

Not to be cited without the
permission of the authors¹

Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 86/8

Ne pas citer sans
autorisation des auteurs¹

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 86/8

**Review of Management Units in the Gulf
of Maine Area: - Argentina silus (Ascanius)**

by

R.G. Halliday
Marine Fish Division
Fisheries Research Branch
Scotia-Fundy Region
Department of Fisheries and Oceans
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2

¹ This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research Documents are produced in the official language in which they are provided to the Secretariat by the author.

¹ Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

Abstract

Management units for argentine were established as Div. 4VWX and as Subarea 5 by ICNAF in 1974. The rationale was administrative convenience as scientific advice provided at that time was that these areas should be combined for management purposes. Advice in 1974 was based on observed clines in vertebral counts and parasite infestations and widespread distribution of ripening fish, which suggested that there is a complex of stock units spread along the edge of the northwest Atlantic shelf. There are no new data relevant to stock structure. Not enough is known to justify definition of "best" lines for geographic separation of unit stocks, but fishable concentrations of argentine appear to be restricted to Canadian waters.

Résumé

En 1974, la CIPANO a désigné les unités de gestion relatives à l'argentine par la Div. 4VWX et le sous-secteur 5. La raison en était de faciliter la gestion, puisqu'à l'époque, les chercheurs conseillaient de combiner ces secteurs aux fins de gestion. En 1974, les conseils étaient basés sur les tendances observées du dénombrement des vertèbres et des infestations de parasites et sur la distribution étendue des poissons proches de la maturité; ceci suggérait l'existence d'un complexe d'unités de peuplement piscicole étalées de long du bord nord-ouest du plateau continental atlantique. On ne dispose pas de nouvelles données sur la structure des peuplements. Nous en savons trop peu pour justifier la définition des "meilleures" lignes de séparation géographique des unités de peuplement, mais les concentrations exploitables d'argentine semblent se limiter aux eaux canadiennes.

History of Management Area Definition

Management units for argentine in the northwestern Atlantic were established as Div. 4VWX and as Subarea 5 at the January 1974 special meeting of ICNAF and became applicable in 1974 (ICNAF, 1974a). There have been no changes in management areas since their establishment but separate management of argentine in Subarea 5 was discontinued after 1974 when they were included in the "Other Finfish" category and managed along with several other species under a single TAC applying to Subareas 5 and 6 (ICNAF, 1974a).

Biological aspects of argentine management were first considered by STACRES of ICNAF at its meeting of January 1974 (ICNAF, 1974b). STACRES concluded that "As there is no precise separation of stocks between SA5 and Div. 4X and it is possible that some argentine catches in SA5 are from Div. 4X stocks, it is not possible at this time to define the potential yield from SA4 distinct from that of SA5. Thus, it may be desirable to manage argentine, as for pollock, and combine SA4 and 5 for management purposes." The report of STACRES went on to provide a single TAC recommendation for the combined subareas but also to state "To prevent local overexploitation, it would be appropriate to divide this TAC equally between Div. 4VWX and SA5".

The Fisheries Commission of ICNAF chose to partition the TAC set for 1974 equally between Div. 4VWX and Subarea 5. (Essentially, it set separate TACs for these two areas.) This decision was based on administrative convenience. The Fisheries Commission was in the process of establishing a second tier TAC system for Subarea 5. Pollock, which was managed on the basis of Div. 4VWX + Subarea 5, was already causing problems because it did not fit neatly under the second tier TAC for Subarea 5. There was a strong motivation to make management areas for single species TAC management coincide with that for the multi-species (2nd tier) TAC; the 2nd tier system would otherwise be prejudiced. While STACRES preferred that argentine be dealt with in the same way as pollock with a single TAC for Div. 4VWX and Subarea 5, it recognized the Commission's problem by advising on how to partition the TAC between Subareas (i.e. equally).

An interim USA-Canada fisheries agreement reached at the time of extension of jurisdiction in 1977 provided that there be no fishing by third countries in the disputed zone in the Gulf of Maine Area. This agreement remained in effect until the ICJ decision in 1984 and made argentine management in Subarea 5 a non-issue during the dispute period for Canada, and essentially also for the USA. The USA has not addressed the question of argentine management within its post-1976 regulatory framework. Canada has continued to recognize Div. 4VWX and Subarea 5 as the units of regulation. (In the Draft Fisheries Agreement of 1979 between the USA and Canada, however, argentine in all of Div. 4VWX and Subarea 5 were placed in a single management unit, and Canada specified as the Party of primary interest with respect to management.)

