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Stock Status of the Argentine, *Argentina Silus* Ascanius, on the Scotian Shelf (Div. 4VWX)

by

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Abstract

Catches and their size composition in the commercial argentine fishery on the Scotian Shelf are reviewed and the impact of regulation on these is discussed. Biomass and population size composition estimates from stratified-random research vessel surveys in Div. 4VWX in 1970-83 are presented. Population abundance has increased, perhaps by several fold, between the early 1970s and early 1980s, apparently in response both to reduced fishing pressure and good recruitment. The 1980 year-class is, relatively, a strong one. A substantial proportion, perhaps 50%, of the population occurs in the Fundian Channel - Bay of Fundy region which is presently inaccessable to the fishery.

Résumé

Le présent document contient une revue des prises et de leur composition par taille dans la pêche commerciale des argentines sur la plate-forme Scotian et une analyse de la façon dont elles sont influencées par la réglementation. On y présente des estimations de biomasse dérivées de relevés par navires de recherche stratifiés au hasard dans les div. 4VWX entre 1970 et 1983. L'effectif de la population a augmenté, peut-être de plusieurs fois, du début des années 1970 à celui des années 1980, en réponse, semble-t-il, à la fois à une diminution d'effort de pêche et à un bon recrutement. La classe d'âge de 1980 est, relativement parlant, abondante. Un proportion substantielle, peut-être 50 %, de la population se trouve dans la région du chenal Fundian - baie de Fundy, actuellement inaccessible à la pêche.

Introduction

The Atlantic argentine (Argentina silus Ascanius) is a low arctic-temperate species with an amphi-Atlantic distribution. In the northwestern Atlantic the centre of its abundance is on the Scotian Shelf and it is, at least occassionally, abundant on the northeastern edge of Georges Bank. Argentine have been spasmodically fished in these areas from the early 1960s and catches have been subject to controls from 1974.

Stock abundance and fishery trends have previously been described by Halliday (1974), Sinclair (1980, 1981) and Koeller (1982, 1983). The present paper, through review of most recent research vessel survey and commercial fishery data, updates the recent series of stock status reports.

Commercial Fishery

USSR small-mesh gear fisheries began in Subareas 4 and 5 in 1961 and it is likely that some argentines were taken in 1961-62 and reported among the species-unspecified catches. By 1963, catches were sufficiently large to merit separate reporting to, and recording in, the ICNAF statistical system (ICNAF, 1963). Catches were high in the early 1960s with a peak catch of 49,000 t from the Convention Area in 1966 (Table 1). Catches were lower in the late 1960s but a period of higher catches occurred in the early 1970s with about 38,000 t being taken in 1972 and 1974. Extensions of fisheries jurisdictions by the USA and Canada in 1977, by placing northeastern Georges Bank and some adjacent waters in dispute, eliminated the possibility of third party fishing in a previously important argentine fishing area. Coincidentally, small-mesh gear fisheries in Div. 4VWX were restricted to the area seaward of the small mesh gear line and seasonally to 15 April-15 November. Argentine fishing has been ancilliary to other, higher-volume, small mesh gear fisheries, particularly those for silver hake and, in the mid to late 1970s, squid. The change in fishing conditions in 1977 resulted in a substantial reduction in argentine catches in that and subsequent years. These have been taken mostly as by-catch but with some opportunistic directed fishing, particularly by the Japanese fleet in conjunction with its squid fishery (Koeller, 1982; Sinclair, 1981). In 1981-82, argentine catches were only about 400 t. Although 1983 provisional catches suggest an increase to about 800 t, these recent catches are the lowest recorded since 1963. The further reduction in catch from 1981 coincides with a substantial reduction in the Scotian Shelf squid fishery.

Use of official NAFO statistics, FLASH, and International Observer Programme (IOP) data series for derivation of commercial vessel catch rates as indicators of abundance was explored in some detail by Koeller (1982). He illustrated the difficulties in derivation and subsequent interpretation of catch rate series in the prevailing circumstances where factors other than argentine abundance have had major impact on fishing opportunity and practice. No further efforts are made here to develop abundance indicators from commercial data.

Reports on the size composition of commercial catches are not comprehensive. Japanese catches in 1970 and 1971 were predominantly of fish greater than 30 cm (Ikeda, 1971, 1972). USSR catches in 1968 had mean lengths of 27 cm in May and about 30 cm in September-November in the Browns Bank area but 23-25 cm off Sable Island (Konstantinov and Noskov, 1969). In 1972, USSR catches were mainly of fish 29-35 cm, and in 1973 in the Browns Bank area of fish 33-38 cm (Konstantinov and Noskov, 1973, 1974). In 1975 and 1976, Browns Bank catches were mainly of fish 26-32 cm long with means at 30 cm. Emerald Bank fish were rather smaller in these years with means of 28 cm (Konstantinov and Noskov, 1978). These records suggest that argentines taken in the Emerald-Sable Island Banks area (Div. 4W) tended to be smaller than those taken on grounds to the west.

Regulatory changes in 1977 indicated above restricted the fishery to the central Scotian Shelf edge area. Sinclair (1980) provided length-frequencies for the international catch from this area in 1977-79 from the IOP. These showed peak catches at 23 cm and 31 cm in 1977, 26 cm in 1978, and at 23 cm and 30 cm in 1979. Sinclair drew attention to the fact that these frequencies were very similar to those from Div. 4VWX research vessel surveys in July of the same years. There was a tendency, however, for a rather higher proportional representation of the larger size groups in the commercial frequencies, particularly in 1979.

