

*Fisheridirektoratet*  
*Biblioteket*Report of Working Group on the Establishment of an  
International Herring Research SchemeA. Participation

The Working Group, set up at the Council Meeting in Copenhagen in 1962 (see report of Herring Committee, especially Appendix II; Proc. Verb. de la Réunion 1962; pp. 66-77), met at the Institute of Marine Research, Bergen, from August 13 - 17, 1963. The following members participated:

Mr. F. Devold (Norway),  
Dr. G. Hempel (W. Germany), Chairman of Herring Committee,  
Mr. B.B. Parrish (Scotland), elected chairman for the Meeting,  
Mr. K. Popp Madsen (Denmark), elected rapporteur for the Meeting.

Mr. O.J. Østvedt, Mr. O. Dragesund, and Mr. O. Dahl (Norway) were co-opted to the Working Group for the duration of the Meeting and Mr. O. Aasen (Norway) also attended some of the discussions. Unfortunately, the USSR representative and the General Secretary of ICES were not present.

B. Research needs

The Working Group first examined its main tasks in the light of the earlier deliberations and discussions of this problem at the Herring Symposium in 1961 and subsequently by the Herring Committee at its Annual Meeting in 1961 and 1962. It agreed that at present, the activities of international Working Groups, set up by ICES to answer important questions concerning the dynamics of the exploited herring stocks in the North Sea and the Atlanto-Scandinavian area are hampered by lack of accurate knowledge of some of the biological processes and dynamic properties of these stocks. Some specific biological problems confronting these Working Groups (see reports of North Sea and Atlanto-Scandian Working Groups) about which precise information is required are as follows:-

- (a) The gonad maturation cycle, its variations from year to year and the factors governing it.
- (b) Fecundity and egg size, their variation from year to year and throughout the maturation cycle, and their relation with environmental factors (including the endocrine system).
- (c) Studies of larval production, dispersal and survival in relation to spawning stock size and composition, and their variations with environmental factors.
- (d) Growth zone formation in scales and otoliths, and their relation with environmental factors.
- (e) Studies of blood types and their development in juvenile and adult herring.
- (f) Experimental studies of the efficiency of external and internal tags, tagging mortality, and shedding, and effects of tagging on fish.

The Working Group, therefore, agreed unanimously that, as emphasized previously by the Herring Committee and its Working Groups during their recent meetings, as a way to obtain more precise information on these (and other) processes and properties, investigations are needed on small self contained herring stocks in well defined localities, free from many of the complexities (eg. size of area, stock mixing etc.) of the open sea situation, and where reasonably reliable quantitative long and short term, controlled, studies can be made.

C. Basic requirements for locality and fish stock.

The Working Group considered next the desired features of a locality and fish stock(s) to meet these needs. These were considered to be as follows:-

- (a) The area must be small i.e. water mass not exceeding about 10 sq. km and containing a herring stock (or perhaps have clearly identifiable stocks - eg. spring and autumn spawners) of not less than 200,000 - 400,000 adult individuals (500-1000 hectolitres).
- (b) The fish stock(s) must be self-contained with little or no exchange of adult fish with other localities.
- (c) The physical, chemical and biological properties of the water mass should be as similar to the open sea as possible (eg. temp., salinity, O<sub>2</sub>, nutritions and plankton production). It should be mostly free from severe iceing in winter, and free from serious pollution.
- (d) The locality should have easy access by road or sea transport from a research centre (eg. from Bergen).
- (e) The stock of herring should not be heavily exploited commercially, but statistics of any fishing which does take place should be available.
- (f) The entrance(s) to the localities should be narrow and shallow to allow if necessary, the erection of temporary or permanent barriers to the emigration or imigration of fish (at least of adults).
- (g) The bottom topography of the locality should be as regular as possible and the depth should not be too deep (i.e. not exceeding 60-80 metres) over the main part of the basin. Small, narrow mouthed bays, suitable for isolating small groups of fish for controlled experimental work (eg. tagging and behaviour studies), leading off the main water mass are desirable.
- (h) The locality should be one in which the amount of sea traffic is small.
- (i) The water mass should contain other fish species, especially predators of herring.
- (j) The shores of the locality should have sites suitable for the erection of temporary or permanent buildings (laboratory, accomodation stores, landings stage, boat house etc.) close to a road and within easy reach of fresh water and electricity supplies.

