New Zealand Fisheries Assessment Research Document 88/19

Jack mackerels

J.B. Jones

MAFFish Fisheries Research Centre
P O Box 297
Wellington

December 1988

MAFFish, N.Z. Ministry of Agriculture and Fisheries

Jack mackerels

(Trachurus novaezelandiae, T. declivis, T. murphyi)

I. Introduction

(a) Overview

There are three species of jack mackerels (Trachurus declivis, T. novaezelandiae, and T. murphyi) in New Zealand waters. They are not separated for management purposes but are treated as one stock.

This paper is a compilation of information provided in the 1986 and 1987 stock assessment papers with domestic fisheries data updated to december 1986 and the EEZ data updated to the end of the 1985/86 fishing year. Available biological information is summarised.

(b) Description of the fishery:

Jack mackerels, or horse mackerels, are pelagic, schooling in summer around the North Island and northern parts of the South Island. They can be caught at all depths on the New Zealand shelf. Nosov & Platoshina (1975) considered them to be one of the dominant fish on the New Zealand plateau north of Cook Strait.

Though there is a large international trade in jack mackerels (world catch of some 3.6 million tonnes in 1985) these fish are not popular in New Zealand and have commonly been discarded. For this reason domestic reported landings were low, representing bycatch, until the mid 1960's when deliberate attempts were made to catch mackerel by purse seining. At about the same time Japanese bottom trawlers began to take significant tonnages of jack mackerel. Reported landings are shown in tables 1 and 2.

For the 1986/87 fishing year a Total Allowable Catch of 20 000 t was set for the Challenger and Central (west) areas combined. In 1987 it was announced that the fishery was to be included in the Individual Transferable Quota scheme, using the fishing year commencing 1 October 1986 as the period to be used in determining provisional maximum ITQ's. A substantial increase in reported domestic landings can be expected from that date. A

court injunction taken out against MAF in 1987 by Maori tribal interests has affected the full implementation of the ITQ scheme.

The 1987/88 gazetted TACs (tonnes) are as follows:

Area	Domestic + charters	Foreign licenced	Total
Kermadec	10	-	10
Challenger, Central (West) + part Auckland (West)	15 210	4790	20 000
Auckland (east), + Central (east)	5 970 #	-	5 970
Southeast, Southland, + Subantarctic	1 740 #	460	2 200
Total	22 930	5250	28 180

= set as non-transferable Individual Quota in Dec. 1987 to expire at the end of the 1987/88 fishing year.

Research on the jack mackerels in New Zealand waters has been intermittent, and the information is scattered.

Current management boundaries:

The Auckland (West) area is modified by excluding the waters of the territorial sea north of 36° S.

From 1st April 1981, foreign licenced vessels (but not chartered vessels) have been excluded from the area north of 38° S as a condition on their permits.

(c) Review of the literature

Although Hector (1872) suggested that there were two species of jack mackerel in New Zealand waters, that was only confirmed 105 years later using both morphometric (Stephenson & Robertson 1977) and biochemical (Gauldie *et al.* 1977) techniques. A comparison of the biology and behaviour of the then known species (*T. novaezelandiae* and *T. declivis*) was given in Robertson (1978). Biological data on *T. declivis* in Australian waters is provided by Gasior & Kompowski (1982) and Williams & Pullen (1986).

In 1986 it became apparent that there was a third species present in New Zealand waters, identified as *T. murphyi* by

Japanese taxonomists. An introduction to the large literature on T. murphyi (which in the eastern Pacific supports a fishery which landed 2 million tonnes in 1985 (FAO yearbook of fishery statistics)) is provided by Abramov & Kotlyar (1980). Trachurus murphyi juveniles form the major food source of albacore in the central south Pacific (Bailey 1988), and occur along the sub-tropical convergence zone. The presence of such large numbers of juveniles suggests a large spawning resource of mackerel exists in the western region of the sub-tropical convergence (Evseenko 1987, Bailey 1988).

Papers on spawning, seasonal and yearly fluctuations, and stock assessment of "T. declivis" were published by Soviet scientists (Nosov 1975a,b; Nosov & Platoshina 1975; Nosov & Shurunov 1975) but their failure to recognise the multispecies nature of the fishery has reduced the value of their observations.

II. Review of the fishery

(a) Catch/effort data

It is not possible to calculate catch effort data for the domestic fishery due to erratic reporting of catch.

Catch effort data is available and has been extracted for the foreign chartered and foreign licenced vessels in the Taranaki Bight, from 1978-1983 (Figure 1).

(b) Other information

Landings data for jack mackerels are available in the Annual Report of the Marine Department from 1940 (table 1).

The total recorded landings for jack mackerels between 1970 and 1986 are summarised in table 2. Catches for 1984-86 by domestic area are shown in figure 2, and a breakdown of 1985 domestic catch by area and month is given in table 3. This shows that the main catching activity in spring and summer is by Tauranga and Gisborne based purse-seiners; while the summer fishery by Nelson purse-seiners in areas 38, 17 and 18 also contributes. There is almost no overlap in fishery between local and "deepwater" fleets which fish domestic areas 36, 40 and 41.

Catches by foreign licensed and joint venture vessels are given in tables 2 & 4, and figure 3, and this is broken down by area (table 4) and by areas D, F(W) & H, by month in figure 4. Catches in area G occur only in October-December.

(c) Maori and recreational fishing patterns.

There is a recreational fishery based on lining and netting by various ethnic groups, particularly in harbours and estuaries. The quantity taken is unknown.

(d) Economic factors.

Catches of Jack mackerel in New Zealand waters by Japanese vessels are strongly influenced by the quantities of frozen jack mackerel available on the Japanese market.

The presence of a resource of jack mackerel in international (and therefore unregulated) waters to the east of New Zealand may have an impact on the amounts caught by foreign nations in New Zealand waters. The USSR took 20 000 tonnes of Trachurus from the eastern side of FAO area 81 (25° S to 60° S; 150 °W to 105 W)°i 1985.

