Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC
Res. Doc. # 82/38

Rationale for Establishing a TAC in Hebron Fiord During 1982

by

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Abstract

Quota regulations on Arctic charr stocks in the immediate Nain area have led to the expansion of the fishery into the Hebron and Saglek region during 1981. These areas have been virtually unexploited since the 1960's when average production of Arctic charr was 19 t and 62 t from Hebron Fiord and Saglek Fiord respectively. Comparison of biological characteristics and physical characteristics of production areas from other fishing regions suggest a sustainable yield would be about 21 t y^{-1}.

Résumé

Par suite de l'imposition de contingents sur les stocks d'ombles chevaliers dans la région de Nain, la pêche s'est élargie à la région de Hebron et de Saglek en 1981. Ces régions étaient demeurées pratiquement inexploitées depuis les années 1960, alors que la production moyenne de cette espèce était de 19 t dans le fjord Hebron et de 62 t dans le fjord Saglek. Si l'on compare les caractéristiques biologiques et les caractéristiques physiques des zones de production d'autres lieux de pêche, on est porté à croire que le rendement soutenu serait d'environ 21 t par an.

Introduction

The traditional northern Labrador Arctic charr fishery extended along the coast from Hamilton Inlet north to Ryan's Bay (Coady and Best 1976). During the late 1960's an Inuit cooperative society was formed at Port Burwell and an annual commercial harvest of 23-27 t was taken almost exclusively on the northern Labrador coastline. Fishing effort during the past 10 years, however, has been confined to the region extending from Hamilton Inlet north to Hebron Fiord (Fig. 1). While in excess of 1100 t of anadromous charr have been harvested within this 500 km stretch of coastline during the past five years, 86% were caught within the Nain fishing region (Fig. 1). Owing to the intense fishery that occurred in the immediate Nain area during the mid-late 1970's, quotas were established on Voisey Bay, Anaktalik Bay, and Tikkoatokak Bay charr stocks. In addition, the Nain Bay area was closed to commercial fishing for a period of five years beginning in 1978.

Reduction in TAC's for 1981 contributed to the expansion of the fishery into the Hebron-Saglek region. Commercial production of Arctic charr in these areas totalled 70 t and represented approximately 30% of the total northern Labrador catch. Age and size distributions of the stocks indicated that populations were in excellent condition. Of the 14 areas fished within the Nain fishing region during 1981, the first and third highest catch rates occurred in Hebron Fiord and Saglek Fiord respectively.

This report reexamines information collected from the Hebron Fiord during 1981 and discusses the rationale for establishing a total allowable catch in the area for 1982.

Materials and Methods

Catch and effort information were obtained from purchase slip records from the commercial fishery in Hebron Fiord during 1981. Age length keys (sample N = 413) and length frequencies (sample N = 4850) were used to derive an estimate of the total numbers at age in the commercial catch. Weights at age were obtained from age sampling of the 1980 experimental fishery and 1981 commercial fishery.

Partial recruitment rates were obtained by comparing the percent at age in the commercial catch with percent at age from research fishing (1978-80) using a series of different meshed size gillnets. The ratio of these percentages provides a measure of selectivity with the highest value assigned the value of 1.0 for fully recruited fish (Table 2). Partial recruitment rates and mean weight at age were used to calculate yield per recruit by the method of Thompson and Bell (Ricker 1975; Rivard 1980).

Total mortality was estimated from a catch curve using relative number at age from 1980 and 1981 samples (Fig. 3).

Results and Discussion

Commercial production of Arctic charr from Hebron Fiord during 1981 was 39.9 t (Table 1). Catch per unit of effort was 376 kg/man-week suggesting an

abundance of charr in the fiord. The percentage of catch over 2.3 kg (gutted head-on weight) was 34. This value is similar to those observed from the Voisey Bay and Anaktalik Bay areas from 1976-78.

An estimated 17,804 charr were captured with a mean age of 11.0 years. Mean age in other areas fished in 1981 were: Voisey Bay 9.1; Anaktalik Bay 9.4; Tikkoatokak Bay 9.3; Okak Bay 9.7; Saglek Fiord 11.0.

