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The char (Salvelinus alpinus L.) in Katnosa Lake
Age, growth, population, mortality and exploitation

by M. Dalene

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PREFACE

The subject matter for the thesis was suggested by Scientific Consultant Kjell W. Jensen.

Field work and analyses were carried out in cooperation with Cand. mag. (grad. student) Björn Erik Edvardsen who carried out a study on perch in Katnosa Lake. I would hereby like to extend special thanks to him for all help and assistance. The cooperation with him has been inspiring.

Amanuensis (Assistant Prof.) Hans Nordeng has been my guide at the Zoological Laboratory. I have received help and guidance from him during the field work, preparation and writing up of the report.

Group leader Rikvald Hansen in O.F.A. has been of great assistance during the field work. His thorough knowledge of Katnosa has been very valuable, and his team has given us many valuable data from their fishery for spawning char.

Scientific consultant Kjell W. Jensen has contributed with guidance and valuable information.

The Laboratory for Applied Microscopy through University lecturer Johan Basberg has assisted with photography of otoliths.

Employees and students at the Zoological Laboratory have assisted in various ways.

My wife, Bodil, has typed the thesis.

The Municipality of Oslo through Mr. Per Finstad has made houses and boats available to us.

Lövenskiold-Vaekerö through chief forester Odd Venas has been very cooperative throughout the study. Special permits were issued for the periods when intensive field studies were carried out.

The University of Oslo has covered all travel expenses in connection with the study.

I hereby express my heartfelt thanks for all help and assistance given to me.

Blinderen, April 1973

Morten Dalene

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INTRODUCTION

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The char (Arctic Char, Alpine Char), Salvelinus alpinus (L) often show a tendency to form over-populated stocks consisting of poor quality, small fish. The tendency towards over-population is especially great in regulated lakes. In regulated waters in Eastern Norway, char are only found as small fish that seldom grow larger than 26-27 cm (Aass 1964).

Char were introduced to Katnosa Lake through lakes located higher in the river system (Ølja and Tverrsjøen) about 1915. At this time Katnosa had a large population of whitefish Coregonus lavaretus (L), brown trout, Salmo trutta L., perch, Perca fluviatilis L., and minnow, Phoxinus phoxinus (L). The whitefish were introduced around 1900 through Spålsvasdraget which had been stocked with fry of fall whitefish (Dahl 1933). In spite of the presence of the whitefish, the char managed to establish a viable population. The lakes in Nordmarka just to the north of Oslo are one of the few examples where whitefish and char can be found as equals in one and the same lake.

The char in Katnosa have existed as an "over-populated" stock of small fish ever since the 1940's. In 1967 the average size for spawning fish was about 20 cm. In the same year an experimental fishery for char was started by O.F.A. The purpose of this fishery was to thin out the population to such a degree that the growing conditions of the fish could be improved. To decimate char populations through intensive fishery has on several occasions been demonstrated to be very difficult. A concrete example is Tunhovd Fjord where the char population seems to be unchanged in spite of the fact that 2.1-2.6 kg fish per hectare is being cropped

annually (Aass 1965). Similarly, most other examples are from lakes where char occur alone or dominate quantitatively. In Katnosa where char cannot be said to dominate the fish fauna, it is therefore interesting to see how an intensive fishery will affect the population.

My studies, which were carried out in the years 1970-71, will form the basis for a later analysis of the effect of fishing on the char population. I plan to study age, growth, age of spawning, stock size and mortality.

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Correct age determination is fundamentally important for any biological investigation. It is very difficult to determine the age of char (Nordeng 1961). Nordeng showed that scales from char from Salangen were unreliable for age determinations. However, the zones in the otoliths were shown to indicate the correct age. The same was demonstrated for my material. The otoliths were therefore used to determine ages and for back-calculating lengths.

Population size and mortality have in the following been determined from tagging experiments. Dahl (1917) was the first to use tagging and recaptures to determine the population size of fish. The method is today quite commonly used in population ecology. The method has earlier been used on char by Lindström, Fagerström and Gustavson, 1970.

DESCRIPTION OF AREA

Katnosa is located in Nordmarka just to the north of Oslo and is a border lake between the counties of Oppland and Buskerud. The lake is part of the Aker River system. The exact location is $60^{\circ}9' N$ and $10^{\circ}34' E$ at an altitude of 464 meters above sea level. The surface area is 177 hectare (ha). Greatest depth is 54 m. In connection with log transportation in the water system, the lake has been regulated by 6.26 m.

Geological conditions around the lake are dominated by the two calcium-poor minerals nordmarkitt^{*)} and kjelsaasitt (Brogger and Schetelig, 1923). The lake is surrounded by coniferous forests, chiefly fir.

A farm was located on the east side of the lake in earlier years (Figure 1). The farm is now only used as a residence by the only permanent residents at Katnosa.

The bottom conditions vary from large rocks to mud.

Katnosa has three major tributaries (Figure 1). These come respectively from Fidlingen to the north east, Aklangen to the north west and Spålen to the west. These are all "wood lakes" of the same type as the lake studied. The river from Katnosa flows southwards to Sandungen (Figure 1).

Table 1 shows the results of hydrographic studies in Katnosa which were carried out September 3, 1970 (Dalene and Edvardsen 1970, unpublished). These studies show that Katnosa should be considered to be an oligotrophic lake type. This is mainly indicated by the oxygen analyses which show very

*) nordmarkite

high O_2 - contents even close to the bottom. Water color and transparency indicate that the water must have a certain humus content. Both Mg-hardness, Ca-hardness and specific conductivity show relatively low values which is typical for an oligotrophic lake. pH varied from 6.5 - 6 from the surface towards the bottom.

The fish fauna consists of the following species: Brown trout Salmo trutta L., char Salvenius alpinus (L), whitefish Coregonus lavaretus (L), perch Perca fluviatilis L, and minnow, Phoxinus phoxinus (L). In addition to the fish species mentioned the lake also has a population of freshwater cray fish Potamobius astacus (L.).

p.4

The vegetation in the lake has not been studied.

KATNOSA

Scale: 1:20,000

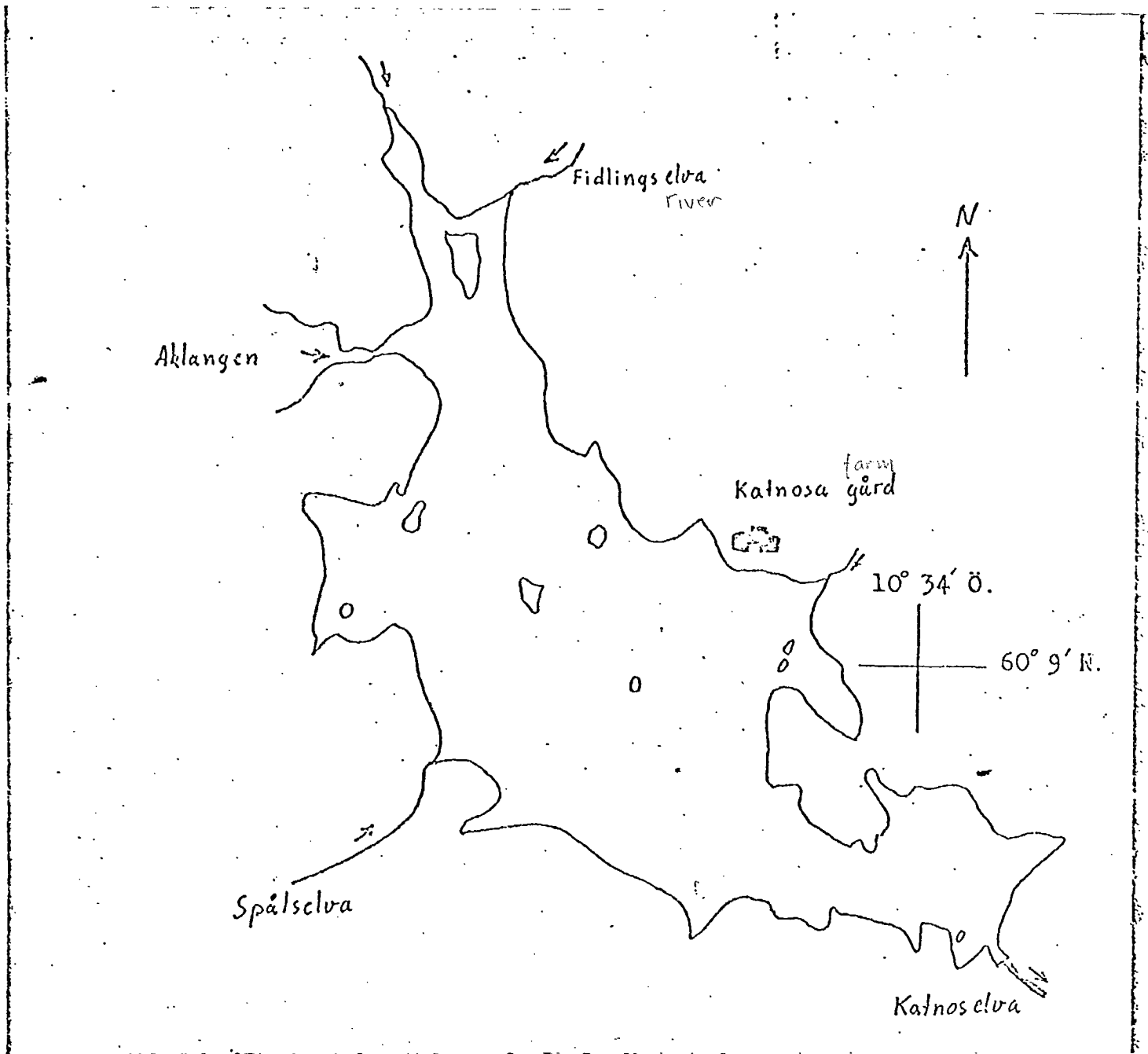


Figure 1: Map of Lake Katnosa

TABLE 1. Hydrographic conditions in Katnosa Lake from a study carried out September 3, 1970. The table shows O₂ contents, temperature, Mg and Ca - hardness, specific conductivity, pH, depth of view and water color, at the surface, at 10 m depth and at 50 m depth.

| DEPTH | | | | | | | | Depth of View | Water Color |
|-------|------------------|---------------------|----------|---------|---------|-----------------|-----|---------------|--|
| Dybde | O ₂ % | O ₂ mg/l | Temp. °C | Mg mg/l | Ca mg/l | H ₁₈ | pH | Siktedyp | Vannfarge |
| 0 m. | 124 | 10 | 14,0 | 3 | 5 | 20,3 | 6,5 | 4,20 m. | Grønlig/ gul Greenish/ yellow |
| 10 m. | 120 | 9,8 | 9,0 | 3 | 5 | 20,3 | 6,2 | | |
| 50 m. | 85 | 8,5 | 5,0 | 3 | 5 | 20,3 | 6 | | |

MATERIALS AND METHODSA. Collection

p.7

During the period 2/5-1970 to 20/11-1971, material was collected from a total of 708 char. A total of 189 fish in this material were recaptures of fish tagged one year earlier. It has been shown several times that exterior mechanical tags have a growth-inhibiting effect on fish (Smith 1957, Eschmeyer 1959, Möller-Christiansen 1961 and DeRoche 1963). This material has therefore been left out in places where it may have some effect on the results.

The material can be roughly divided in three according to fishing methods:

| | |
|--------------------------------|----------------|
| Fished with bottom gillnets: | 448 fish |
| Fished with floating gillnets: | 228 fish |
| Fished with bait and hook: | <u>32 fish</u> |
| TOTAL: | 708 fish |

The gillnets were regular bottom gillnets with a meshsize varying from 26 mm (34 omf.) to 21 mm (30 omf.). The floating nets that were used were 6 m deep. These were only used from the surface of the lake. Two series with the following mesh sizes were used: 16 mm (40 omf.), 19 mm (32 omf.), 22 mm (28 omf.), 24 mm (26 omf.), 26 mm (24 omf.), 29 mm (22 omf.), 31.5 mm (20 omf.), 35 mm (18 omf.), and 40 mm (16 omf.).

Figure 2 shows the length frequency distribution of brook trout caught with the various mesh sizes in the floating net series. All mesh

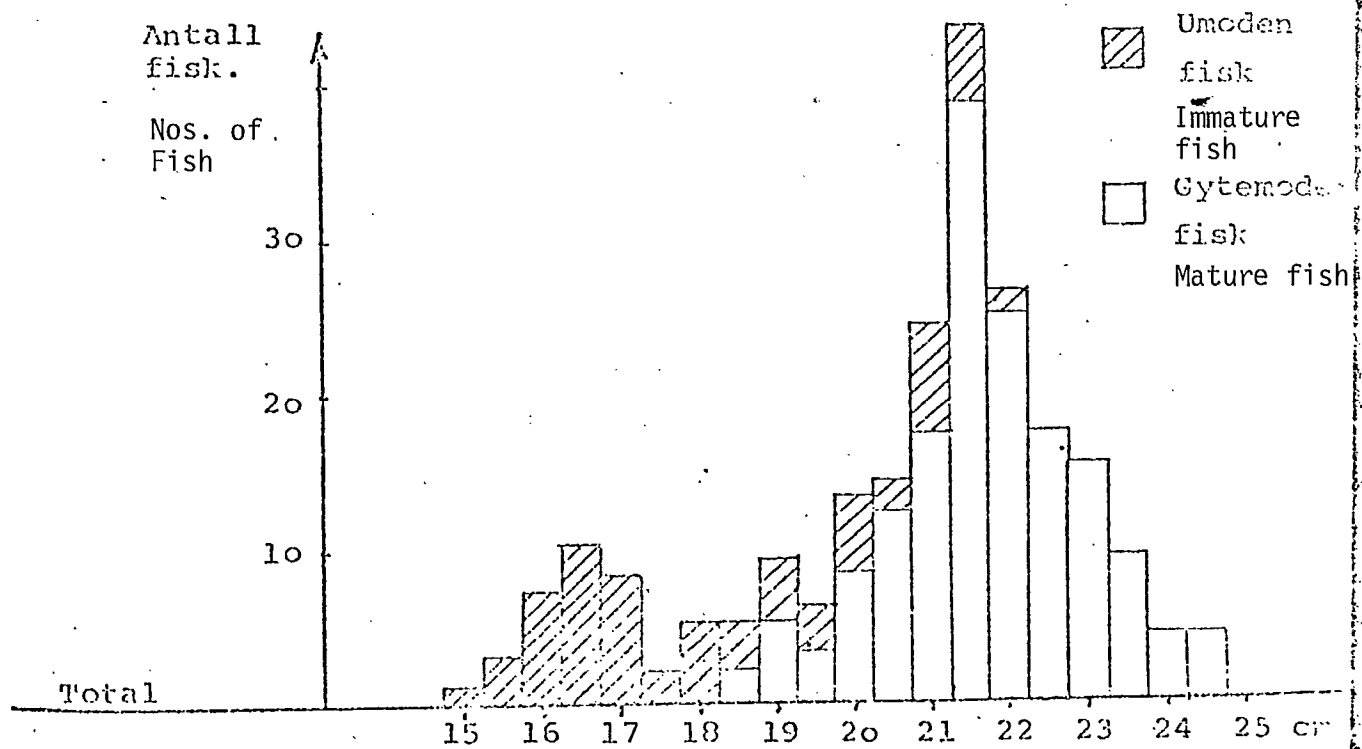
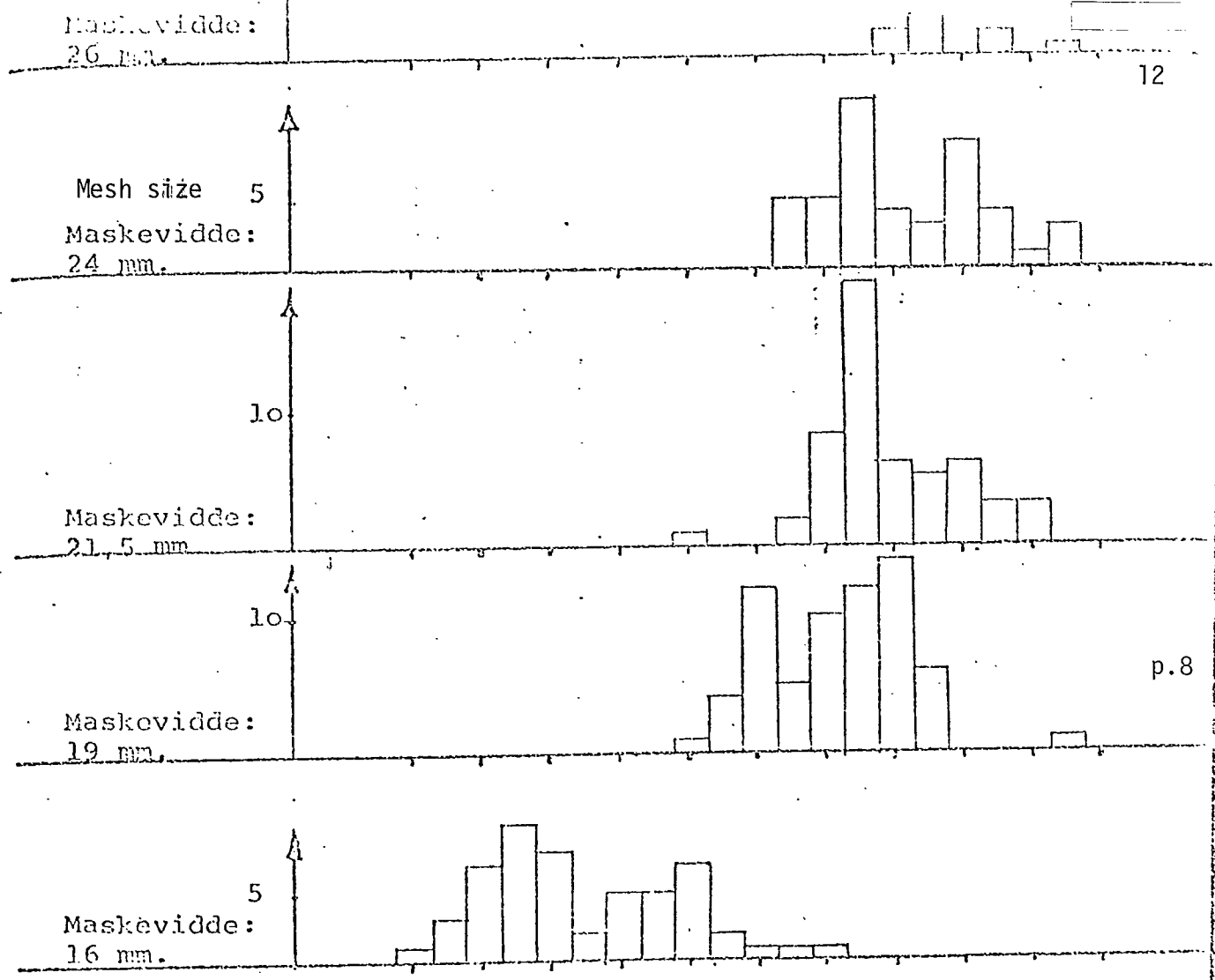


Figure 2: The length frequency distribution of char caught in floating nets 1971.