III. Research

(a) Review studies of stock structure

A biochemical study by Richardson (1982) showed that from the distribution of gene and genotype frequencies, the New Zealand and Western Australian T. declivis are distinct sub-populations, and that the New Zealand fish were probably distinct from those around south-eastern Australia.

(b) Review of resource surveys

See below under biomass estimates.

(c) Other studies

Length-frequency data:
There is a substantial amount of length frequency data for jack mackerels, collected both by Fisheries staff and by the Fisheries Observers scheme. Published length frequency data can be found in James (1975).

Compositional analysis of T. declivis and T. novaezelandiae from the east coast of the North Island can be found in Vlieg (1982).

Mesh selection:
Prior to the introduction of the EEZ the Japanese used a codend mesh of about 60 mm for catching jack mackerel on the New Zealand shelf. Diplomatic approaches were made to reduce the codend mesh limit of 100 mm for this fishery and in 1981 the differences in catch between a 75 mm codend and a 100 mm codend

were investigated during the Tomi Maru survey of the Taranaki Bight area. From the results it was concluded that the 75 mm codend could catch small sized jack mackerel (less than 30 cm in fork length) which were not readily retained by the 100 mm mesh and for which there is a market in Japan. There was little evidence to suggest that the use of a 75 mm codend would materially increase the bycatch of species of value to the domestic fishery (Anon. 1981).

During the 1984/85 season vessels were permitted to use a 60 mm mesh in this fishery, by special provisions included on individual vessel permits, but the experiment has not been repeated and the number of vessels involved was not documented.

(d) estimates of biomass

From assumptions based on aerial sightings data and age studies, Robertson (1978) estimated a very conservative total New Zealand annual yield of 36,000 tonnes of jack mackerel. After collating Russian and Japanese estimates Robertson & Eggleston (1979) revised Robertson's (1978) estimate to an annual yield for the whole of New Zealand of between 48,000 and 187,000 tonnes.

i. Central west coast New Zealand.

The main reported commercial catch of jack mackerel is taken almost entirely by Japanese chartered and licenced trawlers working that part of the old areas H and G which included the North Taranaki Bight and the Challenger ridge. The fishery is a seasonal one.

Because of the need to provide more accurate fish population biomass estimates to manage the fishery in that area, two joint Japanese / New Zealand research surveys of area H and northern area G, between 37 30'S and 41 30'S, were carried out. The results from the first, by Tomi Maru (350 GRT) in the summer of 1980-1981, were thought to be a gross underestimation because of the low towing speed (average 3.25 kn). Accordingly, the Japanese made available Shinkai Maru (3393 GRT) in October-November 1981, and the results from this survey (average towing speed 3.8 kn) are thought to be the most reliable for this area. The biomass (tonnes) for the two species in the area (excluding territorial waters inside the 12 mile limit, and outer Tasman Bay (Figure 3) was estimated using the swept area of the net (Robertson et al. 1981). As it is unlikely that the species can be targeted for separately, the separate species biomass indices given in Robertson et al. (1981) were combined and an approximate yield for the survey area was taken by reducing the "wingtip biomass index" by the factor of 0.62 to obtain an "area swept biomass index" (equivalent to the average of the values obtained from the areas swept by the doors and by the net wing tips) of 128 898 t. Assuming a 15% annual productivity for jack mackerel this gave an

annual productivity of about 20 000 tonnes (Jones 1986).

ii. Other areas.

Biomass estimates of jack mackerels from other areas are tabled (Figure 5). These estimates were obtained from surveys aimed at other species rather than the jack mackerels.

There is also a resource of small to medium sized jack mackerel in the Bay of Plenty and Hauraki Gulf, as evidenced by the common occurrence of juvenile jack mackerels in the trawls during snapper surveys, and the frequent sightings of large schools (200-260 tonnes each) by pilots flying from purse-seine vessels during 1984, 1985 and 1986. However, there have been no stratified random trawl surveys in the Bay of Plenty region which have included jack mackerel resources.

(e) estimates of short and long term yield.

The maximum constant yield for Challenger and Central (West) is recommended as 20 000 t which is half the recruited biomass estimated from the 1981 survey, times 0.3 (estimated value of M as an approximation to $_{o}F_{1}$). The value of M was derived from ages obtained from otoliths, and also from catch/age curves). The survey area did not include the waters inside 12 miles, or the outer Tasman Bay, or all of the currently defined management area. It was also assumed that there was no fish above the net mouth and, apart from using the average of the wingspread and doorspread as the area swept, no allowance was made for escapement. The survey is therefore considered to be conservative.

Recruited biomass surveys around the South Island, Chatham Rise and Islands provide a combined yield estimation (using the same parameters) of about 1600 t. There is a further, probably large, resource around the east coast of the North Island and Bay of Plenty which has not been surveyed but from aerial sightings the annual yield has been estimated at perhaps 5000 t.

The average domestic and deepwater catch over the period 1971-1986, excluding the 3 years after the introduction of the EEZ when the catch was below 10 000 t, was 14 300 tonnes.

The yield levels set are on the information currently available, considered to be conservative. The only fishery area which might be under heavy fishing pressure is that targeted by large trawlers off the Taranaki peninsula. Elsewhere, and especially inside the 12 mile limit, jack mackerels are considered to be under-utilised (but not necessarily catchable)

but until markets for jack mackerel become available which are accessible by the domestic fishermen this fish will remain an unwanted bycatch.

Current annual yield:

In the absence of current biomass estimates this cannot be obtained.

(f) Factors modifying yield estimates

The relevance of a single year (1981) biomass survey to a fishery in 1988/89 is open to question, yet it is the only biomass information we have on the main fishing grounds. There is no information available on biomass fluctuations of jack mackerels in New Zealand waters, but with an M value of 0.3 large fluctuations might be expected to occur.

(g) Models

None attempted.

