven (six) all were found to have cheek teeth with both posterior and anterior cusps, a character which, according to Jones, Scott and Lord, is said to be typical to the two other fur seals (*A. tasmanicus* and *A. doriferus*).

Concerning the statement of Jones that the skull of the smallest species, *A. forsteri*, never exceeds a length of 230 mm (table 10) it might be mentioned that in the collection at the British Museum there are skulls of a length of up to 248 mm, i.e. nearly the same as the stated maximum skull length in the largest speeies, *A. doriferus*. And certainly the skull length in *A. forsteri* migth even be still larger in older males, as the largest of the male skulls examined had a suture age of 28 only.

In the same direction points the fact that the skulls in adult females of *A. forsteri* are relatively large compared with female skulls in other species of fur seals. That might e.g., be seen by comparing the relative skull sizes in males and females of *A. pusillus* and *A. forsteri*, as below.

Table 11. *Maximal skull size and suture age in Arctocephalus pusillus and A. forsteri.*

	A. pusillus		*A. forsteri*	
	Male	Female	Male	Female
Max. skull length	285 mm	227 mm	248 mm	239 mm
Suture age	36	36	28	36

From the papers on the subject already mentioned and, as far as can be decided from the skulls of *A. forsteri* examined, the three species of fur seals recorded from the Australian–New Zealand region by Jones, Scott and Lord are so close that they hardly can be maintained as separate species.

[1] In the collection of the California Academy of Science a male skull No. 6039 labelled *Otaria cinerea-A. doriferus*, is to be found. As the specimen, however, has been kept in the Melbourne Aquarium, this skull is left out of question here because skulls from other Otarids in captivity (*Zalophus californianus*) often reveal highly abnormal features.

Until further investigations on a larger material might settle the question definitely, it seems most reasonable to refer the fur seals from this region to one and the same species, *Arctocephalus forsteri* Lesson (syn. *A. doriferus* Jones, *A. tasmanicus* Scott and Lord).

If this interpretation of the Australian fur seals proves to be correct,

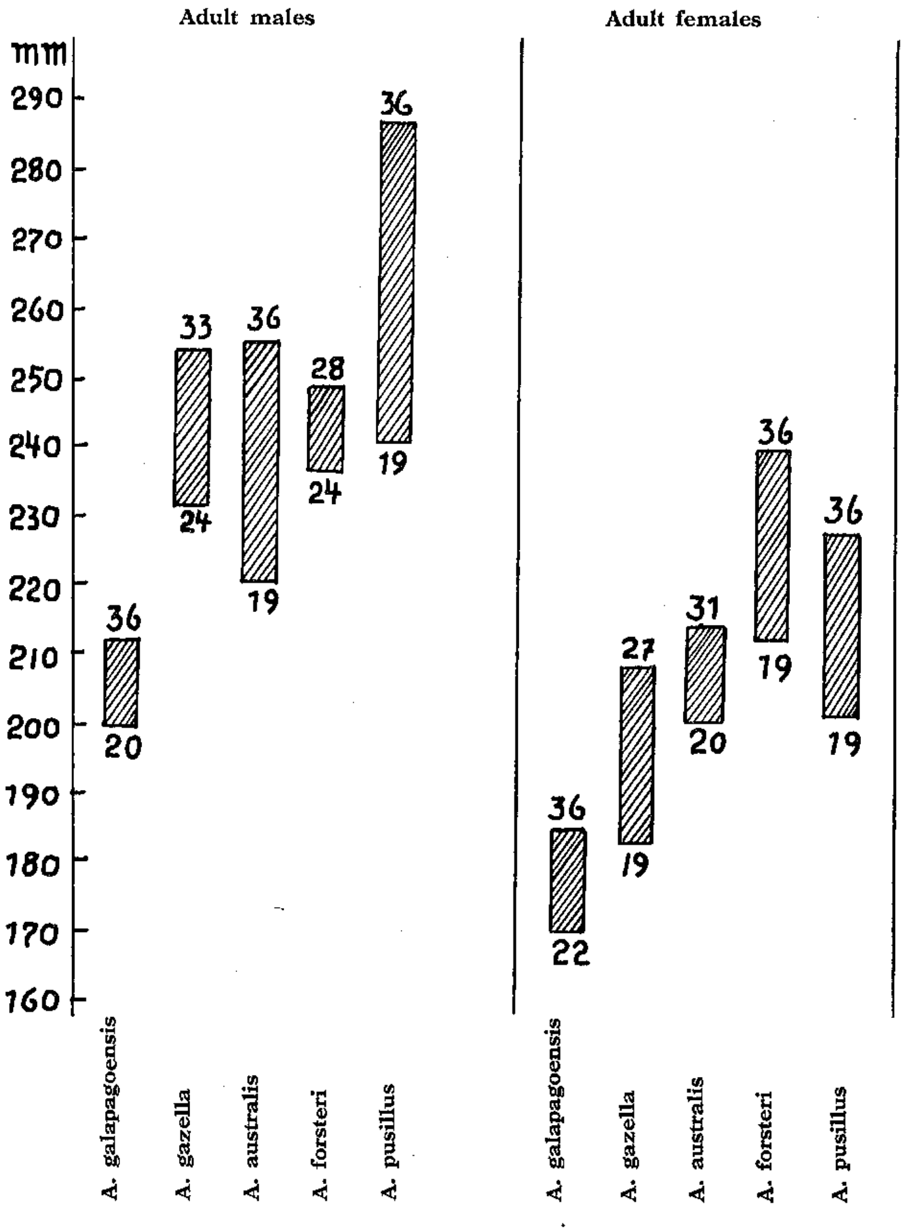


Fig. 32. Length of skull in the various species of *Arctocephalus*. Numbers below and above columns indicate suture age of youngest and oldest specimen examined.

the area of distribution of each species of *Arctocephalus* would be so well separated that intermingling of the various species should be out of question.

However, some unsolved questions still remain, e.g. what kinds of fur seals inhabit isolated islands as Tristan da Cunha and South Georgia? In both these places fur seals formerly were very abundant, but now they are extremely rare or probably quite exterminated. Unfortunately I have not been able to obtain any fur seal skulls from these localities, and when I visited Tristan da Cunha as a member of the Norwegian Scientific Expedition 1937-38, I only succeeded in getting a single fore flipper of a fur seal caught at one of the smaller islands, Inaccessible. Probably the fur seal of South Georgia will prove to belong to the species *Arctocephalus australis*, that of Tristan da Cunha to *A. gazella* or *A. pusillus*.

Among the skull characters distinguishing the species of *Arctocephalus* a few of the most important ones should be mentioned. To start with the size of the various species, the particulars of skull length in young as well as in adult specimens is compiled in table D (p. 72), a graph of which as far as the adult specimens are concerned, is represented in fig. 32.

As seen from the graph, measurements of skull sizes in adult fur seals might to a certain degree be useful in distinguishing the different species. *A. pusillus* is, anyway in the males, distinctly larger than the other ones, *A. galapagoensis* is the smallest, while *A. australis*, *A. gazella* and *A. forsteri* are medium sized. The males of the last species may certainly attain a considerably larger size than indicated from the figure which includes fairly young males only (highest suture age 28).

In most of the species of *Arctocephalus* the cheek teeth in the upper as well as in the lower jaw have a marked cingulum and more or less prominent secondary cusps. That is true in *A. pusillus*, *A. australis* and *A. galapagoensis* where the cheek teeth are relatively large and always with distinct anterior and posterior secondary cusps.[1] In *A. forsteri* also two secondary cusps are generally found, but occasionally there might be only one (see p. 47). In *A. gazella*, however, secondary cusps never occur, and the cheek teeth are all exceptionally slender and narrow compared with those in the other species of *Arctocephalus*. A good and exact picture of this narrowness of the cheek teeth is found by measuring the antero-posterior diameter of each tooth and compare the sum obtained (for all the six cheek teeth on each side of the upper jaw) with the corresponding length of the jaw (here measured from hind border canini to hind border last cheek tooth, see fig. 6, char. 11). The result of these calculations is represented in fig. 33.

As seen from the figure the relative size of the cheek teeth in *A. ga-*

[1] The only exception is the last upper cheek tooth which generally is somewhat smaller than those in front and sometimes with the secondary cusps absent. In very old specimens the secondary cusps might be more or less worn, but even so, indications on the type of the teeth are to be found.

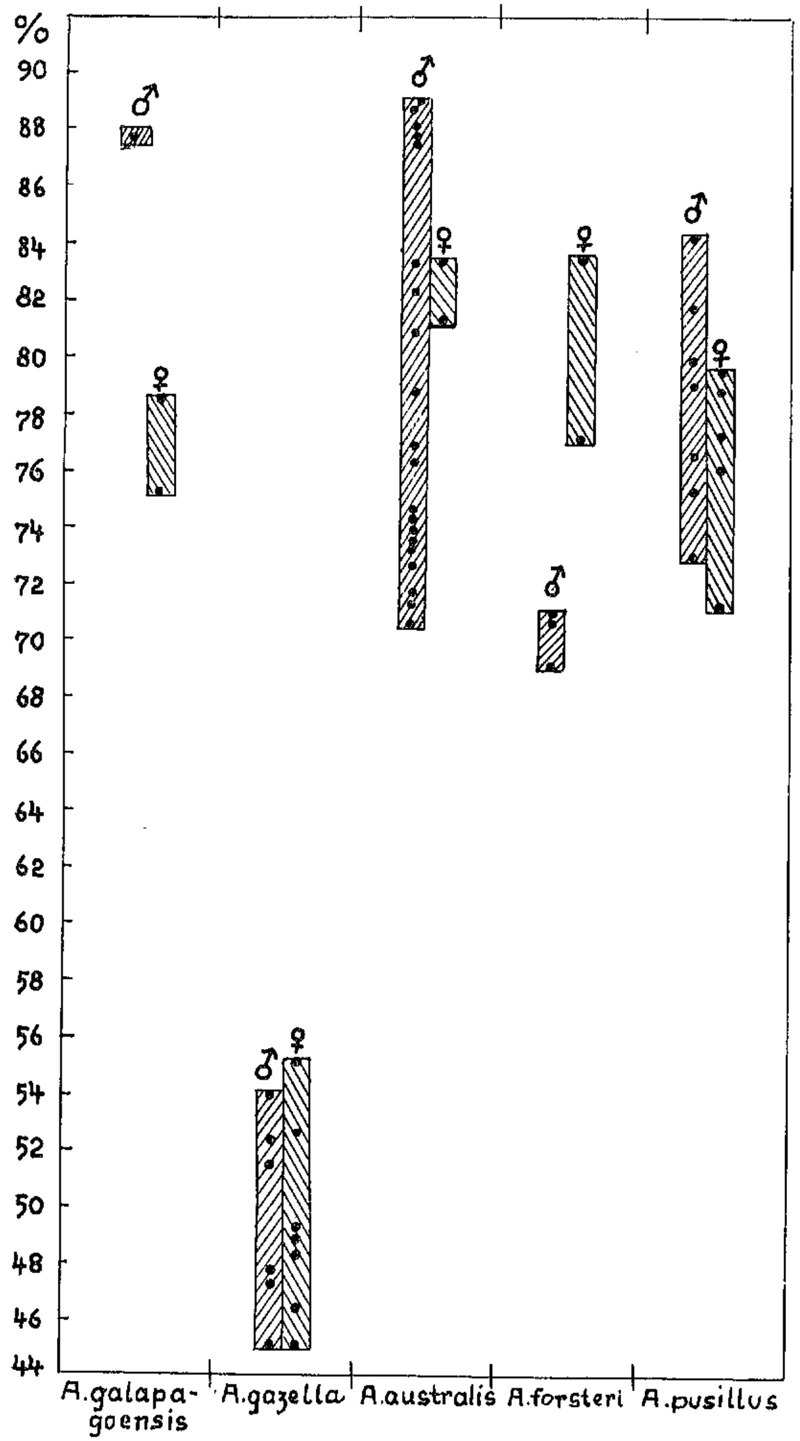


Fig. 33. Relative size of cheek teeth in adult specimens of *Arctocephalus*. Antero-posterior diameter of the 6 upper cheek teeth as percentage of the distance hind border canini – hind border last cheek tooth. Each . indicate one specimen.

zella is extremely low amounting to some 50 % only, while in the other species the average is around 80 % with no observations less than 69 %. Of course, more material especially of *A. galapagoensis* and *A. forsteri* should be wanted because so many of the skulls examined have to be excluded in this connection due to lack of one or another of the cheek teeth. However, some further comments on the size of each single cheek tooth in adult as well as young specimens of fur seals are to be found on pp. 58-59 and table. F p. 74.