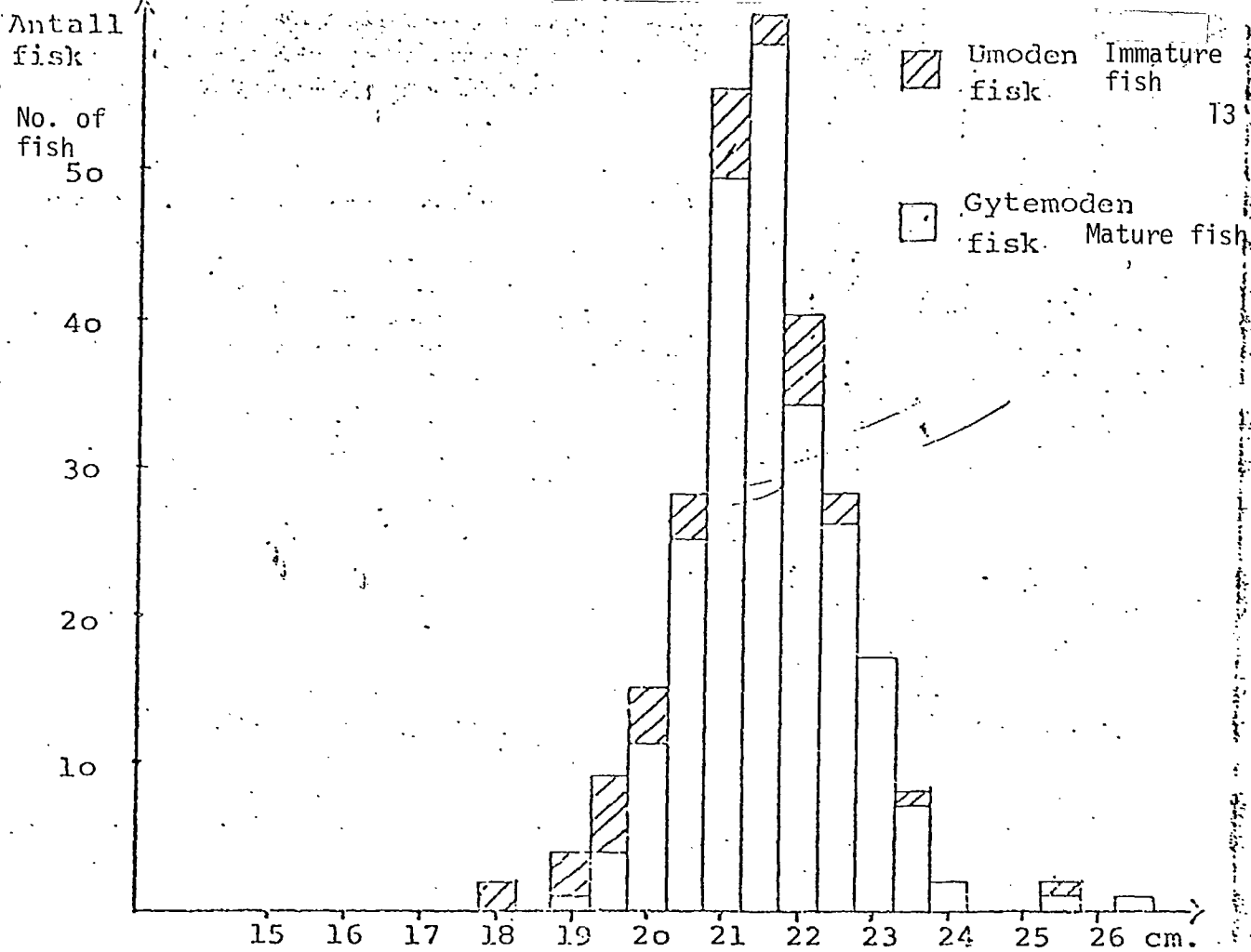


Figure 3: Length-frequency distribution of char caught with bottom gillnets in 1970 and 1971.

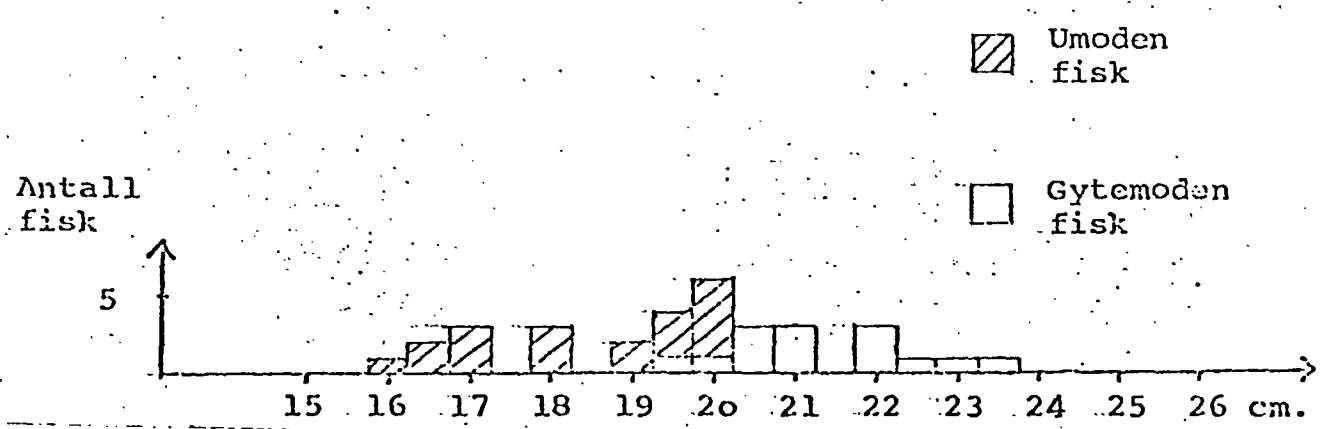


Figure 4: Length frequency distribution of char which were caught with bait and hook, winter 1970-71.

sizes represent similar fishing effort, i.e. 32 net-nights. Nets with mesh sizes above 26 mm did not catch char. It can be seen from the figure that the length frequency distribution from the various mesh sizes shows good overlap. It can therefore be assumed that no length groups have been specially selected in this material. The material from the floating net catches must therefore be assumed to be representative for the part of the population that is above 15-16 cm.

Figure 3 shows the length-frequency distribution of the fish caught in bottom gillnets. By comparing these with Figure 2 it can be assumed that this material is representative of the sexually mature part of the population.

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Figure 4 shows the length frequency distribution of fish caught by fishing through the ice.

All the material (Figure 2, 3, and 4) consists of fish between 15 and 26.5 cm. Fish above 26-27 cm was not encountered from a material of ca. 9,300 fish taken by O.F.A. throughout the last five years.

Later age determinations showed that fish two years old or younger were completely missing from the material. Fish with three growth seasons behind them, occurred with lengths evenly distributed from 15 to 18.5 cm. Great efforts were made to obtain material from the youngest year classes. Ordinary bottom gillnets with a mesh size of 10 mm (64 omf.) was tried both as bottom and floating nets in the spring and fall, 1971. None gave any results. Seine was not used due to the difficult bottom conditions.

Every fish in the material was studied immediately after being caught. The length was measured to the nearest millimeter from the tip of the head to the tip of the tail with the tail fin in natural position. The weight was recorded to the nearest gram. The sex was noted, and development of the gonads was graded according to Dahl's scale (Dahl 1917). Samples of the scales were taken from an area on the lateral line between the dorsal fin and the adipose fin. Both otoliths from each fish were taken. Otoliths and scale samples were kept dry in the same paper envelope.

B. Analyses of Scales

The scale samples were washed and mounted between two glass plates and their structures were read in a Wetzlar projector with microscopic lens. The samples were read by Cand. mag. Björn Erik Edvardsen.

Nordeng (1961) has earlier shown that the scales can often be unsuitable for age determination of char. The scale samples from Katnosa were also very difficult to read. A total of 50 scale samples were therefore read in order to check the validity of this method. By comparing scale readings with otolith readings, it turned out that only ca. 28% showed the same number of winter zones. These were mostly immature fish. A total of 12% of the scales showed one winter zone less than the corresponding otoliths. The rest of the scales were unreadable (24%) or showed more than one winter zone less than the otoliths (36%). The last groups were dominated by sexually mature fish. Based on this test, and with support in Nordeng's work, I decided to exclude scale analyses as a basis for age determination.

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C. Analyses of Otoliths

Ease of reading otoliths. Where possible, the right otolith was always used. The otoliths were cleared in alcohol a few minutes before being placed in xylene and read. The reading was done through an ordinary binocular magnifying glass in reflected light. All material was read by Cand. Mag. Björn Erik Edvardsen and myself independently.

Otoliths were classified according to readability according to Nordeng 1961:

- a) Confident of reading (certain) Distinct zones. Same result with each reading.
- b) Fairly confident of reading (Fairly certain) One or two doubtful zones. Same result for each reading.
- c) Uncertain reading. Unclear hyaline zones, especially in center. At least one doubtful zone, and often differing results for each reading.
- d) Unreadable.

c) and d) were classified as unusable for age determinations.

Table 2 shows the distribution of the material with respect to readability.

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TABLE 2. Readability of the Otoliths

| | <u>Readability</u> | <u>No. of Fish</u> | <u>%</u> |
|----------|--------------------|--------------------|----------|
| Usable | a. Certain | 387 | 54.0 |
| | b. Almost Certain | 196 | 28.0 |
| Unusable | c. Uncertain | 87 | 12.4 |
| | d. Unreadable | 39 | 5.6 |

It can be seen from the table that as many as 18% of the otoliths are unusable for age distribution (c and d).

Grinding of the otolith so that the hyaline zones appear clearer, is a procedure often followed in order to make otoliths more readable. This procedure was also used on this material. I followed a method described by Nordeng (1961). Before grinding, the otoliths were cast in a transparent medium: Terplet acrylic glue type R. This is a reacting glue consisting of two components: Glue + hardener. The otolith was placed in a glass tube with the convex side down. The mixed glue was then poured into the tube. After curing for ca. two days, the glass was broken so that a glassy-clear plug with the otolith on top was obtained. The otolith was then carefully ground from the convex side. For the grinding a dentists drill with a Viking Dental grinding stone was used. The grinding was continuously checked through a binocular magnifier. As a light reflecting medium, creosote was used and this also had the advantage that it dissolved the grinding dust from the imbedding medium.

Otoliths from all the fish taken by floating gillnets in the spring of 1971 (149 fish) were imbedded and ground. In Table 3 the otoliths from this material are grouped together according to readability before and after grinding.

The table shows that readable otoliths (a and b) have increased from 61.2% to 93.3%. The poorly readable and non - usable (c and d) have decreased from 28.8% to 6.7% following grinding. The

TABLE 3. Readability of Ground and Unground
Otoliths in Char Caught in Floating Nets, Spring 1971

| Readability | Before Grinding | | After Grinding | |
|-------------------|-----------------|------|----------------|------|
| | No. | % | No. | % |
| a) Certain | 64 | 43.0 | 98 | 65.8 |
| b) Almost Certain | 42 | 28.2 | 41 | 27.5 |
| c) Not Certain | 26 | 17.4 | 7 | 4.7 |
| d) Non Readable | 17 | 11.4 | 3 | 2.0 |

64 otoliths that had been read with confidence (certain - a) before grinding, did not change following grinding. Of the 42 that were almost certain (b), three showed an additional one or more winter zones after grinding. All additional zones appeared towards the center of the otolith. Of the 26 uncertain (c), seven remained the same after grinding. Of the 17 non-readable (d), three remained the same after grinding.

On the basis of these results, all c and d grouped otoliths in the rest of the material were ground, and all b grouped were thoroughly checked and where there was a suspicion of hidden zones towards the middle, these otoliths were also ground. Table 4 shows the total material grouped according to readability after necessary grinding was carried out.

TABLE 4. The Total Material Grouped According to
Readability Following Necessary Grinding of the Otolith

| | Readability | No. | % | |
|------------|-------------------|-----|------|-------|
| Usable | a. Certain | 498 | 71.1 | } 95% |
| | b. Almost Certain | 167 | 23.9 | |
| Not Usable | c. Uncertain | 26 | 3.7 | } 5% |
| | d. Unreadable | | 1.3 | |

It can be seen here that 5% of the otoliths are unusable for age determinations. A total of 86% of these unreadable otoliths (31) could with some certainty be estimated to be older fish, i.e. more than 7 years. It should therefore be noted that older fish may be somewhat underrepresented in the age determination.

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Measurements of the Otolith, Choice of Suitable Radius for Zone Measurement. Due to the fact that the otoliths were to be used for back-calculation of fish length, the distances from the center to the outer edge and from the center to the beginning of each winter zone were measured. The measurements were made in a binocular magnifier with the help of a graduated (micrometer) eye piece. The graduations extended from 0 to 10, with 20 divisions between each unit. The scale was multiplied by 10. The recorded measurements could then be given with an accuracy of 0.5 units.

In order to find out where in the otolith it was best to carry out zone measurements, a test was carried out. In 243 otoliths, the hyaline zones were observed along 3 radii: a, b and c. (See Figure 5.)

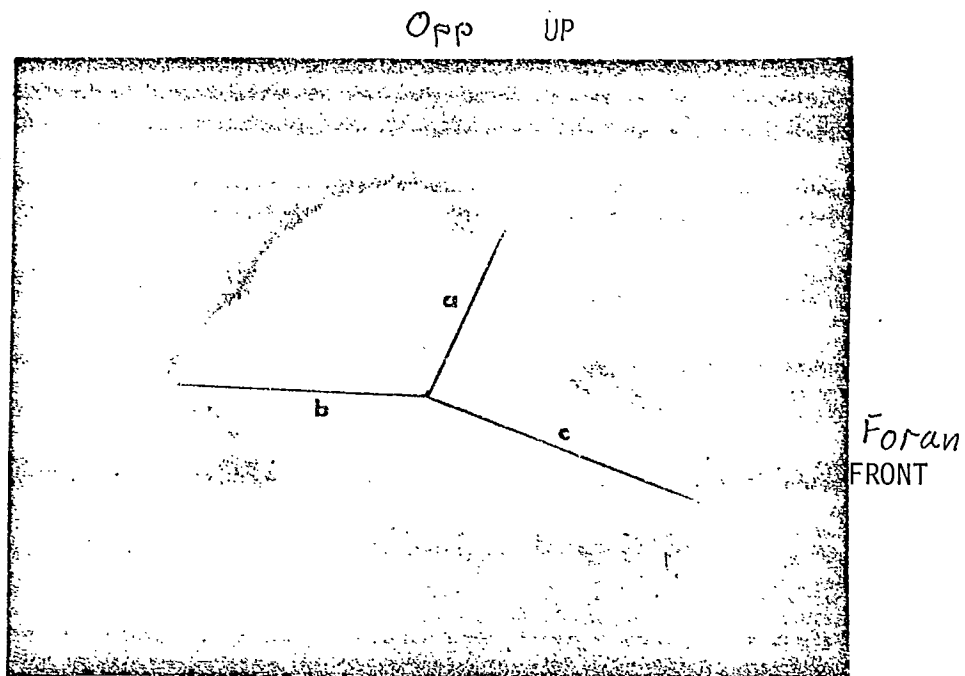


Figure 5. Right otolith, convex side. The otolith is oriented as located in the fish. A, b and c are radii that were measured in the otolith.

For each radius measured, a notation was made if the zones were difficult to distinguish or if the otolith was destroyed or misformed. (Table 5)

p.15

TABLE 5. Comparison of Radius a, b and c With Regard to Usability for Measuring Zone Distances

| | a | b | c |
|----------------------|------|------|------|
| Total no. read | 253 | 253 | 253 |
| Not clear, difficult | 42 | 32 | 87 |
| Broken or misformed | 31 | 3 | 18 |
| Sum unusable | 73 | 35 | 105 |
| % unusable | 28.8 | 13.8 | 41.5 |

The table shows that 13.8% of the otoliths were unusable for zone measurements along radius b. A total of 28.8% could not be used for zone measurement along radius a, and 41.5% of the otoliths were unusable for zone measurement along radius c. This shows that radius b is preferable when zone distances are to be measured in the otolith. All zone distances in the rest of the char sample material were therefore measured along radius b.

D. Fish Taggings

Experimental tagging was started in the winter of 1969-70 (16/12 - 25/4) when 169 char were tagged with Carlin tags (Carlin 1955). In the fishing during the spawning period 1970 (21/10 - 5/11) a total of 487 char were tagged with Carlin tags. Just before the spawning fishery started in earnest in the fall of 1971 (19/10 - 30/10) a total of 235 char were tagged by clipping the adipose fin.

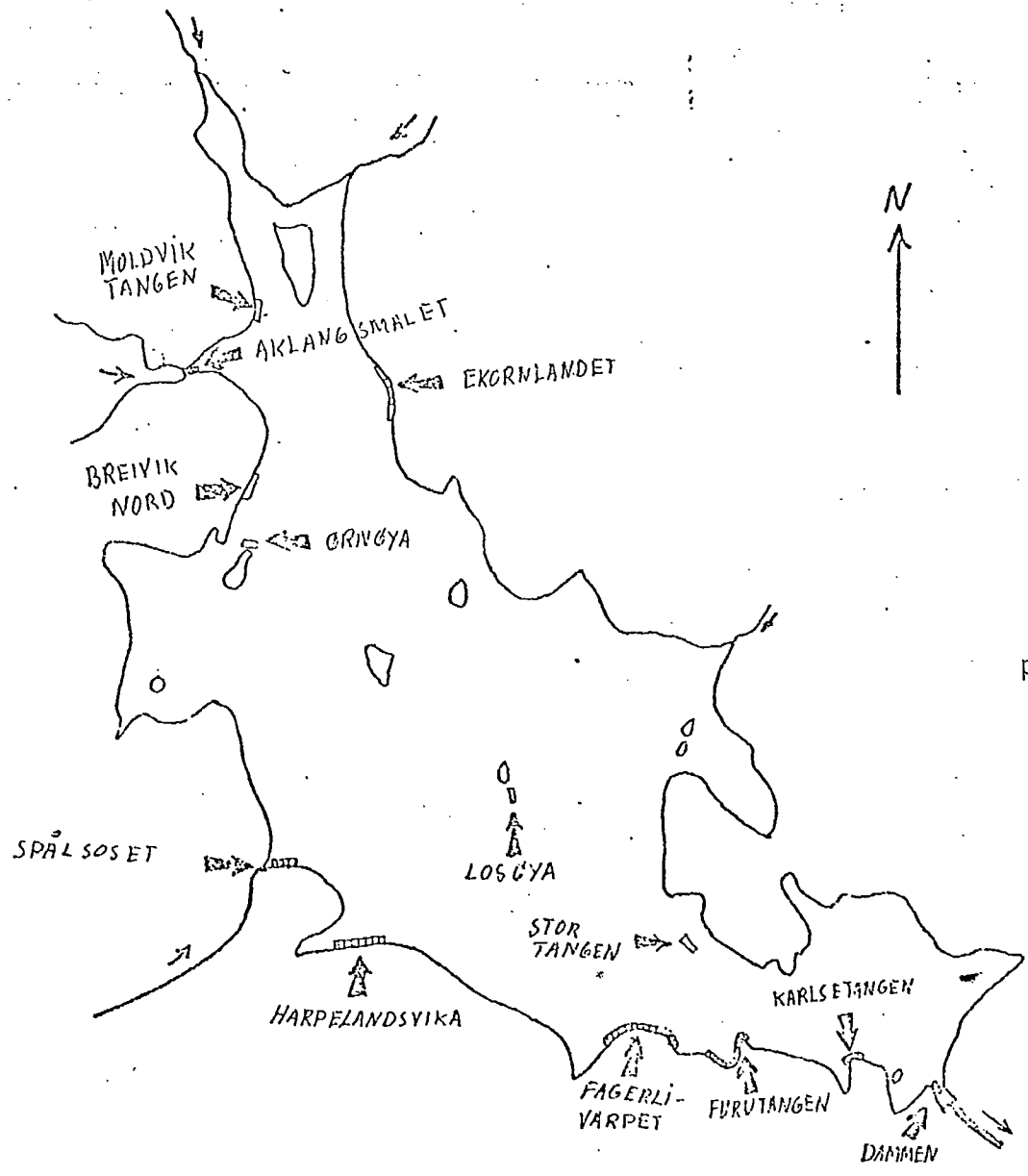
Catching Methods. During the winter 1969-70 the fish were caught with bait and hook through the ice. Fish that were not injured were tagged and released immediately afterwards. Small fly-hooks no. 10 were used since they did not seem to damage the fish mouths to any extent.

The tagging during the spawning period 1970 and 1971 were based on gillnet caught fish. The fish were carefully removed from the nets under water. All fish without visible damage were placed in a submerged crate where they were kept under observation for about 24 hours. Fish that appeared to be weak were removed. It appeared that immature

fish tolerated the handling very poorly, and only a few of these were therefore tagged. The spawning fish did not appear to have suffered any damage from this treatment. Experience has shown that spawning fish are much hardier than immature fish. The slime (mucus) production is greater and the scales seem to be more securely fastened. These are factors that to a considerable degree contribute to lessen injuries during recaptures in the spawning period. None of the recaptures taken that same year and the next year showed any fungus infection or other injuries. It is therefore reason to believe that the method of capture has been gentle.

Before the fish were tagged in 1970 they were weighed, measured and sexed. The weight was determined to the nearest gram and the length to the nearest millimeter. It must be noted that the probability for errors in the measurement is considerably greater for living material than for dead so that there is some uncertainty in the measurements. We did not find it necessary to use any kind of anesthetic in the tagging process. Carlin-tags and similar tags that are fastened under the dorsal fin, have been shown to be very suitable for salmonids (Carlin 1955, Nordeng 1961, Aass 1971). Loss of tags appears to occur only to a limited extent in this tagging method, possibly because the bones from the dorsal fin act as an anchor (Carlin 1955).

The collective tagging in the fall of 1971 was carried out quite simply by clipping the adipose fin. This is a commonly used tagging method for salmonids, and several studies have shown that the method has very little damaging effect on the fish (Eschmeyer 1959, Shetter 1951, Stauffer and Hansen 1969).



p.17



-  SIKRE GYTEPLASSER Definite spawning areas
-  USIKRE GYTEPLASSER Uncertain spawning areas

Figure 6: Spawning areas for char in Katnosa.

Tagging Locations: Six spawning areas for char have earlier been located in Katnosa: Dammen, Karlsetangen, Furutangen, Fagerlivarpet, Harpelandsvika and Spålsoset (see map figure 6).