Noskov (1981, 1982) gave length-frequencies of USSR catches in 1977-81 (Fig. 1). Those for 1977-78 are similar to those shown by Sinclair for the international catch but that for 1979 had modes at 28 cm and 34 cm rather than at 30 cm, and did not show a mode at 23 cm. The 1980 frequency was uni-modal at 28 cm while that for 1981 had a primary peak at 29 cm and a secondary one at 32 cm. That for 1980 does not resemble the July research vessel survey frequency for that year, but that for 1981 is not dissimilar (Fig. 5). The number of length measurements available to Noskov were not extensive in 1979-81 (500-1000), but sample size was large in 1977-78 (3,500 and 8,200 respectively).

The IOP argentine length-frequency data for 1980 and 1981 are presently undergoing editing and are not yet available for analysis. Data for 1982 and 1983 are available, however. Details of the sampling data and weighting of catch are given in Table 2. International catches in 1982 were composed to a large extent of small fish with a modal length of 21 cm. In 1983, small fish again composed most of the catch although these were larger than in 1982. Modal size was 24 cm (Fig. 2).

Research Vessel Surveys

Stratified-random bottom trawl surveys have been conducted in Div. 4VWX annually in July since 1970 and, in addition, in spring and fall (usually March and October) since 1979. On some occassions in 1980-83, comparative fishing experiments have resulted in two surveys being conducted in the same season and year. Biomass estimates from these surveys are summarised to the end of 1983 in Table 3 for eastern, central and western shelf regions essentially as defined by Koeller (1983).

A substantial proportion of the biomass is in the western (Fundian Channel - Bay of Fundy) region (Table 3) which is presently inaccessable to the fishery.

Comparative fishing experiments between the A.T. Cameron and Lady Hammond in summers of 1980 and 1981 gave biomass estimates which were similar in 1980 but much higher for the Lady Hammond than for the A.T. Cameron in 1981. Comparative fishing between the Lady Hammond and Alfred Needler in summer 1983 gave similar biomass estimates. Another comparison in fall 1982 is difficult to interpret due to incomplete coverage by the Alfred Needler, but the Alfred Needler caught more in the Central Shelf region despite incomplete coverage. (The net mouth width used here in biomass calculations for the Western IIA net on the Lady Hammond and Alfred Needler is 34 feet.)

Estimated population numbers at length (Fig. 3) indicate that the Lady Hammond caught more small fish around 25 cm than did the A.T. Cameron in summer 1980 but fewer large fish, with a resulting similar estimate of biomass. In summer 1981, the Lady Hammond caught many more fish larger than 30 cm and slightly fewer smaller fish than the A.T. Cameron, giving a substantially greater biomass estimate. In fall 1982, the Lady Hammond caught fewer small fish of about 21 cm but more larger fish of 30-35 cm for a higher biomass estimate, but this comparison is confounded by incomplete coverage by the Alfred Needler. In summer 1983, the Lady Hammond again caught fewer small fish of about 25 cm but more larger fish 30-35 cm for a comparable biomass estimate to the Alfred Needler.

Given the high variability of research vessel survey estimates, the differences between vessels in these comparative fishing experiments are not large. There is some suggestion in the data that the Alfred Needer may catch more small fish and fewer large fish than the Lady Hammond, but the Alfred Needler missed Strata 80-95 in fall 1982 where catches tend to be of large fish (Koeller, 1982). For the purpose of describing general abundance trends, the survey biomass data are used without inter-vessel adjustments.

Biomass estimates have increased from 1977 (Table 3). High variation among estimates masks trends when data points are plotted individually (Fig. 4). The data have been combined and smoothed to clarify trends. In addition, the 1978 point has been adjusted by removing one very large set which gives what appears to be an anomalous estimate (Koeller, 1983). The resultant series suggests that biomass declined from 1970 to about 1975, increased and remained stable in 1976 to 1980, then increased again through 1981-82 (Fig. 4). There may have been a decrease during 1983. The change between 1973-75 and the period fall 1982-summer 1983 was from 2,000 t to 10-13,000 t, a five to six times increase. Comparing the 1973-75 and 1981-83 periods indicates an increase of four times.

Population number at length estimates from 1970-81 A.T. Cameron surveys (Fig. 5) suggest that the increase in biomass in 1977, and its maintenance in the late 1970s resulted from recruitment of strong year-classes which show up in the 20-25 cm length range in 1977 and, to a

lesser extent, in 1979. Moderate recruitment in 1973 and 1974 did not produce a similar biomass increase but this may have resulted from differential effects of fishing, quite large catches being taken in 1974-76.

Population number at length estimates from seasonal surveys beginning in spring 1979 illustrate in detail the progression of new year-classes into the population (Fig. 6). Biomass increase in 1981-83 is associated with recruitment of a large year-class first detected in spring 1981 at about 10 cm, reaching a mode of 25 cm by summer 1983.

Conclusions

Catch controls on A. silus in Div. 4VWX, introduced at a level of 25,000 t in 1974, were reduced in 1977 to 20,000 t. Most recent stock status reviews (Koeller, 1982, 1983) have resulted in an advised catch limit of 10,000 t but no overall TAC was set by Canadian authorities for 1983 or 1984. (Japan did, nonetheless, have an allocation of 3,100 t for 1983.)

