RESTRICTED

International Commission for the Northwest Atlantic Fisheries

Serial No. 3953
(D.c.9)

ICNAF Res. Doc. 76/VI/120

ANNUAL MEETING - JUNE 1976

Capelin (Mallotus villosus) Research in the ICNAF Area, 1973-76

by

J. Carscadden
Department of the Environment
Fisheries and Marine Service
Newfoundland Biological Station
St. John's, Newfoundland

The capelin fishery and its regulation

The capelin fishery in the Newfoundland area (Subareas 2 and 3) has historically been small and most important in Canadian coastal waters. However, in 1972, offshore catches of 71,000 tons were reported, most of which were taken in Subarea 2 and Div. 3K. In 1973, the catches increased sharply to 272,000 tons, half being taken in Subarea 2 and Div. 3K and half in Div. 3LNOPs. At the 1973 Annual Meeting, the Assessments Subcommittee of ICNAF recommended a pre-emptive quota of 250,000 tons for 1974. During the 1974 fishery, approximately 288,000 tons were taken, mostly in Subarea 3. At the Assessments Subcommittee meeting of 1974, the TAC was adjusted to 500,000 tons beginning in 1975 and remaining in effect for 3 years. This fishery was to be restricted to mature fish. As a result of the STACRES meeting in Bergen, January 1975, it was noted that "improvement in advice to the Commission on the management of capelin and on the effects of capelin fisheries on other fisheries depends critically on direct estimations of capelin abundance and on research in species interactions" (ICNAF Redbook 1975). While recognizing that surveys would yield valuable short-term results, the importance of expanding present research programs to yield results on species interactions was also emphasized.

This report summarizes recent information on capelin pertinent to management of the capelin resource in ICNAF Subareas 2 and 3. Proposed Canadian research in 1976 is also outlined.

Biological characteristics

A number of reports dealing with various aspects of capelin biology have recently been published. Average lengths and ages of spawning capelin have not changed since fishing of capelin became heavy after 1972 (Dommasnes et al. 1974, Furevik and Westergaard 1975, Kovalyov and Kudrin 1975, Labarta 1976, Sangolt and Ulltang 1976, Seliverstov and Kovalev 1976, Serebrov et al. 1975 Ulltang 1975a). Winters (1975) noted an increase in mean age at maturity of capelin between 1967 and 1974 and suggested that this was due to an intensification of a cooling trend since 1971. Thus, age at maturity was related to these growth-induced variations in rate of maturation but not survival. Biological characteristics of Grand Bank capelin including data on length and weight at age, secondary sexual characteristics, maturity, nematode infection and total mortality were reported by Winters and Campbell (1974). Winters

(1974a) reported a north-south cline in growth with Labrador capelin growing slowly but reaching a large final size, Notre Dame Bay capelin exhibiting intermediate growth rates and Grand Bank capelin growing fastest. He attributed these differences in growth rates to differences in hydrographical conditions between areas.

Data concerning distribution of immature capelin have been given by Carscadden (1976), Dragesund and Monstad (1973), Sangolt and Ulltang (1976), Seliverstov and Kovalev (1976) and Ulltang (1975a). Food and feeding of capelin in the Labrador area in August-November was reported by Chan and Carscadden (1976). Ulltang (1975b) noted that after heavy fishing of capelin in the Barents Sea there were a number of abundant year-classes and as a result there were too many capelin for the available food. Thus, although the 1975 spawning stock was predicted to be very large, the intense intra-specific competition resulted in reduced growth and poor condition and in fact the spawning stock would be low. Ulltang suggested that scientists should closely monitor capelin in ICNAF areas for similar patterns.

Trophic relationship of capelin

Capelin are the most important forage fish in ICNAF Subareas 2 and 3 and Winters (1975) has summarized the data available up to 1975. Stanek (1975) gave a detailed account of cod feeding on capelin offshore in Div. 2J-3KLNOP. Capelin were relatively unimportant as forage fish for cod in Div. 2J and 3K with less than 3% of the cod feeding on capelin. In Div. 3LNOP capelin were most important in the spring with approximately 33% of the cod taking capelin. This intensity declined in the remainder of the year to 9.7% in winter, 6.3% in summer and 0.7% in autumn. In Div. 2J and 3K, in the part free of ice during March 1975, cod, Greenland halibut, witch flounder, golden redfish, and beaked redfish were not feeding on capelin. However, in the Avalon Channel capelin were important sources of food accounting for nearly 100% of the cod diet at the end of March (Seliverstov and Kovalev 1976). Ulltang (1974) and Smedstad (1975) reported that Barents Sea capelin are important in the diet of cod but any decline in cod stocks could not be blamed on a decline of capelin resulting from heavy fishing pressure since capelin had in fact increased in numbers. Winters (1975) estimated that during 1947-51 cod in Div. 2J-3KL annually consumed 3.97×10^6 tons of capelin but, due to the decline in cod stocks in recent years, approximately 0.97×10^6 tons of capelin were surplus to maintenance of the present cod stocks.

