

# **THE ANCHOVY REDUCTION FISHERY FOR THE 1976-77 SEASON**



**by**

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**MARINE RESOURCES  
TECHNICAL REPORT NO. 42**

**1979**

CALIFORNIA DEPARTMENT OF FISH AND GAME  
MARINE RESOURCES TECHNICAL REPORTS

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#### ABSTRACT

The 1976-77 anchovy season ended with landings of 92,515 mt (101,433 tons) in southern California and 4,571 mt (5,041 tons) in central California. Southern California catches were dominated by age groups III (27%) and 0 (28%) while 77% of central California's landings were age groups III through VI. Numerical sex ratios were calculated to be 1.1:1 and 2:1 female to male for southern and central California respectively.

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## ACKNOWLEDGEMENTS

This paper could not have been completed without the help and cooperation of many people, to name a few are Richard Klingbeil for his help in all aspects of the project with assistance from John Seapin, William Lang, Jerome Spratt, and Marian Haxby. The typing was performed by the efficient team of Paula Riley and Charel Cueva. Editorial comments were provided by Herbert Frey and Raymond Ally.

## INTRODUCTION

This report is the result of a monitoring program of the anchovy reduction fishery and is the tenth such report since the beginning of the fishery in 1965. The fishery is centered in two areas; off southern California and in Monterey Bay.

Data on estimated numbers by size class, year class, weight, maturity and sex were derived from 4,872 anchovies sampled at Terminal Island in southern California; and 162 individuals from Moss Landing (Monterey). Age was determined by the technique described by Collins and Spratt (1969). Methods of sampling were previously discussed by Collins (1971). Sexual maturity index was described by Sunada (1977).

## THE FISHERY

### Southern California

Fishing began in this region on September 15, 1976 and ended on May 15, 1977. The season's landings reached 92,515 metric tons (101,433 tons) of which 77,644 mt (85,031 tons) were caught by the San Pedro fleet and the remaining 14,871 mt (16,396 tons) by the Port Hueneme boats (Table 1). The quota was increased to 109,000 mt (120,000 tons) from the initial 90,718 mt (100,000 tons) on March 31, 1977 by the Fish and Game Commission.

The San Pedro fleet size remained relatively constant at 40 vessels during the season while three boats composed the Port Hueneme fleet. Processing capacities at both ports remained unchanged at 1,678 mt (1,850 tons) from the previous season (Sunada, 1977).

Initial fish price was negotiated at \$39.75 per short ton of anchovies, gradually increasing throughout the season reaching a high of \$58.75 per ton and closing in May at \$56.85 per ton.

Price negotiations delayed any intensive fishing until mid-November while winter storms curtailed some fishing in December. Landings in November reached 25,584 mt (28,200 tons) which was 28% of the season's total. January and February landings were low due to unavailability of fish and poor weather conditions (Table 1). Spring fishing improved considerably, when 19,636 mt (21,845 tons) were landed in March, although fishing success declined during the remaining months.

Over half of the catches were made in the San Pedro Channel region while the Port Hueneme area was second with 18% (Table 2). The Santa Barbara region was the site of heavy fishing during September although this area contributed only 10.1% of the total catch (Table 2). Santa Monica Bay-Point Dume area contributed nearly 12% with the remaining tonnage caught off Santa Catalina Island and Oceanside regions (Table 2).

#### Central California

Fishing in this region began on August 1, 1976, ending on May 15, 1977 with a seasonal quota of 13,608 mt (15,000 tons). The season's total amounted to 4,571 mt (5,041 tons) with over half the catches taken in November and December (Table 1).

A maximum of six boats operated in this area, although most of these boats departed in January for the San Francisco Bay herring fishery and returned in April. Anchovy prices were similar to southern California price. Fishing grounds were located predominantly in Monterey Bay.

#### AGE COMPOSITION OF THE CATCH

##### Southern California

The season's landings at Terminal Island were characterized by large numbers of young of the year fish (1976 year class) which totaled nearly 28% by number, far above the 10 year mean of 9.4%. Numbers of



TABLE 1. Anchovy Landings for 1976-77 Season by Port - Weight in Metric Tons

Month	Moss Landing	Port Hueneme	Terminal Island	Total	%
August	313	0	0	313	0.3
September	500	1,659	4,529	6,688	6.9
October	197	3,312	6,477	9,986	10.4
November	1,534	5,083	20,501	27,118	28.1
December	923	3,299	16,217	20,439	21.2
January	28	346	1,823	2,197	2.3
February	63	185	38	286	0.3
March	179	615	19,021	19,815	20.5
April	834	372	6,960	8,166	8.4
May	0	0	1,578	1,578	1.6
Total	4,571	14,871	77,144	96,586	100.0
Short tons	5,041	16,398	85,037	106,476	
%	4.7	15.4	79.9		

TABLE 2. Southern California Landings by Block Origin and Area, Weight in Metric Tons

