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Analyses of mackerel by-catch in the international fishery in ICNAF Subarea 5
and Statistical Area 6 determined from individual trawl hauls

by

Fredric M. Serchuk

National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543 USA

Abstract

Mackerel by-catch in the international fishery operating in ICNAF Subarea 6 and Statistical Area 6 during 1974-1976 was assessed from 137 individual trawl haul catches observed by USA officials during courtesy vessel boardings and inspections conducted under the ICNAF Scheme of Joint International Enforcement. By-catch ratios were determined for each haul and were also derived for country, area, time, and gear-type categories. Few differences in mackerel by-catch ratios were evident between years or between countries during any month for a particular fishing gear (pelagic or bottom trawl). Equally, by-catch ratio differences between areas fished during similar time periods with similar fishing gear were slight. A consistent distinction in by-catch was found between fishing gear; bottom trawls generally had much higher by-catch ratios than pelagic ones. Herring, alewife, squid, hake and dogfish were the most frequent by-catch species. The USSR pelagic mackerel fishery possessed the lowest by-catch ratio of any of the countries analyzed although the data were not sufficient to statistically examine country by-catch differences. By-catch values determined from the trawl haul analyses were considerably smaller than the corresponding ratios derived from the ICNAF Statistical Bulletin. Possible reasons for this discrepancy are enumerated.

Introduction

Since 1973, the regulation of all major directed fisheries in ICNAF Subarea 5 and Statistical Area 6 has consisted of a system of national quotas. Derivation of these national quotas from fishing effort and nominal catch data has required that the effect of incidental catch or by-catch be considered in the management of mixed species fisheries. Accordingly, accurate assessment of by-catch ratios in the principal directed fisheries is basic to this objective.

The data base generally used to estimate the proportions of by-catch and directed catch is the summary information tabulated in Table 5 of the ICNAF Statistical Bulletin. These records were employed in the linear programming simulation analyses of Palmer et al. (1976) and Brown et al. (1973, 1975). Inadequacies in data reporting on logbooks and to ICNAF (ICNAF 1974, 1975a, 1975b, 1976; Lopez-Veiga and Vazquez, 1974; Brown et al. 1975), however, may cause by-catch ratios calculated from the Bulletin values to be in error. The lack of reporting or underestimates of by-catch reported on logbooks will cause by-catch ratios to be underestimated while combination of data from more than one directed fishery under a mixed category will result in an overestimation of by-catch. Hence, a more detailed assessment of by-catch appears desirable.

The present paper summarizes mackerel by-catch data from 1974-1976 based on the composition of trawl catches observed by USA officials during courtesy vessel boardings and inspections conducted under the ICNAF Scheme of Joint International Enforcement. Observations were made on fishing vessels from ten different countries and were conducted during various times throughout the year. The

purpose of this paper is to indicate the spatial and temporal trends occurring in mackerel by-catch and relate these to specific country-gear mackerel fisheries. Additionally, a comparison of by-catch ratios between the Bulletin and boarding data is performed.

Methods and Materials

Information on the species composition and biomass of trawl hauls by fishing vessels was obtained from USA inspection and boarding reports. Only those trawl hauls which contained mackerel were selected for analysis. For the 1974-1976 period, 137 mackerel-containing hauls were evaluated. Data from these hauls were identified by several factors: country, vessel type, gear, area fished, year, and month (Table 1). Determination of last haulback biomass and composition was generally assessed independently by the USA officials (NMFS, Northeast Region, Law Enforcement Division, Boarding Form Instructions Letter, dated 30 September 1974), although, in some cases, the vessel's trawl logbook was used to obtain this information.

Each trawl haul was characterized by the species which comprised a simple plurality of the weight of the catch, and this species was designated the "main species" sought. For each haul, the biomass of each species was expressed as a proportion of the catch of the main species. This ratio "r", which may vary from zero to unity for any species, is a measure of the by-catch expressed as a fraction of the main species caught.

In some cases, two species of equal biomass predominated a trawl catch. When this occurred, both species were listed as main species, and by-catch ratios were determined using the weight of only one of the species.

Overall species by-catch ratios (country/month/area/gear-type values) for hauls in which mackerel was the main species were obtained by summing the catch biomass over the appropriate hauls and computing "r" as described above. This procedure is equivalent to computing a weighted mean and was used because of the large variation in the weight caught within similar trawl hauls. Hauls for which only percent composition of the catch (rather than biomass) was recorded were omitted from the overall by-catch calculation since they lacked weighting factors.

Results and Discussion

By-catch ratios of the trawl hauls examined by USA boarding and inspection officials are presented by ICAF Convention and Statistical Areas in Tables 2-6. Tables 7-11 summarize these findings by months for all years for which data were available. Generally, there was little difference in the species composition and by-catch ratios during any month, between these years or between countries, for a particular fishing gear (pelagic or bottom) in any area. Differences that occurred were usually associated with hauls having a relatively small total catch (≤ 2 tons). The similarity in type and magnitude of monthly by-catch between years corroborates the findings of Brennan (1975) which showed no consistent yearly differences in a country's annual by-catch ratio.

For all areas combined, mackerel was the main species landed in 81.4% (70/86) of the pelagic hauls and 45.1% (23/51) of the bottom hauls analyzed. By-catch values for pelagic mackerel catches were similar for all countries between areas during December-April when almost all species ratios were much less than 0.06. For these months, 88% (59/67) of the total pelagic hauls examined were predominated by mackerel (suggesting a highly directed fishery during this period), with 64% of these representing mackerel-only catches.

Although by-catch ratios of species caught in bottom hauls containing mackerel as the main finfish were of the same magnitude as the pelagic hauls taken in winter and early spring (most values < 0.06), only 48.6% (17/35) of these efforts resulted in mackerel-dominated catches. Hence, the by-catch values derived from the bottom trawl hauls for mackerel are misleading since this type of fishery can hardly be categorized as "directed".

Overall by-catch ratios for Subarea 5 and Statistical Area 6 (Table 12) further illustrated the difference in incidental catch between pelagic and bottom gear. In both areas, by-catch ratios were usually higher for bottom hauls than for pelagic ones. This distinction was evident in almost all countries which fished with both trawl types.

Herring, alewife, squid, hake, and dogfish were the groups most often taken as by-catch in the mackerel-dominated hauls. Overall monthly by-catch ratios for these species ranged as high as 1.00 for herring and alewife (Bulgaria, April, 5Ze, pelagic trawl and GDR, November, 5Ze, pelagic trawl), 0.670 for squid (Japan, March, 6B, bottom trawl), 0.337 for silver hake (USSR, May, 5Ze, bottom trawl), and 0.069 for dogfish (Cuba, March, 5Ze, bottom trawl). Usually these same groups appeared as main species in the hauls in which mackerel were present but did not comprise a plurality of the biomass (Table 13). In most of these cases, it is significant to note that mackerel was the largest by-catch species. These findings parallel the by-catch observations tabulated in Appendix Table 1 of Palmer et al. (1976) where mackerel is listed as the dominant by-catch species in the directed fisheries for silver hake, herring, and squid.

Due to the variability of the presence of individual species caught in hauls in which mackerel was the main species, the limited number of hauls analyzed in any country/month/area category, and the lack of a statistically valid sampling design, it is difficult to assess the statistical significance of the computed by-catch ratios, and thus the observed differences should not be interpreted literally. However, a general indication of the magnitude of mackerel by-catch was achieved by examining the distribution of the composite by-catch by country and area over all hauls (Tables 14-17). In the country analyses (Tables 14 and 15), the USSR exhibited the most directed pelagic fishery for mackerel (94.9% of the hauls were predominated by mackerel), followed by Bulgaria (88.9%), GDR (83.3%), and Poland (65.0%). The USSR pelagic fishery also possessed the lowest by-catch ratio with 94.6% of the directed hauls containing 3% or less of by-catch biomass. Corresponding values at the 3% level for the other major countries in the pelagic mackerel fishery were: GDR (70.0%), Bulgaria (62.5%), and Poland (30.8%). Overall, 75.7% of the directed mackerel pelagic hauls contained a by-catch of less than 3%.

