

# THE NORTHERN ANCHOVY FISHERY FOR THE 1975-76 SEASON



by

**JOHN S. SUNADA**

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## ABSTRACT

Anchovy landings for the 1975-76 season totaled 127,829 mg (140,906 short tons). Southern California samples exhibited the preponderance of age group II (1973 year class) followed by age group III (1972 year class). Younger age groups were present in below average numbers. Numerical sex ratios were calculated to be 1.5:1 and 1.9:1 female to male for southern and central California respectively.

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## INTRODUCTION

The northern anchovy, *Engraulis mordax*, constituted a minor fishery until 1965, when permission was granted for an anchovy fishery for reduction (Messersmith, 1969). Landings have gradually increased since 1965, reflecting the high demand for fish meal products.

As a result of this economic interest, a monitoring program was initiated in 1965. This is the ninth in a series of reports concerning the age, length, and sex composition of anchovy landings for reduction in California.

## METHODS

Methods of sampling and age determination were those described by Collins (1971). Estimated numbers by length, year class, weight, sex and sexual maturity were calculated from 8,087 fish taken at Terminal Island and 170 fish from Moss Landings.

Otoliths were used for age determination and age assigned according to methods described by Collins and Spratt (1969). The sexual maturation index was based on methods devised by Hjort (1914), using seven stages, with Stage 1 being immature, progressing in development with each stage, culminating with Stage 6 as spawning condition (Table 1). Stage 7 was considered the spent condition.

## THE FISHERY

### Southern Permit Area

The southern area opened on September 15, 1975, and closed May 15, 1976. This area has an annual quota of 100,000 short tons or 90,718 Mg, but was increased to 150,000 short tons or 136,078 Mg on January 23, 1976.

Quoted anchovy price on opening day was \$32.50 per short ton of fish while the season ended with a price of \$31 per ton to the fishermen,

TABLE 1. State of Sexual Organs as Defined by J. Hjort

Immature

Stage I. Virgin individuals. Very small sexual organs close under vertebral column. Female wine-colored torpedo-shaped ovaries about 2-3 cm long and 2-3 mm thick. Eggs invisible to naked eye. Male whitish or greyish brown, knife-shaped testes 2-3 cm long and 2-3 mm broad.

Mature

Stage II: Maturing virgins or recovering spents. Ovaries somewhat longer than half the length of ventral cavity. About 1 cm diam. Eggs small but visible to naked eye. Milt whitish, somewhat bloodshot. Testes same size as ovaries, but still thin and knife-shaped.

Stage III: Sexual organs more swollen, occupying about half the ventral cavity.

Stage IV: Ovaries and testes nearly filling 2/3 of ventral cavity. Eggs not transparent; milt whitish, swollen.

Stage V: Sexual organs filling ventral cavity. Ovaries with some large transparent eggs. Milt white, not yet running.

Stage VI: Roe and milt running (spawning).

Stage VII: Spents. Ovaries slack with residual eggs. Testes baggy, bloodshot.



although anchovy price fluctuated between \$29 to \$31 per ton throughout the season.

The southern area, extending from Point Buchon to the Mexican border, contained two fishing fleets; one harbored at Port Hueneme consisting of two purse seiners, and the other at Terminal Island with 45 boats. Terminal Island processors were limited to a daily processing capacity of 1,451 Mg (1,600 short tons), thus they imposed daily boat limits ranging from 32 Mg (35 short tons) to 100 Mg (110 short tons). Port Hueneme facilities maintained a processing capability of 227 Mg (250 short tons) per day.

Both fleets began fishing immediately after the season opened, since the price was negotiated prior to the season. Total landings for the season were a record 123,029 Mg (135,615 short tons) of which 102,940 Mg (113,473 short tons) were landed at Terminal Island and 20,089 Mg (22,145 short tons) at Port Hueneme (Table 2). Fishing during fall and winter months proved highly successful with November landings totalling 22,419 Mg (24,712 short tons).

Major fishing grounds located in the San Pedro Channel contributed 49% of the total catch followed by the Santa Barbara region with 22%. The latter region sustained heavy fishing during the fall and winter months (Table 3). The spring fishery shifted southward towards San Pedro Channel and Catalina Island areas coupled with declining landings.

#### Northern Permit Area

Fishing was allowed on August 1, 1975, and closing on May 15, 1976. The season's total of 4,800 Mg (5,290 short tons) did not exceed the annual quota of 15,000 short tons of 13,608 Mg (Table 2).

Opening anchovy price was \$28 per ton, increasing to \$29 per ton at season's end.

TABLE 2. Anchovy Landings for 1975-76 Season by Port -- Weight in Megagrams.

| Month        | Moss Landing | Port Hueneme | Terminal Island | Total     | %     |
|--------------|--------------|--------------|-----------------|-----------|-------|
| August       | 524          | 0            | 0               | 524       | 0.4   |
| September    | 1,009        | 1,840        | 11,982          | 14,831    | 11.6  |
| October      | 1,475        | 5,303        | 16,615          | 23,393    | 18.3  |
| November     | 500          | 4,386        | 13,611          | 18,497    | 14.4  |
| December     | 369          | 4,712        | 17,850          | 22,931    | 18.0  |
| January      | 553          | 2,834        | 14,589          | 17,976    | 14.0  |
| February     | 158          | 68           | 1,319           | 1,545     | 1.3   |
| March        | 198          | 0            | 10,326          | 10,524    | 8.3   |
| April        | 14           | 946          | 15,164          | 16,124    | 12.6  |
| May          |              |              | 1,484           | 1,484     | 1.1   |
| Total        | 4,800        | 20,088       | 102,940         | 127,829   |       |
| (short tons) | (5,291)      | (22,143)     | (113,472)       | (140,906) |       |
| %            | 3.8          | 15.7         | 80.5            | 100       | 100.0 |

TABLE 3. Southern California Landings by Block Origin and Area, Weight in Megagrams.

| Area              | Block #            | September | October | November | December | January | February | March  | April  | May   | Total   |
|-------------------|--------------------|-----------|---------|----------|----------|---------|----------|--------|--------|-------|---------|
| Santa Barbara     | 653-670            | 1,329     | 5,143   | 11,730   | 4,947    | 2,589   | 494      |        | 900    | 64    | 27,223  |
| %                 |                    | 9.6       | 23.5    | 65.1     | 22.1     | 15.0    | 35.7     |        | 5.6    | 4.1   | 22.13   |
| Port Hueneme      | 682-688            | 191       | 1,111   | 1,964    | 2,943    | 900     | 44       |        | 388    | 101   | 7,741   |
| %                 |                    | 1.4       | 5.1     | 10.9     | 13.1     | 5.8     | 3.2      |        | 2.4    | 6.5   | 6.29    |
| Point Dume        | 701-707            | 597       | 891     | 729      | 5,144    | 4,531   | 87       | 151    | 1,861  | 495   | 14,486  |
| %                 |                    | 4.3       | 4.1     | 4.0      | 22.8     | 26.2    | 6.3      | 1.5    | 11.6   | 32.0  | 11.77   |
| San Pedro Channel | 719-743            | 11,293    | 11,108  | 3,517    | 8,677    | 8,380   | 706      | 4,198  | 12,136 | 824   | 60,839  |
| %                 |                    | 81.8      | 50.6    | 19.6     | 38.3     | 47.7    | 50.8     | 40.7   | 75.3   | 57.3  | 49.45   |
| Catalina Island   | 758-762<br>805-807 | 412       | 3,665   | 57       | 824      | 900     | 56       | 3,598  | 825    |       | 10,337  |
| %                 |                    | 2.9       | 16.7    | 0.3      | 3.7      | 5.2     | 4.0      | 34.8   | 5.1    |       | 8.40    |
| Oceanside         | 757,802-844        |           |         |          |          | 24      |          | 2,379  |        |       | 2,403   |
| %                 |                    |           |         |          |          | 0.1     |          | 2.3    |        |       | 1.95    |
| Total             |                    | 13,822    | 21,918  | 17,997   | 22,562   | 17,423  | 1,387    | 10,326 | 16,110 | 1,484 | 123,029 |
| %                 |                    | 11.23     | 17.81   | 14.63    | 18.34    | 14.16   | 1.13     | 8.38   | 13.09  | 1.21  |         |

The Monterey fleet of four lampara and five purse seiners, was most successful during fall months with decreasing catches in winter and spring. Fishing grounds were near Santa Cruz, Monterey, and Moss Landing (Table 4).