In 1976, ICNAF established the small-mesh gear line (SMGL) along the edge of the Scotian Shelf. Canada adopted this regulation on extension of

jurisdiction and has since maintained it, with various modifications. In effect, this has restricted argentine fishing in Div. 4VWX to a strip along the shelf edge, seaward of the SMGL, since 1976. The rationale for this regulation was minimization of bycatches of species subject to large-mesh (130 mm) gear regulations, particularly haddock and cod.

Biological Basis for Definition of Unit Stocks

The STACRES report of January 1974 was based upon a review of the stock structure, and other aspects of argentine biology, by Halliday (MS 1974). With regard to stock structure, morphological observations by Borodulina (1964, 1968) and Shevchuk (MS 1973), parasite infestation data of Scott (1969), observations on the distribution of ripening and spawning fish by Emery and McCracken (1966), Konstantinov and Noskov (1972) and Noskov and Zakharov (1964), and Halliday's own observations on vertebral counts, were utilized to reach the following conclusion:

"... the Scotian Shelf is apparently inhabited by a complex of stock units with limited mixing among adjacent units, resulting in observable clines in morphometric characteristics and biological parameters. It is likely that this is also true in other areas of the northwestern Atlantic."

In accepting this conclusion, STACRES supported its point that there was no precise separation of stocks between Subarea 5 and Div. 4X by emphasizing that high concentrations occur in the Fundian Channel, the boundary between these areas, in the spawning season.

On the basis of differences in length and weight at age and otolith weight to fish length relationships among samples from Div. 3Ø, 4W, and 4X, Borodulina concluded that local, isolated, populations occur in each area. Her samples from Div. 3Ø and 4W were small with a limited range of size and age, however, and differences in length and weight at age could have resulted from sampling bias. Differences in otolith weight at length between fish from Div. 4X and Div. 3Ø were large (Div. 4X otoliths were 35% heavier at fish length of 40 cm). Otolith weights were similar between Div. 4X and Div. 4W fish, however. Thus, Borodulina's conclusions concerning differences between Div. 4X and 4W fish are not well supported by her data, but the difference between these and Div. 3Ø fish is more convincing.

Shevchuk had samples available to him from the southern slopes of Browns Bank (Div. 4X), Emerald Basin (Div. 4W) and from south of Banquereau (Div. 4V). Of 12 meristic and morphological characters examined and compared between Div. 4X and 4W fish, only vertebral counts differed significantly in both sexes. Means (sexes combined) for Div. 4X and 4W were 65.71 and 66.39 respectively. Length and weight at age differed between Div. 4X and 4W fish, but not between those from Div. 4X and Div. 4V. However, otolith weight at length in Div. 4V fish was lower than that for the more western areas. Otolith length/breadth ratio was significantly lower in Div. 4X fish (greater than 30 cm) than in those from the more eastern areas. On these bases, he concluded that there are separate populations in Div. 4X and Div. 4W and suggested that another separate group exists in Div. 4V.

Scott, based on 12 samples spread from St. Pierre Bank (Div. 3P) to the Fundian Channel (Div. 4X), concluded that trematode parasites were not suitable for use as biological tags to distinguish populations of A. silus. He did, however, observe a latitudinal cline in intensity of infestation of Lecithophyllum botryophorum, concluding that this is consistent with a fairly continuous distribution of argentine with no great migratory movements or separation into populations.

Halliday had 12 sets of vertebral counts (50-100 fish each) from diverse locations between Georges Bank (Subdiv. 5Ze) and St. Pierre Bank (Div. 3P). These showed a cline in vertebral count, with low average values of about 65.50 in the southwest and high values of above 65.90 in the northeast, one Emerald Basin sample being an exception. (This sample gave an average of 65.38, the lowest in the series.) These counts were lower than those given by Shevchuk which is not readily explainable, although the observations were likely made several years apart.

An observation of argentine spawning in the Emerald Bank area in 1963 by Noskov and Zakharov (1964) was confirmed as occurring in Emerald Basin by Emery and McCracken (1966) in 1965, and by Halliday (MS 1974) in 1967 and 1968. Soviet observations on gonad condition had suggested to them that spawning also occurred on the slopes of Browns Bank and Banquereau (Konstantinov and Noskov, 1972) and, along with the authors' observations of ripening fish along the edge of the central Scotian Shelf, this led Halliday to speculate that spawning was widespread along the entire shelf edge.

