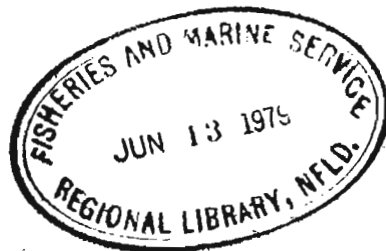


Pacific Oyster Breeding in Pendrell Sound, 1974

N. Bourne and G. D. Heritage



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Fisheries and Marine Service
Resource Services Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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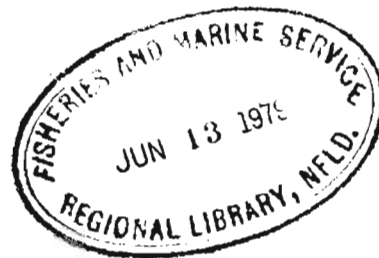
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ABSTRACT

Bourne, N., and G. D. Heritage. 1978. Pacific oyster breeding in Pendrell Sound, 1974. Fish. Mar. Serv. Tech. Rep. 858: 130 p.

Pendrell Sound is the main Pacific oyster, Crassostrea gigas Thunberg, breeding area in British Columbia. In 1974 an extensive research program was undertaken to determine if changes had occurred in waters of the Sound that seriously affect successful oyster breeding and also to assess the monitoring program and determine if it could be improved to provide a more accurate prediction service for the industry. Results of the work are presented here. Meteorological and oceanographic conditions were unsatisfactory for successful oyster breeding in the early part of the summer but improved in late July and a stable surface layer was present in Pendrell Sound for most of the latter part of the summer. Limited spawning occurred in late July. Densities of oyster larvae were low compared to those in previous years but survival to the late stages was well above average. A commercial set was predicted and obtained by the industry. Optimum setting was found in the central part of the Sound at the top and bottom of the large gyral circulation pattern there. Modifications to the monitoring procedure are suggested based on results of the 1974 work.

Key words: Natural breeding, seed collection, oyster, Crassostrea gigas, British Columbia.

RÉSUMÉ

Bourne, N., and G. D. Heritage. 1978. Pacific oyster breeding in Pendrell Sound, 1974. Fish. Mar. Serv. Tech. Rep. 858: 130 p.

Le chenal Pendrell est le principal lieu d'élevage de l'huître Crassostrea gigas Thunberg en Colombie-Britannique. En 1974 a été lancé un vaste programme de recherche portant sur l'ampleur des changements subis par les eaux du chenal et leurs effets possibles sur l'ostréiculture; il s'agissait par ailleurs d'évaluer la qualité du programme de contrôle et de déterminer s'il était possible de l'améliorer pour offrir à l'industrie des prévisions plus fiables. Le présent rapport donne les résultats obtenus. Les conditions météorologiques et océanographiques n'étaient pas bonnes pour l'ostréiculture au début de l'été, mais se sont améliorées à la fin de juillet, et on a pu noter une couche superficielle stable dans le chenal pendant la majeure partie de la fin de l'été. La fraye, survenue vers la fin de juillet, s'est révélée limitée. Par rapport aux années précédentes, la densité des larves d'huîtres était faible, mais le taux de survie aux étapes ultérieures se situait nettement au-dessus de la moyenne. On a prévu une densité exploitable, que l'industrie a obtenue. La densité s'est révélée la plus forte dans la partie centrale du chenal, en haut et en bas d'un ample mouvement giratoire qui se forme dans ce secteur. À partir des résultats de 1974, on propose des modifications à la méthode de contrôle.

Mots clés: ostréiculture naturelle, captage du naissain, huître, Crassostrea gigas, Colombie-Britannique.

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INTRODUCTION

Pendrell Sound is the principal area in British Columbia where the oyster industry can rely on obtaining sufficient quantities of Pacific oyster, Crassostrea gigas Thunberg,^a seed for its needs. Studies to assess factors affecting oyster breeding in the Sound have been carried out since 1949 and the information is used to provide a spatfall forecasting service for the industry to assist them with their seed-collecting operations. Forecasting is necessary so that collectors will be immersed at the correct time to obtain an optimum set but not become fouled since fouling hinders settlement.

Although oyster breeding has been generally successful since Pendrell Sound was first discovered as a seed-collecting area in 1948, very light sets have occurred in some years and there have been failures (Quayle 1969, 1974; Bourne 1978). In recent years several unexplained anomalies have occurred during the breeding season which have greatly affected the success of spatfall--very low salinities in the Sound, blooms of macro-phytoplankton, heavy mortalities of early stage larvae, lengthy larval periods, and unusual and irregular spatfall. In 1973 there was a breeding failure in spite of massive spawning and large quantities of early stage larvae. This has caused concern and raised the question of whether subtle changes are occurring in Pendrell Sound that are seriously affecting oyster breeding. The industry expressed concern about the reliability of Pendrell Sound for future seed requirements.

In 1974 an extensive research project was initiated in Pendrell Sound to assess factors affecting oyster breeding, determine if changes have occurred recently that affect breeding, and decide whether the forecasting service could be improved.

The Pacific Biological Station barge VELELLA and sampling equipment were anchored in the Sound on June 23. To maximize coverage of the Sound for a radar tracking drift drogue experiment, the VELELLA was stationed about 200 m off Station 5 (Fig. 1). Rafts with monitoring equipment were anchored at Stations 1, 2, and 4. Hydrographic measurements and biological sampling were greatly increased, both in number of stations and frequency of sampling, during the summer, compared to work in previous years. The barge and sampling equipment were removed on September 17.

In addition to the work described here, research projects were also undertaken by two other agencies of the Fisheries and Marine Service, Canada Department of Environment--the Patricia Bay Ocean Institute, Victoria, British Columbia; and the Pacific Environment Institute, West Vancouver, British Columbia. The Patricia Bay Ocean Institute undertook studies of the physical

^aFor brevity in this report, the term oyster refers to the Pacific oyster, Crassostrea gigas Thunberg.

oceanography of Pendrell Sound including studies of heat and salt budget of the Sound, surface water circulation, and temperature profile time series. The Pacific Environmental Institute undertook a study of primary production and phytoplankton succession in Pendrell and Hotham Sounds. Results of these investigations have been reported elsewhere (Stockner and Cliff 1975; Buckingham 1976; Landry 1976).

The present report summarizes results of work carried out by Pacific Biological Station personnel in Pendrell Sound in 1974. These data are now on computer tapes at the Pacific Biological Station.

WEATHER

Observations of cloud cover and maximum/minimum air temperatures in Pendrell Sound were recorded daily. Evidence of rainfall was noted but exact amounts were not recorded.

Daily meteorological observations were made at Whaletown, Cortes Island about 31 km from Pendrell Sound (Fig. 2). In mountainous regions, weather can vary considerably between two locations as close as Whaletown and Pendrell Sound but it has been assumed that the Whaletown data gives an accurate indication of weather patterns in Pendrell Sound (Bourne 1978). In 1974 meteorological data from the two locations were compared and there was good agreement between them (Fig. 3); when it was overcast or partly cloudy at Whaletown the same weather conditions generally prevailed in Pendrell Sound. Cloud cover was more extensive and rainfall heavier in Pendrell Sound than at Whaletown which would be expected as weather systems come in contact with the coast mountains of the mainland.

June was generally cool and wet in coastal British Columbia and precipitation above normal. Abnormally cool wet weather occurred in the first three weeks of July, mean air temperatures were 1-3 C below normal and precipitation was well above normal. In Pendrell Sound the weather was cloudy and wet until July 26 when a 16-day period of clear sunny weather began (Fig. 3). Minimum air temperatures gradually increased through July, reaching a maximum at the end of the month (Fig. 4). Maximum daily air temperatures fluctuated during most of July with a maximum occurring at the end of the month. August was generally dry and sunny with mean monthly air temperatures above normal and light precipitation. In Pendrell Sound there was a 2-week period of cloudy weather with little precipitation, the latter part of the month was clear and sunny. Minimum air temperatures generally remained above 16 C and increased slightly at the end of the month. Maximum air temperatures remained around 30 C until mid-August, declined because of cloudy weather, then increased again at the end of the month. The first week of September was cloudy and wet but the remainder of the month was generally sunny and warm and precipitation was well below normal. In Pendrell Sound both minimum and maximum air temperatures decreased sharply at the beginning of the month but increased after the first 10 days when sunny weather returned.

HYDROGRAPHIC CONDITIONS

Continuous water temperature measurements were made at a depth of 1 m at Stations 1, 2, and 4 with 7-day recording thermographs, and at 3 m with 31-day temperature recorders. Daily temperature and salinity profiles from the surface to a depth of 20 m were made at Stations 1, 2, 4, 5, 6, and 8, using a Beckman RS5-3 portable salinometer. Similar measurements were made every second day from August 1-24 and daily from August 24-September 16 at Station 10, and every second day from August 5-21 at Station 36 in Waddington Channel. Temperature-salinity profiles were made on June 25, and July 3, 10, 17 and 29, in waters around East Redonda Island (Homfray, Pryce and Waddington Channels, Fig. 1) to observe the presence and depth of the freshwater layer from Toba Inlet.

Water temperatures

Water temperatures at the 1 m depth at Stations 1, 2, and 4, were similar (Fig. 5). Temperatures were 20 C or above when equipment was installed in late June but declined immediately because of cloudy, cool weather (Fig. 3). Temperatures began to increase in early July and remained above 20 C for a brief period at Stations 1 and 2 before declining, again because of adverse weather. After mid-July temperatures increased, reached a maximum in the first few days of August and remained above 20 C from July 26 to August 19. Temperatures fell below 20 C for a brief period in late August, then rose above this temperature in late August and early September, then declined.

At 3 m the data are limited except at Station 2 (Fig. 6). Water temperatures declined in late June, increased in early July to a brief maximum, then declined slightly. A gradual increase in temperature occurred during the remainder of July and temperatures were above 20 C for two brief periods in late July and early August. Water temperatures gradually declined in August, rose briefly in early September and then declined.

Contour plots show surface water temperature patterns in the Sound throughout the summer (Fig. 7-14). When sampling began a thermocline had formed principally in the central part of the Sound (Stations 4, 5, and 6), at the 5-6 m depth but disappeared at the end of the month. Another weak thermocline formed in early July during a period of generally cloudy wet weather, but disappeared about July 10 because of continuous cool cloudy weather. No thermocline was evident from then until the end of the month but a clearly defined one formed at all Stations at the end of July and remained until about August 20. After this it became attenuated, reformed at the 3-4 m depth during the first week of September, then disappeared. In September a thermocline was evident in the head of the Sound but not at the other Stations.

The thermocline was more clearly defined in the head of the Sound than in the central part, which would be expected since hydrographic conditions are more stable in the head than in other parts of the Sound. During the period the major thermocline was present (late July to August 20) its depth fluctuated but was generally between 2-3 m. The 20 C isotherm seldom reached a depth of 3 m. Fluctuations in depth tended to be of short duration and may have been due to internal waves (Buckingham 1976).

Meteorological conditions had a pronounced effect on the thin surface layer and the formation and position of the thermocline. Cool, cloudy weather caused cooling of the surface layer and the thermocline broke down; periods of clear sunny weather produced warming trends and the thermocline reformed. Heating of this thin surface layer and formation of the thermocline is largely dependent on solar insolation (Buckingham 1976).

At the mouth of the Sound and in Waddington Channel, surface water temperatures were slightly cooler at Station 36 than at Station 8 which was probably due to the greater influence of colder water from Toba Inlet (Fig. 12, 14). A thermocline was present at Station 36 at the 2-3 m depth but disappeared about August 20, the same time it broke down at Station 8. When sampling began in Waddington Channel there was an inversion of 20 C water at 1-3 m which disappeared by August 7. This inversion was caused by cooler fresh water from Toba Inlet sliding over the 20 C layer; salinity of this water was much reduced (Fig. 14). The amount of fresh water was not extensive and did not cause decreased salinities in the Sound. However, it may have contributed to the breakdown of the thermocline in Waddington Channel and probably affected surface water temperatures at the mouth of the Sound.

Water temperature profiles at Stations 4, 5, 6, and 10 (central part of the Sound) were similar, although they differed from those at the mouth and in the head of the Sound. Surface water temperatures here were slightly warmer than at the mouth but slightly cooler than in the head of the Sound. The major thermocline was at 2-4 m and the 20 C isotherm extended to a depth of 2-3 m. The thermocline fluctuated less at Station 10 than at Stations 4, 5, and 6, but this was probably due to more frequent sampling at the latter Stations. Daily sampling (August 24-September 16) at Station 10 showed a similar temperature regime to that at the other Stations during the same period.

Temperature profiles at Stations 1 and 2 were similar, although they differed slightly from those in the central part and at the mouth of the Sound. Hydrographic conditions were more stable there and the thermocline tended to be more clearly defined and last longer than elsewhere.

Salinity

The salinity regime differed to that of temperature. A halocline was present when equipment was installed on June 23 and remained evident throughout the sampling period, although it was attenuated in late June and through most of July (Fig. 15-21). At this time the thermocline disappeared.

During August and September the halocline was particularly well defined at all Stations; frequently there was a salinity difference of 6‰ in a depth of 1 m. The halocline fluctuated in depth during the summer; in late June it was at 5 m but was at 0-1 m by the end of the month. In early July it was at the 5 m depth but was 2-4 m in depth for the remainder of the month. From the end of July until mid-September the halocline fluctuated around the 2-3 m depth, particularly in the central part of the Sound. During this period the position of the halocline and thermocline coincided, forming a strong pycnocline.

After formation of the pycnocline in late July, salinities in the surface waters remained about 17‰ throughout the Sound. No large intrusions of fresh water occurred as observed in previous years (Quayle 1974). Salinities did drop below 15‰ for a few days at Station 8 at the end of July and beginning of August but then increased above this level for the remainder of the sampling period.

Salinities at Stations 8 and 36 were similar. When sampling began at Station 36, there was a surface layer of low salinity water at both Stations but it quickly disappeared and salinities remained above 15‰ for the rest of the summer. The halocline was shallower at Station 36 than at Station 8 and was in the top meter when sampling terminated on August 21. At this time the halocline at Station 8 was at 0-1.5 m but became deeper.

Salinities at Stations 4, 5, 6, and 10 (central part of the Sound) were similar. The halocline fluctuated in depth during the summer but was generally between 1-3 m. Fluctuations were more noticeable at Stations 4, 5, and 6 than at 10. These fluctuations were observed with temperature but again it was probably due to frequency of sampling. Results were similar at all four Stations when sampling was done daily.

Salinities at Stations 1 and 2 were similar but differ slightly from those in the central part of the Sound. Generally the depth of the halocline was 1-3 m during the course of the summer.

TEMPERATURE-SALINITY PROFILES AROUND EAST REDONDA ISLAND

Temperature-salinity profiles were made in waters surrounding East Redonda Island (Homfray, Pryce and Waddington channels) at weekly intervals in late June and July to determine the presence of Toba Inlet waters adjacent to Pendrell Sound (Table 1).

In Homfray Channel thermal stratification was weak but was more evident at Station 30 than at 31. No thermocline was present at either station on July 17. A halocline was evident throughout the sampling period: 3-4 m in depth on June 26, shallower on July 3 and 10, and then deeper on July 17. A pulse of fresh water must have come down Homfray Channel from Toba Inlet after July 3 since surface salinities were considerably reduced on July 10 at both stations but had increased by July 17.

In Pryce Channel (Stations 32 and 33) little thermal stratification occurred except at Station 33 on July 29. A strong halocline was present at both stations until July 10 at the 2-3 m depth; a sharp decrease in surface salinities occurred at both stations on July 10. Surface salinities increased by July 17 and the halocline was much less defined at both stations. On July 29 surface salinities decreased significantly and the halocline was more clearly defined at Station 33.

There was little thermal stratification at Station 34 until July 29, but a well defined halocline was present at the 2-4 m depth. The sharp decrease in surface salinities on July 10 is noticeable and reduced surface salinities were present on July 29. Strong turbulence at this station may affect formation and depth of a thermocline or halocline.

In Waddington Channel (Station 35) a thermocline was present except on July 17. A halocline was apparent at 2-4 m. Decreases in surface salinities were evident on July 10 and 29.

During the period of sampling waters around East Redonda Island, a halocline was present at all stations but the thermocline was weak and frequently absent.

SURFACE WATER NUTRIENTS

Weekly samples of surface water were taken from a depth of 0.5 m at Station 4 to measure nutrient levels in the surface layer during the summer (Table 2). Nitrates and phosphates were present at low levels during the summer, lower than in adjacent Strait of Georgia waters (Stephens et al. 1969). This is particularly true for waters above the pycnocline. Once the pycnocline formed, both phosphates and nitrates declined. The slight increase in concentration of both on September 9 may have been caused by heavy rains in early September, which washed nutrients into the Sound.

SPAWNING AND LARVAL DEVELOPMENT

Spawning was determined as in previous years (Heritage et al. 1976; Bourne 1978): observing adults spawning, the presence of "white water", or by the appearance or sudden increase in numbers of straight hinge larvae in the plankton.

Plankton sampling was carried out by two methods: quantitative samples with the pump sampler (Quayle and Terhune 1967), and qualitative-quantitative samples by 5-min surface plankton tows with a standard net (Heritage et al. 1976).

In 1974, spot samples were taken with the pump sampler rather than the transect samples of the previous years (Quayle 1974). The pump sampler was constructed of 51 mm (2-inch) polyvinylchloride pipe with 4.75 mm (3/16 inch) holes at 50.8 mm (2-inch) intervals extending from 0-2.5 m. The flexibility of the pipe made high-speed running samples impossible. From July 27 to August 3, 100 pump samples were made while the boat drifted. After August 3, samples were taken while the boat moved slowly ahead, and in pumping 100 a distance of about 30 m was covered. Daily samples were taken between Stations 1-2 and at Stations 4, 5, 6, and 8. In August, samples were taken every other day at Stations 10 and 36.

Surface plankton tows were made in late afternoon or early evening after direct sunlight had left the surface of the water. Tows were made daily between Stations 1-2 and at Station 4 throughout the summer and occasionally at Stations 6 and 8 in August and September. Relative abundance of bivalve larvae was calculated after the method of Heritage et al. (1976).

Condition of adults

Periodic samples of adult oysters were examined macroscopically and microscopically to determine stage of gonadal development. In late June, gonads were developing and by July 11 both males and females were ripe and ready to spawn (Table 3).

In several samples sexes could not be distinguished. Quayle (1969) has described the typical Pacific oyster gonadal cycle in British Columbia. After spawning, the body of the oyster is nearly transparent. It becomes filled out as the animal fills gonadal tissue with glycogen after feeding on the fall plankton bloom. More glycogen is added after the spring plankton bloom and this is converted to eggs and sperm.

In Pendrell Sound there is virtually no fall plankton bloom, and oysters overwinter in a thin, emaciated condition (Quayle, personal communication). Nutrients needed for egg and sperm formation are obtained almost entirely from the spring plankton bloom.

In 1974 some oysters apparently did not obtain sufficient nutrients from the spring plankton bloom to produce eggs or sperm. Few studies have been carried out to measure phytoplankton production in Pendrell Sound. Stephens et al. (1969) showed a seasonal variation in chlorophyll a, particulate carbon and soluble carbon in Pendrell Sound during a period of one year, 1966-67. Stockner and Cliff (1975) found phytoplankton was sparse at all depths in Pendrell Sound during 1974 and significant changes in phytoplankton numbers and volume did not occur until mid-August. Their sampling was carried out on five dates (March 19, April 20, July 9, August 14, and September 17, 1974). No annual comparative data are available. The extent of the spring plankton bloom has a marked influence on production of eggs and sperm in oysters in Pendrell Sound. Studies should be undertaken to assess the importance of the spring plankton bloom to egg and sperm production in oysters in Pendrell Sound since Helm et al. (1973) have shown that starvation and stress affect subsequent larval development.

Spawning

Light spawnings were observed in the head of the Sound on July 30 and August 13, and at Stations 9 and 10 on August 2.

The first spawning occurred about July 22 or 23 since small numbers of straight hinge larvae were found in surface plankton tows on July 24 at Station 1; on July 26, straight hinge larvae were found in plankton tows at both Stations 1 and 4 (Fig. 22). Spawning increased in intensity and there was a maximum at the end of July and beginning of August. Light spawning continued during the first part of August; another smaller pulse occurred from August 20-25. Limited spawning continued into the first few days of September.

The two spawning maxima were recorded by both sampling methods at all sampling stations (Fig. 22-26). In the first spawning a peak occurred about July 29. Numbers of straight hinge larvae then declined but another peak occurred about August 1. The slight decrease in numbers between the two maxima may be due to sampling error but it was more likely due to mortalities and the fact that some larvae advanced to the early umbone stage. The second peak about August 1 resulted from another spawning pulse during the period of maximum spawning.

Larval development

A significant feature of larval development in 1974 was the low larval density during the summer. In past years, counts of 1-2 thousand straight hinge larvae per 100 ℓ were common (Quayle 1974; Heritage et al. 1976; Bourne 1978). In 1974 the largest number of straight hinge larvae was 480 per 100 ℓ at Station 1 on August 1, but generally numbers of this stage larvae were below 150 per 100 ℓ . Low larval numbers may have been due in part to the limited area covered during sampling but most likely reflect low larval abundance in the Sound during the summer. Low numbers of larvae may have resulted from the emaciated condition of adults which produced limited quantities of eggs and sperm.

Although larval numbers were low, survival was good. A maximum of 460 early umbone larvae per 100 ℓ was recorded at Station 4 on August 7; mid and late umbone larvae in numbers over 50 and 25 per 100 ℓ respectively were common. Modest numbers of eyed larvae were found at all stations. Larval survival from the second spawning in late August was not as good as the first and few larvae were found in the plankton in mid-September.

Larval abundance was comparable in the two sampling methods (Fig. 22-26). Both sampling methods showed two spawning maxima and similar maxima of the different larval stages as they developed during the summer. Although plankton tow data provide a relative estimate of numbers (Heritage et al. 1976) the 1974 data showed good survival of larvae until the late developmental stages. Results of plankton tows also showed that Pacific oysters dominated the bivalve larvae population in the plankton during the period of sampling (Fig. 27, 28).

The extensive larval sampling program of 1974 provided an opportunity to compare the synoptic distribution of oyster larvae in the Sound. The distribution and number of different stage oyster larvae in the plankton were similar in the head and central part of the Sound. Generally spawning occurs first and often in greater intensity in the head of the Sound. Numbers of larvae are frequently higher in the head, at least for the initial developmental stages, until larger spawnings occur in the central area or until larvae are washed out of the head and into the central part of the Sound. In 1974, spawning occurred almost simultaneously in the two areas. Further, there was limited dispersion of larvae from the head to the central part of the Sound and larval density remained similar in the two areas during the sampling period.

Stations 4, 5, and 10 are located in the central part of the Sound and are part of the same circulation pattern. In general, larval distribution and abundance were similar at the three stations; the data at Station 10 are limited. The first maximum in straight hinge larval abundance was not evident at Station 10 because of the lateness of sampling and because initial sampling was carried out every other day. Survival of larvae from the first spawning was good at all three stations. The second spawning maximum was evident at all three stations and growth and survival were similar at the three locations until sampling ended.

At Station 6 larval development and abundance were similar to those in the central part of the Sound (Fig. 22-25). No maximum in abundance of straight hinge larvae was seen for the first spawning in plankton two data because of the lateness of sampling; the maximum is evident in pump samples. Growth and abundance of larvae were similar to those observed at stations in the central part of the Sound. The second spawning pulse was evident in both plankton tows and pump samples. These data indicate that Station 6 is part of the large gyral circulation pattern in the central Sound; some larvae probably reach as far as Station 6, and then most are recycled back into the central part of the Sound. This hypothesis is supported by results of the drift drogue study (Landry 1976). Drogues moved down the west side of the central part of the Sound to about the narrows (Station 6) where most were recycled back into the Sound rather than slipping through the narrows and out of the Sound.

Sampling at the mouth of the Sound (Station 8) and outside in Waddington Channel (Station 36) was intended to measure the extent of breeding in that area and determine whether large quantities of larvae were swept out of the Sound and into Waddington Channel.

The appearance, development and growth of oyster larvae at Station 8 was similar to that in the central part of the Sound although numbers were much reduced. Straight hinge larvae occurred in abundance in late July and early August but survival to the later stages was reduced compared to other stations. A second maximum in straight hinge larval abundance occurred from August 18-21.

These data show that spawning occurred at approximately the same time throughout the Sound and that larvae of similar developmental stages were distributed in varying densities throughout the Sound at similar times.

Sampling at Station 36 was limited but did show that early developmental stage larvae from the first spawning occurred in early August in Waddington Channel. Survival was poor and only modest numbers survived to the late umbone stage.

Results of sampling at Stations 8 and 36 showed no large accumulation of larvae, particularly later stage larvae. This indicated that large quantities of larvae were not washed out of the Sound and into Waddington Channel. Larvae tended to remain in the gyral circulation pattern of the central part of the Sound and only minor quantities were washed out to the mouth and into Waddington Channel.

SPATFALL

Spatfall was monitored daily and weekly. Additional experiments were carried out to assess the suitability of asbestos plates as a setting surface for oyster larvae; determine the variability of spatfall at different locations in the Sound and on commercial rafts, and assess the suitability of artificial cultch for catching spat.

Daily spatfall was monitored by immersing well leached asbestos plates (10 cm × 10 cm) at Station 5, beginning August 11. Plates were put out at 1600 hr and removed at the same time the following day.

Weekly spatfall and spatfall patterns in the Sound were monitored by immersing strings of oyster shell cultch at Stations 1, 2, 3, 4, 5, 6E, 6W, and 10, beginning August 12. Samples of cultch were removed weekly to determine the extent of settlement during the week. The remainder was left immersed until equipment was removed on September 17 to determine total spatfall and measure spat growth. Growth was recorded as length, i.e. distance from the umbone to the ventral margin of the shell.

In previous years, marked variability was found in the spatial distribution of spatfall on commercial cultch (Quayle 1974). Spatfall at one end of a raft might be heavy but light or non-existent in the middle or at the other end of the raft. To obtain a measure of this variability, asbestos plates were suspended from commercial rafts at Station 5 on August 14 and at Station 1 on August 15, as shown in Fig. 29 and 30. Both sets of plates were collected on September 17.

Artificial cultch (Anon. 1970) with a variety of formulae was supplied by B.C. Research for testing. It was immersed at Station 2 on August 8 and removed on September 17.

First spatfall was recorded for the 24-hour period August 13-14 (Fig. 31). This was later than usual for initial spatfall in Pendrell Sound (Quayle 1974). After initial settlement, daily spatfall increased quickly to a maximum, mean 14.9 spat per plate, during the 24-hour period August 21-22, then declined to zero on September 1-2. Another smaller maximum occurred from September 8-10. No further spatfall was recorded after September 14. Accumulated mean total spatfall was 82.4 spat per asbestos plate.

Assuming the peak of first spawning occurred about July 29, larval development took approximately 24 days. At water temperatures existent in the Sound at the time (Fig. 5) this is slower growth than normal (Quayle 1974; Bourne 1978).

Results of weekly spatfall monitoring are shown in Table 4. Some differences exist between these data and daily spatfall data at Station 5. Spatfall began during the week of August 12-19; heaviest spatfall was at Station 5. Major settlement occurred during the 2-week interval, August 19-September 2. From August 19-26 maximum spatfall was at Station 6W, next highest at Stations 4 and 5. In the next week, August 26-September 2, spatfall dropped significantly at Stations 4 and 5 (which agrees with the daily spatfall data), and, to a lesser extent, at Stations 6W and 6E. However, it increased sharply at Stations 1, 2, and 3. Settlement remained at about the same level at Station 10. After September 2, spatfall was low at all stations but minor peaks did occur at Stations 5 and 6W which agrees with the daily spatfall data. Accumulative spatfall from all these data show Stations 3 and 6W had the heaviest spatfall during the summer, followed by Stations 4 and 5; Stations 1 and 6E had the least (Table 4).

Sizes of the largest spat on weekly cultch are shown in Table 5. Maximum mean lengths were smaller than in most years due to the lateness of the set. Growth of spat on cultch exposed on August 12 was generally 2-3 mm greater than on cultch exposed on August 19. Spat on cultch exposed on August 26 was 1-2 mm less than on cultch exposed the previous week.

Spat counts on asbestos cultch exposed at the barge (Station 5) and removed on September 17 differ slightly from those on daily and weekly cultch (Tables 4 and 6). Catching surfaces of oyster shells and asbestos plates are comparable, approximately 200 cm². Spat counts were generally higher on asbestos cultch than on shell cultch. Asbestos cultch has a rough side and a smooth side, but the type of surface had little effect on settlement. Heaviest settlement was on the upper surface regardless of which side was up. The reason for higher spatfall on asbestos plates may be twofold: firstly, oyster larvae may prefer asbestos to oyster shells as a settling surface; secondly, asbestos plates were separated by 5 cm spacers which provided more water circulation, which in turn could have brought more larvae in contact with the plates.

Asbestos plates suspended from commercial rafts did not show any consistent trends in spatfall (Table 7, 8). Spatfall was heavier on plates exposed in the head of the Sound (between Stations 1-2) than at Station 5, which disagrees with data presented in Table 4. The close proximity of commercial rafts to the shore at Station 5 may have reduced water circulation and hence the number of larvae coming in contact with the cultch. Rafts in the head of the Sound jutted out perpendicular to the shore and were exposed to maximum circulation, although water circulation is less there than at Station 5.

At Station 5 there was little difference in spat counts on cultch suspended from the inside or outside rows of rafts. Cultch in the middle of rafts had lower counts than cultch at the ends which may have been due to small differences in water currents. At the head of the Sound, highest counts were on plates suspended on rafts at the outer edge of the rows of rafts but no consistent pattern is evident (Fig. 29, 30; Tables 7, 8).

Spat counts on asbestos plates suspended from commercial floats were higher than counts on commercial oyster cultch suspended from the same floats. Again, this may have been due to a larval preference for asbestos plates or to the fact that the plates were well separated allowing for greater water circulation as explained above. Furthermore, asbestos plates had clean surfaces while much of the commercial cultch was dirty. Dirty cultch is a poorer setting surface than clean cultch.

Spatfall was heavier on the lower surface compared to the upper surface of asbestos plates suspended from commercial floats (Table 7, 8). This disagrees with observations at other locations and for other years (Quayle 1974; Bourne 1978). No explanation can be offered for this anomaly. It was not due to a preference for the smooth or rough side of the plates since half the plates were suspended with the smooth side down and half with it up. Further, roughness or smoothness was not a factor in intensity of spatfall on plates suspended from the barge.

Spatfall on artificial cultch is shown in Table 9. Settlement on this cultch was lighter than on oyster shell cultch; mean spat counts ranged from 1.4 to 6.5 spat per piece of cultch. Artificial cultch has a surface area of about 70 cm² (35 cm² per side) compared to a surface area of about 200 cm² for oyster shell cultch. Allowing for differences in surface area, settlement on artificial cultch was below that of oyster shell cultch at Station 2. In previous years spatfall on artificial cultch has been comparable to that on oyster shell cultch (Bourne 1978). A possible explanation for the low catches in 1974 was that the formulae used in manufacturing the cultch were unsuitable as a settling surface. The cultch was leached for a sufficient time prior to settlement. Condition of the cultch at the end of the summer is shown in Table 9.