Historically, both the Fundian Channel and Central Shelf regions were important to the fishery and there is an indication from commercial sampling data that argentines caught in the Fundian Channel area tended to be larger than those from the Central Shelf. Research vessel survey data suggest that, on average (all surveys in Table 3 with complete coverage of important strata), about 60% of the biomass is in the Fundian Channel-Bay of Fundy region, and confirm that fish in this region tend to be larger than to the east (Koeller, 1982). It is this region which is presently inaccessable to fishing. The estimate of 60% of the biomass being in this region may be too high. If the 1978 survey is discounted as anomalous, as was done when discussing abundance trends above, the estimate becomes 50%. Some bias has also been introduced as the surveys are restricted to depths less than 200 fm. All argentines in the Fundian Channel-Bay of Fundy region are within the survey area as depths are shallower than 200 fm, but along the shelf edge argentines occur deeper than the survey area. These argentines outside the survey area will tend to be larger than those inside as there is a correlation between fish size and depth (Emery and McCracken, 1966). Nonetheless, a substantial proportion of the population is presently inaccessable to the fishery.

Population abundance, as estimated from research vessel surveys, has increased several fold between the early 1970s and the early 1980s. This appears to be a response both to reduced fishing pressure and good recruitment. The impact of good recruitment is most noticable in the 1981-83 period. The commercial fishery has been well sampled in the post-1976 period and it is clear that there is little difference between commercial and research vessel length-frequencies. This may be a function of the incidental nature of the present fishery. It is likely that the year-class dominating commercial and summer research catches in 1982 at about 20 cm and in 1983 at 25 cm is age 2 and age 3 respectively in these years (Halliday, unpublished data) and is therefore the 1980 year-class.

It is not possible to judge how present stock size relates to long-term average levels at some particular level of exploitation rate. It is higher than in the early 1970s, and more limited USA research vessel survey data for the Fundian Channel region suggest that it is higher than at any time since the early 1960s (Koeller, 1982, 1983). However, the 1960s and early 1970s were periods of substantial catches.

In the context of pre-extension of jurisdiction catches when, on average (1963-76), about 7,500 t were taken from Subarea 4 and about 17,000 t from the Northwest Atlantic (mainly Subareas 4 and 5), recent advice on a catch level of 10,000 t for Subarea 4 does not appear restrictive. There is no basis in the data presented here to change this advice, which represents guidance on long-term expectations for average yield. In the present fishery context there is little interest being exhibited in directed fishing for argentines. While there may be reason to fear localised over-exploitation if there were concerted efforts to take a TAC of 10,000 t from the present restricted area of fishing in the Central Shelf region, catches at post-1976 levels do not give much grounds for concern.

Localised over-exploitation could result if there is limited mixing between fished and unfished areas. Halliday (1974) concluded on the basis of vertebral counts, parasite infestations, and geographic occurrences of spawning fish, that "the Scotian Shelf is apparently inhabited by a complex of stock units with limited mixing among adjacent units, resulting in observable clines in morphometric characters and biological parameters". Accepting this conclusion gives grounds for considering a partitioning of the potential Scotian Shelf catch based, perhaps, on research vessel survey estimates which suggest that about 50% could be taken from the Central Shelf region.

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I am grateful to A.F. Sinclair for provision of IOP catch and sampling data for argentine and to both him and P.A. Koeller for access to their files and for helpful discussion of data analysis.

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Table 1. Nominal catches (t) of Argentina silus by NAFO Subarea and country, 1963-82.

	NAFO SUBAREA							COUNTRY					
Year	1	2	3	4	5	6	Total	USSR	FRG	Japan	Cuba	Misc.	Unknown
1963	-	-	-	8,127	4,210	-	12,337	12,337	-	-	-	-	-
1964	13	-	-	4,943	12,830	952	18,738	18,725	13	-	-	-	-
1965	-	-	-	5,611	9,453	166	15,230	15,230	-	-	-	-	-
1966	-	-	119	14,983	33,938	-	49,040	49,040	-	-	-	-	-
1967	-	-	825	4,271	2,026	-	7,122	7,015	-	42	-	65	-
1968	-	-	449	2,675	1,481	853	5,458	4,184	-	1,274	-	-	-
1969	-	5	106	5,354	2,608	5	8,078	5,707	-	2,338	-	28	5
1970	-	-	793	4,553	1,369	10	6,725	2,614	-	4,100	-	1	10
1971	-	-	532	6,715	7,293	-	14,540	5,535	-	9,003	-	2	-
1972	-	-	262	5,868	32,707	-	38,837	38,127	-	710	-	-	-
1973	-	-	138	1,444	2,512	-	4,094	3,691	-	403	-	-	-
1974	-	-	545	17,496	19,695	-	37,736	37,172	-	557	-	7	-
1975	-	-	16	14,691	1,398	68	16,173	16,052	-	56	-	65	-
1976	-	-	163	7,010	322	-	7,495	6,895	-	384	112	104	-
1977	-	-	-	2,489	-	-	2,489	219	136	2,115	15	4	-
1978	100	-	-	1,897	-	-	1,997	330	101	1,545	21	-	-
1979	228	-	-	2,640	-	-	2,868	232	228	2,407	1	-	-
1980	-	-	-	2,053	-	-	2,053	528	-	1,521	4	-	-
1981	19	-	-	369	-	-	388	71	19	298	-	-	-
1982	17	-	12	417	-	-	446	201	17	174	54	-	-
1983*	-	-	-	844	-	-	844	346	-	155	343	-	-

*Provisional statistics obtained from FLASH.