Besides the characters mentioned, some other skull proportions which have proved to be useful in distinguishing the species of *Arctocephalus* are given in the following figures 34–45, graphically represented in the same way as those for separgatin the genera (figs. 9–19). The corresponding absolute values of the skull measurements are to be found in table E (p. 73).

Even if the material is small, and the degree of variation in most characters is too large to give a complete separation, these characters might give an indication sufficient to be a good help in identifying the species.

The figures speak for themselves but a few characteristic features should be mentioned.

Figs. 34 and 35 reveal that *A. pusillus* and *A. forsteri* have a longer snout than the other species, whereas fig. 36 indicates long nasals as typical of *A. pusillus* only. Furthermore, it is found that the skull of *A. gazella* might be distinguished from *A. forsteri* by the greater breadth in the supraorbital region (fig. 37, 38) as well as by the greater height in the rear part of the skull (fig. 42). On the other hand, *A. pusillus* might, in addition to the characters mentioned, also be distinguished from *A. gazella* and *A. australis* by the shorter distance from basion to pterygoid (fig. 40) as well as by the less breadth of the brain case (fig. 41).

The narrow cheek teeth in *A. gazella* mentioned before, might also be expressed by the relatively great distance between each tooth. In figs. 43 and 44 the space between the 3rd - 4th and 4th - 5th cheek tooth respectively, clearly shows the marked difference between *A. gazella* and the other species.

The great individual variation in the skull characters mentioned might to a certain degree be ascribed to changes in skull proportions during the growth of the animals. I hope later on to have an poportunity of returning to this problem, but the trouble is to get a material large enough. As far as I know, the 5 skulls from adult males of *A. galapagoensis* dealt with here are the only ones now available of this species. From *A. gazella* correspondingly 6–7 adult male skulls are available, and from *A. forsteri* 5 skulls only, besides what might be met with in Australian collections. In *A. australis* and *A. pusillus* a somewhat larger material is available, and more might be procured from the living stock. It should thus be possible to carry out more thorough skull examinations of these two species, a work already started by R. W. Rand (1949) concerning *A.pusillus* from the west coast of South Africa.

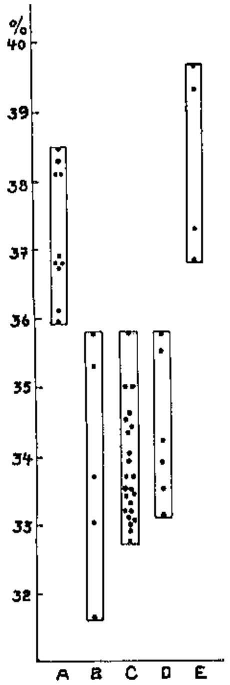


Fig. 34. Distance gnathion–upper nasals.

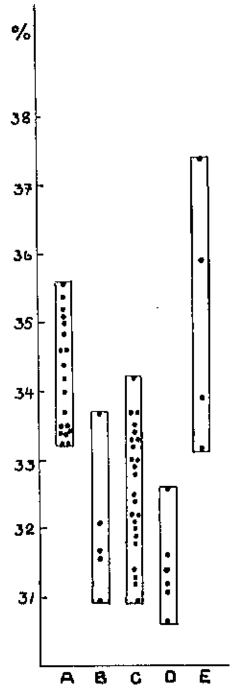


Fig. 35. Distance gnathion–preorbital processes.

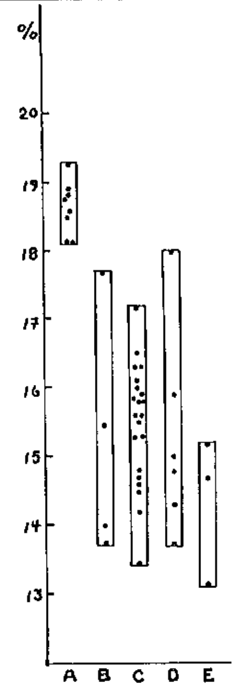


Fig. 36. Length of nasals.

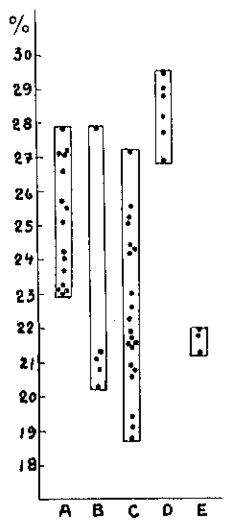


Fig. 37. Breadth at supraorbital processes.

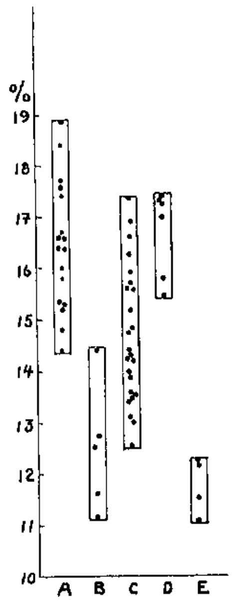


Fig. 38. Interorbital constriction.

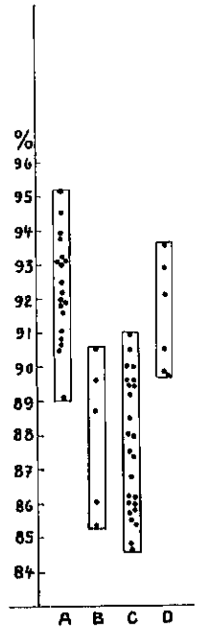


Fig. 39. Distance gnathion–middle occipital crest.

Figs. 34—39. Skull proportions (as % of skull length) in adult males of the following 5 species of Arctocephalus:
A) A. pusillus. B) A. galapagoensis. C) A. australis. D) A. gazella. E) A. forsteri.

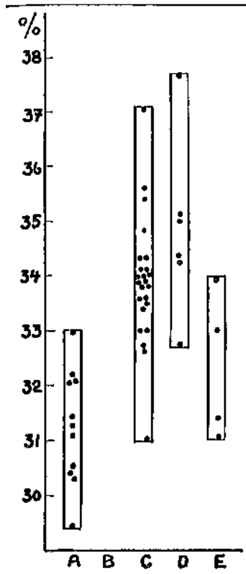


Fig. 40. Distance basion–pterygoid.

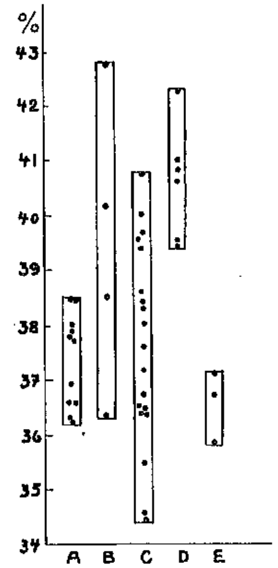


Fig. 41. Breadth of brain case.

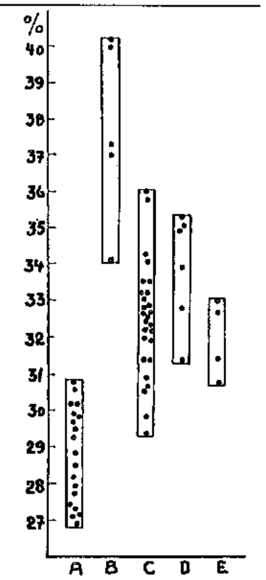


Fig. 42. Height at auditory meatus.

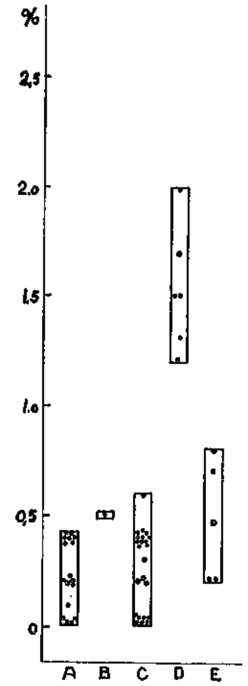


Fig. 43. Distance 3rd–4th cheek tooth.

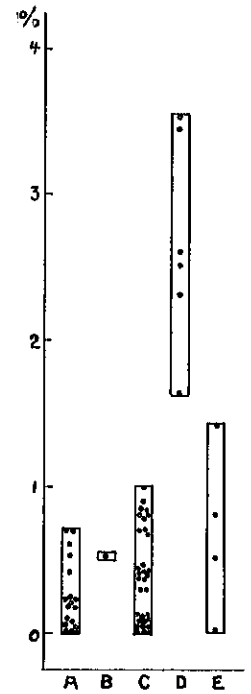


Fig. 44. Distance 4th–5th cheek tooth.

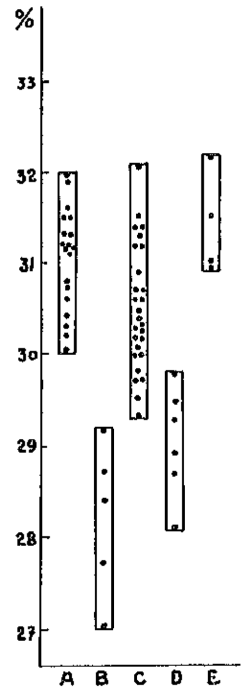


Fig. 45. Gnathion–foramen infraorbitale.

Figs. 40—45. Skull proportions (as % of skull length) in adult males of the following species of Arctocephalus:
A) A. pusillus B) A. galapagoensis. C) A. australis. D) A. gazella. E) A. forsteri.

SPECIAL PART

Seals from the Antarctic, Collected during the Cruises of «Norvegia» in the Years 1927–1929.

9. The Leopard Seal.

Hydrurga leptonyx (De Blainville).

This seal was observed now and then in the pack ice during the cruises of the vessel. Two specimens were secured, one near the South Sandwich (No. 7766, November 29th 1928), the other near the Bouvet Island (No. 7767, January 15th 1929). These positions both fall within the earlier known limits of distribution of the Leopard Seal which, according to Hamilton (1939b p. 242), is recorded from most parts of the Subantarctic and Antarctic region.

As fairly little is known about the various dimensions of this large seal, it might be of interest to give the particulars noted by Dr. Olstad concerning the specimen from near Bouvet Island. (No particulars are at hand from the other specimen recorded).

No. 7767. Female, body length 317 cm, axillary girth 166 cm, length of fore flipper 82 cm, breadth (border) of fore flipper 44,5 cm, length of hind flipper 56 cm, breadth of hind flipper 82 cm. Total weight 453.5 kg made up of: liver 9 kg, stomach, gut and lungs 32 kg, carcase 224.5 kg, skin 31 kg, blubber 157 kg. The specimen was in the stage of moulting.