#### AGE COMPOSITION OF THE CATCH

##### Southern California

The dominant age group during the 1975-76 season was age group II (1973 year class) totaling 38% by number and 36% by weight of the sampled catch, followed by age group III (1972 year class) consisting of 34% by number and 35% by weight (Table 5). The older age groups III-V (1972-1970 year classes) constituted an unusually high percentage of the catch; 49% by number and 53% by weight. These same age groups dominated the spring samples when they averaged 62% by number (Figure 1).

Young-of-the-year (1975 year class) and age group I (1974 year class) fish totaled a below average 13% by number and 10% by weight (Table 5). Their low numbers became evident during spring (Figure 1) when normally they appeared in sizeable numbers (Sunada, 1976). This trend may indicate low recruitment for these age groups.

##### Central California

Fish of older age groups III-VI (1972-1969 year classes) completely dominated the catch with 79% by number and 85% by weight (Table 6). Age group I (1974 year class) was nearly absent totaling 1% by number and 0.4% by weight, while the young-of-the-year (1975 year class) fish amounted to 5.8% by number and 2% by weight (Table 6). Young-of-the-year (1975 year class) fish became recruitable during the fall when they comprised 13% by number (Figure 2).

TABLE 4. Central California Landings by Block Origin, Weight in Megagrams.

| Block #      | August       | September    | October      | November     | December    | January      | February    | March       | April      | May | Total        |
|--------------|--------------|--------------|--------------|--------------|-------------|--------------|-------------|-------------|------------|-----|--------------|
| 508          | 460          | 379          | 530          |              |             |              |             |             |            |     | 1,369        |
| %            | 9.58         | 7.89         | 11.04        |              |             |              |             |             |            |     | 28.52        |
| 509          |              |              | 54           | 54           |             |              |             |             |            |     | 108          |
| %            |              |              | 1.12         | 1.12         |             |              |             |             |            |     | 2.25         |
| 516          |              | 197          | 715          | 411          | 369         | 553          | 158         | 198         | 14         |     | 2,615        |
| %            |              | 4.10         | 14.89        | 8.56         | 7.69        | 11.52        | 3.29        | 4.12        | .29        |     | 54.48        |
| 517          | 64           | 368          | 26           | 35           |             |              |             |             |            |     | 493          |
| %            | 1.33         | 7.67         | .54          | .73          |             |              |             |             |            |     | 10.27        |
| 519          |              |              | 150          |              |             |              |             |             |            |     | 150          |
| %            |              |              | 3.12         |              |             |              |             |             |            |     | 3.12         |
| 526          |              |              | 65           |              |             |              |             |             |            |     | 65           |
| %            |              |              | 1.35         |              |             |              |             |             |            |     | 1.35         |
| <b>Total</b> | <b>524</b>   | <b>1,009</b> | <b>1,475</b> | <b>500</b>   | <b>369</b>  | <b>553</b>   | <b>158</b>  | <b>198</b>  | <b>14</b>  |     | <b>4,800</b> |
| <b>%</b>     | <b>10.92</b> | <b>21.02</b> | <b>30.73</b> | <b>10.42</b> | <b>7.69</b> | <b>11.52</b> | <b>3.29</b> | <b>4.12</b> | <b>.29</b> |     |              |

TABLE 5. Estimated Number and Weight of Anchovies Landed at Terminal Island by Age and Year-Class for 1975-76 Season.

|                     | 0<br>1975   | I<br>1974   | II<br>1973    | III<br>1972   | IV<br>1971  | V<br>1970   | VI<br>1969 | Total         |
|---------------------|-------------|-------------|---------------|---------------|-------------|-------------|------------|---------------|
| Estimated numbers   | 119,715,000 | 509,216,000 | 1,791,742,000 | 1,636,685,000 | 581,216,000 | 157,356,000 | 10,395,000 | 4,806,325,000 |
| Standard deviation  | 15,905,843  | 17,334,849  | 27,095,021    | 24,649,477    | 16,422,385  | 9,142,399   | 2,275,136  |               |
| Percent             | 2.4         | 10.5        | 37.7          | 34.0          | 12.0        | 3.2         | 0.2        |               |
| Estimated megagrams | 1,246       | 9,377       | 36,672        | 35,690        | 14,757      | 4,575       | 312        | 102,630       |
| Standard deviation  | 176         | 316         | 549           | 549           | 428         | 274         | 71         |               |
| Percent             | 1.2         | 9.2         | 35.7          | 34.7          | 14.4        | 4.4         | 0.4        | 100.0         |

TABLE 6. Estimated Number and Weight of Anchovies Landed at Moss Landing by Age and Year-Class for 1975-76 Season.

|                     | 0<br>1975 | I<br>1974 | II<br>1973 | III<br>1972 | IV<br>1971 | V<br>1970  | VI<br>1969 | Total       |
|---------------------|-----------|-----------|------------|-------------|------------|------------|------------|-------------|
| Estimated numbers   | 6,588,800 | 1,122,800 | 15,761,900 | 30,729,300  | 28,578,600 | 25,212,000 | 5,768,600  | 113,762,000 |
| Standard deviation  | 9,316,399 | 1,300,243 | 5,499,306  | 3,322,438   | 5,525,953  | 9,239,312  | 5,583,000  |             |
| Percent             | 5.8       | 1.0       | 13.8       | 27.0        | 25.1       | 22.2       | 5.1        | 100.0       |
| Estimated megagrams | 71        | 14        | 437        | 892         | 962        | 903        | 228        | 3,507       |
| Standard deviation  | 102       | 17        | 145        | 111         | 190        | 312        | 209        |             |
| Percent             | 2.0       | .4        | 12.5       | 25.4        | 27.4       | 25.8       | 6.5        | 100.0       |