Table 2. Estimation of removals in 1982 and 1983; IOP sample summary and weighting procedures.

YEAR: 1982[1]

Country	Division	Month	No. of Samples	Number Measured	Associated Catch
Cuba	4W	May-July	15	2875	53
Japan	4WX	Aug-Sept	5	1136	163
Poland	4X	July-Aug	4	796	-
USSR	4WX	Apr-July	30	5465	201
Total	4WX	Apr-Sept	54	10272	417

YEAR: 1983[2]

Country	Division	Month	No. of Samples	Number Measured	Associated Catch
Cuba	4WX	Apr-June	17	2741	343
Italy	4X	August	1	159	1
Japan	4WX	Aug-Sept	7	1487	155
Portugal	4Vs	April	1	56	+
USSR	4WX	Apr-July	31	6283	346
Total	4VWX	Apr-Sept	57	10726	845[3]

1 Provisional sample weighting based on total of sample length-frequencies raised to annual international catch (i.e. weighted by sample sizes irrespective of month, Division, and country).

2 Sample weighting was by month and unit area within country based on ratios of observed catches in IOP. This assumes that distribution of observed catches by month and unit area was representative of distribution of total catch.

3 Italian and Portugese catches not shown in FLASH. Observed catches in IOP added to FLASH total.

Table 3. Biomass estimates of Argentina silus on the Scotian Shelf from stratified-random bottom trawl surveys in a) summer, b) spring, and c) fall. (Biomass in metric tons. A = A.T. Cameron, H = Lady Hammond, N = Alfred Needler.)

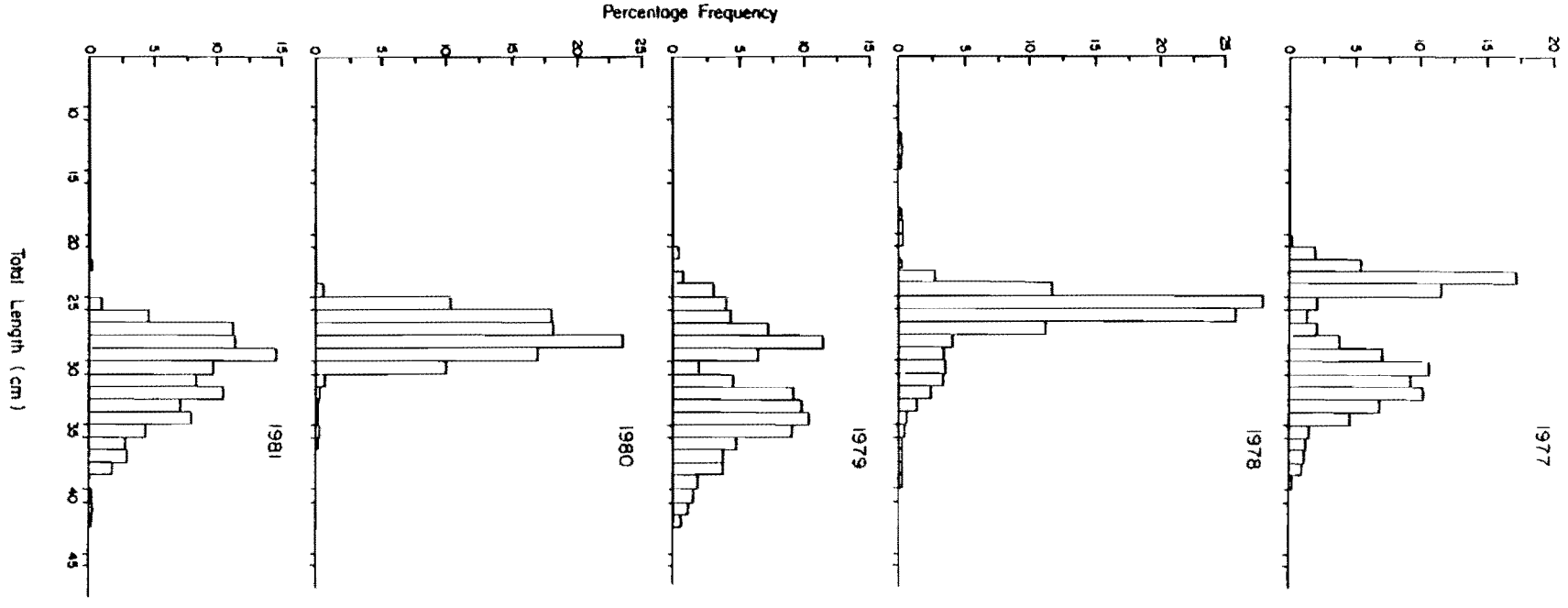
		AREA[1]		
Cruise	Year	Fundian Channel-Bay of Fundy	Central Shelf	Banquereau-Sable Island	Total
a) SUMMER					
A175/6	1970	4637	768	78	5483
A188/9	1971	3236	1705	623	5564
A200/1	1972	618	170	183	971
A212/3	1973	1081	1318	127	2526
A225/6	1974	1085	1591	104	2780
A236/7	1975	242	135	188	565
A250/1	1976	1806	244	0	2050
A265/6	1977	5622	2288	5	7915
A279/80	1978	24900	1603	11	26514
A292/3	1979	4047	3264	108	7419
A306/7 (H37/8)	1980	3065 (1056)	556 (2704)[3]	71 (173)	3692 (3933)
A321/2 (H59/60)	1981	4202 (18324)	1735 (523)[3]	83 (88)	6020 (18935)
- (H80/1)	1982	- (395)	- (3312)[3]	- (392)	- (4099)
N12/3[2] (H101/2)	1983	2658 (3395)	9166 (9004)[3]	61 (71)	11885 (12470)
b) SPRING					
H13/4	1979	271[3]	209	0	480
H33/4	1980	1598	1286	20	2904
H48/9	1981	327[3]	2293	372	2991
H71/2	1982	111[3]	2988	1707	4806
H94/5[2]	1983	1059	14771	545	16375
c) FALL					
H26/7	1979	3135	565	22[3]	3722
H42/3	1980	3407	917	24	4348
H64/5	1981	1449	1358	206	3013
H84/5[2] (NO2/3)	1982	10353 (-)[3]	4134 (8009)[3]	68 (31)[3]	14555 (8040)
- (N17/8)[2]	1983	- (186)	- (2219)	- (44)	- (2449)