Bottom trawling efforts for mackerel were much less productive in securing mackerel as the main species than were the pelagic hauls, and resulted in a larger by-catch (Table 15). Although the USSR again displayed the lowest by-catch (61.5% of directed mackerel hauls had less than 3% by-catch biomass), only 39.1% of the total directed hauls had a by-catch biomass of this amount. Clearly, bottom trawling for mackerel is relatively unselective.

Pelagic trawling for mackerel was most species-selective in Division 6A where all hauls analyzed had mackerel as the main species (Table 16). However, the lowest proportion of by-catch was achieved in Subdivision 5Zw; here all mackerel-directed pelagic hauls contained less than 3% by-catch, with all but one haul (95%) possessing no species other than mackerel. A by-catch of less than 3% was obtained in 74.2% of the pelagic mackerel hauls made over all fishery areas.

As expected, by-catch in directed mackerel bottom hauls in all areas fished was large (Table 17). By-catch frequencies were lowest in Subdivision 5Ze (66.7% of the hauls here contained less than 3% by-catch biomass) but only 56% of the total hauls made in this area had mackerel as the main species. For all areas combined, less than 46% of the bottom hauls were mackerel-dominated and only 39.1% of these had a by-catch of less than 3%.

Comparison of the overall country by-catch ratios (all gear and areas) with those derived from the ICNAF Statistical Bulletin (listed in Palmer et al., 1976) shows that the trawl haul values are considerably smaller than the Bulletin values for each of the four major nations fishing mackerel (Table 18). For most of the by-catch species, the trawl haul ratios are an order of magnitude less than the Bulletin ratios. This pronounced difference between the data sets is probably real and may be due to the following reasons: 1) exclusion of trawl hauls which were directed for mackerel but which failed to catch mackerel as the main species. This situation would cause the trawl haul ratios to be biased downward; 2) comparison of the 1974-1976 trawl haul data with the 1972-1974 Bulletin data will reveal differences since the older Bulletin values reflect the mixed fishery status prevalent in those years. More recent data (now unavailable) should more closely approximate the trawl haul values; 3) the Bulletin values for 1972-1974 reflect a greater effort with bottom gear than is currently employed. Hence, these ratios are overestimates of the present incidental catch; and 4) trawl haul data derived from logbooks may be underestimates if discards have been excluded or small quantities not recorded. Comparison of the trawl logbook catch with the production logbook values observed by international inspectors suggests that this latter situation is not infrequent.

Although the present analyses indicate that by-catch ratios are generally minimal in the pelagic mackerel fishery, continued future monitoring of the by-catch is needed. This is required because pelagic trawls can be fished near the bottom and thus achieve the higher by-catch observed in bottom trawls. Even pelagic hauls were noted to occasionally result in high by-catch values (up to 1.00) for critical species. Hence, efforts to more rigorously determine the directed fishery of a country's fleet and more accurate reporting and monitoring of fishery by-catch will be beneficial in deriving more representative future by-catch values.

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Table 1. Summary of trawl hauls containing mackerel obtained from USA courtesy vessel boarding and inspection reports, 1974-1976.

Country	Total number of trawls analyzed	No. of trawls analyzed			
		Month	Area	Vessel type	Gear
USSR	65	Jan - 8	5Ze-36	Stern-62	Bottom - 26
		Feb -20	5Zw-18	Side - 3	Pelagic- 39
		Mar -19	6A - 9		
		Apr - 8	6B - 2		
		May - 3			
		Jun - 3			
		Oct - 3			
		Dec - 1			
Poland	25	Jan - 5	5Ze-10	Stern-21	Bottom - 5
		Feb - 1	5Zw- 1	Side - 4	Pelagic -20
		Mar - 2	6A - 4		
		Apr - 5	6B - 5		
		May - 4	6C - 2		
		Nov - 8	5Y - 3		
Bulgaria	10	Jan - 2	5Ze- 2	Stern-10	Bottom - 1
		Feb - 1	5Zw- 6		Pelagic - 9
		Mar - 2	6A - 1		
		Apr - 1	6B - 1		
		May - 2			
Ireland	2	May - 1	6A - 2	Stern- 2	Bottom - 2
		Nov - 1			
GDR	15	Jan - 6	5Ze- 2	Stern-10	Bottom - 3
		Feb - 4	5Zw- 2	Side - 5	Pelagic- 12
		Mar - 1	6A - 3		
		Apr - 1	6B - 7		
		May - 2	6C - 1		
		Nov - 1			
Japan	5	Nov - 3	6A - 1	Stern -5	Bottom - 3
		Nov - 2	6B - 2		Pelagic- 2
			6C - 1		
			6D - 1		
Spain	7	Feb - 2	5Zw - 2	Stern- 5	Bottom - 7
		Mar - 4	6A - 3	Side - 2	
		May - 1	6B - 2		
Romania	1	Oct - 1	5Ze - 1	Stern - 1	Pelagic - 1
Cuba	5	Mar - 4	5Ze - 4	Stern - 5	Bottom - 3
		May - 1	5Zw - 1		Pelagic - 2
Italy	2	Apr - 2	6B - 2	Stern - 2	Bottom - 1 Pelagic - 1
Totals	137	Jan -21	5Ze -55	Stern-123	Bottom -51
		Feb -28	5Zw -30	Side- 14	Pelagic-86
		Mar -35	6A -23		
		Apr -17	6B -21		
		May -14	6C - 4		
		Jun - 3	6D - 1		
		Oct - 4	5Y - 3		
		Nov -12			
		Dec - 3			

Table 2. By-catch ratios of species caught in individual trawl hauls containing mackerel in ICNAF Subdiv. 52e. Catch data obtained from USA courtesy boarding and inspection reports, 1974-1976.