Area	Block #	September	October	November	December	January	February	March	April	May	Total	Percent
Santa Barbara	653-670	3,019	1,653	234	4,299	27	...	...	...	...	9,232	10.0
Port Hueneme	682-688	2,074	3,963	5,211	3,890	346	185	615	372	...	16,656	18.1
Point Dume	701-707	638	1,595	2,425	5,268	590	...	119	...	...	10,635	11.6
San Pedro Channel	719-743	400	2,521	17,607	5,764	1,206	38	16,354	2,779	1,056	47,725	51.9
Catalina Island	758-762 805-807	...	55	...	275	...	...	2,447	2,848	459	6,084	6.6
Oceanside	757,802-	54	...	105	17	...	...	105	1,333	70	1,684	1.8
Total		6,185	9,787	25,582	19,513	2,169	223	19,640	7,332	1,585	92,015	
%		6.7	10.6	27.8	21.2	2.4	0.2	21.3	8.0	1.8		100.0

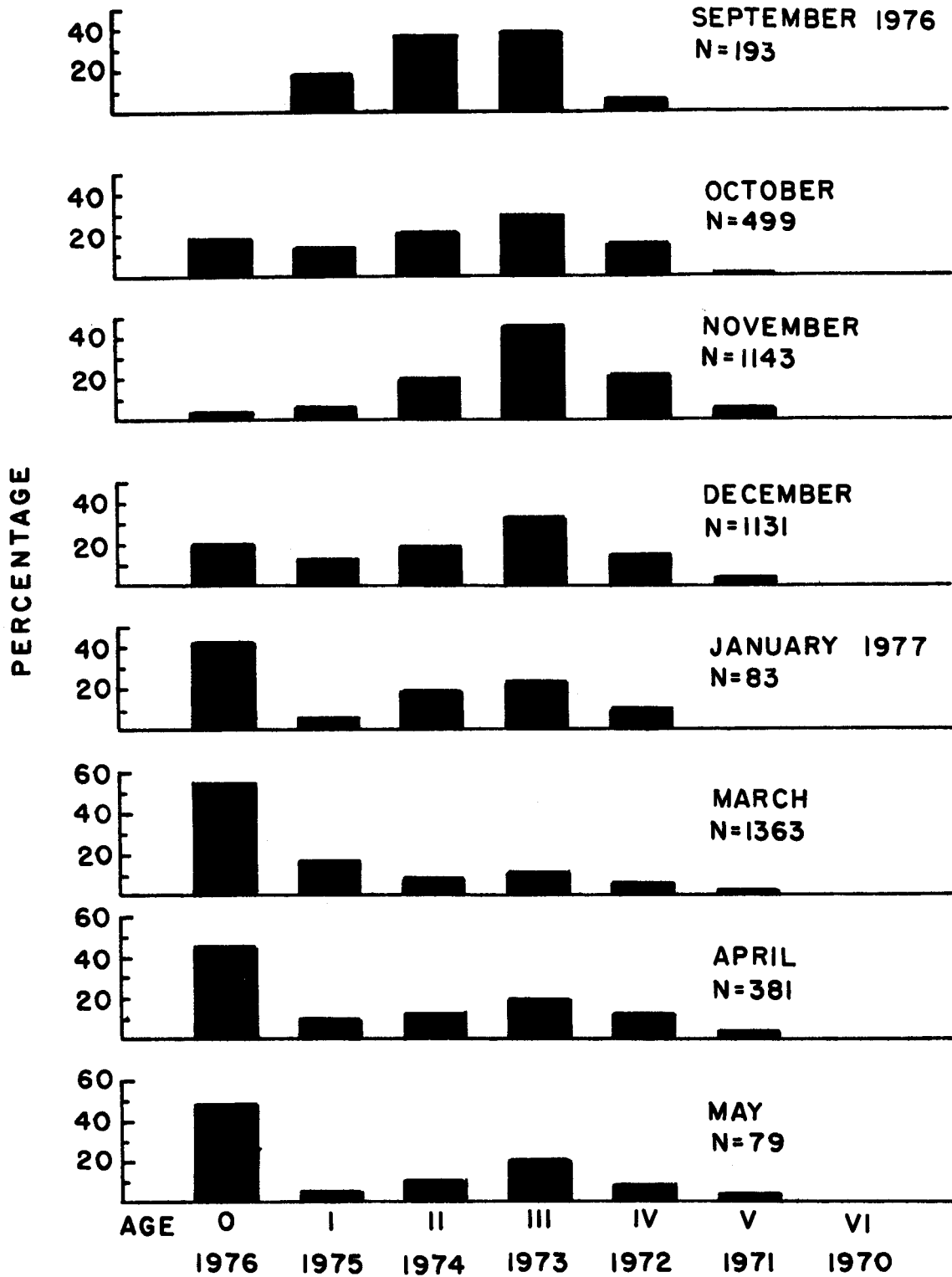


FIGURE I Anchovy age composition by month  
southern California 1976-77 Season

these fish accounted for over 50% of the fish sampled in March and dominated the catch in April and May (Figure 1). Age group III also totaled 28% by number but dominated the catch in terms of weight with 32% (Table 3). These fish became less numerous late in the season (Figure 1).