[1] Fundian Channel-Bay of Fundy = Strata 80-95; Central Shelf = Strata 60-78; Banquereau-Sable Island = Strata 46-59.

[2] Preliminary analysis - data editing not completed.

[3] Important strata not sampled. (H13/4:72. H26/7: 46,49-52. H48/9:83-84. H59/60:60-61,65-66,72,77. H71/2:83. H101/2:61,65-66,72. NO2/3:49-54,77-78,80-91.)

Fig. 1. Length frequency of USSR commercial catch of A. silus in Division 4VWX, 1977-81 as reported by Noskov (1981, 1982). Note that measurement given is total length.



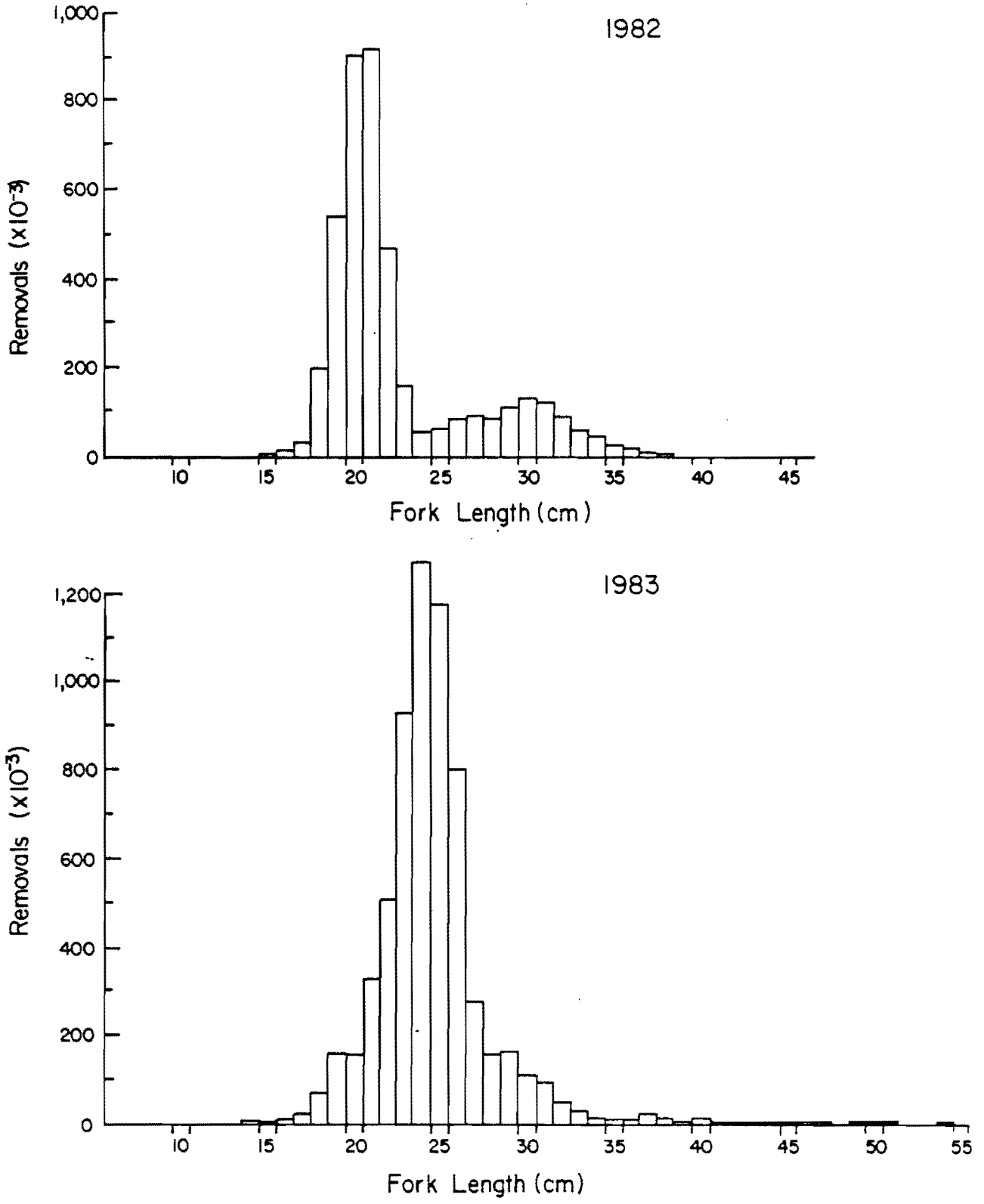


Fig. 2. Estimated number of removals at length of A. silus by the international fishery in Division 4VWX in 1982-83, based on IOP sampling.