D. Examination of localities near Bergen.

The Working Group spent the greater part of the time at its disposal making a survey of three localities near Bergen, which had been selected by the Norwegian scientists as possible sites, meeting most of all these requirements. Each of these sites is a small arm, (termed "Poll" in Norway), of an open fjord with one or more narrow entrances, and known to contain herring at least for part of the year, including the spawning season.

The names of these "Polls" are as follows:-

- (a) Fjellspollen (Fjeldspollen),
- (b) Lindåspollen,
- (c) Heiamarkpollen (Heidemarkpollen).

Descriptions of the physical characteristics of these polls and details of what is known of the herring stocks inhabiting them are given in Appendix to this report and Figures 1 - 4.

It is clear from these descriptions that all of the sites examined fulfill most of the basic requirements specified above. For example, all of them are small, having narrow entrances through which there is water exchange with the open sea; they are known to contain herring (both spring and autumn spawners) at least for part of the year, including the spawning season, which can be

fished with "normal" fishing gear (anchored gill-nets or purse seine).

However it was evident to the Working Group, following its examinations of the sites and the available information about them, that there is at present considerable uncertainty regarding the general biological properties of the herring in these localities. The principal uncertainties are as follows:-

- (a) Although herring have been observed in the polls in different seasons it is not known if they remain as an intact stock throughout the year or whether there is a substantial exchange of adolescent and adult herring with the neighbouring fjords. Further, although annual commercial catches of up to 100 hectolitres are taken in the polls, nothing is known of the size of the herring stocks in them. During the echosurveys carried out in both the Lindåspollen and Heiamarkpollen a single, large herring "plum" trace and a number of smaller traces of unknown identity were recorded, but no longer term records of this sort are available.
- (b) It is not known whether the larvae and adolescent fish derived from spawning in the polls are mostly retained within it or whether there is a large loss of them through the entrance. However, fishermen in the area report that adolescent herring are present in the polls, at least in some years. Furthermore, the extent of the entry of larvae and adolescent fish from outside the polls is not known.
- (c) Insufficient is known of the annual range of environmental conditions (hydrographical and biological) especially during the winter, when ice may be a hindrance to fishing etc.
- (d) The technical sociological and legal problems involved in erecting fish barriers at the entrance to the polls, should this be necessary, are not known.
- (e) Insufficient is known of the stocks of other species in the polls.

Thus it is clear from the statements above, that the working Group is not able to make any definite proposals concerning the launching of the elaborate international research scheme, before more detailed knowledge of the various sites and the stocks of herring inhabiting them has been obtained. Especially the evidence is insufficient as to whether the herring in these polls constitute self contained stocks.

#### E. General considerations of future work.

It is felt by the Working Group that a step by step development as outlined below would meet these requirements while keeping expenditure of work and costs within reasonable limits.

1st stage. Further preliminary surveys in 1963/64 concerning:

- (i) Size of herring stocks
- (ii) Identification of stocks and degree of exchange.
- (iii) Technical and legal problems connected with the enclosure of water areas.

2nd stage. Detailed surveys in 1964/65 with special regard to environmental factors:

- (i) Hydrography, plankton, predators, etc.
- (ii) Small scale ad hoc experiments with herring especially on the management of a landlocked stock.  
(Transplantation experiments, effect of confinement to small water bodies etc. etc.)

3rd stage. Launching of full scale project governed by the knowledge and experience gained in the initial and transitional stages.

The Working Group only considered in detail how to deal with the first stage, i.e. the work to be undertaken in 1963/64.

F. Proposed working programme 1963/64

1. Stock composition. As minimum requirements the following characters should be sampled regularly from the 3 localities under survey:

Length  
Weight  
Age  
Scale and otolith types  
Maturity  
Intestinal fat  
V. S.  
Egg size in spawning herring.

The sampling rate should be one sample a month from each locality and the sample size preferably not less than 100 specimens.

Samples from Heiamarkspoll and Fjellspoll can be obtained from local fishermen. In order to reduce sampling bias it will be necessary to supply the respective fishermen with nylon drift nets of different mesh size and to offer a certain surplus payment for the catch.

In the Lindås poll the commercial fishery is too infrequent to offer reliable sampling facilities and samples from this locality must mainly be secured by research vessels. As this has to be done when convenient it may not prove possible to secure a sample each month, but the spawning seasons should certainly be covered.