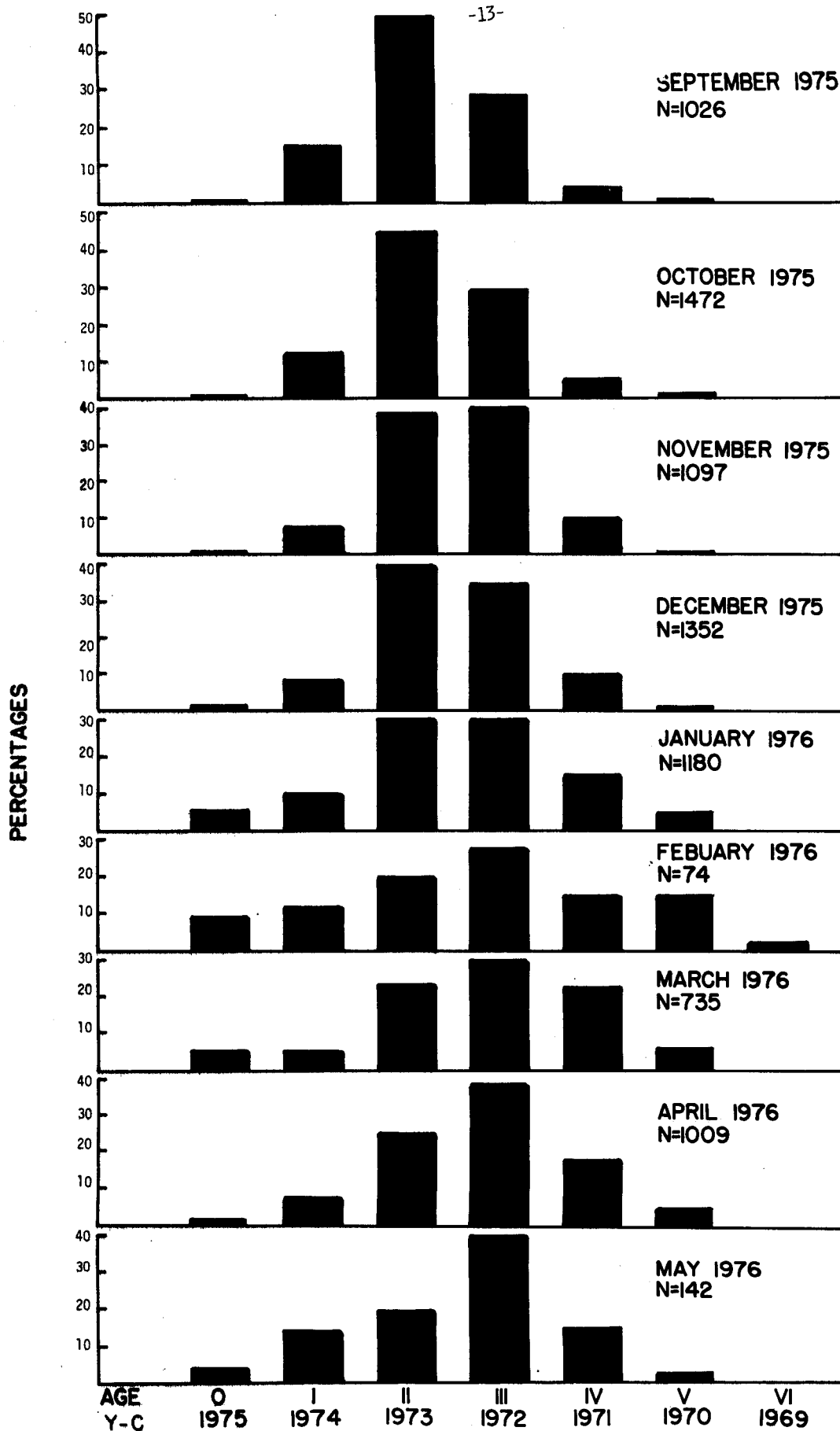
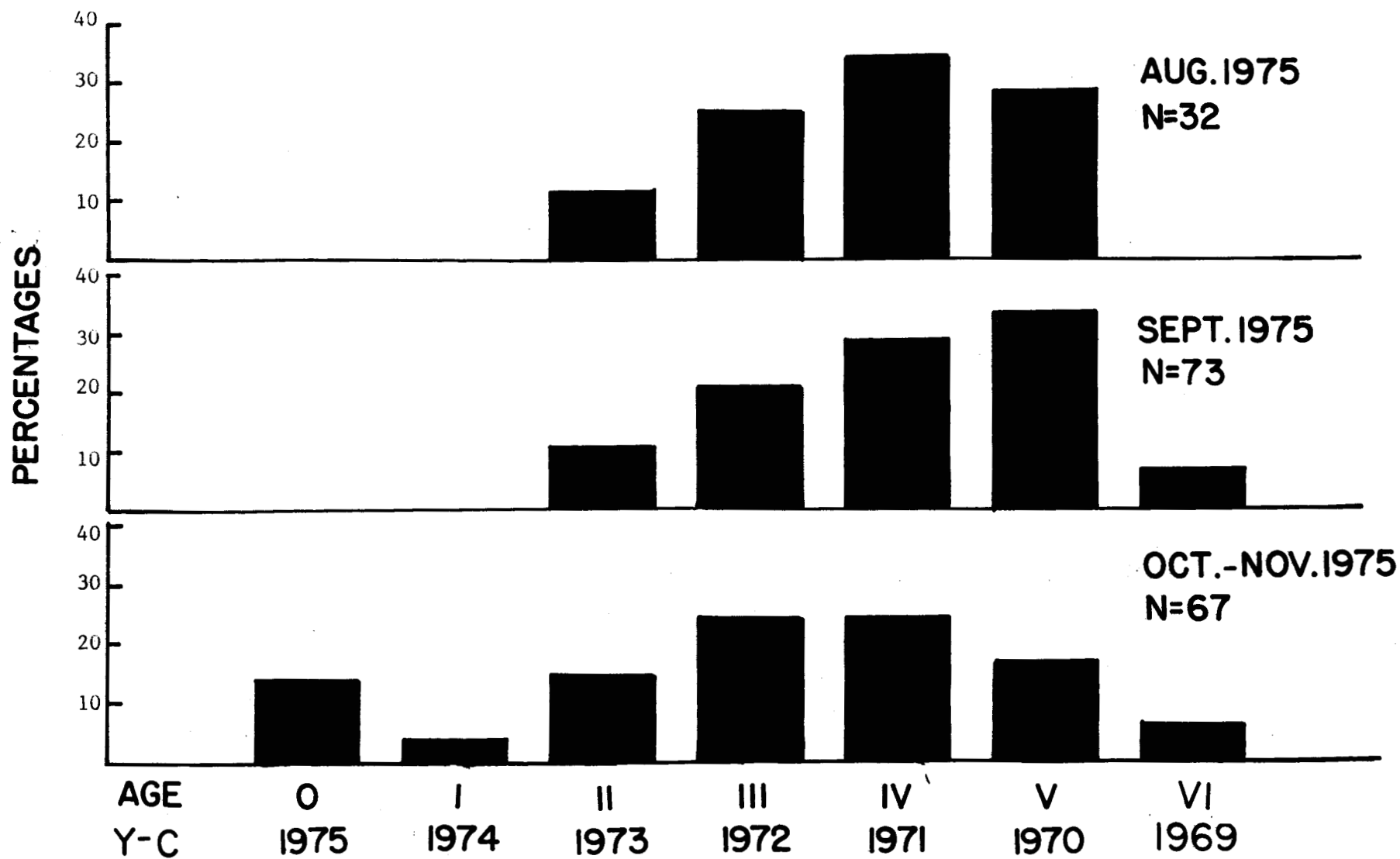


FIGURE I Anchovy age composition by month  
southern California 1975-76 Season



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FIGURE 2 Anchovy age composition by month central California 1975-76 Season



LENGTH COMPOSITION OF THE CATCH

Southern California

Fish larger than 125 mm (4.9 inches) SL constituted 64% of the estimated 4.8 billion fish landed at Terminal Island, although lengths ranged from 78 mm to 171 mm (3.0 to 6.7 inches) SL (Table 7). Since the 1972-73 season, sampled mean length of the anchovy has been increasing. The season continued this trend with 128 mm (5.0 inches) SL as average length, as compared to 125 mm (4.9 inches) SL for the 1974-75 season (Sunada, 1977).