Widespread spawning along the shelf was consistent with the observations on clines in vertebral counts and parasite infestations and led to the conclusion that there is a complex of stock units, with limited mixing among adjacent units, spread along the edge of the northwest Atlantic shelf. This was not inconsistent with the observations of Borodulina or Shevchuk who found differences between characteristics of populations at discrete, fairly widely separated, but arbitrarily chosen, points.

It may well prove to be the case that there are fewer, more clearly identifiable, spawning groups than was implied by Halliday (MS 1974). Distribution of ripening fish is a poor indicator of spawning location as migrations may occur during ripening and prior to spawning. A discrete spawning location in Emerald Basin is clearly established. It is unfortunate that Soviet data have not been presented in detail but the report of Konstantinov and Noskov (1973) is particularly convincing that there is a spawning site in the Fundian Channel, probably in and around Georges Basin. They report that the Soviet catch of over 30,000 t of argentines taken in April 1972 (i.e. peak spawning time in Emerald Basin) was from "dense pre-spawning accumulations of argentine ... located in the Georges Basin." The Soviet claim of a third site on Banquereau Bank remains unsubstantiated, but accepting the hypothesis of three sites in the Scotian Shelf-Georges Bank region could provide enough spawning stocks to account for the differences in characteristics observed in fish from various locations along the shelf if one assumes some, but limited, mixing along the shelf edge during the non-spawning period.

There are no new data since the earlier review (Halliday, MS 1974) which reflect directly on stock structure with the exception of a study on growth by Shevchuk (1977). He concluded that his earlier growth data (Shevchuk, MS 1973) had been unreliable and that, in fact, there are no differences in growth between Browns and Emerald banks argentine. Thus, no growth differences have been reliably demonstrated for argentine among localities in Subareas 4 and 5.

Distribution of argentine and of its fishery

Research vessel catches on standard bottom-trawling surveys by the USA and Canada in the Gulf of Maine Area in the period from the mid-1960s to the end of the 1970s (Almeida et al., MS 1984; Scott, 1976; Sinclair, MS 1981) indicate that argentine are most dense in the Fundian Channel and along the edge of the Scotian Shelf (Fig. 1). Argentine can occur in dense concentrations on the eastern edge of Georges Bank north of Corsair Canyon (McKenzie, MS 1966) but USA surveys indicate that this is not a persistent feature of argentine distribution.

No argentine have been reported as caught in Subarea 5 fisheries since extensions of jurisdiction in 1977. Prior to that date, more argentine were reported caught in Subarea 5 than in Subarea 4 (9,000 t versus 7,000 t annually on average in 1963-76 --ICNAF Stat. Bull. vol. 13-26). Although most Subarea 5 catches were reported from Subdiv. 5Ze, significant amounts were recorded from Subdiv. 5Zw and some argentine have been reported even from Subarea 6. A. silus does not occur in these latter areas except as isolated specimens, thus such catch records are judged to be in error. Assignment of catches between Subdiv. 5Ze and Div. 4X is also likely to have an element of arbitrariness to it, in addition to the more general level of error in assignment to area of capture implied by the reports of more southern catches. Descriptions of fisheries in annual USSR Research Reports to ICNAF provide no comment on their Subarea 5 argentine fisheries with the exception of the large 1972 fishery. Konstantinov and Noskov (1973) reported that the 1972 fishery was based on dense prespawning accumulations of argentine located in Georges Basin which is the deepest part of the Fundian Channel and which is divided by the Subarea 4/5 line. Although caught in Subarea 5, these authors conclude that "Because the Georges Basin concentrations belong properly to the Browns Bank stock, it is not surprising to see the composition of catches in both areas essentially the same".

Taking the description by Kostantinov and Noskov of the 1972 fishery together with results of the extensive research vessel coverage of the area, it seems likely that fishing opportunities for argentine in Subarea 5 cannot be relied upon despite the statistical record. They are unreliable in the sense that fishable concentrations may not always occur in the area (although obviously they may be large when they do). These concentrations which do occur may prove to be extensions of the distribution of fish which spawn, and at other times, are available to fishing, in Div. 4X.

Boundaries for statistical and managerial purposes

Not enough is known about argentine stock structure and patterns of movement to justify definition of "best" lines for the geographic separation

of unit stocks. There are no obvious discontinuities in the distribution of argentine along the edge of the shelf. The only line which could be justified based on present knowledge is one which puts the Georges Basin and Emerald Basin spawning locations into separate management units. The present Div. 4W/4X line does this, although one might guess that a more equidistant line, rather further to the west, would be an improvement.