Mo/Yr	Nation	Vessel type	Gear	Main species	Mackerel catch (tons)	Mackerel by-catch ratio	Sqd	Hake	Dog	Her	LoI	III	Flo	Cod	Ale	But	S H	R H	Scup	OSP
Jan 75	USSR	Stern	PeI	Mac	15	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb 75	USSR	Stern	PeI	Mac Mac	8 3	1.00 1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Pol	Stern	PeI	Sqd	0.06	1.00	0.40	-	-	-	-	-	-	-	-	-	-	-	-
Feb 76	USSR	Stern	PeI	Mac Mac Mac Mac Mac	3 2 0.16 15 20	1.00 1.00 1.00 1.00 1.00	-	0.13	0.20	-	-	0.31	-	-	-	-	-	-	-	-
		Stern	Bot	Hak Mac Mac Mac Mac Mac	1.5 25 23 9.4 10 20	0.33 1.00 1.00 1.00 1.00 1.00	-	1.00	0.05	-	-	-	0.111	0.111	-	-	-	0.044	-	-
Mar 75	USSR	Stern	PeI	Mac Mac Mac Mac	0.5 2 4 5	1.00 1.00 1.00 1.00	-	0.01	-	-	-	-	-	0.01 0.001	-	-	-	-	-	-
		Stern	Bot	Mac	3	1.00	-	-	-	-	0.30	0.03	-	-	-	-	-	-	-	-
Mar 76	USSR	Stern	PeI	Mac Mac	7 50	1.00 1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02
		Stern	Bot	Mac Mac Mac	25 30 20	1.00 1.00 1.00	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
		Side	Bot	Sqd	0.05	0.50	1.00	-	-	-	-	-	-	-	-	-	-	0.70	-	0.20
	Cuba	Stern	PeI	Mac	3	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Stern	Bot	Mac Mac Mac	3 9 2.5	1.00 1.00 1.00	-	0.08	0.11	-	-	-	-	-	-	-	-	-	-	-
Apr 75	BuI	Stern	PeI	Mac & Her	1.4	1.00	0.57	-	-	1.00	-	-	-	-	-	0.29	-	-	-	-
Apr 76	USSR	Stern	Bot	S H S H	0.04 0.08	0.01 0.01	-	-	-	-	-	-	-	-	-	-	1.00 1.00	-	-	-
		Pol	Stern	PeI	Mac Mac III	10 16 0.06	1.00 1.00 <0.01	-	-	-	-	-	0.05 1.00	-	-	-	<0.01	-	-	-
May 75	USSR	Side Stern	Bot	Mac Mac & S H	120 0.6	1.00 1.00	-	-	-	-	0.07	0.05	0.13	-	-	-	0.33 1.00	0.13 0.05	-	0.07 0.04
		Pol	Stern	Bot	III	0.1	<0.01	-	-	-	-	1.00	-	-	<0.01	<0.01	<0.01	<0.01	-	-
		BuI	Stern	PeI	Mac & Her	0.5	1.00	-	-	1.00	-	-	-	-	-	-	-	-	-	-
May 76	GDR	Stern	PeI	III	1.2	0.06	-	-	-	-	-	1.00	-	-	-	0.06	-	-	-	-
Jun 76	USSR	Stern	Bot	S H S H Hak	<0.04 0.015 0.04	<0.01 0.003 0.01	0.003 0.39	-	1.00	-	-	-	0.01	-	-	-	1.00	-	-	-
Oct 74	USSR	Stern	Bot	R H S H S H	0.5 0.5 0.2	0.07 0.08 0.15	-	-	-	0.07 0.04	-	-	-	0.07 0.28	0.03	-	0.04	0.07 1.00	1.00	0.07
Oct 75	Rom	Stern	PeI	Her	0.2	0.06	0.06	-	-	1.00	-	-	-	-	-	-	-	-	-	-
Nov 74	GDR	Stern	PeI	Mac & Ale	13.5	1.00	-	-	-	0.22	-	-	-	-	-	1.00	-	-	-	-
		Pol	Stern	PeI	Her Mac Mac Mac Mac	0.3 20 24 2.4 0.3	0.05 - - - -	-	-	-	1.00	-	-	-	0.05	-	0.25	-	-	-
Dec 74	USSR	Stern	PeI	Mac	0.25	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.25

Table 3. By-catch ratio of species caught in individual trawl hauls containing mackerel in ICNAF Subdiv. 52w. Catch data obtained from USA courtesy vessel boarding and inspection reports, 1974-1976.

Mo/Yr	Nation	Vessel type	Gear	Main species	Mackerel catch (tons)	Mackerel by-catch ratio	Sqd	Hake	Dog	Her	LoI	III	Flo	Cod	Ale	But	S H	R H	Scp	Lob	Shad	OSP			
Jan 75	USSR	Stern	Pel	Mac	0.5	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
				Mac	40	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				Mac	10	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	19	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bul	Stern	Pel	Mac	10	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Feb 75	USSR	Stern	Pel	Mac	10	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	20	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GDR	Stern	Pel	Mac	15	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Feb 76	Spa	Stern	Bot	LoI	0.2	0.09	-	-	-	-	1.00	-	-	-	-	-	-	-	-	-	-	-	-		
				LoI	0.2	0.06	-	0.03	-	1.00	0.16	0.03	-	-	-	-	-	-	-	-	-	-	-	-	
Mar 75	USSR	Stern	Pel	Mac	100%	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	6	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	3	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	15	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	18	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	3	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	15	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bul	Stern	Pel	S H	0.45	0.19	-	-	0.03	0.01	-	-	-	-	0.03	1.00	-	-	-	-	-			
Apr 75	USSR	Stern	Pel	Her	0.4	0.27	-	-	0.20	1.00	0.07	-	-	-	-	-	-	-	0.40	-	-	-	-		
				Her	0.8	0.50	0.06	-	0.75	1.00	-	-	-	-	-	-	0.06	0.13	-	-	-	-	-	-	
						Stern	Bot	Dog	3%	0.03	-	-	1.00	0.01	-	-	-	-	-	0.01	-	-	-	0.01	-
				Mac	2	1.00	-	-	0.01	-	-	-	-	-	-	0.01	0.01	-	-	0.01	-	-			
		Pol	Side	Bot	Mac	2	1.00	-	-	-	0.02	-	-	-	-	0.01	0.01	-	-	0.01	-	-			
May 75	USSR	Stern	Bot	Hak	<0.4*	0.20*	-	1.00	-	0.30	-	-	-	-	-	-	-	-	-	-	-	0.20			
				Mac	5.2	1.00	0.15	0.08	-	0.15	-	-	<0.02	-	-	-	-	-	<0.01	-	-	-	-	-	
May 76	GDR	Stern	Pel	Mac	30	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	30	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Cuba	Stern	Pel	Mac	30	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Dec 74	Bul	Stern	Pel	Mac	4.9	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	6	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	

*Combined in total by-catch.

Table 4. By-catch ratios of species caught in individual trawl hauls containing mackerel in Division 6A. Catch data obtained from USA courtesy vessel boarding and inspection reports, 1974-1976.

Mo/Yr	Nation	Vessel type	Gear	Main species	Mackerel catch (tons)	Mackerel by-catch ratio	Sqd	Hake	Dog	Her	LoI	III	Flo	Cod	Ale	But	S H	Scup	Men	OPS			
Jan 75	Pol	Stern	Pel	Mac	69	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				Mac	42	1.00	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	
Jan 76	GDR	Side	Pel	Mac	0.7	1.00	-	-	-	-	-	-	-	0.06	0.06	-	-	-	-	-	-		
				Mac	20	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		USSR	Stern	Pel	Mac	22	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Feb 76	USSR	Stern	Pel	Mac	9.9	1.00	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-		
				Mac	30	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				Mac	30	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				Mac	31	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				Mac	2	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				Mac	1	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Mar 75	GDR	Stern	Pel	Mac	20	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
						Bul	Stern	Pel	Mac	34.9	1.00	-	0.001	0.001	-	-	0.001	-	-	-	-	-	-
						Jap	Stern	Bot	LoI	0.03	0.27	-	-	-	1.00	-	-	-	0.09	-	-	-	-
				Spa	Stern	Bot	Mac	1	1.00	0.30	0.01	-	-	0.02	-	-	-	-	-	0.02			
				But	10%	0.25	0.88	0.13	0.13	-	-	-	0.13	-	-	1.00	-	-	-	-			
				Sqd	0.9*	0.43*	1.00	-	-	-	-	-	-	-	-	-	-	-	-	0.43			
Apr 75	USSR	Stern	Bot	Mac	2.4	1.00	0.04	0.04	-	0.13	-	-	0.04	-	-	-	-	-	-	0.04	-		
Apr 76	GDR	Stern	Pel	Mac	19.8	1.00	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
May 75	Pol	Side	Bot	Scup	0.3	0.21	-	-	-	-	-	-	-	-	-	-	-	-	1.00	-	-		
				Mac	5	1.00	-	-	-	0.20	-	-	-	-	-	-	-	0.20	-	0.20	-	-	
May 76	Ire	Stern	Bot	III	0.4	0.04	-	<0.01	-	-	-	1.00	-	-	-	<0.01	-	-	-	-	-		
Nov 74	Ire	Stern	Bot	LoI & But	2%*	0.04*	-	-	-	-	1.00	-	-	-	-	1.00	-	-	-	-	0.04		

*Combined in total by-catch.