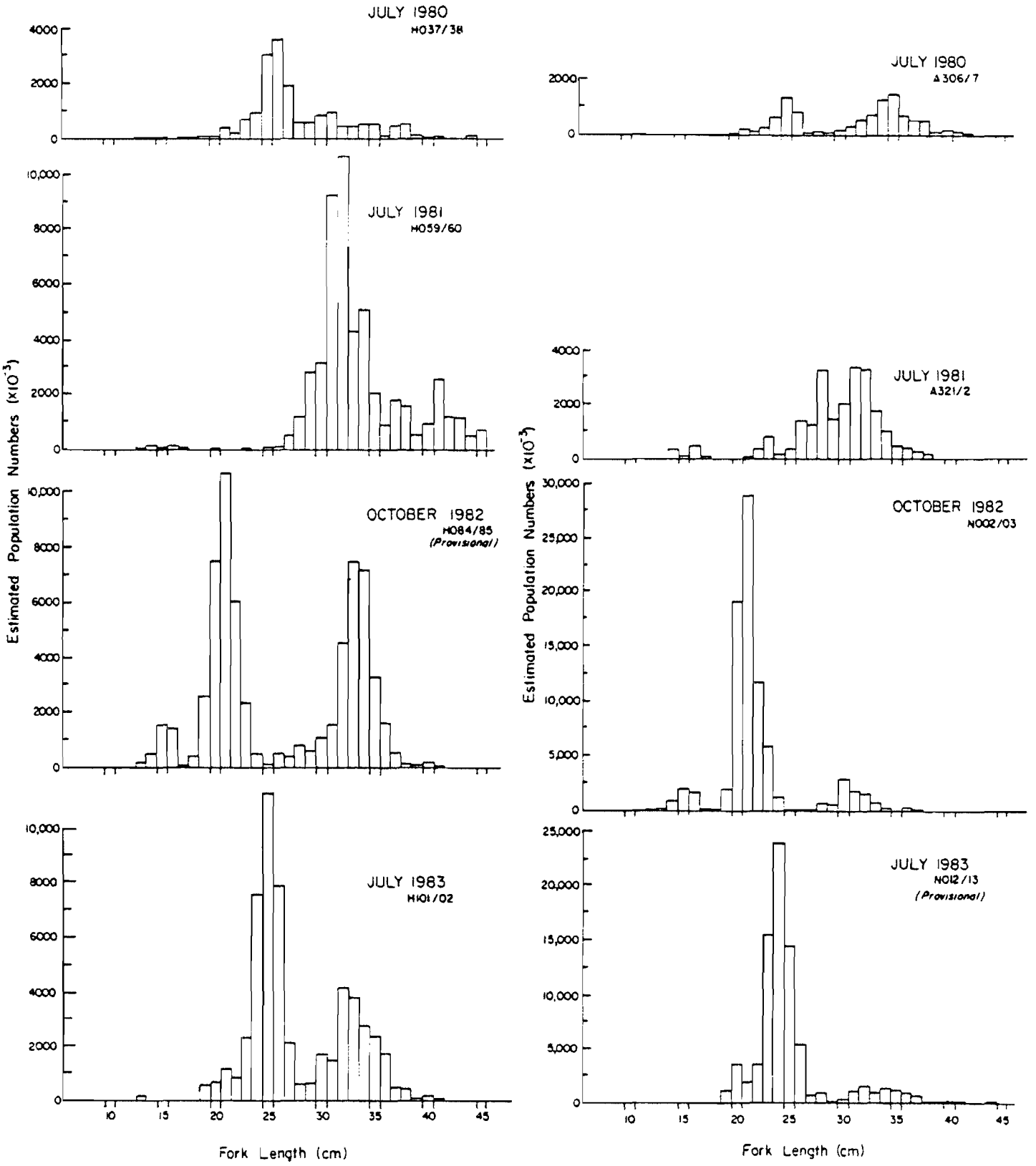
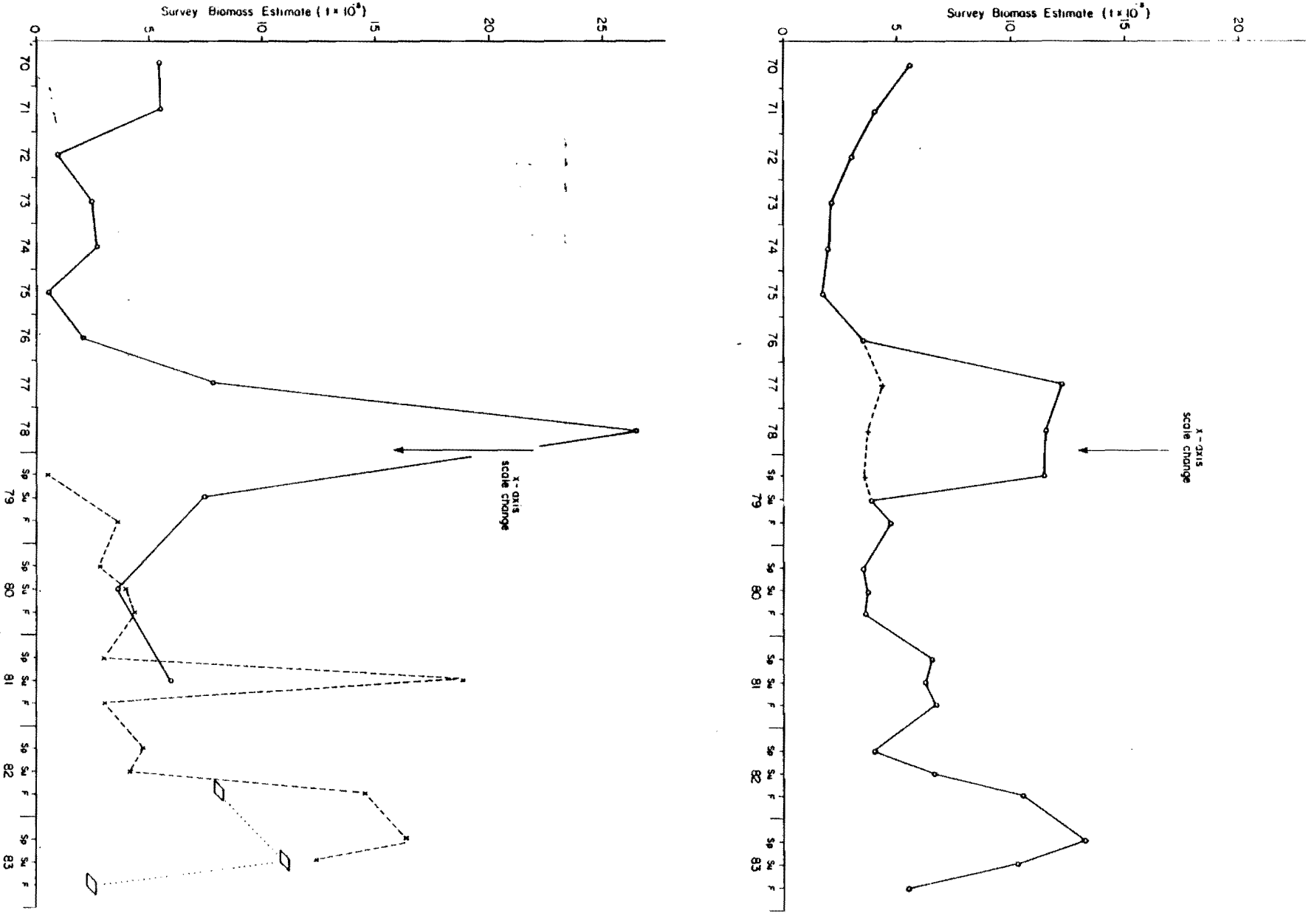