Table 12. *Measurements of Leopard Seal Skulls. Females.*

	«Norvegia» specimens		Specimens examined by Hamilton		
	South Sandwich	Bouvet*	Second year	Third year	Fourth year and over
Body length ....(cm)	—	317	251–305	274–345	292–358
Condylobasal length of skull (mm)	384	—	373–405	385–425	395–431
Maximum zygomatic width »	205	—	187–208	202–232	200–253
Minimum width of frontal bones (interorbital bar)...... »	48,5	45,7	37–44	38–43,5	36,5–44
Maximum anterior width of frontals .... »	82,4	87,7	65–86	78,5–92,5	70–101
Width of maxillae at level of upper canine teeth .... »	71	77	68,5–76,5	72–82	71,5–90
Width of the anterior margin of the premaxillae .... »	42,6	48,3	41–52	45,5–52	41,5–55
Width of nasopharynx near ventral end of the pterygo-palatine suture .... »	53	45,4	41,5–52	42–49	34,5–52,5
Length of cheek teeth row (alveol) .... »	98,5	99,5	98–108,5	97–109	99–112,5

*Skull badly damaged.

Hamilton (1939b pp. 252–256) has in his survey of the Leopard Seal arranged the specimens considered (32 females) in year groups mainly based upon various skull dimensions. In table 12 the corresponding skull measurements in the «Norvegia» specimens are given and compared with Hamilton's particulars. It appears that the Norwegia specimens probably are 2–3 years old, the high degree of variation in the various skull dimensions do not admit of a more accurate age determination. In the skull from Bouvet the ossification (suture closure) is somewhat more advanced, indicating that this species is the oldest one.

10. The Weddell Seal.

Leptonychotes weddelli (Lesson).

No skulls from this seal are at hand, but Dr. Olstad has observations about 8 Weddell Seals examined during the cruise of «Norvegia» which certainly should be mentioned .All the 8 specimens were from Deception Island, and collected during the period of 2nd–15th of December 1927. The further particulars are seen from the table below.

Table 13. *Leptonychotes weddelli from Deception.*

Sex:	Males			Females				
Age:	First year			First year		Second year		4th year or more
Ref. no.	41	40	14	29	42	43	53	20
Body length ....(cm)	159	164	188	157	164	230	236	261
Axillary girth....... »	93	95	112	87	90	137	120	140
Length of fore flippers ,outer edge .... »	29	30	33	31	32	39	34	39
Breadth of fore flippers .... »	19	20	20	22	19	29	27	27
Length of hind flippers (from base of tail) .. »	30	29	36	35	35	46	42	42
Breadth of hind flippers .... »	48	49	49	47	45	70	65	60
Weigth of carcase without head ......(kg)	31	35	68	39	30	115	116	113
Weight of head and skin .... »	12,5	11	16	19	12	30	31	32
Weight of blubber »	27,5	25	34	27,5	33	80	47	55
Total weight .... »	71	71	118	85,5	75	225	194	200

When comparing the particulars of this table with those given by Bertram in his comprehensive paper on the Weddell Seal (1940) we find that all the 3 males at hand, as well as the 2 smallest of the females, are in their first year of age, probably not more than 3 months old. The following 2 females in the table (Nos. 43 and 53) are both in their second year, while the largest female (No. 20) is 4 years or more.

The particulars of weight are of special interest as fairly little is known from before about that question. Dr. Olstad's particulars for the Weddell Seal specimens in their first year agree with those given by Bertram (1940 p. 35). For specimens in their second year no observations of weight are earlier known. Regarding adult females Bruce (1913a pp. 570–574) gives the total weight from 2 specimens to be: 370–412 kg (838–908 lb.) at a length of 280–293 cm (110–115½ in.).The «Norvegia» specimen is somewhat smaller (261 cm), but must moreover have been exceptionally lean as the total weight is only 200 kg. This difference may probably be ascribed to the different dates of collecting, the Bruce specimens from September, possibly before parturition, the «Norvegia» specimen from December, after the period of lactation.

The Weddell Seal is known nearly all round the Antarctic coasts.

11. The Crabeater Seal.

Lobodon carcinophagus (Jacquinot & Pucheran).

According to Olstad (1929 p. 532) the Crabeater is one of the seals more commonly observed in the pack ice. Four specimens were collected, two of them south of Bouvet Island (Nos. 7764 and 7765, November 21st and 29th 1928), the other two somewhat further to the west (Nos. 7762 and 7763, January 10th 1929) at a position of about 60° S, 11° W. According to Bertram (1940 p. 85), this species is the most abundant of the Antarctic seals, mainly restricted to the pack ice, and having a circumpolar distribution.

In table 14 some particulars are given from three of the „Norvegia" specimens, in the fourth the skull was quite smashed.

Concerning the skull measurements, they all fall within the limits given by Bertram (1940 pp. 106–113). The only exception is the skull No. 7762 which has a length of only 222 mm, while the smallest skull mentioned by Bertram is 230 mm.

The small size of the two skulls Nos. 7762 and 7763, the corresponding low body length, the open sutures of the skulls, and the juvenile dentition, indicate that these specimens are fairly young, probably not more than a few months old. Skull No. 7765, however, is older, probably from a specimen two years old or more (Bertram 1940).

Weight particulars of Crabeater Seals are very few. Bertram (1940 p. 99) suggests from the few details known that an adult male might attain a

Table 14. *Lobodon carcinophagus collected by the «Norvegia».*

Ref. No.	7762	7763	7765
Sex	♂	♂	♀
Skull length	222 mm	251 mm	284 mm
Zygomatic width of skull	124 »	129 »	150 »
Mastoid width of skull	—	142 »	158 »
Body length of the seal	155 cm	189 cm	—
Axillary girth	91 »	114 »	—
Length of fore flippers, outer edge	38 »	41 »	—
Breadth of fore flippers,	25 »	28 »	—
Length of hind flippers	45 »	43 »	—
Breadth of hind flippers	50 »	55 »	—
Total weight of the seal	75 kg	95 kg	—
Weight of the blubber	—	19 »	—

weight of some 225 kg (494 1b), while a pup at birth probably weighs about 23 kg (50 1b). The two small «Norvegia» specimens have, as seen from the table, a total weight of 75 and 95 kg respectively. As these specimens certainly are fairly young (a few months), these weight-measures confirm the supposition advanced by previous writers on the subject, that the young Crabeater Seal grows very fast during the first months of its life.

12. The Elephant Seal.

Miorunga leonina (Linn).

The Elephant Seal which is so widely distributed in the Sub-antarctic region had not been recorded from Bouvet until Dr. Olstad in December 1928 observed a small herd there containing some 70–80 specimens. Olstad states that the conditions at Bouvet, with small beaches mostly covered with ice, do not give any possibilities for the stock of Elephant Seal there to grow much higher.

The stock merely consisted of cows and young specimens, most of them moulting. This observation (from December) indicates a somewhat earlier moulting season of the Bouvet specimens compared with those from South Georgia where Matthews (1929 p. 442) states that the moulting with the cows and yearlings «starts about halfway through January and is in full swing during February. With the bulls is starts in February and lasts to the end of March».

Besides the stock of Elephant Seals at Bouvet, Olstad examined another specimen of the same species at South Georgia 16th of February 1928. For this species he gives the following particulars :Female, body length 233 cm, axillary girth 121,5 cm, length of fore flipper (outer edge) 39 cm, breadth of fore flipper 19 cm, length of hind flipper (from joint) 49 cm. Total weight 211 kg, dispersed in the following way: carcase 110 kg, skin 29 kg, blubber 72 kg.

Judging from the particulars given by Matthews (1929 p. 241) the female mentioned should be in its third year of life.

13. The Kerguelen Fur Seal.

Arctocephalus gazella (Peters).

The original description of this species (Peters 1875 p. 393) was based upon two specimens, a male and a female, captured by the «Gazella» at the Kerguelen Island in the year 1874. Later on Peters (1876 p. 315) ascertained that only the female had been collected at Kerguelen while the male, from which the skin only was saved, was either from St. Paul or Amsterdam Island. The latter specimen which he now described as a new species, *A. elegans*, is later on (Allen 1905 p. 122) again referred to *A. gazella* (Peters).

In 1874 «Challenger» obtained 2 young specimen of *A. gazella* from the Kerguelen (Turner 1888 p. 36), but after that time no more specimens of this fur seal seem to have been recorded[1].

From what is said above it appears that the hitherto known collection of *A. gazella* is quite sparse, and the description of the species has been based upon female or young male skulls only. That is the reason why Turner (1912 p. 177) mentions a characteristic as «sagittal crest absent» to be typical of this species. In fact the sagittal crest is distinctly developed in the adult males (see Pl. VII) and is of a corresponding shape as in adult males of the other species of *Arctocephalus*.

Other skull characters mentioned by Turner (1912 p. 177) as typical to *A. gazella*, however, hold good, viz. «tympanic almost flattened; mastoid moderate; upper and lower post-canines with one large cusp and no secondary cusps; 6th post-canine much smaller than the others».

The extremely narrow cheek teeth in *Arctocephalus gazella* has earlier (fig. 33) been pointed out as one of the most important characters distinguishing this species from all the others of the genus. As, however, that figure represents only relative values and, furthermore, is based upon the assumption, which quite often does not hold good, that all the six cheek teeth are present, it might be of interest to give the absolute measurements for each of the six cheek teeth separately (table F p. 74). In the table are included the tooth-measurements from both males and females, adults and young ones. To get a more general view of the specific value of this character, the particulars from Group II (young ones) are graphically represented in fig. 46. This group is selected because of the less wear of the teeth, compared with that of the adult specimens.

It appears quite evident from the figure how easily skulls of *A. gazella* can be identified just by measuring the diameter of the cheek teeth; even the measurement of a single tooth might generally be sufficient. It is true that the first cheek tooth in *A. gazella* might attain a size large enough

[1] Patrice Paulian has now recorded the capture of an adult male of *A. gazella* at the Kerguelen (1952). A comparison of this skull with those from Bouvet would be of the greatest interest.

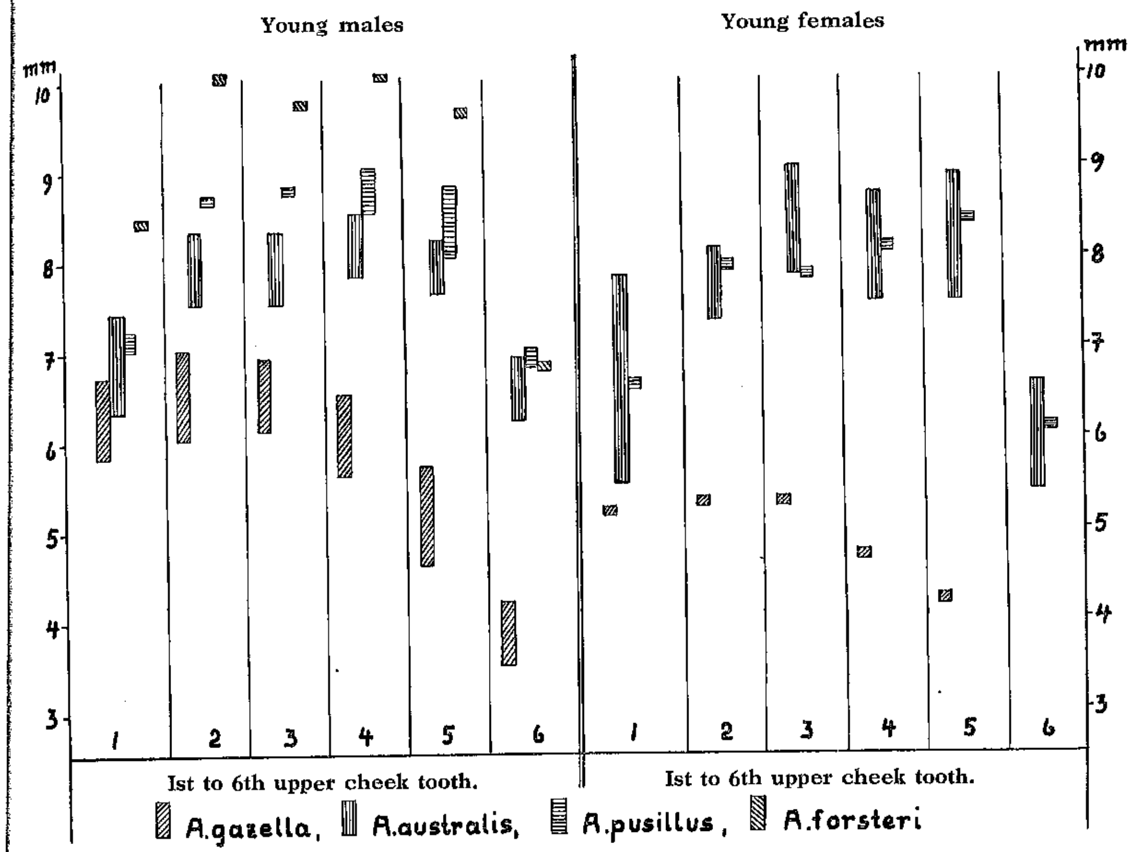


Fig. 46. Antero-posterior diameter (mm) of upper cheek teeth in young specimens of *Arctocephalus* (suture age 12–18). (See table F).

to overlap that of *A. australis*, but in all the five rear cheek teeth the size-values are well separated. The figure also clearly indicate that *A. forsteri* has the broadest cheek teeth, *A. gazella* the most narrow ones.