Table 5. By-catch ratio of species caught in individual trawl hauls containing mackerel in Division 6B. Catch data obtained from USA courtesy vessel boarding and inspection reports, 1974-1976.

Mo/Yr	Nation	Vessel type	Gear	Main species	Mackerel catch (tons)	Mackerel by-catch ratio	Sqd	Hake	Dog	Her	LoI	III	Flo	Cod	Ale	But	S H	Lob	OSP
Jan 75	PoI	Stern	Pel	Mac & Cod	0.1	1.00	-	-	0.50	-	-	-	-	1.00	-	-	0.83	-	-
Jan 76	USSR	Stern	Pel	Mac	1	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	GDR	Side	Pel	Ale	0.2	0.67	-	-	-	0.10	-	-	-	-	1.00	-	-	-	-
		Stern	Pel	Mac	31.5	1.00	-	-	-	-	-	-	-	-	0.11	-	-	-	-
				Mac	29.7	1.00	-	-	0.005	-	-	-	-	-	0.005	-	-	-	-
		Side	Bot	Ale	1.2	0.25	-	-	0.01	0.01	-	-	-	-	1.00	-	-	-	-
				Mac	2.3	1.00	-	-	-	-	-	-	-	-	0.09	-	-	-	-
	PoI	Stern	Pel	Mac	5	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
				Mac	25	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	BuI	Stern	Pel	Mac & Ale	10	1.00	-	-	-	-	-	-	-	-	1.00	-	-	-	-
Feb 76	GDR	Stern	Pel	Mac	6.7	1.00	-	-	-	-	-	-	-	-	0.04	-	-	-	-
		Side	Bot	Ale	10%*	0.11*	-	-	-	-	-	-	-	-	1.00	-	-	-	0.11
Mar 75	Spa	Side	Bot	LoI	0.03*	0.01*	-	-	-	-	1.00	0.43	-	-	-	-	-	-	0.01
	Jap	Stern	Bot	Mac	0.3	1.00	0.67	0.33	0.33	-	-	-	0.33	-	-	0.67	-	-	-
				LoI	0.01*	0.01*	-	-	-	-	1.00	0.13	-	-	-	0.13	-	-	0.01
Apr 75	PoI	Side	Bot	Mac	0.8	1.00	-	-	-	0.50	-	-	-	-	0.50	-	-	-	0.50
	USSR	Side	Bot	LoI	5%	0.06	-	-	-	-	1.00	-	-	-	-	0.03	-	-	0.02
Apr 76	Ita	Stern	Bot	III & LoI	0.1	0.02	-	-	-	-	1.00	1.00	-	-	-	-	0.02	-	-
		Stern	Pel	III	0.2	0.03	-	-	-	-	0.01	1.00	-	-	-	0.03	-	0.01	-
May 75	PoI	Side	Bot	Mac & Her	30%	1.00	-	-	-	1.00	-	-	-	-	0.50	-	-	-	0.83
May 76	Spa	Stern	Bot	III	0.1	0.02	-	-	-	-	-	1.00	-	-	-	-	0.02	-	-

*Combined in total by-catch.

Table 6. By-catch ratios of species caught in individual trawl hauls containing mackerel in Div. 6C, 6D, and 5Y. Catch data obtained from USA courtesy vessel boarding and inspection reports, 1974-1976.

Mo/Yr	Nation	Vessel type	Gear	Main species	Mackerel catch (tons)	Mackerel by-catch ratio	Sqd	Hake	Dog	Her	LoI	Flo	Ale	But	S H	R H	Lob	OSP	
DIV 6C																			
Feb 76	GDR	Stern	Pel	Mac	39.6	1.00	-	-	-	-	-	-	0.01	-	-	-	-	-	-
Mar 75	PoI	Stern	Pel	Ale	1%	0.01	-	-	0.01	-	-	-	1.00	-	-	-	-	-	0.02
				Mac	90%	1.00	-	-	0.01	0.02	-	-	0.07	-	-	-	-	-	-
Nov 74	Jap	Stern	Pel	Sqd	0.025	0.025	1.00	0.025	0.025	0.40	-	0.025	-	0.20	-	-	-	-	0.20
DIV 6D																			
Nov 74	Jap	Stern	Pel	LoI	0.6	0.33	-	-	-	-	1.00	-	-	-	-	-	0.17	0.05	0.09
DIV 5Y																			
Nov 74	PoI	Stern	Pel	Her	0.03	0.11	-	-	-	1.00	-	-	-	-	-	-	-	-	-
Nov 75	PoI	Stern	Pel	Her	1.1	0.06	-	-	-	1.00	-	-	0.06	-	-	-	-	-	-
				Her	4%	0.04	-	-	-	1.00	-	-	-	-	0.01	-	-	-	-

Table 7. Monthly by-catch ratios of species caught in trawl hauls in which mackerel was the main species landed (ICNAF Subdivision 5Ze).

Mo	Nation	Gear	No. of mackerel trawls	No. of mackerel caught	Total mackerel caught (tons)	Squid	Hake	Dog	Her	Loj	I11	F1o	Cod	Ale	But	S.H	R H	OSP
Jan	USSR	Pel	1	1	15	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	USSR	Pel	7	5	51.15	-	0.0004	0.059	-	-	0.001	-	-	-	-	-	-	-
		Bot	5	4	87.4	-	-	0.006	-	-	-	-	-	-	-	-	-	-
Mar	USSR	Pel	6	3	68.5	-	0.0003	-	-	-	-	-	0.0004	-	-	-	-	0.015
		Bot	4	2	78	-	-	-	-	0.012	0.001	0.001	-	-	-	-	-	-
	Cuba	Pel	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
		Bot	3	1	14.5	-	0.014	0.069	-	-	-	-	-	-	-	-	-	-
Apr	Pol	Pel	2	0	26	-	-	-	-	-	0.019	-	-	-	-	-	-	0.019
	Bu1	Pel	1	0	1.4	0.571	-	-	1.00	-	-	-	-	-	0.286	-	-	-
	Bu1	Pel	1	0	0.5	-	-	-	1.00	-	-	-	-	-	-	-	-	-
May	USSR	Bot	2	0	120.6	-	-	-	-	0.0002	0.0003	0.133	-	-	0.0008	0.337	0.133	0.066
	Pol	Pel	4	1	46.7	-	0.006	-	0.008	-	-	-	0.001	0.128	-	-	-	0.002
	GDR	Pel	1	0	13.5	-	-	-	0.222	-	-	-	-	1.000	-	-	-	-
Dec	USSR	Pel	1	1	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	USSR	Pel	15	10	134.90	-	0.0003	0.022	-	-	0.0004	-	0.0002	-	-	-	-	0.007
		Bot	11	6	286	-	-	0.002	-	0.003	0.0005	0.056	-	-	0.0003	0.142	0.056	0.028
		All Gr	26	16	420.90	-	0.0001	0.008	-	0.0022	0.0005	0.038	0.0001	-	0.0002	0.096	0.038	0.021
	Pol	Pel	6	1	72.7	-	0.004	-	0.005	-	0.007	-	0.0007	0.063	-	-	-	0.008
	Bu1	Pel	2	0	1.9	0.421	-	-	1.000	-	-	-	-	-	0.211	-	-	-
	GDR	Pel	1	0	13.5	-	-	-	0.222	-	-	-	-	1.000	-	-	-	-
	Cuba	Pel	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cuba	Bot	3	1	14.5	-	0.014	0.069	-	-	-	-	-	-	-	-	-	-
	Cuba	All Gr	4	2	17.5	-	0.011	0.057	-	-	-	-	-	-	-	-	-	-
Grand Totals	All Nat	Pel	25	12	226	0.004	0.002	0.002	0.023	-	0.002	-	0.0003	0.086	0.002	-	-	0.007
	All Nat	Bot	14	7	300.5	-	0.0007	0.005	-	0.003	0.0005	0.054	-	-	0.0003	0.135	0.053	0.027
	All Nat	All Gr	39	19	526.5	0.002	0.001	0.009	0.010	0.002	0.001	0.031	0.0001	0.037	0.0009	0.077	0.030	0.018

Hauls in which mackerel comprised a plurality of the catch biomass.