In comparison with data collected on the Hebron stock from 1953 (Andrews and Lear 1956) certain characteristics have remained relatively constant. Mean age of the catch in 1953 was 10.4 years in comparison to 10.9 during 1981. Approximately 70% of the catch in 1953 consisted of 9-12 year old charr. In 1981, 75% of the catch were in the same age category. With respect to age distribution, in 1953 the maximum age attained was only 14 years with 12-14 year old charr representing 20% of the total catch. In contrast, maximum age found in the 1981 sample was 20 years with 30% of the catch 12-20 years old.

Growth rate has increased considerably in comparison with 1953 data. Mean length of the catch in 1953 was 49.5 cm (mean age 10.4 years) while in 1981 the mean length of Hebron fish was 56.4 cm (mean age 10.9 years). It is not known whether the increased rate of growth was a population response to exploitation as occasionally observed in other exploited fish stocks (Jensen 1981).

Average total mortality in effect from 1970-80 was $\bar{Z} = 0.39$ (95% C.L. = 0.34 - 0.45). Assuming a rate of natural mortality of 0.2 the yield per recruit analysis calculated $F_{0.1}$ to be 0.34. An estimate of fishing mortality is not available for 1981. Without this estimate it is difficult to assign quantitatively a TAC for 1982 based upon fishing at $F_{0.1}$.

Figure 2 illustrates changes in size composition of stocks in Voisey Bay, Tikkoatokak Bay and Okak Bay. While populations have maintained relatively stable length distributions, changes have occurred in the weight composition of the stocks. There has been a progressive decline in condition of fish over time (Fig. 2).

It is expected that catch and catch rates will remain high for several years in the Hebron area if fishing is maintained at the same rate as in 1981. It is also expected that the proportion of large charr in the catch will begin to decline after a few years of heavy fishing. Whether or not the current level of exploitation (1981) is in excess of the sustainable yield of the Hebron population is not known.

Production capability of these charr populations are dependent, directly or indirectly, on the availability of freshwater habitat. A comparison of several areas is presented in Table 3. Inherent biological characteristics differ between these populations, thus a direct comparison of the physical characteristics may not be entirely appropriate. Nevertheless, it is evident that the Tikkoatokak Bay stock has the greatest amount of accessible river habitat available. This stock also has had the greatest commercial production during the past 5 years. In comparison, the Hebron area has 25% less river habitat available than the Tikkoatokak area. More important, however, may be the relationship of the available standing freshwater areas. Tikkoatokak Bay has 174 sq km of lake area available to its charr stocks. In contrast, the Hebron region has only 26 sq km of lake area available.

Commercial production of Arctic charr reached a peak of 55 t in Tikkoatokak Bay in 1978. Sustained exploitation at this level was too high and subsequent assessments reduced the available harvest to 28 t for 1981 (Dempson 1981) and 35 t for 1982. Using the available freshwater habitat as a guide, commercial production of Arctic charr in the Hebron area should be less than the recommended TAC for the Tikkoatokak area in 1982 (35 t). By giving equal weight in terms of production to lake area and accessible river habitat then Tikkoatokak Bay can be given a production value of 2.0 (174 sq km lake area = 1.0; 88331 units of river habitat = 1.0; total production value = 2.0). In comparison with Tikkoatokak Bay, Hebron has a relative production value of 0.9 (26 sq km lake area = 0.149 of Tikkoatokak lake area; 65982 units of river habitat = 0.747 of Tikkoatokak river habitat; total production value 0.9). By relating the ratio of these two production values (Tikkoatokak = 2.0; Hebron = 0.9) to the TAC for Tikkoatokak Bay (35 t) a TAC of 16 t is derived for the Hebron Fiord.

Alternatively, an estimated TAC can be calculated for Hebron Fiord utilizing available river habitat only. While available lake habitat is undoubtedly important it is difficult at this stage to quantify or qualify the direct relationship of lake area to production. Thus by relating available river habitat in Tikkoatokak Bay to the TAC of 35 t, a TAC of 26.1 t is derived for Hebron Fiord.

Table 4 summarizes the commercial production of Arctic charr from the Hebron region during the 1960's. Average production was 19.5 t, however, this was undoubtedly influenced by the limited effort expended in this area. The mean of the above two estimated TAC's for Hebron is comparable with the average commercial production during 1960's.

Hebron fish have a slower rate of growth than Tikkoatokak Bay charr and fish mature at an older age (Table 5), therefore increasing the time delay for population characteristics to respond to high levels of exploitation. Taking this into consideration the higher of the two estimated TAC's of 26.1 t can be reduced by the percentage difference in the mean ages of maturation between Hebron Fiord and Tikkoatokak Bay female charr. This difference was 21.5% (mean age at maturation for Tikkoatokak Bay and Hebron Fiord Arctic charr was 7.9 and 9.6 years respectively) which now yields a TAC of 20.5 t.

