

International Council for the
Exploration of the Sea

C.M. 1967 / N:6
Marine Mammals Committee

NORWEGIAN SEAL RESEARCH

by

Torger Øritsland

Institute of Marine Research,
Directorate of Fisheries,
Bergen, Norway.

Contents:

1. Introduction
2. Previous investigations
3. Current research
4. Field work
5. Tagging
6. Serology
7. Craniometry
8. Age determination
9. Age, growth, and mortality
10. Reproduction
11. Catch and effort statistics
12. Air surveys
13. Joint Soviet-Norwegian study of harp seals
14. Antarctic seals
15. Survey of coastal seals
16. Physiology
17. Parasitology
18. Miscellaneous
19. Summary
20. References
21. Tables

1. Introduction

Commercial sealing has been a trade of some importance to Norway since 1847 when the first Norwegian ship joined the British, German, and Danish vessels which hunted harp seals in the Greenland Sea. Biological research started much later, and did not keep pace with the development of the industry. Nevertheless, some work has been done through the years, and the purpose of this paper is to report on Norwegian seal research with a review of earlier investigations and an account of current activities.

2. Previous investigations

An early account of the biology of seals and Norwegian sealing in North Atlantic waters was given by Alf Wollebæk (1907). Dr. Hjalmar Broch described reproductive organs, tongue papillae and glands, and dentition in foetal grey seals (Broch 1914a, 1914b). Fridtjof Nansen's narrative (1924) of his first experiences in Arctic waters on board a sealing vessel in the Greenland Sea in 1882, contains valuable chapters on seal biology, and this book has later been extensively used as a source of information.

Seal research was initiated by the Directorate of Fisheries and carried out by Thor Iversen in the White Sea in 1925. Iversen's report (1927) contains information on the history of commercial sealing and hunting statistics. In a later publication (Iversen 1938) this information is brought more up to date. Meanwhile a Soviet-Norwegian Sealing Commission was established in 1926 to consider regulations of sealing in the White Sea area.

Studies of seals with emphasis on the White Sea harp seal, were initiated by the Commission, and field work on commercial vessels was organized by the Norwegian fraction of the Commission. Material and data were collected in the White Sea, but also in the Greenland Sea and the Denmark Strait during the years 1926-1937. Results have been published by Bergersen (1931), Høst (1932), and Sivertsen (1935, 1941). Data on hooded seals have not been published, but some results were reported by Høst (1948).

General studies were also performed by Birger Rasmussen who followed two ships on an exploratory sealing expedition to Newfoundland in 1938 (Rasmussen 1938).

Antarctic seals were collected during the cruises of "Norwegia" in 1928-1929. Dr. E. Sivertsen's work on crania from this expedition led to a study of Otariid skulls (Sivertsen 1953, 1954).

To complete the picture of prewar Norwegian seal research, it may also be mentioned that Dr. P.F. Scholander studied diving in seals

and other animals at the Physiological Institute, University of Oslo, in the years 1937-1939 (Scholander 1940).

3. Current research

In 1951 seal research was adopted by the Institute of Marine Research, Directorate of Fisheries, Bergen, with Dr. Birger Rasmussen in charge. Investigations were carried out parallel to other activities with seasonally engaged help for field work. However, one junior scientific officer has been employed full time since 1961, and one technical assistant since 1966. An annual governmental allowance is now available, and additional support is granted from the Sealing Fund, according to requirements.

Research was stimulated by the establishment of the Norwegian Sealing Council in 1953. The Sealing Commission for the North-east Atlantic was established in 1959, and since then Norwegian and Soviet research has been coordinated and reports exchanged through this organisation. Contact with seal scientists of the Fisheries Research Board of Canada has been kept up since 1951. From 1966 Norwegian and Canadian research at Newfoundland is coordinated and reported through the ICNAF Seal Panel.

Investigations at the Institute of Marine Research were planned to supply necessary data for stock assessment and population dynamics of the economically most important species, the harp and hooded seals. However, material is also collected for other studies and from other species, and upon request special studies at other institutions are supplied with material as far as feasible.

Preliminary results of work on harp and hooded seals up to 1956 were published by Rasmussen (1957b), and further results were included in a later paper on the hooded seal (Rasmussen 1969). Reference to other publications which deal with special studies, will be made below.