In connection with the char decimation in Katnosa, extensive investigations with echo sounder were carried out in 1967, 1968, and 1969 in the spawning period in order to locate other spawning areas ("O.F.A. News", No. 1, 1968, No. 1, 1969, and No. 1, 1970). Concentrations of fish were located in the following areas: Moldviktangen, Aklangssmalet, Breivik nord, Ørnøya, Ekornlandet, Losøya south and Stortangen (See Figure 6). These areas were at the same time fished with gillnets, but the results were quite variable. None of the locations appeared to be spawning areas of importance. Of the new localities, only Aklangssmalet and Ekornlandet yielded catches large enough so that tagging could be carried out.

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TABLE 6. Summary of Taggings and Tagging Localities.

| Locality | Carlin-tag Carlin-merket | Carlin-tag Carlin-merket | Finneklippet | |
|----------------|----------------------------------|-----------------------------|------------------------|-----|
| Lokalitet | Winter 1969-70 Vinter 1969-70 | Fall 1970 Høst 1970 | Fall 1971 Høst 1971 | Sum |
| Dammen | 0 | 62 | 4 | 66 |
| Karlsetangen | 0 | | 24 | 24 |
| Furutangen | 0 | 34 | 21 | 55 |
| Fagerlivarpet | 114 | 158 | 95 | 367 |
| Harpelandsvika | 0 | 87 | 33 | 120 |
| Spålsoset | 34 | 75 | 44 | 153 |
| Breiviktangen | 0 | 0 | 9 | 9 |
| Aklangssmalet | 2 | 16 | 5 | 23 |
| Ekornlandet | 19 | 49 | 0 | 68 |
| Stortangen | 0 | 6 | 0 | 6 |
| Total | 169 | 487 | 235 | 855 |

It can be seen that Fagerlivarpet dominate with respect to the number of fish tagged and fin clipped. This is also by far the largest spawning area in the lake.

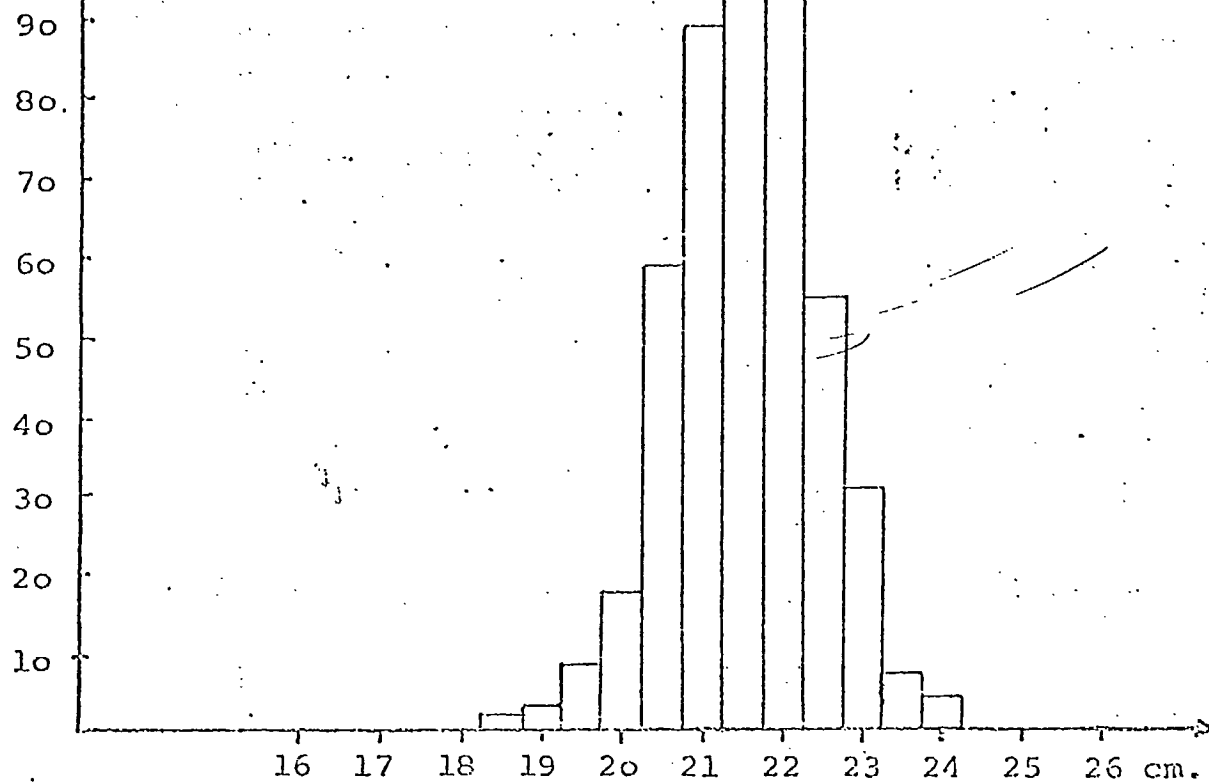
All tagging locations are assumed to be spawning areas for char for the following reasons:

1. The localities yield char catches on bottom gillnets only in the spawning period, ca. 15/10 to freeze up. p.19
2. Ca. 90% of char taken is spawning fish.
3. In all localities immature and mature char are found with recently eaten char roe in their stomachs.

Tagging Material. Among the tagged fish in the fall of 1970 there were 12 immatures. Of the spawning fish, 189 or 25.1% were females. Surplus of males is usual in catches of char at spawning time, and is probably caused by differing spawning activity by the two sexes. Figure 7 shows the length frequency distribution of char tagged in the fall of 1970. This length frequency distribution resembles that shown in Figure 3 which is assumed to be representative for the spawning fish. It is therefore assumed that a representative selection of the spawning fish population was tagged in the fall of 1970.

No lengths were measured in the 1971 fin clipping, but the gear used was the same as the year before and it must therefore be assumed that a representative material was fin clipped. There were 31 immatures in the fin clipped material, and of remainder, 45 or 22% were female.

Antall
fisk
No. of
fish



p.20

Figure 7: Length frequency distribution of char that were tagged in the period 20/10 - 5/11- 1970. Bottom gillnets.

Antall
fisk

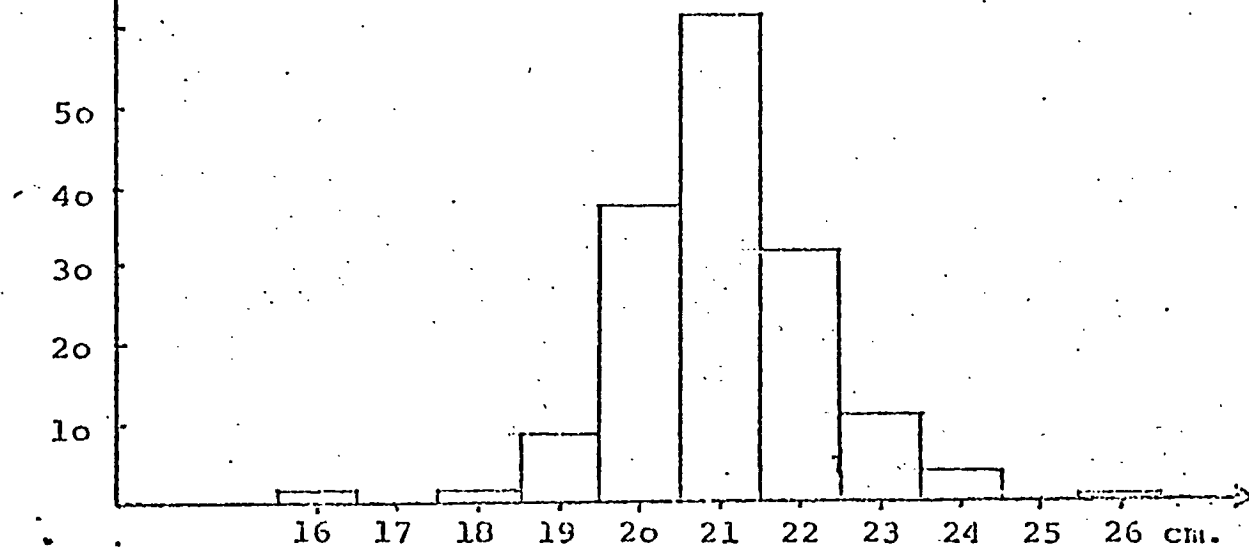


Figure 8: Length frequency distribution of char which were tagged in the period 16/12 - 1969 to 25/4 - 1970. Fishing gear: Hook and bait.

Figure 8 shows the length frequency distribution of fish tagged in the winter of 1969-70. The fish were not segregated into matures and immatures, and the sexes were not determined. It is therefore difficult to tell which part of the population was represented by this material.

Methods of Calculation. In calculating the population size I have used Petersens formula with Bailys correction (Ricker 1958)

$$\hat{N} = \frac{M(C+1)}{R+1}$$

\hat{N} = Stock size

M = Number of fish tagged

C = Total catch after tagging

R = Number tagged in total catch.

95% confidence interval is found by calculating 95% confidence interval for $\frac{R+1}{C+1}$ by the use of the t - distribution (Snedecor 1956).

Yearly survival rate is calculated from the following formula (Ricker 1958): p.21

$$\hat{S}_1 = \frac{R_{12} M_2}{M_1 (R_{22} + 1)}$$

\hat{S}_1 = Survival Rate

R_{12} = No. of recaptures second year of fish tagged first year.

R_{22} = No. of recaptures second year of fish tagged second year.

M_1 = No. of fish tagged in the beginning of first year.

M_2 = No. of fish tagged in the beginning of second year.

$$\text{Variance for } \hat{S}_1: V(\hat{S}_1) = \hat{S}_1^2 \cdot \frac{(M_2)^2 R_{12} (R_{12}-1)}{(M_1)^2 (R_{22} + 1) (R_{22} + 2)}$$

95% confidence interval for \hat{S}_1 then becomes: $\hat{S}_1 \pm 2 \sqrt{V(\hat{S}_1)}$

RESULTS AND DISCUSSION

p.22

A. Timing for Zone Formation in Otoliths

Nordeng (1961) showed that otoliths indicated correct ages for char in Salangen Lake. It is reasonable to assume that this is also the case for my material if the otoliths form definite yearly winter zones. An indication of the otoliths being formed yearly is given by looking at the character of the edge of otoliths taken at various times of the year. Table 7 shows the edge character of otolith material taken spring-fall-winter, 1971. The terminology is in accordance with Jensen, A.C. (1965):

h = small hyaline zone at the edge

H = wide hyaline zone at the edge

o = small opaque zone at the edge

O = wide opaque zone at the edge

TABLE 7. Character of the Edge of Otoliths From Char Caught Throughout the Year 1971

| | | No. of Fish | h | H | o | O | %h | %H | %o | %O |
|---------|-------|-------------|-----|----|----|----|-----|----|----|----|
| | | Ant. fisk | | | | | | | | |
| Winter | | | | | | | | | | |
| Vinter: | Jan. | 9 | 9 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| Vår | May | 49 | 0 | 46 | 3 | 0 | 0 | 94 | 6 | 0 |
| Spring | June | 110 | 0 | 95 | 15 | 0 | 0 | 86 | 14 | 0 |
| | Sept. | 68 | 51 | 0 | 0 | 17 | 75 | 0 | 0 | 25 |
| Høst | Oct. | 104 | 98 | 0 | 0 | 6 | 94 | 0 | 0 | 6 |
| Fall | Nov. | 150 | 150 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |

In January it was noted that all the otolith sample material had a narrow hyaline edge. In May most of them had a definite hyaline edge (winter zone), and a few had started to form opaque material outside. In June there is an increase in otoliths with opaque material at the edge, i.e. a beginning summer zone formation. Samples from July were unfortunately missing, but samples taken in September show that ca. 25% has a broad zone on the outside. However, most of them (75%) show a slight hyaline deposit outside the opaque. Later in the fall the hyaline formation on the edge becomes more noticeable, and in November all otoliths again have hyaline material on the outside.

p.23

These data indicate that the hyaline zones are yearly occurrences in the otoliths, and that they are formed in the period October - November/ May.

B. The Relationship Between Otolith Radius and Fish Length

Figure 9 shows the relationship between otolith radius b and fish length. The fish length is measured in centimetres, otolith radius is a relative number. All fish within each half centimetre are pooled together, and the corresponding average value for otolith radius is drawn as a dot. Standard deviation is shown as vertical columns on each side of the average value. Smallest and largest otolith radius within each length group is marked with a vertical line. The number of observed data within each length group is indicated under the points of the curve. The abscissa values often deviate somewhat from whole and half centimeters; this is caused by the fact that I have used weighted mean values, i.e. I calculated the actual average value within each half centimetre group and used this as the abscissa value.

The curve gives an indication of linear regression between otolith radius and fish length. The linearity is especially noticeable between 20 and 23.5 cm where we can find most of the values.

Lorenz (1928) published a method to calculate linear regression lines from a cluster of points by the use of the least square method. It is also possible to calculate a coefficient (k) as a measure of the correlation between the point cluster and regression line (Snedecor, 1956). This coefficient varies in actual fact between 0 and 1, where 1 indicates total correlation, i.e. that all points are located on the regression line. When $k = 0$ the cluster of points describe an approximate circle, and we have no linear correlation. The equation for the regression line and the coefficient for linear correlation was calculated on the basis of data from each individual fish in the data material. The calculations were carried out with the use of a computer:

Regression line: $y = -7.1 + 2.4 X$

p.25

Linear correlation coefficient: $k = 0.86$

A linear correlation coefficient of 0.86 could be said to indicate a usable linear correlation between the point cluster and the regression line, since it is taken into consideration that the material consists of fish within a narrow range of lengths (14.5 - 26.5 cm). If the average values (curve points) are used as a basis for the correlation calculation, a linear correlation coefficient, $k = 0.99$, is obtained. This clearly gives a basis for saying that the points on the curve describes a straight line. These results give reason to claim the following that applies to char between 14.5 and 26.5 cm.

1. The length of the fish and the otolith radius exhibit a linear regression.
2. The relationship between otolith radius and fish length is described by the equation: $y = -7.1 + 2.4 X$ where y is variable for otolith radius and x is variable for fish length.

C. Calculated Fish Length

The regression line between otolith radius and fish length does not go through the origin, but intercepts the X - axis at point (1.8, 0) (Figure 9). The relationship between otolith - radius and fish length does not become directly proportional for that reason. Lea-Dahls (1910) formula for back-calculating lengths must therefore be used in its modified form (Lee 1920):

$$ln - C = \frac{On}{O} (1-C)$$

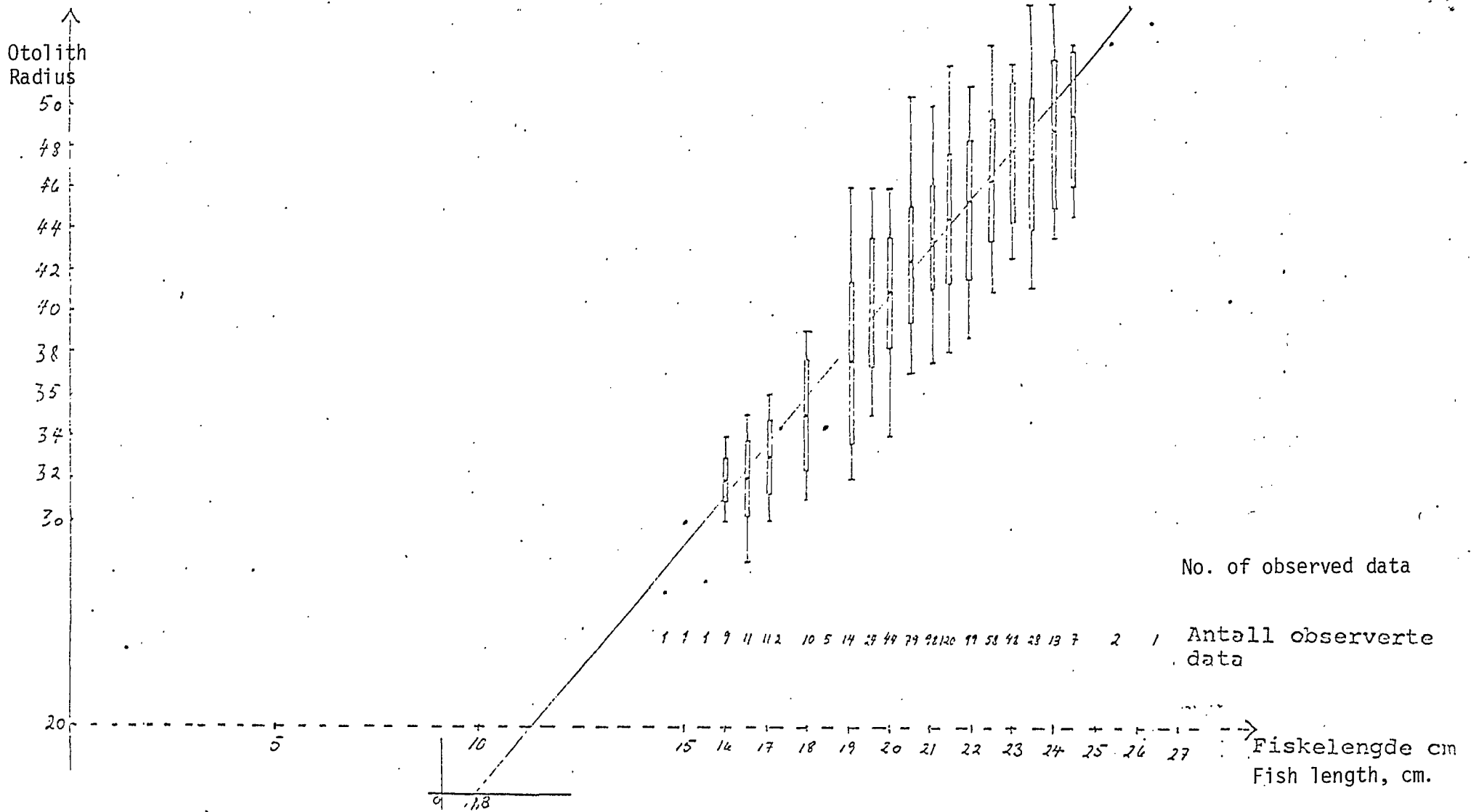


Fig.9: Forholdet mellom otolitradius og fiskelengde. (Grunnlinjen er flyttet opp av plasshensyn.)

Figure 9. Relationship between otolith radius and fish length (the x-axis is moved up for space reasons).

Where - C = the intercept of the regression line with the abscissa
 l_n = length of the fish when the winter zone was formed
 l = fish length when the otolith sample was taken
 O_n = distance from center to the winter zone in the otolith.
 O = total otolith radius.

Figure 10 shows regression curves between calculated fish lengths and age (growth curve) for the year classes 1964-1968. The regression line between otolith radius and fish length (Figure 9) that the length calculations are based on, has only been shown to apply for fish between 14.5 and 26.5 cm. It follows that the length calculations on Figure 10 must be considered to be uncertain below age 3. p.26

Figure 10 shows that the younger year classes show better growth than the older. The differences are in some cases considerable. For instance, if we consider the length of the fish at the start of the fourth winter, it can be seen that the 1968 year class averaged 20 cm, while the 1964 year class on an average was only 17 cm at the same age. This is a difference of as much as 15%. It can also be seen that the 1968 year class reached a length of ca. 17 cm one year earlier than the 1964 year class.

Figure 10 does not only mean that the char have improved their growth rates in recent years. Growth curves that show better growth for younger year classes in relation to older, is a phenomenon which is commonly observed in growth calculations of fish. The phenomenon is called Lees phenomenon (Lee 1912). Many explanations have been suggested

(Van Oosten 1929, Jones 1958, Smith 1956 and Taylor 1958). It is probably a number of factors that apply in each case. The following factors are considered to be most plausible:

1. Selective catch of sample material: The fishing method can influence the selection of the largest and fastest growing individuals in the younger year classes.
2. Wrong method for back calculating length: One can for instance have assumed a linear regression between otolith - (scale) - radius and fish length where the regression line is really curved. Otherwise, the calculations could have been based on direct proportionality between fish length and otolith - (scale) - radius where it would have been more correct to use Lees correction.
3. Selective natural mortality: Fast growing fish can have higher mortality than slower growing fish. p.28
4. Selective mortality due to fishing: The slower-growing fish can have avoided the fishing gear through a longer period than the fast growing. This will lead to a predominance of slower growing fish among the older year classes.

Avoidance of selective catch (factor no. 1) has been attempted by using gillnet series with varying mesh sizes (see chapter "Materials and Methods". A. Collection). There is therefore reason to believe that factor no. 1 has not been decisive in my case.