Historically, age group II fish have been the dominant age group; however, this age group contributed very little to the fishery. Age group I also were present in below average numbers. These two age groups totaled only 28% by number as compared to 48% for the same age groups during the previous season (Sunada, 1977). The numbers of these age groups indicate poor spawning success in 1974 and 1975.

Older age groups (IV-VII) were present in above average numbers, especially age group IV with 13% (Table 3).

#### Central California

Fish from older age groups historically dominated the catch as was the case during this season when 77% by number of the catch comprise fish from age groups III through VI while the younger age groups 0 to II totaled only 23% (Table 4). The noticeable absence of these young age groups can indicate poor spawning during 1974 through 1976. The lack of 0 age group fish in the catch differs greatly with southern California data.

#### LENGTH COMPOSITION OF THE CATCH

##### Southern California

Anchovies landed at Terminal Island measured between 78 mm to 158 mm (3 to 6.2 inches) SL with an average length of 121 mm (4.8 inches) SL (Table 5). In addition to the mean length being smaller than 128 mm (5.0 inches) SL of last season's (Sunada, 1977), 56% of the estimated

TABLE 3. Estimated Number and Weight of Anchovies Landed at Terminal Island by Age and Year-Class for 1976-77 Season

	0 1976	I 1975	II 1974	III 1973	IV 1972	V 1971	VI 1970	VII 1969	Total
Estimated Numbers	1,181,440,000	507,805,000	688,665,000	1,186,351,000	570,868,000	109,868,000	8,472,000	1,661,000	4,255,130,000
Standard Deviation	59,396,526	23,424,496	23,371,280	28,063,247	21,533,733	10,294,094	2,403,412	1,116,347	
Percent	27.8	11.9	16.2	27.9	13.4	2.5	0.2	0.1	100.0
Estimated Metric tons	14,733	7,857	13,367	24,848	13,080	2,724	205	45	76,859
Standard Deviation	635	359	453	594	524	262	60	32	
Percent	19.4	10.2	17.3	32.3	17.0	3.5	0.2	0.1	100.0

TABLE 4. Estimated Number and Weight of Anchovies Landed at Moss Landing by Age and Year-Class for 1976-77 Season

Estimated Numbers	797,000	8,774,000	13,209,000	21,068,000	29,182,000	21,842,000	5,159,000		100,031,000
Standard Deviation	1,919,946	4,020,408	5,595,998	5,093,219	5,682,948	3,654,730	1,939,939		
Percent	0.8	8.8	13.2	21.1	29.2	21.8	5.1		100.0
Estimated Metric tons	10	202	351	620	884	676	187		2,930
Standard Deviation	23	99	155	151	149	99	84		
Percent	0.3	6.9	12.0	21.2	30.2	23.0	6.4		100.0

TABLE 5. Length Frequency of Anchovy (all fish) for Southern California During the 1976-77 Season.

Standard Length	1976 0	1975 I	1974 II	1973 III	1972 IV	1971 V	1970 VI	1969 VII	Total
78	1								1
80	2								2
82	3								3
84	8								8
86	6								6
88	13								13
90	20	1							21
92	24	3	1						28
94	40	7							47
96	84	3							87
98	79	13	1						93
100	87	7	2	1					97
102	91	13		1					105
104	120	21	4	2					147
106	118	24	2						144
108	86	46	3		1				136
110	99	35	10	12	2				158
112	145	58	11	10	4				228
114	128	62	48	24	2				264
116	83	77	50	45	9	1			265
118	52	61	60	68	14				255
120	33	50	64	70	19	1	1		238
122	16	40	80	88	30	6	3		263
124	6	23	74	97	37	4		1	242
126	4	24	91	134	48	5			306
128		12	95	138	54	7			306
130		4	71	142	70	9			296
132		3	54	182	79	14	1		333
134	1	1	26	126	72	17	2		245
136		1	31	95	45	11			183
138			7	53	51	6			117
140			3	31	38	5			77
142			2	15	28	8	1		54
144			1	5	24	6	1		37
146				8	16	6		1	31
148				4	4	3			11
150				1	2	7			10
152					4	3			7
154						1			1
156					1	4			5
158				1			1		2
160									
Total	1,349	589	791	1,353	654	124	10	2	4,872
$\bar{X}$	107	115	125	129	132	137	133	135	121
S.E.M.	0.23	0.32	0.27	0.20	0.30	0.9	3.8	11.3	

4.25 billion fish were smaller than 125 mm (4.9 inches) SL as compared to 36% below 125 mm (4.9 inches) SL during the 1975-76 season (Table 6).

Length distributions during the fall showed several modes between 120 and 135 mm (4.7 to 5.3 inches) SL while the winter and spring months displayed numerous modes in the 100 to 120 mm (3.9 to 4.7 inches) SL range, representing recruitment of age group 0 (1976 year class) fish (Figure 2). Age group 0 fish were slightly larger than fish of the same age group during the previous season (Table 5).

Females generally were larger than males as was the case during the past several seasons (Table 7).