Sea mammals also consume considerable amounts of capelin (Sergeant 1963, 1973) and Winters (1975) estimated that in the past fin whales consumed 360,000 tons of capelin annually. With the decline of fin whales and other whale species in the last two decades it is probable that there has been approximately 125,000 tons surplus production of capelin annually. Seals are also capelin predators. The annual capelin consumption by seals in the past was about 430,000 tons but the decline in the seal population has produced a surplus annual production of 130,000 tons (Winters 1975).

Sea birds are also important capelin predators during both the overwintering period and the breeding period. Greater shearwaters alone number approximately

7 x 10^6 in the Newfoundland area during the summer (Winters 1975). No estimates of rates of capelin consumption by sea birds are available.

Capelin stocks

Although data were available regarding seasonal distribution of capelin Campbell and Winters (1973) were the first to consolidate this data and describe possible spawning stocks. They suggested that there were four main stocks of capelin in the Labrador and Newfoundland area: A. Labrador-Northeast Newfoundland stock; B. Northern Grand Bank-Avalon stock; C. South Grand Bank stock; D. St. Pierre-Green Bank stock. Winters (1974b) suggested that because of growth differences of capelin from Div. 2J and 3K these capelin were probably different stocks.

Although the different capelin stocks are probably discrete during spawning (and each stock may be composed of a number of subunits) there are indications that mixing does occur at other times of the year. The Northern Grand Bank-Avalon stock and the South Grand Bank stock probably mix during overwintering and feeding periods on the Northern Grand Bank (Bakanev et al. 1976; Campbell and Winters 1973; Dragesund and Monstad 1973; Kovalyov and Kudrin 1973, 1975; Seliverstov and Kovalyev 1976; Winters 1974b). The stocks of capelin spawning in Div. 3K and 2J probably mix during feeding periods in Div. 2J (Winters 1974b). It is known that capelin are also present in Newfoundland and Labrador coastal waters during the overwintering and pre-spawning periods. Payne (1975) has been unsuccessful in defining Newfoundland stocks using electrophoretic separation of liver and skeletal muscle esterases although capelin from Northwest Territories exhibited different allele frequencies from Newfoundland capelin.

Estimates of capelin abundance

Since classical techniques using fisheries data are not feasible in estimating capelin abundance because of the life history of the species (Ulltang 1974), three other approaches have been attempted: mathematical, surplus production and acoustic. Gulimov and Kovalev (1975) estimated the total biomass of capelin to be from 12.36 x 10^6 to 19.00 x 10^6 tons annually between 1971 and 1974 using one mathematical model while a second model yielded estimates ranging from 1.12 x 10^6 to 1.72 x 10^6 tons in the same period. They concluded that the total stock was probably not below 1.23 x 10^6 tons annually and therefore a catch of 750,000 to 800,000 tons would be reasonable.

In a surplus production model Campbell and Winters (1973) suggested that 2.2-3.7 x 10^6 tons of capelin were eaten annually by predators in the Newfoundland area. Winters (1975) refined these calculations and estimated that, due to the decline of cod, seal and whale stocks in the Northwest Atlantic, the total excess capelin production was approximately 1.25 x 10^6 tons. Because of both substantial stock (11X) and recruitment (17X) variations estimated for the Barents Sea capelin (Gjøsaeter 1972), Winters suggested that a TAC of 250,000 tons would be reasonable.

Using an echo integration system supplemented with trawl surveys, Dragesund and Monstad (1973) estimated that the capelin biomass in the area from the Avalon Peninsula to the Southeast Shoal of the Grand Bank was 0.8×10^6 tons between May 17-June 19, 1972. Soviet estimates of the total Newfoundland stock measured in the Labrador area during October-November, 1974 was 1.33×10^6 tons (Serebrov et al. 1975) using a technique involving calculation of school volumes and densities of capelin. From this estimate the suggested catch was 650,000 to 680,000 tons. Using similar techniques as well as an echo integration system Bakanev et al. (1976) estimated the biomass of capelin in Div. 2J and 3K during October, 1975 to be 0.98×10^6 tons. Again using volume estimation, photographic techniques and echo integration Seliverstov and Kovalev (1976) estimated that the Southeast Shoal spawning stock consisted of 1.05×10^6 tons. They considered this was an underestimate because the survey covered only part of the spawning season and capelin were moving into the spawning area after the estimate was made.

Proposed Canadian capelin studies in 1976

1) Attempt to delineate stocks of capelin in Newfoundland and Labrador area using meristics.

2) Acoustic estimates of capelin biomass in Newfoundland and Labrador area, specifically the Southeast Shoal spawning stock and capelin in Div. 2J and 3K in October-November.

3) Continue the collections of spawning capelin, inshore and offshore, and of offshore capelin at other times of the year to provide baseline biological data.