Subject to the adoption of the proposed working programme, Norway is willing to supervise the sampling and to do the main part of the analyses involved while other laboratories (eg. Denmark, Germany and Scotland) are ready to assist wherever possible for example in scale reading, otolith typing etc.

2. Echo surveys. In order to obtain information on stock size, schooling behaviour and possible "intra-poll" movements throughout the year, monthly echo surveys should be carried out in all three localities. This work requires a research vessel or hired commercial vessel for about 3 days a month and will probably have to be executed wholly by Norway.
3. Spawning surveys. Besides the echosurveys an estimate of the spawning stock size should be made from larval abundance indices. If possible egg sampling by grab and other methods suitable for estimating location, size and importance of spawning sites should be undertaken as well. The possible emigration of spents and the exchange of larvae through the inlets of the polls should be investigated with suitable gear.
4. Gear experiments. The uneven configuration of the bottom, the strong tidal currents in the inlets and the considerable depths in some of the localities, raise certain problems as to which gear would be most suitable for sampling the stock. It was decided that members of the Working Group should bear the problem in mind and consider the possibility of introducing local gear from countries where fishery is carried out under similar conditions (e.g. boom net, boyed pound nets etc.).
5. Technical and legal aspects. In all areas a rather considerable traffic by small and bigger boats creates the problem of how to close an inlet to the passage of adolescent and adult herring without hampering the free passage of vessels. The combination of a sluice and a permanent net barrier is supposed to be the most feasible, though rather costly, solution. In any event expert technical advice on possibilities and costs should be obtained from the Norwegian authorities. A problem which may prove to be of considerable importance is the reaction of the local communities (fishermen, landowners etc.) towards the enclosure of any landlocked fjord. The local inhabitants probably demand certain compensations which could be of a considerable magnitude. This as well as other legal problems which may arise in this context should certainly be clarified by consulting appropriate experts.
6. Additional information. An excellent chart of the Lindås poll has already been made at the Norwegian Institute from a detailed bottom sounding survey. In view of its obvious value the Working Group would heartily welcome a similar work to be undertaken in case of the

Fjellspoll and Heiamark poll. In fact, Norwegian workers offered to undertake this task. It is further considered to be desirable that some information on a few additional polls be obtained, e.g. the Fauskangerpoll and Kjerrgårdosen both of which merits from the close vicinity of Bergen. More detailed information on the conditions of the various polls should be obtained from local people.

7. Working Group meeting. Subject to the adoption of the working programme as outlined above, it is recommended that the Working Group meets again in Bergen in the first half of April 1964. This time coincides with the termination of the spring spawning and would permit the entire group to take part in the surveys. The group would further evaluate the echo recordings and sampling data collected by then. The early date would also permit the group to make appropriate changes in the working programme if it should prove desirable from the knowledge gained up to that time.

G. Acknowledgements.

The Working Group wishes to express its appreciation of the very considerable efforts made by the scientific staff of the Norwegian Institute for Marine Research during the past year in obtaining information on the fish stocks in these and other polls, and for their offer to undertake the major part of the proposed additional preliminary studies in 1963-64. It wishes, further, to thank the Director and staff of the Institute for the generous facilities provided during the course of this meeting of the Working Group in Bergen.

APPENDIX

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Description of the different polls

The geographical situation of the three polls under consideration is shown in Fig. 1, sketches of the polls are given in figs. 2-4. A detailed chart of Lindås-pollen has been produced by the Fiskeridirektoratet, and similar charts of Fjell- and Heiamarkpollen could be produced. Biological data about the herring stocks are available for Lindås- and Fjell-poll. Echoscounding of the Fjell pollen has not been undertaken so far. Temperature measurements at different depths and echoscoundings have been done at the Working Groups visit in the Lindås- and Heiamark-poll.

Fjellspollen.

Geographical situation

The Poll is situated on the island Sotra 20 km southwest of Bergen. To reach the poll from Bergen one may go by bus to Alvøen (40 min. drive) and from here by ferry to Bratholmen (10 min., about 10 connections per day) and further on by bus either to Nessjøen (30 min.) or to Dalseide (30 min.) This latter spot is directly situated at the pollen, whereas from Nessjøen one has to undertake a 10 min. trip by motor boat to the pollen. (Fig. 4). Except in the southern most branch of the pollen where a few farmers live, only two small farms are situated ashore the poll, one at Dalseide and the other one just inside the entrance (the fisherman's hut).