Table 8. Monthly by-catch ratios of species caught in trawl hauls in which mackerel was the main species landed (ICNAF Subdivision 52W).

Month	Nation	Gear	No. of		Tot mack caught (tons)	Sqd	Hak	Dog	Her	Lo1	I11	F1d	But	S H	Scp	Lob	Shad
			mac trawls ¹	mac only trawls													
Jan	USSR	Pel	4	4	69.5	-	-	-	-	-	-	-	-	-	-	-	-
	Bul	Pel	1	1	10.0	-	-	-	-	-	-	-	-	-	-	-	-
Feb	USSR	Pel	1	1	10.0	-	-	-	-	-	-	-	-	-	-	-	-
	Bul	Pel	1	1	20.0	-	-	-	-	-	-	-	-	-	-	-	-
	GDR	Pel	1	1	15.0	-	-	-	-	-	-	-	-	-	-	-	-
Mar	USSR	Pel	8	8	65.0	-	-	-	-	-	-	-	-	-	-	-	-
Apr	USSR	Bot	1	0	2.0	-	-	0.010	-	-	-	-	-	0.010	-	0.010	-
	Pol	Bot	1	0	2.0	-	-	-	-	0.020	-	-	0.010	0.010	-	0.010	-
May	GDR	Pel	1	1	30.0	-	-	-	-	-	-	-	-	-	-	-	-
	Cuba	Pel	1	1	30.0	-	-	-	-	-	-	-	-	-	-	-	-
	Bul	Bot	1	0	5.2	0.154	0.077	-	0.154	-	-	0.019	-	-	0.019	-	-
Dec	Bul	Pel	2	1	10.9	-	-	-	-	-	-	-	-	-	-	-	0.009
Totals	USSR	Pel	13	13	144.5	-	-	-	-	-	-	-	-	-	-	-	-
	USSR	Bot	1	0	2.0	-	-	0.010	-	-	-	-	-	0.010	-	0.010	-
	USSR	All gr	14	13	146.5	-	-	0.0001	-	-	-	-	-	0.0001	-	0.0001	-
	Pol	Bot	1	0	2.0	-	-	-	-	0.020	-	-	0.010	0.010	-	0.010	-
	Bul	Pel	4	3	40.9	-	-	-	-	-	-	0.019	-	-	-	0.002	-
	Bul	Bot	1	0	5.2	0.154	0.077	-	0.154	-	-	0.002	-	-	0.019	-	-
	Bul	All gr	5	3	46.1	0.017	0.077	-	0.009	-	-	0.002	-	-	0.002	-	0.002
	GDR	Pel	2	2	45.0	-	-	-	-	-	-	-	-	-	-	-	-
	Cuba	Pel	1	1	30.0	-	-	-	-	-	-	-	-	-	-	-	-
Grand Tot	All nat	Pel	20	19	260.4	-	-	-	-	0.004	-	0.011	0.002	0.004	0.011	0.004	0.0004
	All nat	Bot	3	0	9.2	0.087	0.043	0.002	0.087	0.004	-	-	-	-	-	-	-
	All nat	All gr	23	19	269.6	0.003	0.001	0.00007	0.003	0.0001	-	0.0004	0.00007	0.0001	0.0004	0.0001	0.0004

¹Hauls in which mackerel comprised a plurality of the catch biomass.

Table 9. Monthly by-catch ratios of species caught in total hauls in which mackerel was the main species landed (Division 6A).

Month	Nation	Gear	No. of		Sgd	Hak	Dog	Her	Flt	Cod	Ale	But	SH	Scp	Shad	OSP
			mac trawls	Tot mac mac only caught trawls (tons)												
Jan	USSR	Pel	2	2	44.0	-	-	-	-	-	-	-	-	-	-	-
	Pol	Pel	2	1	111.0	-	-	-	-	-	0.036	-	-	-	-	-
	GDR	Pel	1	0	0.7	-	-	-	-	0.057	0.057	-	-	-	-	-
Feb	USSR	Pel	6	5	103.9	-	-	-	-	-	-	-	0.001	-	-	-
	GDR	Pel	1	1	20.0	-	-	-	-	-	-	-	-	-	-	-
Mar	Bu1	Pel	1	0	34.9	-	0.0009	-	-	0.0009	-	-	-	-	-	-
	Spa	Bot	1	0	1.0	0.300	0.010	-	0.020	-	-	-	-	-	-	0.020
	GDR	Pel	1	0	19.8	0.010	-	-	-	-	-	-	-	-	-	-
Apr	USSR	Bot	1	0	2.4	0.042	0.042	-	0.125	0.042	-	-	-	-	Men 0.042	-
	Pol	Pel	1	0	5.0	-	-	0.200	-	-	-	0.200	-	0.200	-	-
Totals	USSR	Pel	8	7	147.9	-	-	-	-	-	-	-	0.0007	-	-	-
	USSR	Bot	1	0	2.4	0.042	0.042	-	0.125	0.042	-	-	-	-	0.042	-
	USSR	All gr	9	7	150.3	0.0007	0.0007	-	0.002	0.0007	-	-	0.0007	-	0.0007	-
Grand Totals	Pol	Pel	3	1	116.0	-	-	0.009	-	-	0.034	0.009	-	0.009	-	-
	Bu1	Pel	1	0	34.9	-	0.0009	0.0009	-	-	-	-	-	-	-	-
	GDR	Pel	3	1	40.5	0.005	-	-	-	0.001	0.001	-	-	-	-	-
Grand Totals	Spa	Bot	1	0	1.0	0.300	0.010	-	0.020	-	-	-	-	-	-	0.020
	All Nat	Pel	15	9	339.3	0.0006	0.00009	0.00009	0.003	-	0.0002	0.012	0.003	0.0003	0.003	-
	All Nat	Bot	2	0	3.4	0.118	0.032	-	0.088	0.035	-	-	-	-	0.029	0.006
Grand Totals	All Nat	All gr	17	9	342.7	0.002	0.0004	0.00009	0.004	0.0004	0.0002	0.012	0.003	0.0003	0.0003	0.00005

1 Hauls in which mackerel comprised a plurality of the catch biomass.

Table 10. Monthly by-catch ratios of species caught in trawl hauls in which mackerel was the main species landed (Division 68).