Wrong method in back calculating (factor no. 2) should not have had a decisive influence on the result. It has been shown that a linear

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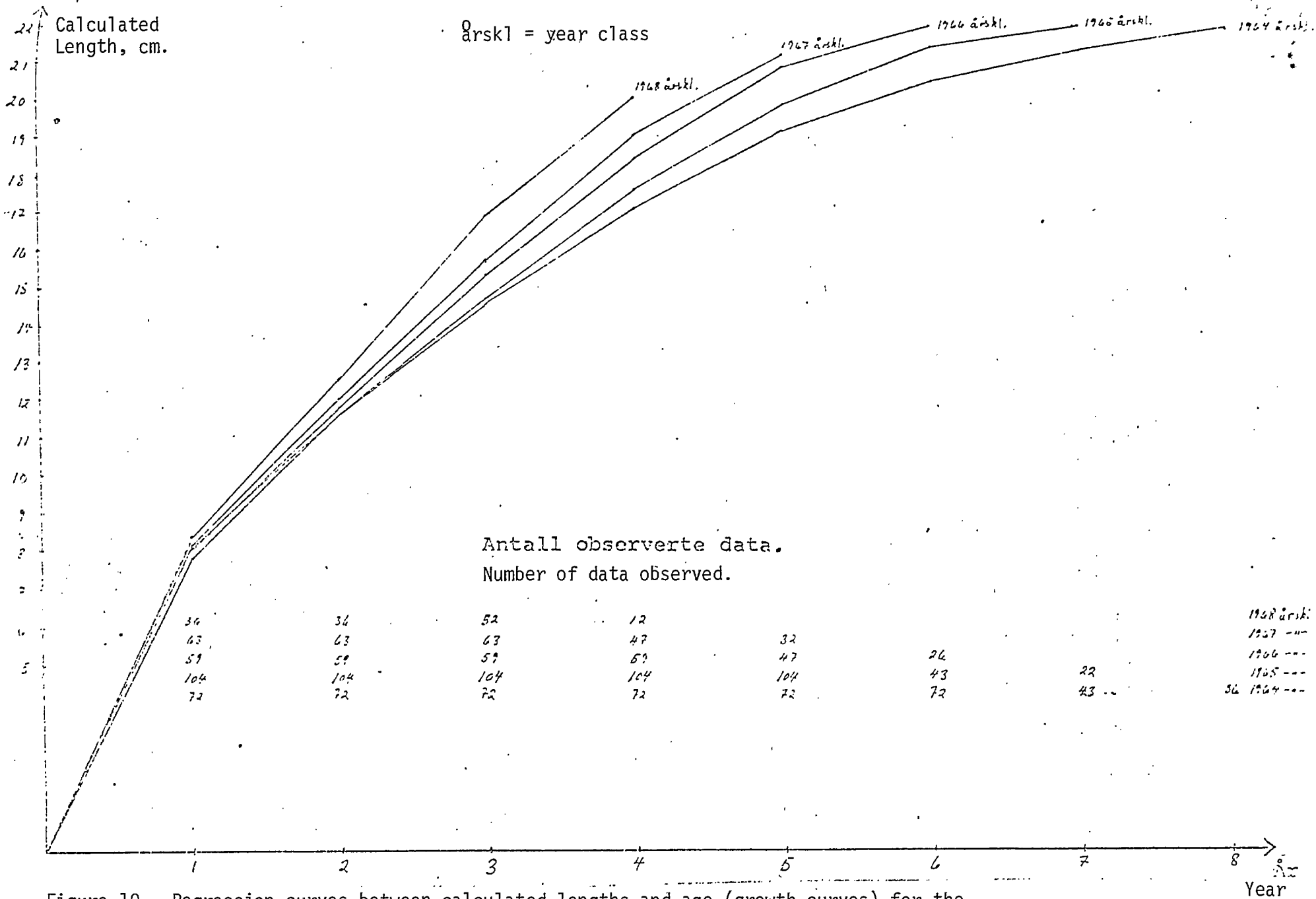


Figure 10. Regression curves between calculated lengths and age (growth curves) for the year classes 1964-1968.

regression is valid between otolith radius and fish length (page 23 in original). It has also been shown that the calculations should be carried out according to the Lea-Dahl method with Lees correction (page 25). The last points on the growth curves in Figure 10 are average lengths for fish caught in October/November 1971. It can be seen from the curves that for instance 5, 6 and 7 year olds respectively are approximately the same length when caught. This should show that Lee's phenomenon is demonstrated without the length calculation method having influenced the result.

With regards to selective natural mortality (factor No. 3) it is difficult to evaluate this factor. But it should not be excluded as a possible explanation for the observed growth phenomenon in Figure 10.

Factor no. 4, selective mortality due to fishing, must in this case be assumed to be an important reason for the growth curves obtained as shown in Figure 10. The decimation fishery for char in the spawning period which has been carried out since 1967, and which is still being carried out, has chiefly been carried out with nets of a certain mesh size, 24 mm (26 omf). It is therefore reason to assume that this fishing method represents a selection of fast-growing individuals, but it should not be excluded that the growth curves in Figure 10 reflects a real relationship in the population. This means that the char have achieved higher growth rates in the last few years. Table 8 shows the average lengths of char caught in the decimation fishery 1967-72. Average catch per net-night for each year is also included. (The information is taken from "OFA News", no. 1, 1968; no. 1, 1969, no. 1, 1970; no. 1, 1971; and no. 1, 1972. The information for 1972 is personal information from Mr. Rikvald Hansen.)

g. 3 per

p.29

TABLE 8. Average length for fish in the catches, and average number of fish caught per net-night in the decimation fishery for char in Katnosa 1967-72. In 1967 fish lengths were measured from the tip of the nose to the longest part of the tail fin with the tail fin held together. The other measurements were carried out with the tail fin in natural position.

| Year År | Average Length Gj.sn. lengde | Average No. of fish caught per net-night Gj.sn. antall fisk fanget pr. garnnatt |
|------------|---------------------------------|--|
| 1967 | 21,39 | Ukjent |
| 1968 | 19,10 | 6,60 |
| 1969 | 21,35 | 13,00 |
| 1970 | 21,54 | 12,60 |
| 1971 | 22,19 | 9,04 |
| 1972 | 22,47 | 8,70 |

It can be seen from the table that the average lengths for fish in the catches have increased from year to year.

Average number of fish caught per net-night has varied somewhat, but it must be made clear that these values have been strongly influenced by other conditions such as weather, temperature, water level, etc. From 1969 - 1972 a definite decline in the average number of fish per net per night can be observed. This decline has occurred in spite of the increasing experience of fishermen and better knowledge of good net fishing areas.

These results seem to indicate that the decimation fishery has contributed to a reduction of the population. This has probably contributed to increased food availability for individual fish to such extent that the growth rate has been affected.

D. Spawning Age

p.30

Otoliths from sexually mature char often show a varying number of narrow, hyaline summer zones out towards the edge. Nordeng (1961) found that these were spawning zones, i.e. zones which were formed after the fish had reached maturity. Between the wide, inner summer zones and the narrow spawning zones, a medium width summer zone is usually found. This means that it is formed during the summer in the year the fish spawns for the first time (Figure 11).

Table 9 shows otolith material from 407 char caught in the falls of 1970 and 1971 in Katnosa. (Fall-caught char is shown because spawners can be separated from non-spawners with more confidence at this time.) Otoliths from spawning fish are listed in the left column, A. Otoliths from non-spawners are listed in the right column, B. The otoliths were classified in 4 groups:

1. The otolith clearly shows one or more spawning zones, the maturing zone is clear (Figure 11).
2. The otolith shows one or more spawning zones, smooth transition between immature zones and spawning zones, the maturing zone is therefore difficult to determine (Figure 12).
3. No spawning zones in the otolith. Last summer zone clearly narrower than the next-to-last zone (Figure 13).

4. No spawning zones in the otolith. Last summer zone not narrower than next-to-last (Figure 14).

TABLE 9. Zone Types in Otoliths From Char Caught in Katnosa in the Fall of 1970 and 1971.

| | | A. | | B. | |
|----------------------------|------------------------------|----------|------|--------------|------|
| | | Spawners | | Non-Spawners | |
| One or more spawning zones | | No. | % | No. | % |
| I ell. fl. gytesoner | 1. Certain maturing zone | 185 | 66,9 | 20 | 20,8 |
| | 2. Uncertain maturing zone | 23 | | 0 | |
| Engen | 3. Last summer zone - narrow | 93 | 33,1 | 13 | 7,2 |
| | 4. Last summer zone - wide | 10 | | 11 | |
| No spawning zone | | Total | | 96 | 100 |

Before I discuss Table 9 in total, I must comment on column 1B which shows that 20.8% of the non-spawners had clear spawning zones in their otoliths. Eleven of these fish had been tagged earlier as spawners. There is therefore reason to assume that this whole group consists of fish that have spawned earlier, but are now "resting" ("resters").

p.33

If it is assumed that column 1B represents "resters", Table 9 shows that no immature fish have formed spawning zones in the otoliths. This means that the spawning zones in the otoliths are only formed after the char have become sexually mature.

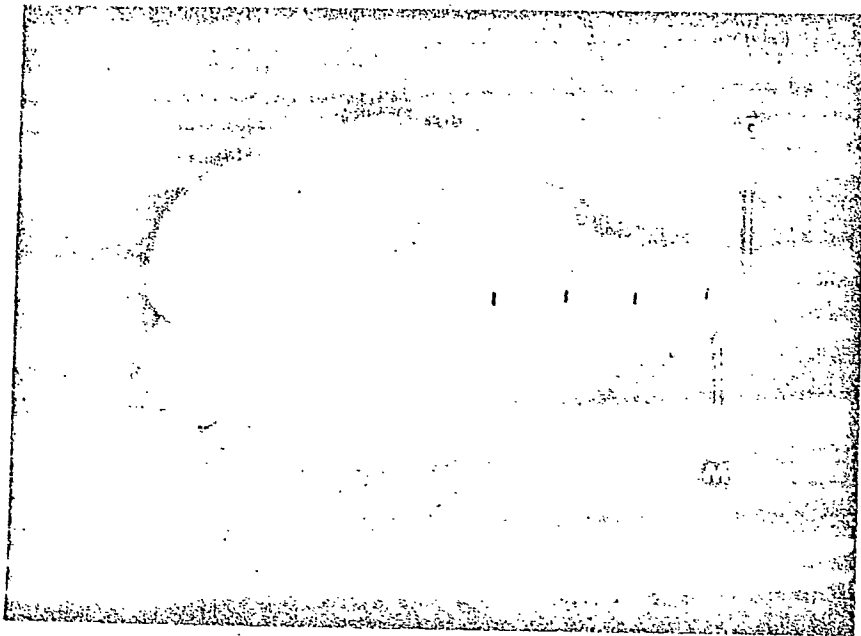


Figure 11. Otolith from 5 year old ripening char caught 16/9-1971. M is maturing zone and G is first spawning zone.

p.31

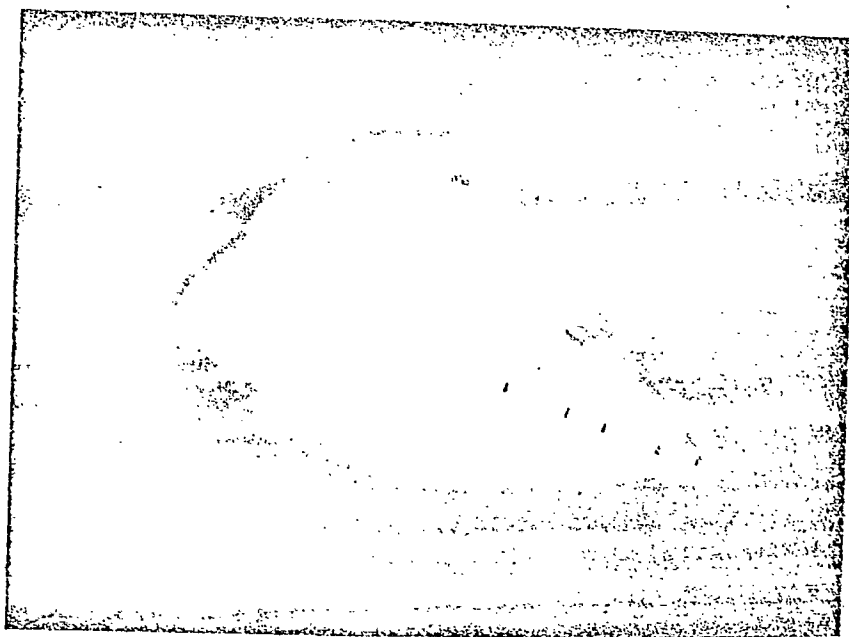


Figure 12. Otolith from 6 year old ripening char caught 14/10-1970. The three outer summer zones are approximately equally wide. It is therefore difficult to decide which zones are maturing zones and which are spawning zones.

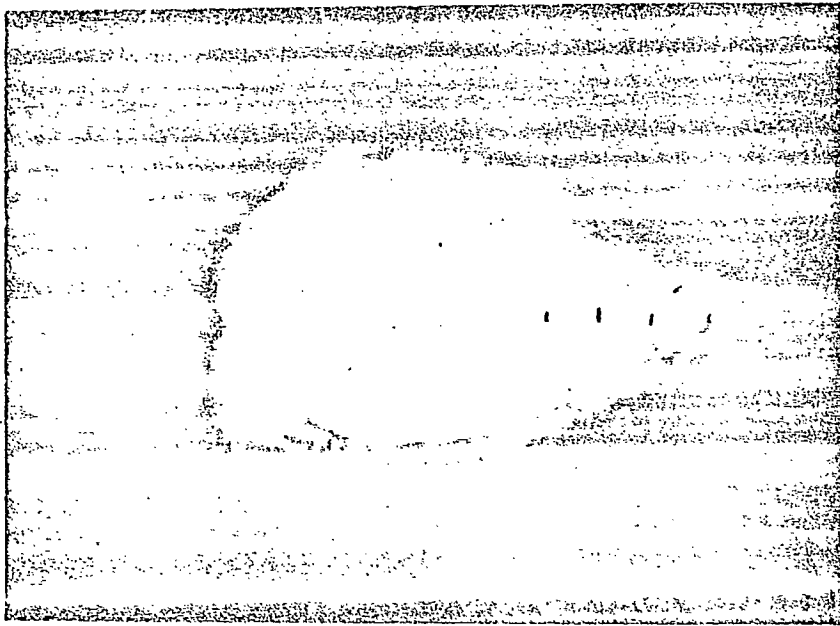


Figure 13. Otolith from five year old ripening char caught 18/10-1971. Latest summer zone is narrow.

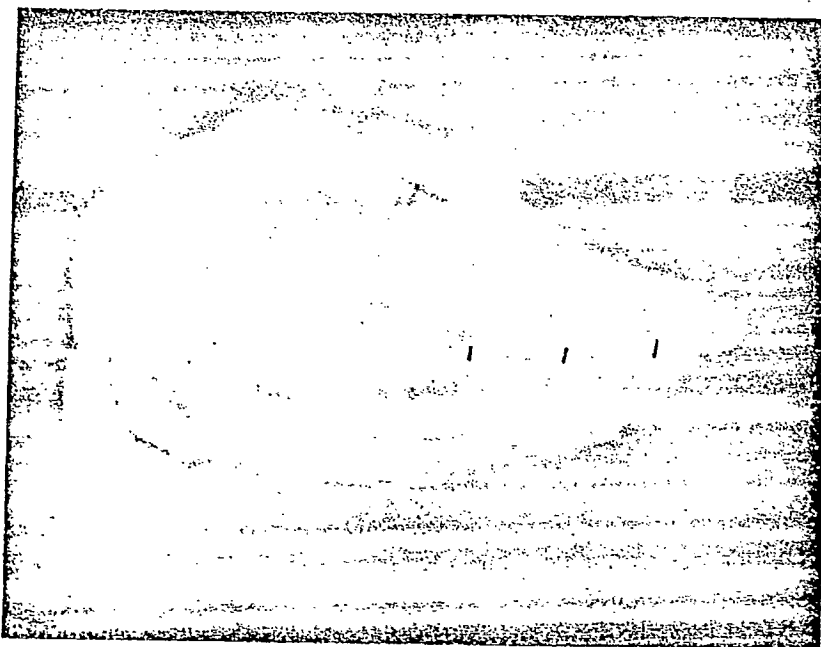


Figure 14. Otolith from three year old immature char caught 4/11-1970. Latest summer zone is wide.

Of the spawning fish that did not have spawning zones in the otoliths, most (93 fish, column 3A) exhibited a narrow past summer zone. Most of the immature fish (63, column 4B) had a wide summer zone. This indicates that these spawning fish were in the progress of forming a narrow maturing zone and were therefore first-time spawners.

The fact that some otoliths from the spawning fish (10 fish, column 4A) had wide summer zones, and some of the otoliths from the immature (13 fish, column 3B) had narrow summer zones show that the maturing zone cannot be considered to be reliable in all otoliths. This is shown clearly in column 1A where it can be seen that the maturing zone is difficult to determine in 23 otoliths.

These results show that the spawning age of the fish can often be determined from the otolith, but the zone that is formed at first spawning can in some instances be difficult to segregate. One should therefore be observant of the fact that errors can be made in reading these otoliths.

Table 10 shows at which age the spawning fish had maturing zones in their otoliths, i.e. at which age they became sexually mature. The age groups six years and older were used as basis since 100% of the fish were mature in these age groups. Fish without spawning zones in their otoliths are all interpreted as being first-time spawners. Otherwise, fish where the maturing zone in the otolith is difficult to read have been left out.

TABLE 10. Age at Formation of Maturing Zone in Otolith

p.34

| Age Group Alders- grupper | Age at formation of maturing zone. Alder ved dannelse av modningszone. | | | | | | Total | | | |
|---------------------------------|---|---|----------------------|------|----------------------|------|----------------------|------|-----|-----|
| | 3 år years No. Ant. % | | 4 år years Ant. % | | 5 år years Ant. % | | 6 år years Ant. % | | | |
| 6 år years | 0 | 0 | 69 | 36,6 | 114 | 60,2 | 6 | 3,2 | 189 | 100 |
| 7 år years | 0 | 0 | 45 | 48,5 | 44 | 47,3 | 4 | 4,2 | 93 | 100 |
| 8 år years | 0 | 0 | 9 | 53,0 | 6 | 35,0 | 2 | 12,0 | 17 | 100 |
| Total | 0 | 0 | 123 | 41,0 | 164 | 55,0 | 12 | 4,0 | 299 | 100 |

The table shows that 41% has formed maturing zones in the otoliths as four year olds, 55% as five year olds and 4% as six year olds.

These results must be interpreted to mean that char in Katnosa spawn for the first time at ages varying from 4 to 6 years. The bulk of the fish spawn for the first time as four and five year olds. A spawning age of five years seems to be somewhat more common than four years.

In order to determine if there were any differences between males and females with respect to spawning age, the average age at first spawning for both sexes was calculated. The age groups from six years and up were used as basis.

Males - 215 fish: average age at first spawning - 4.56 years

Females - 86 fish: average age at first spawning - 4.61 years.

Even if these calculations show that females are on the average slightly older than males at first spawning, the difference is far from significant. It, therefore, appears as if the sexes are not different with regard to spawning age.

E. "Resters"

In the last chapter on spawning ages, it was mentioned that 11 tagged char had been recaptured in a resting stage the fall after they had been tagged as spawners. A further nine fish were noted as non-spawners even if they showed clear spawning zones in the otoliths (Table 9). All of these nine fish were without spawning coloration and had firm belly muscles. It was therefore very little that indicated that these were fish that had spawned earlier in the fall. Of the nine non-tagged fish, five could be identified as "resters" immediately in that they had long, undeveloped gonads which obviously had been developed earlier. The other four were difficult to segregate from immature fish morphologically. Among the tagged fish there were also two fish that were difficult to segregate from the immatures. It is therefore some reason to assume that the four "uncertain" tagged fish were also "resters".

p.35

Among the 20 fish assumed to be resters, there were only two males. The sex ratio among the remaining non-spawning fish caught in the same period was 44 males and 36 females. The preponderance of females in the "rester" group was obviously not caused by a general preponderance within the non-spawning group. The material is too small to say anything for certain about the ratio males/females within the "rester" group. But there is reason to believe that the "rester" group is mainly recruited from females.

Most of the fall samples of fish were caught at spawning time on the spawning grounds. It is therefore likely that the "resters" are under-represented in the sample material in relation to the spawning fish. What part of the sexually mature individuals that are in a resting

stage is therefore difficult to determine on the basis of this material. The spawners plus "resters" total 341 individuals (321 + 20). The "resters" then comprise ca. 6% of the sexually mature individuals in the sample material. It can therefore be assumed that at least 6% of the sexually mature fish have resting years. If we study the sample material caught in floating gillnets in the fall of 1971, it can be found that the spawners and "resters" total 47 fish (42 + 5). This means that the "resters" total ca. 10% of the sexually mature individuals in the sample material. This material should be more representative, but it is too small to give a reliable picture of the corresponding ratios in the population as a whole.