4. Field work

A summarized account of field work since 1951 is given in table 1. It will appear that most of the work has been done on board commercial sealing vessels during hunting seasons. Working conditions are somewhat less than ideal on these ships, owing to the fact that they have no laboratory facilities, and because the seal hunt can not be disturbed. However, interested captains and crew members help whenever they can, and there is an ample supply of seals, so restricted studies can be performed.

Through experience a procedure has been developed for rapid collection of desired data and material: With a steel tape standard length is measured from tip of nose to tip of tail, and blubber thickness measured in the initial cut made for skinning. The jaw is cut off with an axe or a cable-cutter, reproductive organs are collected, and the stomach is opened. Possible stomach contents are sampled. On a scratch pad notes are made on measurements, presence or absence of stomach contents and parasites, and for females also on presence or absence of foetus, pup, and milk. Notes and samples are put into one deep plastic bag for each seal, and the animal may be left to the crew for skinning. Later the same day samples are transferred to gauze bags, marked with numbered metal discs, and preserved in 4% formalin or salted. All data are transferred to data-forms. Additional material like crania or blood samples, are collected as required when circumstances allow. This collecting has been made on most trips. In some seasons, however, blood sampling for serological studies has had priority, and in 1965 physiological studies were the main object of work at Newfoundland.

A chartered relief vessel has been operating in the Greenland Sea during the sealing season every year since 1953. Representatives on board have collected data on the location of seal patches and ice limits, tagged seals, and collected some material through the years. However, an increasing demand for technical and medical aid has limited biological research on this ship to a minimum in recent years, and future activities will be confined to tagging and survey of ice conditions and patches of seals.

On a chartered sealing vessel, material from pregnant female seals was collected in the Greenland Sea before the hunting season in 1962. Joint Soviet-Norwegian investigations and attempts at air surveys will be considered under separate headings below.

Reports on field work were published up to and including 1954 (Halmø 1952, 1955; Rasmussen 1952, 1954, 1957a; Øynes and Rasmussen 1955). For later years typed or mimeographed reports of field activities are available at the Institute of Marine Research.

5. Tagging

Taggings of harp and hooded seals from 1951 to 1963 and recoveries up to October 1963 were reported by Rasmussen and Øritsland (1964). Later taggings are summarized in table 2.

During the period October 1963 - September 1967, 7 tagged seals have been recaptured one year or more after the tagging. These recaptures are listed in table 3. Three harp seals tagged in the

Barents Sea in 1963 were caught in the same area the next year. Of the four recaptured hooded seals, three had been tagged and were caught again in the Greenland Sea. It may be mentioned that A0107 was a four years old female with a suckling pup when she was caught. The dispersal of immature Newfoundland hooded seals is illustrated by A0143 which was caught in the Amerdloq fiord near Holsteinsborg, West Greenland, one year after the tagging near Funk Island, Newfoundland.

In 1964 and 1965 five ringed seal pups were tagged in the Greenland Sea and the Barents Sea, but no recaptures have been reported yet. One grey seal pup was tagged and released in Bergen harbour in January 1964. This animal was caught in a drift-net some 100 naut. miles further North on the coast one month later.

Tail-tags and tagging technique were described by Rasmussen and Øritsland (1964). PVC tail-tags have been used on most animals also in 1964-1967. In 1964 a series of blue "Jumbo Rototags" (manufactured by Messrs. Dalton, Henley, England) was kindly supplied by The Nature Conservancy, Edinburgh. These moulded nylon tags with engraved text "inform london zoo" and serial numbers, were used on 140 of the tagged animals, either alone (51 seals) or in combination with the tail-tag (89 seals). "Rototags" were also tried on five hooded seal pups, kept for experiments at the laboratories in Bergen for up to 32 days.

The "Rototags" were applied to the fold of skin and connective tissue at the trailing edge of one of the fore-flippers, or to the web next to the middle digit of one of the hind-flippers, about 8 cm inside the edge of the web. The latter position appears to be best, and the "Rototags" which are resistant to wear and breakage and easy to apply, seem to be well suited for tagging of seals.

6. Serology

Investigations of polymorphic characteristics of harp and hooded seals were started in 1962. Initial work with erythrocyte antigens (blood types) proved these to be impractical for population studies of seals (Møller, Nævdal, and Valen 1966). However, electrophoretic techniques had been developed for serological studies, and during 1963 and 1964 hemoglobins and sera were collected for investigations of blood protein polymorphism. Results from a study of harp seals were published by Nævdal (1966a), who found genetically controlled differences between populations at Newfoundland and in Northeastern Atlantic waters.