Fig. 3. Estimated population numbers at length of A. silus in Division 4VWX from stratified-random bottom trawl surveys conducted while comparative fishing between A.T. Cameron and Lady Hammond in July 1980 and 1981, and between Lady Hammond and Alfred Needler in October 1982 and July 1983. (Note change of vertical scale by x2.5 for Alfred Needler surveys.)

Fig. 4. Population biomass estimates of A. silus in Division 4VWX, 1970-83, from stratified-random bottom trawl surveys. Lower: unadjusted estimates by vessel (circles - A.T. Cameron, crosses - Lady Hammond, parallelograms - Alfred Needler). Upper: smoothed estimates using 3-yr. running means (first and last points given double weight in calculating 2-yr. mean); estimates unadjusted for vessel or season but estimates for the same season and year averaged before smoothing. Dashed line connects means recalculated after exclusion of one large set in 1978.



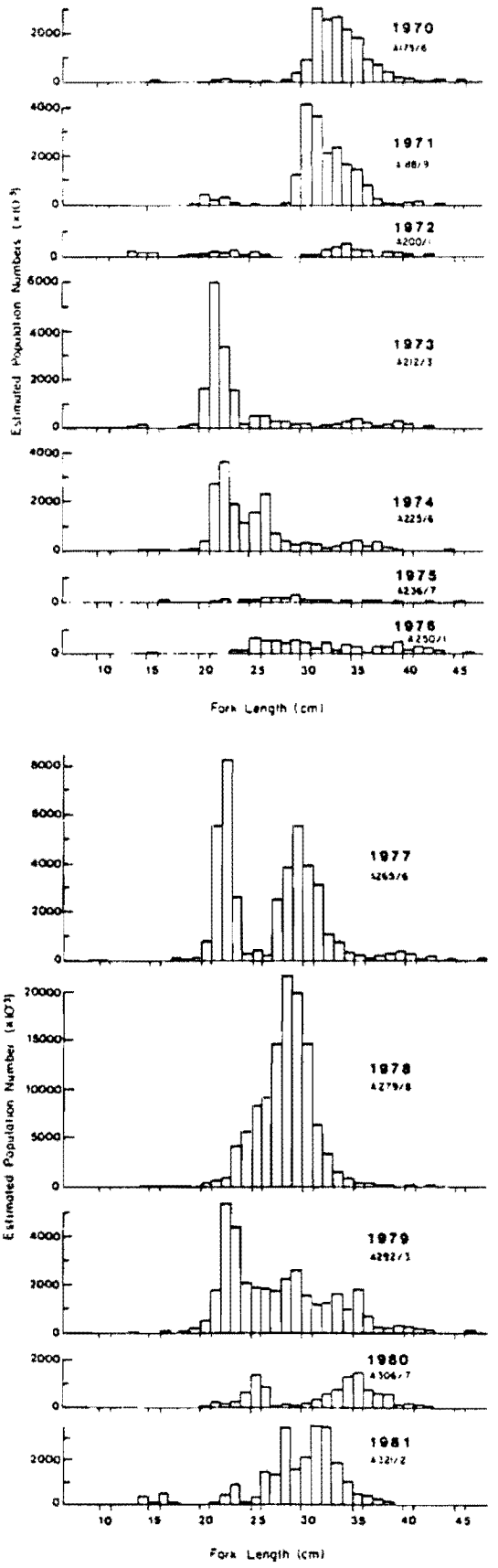


Fig. 5. Estimated population numbers at length of A. silus in Division 4VWX from stratified-random bottom trawl surveys conducted by A.T. Cameron in July, 1970-81. (Note change of vertical scale by x2.5 for 1978 survey.)

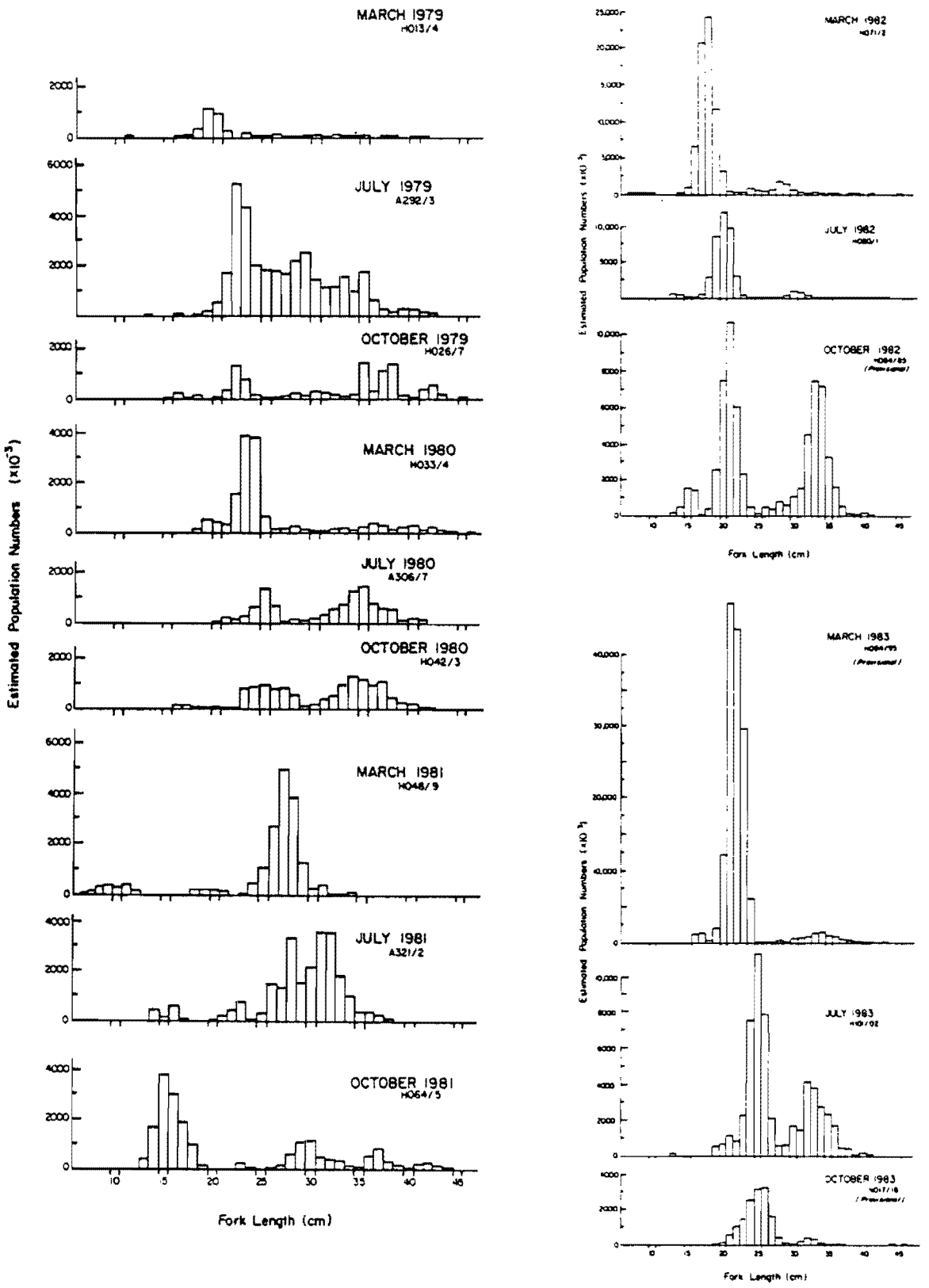


Fig. 6. Estimated population numbers at length of A. silus in Division 4VWX from stratified-random bottom trawl surveys conducted seasonally (spring, summer, and fall) from March 1979 to October 1983. (Note change of vertical scale by x2.5 for large estimates).