I have not found publications that shed any more light on the occurrence of "resters" in land-locked char. But it is commonly assumed that char very rarely have resting years (Aass 1968). The results from Katnosa Lake seem to indicate that a minimal number of the sexually mature char have resting years. The real number could possibly be around 10%. This seems to be high as compared with the numbers generally accepted.

p.36

F. Age Frequency Distribution

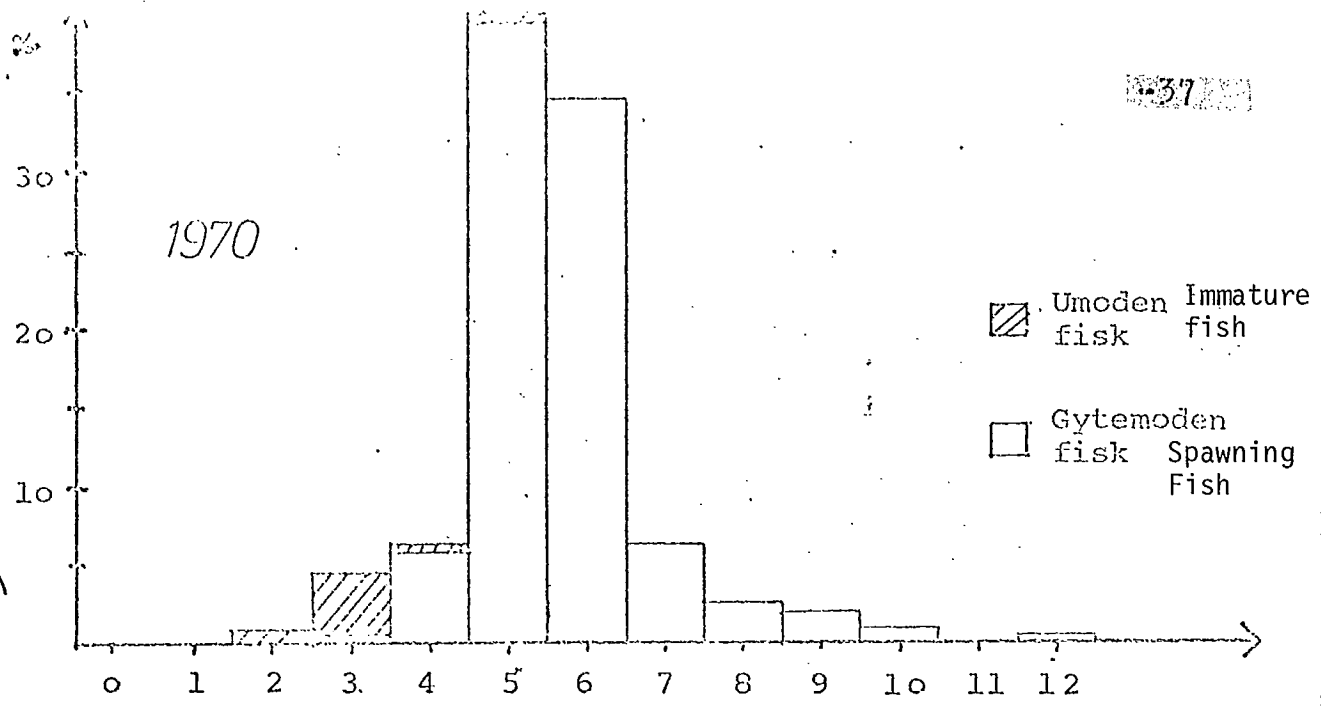
How representative is the age frequency distribution? Figure 15A and Figure 15B show the age distribution of char caught with bottom gillnets during the spawning periods 1970 and 1971. Figure 15C shows the age frequency distribution of char caught in floating gillnets fall-spring 1971. Age is indicated along the abscissa, frequency (% of total catch) along the ordinate.

The age frequency-distribution for fish caught during spawning time (Figures 15A and 15B) is dominated by spawning fish and is not representative of the whole char population.

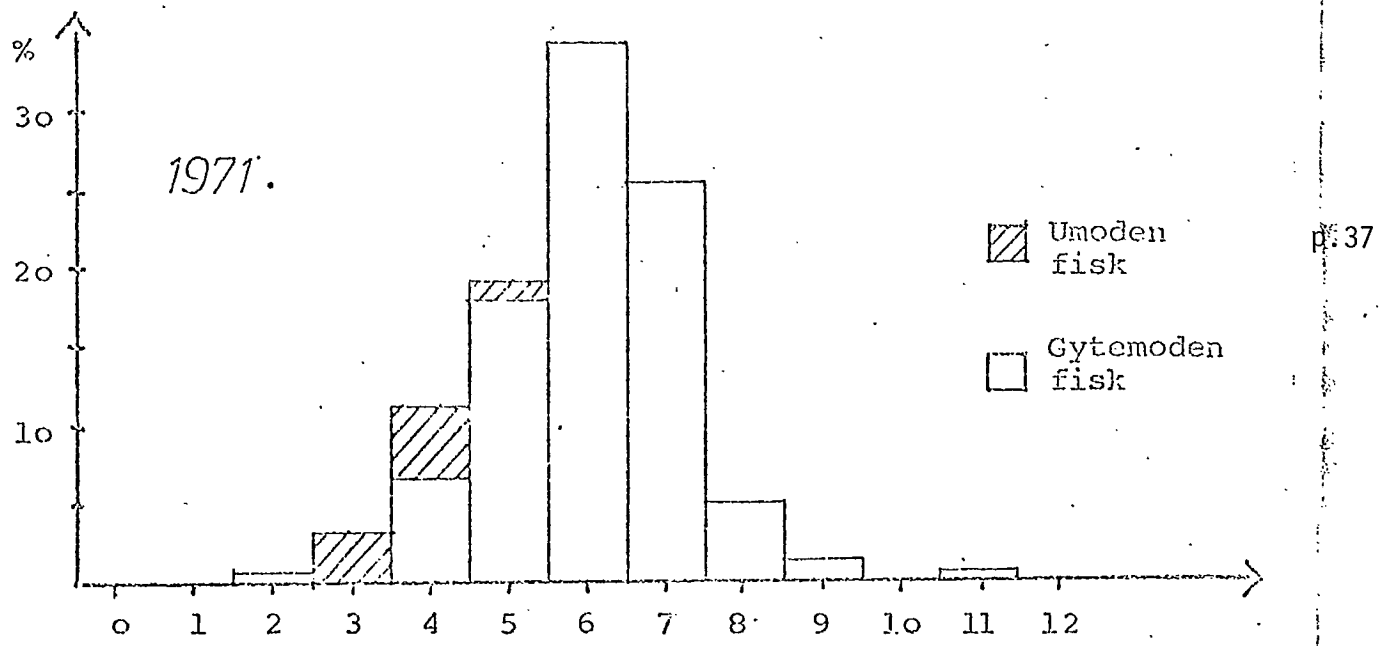
It can be seen that the spawning fish exhibit a nearly identical age distribution in the floating- and bottom net catches from 1971. That two different catching methods will give similar results at different times can be taken as an indication that the result is representative. Therefore, the age-frequency distribution for spawning fish caught in bottom nets and floating nets is representative.

In the floating net catches (Figure 15C) it can be seen that the four year olds occur in larger numbers than the three year olds, which again are more numerous than the two year olds. The annual mortality should mean that younger fish should occur in larger numbers than older fish. It is therefore obvious that the age frequency distribution for fish caught in floating nets (Figure 15C) is not representative of the immature fish population. A probable reason for this can be found by looking closer at Figure 2 in the chapter "Materials and Methods". It can be seen here that fish between 15 and 18.5 cm have been caught only in nets of 16 mm mesh size. Fish above this size show a tendency to be caught in nets of varying mesh sizes. This means that fish above 18.5 cm length have been subjected to higher catch intensity than fish below this size. All two year olds, most three year olds (80%) and some four year olds (19%) were under 18.5 cm when caught. Many two year olds had not yet grown to catchable size. (They occur for instance only in the fall catches.) From this it can be concluded that the younger year classes have been under-represented in the floating net catches, and that Figure 15C therefore does not give a representative picture of the relative strengths of age groups for fish under five years old. p.38

A



B



C

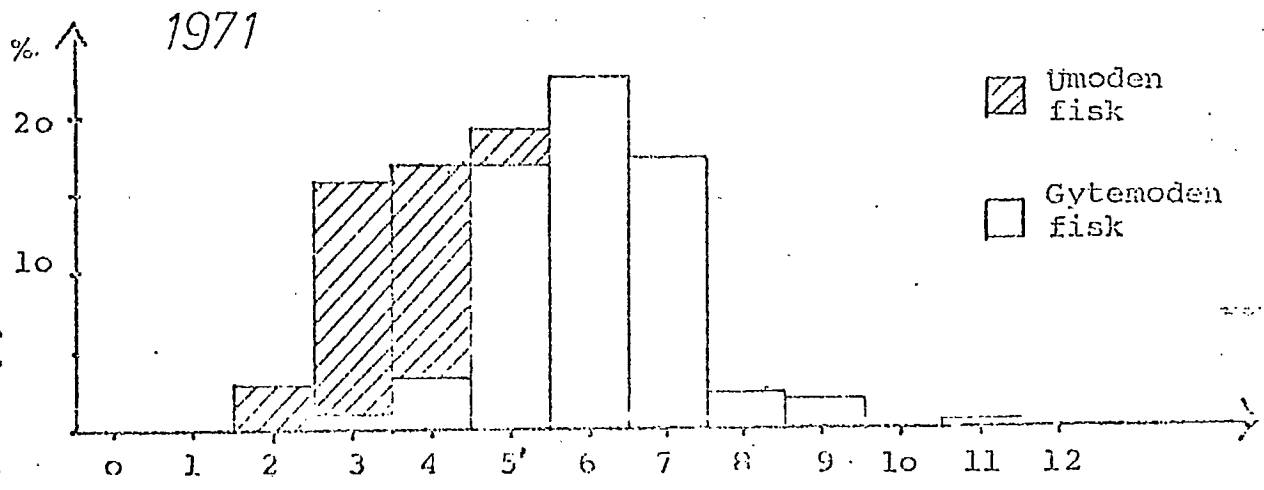


Figure 15. A: Age frequency distribution of char caught in bottom nets at spawning time 1970. B: Age frequency distribution of char, caught in bottom nets at spawning time 1971. C: Age frequency distribution of char caught in floating nets 1971.

Sexual Maturity: Figures 15A, 15B and 15C (especially Figure 15C) show that sexually mature fish occur from age groups three years and up. Among the age groups over five years old there are no immature fish. This indicates that sexual maturity occur at ages from 3 to 6 years. This is in accordance with what I found out by analyzing spawning zones in otoliths (Table 10).

p.38
cont'd.

Year Class Dominance: The spawning fish caught in 1970 (Figure 15A) were dominated by the age groups 5-6 years. In 1971 (Figure 15B and 15C) the age groups 6-7 year old dominated among the spawning fish. It therefore appears that the year classes born in 1964 and 1965 were more numerous than the year classes born before and after. Year class variations seem to be common in char found in regulated waters (Aass 1964 and 1965). The reasons can be complicated, but it is reasonable to believe that various degrees of lowering the water level in winter contribute to a considerable degree to uneven recruitment (Aass 1964, Dahl 1933). The degree of water regulation varies from winter to winter. The spawning areas in Katnosa seem to be quite shallow; from 2 to 8 m. under highest water level. It is therefore reasonable to assume that some spawn and larvae could have been exposed to air in some winters. Table 11 shows water level measurements about November 1 and March 15 of each year in the period 1962 - 1972. The water level measurements on November 1 are taken when char spawning is underway. The water level measurements on or about March 15 are chosen because hatching is estimated to begin in this period (Aass 1964, Dahl 1933). The data were obtained from Oslo Municipal Forest Management Council.

TABLE 11. Water Level Measurements From Katnosa in the Period 1962-1972

| | Ca. 1/11 | Ca. 15/3 | | Ca. 1/11 | Ca. 15/3 |
|---------|----------|----------|---------|----------|----------|
| 1962/63 | 5,0 | 2,9 | 1968/69 | 5,78 | 5,46 |
| 1963/64 | 5,56 | 5,00 | 1969/70 | 3,93 | 1,98 |
| 1964/65 | 5,97 | 4,06 | 1970/71 | 5,71 | 5,37 |
| 1965/66 | 5,10 | 3,59 | 1971/72 | 5,03 | 2,93 |
| 1966/67 | 5,10 | 4,62 | 1972/73 | 5,55 | — |
| 1967/68 | 6,25 | 4,72 | | | |

The most favorable spawning areas are located between depths 4 and 2, i.e. from 2-4 m under highest water level (6). By looking at Table 11 it is seen that spawn could have been exposed in the winters of 1962/63, 1965/66, 1969/70 and 1971/72. The lowering of the water level is assumed to have had little effect in the winters of 1963/64, 1964/65, 1966/67, 1967/68, 1968/69 and 1970/71. It can be seen that the 1964 and 1965 year classes probably had more favorable conditions during hatching than both the 1963 and 1966 year classes. This agrees well with observations from the age frequency distributions shown in Figures 15A, 15B, and 15C, where the 1964 and 1965 year classes seem to dominate in relation to the 1963 and 1966 year classes. There is probably reason to assume that the lowering of water levels that occur some winters could have some influence on the recruitment of char.

G. Stock Size

Tagging by adipose fin clipping in the period 19/10 - 30/10, 1971, and recaptures in the period 31/10 - 20/11, 1971, will form the basis for calculations on the size of the char population.

Taggings and recaptures on a scale sufficient to be used in calculations on stock size of the char population, could only be carried out in the actual spawning period. Both the tagged and the captured fish were therefore mainly spawning fish. In the stock calculations only spawning fish were used, and the estimate will therefore only indicate the size of the spawning population.

p.40

Assumptions for Using the Petersen Method: The Petersen method which the calculations are built on, is purely a statistical method. By using the method on living material, certain assumptions must be made if the results are to be reliable. The most important assumptions are as follows (Ricker 1958):

1. The mortality for tagged fish must be the same as for non-tagged fish in the period between tagging and recapture.
2. Catchability for tagged fish must be the same as for non-tagged fish. (For instance: The tagging method must not contribute to the fish being easier caught in nets.)
3. Loss of tags must not occur in the period between tagging and recapture.
4. All recaptures must be reported.
5. Recruitment to the catchable part of the population must be small during the recapture period.

6. Tagged fish must distribute themselves evenly among the non-tagged fish.

These assumptions are difficult to fulfill completely, and I will in the following evaluate to which extent our tagging experiments did fulfill these assumptions.

Re no. 1 above: Clipping of the adipose fin of salmonids has been shown to cause negligible mortality (Eschmeyer 1959, Stauffer and Hansen 1969, Shetter 1951). A possible difference in mortality between tagged and non-tagged char will in addition have very little effect due to the short period between tagging and recapture.

Re no. 2: It must be assumed that the catchability of the fish in gillnets is not changed by clipping the adipose fin.

Re no. 3: Loss of tags in the meaning of the word will not occur when fish are tagged by fin clipping. A possible "camouflage" of the tagging as a result of the fin growing out is not possible due to the short period between tagging and recapture.

Re no. 4: All catches in the spawning period were checked by Mr. Björn Erik Edvardsen and myself. Each fish was thoroughly checked in order to make sure that no tagged fish were missed.

p.41

Re. no. 5: Ordinary recruitment by fish growing to catchable size was excluded in our tagging experiments which only included spawning fish. One should be observant of the fact that the fish were only catchable in the period they were on the spawning grounds. This special case

could give rise to errors if for instance tagged char finished spawning, disappeared from the spawning grounds and could not be caught again later in that spawning period. Wrong results could also occur if new spawning fish move on to the spawning grounds in the recapture period and later.

Table 13 shows recaptures in the period 31/10-20/11 - 1971. The table also shows the total catch of spawning fish and the calculated percentage of recaptures for each fishing day.

TABLE 13. Summary of recaptures of fish in total catches in the period 31/10 to 20/11 -1971. The fish were fin clipped 19/10 to 30/10 the same year.

| Date | 31/10 | 1/11 | 2/11 | 3/11 | 5/11 | 7/11 | 8/11 | 9/11 | 10/11 | 13/11 | 20/11 |
|-------------|-------|------|------|------|------|------|------|------|-------|-------|-------|
| Total Catch | 203 | 221 | 85 | 107 | 112 | 104 | 76 | 65 | 73 | 106 | 134 |
| Recaptures | 7 | 9 | 4 | 2 | 5 | 10 | 2 | 2 | 3 | 1 | 5 |
| Re cap % | 3,45 | 4,07 | 4,70 | 1,87 | 4,46 | 9,64 | 2,63 | 3,08 | 4,12 | 0,95 | 3,73 |

It can be seen from the table that the recapture percentage is relatively stable around 3-5% with the exception of the days 3/11 (1.87%), 7/11 (9.64%) and 13/11 (0.95%). This stability in recapture percentages indicates little movement to and from the spawning population in the recapture period. A steady movement to and from the spawning fish after tagging would necessarily have resulted in a decrease in recapture percent.

The sample material does not permit any closer assessment of this question, but the result gives us reason to assume that recruitment and removal in the spawning period does not occur to any great extent.

The assumptions in No. 1-5 all seem to be fulfilled in this tagging experiment, and these will therefore play a minor role as sources of error in calculating the size of the population.

p.42

Re No. 6: It is difficult to evaluate if tagged fish distribute themselves among the non-tagged fish. As we are working with living animals, one must count on a certain uncertainty around this point. It can therefore be necessary with a further commentary to this assumption.

Table 12 shows tagging localities with the number of ready to spawn char that were tagged in the period 21/10-26/10-1970 in addition to recapture localities and also the numbers recaptured in the period 27/10-6/11 in the same year. The numbers in parenthesis under Fagerlivarpet refer to the fishery by O.F.A. which was carried out only at this spawning area in 1970 because of the ongoing tagging experiments. The other numbers refer to our own catches. Our catch effort was approximately equal on all spawning areas. Karlsetangen and Dammen are combined since char from these two spawning areas were not separated during tagging. In order to make the summary easier to read, a frame has been drawn around the recaptures made on the same spawning areas where they were tagged.

The table shows that the recaptures were made on several spawning areas. A total of 91 char were recaptured; of these 45 (49.5%) were recaptured on the spawning ground where they were tagged, while 45 (50.5%) were recaptured on other spawning grounds.

These results show that char tagged on certain spawning grounds distribute themselves to a certain extent to other spawning areas. However, the distribution does not seem to be random, in that half of all the recaptured char in the table were recaptured on the spawning ground where they were tagged.

As a conclusion, it must be assumed that there is some migration of ready-to-spawn char between various spawning areas, but the bulk seems to remain in one area.

The stationary tendency in the spawning period will, to a considerable degree, contribute to an uneven distribution of tagged fish among the whole spawning population. This fact will naturally be compensated for by having the tagging and following recaptures spread as much as possible to all spawning areas. The degree of compensation is difficult to estimate and there will therefore always be doubt about the even distribution of tagged fish among non-tagged. In our case, newly discovered spawning areas could for instance lead to incorrect population estimates.

Differing catchability for males and females; influence on population estimates: From the catches in the spawning period it was experienced that females were less catchable than males. The catchability of males appeared to increase somewhat later in the spawning period. I will in the following evaluate the consequences this may have for the population calculations. In order to illuminate the problem, I will use two examples. In both examples, I assume a population of N fish, where M were tagged and C fish were caught after the tagging period. Males and females are assumed to occur in the ratio 1:1 in the population in both cases. In example A it is assumed that males and females are

TABLE 12. Summary of char tagged in the spawning period 21/10 to 26/10-1970 and recaptures in the period 27/10 to 6/11 the same year. (The numbers in brackets are recaptures that were taken during fishery by O.F.A., the other recaptures are taken during our own fishery. The numbers in frames represent fish which were caught on the same locality as tagged.)

| Lokalitet Locality | NERISET TAGGED | RECAPTURED GJENFANGET | | | | | | Sum | |
|---|--------------------------------------|-----------------------|-----------------|--------------------|------------------|----------------|------------------|-------|----|
| | Number Antall merket Tagged | Karlset.- Dammen | Furu- tangen | Fagerli- varpet | Harpel.- vika | Spåls- oset | Ekorn- landet | Total | □ |
| Furu-tangen- varpet | 59 | 7 | 0 | (7) 1 | 2 | 1 | 0 | 18 | 7 |
| Furu-tangen | 30 | 1 | 0 | (7) 1 | 2 | 0 | 0 | 11 | 0 |
| Fagerli-varpet | 42 | 0 | 0 | (13) 6 | 1 | 1 | 0 | 21 | 19 |
| Støtu på Fagerliv., sløppen v/Dammen | 24 | 3 | 0 | (3) 0 | 1 | 0 | 0 | 7 | 3 |
| Harpelandsvika | 44 | 0 | 0 | (3) 1 | 11 | 1 | 0 | 16 | 11 |
| Spålsoset | 49 | 1 | 0 | (4) 2 | 1 | 5 | 0 | 13 | 5 |
| Ekornlandet | 30 | 0 | 0 | (4) 0 | 1 | 0 | 0 | 5 | 0 |
| | | | | | | | Sum | 91 | 45 |

equally catchable. In example B the ratio between males and females in the tagging period is M , and the corresponding ratio in the recapture period is N . In both examples a theoretical recapture is calculated by the help of the Peterson method. In example A the population is estimated to be homogeneous so that males and females can be combined in the calculations.