Results from a comparative study of blood proteins from harp,

hooded, bearded, and ringed seals have also been published (Nævdal 1966b). Special attention was paid to the hooded seal, and complicated individual variations were found in the haptoglobins. Variations were also found in another group of proteins, and these indicate a difference between samples from Newfoundland and from the Greenland Sea - Denmark Strait area.

In 1965 sera were collected from harp seals in the Jan Mayen area (93 specimens), in the Barents Sea (7), and at Newfoundland (40). Analysis of these confirmed earlier results. Sera from 93 harp seals and 101 hooded seals were collected at Newfoundland in 1967. These are now being analysed, and special attention will again be paid to haptoglobin variations in hooded seals. Plans for further studies include sampling of sera from harp seals in the Gulf of St. Lawrence, for comparison with harp seals off Labrador - North-eastern Newfoundland.

A search for possible amylase polymorphism has also been initiated, and pancreases from 49 harp and 19 hooded seals were collected at Newfoundland in 1967.

7. Craniometry.

A collection of harp seal skulls at the Zoological Museum, Trondheim, now amounts to about 450 specimens, including 146 collected at Newfoundland, 107 collected in the Greenland Sea, and 194 collected in the White Sea - Barents Sea area. Professor Dr. Erling Sivertsen is planning a craniometric study of these skulls.

At the Zoological Museum, University of Bergen, work has started on a collection of hooded seal skulls which include 36 from Newfoundland, 80 from the Denmark Strait, and 97 from the Greenland Sea (total 213). In addition 8 hooded seal skulls collected at Newfoundland have been made available for this study by the Arctic Biological Station, Fish. Res. Bd. Canada. Preliminary results indicate a difference in adult male snouth length between skulls from Newfoundland and skulls from the Greenland Sea (Rolf W. Lie, unpublished data 1967).

8. Age determination

After initial experiments in the early 1950-ies with thin tooth-sections and transmitted light, age determinations were made by reflected light on the cut surface of bisected canine teeth. In 1965 age determinations of 207 harp seals and 30 hooded seals were checked on thin sections by Dr. D.E. Sergeant, Fish. Res. Bd. Canada. For older harp seals a definite bias towards low ages was

demonstrated in age determinations from bisected teeth. However, a satisfactory agreement was arrived at when sections were used.

The same year a new cutting machine was constructed from a model developed by Soviet scientists (courtesy M. Ya. Yakovenko and R. Sh. Khuzin, PINRO, Murmansk). This high-speed circular saw is fitted with two parallel blades (costume jewellery saw-blades), water cooling, and a sliding platform. The machine cuts 0.2 mm thick sections which may be mounted for reading without further grinding or other treatment. Therefore age determinations are now again made on thin sections by transmitted light. Auxiliary reflected light is used to achieve better contrast in poorly calcified teeth.

Included two specimens reported by Rasmussen and Øritsland (1964) and two Norwegian recoveries from Canadian taggings (courtesy Dr. D. E. Sergeant), teeth have now been collected from 6 marked animals of known age:

- S707 - hooded seal, one year,
- S554 - harp seal, four years,
- A0114 - harp seal, one year,
- A0127 - harp seal, two years (marked as one year old, length 132 cm),
- Can.0399 - harp seal, one year, and
- Can.0402 - harp seal, one year.

Tooth sections from these animals all show annual formation of zones in the dentine.

9. Age, growth, and mortality

The length-distribution of 260 hooded seal pups measured in the Greenland Sea, was published by Rasmussen (1960), who found a mean birth-weaning length of 100 cm. Comparable measurements of 332 hooded seal pups at Newfoundland in 1967 indicate a mean birth-weaning length of 105 cm for hooded seals in that area. Measurements are also available for 499 Newfoundland harp seal pups.

Data on age and length of hooded seals were published as growth curves by Rasmussen (1957b, 1960). Additional data are now available for about 400 hooded seals, 350 harp seals, 50 bearded seals, and 25 ringed seals. Again a difference is indicated in adult length between hooded seals at Newfoundland and hooded seals in the Greenland Sea, but more measurements are needed from Newfoundland to affirm this.

Age distributions of moulting harp seals in the Greenland Sea 1953-1956 were published by Rasmussen (1957b). Data are also

available for 1957-1959 and 1962-1963. Since then, however, no material has been collected because it was found that samples hardly were representative of the stock. The age distribution of Barents Sea harp seals was studied 1963-1965.