In conjunction with the resumption of commercial fishing in the Hebron area during 1981, a research project was initiated on Ikarut River, Hebron Fiord. One objective was to be able to obtain biological information on a virtually unexploited stock prior to or at least concurrent with the development of a commercial fishery. Few opportunities are available to study unexploited populations prior to full scale commercial exploitation. Owing to the importance of the project with respect to the opportunity in which to study a relatively unexploited stock, it is felt that commercial exploitation in the Hebron Fiord should be kept at a minimum level for the next several years. Studies on heavily exploited stocks fail to give complete information on age and size structure, recruitment potential and estimated sustainable yield prior to any effects of exploitation on the population. Past assessments have pointed out shortcomings of conventional assessment models when applied to the complex life history characteristics of anadromous salmonids. By keeping the exploitation at a low level information characteristics of the stock selected by the fishery can be compared with population information derived from counting fence studies. It may be possible to utilize the latter information to assist in the eventual

assessment of the stock by refining or modifying conventional assessment models.

Presently biological characteristics and the production capacity of Ikarut River are being investigated in addition to studying movement patterns and relationships of charr from other rivers in the fiord. In consideration of the above comparisons of biological and physical characteristics of different stocks and areas and the importance of on-going research, it is recommended that until additional information is available a TAC of 21 t be established.

References

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Table 1. Estimated numbers at age, weight at age for Hebron Fiord Arctic charr, 1981.

Age	Number	Weight (kg-round)
7	115	1.10
8	997	1.55
9	3830	1.95
10	4644	2.32
11	2993	2.62
12	2025	2.56
13	1097	2.68
14	881	2.87
15	574	2.34
16	193	1.69
17	170	3.32
18	71	3.11
19	116	3.04
20	98	3.03
Total	17,804	
Total catch (kg-round)		39,890
Effort (man-weeks)		106
C/E		376
% >2.3 kg (gutted head on)		34

Table 2. Partial recruitment values derived from comparisons of percent at age in the commercial catch (1981) with percent at age from research fishing, 1978-80.

	Research (R)	Commercial (C)	C/R	Partial Recruitment
7	19.6	0.6	0.031	0.01
8	16.3	5.6	0.345	0.11
9	10.0	21.5	2.150	0.69
10	8.3	26.1	3.133	1.00
11	7.9	16.8	2.121	1.00
12	6.7	11.4	1.709	1.00
13	4.0	6.2	1.566	1.00
14	2.7	4.9	1.808	1.00
15	1.9	3.2	1.702	1.00
16	1.0	1.1	1.058	1.00
17	1.7	1.0	0.599	1.00
18	0.8	0.4	0.482	1.00
19	1.0	0.7	0.673	1.00
20	0.4	0.5	1.190	1.00

Table 3. Summary of physical characteristics in relation to commercial production estimates of Arctic charr in several northern Labrador areas.

	Drainage area (sq km)	Lake area (sq km)	Total accessible units[a]	Marine area (sq km)	Total catch (1977-81) (kg)	Average catch (1977-81) (kg)
Voisey Bay	6004	-	16,896		105,821	21,164
Tikkoatokak Bay	4986	174	88,331	104	202,626	40,525
Okak Bay	2727	100	6,700		118,361	23,672
Hebron Fiord	4071	26	65,982	225		

[a]one unit equal 100 m^2.

Table 4. Summary of Arctic charr production (kg-round) in Hebron Fiord.

Year	Hebron
1961	15,701
1962	27,327
1966	8,831
1967	14,250
1968	13,412
1969	37,386
1981	39,890
Average 1961-69	19,485

Table 5. Age and length (cm) at 50% maturity of Arctic charr from different areas in northern Labrador.

