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# SOUTHWEST FISHERIES SCIENCE CENTER

NATIONAL MARINE FISHERIES SERVICE

SOUTHWEST FISHERIES SCIENCE CENTER

P.O. BOX 271

LA JOLLA, CA 92038

MAY 1993

Collection of Jack Mackerel,  
*Trachurus symmetricus*, off  
Southern California during 1991  
Cooperative U.S.-U.S.S.R. Cruise

By

Beverly J. Macewicz and Dimitry N. Abramenkoff

ADMINISTRATIVE REPORT LJ-93-07



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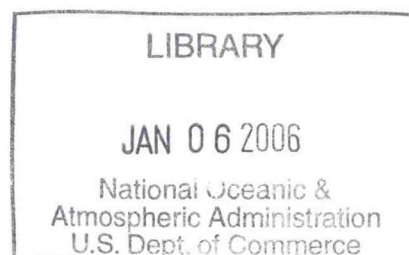
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## Introduction

Jack mackerel, *Trachurus symmetricus*, range from Baja California to the Gulf of Alaska and from coastal waters up to 1000 miles offshore (MacCall and Stauffer 1983). In southern California it has been commercially fished since 1947. The fishery concentrated mostly on catching the small fish (10 to 30 cm FL) from local waters (MacCall and Stauffer 1983; Mason 1991). Large fish (about 50 cm) were reported offshore and to the north (Stepanenko 1979; MacCall et. al 1980). Interest has increased lately in an offshore trawl fishery for jack mackerel. To better understand the dynamics of the offshore population and obtain samples for reproduction and age studies, the Southwest Fisheries Science Center (SWFSC) participated in a cooperative U.S.-Soviet Jack Mackerel Cruise, a 30 day leg of a longer U.S.-Soviet cooperative cruise arranged by the Alaska Fisheries Science Center.

## Collection Methods

On March 21, 1991, Dimitry N. Abramenkoff (fishery biologist, SWFSC) boarded the Russian fishery reseach trawler, *Novodrutsk*, from a Coast Guard Cutter in Monterey Bay, California. The *Novodrutsk* sailed south to the study area off southern California (Figure 1). Abramenkoff worked with Dr. M. Stepanenko and Dr. Y. Yermakov, Soviet scientists from the Pacific Research Institute of Fisheries and Oceanography (TINRO) in Vladivostok, Russia. On April

9, after completing 36 trawls, *Novodrutsk* proceeded north, arriving in Seattle on April 21, 1991.

Hydro-acoustic methods were used to locate schools, and jack mackerel were caught using a nearly square pelagic trawl with a vertical and horizontal opening of 75-80 meters. Thirty-three trawls were made at night and three were made during daylight hours (Table 1). The ship's speed during trawling was from 4.2 to 5.5 knots. The depth of trawling ranged from 40-145 meters. The duration of trawling ranged from 50 minutes to 8 hours and 40 minutes (Table 2). The sea-surface temperature ranged from 13.5 °C to 14.7 °C.

Total weight (kg) and total number of fish of all species taken in the trawl were estimated by the Soviet scientists. Jack mackerel specimens were processed by the U.S. scientist to obtain biological data. Jack mackerel, *T. symmetricus*, were randomly sampled from the catch. Up to 100 fish from each trawl haul were measured (fork length) to the nearest millimeter, sexed, and their gonads visually classified. Males were assigned to one of two classes based on the presence or absence of milt flowing from the testes. Ovaries were assigned to one of three classes: no yolked oocytes present (inactive) ; yolked oocytes present (active); and translucent hydrated oocytes present (spawning, soon or very recently). Additionally, up to 25 random females and five males per trawl were individually weighed (to the nearest gram), then their

gonads were removed and preserved in 10% neutral buffered formalin, and finally, the otoliths and some scales were removed and preserved in 50% ETOH.

## Results

The survey off southern California produced interesting results. Thirty-one trawls, out of the 36 pelagic trawls attempted, yielded jack mackerel, *Trachurus symmetricus*, with an incidental catch of substantial amounts of chub mackerel, *Scomber japonicus*, and Pacific sardine, *Sardinops sagax* (Table 2). The total weight of the catch in the positive trawls ranged from 0.2 tons to 63 tons for the three species. The other fish species of minor incidence in the catch are listed in Table 3. The bycatch of Pacific sardine and chub mackerel was particularly interesting because they were caught far offshore, about 200 nautical miles from the southern California coastline (Figure 1).