For hooded seals data on age distribution in 1955-1958 have been published (Rasmussen 1960). Age distributions of moulting hooded seals in the Denmark Strait 1956-1960 were reviewed by Rasmussen (1962), with estimates of mortalities in this species. Since 1960 there has been no Norwegian hunt in the Denmark Strait, but material for age-analysis has been supplied from a Greenland vessel by the Royal Greenlandic Trade Company, Copenhagen, for the years 1962-1964 and 1966. It is expected that additional samples will be provided by this Company also in future years. Unpublished age distributions are available in mimeographed progress reports to the Norwegian Sealing Council.

10. Reproduction

Results from a study of reproduction in female hooded seals were published by Øritsland (1964). Additional material have since been collected from 60 female hoods. Material is also available from 350 male hooded seals, included 9 collected in West Greenland in August-September 1962, and work on this material is progressing.

With regard to harp seals, data are available from 300 females and 100 males. Reproductive organs with accompanying material for age determinations have also been collected from 50 bearded seals and 20 ringed seals.

11. Catch and effort statistics

Hunting statistics have been published by the Directorate of Fisheries for all years since 1924 (Fiskeridirektøren 1926-1966). However, these statistics are lacking in desired detail, and therefore had to be checked against original records and supplemented with information from registry books. Revised data are now available for catch and effort, and a tentative analysis of catch per unit of effort-day for Norwegian hunt at Newfoundland has been submitted to the ICNAF Seal Panel (Øritsland 1966). Further analyses are in progress, but the evaluation of different effort data, like tonnage, engine power of ships, duration of trips, and size of crews, is still a problem.

12. Air surveys

Repeated attempts to survey breeding patches in the Greenland Sea by helicopter based on the relief vessel, have not been successful. A report on the first experiments in 1954 was given by Rasmussen (1954), and later attempts have been reported in the annual progress reports. Apart from weather conditions, the main obstacle to these surveys has been the fact that the relief vessel has to assist the sealers at a moments notice. Helicopters were not used in 1966 and 1967, and the helicopter surveys have now been given up.

Air surveys of moulting hooded seals in the Denmark Strait were tried in 1959 and 1960 (Øritsland 1960a), and again in 1962. Also these surveys were abandoned after an appraisal of expenses against possible results.

13. Joint Soviet-Norwegian study of harp seals

A study of moulting harp seals in the Greenland Sea was initiated by the Sealing Commission for the Northeast Atlantic. Soviet and Norwegian scientists have cooperated in field work on a Soviet ship in May 1964 and on a Norwegian ship in May-June 1965. The program is intended to supply data which may be representative of the stock, and includes survey of ice and patches of seals, and studies of the moulting process, age- and sex-composition, reproduction, feeding, growth, parasites, and serology. Material has been collected from a total of 356 males and 170 females, but the end of the moulting period has not been covered yet, so further sampling will be necessary to complete the studies.

14. Antarctic seals

Accidental observations in 1959/1960 on fur seals in the South Orkneys were reported by Øritsland (1960b).

In August-October 1964 a Norwegian sealing vessel caught some 11 hundred seals in the pack-ice of the Scotia Sea. Research was undertaken by the Institute of Marine Research, and material was collected for studies of feeding, age and growth, sexual maturity and cycle, and parasitology from the following adult and subadult seals:

Crabeater males	86
" females	132
Leopard males	33
" females	51
Ross males	7
" females	8

Elephant males	4
Fur seal male	1

In addition, sex and maturity were determined in crabeater seals for a study of sex-ratio and fecundity in this species. Data on sex and length were also collected from 199 near-term foetuses and three newly-born pups. The catch, and counts performed during recco-flights with helicopter, have supplied information on relative abundance and density of seals in the pack-ice. Work on the collected material and data has not been finished yet, but it is hoped that results can be published in 1968.

15. Survey of coastal seals

Harbour seals and grey seals on the Norwegian coast were surveyed during 1962-1965, and the results have been reported by Øynes (1964, 1966). There are no current plans for further studies of these species.

16. Physiology

An investigation of "ice-burning" of seal skins is still in progress at the Institute of Zoophysiology, University of Oslo. Field work was completed at Newfoundland in 1965, and is now supplemented with experimental work on living and dead tissue.

