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ABSTRACT

A Pismo clam, *Tivela stultorum*, survey was conducted in January 1977 on selected southern California beaches. Effort and catch information was collected through clammer interviews. Estimates for the two day survey were 1,596 clammers spending 2,506 hours to take 6,139 clams. Comparisons were made between the 1977 survey results and previous surveys.

Clams were collected for length and age studies. Compliance to the 4.5-inch (114.3 mm) minimum size limit appeared to be good.

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INTRODUCTION

A recreational fishery occurs on Pismo clam, *Tivela stultorum*, stocks in California marine waters. A survey was initiated in 1975 to evaluate the importance of clamming and its possible effects on clam stocks. This is the third report on survey, age composition, and size results. This survey was conducted January 16 and 17, 1977.

Pismo clams are found on nearly all sandy beaches along the open coast between Halfmoon Bay and Imperial Beach in California. They are taken from sand exposed by an average low tide to depths exceeding 24.4 m (80 feet) (Fitch 1961). Clams from some southern California beaches are found only subtidally.

A Pismo clam season in southern California is defined as the period during the year when minus tides occur between 1000 and 2200 hours. This situation occurs from September to May each year. Subtidal clams are available year round to skin and scuba divers. Fishing hours are regulated from $\frac{1}{2}$ hr before sunrise to $\frac{1}{2}$ hr after sunset.

METHODS AND PROCEDURES

Census Methods

Interviewers questioned as many clambers or group of clambers as possible as to the number of clambers in party, digging implements used, hours clammed, legal clams harvested, and sublegal clams found which ranged in size from 88.9 to 114.3 mm (3.5 to 4.5 inches). Four interviewers measured clams captured and retained by clambers. Two observers flew in a Department airplane and counted clambers along the southern California coastline. Interviewers made counts of clambers in a limited section of each beach every $\frac{1}{2}$ hr to provide turnover curves. These turnover curves

were used with counts from the airplane to provide total clammer hours.

To eliminate group phenomenon bias, effort estimates were based on the number of digging implements and not on number of persons in a party. The computed effort of four persons with only two digging implements would be for the two digging implements.

Growth and Aging Procedures

Clams were collected during minus tides at the same beaches where clammers were interviewed. Clams were taken by probing the sand with a six-tine "potato" fork. All clams found were measured and aged.

Calculations of length at age were done by the "annual ring" method (Weymouth 1923). Measurements were made to the nearest millimeter in the greatest antero-posterior dimension at each dark colored band or "growth ring."

Survey Catch and Effort Estimates

Total number of clammers, clammer hours, and legal clams were estimated for beaches where there were both interviews and counts from the airplane. Estimates were made using turnover curves (Miller and Gotshall 1965:13-15) for each beach area to estimate the portion of total clammer effort represented by counts made from the airplane.

Formulas for making various estimates were as follows:

$$E = n/2c$$

where: E = Total clammer hours

n = Count of clammers from airplane for a section of beach

c = Proportion of total clammer effort during 1/2-hr count when plane flew over section of beach

$$C = EN/T$$

where: C = Total number of clammers

T = Total clamming hours compiled by interviewers for section
of beach

N = Total numbers of clammers interviewed for section of beach

$$TC = C(a)$$

where: TC = Total number of legal clams taken per section of beach

a = The average catch of legal clams per clammer day

RESULTS

Ventura County

Silver Strand

Silver Strand was sampled only in 1977 (Table 1). Effort was low and few conclusions can be drawn from this sample.

Ormond Beach

The 1977 C/D was 7.56 legal clams, while the C/H was 4.49 legal clams. Clammers spent approximately the same amount of time clamming in 1976 and 1977, but their Catch per Day (C/D) and Catch per Hour (C/H) more than doubled in 1977 (Table 1). The C/H for sublegal clams remained fairly low.

Los Angeles County

Zuma Beach

Zuma Beach was sampled for the first time in 1977. A large population of subtidal clams is known to exist on this beach. The catch of legal sized clams was low, while the C/H of sublegal clams was moderate (Table 1).