It can be seen that the calculated recapture in example B deviates from the calculated recapture in example A by a factor:

$$2 \cdot \frac{MN + L}{(M + 1)(N + 1)}$$

This factor will vary between 1 and 2 if N and

M vary between 1 and ∞ . This means that the recapture rate observed if males and females have different catchability, is always greater than the recapture achieved if males and females are equally catchable. If a population calculation is carried out on a population with differing catchability for males and females without taking this into consideration, a recapture rate which is too high to give a correct result will be observed. This means that the population is underestimated. In such cases the observed recaptures: $\left[\frac{MC}{N} \cdot 2 \frac{MN + 1}{(M + 1)(N + 1)} \right]$ through multiplication with the factor $\frac{(M + 1)(N + 1)}{2(MN + 1)}$ are converted to the recaptures that will give correct result in the population calculation. In this way it becomes possible to use the whole sample material without dividing it up and calculate males and females separately. This corrective method is dependent on an estimation of N and M . The statistical uncertainty of this estimation will add an extra uncertainty to the population estimate.

EXAMPLE A

Males and females are equally catchable in the tagging and recapture periods.

Total population = N

Number tagged = M

Catch = C

Calculated recaptures of tagged fish (R) from Peterson's formula.

$$R = \frac{M \cdot C}{N}$$

EXAMPLE B

p.45

The ratio between males and females in the catches in the tagging period is $M:1$. In the recapture period the ratio is $N:1$.

$$\text{Total Population} = N \begin{cases} \rightarrow N_{\sigma} = \frac{N}{2} \\ \rightarrow N_{\text{f}} = \frac{N}{2} \end{cases}$$

$$\text{Number tagged} = M \begin{cases} \rightarrow M_{\sigma} = M \cdot \frac{m}{m+1} \\ \rightarrow M_{\text{f}} = M \cdot \frac{1}{m+1} \end{cases}$$

$$\text{Catch} = C \begin{cases} \rightarrow C_{\sigma} = C \cdot \frac{n}{n+1} \\ \rightarrow C_{\text{f}} = C \cdot \frac{1}{n+1} \end{cases}$$

Calculated recaptures of tagged fish (R) from Peterson's formula:

$$R = R_{\sigma} + R_{\text{f}}$$

$$R = \frac{\left(M \cdot \frac{m}{m+1}\right) \left(C \cdot \frac{n}{n+1}\right)}{\frac{N}{2}} + \frac{\left(M \cdot \frac{1}{m+1}\right) \left(C \cdot \frac{1}{n+1}\right)}{\frac{N}{2}}$$

$$R = \frac{MC}{\frac{N}{2}} \left[\frac{m \cdot n}{(m+1)(n+1)} + \frac{1}{(m+1)(n+1)} \right]$$

$$R = \frac{MC}{N} \cdot 2 \frac{mn+1}{(m+1)(n+1)}$$

Table 14 shows a daily summary of the relationship between males and females during the spawning period 1971. On the basis of this table, I have roughly indicated the 95% confidence interval for N and M by setting it equal to $\pm 2X$ standard error for individual observation of M and N. It is difficult to calculate standard error for N and M directly due to the fact that the individual observations have been made on the basis of different numbers of fish. I have made a rough approximation by dividing up each day's samples in portions of 34 fish. (The average for October 22 which was calculated from 106 fish, has for example been counted three times in the calculation, while the average for October 20 which was calculated from 30 fish, has been used once etc.). The calculations yield $\bar{n} = 2.7$ and $\bar{m} = 2.3$. The 95% confidence interval is in both cases ± 0.2 .

p.47

Calculations of Population Size: Table 15 shows a summary of taggings, catches and recaptures of spawning fish in the spawning period 1971. The results in the table will form the basis for the population estimates.

TABLE 15. Summary and Results from Tagging Experiments in the Spawning Period 19/10 to 20/11 - 1971

| | Number Tagged | Number Caught | Number Recaptured |
|------|---------------------------|---------------------------|---------------------------|
| | M | C | R |
| | Antall merket 19/10-30/10 | Antall fanget 31/10-20/11 | Antall gjenf. 31/10-20/11 |
| ♂♂ | 147 | 892 | 42 |
| ♀♀ | 57 | 394 | 8 |
| Tot. | 204 | 1286 | 50 |

TABLE 14. Daily summary of the ratio of males to females in the tagging and recapture periods 1971.

| Dato | Merkeperioden Tagging Period | | | | | | | | | | | | Recapture Gjenfangstperioden Period | | | | | | | | | | |
|-------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------|------|------|------|------|------|------|------|-------|-------|-------|
| | 19/10 | 20/10 | 21/10 | 22/10 | 23/10 | 24/10 | 25/10 | 26/10 | 27/10 | 28/10 | 29/10 | 30/10 | 31/10 | 1/11 | 2/11 | 3/11 | 5/11 | 7/11 | 8/11 | 9/11 | 10/11 | 13/11 | 20/11 |
| Totalfangst | 73 | 30 | 31 | 106 | 40 | 99 | 101 | 149 | 234 | 194 | 32 | 123 | 203 | 222 | 85 | 107 | 112 | 104 | 76 | 65 | 73 | 106 | 124 |
| M | 61 | 22 | 35 | 77 | 32 | 71 | 68 | 110 | 169 | 139 | 62 | 91 | 142 | 155 | 70 | 73 | 79 | 70 | 48 | 40 | 50 | 76 | 89 |
| F | 12 | 8 | 26 | 29 | 8 | 28 | 33 | 39 | 65 | 55 | 20 | 37 | 61 | 67 | 15 | 34 | 33 | 34 | 28 | 25 | 33 | 30 | 45 |
| M/F | 5,1 | 2,8 | 2,1 | 2,7 | 4,0 | 2,6 | 2,1 | 2,8 | 2,6 | 2,5 | 3,2 | 2,4 | 2,3 | 2,3 | 4,5 | 2,2 | 2,4 | 2,1 | 1,7 | 1,6 | 2,2 | 2,5 | 2,0 |

$\bar{n} = 2,7$ (stand.feil 0,1. 95% konf.interv.= 0,2)

$\bar{m} = 2,3$ (stand.feil 0,1. 95% konf.interv.=0,2)

$\bar{n} = 2.7$ (standard error 0.1. 95% confidence interv. = 0.2)

With these results as listed there are three possibilities for calculating the total population of spawners:

p.47
Cont'd.

1. Calculate the population for males and females separately and sum up.
2. Calculate the population for males and assume that the total population to be the double of this, assuming the number of males to be equal to the number of females.
3. Calculate the population directly by using the numbers for total number tagged and caught, but use a theoretically calculated recapture as earlier explained. (The theoretically calculated recapture will in this case be 42.5 with ± 1 as confidence interv.) This method also assumes that the number of males equals the number of females in the population.

These two methods of calculation assume there are as many males as females in the population. There is reason to believe that the last few years' decimation fishery where more males are taken, could have influenced the sex ratio, so that there are now more females. This must therefore be counted as a possible source of error in the last two methods of calculation.

p.48

Table 16 shows population estimates calculated by these three methods. Included in these estimates are 1,271 spawning fish, 927 males and 344 females, which were caught during the fall of 1971 before the recapture period started.

TABLE 16. Petersen Estimates of the size of the char population (spawning fish) in Katnosa. (1,271 spawning fish, 927 males and 344 females, which were caught in the fall of 1971, before the recapture period is added to the calculated population in each case).

| | Lower Limit for 95% Confidence Interval | Best Estimated Value | Upper Limit for 95% confidence Interval |
|--|---|----------------------------|--|
| | Nedre grense for 95% konfidens- intervall | Beste estimerte verdi | Øvre grense for 95% konfidens- intervall |
| Bestand ♂♂ Population | 3298 | 3980 | 5251 |
| Bestand ♀♀ Population | 1844 | 2846 | 7469 |
| Best. ♂♂ + best. ♀♀ population | 5142 | 6826 | 12720 |
| 2 x Best. ♂♂ | 6596 | 7960 | 10502 |
| Hele best. bereg- net direkte ved bruk av en teo- retisk utregnet gjenfangst | 5907 | 7275 | 10141 |

Whole pop. calc. direct
by use of theor. calc.
recapt.

The confidence intervals in Table 16 show that the population of males is much better estimated than the population of females. This is, of course, due to the fact that the sample material for females that the calculations are based on is much smaller than the material for males. The whole population is therefore estimated better by taking 2X the population of males, than by adding the male and female population.

It can be seen that the estimate found by taking 2X male population checks well with the estimate found by direct calculation. From these two estimates the spawning population can be roughly estimated to be 7-8,000 fish, with 95% statistical probability for the numbers being between ca. 6,000 and 10,500.

In evaluating the estimated spawning population, the non-
statistical sources of error that can have affected the results must
be taken into consideration. The effects of these sources of error are
impossible to quantify. One must be satisfied to evaluate in which direc-
tion the various sources of error will affect the population estimates.
I have earlier mentioned some possible sources of error and two of these
must be assumed to be of special importance.

p.49

1. Since the tagged fish are spawning fish and are therefore largely stationary in the period between tagging and recapture, non-discovered spawning areas could have resulted in tagged fish not being evenly distributed between the non-tagged. In such case the spawning population would have been underestimated.
2. Since the last few years' spawning fishery has taken mostly males, it is likely that there is now a surplus of females in the population. The methods of calculation that I have used will, in such case, lead to an underestimate of the population.

These sources of error give reason to believe that a spawning population of 7-8,000 char can be a somewhat low estimate.

The population estimate of spawning fish excludes the year classes younger than three years, most three year olds, some 4 year olds and a few five year olds (see Figure 15, page 37 in original).

Catches and recaptures in the ice fishery could form the basis for a population estimate which applies to a larger part of the population. Our own experiences have shown that the ice fishery yield catches of fish from ca. 16 cm and up. This means that three winter old fish and older are caught in this fishery. A population estimate on this basis must therefore be roughly assumed to apply for fish that are three years and older.

Table 17 gives a summary of char tagged in the spawning period 1970, and subsequent catch and recaptures in the ice fishery during the winter of 1970-71. The information is given by ice fishermen at our request.

TABLE 17. Number of Char Tagged 1970 and Total Catch and Recaptures in the Ice Fishery in the Winter of 1970/71.

| Tagged Fall 1970 | Total Catch Winter 1970/71 | Recaptured Winter 1970/71 |
|------------------|-------------------------------|------------------------------|
| 438 | 880 | 25 |

Table 18 gives a population estimate with 95% confidence interval p.50 calculated from the material in Table 17,

TABLE 18. Population Estimate Calculated From Data in Table 17

| Lower Limit 95% Confidence Interval | Best Estimated Value | Upper Limit 95% Confidence Interval |
|--|-------------------------|--|
| 11,231 | 15,420 | 25,765 |

The estimate in Table 18 must be considered to be uncertain, since there is a large difference between upper and lower limits for the 95% confidence interval (27,765-11,231).

Systematic sources of error that must be taken into consideration in evaluating this estimate are as follows:

1. Increased mortality of tagged fish as a result of the tagging method.
2. Loss of tags in the period tagging - recapture.
3. It is very uncertain if the tagged fish have distributed themselves among the non-tagged.
4. It is likely that the fishermen that did not have any recaptures, have not reported as well as the fishermen that had recaptures.
5. It is possible that the fish that had spawned are feeding more actively than the immature fish, and are therefore caught easier.

Of these sources of error, nos. 1 and 2 will result in an over-estimated population. Nos. 4 and 5 will result in an underestimated population. Source no. 3 could move the estimate in both directions. It is difficult to say how important the various sources of error are, and since their effect is unknown, the estimate must be considered to be very uncertain.

H. Mortality

The tagging that was carried out in the spawning period 20/10 to 5/11-1970 and the tagging 19/10 to 30/10-1971 for the basis for an estimate of total annual mortality for the sexually mature char population. The procedure used is described in the chapter C, "Materials and Methods". The method calculates the survival rate from the end of the first tagging period to the end of the last tagging period, in this case from 5/11-1970 to 30/10-1971. p.51

Table 19 gives a summary of the numbers tagged in 1970 (M_1) and 1972 (M_2) and the recaptures of these (R_{12} and R_{22}) in the recapture period 31/10-20/11-1971. The calculated survival rate (s_1) with standard deviation and 95% confidence interval is also included in the table.

TABLE 19. Survival Rates Calculated from Taggings and Recaptures in 1970 and 1971.

| | |
|----------|--|
| M_1 | = No. of fish tagged in the fall of 1970 (20/10-5/11) |
| M_2 | = No. of fish tagged in the fall of 1971 (19/10-30/10) |
| R_{12} | = Recaptures of 1970-tagged fish in 1971 (31/10-20/11) |
| R_{22} | = Recaptures of 1971-tagged fish in 1971 (31/10-20/11) |
| S_1 | = Survival rate from 5/11-1970 to 30/10-1971 |

95% confidence interval is estimated to

$S_1 \pm 2 \times$ standard deviation.

| M_1 | M_2 | R_{12} | R_{22} | S_1 | St. Deviation | 95% Conf. Interval |
|-------|-------|----------|----------|-------|---------------|--------------------|
| 427 | 204 | 48 | 42 | 0.53 | 0.09 | 0.35 - 0.71 |

From the table it can be seen that the rate of surviving spawning fish from 5/11-1970 to 30/10-1971 is estimated to be 0.53 or 53%. The confidence interval is sufficiently wide (0.35-0.71) that one must count on a certain statistical uncertainty.

Mortality sources that can have affected the population in the period where the estimated S_1 applies, are the following: Natural mortality, mortality from the ice fishery in the winter of 1970-71, mortality from the floating gillnet fishery in 1971, mortality from the spawning fishery before 31/10-1971. In an estimate over yearly survival rate, it would also be natural to consider mortalities due to the rest of the spawning fishery after 30/10-1971. This can easily be done since we know the degree of exploitation in this fishery which can be estimated

by:
$$\frac{R_{22}}{M_2} = \frac{50}{204} = \frac{1}{4}$$

This means that 3/4 of the spawning fish present survived the last part of the spawning fishery in 1971. The total survival rate is therefore $0.53 \times \frac{3}{4} = 0.40$. This means that the total mortality among spawning fish in the period 5/11-1970 to 20/11-1971 is 0.60 or 60%.

The systematic sources of error that can have influenced the estimate are the following:

1. In 1970 the fish were tagged with Carlin tags. The tagging in 1971 was carried out by clipping the adipose fin. It is reasonable to believe that fish with Carlin tags are easier caught in gillnets than the fin clipped fish. Accumulated Carlin-tagged fish in relation to

fin-clipped fish in the recaptures in 1971 will result in the survival rate being overestimated. This source of error will be somewhat modified by the fact that the floating gillnet fishery and the spawning fishery before 31/10-1971 probably has represented a higher mortality for tagged fish than for untagged fish; something that will contribute to give an underestimated survival rate.

2. Spawning fish that are going into a rest year, will to a lesser degree be caught in the next spawning period. This will lead to the survival rate being somewhat underestimated.

3. Different catchabilities for males and females in the spawning period will also affect the calculations for survival rate. It is chiefly males that were caught and tagged and also recaptured. For that reason the calculated survival rate will be most representative for the males in the population. However, it must be assumed that the survival rate for females is somewhat higher due to lower catchability during the spawning fishery. The females that have been tagged, will, due to lower catchability, lead to the estimated S_1 being further underestimated. It is therefore good reason to assume that the lower catchability of females will lead to an underestimated survival rate.

Of these three sources of error, I consider 1 and 3 as being the most important. These sources of error will contribute to pulling the results in each direction, and it is difficult to say what the resultant effect will be. However, I believe that no. 3 in this case is of greatest importance. It is therefore a certain possibility that the survival rate is somewhat underestimated. This is the same as saying that the mortality rate is overestimated. The mortality (60%) can therefore be estimated as being somewhat too high.

I. Exploitation

The char population in Katnosa is chiefly exploited through ice fishing in the winter and gillnet fishery by O.F.A., in the spawning period. In the summer there is practically no exploitation.

Table 20 gives the results from the O.F.A. char fishery 1967-1972.

TABLE 20. Yield from the O.F.A. Char Fishery 1967-72

| | Number of Fish | |
|------|----------------|---------|
| | Antall fisk | kg./ha. |
| 1967 | 1055 | 0,49 |
| 1968 | 1328 | ca.0,60 |
| 1969 | 1846 | 0,78 |
| 1970 | 2014 | 1,01 |
| 1971 | 3073 | 1,56 |
| 1972 | 3003 | 1,61 |

It can be seen from the table that the yield has increased for each year from 0.49 kg/ha in 1967 to 1.61 kg/ha in 1972.

In the winter of 1970-71, I estimate that ca. 2,500 fish were caught by ice fishermen. This number is estimated from counting ice fishermen and from catch statistics from a few. The yield from the ice fishery corresponds to ca. 1 kg/ha. The fishing intensity in the ice fishery appears to have been constant in the last few years, and it is therefore possible that the yield can have been in the range of 1 kg/ha for several winters.

It can be seen that the ice fishery has given a total yearly yield of over 2 kg/ha after 1970. In 1971 and 1972 it can be estimated that the yield has been ca. 2.5 kg/ha. For comparison, the yearly yield of char in the Tunhovd Fjord was estimated to be 2.1-2.6 kg/ha. This yield is among the highest registered in a regulated lake in this country (Aass 1967). In Katnosa there are char together with healthy populations of perch, whitefish and a smaller population of trout. In the Tunhovd Fjord, the char dominate and the only other species is a small trout population. It is known that the production of a fish species is greatest if that species is alone or together with at the most one other species (Carlander 1955).

It is therefore reason to assume that the production of char in Katnosa will be less than in Tunhovd Fjord. A yearly yield of 2.0-2.5 kg/ha in Katnosa must therefore be assumed to represent a high rate of exploitation.

SUMMARY

The study was carried out in Katnosa Lake in Nordmarka near Oslo, (60°9'N and 10°34'E). Age, growth, sexual maturity, resting frequency, population size, mortality and exploitation of char was investigated.

The study material consisted of 708 char which were caught in the period between 2/5-1970 and 20/11-1971. The fishing method was bottom gillnets, floating gillnets and hook and bait. In the winter of 1969-70 a total of 169 char were tagged with Carlin tags. A further 487 were tagged with Carlin tags in the fall of 1970. In the fall of 1971 a total of 235 char were tagged by clipping the adipose fin.

The otoliths were used for age determination. Studies of the character of the edge of the otoliths throughout the year 1971 showed that an opaque and a hyaline zone were deposited in the span of year.

A linear regression between otolith radius and fish length was established (Regression line $y = 7.1 + 2.4X$).

Growth curves for various year classes which were based on back-calculated lengths, clearly showed Lees phenomenon. Selective mortality due to fishing was assumed to be the probable reason for the phenomenon. It is also possible that the growth curves show an actual situation, i.e. that the growth rate has improved over the past few years.

Age of first spawning was determined by the help of the zone in the otolith indicating sexual maturity. The results showed that most of the char in Katnosa became sexually mature at 4-5 years of age. No difference in spawning age between males and females was found. At least 6% of the sexually mature char had a "rest" year. Females dominate among the "resters".

The age frequency distribution for fish caught in 1970 and 1971 showed that the 1964 and 1965 year classes were dominating. A correlation between the degree of lowering of the lake in the winter and recruitment of char was indicated.

In the population calculations, it was shown that the observed recaptures give an underestimated population size when using Petersens formula, if males and females exhibit different catchabilities. This would be corrected by multiplying the observed recaptures by

$$\frac{(M + 1) (N + 1)}{2(MN + 1)} \quad (M = \text{ration males/females in the tagging period};$$

$N = \text{ration males/females in the recapture period.})$

The spawning population was estimated to ca. 8,000 individuals.

Total yearly mortality for spawning fish in 1970-71 was estimated to be ca. 0.60.

The yield of char in Katnosa was estimated to be ca. 2-2.5 kg/hectare in the years 1970-72.