Topography

The entrance from the sea is divided by a small island, the one on the northern side of the island being 10 m broad and 2 m deep, and the southern one 10 m broad and 2 m deep. The average speed of the stream going in and out is roughly estimated to be 3-4 knots. The tidal range being 1 m. The poll itself is 5 km long with a breadth ranging from 200 to 400 m, the maximum depth being 50 m with an average depth of approximately 20-30 m. At the western side of the northern branch a smaller poll is situated, which is connected to the main poll by an entrance of 15 m breadth and 2-3 m depth. Into the northern most part of the poll a narrow stream brings fresh water from small lakes of a moorland valley. Up to now, no echo survey of the poll has been undertaken to investigate the bottom topography, but it is likely that the bottom has a V-shape in a profile in W-E direction. The bottom is rocky and rather steep on both sides except on a few places in the southern and northern part of the poll, at Dalseide and at the fisherman's house.

Hydrography

No hydrographical observations have been carried out and very little is known about the environment. The water will probably have the lowest salinity in the northern branch, where most of the fresh water is coming into the poll. The poll is mainly covered by ice in this part during the winter, whereas in the area inside the main entrance ice is only found in extremely cold winters.

Fish

A number of fish species is known to occur, especially coalfish, cod and herring.

According to the local fisherman adult herring are found in the poll during the whole year and fishing for home consumption takes place most of the year. The total catch of one single fisherman amounted in 1962 to 8  $\frac{1}{2}$  hl. Scanty fishing of one or two other fishermen may bring the total catch up to 20 hl. The best catches (up to 2  $\frac{1}{2}$  hl a night) are taken in spring, by setting gill nets across the middle of the poll. In late autumn fishing takes place also with gill nets mainly at the western side of both ends of the poll.

The samples secured from the poll (Sept. 1962 to April 1963) show that herring ranging in length from 20 to 33 cm are fished. The samples consist from 1 to 8 years old herring, the 2 and 3 years olds predominating.

The investigation of the maturity stages reveal that both spring and

autumn spawners are present in the poll. According to the samples it is likely that the spring spawners are in the majority. Also the vertebral counts confirm that both autumn and spring spawners are found.

According to the present knowledge about the herring in Fjellspollen it is difficult to state whether the two different spawning groups are self-contained or not. It is likely, however, that an exchange may take place at least in some years with herring outside the poll.

#### Possible sites for buildings etc.

Most parts of the coastline of the poll are uninhabitable, but at both ends and in one or other occasions likely places for buildings were observed.

### Heiamarkpollen.

#### Geographical situation

The Heiamark-poll is a landlocked fjord on the island Hufferøy, 35 km south of Bergen. It can be reached by car going to Hjellevstad or Espe-grend (Biological Station), 40 min. from Bergen, and then by boat (2 hours).

Part of the route has to cross waters open to the sea and may be difficult to pass for small boats under very bad weather conditions. In this case the island can be reached on a more sheltered route from the southern end of the Fana-peninsula.

The public transportation to the poll by ferry and road is poor and time consuming at the present time, but is supposed to improve in the course of the next five years. At the island itself only one small road leads to the poll.

The poll is surrounded by hilly forests and some open landscape. At the western coast of the poll the small community of Heiamark and some isolated houses are situated. At the end of different bays at the eastern side several huts and a saw-mill are situated. Heiamark is the home port for several small vessels serving as a ferry to Bergen three times a week. Within the poll motorboats and rowing boats are used for fishing and transport.

#### Topography

The Heiamark poll is very irregularly shaped. Its largest diameter is 3 km, its surface about 3 km<sup>2</sup>. The coast line shows several bays of different size and shape, some of them are also nearly landlocked. The maximum depth recorded so far is 112 m, the central part is of about 80 m depth, the inshore bays about 30 m. The profile of the bottom is very irregular, the seafloor seems to consist of rock except the entrance where a wide area of smooth shallow sand was observed.

The access to the poll is a loch about 3 km long and 1 km wide with several islands in its middle part. The entrance to the poll is mainly blocked by three islands. The westerly by-pass round the westerly island is like a shallow stream, at the east side of this island is the main entrance, about 50 m wide and 6 m deep and narrowed by a mole constructed of block stones. The current in the entrance was estimated to be about 2-3 knots. Eastwards two very narrow and shallow inlets are separated by another small island. The tidal range is about 1 m.