It is clear that the present Subarea 4/5 boundary is not useful in separating unit stocks. The ICJ line, on the other hand, circumscribes well the area in which fishable concentrations of argentines have been known to occur, these lying on the Canadian side of the line. The ICJ line is, then, the more useful as a management boundary.

Creation of a new statistical Division (Subdivision) from northeast Georges Bank will not matter greatly to argentine stock assessment or management as it appears that northeastern Georges Bank catches should be treated along with those from adjacent parts of Div. 4X in any case. The location of the Subdiv. 5Ze/5Zw boundary is irrelevant to argentine management. Subdivision of Div. 4X at about 65°30'W would provide another statistical line which would place the two known argentine spawning locations in separate statistical units i.e. it would provide an alternative management boundary to the Div. 4X/4W line. It would be about as far to the west of an equidistant line between spawning sites as the Div. 4W line is to the east, however, and it does not confer any obvious advantages over the latter.

As there are essentially no new data obtained since the STACRES review of 1974, and no reason to revise significantly interpretations of data available at that time, there is no basis on which to change scientific views on management units. The only necessary revision to advice arises from the recent definition of the ICJ line. As fishable concentrations of argentine occur only in the Canadian part of Subarea 5, the single management unit suggested by STACRES can be redefined as the Canadian parts of Div. 4VWX and Subarea 5 without prejudice to potential management effectiveness.

Recommendations for future research

An inventory of spawning sites in the Georges Bank-Scotian Shelf area would, perhaps, be the most useful information in determination of most appropriate management units. As eggs and larvae are bathypelagic, and thus difficult to sample, the most feasible approach to such an inventory would be to conduct a trawl survey for adults at the peak of the spawning season in April along the shelf edge and in all the deep basins.

References

- Almeida, F.P., T.R. Azarovitz, L. O'Brian, and E.W. Pritchard. MS 1984. The distribution of major finfish and shellfish species collected during NEFC bottom trawl surveys, 1965-1978. US NMFS Woods Hole Lab. Ref. Doc. No. 84-21, 101 pp.

- Borodulina, O.D. 1964. [Some data on the biology of the argentine, Argentine silus (Ascanius).] Voprosy Ichtiologii, T. 4, Vyp. 1, 68-81. (Also: Ministry of Agriculture, Fisheries and Food, U.K., Translation No. N.S. 59, 1965.)
- Borodulina, O.D. 1968. Argentina silus in the Atlantic Ocean. Cons. Int. Explor. Mer Rapp. et Proc.-Verb., 158: 54-57.
- Emery, A.R. and F.D. McCracken. 1966. Biology of the Atlantic argentine (Argentina silus Ascanius) on the Scotian Shelf. J. Fish. Res. Bd. Canada, 23: 1145-1160.
- Halliday, R.G. MS 1974. A review of the biology of the Atlantic argentine, with particular reference to the Scotian Shelf. ICNAF Res. Doc. 74/21, Ser. No. 3168, 20pp.
- ICNAF. 1974a. Proceedings of the Third Special Meeting October 1973, Fourth Special Meeting January 1974, 24th Annual Meeting June 1974, 258 pp.
- ICNAF. 1974b. Standing Committee on Research and Statistics, Proceedings. Redbook 1974, 154 pp.
- Konstantinov, K.G., and A.S. Noskov. 1972. USSR Research Report, 1971. ICNAF Redbook 1972, Pt II: 81-94.
- Konstantinov, K.G., and A.S. Noskov. 1973. USSR Research Report, 1972. ICNAF Redbook 1973, Pt II: 77-91.
- McKenzie, R.A. MS 1966. Offshore exploratory fishing (argentine, silver hake) July-August 1965. Fish. Res. Bd. Canada Man. Rep. 863, 59 pp.
- Noskov, A.S. and G.P. Zakharov. 1964. Soviet research report, 1963. ICNAF Redbook 1964, Pt II: 92-112.
- Scott, J.S. 1969. Trematode populations in the Atlantic argentine, Argentina silus, and their use as biological indicators. J. Fish. Res. Bd. Canada, 26: 879-891.
- Scott, J.S. 1976. Summer distribution of groundfish on the Scotian Shelf 1970-74. Fish. Mar. Ser. Res. Dev. Tech. Rep. 635, 51 pp.
- Shevchuk, L.I. MS 1973. On argentine stock locality in the northwest Atlantic (ICNAF Div. 4V, 4W and 4X). ICNAF Res. Doc. 73/25, Ser. No. 2958, 6 pp.
- Shevchuk, L.I. 1977. [Age and growth of argentine from Nova Scotia, p49-59. In: Stock estimation and regulation of fishery in the Atlantic Ocean.] Tr. AtlantNIRO, 73. Consulted as: Shevchuk, L.I. MS 1976. ICNAF Res. Doc. 76/56, Ser. No. 3842, 9 pp.
- Sinclair, A.F. MS 1981. Recent trends in argentine abundance on the Scotian Shelf. NAFO SCR Doc. 81/71, Ser. No. N356, 7 pp.