In the adults (see table F) the very same tooth-conditions are found. In the males the first and second tooth might overlap but none of the rear ones, and in the females all cheek teeth in *A. gazella* are well separated by their smaller size from those of the other species. The second smallest tooth-size is generally found in *A. australis*, the largest size in *A. forsteri* or *A. pusillus*. (Further details, like number of specimens, suture age etc., are seen in table F).

The skull characters in adult males of *A. gazella* found to be of specific value have been thoroughly discussed earlier in this paper. A corresponding treatment of the skulls from females and young specimens is in preparation. I may, therefore, concerning these skull characters, restrict myself to refer the reader to table G (pp. 75-76) where various measurements from each of the 26 serviceable skulls from Bouvet Island are compiled.

Only a few remarks about the conformity of the skulls from Bouvet and those earlier recorded from Kerguelen should be mentioned.

Besides those from Bouvet the following three skulls were examined:

a. British Museum. *A. gazella.* Challenger Exp.[1]
b. Anatom. Museum, Edinburgh. *A. gazella.* Kerguelen. Chall. Exp.
c. » » » » » —»—

All three skulls are fairly small and originate from young specimens as seen from the following particulars:

a. Skull length 212 mm, suture age 14
b. » » 211 » » » 16
c. » » 162 » » » 12

No sex is stated on any of the labels, but if we compare the particulars above with those of table D we find that, anyway, the two larger ones are certainly young males. These two skulls agree so fully in all characters examined with the skulls from Bouvet of corresponding age and size, that all these skulls certainly have to be referred to one and the same species. We may point out only one example: antero-posterior diameter of the upper cheek teeth. The only skull from Kerguelen with all upper cheek teeth retained is No. c, where the following tooth-diameters was found: I–5,9 mm, II–6,1 mm, III–6,1 mm, IV–5,7 mm, V–4,7 mm, and VI–3,8 mm. If we compare these values with those of fig. 46, there will be no doubt about referring both the Bouvet and the Kerguelen specimens to one and the same species, *Arctocephalus gazella* (Peters).

We would now briefly deal with some general features concerning the stock of fur seals at Bouvet Island, mainly based upon notes from the journals kindly placed at the author's disposal by Dr. Olstad.

From earlier days three observations of fur seals at Bouvet Island are recorded. The first one was made by a French naval officer Lozier Bouvet as early as in 1739 (see Aagaard 1930 p. 454). In 1822 the crew from an American sealing vessel «Wasp» landed at Bouvet Island and secured some 200 fur seal skins, and in 1878 some 500 fur seals were caught by the sealer «Golden West».

The «Norvegia» Expedition in 1927–29, however, is the only one which brought home collections for scientific purpose. Olstad (1929 pp. 514–518) has given a very instructive description of the fur seal stock there in 1928–29, and below I quote (translated to English) from his observations regarding this rare fur seal and its habits at the lonely island, Bouvet.

Olstad writes:

«Another seal species occurring here, is the fur seal. The localities on these islands, where this animal finds conditions satisfying during its stay on land, are the before mentioned, clean-washed rocky places on Lars I. and Bouvet. During our visit we found fur seals scattered all over the territory in these localities. The stock partly consisted of older males accompanied by one or more females with cubs, partly of males which had as yet not established families. These males were mostly younger and smaller animals which generally had their abode on the outskirts of the colonies, or in such places where the families lay more scattered.

[1] This specimen is probably from Kerguelen too?

Besides these smaller males also a few unmatched, larger males occurred. I did not observe females which were not in propagation; however, it was evident that a few of them had lost their cubs.

I counted over in some suitable places to get an idea about the size of the individual families and the ratio between males, females, and cubs. The results of these countings were that out of 15 males 7 had 1 or 2 females each, whereas the remaining males were accompanied by 3 to 5 females. I counted 32 females and 29 cubs together with these 15 males. It is possible that the number of females may have been a little larger than the countings show, because some of the females as well as unmatched males now and again paid shorter visits to the sea. This, however, only to a small extent was the case and in no way disturbs the general picture of the size of the families given by the counting.

Another counting which I undertook, and where besides the males living together with their families I also counted the unmatched males, gave as a result: 78 males, 36 females, and 32 cubs. Besides demonstrating that females and cubs are all but equal in numbers, this counting also shows us that the males are predominant in the colony.

I carried out some investigations concerning the size of the fur seales; from these it appears that the largest males examined weighed some 150 kilos with a total length of about 180 cm. Females as well as the smallest unmatched males on the other hand varied from about 30 to 50 kilos with lengths of some 115 to 140 cm respectively. Most of the unmatched males, however, were larger, presumably mostly weighing between 50 and 100 kilos. The size of the cubs examined during my stay in the days about December 20, 1928, varied from 9.5 to 5 kilos.

In all the specimens examined the quantity of blubber was small. In one case I found 34 kilos, but generally much less was found, commonly only some few kilos. This is also likely because the fur seal at this time only takes very little nourishment. Most of the stomachs examined were empty, but a few smaller males and females had squids, crustaceans, and fish in the ventricle.

As to the moulting, I shall confine myself to the remark that no indication of moulting was observed in the animals killed during my visit and among those which I otherwise observed the moulting had commenced only in one old male.

No other observations were made concerning the time of birth of the cub than those appearing from observations of their sizes. I shall therefore only mention that the smallest one of the cubs examined had its umbilical cord extant.

I estimated the size of the stock to about 1000 to 1200 animals, males, females, and cubs taken together. About 100 specimens had their place of resort on Norvegiaodden (The Norvegia Point), whereas the others were found on Lars I. As it is known, however, the «Norvegia» also in the previous year visited the same territories, and some of the crew who took part in both expeditions, pointed out that at the first time there had been positively more seals on both Lars I. and Bouvet itself than we found last time. It is therefore possible that the numbers of seals having resort to these two islands year by year vary to some degree.

It was an amusing sight to watch the fur seal during its stay on land. Probably the cubs were the most taking. Most of them were as yet almost quite black and waddled about in quite a funny way. Sometimes we saw them playing together like puppies. They could also be angry, and if somebody tried to take them, they heartily held their own, and in such cases they set up a growling sound; otherwise their voice very much recalled that of kidlings.

However, the old males dominated everything sitting on the crags, the forepart of the body raished, and surrounded by their family. They always seems to be on guard. If another male approached, it was immediately chased away, and if it did not go away, fighting arose which could be rather serious if the opponents were co-equal. During their fighting they faced each other with raised foreparts trying to bite. They especially tried to hit the parts around the eyes and the neck, sometimes also one of the flippers. Having got some good grip or other, they took their time, now and again pulling or tearing rather forcibly at the antagonist.

During fighting between the males females as well as cubs tried to move away to some distance from the fighters.

The animals showed no shyness towards human beings on land. On the contrary, males with families attached when being approached. The males evidently were also especially watchful with regard to the cubs. Thus if somebody tried to capture one of these, I several times observed the male coming to rescue it.»

When «Norvegia» visited Bouvet in 1928 Olstad had an opportunity to examine 37 specimens of the fur seal. They were collected during a few days, from December 17th–21st. From Olstad's journals I have compiled the particulars of the following tables 16 and 17, where the measurements of skull length and suture age are included in the cases where such determinations could be done.

Besides distinguishing the three main groups earlier used: adults, young ones and cubs, which here are well separated by characters such as suture age, skull length, body length and total weight, the group «young ones» is in the table tentatively divided into two sub-groups, due to the

Table 15. *Measurements, weights and suture age of Arctocephalus gazella, males.*

Ref. no.	Suture age	Body length cm	Skull length mm	Length of fore flipper, outer edge cm	Fore flipper stretch at terminal phalanges cm	Length of hind flipper from joint cm	Breadth of hind flipper cm	Axillary girth cm	Weight of blubber kg	Total weight kg
Adult males.										
7744	33	184	244	65	48	45	29	114	16	135
—31	32	182	237	72	49	49	30	118	16	123
—33	33	179	234	67	41	49	28	127	9	145
—36	27	179	250	58	38	43,5	31	124	17	143
—37	24	178	231	57,5	45	45	32	139	34	137
—35	24	179	254	70,5	41	45,5	27	118	17	120
Young males, 2 years old.										
—27	18	148	218	66	37	40	24	91	9	63
—28	18	135	216	63	34	43	22	95	8,5	63
—29	16	140	217	58	35	39	24,5	89	8	62
—52	16	132	216	58	31	35	21,5	78	6	50
—32	15	138	218	62	37	40	23	91	7	52
Young males, 1 year old.										
—49	14	112	196	48	30,5	34	20,5	86	3	45
—34	14	117	197	49	34	34	18	72	4	40
—48	14	111	186	49	29,5	31	20	71	2,5	32
—61	—	105	—	42	33	29	16,5	64	3	28
Male pups, a few weeks old.										
—59	9	68	—	25	16	18	12	37	0,4	6,5
—57	9	72	—	29,5	17	20	12	42	0,9	7,5
—40	9	76	—	29	17,5	20	13	45	0,6	8,5
—60	9	68	129	31	19	21	15	43	0,25	7,5
—	—	63	—	28	18,5	20	12	39	0,2	8,5

large difference in size (body length, skull length) between the larger and smaller specimens of this group. It seems reasonable to suppose that these two groups represent young seals one and two years old respectively. Demarcation of the two year-classes seems to be at a suture age around 14–15.

As regards the weight of the blubber in the males, the difference between young ones and adults is not so well marked. This fact has certainly to be considered in connection with the mating season. Even if some of the young ones, the bachelors, might attain sexual maturity at the end of their second year, they certainly are kept away from the harems by the old bulls and are thus not subject to such a high degree of amaciation as the older ones.

In the same connection it is seen from the table that the three oldest and largest bulls (age 32–33) which we might suppose have had the largest harems, have a less blubber-weight than the younger adult specimens (age 23–27). The exceptionally large amount of blubber in the male No. 7737 indicates that this specimen has been a bachelor.

In the females, the rate of growth is much less than that of the males, in accordance with what is known from all the other species of Otarids. It is further seen from the table that the single young female at hand (suture age 14) has arrived at the same size and weight as the smaller specimens of the adult females. This indicates that the females might get sexually mature one year earlier than the males and that they probably are impregnated at the beginning of their second year and have their first pup when they are two years old.

If we compare these results with those of Rand (1949) as regards the Cape Fur Seal (*A. pusillus*) ,we find good conformity concerning the males of the two species as Rand (1949 b p. 17) states that the males of *A. pusillus* also attain sexual maturity at the beginning of their third year. Concerning the females there might be a difference. Rand (1949 a p. 8) states that the females of *A. pusillus* attain sexual maturity at the same age as the males (at the beginning of their third year), while we suggested that in the females of *A. gazella* the sexual maturity was attained one year earlier. However, the material of *A. gazella* is very limited, and to settle the question definitely a larger material especially of young females would be desirable.