	Male							Female					
		Age			Length				Age			Length	
	N	Range	Age_{50}	S.E.	Range	Lth_{50}	S.E.	N	Range	Age_{50}	S.E.	Range	Lth_{50}	S.E.
Fraser River	403	1-13	5.2	0.1	4.4-72.8	24.5	0.1	519	1-18	6.9	0.1	4.1-66.5	38.1	0.0
Tikkoatokak Bay	52	6-13	7.2	0.4	40.8-66.2	44.4	0.3	70	6-15	7.9	0.2	39.4-71.0	46.3	0.2
Okak Bay	130	6-18	6.6	0.2	34.3-60.7	39.6	0.2	165	6-18	8.5	0.1	32.9-60.8	42.0	0.1
Napartok Bay	136	5-20	6.3	0.3	15.7-66.4	33.0	0.3	191	6-19	8.5	0.1	30.3-62.5	42.0	0.1
Hebron Fiord	235	4-21	8.0	0.1	21.7-75.5	40.8	0.1	245	4-21	9.6	0.1	22.1-74.8	45.9	0.1
Saglek Fiord	236	3-17	7.3	0.1	16.5-67.0	40.1	0.1	280	3-21	10.0	0.1	18.2-59.7	47.3	0.1
Ramah Bay	108	5-17	7.4	0.2	21.0-71.9	39.3	0.2	110	6-16	10.2	0.2	33.6-58.9	49.9	0.1

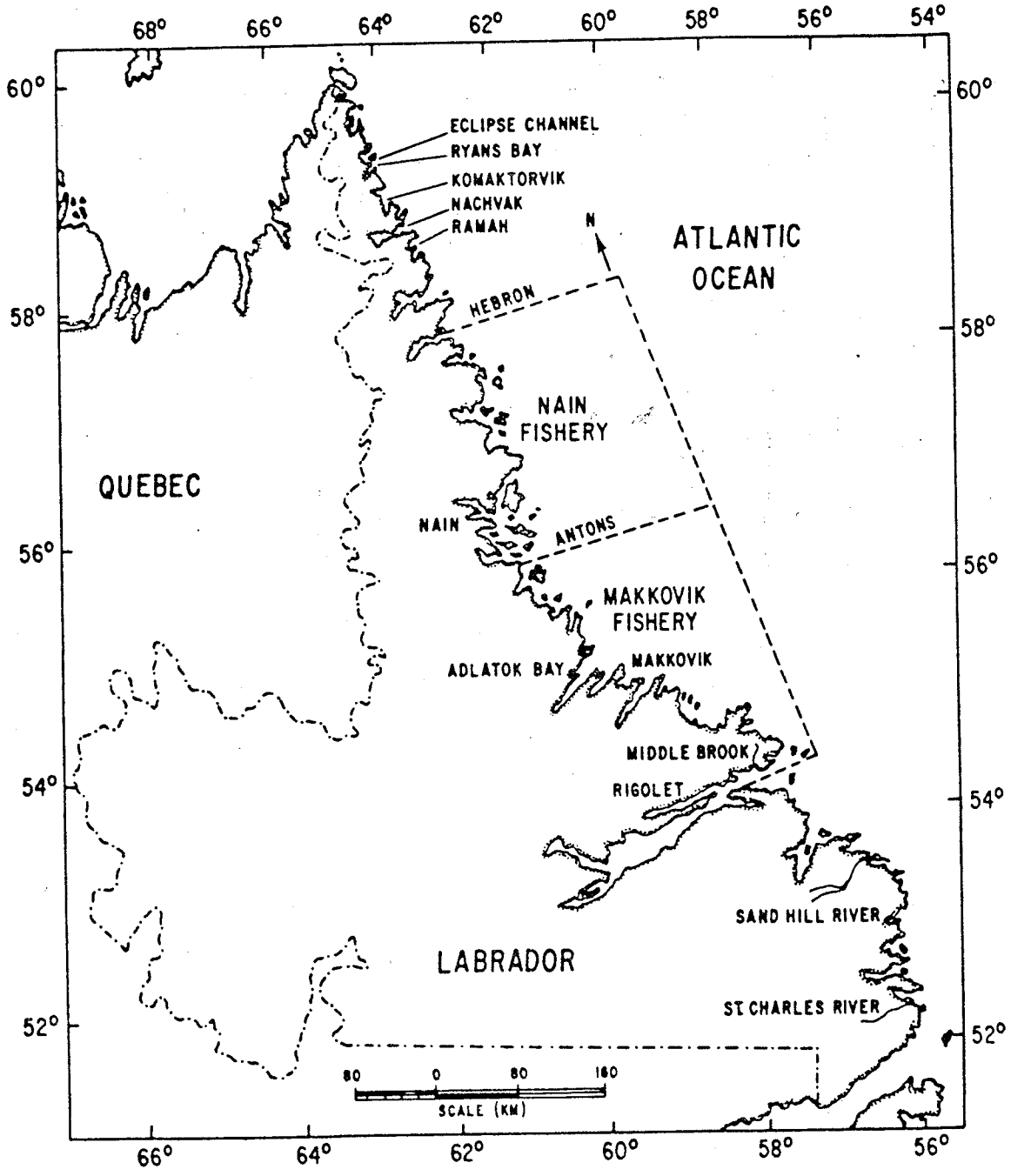

Fig. 1. Extent of major Arctic charr fishing regions in northern Labrador.