Month	Nation	Gear	No. of mackerel trawls ¹	No. of mack only trawls	Total mack caught (tons)	Sqd	Hak	Dog	Hier	Fld	Cod	Ale	But	S.H	DSP
Jan	Pol	Pel	3	2	30.1	-	-	0.002	-	-	0.003	-	-	0.003	-
	USSR	Pel	1	1	1.0	-	-	-	-	-	-	-	-	-	-
	GDR	Pel	2	0	61.2	-	-	0.002	-	-	-	0.060	-	-	-
		Bot	1	0	2.3	-	-	-	-	-	-	0.087	-	-	-
	Bulg	Pel	1	0	10.0	-	-	-	-	-	-	1.000	-	-	-
Feb	GDR	Pel	1	0	6.7	-	-	-	-	-	-	0.045	-	-	-
Mar	Jap	Bot	1	0	0.3	0.667	0.333	0.333	-	0.333	-	-	0.667	-	-
Apr	Pol	Bot	1	0	0.8	-	-	-	0.500	-	-	0.500	-	-	0.500
May	Pol	Bot	1	0	30.3	-	-	-	1.000	-	-	0.500	-	-	0.833
Total	USSR	Pel	1	1	1.0	-	-	-	-	-	-	-	-	-	-
	Pol	Pel	3	2	30.1	-	-	0.002	-	-	0.003	-	-	0.003	-
	Pol	Bot	2	0	0.8	-	-	-	0.500	-	-	0.500	-	-	0.500
	Pol	All gr	5	2	30.9	-	-	0.002	0.013	-	0.003	0.013	-	0.003	0.013
	Bul	Pel	1	0	10.0	-	-	-	-	-	-	1.000	-	-	-
	GDR	Pel	3	0	67.9	-	-	0.002	-	-	-	0.058	-	-	-
	GDR	Bot	1	0	2.3	-	-	-	-	-	-	0.087	-	-	-
	GDR	All gr	4	0	70.2	-	-	0.002	-	-	-	0.059	-	-	-
	Jap	Bot	1	0	0.3	0.667	0.333	0.333	-	0.333	-	-	0.667	-	-
Grand Totals	All nat	Pel	8	3	109.0	-	-	0.002	-	-	0.0009	0.128	-	0.0008	-
	All nat	Bot	4	0	3.4	0.059	0.029	0.029	0.118	0.029	-	0.176	0.059	-	0.118
	All nat	All gr	12	3	112.4	0.002	0.0009	0.003	0.004	0.0009	0.0009	0.129	0.002	0.0007	0.004

¹Hauls in which mackerel comprised a plurality of the catch biomass.

Table 11. Monthly by-catch ratios of species caught in trawl hauls in which mackerel was the main species landed (Div. 6C, 6D and 5Y).

Month	Nation	Gear	No. of ¹ mackerel trawls	No. of mac only trawls	Total mac caught (tons)	Dog	Her	Alewife
DIV 6C								
Feb	GDR	Pe1	1	0	39.6	-	-	0.010
Mar	Pol	Pe1	1	0	90%	0.011	0.022	0.067
Grand Totals	All Nat	Pe1	2	0	39.6	-	-	0.010

DIV 6D - None

DIV 5Y - None

¹Hauls in which mackerel comprised a plurality of the catch biomass.

Table 12. Overall by-catch ratio of species caught in trawl haul in which mackerel was the main species landed. Data are presented for SAS, SA6 and SA5 and 6 combined.

Nation	Gear	No. of mac trawls	No. mac only trawls	Tot mac caught (tons)	Sqd	Hake	Dog	Herr	Loi	[1]	Fld	Cod	Atc	But	SH	NH	Scp	Lob	Shad	OSP	
SUBAREA 5																					
USSR	Pol	28	23	279.40	-	0.0001	0.011	-	-	0.0002	-	0.00009	-	-	-	-	-	-	-	0.004	
USSR	Bot	12	6	288.00	-	-	0.002	-	0.003	0.0005	0.056	-	-	0.0003	0.141	0.056	-	-	0.0007	0.028	
USSR	All Gr	40	29	567.40	-	0.00007	0.006	-	0.002	0.0003	0.028	0.00004	-	0.00002	0.072	0.028	-	-	0.00004	0.016	
Pol	Pol	6	1	72.7	-	0.004	-	0.005	-	0.007	-	0.0007	0.083	-	-	-	-	-	-	0.008	
Pol	Bot	1	0	2.0	-	-	-	-	0.028	-	-	-	-	0.010	0.010	-	-	-	0.010	-	
Pol	All Gr	7	1	74.7	-	0.004	-	0.005	0.006	0.007	-	0.0007	0.080	0.0003	0.0003	-	-	-	0.0003	0.008	
Bul	Pol	6	3	42.8	0.019	-	-	0.044	-	-	-	-	-	0.009	-	-	-	-	-	-	
Bul	Bot	1	0	8.2	0.017	0.77	-	0.009	-	-	0.019	-	-	-	-	-	-	0.019	-	-	
Bul	All Gr	7	3	48.0	0.033	0.008	-	0.056	-	-	0.002	-	-	0.008	-	-	-	0.002	-	-	
GDR	Pol	3	2	88.5	-	-	-	0.051	-	-	-	-	0.231	-	-	-	-	-	-	-	
Cuba	Pol	2	2	33.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cuba	Bot	3	1	14.5	-	0.014	0.069	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cuba	All Gr	5	3	47.5	-	0.004	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	
Grand Tot	All Nat	Pol	45	31	486.40	0.002	0.0007	0.006	0.011	-	0.001	-	0.0002	0.040	0.0008	-	-	-	-	0.003	
Grand Tot	All Nat	Bot	17	7	309.70	0.003	0.002	0.005	0.003	0.0005	0.052	-	-	0.0004	0.131	0.052	0.0003	0.0001	-	0.026	
Grand Tot	All Nat	All Gr	62	38	796.10	0.002	0.001	0.006	0.008	0.001	0.0009	0.020	0.00009	0.024	0.0007	0.051	0.020	0.0001	0.00005	-	0.012
STAT AREA 6																					
USSR	Pol	9	8	148.90	-	-	-	-	-	-	-	-	-	-	0.0007	-	-	-	-	-	
USSR	Bot	1	0	2.40	0.042	0.042	-	0.125	-	-	0.042	-	-	-	-	-	-	-	-	0.042	
USSR	All Gr	10	8	151.30	0.0007	0.0007	-	0.002	-	-	0.0007	-	-	-	0.0007	-	-	-	0.00003	0.0007	
Pol	Pol	7	3	148.10	-	-	0.0003	0.007	-	-	-	0.0007	0.027	0.007	0.0006	-	-	0.007	-	-	
Pol	Bot	2	0	8.5	-	-	-	-	-	-	-	0.500	-	-	-	-	-	-	-	0.600	
Pol	All Gr	9	3	148.90	-	-	0.0003	0.010	-	-	-	0.0007	0.030	0.007	0.0006	-	-	0.007	-	0.603	
Bul	Pol	2	0	44.90	-	0.0007	0.0007	-	-	-	-	0.0007	0.223	-	-	-	-	-	-	-	
GDR	Pol	7	1	148.00	0.001	-	0.001	-	-	-	-	0.0003	0.030	-	-	-	-	-	-	-	
GDR	Bot	1	0	2.3	-	-	-	-	-	-	-	0.087	-	-	-	-	-	-	-	-	
GDR	All Gr	8	1	150.30	0.001	-	0.001	-	-	-	-	0.0003	0.031	-	-	-	-	-	-	-	
Spa	Bot	1	0	1.00	0.300	0.010	-	-	-	-	0.020	-	-	-	-	-	-	-	-	0.020	
Jap	Bot	1	0	0.30	0.667	0.333	0.333	-	-	-	0.333	-	-	0.667	-	-	-	-	-	-	
Grand Tot	All Nat	Pol	25	12	487.90	0.0004	0.00006	0.0005	0.002	-	-	0.0003	0.038	0.002	0.0004	-	-	0.002	-	-	
Grand Tot	All Nat	Bot	6	0	6.8	0.088	0.031	0.015	0.103	-	0.032	-	0.088	0.029	-	-	-	-	-	0.015	
Grand Tot	All Nat	All Gr	31	12	494.7	0.002	0.0005	0.0007	0.003	-	-	0.0004	0.0003	0.038	0.002	0.0004	-	-	0.002	-	0.0002
SUBAREA 5 & STATIST. AREA 6																					
USSR	Pol	37	31	428.30	-	0.00009	0.007	-	-	0.0001	-	0.00006	-	-	0.0002	-	-	-	-	0.002	
USSR	Bot	13	6	290.40	0.0003	0.0003	0.002	0.001	0.003	0.0005	0.056	-	-	0.0003	0.140	0.055	-	-	0.00007	0.00003	
USSR	All Gr	50	37	718.70	0.0001	0.0002	0.006	0.0004	0.001	0.0003	0.023	0.00003	-	0.00001	0.057	0.022	-	-	0.00003	0.00001	
Pol	Pol	13	4	218.80	-	0.001	0.0002	0.006	-	0.002	-	0.0007	0.046	0.005	0.0004	-	-	0.005	-	0.003	
Pol	Bot	3	0	2.8	-	-	-	0.143	0.014	-	-	-	0.143	0.007	0.007	-	-	0.007	-	0.143	
Pol	All Gr	16	4	221.60	-	0.001	0.0002	0.008	0.0002	0.002	-	0.0007	0.047	0.005	0.0005	-	-	0.005	0.00009	0.004	
Bul	Pol	8	3	87.7	0.009	0.0003	0.0003	0.022	-	-	-	0.0003	0.114	0.005	-	-	-	-	-	-	
Bul	Bot	1	0	5.2	0.017	0.077	-	0.009	-	-	0.019	-	-	-	-	-	-	0.019	-	-	
Bul	All Gr	9	3	92.9	0.009	0.005	0.0003	0.029	-	-	0.001	0.0003	0.108	0.004	-	-	-	0.001	-	-	
GDR	Pol	10	3	206.5	0.001	-	0.0007	0.015	-	-	-	0.0002	0.087	-	-	-	-	-	-	-	
GDR	Bot	1	0	2.3	-	-	-	-	-	-	-	0.087	-	-	-	-	-	-	-	-	
GDR	All Gr	11	3	208.8	0.001	-	0.0007	0.014	-	-	-	0.0002	0.087	-	-	-	-	-	-	-	
Cuba	Pol	2	2	33.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cuba	Bot	3	1	14.5	-	0.014	0.069	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cuba	All Gr	5	3	47.5	-	0.004	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	
Spa	Bot	1	0	1.0	0.300	0.010	-	-	-	-	0.020	-	-	-	-	-	-	-	-	0.020	
Jap	Bot	1	0	0.3	0.667	0.333	0.333	-	-	-	0.333	-	-	0.667	-	-	-	-	-	-	
Grand Tot	All Nat	Pol	70	43	974.3	0.001	0.0004	0.003	0.006	-	0.0006	-	0.0003	0.039	0.001	0.0002	-	-	0.001	-	
Grand Tot	All Nat	Bot	23	7	316.5	0.004	0.003	0.005	0.006	0.003	0.0004	0.052	-	0.002	0.001	0.128	0.051	0.0003	0.0001	0.00003	
Grand Tot	All Nat	All Gr	93	50	1290.8	0.002	0.0009	0.004	0.006	0.0008	0.0005	0.013	0.0002	0.030	0.001	0.032	0.012	0.0009	0.00003	0.000008	