Hermosa Beach

Fewer people were observed clamming in 1977 than in the previous two

TABLE 1. Number of Clammers, Hours, Numbers of Legal and Sublegal Pismo Clams Sampled, Catch per Day (C/D) and Catch per Hour (C/H) at Ventura, Los Angeles, and Orange County Beaches During January 1975, 1976, and 1977 Low Tide Periods.

| | Year | No. of clammers* | Hours | Legal | | Sublegal | | January Dates | |
|------------------------------|------|---------------------|--------|-------|------|----------|-------|------------------|------------|
| | | | | No. | C/D | C/H | No. | | C/H |
| Ventura County | | | | | | | | | |
| Silver Strand | 1977 | 8 | 10.25 | 33 | 4.13 | 3.22 | 0 | 0 | 17 |
| Ormond Beach | 1976 | 17 | 25 | 59 | 3.47 | 2.36 | 75 | 3.00 | 16, 18 |
| | 1977 | 57 | 96 | 431 | 7.56 | 4.49 | 215 | 2.24 | 16, 17 |
| Los Angeles County | | | | | | | | | |
| Zuma Beach | 1977 | 29 | 59 | 59 | 2.03 | 1.00 | 255 | 4.32 | 16, 17 |
| Hermosa Beach | 1975 | 20 | 46 | 39 | 1.95 | 0.85 | 85 | 1.85 | 25 |
| | 1976 | 45 | 78.25 | 311 | 6.91 | 3.97 | 334 | 4.27 | 16, 17 |
| | 1977 | 17 | 20.00 | 39 | 2.29 | 1.95 | 80 | 4.00 | 16, 17 |
| Long Beach | 1975 | 69 | 117 | 203 | 2.94 | 1.74 | 304 | 2.60 | 25 |
| | 1976 | 118 | 179.75 | 656 | 5.56 | 3.64 | 497 | 2.76 | 16, 17, 18 |
| | 1977 | 60 | 113.00 | 348 | 5.80 | 3.08 | 243 | 2.15 | 16, 17 |
| Orange County | | | | | | | | | |
| Seal Beach | 1975 | 90 | 133 | 269 | 2.99 | 2.02 | 258 | 1.94 | 25, 26 |
| | 1976 | 53 | 84.50 | 87 | 1.64 | 1.03 | 152 | 1.80 | 16, 17, 18 |
| | 1977 | 35 | 51.50 | 20 | 0.57 | 0.39 | 72 | 1.40 | 16, 17 |
| Bolsa Chica-Huntington Pier | 1975 | 585 | 707 | 826 | 1.41 | 1.17 | 148 | 0.21 | 25, 26 |
| | 1976 | 268 | 451.25 | 852 | 3.18 | 1.89 | 269 | 0.60 | 16, 17, 18 |
| | 1977 | 143 | 216.05 | 364 | 2.55 | 1.68 | 90 | 0.42 | 16, 17 |
| Huntington Pier-Santa Ana R. | 1975 | 495 | 830 | 2,244 | 4.53 | 2.70 | 2,224 | 2.68 | 25, 26 |
| | 1976 | 680 | 990 | 3,783 | 5.56 | 3.82 | 2,064 | 2.08 | 16, 17, 18 |
| | 1977 | 385 | 595.92 | 1,668 | 4.33 | 2.80 | 2,626 | 4.41 | 16, 17 |
| Santa Ana R.-Newport Pier | 1975 | 100 | 158 | 677 | 6.77 | 4.28 | 324 | 2.05 | 25, 26 |
| | 1976 | 99 | 119.75 | 437 | 4.41 | 3.65 | 585 | 4.89 | 16, 17, 18 |
| | 1977 | 33 | 55.75 | 94 | 2.85 | 1.69 | 675 | 12.10 | 16, 17 |

*This was a measure of the number of digging implements, i.e. forks, not number of clammers

years, and less time was spent per person clamming. Catch rates of legal clams declined in 1977, however, the C/H for sublegal clams remained moderate. Heavy surf on this westerly facing beach may have been the major factor in the overall lower catch rates.

Long Beach

The C/D and C/H for legal clams remained high in 1977, while the number of clambers declined. The C/H for sublegal clams remained fairly low this year (2.15).

Orange County

Seal Beach

Legal clam catch rates continued to decline to extremely low levels (Table 1). Poor recruitment of sublegal clams means that clamming at this beach should not improve next year.

Bolsa Chica to Huntington Beach Pier

Due to construction for augmentation of Bolsa Chica Beach State Park, a large section of this beach was closed to direct public access from Pacific Coast Highway. This closure and low catch rates resulted in fewer clambers being interviewed in 1977. The C/D and C/H for legal clams remained low. The C/H for sublegal clams continued to be extremely low and was the lowest of all beaches sampled. Prospects for improved clamming in the future are poor due to very little recruitment and small numbers of legal clams.