TABLE 7. Estimated Number by Length of Anchovies Landed at Terminal Island and Moss Landing During 1975-76 Season.

| Length group (mm SL) | TERMINAL ISLAND  |                    |                     | MOSS LANDING     |                    |                     |
|----------------------|------------------|--------------------|---------------------|------------------|--------------------|---------------------|
|                      | Estimated number | Standard deviation | Percent of landings | Estimated number | Standard deviation | Percent of landings |
| 75-84                | 2,951,000        | 1,293,540          | 0.1                 |                  |                    |                     |
| 85-94                | 22,656,000       | 4,312,257          | 0.5                 | 789,200          | 1,245,035          | 0.7                 |
| 95-104               | 62,600,000       | 11,360,078         | 1.3                 | 5,363,700        | 6,946,053          | 4.7                 |
| 105-114              | 192,505,000      | 13,589,613         | 4.0                 | 1,549,800        | 2,307,926          | 1.4                 |
| 115-124              | 1,445,752,000    | 31,963,551         | 30.0                | 3,228,600        | 2,595,955          | 2.9                 |
| 125-134              | 2,048,392,000    | 28,789,314         | 42.6                | 21,835,700       | 6,373,926          | 19.2                |
| 135-144              | 787,656,000      | 20,570,144         | 16.3                | 46,263,200       | 3,748,559          | 40.7                |
| 145-154              | 198,566,000      | 10,062,714         | 4.2                 | 27,572,800       | 6,456,634          | 24.2                |
| 155-164              | 41,769,000       | 4,735,807          | 0.9                 | 4,361,800        | 1,484,332          | 3.8                 |
| 165-174              | 3,478,000        | 1,203,918          | 0.1                 | 2,788,200        | 2,783,078          | 2.4                 |
| Total                | 4,806,325,000    |                    | 100.0               | 113,762,000      |                    | 100.0               |

Monthly length frequencies indicated a scarcity of smaller fish during late winter and spring which was alarming since this was the period when young fish are recruited (Figure 3).

Lengths at age for most age groups (Table 8) were similar to lengths from 1974-75 season (Sunada, 1977). Females were slightly larger than males for most age groups (Table 9).

#### Central California

The preponderance of older fish was reflected by the 70% of the 114 million being greater than 135 mm (5.3 inches) SL (Table 7). This is nearly twice the 40% from the previous season's results (Sunada, 1977).

Mean length for the season was 140 mm (5.5 inches) SL (Table 10), which was considerably larger than the 131 mm (5.1 inches) SL for the 1974-75 season (Sunada, 1977). The females were slightly larger than males in most age groups (Table 9). This trend seems consistent with previous results.

Monthly length frequencies revealed the recruitment of small fish during late fall (Figure 4) as was previously noted during the 1974-75 season (Sunada, 1977).

#### SEXUAL MATURITY AND SEX RATIO

##### Southern California

Sexual development of anchovies occurred throughout the season, reaching mature and near-mature conditions (Stage 4-6) in March and April. Males matured slightly earlier than females as was noted during March (Figure 5).

The female to male numerical ratio of 1.5:1 and weight ratio of 1.6:1 (Table 11) was a slight decline from the previous season's values of 1.6:1 and 1.7:1 respectively (Sunada, 1977). Males were dominant among younger fish while greater proportions of females prevailed at older ages (Figure 6).

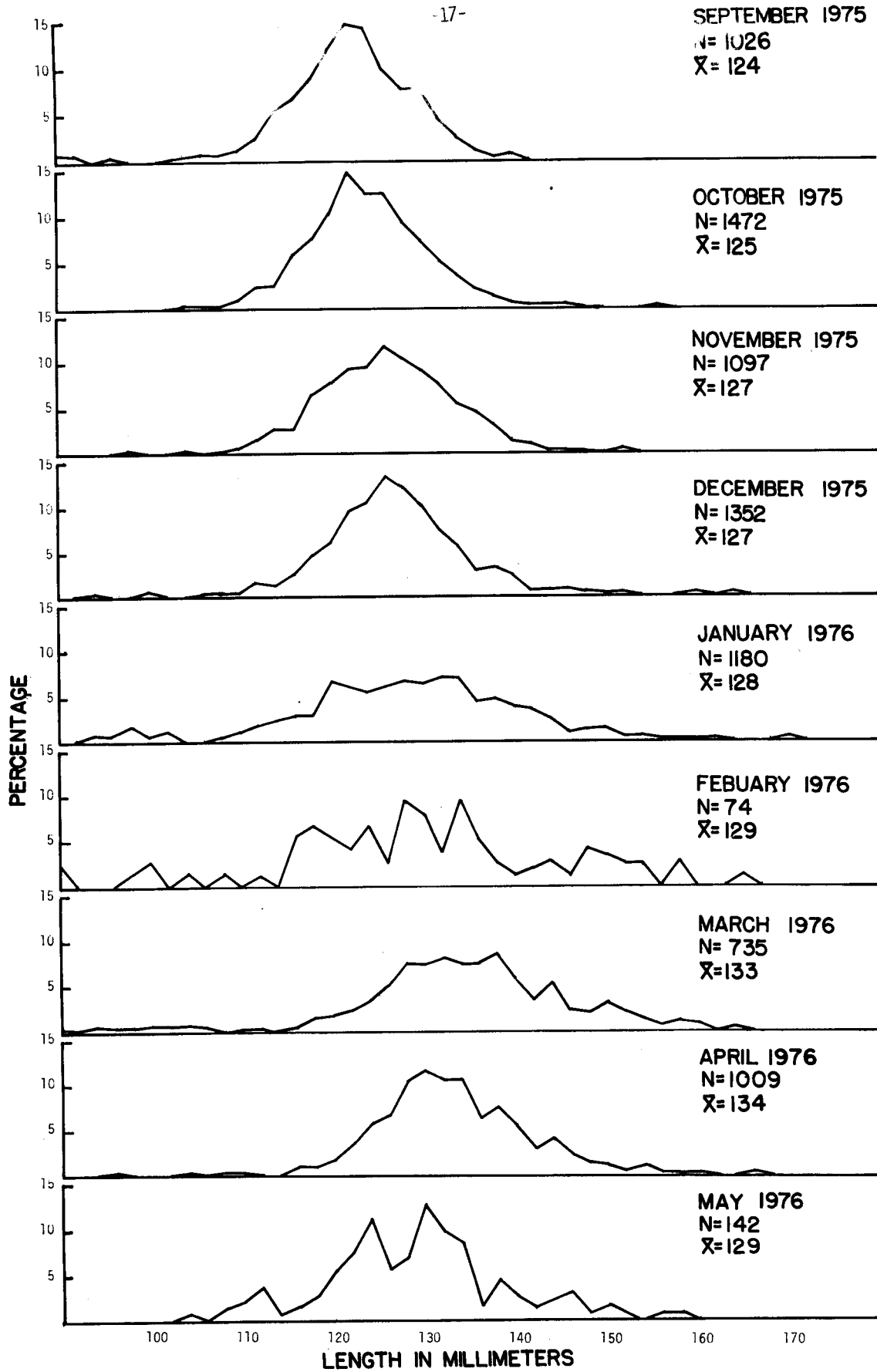


FIGURE 3 Anchovy length frequency by month  
southern California 1975-76 Season

TABLE 8. Length Frequency of Anchovy (all fish) Landed in Southern California During the 1975-76 Season.