#### Central California

Anchovy size ranged from 100 to 160 mm (3.9 to 6.3 inches) SL with a mean length of 139 mm (5.5 inches) SL (Table 8). Of the estimated 100 million fish, 47% were between 135-144 mm (5.3 to 5.7 inches) SL size range (Table 6). The absence of small fish could indicate poor survival of these young fish as it was apparent in the age composition.

The average length of a female fish was slightly greater than a male, although males of certain age groups were larger than females (Table 7).

#### SEXUAL MATURITY AND SEX RATIO

##### Southern California

Mature and near mature (stage 4-6) fish were most prevalent during January through April with the highest incidence of mature fish occurring in April (Figure 3). Males appear to mature earlier than females.

The female to male numerical ratio of 1.1:1 and weight ratio of 1.2:1 (Table 9) were lower than the previous season's ratios of 1.5:1 and 1.6:1 respectively (Sunada, 1977). The large numbers of age group 0 fish may have contributed to the lower ratios, since males were

TABLE 6. Estimated Number by Length of Anchovies Landed at Terminal Island and Moss Landing During 1976-77 Season.

Length Group (mm SL)	TERMINAL ISLAND			MOSS LANDING		
	Estimated Number	Standard Deviation	Percent of Total	Estimated Number	Standard Deviation	Percent of Total
75- 84	7,617,000	3,973,676	0.1			
85- 94	77,869,000	19,541,693	1.8			
95-104	427,591,000	38,106,930	10.2	399,000	959,973	0.4
105-114	759,499,000	30,041,375	17.8	1,210,000	2,815,274	1.2
115-124	1,099,817,000	31,873,814	25.8	4,861,000	2,675,802	4.9
125-134	1,314,966,000	30,651,214	30.9	20,296,000	3,437,730	20.3
135-144	491,104,000	20,251,704	11.7	46,830,000	4,527,832	46.8
145-154	70,940,000	7,297,560	1.6	23,043,000	1,762,932	23.0
155-164	5,727,000	2,125,196	0.1	3,392,000	1,976,092	3.4
Total	4,255,130,000		100.0	100,031,000		100.0