#### Hydrography

The amount of fresh-water coming into the poll for most of the year is small compared with the surface of the poll and the tidal exchange of water. In the south-eastern part of the main body the water temperature was found on this visit to be 15.5°C at the surface, 14.6°C at 10 m, 10.0°C at 20 m. No H<sub>2</sub>S was recorded at 20 m depth. The water of the poll is extremely clear. Due to its salinity and close connection to the open sea presumably the Heiamark pollen will not have a considerable coverage by ice during winter.

#### Fish

According to reports from local inhabitants herring is distributed all over the poll and is caught mainly in spring and in autumn. Spawning is assumed to take place in both spring and autumn, but the spawning places were not specified. The echosurvey showed a considerable number of traces,

some of them presumable caused by herring. A shoal of young herring or sprat was observed near the surface. Large concentrations of young fish either gobiids or gadoids were seen in shallow waters together with adult labrids. One young pollack was caught by hook (empty stomach). Further information about the fish and the fisheries in the pollen can easily be drawn from the local population which consists partly of members of the crew of the Norwegian research vessels and of other trained fishermen.

#### Possible sites for a station

Several places seem to be suitable for establishing a station as far as the topography of the coast is concerned and if only access by boat is needed. A more precise answer is only possible when the plans for the new road system on Huftarøy are known.

#### Lindås poll

##### Geographical situation and traffic.

The Lindås poll is a landlocked fjord system situated on the mainland 35 km north of Bergen. It can be reached by car (and a ferry-boat) in 1 ½ hours or by boat, 3 hours from Bergen. The surrounding of the poll is farmland and forests. The community of Lindås is situated at the northern side of Spjeldnesosen. Several huts for summer holidays are scattered all round the poll. No industry except a saw-mill at Fjellangervåg in the vicinity of the poll.

The main population center, Lindås, in Spjeldnesosen, has no longer a regular service by boat from Bergen. Most of the traffic goes over land.

No commercial fishery occur regularly, but occasionally a purse-seiner fishes there.

The Lindås area is a favourite holiday center and during summertime several sportfishermen use to come there.

##### Topography

The poll is divided in three, Fjellangervåg, Spjeldnesosen and Straumsosen.

Fjellangervåg is the innermost part and is connected with Spjeldnesosen through a narrow channel (Haukenæsstrømmen), 30-40 m broad and 1500 m long with a depth of about 4 m. Maximum depth of the Fjellangervåg is 81 m.

Spjeldnesosen is the largest part, 3-4 km long and 1 ½ km broad. Maximum depth is 89 m. It is separated from Straumsosen by two small islands and the connection is about 200-300 m at the most, with depth less than 10 m.

Straumsosen is connected with the fjord outside, Lurefjord, by three narrow entrances. Two of them can only be passed by small boats on high tide. In the third one is a sluice with a depth of 3 m. The maximum depth in Straumsosen is 55 m.

Both in Spjeldnesosen and Straumsosen there are several smaller islands, bays, and narrow "arms". Especially should be mentioned Kvalvåg, about 2 km long, and only 30-100 m broad, connected with Straumsosen.

The bottom of the polls consist mainly of rocks, the profile as shown by echosounding is rather irregular.

##### Hydrography

There is considerable inflow of fresh water at the eastern side of Fjellangervåg. This part has a surfacelayer of low salinity, which is stained by humus at least in summer time.

Temperature measurements on 14. August show a sharp thermocline at 10 m depth with a temperature of 19.3°C at the surface and 4.9°C at the bottom (49 m). Near the bottom a considerable amount of H<sub>2</sub>S was observed.

In the other parts of Lindås poll the salinity at the surface is higher than in Fjellangervåg. No hydrographical data are available for these parts.

In most winters the Fjellangervåg is covered by ice and also in the two other parts ice conditions are often severe preventing all traffic by



boat during longer or shorter parts of the Winter.

### Fish

A number of fish species is known to occur, especially coalfish, cod and herring. Herring is caught every year, mainly during the autumn, by local fishermen for their home consumption. In November 1962 almost 100 hl herring was caught by a purse seiner using artificial light. In former times the Lindås poll was famous for its oysters.

Since November 1962 4 samples of herring from purse seine, drift net and hand line catches have been secured.