Provisional results show that "ice-burning" is a temperature-dependant process, starting with a change in colour at about +40°C. At 45°-47°C the hair-cuticle split from the stratum corneum, and the hairs loosen in their follicles. Stratum corneum split off at 50°C, and resistance against tensile stress decreases abruptly between 52° and 58°C. In the skins of dead seals even higher temperatures may be produced by absorption and accumulation of energy from the sun, and conditions for this absorption are presently being investigated. The regulation of the insulating properties of blubber is also studied (Nils A. Øritsland, unpublished report 1967).

17. Parasitology

Parasitic nematodes have been studied and a new species has been described by Berland (1964). Additional material and data have been collected, and further studies have been planned at the Zoological Museum, University of Bergen.

18. Miscellaneous

From observations made during field work in 1956-1960, Berland (1958, 1966) has described the morphology of the hooded seal hood, and discussed its possible function.

Blubber thickness has been measured in about 200 harp seals and 100 hooded seals. This, however, is hardly enough to illustrate changes in physical condition during breeding and moult, and measurements will be continued. Data have also been collected from 40 bearded seals and 15 ringed seals. Very few weights have been recorded, but weighings and measurements of girth will be given a higher priority in future field work.

Stomach contents have been found in 29 of 217 harp seals, 16 of 101 hooded seals, 24 of 46 bearded seals, and 3 of 23 ringed seals. Some samples have been collected for identification, but the report on the findings will be put off until further data have been collected. It may be mentioned here that shrimps and capelin were found in stomachs of breeding and moulting harp seals at Newfoundland in 1967.

19. Summary

References are made to previous Norwegian investigations and to work which was organized by the Soviet-Norwegian Sealing Commission of 1926.

Seal research is now centered at the Institute of Marine Research, Bergen, and supported by the Norwegian Sealing Council and the Sealing Fund. Studies are coordinated with Soviet and Canadian efforts through the Sealing Commission for the Northeast Atlantic and the ICNAF Seal Panel.

Field work has been carried out throughout the years from 1951 to 1967. Efforts have been concentrated on harp and hooded seals, and most of the work has been done in the Greenland Sea. A procedure for work on commercial sealing vessels is outlined.

Reference is made to a report on tagging of seals from 1951 to 1963. In 1964-1967 57 hooded seals and 186 harp seals were tagged, and 13 seals recaptured within the tagging season. 7 tags have been recovered one or more years after the tagging. A new type of tag has been tried, and this appears to be well suited for tagging of seals.

It has been found that seal populations may be identified by polymorphic characteristics which are revealed by serological techniques. These studies are being continued.

A craniometric study of hooded seals is in progress, and skulls have also been collected from harp seals.

Age determinations have been checked against Canadian determinations. A cutting machine has been constructed, and teeth have been collected from 6 marked seals of known age.

Reference is made to published and to recently collected data on growth rates, age distributions, and mortalities.

Reproduction in female hooded seals has been studied. Material has also been collected for studies of reproduction in harp seals and male hooded seals.

Norwegian catch statistics have been revised and data on effort collected. Analyses of these data are progressing.

Air surveys have been tried, but are now abandoned.

Incomplete material has been collected for joint Soviet-Norwegian studies of moulting harp seals in the Greenland Sea.

Antarctic seals were studied during an exploratory sealing expedition to the Scotia Sea.

Harbour seals and grey seals on the coast of Norway have been surveyed.

Reference is made to physiological and parasitological investigations, and finally it is mentioned that data on changes in physical condition and data on feeding still are incomplete.

20. References

- Bergersen, B. 1931. Beiträge zur Kenntnis der Haut einiger Pinnipeden unter besonderer Berücksichtigung der Haut der *Phoca groenlandica*. Skr. norske Vidensk.-Akad. Mat.-naturv. Kl. 1931 (5):i-vi, 1-179, pl.1-22.
- Berland, B. 1958. The hood of the hooded seal, *Cystophora cristata* Erxl. Nature, Lond. 182:408-409.
- 1964. *Phocascaris cystophorae* sp. nov. (Nematoda) from the hooded seal, with an emendation of the genus. Årbok Univ. Bergen 1963 (17):1-21.
- 1966. The hood and its extrusible balloon in the hooded seal - *Cystophora cristata* Erxl. Årbok norsk Polarinst. 1965:95-102, 1 pl.
- Broch, H. 1914a. Bemerkungen über anatomische Verhältnisse der Kegelrobbe. I. Anat. Anz. 45:548-560.
- 1914b. Bemerkungen über anatomische Verhältnisse der Kegelrobbe. II. Anat. Anz. 46:194-200.