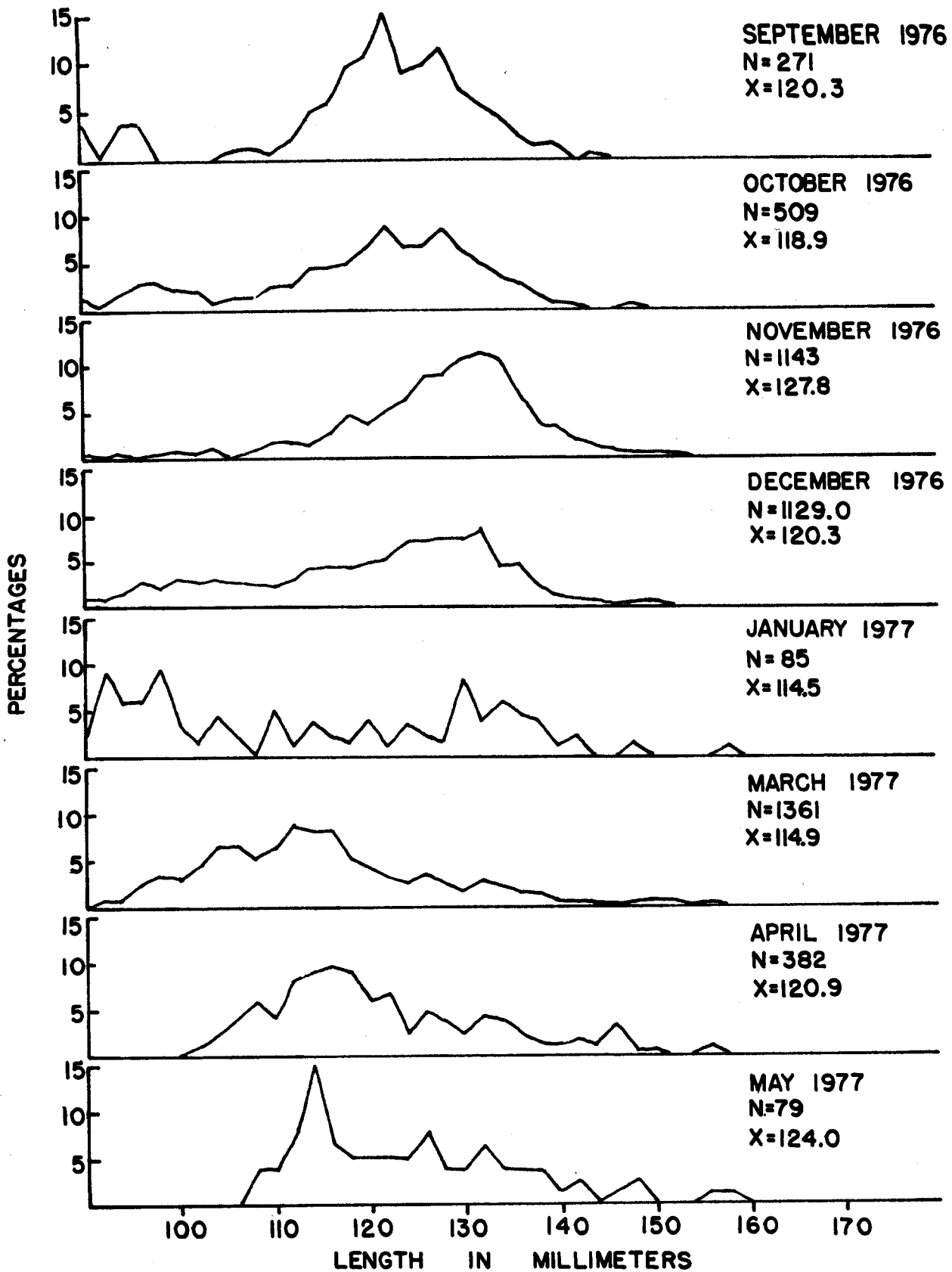


FIGURE 2. Anchovy length-frequency by month. Southern California. 1976-1977 Season.

TABLE 7. Mean Length (mm SL) of Males and Females Landed at Terminal Island and Moss Landing by Year Class

	1976	1975	1974	1973	1972	1971	1970	1969	Length for all Year Classes
	0	I	II	III	IV	V	VI	VII	
<u>Terminal Island</u>									
Males Length	107	114	124	127	131	134	137		120
Females Length	109	117	126	130	134	139	134	135	124
<u>Moss Landing</u>									
Males Length	106	123	129	138	142	145	150		137
Females Length		130	136	140	140	144	150		140

TABLE 8. Length Frequency of Anchovy (all fish) for Central California During the 1976-77 Season.

Standard Length	1976 0	1975 I	1974 II	1973 III	1972 IV	1971 V	1970 VI	1969 VII	Total
100									
102									
104	1								1
106									
108	1				1				2
110									
112			1						1
114									
116									
118		1							1
120		2	1						3
122		2							2
124		2	1	2					5
126		2		1		1			4
128		2	2	1	1				6
130		1	3						4
132		1	3	1	2	2			9
134			2	3	3	2			10
136			1	6	4	2	1		14
138			4	4	6	2			16
140			2	6	8	4			20
142				5	6	1	1		13
144				2	7	4	1		14
146			1	1	2	4			8
148		1	1	2	1	5			10
150				2	2	2	2		8
152					2	1			3
154					1	3			4
156						1	1		2
158							1		1
160							1		1
162									
164									
166									
168									
170									
172									
174									
176									
178									
180									
Total	2	14	22	36	46	34	8		162
$\bar{X}$	106	127	133	139	141	144	150		139
SEM	2.47	1.98	1.75	1.07	1.09	1.27	2.97		

