Oyster Spat (*Crassostrea virginica*) Collection at Gillis Cove, Cape Breton, Nova Scotia: An Analysis of Collector Efficacy

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OYSTER SPAT (*CRASSOSTREA VIRGINICA*) COLLECTION AT GILLIS COVE, CAPE BRETON ISLAND, NOVA SCOTIA: AN ANALYSIS OF COLLECTOR EFFICACY

by

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ABSTRACT

Freeman, K.R. and S.K. Denny. 2003. Oyster spat (*Crassostrea virginica*) collection at Gillis Cove, Cape Breton Island, Nova Scotia: An analysis of collector efficacy. Can. Tech. Rep. Fish. Aquat. Sci. 2470: vi + 50 p.

Oyster spat (*Crassostrea virginica*) collection from the Bras d'Or Lake in Cape Breton Island, Nova Scotia, has undergone a recent methodological re-examination by the Department of Fisheries & Oceans and the Eskasoni Fish & Wildlife Commission. Driven partly by increasing site closures due to pollution and a desire by different interest groups to improve annual landings of this valued shellfish, the study was conducted at Gillis Cove, an historically well-established site for oyster recruitment. The efficacy of several different collectors was examined and included these traditional styles: scallop Shell Strings, Chinese Hats, Veneer Rings, and Harps. Large and Small plastic Mesh plus single strands of nylon cordage called "Bolts" were also tested. Randomized-blocks analyses were used to examine collector types for depth effects on spat density and growth. These showed significant depth differences in spat density for Large Mesh, Shell Strings and Bolts but not for Small Mesh: usually there was least density at the Top depth (usually 0.5 m deep or less). Only Shell Strings on the Lower surface showed any understandable effect of depth on growth—shell length being least at the Bottom depth (1.0 m deep or more). Analyses of variance were used to examine the effect of collector type on spat density and growth. Usually the Top depth showed the least spat density—Shell Strings were the exception. In growth, Mesh yielded the longest shell lengths and Veneer Rings the shortest; the other collectors gave results between these extremes. Because of ready availability of materials combined with proven superior collection, growth, ease of harvesting, handling and storage, Small Mesh was regarded as the best choice overall.

RÉSUMÉ

Freeman, K.R. and S.K. Denny. 2003. Oyster spat (*Crassostrea virginica*) collection at Gillis Cove, Cape Breton Island, Nova Scotia: An analysis of collector efficacy. Can. Tech. Rep. Fish. Aquat. Sci. 2470: vi + 50 p.

La collecte de naissain d'huîtres américaines (*Crassostrea virginica*) dans le lac Bras d'Or, à l'île du Cap-Breton (Nouvelle-Écosse), a récemment fait l'objet d'un nouvel examen méthodologique effectué par le ministère des Pêches et des Océans et la Eskasoni Fish and Wildlife Commission. Motivée notamment par le nombre croissant de fermetures de sites en raison de la pollution et par le désir de différents groupes d'intérêt d'accroître les débarquements annuels de ce mollusque important, l'étude a été menée dans l'anse Gillis, un site reconnu pour le bon recrutement d'huîtres au fil des ans. Nous avons mis à l'essai plusieurs collecteurs afin de déterminer leur efficacité: les collecteurs classiques, soit les chapelets de coquilles de pétoncles, les chapeaux chinois, les anneaux de placage et les harpes, de même que des grillages de plastique (à petites et grandes mailles) et des cordes en nylon. Nous avons utilisé des analyses par blocs aléatoires pour étudier les effets de la profondeur sur la densité et la croissance du naissain sur chaque type de collecteur. Nous avons observé des différences significatives dans la densité du naissain entre les profondeurs pour les grillages en plastique à grandes mailles, les chapelets de coquillles de pétoncles et les cordes de nylon mais aucune différence sur grillages en plastique à petites mailles; généralement, on trouvait la plus basse densité près de la surface (profondeur de 0.5 m ou moins). Seulement sur la face inférieure des coquilles de pétoncles en chapelet avons nous trouvé un effet compréhensible de la profondeur sur la croissance du naissain-la croissance en longueur du naissain étant plus faible en profondeur (1.0 m et plus). Nous avons eu recours à une analyse de variance pour examiner l'effet des différents types de collecteurs sur la densité du naissain et sur sa croissance. Habituellement, on a observé les plus faibles densités près de la surface sauf pour les chapelets de coquilles. Nous avons eu la meilleure croissance sur les grillages en plastiques et la plus pauvre sur les anneaux de placage; les résultats obtenus sur les autres collecteurs se situent entre ces deux extrêmes. Le grillage à petites mailles est considéré comme le meilleur choix en raison de la facilité d'obtention des matériaux et de ses qualités supérieures en ce qui concerne le captage et la croissance du naissain ainsi que la facilité de récolte, de manutention et d'entreposage.

NIKANATUEK

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Mntmu'k (*Crassotrea virginica*) wa'wmual Pitu'pok, Unama'kik ili-ankaptasikip, ankaptmi'tip Department of Fisheries and Oceans aqq Eskasoni Fish and Wildlife Commission. Ankaptasikip mita kepjoqatasikipnn mita mejike'kip ta'n etli-nukwenupni'kw mntmu'k aqq pilue'k ta'n wenik ketu kejitu'tip ta'n tli-apoqnmi'titew wli-piami-nukwenew mntmu'k. Etl ankaptasikip Gillis Cove, ta'n sa'q weli-kwitijik mntmu'k. Ta'n tel wl-lukwitikipni'kw wla nuji-mawo'tu'titewk ankaptasikip. Ankaptasi'pni'kl sasqale'sek apap'ijk,Chinese'l a'kwesnn, kmuje'l episkaqawikkl aqq harpl. Meski'kl aqq apje'jkl plastic meshl ta'n wiaqi nastekl "boltl" wiaqi-ankaptasikpnn. Kepaqsi weswa'tasiksipnn testl, ankaptasikipni'kw kaqismilamu'ksijik nuji-mawo'tu'titewk ta'n istu-temikkl wjit ta'n teli wli-nukwekl mntmu'k wa'wmual. Analysis of variance ewewasikip ta'n newte tel-temikk wjit msit nuji-mawo'tu'titewk ankaptasikip. Mu istue'ktnukip ta'n pilui-temikl pasik na'sik meski'kewel meshl, apje'jkewe'l meshl aqq harpl iknmitip mawi pukwelkl wa'wl, pasi'k aji-pase'kip maw-elkip sasqale'sey apapi'j, bolt-iktuk aqq harp-iktuk. Mawi-apje'jk mawatasikip Chinese'l a'kwesnn, boltl, wskitkuk kmuje'l episkaqawikkl aqq ke'kwey sasqalese'k apapi'jk. Nutki-pase'kip Chinese'l akwesnn aqq kmuje'l episkaqawikkl. Mita ta'n tel wli-eykip koqoey ki's kelukip ta'n teli-mawotasikip koqoey, welikwekip, naqmasi-menatumkip, nujotasik aqq nuji-klotmk, apje'jkewey meshl teli-swatasikip mawi-kluktn.

INTRODUCTION

Bras d'Or Lake in Cape Breton, Nova Scotia, is characterized by numerous protected, shallow, and frequently hard-bottom bays. Open directly to the sea to the north through Great Bras d'Or and Little Bras d'Or Channels, and to a very limited degree in the southeast by a lock system through St. Peters Canal, the lake has variable salinities between 5 and 27 ‰. It has a small, possibly genetically distinct population of American oysters, *Crassostrea virginica*, which has been kept separate from introduced oysters by legislated prohibition under the Nova Scotia Aquaculture Regulations (1990) and by other legislation preceding it. The excellent spring and summer conditions for oyster reproduction and growth in the Bras d'Or, combined with its genetic isolation, bestows on this isolated population a special status.

In 1992, the Eskasoni Fish & Wildlife Commission (EFWC) began to research the most economically feasible methods of cultivating this oyster. In the context of potential commercial exploitation, it was proposed that different aspects of the life cycle of *Crassostrea* should be examined during the program, with a view to improving both product quality and growth efficiency compared with traditional bottom cultivation methods. Oysters naturally-settled on suitable bottom currently comprise the bulk of the industry in Cape Breton but it takes six to seven years for animals so reared to attain market size. Further, increasing pollution of traditionally harvested and leased areas in the Bras d'Or Lake now limits that production through closures. Recent sales of *C. virginica* from the Bras d'Or have been modest, annual reporting for the year 2001 being approximately $900,000. It is the Commission's belief that the oyster resource is under-exploited, and that despite increasing closures due to coliform contamination there is potential, in certain areas, for development.

One of the program requirements was access to a suitable study site. Since the 1930's, Gillis Cove, near Orangedale, had been known to Department of Fisheries & Oceans (DFO) as a reliable oyster spat collection area and it was eventually legally established as a site solely for that purpose. In the 1960's and continuing to 1976, Gillis Cove was a DFO field station site for *Crassostrea* studies. Following completion of DFO use of the cove, a private shellfish grower used it as an oyster collection site well into the 1980's. An arrangement was made in the early 1990's between DFO and the EFWC to allow the Commission to occupy and use the property for oyster research. With DFO support, that use began in 1994 commencing with the oyster cultivation program that continued through 1998 and the cove is currently being used as a seed source for growout areas elsewhere in Bras d'Or Lake.

An initial study, carried out under the auspices of the EFWC (Brian C. Muise and Associates, 1992) suggested that examining spat collection efficiencies would be fundamental to the success of such a program, particularly as the introduction of stock foreign to the Bras d'Or Lake was out of the question. The decision was therefore made to begin by examining collection efficacy of several spat collectors previously, or currently, used in the Maritime oyster industry (Chinese Hats, Veneer Rings, Harps and Shell Strings) as well as Large plastic Mesh and Small (Vexar™) Mesh and single strand nylon cordage (called "Bolts"). This initial phase of the program, conducted at Gillis Cove in 1994, is reported here.

The DFO scientist who was responsible for designing, planning and executing the experiment reported here left the Department after all the fieldwork was completed. Rather than see potentially useful information lie fallow, the senior author was persuaded to collate and analyse the data available, then prepare this report in the hope that it might provide some guidance for future studies of oyster spat collection methods. The fact that the senior author, and writer, at no time observed the collection methods on site and had no involvement in retrieving the raw observations leaves him with rather more caution about the findings than would otherwise be true. Nevertheless, that caution does not extend to discounting the interesting findings altogether.

MATERIALS AND PROCEDURE

DESCRIPTION OF GILLIS COVE

Gillis Cove is situated on the north side of North Basin in the western portion of Bras d'Or Lake, Cape Breton Island, Nova Scotia (Figure 1). This crescent-shaped cove, with a central axis length of 0.75 km and a maximum width of 0.2 km, has an estimated surface area of 0.11 km^2 and an entrance onto North Basin approximately 70 m wide. During June and early July, surface salinity ranges from a mean high of 20.8 to a mean low of 9‰ and is influenced by two small, intermittent streams causing occasional dips to 6‰. Average maximum water depth along the middle portion of the cove is 4.0 m and at the entrance the maximum depth is 5.5 m. Tides in North Basin have a semi-diurnal amplitude of 4 cm, a diurnal amplitude of 1 - 2 cm, but within the lake system water levels are affected principally by atmospheric pressure changes over Sidney Bight, the patch of Atlantic Ocean immediately adjacent to the northeast side of Cape Breton at the seaward (north) end of Great Bras d'Or Channel, the deeper and wider of the two northerly entrances to the lake from the Atlantic. These pressure effects can induce Bras d'Or water level changes approaching 0.5 m, detectable over the entire lake complex (B. Petrie, personal communication). Prevailing late spring to early summer winds are southerly which tend to keep surface water within Gillis Cove thus limiting water exchange between the cove and North Basin. With mean late spring and summer salinities and temperatures holding within reported favourable limits (Kennedy, et al. 1996) for *Crassostrea*, Gillis Cove is ideal for both broodstock maturation and spat collection.

RAFT TYPES AND SITING

Collectors were suspended from a series of rafts, eighteen of which were deployed in sets of two or three at seven locations in the cove (Figure 1). Raft groups were anchored at both ends with no set orientation. Raft Nos. 1-15 were rectangular, with floatation on each corner and with parallel wooden rails laid across at 0.30 to 0.46 m centers from which the collectors were suspended. Raft Nos. 16 - 18 were of aluminum construction being roughly square and having horizontal aluminum tanks on two opposing sides and

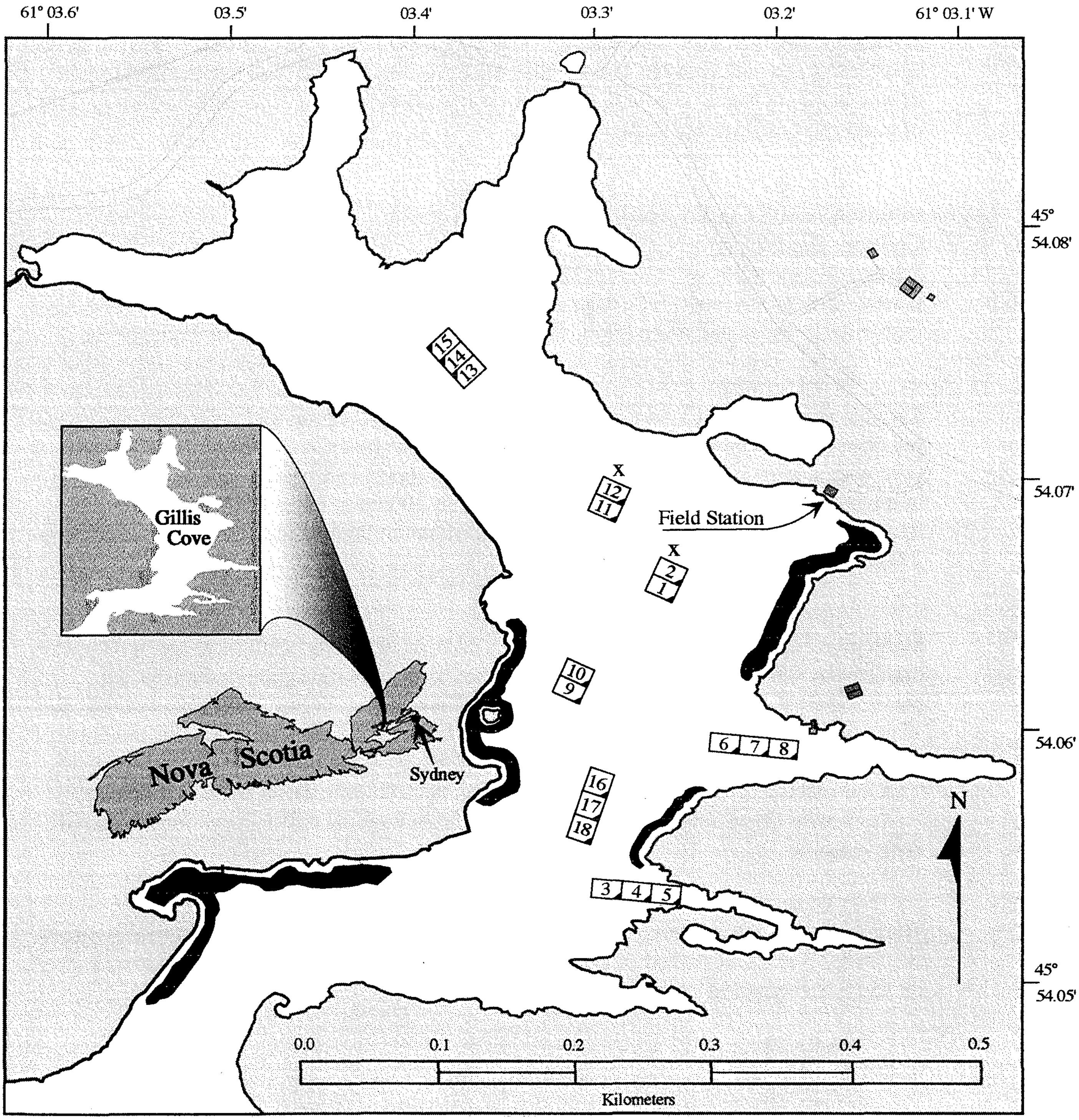

Figure 1. Gillis Cove showing raft locations and numbers, sampling stations (X), and oyster beds [ ]. For clarity, raft scale is exaggerated in this illustration.

held apart by aluminum framing members. A central aluminum beam parallel to the floatation tanks and attached to the framing members divided the collectors into two groups. Rails on these three rafts were approximately half the length of rails in the other raft design, and collector deployments were staggered amongst "half rails". That is, if the first half of row one (rail No.1) was used, the opposing half was not but the second half of row two (rail No. 2) was then used. Appendix Tables 1a - d represent the arrangement of collector deployments among the rafts.