| Standard length | 1975<br>0 | 1974<br>I | 1973<br>II | 1972<br>III | 1971<br>IV | 1970<br>V | 1969<br>VI | Total<br>Total |
|-----------------|-----------|-----------|------------|-------------|------------|-----------|------------|----------------|
| 78              | 1         |           |            |             |            |           |            | 1              |
| 80              | 1         |           |            |             |            |           |            | 1              |
| 82              | 1         |           |            |             |            |           |            | 1              |
| 84              | 3         |           |            |             |            |           |            | 3              |
| 86              | 3         | 2         |            |             |            |           |            | 5              |
| 88              | 5         | 1         |            |             |            |           |            | 6              |
| 90              | 8         | 2         |            |             |            |           |            | 10             |
| 92              | 4         | 2         |            |             |            |           |            | 6              |
| 94              | 16        | 1         |            |             |            |           |            | 17             |
| 96              | 20        |           |            |             |            |           |            | 20             |
| 98              | 25        | 1         |            |             |            |           |            | 26             |
| 100             | 25        |           |            |             |            |           |            | 25             |
| 102             | 19        | 1         |            |             |            |           |            | 20             |
| 104             | 17        | 2         |            | 1           |            |           |            | 20             |
| 106             | 7         | 5         | 4          | 1           |            |           |            | 17             |
| 108             | 8         | 9         | 13         | 7           |            |           |            | 37             |
| 110             | 9         | 19        | 31         | 6           |            |           |            | 65             |
| 112             | 7         | 27        | 59         | 35          | 3          |           |            | 131            |
| 114             | 2         | 42        | 70         | 39          | 2          |           |            | 155            |
| 116             | 5         | 68        | 106        | 84          | 3          | 2         |            | 268            |
| 118             | 9         | 106       | 186        | 103         | 9          | 1         |            | 414            |
| 120             | 1         | 117       | 264        | 156         | 24         | 2         |            | 564            |
| 122             | 1         | 128       | 353        | 218         | 23         | 6         | 1          | 730            |
| 124             | 3         | 100       | 371        | 212         | 55         | 13        |            | 754            |
| 126             | 1         | 78        | 361        | 279         | 59         | 9         |            | 787            |
| 128             |           | 63        | 353        | 280         | 55         | 9         | 1          | 761            |
| 130             |           | 41        | 309        | 277         | 65         | 11        | 1          | 704            |
| 132             |           | 16        | 185        | 288         | 83         | 10        | 1          | 583            |
| 134             |           | 11        | 146        | 232         | 86         | 13        |            | 488            |
| 136             |           | 4         | 75         | 165         | 71         | 7         |            | 322            |
| 138             |           | 3         | 76         | 138         | 81         | 10        | 2          | 310            |
| 140             |           | 1         | 29         | 88          | 84         | 17        |            | 219            |
| 142             |           |           | 13         | 53          | 56         | 11        |            | 133            |
| 144             |           | 1         | 7          | 46          | 70         | 19        | 1          | 144            |
| 146             |           |           | 4          | 26          | 37         | 14        | 1          | 82             |
| 148             |           |           | 3          | 11          | 34         | 16        |            | 64             |
| 150             |           |           | 4          | 5           | 26         | 21        |            | 56             |
| 152             |           |           |            | 3           | 22         | 18        |            | 43             |
| 154             |           |           |            | 4           | 10         | 21        |            | 35             |
| 156             |           |           |            | 2           | 7          | 8         |            | 17             |
| 158             |           |           |            | 1           | 6          | 7         | 1          | 15             |
| 160             |           |           |            |             | 1          | 9         | 3          | 13             |
| 162             |           |           |            |             | 1          | 3         | 1          | 5              |
| 164             |           |           |            |             |            | 4         | 2          | 6              |
| 166             |           |           |            | 1           |            |           |            | 1              |
| 168             |           |           |            |             |            |           |            |                |
| 170             |           |           |            |             |            |           | 1          | 1              |
| 172             |           |           |            |             |            |           |            |                |
| N               | 201       | 851       | 3022       | 2761        | 973        | 261       | 16         | 8087           |
| $\bar{x}$       | 101       | 122       | 126        | 129         | 136        | 143       | 149        | 128            |
| SEM             | 0.63      | 0.23      | 0.12       | 0.15        | 0.28       | 0.71      | 3.90       |                |

TABLE 9. Mean Length (mm SL) of Males and Females Landed at Terminal Island and Moss Landing by Year Class.

|                        | 1975<br>(0) | 1974<br>I | 1973<br>II | 1972<br>III | 1971<br>IV | 1970<br>V | 1969<br>VI | Length for all<br>year classes |
|------------------------|-------------|-----------|------------|-------------|------------|-----------|------------|--------------------------------|
| <u>Terminal Island</u> |             |           |            |             |            |           |            |                                |
| Males                  |             |           |            |             |            |           |            |                                |
| length                 | 103         | 121       | 125        | 129         | 135        | 141       | 140        | 126                            |
| Females                |             |           |            |             |            |           |            |                                |
| length                 | 103         | 123       | 127        | 130         | 137        | 144       | 152        | 129                            |
| <u>Moss Landings</u>   |             |           |            |             |            |           |            |                                |
| Males                  |             |           |            |             |            |           |            |                                |
| length                 | 106         | -         | 132        | 137         | 144        | 145       | 163        | 140                            |
| Females                |             |           |            |             |            |           |            |                                |
| length                 | 99          | 103       | 136        | 137         | 145        | 150       | 156        | 142                            |

TABLE 10. Length Frequency of Anchovy (all fish) Landed in Central California During the 1975-76 Season.

| Standard length | 1975<br>0 | 1974<br>I | 1973<br>II | 1972<br>III | 1971<br>IV | 1970<br>V | 1969<br>VI | Total |
|-----------------|-----------|-----------|------------|-------------|------------|-----------|------------|-------|
| 90              |           |           |            |             |            |           |            |       |
| 92              | 1         |           |            |             |            |           |            | 1     |
| 94              |           |           |            |             |            |           |            |       |
| 96              | 1         |           |            |             |            |           |            | 1     |
| 98              | 1         |           |            |             |            |           |            | 1     |
| 100             | 2         |           |            |             |            |           |            | 2     |
| 102             | 2         | 2         |            |             |            |           |            | 4     |
| 104             |           |           |            |             |            |           |            |       |
| 106             | 2         |           |            |             |            |           |            | 2     |
| 108             |           |           |            |             |            |           |            |       |
| 110             |           |           |            |             |            |           |            |       |
| 112             |           |           |            |             |            |           |            |       |
| 114             |           |           |            |             |            |           |            |       |
| 116             |           |           |            |             |            |           |            |       |
| 118             |           |           |            |             |            |           |            |       |
| 120             |           |           |            | 1           |            |           |            | 1     |
| 122             |           |           | 1          |             |            |           |            | 1     |
| 124             |           |           |            | 2           |            |           |            | 2     |
| 126             |           |           | 1          | 1           |            |           |            | 2     |
| 128             |           |           | 3          |             |            |           |            | 3     |
| 130             |           |           | 2          | 4           |            |           |            | 6     |
| 132             |           |           | 4          | 2           | 2          |           |            | 8     |
| 134             |           |           | 1          | 6           | 3          |           |            | 10    |
| 136             |           |           | 2          | 3           | 2          | 2         | 1          | 10    |
| 138             |           |           | 5          | 6           | 3          |           |            | 14    |
| 140             |           |           | 2          | 4           | 4          | 2         |            | 12    |
| 142             |           |           |            | 5           | 6          | 4         |            | 15    |
| 144             |           |           | 1          | 4           | 7          | 6         |            | 18    |
| 146             |           |           |            | 1           | 6          | 5         | 1          | 13    |
| 148             |           |           |            | 1           | 2          | 2         |            | 5     |
| 150             |           |           |            | 1           | 3          | 8         |            | 12    |
| 152             |           |           |            |             | 4          | 3         |            | 7     |
| 154             |           |           |            |             | 3          | 5         |            | 8     |
| 156             |           |           |            |             | 2          | 4         |            | 6     |
| 158             |           |           |            |             |            | 1         | 1          | 2     |
| 160             |           |           |            |             |            | 2         |            | 2     |
| 162             |           |           |            |             |            |           | 1          | 1     |
| 164             |           |           |            |             |            |           | 1          | 1     |
| 166             |           |           |            |             |            |           | 1          | 1     |
| 168             |           |           |            |             |            |           |            |       |
| 170             |           |           |            |             |            |           |            |       |
| 172             |           |           |            |             |            |           | 1          | 1     |
| 174             |           |           |            |             |            |           |            |       |
| N               | 9         | 2         | 22         | 41          | 47         | 44        | 7          | 172   |
| $\bar{x}$       | 101       | 103       | 134        | 137         | 145        | 149       | 158        | 140   |
| SEM             | 1.53      | 0         | 1.17       | 1.05        | 0.95       | 0.92      | 4.85       |       |