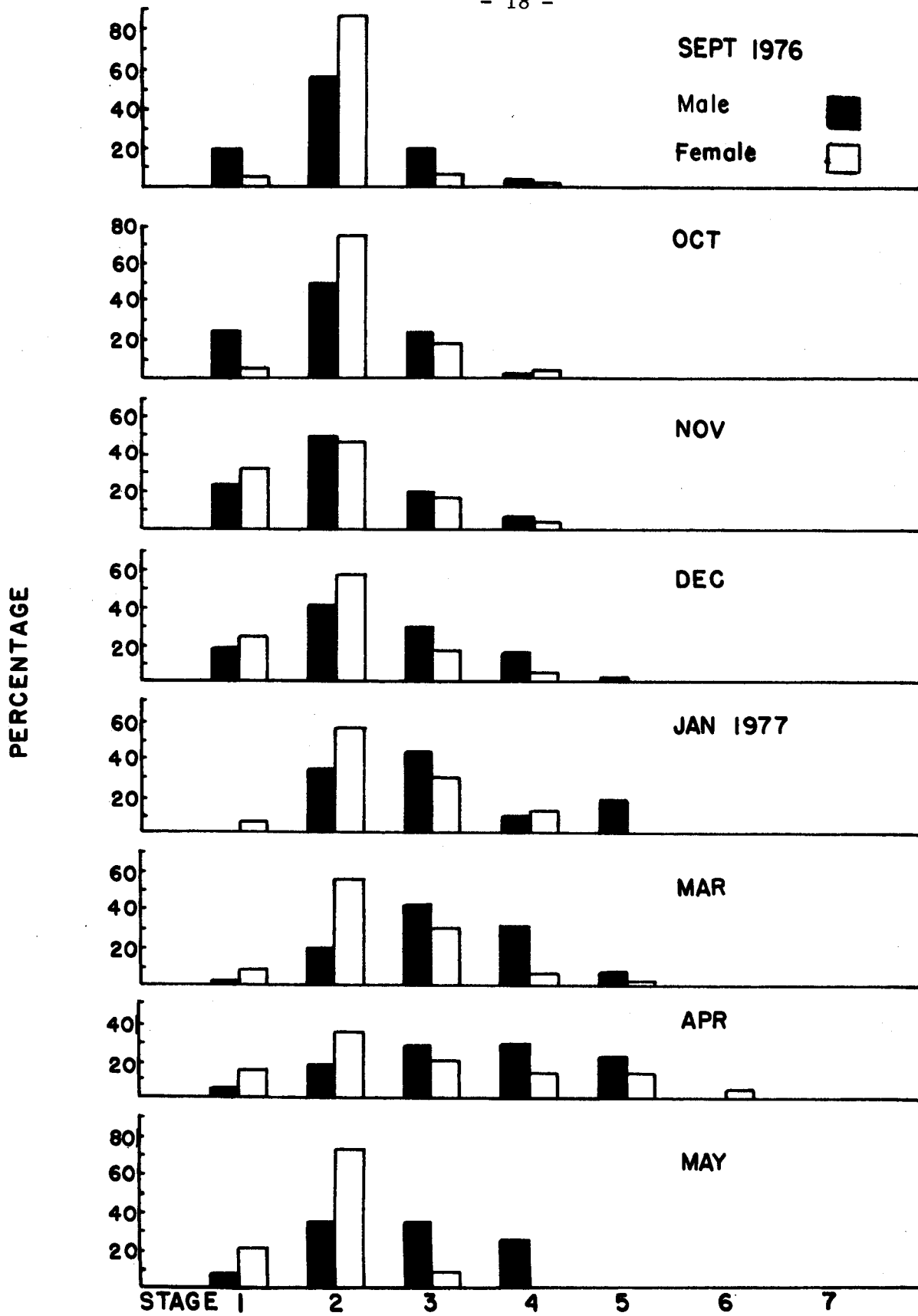


FIGURE 3. Sexual maturity of anchovies from southern California. 1976 - 77 Season.

slightly more numerous in age group 0 (Figure 4).

#### Central California

Sexually mature fish appeared in November and December although the sample sizes were few, which may have biased the results (Figure 5).

Females outnumbered the males 2:1 by number and 2.2:1 by weight (Table 9). These ratios were greater than the previous season's figures of 1.93:1 by number and 1.98:1 by weight (Sunada, 1977). Males were more numerous in the younger age groups as compared to older age groups (Figure 4).

#### CONCLUSION

The southern California data indicated the early recruitment of the 1976 year class, while the 1975 and 1974 cohorts were present in below normal numbers, coinciding with previous season's low numbers. This trend definitely implied low survival for these year classes, but the 1973 year appeared in above average numbers as did the 1972 year class.

Central California data showed the usual occurrence of older age groups as the catch comprised mainly of the 1973, 1972 and 1971 cohorts. The younger fish were noticeably scarce in numbers.

The sex ratios for southern California fish were nearly 1:1, possibly due to the abundance of young fish, while central California sex ratio was 2 females to every male. The absence of young fish could account for this variance in ratios.