- Brøgger og Shetelig. 1923. Geologisk oversiktskart over
Krisianiafeltet. Norges geologiske undersøkelser 1923.
- Carlander, K.D. The standing Crop og Fish in Lakes. J. Fish. Res.
Bd Can. 12, 534 - 570.
- Carlin, B. 1955. Tagging of salmon smolts in the river Lagan.
Rep. Inst. Freshwat. Res. Drottningholm 36, 57 - 74.
- Dahl, K. 1910. The age and growth of salmon and trout in Norway,
as shown by their scales. Salmon and trout Association,
London.
- Dahl, K. 1917. Studier og forsøk over ørret og ørretvann. Fiskeri-
inspekt. innberetn. 1917.
- Dahl, K. 1933. Vassreguleringsens virkninger på fisket i innsjøer.
J.W. Cappelens forlag 120 s.
- De Roche, S.E. 1963. Slowed Growth of Lake Trout Following
Tagging. Trans. Am. Fish. Soc. 92, 185 - 186.
- Eschmeyer, P.H. 1959. Survival and retention of tags, and growth
of tagged lake trout in a rearing pond. Progve Fish Cult.
21, 17 -21.
- Jensen, A.C. 1965. A standard terminology and notation for
otolith readers. ICNAF Res. Bull. 2, 5 - 7.
- Jones, R. 1958. Lee's phenomenon of "apparent change in growth
rate" with particular reference to haddock and plaice.
Spec. Publ. int. Comm. N.W. Atlant. Fish. 1, 229 -
242.
- Lea, H. 1910. On the methods used in herring investigations.
Publ. Counc. Cons. mar. int. Exton. Mon. 53.

- Lee, R.M. 1912. An investigation into the methods of growth determination in fishes. Publ. Circ. Cons perm. int. Explor. Mer 63, 34p.
- Lee, R.M. 1920. A review of the methods of age and growth determinations in fishes by means of scales. Fishery invest. Lond. Ser. 2, 4, 2, 32p.
- Lindstrøm, T., Å. Fagerstrøm og K.J. Gustavson. 1970. Fishing pressure, growth and recruitment in a small high mountain lake. Rep. Inst. Freshwat. Res. Drottningholm 50, 100 - 132.
- Lorenz, P. 1928. Der Trend Vierteljahreshefte zur Konjunkturforschung, Sonderhefte 9.
- Møller-Cristensen, J. (M S 1961) Survey of the Danish sole tagging experiments with notes on the growth rate. Cons. perm. int. Explor. Mer, Near Northern Seas Comm., 1961 meeting, Rep. No. 126, 14 p.
- Nordeng, H. 1961. On the biology of char (Salmo alpinus L.) in Salangen, North Norway. Nytt Mag. Zool. 10, 67 - 123.
- Ricker, W.E. 1958. Handbook of computations for biological statistics of fish populations. Bull. Fish. Res. Bd Can. 119, 300 p.
- Shetter, D.S. 1951. The Effect of Finremoval on Fingerling Lake Trout Trans. Am. Fish. Soc. 80, 260 - 277.
- Smith, M.V. 1957. Comparative Survival and Growth of Tagged and Untagged Brook Trout. Can. Fish Cult. 20, 1 - 6.
- Smith, S.H. 1956. Life history of lake herring of Green Bay, Lake Michigan Fishery Bull. Fish Wildl. serv. U.S. 57, 87 - 138.

- Snedecor, G.W. 1956. Statistical methods. 5th ed. The Iowa State University Press. 585 p.
- Stauffer, T.M. and M.J. Hansen. 1969. Mark Retention, Survival and growth of Jaw tagged and Fin clipped Rainbow Trout. Trans. Am. Fish. Soc. 98, 225 - 229.
- Taylor, C.C. 1958. A note on Lee's phenomenon in Georges Bank haddock. Spec. Publ. int. Commn. NW. Atlant. Fish. 1, 243 - 251.
- Van Oosten, J. 1929. Life history of the lake herring (Leucichthys artedii LeSueur) of Lake Huron, as revealed by its scales, with a critique of the scale method. Bull. Bur. Fish Wash. 44, 265 - 448.
- Aass, P. 1964. Reguleringer og røyerekuttering. Jakt fiske og friluftsliv. 1964. nr. 9, 378 - 381.
- Aass, P. 1965. Rødingvandring i Pålshufjord og Tunhovdfjord. Informasjon från Sötvattenslaboratoriet Drottningholm. 1965. nr. 4.
- Aass, P. 1970. The Winter Migrations of Char, Salvelinus alpinus L., in the Hydroelectric Reservoirs Tunhovdfjord and Pålshufjord, Norway Rep. inst. Freshwat. Res. Drottningholm 50, 5 - 44.

LITERATURE

- Brøgger and Shetelig, 1923. Geological map of the Oslo area. p.57
Norwegian Geological Investigations 1923.
- Dahl, K. 1917. Studies and experiments on trout and trout lakes.
Fisheries Inspection Reports 1917.
- Dahl, K. 1933. The effect of water level regulation on the fishery in
lakes. J. W. Cappelen Publishers 120 p.
- Aass, P. 1964. Regulations and char recruitment. Hunting, Fishing p.59
and Outdoor Life. 1964, No. 9, 378-381.
- Aass, P. 1965. Char migrations in Pølsbufjord and Tunhovdfjord. Infor-
mation from Fresh Water Laboratory Drottningholm, 1965, No. 4.

PRIMERTABELL 7. Gjennomsnittlig otolittradius (radius c) for fisk i lengdegruppene
 14,5 - 25 cm. Antall observasjoner og standardavvik for observasjonene
 er også tatt med.

Primary Table 1. Average otolith radius (radius C) for fish in the length groups 14.5-25 cm.
 The number of observations and standard deviations for the observations are
 also included.

| | 14,5 | 15 | 15,5 | 16 | 16,5 | 17 | 17,5 | 18 | 18,5 | 19 | 19,5 | 20 | 20,5 | 21 | 21,5 | 22 | 22,5 | 23 | 23,5 | 24 | 24,5 | 25 cm |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Average Otolith otolith rad. radius | 26,6 | 30,0 | 27,0 | 31,9 | 32,0 | 33,0 | 34,5 | 35,1 | 34,3 | 37,6 | 40,5 | 40,9 | 42,5 | 43,6 | 44,6 | 45,3 | 46,3 | 47,7 | 47,4 | 48,8 | 49,5 | 53,0 |
| Standard Deviation | - | - | - | 1,13 | 1,79 | 1,67 | - | 2,64 | - | 3,90 | 3,19 | 2,73 | 2,94 | 2,55 | 3,19 | 3,08 | 3,16 | 3,40 | 3,41 | 3,47 | 3,18 | - |
| obs. No. of obser- vations | 1 | 1 | 1 | 9 | 11 | 11 | 2 | 10 | 5 | 14 | 24 | 44 | 49 | 98 | 120 | 99 | 53 | 48 | 28 | 13 | 7 | 2 |

PRIMERTABELL 2. Beregnet lengde (\bar{X}) ved vinter, for årsklassene 1964 - 1968. Antall observasjoner (Ant. obs.) og standarddeviasjon for observasjonene (SDX) er også tatt med.

Primary Table 2. Calculated length (\bar{X}) in winter for the 1964-1968 yearclasses. Number of observations (No. obs.) and standard deviations for the observations (SDX) are also included.

| Year Class Årsklasse | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | | 6 | | | 7 | | | Vi |
|-------------------------|-----------|------|-----------|-----------|------|-----------|-----------|------|-----------|-----------|------|-----------|-----------|------|-----------|-----------|------|-----------|-----------|------|-----------|----|
| | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | \bar{X} | SDX | Ant. obs. | |
| 1964 | 123 | 0,56 | 36 | 125 | 0,55 | 36 | 169 | 1,05 | 32 | | | | | | | | | | | | | |
| 1967 | 141 | 0,66 | 63 | 120 | 1,03 | 63 | 157 | 1,10 | 63 | 190 | 1,32 | 47 | | | | | | | | | | |
| 1968 | 140 | 0,55 | 59 | 118 | 0,74 | 59 | 153 | 0,70 | 59 | 184 | 1,03 | 59 | 208 | 1,13 | 44 | | | | | | | |
| 1965 | 140 | 0,58 | 104 | 116 | 0,72 | 104 | 147 | 0,86 | 104 | 175 | 1,15 | 104 | 198 | 1,11 | 104 | 213 | 1,30 | 43 | | | | |
| 1966 | 148 | 0,60 | 72 | 116 | 1,03 | 72 | 146 | 1,25 | 72 | 171 | 1,60 | 72 | 191 | 1,51 | 72 | 204 | 1,50 | 72 | 212 | 1,46 | 43 | |

PRIMERTABELL 3. Oversikt over røyer som er merket og senere gjenfanget.

Primary Table 3. Summary on char tagged and later recaptured.

| Tag. No. Merke nr. | Tagged MERKET | | | Year Ar | Recaptured and Released GJENFANGET OG SLUPPET FRI | Recaptured and Killed GJENFANGET OG DREPT | | | |
|-----------------------|------------------|--------------|------------|------------|--|--|--------------|------------|--------------|
| | Location Sted | Date Dato | Year Ar | | | Location Sted | Date Dato | Year Ar | Sex Kjønn |
| 604 | Sp | 16/12 | 1969 | | Ha | 5/11 | 1970 | ♀ | |
| 605 | " | " | " | | Sp | 22/10 | 1970 | - | |
| 607 | " | " | " | | Sp | 22/10 | 1970 | ♀ | |
| 614 | " | " | " | | Fa | 1/2 | 1970 | - | |
| 617 | " | " | " | | Fa | 31/10 | 1970 | ♀ | |
| 618 | " | " | " | | -- | 19/12 | 1971 | - | |
| 619 | " | " | " | | Ka | 25/10 | 1970 | ♂ | |
| 620 | Sp | 17/12 | " | | Sp | 1/11 | 1970 | ♀ | |
| 621 | " | " | " | | Fa | 27/10 | 1970 | ♂ | |
| 622 | " | " | " | | Ha | 27/10 | 1970 | - | |
| 642 | Fa | 17/12 | " | | Fa | 31/10 | 1970 | ♂ | |
| 644 | " | " | " | | Fu | 30/10 | 1971 | ♀ | |
| 648 | Ek | 18/12 | " | | Ek | 31/10 | 1970 | ♂ | |
| 651 | " | " | " | | Fa | 23/10 | 1970 | ♀ | |
| 658 | " | " | " | | Fa | 23/10 | 1970 | ♂ | |
| 667 | Fa | 19/12 | " | | Fa | 11/1 | 1970 | - | |
| 670 | " | " | " | | Fa | 3/11 | 1971 | ♀ | |
| 672 | " | " | " | | Fa | 5/11 | 1970 | - | |
| 674 | " | " | " | | Ha | 4/10 | 1971 | ♀ | |
| 675 | " | " | " | | Sp | 27/10 | 1970 | ♂ | |
| 677 | " | " | " | | Fa | 23/10 | 1970 | ♂ | |
| 678 | " | " | " | | Fa | 22/10 | 1970 | ♂ | |
| 679 | " | " | " | | Fa | 1/11 | 1970 | ♀ | |
| 695 | Fa | 27/12 | " | | Fa | 20/10 | 1970 | ♂ | |
| 696 | " | " | " | | Fa | 29/10 | 1970 | ♂ | |

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|-----------------|---|---|
| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^X | = | Fanget ved Fagerlivarpet utsatt ved Dammen |
| Ha | = | Harpelandsvika |
| Sp | = | Spålsoset |
| Ak | = | Aklangsmålet |
| Ek | = | Ekornlandet |
| St | = | Stortangen |

PRIMERTABELL 3 forts.
Continued

MERKET

GJENFANGET OG SLUPPET FRI

GJENFANGET OG DREPT

| nr. | Sted | Date | År |
|-----|------|-------|------|
| 667 | Fa | 27/12 | 1969 |
| 692 | " | " | " |
| 699 | " | " | " |
| 700 | " | " | " |
| 705 | " | " | " |
| 709 | " | " | " |
| 712 | Fa | 29/12 | " |
| 719 | " | " | " |
| 722 | " | " | " |
| 725 | " | " | " |
| 727 | " | " | " |
| 729 | " | " | " |
| 731 | " | " | " |
| 741 | " | " | " |
| 742 | " | " | " |
| 744 | " | " | " |
| 746 | Fa | 15/1 | 1970 |
| 750 | " | " | " |
| 759 | " | " | " |
| 764 | Fa | 19/4 | " |
| 766 | " | " | " |
| 767 | " | " | " |
| 770 | " | " | " |
| 773 | Fa | 25/4 | " |

| Sted | Date | År | Kjønn |
|------|-------|------|-------|
| Fa | 23/10 | 1970 | ♂ |
| Sp | 16/1 | 1971 | - |
| Sp | 22/10 | 1970 | ♂ |
| Fa | 30/10 | 1970 | - |
| Fu | 1/11 | 1971 | ♀ |
| Fa | 22/10 | 1970 | ♀ |
| Fa | 27/10 | 1971 | ♂ |
| Fu | 22/10 | 1970 | ♀ |
| Fa | 5/11 | 1971 | ♀ |
| Fa | 30/10 | 1970 | - |
| Fa | 20/10 | 1970 | ♀ |
| Fa | 4/10 | 1971 | ♀ |
| Fa | 24/10 | 1970 | ♀ |
| Fa | 20/10 | 1970 | ♀ |
| Fu | 29/12 | 1970 | ♀ |
| Fa | 23/10 | 1970 | ♂ |
| Fu | 8/11 | 1971 | ♀ |
| Fa | 25/10 | 1970 | - |
| Fa | 31/10 | 1970 | ♀ |
| Fa | 31/10 | 1970 | ♂ |
| Fa | 23/10 | 1970 | ♀ |
| Fu | 3/10 | 1970 | - |
| Fa | 20/10 | 1970 | ♂ |
| Sp | 23/10 | 1970 | - |

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| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^x | = | Fanget ved Fagerli utsatt ved Dammen |
| Ha | = | Harpelandsvika |
| Sp | = | Spålsoset |
| Ak | = | Aklangsmalet |
| Ek | = | Ekornlandet |
| St | = | Stortangen |

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|-----|----|-------|---|------------|
| 952 | Fa | 21/10 | " | Fa 2/11-70 |
| 953 | " | " | " | |
| 956 | " | " | " | |
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| 961 | " | " | " | |
| 962 | " | " | " | |
| 963 | " | " | " | |

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|----|-------|------|---|
| Ka | 29/10 | 1971 | ♀ |
| Fa | 27/10 | 1971 | ♂ |
| Fa | 25/10 | 1970 | ♀ |
| Fa | 29/10 | 1970 | ♂ |
| Fa | 30/10 | 1970 | ♂ |
| Fa | 30/10 | 1970 | ♂ |
| Fa | 29/10 | 1970 | ♂ |
| Fa | 27/10 | 1970 | ♂ |
| -- | 31/10 | 1970 | ♂ |

PRIMERTABELL 3 forts.

MERKET

GJENFANGET OG SLUPPET FRI

GJENFANGET OG DREPT

| Merke nr. | Sted | Dato | År |
|-----------|-----------------|-------|------|
| 1001 | Fa | 21/10 | 1970 |
| 1002 | " | " | " |
| 1003 | " | " | " |
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| 1099 | " | " | " |
| 1100 | " | " | " |
| A 88001 | Fa ^X | 21/10 | " |
| 003 | " | " | " |
| 004 | " | " | " |
| 005 | " | " | " |
| 007 | " | " | " |
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| 014 | " | " | " |
| 018 | " | " | " |
| 021 | " | " | " |
| 022 | " | " | " |
| 024 | " | " | " |

Ha 24/10-70
Fa 2/11-70
Sp 27/10-70

Ka 5/11-70

Fu 16/1-71

Ka 23/10-70
Ka 25/10-70
Ha 28/10-70, Fa 6/11-70

| Sted | Dato | År | Kjønn |
|------|-------|------|-------|
| Fu | 27/10 | 1971 | ♂ |
| Fa | 5/11 | 1971 | ♂ |
| -- | 29/11 | 1970 | ♂ |
| -- | 30/10 | 1970 | ♂ |
| Fa | 18/10 | 1971 | ♂ |
| Sp | 6/10 | 1971 | ♂ |
| Da | 3/1 | 1971 | ♀ |
| -- | 30/10 | 1970 | ♂ |
| Sp | 1/11 | 1972 | ♂ |
| Fu | 13/12 | 1970 | ♂ |
| Fu | 30/12 | 1970 | ♂ |
| Fa | 22/10 | 1971 | ♂ |
| Fa | 29/10 | 1970 | ♂ |
| -- | 30/10 | 1970 | ♂ |
| Fa | 25/10 | 1970 | ♂ |
| Fa | 27/10 | 1970 | ♂ |
| -- | 31/10 | 1970 | ♂ |
| Fa | 25/10 | 1970 | ♂ |
| -- | 30/10 | 1970 | ♀ |
| Fa | 23/10 | 1971 | ♂ |
| Fu | 20/12 | 1970 | ♂ |
| Fa | 24/10 | 1970 | ♂ |
| Fa | 29/10 | 1970 | ♂ |
| Fa | 19/10 | 1971 | ♂ |
| Ha | 28/10 | 1971 | ♂ |
| Fu | 31/10 | 1971 | ♂ |
| Fa | 24/10 | 1970 | ♀ |
| Fa | 31/10 | 1971 | ♂ |
| Ka | 19/10 | 1971 | ♂ |
| Fa | 7/11 | 1971 | ♂ |
| Fa | 2/11 | 1971 | ♂ |

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|-----------------|---|--|
| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^X | = | Fanget ved Fagerlivarpet utsatt ved Dammen |
| Ha | = | Harpelandsvika |
| Sp | = | Spålsoset |
| Ak | = | Aklangsmalet |
| Ek | = | Ekornlandet |
| St | = | Stortangen |

PRIMERTABELL 3 forts.

IKENNET GJENFANGET OG SLUPPET FRI

GJENFANGET OG DREPT

| Merke | Sted | Dato | År | Kjønn |
|---------|------|-------|------|-------|
| A 88033 | Ek | 22/10 | 1970 | ♂ |
| 834 | " | " | " | ♂ |
| 835 | " | " | " | ♂ |
| 837 | " | " | " | ♂ |
| 839 | " | " | " | ♂ |
| 840 | " | " | " | ♂ |
| 841 | " | " | " | ♂ |
| 842 | " | " | " | ♂ |
| 843 | " | " | " | ♂ |
| 845 | Fa | 22/10 | 1970 | ♀ |
| 846 | " | " | " | ♂ |
| 847 | " | " | " | ♂ |
| 848 | " | " | " | ♀ |
| 851 | " | " | " | ♂ |
| 852 | " | " | " | ♀ |
| 853 | " | " | " | ♂ |
| 857 | " | " | " | ♀ |
| 859 | " | " | " | ♂ |
| 860 | " | " | " | ♂ |
| 861 | " | " | " | ♂ |
| 862 | " | " | " | ♀ |
| 863 | " | " | " | ♂ |
| 866 | Sp | 23/10 | 1971 | ♂ |
| 867 | " | " | " | ♂ |
| 868 | " | " | " | ♂ |
| 871 | " | " | " | ♂ |
| 872 | " | " | " | ♂ |
| 873 | " | " | " | ♂ |
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| 877 | " | " | " | ♀ |
| 881 | " | " | " | ♀ |
| 885 | " | " | " | ♂ |
| 884 | " | " | " | ♂ |
| 887 | " | " | " | ♀ |
| 889 | " | " | " | ♂ |

Ha 28/10-70

Ka 5/11-70

Ha 28/10-70

Ha 28/10-70

Sp 15/1-71

Fa 5/11-70

Sp 27/10-70

| | | |
|-----------------|---|--------------------------------------|
| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^x | = | Fanget ved Fager utsatt ved Damme |
| Ha | = | Harpelandsvika |
| Sp | = | Spålsoset |
| Ak | = | Aklangsmalet |
| EK | = | Ekornlandet |
| St | = | Stortangen |

PRIMERTABELL 3 forts.

| Merkekn. | MERKET | | GJENFANGET OG SLUPPET FRI | | GJENFANGET OG DREPT | | | |
|----------|--------|-------|---------------------------|----------------------------------|---------------------|----------------------------------|------|-------|
| | Sted | Dato | Sted | År | Sted | Dato | År | Kjønn |
| A 83091 | Sp | 23/10 | Sp | 2/11-70 | Sp | 30/10 | 1971 | ♂ |
| 094 | " | " | " | " | Sp | 21/10 | 1971 | ♂ |
| 097 | " | " | " | " | -- | 31/10 | 1970 | ♂ |
| 101 | " | " | " | " | Sp | 27/10-70 | | ♂ |
| 102 | " | " | " | " | Ha | 28/10-70 | | ♂ |
| 103 | " | " | " | " | | | | ♂ |
| 104 | " | " | " | " | | | | ♀ |
| 105 | " | " | " | " | Sp | 27/10 | 1971 | ♂ |
| 109 | " | " | " | " | Fa | 5/11-70 | | ♂ |
| 110 | " | " | " | " | Ka | 2/11-70 | | ♂ |
| 116 | " | " | " | " | Sp | 27/10-70 | | ♂ |
| 117 | " | " | " | " | | | | ♂ |
| 118 | " | " | " | " | | | | ♂ |
| 119 | " | " | " | " | Sp | 1/11-70 | | ♀ |
| 124 | Ka/Da | 24/10 | Sp | 29/10-70, Sp 1/11-70, Sp 16/1-71 | Fa | 30/10 | 1970 | ♀ |
| 125 | " | " | Sp | 29/10-70, Sp 1/11-70, Sp 16/1-71 | Fa | 30/10 | 1970 | ♂ |
| 126 | " | " | " | " | Sp | 24/10 | 1971 | ♂ |
| 127 | " | " | " | " | Fa | 18/10 | 1971 | ♀ |
| 128 | " | " | " | " | Da | 18/10 | 1971 | ♀ |
| 129 | " | " | " | " | | | | ♂ |
| 130 | " | " | " | " | Ek | 3/11 | 1971 | ♂ |
| 131 | " | " | " | " | Fa | 18/10 | 1971 | ♀ |
| 132 | " | " | " | " | Da | ----- | 1971 | ♂ |
| 133 | " | " | " | " | Fu | 19/10 | 1971 | ♂ |
| 134 | " | " | " | " | | | | ♀ |
| 135 | " | " | " | " | Ka | 5/11-70 | | ♂ |
| 136 | " | " | " | " | Ka | 26/10-70, Fa 2/11-70, Fa 5/11-70 | | ♂ |
| 137 | " | " | " | " | | | | ♂ |
| 138 | " | " | " | " | | | | ♂ |
| 139 | " | " | " | " | | | | ♂ |
| 140 | " | " | " | " | | | | ♀ |
| 141 | " | " | " | " | | | | ♂ |
| 142 | " | " | " | " | | | | ♂ |
| 143 | " | " | " | " | | | | ♀ |
| 144 | " | " | " | " | | | | ♂ |
| 145 | " | " | " | " | | | | ♂ |
| 146 | " | " | " | " | | | | ♂ |
| 147 | " | " | " | " | | | | ♀ |
| 148 | " | " | " | " | | | | ♂ |
| 149 | " | " | " | " | | | | ♂ |
| 150 | " | " | " | " | | | | ♂ |
| 152 | " | " | " | " | | | | ♀ |
| 154 | " | " | " | " | | | | ♂ |
| 156 | " | " | " | " | | | | ♂ |
| 159 | " | " | " | " | | | | ♂ |
| 160 | " | " | " | " | | | | ♀ |
| 161 | " | " | " | " | | | | ♂ |
| 162 | " | " | " | " | | | | ♂ |
| 163 | " | " | " | " | | | | ♂ |
| 164 | " | " | " | " | | | | ♂ |

Da = Dammen
 Ka = Karlsetangen
 Fu = Furutangen
 Fa = Fagerlivarpet
 Fa^x = Fanget ved Fager utsatt ved Damme
 Ha = Harpelandsvika
 Sp = Spålsoset
 Ak = Aklangsmålet
 Ek = Ekornlandet
 St = Stortangen

PRIMERTABELL 3 forts.

