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Harp seals and their foods: How do they interact?

by

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INTRODUCTION

Particularly during the late 1960's, many fish stocks in the northwest Atlantic were overexploited and a number remain depleted today (Pinhorn 1976, pers. comm.). The general pattern of overexploitation and the recent rapid development and collapse of the capelin (Mallotus villosus) fishery has generated concern about the possible impact of reduced prey biomass on marine mammal populations in this area. Of particular interest is the possible detrimental effect of reduced prey availability on the Northwest Atlantic harp seal population (Pagophilus groenlandicus). A period of heavy hunting reduced the population size of harp seals age one and older by more than 50% between 1952 and the early 1970's (Beddington and Williams 1980; Lett et al. 1978; Winters 1978). Since the introduction of quotas in 1972, population size has stabilized and likely is slowly recovering (Roff and Bowen 1980; Lett et al. 1978; Winters 1978). Management policy of the Canadian Government over the past few years has been to set the total allowable catch at levels such that a slow increase in population size may be expected to occur (Mercer MS 1979). The question then is to what extent might present and future levels of commercial fishing compromise this objective? Concern has also been expressed about the effect of increasing marine mammal populations on fisheries yields.

FOODS OF HARP SEALS

The foraging ecology of harp seals has received relatively little attention and although the major prey species are likely known the relative importance, seasonal, and yearly variability of foods in the diet are poorly understood. The most comprehensive study of harp seal diets to date is that of Sergeant (1973) which summarized the existing scanty literature and added significant new data collected over the period 1952-71. Of the 1129 stomachs collected by Sergeant only 421 (37.4%) contained food. Winter feeding in the Gulf of St. Lawrence is based on 180 samples, however, the composition of the diets of southward migrants and Gulf harp seals in spring is based on 30 and 141 stomachs respectively. Our knowledge of the foods of harp seals in the Front herd (eastern Newfoundland and Labrador) comes from the quantitative analysis of 70 stomachs collected from St. Anthony, Newfoundland, 1971 (Sergeant 1973). Harp seal foods during the summer have been compiled from qualitative hunter reports in West Greenland (Kapel and Geisler 1979; Kapel 1973). The most recent review of harp seal feeding is found in Beddington and Williams (1980).

Harp seal pups are nursed for approximately two weeks with a fat rich milk whose composition has recently been studied by Lavigne, Stewart and Fletcher (MS 1980). At three to four weeks of age the moulted pup acquires the juvenile pelage and is known as a beater. Beaters, after a period of apparently voluntary fasting (Worthy, Lavigne and Bowen 1980), begin to feed in April on small crustaceans, however, we know little of beater diets. Sergeant (1973) reported that six of seven beater stomachs collected in April contained euphausiids of the genus Thysanoessa. Stewart and Lavigne (1980a) found that 6 of 12 beater stomachs sampled at this time contained shrimp (Pandalus sp.) and Sergeant (1976) reported that the stomachs of several beaters taken on the northeastern Newfoundland Shelf contained shrimp (Pandalus borealis). It appears from the qualitative reports from hunters compiled by Kapel (1973) that young harp seals in Greenland waters feed heavily on small crustaceans and to a lesser extent on small fish, predominantly capelin.

Wintering sub-adults and adults in the Gulf of St. Lawrence appear to feed chiefly on capelin, but other pelagic fish, decapod and euphausiid Crustacea were occasionally found (Sergeant 1973). However, a sample from the Magdalen Islands showed that herring was the most common food with several flatfish (Pleuronectidae) also being recorded. There is some evidence that shrimp, Pandalus borealis, may be an important food in both the Gulf of St. Lawrence and the northeastern Newfoundland Shelf (Bowen, unpubl. data; Innes, Stewart and Lavigne 1979; Sergeant 1976).

Harp seals are segregated by age during the summer. Beaters and sub-adults are found mainly along the shores of West Greenland, while adults are generally found in the Canadian Arctic (Sergeant 1965). Little is known of harp seal foods in the Canadian Arctic, but Kapel (1973) reports that seals feed largely on capelin, and decapod (Pandalus sp.) and euphausiid Crustacea in West Greenland. He noted considerable regional variation in the diet and suggested that in some areas capelin is replaced by crustaceans as the major food. More recently Kapel and Geisler (1979) reported that stomachs collected from Umanak district, which in the early 1970's had indicated significant feeding on crustaceans, contained large quantities of polar cod (Boreogadus saida) in 1978 and 1979.