- Fiskeridirektøren, 1926-1966. Selfangsten ... Årsberetn. Norg. Fisk. 1924-1965.
- Halmø, K. 1952. Rapport fra tur til Vesterisen mars-april 1951. Årsberetn. Norg. Fisk. 1951 (5):86-106.
- 1955. Rapport om selfangsten ved Newfoundland sesongen 1952. Årsberetn. Norg. Fisk. 1952 (5):48-56.
- Høst, P. 1932. Phocascaris phocae n.g.n. sp., eine neue Askaridenart aus Phoca groenlandica Fabr. Zentbl. Bakt. ParasitKde. 125:335-340.
- 1948. Undersøkelser over klappmyss. Oslo, Ministry of Fisheries, 15 p., 5 fig. [Mimeo. Text of lecture to the seal meeting, Oslo, October 25th 1948.]
- Iversen, T. 1927. Drivis og selfangst. Årsberetn. Norg. Fisk. 1927 (1):1-84.
- 1938. Der Norwegische Robbenfang. Handb. Seefisch. Nordeur. 8 (1b) : i-iv, 67-94, pl.21-30.
- Møller, D., Nævdal, G., and Valen, A. 1966. Rapport om arbeidet med blodanalyser for populasjonsundersøkelser. Fiskets Gang 52 : 233-240, 257-265. Fisker og Havet 1966 (2): 1-17. [English summary]
- Nansen, F. 1924. Blant sel og bjørn. Min første Ishavsferd. Kristiania, Jacob Dybwads Forlag, 285 p. map.
- Nævdal, G. 1966a. Protein polymorphism used for identification of harp seal populations. Årbok Univ. Bergen 1965 (9):1-20.
- 1966b. Hemoglobin and serum proteins in four North Atlantic seals, studied by electrophoresis. FiskDir.Skr. Ser. HavUnders. 14 : 37-50.
- Rasmussen, B. 1938. Beretning om forsøksekspedisjonen til selfeltet ved Newfoundland våren 1938. Med journalutdrag av Julius Johnsen. Bergen, Directorate of Fisheries, 29 p., map. [Mimeo.]
- 1952. Selfangsten ved Newfoundland våren 1951. Årsberetn. Norg. Fisk. 1951 (5):53-85.
- 1954. De biologiske undersøkelser under selfangsten i Vesterisen 1954. Fiskets Gang 40 : 619-621, 624.
- 1957a. Beretning om selfangstundersøkelsene i Vesterisen våren 1953. Årsberetn. Norg. Fisk. 1953 (9) : 106-110.
- 1957b. Beskatning og beskyttelse av selforekomstene i Vesterisen. Exploitation and protection of the East Greenland seal herds. Norsk Hvalfangsttid. 46: 45-59.
- 1960. Om klappmyssbestanden i det nordlige Atlanterhav. Fisker og Havet 1960 (1) : 1-23. [On the stock of hood seals in the northern Atlantic. Transl. Ser. Fish. Res. Bd. Can. 387 : 1-29.]
- 1962. Klappmyssens aldersfordeling i Danmarkstredet. Fiskets Gang 48 : 60-62. Fisker og Havet 1962 (2) : 1-3. [English summary.]
- Rasmussen, B. and Øritsland, T. 1964. Norwegian tagging of harp seals and hooded seals in North Atlantic waters. FiskDir. Skr. Ser. HavUnders. 13 (7) : 43-55.