COLLECTOR STYLES AND DEPLOYMENT

Collector Descriptions

Seven collector types were used: Chinese Hats (CH), Large plastic Mesh (LM), Small plastic Mesh (SM),Harps (H), Bolts (B), Veneer Rings (VR) and Shell Strings (SS). Figure 2 illustrates the seven types, described below, and their depths of deployment.

Shell Strings

Single scallop shells of an approximate average height of 12 cm had 1 cm diameter holes punched in their centers and were placed concave side down on 12-gauge vinyl-coated wire with spacers (~5 cm long) between them to support and separate the shells. The numbers of shells per collector ranged from 15 to 29 with a mean of 23. Shell String lengths ranged from 1.5 to 2.0 m. Suspension depth to the top shell of each collector was 1 foot (0.30 m) (Figure 2).

Chinese Hats

Standard oyster collection devices, these are perforated, plastic shallow cones, 0.34 m in diameter by 0.09 m high with a hole at the apex through which slides a 5 cm (o. d.) plastic pipe on which they are stacked, twelve "hats" per collector, with spacers between. These twelve-unit assemblages, each considered to be one collector, were first covered with a thin cement coating before being stacked on the pipe, then vertically suspended with 2.0 feet (0.61 m) of water above the top of each (Figure 2). A randomly selected collector was disassembled and the top, sixth and bottom (twelfth) "hats" were taken for spat sampling.

Veneer Rings

Two rings, 17.8 cm in diameter and made from 3 inch (7.62 cm) wide wood veneer, were suspended one above the other, 3.0 feet (0.91 m) below the surface to the upper ring after having been coated in cement and dried (Figure 2).

Large Mesh

Rolls of two-inch (~5 cm) plastic mesh were cut into strips approximately 54 cm wide by 125 cm long. These collectors could also be described as being 6 squares (or diamonds) wide by 16 long, were weighted by a small piece of cement attached to one end and vertically suspended from cross pieces on the rafts such that the upper part of the mesh was 2.0 feet (0.61 m) below the surface (Figure 2). Although machine manufactured, the "diamond to diamond" measurements across the material were inconsistent, as were

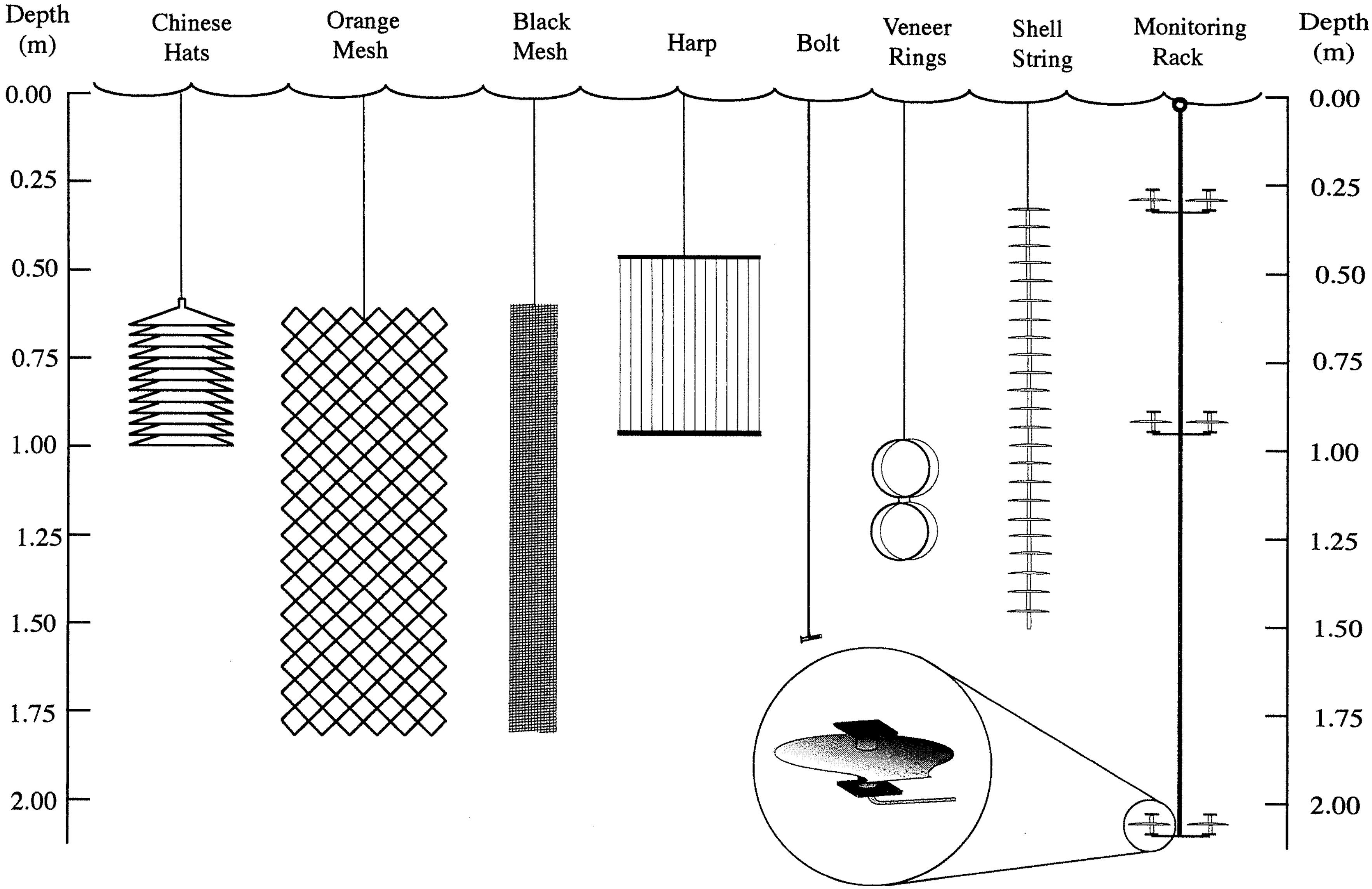

Figure 2. Approximate relative sizes, configurations and deployment depths of collector types tested and of the monitoring racks used to determine spat settlement onset.

those of the strands that formed each mesh. Overall mean mesh and strand dimensions were calculated, however, and are given in Figure 3. Omitting row 16, the total surface area of one side of this collector (15 rows and 6 columns of "diamonds") was estimated to be 1,309.5 cm^2, and of one side of one mesh, inclusive of shared corners, 15.48 cm^2.

Small Mesh

Rolls of half-inch (10 mm) Vexar™ mesh were cut into strips approximately 125 cm long by 15 to 25 cm wide. As with Large Mesh collectors, these were weighted by a small piece of cement attached to one end and suspended in a similar fashion to the Large Mesh. Mesh and strand size were quite consistent throughout the material and the total surface area of one side of a collector of 15.2 cm width by 125 cm long (13 by 104 "squares", and oriented as in Figure 3) was estimated to be 1502.8 cm^2. The sampled area, which was one side of four contiguous squares (arranged 2 by 2) was 6.79 cm^2.

Harps

As with Chinese Hats, these are also traditional collecting devices but comprised of fourteen bands of flexible plastic held top and bottom by headers made of similar, but more rigid, material. Each Harp was comprised of 14 bands that were 3/8 inch (9 mm) wide by 17 1/4 inch (44.5 cm) long and spaced at 1 3/8 inch (3.5 cm) centers. This style of collector was suspended in the water with the bands vertical, the lower header inter-band spaces being filled with cement to ensure that the vertical position was maintained. The upper header was positioned 1 foot 6 inches (0.46 m) below the water surface, the lower header was then at 0.91 m (Figure 2).

Bolts

These were lengths of green, 5.2 mm diameter braided nylon cordage, weighted at one end with a metal bolt (hence the name) and suspended with 60 inches (1.52 m) of its length submerged (Figure 2).

SALINITY AND TEMPERATURE MONITORING, AND GONAD MATURATION

Beginning the first week of June and continuing to the end of July, weekly samples of 8 to 20 adult oysters were selected from the natural beds in Gillis Cove and inspected to determine nearness to spawning. Oysters were opened and their gonads were individually rated according to the criteria in Table 1. This four-point scheme is a simplification of a ten-point system first produced by Butler (1947).

Table 1. Gonad maturation rating system for wild adult American oysters, Gillis Cove.

Numerical Value	Gonad State	Gonad State Description
1	Spent	Tissue flaccid and translucent
2	Immature	Gonad 75% translucent
3	Maturing	Digestive gland visible, gonad 25% translucent, tissue opaque
4	Ripe	Digestive gland barely visible, tissue cream-coloured and opaque

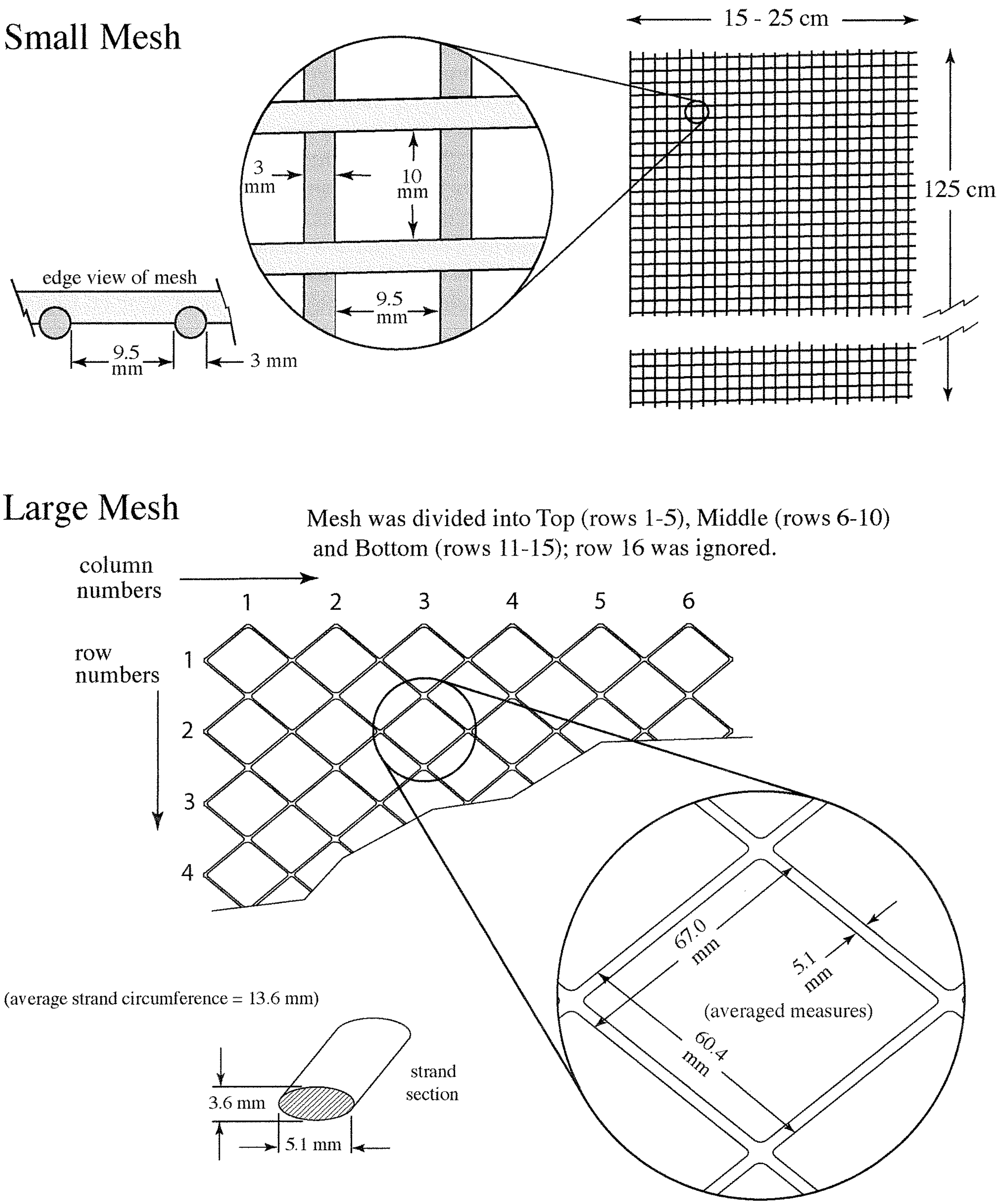

Figure 3. Small and Large Mesh materials used in spat collection. Magnified views of mesh in the figure are stylized; material surfaces in both cases were not as smooth as shown.

Gonad maturation is affected by hydrographic conditions, principally temperature and salinity, which are both annually variable at any geographical location (Galtsoff 1964). A model 30 Yellow Springs Instruments temperature/salinity recorder was used in the regular collection of these data from two sampling sites in Gillis Cove, one at raft No.12, the other at raft No. 2 (Figure 1). Readings were taken at least at one of the two sites, twice daily and at depths of surface, 1 foot, 2 feet and 3 feet (0.0, 0.3, 0.61 and 0.91 m). Data were averaged over the two sites when both were sampled (see Appendix Table 2). Temperature was used in combination with other indicators, including observations of wild stock gonads, as a signal for spawning onset and as a guide for eventual collector deployment. As drastically lowered salinity can have detrimental effects on oyster reproduction, it was monitored to assure field staff that biological events were on target.

MONITORING OF OYSTER LARVAE, EARLY SPAT SETTLEMENT AND COLLECTOR DEPLOYMENT

In July, oyster larvae were collected daily by pumping water at raft No. 12 through 25 µm Nitex screen and age estimates (in days) were made of any larvae captured. In addition, settlement was monitored daily by noting spat on scallop shells mounted each day on a "monitoring rack" (Figure 2), suspended from raft No.12. This monitoring rack style had been used for years in the cove and was left unchanged for this study. Scallop shells were mounted at depths of 1 foot (0.30 m), 3 feet (0.91 m) and 7 feet (2.13 m). Originally, one of the two shells at any depth was to be removed and replaced at 24-hour intervals and the other at 48-hour intervals. At this study site, however, because of intense algal fouling, staff used only a single shell at each depth to monitor 24-hour settlements. Shells were held between rubber spacers on U-shaped metal rods attached to a central metal bar hanging vertically in the water (Figure 2). When the daily concentration of settled spat reached 25 per shell, at any depth, deployment of the full suite of experimental collectors was begun; in 1994 that day was July 19. The full suite of collectors was completely deployed by July 20.

Among rafts 13 to 15, situated in the northwest corner of the cove, collectors were arranged in ascending order in a southwest to northeast direction (the orientation of the rails) and numbering began on the most westerly corner of these rafts and proceeded towards the northeast, rail by rail, across the raft, for each of these three rafts. The remaining fifteen rafts were oriented with their rails more or less at right angles to these other three (i.e., oriented approximately southeast to northwest) and collector numbering direction was adjusted accordingly.

From a container with eighteen sequentially numbered tiles, three (Nos. 1, 2 and 17) were randomly selected representing the three rafts from which collectors would be taken for spat sampling. All collector types were represented among the three rafts chosen for sampling, but the distribution of each collector type was uneven among them. Collector numbering on these three rafts began in the southeast corners and proceeded northwesterly, rail by rail, across the raft. The starting points for numbering collectors on each raft are indicated in Figure 1 by a black triangle in one corner of each raft.