The samples, totalling 455 herring, show that herring from 2-13 years old, ranging in length from 20.5 to 33.5 cm were fished. The 3 years old herring were most numerous. Both the 2 and 3 years old consisted, however, of two different length groups. The scale analysis showed that the larger ones had a similar scale pattern to the recruit spawners and immature herring of the year-classes 1959 and 1960 in the winter herring. The vertebrae counts also showed a higher value for this group of herring, 57.12, as against 56.62 for the rest of the samples. Apparently there had been an imigration of young herring from the Lurefjord into the Lindås poll.

Herring in maturity stage VI and VII were caught at the end of March in Spjeldnesosen. According to information from people living at Lindås herring in spawning condition have also been caught in Fjellangervåg.

In November 1962 herring caught by purse seine were tagged with Lea external tags and released in Spjeldnesosen. Four were recaptured in 1962 and 79 in 1963, all of which were taken in the Lindås poll. Of the recaptures 66 were found in a drift net catch, which consisted of about 90 herring only. The tagged herring were, however, considerably smaller than the untagged ones which suggests that the tagged herring may have been trapped by the tag.

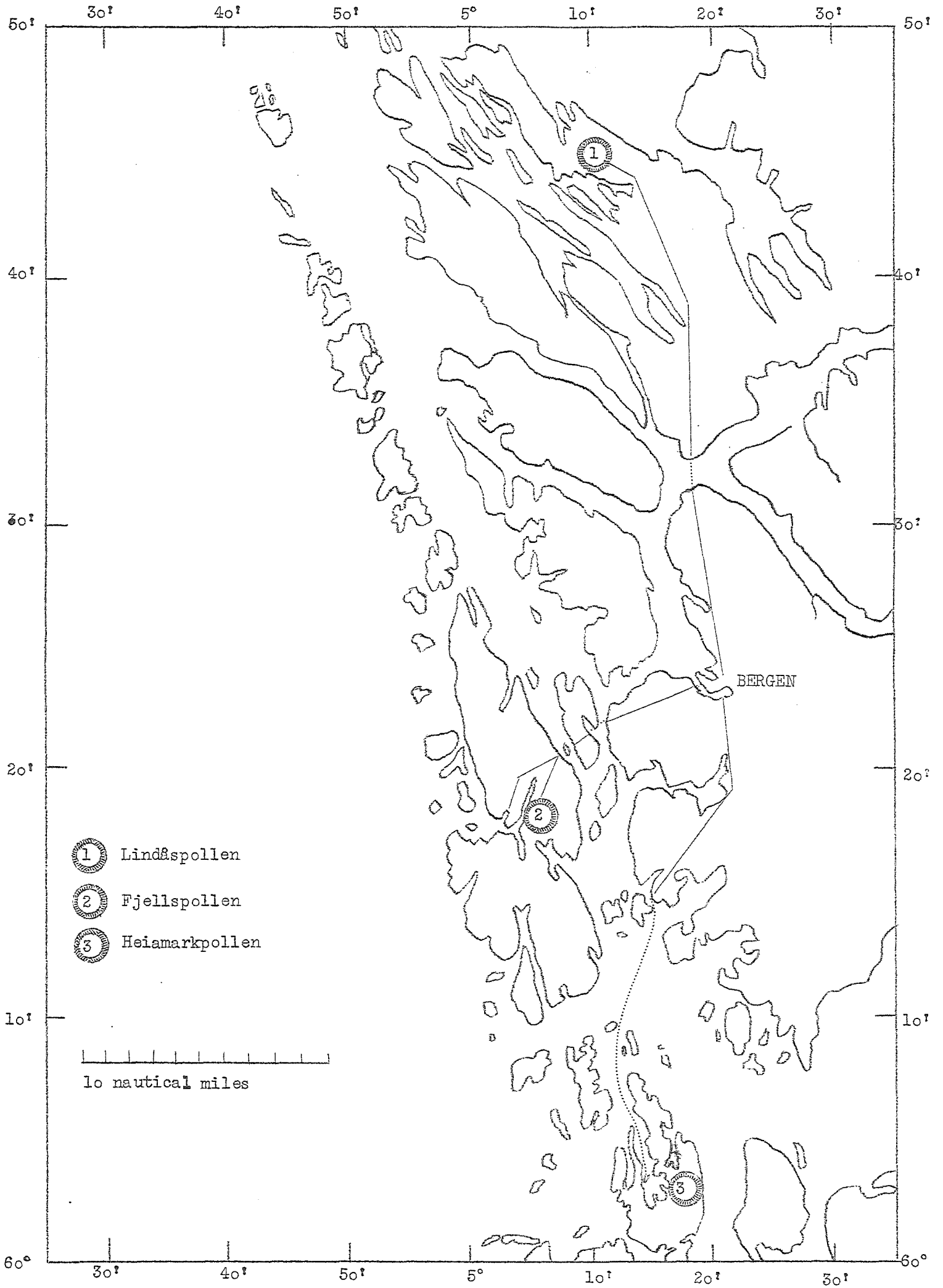
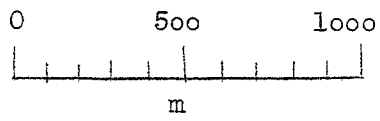