In summary, harp seals inhabiting the northwest Atlantic feed cheifly on pelagic fish, especially capelin, and pelagic and benthic Crustacea (Euphausiacea, Mysidacea, Amphipoda, and Decapoda), with small quantities of benthic fish which include redfish (Sebastes marinus), cod (Gadus morhua), American plaice (Hippoglossoides platessoides), and Greenland halibut (Reinhardtius hippoglossoides). Recent information suggests that polar cod in the north and shrimps throughout the harp seal's range may be more important foods than previously recognized.

STATUS OF HARP SEAL PREY POPULATIONS

With few exceptions, the prey of harp seals are commercially harvested by man. This section reviews the trend in abundance of commercial fish and invertebrate stocks during the period 1955-79. Unless otherwise stated the information has been extracted from Templeman (1966), Pinhorn (1976, MS 1981), and ICNAF/NAFO Statistical Bulletins. Figures 1 and 2 show the catch of selected species or species complexes in ICNAF Statistical areas 0-4 (Fig. 3) for the period 1955-79. Although effort data are not shown it can be generally assumed that decreasing catches result from a decline in stock biomass rather than reduced fishing effort. In Fig. 1A, we see that with the exception of haddock (Melanogrammus aeglefinus) the catch of groundfish species excluding cod increased from 100,000 MT in 1955 to a peak of almost 650,000 MT in 1973 and thereafter declined rapidly. Redfish landings show a similar trend in the 1970's, but also experienced a period of overexploitation in the late 1950's.

Commercial harvests of pelagic fishes, especially herring (Clupea harengus), increased rapidly during the late 1960's resulting in overexploitation of most stocks and a decline in landings from a peak of 580,000 MT in 1969 to approximately 250,000 MT in the late 1970's. At present all herring stocks on the Atlantic coast are either fully-exploited or overexploited. During the early part of this century, capelin was used extensively for fertilizer and as bait in the cod line fishery. Landings were as high as 25,000 MT from the inshore Newfoundland area. An international offshore fishery for capelin in NAFO areas 2 and 3 commenced in 1972 with catches of 73,000 MT and landings quickly increased to 366,000 in 1976 (Fig. 2B). However, just as quickly catches dropped to 33,000 MT in 1979. This led to a closure of offshore fishing in 1980. Lack of refined estimates of capelin biomass, together with substantial fluctuations in recruitment, render yield predictions extremely difficult. Nevertheless it is expected that a long-term total allowable catch of 200,000 MT may be reasonable. In the Gulf of St. Lawrence catches of approximately 8,000 MT were taken in 1978 and 1979, but declined in 1980. It is expected that catches could be increased to 20-25,000 MT in this area.

The most important commercial fish species in NAFO areas 1-4 is cod as demonstrated by the close relationship between cod catches and total fish catches over the period 1955-79 (Fig. 2). Cod landings peaked in the late 1960's at over 1,800,000 MT then steadily declined to about 400,000 MT in 1978. All stocks remain depleted, but are projected to increase over the next few years.

Commercial fishing for shrimp in the Gulf of St. Lawrence began in 1965 in the Sept-Iles area, in 1970 in the Esquiman Channel and in 1974 in the area north of Anticosti Island. An area to the south of Anticosti remains virtually unexploited. After a period of slow development the catches in the Sept-Iles area increased from 1,300 MT in 1973 to 3,000 MT in 1979. Similar increases in catches have been observed in Esquiman Channel. Exploitation of shrimp off Labrador and in the Canadian Arctic began in the mid-1970's with catches showing an increasing trend between 1976 and 1979. The nominal catch of shrimp in NAFO Subarea 0 (West Greenland) increased from less than 10,000 MT prior to 1973 to 50,000 MT in 1976 and declined to 33,000 MT in 1979. However, the decline in abundance, evident from 1976 to 1978, appears to have levelled off and some increase is indicated for 1980.