References

Abramov, A.A. and Kotlyar, A.N. 1980: Some biological features of the Peruvian jack mackerel, Trachurus symmetricus murphyi. Journal of ichthyology 80:25-31

Anon. 1981 (unpublished): Report on the Japan / New Zealand joint jack mackerel survey in areas H and G by Tomi Maru No. 55. Japan Marine Fishery Resource Research Centre, Unpublished report. June 1981. 33pp.

Bailey, K. 1988 (in press): Description and surface distribution of juvenile Peruvian jack mackerel Trachurus murphyi Nichols from the subtropical convergence zone of the Central South Pacific. Fishery Bulletin (US)

Evseenko, S.A. 1987: Reproduction of Peruvian jack mackerel, Trachurus symmetricus murphyi, in the southern Pacific. Voprosy iktiologii 2:264-273.

Gasior, W. and Kompowski, A. 1982: Biological and fishery related observations on jack mackerel, Trachurus declivis (Jenyns, 1841) stock during spawning off south-east Australia. Acta ichthyologica et piscatoria 12:3-20

Gauldie, R.W., Purnell, D., & Robertson, D.A. 1977: Some biochemical similarities and differences between two jack mackerel species, Trachurus declivis and T. novaezelandiae. Comparative biochemistry and physiology.,58B:389-391

Hector, J. 1872: Notes on the edible fishes. pp. 95-133 [In] Hutton, J.H. 1872: Fishes of New Zealand, Hughes, Wellington, 133pp, XII plates.

Hurst, R.J. and Bagley, N.W. 1987: Results of a trawl survey of barracouta and associated finfish near the Chatham Islands, New Zealand, December 1983. New Zealand Fisheries technical report 3. 44 pp.

Hurst, R. and Fenaughty, J.M. 1985 (unpublished): Report on biomass surveys 1980-84: Summaries and additional information. Internal report No. 21 Fisheries Research Division, Library, Wellington. 53pp.

James, G.D. 1975: Size composition of jack mackerel catches from the west coast of New Zealand. N.Z. journal of marine and freshwater research 9:45-52.

Jones, J.B. 1986: Jack mackerels. In Baird, G.G. and McKoy, J.L. (Eds). Background papers for the Total Allowable Catch recommendations for the 1986-87 New Zealand fishing year pp. 75-81. (Discussion paper, Fisheries Research Division Library, Wellington).

Nosov, E.V. 1975a: The influence of hydrometerological conditions on the distribution and features of the vertical migrations of the scad -(Trachurus declivis Jenyns). Izvestiya TINRO [Transactions of the Pacific Ocean scientific research institute for fisheries and oceanography] 96:197-208. [in Russian]

Nosov, E.V. 1975b: Determining natural mortality and number using the example of the New Zealand jack mackerel (Trachurus declivis Jenyns). Izvestiya TINRO [Transactions of the Pacific Ocean scientific research institute for fisheries and oceanography] 98:55-66. [in Russian]

Nosov, E.V. & Platoshina, L.K. 1975: The reproduction of New Zealand jack mackerel (Trachurus declivis Jenyns) on the New Zealand plateau. Izvestiya TINRO [Transactions of the Pacific Ocean scientific research institute for fisheries and oceanography] 98:67-79. [in Russian]

Nosov, E.V. & Shurunov, N.A. 1975: Some features of seasonal and year to year variation in the distribution of the jack mackerel (Trachurus declivis Jenyns) . Research into the biology of fish and commercial oceanography, Pacific Ocean scientific research institute for fisheries and oceanography, No. 6:91-104. [in Russian]

Richardson, B.J. 1982: Geographical distribution of electrophoretically detected protein variation in Australian commercial fishes. I. Jack mackerel, Trachurus declivis Jenyns. Australian journal of marine and freshwater research 33:917-26.

Robertson,D.A. 1978: The New Zealand jack mackerel fishery. In Habib, G. and Roberts, P.E. (Ed). Proceedings of the pelagic fisheries conference July 1977 pp. 43-47. Fisheries Research Division occasional publication N.Z. Ministry of Agriculture and Fisheries No. 15.

Robertson, D.A., and Eggleston, D. 1979: Shelf resources: jack mackerel and barracuda. In Elder, R.D., and Taylor J.L. (Ed). Prospects and problems for New Zealand's demersal fisheries. Proceedings of the demersal fisheries conference, Oct. 1978, pp. 30-34. Fisheries Research Division occasional publication, N.Z. Ministry of Agriculture and Fisheries. No. 19.

Robertson, D.A., Grimes, P.J., and Francis, R.I.C.C. 1981 (unpublished): Central west coast fish biomass survey. October- November 1981. Unpublished internal report. Fisheries Research Division. 31 pp.

Stephenson, A.B. and Robertson, D.A. 1977: The New Zealand species of Trachurus (Pisces: Carangidae). Journal of the Royal Society of New Zealand. 7(2): 243-253.

Vlieg, P. 1982: Compositional analysis of jack mackerel and blue mackerel. New Zealand journal of science 25:229-232

Williams, H. and Pullen, G. 1986: A synopsis of biological data on the jack mackerel Trachurus declivis Jenyns. Department of Sea Fisheries, Tasmania. Technical report 10:34pp.

FIGURE CAPTIONS

figure 1. Catch Per Unit Effort for vessels targetting JMA in area H, 1978-1983.

figure 2. Catch (t) by Fisheries Management Area 1984-1986. Catch not reported by area in 1984 = 15942 t;1985 = 1834 t;1986 = 10502 t.

figure 3. Catch by month for licenced and chartered vessels, all areas combined, 1983/84 - 1985/86 fishing years.

figure 4. Catch by area and month (all vessels combined) for areas D,F(w),H; 1983/84 - 1985/86 fishing years.

figure 5. Total Japanese mackerel landings (multiply scale by a factor of 10), and New Zealand landings by Japanese licenced and chartered vessels, 1971-1985.

TABLE 1: Domestic landings of jack mackerels, 1939-1970, from the Annual Report of the Marine Department.