Collectors of any one type were numbered sequentially over all rafts, rail by rail, beginning with raft No. 1, to the last of that collector type found on raft No. 18 (Figure 1, Appendix Tables 1a - d). For spat sampling, three collectors of each type were chosen by randomly selecting three tiles from a container of sequentially numbered tiles representing the total number of collectors of that type deployed among rafts 1, 2 and 17.

Oyster Spat Sampling, by Collector Type

The main sampling to determine spat density and mean length per collector was done from August 16 to August 22, as follows. Spat were physically removed from Bolts, Harps, Large Mesh, Small Mesh, and placed in labeled vials for later counting and sizing. Shell length measuring and counting were performed *in situ* on Veneer Rings, Shell Strings and Chinese Hats. In every sampling instance, whether for a specific depth range (Top, Middle, Bottom) or in the case of Veneer Rings where only one depth was used, three separate spat samples were either taken or recorded. Means were then calculated for both the density and shell length data gathered. Lengths, to the nearest mm, were taken by using a set of calipers. Dates are indicated when specific collector types were sampled.

Shell Strings (SU, SL): August 17, 18

All shells in a selected "string" were counted and that number divided by three to enable designation of the Top, Middle and Bottom ranges from which one shell each was selected for spat sampling. Each shell string randomly selected for counting had 23 shells each. A one-inch square (6.4516 cm^2) indelible ink stamp was used in designating the sampling area in both upper (SU) and lower (SL) surfaces of the shells selected. A clear plastic circular grid template was used on the shells to determine the position of the stamp that, in some instances if positioned towards the edge, extended beyond the shell (Figure 4). In these cases fractional estimates were made of the total stamp area actually on the shell, and spat counts extrapolated to full square inch (6.4516 cm^2) equivalents. The template degree line running from 0 to 180 was positioned such that it ran at right angles to the hinge, through the shell's center, dividing the shell into two equal halves. Concentric circle designations, once the template was placed on the shell, were established as follows: the circle just beyond the edge of the shell was "0", the edge of the shell itself was "1", the next circle in was "2", etc. (Figure 4). Raw data for replicate Shell String sampling are in Appendix Tables 3a and 3b.

Chinese Hats (CU, CL): August 16, 17

The area sampled (on both the upper and under surfaces of the three "hats" per collector) was a one-inch square area (6.4516 cm^2) marked on the surface by using the rubber stamp and indelible ink used for the shells. The stamp was positioned by using another (larger) plastic, transparent template that was designed to fit, separately, into the lower and onto the upper surfaces of the hat. The template surface was marked by 36 radial lines, each 10 degrees apart, and by concentric circles of radii decreasing by one inch (2.54 cm) beginning from the circumference of the hat and ending at the outer edge of the central hole where the support pipe was positioned.

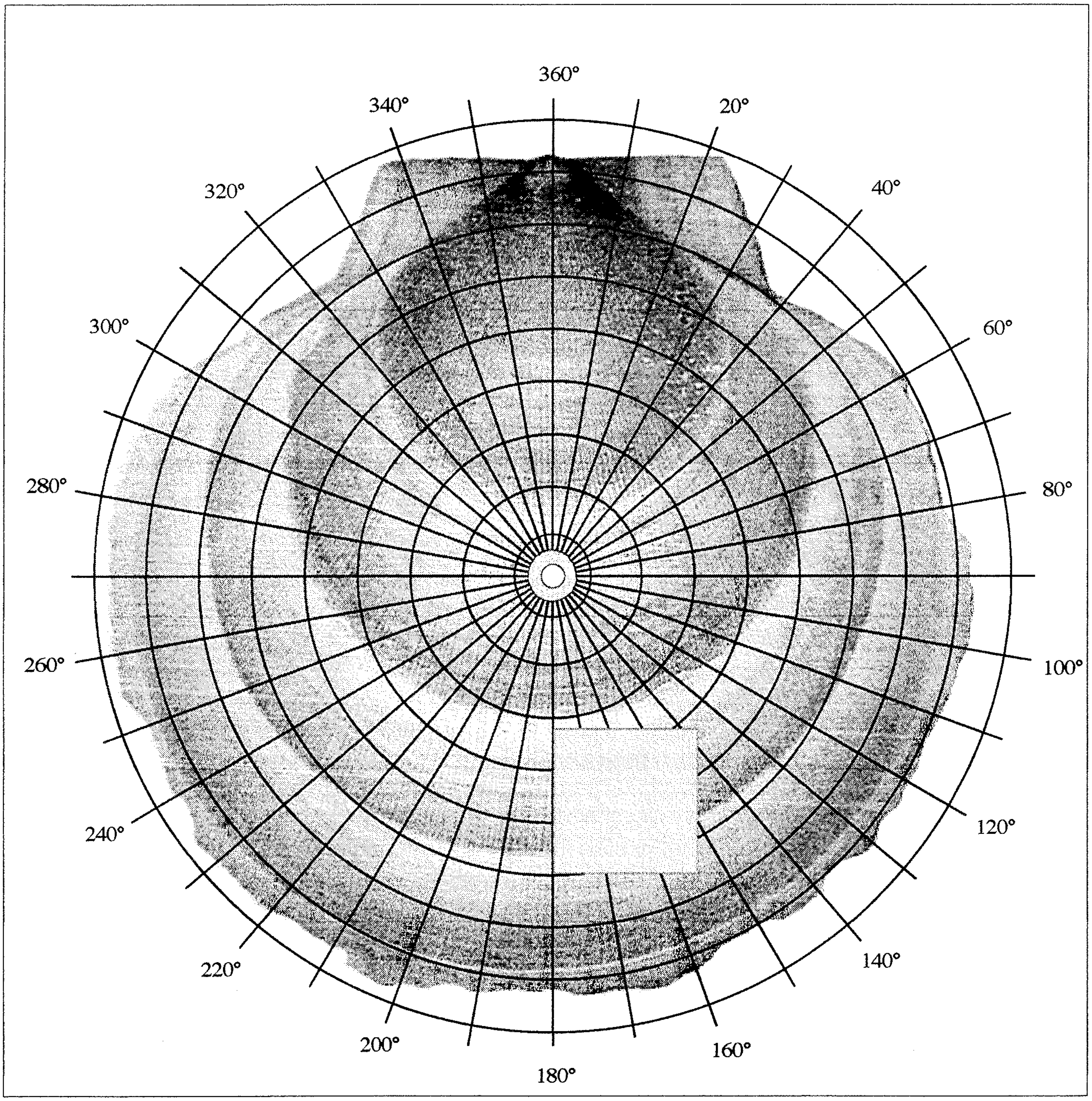

Figure 4. Scallop shell with transparent grid in place and showing the position of the one-inch square stamp impression at ring 4, 180°, where sampling would be done. The circle number beyond the shell edge is '0', the shell edge is No. 1, the next circle in is No. 2, etc. (Illustration is not exactly to scale.)

Once the template was placed against either the upper or underside surface of the plastic cone, a random number from 1 to 36 was drawn from a container of 36 numbered tiles. This number represented one of thirty-six "10° lines" around the collector. Positioning of the template's zero degree point on the periphery of the hat was done randomly as there were no distinguishing features of the plastic rim to use as a reference point. The hat was positioned such that the selected 10° interval line was towards the operator, thus establishing consistent "right" or "left" relativity for positioning of the stamp. From a container of five tiles numbered sequentially from 1-5, one number was withdrawn. This number then represented a specific concentric circle of the five on each hat. The combined sector and circle numbers were used as a guide to positioning the stamp imprint that delineated the sample area. The stamp was positioned with one edge aligned with the degree line chosen (i.e., with one edge parallel to the slant height of the cone), and with the left corner nearest the operator directly over the coordinates selected. Therefore, in all cases, the square sampled was to the right of the coordinates selected. To ensure the best alignment of the corner of the stamp with the spot directly under the clear plastic template, either an obvious reference point was noted at the desired location and the template removed to allow the stamp to be applied, or the template was bent upwards allowing the operator to position a finger tip at the reference point as a guide for the stamp. While obviously not absolutely precise positioning, this was the best method developed.

The resulting blue indelible ink square was the area sampled. Spat measured and counted (*in situ*) were those that were entirely within the square plus those which had settled within the square but whose edges had grown beyond the square's boundary. Not included were those that had settled outside the square but had grown into it. Both the upper (CU) and lower (CL) surfaces of the Chinese Hat chosen were sampled in this way. Raw data for Chinese Hat replicate sampling are in Appendix Table 3c and 3d.

Veneer Rings (VO, VI): August 22

A coin was flipped to select either the upper or lower Veneer Ring in a set (on every occasion the top ring was selected). Placing the ring on a level surface on its side, and beginning from the seam in the ring, a clear template with radial degrees marked on it was centered and placed over the upper edge of the ring with the zero degree mark in line with the ring seam. The sector selection process used with Chinese Hats and Shell Strings was also employed to identify the 10° sector for sampling Veneer Rings. The veneer band was 3 inches (7.62 cm) wide and this was divided into three parallel 1-inch (2.54 cm) strips running around the ring, numbered from the upper edge downwards when the ring was placed horizontally on one side. Again, by randomly selecting one tile from a container of three sequentially numbered tiles, the band was chosen from which spat would be collected on the outside of the veneer (VO). Another sample was taken from the inner surface of the ring (VI) after making further random tile selections for both radial line and one-inch bands. The reference point for the inside sampling was first located on the outside of the ring, then by subsequent careful measuring, that position was transferred to a spot on the inner surface. Again, while not absolutely precise, this was the best procedure developed. Raw data for Veneer Ring replicate sampling are in Appendix Table 3e.

Large Mesh (LM): August 19

The mesh strands were somewhat flattened or crudely elliptical in cross section. The chosen collector was carefully placed on a flat, horizontal surface to avoid accidentally dislodging spat. There was no intentional selection of one side over the other. The mesh sheet was divided into Top, Middle and Bottom sections, each of these sections having five diamonds (or mesh "squares") down the side and six across the width (Figure 3). The sixteenth, or bottom-most row of squares, was ignored. By randomly selecting numbered tiles from a container, one of the six points on the top row of each of the three divisions (Top, Middle, Bottom) was chosen representing a column of squares, counting from the left. A horizontal row of diamonds was similarly selected down the left side of the collector. The intersection of the chosen column and row marked the single "square" that was sampled (Figure 3) for that depth segment. The total area sampled of one side of one square was approximately 15.48 cm^2. Raw data for Large Mesh replicate sampling are in Appendix Table 3f.

Small Mesh (SM): August 18

"Half inch" (10 mm) black Vexar™ mesh was cut into strips 6 inches (15.2 cm) wide by 49 inches (124.5 cm) in length. Compared with the Large Mesh, the Small Mesh configuration was more nearly a square, and fibers running one direction were more "attached" to those running the other direction than running "through" each other (Figure 3). Squares to be sampled were selected as follows. By assigning numbers to empty spaces going across the top edge of the collector, and separately down the left side, then randomly drawing tiles from separate containers of sequentially marked tiles representing these horizontal then vertical spaces, one particular square was chosen. This square always represented the upper left in the set of four (arranged 2 by 2) that were sampled. On no occasion during this selection procedure was either the extreme right column or the very bottom row in a depth range (Top, Middle, Bottom) selected. Raw data for Small Mesh replicate sampling are in Appendix Table 3g.

Harps (H): August 16, 17

The selected Harp was retrieved and, by using a piece of string previously attached to one corner of the harp as a reference point for a side, the numbering sequence of the 14 prongs was identified. By a random selection of one tile from 14 numbered tiles in a container, the particular prong for a given collector was identified for sampling. By flipping a coin it was determined which of either the left or right side of the prong would be sampled. The upper, middle and lower thirds of each harp, and therefore of the prong for sampling, was defined by first measuring then dividing the prong into three equal parts and by marking with a paper clip. Each 1/3 of a prong side represented 2.2991 square inches (14.8333 cm^2) of surface sampled. These segments were individually stripped of spat that were then designated as having come from Top, Middle and Bottom samples for later counting and shell length measuring. Note that with Harps, which covered a restricted depth range, these three samples were eventually considered to have been "Top" replicates only, for statistical analysis. Raw data for Harp sampling are in Appendix Table 3h.

Bolts (B): August 22

Each submerged portion was divided into three equal sections (Top, Middle, Bottom) and, depending on the length (in inches) of each, the appropriate number of tiles was placed into a container and three were randomly selected for each of Top, Middle and Bottom. Each of those three "inches" within a section was then sampled for spat that were removed from the entire circumference of the cordage. The surface area sampled from one inch (2.54 cm) of cordage was approximately 4.14 cm^2. Raw data for replicate Bolt sampling are in Appendix Table 3i.

DATA TREATMENT

Gonad maturation, temperature and salinity monitoring

After each adult animal was rated according to the scheme in Table 1, a gonad index for a given sampling day was defined as the arithmetic mean of the numerical values given to individual oysters. The index as originally used placed the fourth level as "spent" and level 1 as "immature". As the result was intended to provide a measure of the state of population readiness to spawn it was therefore believed that a revision was in order. It was felt that the definitions in Table 1 (level 1= spent, level 3 = ripe, etc.) would present this picture more accurately as rising numerical values would follow rising gamete concentrations. For the purposes of this work it was assumed that the higher the mean value the closer to spawning was the majority of oysters. Given the potential influence that salinity and temperature have on oyster reproduction, these were plotted together with the mean gonad index values. The temperature and salinity data were also plotted separately, but with standard deviations about their means. Raw temperature and salinity data are reported with gonad index data in Appendix Table 2.

Spat Density

The depths at which data were taken are represented in Table 2. In the case of Shell Strings, spat counts and measurements were made *in situ* on the scallop shell upper surfaces (SU) and the lower surfaces (SL) and the same was done for Chinese Hats (i.e., CU and CL) and on the outside and inside of Veneer Rings (i.e., VO and VI).

Table 2. Approximate (±5 cm) depth ranges (m) of collectors in the three depth categories (Top, Middle, Bottom).

Collector Type	Code	Top	Middle	Bottom
Small Mesh	SM	0.61 - 0.99	0.99 - 1.37	1.37 - 1.75
Large Mesh	LM	0.61 - 0.99	0.99 - 1.37	1.37 - 1.75
Shell Strings (Upper)	SU	0.30 - 0.66	0.66 - 1.08	1.08 - 1.44
Shell Strings (Lower)	SL	0.30 - 0.66	0.66 - 1.08	1.08 - 1.44
Bolts	B	0 - 0.51	0.51 - 1.01	1.01 - 1.52
Harps	H	0.46 - 0.61	0.61 - 0.75	0.75 - 0.90
Chinese Hats (Upper)	CU	0.70	0.84	1.01
Chinese Hats (Lower)	CL	0.70	0.84	1.01
Veneer Rings (Outer)	VO	--	0.91	--
Veneer Rings (Inner)	VI	--	0.91	--

Spat Settlement Density By Collector Type

The mean spat counts per cm^2, by collector type and depth, are shown in Appendix Table 4a.

To evaluate whether there were depth effects, a randomized-blocks analysis across the three depths (Top, Middle, Bottom) was performed for each of the first five collector types above, shown in Table 2, deployed at these depths. (The range of depths for the remaining five collectors (Harps, to Veneer Rings) was too restricted to justify such analysis.) A common error variance was computed and used for all five of these randomized blocks, and analysis was followed by post-hoc evaluation of contrasts across the means by using the method of Rodger (1974) and his special table of F-ratios (Rodger, 1975).

Spat Density Differences Among All Collectors By Common Depth

The actual depths at which collectors were placed are shown in Table 2 and the spat density data, for all ten collector types, were classified into four equal depth sets (half meter ranges) from the surface to 2 m. Analysis of variance was performed over collector averages. To reduce any influence that different average depths might have, the Harp and Veneer Ring data were moved down and classified as 1.0 – 1.5 m so that all ten treatments could then be analysed at a more or less single, common depth.