Table 16. *Measurements, weights and suture age of Arctocephalus gazella, females.*

Ref. no.	Suture age	Body length cm	Skull length mm	Length of fore flipper outer edge cm	Fore flipper stretch at terminal phalanges cm	Length of hind flipper from joint cm	Breadth of hind flipper cm	Axillary girth cm	Weight of blubber kg	Total weight kg
					Adult females.					
7753	27	140	206	55	36	42	21,5	83	4	48
—46	27	117	197	50,5	35	40	20	86	8	45
—45	26	136	208	55	34	35	18,5	83	7	50
—30	25	126	197	47	33	37	19	74	3,5	43
—39	25	133	199	48	30,5	36	19,5	83	5,5	45
—51	24	126	200	50,5	30	35	20,5	82	5,5	45
—38	20	115	187	49	30,5	32,5	19,5	66	2,5	30
—54	19	114	186	43	25	32	19	79	9	45
—47	19	120	184	48	32	38	20	66	4	30
—43	—	114	188	43	25,5	32	20	67	—	39
—	—	117	—	40,5	26	32,5	21,5	68,5	3	32
					Young females.					
—50	14	115	183	47	26	32	18	70	—	30
					Female pups.					
—56	9	69	—	24,5	17	19	11	42	0,75	8
—58	9	72	—	27	17,5	21	11	42	4	8
—55	9	58	118	22,5	15	17,5	10,5	34	0,2	5
—42	9	70	—	28	17	18,5	11	45	1	9
—	—	74	—	31	20	21,5	12	47	1,1	9,5

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Table A. *Size of Otarian skulls within the three suture-age groups.*

Species	I. Adults							II. Young ones							III. Cubs						
	Number of skulls examined	Suture age			Skull length (mm)			Number of skulls examined	Suture age			Skull length (mm)			Number of skulls examined	Suture age			Skull length (mm)		
		min.	mean	max.	min.	mean	max.		min.	mean	max.	min.	mean	max.		min.	mean	max.	min.	mean	max.
Males																					
Callorhinus ursinus	7	23	29.3	36	221	239	254	18	10	13,9	18	180	191	232	9	9	9	9	128	134	148
Arctocephalus gazella	6	22	28,7	33	231	242	254	8	13	15,6	18	186	208	218	3	9	9	9	128	129	129
Arctophoca townsendi	1	—	25	—	—	247	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zalophus californianus	8	20	30,4	36	277	294	323	4	11	14,8	18	212	233	260	3	9	9	9	151	165	192
Neophoca cinerea	6	23	31,6	36	292	311	346	4	12	14	16	238	263	293	1	—	9	—	—	157	—
Otaria byronia	43	19	27,8	36	310	339	393	31	11	13,2	18	194	246	324	19	9	9,2	10	148	188	209
Eumetopias jubata	11	20	23,4	30	357	374	397	—	—	—	—	—	—	—	5	9	9	9	184	236	285
Females																					
Callorhinus ursinus	4	26	27	28	186	190	193	5	10	13,4	17	165	171	178	4	9	9	9	121	123,8	125
Arctocephalus gazella	8	19	24	27	184	196	208	1	—	14	—	—	183	—	1	—	9	—	—	118	—
Arctophoca townsendi	1	—	19	—	—	217	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zalophus californianus	11	20	27,3	33	231	238	251	3	11	13,3	16	206	210	214	1	—	9	—	—	138	—
Neophoca cinerea	1	—	20	—	—	259	—	10	14	16,2	18	195	231	280	—	—	—	—	—	—	—
Otaria byronia	28	19	25,2	31	249	263	275	81	11	15	18	196	237	264	7	9	9,1	10	125	161	187
Eumetopias jubata	4	20	23	26	301	312	327	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species		Skull length	Br. of zygomatic root of maxilla	Interorbital constriction	Breadth at supraorb. proc.	Breadth at mastoid	Palatal notch-incisors	Width of anterior nares	Gnathion – post. end of maxilla	Breadth of skull at canines	Distance 4th – 5th cheek tooth	Occ. crest – mastoid	Br. of condyles of lower jaw
Zalophus californianus and Z. wollebæki	max.	323	21,5	57,2	84	173,5	134	34	150	80	3,5	147	52,3
	mean	277,1	15,4	44,3	70,7	136,3	115,9	27,1	128	57,6	1,5	120,5	43,7
	min.	248	12,3	37	61	112,6	101,5	22,5	115	48,5	0	100	34,7
	No.	40	33	38	35	39	33	33	34	38	27	32	20
Neophoca cinerea	max.	346	24	68	131,5	181	177	46	163	92	4	144	59
	mean	310,6	20,3	56,1	91	169,2	154,5	37,2	150,5	78,2	1,3	136,5	52,7
	min.	292	18	44	66	155	137,5	34	145	66	0	128,5	45
	No.	8	8	7	8	7	6	7	6	7	8	8	8
Eumetopias jubata	max.	397	35,2	101,6	134	230	210	52	195	105	28	183	77
	mean	373,6	29,9	89	121,7	209,3	189,8	47,1	185,5	94,8	24,6	165,9	67
	min.	357	25,8	76	106	183	176	43	175	85,5	21	149,5	62
	No.	13	10	13	13	13	12	8	11	13	13	10	10
Arctophoca philippii and A. townsendi	max.	256	21,5	30,7	48	127	111	—	132	47,3	9,5	105	30
	mean	251,5	19,6	27,4	47	122,5	109,9	27,5	127,5	46,7	6	101	27,2
	min.	247	17,7	24,1	46	117,5	108,8	—	123	46	2,5	97	24,5
	No.	2	2	2	2	2	2	1	2	2	2	2	2
Callorhinus ursinus	max.	254	19,3	46	71	147	101	37	110	59	3,5	121	38
	mean	241,5	16,5	41,2	61	132,1	88,7	34	103	52,1	1,2	114,1	36
	min.	221	14	33,2	49	115	79,5	31	93	46,5	0,5	103	34
	No.	12	12	11	11	11	12	5	12	12	12	11	6
Otaria byronia	max.	393	38,5	98	152	240	265	50	200	135	2	212	78
	mean	338,5	27,1	75,1	113,6	190	209,8	43,4	183,6	97,8	0,5	166,2	60,8
	min.	302	21,5	62	93	159	178	39	165	81	0	137	50
	No.	47	43	46	39	45	42	34	38	40	39	43	32
Arctocephalus (5 species, see table D)	max.	286	23,7	52	75,2	176,3	129	35	137	72	8,3	140	54
	mean	246,7	17,9	37,5	58,9	141,3	108,8	29,7	116,0	57,2	1,3	118,8	41,2
	min.	200	13	22,7	40,4	106	80	21,7	93	44,5	0	85,5	29
	No.	66	62	56	49	60	60	29	61	59	61	36	40

Table C. *Various measurements in adult male skulls of Zalophus californianus and Zalophus wollebæki.*

Skull measurements	Z. californianus				Z. wollebæki			
	No.	min.	mean	max.	No.	min.	mean	max.
Skull length ....(mm)	20	277	292	323	23	248	264	276
Gnathion – preorb. proc. .... »	17	95	102,8	108	23	83	88,9	94
Breadth at preorb. proc. .... »	16	84	88,4	102	18	63	68,3	73
Interorbital constriction .... »	20	43	49,2	57	21	35	39,4	42
Breadth of brain case .... »	19	76	81,9	87	23	78	83	87
Zygomatic breadth .... »	20	150	166,6	187	19	126	142,9	151
Mastoid breadth .... »	20	134	150,6	174	23	105	123,2	136
Gnathion – postglenoid proc. .... »	16	208	221,2	235	23	182	197,7	209
Breadth of condyles of lower jaw »	13	42	47,1	52	8	37	38,9	41
Basion – bend pterygoid .... »	7	91	94,8	106	16	84	86,8	91

Table D. *Suture age and size of the skulls in the various species of Arctocephalus.*

Species	I. Adults							II. Young ones							III. Cubs						
	No. of sp.	Suture age			Skull length (mm)			No. of sp.	Suture age			Skull length (mm)			No. of sp.	Suture age			Skull length (mm)		
		min.	mean	max.	min.	mean	max.		min.	mean	max.	min.	mean	max.		min.	mean	max.	min.	mean	max.
	Males																				
Arctocephalus galapagoensis	5	20	28	36	200	206	212	1	—	12	—	—	161	—		—	—	—	—	—	—
» gazella	6	24	29	33	231	242	254	8	13	16	18	186	209	218	3	9	9	9	128	129	130
» australis	42	19	26	36	220	238	255	17	12	17	18	180	196	227	—	—	—	—	—	—	—
» forsteri	4	24	25	28	236	242	248	1	—	15	—	—	218	—	1	—	9	—	—	155	—
» pusillus	22	19	30	36	240	266	286	6	11	15	17	185	209	227	2	9	9	9	130	137	143
	Females																				
Arctocephalus galapagoensis	6	22	28	36	170	179	184		—	—	—	—	—	—	—	—	—	—	—	—	—
» gazella	8	19	24	27	183	196	208	1	—	14	—	—	183	—	1	—	9	—	—	118	—
» australis	4	20	25	31	200	206	214	10	13	16	18	166	178	197	—	—	—	—	—	—	—
» forsteri	3	19	27	36	212	228	239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
» pusillus	8	19	27	36	201	214	237	4	11	14	16	167	177	193	1	—	9	—	—	118	—

Table E. *Skull measurements (mm) in adult males of Arctocephalus.*

Species		Skull length	Interorb. constriction	Breadth at supraorb. proc.	Length of nasals	Gnathion – middle occ. crest	Basion – bend pterygoid	Height of skull at auditory meatus	Breadth of brain case	Gnathion – upper nasals	Distance 3rd–4th cheek tooth	Distance 4th–5th cheek tooth	Gnathion – preorb. proc.	Gnathion – foramen infraorbitale
A. australis	max.	255	41	64,5	41	223	90,5	97	85	88	1,5	2,5	85	84
	mean	238,9	35,6	54,0	37,3	210	81,5	90	78 ,8	81,5	0,7	0,8	78,5	74
	min.	220	30,3	44,8	32	196	75	80	73	77	0	0	72	69
	No.	32	24	21	21	25	24	19	27	23	25	32	24	28
A. pusillus	max.	286	52	75,2	54,2	267	91,5	110	83,5	105	1	1	98	90
	mean	274	45,0	69,0	50,3	252,7	85,7	102,4	78,8	100,8	0,5	0,3	93,6	85
	min.	256	38	58,7	45	235	78,5	95	71,6	95	0	0	86	79,5
	No.	19	17	14	9	19	11	11	19	10	15	18	19	19
A. gazella	max.	254	43,6	74,8	45,8	236	88,3	100	86	91	5	8,3	83	74,4
	mean	241,7	40,6	68,4	36,7	221	84,2	98,0	81,8	82,1	3,7	6,8	76	70,4
	min.	231	36,5	62,8	31,7	207	81,3	95	78,3	76,4	2,7	4,1	70,6	65
	No.	6	6	6	6	6	6	6	6	6	6	6	6	6
A. galapagoensis	max.	212	29	56	37,5	190	—	86	81	76	—	—	71,5	62
	mean	205,8	25,7	45,7	31,5	180,8	—	80,5	77,5	69,8	1,0	1,0	65,9	57,9
	min.	200	22,7	40,4	28	172	—	74	72	64,5	—	—	63	55
	No.	5	5	5	4	5	—	4	5	5	1	1	5	5
A. forsteri	max.	248	30	54	52	—	84	91	78,5	97,5	2	3,3	89	78
	mean	241,7	28,4	52,6	46,8	—	78,1	88,5	77,1	92	1,2	1,7	84,8	75,9
	min.	236	27,2	52	44	—	74	85	76	84,5	0,5	0	80	73
	No.	4	4	3	3	—	4	3	4	4	4	4	4	4