From 29 of the trawls, a total of 2656 jack mackerel were sampled for biological data. Gonads and otoliths from 593 jack mackerel were preserved to be analyzed later. The size of jack mackerel ranged from a 25-cm reproductively inactive female to a 62-cm active male. Most of the jack mackerel were between 39 cm and 44 cm fork length (Table 4). Although the sex ratios varied between trawls from 25% to 61% females, the average sex ratio was about 50%. The majority of the jack mackerel were mature: most males had



running milt and 91.7% of the females had advanced yolked oocytes (Table 5). About 5% of the females sampled had hydrated oocytes, indicating that spawning was occurring at that time.

## LITERATURE CITED

- MacCall, A. D., and G. D. Stauffer. 1983. Biology and fishery potential of jack mackerel (*Trachurus symmetricus*). Calif. Coop. Oceanic Fish. Invest. Rep. 24:46-56.
- MacCall, A. D., H. W. Frey, D. D. Huppert, J. A. McMillan, and G. D. Stauffer. 1980. Biology and economics of the fishery for jack mackerel in the northeastern Pacific. NOAA Tech. Memo. NMFS 4.
- Mason, J. E. 1991. Variations in the catch of jack mackerel in the southern California purse seine fishery. Calif. Coop. Oceanic Fish. Invest. Rep. 32:143-151.
- Stepanenko, M. A. 1979. Some traits of biology and reproduction rate and conditions of California jack mackerel. Presented to the 1979 U.S.-U.S.S.R. Bilateral Meeting on Fisheries Assessment in the North Pacific, Seattle, June 5-8, 1979.



Table 1. Position, sea surface temperature, date and time started trawling of the midwater trawls attempted during the 1991 jack mackerel survey off Southern California.

Trawl #	Date Mo Day	Time PST	Trawl Position				Sea Surface Temp. °C
			Start		End		
			latitude	longitude	latitude	longitude	
1	03 23	1420	31°40.0'N	123°49.8'W	31°45.0'N	123°47.5'W	14.3
2	03 23	1902	31°37.6'N	123°50.5'W	31°44.1'N	123°42.2'W	14.2
3	03 23	2256	31°37.5'N	123°54.3'W	31°34.0'N	123°47.9'W	14.1
4	03 24	1856	31°08.1'N	124°16.4'W	31°11.6'N	124°08.0'W	14.2
5	03 24	0202	30°48.3'N	124°14.2'W	30°48.3'N	124°10.5'W	14.7
6	03 25	1921	32°04.5'N	123°42.6'W	32°06.7'N	123°39.2'W	13.9
7	03 25	2200	32°14.2'N	123°31.4'W	32°06.9'N	123°14.0'W	13.8
8	03 26	1300	32°19.7'N	124°57.7'W	32°18.6'N	124°49.6'W	13.5
9	03 26	1905	32°22.9'N	125°15.2'W	32°14.5'N	124°58.3'W	13.9
10	03 27	0130	32°21.0'N	125°05.4'W	32°13.0'N	125°58.7'W	13.5
11	03 27	1920	32°39.1'N	125°40.5'W	32°21.8'N	125°23.8'W	14.0
12	03 28	0325	32°36.3'N	125°41.8'W	32°25.8'N	125°26.4'W	13.9
13	03 28	1816	32°48.7'N	125°57.7'W	32°28.7'N	125°41.8'W	13.9
14	03 29	0300	32°47.3'N	125°57.1'W	32°28.8'N	125°41.9'W	13.9
15	03 29	1815	32°58.1'N	126°14.1'W	32°28.4'N	125°55.8'W	14.2
16	03 30	0110	32°41.9'N	125°48.2'W	32°20.7'N	125°21.1'W	13.9
17	03 30	1842	33°01.6'N	126°25.9'W	33°00.9'N	126°16.0'W	14.0
18	03 30	2235	33°01.6'N	126°15.6'W	32°56.8'N	126°36.2'W	14.0
19	03 31	1900	33°00.1'N	126°30.5'W	33°01.6'N	126°14.5'W	14.1
20	03 31	2310	33°00.7'N	126°21.4'W	33°03.0'N	126°02.0'W	14.0
21	04 01	0505	33°01.5'N	126°11.5'W	32°59.7'N	126°27.7'W	14.0
22	04 01	1830	33°00.9'N	125°48.3'W	32°52.9'N	125°36.0'W	14.0
23	04 01	2350	33°03.0'N	125°46.7'W	33°00.1'N	125°20.9'W	14.1
24	04 02	1845	33°12.5'N	125°25.1'W	33°05.6'N	125°13.4'W	13.8
25	04 02	2335	33°13.6'N	125°23.1'W	33°11.9'N	125°03.1'W	14.1
26	04 03	0435	33°14.6'N	125°01.7'W	33°08.9'N	125°11.2'W	13.9
27	04 03	1925	33°03.1'N	125°03.9'W	32°42.8'N	124°40.7'W	14.2
28	04 05	1935	32°05.1'N	124°25.7'W	31°47.7'N	124°05.2'W	14.2
29	04 06	1030	33°11.1'N	123°36.5'W	32°52.8'N	123°28.6'W	14.4
30	04 06	1915	32°23.0'N	123°41.2'W	32°15.2'N	123°37.2'W	14.4
31	04 06	2345	32°21.8'N	123°45.6'W	32°05.0'N	123°41.4'W	14.4
32	04 07	1835	32°45.1'N	123°42.3'W	32°25.1'N	123°42.0'W	14.0
33	04 08	0230	32°41.3'N	123°47.9'W	32°24.4'N	123°41.7'W	14.0
34	04 08	1945	32°41.7'N	123°32.4'W	32°26.2'N	123°26.5'W	14.2
35	04 09	0215	32°36.6'N	123°34.3'W	32°20.4'N	123°35.6'W	14.2
36	04 09	1910	32°48.7'N	123°31.2'W	32°04.5'N	123°30.5'W	14.1