1 Hauls in which mackerel comprised plurality of the catch biomass.

Table 13. Monthly by-catch ratios of species caught in trawl hauls in which mackerel was landed but was not the main species. Data are presented by area, country and gear-type.

Location	Nation	Gear	Mo	Principal species caught	Principal species caught																	
					Mac	Squid	Hake	Dog	Her	LoI	III	Flo	Cod	Ale	But	S H	R H	Scp	Lob	OSP		
SUBDIV 5Za	USSR	Bot	Feb	Hak	0.333	-	1.000	-	-	-	-	-	0.111	0.111	-	-	0.044	-	-	-	-	
			Mar	Sqd	0.500	1.000	-	-	-	-	-	-	-	-	-	-	-	0.700	-	-	-	0.200
			Apr	S H	0.010	-	-	-	-	-	-	-	-	-	-	-	-	1.000	-	-	-	-
			Jun	S H	0.004	0.088	-	-	-	-	-	-	-	0.003	-	-	-	1.000	-	-	-	-
			Oct	S H	0.095	-	0.054	-	-	0.034	-	-	-	0.052	0.005	-	0.034	1.000	-	-	-	-
				R H	0.067	-	-	-	0.067	-	-	-	0.067	-	-	0.067	1.000	-	-	-	-	
		Pol	Pel	Feb	Sqd	0.600	1.000	0.400	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Apr			III	0.005	-	-	-	-	-	1.000	-	-	-	-	0.005	-	-	-	-	-	
	Nov			Her	0.047	-	-	-	1.000	-	-	-	-	0.047	-	-	-	-	-	-	-	
			Bot	May	III	0.001	-	-	-	-	-	1.000	-	-	0.001	0.001	0.001	0.001	-	-	-	-
		May		III	0.056	-	-	-	-	-	1.000	-	-	-	0.056	-	-	-	-	-		
	Rom	Pel	Oct	Her	0.006	0.006	-	-	1.000	-	-	-	-	-	-	-	-	-	-	-		
SUBDIV 5Zb	USSR	Pel	Apr	Her	0.387	0.065	-	0.484	1.000	-	-	-	-	-	-	0.032	0.065	0.194	-	-	-	
			Bot	Apr	Dog	0.030	-	-	1.000	0.010	-	-	-	-	-	-	-	0.010	-	-	-	0.200
			Bot	Mar	S H	0.188	-	-	-	0.025	0.013	-	-	-	-	0.025	1.000	-	-	-	-	
				Feb	LoI	0.074	-	0.019	-	-	1.000	0.093	0.019	-	-	-	-	-	-	-	-	
DIV 6A	Pol	Bot	May	Scp	0.214	-	-	-	-	-	-	-	-	-	-	-	-	1.000	-	1.000		
			Spa	Bot	Mar	But	0.250	0.875	0.125	0.125	-	-	-	0.125	-	-	1.000	-	-	-	-	0.429
			Bot	May	III	0.035	-	0.009	-	-	-	1.000	-	-	0.009	-	-	-	-	-		
				Nov	LoI & But	-	-	-	-	1.000	-	-	-	1.000	-	-	-	-	-	0.040		
	Jap	Bot	Mar	LoI	0.273	-	-	-	-	1.000	-	-	-	0.091	-	-	-	-	-			
DIV 6B	USSR	Bot	Apr	LoI	0.060	-	-	-	-	1.000	-	-	-	-	0.030	-	-	-	-	0.020		
					Pel	Jan	Ale	0.667	-	-	-	0.100	-	-	-	1.000	-	-	-	-	-	
				Jan		Ale	0.250	-	-	0.010	0.010	-	-	-	1.000	-	-	-	-	-		
				Feb	Ale	-	-	-	-	-	-	-	0.037	1.000	-	-	-	-	-	0.110		
			Bot	Mar	LoI	-	-	-	-	-	1.000	0.429	-	-	-	-	-	-	-	-	0.014	
				May	III	0.021	-	-	-	-	-	1.000	-	-	-	0.021	-	-	-	-		
		Jap	Bot	Mar	LoI	-	-	-	-	-	1.000	0.125	-	-	-	0.125	-	-	-	-	0.013	
	Ita	Pel	Apr	III	0.027	-	-	-	-	0.013	1.000	-	-	-	0.027	-	-	-	0.013			
		Bot	Apr	LoI & III	0.023	-	-	-	-	1.000	1.000	-	-	-	-	0.023	-	-	-	-		
				Mar	Ale	0.010	-	-	0.010	-	-	-	-	1.000	-	-	-	-	-	0.020		
	Jap	Pel	Nov	Sqd	-	1.000	-	-	0.400	-	-	-	-	-	0.200	-	-	-	-	0.220		
DIV 6D	Jap	Pel	Nov	LoI	0.333	-	-	-	-	1.000	-	-	-	-	-	-	-	0.167	-	0.050	0.088	
DIV 5Y	Pol	Pel	Nov	Her	0.055	-	-	-	1.000	-	-	-	-	0.055	-	-	-	-	-	-		