Table F. *Antero-posterior diameter (mm) of the upper cheek teeth in the 5 species of Arctocephalus. Average sizes from both sides of the jaw.*

		Adult males			Adult females			Young males			Young females		
		6 specimens			7 specimens			9 specimens			1 specimen		
		min.	mean	max.	min.	mean	max.	min.	mean	max.	min.	mean	max.
A. gazella	Cheek teeth 1	5,5	5,9	6,3	4,8	5,0	5,3	5,8	6,2	6,7	—	5,2	—
	2	6,0	6,4	7,1	4,7	5,0	5,3	6,0	6,5	7,0	—	5,3	—
	3	6,0	6,5	7,0	4,0	4,8	5,3	6,1	6,5	6,9	—	5,3	—
	4	5,2	5,8	6,7	4,2	4,5	4,8	5,6	5,9	6,5	—	4,7	—
	5	4,6	5,1	5,7	4,3	4,6	5,0	4,6	5,2	5,7	—	4,2	—
	6	3,3	4,1	4,7	3,1	3,5	4,0	3,5	3,8	4,2	—	3,2	—
	Suture age	22	28,7	33	19	24,1	27	13	15,7	18	—	14	—
		20 specimens			2 specimens			6 specimens			6 specimens		
A. australis	Cheek teeth 1	6.3	7,0	7,6	5,8	6,3	6,7	6,3	6,8	4,7	5,5	6,9	7,8
	2	6,5	7,7	8,6	7,3	7,3	7,3	7,5	7,9	8,3	7,3	7,7	8,1
	3	7,0	8,1	9,1	7,9	8,0	8,1	7,5	8,2	8,3	7,8	8,2	9,0
	4	6,8	8,0	8,7	7,2	7,5	7,8	7,8	8,0	8,5	7,5	8,1	8,7
	5	6,4	7,7	8,7	7,3	7,4	7,5	7,6	7,9	8,2	7,5	7,8	8,9
	6	4,7	6,3	7,0	5,1	5,5	5,8	6,2	6,5	6,9	5,4	5,9	6,6
	Suture age	19	26,3	34	19	19,5	20	12	15,5	18	14	16,5	18
		7 specimens			5 specimens			6 specimens			1 specimen		
A. pusillus	Cheek teeth 1	7,0	7,7	8,4	6,3	6,7	7,2	7,0	7,1	7,2	—	6,6	—
	2	8,4	8,9	1,0	7,5	8,0	8,2	8,6	8,6	8,7	—	7,9	—
	3	8,5	9,2	9,7	7,8	7,9	8,1	8,7	8,7	8,8	—	7,8	—
	4	8,5	9,1	9,7	7,7	8,0	8,4	8,5	8,8	9,0	—	8,1	—
	5	8,1	9,0	9,6	7,5	7,9	8,1	8,0	8,4	8,8	—	8,4	—
	6	6,2	6,6	7,3	5,8	6,1	6,4	6,8	6,9	7,0	—	6,1	—
	Suture age	19	28,9	36	22	28,2	36	16	16	16	—	15	—
		3 specimens			2 specimens			1 specimen					
A. forsteri	Cheek teeth 1	6,5	6,6	6,9	7,2	7,6	7,9	—	8,4	—	—	—	—
	2	7,0	7,1	7,2	8,4	8,7	9,0	—	10	—	—	—	—
	3	7,4	7,7	8,4	8,6	8,7	8,8	—	9,7	—	—	—	—
	4	7,2	7,7	8,0	8,8	8,8	8,8	—	10	—	—	—	—
	5	7,4	7,7	8,0	8,8	8,8	8,8	—	9,6	—	—	—	—
	6	5,6	6,1	6,4	6,8	7,0	7,1	—	7,8	—	—	—	—
	Suture age	24	25	28	27	31	36	—	15	—	—	—	—
		1 specimen			2 specimens								
A. galapagoensis	Cheek teeth 1	—	7,2	—	5,8	6,0	6,2	—	—	—	—	—	—
	2	—	7,9	—	6,3	6,4	6,4	—	—	—	—	—	—
	3	—	8,1	—	6,3	6,4	6,5	—	—	—	—	—	—
	4	—	7,8	—	6,4	6,5	6,5	—	—	—	—	—	—
	5	—	8,1	—	6,7	7,0	7,3	—	—	—	—	—	—
	6	—	6,2	—	5,0	5,2	5,3	—	—	—	—	—	—
	Suture age	—	28	—	23	26	28	—	—	—	—	—	—

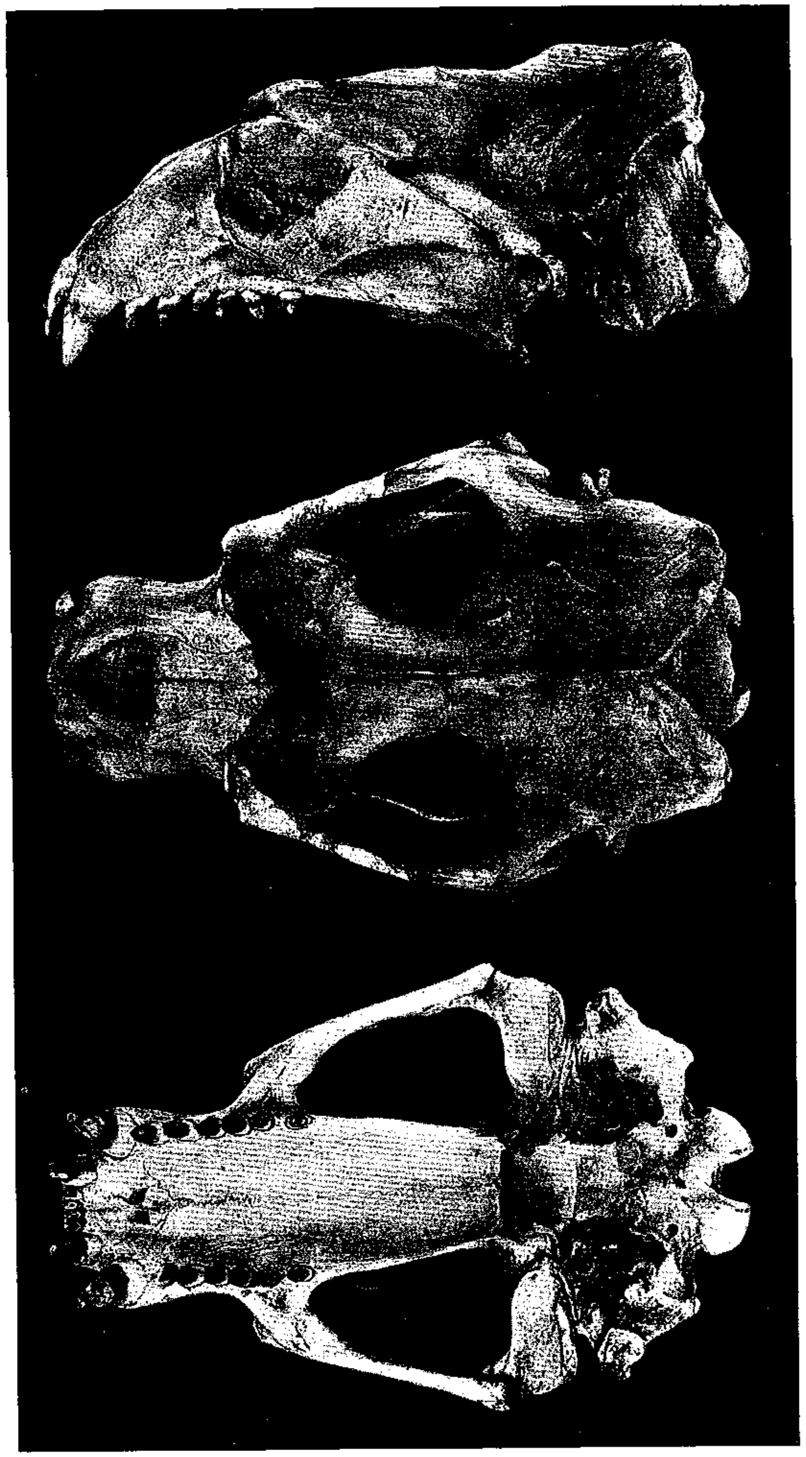
Table G. *Skull measurements in the «Norvegia» collection of Arctocephalus gazella.*

Reference no.	Suture age	Skull length	Zygomatic breadth	Mastoid breadth	Breadth of skull at canines	Breadth at preorb. proc.	Breadth at supraorb. proc.	Breadth of brain case	Auditory breadth	Gnathion - preorb. proc.	Length of nasals	Gnathion - upper end of nasals	Gnathion - post. end of maxilla	Palatal notch - incissors	Breadth of zygomatic root of maxilla	Interorbital constriction	Basion - pterygoid	Heigth of skull at auditory meatus	Distance 3rd-4th cheek tooth	Distance 4th-5th cheek tooth	Br. of condyles, lower jaw
										Adult males.											
7735	24	254	150,0	141,3	59,0	76	74,8	86	116,3	83	45,8	91	127,7	115,0	19,6	43,6	87	100	3,4	6,5	38,8
—36	27	250	150,3	144,6	61,7	69	71,8	78,3	123,2	78	39,6	83,7	124,2	119,0	19,8	43,6	81,7	99	3,7	4,1	34,8
—44	33	244	142,0	135,2	56,2	67,3	68,8	80	114,8	76	34,8	80,8	117,0	110,0	22,0	38,6	85,4	100	5,0	8,0	37,8
—31	32	237	146,6	135,0	55,6	66,2	68,6	83	112,2	74,4	35,5	81,0	117,0	113,0	16,6	36,5	81,3	96	4,0	8,3	40,0
—33	33	234	153,2	148,7	58,6	73,7	62,8	82	128	74	34,6	79,4	112,4	102,3	21,2	41,0	88,3	98	3,6	8	37,5
—37	24	231	145,2	134,3	56,5	68,3	63,8	81,7	114,1	70,6	31,7	76,4	116,0	106,0	19,6	40,2	81,4	95	2,7	5,7	34,8
										Young males.											
7727	18	218,3	130,0	120,4	49,0	61,8	54,6	83,0	105,8	68,4	34,2	74,5	103	95	15,4	31	80	84	3,6	5,0	28,5
—32	15	217,7	119,0	111,0	46,0	58,6	52,0	84,5	100	66	33,0	74	102	91	13,1	26,8	83	84	3,3	5,5	28
—28	18	216,3	124,0	120,5	43,0	55,0	53,0	81,0	103	68	35,0	71	100	90,8	16,5	29,3	80,5	84	4,0	5,4	27
—29	16	216,6	127,7	120,6	45,6	58,0	54,0	87,0	103	67,5	37,5	75	107,5	98,5	17,1	31,6	77,5	91	4,0	5,5	31
—52	16	206,7	119,0	110,5	40,8	55,7	54,3	87,0	99,5	64	33,2	70,5	100	87	15,3	30	74,3	85	3,6	5,3	26
—34	13	197,0	113	104,0	39,6	52,7	47,0	87,0	98,0	59,0	29,2	63	94	83,5	17,0	28,2	74,0	83	3,0	6,0	25
—49	14	196,0	116	104,0	40,2	50,6	50,5	86,5	96,0	60	29,5	63,6	95	80	13,8	26,4	72,0	84	2,0	4,0	25,8
—48	15	185,5	109	100,5	38,0	49,0	45,7	86,0	90,0	54	25,2	56,5	—	77,5	13,0	24	72,5	78	2,3	2,5	23,7
										Male pups.											
7760	9	128,5	76	—	24	37,3	—	73,0	ca. 73	—	24	46	56	50	11	21	55	67	—	—	13
—41	9	128,0	78	—	25,5	36,0	36	73,0	ca. 73	40	21	45	57	53	11	21	54	65	—	—	15,2