- Scholander, P.F. 1940. Experimental investigations on the respiratory function in diving mammals and birds. Hvalråd. Skr. 22 : 1-131.
- Sivertsen, E. 1935. Über die chemische Zusammensetzung von Robbenmilch. Nytt Mag. Naturvid. 75 : 183-185.
- 1941. On the biology of the harp seal Phoca groenlandica Erxl. Investigations carried out in the White Sea 1925-1937. Hvalråd. Skr. 26 : i-ix, 1-166, pl. 1-11.
 - 1953. A new species of sea lion, Zalophus wollebæki, from the Galapagos Islands. K. norske Vidensk. Selsk. Forh. 26 (1) : 1-3.
 - 1954. A survey of the eared seals (family Otariidae) with remarks on the Antarctic seals collected by M/K "Norvegia" in 1928-1929. Scient. Results Norw. Antarct. Exped. 36 : 1-76, pl. 1-10.
- Wollebæk, A. 1907. Ueber die Biologie der Seehunde und die Seehundjagd im europæischen Eismeer, hauptsæchlich nach norwegischen Quellen. Rapp. P.-v. Réun. Cons. perm. int. Explor. Mer 8 : 5-82, pls. I-XII.
- Øritsland, T. 1960a. Flyleting etter klappmyss på fangstfeltet i Danmarkstredet. Fauna, Oslo 13 : 153-162, 2 maps. [English summary.]
- 1960b. Fur seals breeding in the South Orkney Islands. Norsk Hvalfangsttid. 49 : 220-225.
 - 1964. Klappmyssshunnens forplantningsbiologi. Fiskets Gang 50 : 5-19. Fisken og Havet 1964 (1) : 1-15. [English summary.]
 - 1966. Norwegian catch and effort statistics for harp and hooded seals in the Frønt area and Gulf area, 1937-1966. Int. Commn NW. Atlantic Fish. Ser. No. 1760 : 1-5.
- Øynes, P. 1964. Sel på norskekysten fra Finnmark til Møre. Fiskets Gang 50 : 694-707. Fisken og Havet 1964 (5) : 1-14. [English summary.]
- 1966. Sel i Sør-Norge. Fiskets Gang 52 : 834-839. Fisken og Havet 1966 (4) : 16-21. [English summary.]
- Øynes, P. and Rasmussen, B. 1955. Rapport fra tur til Vestreisen mars-april 1952. Årsberetn. Norg. Fisk. 1952 (5) : 57-63.

21. Tables

Table 1. Field work in Norwegian Seal research 1951 - 1967.
 C = commercial sealing vessel, R = chartered relief vessel, S = special expedition, and A = air survey.

Year	Newfoundland	Denmark Strait	Greenland Sea	Barents Sea	Antarctic
1951	C		C		
1952	C		C		
1953			R		
1954			R		
1955		C	R		
1956		C	R		
1957		C	R		
1958		CC	CR		
1959		CA	CCR		
1960		CA	CR		
1961			R		
1962		A	RS		
1963			CCR	CC	
1964	C	C	CRS	C	C
1965	C		RS	C	
1966			R		
1967	C		R		

Table 2. Summary of Norwegian taggings of harp and hooded seals 1964 - 1967.

Year of tagging	Harp seals			Hooded seals		
	No. tagged	Recoveries		No. tagged	Recoveries	
		Same year	Later		Same year	Later
<u>A) Newfoundland</u>						
1964	0			19	0	1
1967	0			69	5	
Sum A)	0			88	5	1
<u>B) Greenland Sea</u>						
1964	4	0	0	13 ¹⁾	1	1
1965	4	0	0	45 ²⁾	1	0
1966	3	0	0	14	1	0
1967	0			26	2	
Sum B)	11	0	0	98	5	1
<u>C) Barents Sea</u>						
1964	12 ³⁾	1	0	0		
1965	34	2	0	0		
Sum C)	46	3	0	0		
Total	57	3	0	186	10	2

1) 13 pups, 2 subadults. 2) 14 pups, 40 subadults, 1 adult ♀.
3) 10 pups, 2 subadults.

Table 3. Recoveries of tagged harp and hooded seals one year or more after tagging. Reports 16. October 1963 - 30. September 1967.

Tag No.	Tagged		Recovered	
	Date	Position	Date	Position
<u>Harp Seals</u>				
A 0108	20.04.63	70° 54'N 45° 50'E	04.05.64	70° 40'N 52° 30'E
A 0114	22.04.63	71° 40'N 46° E	05.05.64	66° 50'N 42° 00'E
A 0127	03.05.63	69° 24'N 43° 52'E	07.05.64	68° 30'N 39° 06'E
<u>Hooded Seals</u>				
A 0032	27.04.63	70° 18'N 14° 58'W	27.04.64	73° 20'N 01° W
A 0107	10.04.63	72° 20'N 03° W	27.03.67	70° 40'N 06° W
A 0143	28.03.64	50° 06'N 53° 15'W	14.04.65	Holsteinsborg W. Greenl.
A 0064	19.05.64	74° 00'N 00° 45'E	22.03.67	71° 20'N 06° 45'W