Year	landings (t)	year	landings (t)
1939 £	2	1955	16
1940	4	1956	4
1941	2	1957	8
1942	4	1958	10
1943	<1	1959	3
1944 *	10	1960	7
1945	9	1961	7
1946	11	1962	12
1947	19	1963	23
1948	10	1964	21
1949	29	1965	25
1950	17	1966	109
1951	10	1967	502
1952	14	1968	621
1953	13	1969	327
1954	6	1970	250

£ = year ending 31 March of year following.
* = year ending 31 December

TABLE 2. Total landings in the New Zealand EEZ by nation 1970 to 1986.

year	domestic vessels	foreign chartered vessels	foreign licenced vessels				Grand total
			Japan	Korea	Russia	total	
1970	250		8128			8128	8378
1971	631		13301			13301	13932
1972	586		18070		600	18670	19256
1973	723		14964		200	15164	15887
1974	1473		17738		100	17838	19311
1975	317		13486			13486	13803
1976	1044		15145		400	15545	16589
1977	1719		14539	1534	700	16773	18492
1978	1817	2£	4786			4786£	6605
1979	3131	631£	3187*		640	3827£	7589
1980	3320	N/A	1254*			1254	4574
1981	3542	3136	3983*			3983	10664
1982	2822	4380	2936*			2936	10138
1983	2604	5997	4140	345	0	4485	13086
1984	4614	8620	7226	764	0	7990	21224
1985@	3363	9786	5332	1091	0	6423	19572
1986@	4117	8015	1573	1083	0	2656	14788

* = Japanese fisheries data (annual)
£ = 1 April- 31 March year.
@ = 1 October - 30 September year.

Month/Fisheries management area, Jan 85 - Dec 85

MONTH / AREA	J	F	M	A	M	J	J	A	S	O	N	D
?	3683	12	150	578	402	516	311	374	973	585	1303	2660
1												
2	x	x	x	x	x	x	x	x	x	x	2	x
3	x	3	x		x	1	x	x	2	x	x	x
4						x		x				
5		x	x		x		x	x			x	x
6	x	x		x		x	2				x	x
7	2	1	2	4	2	x	x	x	2	x	x	2
8	x		x	x	x	x	x	x	16		x	x
9	x	x	x	1	40	54	3	149	186	107	38	x
10	1	2		1	2		x	x	x	2	x	x
11	x		x	x								
12	x		x	x			x					
13	164	56	x	x		x	x			x	x	
14	44	17	103			x	x	x			x	144
15	31	x		x		x					8	
16	x	x	x			x	1	x	x	x	x	x
17	x	111	59	x	x	x			x	x	26	x
18	3	x	x	173	25	x			2	4	20	1
19												
20	x	3	1	1	1	x	x	x	x	x	1	1
21												
22	2	7	6	5	1	x	x	x	x	x	1	1
23												
24	x	x	x	x	x	x						
25												
26	x	x		x	x	x	x					x
27												
28												
29												
30												
31												
32												
33		x						1	1			
34				x	x	x	x	2	4	1		
35												
36												
37		1		3	x	x			x	x	x	2
38	x	x		5	272	55	3	x	x	13	43	9
39					x				x	x	x	
40	x	x		x	x	1	x	x	1	x	3	x
41	2	2		x	2	3	1	4	1	2	x	5
42	3				x	x	x	x	1	8	16	10
43						x	x	x			x	1
44							x	x		2	2	1
45	4	x	x	x	x	x	x	x	5	21	19	8
46			1	x	x	2	x	x	x	x	6	3
47			x	x	x	x	x	x	2	x	2	
Tot.	3944	228	353	774	750	639	327	539	1203	753	1494	2854

Total: 13,859

x = less than 1 tonne ? = unspecified area

TABLE 4 Jack mackerel catch by EEZ area 1983/84 -1985/86.