ABUNDANCE OF OTHER BIVALVES

Pacific oysters formed the major portion of bivalve larvae in the plankton from late July until early September (Fig. 27, 28).

Blue mussel, Mytilus edulis, larvae were abundant in plankton tows from June to mid-July (Fig. 27, 28, 32-34). Numbers decreased during late July and the first 3 weeks of August, particularly in pump samples. At the end of August abundance increased and moderate numbers were found in plankton tows until mid-September. A heavy set was recorded, particularly at Station 4.

Shipworm, Bankia setacea, larvae were abundant in both plankton tows and pump samples (Fig. 27, 28, 32-34). In surface tows numbers reached a maximum at Stations 1 and 4 during the first half of August (Fig. 27, 28). Pump samples show a major peak in larval abundance around August 20 at all stations. This maximum probably resulted from commercial cultching operations. During this period logs used for floats are pushed around and this activity probably triggers spawning of shipworm populations in the logs.

Native oyster, Ostrea lurida, larval abundance was low in pump samples at all stations except Station 1-2 where small maxima occurred in late July and early August, and in late August (Fig. 27, 28, 32-34). Peak abundance at these times is also seen in surface plankton tows at Stations 1 and 4. The set was light. On weekly cultch minor setting occurred at Stations 2, 3, and 10; below a mean of 1 spat per piece of shell. On asbestos cultch, setting was heavier; mean of 0.5 to 7.1 spat per plate in the head of the Sound, 0.4 to 1.6 spat per plate on commercial rafts at Station 5 but only 0.1 spat per plate at the barge.

Clam larvae occurred in modest numbers in late June, almost disappeared from the plankton until late August when a maximum occurred (Fig. 27, 28, 32-34). The maximum in late August was observed at all stations in pump samples but not in surface plankton tows. A possible explanation for this difference is that clam larvae may tend to remain at deeper depths (e.g. 2 m) and not migrate to the surface. They would be taken in pump samples but not in surface tows. A few littleneck clams, Protothaca staminea, were found on cultch.

ABUNDANCE OF OTHER ORGANISMS

Spirorbis sp. larvae were found in plankton tows in August and a modest set occurred in late August and early September. Heaviest setting was in the head of the Sound but modest numbers were found on cultch at Stations 3, 6E and 6W.

Modest numbers of Haminoea vesicula were found on weekly cultch at Stations 2 and 10 and on asbestos cultch at Station 1 and at the barge.

An attempt was made to identify and quantify phytoplankton and zooplankton in surface tows during the sampling period using the relative abundance method (Heritage et al. 1976). Estimates of abundance of these different groups are on computer tapes. Information on abundance of both phytoplankton and zooplankton is also given by Stockner and Crisp (1976) and for previous years by Stephens et al. (1969).

Zooplankton abundance was generally low until mid-August. In the latter part of August large numbers of comb jellies, Pleurobrachia pileus, were in the plankton. Jellyfish were common in late August and early September. Rotifers were also common during August and September, while copepods, cladocerans and larval fish were moderately abundant in late August.

The importance of macro-phytoplankton blooms to oyster larval survival has been discussed previously (Bourne 1978). Phytoplankton abundance was high in the first part of July probably because of heavy runoff that added nutrients to the Sound. The algae were mainly chain-forming diatoms that decreased substantially towards the end of July and remained much reduced until after the middle of August. On August 21, a large bloom of Noctiluca calcitrans occurred at the mouth of the Sound and spread to the head of the sound by August 23. During the period oyster larvae were present in the water there was little macro-phytoplankton in the surface waters.

These results differ somewhat from those of Stockner and Crisp (1975) who found little phytoplankton in Pendrell Sound on July 9 but large quantities on August 14. However, they point out that most of the phytoplankton was nanophytoplankton. On August 14 the dominant phytoplankton was Leptocylindrus danicus and large quantities of phytoplankton occurred to a depth of 1 m. By September the amount of phytoplankton was greatly reduced. They found heaviest densities near the pycnocline where there is a greater influence of nutrients.

PREDATORS

Cultch was examined for Pseudostylochus ostreophagus but no adults or egg masses were found. Additional samples of commercial cultch were examined in December 1974, and in January and February 1975, but no adults or egg masses were found.

There was a heavy set of starfish, Pisaster ochraceus, in 1974. Few starfish were found on experimental cultch when it was removed on September 17, but starfish 10-25 mm in diameter were common on commercial cultch when examined later in the fall. Samples of Philippine oyster cultch (which is about 1/5 the size of Pacific oyster cultch) examined in February 1975 had 1 starfish per 20 pieces of shell. In another sample, 68 starfish were found on 61 pieces of Pacific oyster shell cultch, some shell had as many as 8 starfish per shell. This heavy set of starfish caused extensive oyster spat mortalities. A sample of 80 pieces of Philippine oyster shell cultch examined in February 1975 had 2.7 dead scars per piece of shell. Most of these mortalities had probably been caused by starfish predation.

DISCUSSION

Surface water temperatures and salinities

Temperatures and salinities of surface waters in Pendrell Sound were similar within each of the three areas (head, centre and mouth) during the summer although there were differences between the three areas. This agrees with Buckingham (1976) who found little variation in temperature structure in the transverse direction of the Sound. Oceanographic conditions in the surface layer were most stable in the head of the Sound and least stable at the mouth. The 1974 results show that temperature-salinity profiles taken every other day at Stations 8, 6, 4, and between 1 and 2 would probably provide sufficient information on the depth and physical conditions in the surface layer for spatfall prediction purposes.

The position of the pycnocline fluctuated at all stations during the sampling period, occasionally by as much as 1-2 m in a 48-hr period. These fluctuations were probably due to internal waves (Buckingham 1976). Further work should be undertaken to determine the exact causes and the periodicity of these fluctuations since they could have an important effect on the position of bivalve larvae in the water column. Previous work (Quayle 1974; Heritage et al. 1976) indicates that at the onset of daylight, oyster larvae migrate downwards in the water column and probably remain just above the pycnocline during the day. After direct sunlight leaves the surface of the water they migrate upwards. In 1974 the holes in the pump sampler only extended to a depth of 2.5 m. If the pycnocline was at a greater depth than this, larvae could be missed, but would be caught if it were this depth or shallower. This would lead to differences in estimates of larval density. Additional studies on fluctuations in the pycnocline are needed and these should include a determination of the position of larvae in relation to the pycnocline during the day.

Unfortunately the temperature and salinity data for surface waters surrounding East Redonda Island are limited. Melt water from Toba Inlet is important in the formation and stability of the surface layer in Pendrell Sound. Pulses of fresh water have had serious effects on surface water salinities and bivalve larval survival in the past (Quayle 1974). It is believed the fresh water from Toba Inlet enters Pendrell Sound, coming down Homfray Channel, up Waddington Channel and then into the Sound (Fig. 1). The top end of Waddington Channel (above Station 34) is too narrow to provide for sufficient flow of fresh water from Toba Inlet down the west side of the Island and into this Channel.

The 1974 data show the flow of fresh water coming from Toba Inlet varies in volume during the summer. Waters around East Redonda Island were subject to pulses of additional amounts of fresh water from Toba Inlet during the sampling period. The pulse that occurred after July 3 was sufficient to lower surface salinities in Pryce, Homfray and Waddington channels, and cause the breakdown of thermal stratification so that the thermocline disappeared from all stations on July 17 (Table 1). However, the pulse did not affect surface salinities in Pendrell Sound (Fig. 15-21). Another fresh water pulse must have occurred between July 17 and 29 since reduced surface salinities

occurred at Stations 33, 34 and 35 on July 29. This pulse of fresh water probably produced the low surface salinities at Stations 8 and 36 at the end of July and beginning of August (Fig. 14, 20). Pulses of fresh water probably result from excessive precipitation or excessive melting of glaciers at the head of Toba Inlet.

Further studies should be carried out to assess the influence of Toba Inlet waters on the surface layer of Pendrell Sound. These should include weekly and perhaps twice weekly measurements of temperatures and salinities of the surface waters around East Redonda Island.

Larvae and spatfall

The occurrence, distribution and growth of Pacific oyster larvae were similar within each of the three areas of the Sound (head, center and mouth) throughout the sampling period although there were significant differences between the three areas (Fig. 22-28). Larval density was much higher in the head and central part of the Sound than at the mouth. No accumulation of larvae occurred at the mouth, indicating that large quantities of larvae were not washed out of the central part of the Sound to the mouth. Day-to-day variations in numbers of larvae existed and may have been due to distribution patterns of the larvae or to sampling error. As mentioned above, the position of the pycnocline could cause differences in estimates of abundance.

Quantitative samples in 1974 were taken with the pump sampler while the boat drifted or moved slowly ahead. The distance covered with these "spot" samples was probably insufficient to provide adequate estimates of oyster larval abundance in the Sound. Larval distribution is probably not random and patchiness of larval distribution could cause marked differences in estimates of abundance. Much greater distances should be covered when taking these samples; either transects across the Sound, or four equal transects from Station 6 to the head of the Sound. Such samples taken every second day would provide adequate information on numbers, distribution and growth of Pacific oyster larvae for spatfall prediction purposes.

An interesting result of the 1974 work was the high survival rate of oyster larvae to late developmental stages. No explanation can be given for this. Causes of larval mortalities have been discussed previously (Bourne, 1978). Detailed studies are needed to determine causes of larval mortalities in Pendrell Sound and their effect on larval densities.

The location of areas of maximum spatfall are of particular interest to the industry. In 1974 heaviest spatfall was at Stations 3 and 6W. Station 3 is at the top of the central part of the Sound, where water currents from the gyral circulation tend to concentrate on shore. These currents would bring more larvae in contact with suspended cultch at this location. Station 6W is at the bottom of the gyral circulation pattern and currents with larvae would again pass by this location (Landry 1976). Further water leaving the Sound does so on the west side of the narrows and would pass by Station 6W, bringing more larvae in contact with cultch and increasing spatfall.

At Station 1 there is little current which probably explains the low spatfall there. Station 6E is barely within the gyral circulation and, further, any water coming into the Sound comes in along this shore. This water has much lower concentrations of larvae, as shown by larval counts at Stations 8 and 36 (Fig. 23, 26, 34). Lower spatfall would be expected at Station 6E.

The industry should consider undertaking spat collection operations at Stations 3 and 6W.

NEWSLETTER

The "British Columbia Pacific Oyster Breeding Newsletter" was continued and thirteen issues were published (Appendix 1).

SUMMARY

1974 was a successful year for Pacific oyster breeding in Pendrell Sound. Although meteorological and hydrographic conditions were unfavourable in early July they improved in mid-summer to provide favourable water temperatures and salinities. A commercial set was predicted and occurred in August.

Five companies exposed a total of 300,000 strings of Philippine oyster cultch and about 75,000 strings of Pacific oyster cultch, or the equivalent in cement-coated veneer and cement diamond chips. Companies had a commercial spatfall; spat counts on Pacific oyster cultch ranged from 8.9-21.3 spat per piece of cultch. On Philippine oyster cultch, counts ranged from 2.8-9.3 spat per piece of shell.

The heavy set of starfish caused heavy losses of spat, and by the time much of the seed was spread on beds, numbers of spat were much reduced.

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Table 1. Temperature (°C) and salinity (‰) profiles to a depth of 10 m in waters surrounding East Redonda Island, June 26-July 29, 1974.

Depth	Temperature					Salinity					Temperature					Salinity				
	June 26	July 3	July 10	July 17	July 29	June 26	July 3	July 10	July 17	July 29	June 26	July 3	July 10	July 17	July 29	June 26	July 3	July 10	July 17	July 29
	<u>Station 30</u>										<u>Station 31</u>									
0	15.1	15.9	17.2	16.7	-	22.4	18.4	14.3	16.7	-	15.9	14.5	15.9	16.0	-	13.8	15.9	10.0	14.4	-
1	15.0	16.0	18.1	16.6	-	22.4	18.5	19.9	16.6	-	16.1	14.8	17.3	15.8	-	14.5	20.4	14.5	17.5	-
2	15.1	15.9	17.7	16.6	-	22.5	19.4	22.0	16.6	-	16.1	14.1	18.0	16.4	-	14.8	21.9	20.1	19.1	-
3	15.0	14.9	17.5	16.6	-	22.7	21.9	22.2	16.9	-	16.1	14.0	16.9	16.7	-	15.6	23.4	22.3	27.3	-
4	14.9	14.2	17.0	16.6	-	22.6	21.8	23.2	19.5	-	15.1	13.8	15.6	16.4	-	24.4	24.7	23.7	22.4	-
5	12.9	14.5	16.2	16.2	-	25.7	23.2	23.7	22.4	-	14.0	13.5	14.6	16.1	-	25.5	25.3	24.9	23.1	-
6	12.8	13.1	15.7	16.2	-	26.3	25.7	24.3	22.6	-	13.8	13.4	14.1	16.0	-	25.8	25.5	25.2	23.4	-
7	12.8	13.0	14.6	15.9	-	26.6	25.8	25.0	22.9	-	13.1	12.9	13.8	15.6	-	26.2	25.8	25.5	24.7	-
8	12.4	12.9	14.1	15.5	-	26.7	25.9	25.2	23.6	-	12.2	12.5	13.3	15.3	-	26.7	26.1	25.6	24.1	-
9	12.0	12.6	13.4	15.3	-	26.9	26.0	25.5	23.9	-	11.5	12.3	12.8	14.9	-	27.1	26.1	26.2	24.6	-
10	11.9	12.6	13.1	15.3	-	27.0	26.1	25.7	24.1	-	11.2	12.4	12.8	14.5	-	27.2	26.3	26.3	25.0	-
	<u>Station 32</u>										<u>Station 33</u>									
0	15.3	13.9	16.3	14.3	-	12.0	15.4	11.6	20.2	-	14.6	14.0	15.4	14.8	18.0	15.3	15.7	10.0	19.4	8.4
1	15.4	13.9	16.1	14.2	-	12.5	15.8	12.8	20.3	-	14.8	14.1	15.4	14.6	18.5	16.8	16.5	11.0	19.5	12.1
2	15.6	13.9	16.2	14.3	-	13.8	21.9	13.5	20.3	-	14.3	14.4	15.1	14.6	15.7	19.6	17.8	13.0	19.6	15.6
3	13.0	13.3	16.7	14.4	-	24.2	22.1	17.7	20.4	-	12.8	13.5	15.0	14.8	14.4	25.5	22.8	17.4	19.7	22.0
4	13.0	13.4	15.8	14.3	-	24.5	23.5	22.1	20.3	-	12.5	12.8	14.8	14.6	13.5	25.7	25.6	21.0	21.0	24.6
5	12.5	13.1	15.0	14.4	-	25.7	25.0	23.5	20.5	-	11.6	12.5	14.3	14.4	13.3	26.8	26.1	23.3	21.4	24.7
6	11.8	12.7	14.2	14.7	-	26.7	25.5	24.9	22.0	-	11.4	12.3	13.8	14.3	11.6	26.9	26.4	24.7	21.5	25.8
7	11.2	12.8	13.9	14.7	-	26.9	25.9	25.3	22.3	-	10.9	12.0	13.5	14.4	11.0	27.0	26.7	25.2	21.9	26.3
8	11.1	12.6	13.5	15.0	-	26.9	26.0	25.2	23.4	-	10.8	11.8	13.1	14.4	10.9	27.1	26.6	25.4	22.5	26.3
9	11.0	12.6	13.2	15.1	-	26.9	25.9	25.5	23.5	-	10.7	11.7	12.7	14.2	10.8	27.2	26.7	25.9	23.4	26.4
10	11.0	12.6	13.2	15.1	-	26.9	25.9	25.5	23.5	-	10.7	11.7	12.7	14.2	10.8	27.2	26.7	25.9	23.4	26.4
	<u>Station 34</u>										<u>Station 35</u>									
0	17.0	14.5	16.2	15.4	19.2	16.9	18.7	12.8	19.0	13.1	17.2	16.5	17.8	17.2	22.1	18.0	19.9	16.9	16.5	14.8
1	17.1	15.0	15.9	15.3	17.6	17.1	20.1	12.7	19.1	14.7	17.3	16.5	18.1	16.8	20.4	18.2	20.3	17.5	17.4	15.7
2	17.1	15.0	17.3	14.8	18.1	17.6	20.7	16.1	20.1	17.3	17.1	16.6	18.5	16.3	19.5	18.9	20.5	18.8	18.1	17.6
3	17.1	14.5	18.4	14.6	17.5	17.9	21.7	18.5	20.2	20.8	16.4	14.3	18.4	16.2	17.1	19.8	22.5	20.7	18.3	22.2
4	16.9	14.0	17.3	14.8	15.0	18.9	21.9	21.4	21.4	23.6	16.2	13.9	16.9	16.5	14.8	20.6	24.1	22.9	20.7	24.2
5	15.1	13.1	16.5	14.8	14.3	24.1	25.1	22.4	22.1	24.2	15.4	13.5	15.2	17.4	14.0	22.8	25.1	24.3	22.0	24.6
6	12.9	13.1	16.0	15.6	12.4	26.1	25.2	22.9	23.0	25.3	14.9	13.4	14.7	16.3	12.8	24.8	25.5	24.6	22.6	25.2
7	12.4	13.0	14.2	15.3	11.7	26.4	25.7	24.8	23.7	26.0	13.0	13.0	14.3	16.3	12.1	26.2	25.7	25.2	23.0	25.8
8	11.5	12.7	13.5	15.2	11.2	26.9	25.9	25.3	24.0	26.3	12.2	12.6	13.5	15.0	11.6	26.7	26.1	25.5	24.4	26.3
9	10.8	12.6	12.9	14.6	11.0	27.3	26.1	25.9	24.5	26.6	11.7	12.3	13.1	14.6	11.1	26.8	26.3	25.9	24.9	26.5
10	10.6	12.6	13.2	14.2	10.7	27.3	26.0	25.6	25.0	26.9	11.4	12.4	12.7	14.3	11.0	27.1	26.5	25.9	24.9	26.6

Table 2. Nutrient levels in water samples collected at a depth of 0.5 m, Station 4, Pendrell Sound, 1974.

Date	PO ₄	NO ₃	NO ₂	NH ₄
June 25	0.13	0.6	<0.04	<0.10
July 22	0.10	0.3	<0.04	<0.10
July 30	0.05	0.6	<0.04	0.23
Aug. 5	0.03	0.3	<0.04	<0.10
Aug. 13	0.09	0.3	<0.04	<0.10
Aug. 19	0.06	0.4	<0.04	0.15
Aug. 26	0.04	0.4	<0.04	0.35
Sept. 2	0.08	0.3	<0.04	<0.10
Sept. 9	0.16	1.3	<0.04	<0.10
Sept. 16	0.09	0.3	<0.04	<0.10
<u>Station 33</u>				
Aug. 29	0.16	0.5	0.04	0.12

Table 3. Stage of gonad development of Pacific oysters in Pendrell Sound, June 24-August 2, 1974.

Date	Station	Number examined			Remarks
June 24	2	8♀	4♂		Males almost ripe; females ripening
	5	7♀	5♂		Males ripening; females ripening
June 30	5	9♀	5♂		Males ripe; females almost ripe
	6E	3♀	4♂		Males ripe; females almost ripe
July 1	2	12♀	4♂	3?	Males ripe; females almost ripe; 3 animals did not fill out and could not be sexed
July 11	2	4♀	8♂		Males ripe; females ripe
July 20	2	9♀	1♂	3?	Ripe; veins well developed; 3 animals did not fill out
	5	7♀	2♂	4?	Ripe, veins well developed; 4 animals did not fill out
July 23	5	10♀	3♂		Ripe and ready to spawn
July 27	2	8♀	1♂	2?	Ripe and ready to spawn; 2 oysters did not fill out
	5	4♀	0♂	8?	Ripe and ready to spawn. Most oysters had not filled out and could not be sexed
August 2	2	8♀	6♂	11?	Very ripe; 11 oysters had not filled out and could not be sexed

Table 4. Range and mean number of Pacific oyster spat per piece of oyster shell cultch exposed for weekly periods at various stations in Pendrell Sound, August 12-September 16, 1974.

Station	1	2	3	4	5	6E	6W	10
	Date In, August 12.		Date Out, August 19					
Range	1-6	1-6	1-6	3-7	2-12	0-3	0-4	0-7
Mean	2.0	2.6	4.1	4.3	5.8	1.6	1.8	2.9
	Date In, August 19.		Date Out, August 26					
Range	1-7	3-19	16-48	28-65	23-75	12-37	33-77	12-35
Mean	3.4	10.8	33.6	43.6	43.0	21.3	53.1	21.4
	Date In, August 26.		Date Out, September 2					
Range	2-36	20-68	40-88	3-48	6-41	5-23	23-79	12-29
Mean	22.5	34.7	65.3	19.8	21.4	13.8	40.6	20.1
	Date In, September 2.		Date Out, September 9					
Range	0-7	0-5	0-6	0-3	1-11	0-5	4-9	1-4
Mean	2.7	2.6	1.5	1.0	4.8	2.5	5.8	2.3
	Date In, September 9.		Date Out, September 16					
Range	0-4	0-4	1-5	1-6	1-9	1-7	2-9	0-6
Mean	1.5	1.7	2.7	3.6	4.7	3.1	5.5	2.7

Table 5. Range and mean length of largest Pacific oyster spat measured on cultch put out at weekly intervals at various stations in Pendrell Sound and removed on September 17, 1974.

Station	1	2	3	4	5	6E	6W	10
<u>Date in, August 12, 1974</u>								
No. spat measured	16	51	14	16	22	19	21	51
Range in length (mm)	7-11	6-12	4-8	6-13	5-8	4-8	3-9	4-9
Mean length (mm)	8.8	8.5	6.5	8.4	7.0	6.1	5.0	5.2
<u>Date in, August 19, 1974</u>								
No. spat measured	11	51	51	11	13	11	-	58
Range in length (mm)	4-6	4-10	3-6	4-8	3-7	4-7	-	3-6
Mean length (mm)	4.5	5.7	4.3	5.8	5.1	5.7	-	4.3
<u>Date in, August 26, 1974</u>								
No. spat measured	18	7	18	4	10	5	6	43
Range in length (mm)	2-5	4-6	3-5	3-4	3-4	2-4	3-4	3-5
Mean length (mm)	3.7	5.0	4.2	3.3	3.2	3.4	3.7	3.3

Table 6. Range and mean number of Pacific oyster spat on asbestos cultch put out on successive days at the barge (Station 5), Pendrell Sound, and removed on September 17, 1974.

Date in	Range in No.	Mean No.	Total mean
Aug. 20	$\frac{38-167}{1-6}$	$\frac{104.8}{3.1}$	107.9
Aug. 21	$\frac{7-53}{0-3}$	$\frac{29.2}{1.7}$	30.9
Aug. 22	$\frac{39-82}{1-16}$	$\frac{49.5}{5.6}$	<u>55.1</u>
Aug. 23	$\frac{4-47}{0-9}$	$\frac{34.2}{2.8}$	37.0
Aug. 24	$\frac{7-141}{0-6}$	$\frac{69.5}{2.4}$	71.9
Aug. 25	$\frac{20-70}{1-5}$	$\frac{38.4}{3.0}$	41.4
Aug. 26	$\frac{1-28}{0-3}$	$\frac{15.4}{1.4}$	16.8
Aug. 27	$\frac{3-31}{2-10}$	$\frac{16.2}{3.8}$	20.0
Aug. 28	$\frac{2-17}{0-4}$	$\frac{12.6}{1.3}$	13.9
Aug. 29	$\frac{2-18}{0-2}$	$\frac{8.8}{0.9}$	9.4
Aug. 30	$\frac{0-16}{0-2}$	$\frac{6.7}{0.9}$	7.6

Upper figure is number of spat on upper surface of asbestos plate, lower number is number of spat on bottom surface of asbestos plate.

Table 7. Range and mean number of Pacific oyster spat on asbestos plate cultch suspended from commercial rafts at Station 5, Pendrell Sound, on August 14, and removed September 17, 1974.

Code no.	Range in No.	Mean no.	Total mean no.
310	$\frac{0-12}{11-42}$	$\frac{2.8}{20.3}$	23.1
551	$\frac{0}{3-12}$	$\frac{0}{8.3}$	8.3
619	$\frac{0-11}{10-26}$	$\frac{5.8}{16.9}$	22.7
350	$\frac{0-10}{11-48}$	$\frac{2.9}{25.3}$	28.2
390	$\frac{0-2}{11-27}$	$\frac{0.2}{16.6}$	16.8
639	$\frac{1-12}{6-27}$	$\frac{7.5}{17.5}$	25.0
343	$\frac{0-11}{1-26}$	$\frac{3.3}{16.8}$	20.1
218	$\frac{0-4}{2-12}$	$\frac{1.2}{5.1}$	6.3
309	$\frac{0-11}{7-23}$	$\frac{4.7}{16.7}$	21.4
471	$\frac{1-10}{7-26}$	$\frac{5.3}{15.7}$	21.0
277	$\frac{0-6}{5-25}$	$\frac{2.7}{14.7}$	17.4

Upper figure is number of spat on upper surface of asbestos plate, lower number is number of spat on bottom surface of asbestos plate.

Table 8. Range and mean number of Pacific oyster spat per piece of asbestos plate cultch suspended from commercial rafts at Station 1, Pendrell Sound, on August 15, and removed September 17, 1974.

Code no.	Range in number	Mean no.	Total mean no.
318	$\frac{8-42}{6-21}$	$\frac{22.7}{10.1}$	32.8
396	$\frac{2-42}{15-30}$	$\frac{11.8}{22.1}$	33.9
577	$\frac{2-35}{13-49}$	$\frac{20.5}{23.3}$	43.8
559	$\frac{0-6}{13-22}$	$\frac{2.8}{16.6}$	19.4
578	$\frac{0-7}{23-51}$	$\frac{2.5}{34.4}$	36.9
235	$\frac{1-13}{19-50}$	$\frac{5.1}{29.3}$	34.4
575	$\frac{15-48}{13-36}$	$\frac{22.2}{21.0}$	43.2
93	$\frac{9-22}{7-59}$	$\frac{12.3}{26.0}$	38.3
495	$\frac{8-27}{9-42}$	$\frac{17.1}{21.3}$	38.4
329	$\frac{4-26}{17-36}$	$\frac{14.9}{23.6}$	38.5
386	$\frac{2-9}{27-50}$	$\frac{4.2}{41.5}$	45.7
385	$\frac{11-19}{26-59}$	$\frac{18.6}{37.4}$	56.0

Table 9. Number of Pacific oyster spat on artificial cultch suspended at Station 2, Pendrell Sound, on August 8 and removed September 17, 1974. Condition of cultch when removed is also shown.

Code no.	Range in number	Mean no.	Largest spat (mm)	Condition of cultch
A-1-W	0-7	1.8	4	Slightly eroded; considerable separation at edges
B-25-D	0-14	3.2	9	Slightly eroded; some separation, none broken
C-1-W	0-4	1.4	6	Considerable erosion, several half-eroded, none broken
A-1-D	0-7	3.2	8	Smooth, somewhat eroded, 41 broken
D-2-W	0-10	3.8	7	Slightly eroded
B-25-W	0-5	2.0	9	Slightly eroded
D-10-D	0-8	2.4	5	Slightly eroded, one broken
E-2-W	0-21	6.5	11	Almost no erosion, none broken
B-D	0-9	3.2	9	Some separation at edges, 3 broken
A-D	1-8	3.8	10	Slightly eroded, 4 broken
C-D	0-4	1.2	5	Smooth, cracked, 1 broken
B-10-D	2-16	6.0	10.5	Almost no erosion, none broken
E-W	1-12	2.6	10	Slightly eroded, 3 with broken edges
R-E-W	0-7	2.0	6	Rough, slightly eroded, none broken
R-B-W	0-6	3.4	9	Rough, slightly eroded, none broken
D-25-W	0-10	3.1	7	Almost no erosion, none broken
R-D-W	0-8	2.2	7	Rough, almost no erosion, none broken
R-D-Semi	0-4	1.8	10	Rough, erosion of edges, none broken
R-B-Semi	1-12	3.1	13	Rough, slightly eroded, none broken
D-10-W	0-8	2.5	10	No erosion, none broken
D-2-D	0-13	5.1	9	Edges eroded, 4 broken

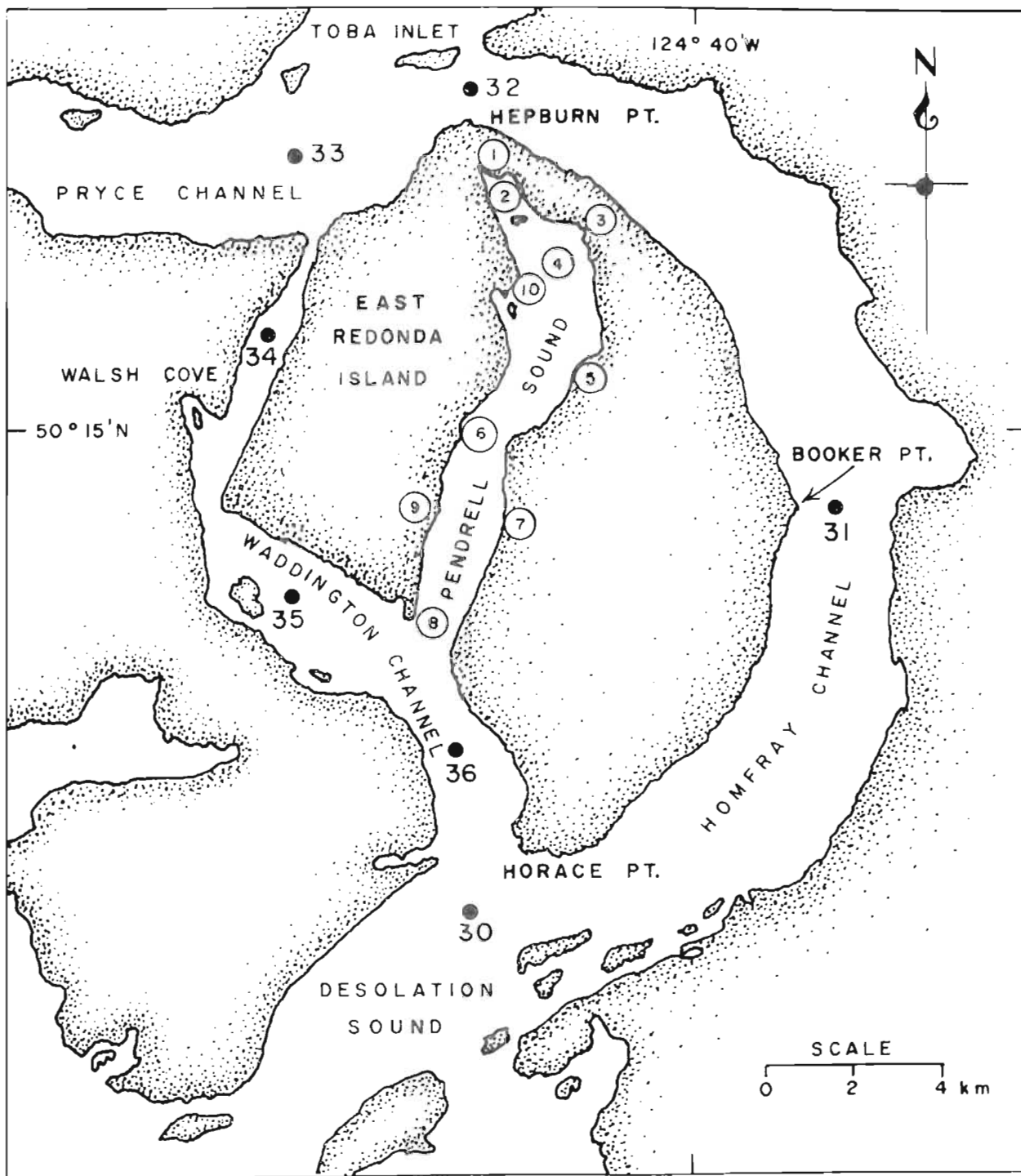


Fig. 1. Pendrell Sound and surrounding waters, showing the location of sampling stations.