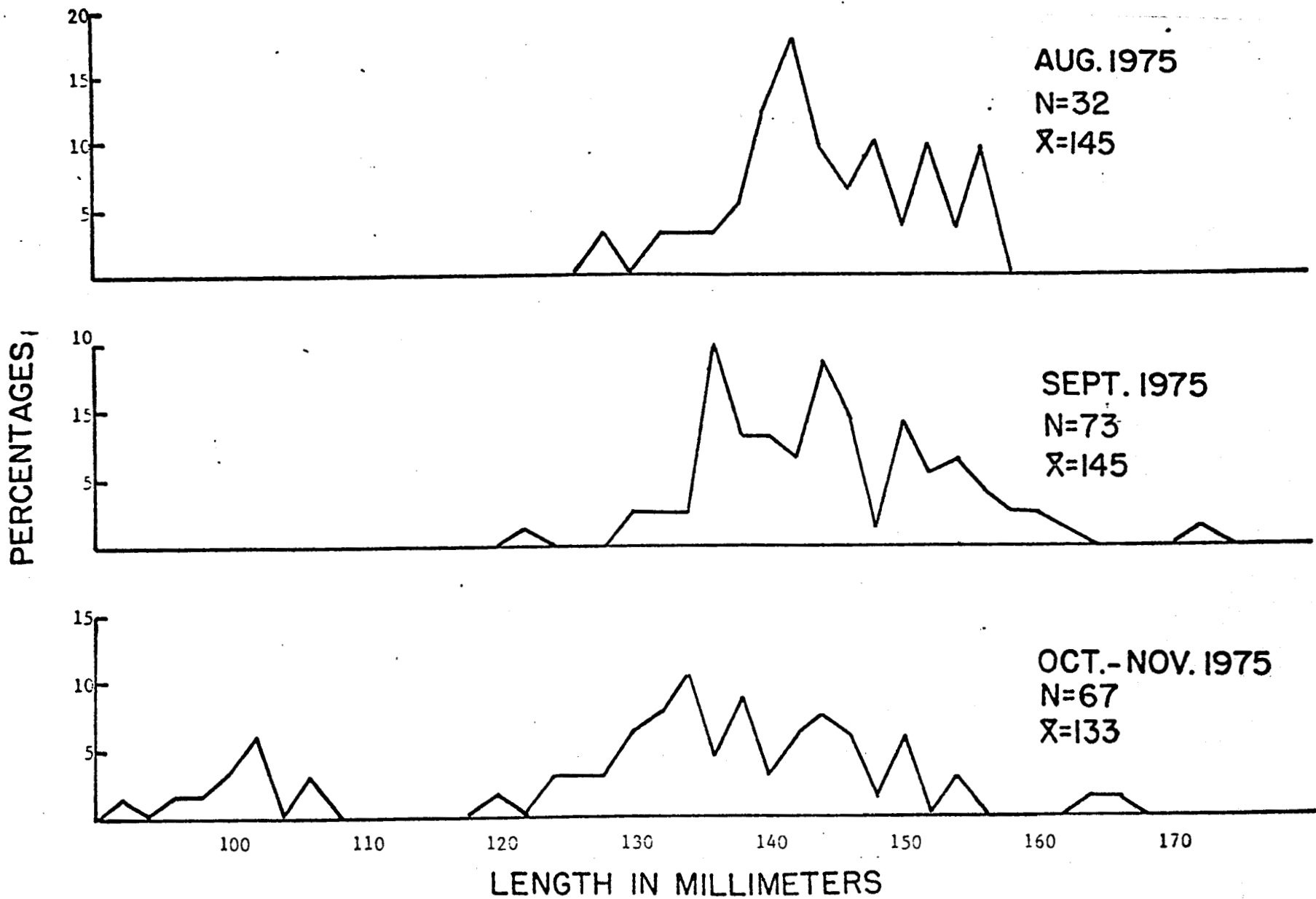


FIGURE 4 Anchovy length frequency by month central California 1975-76 Season

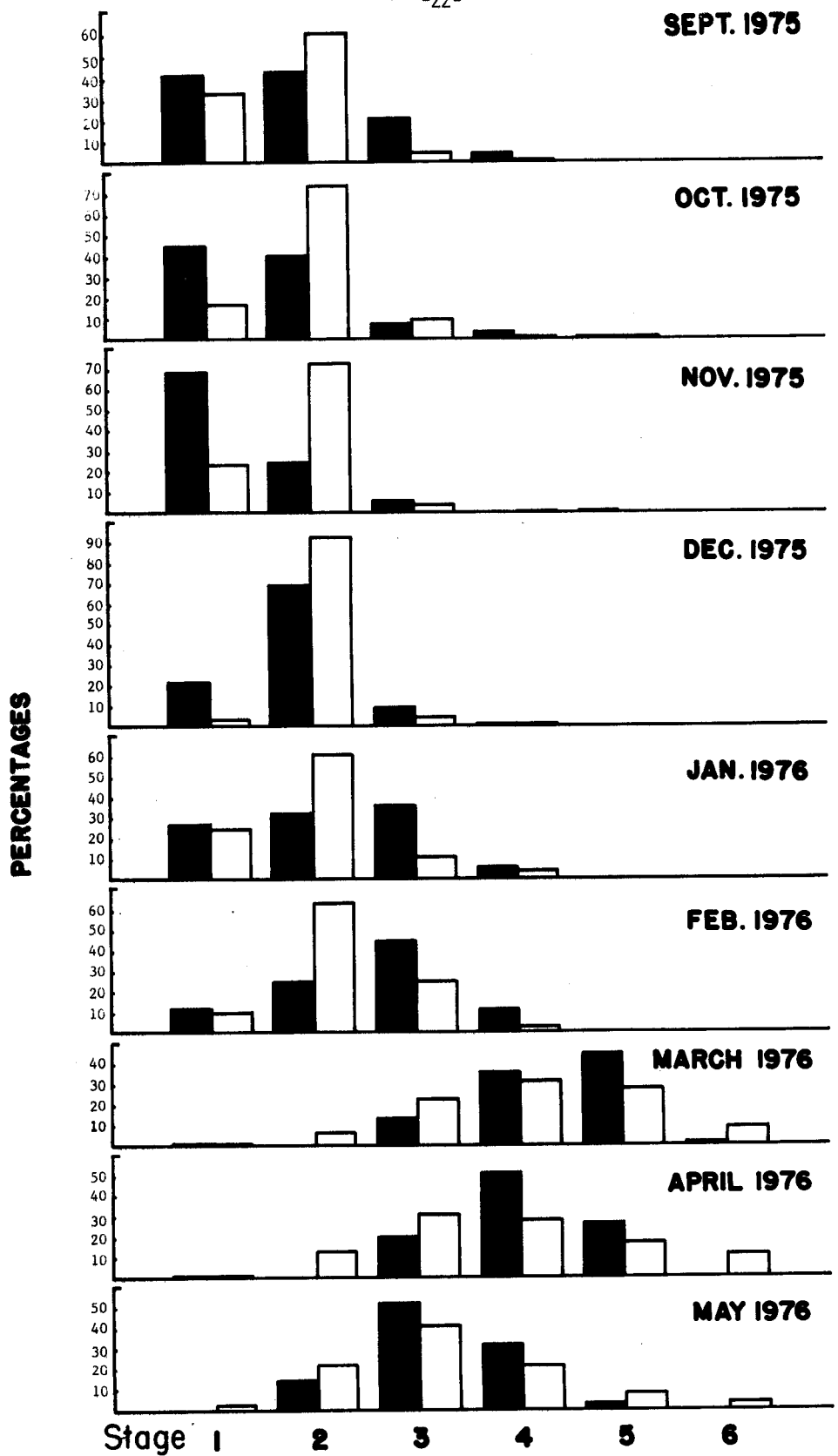


FIGURE 5 Sexual maturity of anchovies from southern California 1975-76 Season

MALE   
FEMALE



TABLE 11. Sex Ratio by Number and Weight of Anchovy Landings for 1975-76 Season.

| Sex ratio by number                          | Terminal Island | Moss Landing |
|--|-----------------|--------------|
| <b>Males</b>                                 |                 |              |
| Number                                       | 1,857,961,000   | 37,963,100   |
| Percent                                      | 38.7            | 33.4         |
| <b>Females</b>                               |                 |              |
| Number                                       | 2,758,566,000   | 73,451,000   |
| Percent                                      | 57.4            | 64.6         |
| <b>Unknown</b>                               |                 |              |
| Number                                       | 189,798,000     | 2,347,900    |
| Percent                                      | 3.9             | 2.0          |
| <hr/>  |                 |              |
| Sex ratio<br>Female:Male                     | 1.48:1          | 1.93:1       |