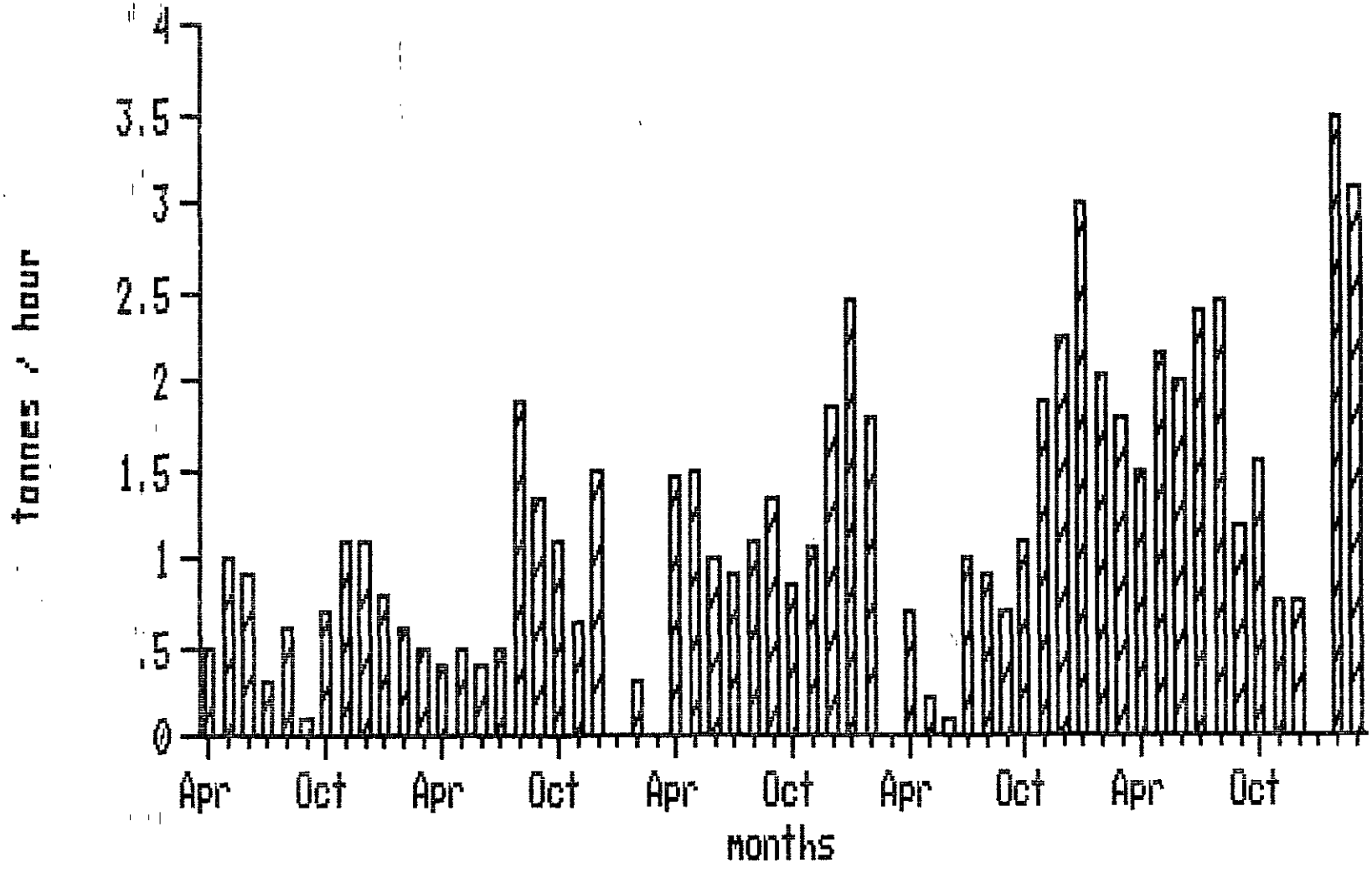
EEZ area	1983/84- FLV	FCV	TOT	1984/85 FLV	FCV	TOT	1985/86 FLV	FCV	TOT
B									
C					45	45		117	117
D	18	-	18	143	226	369		142	142
E	100	-	100	-	-	-	180	1	181
F	32	116	148	72	295	367	135	266	401
G		437	437		463	463		400	400
H	4213	7482	11700	6207	8843	15050	2330	7085	9415
Unknown					2	2			
totals	4363	8035	12403	6423	9786	16296	2645	8015	10656

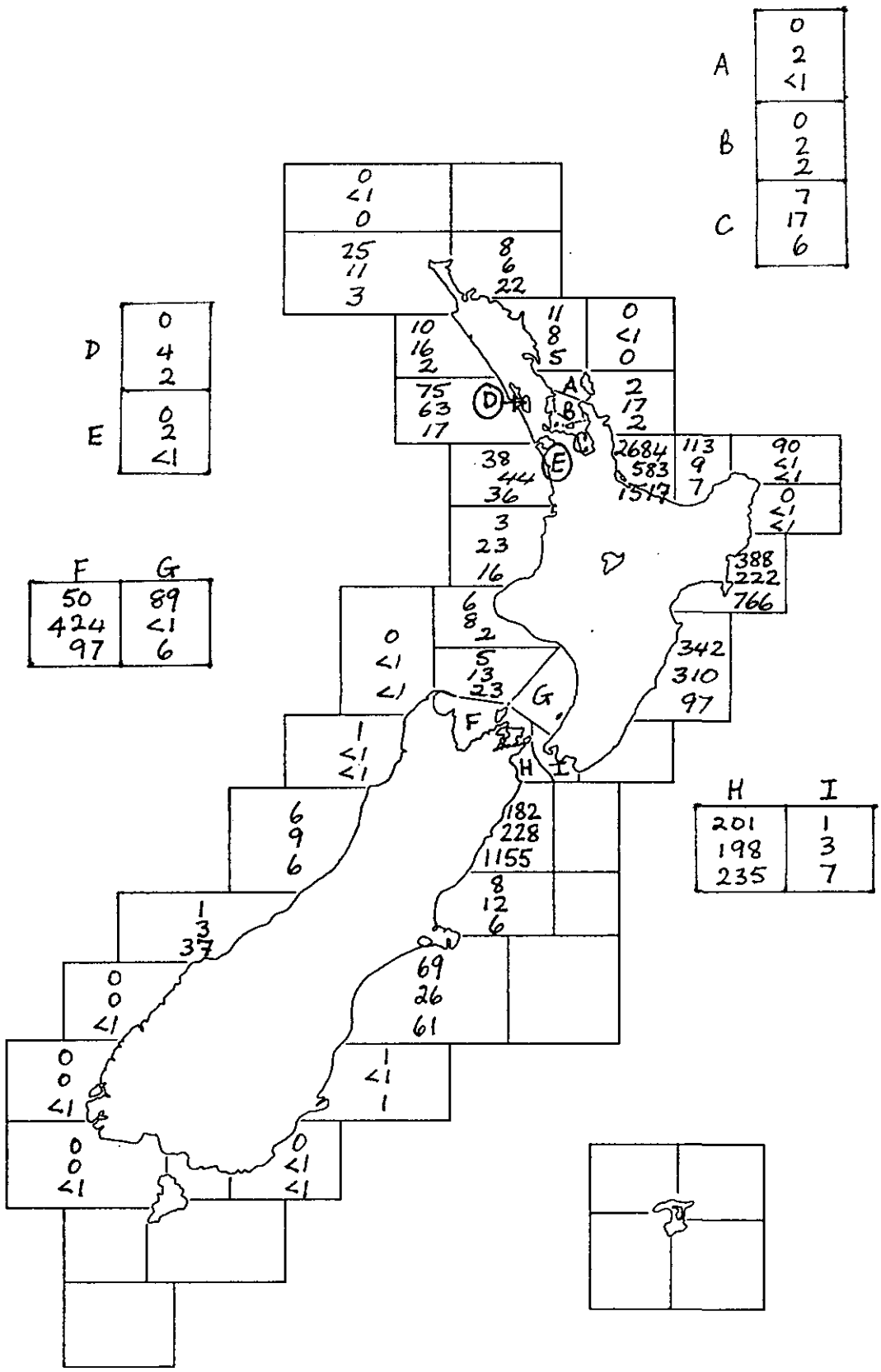
- = less than 1 tonne.