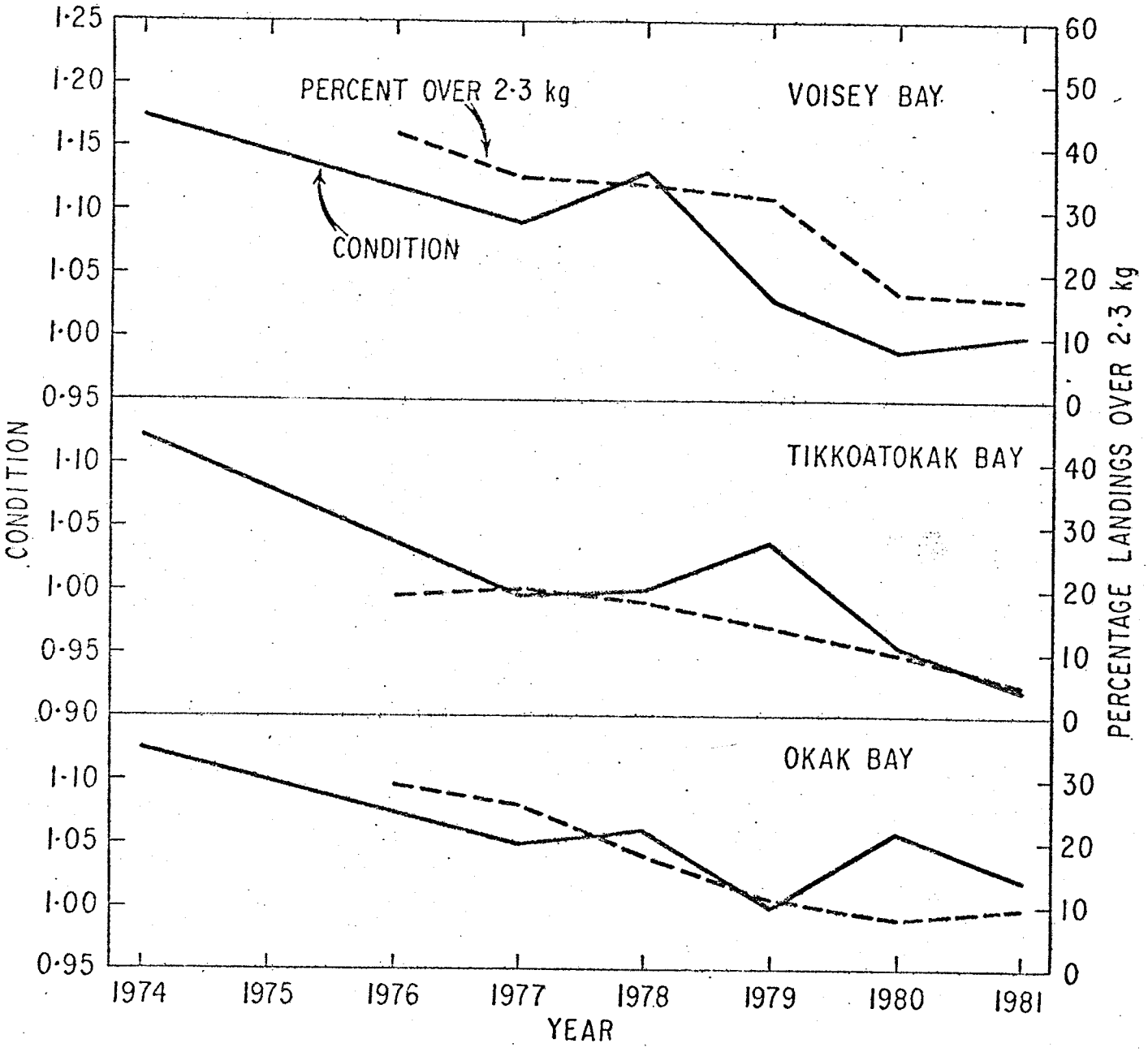

Fig. 2. Change in size composition (percentage over 2.3 kg gutted head-on weight) and decline in fish condition in Voisey Bay, Tikkoatokak Bay and Okak Bay Arctic charr stocks.