Figure 1

Fjellspollen

Figure 2. (2) FJELLSPOLLEN



NESSØYEN

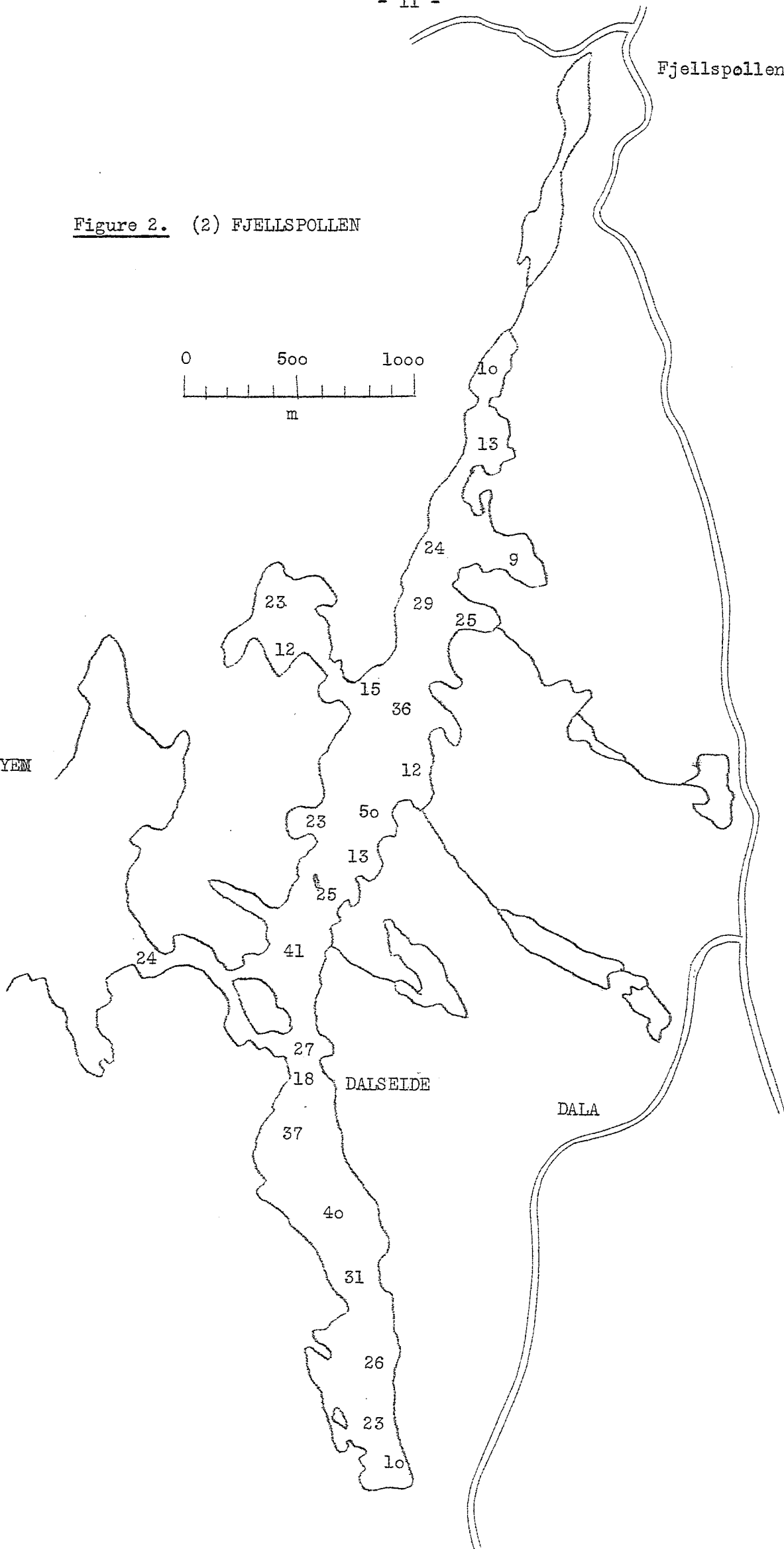