Table 14. Frequency distribution of by-catch in pelagic trawls in which mackerel was the main species landed. Data derived from USA surveillance boarding reports, 1974-1976. All geographical areas in ICNAF Subarea 5 and Statistical Area 6 combined.

By-catch % of total weight of lost trawl	No. of Trawls					Total	% of total "mackerel" trawls	Cumulative %
	USSR	Poland	Bulgaria	GDR	All other countries			
0	31	4	3	3	2	43	61.4	61.4
<3	4		2	4		10	14.3	75.7
5		2		1		3	4.3	80.0
10		2		1		3	4.3	84.3
15						-	-	-
20	1	2				3	4.3	88.6
25						-	-	-
30	1					1	1.4	90.0
35						-	-	-
40		2				2	2.9	92.9
45						-	-	-
50			2			2	2.9	95.8
55				1		1	1.4	97.2
60						-	-	-
65			1			1	1.4	98.6
70		1				1	1.4	100.0
75						-	-	-
80						-	-	-
85						-	-	-
90						-	-	-
95						-	-	-
Total	37	13	8	10	2	70		
Tows in which mackerel was not main species	2	7	1	2	4	16		
Grand total	39	20	9	12	6	86		
% of total hauls in which mackerel was main species	94.9	65.0	88.9	83.3	33.3	81.4		

Table 15. Frequency distribution of by-catch in bottom trawls in which mackerel was the main species landed. Data derived from USA surveillance boarding reports, 1974-1976. All geographical areas in ICNAF Subarea 5 and Statistical Area 6 combined.

By-catch % of total weight of lost trawl	No. of Trawls					Total	% of total "mackerel" trawls	Cumulative %
	USSR	Poland	Bulgaria	GDR	All other countries			
0	6				1	7	30.4	30.4
<3	2					2	8.7	39.1
5	1				1	2	8.7	47.8
10				1	1	2	8.7	56.5
15						-	-	-
20						-	-	-
25	2				1	3	13.0	69.5
30			1			1	4.3	73.8
35		1				1	4.3	78.1
40	1					1	4.3	82.4
45						-	-	-
50						-	-	-
55						-	-	-
60	1	1				2	8.7	91.1
65						-	-	-
70		1				-	-	-
75					1	2	8.7	99.8
80						-	-	-
85						-	-	-
90						-	-	-
95						-	-	-
Total	13	3	1	1	5	23		
Tows in which mackerel was not main species	13	2	-	2	11	28		
Grand Total	26	5	1	3	16	51		
% of total hauls in which mackerel was main species	50.0	60.0	100	33.3	31.3	45.1		

Table 17. Frequency distribution of by-catch in bottom trawls in which mackerel was the main species landed. Data derived from USA surveillance boarding reports, 1974-1976, all countries combined.

By-catch % of total weight of lost trawl	No. of trawls				Total	% of total mackerel trawls	Cumulative %
	Subdiv. 5Ze	Subdiv. 5Zw	Div. 6A	Div. 6B			
0	7				7	30.4	30.4
<3	1	1			2	8.7	39.1
5	2	1			3	13.0	52.1
10	1		1	1	3	13.0	65.1
15					-	-	-
20					-	-	-
25	1		1		2	8.7	73.8
30		1			1	4.3	78.1
35					-	-	-
40	1				1	4.3	82.4
45					-	-	-
50					-	-	-
55					-	-	-
60	1			1	2	8.7	91.1
65					-	-	-
70				2	2	8.7	99.8
80							
85							
90							
95							
Total	14	3	2	4	23		
Tows in which mackerel was not main species	11	4	6	7	28		
Grand Total	25	7	8	11	51		
% of total hauls in which mackerel was main species	56.0	42.9	25	36.3	45.1		

Table 16. Frequency distribution of by-catch in pelagic trawls in which mackerel was the main species landed. Data derived from USA surveillance boarding reports, 1974-1976, all countries combined.

By-catch % of total weight of lost trawl	No. of trawls						Total	% of total mackerel trawls	Cumulative %
	Subdiv. 5Ze	Subdiv. 5Zw	Div. 6A	Div. 6B	Div. 6C	Divs. 6D,5Y			
0	12	19	9	3			43	61.4	61.4
<3	3	1	3	1	1		9	12.9	74.2
5	2			1			3	4.3	78.5
10			2	1	1		4	5.7	84.2
15							-	-	-
20	2						2	2.9	87.1
25	1						1	1.4	88.5
30	1						1	1.4	89.9
35							-	-	-
40	1		1				2	2.9	92.8
45							-	-	-
50	1			1			2	2.9	95.7
55	1						1	1.4	97.1
60							-	-	-
65	1						1	1.4	98.5
70				1			1	1.4	99.9
75									
80									
85									
90									
95									
Total	25	20	15	8	2	0	70		
Tows in which mackerel was not main species	5	3	0	2	2	4	16		
Grand Total	30	23	15	10	4	5	86		
% of total hauls in which mackerel was main species	83.3	87.0	100	80	50	0	81.4		

Table 18. Comparison of by-catch ratios of species caught in trawl hauls containing mackerel (SA 5 and 6) with by-catch ratios derived from the ICNAF Statistical Bulletin (listed in Palmer *et al.* 1976).

Nation		Cod	S H	R H	Hak	Fld	Her	Sqd	Other Pel
USSR	1972	0.003	0.170	0.069	0.239	0.007	0.090	0.011	0.270
	1973	0.010	0.147	0.094	0.241	0.011	0.301	0.017	0.082
	1974	0	0.116	0.011	0.127	0.001	0.026	0.010	0.036
	Trawl haul data	0.00003	0.057	0.022	0.0792	0.023	0.0004	0.0014	0.0181
Pol	1972	0.001	0	0	0.001	0	0.149	0.011	0.051
	1973	0.003	0.001	0	0.004	0	0.075	0.027	0.056
	1974	0.003	0.002	0	0.005	0	0.072	0.044	0.043
	Trawl haul data	0.0007	0.0005	0	0.0015	0	0.008	0.0022	0.0612
Bul	1972	0.003	0.150	0.064	0.214	0.024	0.100	0.021	0.313
	1973	0.001	0.048	0.011	0.059	0.003	0.039	0.013	0.026
	1974	0	0.050	0.016	0.066	0	0.065	0.026	0.035
	Trawl haul data	0.0003	0	0	0.005	0.001	0.029	0.009	0.113
GDR	1972	0	0	0.001	0.001	0	0.037	0	0.018
	1973	0	0.001	0	0.001	0	0.031	0	0.010
	1974	0	0.001	0	0.001	0	0.040	0	0.012
	Trawl haul data	0.0002	0	0	0	0	0.014	0.001	0.088