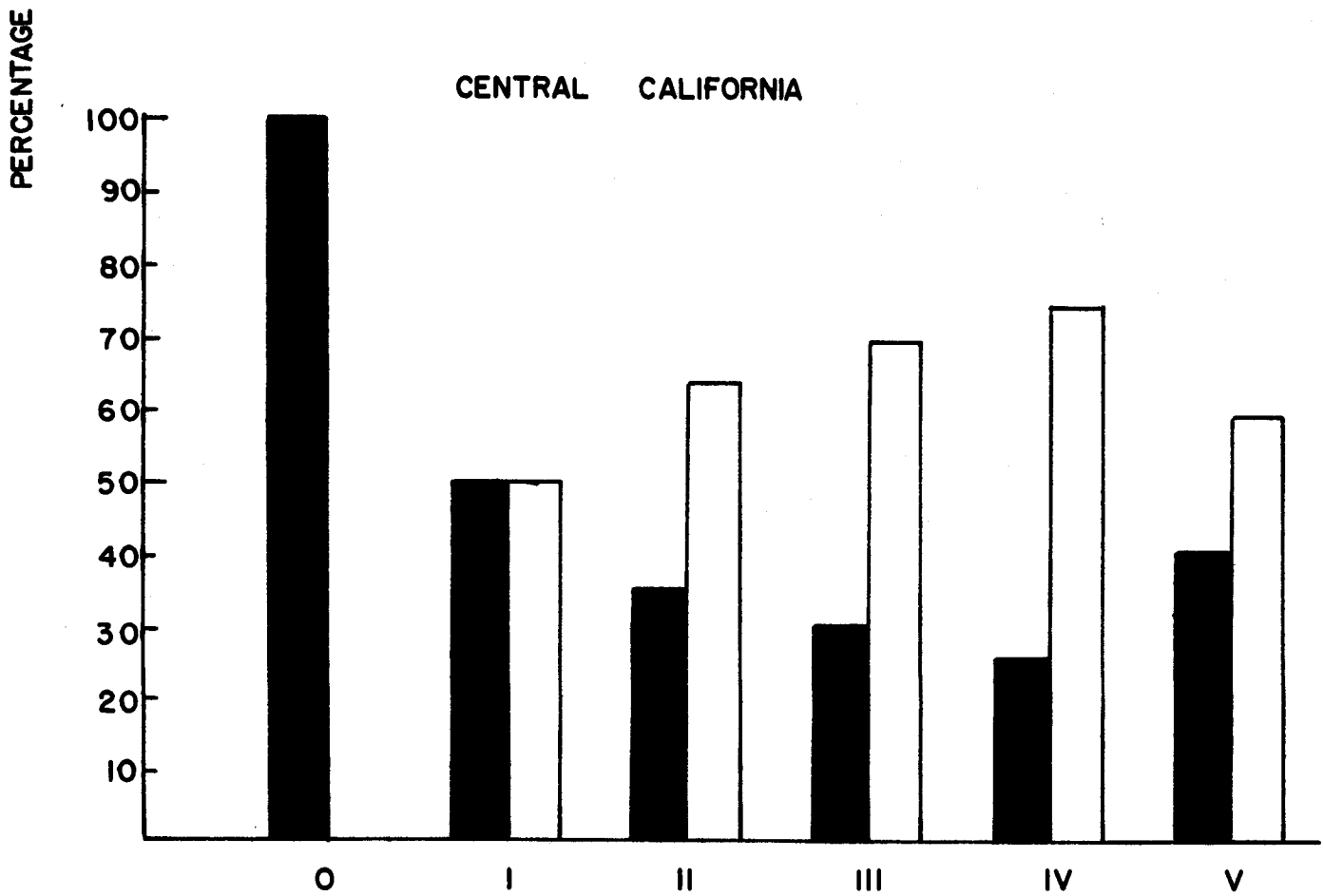
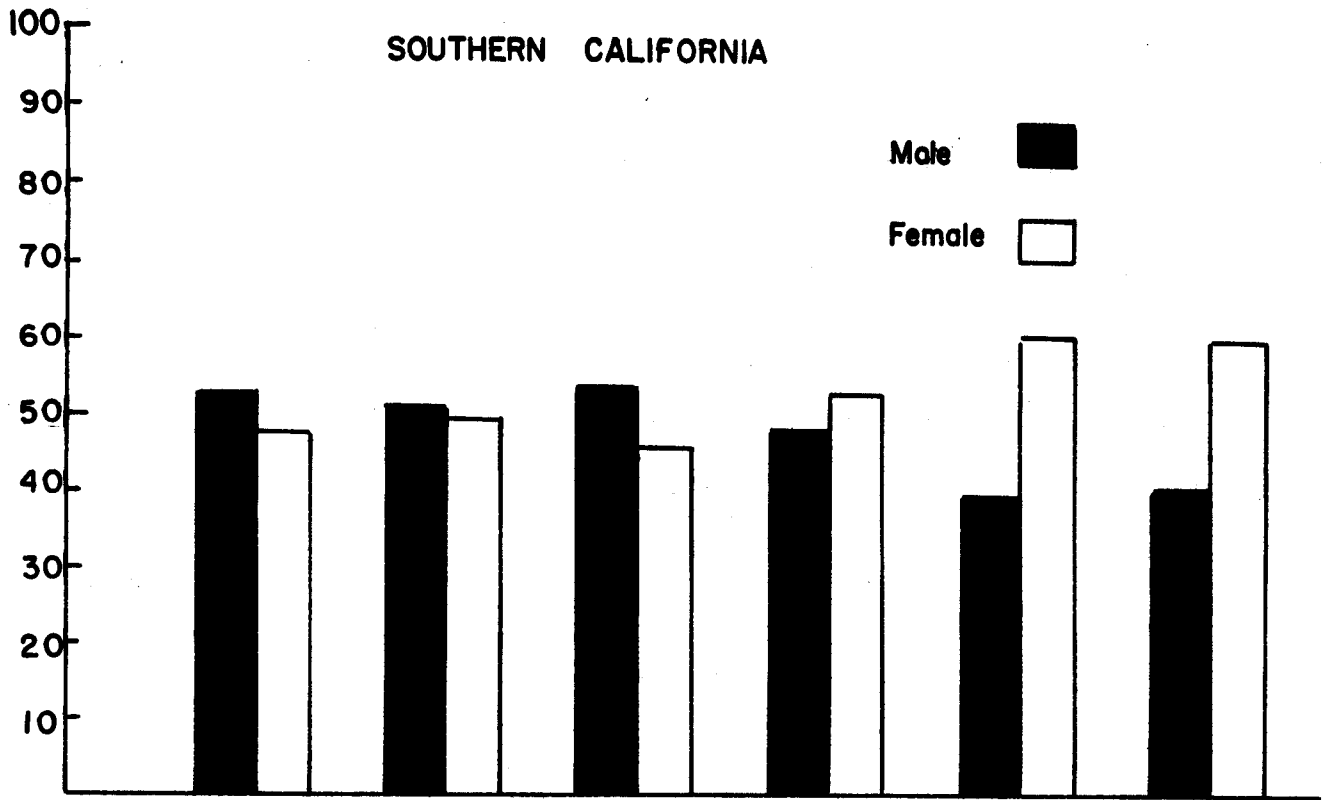


FIGURE 4. Percentage of males and females by age group.