TABLE 5 . Wingtip biomass estimates for Jack mackerels, excluding those in Area H. Adadted from Hurst & Fenaughty (1985) and Hurst & Bagley (1987) and based on swept area = mean of doorspread and wingspread.

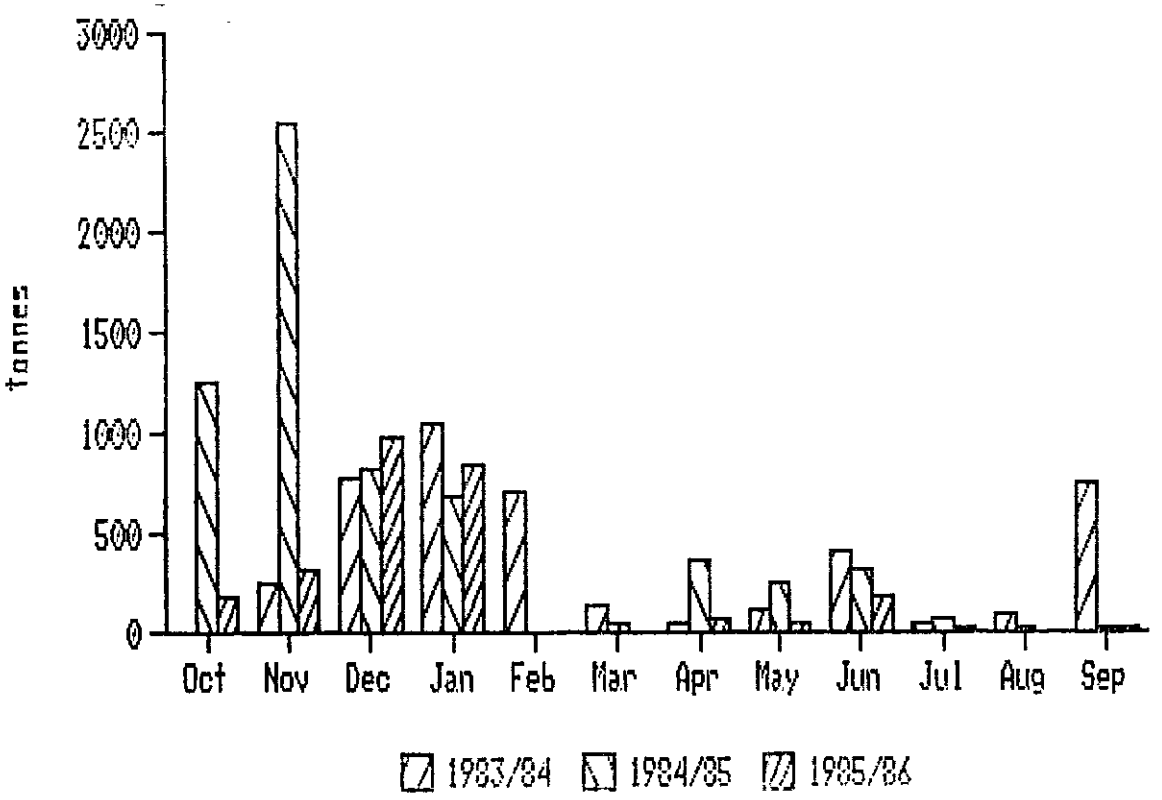
Area	Vessel	Date	Tonnes	c.v.
E/F	Shinkai Maru	June 86	2 800	23
	Akebono Maru	Nov 86	938	58
WCSI	James Cook	Sep/Oct 83	800	30
		Aug/Sep 84	1 000	17
ECSI	James Cook1	Mar 80	973	37
		May 81	15 020	73
		May 82	1 520	29
Chatham Rise	Shinkai Maru	Mar 83	100	73
		Nov/Dec 83	0	0
Chatham Isl.	Akebono Maru	Dec 84	1 300	35
	Shinkai Maru	Jul 86	1 600	21