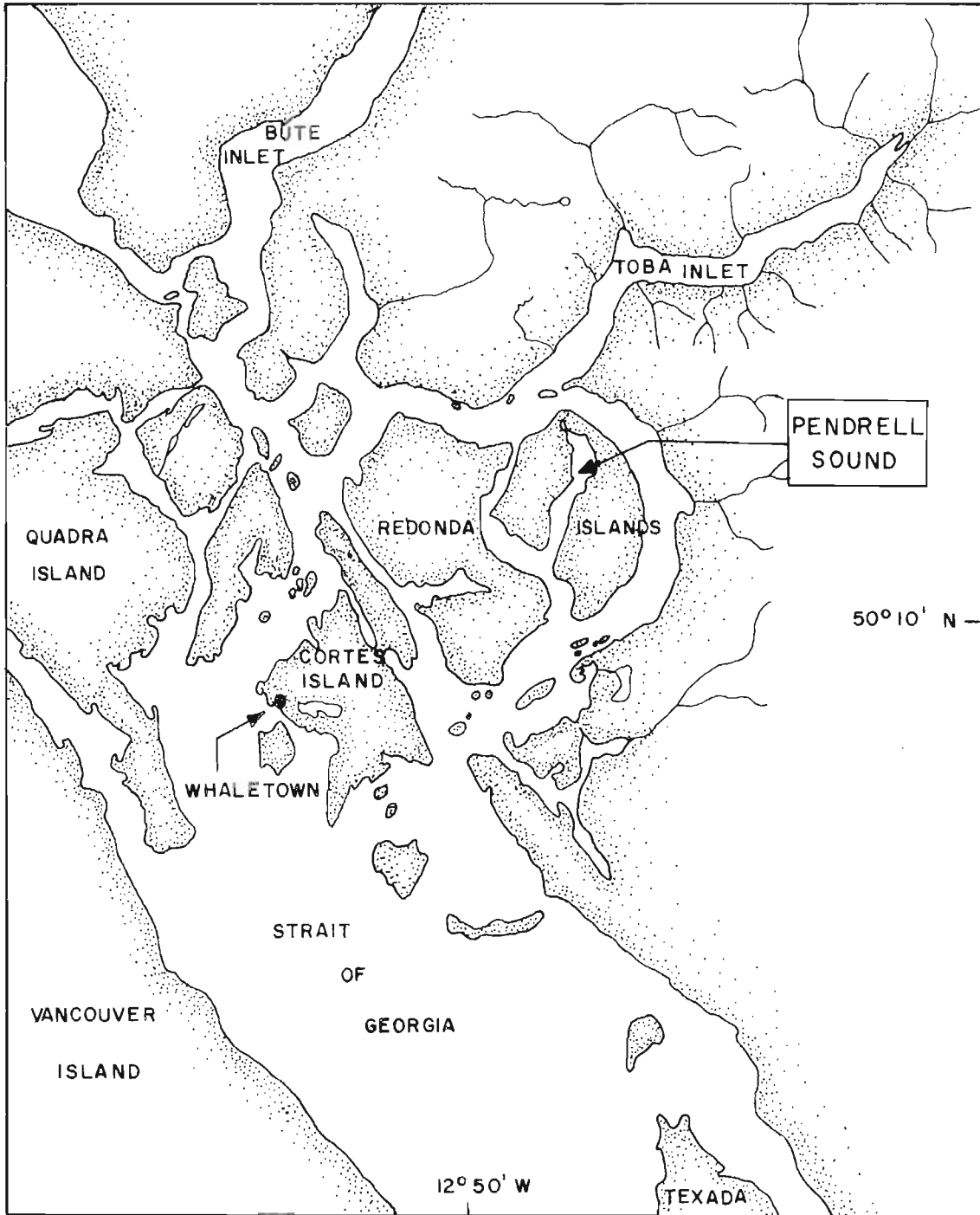
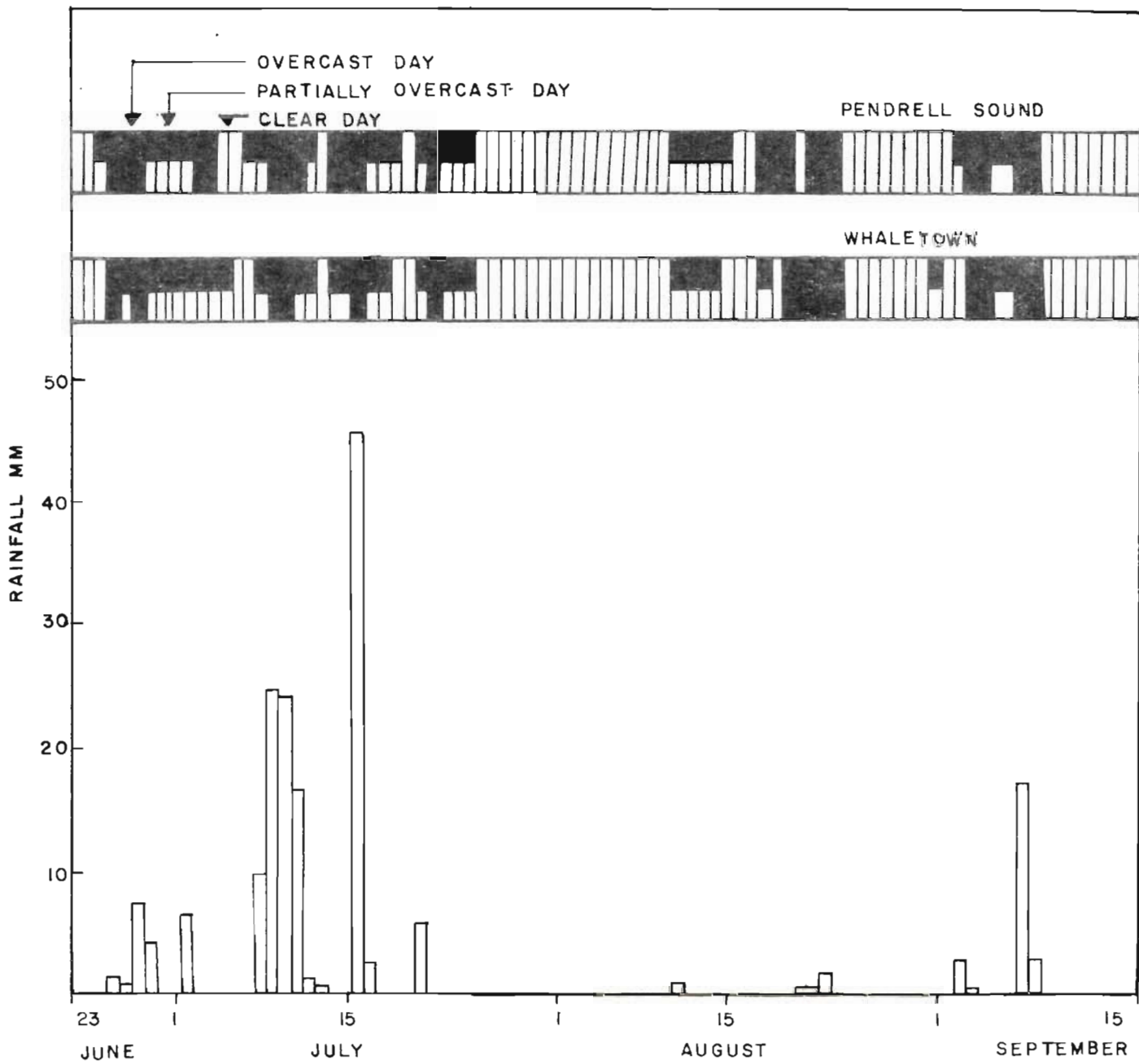


Fig. 2. Northern section of the Strait of Georgia showing the location of Pendrell Sound and Whaletown, British Columbia.

Fig. 3. Cloud and rainfall observations at Whaletown, Cortes Island and cloud cover at Pendrell Sound, British Columbia, June 23-September 17, 1974.



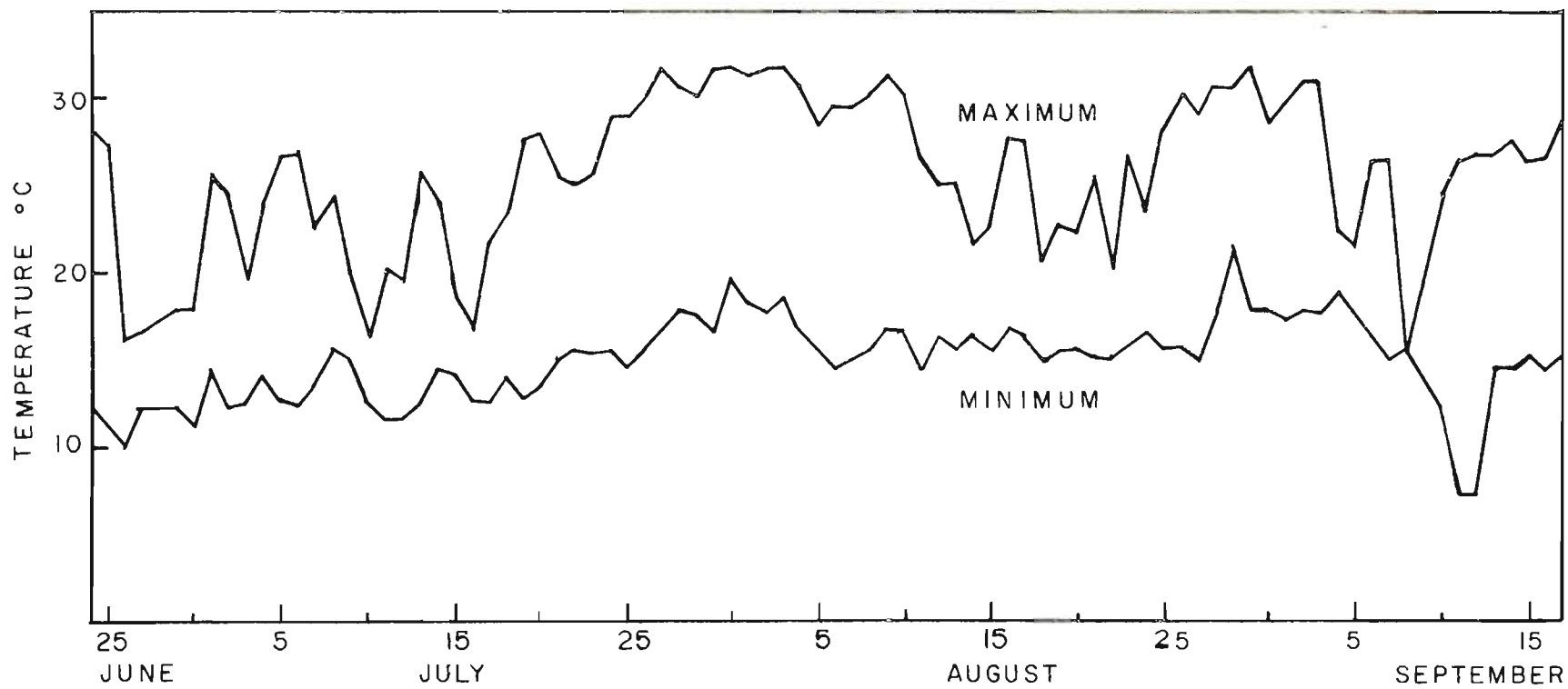


Fig. 4. Daily maximum-minimum air temperatures, Pendrell Sound, June 24-September 17, 1974.

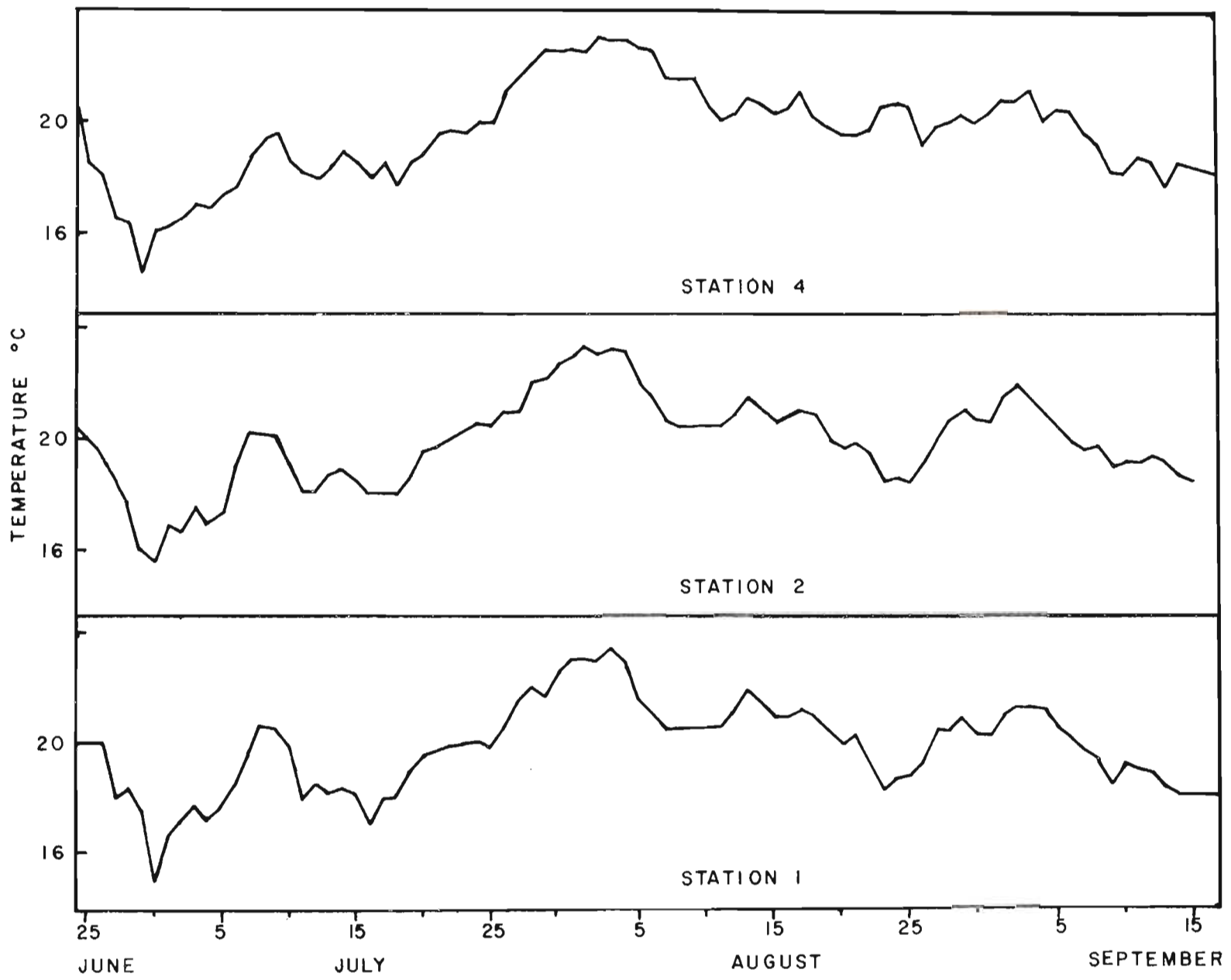


Fig. 5. Mean daily water temperature at 1 m at stations 1, 2, and 4, Pendrell Sound, June 24-September 17, 1974.

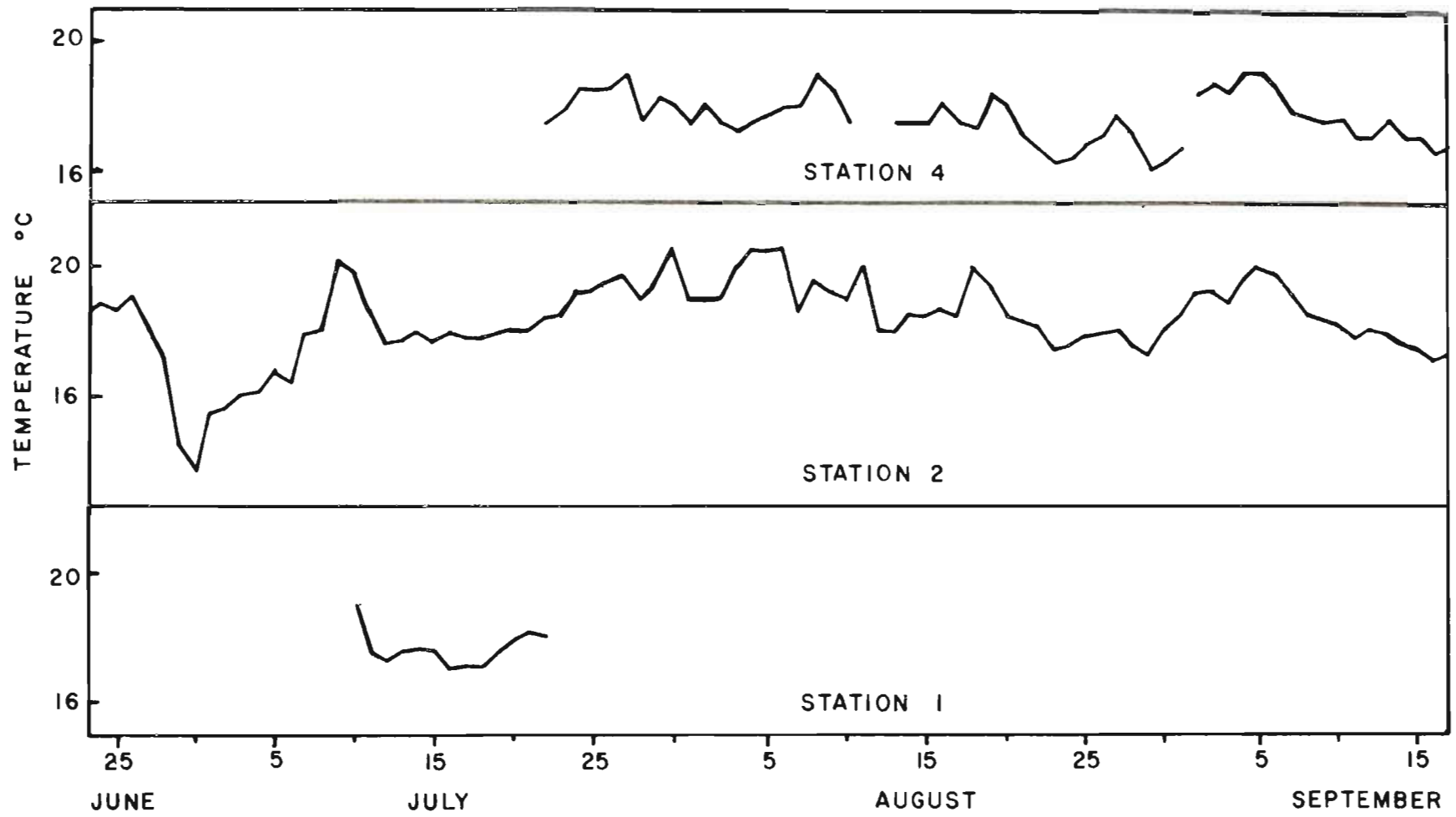


Fig. 6. Mean daily water temperature at 3 m at stations 1, 2 and 4, Pendrell Sound, June 24-September 17, 1974.

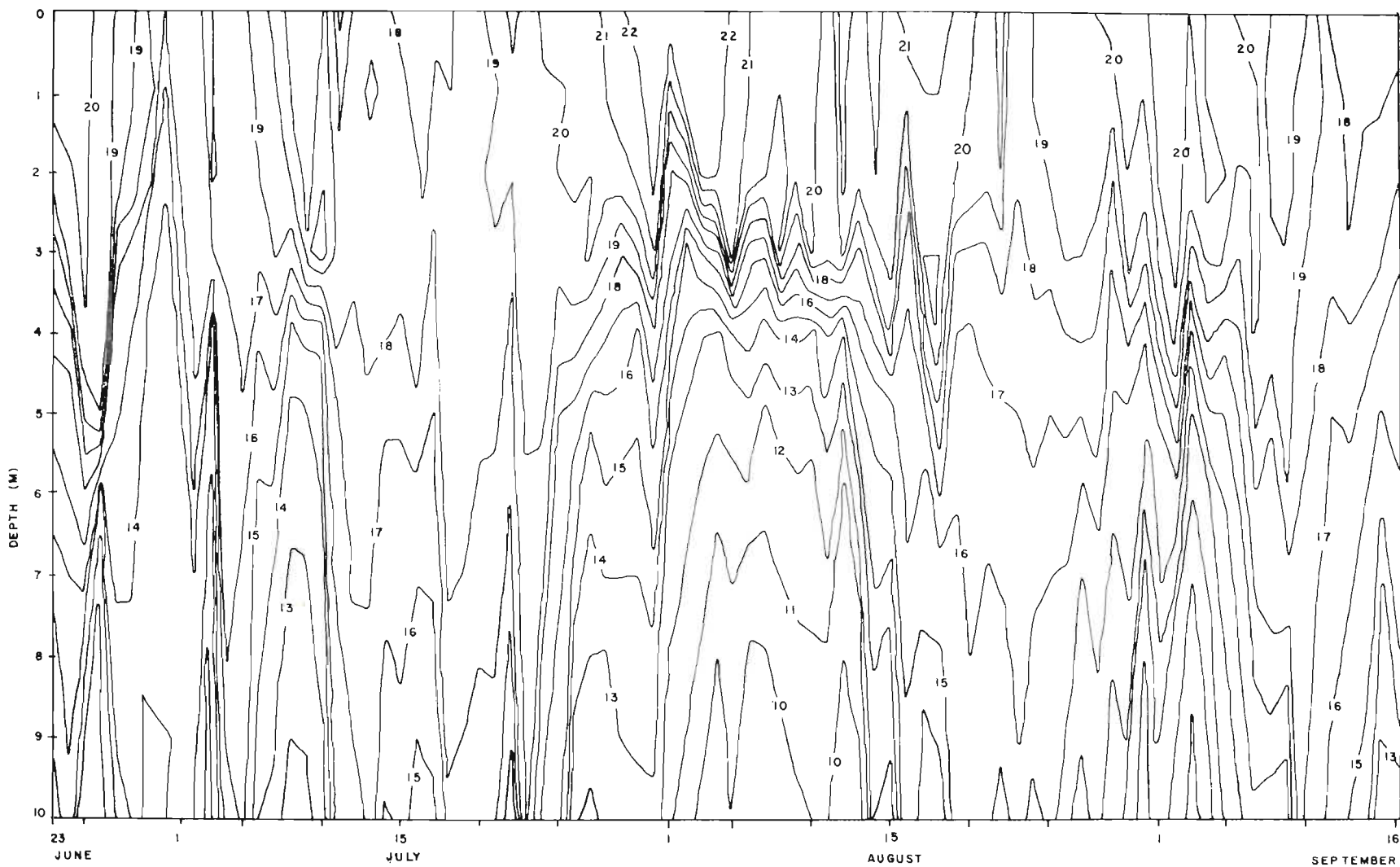


Fig. 7. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 1, Pendrell Sound, June 23-September 16, 1974.

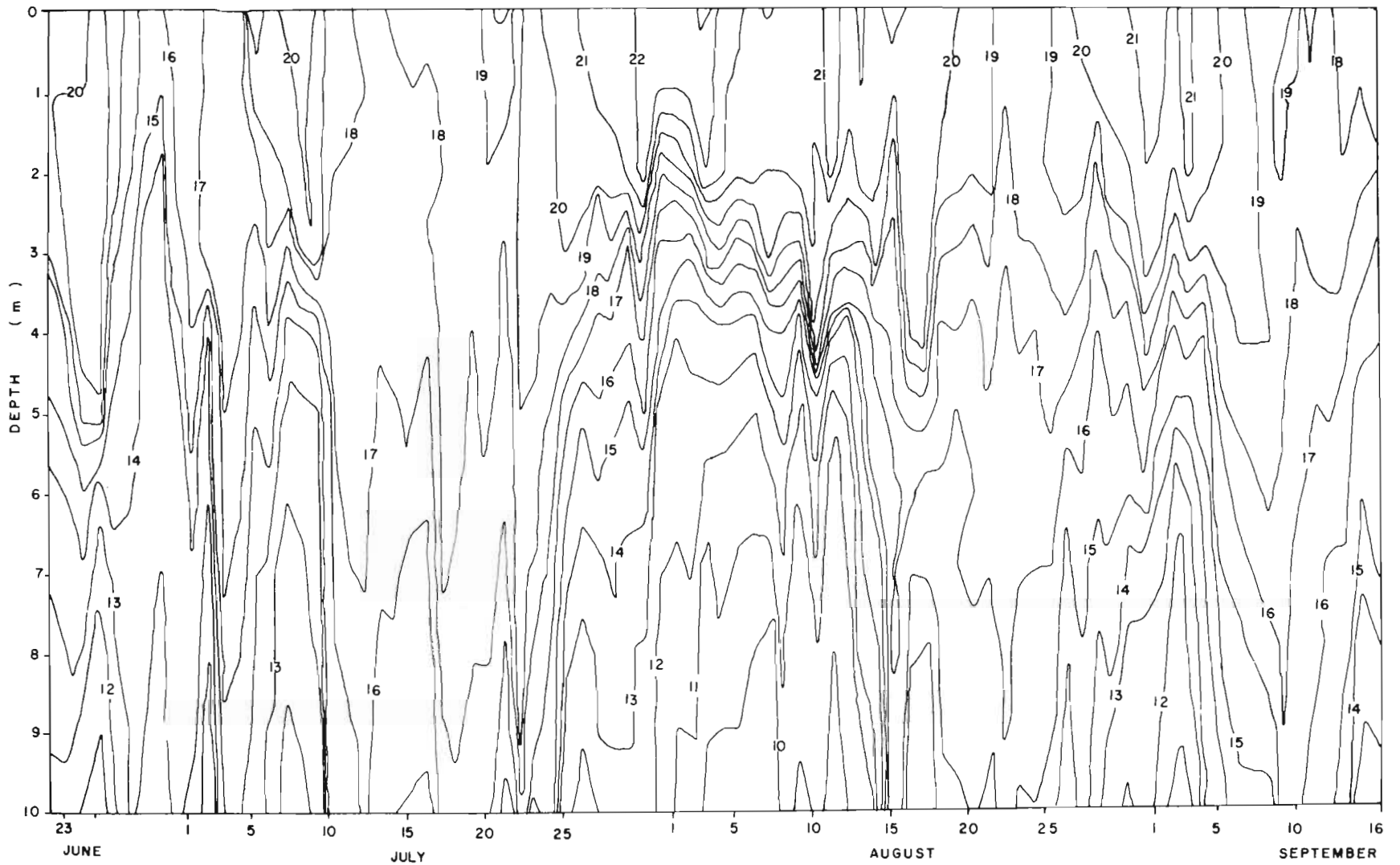


Fig. 8. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 2, Pendrell Sound, June 23-September 16, 1974.

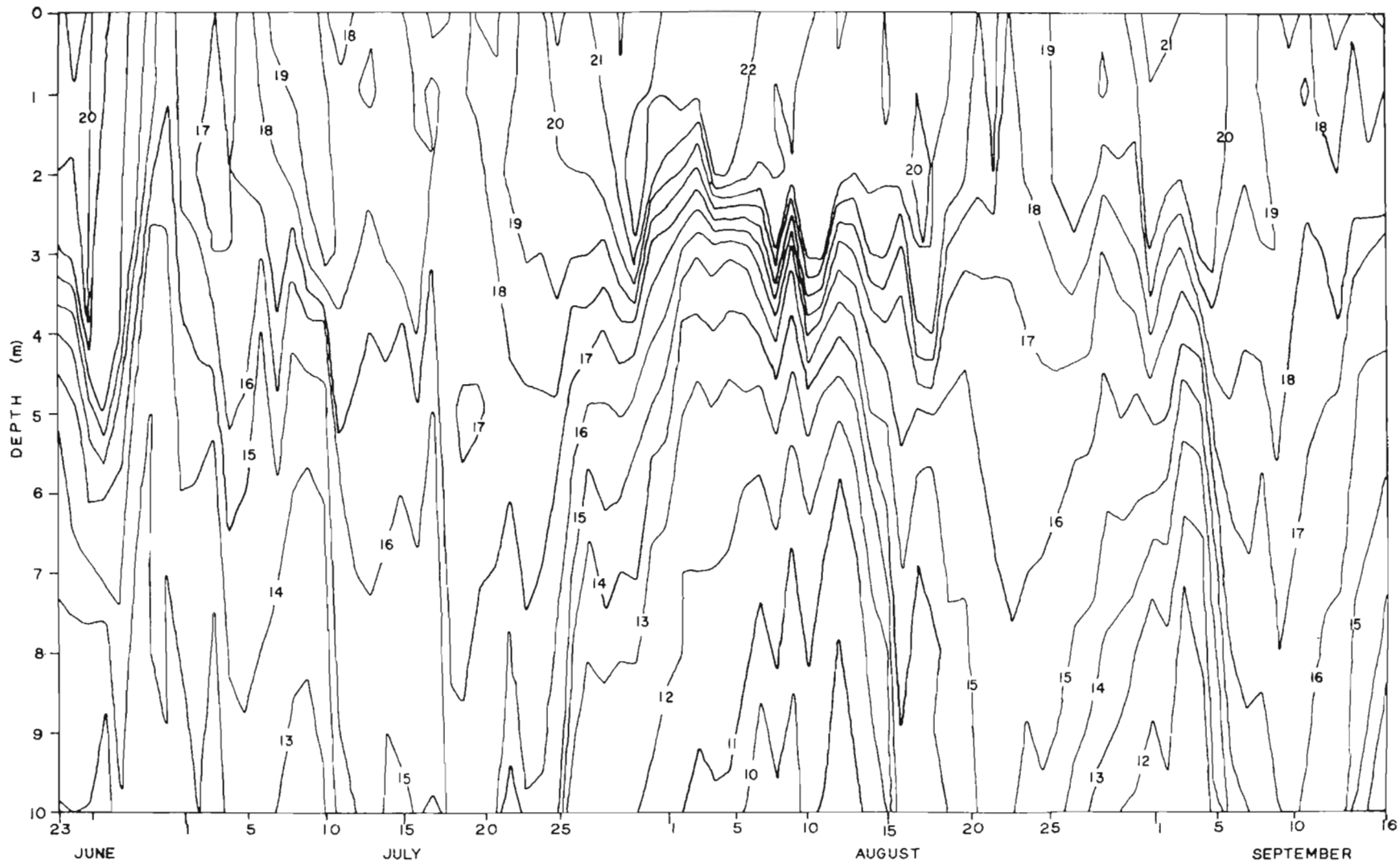


Fig. 9. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 4, Pendrell Sound, June 23-September 16, 1974.