4) Studies at McGill University involving larval and adult capelin and feeding of capelin in the Gulf of St. Lawrence (estuary) should be completed during 1976.

REFERENCES

Bakanev, V. S., A. S. Seliverstov and L. I. Serebrov. 1976. Preliminary instrument estimate of abundance and biomass of capelin off South Labrador and the North Newfoundland Bank (divisions 2J and 3K). Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/54, Ser. No. 3840, 16 p.

Campbell, J. S. and G. H. Winters. 1973. Some biological characteristics of capelin, Mallotus villosus, in the Newfoundland area. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 73/90, Ser. No. 3048, 8 p.

Carscadden, J. 1976. Biological characteristics of capelin (Mallotus villosus) from Div. 3K and 2J in November 1975. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/62, Ser. No. 3849, 5 p.

Chan, M. and J. Carscadden. 1976. The food and feeding of capelin (Mallotus villosus) in the Labrador area during Autumn 1973. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/20, Ser. No. 3800, 5 p.

Dommasnes, A., T. Monstad and G. Sangolt. 1974. The Norwegian capelin fishery on Grand Banks, Newfoundland, 1973 (The "Nordglobal" expedition). Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/63, Ser. No. 3283, 4 p.

Dragesund, O. and T. Monstad. 1973. Observations on capelin (Mallotus villosus) in Newfoundland waters. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 73/33, Ser. No. 2967, 14 p.

Furevik, D. and T. Westergaard. 1975. The capelin fishery on Grand Banks, Newfoundland in 1974 (The Nordglobal expedition). Fisk. Gang 61: 222-225. (Fish. Res. Board Can. Transl. Ser. No. 3471, 1975).

Gjøsaeter, J. 1972. Recruitment of the Barents Sea capelin 1951-1961. ICES C.M. 1972/H:24.

Gulimov, A. V. and S. M. Kovalev. 1975. Estimation of commercial stock of Newfoundland capelin within a single mathematical model. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/6, Ser. No. 3434, 13 p.

Kovalyov, S. M. and B. D. Kudrin. 1973. Soviet investigations on capelin in the Grand Newfoundland Bank area in 1972. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 73/26, Ser. No. 2959, 5 p.

1975. Soviet investigations of Newfoundland capelin in 1974. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/84, Ser. No. 3560, 6 p.

Labarta, E. 1976. Observations on the capelin fishery of the Grand Banks, Newfoundland, June-July 1975. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/9, Ser. No. 3778, 11 p.

Payne, R. H. 1975. Esterase polymorphism in the capelin, Mallotus villosus: Preliminary evidence for geographic variation in allele frequencies at three loci. ICES C.M. 1975/H:28.

Sangolt, G. and Ø. Ulltang. 1976. Norwegian capelin fishery and capelin investigations in Newfoundland and Labrador waters in 1975. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/23, Ser. No. 3803, 8 p.

Seliverstov, A. S. and S. M. Kovalev. 1976. Size of the capelin spawning stock on the Grand Newfoundland Bank. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 76/VI/51, Ser. No. 3837, 14 p.

Serebrov, L. I., V. S. Bakanev and S. M. Kovalev. 1975. The state of Newfoundland capelin stock. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/7, Ser. No. 3435, 11 p.

Sergeant, D. E. 1963. Minke whales, Balaenoptera acutorostrata Lacépède, of the western North Atlantic. J. Fish. Res. Board Can. 20: 1489-1504.

1973. Feeding, growth and productivity of Northwest Atlantic harp seals. J. Fish. Res. Board Can. 30: 17-29.

Smedstad, O. M. 1975. Some notes about the influence of the capelin fishery on the food supply of Arcto-Norwegian cod. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/8, Ser. No. 3436, 7 p.

Stanek, E. 1975. The percentage of capelin in the stomach contents of cod in ICNAF Subareas 2 and 3. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/5, Ser. No. 3433, 9 p.

Ulltang, Ø. 1974. On the management of a capelin fishery. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/90, Ser. No. 3326, 7 p.

1975a. A summary of Norwegian research carried out on capelin in Newfoundland and Labrador waters, 1969-1974. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/3, Ser. No. 3431, 17 p.

1975b. The present capelin situation in the Barents Sea. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/4, Ser. No. 3432, 1 p.

Winters, G. H. 1974a. Back-calculation of the growth of capelin (Mallotus villosus) in the Newfoundland area. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/7, Ser. No. 3150, 16 p.

1974b. Rationale for partition of capelin quota in Subareas 2 and 3. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/12, Ser. No. 3158, 2 p.

1975. Review of capelin ecology and estimation of surplus yield from predator dynamics. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/2, Ser. No. 3430, 25 p.

Winters, G. H. and J. S. Campbell. 1974. Some biological aspects and population parameters of Grand Bank capelin. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 74/76, Ser. No. 3309, 23 p.