Table 2. Estimated number and catch weight of jack mackerel, chub mackerel, and Pacific sardine taken in trawls during the Soviet-U.S.A cooperative research cruise aboard the Soviet vessel the R/V *Novodrutzk* from March 23 to April 09, 1991.

Trawl #	SWFSC Coll #	Sub-sample taken	Trawl Duration (Hours)	Total Number and Weight per Trawl						Sardine	
				Jack Mackerel		Chub Mackerel		Pacific			
				N	Kg	N	Kg	N	Kg		
1	1481	yes	0.50	537	300	0	0	0	0		
2	1482	yes	1.50	6,250	3,500	800	400	400	60	150	
3	1483	yes	2.17	52,000	29,000	163	100	0	0		
4	1484	no	1.90	0	0	0	0	0	0		
5	1485	no	0.50	0	0	0	0	0	0		
6	1486	yes	0.65	No est	203	1	0.4	0	0		
7	1487	yes	3.25	190	180	30	15	14	2.5	179	
8	1488	yes	1.42	1,110	850	80	360	160	35	219	
9	1489	yes	3.58	7,400	5,470	5,550	2,500	140	32	229	
10	1490	yes	2.00	3,370	3,000	1,600	1,000	0	0		
11	1491	yes	4.50	3,500	3,000	13,900	5,500	2,150	450	209	
12	1492	no	3.67	4,227	3,500	1,300	500	10	2.5	259	
13	1493	yes	4.68	12,684	6,000	64,606	23,000	4,000	1,000	250	
14	1494	yes	4.83	23,263	12,888	47,234	16,296	3,871	813	210	
15	1495	yes	4.83	12,667	9,500	45,450	20,000	1,904	400	210	
16	1496	no	6.42	28,805	23,160	13,310	5,790	142	30	211	
17	1497	yes	2.05	17,500	14,000	98,862	43,500	9,524	2,000	210	
18	1498	yes	3.58	24,615	16,000	165,780	63,000	4,280	900	210	
19	1499	yes	2.00	15,380	12,000	7,100	2,700	0	0		
20	1500	yes	3.17	17,790	15,300	5,642	2,370	0	0		
21	1501	no	3.00	0	0	0	0	0	0		
22	1502	yes	2.50	17,850	15,000	9,780	4,500	40	12	300	
23	1503	yes	6.00	22,500	16,380	8,874	3,452	112	28	250	
24	1504	yes	2.08	25,850	21,200	21,800	8,500	715	150	210	
25	1505	no	3.25	0	0	0	0	0	0		
26	1506	yes	2.25	5,448	4,206	2,105	760	25	5	200	
27	1507	yes	5.75	5,358	3,660	3,440	2,150	10	2.5	250	
28	1508	yes	5.33	3,154	3,000	7,247	3,950	0	0		
29	1509	yes	2.17	1,350	1,750	350	250	0	0		
30	1510	no	1.75	0	0	0	0	0	0		
31	1511	yes	3.50	3,604	4,440	11,631	7,560	0	0		
32	1512	yes	4.42	6,400	7,000	31,034	18,000	4	1	250	
33	1513	yes	3.50	7,799	6,980	5,808	3,020	0	0		
34	1514	yes	3.25	1,670	1,500	6,740	3,500	15	3	200	
35	1515	yes	3.08	1,461	1,210	1,312	720	0	0		
36	1516	yes	8.67	5,239	3,940	12,311	5,860	712	190	267	
Total			117.7 h	248,117 kg		249,253.4 kg		6116.5 kg			