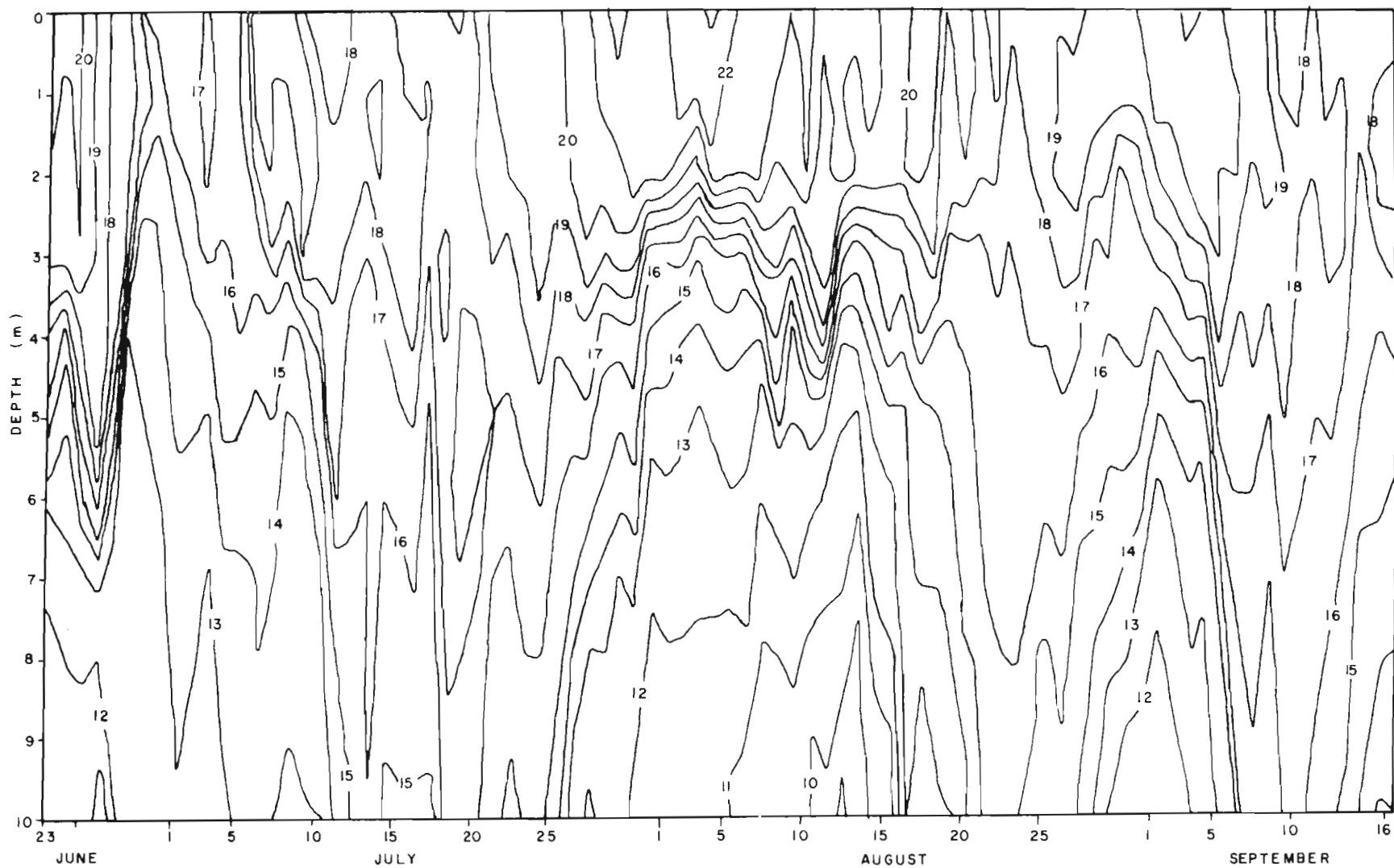


Fig. 10. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 5, Pendrell Sound, June 23-September 16, 1974.

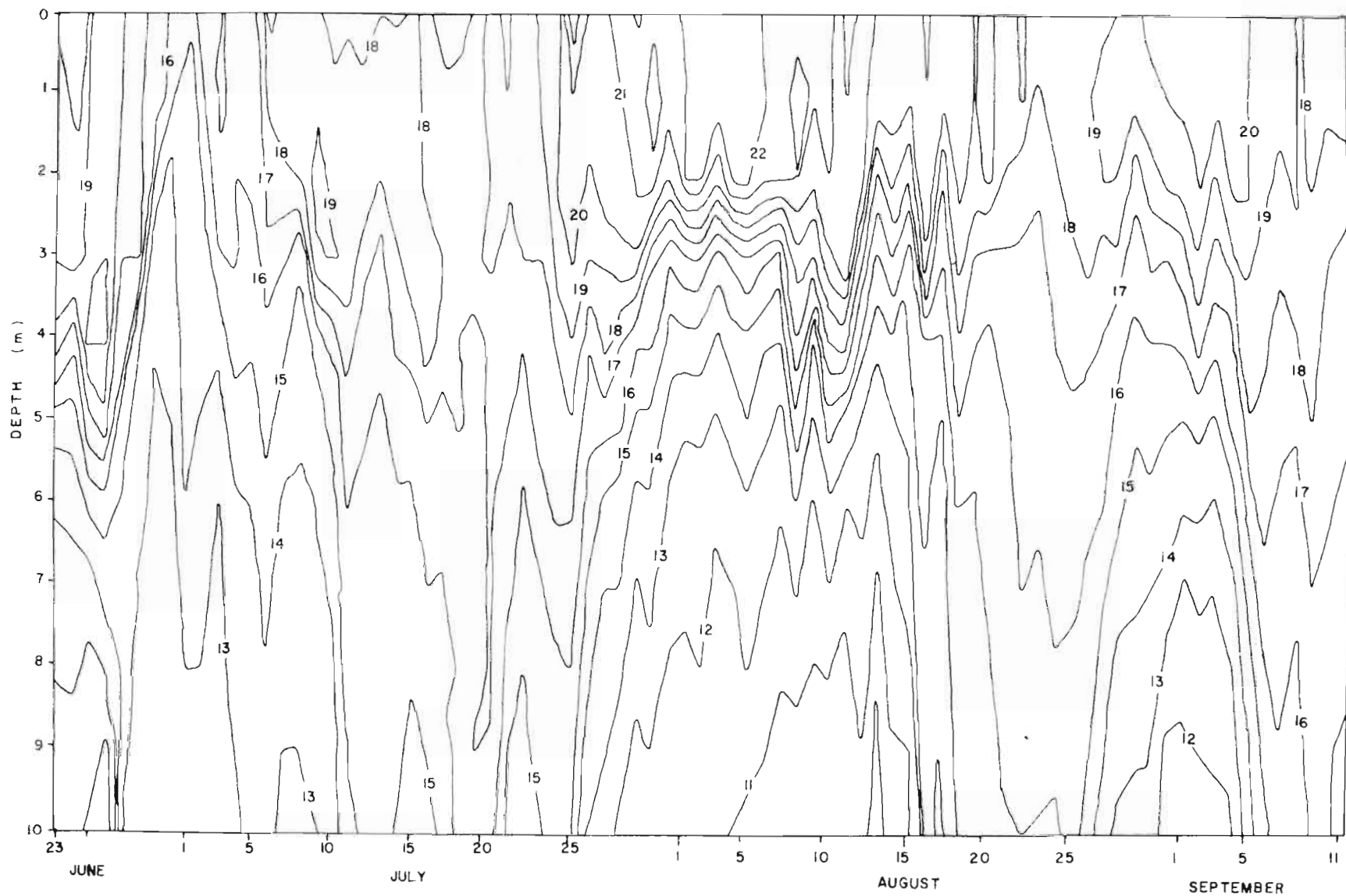


Fig. 11. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 6, Pendrell Sound, June 23-September 16, 1974.

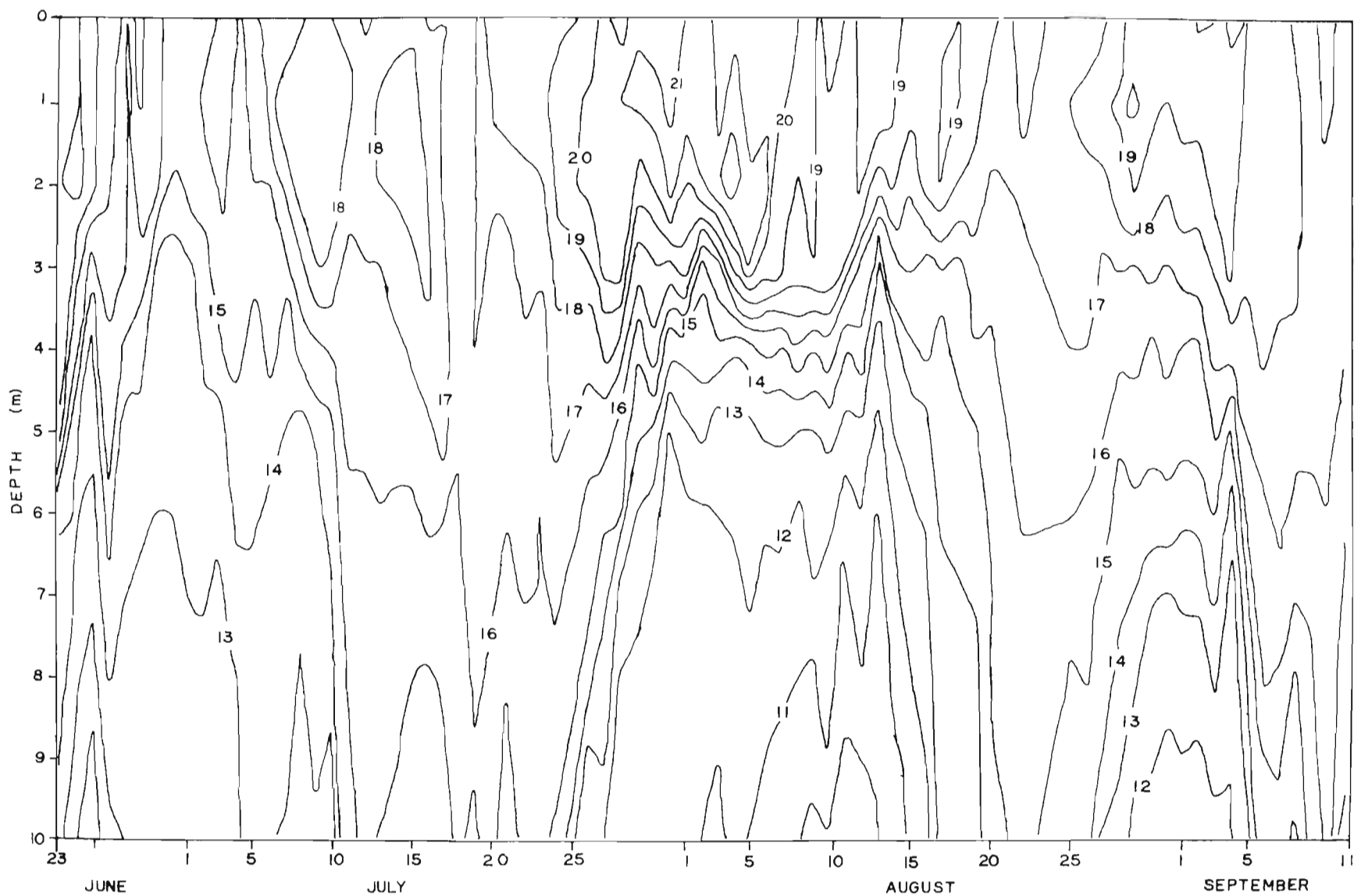


Fig. 12. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 8, Pendrell Sound, June 23-September 16, 1974.

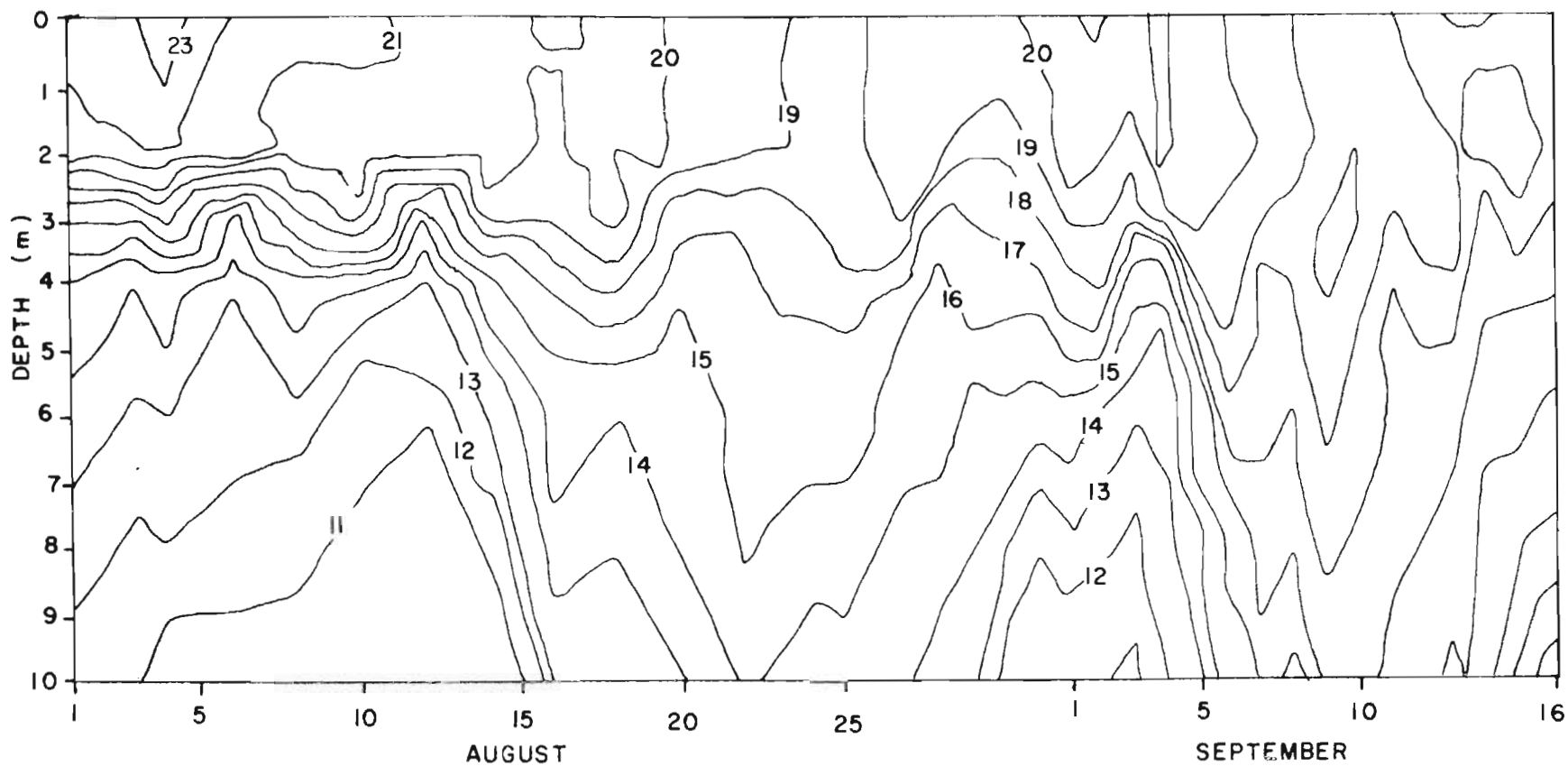


Fig. 13. Temperature contour profile ($^{\circ}\text{C}$) from the surface to a depth of 10 m at Station 10, Pendrell Sound, August 1-September 16, 1974.

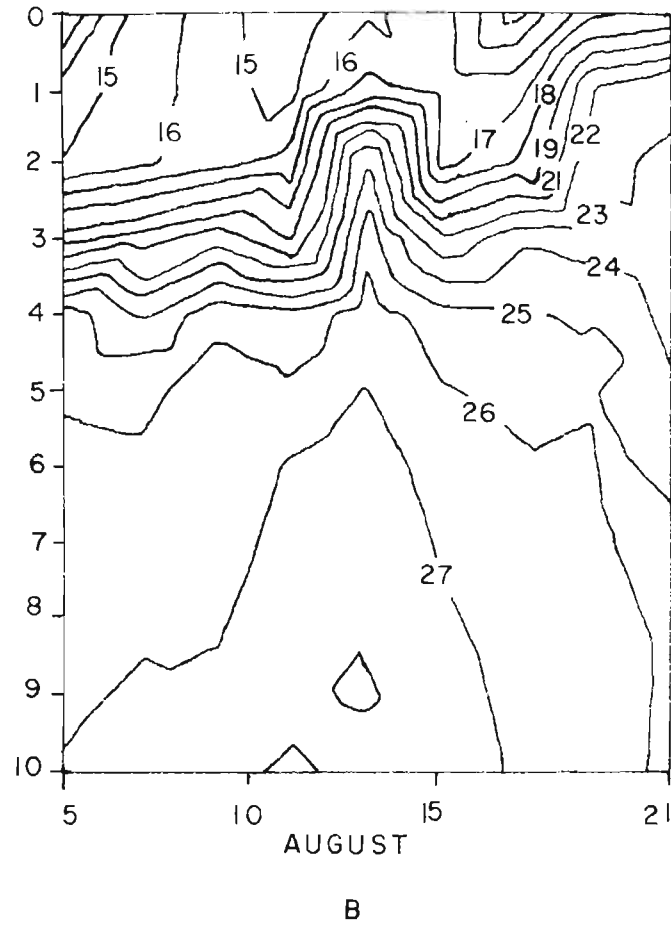
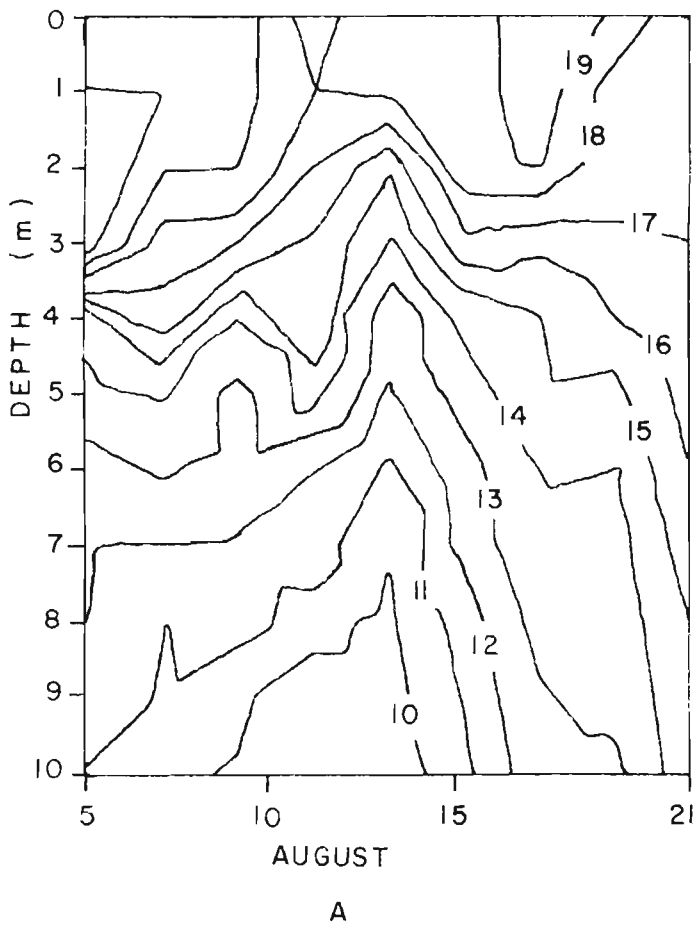


Fig. 14. Temperature ($^{\circ}\text{C}$), A, and salinity (‰), B, contour profile from the surface to a depth of 10 m at Station 36, Waddington Channel, August 5-21, 1974.

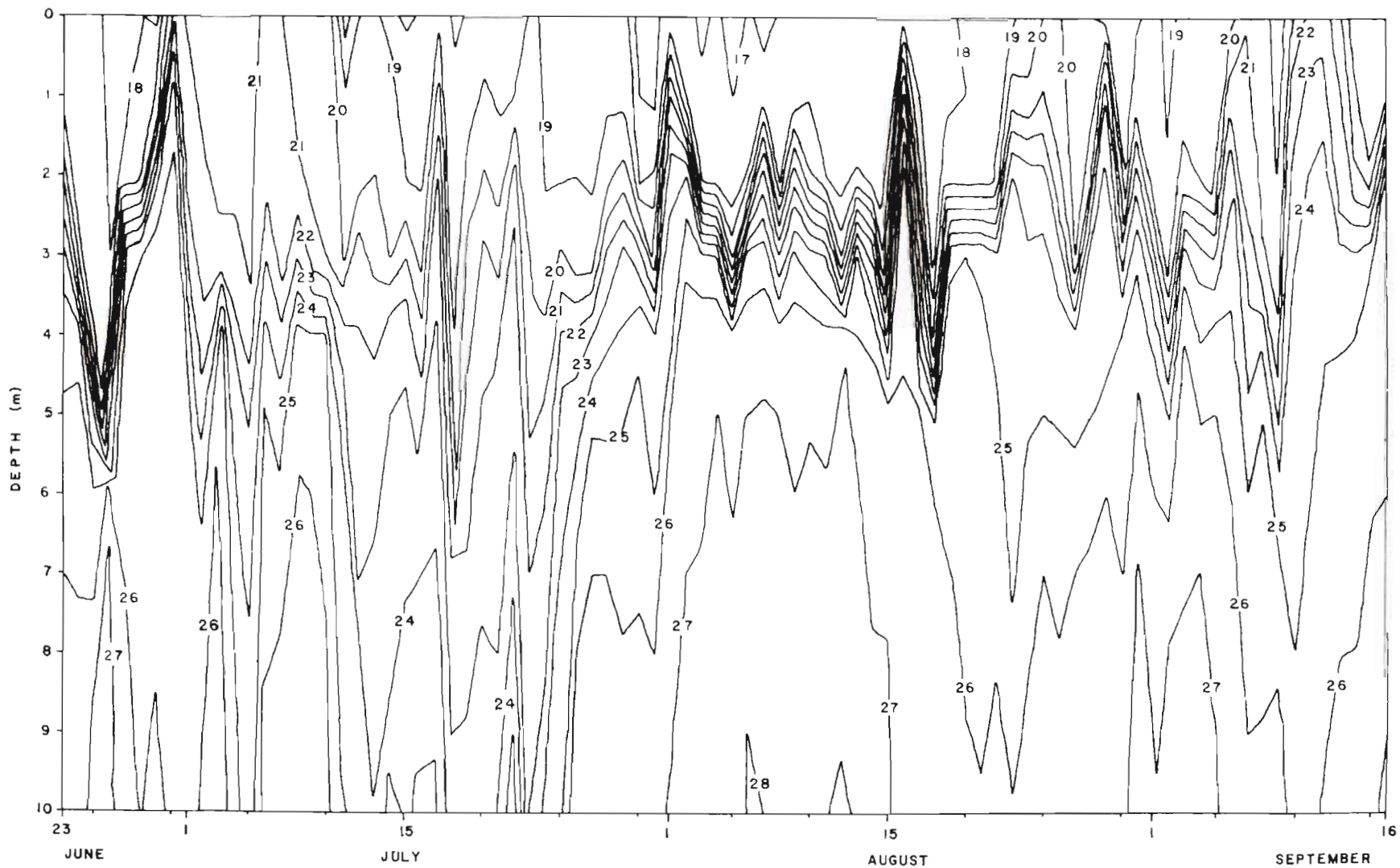


Fig. 15. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 1, Pendrell Sound, June 23-September 16, 1974.

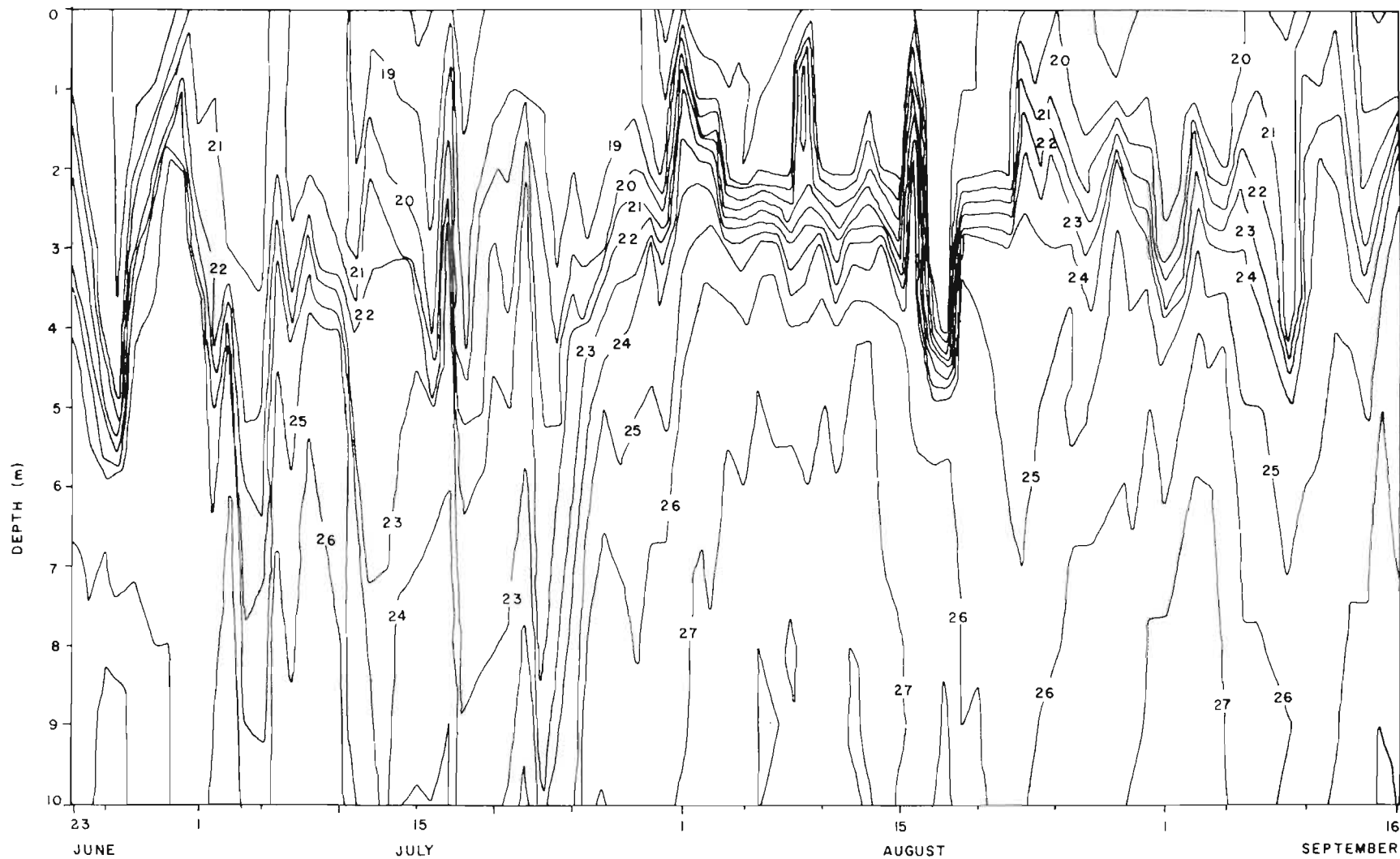


Fig. 16. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 2, Pendrell Sound, June 23-September 16, 1974.

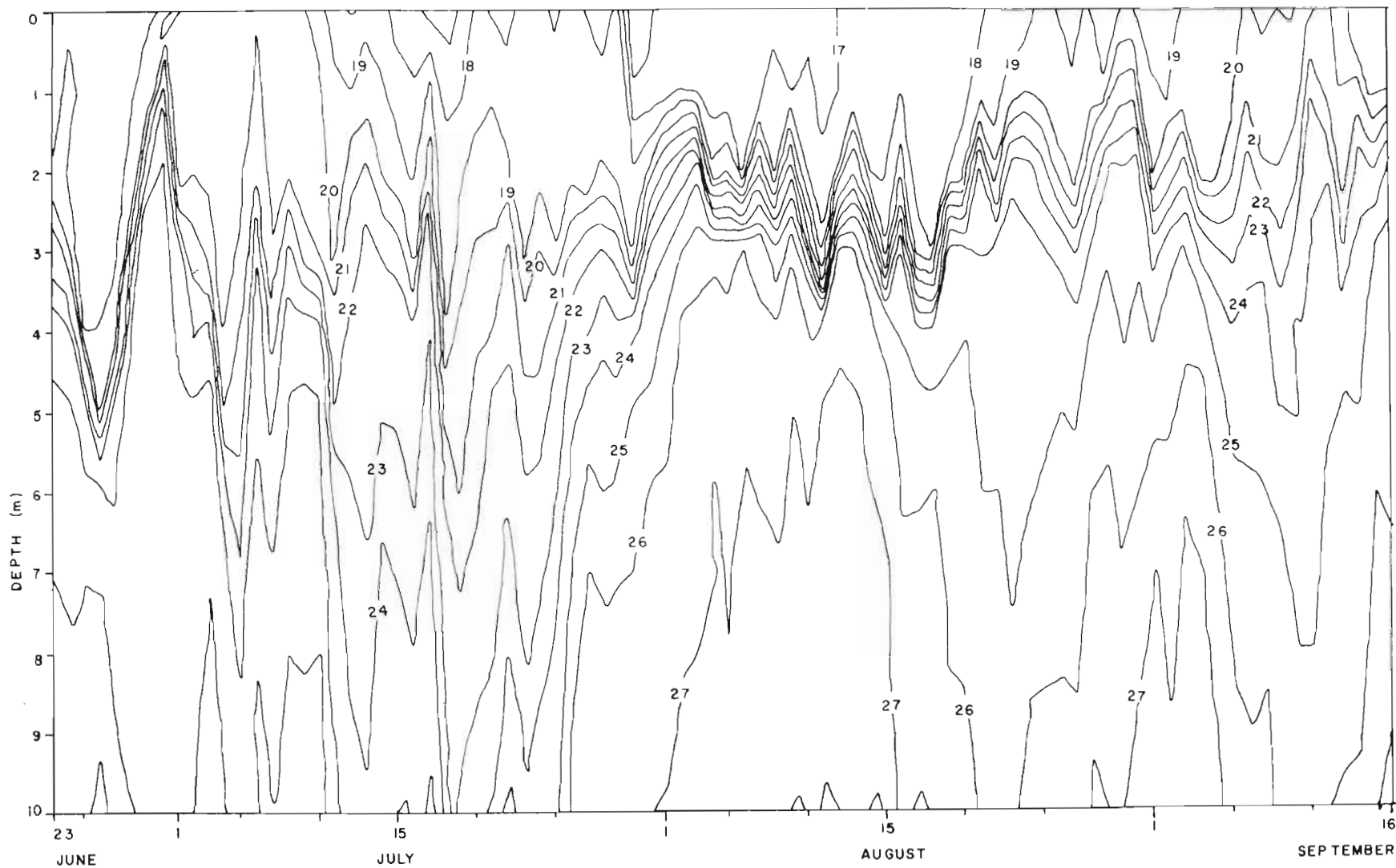


Fig. 17. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 4, Pendrell Sound, June 23-September 16, 1974.