Huntington Beach Pier to Santa Ana River

This popular clamming beach continued to be heavily used by clambers.

The C/D and C/H dropped in 1977, but clamming continued to be good for legal clams. This year's C/H of sublegal clams indicates clamming during the 1977-78 season should remain around the same level.

Santa Ana River to Newport Pier

The catch rate has now decreased each year since the initial 1975 survey (Table 1). This year's catch rate of legal clams was approximately 40% of what it was in 1975. The extremely high C/H of sublegal clams is encouraging for future clamming; however, we feel this high figure should be tempered downward in view of clammers' reports of taking "hundreds of small clams."

San Diego County

Only one unsuccessful Pismo clammer was observed at Imperial Beach during the 1977 survey by Departmental observers.

Coastal Airplane Observations

Coastal airplane observations of beaches were made from the San Diego-Orange County line to Santa Barbara City. Counts of clammers on beaches which were not sampled by interviewers were as follows: 6 at San Clemente City, 19 between the Newport Jetty and Newport Pier, 5 at Cabrillo Beach, 6 on Redondo Beach, 13 from Marina Del Rey to Will Rogers Beach State Park, 98 from Ventura to Pitas Point, and 10 between Sandyland and Santa Barbara City.

Weather and Sea Conditions

The number of clammers decreased at every beach except Ormond Beach. This decreased effort was due, in part, to weather and sea conditions.

In 1976, the high temperatures at beach cities ranged from 25.5 to 32.2 C. The temperatures in 1977 ranged from 23.3 to 27.8 C.

The waves in 1976 ranged from 0.6 to 1.5 m in height along southern California beaches, while in 1977 the range was 1.2 to 3.0 m.

Catch and Effort Estimates

Estimates were made for beaches where there were both interviews and counts from the airplane. Total estimates for Sunday were 1,265 clammers, 1,985 clammer hours, and 4,498 "legal" clams (Table 2). Catch and effort estimates for Monday decreased to 331 clammers, 521 clammer hours, and 1,641 "legal" clams. Clammers were more successful on Monday. The average number of clams per day was 5.0 on Monday, while it was only 3.6 for Sunday. The heaviest utilized beach during the survey was the Huntington Beach Pier - Santa Ana River section with an estimated 582 clammers for both days. Bolsa Chica - Huntington Pier area was utilized heavily also with an estimated 528 clammers (even though the average number of "legal" clams per day was 2.2 clams).

Since only 16.9% of clammers seen from the airplane were on beaches where there were no interviewers, we feel the estimates covered a majority of the clamming which occurred in southern California below Santa Barbara City on January 16 and 17, 1977.

Pismo Clam Length Composition

Compliance to the 4.5 inch (114.3 mm) minimum size limit appeared to be good (Table 3). The size range for legal clams was large for Ventura, Los Angeles, and Orange counties (Table 3). This may indicate a low catch to the total resource, and indicates clams are not being fully exploited as soon as they are recruited to the fishery.

TABLE 2. Estimates of Total Clammer Hours, Clammers, and Number of Clams Harvested on Sampled Southern California Beaches.

| Location | Sunday 1/16/77 | | | Monday 1/17/77 | | |
|----------------------------------|----------------|---------------|-----------------------|----------------|---------------|-------------|
| | Clammers | Clammer hours | Number of legal clams | Clammers | Clammer hours | Legal clams |
| Silver Strand | Not | sampled | | 8 | 10 | 33 |
| Ormond Beach | 174 | 278 | 1,208 | 13 | 26 | 125 |
| Zuma Beach | 26 | 51 | 47 | 6 | 14 | 17 |
| Hermosa Beach | 14 | 15 | 27 | 3 | 5 | 12 |
| Long Beach | 87 | 162 | 544 | 53 | 101 | 277 |
| Seal Beach | 30 | 46 | 15 | 5 | 6 | 5 |
| Bolsa Chica- Huntington Pier | 461 | 669 | 896 | 67 | 110 | 258 |
| Huntington Pier- Santa Ana R. | 426 | 685 | 1,617 | 156 | 216 | 866 |
| Santa Ana R.- Newport Pier | 47 | 79 | 144 | 20 | 33 | 48 |
| TOTALS | 1,265 | 1,985 | 4,498 | 331 | 521 | 1,641 |