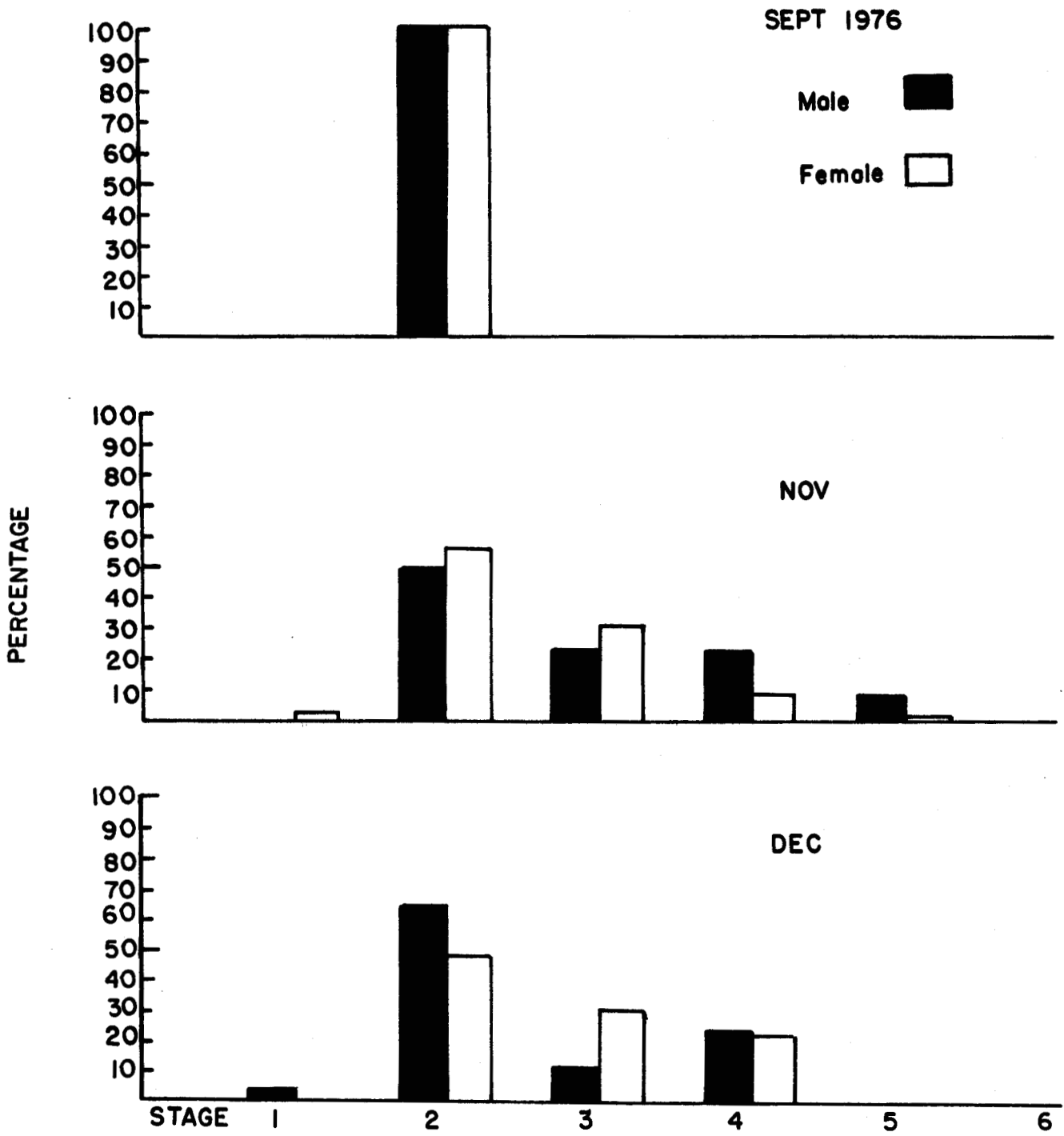


FIGURE 5. Sexual maturity of anchovies from central California.  
1976 - 77 Season.

TABLE 9. Sex Ratio by Number and Weight of Anchovy for 1976-77 Season

Sex Ratio by Number	Terminal Island	Moss Landing
Males		
Number	1,912,566,000	33,295,000
Percent	44.9	33.2
Females		
Number	2,019,378,000	66,735,000
Percent	47.5	66.7
Unknown		
Number	323,186,000	
Percent	7.5	
Total	4,255,130,000	100,030,000
Sex Ratio		
Female:Male	1.1:1	2.0:1

Sex Ratio by Weight (Weight in megagrams)	Terminal Island	Moss Landing
Males		
Weight	33,429	911
Percent	43.6	31.1
Females		
Weight	39,075	2,019
Percent	50.8	68.9
Unknown		
Weight	4,355	
Percent	5.6	
Total	76,859	2,930
Sex Ratio		
Female:Male	1.2:1	2.2:1



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