COMMUNITY INTERACTIONS

Marine mammal/fishery interactions are a subset of the larger class of multispecies interactions and community structure problems. Considerable effort has been devoted to the theoretical and experimental study of communities (see Paine 1980 for recent review). However, when dealing with specific problems we are usually constrained in our use of these results by a lack of data on the biology of the species involved. This is presently the case with the harp seal. As we have seen the foraging ecology of this species is not well understood. It is generally assumed that harp seals are opportunistic in their feeding habits. If this is the case, it is not at all clear what effect the depletion of capelin might have on harp seals if other foods are readily available. For example, both polar cod (H. Lear, pers. comm.) and sand launce (Ammodytes hexapterus) (G.H. Winters, pers. comm.) appear to have increased in recent years. Both are pelagic fish about the same size as capelin and may well serve as suitable harp seal prey. However, it is possible that harp seals incur increased costs when foraging for these alternate foods which make these species uneconomical as prey.

It is therefore extremely difficult to assess the impact of depleted fish stocks on the harp seal population. Clearly experimental manipulation of either the harp seal or its prey would be difficult if not impossible. Thus the study of competitive interactions in such systems must employ indirect methods. One promising approach, that taken by Stewart and Lavigne (MS 1980b), involves morphometric analysis of female harp seals and their pups in the whelping area. The argument here is that changes in per capita food availability will be reflected in female condition and/or pup size at birth and subsequent growth rate. It is possible, however, that only those females which have accumulated sufficient energy for lactation will be found at the whelping patch. To test this hypothesis, morphometric data and reproductive tracts of females are being collected from December to February during the period of rapid blubber deposition of late pregnancy (D.E. Sergeant, pers. comm.; Bowen, unpubl. data). From these data it will be possible to compare the condition of females on the feeding grounds just prior to whelping with those found at whelping patches. A change in the condition of females as judged, for example, be reduced blubber thickness at the time of parturition or lower pup weight may well be the first sign of reduced per capita food. The major drawback of this approach is that it does not address the dynamics of the interactions. Thus there is no way of knowing whether the change in condition we observe is caused by the depletion of capelin or perhaps increased competition with seabirds.

One can also monitor mean age at sexual maturity and pregancy rate as a means of assessing per capita food availability (Bowen, Capstick and Sergeant 1981). This is possible because of the apparent relationship between growth rate and age at maturity in Phocids (Laws 1959). However, due to the time lag involved in a change in mean age at maturity, changes in the proximate condition of females or pups will likely be the most sensitive measure of competition for food.

The impact of food consumption by seals on fisheries yields is equally difficult to assess. Basically, three questions must be answered: what do seals eat, how much do they eat, and how many seals are there? Clearly harp seals feed on many of the commercially harvested fish species. However, the relative proportion of, for example, capelin in harp seal diets throughout the year is not known nor is the variability in the proportion of various foods from year to year. This information is fundamentally important owing to the substantial seasonal variation in the energy content of many fishes (Lavigne et al. 1976).

The question of how much food is eaten is also difficult to answer with any precision. It depends on knowing the age specific energy requirements of seals, the amount of utilizable energy available to seals from different foods and the biomass of the seal population. This in turn depends on knowing the age structure of the population and total population size.

Sergeant (1973) calculated that a population of 1.3 million harp seals would consume about 2 million tons of food per annum. In making this calculation he assumed that the average daily ration of an average harp seal was 5% of body weight. This value was criticized by Boulva (MS 1975) on the basis that most captive seals are fed to obesity. Boulva proposed a value of 3% body weight daily. The reported food consumption rates of pinnipeds in captivity range from 1.75 to 10% of body weight per day (Gallivan and Ronald 1979; Geraci 1975; Keyes 1968). Clearly, such a wide range of values could cause errors of up to 6 times in the estimation of the food requirements of a population.

It may be possible to refine estimates of the total food consumption of the harp seal population using Lavigne et al.'s (1976) estimates of the daily energy requirements of an adult harp seal. However, it is not clear how we could use this calculation to assess the loss in yield to commercial fisheries. A reduction in the abundance of harp seals would undoubtedly lower the natural mortality rate of certain commercial stocks of fish. However, the amount of increase in yield to the fishery will depend on the size of fish eaten by seals relative to those taken by fishing. At present this information is unavailable.