Spat Shell Length

Spat Shell Lengths By Collector Type

The actual mean spat shell lengths, by collector type and depth, are shown in Appendix Table 4. While the number of spat settled per cm^2 on a collector is an important indication of that collector's efficacy, another indicator is spat growth, measured by the mean difference in shell lengths of the spat compared among all collectors. Therefore, as was done for spat density, possible depth effects were sought on shell length by collector. Shell length across depths within collector types was analysed by randomized-blocks design, one analysis for each collector type. Each of these five analyses used the same, common error variance.

Shell-Length Differences Among Collectors

The actual depths at which collectors were placed and the three depth categories (Top, Middle, Bottom) used for the analysis are shown in Table 2. A randomized-blocks analysis across the three depth ranges (Top, Middle, Bottom) was again performed for each of the first five collector types, shown in Table 2, deployed at these depths and once again using the same common error variance. The range of depths for the remaining collector types (Harps to Veneer Rings) was again too restricted to justify such analysis.

RESULTS AND DISCUSSION

SALINITY, TEMPERATURE MONITORING, AND RECRUITMENT PREDICTION

From years of observation at Gillis Cove, it was known that *C. virginica* larval stage duration ranges between 15 and 20 days with 16 days being the usual (Woo and McIver, 1974). Knowing from past experience when the bulk of spawning occurs allows better timing of collector installation although annual variation in weather before spawning can affect gametogenesis and subsequent unpredictable environmental events can, in turn, affect the duration of the larval phase. Collectors installed too late miss the major spatfall, in part because their surfaces may be "unseasoned", while those deployed too early can become fouled with algae (as they do in Gillis Cove), discouraging settlement. While every effort was made to avoid algal contamination, one collector sample was nonetheless compromised by algae and was nearly completely devoid of spat (Appendix Table 3a: Shell string #5, Middle depth, upper surface).

Salinity

Salinity, having been identified as having effects on oyster reproductive processes, was examined as a way of aiding prediction of these events. Butler (1947) reported that salinities constantly below 6‰ limit both gonad development and feeding, but that both improve above that level while Ulanowicz et al. (1980) implicated salinity changes due to rainfall as influencing spatfall. Although field staff kept records of noteworthy meteorological events, weather records for the Cape Breton region were nonetheless consulted. Atmospheric Environment Services of the Department of Environment reported precipitation amounts at Sydney, Nova Scotia, of 3.2 mm, 4.8 mm and 9.4 mm on July 16, 25 and 27 respectively in 1994, near the time of anticipated settlement. None of these amounts, however, suggests a major influence on seawater, assuming that such modest rainfall was also typical of the greater Bras d'Or Lake vicinity, including Gillis Cove, approximately 75 km to the southwest of Sydney (Figure 1). Field staff nevertheless observed heavy rainfall at Gillis Cove on June 24 and 28 that year, and also on each of July 2, 3 and 4. While neither of the June downpours seems to have affected cove salinity, there was an observed mean drop from roughly 20‰ to 16‰ (Figure 5, Appendix Table 2) concurrent with the precipitation events of early July. The salinity drop, and recovery, was well before the spatfall anticipated later that month and there were no further reports in the region, official or otherwise, of heavy precipitation in July. It is unknown whether the effects of this rainfall affected broodstock in the local oyster beds. There were effects observed down to as deep as 0.91 m (Appendix Table 2), the approximate depth from which adults were sampled for gonad index determination, but by the time of the reported heavy rains the major part of annual gametogenesis had already occurred.

The salinity range reported in the literature for *C. virginica* reproduction and recruitment varies widely from 10‰ to 28‰ (see Kennedy et al. 1996 for review) and it is therefore presumed that there was nothing untoward in the salinity profile of June and July, 1994, that would have negatively affected these processes at Gillis Cove. Further, Davis and Calabrese (1964) report that larval development is governed by the salinity at which parents underwent gametogenesis and therefore as the broodstock was local, and relatively shallow, one would thus expect larvae to perform satisfactorily. These authors suggest, however, that the speed of salinity change may be more important than the actual salinity itself and, if so, sustained rainfall could have produced measurable effects. Mean daily salinities observed during this experiment (Figure 5) remained between 14 and 20‰, with the majority between 18.5 and 20‰, a range entirely suitable for oyster growth, gametogenesis and spawning. Due to occasional precipitation, certain surface values dropped well below that range but rapid dissipation of the fresh water meant that any negative effects on the oysters were non-detectable.

Temperature

Compared with salinity, the effects of temperature on oyster reproduction and recruitment are reportedly greater. Annual variations in weather and hydrographic conditions affect the temperature profile of any body of seawater and hence the oyster's general physiological development and in turn the timing of spawning onset. A temperature trigger of 18 to 20°C has long been associated with spawning onset in the American oyster (Butler, 1947). From the mean temperature data it would appear that in 1994 commencement of the major spawning at Gillis Cove would have been between June 26 and June 29 while mean temperatures in this period were between 18 and 20°C (Figure 5). Nevertheless, high variability within the 4 to 8 readings comprising each mean (Figure 6) suggests that some spawning, even if only of brief duration, could have been triggered earlier.

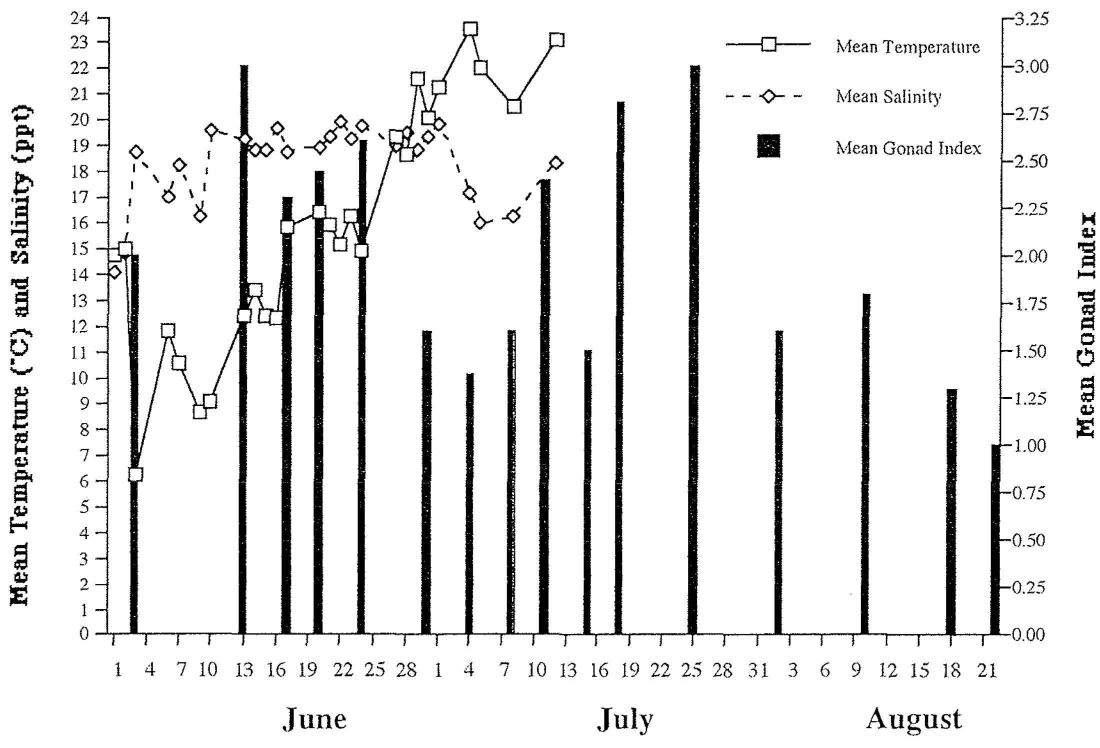

Figure 5. Mean temperature and salinity with respect to population gonad index of *C. virginica*, Gillis Cove, 1994.

In fact, the weekly mean gonad index declines prior to June 26 and that may have been a signal that the oyster population had already begun to spawn. Unfortunately, no gonad index was determined between June 24 and June 30 so the trend in that period is unknown. Furthermore, the certainty as to exactly when major spawning might have occurred is limited given the wide confidence intervals on the small numbers (8 – 20) of oysters taken on each occasion. While the mean index generally climbs in the first five sampling occasions (to June 24) and drops in the following two (June 30, July 4), the index seems to rise again in July to another high between July 18 and 25. The reason for this second peak is unknown but may be a result of sampling inconsistency. This high variability is, nevertheless, consistent with other observations of variable ripeness seen in other populations of the American oyster (Loosanoff and Engle, 1940; Loosanoff, 1942). The general index tendency declines from mid-June to late August, a warm-water trend in keeping with the expected reproductive processes in Maritime inshore bivalves. For the purposes of this study, and notwithstanding signals that some spawning might have occurred in late June, it was assumed from the available information that the major spawning onset actually occurred around July 4. Accordingly, a tentative date of July 19 was established as the time for collector deployment, or one day before the expected onset of the major settlement.

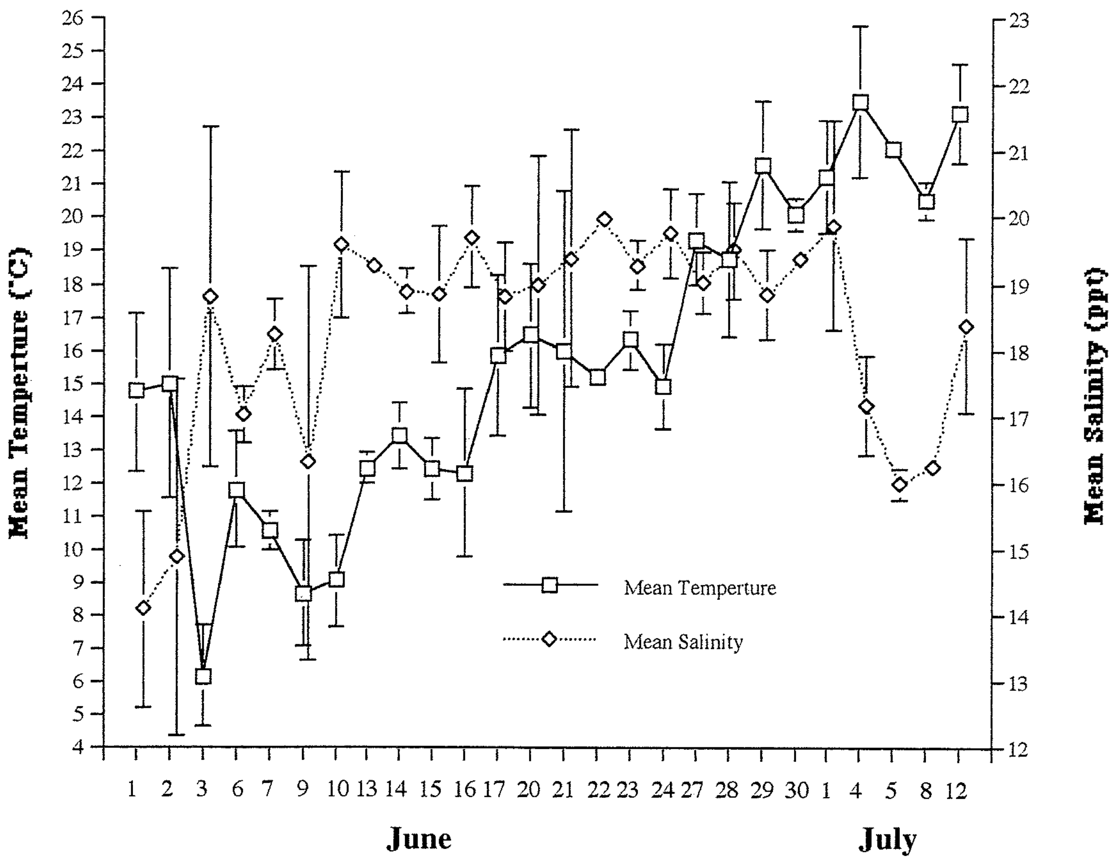

Figure 6. Gillis Cove mean temperature and salinity profiles (± 1S.D.) in June and early July, 1994. Each mean involved 4 or 8 separate readings depending on whether one or both sampling sites had been visited that day (Appendix Table 2).

Medcoff (1955) reported that peak recruitment in Nova Scotia is variable within July and August, a not surprising observation given the annually variable summer winds and precipitation in the province. Hidu and Haskin (1971) have noted a concordance between increased temperature and settlement, an observation that agrees with that of Lutz et al. (1970) who associated increased set with sharply rising temperature. Temperature changes recorded at Gillis Cove show variability both between and within sampling occasions (Figure 6) and one can only speculate what the magnitude of effects of these changes might have been. Given the limited tides in the Bras d'Or Lake, local winds are the most likely cause of this variability as seen, for example, when one compares June 13 (little variation) and June 21, where the temperature at 0.91 m rose 7.9°C and at the surface by 10.4°C (Figure 6, Appendix Table 2). Medcoff (1939) indicates that a temperature drop of only 2°C can retard settlement by six days therefore the fluctuations reported here are not insignificant. Between July 4 and 8, toward the end of the temperature records taken, a mean drop of 3°C was noted (Figure 6). This temperature decline was concurrent with the early July drop in salinity and was most likely linked to the same cause. It was thus entirely possible that similar drops closer to the third week of July could have occurred, delaying settlement.

Recruitment Prediction

Because of the foregoing uncertainties, the final determination of the time for collector deployment—although guided by temperature records, determinations of gonad ripeness (Figure 5) and by local knowledge—was based primarily on the samples of larvae captured in the cove and on the monitoring rack daily spat settlement. Analysis of captured material on July 13, 1994, confirmed the presence in Gillis Cove of *C. virginica* larvae. Age estimations of these larvae ranged from 8 to 10 days, indicating that the majority of spawning had occurred near July 4 and, hence, that major settlement onset would begin 16 days later. The rise from 0 spat at all depths on the spat monitoring rack on July 15, to 24 spat at 0.30 m on July 19, was a count near enough to the established limit of 25 to suggest that day as the most opportune time for collector deployment. That task was completed by July 20 and by then daily settlements had risen to a range between 57 and 207. Subsequent monitoring rack maximum daily sets (>1,000 spat at 1.23 m and 2.13 m) on August 3 and 4 (Appendix Table 2) confirmed the high likelihood that the then seasoned collectors would have been exposed to the summer's major settlement.

COLLECTOR PREPARATION, DEPLOYMENT & SPAT HARVESTING

From a logistic viewpoint, preparation and deployment of the different collector types revealed immediate preferences. The preparation of Harps, Bolts, Small Mesh and Large Mesh was simplest as there was no pre-treatment of materials prior to deployment. Preparing scallop shells for stringing, cementing Chinese Hats and assembling them on pipes, or cementing Harps or assembling and cementing Veneer Rings were time-consuming and labour-intensive operations.

Further, the ease of spat retrieval also varied among collectors; in general the more complex the collector the more difficult the harvesting. Spat removal from Harps and Bolts was relatively simple requiring little else than a gloved hand to wipe the surfaces. In the case of Harps, the cement would separate from the Harp bands leaving an oyster spat with a small piece of cement attached. Spat removal from Veneer Rings, Shell Strings and Chinese Hats required the collectors to be broken, struck and/or scraped, not always with satisfactory yield. Scallop shells provided a very good surface for oyster attachment although, in many cases, the only way to retrieve an oyster spat was to chip the scallop shell around the oyster, leaving a small piece of the shell attached to the oyster. Scallop shells are never re-used, however, even if they are undamaged following harvesting. Chinese Hats were sufficiently porous that the cement adhered well and thus separation of spat was much more difficult than with Harps and the same was true of Veneer Rings. Experience showed that removal of spat from Chinese Hats, Shell Strings and Veneer Rings often resulted in shell damage and that is why spat in these cases were counted and measured *in situ*. Plastic mesh collectors were the easiest from which to remove spat. Each strip of either Large or Small Mesh was bent and many spat simply popped off, the remainder requiring only a light brush with a gloved hand for complete removal. For some reason this process worked better with the Small Mesh than with the Large Mesh, presumably because of different properties between the plastics used in the two types.