Table 3. List of the other 22 fish species taken in the trawls aboard the R/V *Novodrutsk* as identified by the Soviet researchers.

*Bathylagus pacificus*  
*Brama japonica*  
*Ceratoscopelus townsendi*  
*Ceratoscopelus warmingi*  
*Cololabis saira*  
*Diplophos taenia*  
*Gonichthys tenuiculus*  
*Lampadena urophaos*  
*Lampanictus nobilis*  
*Lampris guttatus*  
*Lestidiops ringens*  
*Mola mola*  
*Nansenia candida*  
*Prionace glauca*  
*Scombrolabrax heterolepis*  
*Symbolophorus californiensis*  
*Tactostoma macropus*  
*Tetragonurus cuvieri*  
*Trachipterus altivelis*  
*Trachipterus fukuzakii*  
*Trichiurus nitens*  
*Vinciguerrria nimbaria*



Table 4. Percentage of male and female jack mackerel in a random sample from 29 of the 31 positive collections. Listed also is the mean, standard deviation, and range of fork lengths by sex.

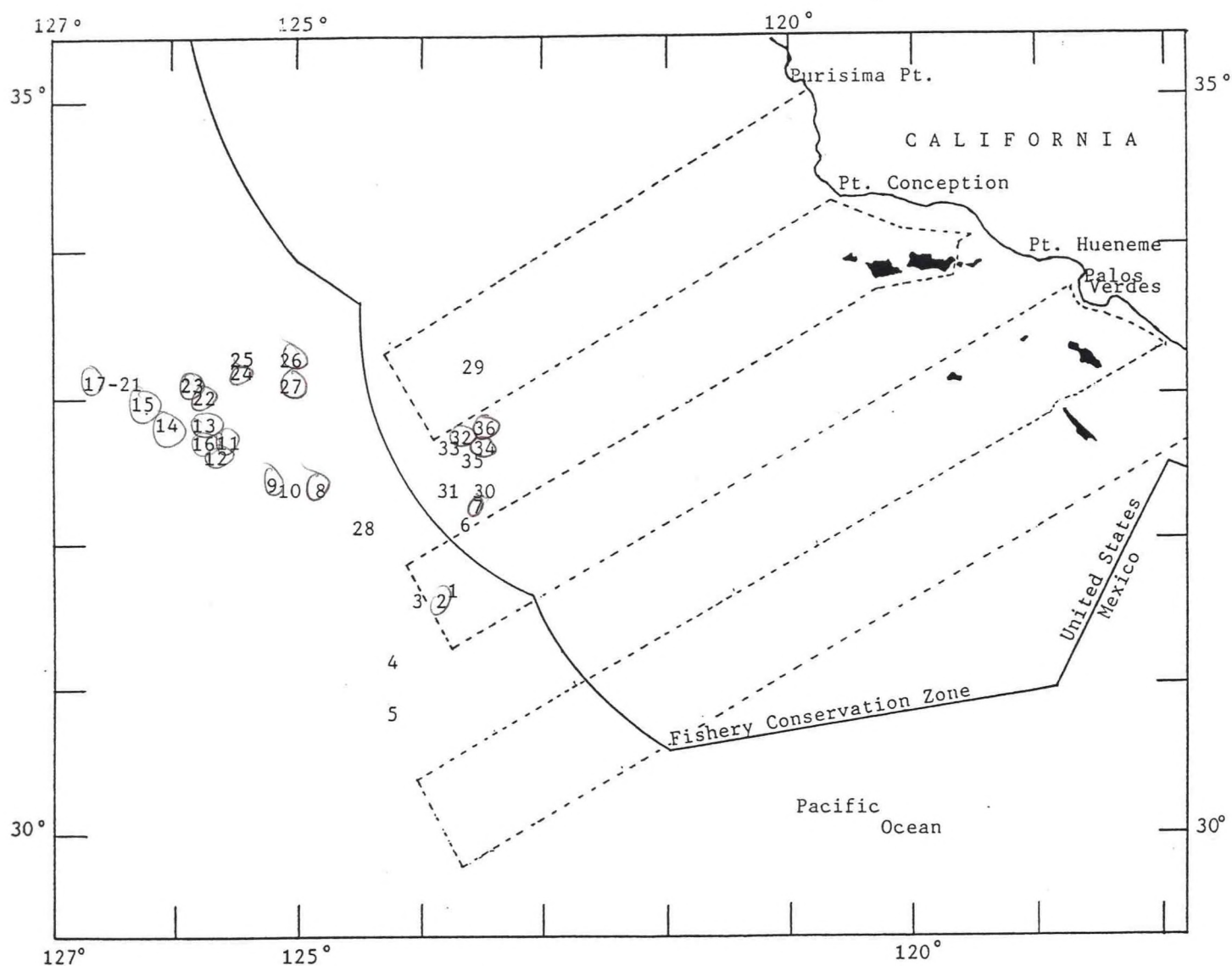
Collection Number	Males				Females				Sample	
	%	Fork Length (mm)			%	Fork Length (mm)			Weight (Kg)	N
		Mean	Std Dev	Range		Mean	Std Dev	Range		
1481	52	410	41	303 - 534	48	396	20	354 - 441	42	65
1482	44	418	22	344 - 462	56	408	24	318 - 443	55	78
1483	47	419	15	387 - 449	53	421	16	401 - 451	27	34
1486	61	447	43	361 - 571	39	434	43	373 - 514	90	100
1487	45	423	46	336 - 524	55	432	37	376 - 570	92	100