CONCLUSIONS

Harp seals in the Northwest Atlantic feed on many commercially harvested fish and invertebrate populations. However, the relative proportion, seasonal and yearly variation of different foods in the diet are poorly documented. It is not possible at the present time to assess the impact of depleted prey populations, especially capelin, on the harp seal population, nor is it possible to calculate with any precision the annual food consumption rate of the seal population and the potential loss in yield to commercial fisheries.

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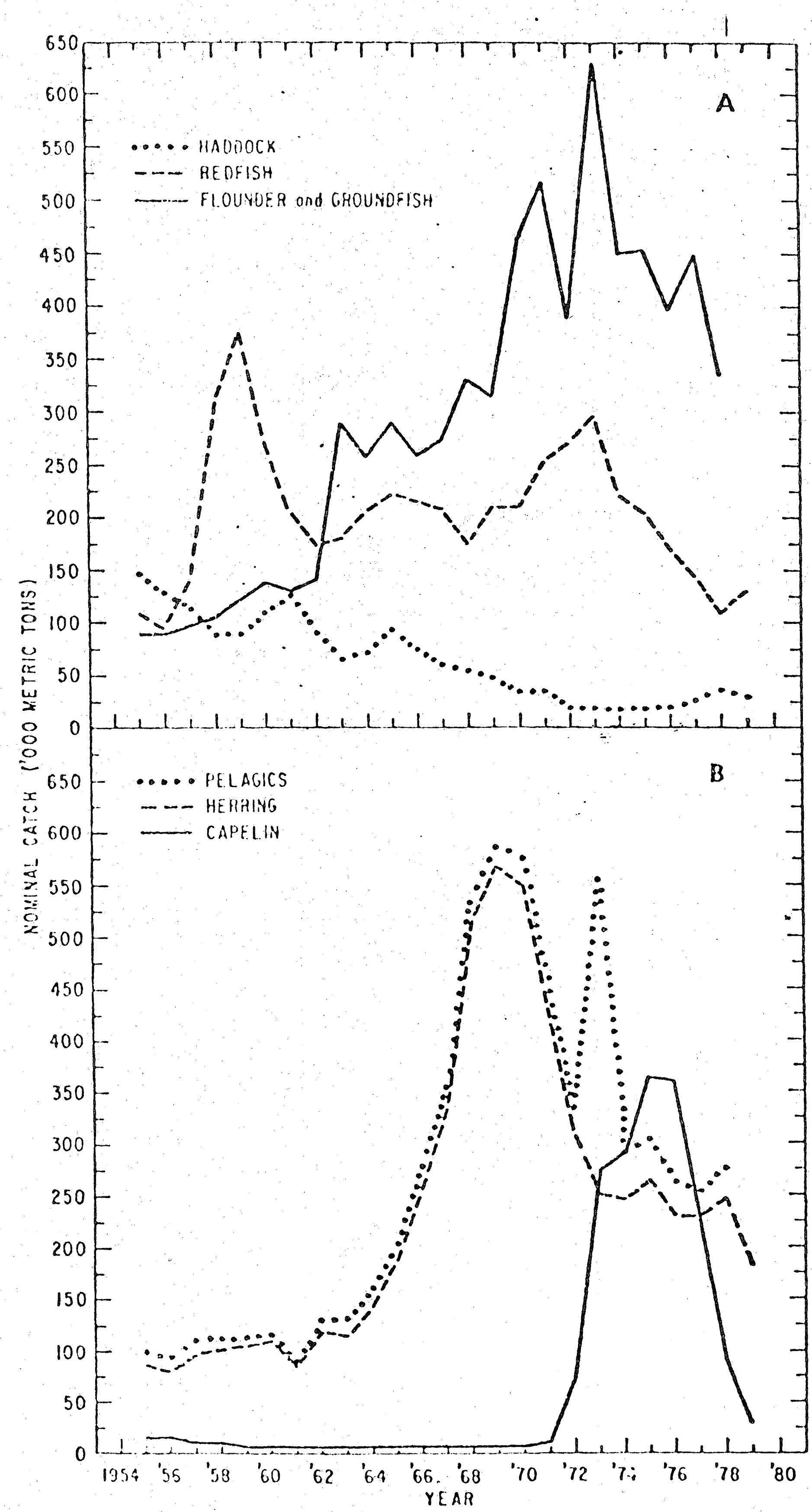

Fig. 1. Nominal catches in thousands of metric tons of A) haddock, redfish, flounder and groundfish excluding cod and B) all pelagic fishes, herring and capelin in NAFO Divisions 0-4 from 1955 to 1979.