| <hr/>  |                 |              |
| Sex ratio by weight<br>(weight in megagrams) | Terminal Island | Moss Landing |
| <b>Males</b>                                 |                 |              |
| Weight                                       | 38,092          | 1,166        |
| Percent                                      | 37.1            | 33.2         |
| <b>Females</b>                               |                 |              |
| Weight                                       | 61,173          | 2,315        |
| Percent                                      | 59.6            | 66.0         |
| <b>Unknown</b>                               |                 |              |
| Weight                                       | 3,217           | 26           |
| Percent                                      | 3.1             | 0.8          |
| <hr/>  |                 |              |
| Sex ratio<br>Female:Male                     | 1.6:1           | 1.98:1       |
| <hr/>  |                 |              |

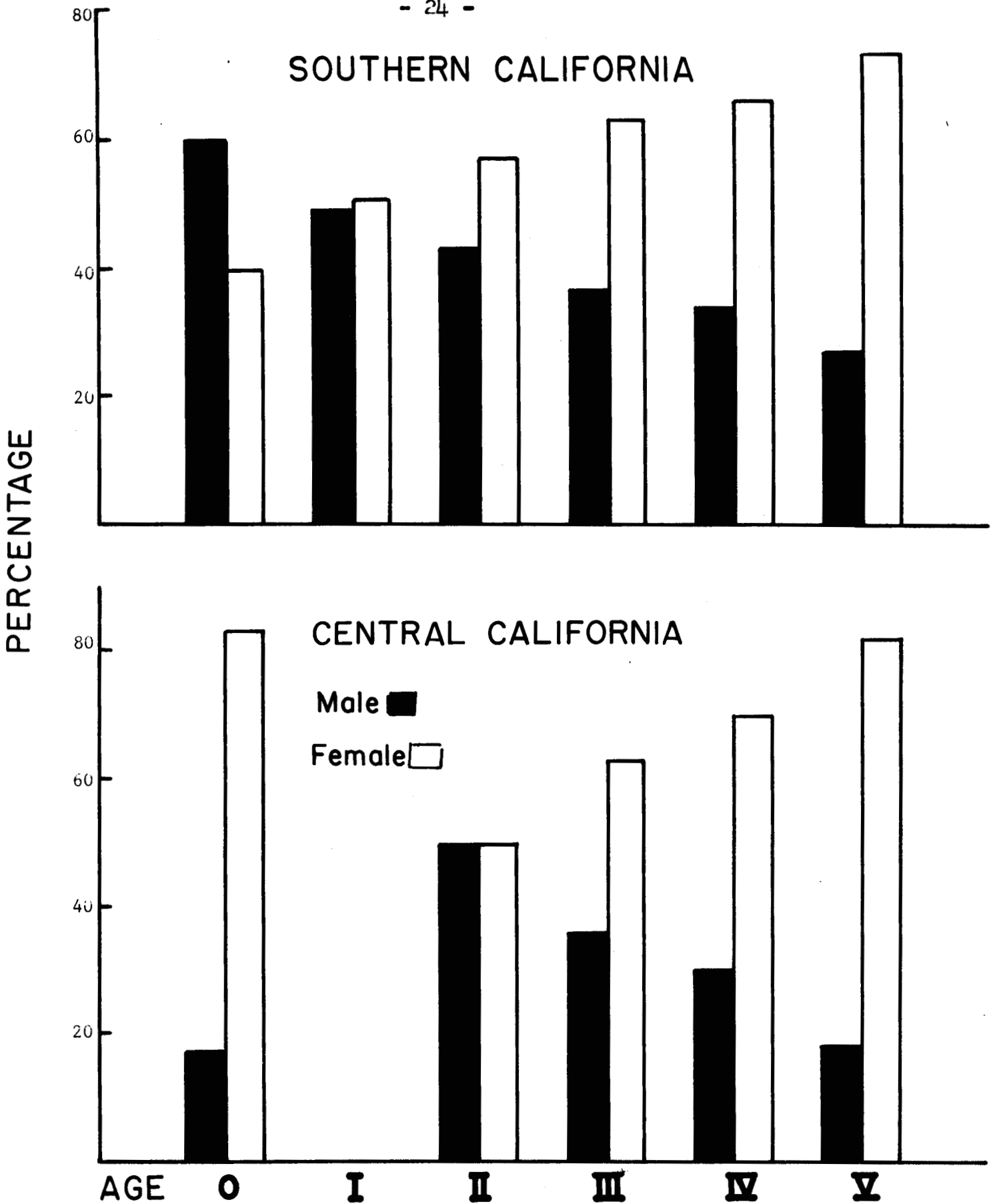


FIGURE 6 Percentage of males and females by age group

Central California

Anchovies from this area were found in the mature state during summer and fall months as compared to the winter and spring months for their southern counterparts (Figure 7).