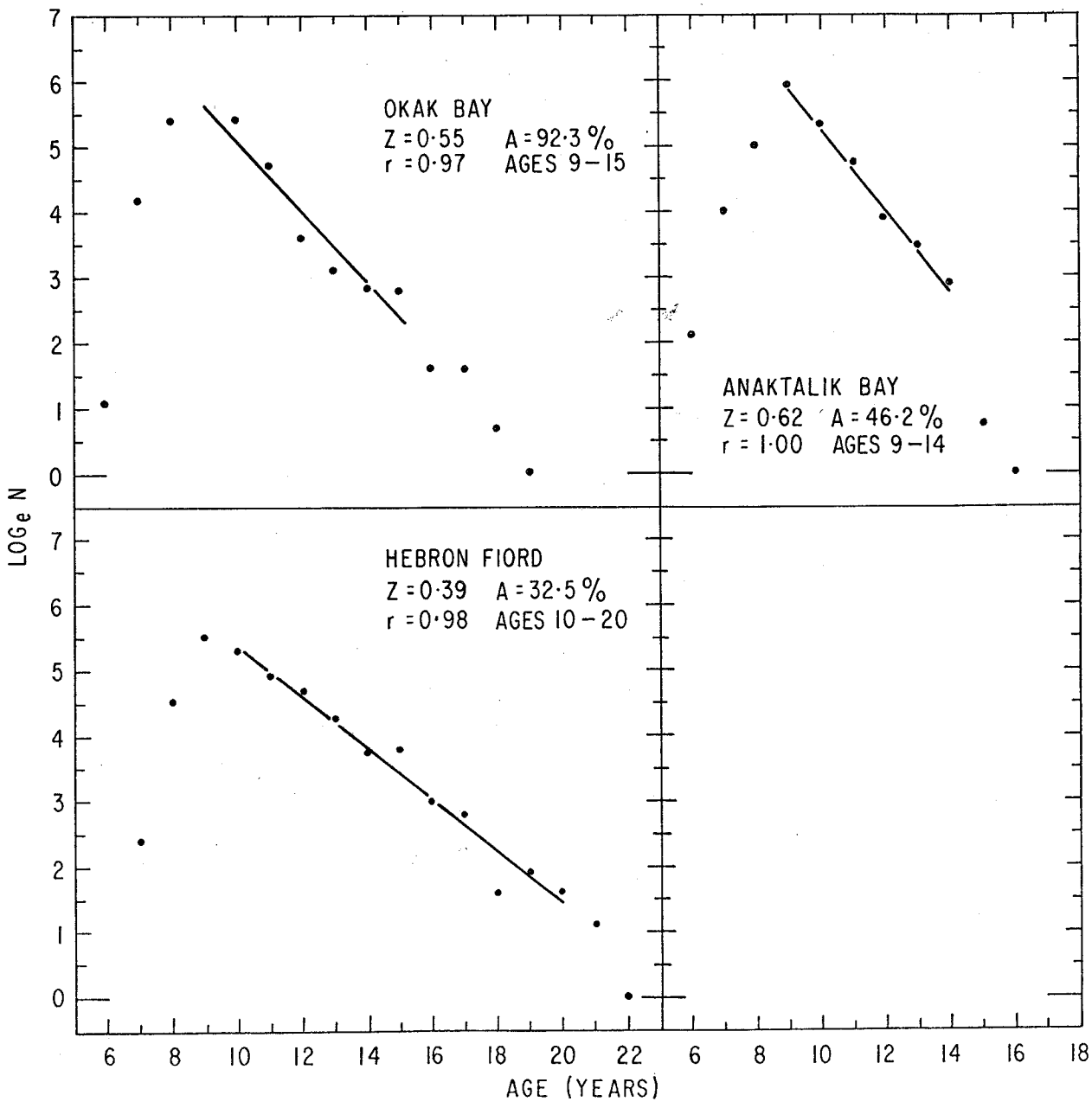

Fig. 3. Catch curves of Arctic charr age frequency distributions from various areas taken by commercial gillnets.