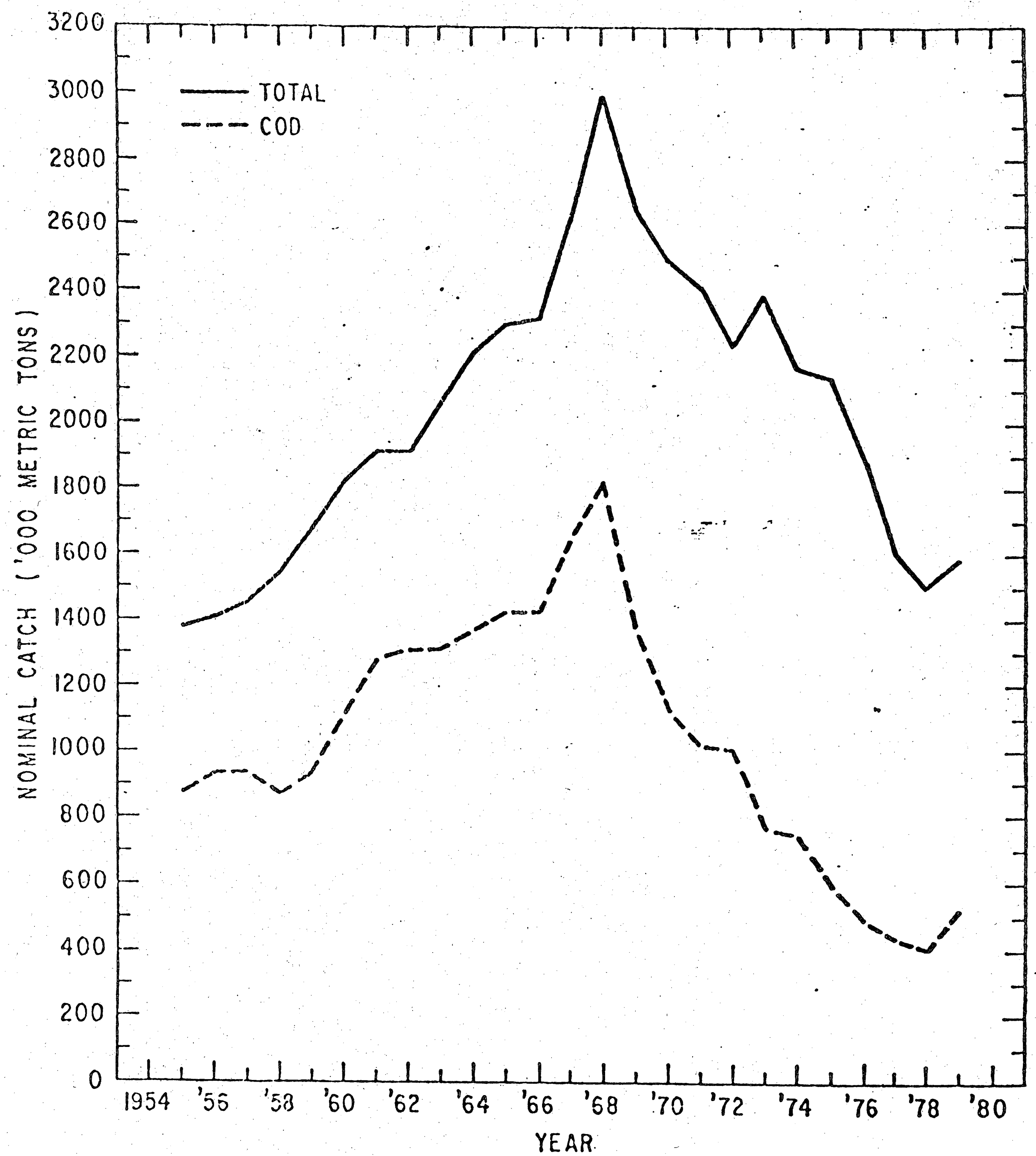

Fig. 2. Nominal catches in thousands of metric tons of all commercial species (total) and cod in NAFO Divisions 0-4 from 1955 to 1979.