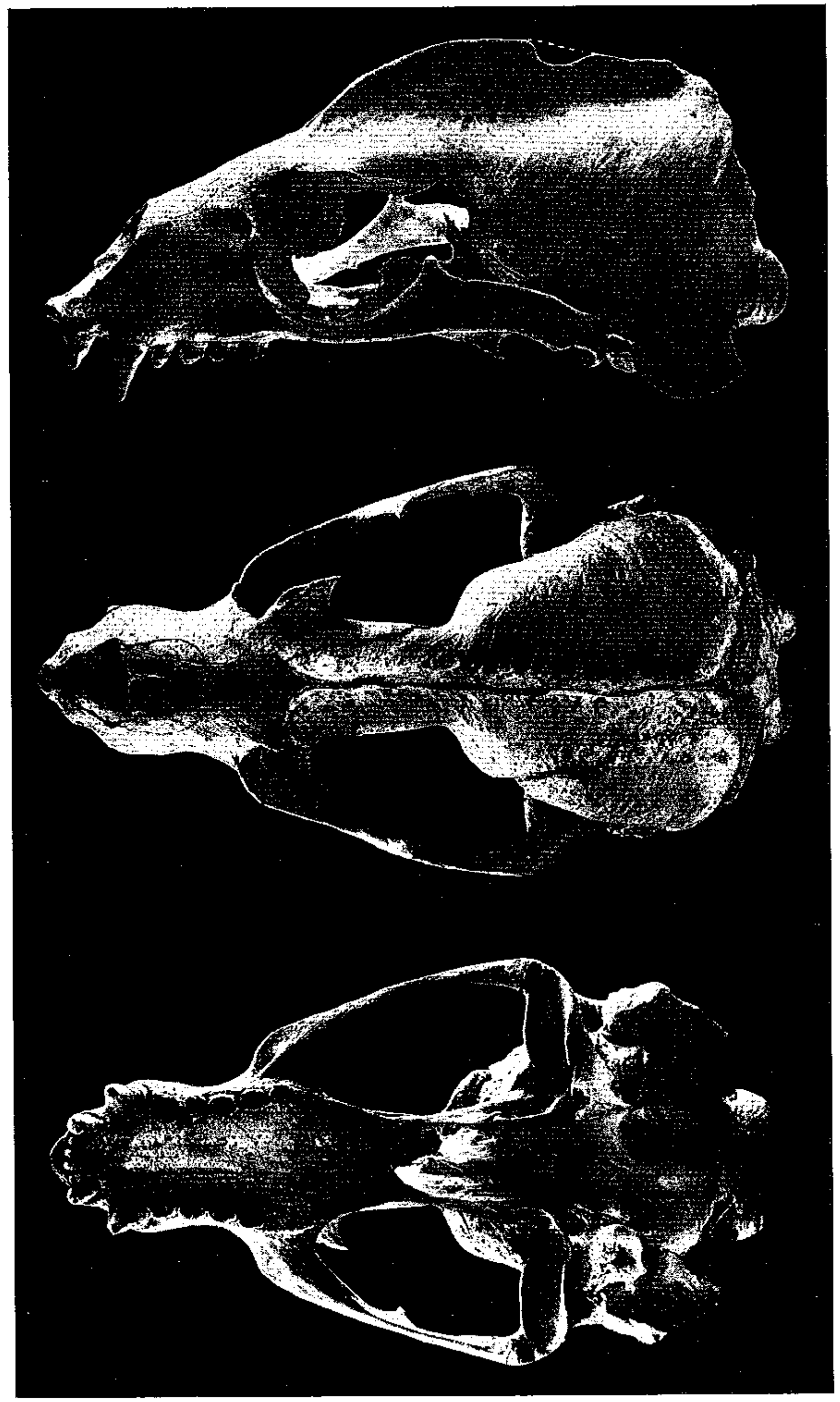
Tabel G. (cont.)

Reference no.	Suture age	Skull length	Zygomatic breadth	Mastoid breadth	Breadth of skull at canines	Breadth at preorb. proc.	Breadth at supraorb. proc.	Breadth of brain case	Auditory breadth	Gnathion – preorb. proc.	Length of nasals	Gnathion – upper end of nasals	Gnathion – post. end of maxilla	Palatal notch – incissors	Breadth of zygomatic root of maxilla	Interorbital constriction	Basion – pterygoid	Heigth of skull at auditory meatus	Distance 3rd–4th cheek tooth	Distance 4th–5th cheek tooth	Br. of condyles, lower jaw
Adult females.																					
7745	26	208,2	121,0	104,3	37,3	53,0	56,4	82,3	75,4	61	33,7	68,5	99	90,7	14,4	29	73,3	77	7,0	4,0	26,2
—53	27	205,7	118,0	101,0	37,5	53,0	46,0	80,0	70,6	61	33	66	96	92,5	13,5	24,7	72	81	4,5	5,0	25,2
—51	24	199,5	117,0	102,3	36,5	52,0	46,0	79,5	70	57	33	66	93,3	80	14,7	24	71	79	4,5	4,5	24,3
—30	25	196,5	110,5	99,6	36,3	47,5	39,6	76,0	71	58	30,7	63,5	95	86	16,8	24	66,8	76	3,5	—	24
—46	27	196,5	111,2	101,5	34,7	48,5	47,3	81,0	72,2	58	34,5	66,7	94	86	16,7	21,8	74	80	5,0	7,5	25
—38	20	187,4	112,0	104,5	33,0	53,0	46,5	85,0	76,8	54	26,8	56,5	87,3	79,3	14,1	26,4	71,6	80	4,0	5,5	23,8
—54	19	185,7	112,0	100	32,0	49,0	43,4	76,0	74,4	51	29	59	86	77	14,6	26,3	70	79	6,0	5,0	21,2
—47	20	183,6	105	ca. 97	32,2	45,7	—	76,0	69	51,5	26,6	56,3	88,5	80,5	15	23,0	66	76	3,3	3,3	22,4
Young female.																					
7750	14	183,2	104,5	ca. 95	31,4	47,4	38,0	81	88	54	24,3	56,5	84	75	14,2	22	69	77	4,0	5,5	21,8
Female pup.																					
7755	9	118	74	—	22,8	35,7	34,7	70	ca. 69	35,5	20	40	52	41,7	11	19,5	51	63	—	—	12,8

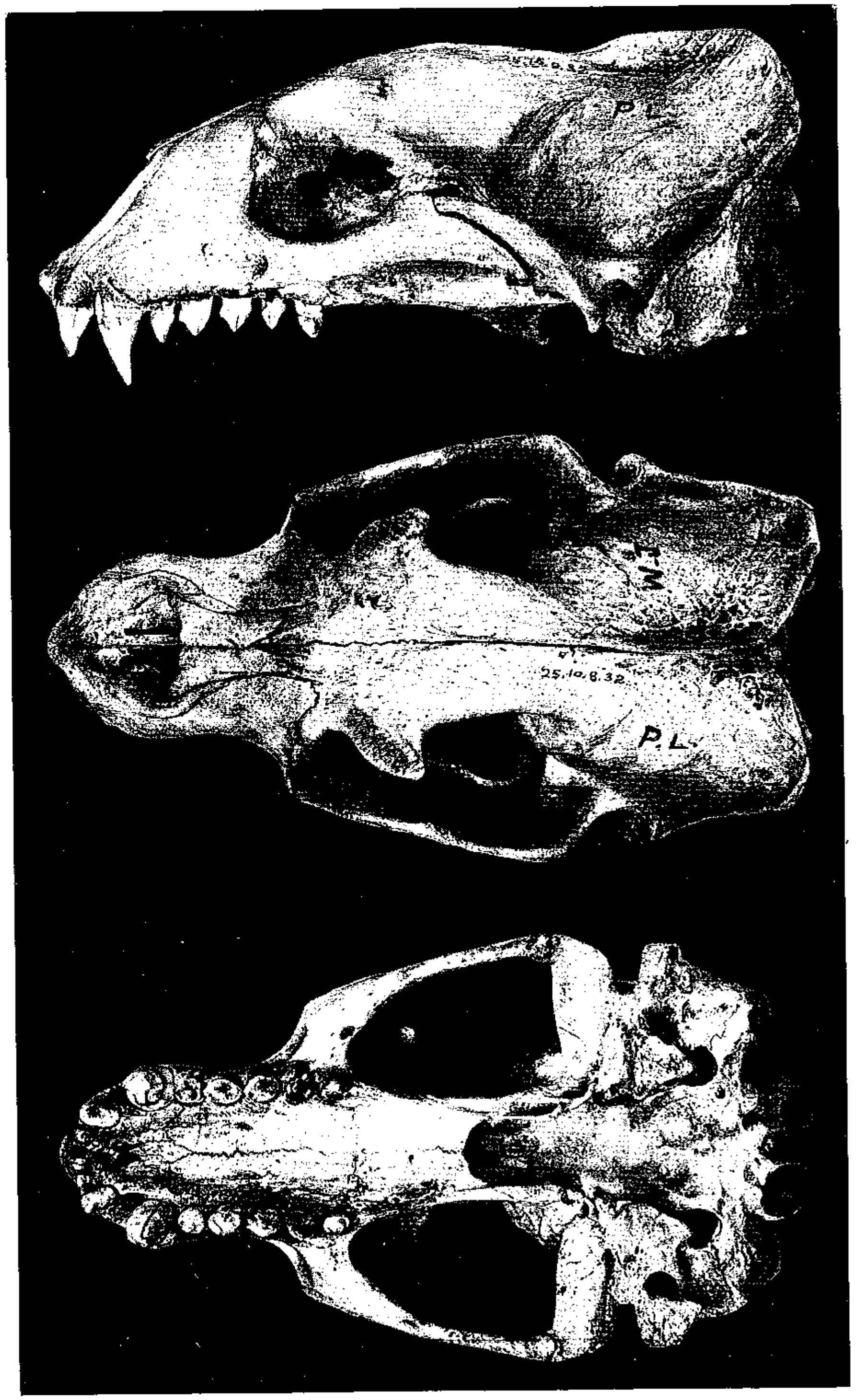
Pl. I. *Eumetopias jubata* (Schreber). Adult male, skull length 358 mm. British Museum. No. 1949. 2.3.18. Brit. Mus. phot.