The ease of plastic mesh and Bolt storage compared with storage of Chinese Hats, Harps, Shell Strings and Veneer Rings was also noted. In addition, plastic mesh has a long expected useful life. Although relative costs of collector manufacture, purchase, preparation and use were not closely monitored in this study, the cost per unit of plastic mesh was among the lowest. Bolts were the least expensive in labour and material.

Spat Settlement Density By Collector Type

The decisions for contrasts led to conclusions about the order of the true means and these are shown, along with the sample means, in Table 3. (To illustrate the above idea: Suppose it is decided that the null contrast $\mu_T - \mu_M = 0$ is false and that $\mu_T - \mu_M = < 0$ is true, whereas it is decided that $\mu_M - \mu_B = 0$ is true, then the first of these decisions says that $\mu_T < \mu_M$, the second that $\mu_M = \mu_B$; so both together say that $\mu_T < \mu_M = \mu_B$. Such "conclusions" are shown, without the Greek letters, in Table 3.)

Table 3. Mean spat densities per cm^2 within collectors at Top (T), Middle (M) and Bottom (B).

Collector	Depth Range	Means	F*	Suggested True Order
SM	Top	2.112	1.681	T = M = B
	Middle	2.178		
	Bottom	2.898		
LM	Top	1.881	3.083	T < M = B
	Middle	2.713		
	Bottom	3.022		
SU	Top	2.308	10.735	M < T = B
	Middle	0.896		
	Bottom	3.066		
SL	Top	1.688	10.280	T < M = B
	Middle	3.358		
	Bottom	3.703		
B	Top	1.771	6.507	T < M = B
	Middle	3.088		
	Bottom	3.382		

* F[.05]; 2, 20 = 2.757

The very low SU result (0.896) at the Middle depth seems to be an anomaly but is likely related to algal fouling that occurred on one of the three shell replicates (Appendix Table 3a, #5, Middle). There were only 2 spat found among three replicate samples taken from this one shell in contrast with at least 21 found at all other Shell String (upper) locations.

Comparisons of Shell upper (SU) and Shell lower (SL) surfaces reveal another anomaly, and that is the Top SU value of 2.308 which is higher than Top SL (1.688). This is similar to Chinese Hats (Table 4) where the average upper (CU) count (1.361) exceeds the average lower (CL) count (1.194). These Upper > Lower effects appear to be at odds with established understanding. Nelson (1953) as well as Ritchie and Menzel (1969) all agree that *C. virginica* larvae tend to avoid strong light or silt and preferentially set on undersides of cultch where possible or, if the water has good light penetration, settle more deeply (Medcoff, 1955). Both the Middle and Bottom values of SL (shell lower) are higher than their corresponding SU (shell upper) values and this does, therefore, make biological sense. However, Nelson (1953) also says that as the turbidity of water rises, spat will be found in increasing numbers on upper surfaces of cultch. On the matter of larvae tending to avoid strong light, spat concentrations reported in Table 3 are greater at the Middle and Bottom depths of LM, SL and B, but there is no statistically reliable depth effect for SM. Depth relationships in LM, SL and B do make some biological sense—fewer spat settle near the surface. A depth effect on density is therefore suggested by these data.

Spat Density Differences Among All Collectors by Common Depth

The four depth ranges over which spat were collected are represented in Table 4. The table shows the means of spat densities (per cm^2) on the collectors at various depth ranges, and the average spat densities over all depths.

Table 4. Mean spat densities (per cm^2) per collector at various depth ranges.

Collector Code	0.0 - 0.50 m	0.5 - 1.0 m	1.0 - 1.5 m	1.5 - 2.0 m	Average
SM	-	2.112	2.178	2.898	2.396
LM	-	1.881	2.713	3.022	2.539
SU	2.308	0.896	3.066	-	2.090
SL	1.688	3.358	3.703	-	2.916
B	1.771	3.088	3.382	-	2.747
CU	-	-	1.361	-	1.361
CL	-	-	1.194	-	1.194
H	-	-	2.802*	-	2.802
VO	-	-	1.877*	-	1.877
VI	-	-	1.671*	-	1.671

*Harps were set at depths between 0.46 – 0.9 m and Veneer rings at 0.91 m (see Table 2 and Figure 2), but these treatments have been classed as 1.0 – 1.5 m in Tables 4 and 6 to enable the analysis of all ten treatments at a more or less common depth.

Analysis of variance of the average spat densities over the 10 collectors yielded F(9, 20) = 2.530 and Rodger's (1975) critical value F[.05]; 9, 20 = 1.146 allows one to claim that the true SM=LM=SU=SL=B=H since the variation in those means gives F(9, 20) = 0.344, and true CU=CL=VO=VI because that yields F(9, 20) = 0.208. Finally, CU=CL=VO=VI < SM=LM=SU=SL=B=H since the difference between the two sets of sample means produces F(9, 20) = 1.978.

The above conclusion was based on results averaged over all depths; but different average depths might have affected that result. For example, SM and LM had an average depth of about 1.25 m while SU, SL, and B had an average depth of about 0.75 m. It therefore seemed prudent to analyse the spat density data at a common depth and 1.0 – 1.5 m seemed most suitable. Though Harp and Veneer Ring depths were above that (at 0.90 and 0.91 m respectively), the results from these collectors were treated as if they had been taken from the 1.0 - 1.5 m depth range so that all ten collectors could be analysed together. The pseudo-classification of these two collectors at 1.0 - 1.5 m is shown in Tables 4 and 6. If treating these two collectors as if they had been at 1.0 - 1.5 m changes their status markedly with respect to the other collectors, that matter will have to be resolved. But as can be seen below, H still lies at the positive extreme while VO and VI remain at the low end.

The ten results at 1.0 - 1.5 m yield F(9, 20) = 3.512, which indicates some differences in the true means for collectors, but the separation of small and large means is not too clear for the data. The best conclusion seems to be that the true values are SU=SL=B=H since the variation in those means yields F(9, 20) = 0.237; likewise the true CU = CL = VO = VI, the sample yielding F(9, 20) = 0.146; then CU=CL=VO=VI < SU=SL=B=H since the difference of the largest and smallest four sample means gives F(9, 20) = 3.050. Finally, the difference in the pair SM and LM give F(9, 20) = 0.074 and comparing the average of those two means with the average of the other eight gives F(9, 20) = 0.003. We conclude that the true SM, LM pair sit in the middle of the other eight, hence CU=CL=VO=VI < SM=LM < SU=SL=B=H.

A variety of factors affects settlement of oysters, some of those being physical (e.g., substrate or cultch quality) rather than strictly environmental (e.g., salinity, temperature). In the former category, the comparative attractiveness to oyster larvae of different collector surfaces was at the core of this field experiment. Surfaces used ranged from relatively smooth plastic (Large Mesh) to rough plastic (Small Mesh) through naturally rough surfaces (Shell Strings) to artificially roughened surfaces (cemented Harps, Chinese Hats). Although Small Mesh strands were illustrated as round (Figure 3) they are unevenly multi-sided and are thus rough by comparison with Large Mesh. Bolt cordage, while having small indentations, had a different texture compared with the plastic mesh materials. From the perspective of oyster larvae nearing metamorphosis, surface quality is critical as they exhibit rugotropism; that is, they settle in small pits and among other irregularities (Galtsoff 1964). These rough or pitted surfaces vary in their attractiveness to larvae [Truitt (1929, 1931) - as referenced by Kennedy et al. 1996] who showed that oyster shell was preferred by larvae above "glass, slag, gravel or wood".

The attraction of rough surfaces is affected, in turn, by other qualities provided by biological films. It has been known for nearly a century (Nelson, 1908) that cultch should be deployed a few days prior to anticipated set so that a surface bio-film can develop. Fitt and Coon (1992) noted that ammonia concentrations, likely a byproduct of microbial filming, rise in crevices to levels stimulating settlement. The present experiment did not examine quality of microfilms on the collectors, but given the availability of these different materials and surfaces, microbial colonization among collectors may well have differed. If so, metabolite concentrations would also have varied and accordingly, among the collector types, there would have been uneven attractiveness to oyster larvae. At the very least, a given lot of collectors on a raft, with the beginnings of an oyster set, may have attracted more larvae through other water-borne chemicals associated with conspecifics as reported by Tamburri et al. (1992), a phenomenon referred to as "gregariousness" by Cole and Knight-Jones (1949) who made similar observations in *Ostrea edulis*.

Further, random collector orientation with respect to currents may have influenced recruitment. Drinnan and Stallworthy (1979) reported massive changes in oyster set according to seemingly minor orientation differences in their scallop shell collectors (not suspended but permanently fixed to the bottom) even though surfaces with light set were immediately adjacent to the most effective ones. Among various suspended collector types used here, some would present a consistent target irrespective of current or rotation of a collector about its single point suspension, and these would be: Chinese Hats, Shell Strings and Bolts. Both Large and Small Mesh, Veneer Rings and Harps would have presented different targets as they lacked the rotational symmetry of the others and their suspension orientation in the water was not controlled. It is assumed, therefore, that these latter collectors presented a haphazard orientation with respect to each other, to prevailing currents, and likely to the larvae themselves. However, whether their orientation might have affected settlement in this experiment is purely speculative as no examination was made for this effect.

<u>Spat Shell Lengths By Collector Type</u>

The results of the randomized blocks analysis are summarised in Table 5. Although differences in shell length due to depth were statistically reliable for SL and B (see Table 5), they are not consistent with one another. The Shell Lower (SL) finding seems easy to understand, with least growth at the Bottom level. The small mean shell length at the middle level for Bolts (B) is inexplicable.

As with spat density calculations, reservations over uneven representation of depths among the averages of all collector types suggested re-analysis based on one depth range (1.0 - 1.5 m) for all. This analysis gave the overall F(9, 20) = 81.588; true VO=VI since F(9, 20) = 0.058; true CU=CL=SU=SL because F(9, 20) = 0.653; true B=H having F(9, 20) = 0.516; true SM=LM with F(9, 20) = 0.038; then VO=VI < CU=CL=SU=SL having F(9, 20) = 23.354; true CU=CL=SU=SL < B=H since F(9, 20) = 8.708; true B=H < SM=LM because F(9, 20) = 2.614; and the overall conclusion that the true means are ordered VO=VI < CU=CL=SU=SL < B=H < SM=LM.

Table 5. Mean shell lengths (mm) within collectors at Top (T), Middle (M), and Bottom (B).

Collector, Depth Range		Means	F*	Suggested True Order
SM	Top	6.481	0.106	T = M = B
	Middle	6.342		
	Bottom	6.565		
LM	Top	6.118	0.318	T = M = B
	Middle	6.503		
	Bottom	6.262		
SU	Top	3.619	2.351	T = M = B
	Middle	3.000		
	Bottom	4.056		
SL	Top	5.654	3.707	B < T = M
	Middle	5.153		
	Bottom	4.334		
B	Top	4.033	6.716	M < T = B
	Middle	3.414		
	Bottom	5.180		

* F[.05]; 2,20 = 2.757

<u>Shell-Length Differences Among Collectors</u>

Table 6 shows the means of oyster spat shell lengths (mm) on the collectors at various depths, and the average shell lengths over all depths.

Table 6. Mean shell lengths (mm) per collector at various depth ranges.

Collector Type	0.0 - 0.50 m	0.5 - 1.0 m	1.0 - 1.5 m	1.5 - 2.0 m	Average
SM	-	6.481	6.342	6.565	6.463
LM	-	6.118	6.503	6.262	6.294
SU	3.619	3.000	4.056	-	3.558
SL	5.654	5.153	4.334	-	5.047
B	4.033	3.414	5.180	-	4.209
CU	-	-	3.725	-	3.725
CL	-	-	3.815	-	3.815
H	-	-	5.774*	-	5.774
VO	-	-	1.435*	-	1.435
VI	-	-	1.635*	-	1.635

* Note, as in Table 4, the re-assignment of Harp and Veneer ring data to 1.0 – 1.5 m for analysis purposes.

Analysis of variance of the average shell lengths over the 10 collectors yielded F(9, 20) = 61.173 and Rodger's critical value F[.05]; 9, 20 = 1.146 allows one to claim that the true SM=LM since the sample means give F(9, 20) = 0.032; true SL=H since sample F(9, 20) = 0.583; true SU=CU=CL=B because their sample means yield F(9, 20) = 0.505; true

VO=VI which has sample $F(9, 20) = 0.044$; then true VO=VI < SU=CU=CL=B having $F(9, 20) = 15.459$; true SU=CU=CL=B < SL=H with $F(9, 20) = 7.383$; true SL=H < LM=SM because $F(9, 20) = 2.068$, giving the overall conclusion that the true means are in the order VO=VI < SU=CU=CL=B < SL=H < LM=SM.

CONCLUSIONS AND RECOMMENDATIONS

1. The choice of which collector to use to maximize spat density would appear to lie among Shell Strings (SU, SL), Harps (H) and Bolts (B) and Mesh (LM, SM). However, given the logistic constraints of using scallop shells, the restricted surface area of Bolts, and the cost of manufacture and preparation of Harps, both Large and Small Mesh appear more attractive although they may fall below this set of four in terms of density collected. Furthermore, since the Small Mesh is much finer and has a greater surface area than that of Large Mesh, a sheet of the former will yield much more spat than a comparably-sized sheet of Large Mesh; so the choice based on density alone is probably between Harps and Small Mesh.

2. Analysis of shell lengths indicates that Small Mesh and Large Mesh yield the greatest growth of spat.

3. Further, the maintenance of and harvesting from Small Mesh is very simple – a flip or two of the mesh releases most of the spat – so should be preferred.

4. Shell Strings, Chinese Hats and Veneer Rings are much more difficult to work with and harvest from than Small Mesh or even Large Mesh; so these three collectors could almost be discounted on those grounds alone.

5. Storage space required for the various collectors favoured Bolts, Small Mesh and Large Mesh.

6. The use of Chinese Hat collectors, an industry standard, is not recommended because of initial cost, storage space required, labour and materials needed for preparation before use. Further, its spat-collecting efficacy is less compared with other less expensive and easier to use materials.

7. Overall, Small Mesh was shown to be the collector easiest to store, prepare for deployment and from which to harvest spat. The generally superior growth on Small Mesh, combined with the highest collection densities recorded, identified it as the most favoured collector in this study.

8. Over the limited range of depths studied, no depth effects for either Small or Large Mesh were noted.

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APPENDIX

Table 1 a. Arrangement of collectors, rafts 1 – 6. Shell Strings = ss, Chinese Hats = Ch, harps = h, Veneer Rings = vr, Large Mesh =lm, Small Mesh = sm. The upper left corners of these tables are the positions of the black triangles in Figure 1 (see page 3) that mark the beginning of collector numbering for a raft. See text on page 8.