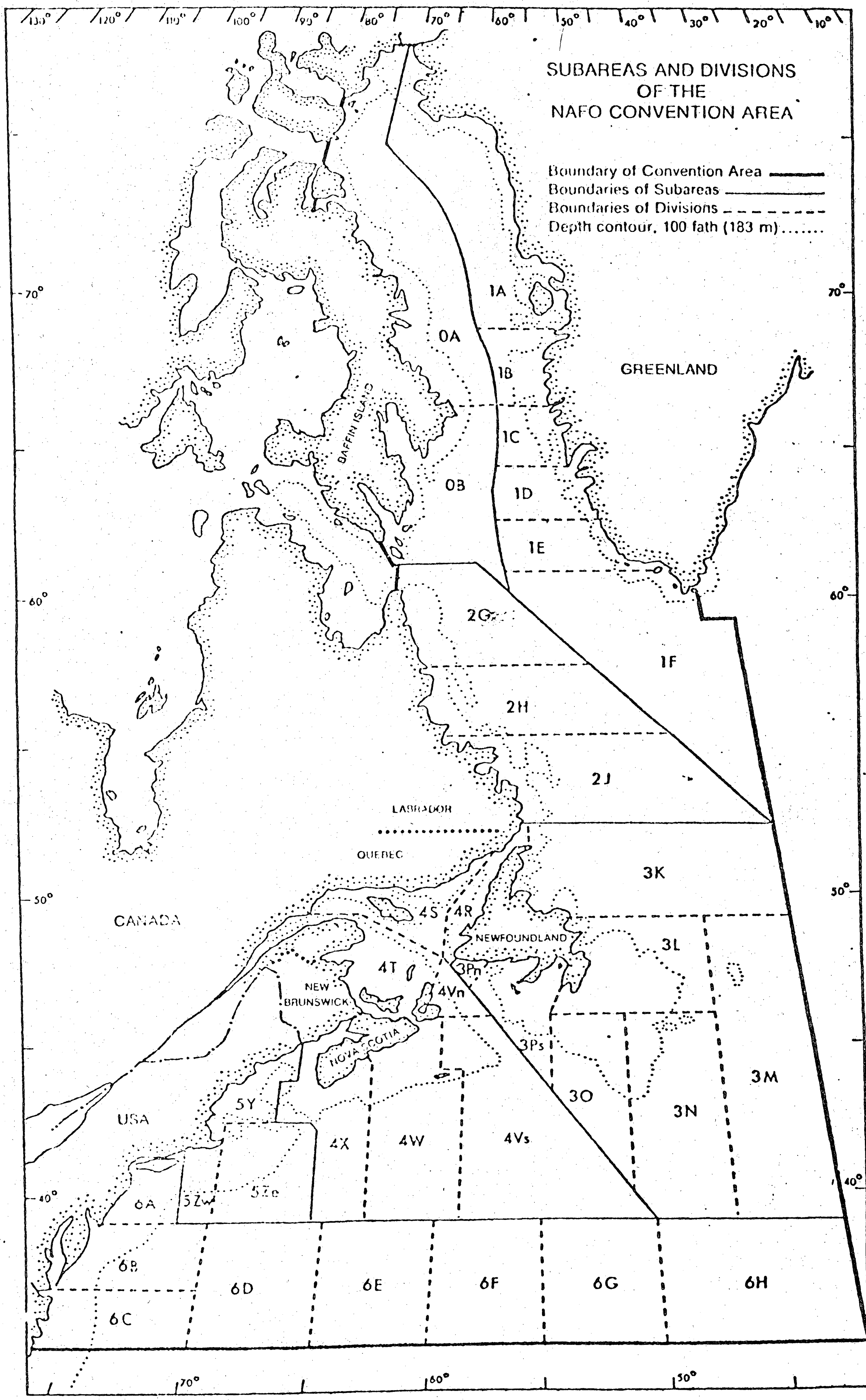

Fig. 3. Map showing subareas and divisions of the Northwest Atlantic Fisheries Organization.