1488	45	420	29	361 - 525	55	413	36	325 - 515	76	100
1489	55	411	21	356 - 485	45	410	28	375 - 485	75	100
1490	75	425	29	368 - 520	25	415	25	387 - 487	59	75
1491	57	427	48	316 - 570	43	392	42	314 - 504	80	100
1493	44	359	58	256 - 520	56	351	49	255 - 486	43	100
1494	56	401	26	355 - 458	44	392	36	324 - 462	28	50
1495	64	399	22	336 - 440	36	407	31	358 - 481	75	100
1497	52	408	21	330 - 488	46	402	14	356 - 424	75	100*
1498	45	412	32	367 - 586	55	407	30	342 - 550	69	100
1499	63	421	27	358 - 528	37	429	39	384 - 553	80	100
1500	39	431	33	387 - 519	61	432	40	367 - 525	87	100
1502	55	406	33	338 - 503	45	401	27	324 - 460	70	100
1503	58	427	31	375 - 528	42	422	28	367 - 499	78	100
1504	56	422	28	356 - 541	44	407	19	373 - 446	82	100
1506	52	419	24	362 - 483	48	404	22	307 - 442	76	100
1507	55	416	40	293 - 568	45	404	42	322 - 530	71	100
1508	48	450	38	383 - 550	52	428	28	386 - 516	97	100
1509	72	502	32	436 - 596	28	485	31	432 - 561	98	74
1511	42	489	38	425 - 587	58	470	33	402 - 570	103	80
1512	44	466	34	414 - 516	56	428	27	390 - 493	85	100
1513	60	449	34	381 - 535	40	435	31	383 - 536	91	100
1514	44	414	19	378 - 449	56	411	17	373 - 444	84	100
1515	52	439	40	394 - 618	48	413	20	370 - 463	84	100
1516	44	418	28	380 - 515	56	407	38	245 - 550	76	100
ALL	52	426	42	256 - 618	48	414	39	245 - 570	2148	2656