Raft 1

Ch		Ch		Ch		Ch				sm			
sm			h	h	h	h	h	h		sm			
	Ch	Ch	Ch	Ch	Ch	Ch	Ch	Ch					
	sm	ss	sm	ss	sm	ss	sm	ss	sm	ss			
	h	h	h	h	h	h	h	h					
lm	ss	sm	lm	ss	sm	lm	sm	ss					
ss	sm	om	ss	sm	ss	sm	ss	sm					
sm	sm		Ch	Ch	Ch	Ch				sm			
ss		sm		lm		ss		sm					

Raft 2

Ch		Ch		Ch		Ch				h			
sm	ss	sm	ss	lm	ss	sm	ss						
	h	h	h	h	h	h	h	h	h				
lm	ss	Ch		Ch		Ch		Ch		sm			
ss	sm	ss	lm	ss	sm	ss	sm	lm	ss				
Ch		ss	Ch	ss	lm		lm			sm			
					Ch								
							lm	sm	ss				
Ch		Ch	Ch			Ch	Ch			Ch			

Raft 3

ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
					vr	h	vr	h	vr				
	Ch	Ch	Ch	Ch	Ch	Ch	Ch	Ch					
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
				h	vr	h	vr	h	vr				
		Ch	Ch	Ch	Ch	Ch	Ch	Ch					
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
		Ch	Ch	Ch	Ch	Ch	Ch	Ch					
				h	vr	h	vr	h	h				
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss

Raft 4

		h		vr		h		h		vr			
		Ch											
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
h		vr		h		vr		h		vr		h	
vr		h		vr		vr		h		vr		h	vr
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
h		vr	vr	vr	vr	vr	vr	vr		h		vr	
	vr	vr	vr			h		vr	vr	vr	vr	vr	
		ss	ss	ss	ss	ss	ss	ss	ss	ss			
		h			h			h			h		

Raft 5

h		h		h			vr			vr			
sm		sm		sm		lm		lm		lm		lm	
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
lm	sm	lm	sm			lm	sm	lm	sm			lm	
		lm	sm					lm	lm	lm	lm	lm	
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
lm	sm	lm	sm			lm	sm	lm	sm			lm	
			sm	lm	sm	lm	sm						
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss

Raft 6

	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
	ss		ss		ss		ss			ss			
h			h		h		h		h				h
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
h			h		h		h		h				h
h		h		h		h		h		h			h
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
	ss			ss			ss			ss		ss	

Table 1 b. Arrangement of collectors, rafts 7 –12. Shell Strings = ss, Chinese hats = Ch, Harps = h, Veneer Rings = vr, Large Mesh =lm, Small Mesh = sm, Bolts = b. The upper left corners of these tables are the positions of the black triangles in Figure 1 (see page 3) that mark the beginning of collector numbering for a raft. See text on page 8.

Raft 7

	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
	h		h		h		h		h		h		
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
	h		h		h		h		h		h		
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
	h		h		h		h		h		h		h
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
	h		h		h		h		h		h		h
	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	

Raft 10

ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
Ch				Ch				Ch				Ch	
h		h			h		h		h		h		h
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
Ch		Ch		Ch		Ch		Ch		Ch		Ch	
h		h		h			h		h		h		
ss			ss			ss				ss			ss
h			Ch		h		h		h		h		h

Raft 8

	h	h		h	h		h	h		h	h		
ss		ss		ss		ss		ss		ss		ss	
	h	h		h	h		h	h		h	h		
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
	h	h		h	h		h	h		h	h		
ss					ss				ss				ss
	h	h		h	h		h	h		h	h		
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	
				h	h		h	h					
ss							ss						ss

Raft 11

ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
ss	ss		ss		ss	ss		ss		ss		ss	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
b	b	b	b	b	b	b	b.	b	b	b	b	b	ss
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
ss		h	h	h		h	h	h		ss		ss	
b	b	b	b	b	b	b	b	b	b	b	b	b	b
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
ss		ss			b	b	b			ss		ss	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss		ss	

Raft 9

ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
Ch					Ch					Ch			Ch
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
h		h		h		h		h		h		h	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
Ch		Ch		Ch		Ch		Ch		Ch		Ch	
	ss		ss		ss		ss		ss	ss		ss	
	h		h		h		h		h		h		

Raft 12

h		h		h			h		h		h		
ss		ss		ss		ss		ss		ss		ss	
h		h		h		h		h		h		h	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
h		h		h		h		h		h		h	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
h		h		h		h		h		h		h	
ss	ss	ss	ss	ss	ss		ss	ss	ss	ss	ss	ss	ss
h			h			h			h				
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss

Table 1 c. Arrangement of collectors, rafts 13 – 15. Shell Strings = ss, Chinese hats = Ch, Harps = h, Veneer Rings = vr, Large Mesh =lm, Small Mesh = sm, Bolts = b. The upper left corners of these tables are the positions of the black triangle in Figure 1 (see page 3) that mark the beginning of collector numbering for a raft. See text on page 8.

Raft 13

h		h		h		h	h		h		h		h
						h							
ss	ss	ss			sm		lm		sm		lm		sm
h	h				h	h	h	h	h			h	h
ss	ss			ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
sm		h		h		h		h	h	h		h	h
sm		lm		sm		lm		sm		lm	sm		lm
h				h				h					h
sm		lm		sm		lm			sm		lm		

Raft 14

h		lm		sm		lm		sm		lm		sm	
ss		ss		ss		ss		ss		ss		ss	ss
h				h				h				h	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
lm		sm		sm		lm		sm		lm		sm	
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
lm			sm			lm			sm		lm		sm
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
h						h							h
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss

Raft 15

ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
h		h		h		h						ss	
ss		ss	ss	ss	ss	ss		ss	ss	ss	ss		ss
h		h		h		h		h		h		sm	sm
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		ss
lm													
ss		ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss
lm	sm		lm	sm		lm	sm		lm	sm		sm	
ss	ss	ss	ss	ss	ss	ss	ss	ss	ss		sm		ss
	sm												

Table 1 d. Arrangement of collectors, rafts 16 – 18. In eight instances collectors were suspended from the outside of the rafts. Shell Strings = ss, Chinese hats = Ch, Harps = h, Veneer Rings = vr, Large Mesh =lm, Small Mesh = sm, Bolts = b. The upper left corners of these tables are the positions of the black triangles in Figure 1 (see page 3) that mark the beginning of collector numbering for a raft. See text on page 8. (Note that a few collectors were deployed on the outside of these rafts.)

Raft 16

lm h

					ss	h	b	vr
lm	h	h	b					
						h	h	
	b	h						
					h	h	ss	h
vr	h	vr	b					
					lm	vr	h	vr
vr	h	b						
						ss	ss	
ss	b	h	b					
					h	h	ss	ss
vr	ss	ss	b					
					ss	vr	h	
b	b	vr						
						ss	ss	lm
	lm	h	b	vr				

Raft 17

vr vr

h	h	b	h					
						h	h	h
sm	h	h	h					
						h	h	h
sm		lm						
					lm	h	h	
lm	h	b						
						h	h	h
b		h						
						h	h	h
b	lm	vr						
						vr	vr	h
h	sm	h	b					
						h	h	vr
lm	h	b	h					
						h	vr	h

lm

Raft 18

lm h

					b	b	lm	h
lm	b	h	b	h				
					h	b	h	h
h	h	h	b					
						b	h	h
	h	h	lm					
					h	b	lm	h
h	b	h	b					
				sm	sm	b	h	h
h	b	h	b					
					h	h		
b	b	h	b					
					lm	b	h	h
b	h	h	b					
					sm	b	h	h
lm	b	h	h					

lm

Table 2. Temperature, salinity, gonad index and spatfall data collected at Gillis Cove, 1994. (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
1-Jun	0.00	16.9	13.0				
	0.30	16.1	13.2				
	0.61	14.5	14.0				
	0.91	11.5	16.2				
2-Jun	0.00	15.2	14.4				
	0.30	14.3	16.2				
	0.61	13.7	16.6				
	0.91	11.3	18.1				
	0.00	21.0	9.5				
	0.30	18.7	12.9				
	0.61	14.9	14.9				
	0.91	10.8	16.4				
3-Jun	0.00	7.3	15.4				
	0.30	7.7	18.3	2 / immature (10)			
	0.61	5.2	20.6				
	0.91	4.6	20.9				
6-Jun	0.00	10.8	17.3				
	0.30	10.7	16.9				
	0.61	10.2	17.1				
	0.91	9.6	17.9				
	0.00	14.2	16.5				
	0.30	13.9	16.9				
	0.61	13.0	16.9				
	0.91	12.0	16.7				
7-Jun	0.00	10.9	18.7				
	0.30	11.1	17.7				
	0.61	10.5	17.9				
	0.91	9.8	18.7				
9-Jun	0.00	7.7	12.4				
	0.30	8.0	12.7				
	0.61	7.8	13.5				
	0.91	7.1	19.6				
	0.00	7.4	17.5				
	0.30	11.3	17.6				
	0.61	10.6	17.9				
	0.91	9.6	19.2				
10-Jun	0.00	10.1	18.6				
	0.30	10.3	18.7				
	0.61	8.4	20.4				
	0.91	7.4	20.7				
13-Jun	0.00	13.0	19.5				
	0.30	12.9	19.4				
	0.61	12.5	19.3				
	0.91	12.2	19.3	3 /maturing (9)			
	0.00	12.4	19.0				
	0.30	12.6	19.1				
	0.61	12.3	19.1				
	0.91	11.5	19.4				

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
14-Jun	0.00	13.2	18.9				
	1.00	13.1	19.0				
	2.00	12.7	19.3				
	3.00	12.2	19.3				
	0.00	15.1	18.2				
	1.00	14.7	18.7				
	2.00	13.3	18.8				
	3.00	13.0	18.9				
15-Jun	0.00	13.5	17.3				
	1.00	12.8	19.2				
	2.00	12.2	19.2				
	3.00	11.3	19.6				
16-Jun	0.00	11.4	19.5				
	0.30	11.4	19.7				
	0.61	10.5	20.0				
	0.91	8.2	21.4				
	0.00	16.4	19.3				
	0.30	14.2	19.3				
	0.61	13.7	18.8				
	0.91	12.7	19.6				
17-Jun	0.00	15.7	19.0				
	0.30	15.0	19.1				
	0.61	14.5	19.1				
	0.91	11.5	20.4	2 / immature (7)			
	0.00	19.2	17.9				
	0.30	18.2	18.1	3 / maturing (3)			
	0.61	17.3	18.1				
	0.91	15.3	18.8				
20-Jun	0.00	16.0	16.8				
	0.30	15.1	19.0				
	0.61	14.6	20.3				
	0.91	13.1	20.7	2 / immature (5)			
	0.00	17.2	20.8				
	0.30	17.7	20.1	3 / maturing (4)			
	0.61	18.2	18.6				
	0.91	19.7	15.5				
21-Jun	0.00	11.9	20.3				
	0.30	11.8	20.9				
	0.61	11.9	21.4				
	0.91	10.6	21.7				
	0.00	22.3	16.7				
	0.30	20.6	17.6				
	0.61	20.1	17.8				
	0.91	18.5	18.6				

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
22-Jun	0	14.9	20.0				
	1	15.2	19.7				
	2	15.1	19.9				
	3	15	20.2				
	0	15.5	19.8				
	1	15.3	20.0				
	2	15.2	20.0				
	3	15.1	20.1				
23-Jun	0	16.3	19.4				
	1	16.2	19.4				
	2	15.6	19.5				
	3	14.7	19.9				
	0	17.4	18.8				
	1	17.4	18.9				
	2	16.7	19.0				
	3	16.1	19.3				
24-Jun	0	16.2	18.7				
	1	15.7	19.1				
	2	15.2	19.7	2-immature (4)			
	3	14.0	19.7				
	0	15.8	19.8	3-maturing (6)			
	1	15.8	19.8				
	2	14.3	20.7				
	3	12.4	20.6				
27-Jun	0	19.9	18.3				
	1	19.4	18.6				
	2	18.3	19.2				
	3	17.1	19.4				
	0	21.2	19.6				
	1	20.9	19.0				
	2	19.5	18.7				
	3	18.3	19.4				
28-Jun	0.30	17.1	20.1				
	0.61	16.5	20.4				
	0.91	16.0	20.2				
	0.00	21.9	19.0				
	0.30	21.1	18.9				
	0.61	20.6	18.6				
	0.91	19.6	18.9				
29-Jun	0.00	20.1	19.2				
	0.30	20.1	19.4				
	0.61	19.9	19.5				
	0.91	19.6	19.5				
	0.00	24.2	17.8				
	0.30	23.7	18.3				
	0.61	23.1	18.2				
	0.91	22.0	18.7				

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
30-Jun	0.00	20.5	19.3	1 / spent (8)			
	0.30	20.4	19.3				
	0.61	20.0	19.4	4 / ripe (2)			
	0.91	19.4	19.5				
1-Jul	0.00	23.2	19.5				
	0.30	19.1	22.2				
	0.61	21.8	19.0				
	0.91	20.9	18.8				
4-Jul	0.00	21.6	16.3				
	0.30	21.5	16.5				
	0.61	21.7	16.7	1 / spent (9)			
	0.91	21.8	16.6				
	0.00	26.7	17.5	3 / ripe (1)			
	0.30	26.2	17.5				
	0.61	25.7	17.8				
	0.91	23.0	18.4				
5-Jul	0.00	22.4	15.7				
	0.30	22.5	15.9				
	0.61	22.5	16.2				
	0.91	22.8	16.1				
6-Jul					0.30	0	12
					1.22	0	12
					2.13	0	12
7-Jul					0.30	0	12
					1.22	0	12
					2.13	0	12
8-Jul	0.00	20.0	16.2	1 / spent (8)	0.30	0	12
	0.30	20.0	16.1		1.22	0	12
	0.61	21.0	16.5	4 / ripe (2)	2.13	0	12
	0.91	21.0	16.2				
9-Jul					0.30	0	12
					1.22	0	12
					2.13	0	12
11-Jul				1 / spent (3)	0.30	0	12
				3 / maturing (7)	1.22	0	12
					2.13	0	12
12-Jul	0.00	25.0	19.5		0.30	0	12
	0.30	23.5	19.5		1.22	0	12
	0.61	22.5	17.5		2.13	0	12
	0.91	21.5	17.0				
13-Jul					0.30	0	12
					1.22	0	12
					2.13	0	12
14-Jul					0.30	0	12
					1.22	0	12
					2.13	0	12

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
15-Jul				1 / spent (8)	0.30	0	12
				3 / maturing (1)	1.22	0	12
				4 / ripe (1)	2.13	0	12
16-Jul					0.30	3	12
					1.22	1	12
					2.13	0	12
17-Jul					0.30	5	12
					1.22	0	12
					2.13	0	12
18-Jul				1 / spent (8)	0.30	2	12
				4 / ripe (12)	1.22	2	12
					2.13	13	12
19-Jul					0.30	24	12
					1.22	12	12
					2.13	10	12
20-Jul					0.30	170	12
					1.22	57	12
					2.13	207	12
21-Jul					0.30	41	12
					1.22	160	12
					2.13	76	12
22-Jul					0.30	106	2
					1.22	303	2
					2.13	128	2
					0.30	491	12
					1.22	295	12
					2.13	398	12
25-Jul					0.30	29	2
				1 / spent (3)	1.22	119	2
					2.13	75	2
				4 / ripe (6)	0.30	102	12
					1.22	137	12
					2.13	24	12
26-Jul					0.30	48	2
					1.22	97	2
					2.13	334	2
					0.30	82	12
					1.22	29	12
					2.13	74	12
27-Jul					0.30	39	2
					1.22	124	2
					2.13	394	2
					0.30	31	12
					1.22	73	12
					2.13	98	12

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
2-Aug					0.30	45	2
				1 / spent (8)	1.22	133	2
					2.13	564	2
				4 / ripe (2)	0.30	237	12
					1.22	79	12
					2.13	94	12
3-Aug					0.30	156	2
					1.22	417	2
					2.13	722	2
					0.30	375	12
					1.22	1008	12
					2.13	643	12
4-Aug					0.30	157	2
					1.22	184	2
					2.13	50	2
					0.30	376	12
					1.22	494	12
					2.13	1034	12
5-Aug					0.30	21	2
					1.22	68	2
					2.13	191	2
					0.30	107	12
					1.22	275	12
					2.13	474	12
8-Aug					0.30	233	2
					1.22	65	2
					2.13	32	2
					0.30	248	12
					1.22	275	12
					2.13	663	12
9-Aug					0.30	21	2
					1.22	68	2
					2.13	63	2
					0.30	391	12
					1.22	107	12
					2.13	80	12

Table 2 (cont'd). (N) = number of oysters found at particular index/states.