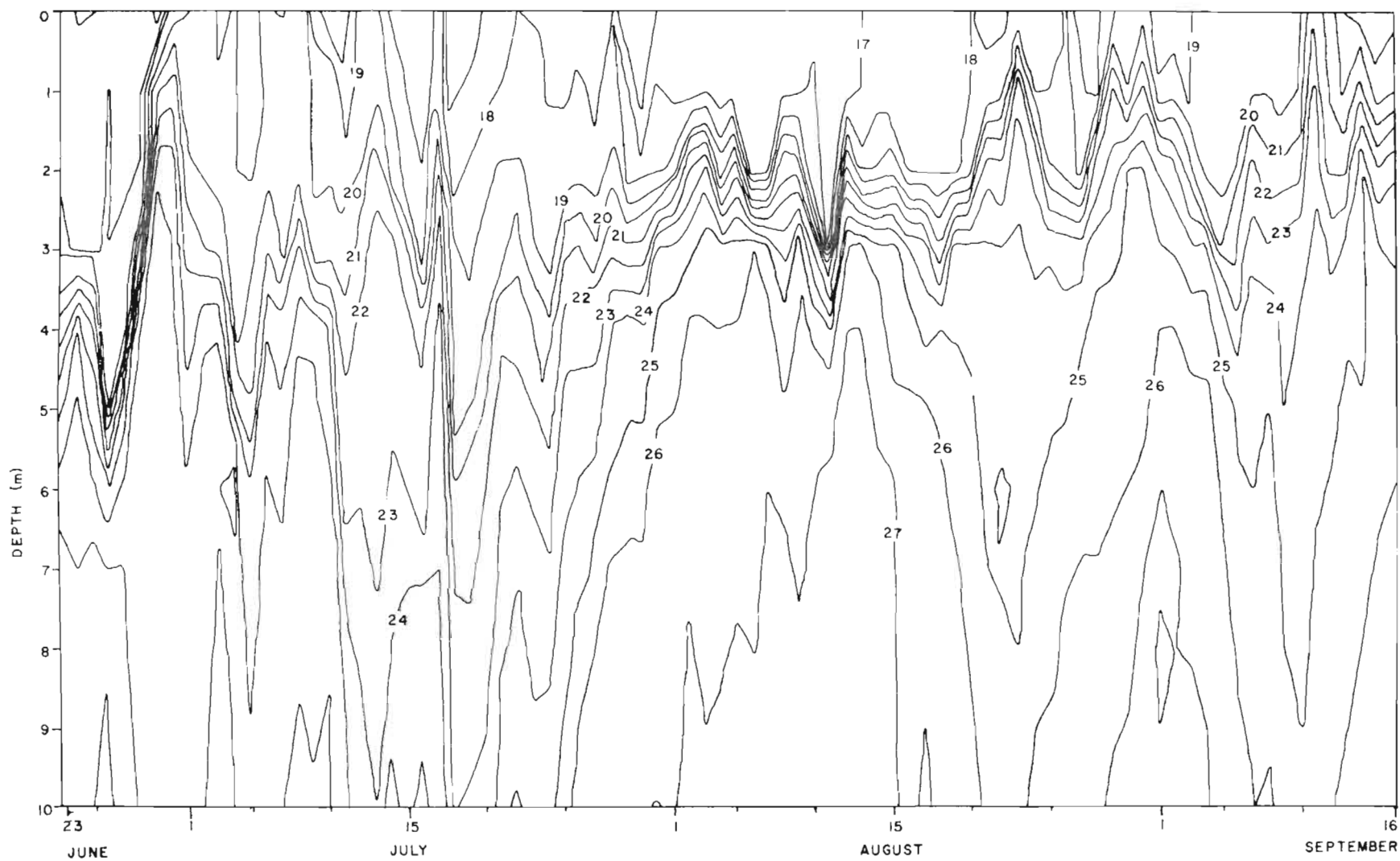


Fig. 18. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 5, Pendrell Sound, June 23-September 16, 1974.

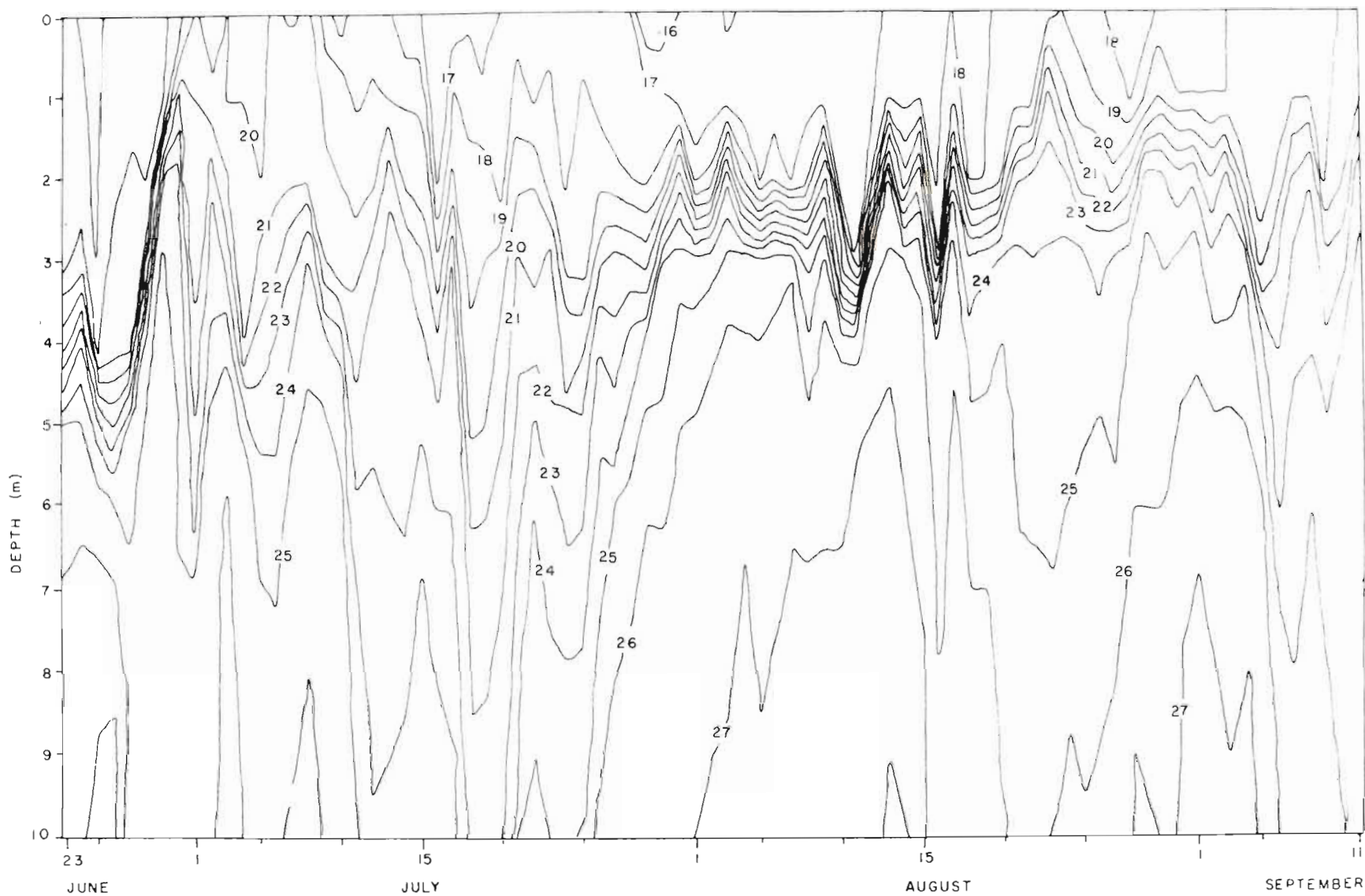


Fig. 19. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 6, Pendrell Sound, June 23-September 16, 1974.

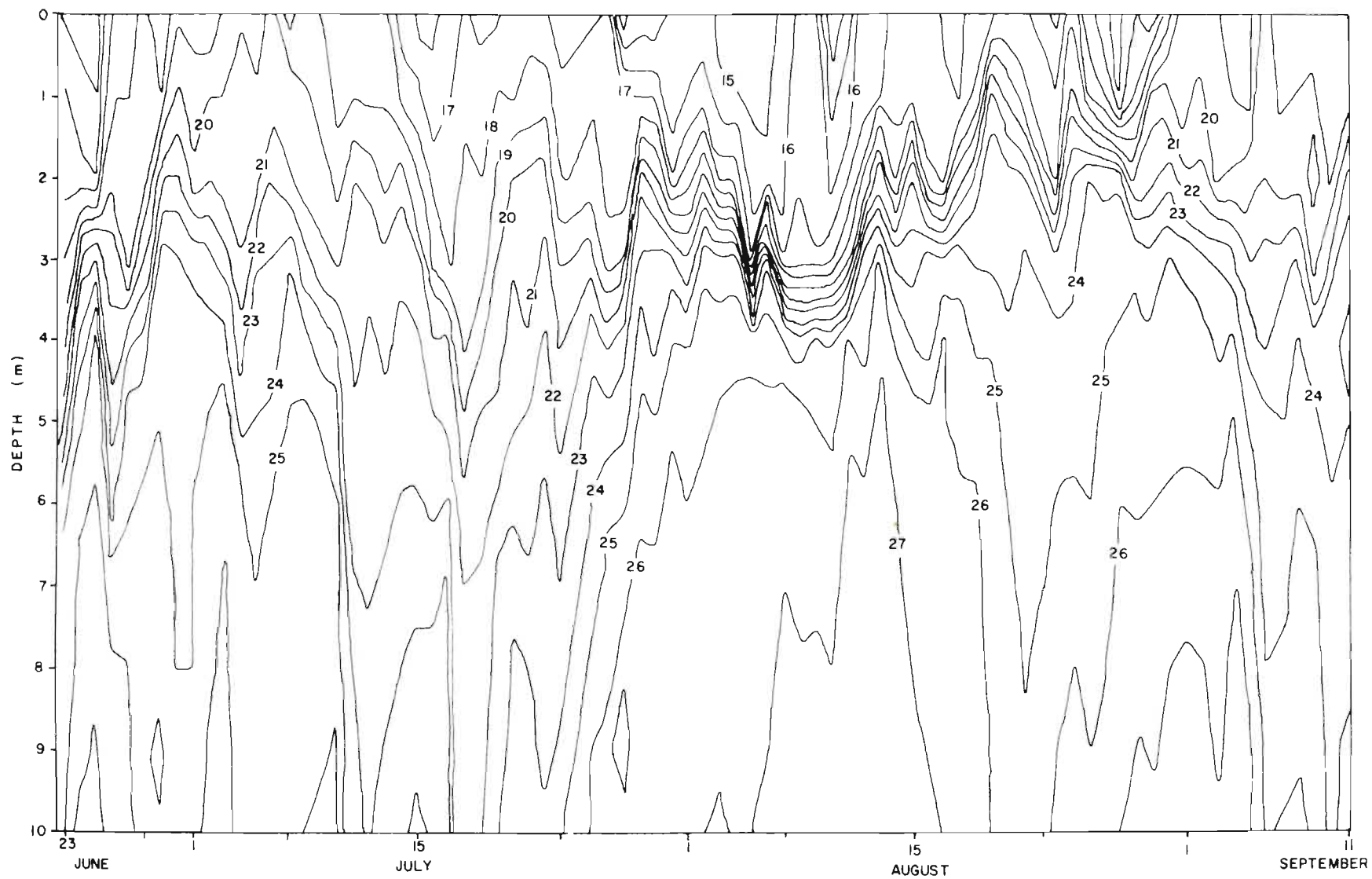


Fig. 20. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 8, Pendrell Sound, June 23-September 11, 1974.

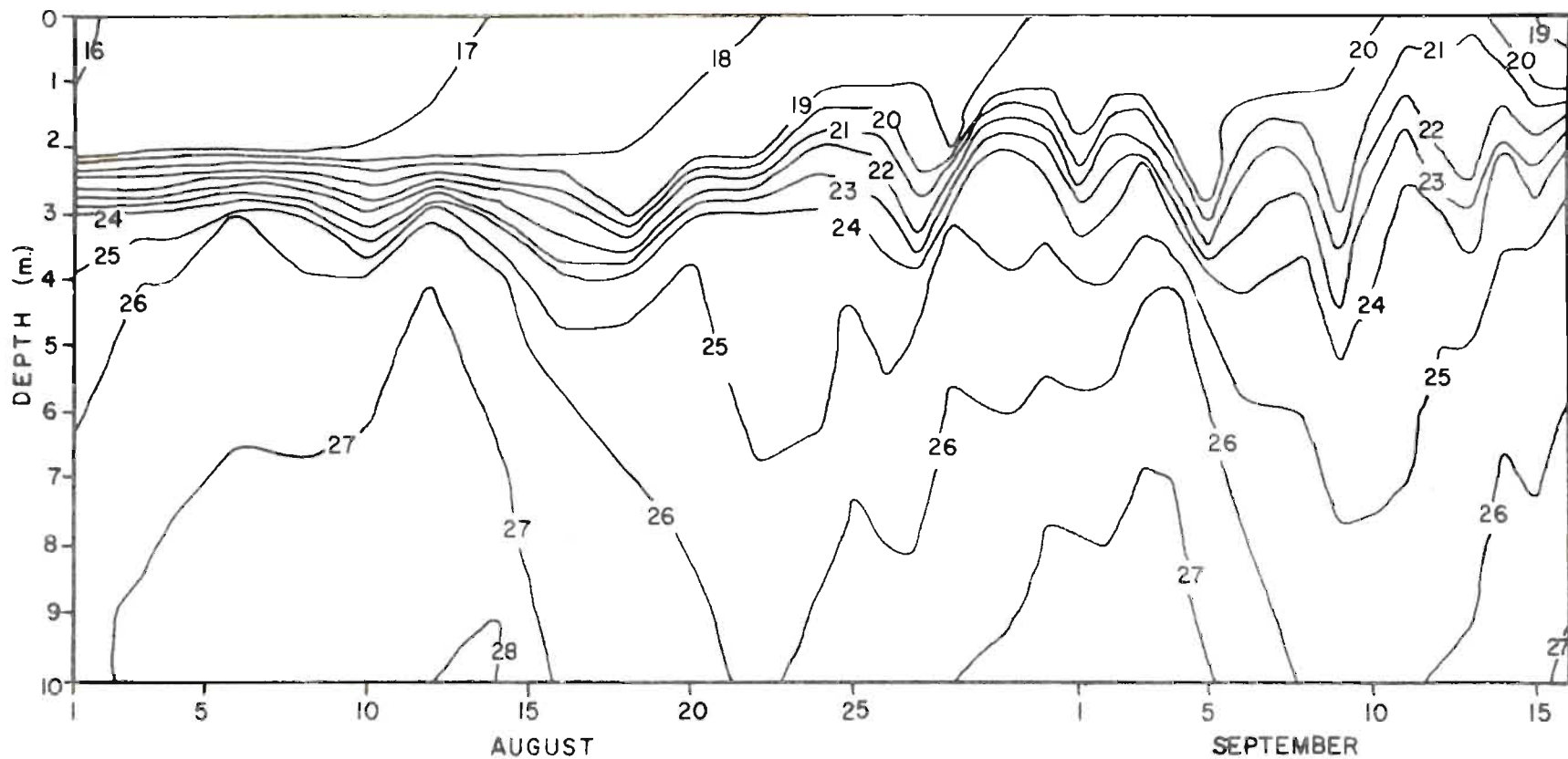


Fig. 21. Salinity contour profile (‰) from the surface to a depth of 10 m at Station 10, Pendrell Sound, August 1-September 16, 1974.

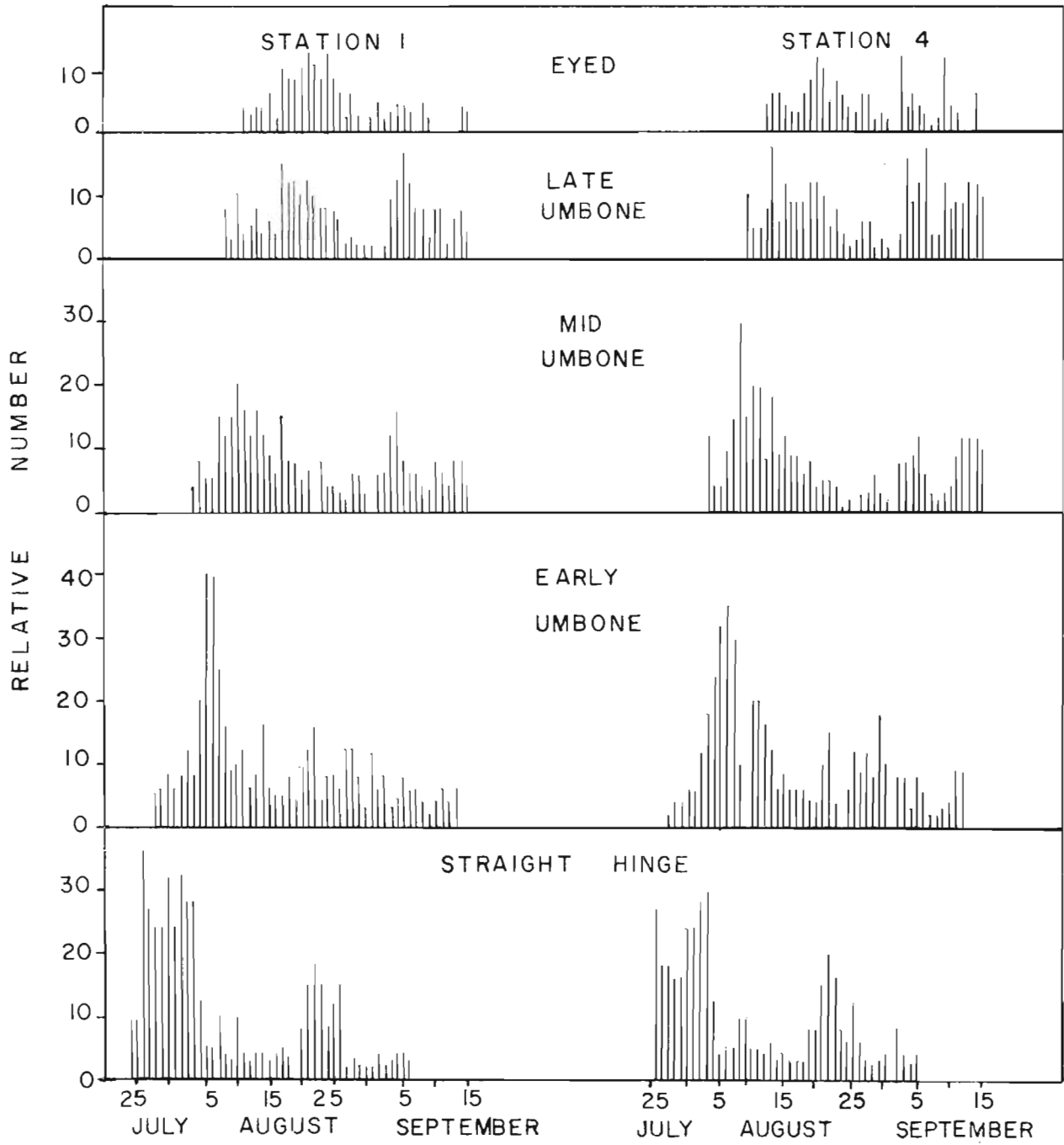


Fig. 22. Relative number of five developmental stages of Pacific oyster larvae in 5-min surface plankton tows at Stations 1 and 4, Pendrell Sound, 1974.

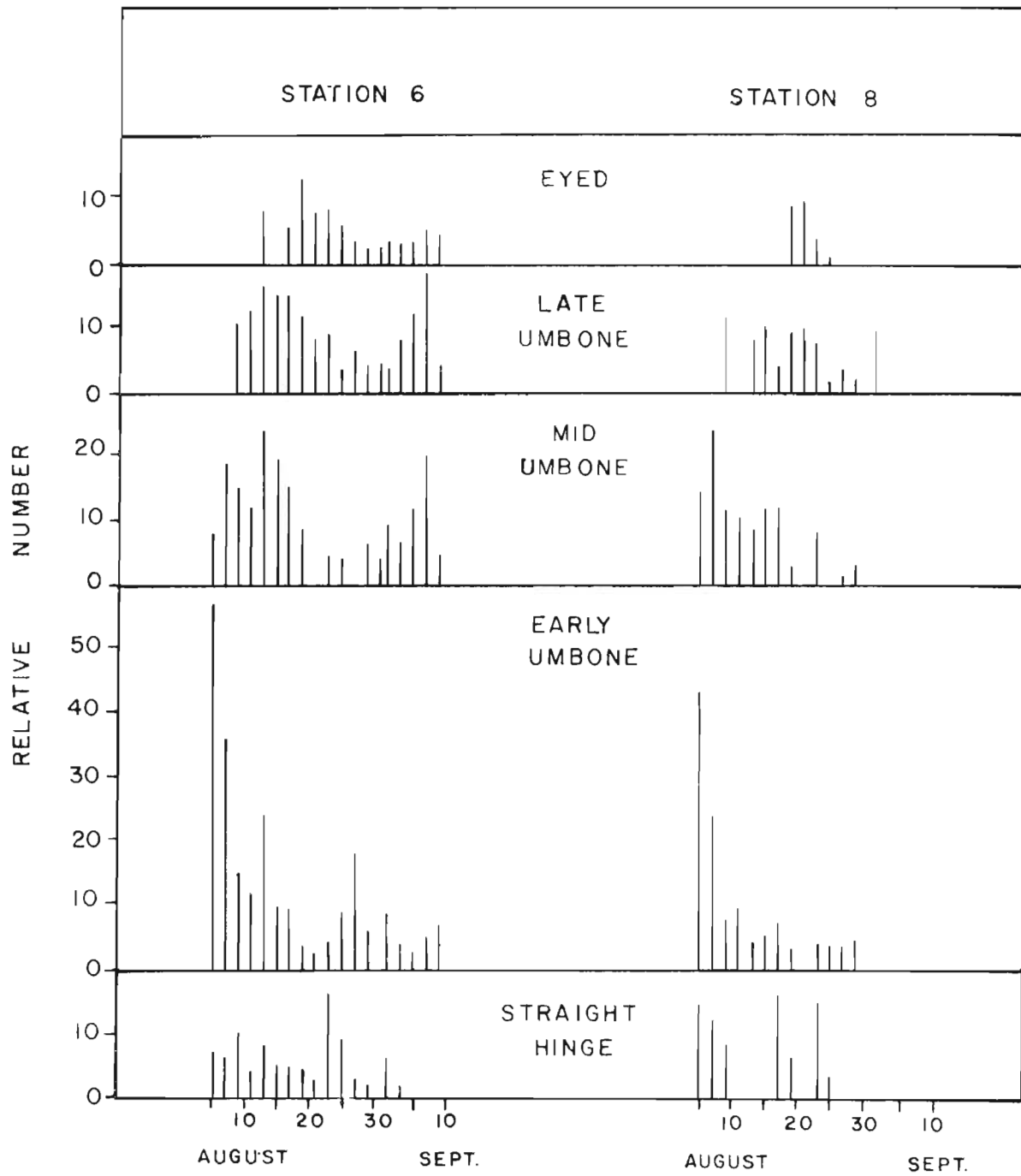


Fig. 23. Relative number of five developmental stages of Pacific oyster larvae in 5-min surface plankton tows at Stations 6 and 8, Pendrell Sound, 1974.

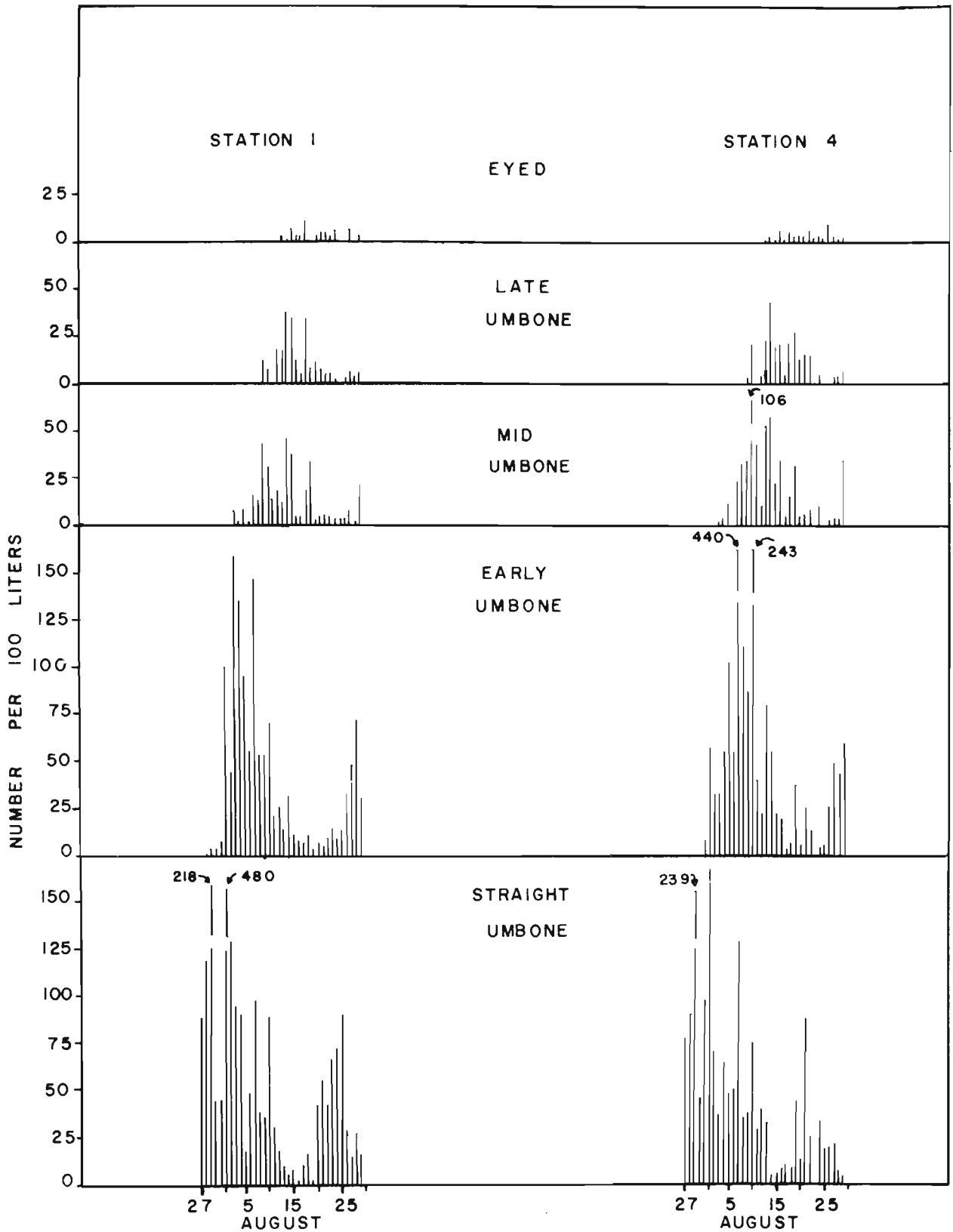


Fig. 24. Number of five developmental stages of Pacific oyster larvae in 100 l pump samples at Stations 1 and 4, Pendrell Sound, 1974.

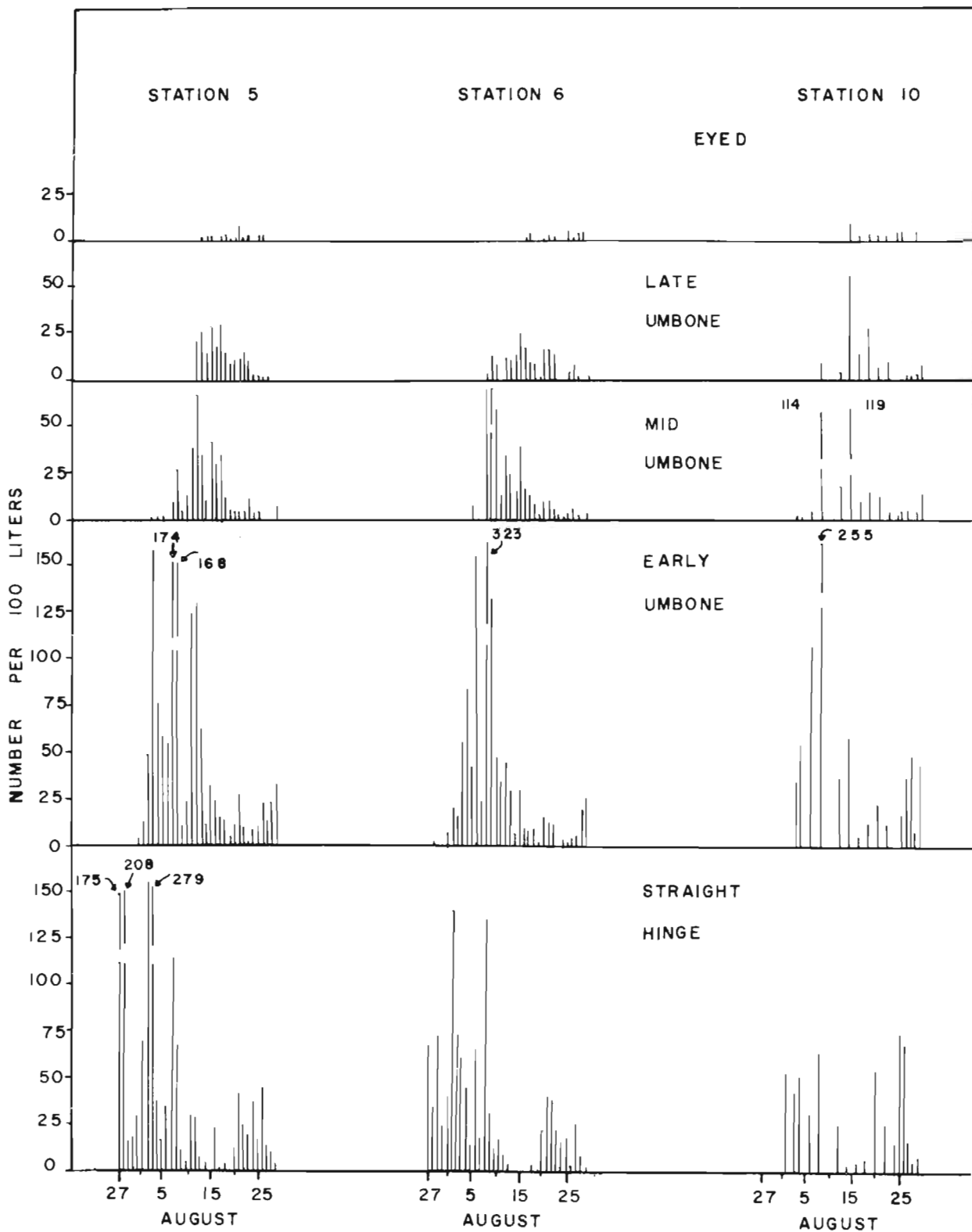


Fig. 25. Number of five developmental stages of Pacific oyster larvae in 100 l pump samples at Stations 5, 6, and 10, Pendrell Sound, 1974.