1 Cruises where c.v. <50 or biomass estimate >100 t. Six cruises between 1980 and 1982 are thus excluded.

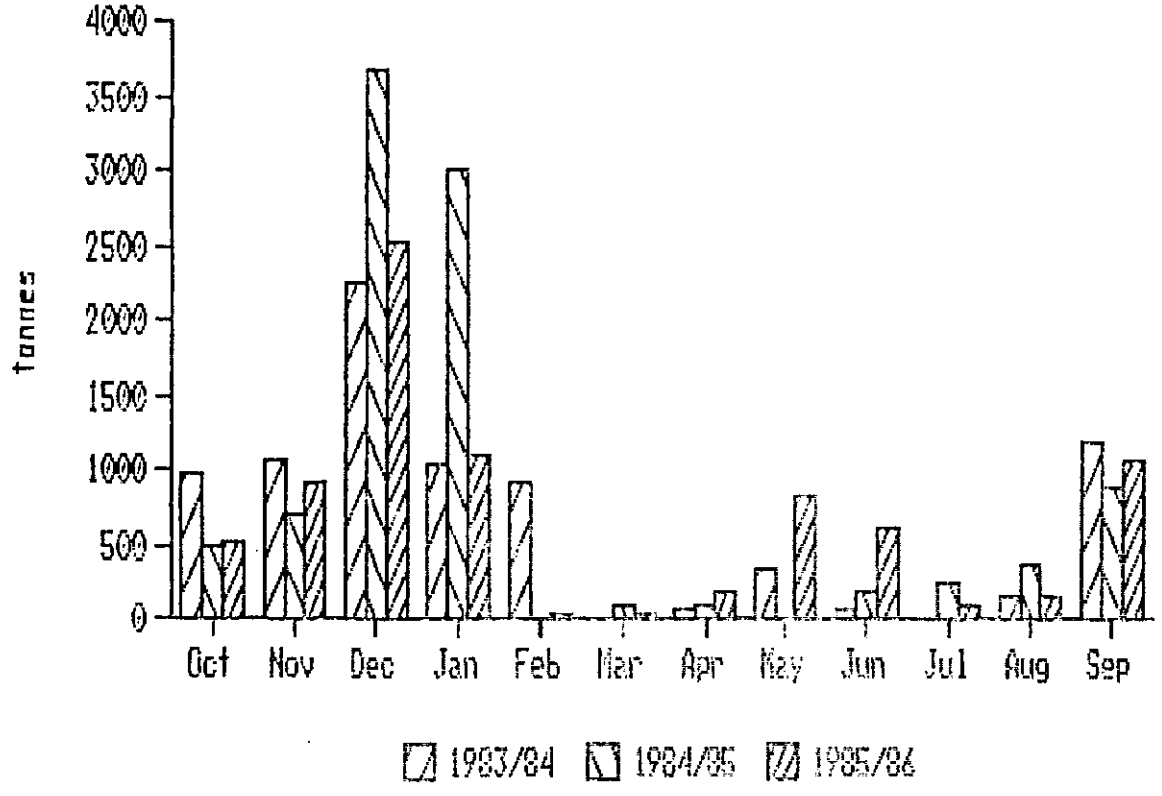

CPUE (all vessels) in area H
catching JMA 1978-1983
tonnes / hour
4
3.5
3
2.5
2
1.5
1
.5
0
Apr
Oct
Apr
Oct
Apr
Oct
Apr
Oct
Apr
Oct
months


A
0
2
<1
B
0
2
2
C
7
17
6
D
0
4
2
E
0
2
<1
F
50
424
97
G
89
<1
6
H
201
198
235
I
1
3
7
0
<1
0
25
11
3
8
6
22
10
16
2
11
8
5
0
<1
0
75
63
17
D
A
B
2
17
2
E
38
44
36
2684
583
1517
113
9
7
90
<1
<1
0
<1
<1
3
23
16
388
222
766
6
8
2
0
<1
<1
5
13
23
G
F
342
310
97
1
<1
<1
H
I
6
9
6
182
228
1155
8
12
6
1
3
37
69
26
61
0
0
<1
0
0
<1
1
<1
1
0
0
<1
0
<1
<1