Date	Depth (m)	Temp (°C)	Salinity (ppt)	Gonad Index/State (N)	Rack Depth (m)	Spat	Raft #
10-Aug					0.30	27	2
				1 / spent (6)	1.22	92	2
					2.13	312	2
				3 / maturing (4)	0.30	78	12
					1.22	86	12
					2.13	453	12
11-Aug					0.30	46	2
					1.22	149	2
					2.13	447	2
					0.30	94	12
					1.22	123	12
					2.13	410	12
					0.30	2	2
					1.22	7	2
					2.13	100	2
					0.30	33	12
					1.22	80	12
					2.13	167	12
15-Aug					0.30	4	2
					1.22	10	2
					2.13	3	2
					0.30	8	12
					1.22	21	12
					2.13	23	12
18-Aug				1 / spent (9)			
				4 / ripe (1)			
22-Aug				1 / spent (10)			

Table 3a. Numbers of spat of specified lengths (mm) sampled from Shell String upper surfaces by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each of one square inch (6.4516 cm^2), were taken. Low numbers on #5, Middle, were associated with fouling by algae.

Shell string (Upper) #23, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	3	0	3	3
2	1	7	4	12	24
3	1	3	8	12	36
4	1	7	8	16	64
5	1	1	4	6	30
6	2	4	4	10	60
7	1	0	0	1	7
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
Sum	7	25	28	60	224

Shell string (Upper) #25, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	4	1	0	5	10
3	6	8	1	15	45
4	4	2	2	8	32
5	0	1	1	2	10
6	2	0	0	2	12
7	0	0	1	1	7
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
Sum	16	12	5	33	116

Shell string (Upper) #5, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	0	1	3	6
3	4	16	6	26	78
4	0	4	0	4	16
5	0	0	0	0	0
6	0	8	0	8	48
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
Sum	6	28	7	41	148

Shell string (Upper) #23, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	1	5	7	14
3	2	2	2	6	18
4	0	5	6	11	44
5	0	2	0	2	10
6	0	1	0	1	6
7	0	1	0	1	7
8	0	1	0	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	3	13	13	29	107

Shell string (Upper) #25, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	4	3	2	9	18
3	3	1	4	8	24
4	0	1	2	3	12
5	0	0	1	1	5
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	7	5	9	21	59

Shell string (Upper) #5, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	0	0	1	2
3	1	0	0	1	3
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	2	0	0	2	5

Shell string (Upper) #23, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	0	0	1	1
2	6	2	7	15	30
3	10	3	9	22	66
4	10	5	7	22	88
5	4	2	3	9	45
6	1	3	2	6	36
7	0	1	1	2	14
8	0	0	3	3	24
9	0	2	0	2	18
10	0	0	0	0	0
11	0	0	0	0	0
Sum	32	18	32	82	322

Shell string (Upper) #25, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	2	1	3	3
2	2	2	3	7	14
3	4	1	10	15	45
4	4	3	5	12	48
5	7	2	1	10	50
6	3	2	2	7	42
7	2	0	4	6	42
8	1	0	1	2	16
9	0	0	1	1	9
10	0	0	0	0	0
11	0	0	0	0	0
Sum	23	12	28	63	269

Shell string (Upper) #5, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	1	2	3	6
3	3	4	5	12	36
4	1	5	2	8	32
5	0	4	0	4	20
6	1	4	0	5	30
7	0	1	0	1	7
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
Sum	5	19	9	33	131

Table 3b. Numbers of spat of specified lengths (mm) sampled from Shell String lower surfaces by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each of one square inch (6.4516 cm^2), were taken.

Shell string (Lower) #23, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	2	1	2	5	5
2	4	0	3	7	14
3	1	0	1	2	6
4	0	0	0	0	0
5	0	0	2	2	10
6	1	1	0	2	12
7	1	0	2	3	21
8	0	1	3	4	32
9	0	0	1	1	9
10	0	0	1	1	10
11	0	1	0	1	11
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
Sum	9	4	15	28	130

Shell string (Lower) #25, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	0	0	1	2
3	0	5	0	5	15
4	1	0	3	4	16
5	0	2	2	4	20
6	7	3	3	13	78
7	3	1	2	6	42
8	2	2	1	5	40
9	1	2	1	4	36
10	0	0	1	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
Sum	15	15	13	43	259

Shell string (Lower) #5, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	0	0	0
3	2	1	1	4	12
4	2	1	0	3	12
5	2	1	2	5	25
6	2	3	3	8	48
7	0	0	0	0	0
8	0	0	2	2	16
9	1	0	1	2	18
10	1	0	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	1	0	1	13
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	1	1	16
Sum	10	7	10	27	170

Shell string (Lower) #23, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	3	1	7	14
3	9	4	3	16	48
4	4	4	5	13	52
5	0	2	2	4	20
6	3	3	1	7	42
7	1	1	0	2	14
8	1	1	2	4	32
9	0	0	1	1	9
10	1	0	1	2	20
11	0	0	0	0	0
12	0	0	0	0	0
Sum	22	18	16	56	251

Shell string (Lower) #25, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	4	3	5	12	24
3	6	8	6	20	60
4	1	0	7	8	32
5	4	1	0	5	25
6	4	3	2	9	54
7	4	3	1	8	56
8	2	0	2	4	32
9	0	0	0	0	0
10	0	1	0	1	10
11	0	1	0	1	11
12	0	0	0	0	0
Sum	25	20	23	68	304

Shell string (Lower) #5, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	3	0	4	8
3	1	2	0	3	9
4	2	3	4	9	36
5	3	1	0	4	20
6	5	5	3	13	78
7	2	8	8	18	126
8	4	4	3	11	88
9	0	0	3	3	27
10	0	1	0	1	10
11	0	0	0	0	0
12	2	0	3	5	60
Sum	20	27	24	71	462

Shell string (Lower) #23, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	2	1	0	3	3
2	0	3	8	11	22
3	2	3	4	9	27
4	7	4	4	15	60
5	6	7	3	16	80
6	2	2	4	8	48
7	1	2	3	6	42
8	1	1	2	4	32
9	0	2	1	3	27
10	0	1	0	1	10
11	0	0	0	0	0
Sum	21	26	29	76	351

Shell string (Lower) #25, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	1	1	1
2	5	5	3	13	26
3	3	8	3	14	42
4	5	3	5	13	52
5	4	2	5	11	55
6	1	0	3	4	24
7	2	1	4	7	49
8	1	1	0	2	16
9	0	1	0	1	9
10	0	0	0	0	0
11	0	0	0	0	0
Sum	21	21	24	66	274

Shell string (Lower) #5, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	5	1	4	10	20
3	3	6	8	17	51
4	6	9	4	19	76
5	3	4	4	11	55
6	6	2	2	10	60
7	3	0	0	3	21
8	2	0	0	2	16
9	0	0	0	0	0
10	0	1	0	1	10
11	0	0	0	0	0
Sum	28	23	22	73	309

Table 3c. Numbers of spat of specified lengths (mm) sampled from Chinese Hat upper surfaces by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each of one square inch (6.4516 cm^2), were taken.

Chinese Hat (Upper) #8, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	1	0	1	1
2	2	2	0	4	8
3	0	1	0	1	3
4	0	1	0	1	4
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	2	5	0	7	16

Chinese Hat (Upper) #18, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	1	0	1	1
2	1	2	0	3	6
3	2	2	0	4	12
4	1	1	2	4	16
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	4	6	2	12	35

Chinese Hat (Upper) #20, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	1	0	1	2
3	0	0	1	1	3
4	0	0	0	0	0
5	0	0	1	1	5
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	0	1	2	3	10

Chinese Hat (Upper) #8, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	11	2	15	30
3	5	3	1	9	27
4	0	3	2	5	20
5	4	1	0	5	25
6	2	0	3	5	30
7	2	1	1	4	28
8	0	0	1	1	8
9	0	0	0	0	0
10	0	0	1	1	10
11	1	0	0	1	11
12	0	0	0	0	0
Sum	16	19	11	46	189

Chinese Hat (Upper) #18, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	1	2	3	6
3	1	0	2	3	9
4	4	2	0	6	24
5	2	0	1	3	15
6	0	1	2	3	18
7	0	1	0	1	7
8	0	0	1	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	7	5	8	20	87

Chinese Hat (Upper) #20, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	1	1	1
2	0	0	1	1	2
3	3	5	0	8	24
4	0	5	5	10	40
5	0	2	0	2	10
6	1	4	0	5	30
7	0	1	0	1	7
8	0	1	0	1	8
9	0	0	0	0	0
10	0	0	1	1	10
11	0	0	0	0	0
12	0	0	0	0	0
Sum	4	18	8	30	132

Chinese Hat (Upper) #8, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	5	1	1	7	14
3	7	2	1	10	30
4	2	0	1	3	12
5	3	2	2	7	35
6	0	0	0	0	0
7	0	4	1	5	35
8	0	0	1	1	8
9	0	0	1	1	9
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	17	9	8	34	143

Chinese Hat (Upper) #18, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	1	0	1	1
2	2	5	1	8	16
3	8	6	2	16	48
4	4	5	5	14	56
5	3	4	5	12	60
6	0	1	2	3	18
7	1	0	0	1	7
8	0	0	1	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	18	22	16	56	214

Chinese Hat (Upper) #20, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	3	3	3
2	0	1	2	3	6
3	6	2	1	9	27
4	1	2	0	3	12
5	2	1	0	3	15
6	2	0	1	3	18
7	0	1	1	2	14
8	0	3	0	3	24
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	11	10	8	29	119

Table 3d. Numbers of spat of specified lengths (mm) sampled from Chinese Hat lower surfaces by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each of one square inch (6.4516 cm^2), were taken.

Chinese Hat (Lower) #8, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	2	2	6	12
3	2	2	0	4	12
4	0	2	0	2	8
5	0	1	0	1	5
6	1	1	0	2	12
7	0	0	0	0	0
8	0	1	0	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	5	9	2	16	57

Chinese Hat (Lower) #18, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	0	0	1	1
2	3	0	3	6	12
3	0	0	0	0	0
4	2	0	1	3	12
5	1	0	1	2	10
6	1	1	2	4	24
7	0	0	3	3	21
8	0	0	1	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	1	0	0	1	11
12	0	0	0	0	0
Sum	9	1	11	21	99

Chinese Hat (Lower) #20, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	5	0	0	5	5
2	4	0	1	5	10
3	1	2	2	5	15
4	2	2	1	5	20
5	1	2	1	4	20
6	0	1	0	1	6
7	0	0	0	0	0
8	1	0	0	1	8
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	14	7	5	26	84

Chinese Hat (Lower) #8, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	1	1	3
4	0	0	4	4	16
5	0	0	0	0	0
6	0	1	1	2	12
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	0	1	6	7	31

Chinese Hat (Lower) #18, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	3	0	6	12
3	2	0	0	2	6
4	1	0	0	1	4
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	1	0	1	9
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	6	4	0	10	31

Chinese Hat (Lower) #20, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	1	0	2	2
2	1	2	1	4	8
3	0	1	2	3	9
4	2	0	1	3	12
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Sum	4	4	4	12	31

Chinese Hat (Lower) #8, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	3	0	6	12
3	2	1	5	8	24
4	1	4	3	8	32
5	2	3	1	6	30
6	3	0	1	4	24
7	0	0	1	1	7
8	1	2	1	4	32
9	0	0	0	0	0
10	1	0	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
Sum	13	13	12	38	171

Chinese Hat (Lower) #18, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	6	1	1	8	16
3	0	2	7	9	27
4	2	1	7	10	40
5	1	3	1	5	25
6	2	4	4	10	60
7	0	2	0	2	14
8	0	1	0	1	8
9	0	0	2	2	18
10	0	0	0	0	0
11	0	1	0	1	11
12	2	0	0	2	24
Sum	13	15	22	50	243

Chinese Hat (Lower) #20, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	4	4	4
2	2	0	3	5	10
3	4	1	3	8	24
4	2	3	2	7	28
5	1	0	0	1	5
6	1	0	0	1	6
7	0	1	0	1	7
8	0	0	0	0	0
9	0	0	0	0	0
10	1	0	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
Sum	11	5	12	28	94

Table 3e. Numbers of spat of specified lengths (mm) sampled from Veneer Ring collectors by depth (Top depth only). Three replicates samples (1, 2, 3), each of one square inch (6.4516 cm^2), were taken.

Veneer Ring (outer), #2					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	1	0	1	1
2	0	3	1	4	8
3	5	4	0	9	27
4	6	5	1	12	48
5	2	2	0	4	20
6	1	1	0	2	12
7	5	0	0	5	35
8	3	0	0	3	24
9	3	0	0	3	27
10	1	0	0	1	10
11	3	0	0	3	33
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	29	16	2	47	245

Veneer Ring (outer), #3					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	3	3	8	16
3	6	3	8	17	51
4	3	5	4	12	48
5	4	0	0	4	20
6	1	3	2	6	36
7	2	3	1	6	42
8	1	2	1	4	32
9	0	2	0	2	18
10	1	0	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	1	0	1	14
15	0	0	0	0	0
Sum	20	22	19	61	287

Veneer Ring (outer), #7					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	0	0	0
3	1	0	0	1	3
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	1	0	0	1	3

Veneer Ring (inner), #2					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	1	0	2	4
3	4	0	5	9	27
4	2	2	2	6	24
5	1	0	2	3	15
6	2	0	0	2	12
7	1	0	2	3	21
8	4	0	0	4	32
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	15	3	11	29	135

Veneer Ring (inner), #3					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	2	2	4	8
3	2	7	1	10	30
4	2	5	0	7	28
5	2	1	1	4	20
6	1	2	2	5	30
7	0	2	0	2	14
8	1	4	0	5	40
9	0	2	0	2	18
10	0	1	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	8	26	6	40	198

Veneer Ring (inner), #7					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	1	1	2
3	0	0	5	5	15
4	1	0	7	8	32
5	2	0	3	5	25
6	1	0	2	3	18
7	1	0	1	2	14
8	1	0	1	2	16
9	0	0	1	1	9
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	1	1	12
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	6	0	22	28	143

Table 3f. Numbers of spat of specified lengths (mm) taken from Large Mesh collectors by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each having a calculated area of 15.48 cm^2, were taken.

Large Mesh #3, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	5	1	8	16
3	5	5	6	16	48
4	5	9	1	15	60
5	4	2	2	8	40
6	6	5	4	15	90
7	4	2	4	10	70
8	1	3	0	4	32
9	5	6	6	17	153
10	2	1	2	5	50
11	3	0	0	3	33
12	1	0	1	2	24
13	1	0	3	4	52
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	1	0	1	18
19	0	0	0	0	0
20	0	1	0	1	20
Sum	39	40	30	109	706

Large Mesh #1, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	2	0	0	2	2
2	1	0	2	3	6
3	5	3	3	11	33
4	2	2	1	5	20
5	1	4	3	8	40
6	3	1	1	5	30
7	2	5	2	9	63
8	0	4	0	4	32
9	0	2	1	3	27
10	0	2	0	2	20
11	0	2	1	3	33
12	0	1	0	1	12
13	0	1	0	1	13
14	0	0	0	0	0
15	0	0	0	0	0
16	1	0	0	1	16
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
Sum	17	27	14	58	347

Large Mesh #7, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	1	4	7	14
3	4	3	9	16	48
4	5	4	3	12	48
5	6	6	5	17	85
6	6	7	7	20	120
7	3	1	1	5	35
8	0	0	0	0	0
9	3	1	1	5	45
10	1	1	1	3	30
11	0	1	1	2	22
12	1	0	0	1	12
13	0	3	0	3	39
14	0	1	1	2	28
15	0	1	0	1	15
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	1	0	0	1	19
20	0	0	0	0	0
Sum	32	30	33	95	560

Large Mesh #3, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	0	0	2	4
3	4	4	3	11	33
4	5	4	3	12	48
5	4	8	5	17	85
6	11	5	9	25	150
7	4	7	9	20	140
8	4	4	7	15	120
9	3	5	3	11	99
10	3	3	1	7	70
11	0	2	2	4	44
12	0	0	0	0	0
13	1	0	0	1	13
14	1	0	0	1	14
Sum	42	42	42	126	820

Large Mesh #1, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	5	2	1	8	16
3	5	2	3	10	30
4	10	7	6	23	92
5	4	5	8	17	85
6	7	6	10	23	138
7	9	6	4	19	133
8	2	7	7	16	128
9	2	3	5	10	90
10	3	2	2	7	70
11	1	3	1	5	55
12	0	1	0	1	12
13	0	0	0	0	0
14	0	0	0	0	0
Sum	48	44	47	139	849

Large Mesh #7, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	5	5	10
3	2	2	5	9	27
4	2	4	2	8	32
5	3	5	2	10	50
6	5	8	8	21	126
7	7	6	6	19	133
8	5	4	5	14	112
9	3	0	3	6	54
10	2	3	1	6	60
11	0	2	4	6	66
12	3	2	3	8	96
13	0	1	0	1	13
14	0	0	0	0	0
Sum	32	37	44	113	779

Large Mesh #3, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	2	0	3	6
3	4	3	5	12	36
4	7	2	10	19	76
5	7	4	5	16	80
6	11	7	0	18	108
7	11	7	11	29	203
8	8	4	7	19	152
9	4	5	2	11	99
10	4	6	1	11	110
11	1	3	1	5	55
12	2	1	2	5	60
13	1	0	1	2	26
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	1	0	0	1	19
Sum	62	44	45	151	1030

Large Mesh #1, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	0	1	2	4
3	6	3	0	9	27
4	7	9	6	22	88
5	6	8	7	21	105
6	4	9	3	16	96
7	5	2	6	13	91
8	7	6	5	18	144
9	3	3	2	8	72
10	3	0	2	5	50
11	4	2	4	10	110
12	2	1	0	3	36
13	1	0	1	2	26
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
Sum	49	43	37	129	849

Large Mesh #7, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	1	6	9	18
3	9	5	10	24	72
4	9	4	6	19	76
5	9	9	12	30	150
6	9	6	9	24	144
7	2	4	4	10	70
8	3	2	2	7	56
9	2	5	2	9	81
10	1	3	3	7	70
11	0	2	0	2	22
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
Sum	46	41	54	141	759

Table 3g. Numbers of spat of specified lengths (mm) taken from Small Mesh collectors by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each having a calculated area of 6.7858 cm^2, were taken.