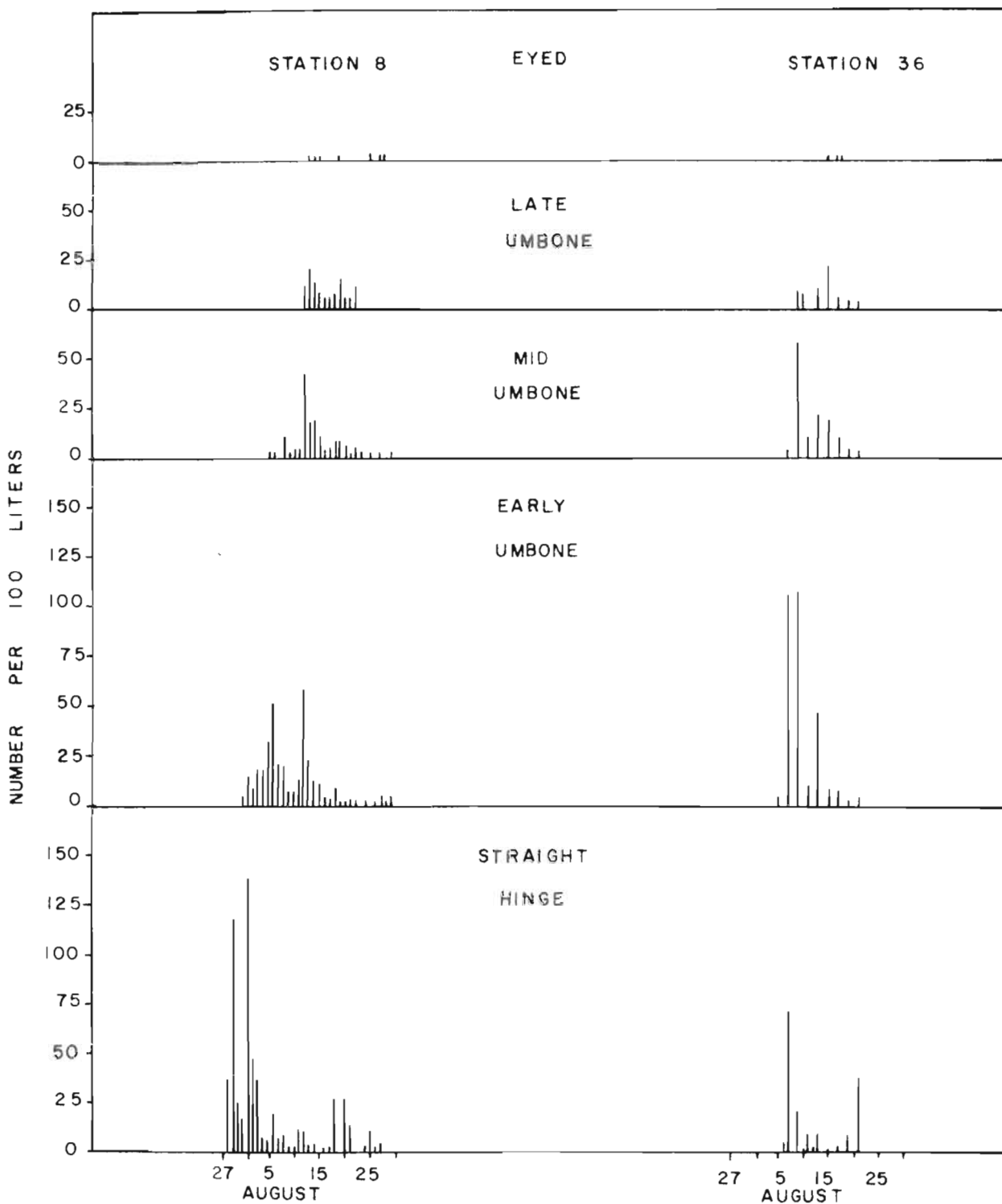


Fig. 26. Number of five developmental stages of Pacific oyster larvae in 100 l pump samples at Stations 8 and 36, Pendrell Sound, 1974.

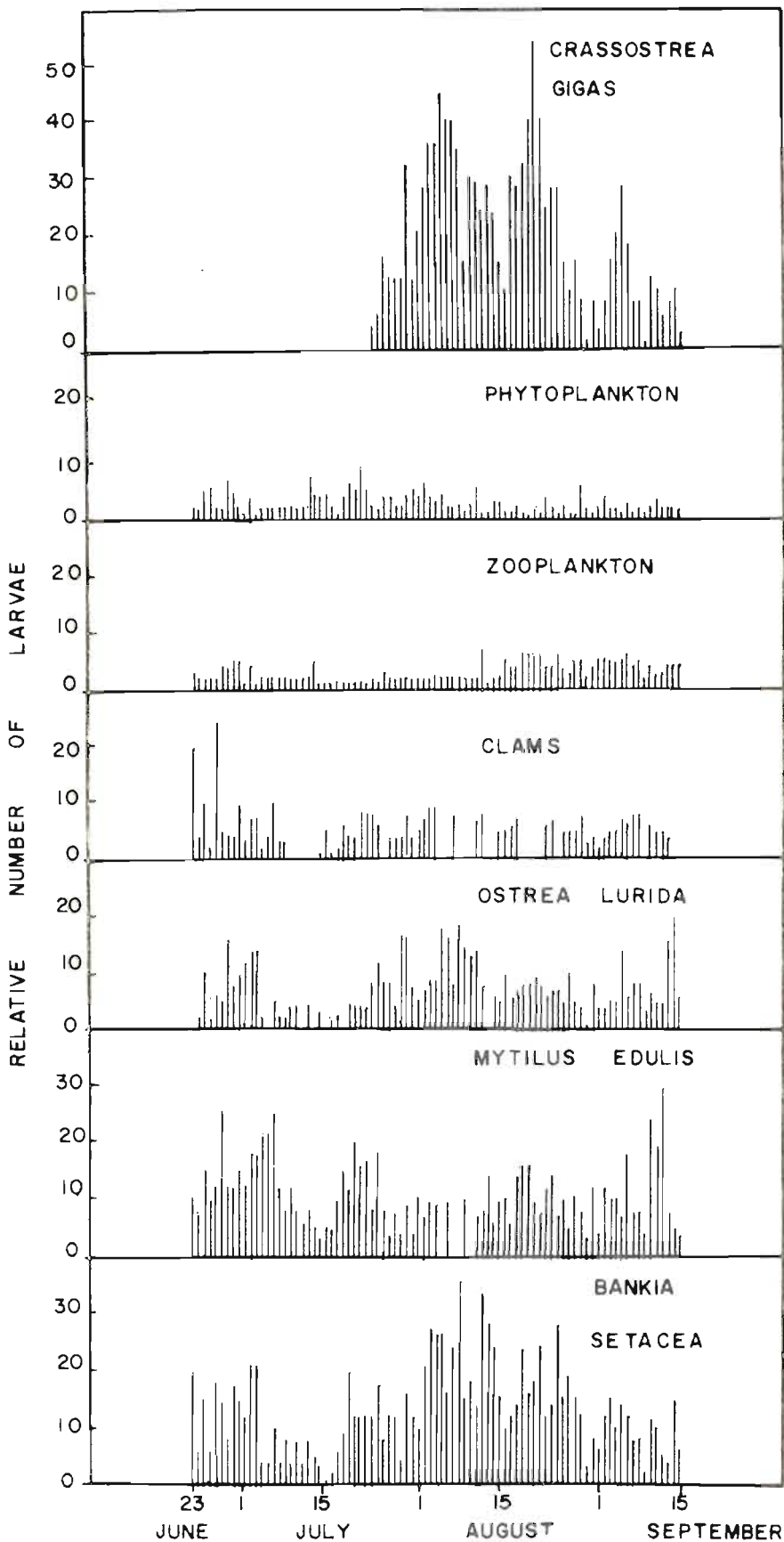


Fig. 27. Relative number of phytoplankton, zooplankton, and larvae of Pacific oysters, clams, Ostrea lurida, Mytilus edulis, and Bankia setacea in 5-min surface plankton tows at Station 1, Pendrell Sound, 1974.

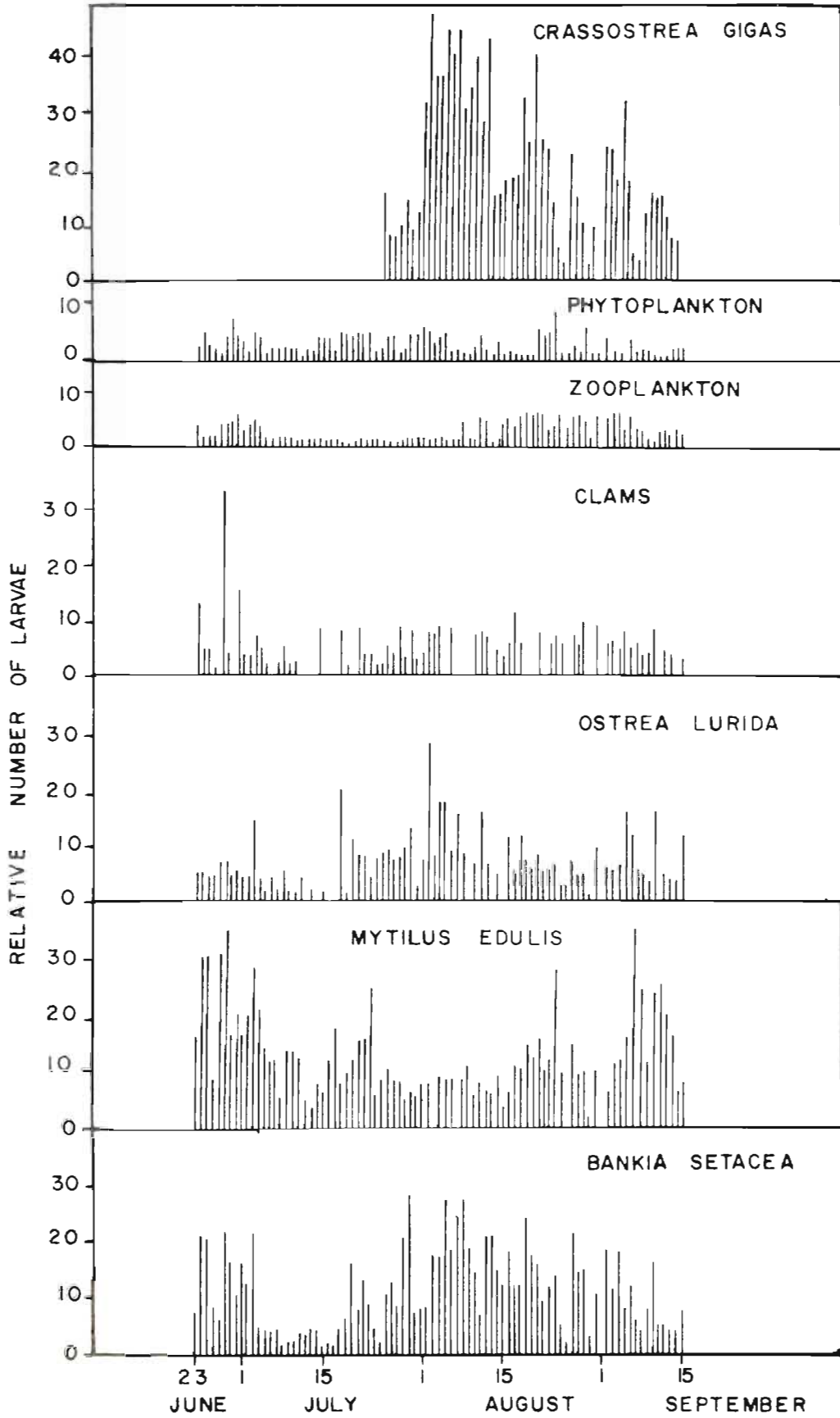


Fig. 28. Relative number of phytoplankton, zooplankton, and larvae of Pacific oysters, clams, *Ostrea lurida*, *Mytilus edulis*, and *Bankia setacea* in 5-min surface plankton tows at Station 4, Pendrell Sound, 1974.

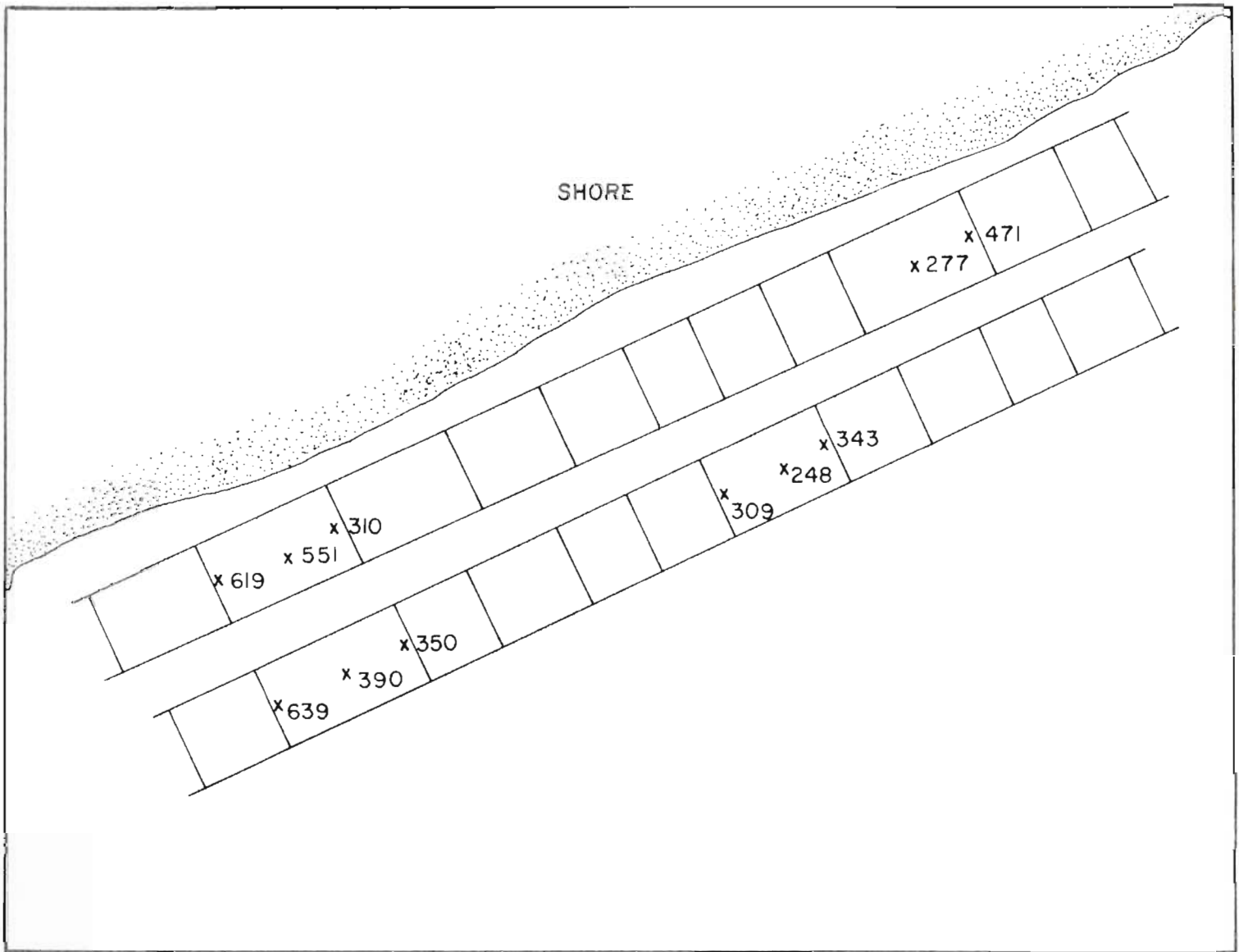


Fig. 29. Configuration of commercial rafts and location of experimental asbestos plates at Station 5, Pendrell Sound, 1974.

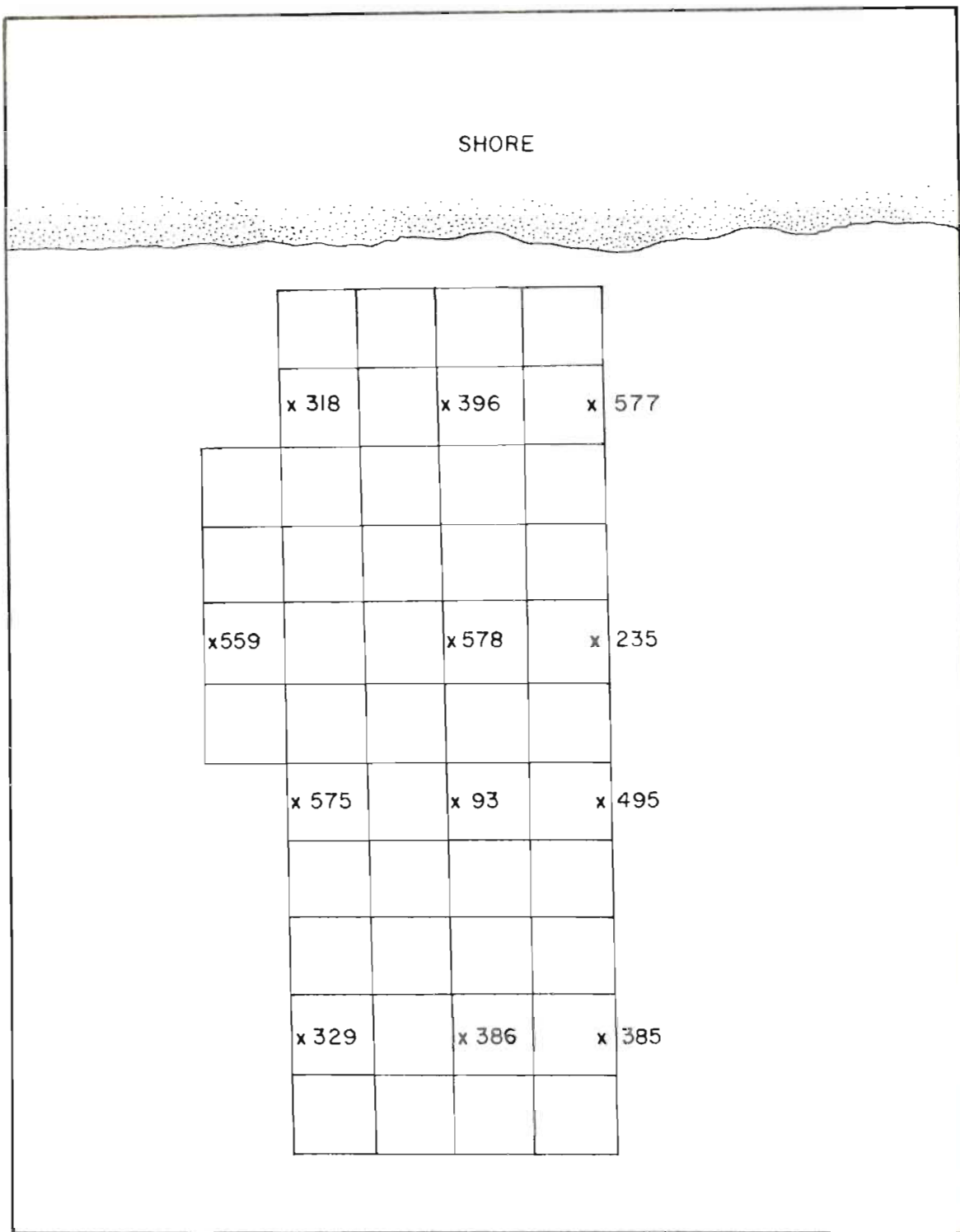


Fig. 30. Configuration of commercial rafts and location of experimental asbestos plates at Station 1, Pendrell Sound, 1974.

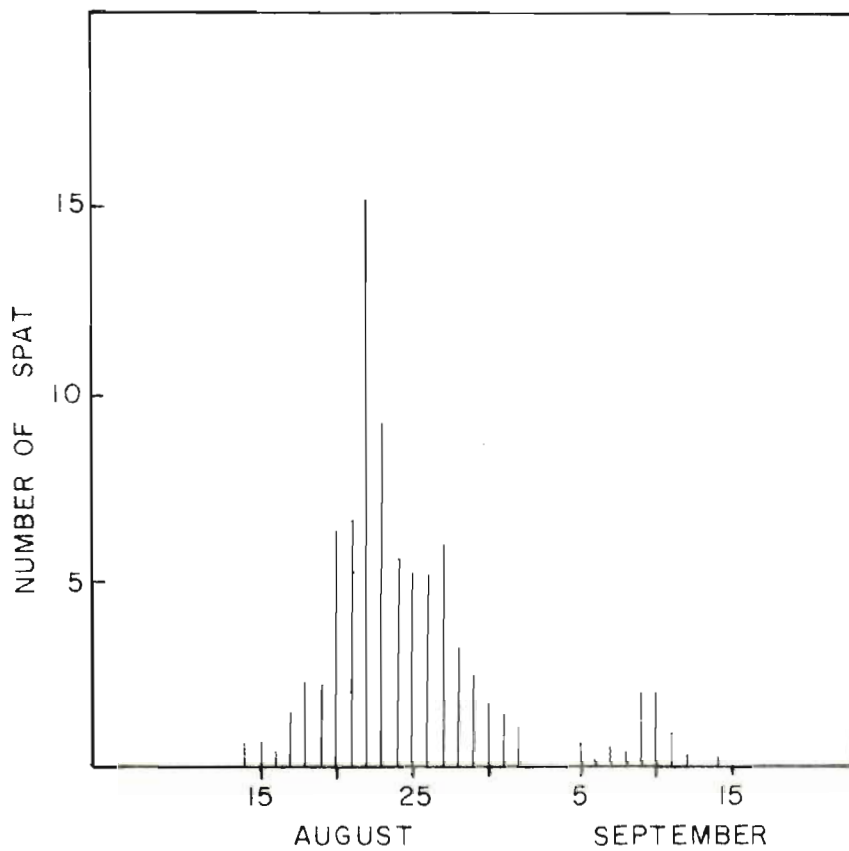


Fig. 31. Mean daily spatfall as recorded on asbestos plates at the VELELLA, Station 5, Pendrell Sound, 1974.

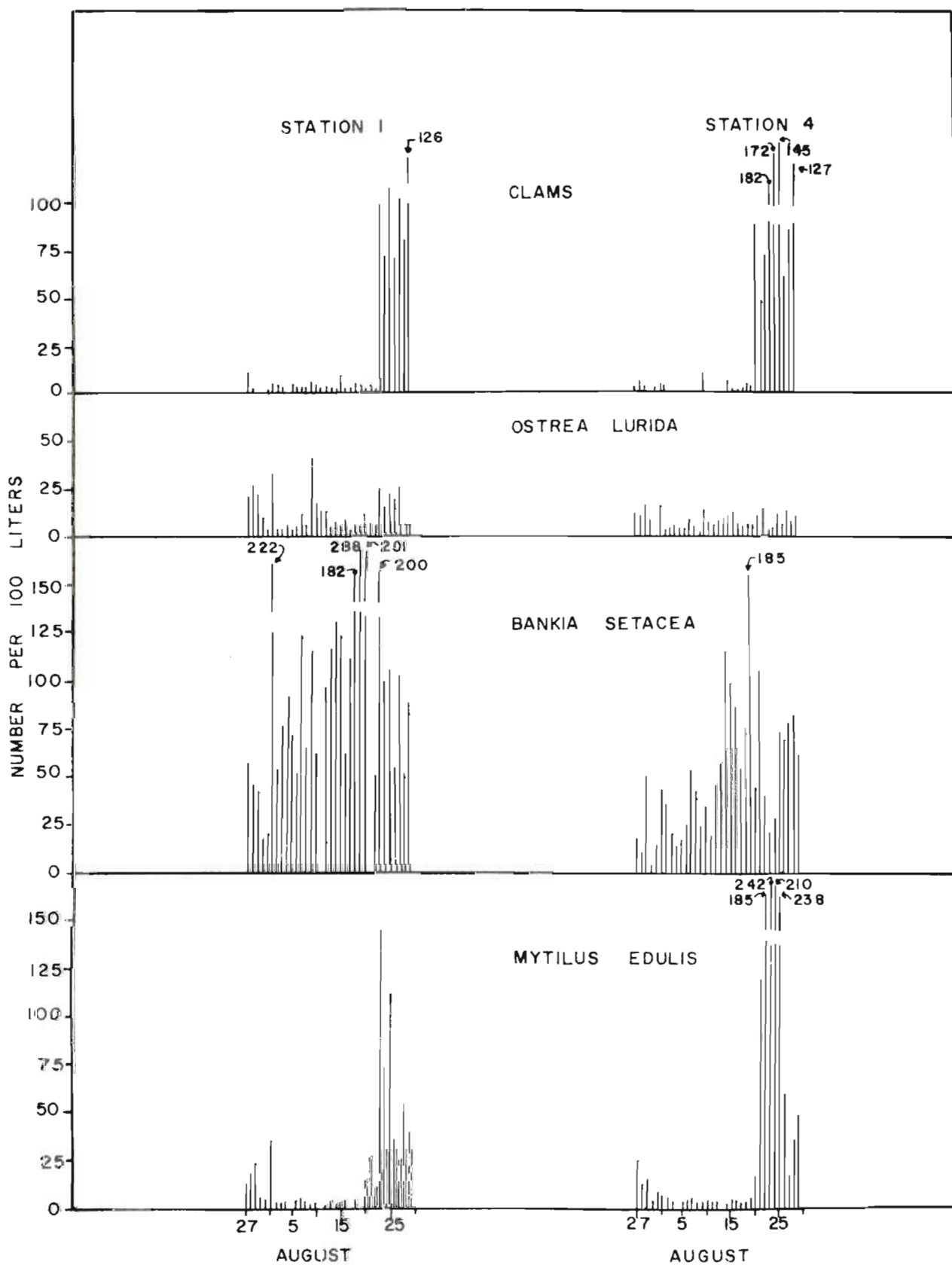


Fig. 32. Number of larvae of clams, *Ostrea lurida*, *Bankia setacea* and *Mytilus edulis* in 100 l pump samples at Stations 1 and 4, Pendrell Sound, 1974.

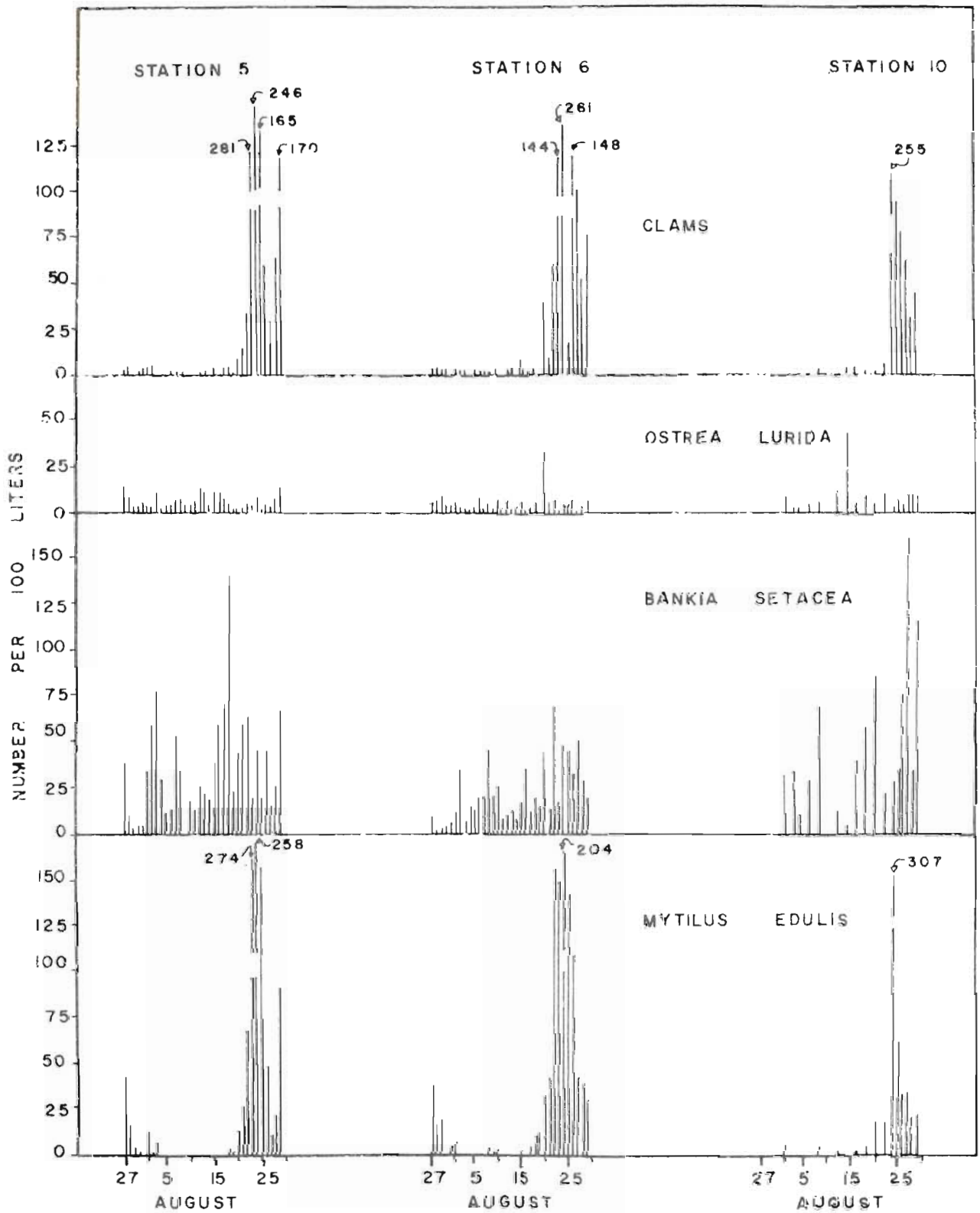


Fig. 33. Number of larvae of clams, *Ostrea lurida*, *Bankia setacea*, and *Mytilus edulis* in 100 l pump samples at Stations 5, 6, and 10, Pendrell Sound, 1974.