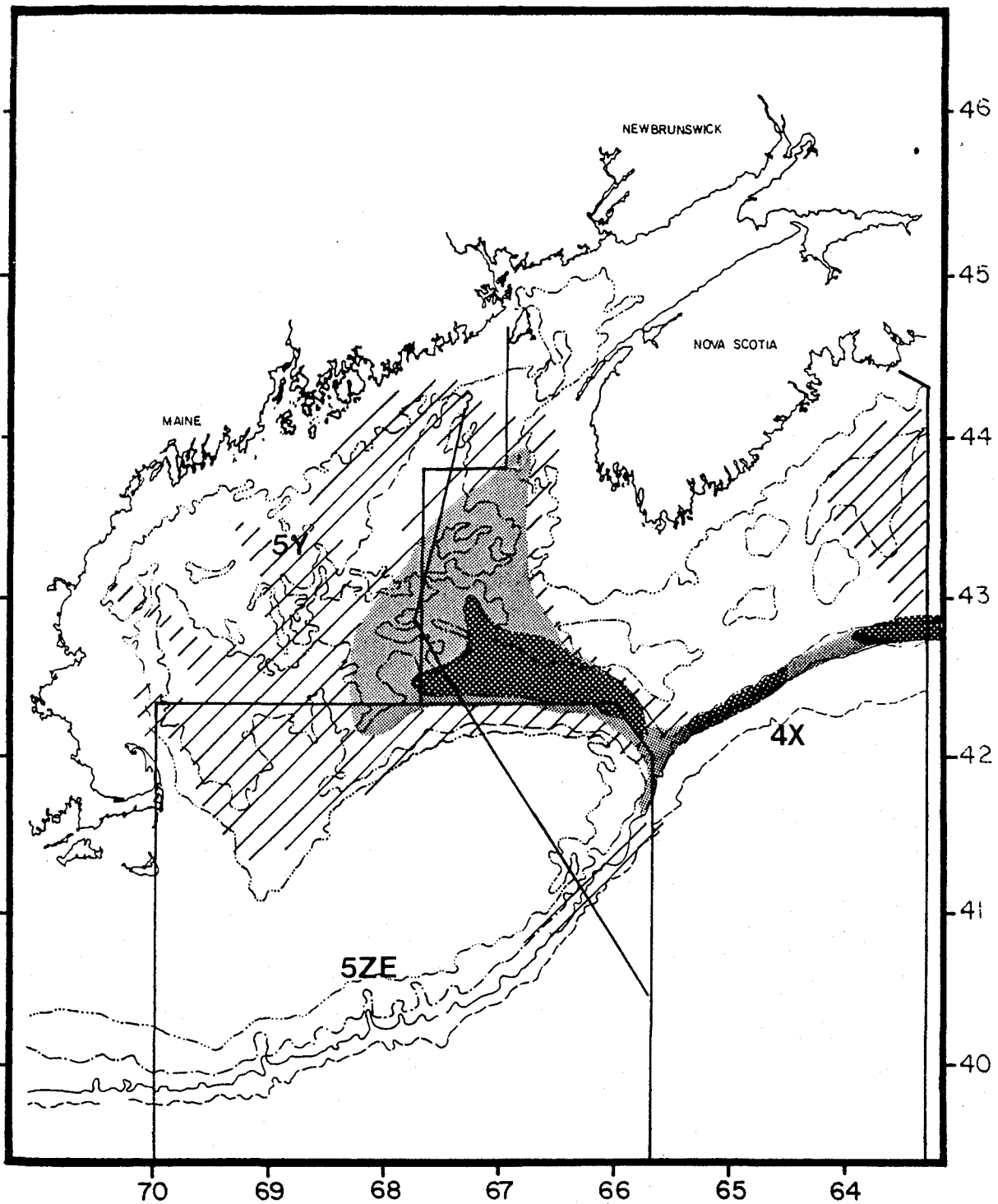


Figure 1. Distribution of *A. silus* based on Canadian and USA research vessel bottom-trawl surveys.