\* Total N includes 2 indeterminate sex fish; lengths were 396 and 425 mm.

Table 5. Percentage of reproductively active female jack mackerel in one centimeter length classes, where N = total number of females in the class. Reproductively active females contain advanced yolked oocytes and were assessed shipboard as active (A) or hydrated (H). The total number of males is given for each length class.

Length class midpoint (cm)	Female		Male
	Percent Active	N	
25	0.0	1	0
26	0.0	1	2
27	0.0	1	1
28	0.0	0	0
29	33.3	3	1
30	50.0	2	4
31	42.9	7	4
32	52.9	17	9
33	64.3	14	4
34	60.0	10	9
35	83.3	6	5
36	66.7	12	23
37	79.2	24	18
38	83.3	72	54
39	94.8	136	77
40	93.2	176	163
41	94.3	212	228
42	92.0	188	204
43	96.0	126	140
44	92.4	53	118
45	100.0	32	63
46	100.0	27	39
47	100.0	27	34
48	97.0	33	36
49	100.0	35	49
50	100.0	20	27
51	100.0	12	22
52	100.0	4	25
53	100.0	3	12
54	100.0	1	9
55	100.0	3	3
56	100.0	1	3
57	100.0	2	3
58	-	0	0
59	-	0	2
60	-	0	1
61	-	0	0
62	-	0	1
All	91.7	1261	1393

Figure 1. Location of the jack mackerel survey. Numbers indicate location and the identification number of the trawls listed in Tables 1 and 3. The dotted line shows the standard CalCOFI sampling pattern from line 76.7 in the north to line 93.3 in the south.





# APPENDIX

## ASCII Data Files

NAME OF FILE	INFORMATION	LENGTH	COLUMNS	DECIMAL(col.#)
<b>JMCP0SIT.DAT</b>				
	Trawl number	2	1-2	
	SWFSC Collection Number	4	3-6	
	Year	2	7-8	
	Month	2	9-10	
	Day	2	11-12	
	Latitude start trawling	6	13-18	17
	Longitude start trawling	7	19-25	24
	Latitude end trawling	6	26-31	30
	Longitude end trawling	7	32-38	37
	Average Depth of trawl	3	39-41	
	Duration of trawling			
	recorded in hours	4	42-45	43
	Time started trawling PST			
	(Pacific Standard Time)	4	46-49	
	Surface Temperature in °C	4	50-53	52
	Meters of Wire Out	3	54-56	
<b>JMCCATCH.DAT</b>				
	Trawl number	2	1-2	
	Jack mackerel-estimate number	5	3-7	
	Jack mack-total weight in kg	5	8-12	
	Pacific mackerel-est. number	6	13-18	
	Pac. mack-tot. weight in kg	7	19-25	24
	Pacific Sardine-est. number	4	26-29	
	Pac. Sard.-tot. weight in kg	6	30-35	34
	SWFSC Collection Number	4	36-39	
	Sample weight in kg			
	of jack mackerel	3	40-42	
	Number of jack mackerel in			
	sample weight	3	43-45	
<b>JMCFISH.DAT</b>				
	Trawl number	3	1-3	
	SWFSC Collection Number	5	4-8	
	Fish Number	4	8-11	
	Fork length in mm	4	12-15	
	Sex (1=male, 2=female)	1	16	
	SWFSC Maturity code			
	(I = inactive, A = active,			
	H = hydrated)	1	17	
	Gonad Removed and Preserved			
	(W=whole, blank=not saved)	1	18	
	Whole wet body Weight (grams)	5	19-23	
	Preserved Otoliths ID number			
	(0 = not saved)	4	24-27	