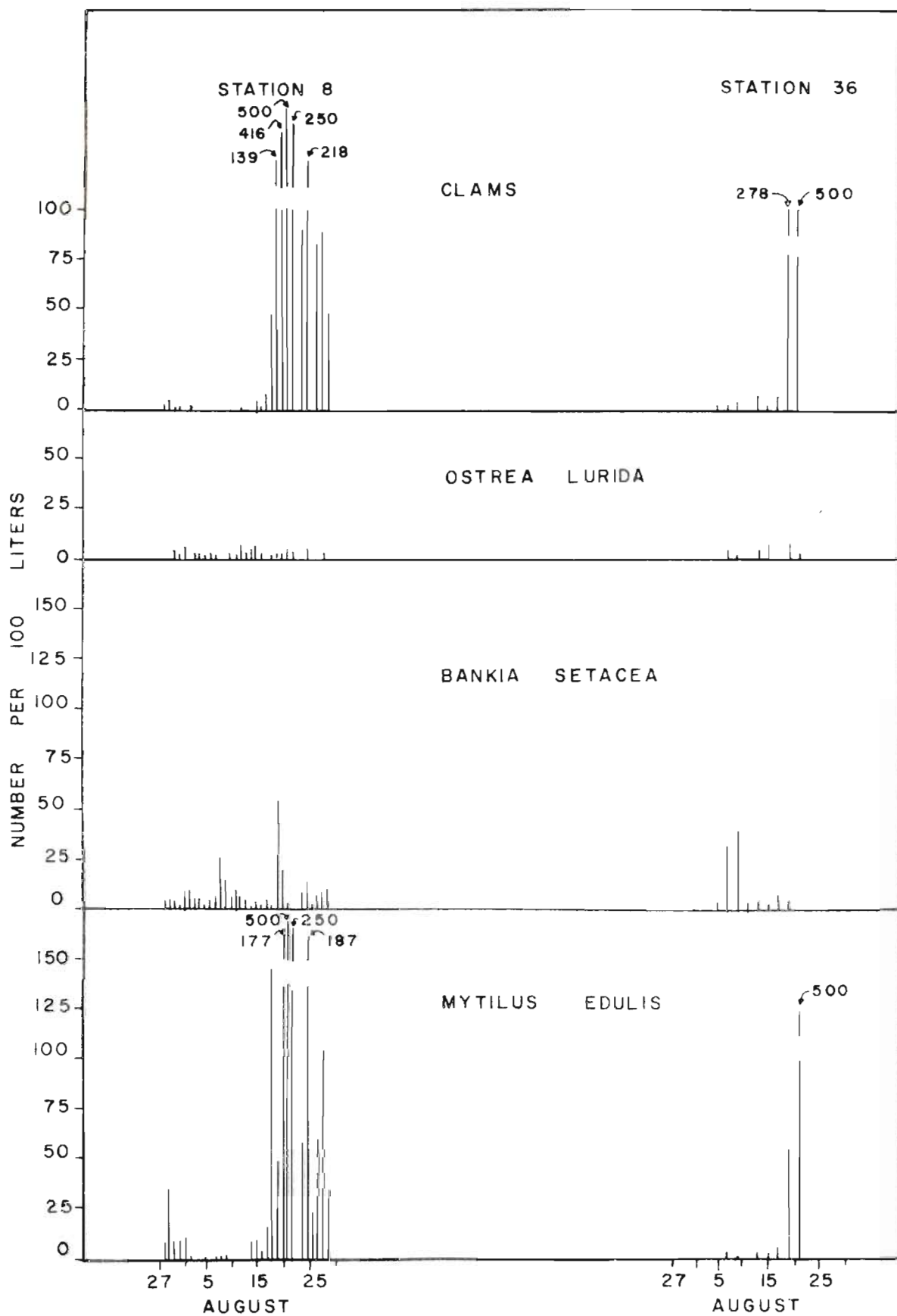
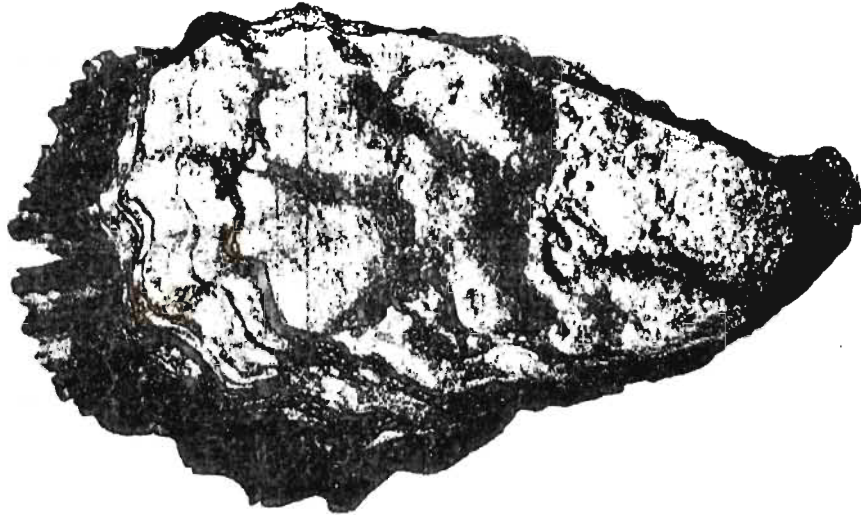


Fig. 34. Number of larvae of clams, *Ostrea lurida*, *Bankia setacea*, and *Mytilus edulis* in 100 l pump samples at Stations 8 and 36, Pendrell Sound, 1974

APPENDIX I



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

June 4, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 1

INTRODUCTION

This is the first issue of the 1974 British Columbia Pacific Oyster Breeding Newsletter which is intended to inform the British Columbia oyster industry of Pacific oyster breeding in the province and assist them in spat collecting operations. The oyster breeding program is again under the direction of Dr. Neil Bourne and Mr. G. Dwight Heritage. Although he has retired, Dr. Quayle plans to spend some time with us this summer.

This year personnel from two other establishments will be undertaking projects in Pendrell Sound; Dr. John G. Stockner is in charge of a project at the Pacific Environment Institute in West Vancouver and Dr. David M. Farmer is in charge of a project being undertaken by the Marine Sciences Directorate at Pat Bay.

As in previous years most of the Pacific oyster spatfall prediction program will be confined to Pendrell Sound, although sampling will be done in other locations including Hotham Sound and Ladysmith Harbour. Oyster breeding information from the State of Washington will also be included in Newsletters from time to time.

PROGRAMS

Ten sampling sites have been established in Pendrell Sound for 1974 although most of the sampling will be done at Stations 1, 2, 4, 5 and 6 (Fig. 1). Floats will be anchored at Stations 1, 2 and 4. Three sampling sites have been established in Hotham Sound and a float will be anchored at Station 1 (Fig. 2).

The following is a brief outline of the programs that will be undertaken this year.

Pacific Environment Institute: Dr. Stockner is interested in measuring primary productivity in Pendrell and Hotham Sounds and comparing production in the two areas. He has already made two sets of measurements in both areas and plans further sampling just prior to spawning, when larvae are in the water, and after settlement.

Marine Sciences Directorate: Dr. Farmer is a physical oceanographer and plans studies which hopefully will enable us to predict the movement of oyster larvae in Pendrell Sound with greater accuracy. He plans to undertake four projects:

- (1) heat and salt budget of Pendrell Sound;
- (2) current studies at two locations;
- (3) study of surface water movement by radar tracking of drift drogues;
- (4) temperature profile time-series using recording thermistor chains.

They have placed two buoys in Pendrell Sound, one at the mouth at Station 8 and one near the islands at Station 2, and plan to place two other buoys on either side of the Sound at Station 6.

Pacific Biological Station: Most of our studies will be confined to Pendrell Sound but we will monitor Hotham Sound and Ladysmith Harbour. Our major projects are:

- (1) to continue to provide spatfall prediction service;
- (2) to assess levels of nutrients in Pendrell and Hotham Sounds;
- (3) to determine abundance of food organisms utilized by oyster larvae;
- (4) to study distribution of oyster larvae in surface layer and correlate it with oceanographic data;
- (5) to study causes of oyster larvae mortalities;
- (6) to measure effects of artificial light and currents on spatfall.

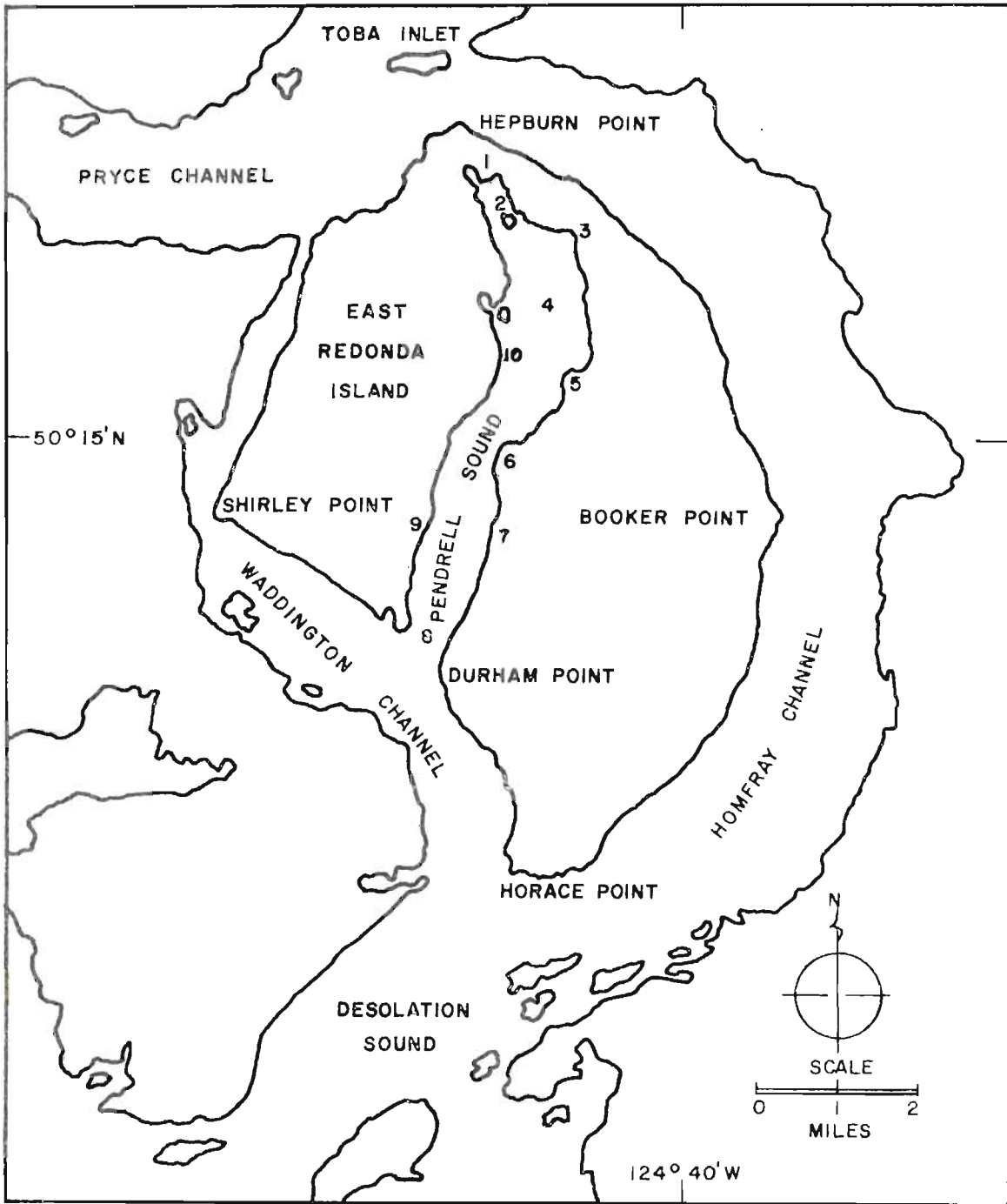


FIG. 1 MAP OF PENDRELL SOUND SHOWING LOCATION OF SAMPLING STATIONS

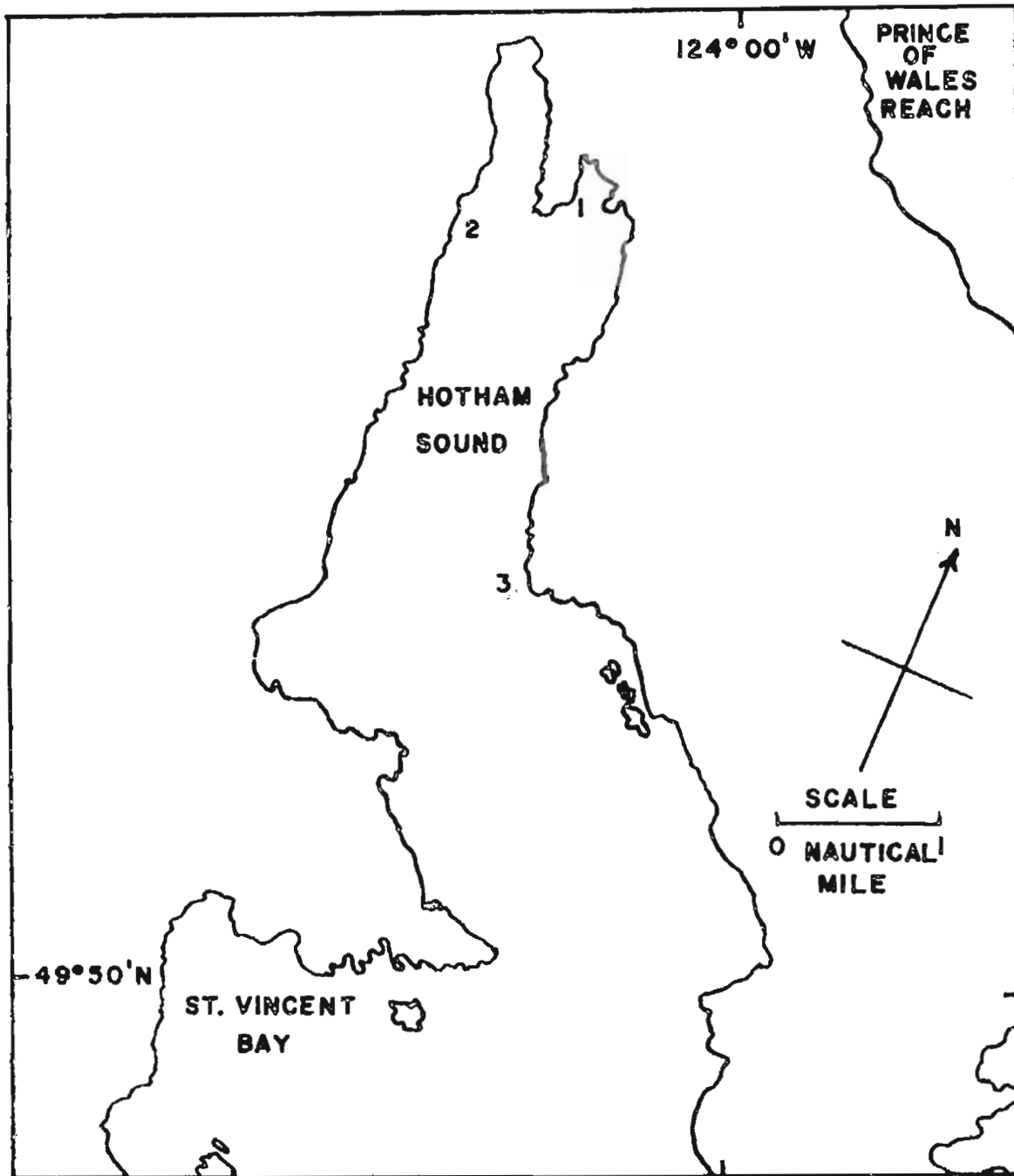


FIG.2 MAP OF HOTHAM SOUND SHOWING LOCATION OF SAMPLING STATIONS

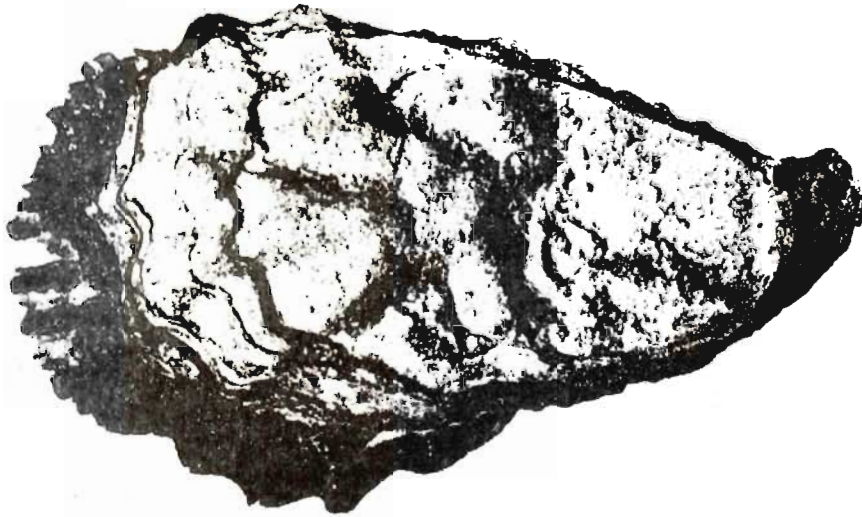
FACILITIES

To enable us to undertake these programs we will have the use of the Pacific Biological Station barge the VELELLA. We plan to tow it to Pendrell Sound sometime during the period June 21-28 and will anchor it off Station 5. The reason for anchoring the barge in this location is to facilitate one of the projects Dr. Farmer plans, a study of surface water movement by radar tracking of drift drogues. To carry out this study we must place the barge in a location to obtain maximum radar sweep of the Sound.

The coffee pot will always be on and if any of you are in Pendrell this summer, drop by and visit us and have a cup of coffee.

Once we tow the VELELLA to Pendrell we plan to issue the Newsletter weekly until the end of the summer. Persons wishing additional information or more up-to-the-minute information can obtain it by writing or phoning the Biological Station (758-5202) or by contacting the VELELLA in Pendrell Sound by radio.

N. Bourne
G. D. Heritage



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

June 27, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 2

Our barge, VELELLA, was towed to Pendrell Sound on June 22 and anchored off Station 5. Sampling floats were put out at Stations 1, 2 and 4, and one will be established in Hotham Sound at the end of the week.

During the present week, oceanographers from the Marine Sciences Service will prepare their gear and place it out in Pendrell Sound.

As pointed out in the past Newsletter, the coffee pot is always on and we invite all of you to drop in and visit us on the VELELLA!

TEMPERATURE AND SALINITY

Temperature and salinity profiles were made at Stations 1, 2, 4, 5, 6 and 8 on June 23. In spite of the cool spring, the surface water layer in Pendrell Sound is quite warm and surface temperatures of 20°C (68°F) and more

were recorded at all stations except Station 8. The surface layer was 2-3 meters in depth. Water temperatures and salinities at a depth of 1 m at the six stations are shown in the following table.

Stations	Temperature		Salinity ‰
	°C	°F	
1	20.3	68.5	18.6
2	20.2	68.4	18.3
4	20.3	68.5	17.8
5	20.8	69.4	17.8
6	19.7	67.5	17.6
8	19.1	66.4	16.1

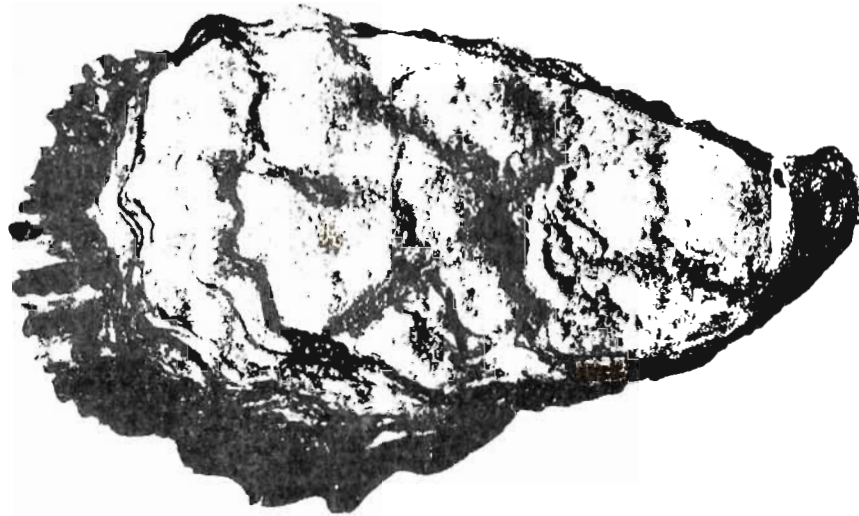
LARVAE

Five-minute surface plankton tows were taken on June 23 at Stations 2 and 4. Considerable numbers of mussel (Mytilus edulis), shipworm (Bankia setacea) and littleneck clam (Protothaca staminea), along with a few native oyster (Ostrea lurida) larvae were identified in the plankton. No Pacific oyster larvae were observed.

CONDITION OF ADULTS

Microscopic examination of adult oysters collected at Pendrell Sound showed that sperm and eggs are developing but the animals have not yet reached spawning condition. However, if warm water conditions continue, adults could be in spawning condition by the end of June.

N. Bourne
G. D. Heritage



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

July 9, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 3

TEMPERATURE AND SALINITY

Because of cloudy cool weather, water temperatures in Pendrell Sound declined during the last week in June; at the 1-m depth they declined from a high of 20.5°C at Station 1 on June 25 to a low of 14.9°C on June 30. Since then water temperatures have gradually increased and on July 5 a temperature of 17.6°C was recorded at Station 1 (Table 1). Salinities have generally increased during the last 10 days and on July 5 were 19‰ or higher at all stations in Pendrell Sound. There is an indication that a surface layer of 3 to 4 meters is forming throughout the Sound.

Temperature and salinity profiles were taken in Homfray, Pryce, and Waddington Channels on June 26 and July 3. Water temperatures at the 1-m depth ranged from 13.9-16.5°C, but salinities were all above 15‰ (Table 2).

LARVAE

Five-minute surface plankton tows have been taken daily at Stations 2 and 4. Mussel larvae, in all larval stages, have been extremely abundant; along with lesser numbers of shipworm, clam (littleneck and Manila) and native oyster larvae. No Pacific oyster larvae have been observed.

CONDITION OF ADULTS

Microscopic examination of adult oysters collected at Stations 2, 5 and 6 showed that sperm and eggs are developing but the animals are not in spawning condition. With a return of warm water the adults could be in spawning condition by mid-July.

OCEANOGRAPHY

Most of the oceanographic equipment is now in place in Pendrell Sound. Thermistor chains, which give a continuous recording of water temperature, have been installed to 50 meters at Stations 2, 5 and 8. Anemometers, which record wind speed and direction, are now in place at Stations 2 and 8, and a small weather station will be set up on the barge. The launch "Squamish" is now in Pendrell Sound and during the past week has been used to take accurate temperature profiles to a depth of 125 meters and periodic salinity-temperature profiles.

Initial runs have been made to calculate the heat budget of Pendrell Sound. This is being accomplished by:

- (1) calculating the amount of heat entering and leaving the Sound through the sea surface;
- (2) measuring the change in the heat content of the Sound;
- (3) the difference between (1) and (2) is a measure of the amount of heat exchange through the mouth.

In this manner we are indirectly determining the movements of water into and out of the Sound. The current meter data being collected at Station 6 will provide supporting evidence for this study.

The thermistor chain at Station 2 will provide information to enable us to determine whether strong northerly winds are able to sweep the surface layer (which contains the oyster larvae) from the head of the Sound out into the main part of the Sound.

During the week July 8-12 the radar drogue study will be undertaken to measure current patterns in the upper surface layer. The study will go on 24 hours a day during the week. Persons observing strange objects floating in the water during this week are asked to steer clear of them since they are probably a part of this experiment.

HOTHAM SOUND

The monitoring station was established in Hotham Sound on June 27. Water temperatures at 1 meter ranged from 15.9 to 16.6°C and salinities were above 17.2‰ at the three stations (Table 3). Microscopic examination of adult oysters indicated eggs and sperm are developing but the adults are not ripe.

Table 1. Water temperature and salinity measurements at a depth of 1 meter in Pendrell Sound, July 3-5, 1974.

Station	July 3		July 4		July 5	
	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰
1	18.0	20.4	17.6	20.8	17.6	20.7
2	17.8	20.7	17.3	20.5	17.4	20.6
4	17.3	20.6	16.7	20.2	17.1	20.2
5	17.5	20.1	16.4	20.1	17.0	18.8
6	17.1	20.0	16.2	20.0	16.7	19.4
8	16.5	20.0	15.9	20.3	16.4	20.1

Table 2. Water temperature and salinity measurements at a depth of 1 meter around East Redonda Island, July 3, 1974.

Station	Temperature (°C)	Salinity (‰)
Horace Head	16.0	18.5
Booker Point	14.8	20.4
Hepburn Point	13.9	15.8
Pryce Channel	14.1	16.5
Walsh Cove	15.0	20.1
Waddington Channel	16.5	20.3

Table 3. Water temperature and salinity measurements at a depth of 1 meter in Hotham Sound, June 27, 1974

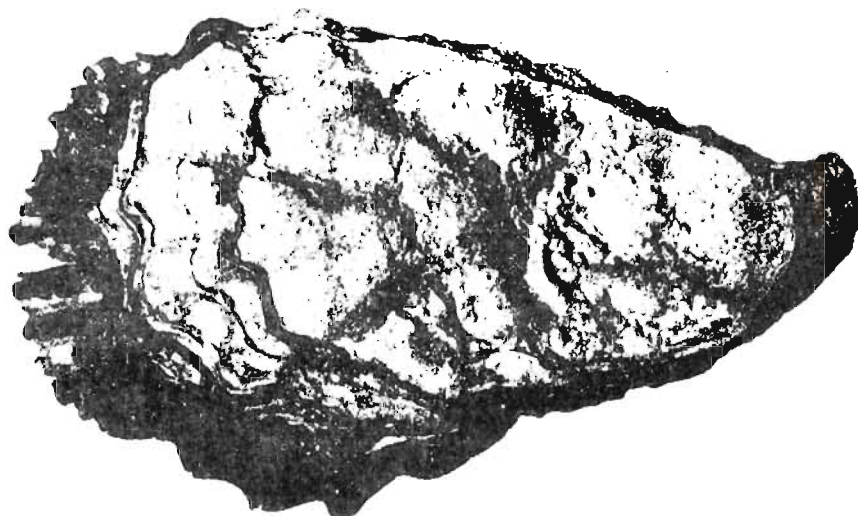
Station	Temperature (°C)	Salinity (‰)
1	16.1	17.2
2	16.6	18.0
3	15.9	19.0

A 5-minute surface plankton tow contained few bivalve larvae; most of which were mussels or shipworms. No Pacific oyster larvae were observed.

LADYSMITH HARBOUR

A temperature recorder was installed at 1 meter at the marina on July 2. A 5-minute surface plankton tow yielded a variety of bivalve larvae but no Pacific oyster larvae.

N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

July 15, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 4

TEMPERATURE AND SALINITY

Since the last Newsletter, weather conditions in south coastal British Columbia have been generally poor and this is reflected in surface water temperatures in Pendrell Sound. At the 1-m depth, water temperatures in Pendrell Sound gradually increased to a high of just over 20°C (68°F) at Stations 1 and 2 on July 9, but with the return of cloudy cool weather they decreased again and were below 20°C at all stations on July 10 and 11 (Table 1). Salinities remained above 20‰ at all stations to July 9. Since then they have dropped slightly but remain about 19‰ (Table 1) which is typical for Pendrell Sound at this time of year. Indications that the surface layer is about 3 m in depth continue but it is obvious that clear sunny hot weather is required to heat the layer to above 20°C.

Temperature and salinity profiles were taken in Homfray, Pryce and Waddington Channels on July 6 and 10. Water temperatures at the 1-m depth ranged from 15.4-18.1°C, salinities from 11.0-19.9‰, indicating melt water is coming down Toba Inlet.

TABLE 1. Water temperatures and salinities at a depth of 1 meter in Pendrell Sound, July 9-11, 1974.

Station	July 9		July 10		July 11	
	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰
1	20.7	20.7	19.8	20.3	17.9	19.1
2	20.3	20.6	19.6	20.2	17.8	18.8
4	19.8	20.1	19.1	20.2	18.4	19.3
5	19.0	19.9	18.5	19.8	17.4	18.2
6	18.9	19.6	18.5	19.6	18.2	18.9
8	18.9	19.9	18.5	18.5	18.1	19.0

LARVAE

Numbers of bivalve larvae in daily surface plankton tows at Stations 2 and 4 generally decreased during the past week. As in the previous 3 weeks, most of the larvae were mussels and were present in all larval stages. Lesser numbers of shipworm, clam and native oyster larvae continued to be found. No Pacific oyster larvae were observed.

CONDITION OF ADULTS

Examination of adults collected at Station 2 showed they are becoming ripe.

OCEANOGRAPHY

For 3 days and 2 nights numerous drifting floats were tracked by radar in Pendrell Sound. This experiment was undertaken to determine the nature of circulation in the surface waters. Although the patterns were complex and must await more detailed analysis before a full description is available, it appeared that a persistent southward current existed on the west shore of the Sound. The tidal exchange appears to induce an anticlockwise motion.

We hope to show movies taken of the radar screen to interested persons on the VELELLA during the summer. It is possible that a second radar-tracking experiment of a more limited nature can be carried out later in the summer.

LADYSMITH HARBOUR

Mean surface water temperatures ranged from 15.8-19.5°C (60.5-66.5°F) from July 2-9. A 5-minute surface plankton tow on July 9 had moderate numbers of bivalve larvae; mostly mussels along with shipworm and clams. No Pacific oyster larvae were observed.

N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

July 24, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 5

TEMPERATURE AND SALINITY

Weather conditions generally improved during the past week and produced a gradual warming of surface waters in Pendrell Sound. Water temperatures of 19°C were observed at the 1-m depth at two stations (Table 1). However, continued hot sunny weather is required in order to give a surface water layer with temperatures above 20°C. Salinities are generally typical for this time of year and are above 17‰ at all stations.

One series of temperature-salinity observations was made around East Redonda Island on July 17. Water temperatures at 1 m ranged from 14.2 to 16.8°C and salinities from 16.6 to 20.3‰, which are rather typical for this time of year.

CONDITION OF ADULTS

Samples of adults taken at several places in the Sound showed that most males are in spawning condition and females are rapidly becoming ripe.

TABLE 1. Water temperatures and salinities at a depth of 1 meter at the six stations in Pendrell Sound, July 19-21, 1974.

Station	July 19		July 20		July 21	
	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰	Temp. °C	Salinity ‰
1	18.6	18.3	18.8	19.2	18.8	18.8
2	18.2	18.2	18.4	18.4	19.1	19.0
4	17.9	17.8	18.3	18.6	18.9	18.9
5	17.8	17.3	17.8	17.7	18.9	18.0
6	17.7	17.5	18.1	17.3	19.0	18.3
8	17.8	17.8	18.3	18.1	18.6	17.9

LARVAE

Numbers of bivalve larvae in daily plankton tows at Stations 2 and 4 were much reduced during the past week. As noted previously, most of the larvae were mussels, with some shipworm, clam and native oyster larvae generally in each tow. No Pacific oyster larvae have been observed.

OCEANOGRAPHY

A heat budget study of Pendrell Sound was started during the past week. Observations undertaken in this study include: a morning and evening run to measure water temperatures to 125 m at nine stations in the Sound; installation of a net radiometer to record the amount of solar radiation entering and leaving the surface waters of the Sound; and meteorological observations made every 3 hours at the barge (these include observations of air temperature, wind, cloud cover, rainfall, humidity, and surface water temperature). The study will continue for another week.