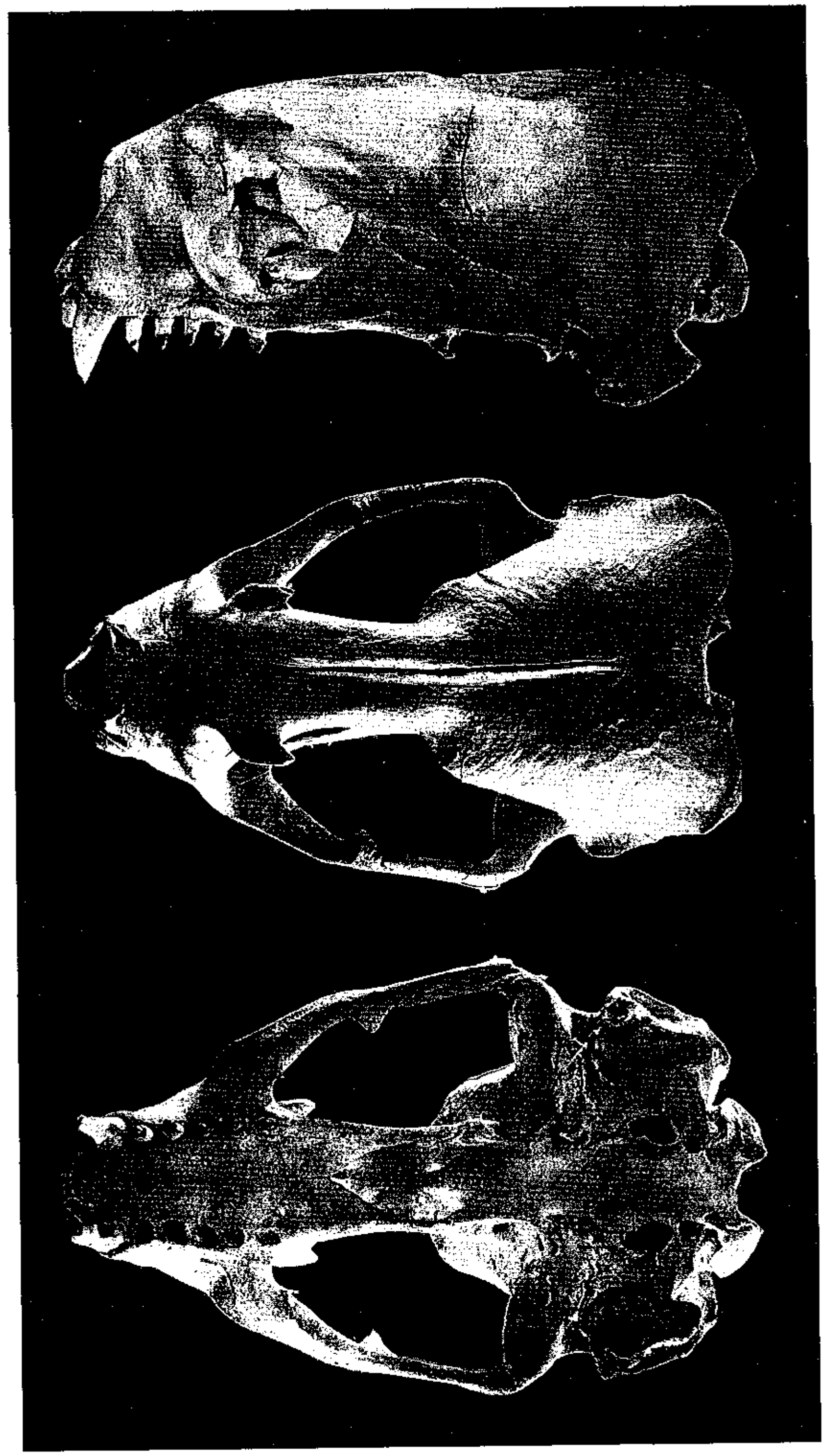
Pl. II. *Otaria byronia* (De Blainville), from Falkland Islands. Adult male, skull length 318 mm. British Museum, Hamilton coll. W. S. 479. Brit. Mus. phot.



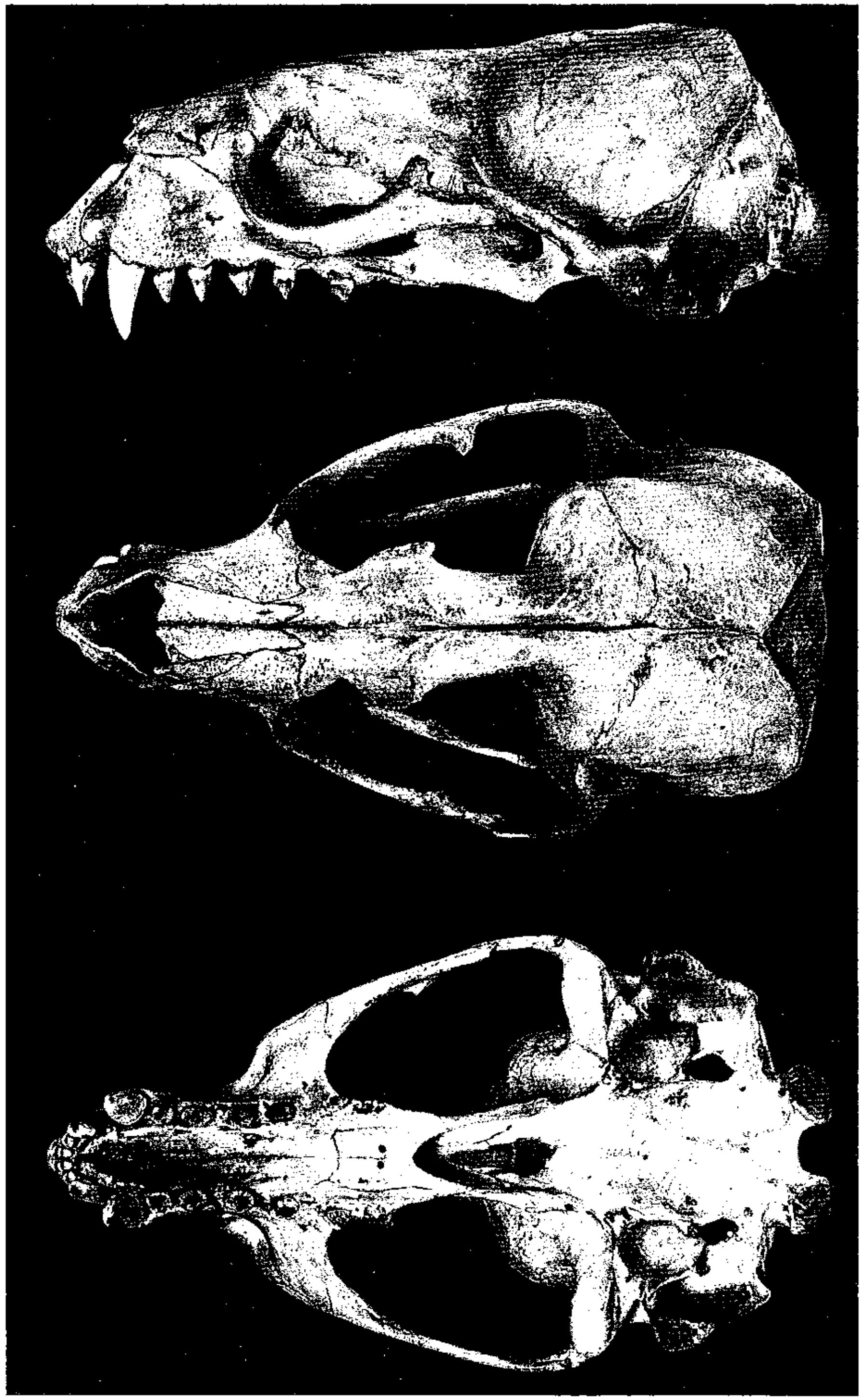
Pl. III. *Zalophus wollebæki* Sivertsen from Galapagos Islands. Adult male, skull length 267 mm. Zoologisk Museum, Oslo. No. 7931. Schröder, Trondheim, phot.



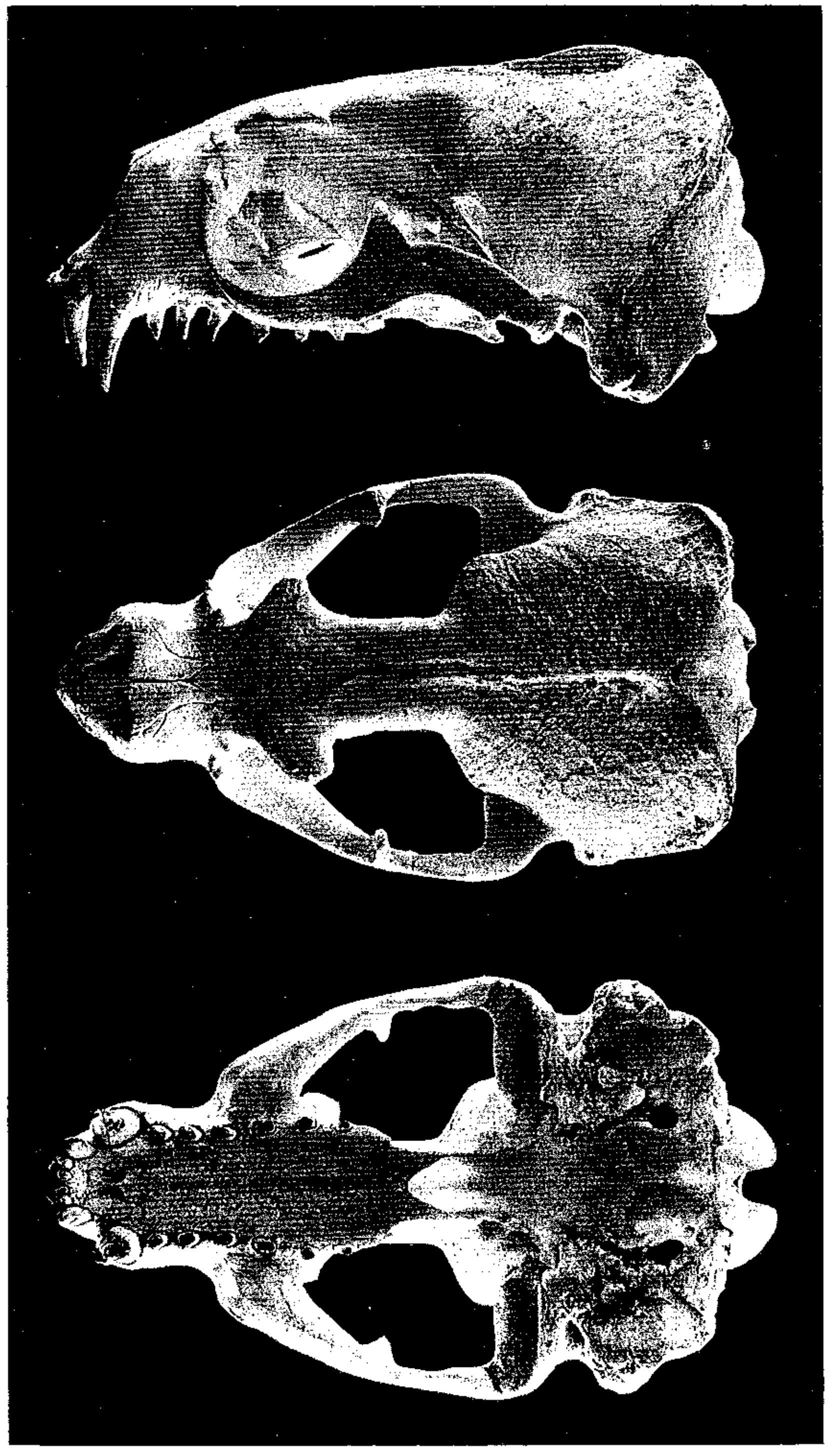
Pl. IV. *Neophoca cinerea* (Peron and Lesuer), from S. Australia. Adult male, skull length 294 mm. British Museum. No. 25. 10.8.32. Brit. Mus. phot.



Pl. V. *Callorhinus ursinus* (Linn), from Pribilof Islands. Adult male, skull length 242 mm. Zoologisk Museum, Oslo. No. 7571. Schröder,Trondheim. phot.



Pl. VI. *Arctophoca philippii* Peters, from Juan Fernandez Island. Adult male, skull length 256 mm. British Museum, 1883. 11.8.1. Brit. Mus. phot.



Pl. VII. *Arctocephalus gazella* (Peters), from Bouvet Island. Adult male, skull length 244 mm. Zoologisk Museum, Oslo, No. 7744. Schröder, Trondheim, phot.

Fig. 1. *Zalophus wollebæki* Sivertsen, from Galapagos Islands. Stuffed female from Zoologisk Museum, Oslo.

Fig. 2. *Arctophoca townsendi* Merriam, from Guadalupe Island, lower California. George A. Bartholomew Jr. phot.

Adult males

of

Zalophus wollebæki Siv.

from Osborn Island,

north of Hood,

Galapagos 1954

Phot. Dr. Eibl-Eibesfeldt,
Max-Plank-Inst.,
Buldern.

Pl. X

Old bull and female of *Arctocephalus gazella* (Peters) from Bouvet Island.
D. Rustad phot. 1927.