MERSET GJENFANGET OG SLUPPET FRI

| Merke nr. | Sted | Dato | År |
|-----------|------|-------|------|
| A 56155 | Ka | 24/10 | 1970 |
| 1166 | " | " | " |
| 1169 | " | " | " |
| 1171 | Ha | 25/10 | " |
| 1172 | " | " | " |
| 1175 | " | " | " |
| 1176 | " | " | " |
| 1178 | " | " | " |
| 1179 | " | " | " |
| 1181 | " | " | " |
| 1184 | " | " | " |
| 1185 | " | " | " |
| 1186 | " | " | " |
| 1187 | " | " | " |
| 1188 | " | " | " |
| 1189 | " | " | " |
| 1191 | " | " | " |
| 1192 | " | " | " |
| 1193 | " | " | " |
| 1194 | " | " | " |
| 1195 | " | " | " |
| 1196 | " | " | " |
| 1198 | " | " | " |
| 201 | " | " | " |
| 202 | " | " | " |
| 203 | " | " | " |
| 204 | " | " | " |
| 205 | " | " | " |
| 206 | " | " | " |
| 207 | " | " | " |
| 208 | " | " | " |
| 211 | " | " | " |
| 213 | Ha | 25/10 | " |
| 216 | " | " | " |
| 219 | " | " | " |
| 220 | " | " | " |

GJENFANGET OG DREPT

| Sted | Dato | År | Kjønn |
|------|-------|------|-------|
| Fu | 25/10 | 1971 | ♂ |
| Da | 26/10 | 1971 | ♂ |
| -- | 30/10 | 1970 | ♂ |
| Ha | 28/10 | 1971 | ♂ |
| Fu | 26/10 | 1971 | ♂ |
| Fa | 29/10 | 1971 | ♂ |
| Fa | 27/10 | 1971 | ♂ |
| Ha | 19/10 | 1971 | ♂ |
| Sp | 30/10 | 1971 | ♂ |
| Fa | 19/10 | 1971 | ♂ |
| Fa | 31/10 | 1970 | ♀ |
| Fa | 30/10 | 1970 | ♂ |
| -- | 31/10 | 1971 | ♂ |
| Sp | 30/10 | 1971 | ♂ |
| Fu | 1/11 | 1971 | ♀ |
| Ha | 24/10 | 1971 | ♂ |
| Ha | 28/10 | 1971 | ♂ |
| -- | 29/11 | 1970 | ♀ |
| Ha | ----- | 1971 | ♀ |
| AK | 3/12 | 1971 | ♂ |
| Ha | 1/11 | 1972 | ♂ |
| Da | 28/10 | 1971 | ♀ |
| Fa | 30/10 | 1970 | ♂ |
| Sp | 30/10 | 1971 | ♂ |
| Fa | 1/11 | 1971 | ♂ |
| Fu | 13/12 | 1970 | ♂ |

| | | |
|-----------------|---|-----------------------------------|
| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^x | = | Fangst ved Fager utsatt ved Damme |
| Ha | = | Harpe landsvik |
| Sp | = | Spålsoset |
| AK | = | Aklangsmålet |
| EK | = | Ekornlandet |
| St | = | Stortangen |

PRIMERTABELL 3 forts.

| Merket | GJENFANGET OG SLUPPET FRI | | | GJENFANGET OG DREPT | | |
|--------|---------------------------|-------|------|---------------------|-------|------|
| | Sted | Dato | År | Sted | Dato | År |
| 225 | Fu | 25/10 | 1970 | Fu | 13/12 | 1970 |
| 226 | " | " | " | Fa | 1/11 | 1970 |
| 227 | " | " | " | | | |
| 229 | " | " | " | Fa | 20/11 | 1971 |
| 230 | " | " | " | Da | 3/1 | 1971 |
| 231 | Ha | 26/10 | | Da | 26/10 | 1971 |
| 234 | " | " | " | Fa | 1/11 | 1970 |
| 237 | " | " | " | Fa | 22/10 | 1971 |
| 238 | " | " | " | Ka | 19/10 | 1971 |
| 239 | " | " | " | | | |
| 241 | " | " | " | Fa | 1/11 | 1970 |
| 242 | " | " | " | Fa | 24/10 | 1971 |
| 244 | " | " | " | Da | 5/11 | 1970 |
| 245 | " | " | " | Ka | 19/10 | 1971 |
| 247 | " | " | " | Da | 27/10 | 1971 |
| 248 | " | " | " | Fa | 25/10 | 1971 |
| 257 | Ek | 27/10 | | Fa | 20/11 | 1971 |
| 259 | " | " | " | | | |
| 260 | " | " | " | Fa | 31/10 | 1971 |
| 261 | " | " | " | Fa | 13/11 | 1971 |
| 262 | " | " | " | Fu | 28/10 | 1971 |
| 264 | " | " | " | AK | 2/1 | 1971 |
| 270 | AK | 28/10 | | Fa | 20/11 | 1971 |
| 275 | " | " | " | Fa | 17/10 | 1971 |
| 279 | " | " | " | Fa | 1/11 | 1970 |
| 281 | Sp | 27/10 | | AK | 29/10 | 1971 |
| 282 | " | " | " | AK | 28/12 | 1970 |
| 284 | " | " | " | Fu | --- | 1972 |
| 285 | " | " | " | | | |
| 286 | " | " | " | | | |
| 288 | " | " | " | Sp | 31/10 | 1970 |
| 289 | " | " | " | | | |
| 290 | " | " | " | | | |
| 291 | " | " | " | | | |
| 292 | " | " | " | | | |
| 293 | " | " | " | | | |
| 294 | " | " | " | | | |
| 295 | " | " | " | | | |
| 296 | " | " | " | | | |
| 297 | " | " | " | | | |
| 298 | " | " | " | | | |
| 299 | " | " | " | | | |
| 300 | " | " | " | | | |
| 301 | " | " | " | | | |
| 302 | " | " | " | | | |
| 303 | " | " | " | | | |
| 304 | " | " | " | | | |
| 305 | " | " | " | | | |

Da = Dammen
 Ka = Karlsetangen
 Fu = Furutangen
 Fa = Fagerlivarpet
 Fa^x = Fanget ved Fagerl
 utsatt ved Dammen
 Ha = Harpelandsvika
 Sp = Spålsoset
 AK = Aklangsmålet
 Ek = Ekornlandet
 St = Stortangen

PRIMERTABELL 3 forts.

MERSET

GJENFANGET OG SLUPPET PRI

GJENFANGET OG DREPT

| Mersemn. | Sted | Dato | År | Kjønn |
|----------|------|-------|------|-------|
| 53309 | Sp | 27/10 | 1970 | ♂ |
| 53310 | " | " | " | ♂ |
| 53311 | S4 | 28/10 | " | ♀ |
| 53312 | AK | 28/10 | " | ♂ |
| 53313 | Ha | 29/10 | " | ♂ |
| 53314 | " | " | " | ♂ |
| 53315 | " | " | " | ♂ |
| 53316 | " | " | " | ♂ |
| 53317 | " | " | " | ♂ |
| 53318 | " | " | " | ♂ |
| 53319 | " | " | " | ♂ |
| 53320 | " | " | " | ♂ |
| 53321 | " | " | " | ♂ |
| 53322 | " | " | " | ♂ |
| 53323 | " | " | " | ♂ |
| 53324 | " | " | " | ♂ |
| 53325 | " | " | " | ♂ |
| 53326 | " | " | " | ♂ |
| 53327 | " | " | " | ♂ |
| 53328 | " | " | " | ♂ |
| 53329 | " | " | " | ♂ |
| 53330 | " | " | " | ♂ |
| 53331 | " | " | " | ♂ |
| 53332 | " | " | " | ♂ |
| 53333 | " | " | " | ♂ |
| 53334 | " | " | " | ♂ |
| 53335 | " | " | " | ♂ |
| 53336 | " | " | " | ♂ |
| 53337 | " | " | " | ♂ |
| 53338 | " | " | " | ♂ |
| 53339 | " | " | " | ♂ |
| 53340 | " | " | " | ♂ |
| 53341 | " | " | " | ♂ |
| 53342 | " | " | " | ♂ |
| 53343 | " | " | " | ♂ |
| 53344 | " | " | " | ♂ |
| 53345 | " | " | " | ♂ |
| 53346 | " | " | " | ♂ |
| 53347 | " | " | " | ♂ |
| 53348 | " | " | " | ♂ |
| 53349 | " | " | " | ♂ |
| 53350 | " | " | " | ♂ |
| 53351 | " | " | " | ♂ |
| 53352 | " | " | " | ♂ |
| 53353 | " | " | " | ♂ |
| 53354 | " | " | " | ♂ |
| 53355 | " | " | " | ♂ |
| 53356 | " | " | " | ♂ |
| 53357 | " | " | " | ♂ |
| 53358 | " | " | " | ♂ |
| 53359 | " | " | " | ♂ |
| 53360 | " | " | " | ♂ |
| 53361 | " | " | " | ♂ |
| 53362 | " | " | " | ♂ |
| 53363 | " | " | " | ♂ |
| 53364 | " | " | " | ♂ |
| 53365 | " | " | " | ♂ |
| 53366 | " | " | " | ♂ |
| 53367 | " | " | " | ♂ |
| 53368 | " | " | " | ♂ |
| 53369 | " | " | " | ♂ |
| 53370 | " | " | " | ♂ |
| 53371 | " | " | " | ♂ |
| 53372 | " | " | " | ♂ |
| 53373 | " | " | " | ♂ |
| 53374 | " | " | " | ♂ |
| 53375 | " | " | " | ♂ |
| 53376 | " | " | " | ♂ |
| 53377 | " | " | " | ♂ |
| 53378 | " | " | " | ♂ |
| 53379 | " | " | " | ♂ |
| 53380 | " | " | " | ♂ |
| 53381 | " | " | " | ♂ |
| 53382 | " | " | " | ♂ |
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| 53384 | " | " | " | ♂ |
| 53385 | " | " | " | ♂ |
| 53386 | " | " | " | ♂ |
| 53387 | " | " | " | ♂ |
| 53388 | " | " | " | ♂ |
| 53389 | " | " | " | ♂ |
| 53390 | " | " | " | ♂ |
| 53391 | " | " | " | ♂ |
| 53392 | " | " | " | ♂ |
| 53393 | " | " | " | ♂ |
| 53394 | " | " | " | ♂ |
| 53395 | " | " | " | ♂ |
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| 53397 | " | " | " | ♂ |
| 53398 | " | " | " | ♂ |
| 53399 | " | " | " | ♂ |
| 53400 | " | " | " | ♂ |
| 53401 | " | " | " | ♂ |
| 53402 | " | " | " | ♂ |
| 53403 | " | " | " | ♂ |
| 53404 | " | " | " | ♂ |
| 53405 | " | " | " | ♂ |
| 53406 | " | " | " | ♂ |
| 53407 | " | " | " | ♂ |
| 53408 | " | " | " | ♂ |
| 53409 | " | " | " | ♂ |
| 53410 | " | " | " | ♂ |
| 53411 | " | " | " | ♂ |
| 53412 | " | " | " | ♂ |
| 53413 | " | " | " | ♂ |
| 53414 | " | " | " | ♂ |
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| 53424 | " | " | " | ♂ |
| 53425 | " | " | " | ♂ |
| 53426 | " | " | " | ♂ |
| 53427 | " | " | " | ♂ |
| 53428 | " | " | " | ♂ |
| 53429 | " | " | " | ♂ |
| 53430 | " | " | " | ♂ |
| 53431 | " | " | " | ♂ |
| 53432 | " | " | " | ♂ |
| 53433 | " | " | " | ♂ |
| 53434 | " | " | " | ♂ |
| 53435 | " | " | " | ♂ |
| 53436 | " | " | " | ♂ |
| 53437 | " | " | " | ♂ |
| 53438 | " | " | " | ♂ |
| 53439 | " | " | " | ♂ |
| 53440 | " | " | " | ♂ |
| 53441 | " | " | " | ♂ |
| 53442 | " | " | " | ♂ |
| 53443 | " | " | " | ♂ |
| 53444 | " | " | " | ♂ |
| 53445 | " | " | " | ♂ |
| 53446 | " | " | " | ♂ |
| 53447 | " | " | " | ♂ |
| 53448 | " | " | " | ♂ |
| 53449 | " | " | " | ♂ |
| 53450 | " | " | " | ♂ |
| 53451 | " | " | " | ♂ |
| 53452 | " | " | " | ♂ |
| 53453 | " | " | " | ♂ |
| 53454 | " | " | " | ♂ |
| 53455 | " | " | " | ♂ |
| 53456 | " | " | " | ♂ |
| 53457 | " | " | " | ♂ |
| 53458 | " | " | " | ♂ |
| 53459 | " | " | " | ♂ |
| 53460 | " | " | " | ♂ |
| 53461 | " | " | " | ♂ |
| 53462 | " | " | " | ♂ |
| 53463 | " | " | " | ♂ |
| 53464 | " | " | " | ♂ |
| 53465 | " | " | " | ♂ |
| 53466 | " | " | " | ♂ |
| 53467 | " | " | " | ♂ |
| 53468 | " | " | " | ♂ |
| 53469 | " | " | " | ♂ |
| 53470 | " | " | " | ♂ |
| 53471 | " | " | " | ♂ |
| 53472 | " | " | " | ♂ |
| 53473 | " | " | " | ♂ |
| 53474 | " | " | " | ♂ |
| 53475 | " | " | " | ♂ |
| 53476 | " | " | " | ♂ |
| 53477 | " | " | " | ♂ |
| 53478 | " | " | " | ♂ |
| 53479 | " | " | " | ♂ |
| 53480 | " | " | " | ♂ |
| 53481 | " | " | " | ♂ |
| 53482 | " | " | " | ♂ |
| 53483 | " | " | " | ♂ |
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| 53486 | " | " | " | ♂ |
| 53487 | " | " | " | ♂ |
| 53488 | " | " | " | ♂ |
| 53489 | " | " | " | ♂ |
| 53490 | " | " | " | ♂ |
| 53491 | " | " | " | ♂ |
| 53492 | " | " | " | ♂ |
| 53493 | " | " | " | ♂ |
| 53494 | " | " | " | ♂ |
| 53495 | " | " | " | ♂ |
| 53496 | " | " | " | ♂ |
| 53497 | " | " | " | ♂ |
| 53498 | " | " | " | ♂ |
| 53499 | " | " | " | ♂ |
| 53500 | " | " | " | ♂ |

Da = Dammen
 Ka = Karlsetangen
 Fu = Furutangen
 Fa = Fagerlivarpet
 Fa^x = Fansen ved Fagerlivarpet
 Ha = Harpelandsvika
 Sp = Spålsoset
 AK = Aklangsmålet
 Ek = Ekornlandet
 St = Stortangen

PRIMERTABELL 3 forts.

| MERKET | | | | GJENFANGET OG SLUPPET FRI | | GJENFANGET OG DREPT | | | |
|-----------|------|------|------|---------------------------|--|---------------------|-------|------|-------|
| Merke-nr. | Sted | Dato | År | | | Sted | Dato | År | Kjønn |
| A 80529 | Fa | 2/11 | 1970 | | | Fa | 2/11 | 1971 | ♂ |
| 80530 | " | " | " | | | Da | 1/11 | 1972 | ♂ |
| 80531 | " | " | " | Fa 5/11-70 | | | | | ♂ |
| 80532 | " | " | " | | | Fa | 7/11 | 1971 | ♂ |
| 80533 | " | " | " | | | Fa | 1/11 | 1971 | ♂ |
| 80534 | " | " | " | | | Fa | 31/10 | 1971 | ♀ |
| 80535 | " | " | " | | | Fa | 5/11 | 1971 | ♂ |
| 80536 | " | " | " | | | Fa | 19/10 | 1971 | ♂ |
| 80537 | " | " | " | | | Fa | 31/10 | 1971 | ♂ |
| 80538 | " | " | " | | | Fu | 1/11 | 1971 | ♂ |
| 80539 | " | " | " | | | Fa | 1/11 | 1971 | ♂ |
| 80540 | " | " | " | Fa 5/11-70 | | Fa | 7/11 | 1971 | ♂ |
| 80541 | " | " | " | | | | | | ♂ |
| 80542 | Fa | 5/11 | " | | | Da | 3/1 | 1971 | ♂ |
| 80543 | " | " | " | | | Fa | 1/11 | 1971 | ♂ |
| 80544 | " | " | " | | | Sp | 1/11 | 1971 | ♂ |
| 80545 | " | " | " | | | Da | 3/1 | 1971 | ♂ |
| 80546 | " | " | " | | | Fa | 28/10 | 1971 | ♂ |
| 80547 | " | " | " | | | Fu | 13/12 | 1970 | ♀ |
| 80548 | " | " | " | | | Fu | 13/12 | 1970 | ♀ |
| 80549 | " | " | " | | | Sp | 27/10 | 1971 | ♂ |
| 80550 | " | " | " | | | Sp | 21/10 | 1971 | ♂ |
| 80551 | " | " | " | Fa 6/11-70 | | Fa | 24/10 | 1971 | ♂ |
| 80552 | " | " | " | | | | | | ♀ |
| 80553 | " | " | " | | | Fa | 7/11 | 1971 | ♂ |
| 80554 | " | " | " | | | Ha | 28/10 | 1971 | ♂ |

- | | | |
|-----------------|---|--------------------------------------|
| Da | = | Dammen |
| Ka | = | Karlsetangen |
| Fu | = | Furutangen |
| Fa | = | Fagerlivarpet |
| Fa ^x | = | Fanget ved Fager utsatt ved Damme |
| Ha | = | Harpelandsvika |
| Sp | = | Spålsoset |
| Ak | = | Aklangsmålet |
| Ek | = | Ekornlandet |
| St | = | Stortangen |