LADYSMITH HARBOUR

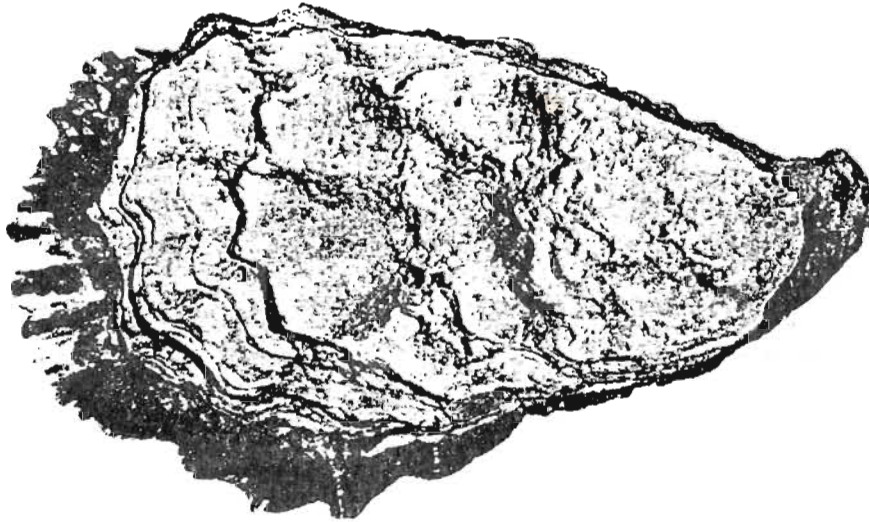
Average daily water temperatures at a depth of 1 m at the Marina in Ladysmith Harbour ranged from 15.6 to 17.4°C during the past week. The maximum temperature recorded for this period was 18.9. A surface plankton tow taken on July 16 had several species of bivalve larvae but no Pacific oyster larvae.

COMMUNICATIONS WITH THE VELELLA

A radio has been installed on the VELELLA and we monitor Channels 2708 or 2015 (B.C. Telephone, Vancouver) from 1100-1300 and 1500-1700. Anyone wishing to contact the VELELLA in Pendrell Sound can do so on these channels or phone the Pacific Biological Station (758-5202) and ask that a message be passed along.

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N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

July 31, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 6

TEMPERATURE AND SALINITY

Surface water temperatures in Pendrell Sound increased during the past week as a result of the clear hot sunny weather. At the 1-m depth, water temperatures of 20°C or above have continued since July 23 at Stations 1 and 2, and since July 24 at Station 3. The maximum temperature at this depth was 22.5°C which was recorded at all three stations on July 26-27. Salinities have remained above 17‰ at Stations 1, 2, 4, 5, and 6, but occasionally fell below 16‰ at Station 8. A low of 13.3‰ was recorded on the surface at Station 6 on July 28. The surface layer is now about 3 m in depth at all stations.

CONDITIONS OF ADULTS AND SPAWNING

Adults from several locations around Pendrell Sound have been examined and all are ripe. No white water was observed last week (July 22-28) but it appears that a light spawning took place on July 25. Straight-hinge Pacific oyster (*Crassostrea gigas*) larvae were found in surface plankton tows at Stations 2 and 4 on July 26. Pump samples taken last week have been yielding approximately 10 straight-hinge oyster larvae per gallon. This spawning was too light for a commercial set.

During the beginning of this week (July 29 and 30) spawning of Pacific oysters (Crassostrea gigas) has taken place. It appears from surface plankton tows that a commercial set will take place.

OCEANOGRAPHY

A heat budget study was started last week but had to be terminated because of equipment failure. The second stage of this study will begin next week.

Film taken during the radar tracking of drift drogues has not been developed yet, but movies will be shown to interested people in a few weeks on the VELELLA.

LADYSMITH HARBOUR

During the week of July 16-23 water temperatures at a depth of 1 meter ranged between 13.4 and 18.9°C. A surface plankton tow done on July 23 yielded no Pacific oyster larvae, a few mussels (Mytilus edulis), and a few clams.

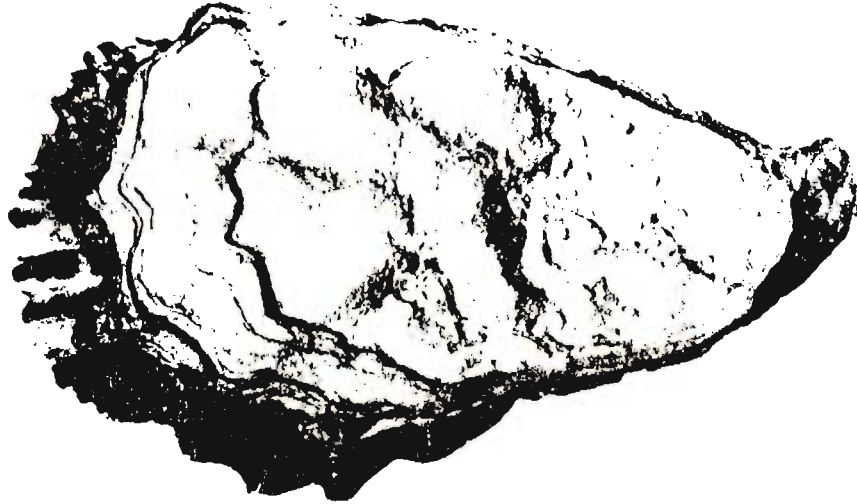
During the week of July 23-30 water temperatures at a depth of 1 meter ranged between 16.7 and 22.8°C. A surface plankton tow on July 30 had modest numbers of Pacific oyster larvae which appeared to be about 4 days old. A few mussels in straight-hinge to eyed larvae stages and a few clams were also found in the tow.

HOTHAM SOUND

Water temperatures at a depth of 1 meter have ranged from 14.5-22.3°C between June 27 and July 30. A temperature-salinity profile taken at Station 1 on July 30 indicates that the warm water layer extends to about 2 m. The temperature of this layer is 20°C, and salinities are just above 16‰.

Surface plankton tows at Stations 1 and 2 on July 30 yielded very few Pacific oyster larvae, a few mussels (Mytilus edulis), and a few clams.

N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

August 6, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 7

TEMPERATURE AND SALINITY

Surface water temperatures in Pendrell Sound increased during the past week as a result of the clear, hot, sunny weather. The average water temperature at the 1-m depth as recorded by the thermographs during the past week was 22.7°C (72.8°F) at Station 1, 23°C (73.4°F) at Station 2 and 22.5°C (72.5°F) at Station 4. Salinities have remained above 15‰ at all Stations except at Station 8, where they fell slightly below this level. The surface layer is now 2 m in depth and sharply defined.

CONDITIONS OF ADULTS AND SPAWNING

Samples of adults from several locations throughout Pendrell Sound were examined during the past week. Although most adults are not very full, all are ripe or spawned out. Spawning was observed in the Sound on July 28, 30 and August 2.

LARVAE

The number of different stage Pacific oyster larvae per 20 Imperial gallon sample on August 2, 3 and 4 at five stations is shown in Table 1. Growth and survival of larvae in Pendrell has been good. Although the numbers of larvae are not large, the result of 5 minute surface plankton tows indicate that sufficient larvae are present to provide a commercial set if adequate survival is maintained. Setting should begin about August 15 and continue through the following week.

Table 1. The number of different stage Pacific oyster larvae per 20 imperial gallons at Stations 1-2, 4, 5 and 6, Pendrell Sound.

Stage	Station 1-2			Station 4			Station 5			Station 6		
	August			August			August			August		
	2	3	4	2	3	4	2	3	4	2	3	4
Straight Hinge	130	93	90	70	35	63	154	273	38	73	60	44
Early Umbone	275	153	123	33	33	60	50	160	76	17	56	88
Mid Umbone	-	8	1	-	1	3	-	2	1	-	2	1

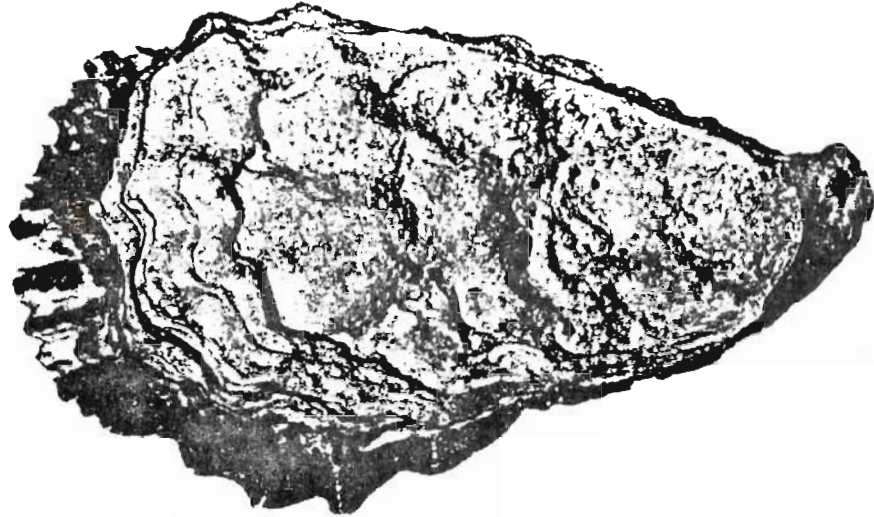
OCEANOGRAPHY

The second phase of the heat budget experiment has been initiated and will continue for two weeks. Movies of the radar drift drogue experiment have now been developed and will be shown to anyone interested in seeing them in the VELELIA from August 19-26.

LADYSMITH HARBOUR

Average daily water temperatures at the 1 meter depth at the Marina in Ladysmith Harbour ranged from 20.5 to 22.5°C, the maximum during this period was 24°C. A surface plankton tow taken on August 6 had moderate numbers of Pacific oyster larvae. Most were in the early umbone stage but some had reached the mid umbone stage. If these larvae survive to settling size, they could provide a commercial set.

N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

August 13, 1974 PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 8

(DELAYED IN MAIL)

TEMPERATURE AND SALINITY

Surface water temperatures in Pendrell Sound decreased during the past week but were still above 20°C. Daily average water temperatures at the 1-m depth as recorded by the thermographs during the past week ranged from 22.9 to 20.5°C at Station 1; 23.2-20.5°C at Station 2; and 22.8-20.0°C at Station 4. Salinities have remained above 16‰ at all stations except Station 8, where they fell to as low as 13‰. The surface layer is now 3 m in depth.

SPAWNING

Although no spawning was observed during the past week, moderate numbers of straight-hinge larvae were found in plankton tows beginning August 7, indicating additional spawning has occurred.

LARVAE

The number of different stage Pacific oyster larvae per 20 Imperial gallon sample on August 9, 10 and 11 at four stations is shown in Table 1. The numbers of larvae are still not large and there appears to be a shift in

numbers from the head of the Sound to the central part, due probably to the strong NW winds. Numbers of larvae in 5-minute surface tows indicate that a commercial set should occur if adequate survival is maintained. Initial setting is expected about August 15.

TABLE 1. The number of different stage Pacific oyster larvae per 20 Imperial gallons at Stations 1-2, 4, 5, and 6, Pendrell Sound.

Stage	Station 1-2			Station 4			Station 5			Station 6		
	August			August			August			August		
	9	10	11	9	10	11	9	10	11	9	10	11
Straight Hinge	36	83	30	37	73	28	12	4	31	30	12	16
Early Umbone	53	71	20	81	241	41	10	23	124	132	47	34
Mid Umbone	43	30	12	33	106	22	5	16	39	54	59	14
Late Umbone	11	8	-	3	21	-	-	1	-	14	9	-

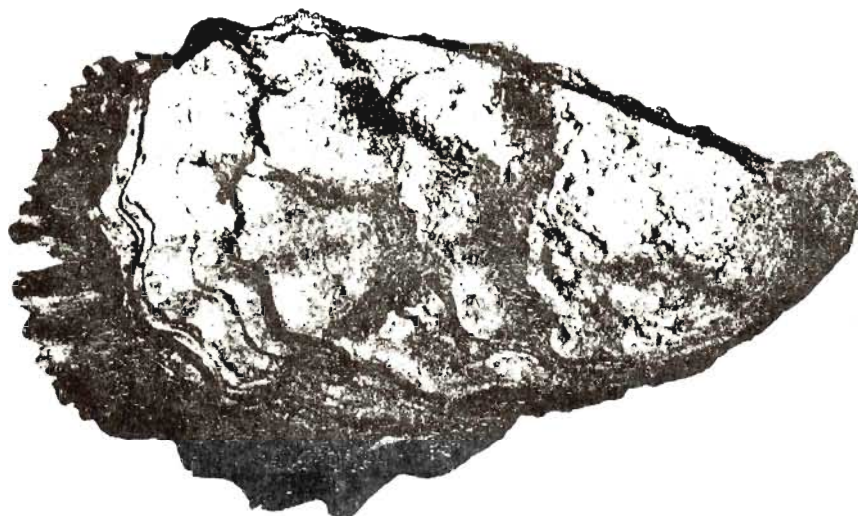
OCEANOGRAPHY

During the past week the instruments on the two buoys and the current meters were serviced and the data are being processed. The second phase of the heat budget experiment is continuing.

HOTHAM SOUND

Temperature-salinity profiles and plankton tows were made in Hotham Sound on August 9. Surface temperatures were barely 20°C and the salinity was above 18‰. Plankton tows at Stations 1 and 2 had good numbers of Pacific oyster larvae, but virtually all were in the straight-hinge stage. If adequate survival is maintained, these larvae would provide a commercial set, but setting would not occur much before August 25.

N. Bourne
G. D. Heritage
D. M. Farmer



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

August 21, 1974 PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 9

INTRODUCTION.

Our apologies for not getting the last Newsletter out. The text for the last Newsletter was given to a pilot in Pendrell Sound for mailing to the Biological Station but to date it has not arrived. It is probably still in the pilot's pocket or misplaced in an airplane.

TEMPERATURE AND SALINITY

Water temperatures in the surface layer of Pendrell Sound have cooled slightly in the past week. However, the average daily temperature at 1 meter, as recorded by the thermographs at Stations 1, 2 and 4 has remained above 20°C. Salinities have remained above 16.5‰ at all Stations except Station 8, and lately have been above 17.5‰. The surface layer is still well defined and varies in thickness from 2-4 meters.

SPAWNING

Light spawning was reported at Station 1 on August 13. Small numbers of straight hinge larvae continue to enter the plankton indicating further light spawning.

LARVAE

Numbers of Pacific oyster larvae in 20 gallon samples have been quite variable. The number of different stage Pacific oyster larvae at three Stations is shown in Table 1. However, numbers of larvae in 5-minute surface tows indicate sufficient numbers to produce a commercial set.

Table 1. Number of different stage Pacific oyster larvae per 20 gallon sample at three Stations in Pendrell Sound.

Stage	Station 1-2			Station 4			Station 5		
	August			August			August		
	16	17	18	16	17	18	16	17	18
Straight Hinge	2	10	17	7	8	7	23	2	4
Early Umbone	8	7	11	19	3	7	25	16	13
Mid Umbone	4	5	18	32	4	14	30	36	14
Late Umbone	12	3	34	20	4	22	18	31	16
Eyed	2	2	11	5	1	5	0	2	3

SETTLEMENT

First spatfall occurred on August 13-14 as recorded by examination of cultch put out daily at the Velella (Station 5). Spatfall since then has continued. Average number of spat per shell in cultch put out on August 12 and examined on August 19 at various locations in the Sound is shown in Table 2. Spatfall is expected to continue until the end of the month.

Table 2. Range and average number of Pacific oyster spat per shell, placed out on August 12 and sampled August 19 in Pendrell Sound.

	Station						
	1	2	3	4	5	6	10
• Range	0-4	1-6	1-6	3-7	2-12	0-4	0-7
Average Number	2	2.7	4.4	4.25	5.75	1.8	2.9

OCEANOGRAPHY

The heat budget study is continuing.

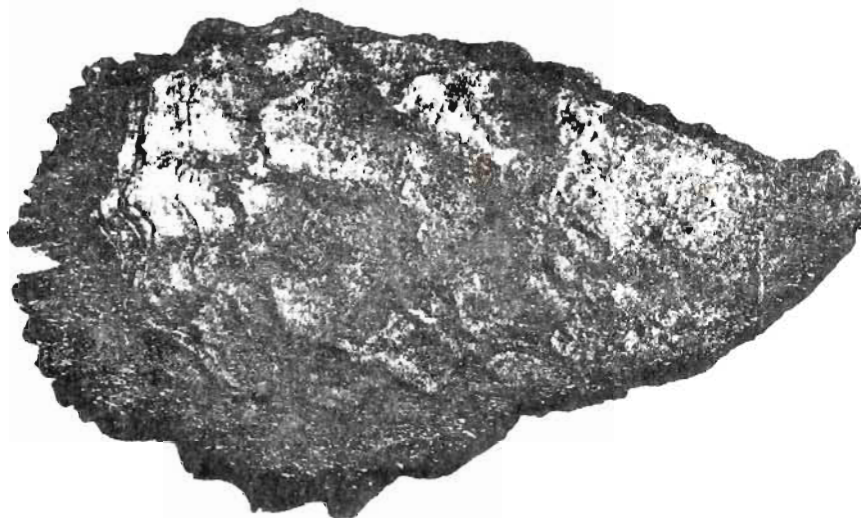
LADYSMITH HARBOUR

Water temperatures in Ladysmith Harbour have declined and are now below 20°C. On August 15, Dr. D. B. Quayle undertook extensive sampling in Ladysmith Harbour. Pacific oyster larvae in modest numbers and of all sizes were found in most samples. If survival is good, there are sufficient larvae to provide a light set; up to 5 per shell.

HOTHAM SOUND

Water temperatures in Hotham Sound are below 20°C. A plankton tow taken at Station 1 on August 21 had modest numbers of Pacific oyster larvae most of which are in the mid umbone stage. If survival is good, these larvae could provide a light set, up to 5 per shell. Spatfall is not expected before the end of the month.

N. Bourne
G. D. Heritage
D. M. Farmer
D. B. Quayle



BRITISH COLUMBIA

PACIFIC OYSTER BREEDING NEWSLETTER

Sept. 3, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 10

TEMPERATURE AND SALINITY

Water temperatures in Pendrell Sound decreased generally during the period August 20-25 and the average daily temperature at the 1-m depth on August 25 fell to 18.8°C at Station 1, 18.5°C at Station 2, and 18.6°C at Station 4. Since then, hot sunny weather has produced warmer water temperatures and the mean daily temperature at the three stations was above 20°C on August 29. Salinities have gradually increased and are now above 18‰ at all stations except Station 8. The surface layer has become less distinct but remains at 1-2 m.

LARVAE

The number of Pacific oyster larvae per 20 gallons on August 27, 28, and 29 at these stations is shown in Table 1. The numbers of late stage larvae have decreased since the last Newsletter, but results of surface plankton tows indicate sufficient numbers to provide continued light setting. Of interest is the number of early and mid umbone larvae which resulted from a spawning about August 18. If weather conditions and survival remain favourable, these larvae could yield significant setting, beginning the second week in September.

SETTLEMENT

Daily observations of spatfall at Station 5 (the barge) showed that maximum settlement occurred during the 24-hr period August 21-22, when an average of 15 spat per shell was recorded. Since then settlement has decreased but was still 2.5 spat per shell for the 24-hr period, August 28-29. The range and average number of spat per shell put out on August 19 and examined on August 26 at various locations in the Sound are shown in Table 2. Spatfall has been good except at Stations 1 and 2, where it has been disappointingly light. This in spite of the fact that larger numbers of late stage larvae were found at Station 1-2 than elsewhere in the Sound. Light settlement is expected to continue until the first week in September.

OCEANOGRAPHY

The heat budget study was completed at the end of August. Water temperature, wind speed and direction, and currents will be monitored until mid-September when the VELELLA will be removed.

LADYSMITH HARBOUR

Water temperatures have gradually decreased and mean daily water temperatures at 1 m are below 20°C. No spat has been found on cultch exposed at the Marina.

TABLE 1. Number of different stage Pacific oyster larvae per 20-gallon sample at three stations in Pendrell Sound

Stage	Station 1-2			Station 4			Station 5		
	August			August			August		
	27	28	29	27	28	29	27	28	29
Straight Hinge	14	27	17	19	7	5	14	11	5
Early umbone	49	71	31	48	44	71	14	22	32
Mid umbone	6	1	21	3	1	34	0	0	7
Late umbone	5	4	5	2	2	5	1	0	1
Eyed	6	0	1	2	1	2	2	0	2

TABLE 2. Range and average number of Pacific oyster spat per shell, placed out on August 19 and sampled August 26 in Pendrell Sound.

	Station							
	1	2	3	4	5	6-East	6-West	10
Range	1-7	3-19	16-48	28-65	23-75	12-37	33-77	12-35
Average Number	3.4	10.8	33.6	43.6	43.0	21.3	53.1	21.4

N. Bourne
G. D. Heritage
D. M. Farmer
D. B. Quayle



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

Sept. 9, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 11

TEMPERATURE AND SALINITY

Water temperatures in Pendrell Sound increased during the week of August 26 to September 2, and the average daily temperature at the 1-m depth was above 20°C at Stations 1, 2 and 4. On September 6, water temperatures in the surface layer were above 20°C at all sampling stations except Station 8. Salinities are now above 19‰ at all stations. The surface layer is now between 2-3 m in depth but is not as well defined as during the previous period.

LARVAE

Pacific oyster larvae from the first spawning (late July) have now virtually disappeared from the plankton. During the past four days, daily spatfall has been below one spat per shell.

However, large numbers of Pacific oyster larvae from a spawning about August 18 are now in the water. Although quantitative sampling has been discontinued, results of surface plankton tows indicate there are sufficient larvae to provide a commercial set if adequate survival is maintained. Most of the larvae are in the late umbone stage and settlement is expected to begin about September 10 and continue until the end of the month.

SETTLEMENT

Daily settlement, as monitored at the VELELLA (Station 5) decreased to below one spat per shell at the end of August. The range and average number of spat per shell on cultch put out on August 26 and removed on September 2 is shown in the table. Heaviest spatfall was at Stations 3 and 6. The accumulative spatfall is now 50 spat per shell or above at all stations except Station 1 (28) and Station 6-East (37).

No further significant spatfall is expected until the larvae from the spawning of about August 18 begin to settle out, which should begin about September 10 and continue to the end of the month.

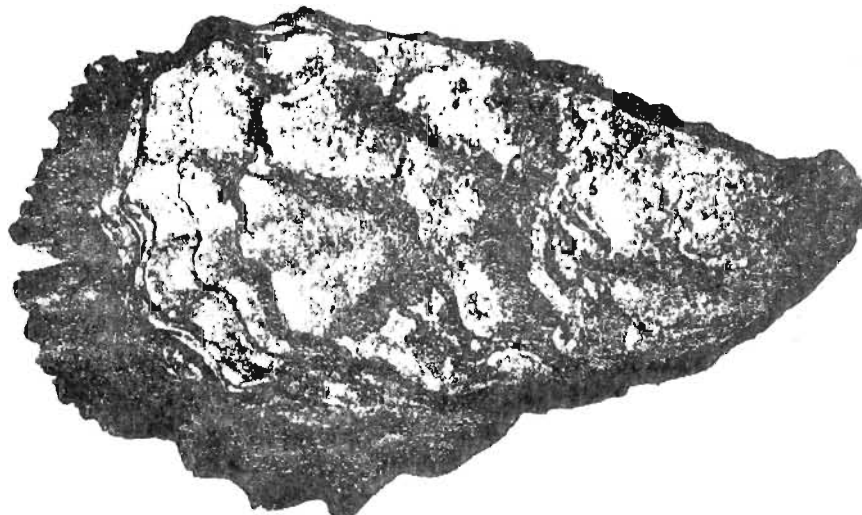
OCEANOGRAPHY

Monitoring of water temperatures, currents, wind speed and velocity will continue until the barge is taken out of Pendrell Sound.

N. Bourne
G. D. Heritage
D. M. Farmer

TABLE 1. Range and average number of Pacific oyster spat per shell, placed out in Pendrell Sound on August 26, and sampled September 2.

	Station							
	1	2	3	4	5	6-East	6-West	10
Range	2-36	20-68	40-88	3-48	6-41	5-23	23-79	12-29
Average Number	22.5	34.7	65.3	19.8	21.4	13.8	40.6	22.6



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

Sept. 12, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 12

TEMPERATURE AND SALINITY

Water temperatures in Pendrell Sound remained above 20°C for the first half of the week September 2-9, but decreased below this temperature in the last few days. The average daily water temperature at the 1-m depth on September 8 was 19.4°C at Station 1, 19.7 at Station 2, and 19.1 at Station 4. Surface salinities remain above 19‰ at all stations. The surface layer is now about 2 m in depth but is becoming less well defined.

LARVAE

Moderate numbers of Pacific oyster larvae continue to be found in surface plankton tows taken at Stations 1-2, 4, 5, 6 and 10. Although the larvae are present in all developmental stages, most are in the late umbone stage and modest numbers are eyed. Some of these larvae have begun to set in the last two days and if survival is adequate, continued settlement should occur through most of the remainder of the month.

SETTLEMENT

The average number of spat per shell on cultch put out on September 2 and removed September 9 is shown in the table. Spatfall was light at all stations during the week, the heaviest spatfall occurring at Stations 5 and 6-West.

Daily spatfall, as monitored at the VELELLA (Station 5) decreased during the week but began to increase again at the end of the week. Shell exposed on September 6 and examined on September 7 had an average of 0.5 spat per shell; shell exposed from September 7 to September 8 had an average of 0.4 spat per shell; but shell exposed from September 8 to 9 had an average of 2 spat per shell. With adequate survival of larvae, significant settlement should continue until the end of the month.

LADYSMITH HARBOUR

Water temperatures have declined in Ladysmith Harbour; the surface temperature was 17.0°C on September 11. No spat has been observed on cultch exposed at the Marina.

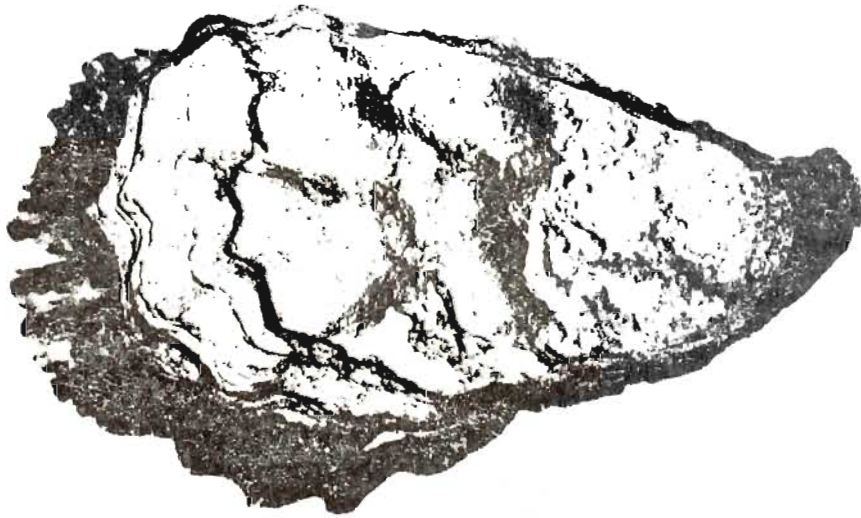
TERMINATION OF OBSERVATIONS

We plan to remove the sampling gear from Pendrell Sound and tow the VELELLA back to Nanaimo during the week of September 16 to 20. One more Newsletter will be issued after we return to Nanaimo.

N. Bourne
G. D. Heritage

TABLE 1. Average number of Pacific oyster spat per shell placed out in Pendrell Sound on September 2 and sampled September 9.

	Station							
	1	2	3	4	5	6-E	6-W	10
Average Number	2.7	2.6	1.5	1.0	4.8	2.5	5.8	2.3



BRITISH COLUMBIA
PACIFIC OYSTER BREEDING NEWSLETTER

Nov. 1, 1974

PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

No. 13

INTRODUCTION

This will be the final Newsletter for the 1974 season. The VELELLA and all sampling gear have been removed from Pendrell Sound, and the cultch has been counted. Results of our observations show that 1974 has been a successful year for Pacific oyster breeding in Pendrell Sound.

Results of spat counts on cultch from the eight sampling stations are shown in Tables 1 and 2. Table 1 shows the range and mean number of spat per shell on cultch put out on August 12 and removed September 17, 1974. Table 2 shows the spatfall for the period September 2-17, 1974.

Most settlement occurred in the 3-week period, August 12-September 2. Results of daily spatfall as recorded at the VELELLA (Station 5) are shown in Table 3 and indicate that major spatting occurred from August 17-29. A mean of over 40 spat per shell occurred at all stations. However as seen in the tables, most abundant spatfall occurred at Stations 4 and 5. The heavier spatfall at these two stations is probably due to strong currents which cause more water and oyster larvae to come into contact with the cultch. Some thought should be given to the future possibility of putting cultch at Stations 4 and 5 rather than at the head of the Sound.

Maximum lengths of spat at each station are shown in Tables 1 and 2. Mean spat lengths measured on September 17 show less growth taking place than in some previous years. However, spat which have been in the water after September 17 appear to have grown considerably.

TABLE 1. Ranges and mean spat counts per shell, shell length of largest spat on cultch put out on August 12 and removed on September 17, 1974, in Pendrell Sound.

Station	1	2	3	4	5	6E	6W	10
Range	6-71	40-92	24-67	78-170	81-298	10-66	32-99	27-53
Mean	45	62	46	133	194	40	57	42
Largest spat (mm)	11	12	8	13	9	8	11	9

TABLE 2. Ranges and mean spat counts per shell, shell length of largest spat on cultch put out on September 2 and removed on September 17, 1974, in Pendrell Sound.

Station	1	2	3	4	5	6E	6W	10
Range	1-11	3-9	0-8	3-16	10-23	3-12	4-14	0-16
Mean	5	6	4	8	17	7	9	5
Largest spat (mm)	2	2	< 1	< 1	< 2	< 1	< 1	< 1

TABLE 3. Mean daily spat counts (per shell) at Station 5, Pendrell Sound.

Date	Mean no. spat per shell	Date	Mean no. spat per shell
August 13-14	0.5	Aug. 31-Sept. 1	1.1
" 14-15	0.6	September 1-2	0.0
" 15-16	0.4	" 2-3	0.1
" 16-17	1.5	" 3-4	0.0
" 17-18	2.2	" 4-5	0.6
" 18-19	1.9	" 5-6	0.1
" 19-20	6.2	" 6-7	0.5
" 20-21	6.5	" 7-8	0.4
" 21-22	14.9	" 8-9	2.0
" 22-23	9.1	" 9-10	2.0
" 23-24	5.5	" 10-11	0.8
" 24-25	5.1	" 11-12	0.3
" 25-26	5.1	" 12-13	0.0
" 26-27	5.9	" 13-14	0.3
" 27-28	3.2	" 14-15	0.0
" 28-29	2.5	" 15-16	0.0
" 29-30	1.7	" 16-17	0.0
" 30-31	1.4		

HOTHAM SOUND

Spat counts on shell from Hotham Sound are shown in Table 4. A mean of four spat per shell was found here and the maximum length observed was 4 mm.

TABLE 4. Ranges and mean spat counts per shell, shell length of largest spat on cultch put out on August 21 and removed on September 16, 1974, Hotham Sound.

String	No. 1	No. 2
Range	0-9	2-8
Mean	4	4
Largest spat (mm)	4	4

LADYSMITH HARBOUR

In spite of modest numbers of oyster larvae in plankton samples taken in August in Ladysmith Harbour, no spat were found on cultch sampled at the marina in Ladysmith. However, small sets have been reported at isolated spots in Ladysmith Harbour.

CONCLUSION

As indicated, this is the final Newsletter for the year. We hope it has been of some use to the industry. We welcome any comments on the Newsletter. Is it useful to you, and how can we improve it?

N. Bourne
G. D. Heritage