Figure 3. (3) HETAMARKPOLLEN

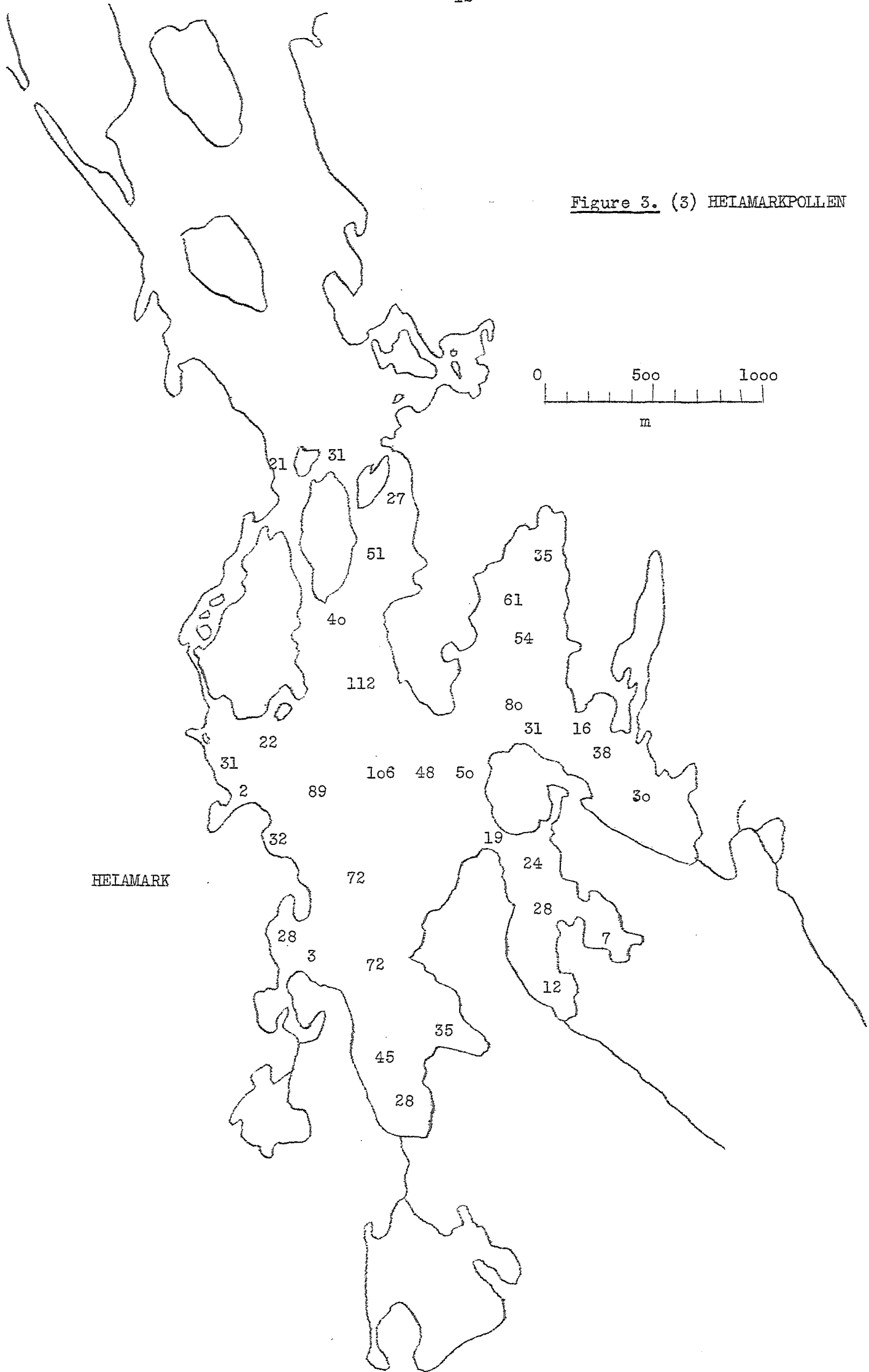


Figure 4. (1) LINDASPOLLEN