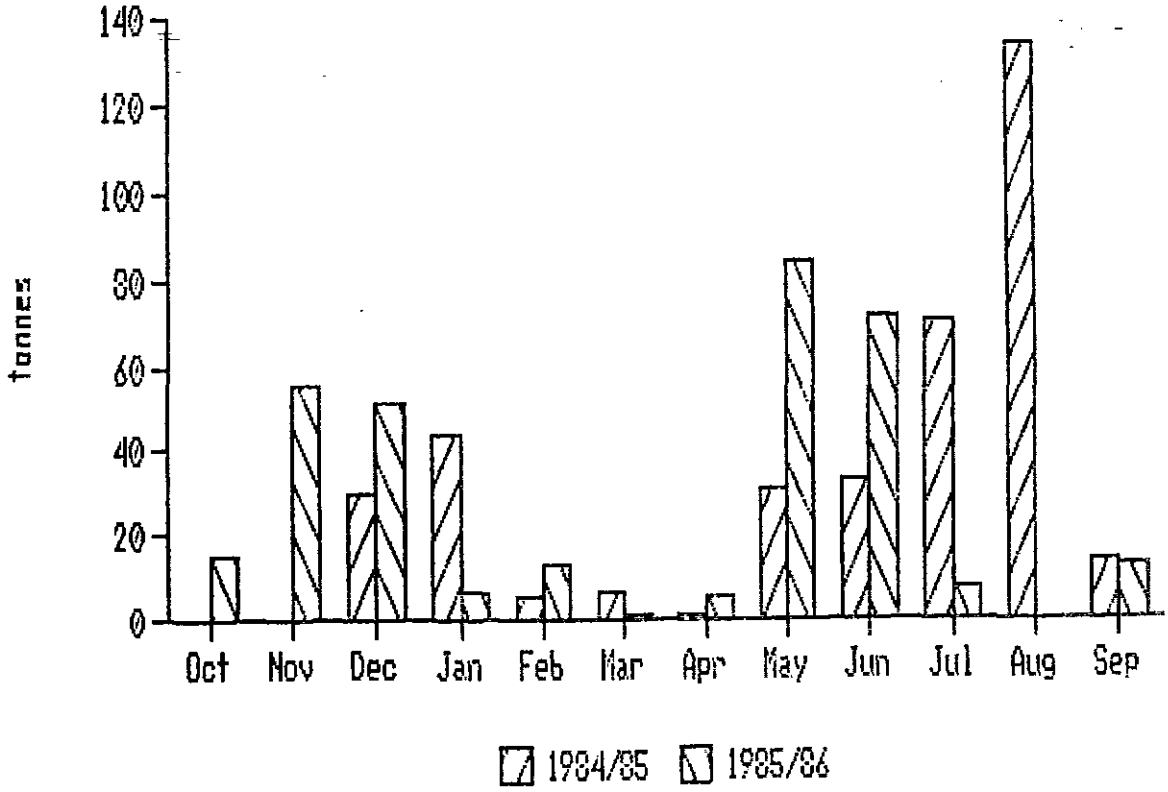
JMA landings by Licenced vessels



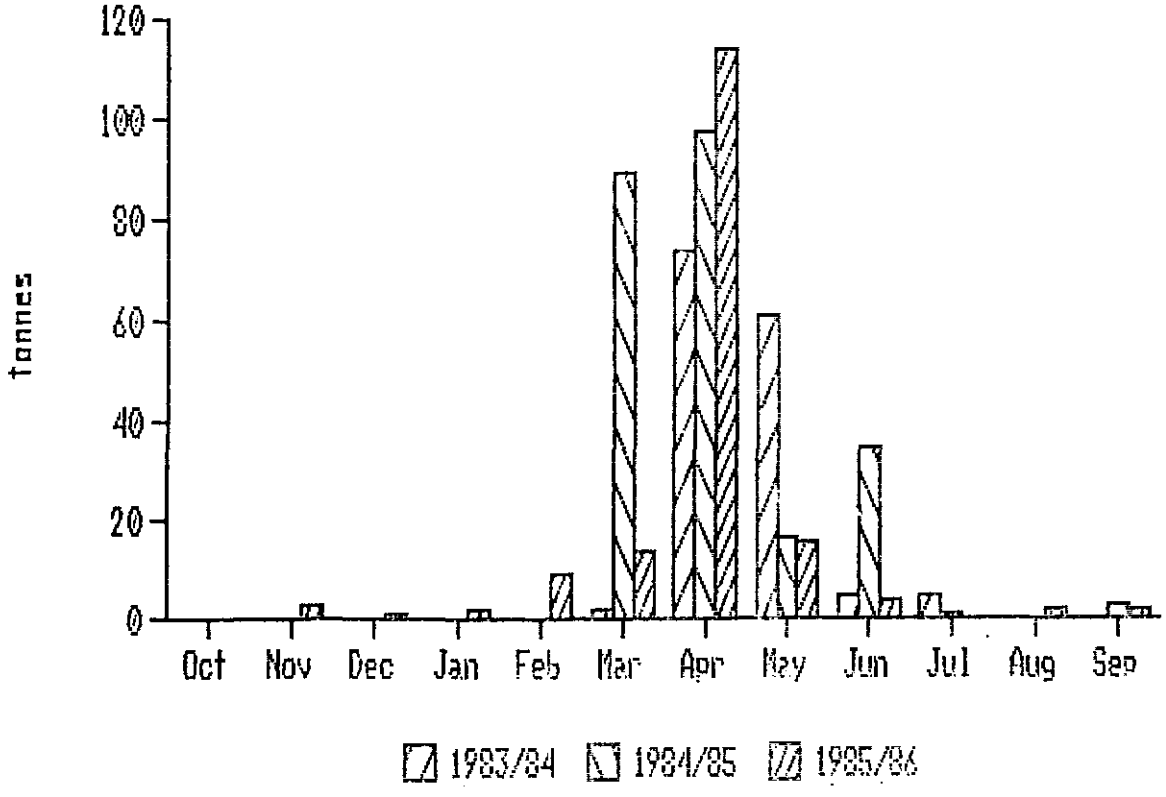
JMA landings by Chartered vessels



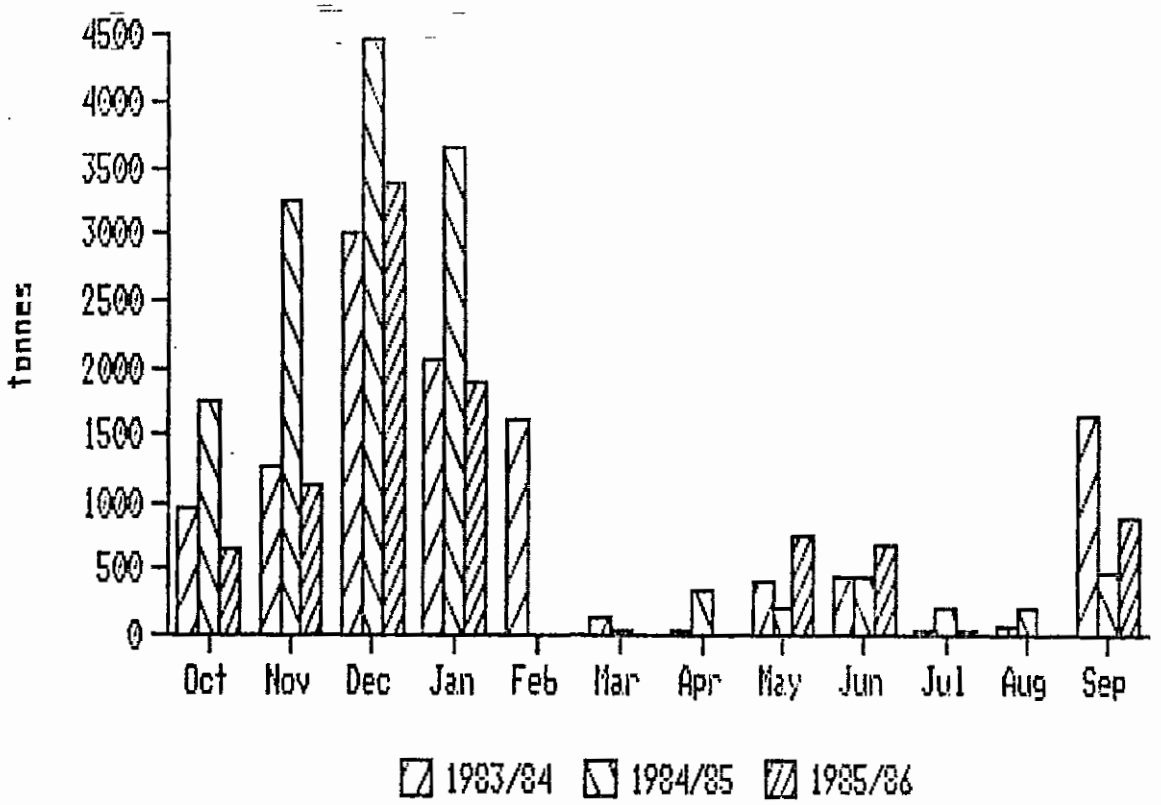
JMA landings in area D



JMA landings in area F(w)



JMA landings in area H



Total JMA catches by year