TABLE 3. Sizes of Pismo Clams Harvested From Southern California Beaches.

| County | Length interval (5 mm) | | | | | | | | | | |
|-------------|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 105- 109.9 | 110- 114.9 | 115- 119.9 | 120- 124.9 | 125- 129.9 | 130- 134.9 | 135- 139.9 | 140- 144.9 | 145- 149.9 | 150- 154.9 | 155- 159.9 |
| Ventura | | 1 | 8 | 36 | 40 | 49 | 30 | 24 | 10 | 5 | 1 |
| Los Angeles | | 5 | 15 | 28 | 22 | 24 | 17 | 12 | 6 | 3 | |
| Orange | 5 | 41 | 76 | 87 | 63 | 48 | 23 | 14 | 12 | 2 | |

Year Class Composition

A total of 142 clams was used to determine year class composition of Pismo clams on Los Angeles and Orange county beaches (Table 4). A large number of year classes was found on the beaches and no one year class dominated the catch. We interpret this to mean that good clamming is dependent on a number of year classes or an accumulation of clams from a number of different years, and that clamming cannot be sustained if it is dependent on only one year class entering the fishery each year.

DISCUSSION

Ormond Beach, Long Beach, and the beach between Huntington Pier and the Santa Ana River continued to provide good clamming. These areas should provide good recreational fishing during the 1977-78 season. The Seal Beach to Huntington Beach pier area continued to provide poor clamming and prospects are that it will not improve due to poor recruitment and a low population of legal clams. Clamming success for legal clams is dropping in the Santa Ana River to Newport Pier area, but large numbers of sublegal clams should mean good clamming in the future. Low population levels may be inferred by a lack of clamming in San Diego county.

Estimates for the 2 day survey were 1,596 clammers spending 2,506 hours to take 6,139 clams. The minus tides during the 2 days surveyed were -0.3 m and -0.4 m respectively as determined for outer harbor Los Angeles, California. During the 1976-77 season, there was a total of 19 minus tides of -0.3 m or lower. If the survey estimates represent typical clamming days, then effort and numbers of clams harvested during a season in southern California is considerable.

Compliance to the 4.5 inches (114.3 mm) minimum size limit was good. Large numbers of clams above 4.5 inches indicate continued existence

TABLE 4. Age Composition of Pismo Clams Sampled on Los Angeles and Orange County Beaches.

| Year Class | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 63 |
|-----------------------|------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Los Angeles | | | | | | | | | | | | | | |
| Number | 1 | 4 | 8 | 8 | 9 | 10 | 4 | 5 | - | - | 2 | - | 2 | - |
| \bar{x} in mm. | 48.8 | 88.05 | 104.99 | 110.31 | 114.21 | 121.71 | 125.75 | 130.02 | - | - | 130.75 | - | 141.55 | - |
| $\hat{\sigma}$ in mm. | - | 5.72 | 1.89 | 8.57 | 8.07 | 10.28 | 6.55 | 6.74 | - | - | 10.39 | - | 9.97 | - |
| Orange | | | | | | | | | | | | | | |
| number | 1 | 3 | 18 | 6 | 9 | 20 | 7 | 11 | 10 | 2 | - | 1 | - | 1 |
| \bar{x} in mm. | 55 | 80.67 | 98.17 | 108.33 | 117.56 | 121.30 | 124.43 | 130.45 | 129.00 | 135.50 | - | 157.00 | - | 141.00 |
| $\hat{\sigma}$ in mm. | | 2.52 | 4.73 | 5.72 | 5.20 | 5.72 | 3.21 | 6.59 | 6.15 | 6.39 | - | - | - | - |

on certain beaches of a large fishable resource, particularly in the Huntington Beach pier to Santa Ana River area.

The 1974 year class was the largest year class found on southern California beaches, but it was not as strong as was indicated from sampling during the 1976 survey (Knaggs, Fleming, and Hardy 1976) when it made up 38.5% of all Pismo clams found on beaches. During the 1977 survey, a large number of year classes was found on the beaches sampled (Table 4). This means that clamming is dependent on an accumulation of clams from different years.

The 1974 year class will begin to be recruited to the fishery in the fall of 1977, but it will not be recruited fully until the fall of 1978.

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