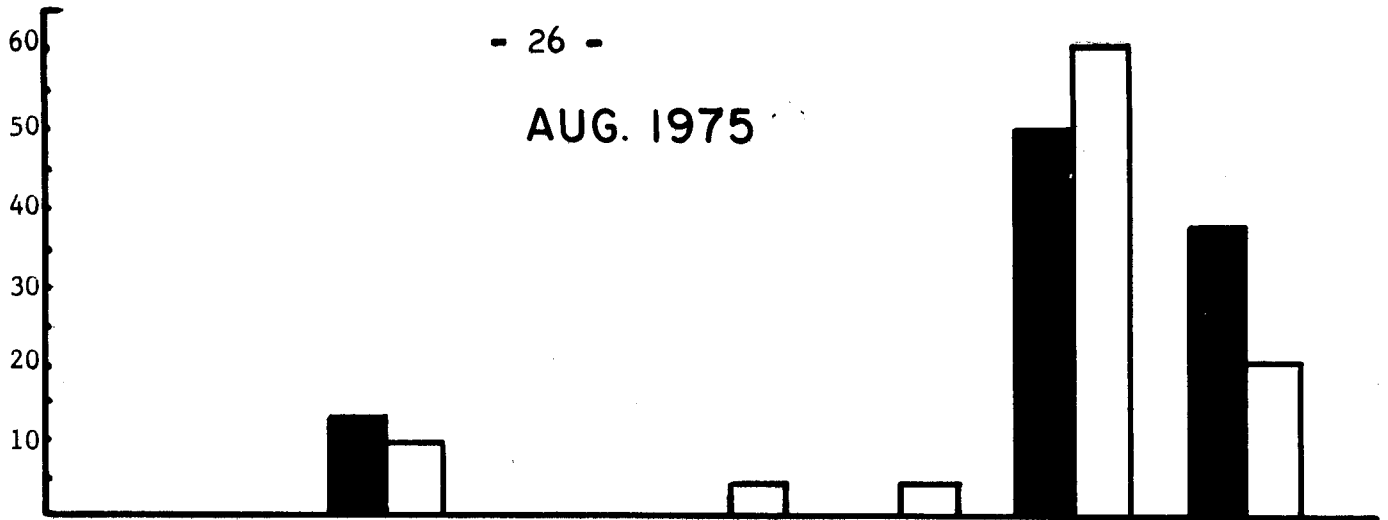
Sex ratios of 1.9 females to every male by number and 2:1 by weight (Table 11) were slightly lower than 2.7:1 by number and 2.9:1 by weight from the previous season (Sunada, 1977). Females were more numerous in older age groups which coincide with past results, although the small sample size for age group 0 could account for the extreme number of females (Figure 7).

CONCLUSION

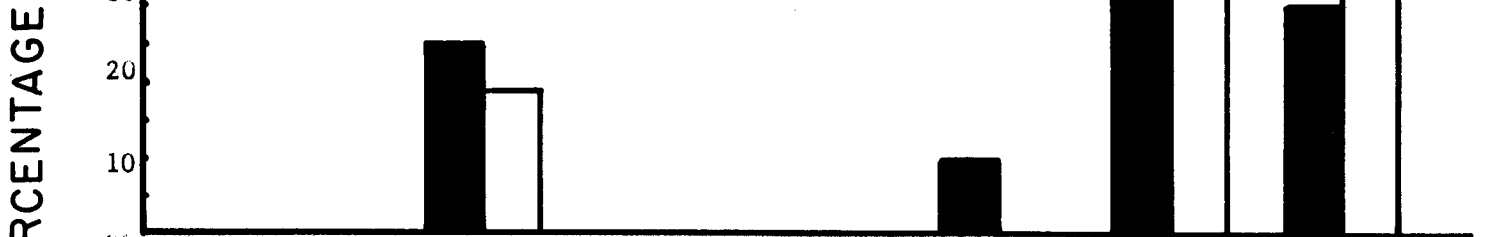
The season's results indicated some alarming trends, those of the diminishing numbers of age groups 0 and I (1975 and 1974 year classes) during winter and spring when these age groups normally appear in substantial numbers. The 1974 year class seems particularly weak, indicating a possible failure in survival, while it was too soon to determine abundance of the 1975 year class. The 1973 year class, although diminishing in spring, appeared in sufficient numbers to indicate adequate survival. A similar occurrence was observed during the previous season (Sunada, 1977).

Central California samples revealed a near absence of 1974 year class fish, which correlated with southern California results. This condition is not unusual since previous season's catches exhibited a lack of young fish.

AUG. 1975



SEP. 1975



OCT.-NOV. 1975

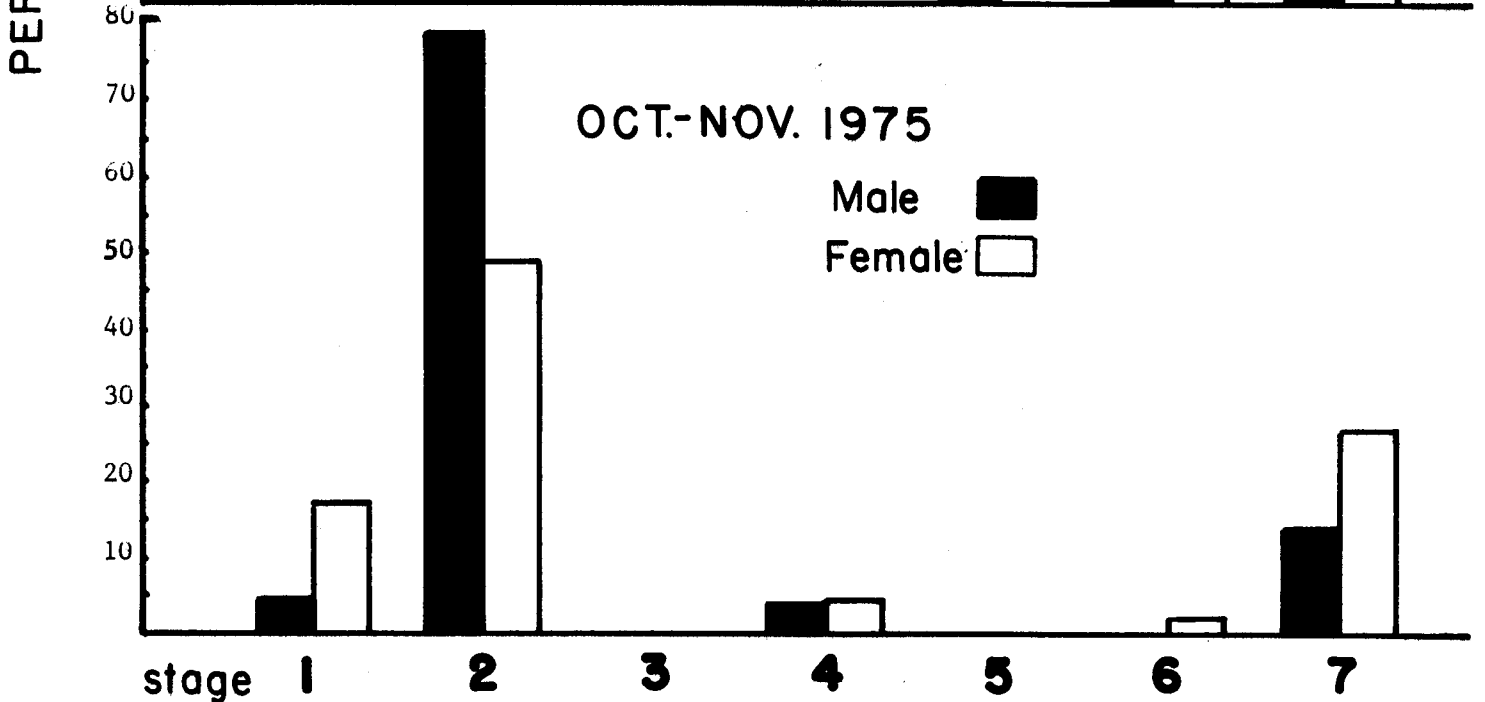


FIGURE 7 Sexual maturity of anchovies from central California 1975-76 Season.

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