Small Mesh #2, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	0	0	1	1
2	4	1	2	7	14
3	3	4	0	7	21
4	4	1	1	6	24
5	2	0	2	4	20
6	1	3	5	9	54
7	0	4	2	6	42
8	1	7	0	8	64
9	0	1	0	1	9
10	2	0	0	2	20
11	2	0	0	2	22
12	0	1	0	1	12
13	0	0	0	0	0
14	0	1	0	1	14
15	0	0	1	1	15
16	0	0	0	0	0
17	1	0	0	1	17
18	0	0	0	0	0
Sum	21	23	13	57	349

Small Mesh #4, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	0	0	0
3	2	0	0	2	6
4	3	1	1	5	20
5	0	0	0	0	0
6	2	2	0	4	24
7	0	0	0	0	0
8	2	1	0	3	24
9	0	2	2	4	36
10	1	2	0	3	30
11	0	0	1	1	11
12	0	0	0	0	0
13	1	0	2	3	39
14	0	0	0	0	0
15	1	0	0	1	15
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
Sum	12	8	6	26	205

Small Mesh #21, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	7	0	2	9	18
3	2	2	2	6	18
4	0	3	2	5	20
5	1	4	2	7	35
6	2	1	1	4	24
7	1	0	2	3	21
8	2	1	1	4	32
9	1	2	1	4	36
10	1	0	0	1	10
11	0	0	2	2	22
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	1	1	14
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
Sum	17	13	16	46	250

Small Mesh #2, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	0	0	0
3	1	1	3	5	15
4	1	4	5	10	40
5	1	10	4	15	75
6	0	3	3	6	36
7	0	2	0	2	14
8	1	1	5	7	56
9	0	3	1	4	36
10	0	1	2	3	30
11	1	0	0	1	11
12	0	1	1	2	24
13	0	0	0	0	0
14	0	0	0	0	0
Sum	5	26	24	55	337

Small Mesh #4, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	0	1	1	2
3	1	0	0	1	3
4	1	1	1	3	12
5	2	1	3	6	30
6	2	2	0	4	24
7	1	1	0	2	14
8	2	2	1	5	40
9	1	1	1	3	27
10	1	2	0	3	30
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Sum	11	10	7	28	182

Small Mesh #21, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	0	0	3	6
3	3	0	3	6	18
4	2	2	2	6	24
5	2	1	3	6	30
6	0	4	0	4	24
7	1	1	5	7	49
8	1	3	2	6	48
9	2	4	2	8	72
10	0	1	0	1	10
11	0	0	0	0	0
12	1	0	0	1	12
13	0	0	1	1	13
14	1	0	0	1	14
Sum	16	16	18	50	320

Small Mesh #2, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	0	1	2	4
3	0	5	2	7	21
4	5	0	3	8	32
5	2	4	3	9	45
6	6	3	3	12	72
7	4	8	4	16	112
8	2	2	6	10	80
9	1	1	2	4	36
10	0	2	1	3	30
11	1	0	1	2	22
12	0	0	0	0	0
13	0	1	0	1	13
14	0	0	0	0	0
Sum	22	26	26	74	467

Small Mesh #4, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	2	1	3	6
3	0	1	0	1	3
4	1	1	0	2	8
5	1	2	1	4	20
6	5	4	1	10	60
7	3	0	0	3	21
8	1	1	3	5	40
9	2	1	1	4	36
10	1	1	1	3	30
11	1	0	1	2	22
12	0	0	0	0	0
13	0	1	0	1	13
14	0	0	0	0	0
Sum	15	14	9	38	259

Small Mesh #21, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	2	1	4	8
3	2	2	0	4	12
4	2	1	4	7	28
5	2	1	3	6	30
6	3	4	5	12	72
7	5	1	1	7	49
8	8	3	3	14	112
9	1	2	1	4	36
10	0	0	1	1	10
11	1	1	1	3	33
12	0	1	1	2	24
13	0	1	0	1	13
14	0	0	0	0	0
Sum	25	19	21	65	427

Table 3h. Numbers of spat of specified lengths (mm) taken from Harp collectors by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each having a calculated area of 14.8333 cm^2, were taken.

Harp #27, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	3	0	0	3	3
2	3	3	2	8	16
3	11	8	5	24	72
4	9	9	0	18	72
5	16	6	12	34	170
6	7	3	8	18	108
7	6	5	13	24	168
8	3	0	6	9	72
9	4	0	0	4	36
10	4	2	2	8	80
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	66	36	48	150	797

Harp #44, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	3	3	3
2	1	1	2	4	8
3	4	4	2	10	30
4	12	12	4	28	112
5	6	14	3	23	115
6	8	9	6	23	138
7	2	12	3	17	119
8	8	5	4	17	136
9	1	3	3	7	63
10	2	3	2	7	70
11	2	0	1	3	33
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	1	1	14
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	46	63	34	143	841

Harp #6, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	5	5	5
2	2	8	1	11	22
3	3	9	7	19	57
4	4	6	2	12	48
5	2	10	0	12	60
6	5	6	4	15	90
7	1	8	2	11	77
8	3	2	4	9	72
9	3	1	2	6	54
10	0	4	1	5	50
11	3	1	2	6	66
12	0	0	1	1	12
13	0	1	0	1	13
14	0	0	2	2	28
15	0	1	2	3	45
16	0	0	1	1	16
17	0	0	0	0	0
Sum	26	57	36	119	715

Harp #27, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	1	2	3	3
2	1	1	0	2	4
3	1	4	1	6	18
4	7	4	11	22	88
5	11	8	14	33	165
6	7	5	8	20	120
7	11	5	4	20	140
8	3	1	2	6	48
9	0	0	2	2	18
10	3	0	1	4	40
11	1	0	1	2	22
12	0	0	1	1	12
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	45	29	47	121	678

Harp #44, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	0	1	2	2
2	3	0	0	3	6
3	8	1	3	12	36
4	2	8	2	12	48
5	10	11	4	25	125
6	5	12	9	26	156
7	1	9	2	12	84
8	3	4	8	15	120
9	1	0	2	3	27
10	1	1	2	4	40
11	0	1	1	2	22
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	35	47	34	116	666

Harp #6, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	5	1	6	12
3	1	2	2	5	15
4	5	5	4	14	56
5	7	8	4	19	95
6	4	9	5	18	108
7	1	5	0	6	42
8	6	2	5	13	104
9	2	4	2	8	72
10	3	3	0	6	60
11	0	3	0	3	33
12	0	2	0	2	24
13	0	0	1	1	13
14	0	0	0	0	0
15	0	0	1	1	15
16	0	0	0	0	0
17	0	0	0	0	0
Sum	29	48	25	102	649

Harp #27, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	0	1	0	1	2
3	5	5	3	13	39
4	7	7	7	21	84
5	10	5	15	30	150
6	14	4	7	25	150
7	10	4	11	25	175
8	2	2	6	10	80
9	1	1	3	5	45
10	2	2	2	6	60
11	0	0	0	0	0
12	2	1	0	3	36
13	0	0	0	0	0
14	0	0	1	1	14
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	53	32	55	140	835

Harp #44, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	1	0	2	2	4
3	3	3	3	6	18
4	6	5	9	14	56
5	6	18	13	31	155
6	6	15	3	24	144
7	3	6	2	11	77
8	5	2	3	10	80
9	2	0	1	3	27
10	1	3	5	9	90
11	0	0	1	1	11
12	1	0	0	1	12
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	34	52	42	128	674

Harp #6, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	8	8	8
2	2	3	6	11	22
3	1	3	6	10	30
4	2	6	4	12	48
5	2	0	1	3	15
6	5	5	4	14	84
7	4	0	2	6	42
8	5	7	6	18	144
9	1	4	4	9	81
10	3	4	1	8	80
11	0	1	1	2	22
12	0	2	0	2	24
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
Sum	25	35	43	103	600

Table 3i. Numbers of spat of specified shell lengths (mm) sampled from Bolt collectors by depth (Top, Middle, Bottom). Three replicate samples (1, 2, 3), each having a calculated area of 4.14 cm ^{2}, were taken.

Bolt #2, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	1	2	2	5	5
2	0	3	1	4	8
3	0	2	2	4	12
4	0	1	0	1	4
5	0	1	1	2	10
6	0	1	2	3	18
7	0	2	2	4	28
8	0	1	1	2	16
9	0	0	0	0	0
10	0	1	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	1	1	13
14	0	0	0	0	0
Sum	1	14	12	27	124

Bolt #5, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	0	6	9	18
3	1	2	5	8	24
4	0	4	4	8	32
5	0	2	1	3	15
6	0	1	0	1	6
7	0	0	0	0	0
8	0	1	0	1	8
9	0	0	0	0	0
10	0	1	0	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Sum	4	11	16	31	113

Bolt #1, Top					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	2	2	2
2	0	0	1	1	2
3	0	0	1	1	3
4	0	0	1	1	4
5	0	0	2	2	10
6	0	0	0	0	0
7	0	0	1	1	7
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Sum	0	0	8	8	28

Bolt #2, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	3	6	2	11	11
2	3	4	2	9	18
3	2	2	1	5	15
4	4	1	3	8	32
5	2	1	0	3	15
6	0	1	4	5	30
7	2	3	0	5	35
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	16	18	12	46	156

Bolt #5, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	3	1	4	8	16
3	5	4	3	12	36
4	1	3	2	6	24
5	1	1	0	2	10
6	0	0	0	0	0
7	1	0	0	1	7
8	0	0	0	0	0
9	0	0	1	1	9
10	0	0	1	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
Sum	11	9	11	31	112

Bolt #1, Middle					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	3	5	5	13	13
2	3	1	1	5	10
3	1	3	3	7	21
4	2	1	1	4	16
5	0	1	1	2	10
6	2	1	1	4	24
7	0	1	1	2	14
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	1	0	0	1	15
Sum	12	13	13	38	123

Bolt #2, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	3	3	3	9	9
2	1	1	4	6	12
3	0	0	0	0	0
4	1	1	2	4	16
5	1	1	1	3	15
6	2	2	2	6	36
7	4	4	0	8	56
8	3	3	0	6	48
9	0	0	0	0	0
10	2	2	0	4	40
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Sum	17	17	12	46	232

Bolt #5, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	0	0	0	0	0
2	2	2	0	4	8
3	2	2	0	4	12
4	0	0	0	0	0
5	0	1	2	3	15
6	3	1	1	5	30
7	1	1	3	5	35
8	0	1	2	3	24
9	0	1	1	2	18
10	0	0	1	1	10
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Sum	8	9	10	27	152

Bolt #1, Bottom					
Replicate	1	2	3	Sum	(Sum)(Len)
Len. (mm)					
1	2	0	2	4	4
2	2	3	2	7	14
3	0	1	0	1	3
4	5	6	5	16	64
5	3	2	3	8	40
6	2	3	2	7	42
7	1	1	1	3	21
8	0	1	0	1	8
9	0	2	0	2	18
10	1	0	1	2	20
11	0	0	0	0	0
12	1	0	1	2	24
13	0	0	0	0	0
14	0	0	0	0	0
Sum	17	19	17	53	258

Table 4a. Mean numbers of oyster spat settled/cm^2 by collector type and depth range.

Collector Type	Code	No.	Top	Middle	Bottom
Small Mesh	SM	2	2.8000	2.7017	3.6350
	SM	4	1.2772	1.3754	1.8666
	SM	21	2.2596	2.4561	3.1929
Large Mesh	LM	3	2.3471	2.7132	3.2515
	LM	1	1.2489	2.9931	2.7778
	LM	7	2.0457	2.4332	3.0362
Shell Strings (Upper)	SU	23	3.1000	1.4983	4.2367
	SU	25	1.7050	1.0850	3.2550
	SU	5	2.1183	0.1033	1.7050
Shell Strings (Lower)	SL	23	1.4467	2.8933	3.9267
	SL	25	2.2217	3.5133	3.4100
	SL	5	1.3950	3.6683	3.7717
Bolts	B	2	2.1739	3.7037	3.7037
	B	5	2.4960	2.4960	2.1739
	B	1	0.6441	3.0596	4.2673
Harps	H	27	3.3708	2.7191	3.1461
	H	44	3.2135	2.6067	2.8764
	H	6	2.6742	2.2921	2.3146
Chinese Hats (Upper)	CU	8	0.3617	2.3767	1.7567
	CU	18	0.6200	1.0333	2.8933
	CU	20	0.1550	1.5500	1.4983
Chinese Hats (Lower)	CL	8	0.8267	0.3617	1.9633
	CL	18	1.0850	0.5167	2.5833
	CL	20	1.3433	0.6200	1.4467
Veneer Rings (Outer)	RO	2	2.4283	n/a	n/a
	RO	3	3.1517	n/a	n/a
	RO	7	0.0517	n/a	n/a
Veneer Rings (Inner)	RI	2	1.4983	n/a	n/a
	RI	3	2.0667	n/a	n/a
	RI	7	1.4467	n/a	n/a

Table 4b. Mean shell lengths (mm) of oyster spat by collector type and depth range.

Collector Type	Code	No.	Top	Middle	Bottom
Small Mesh	SM	2	6.123	6.127	6.311
	SM	4	7.885	6.500	6.816
	SM	21	5.435	6.400	6.569
Large Mesh	LM	3	6.477	6.508	6.821
	LM	1	5.983	6.108	6.581
	LM	7	5.895	6.894	5.383
Shell Strings (Upper)	SU	23	3.733	3.690	3.927
	SU	25	3.515	2.810	4.270
	SU	5	3.610	2.500	3.970
Shell Strings (Lower)	SL	23	4.643	4.482	4.618
	SL	25	6.023	4.471	4.152
	SL	5	6.296	6.507	4.233
Bolts	B	2	4.593	3.391	5.043
	B	5	3.645	3.613	5.630
	B	1	3.500	3.237	4.868
Harps	H	27	5.313	5.603	5.964
	H	44	5.881	5.741	5.266
	H	6	6.008	6.363	5.825
Chinese Hats (Upper)	CU	8	2.286	4.109	4.206
	CU	18	2.917	4.350	3.821
	CU	20	3.333	4.400	4.103
Chinese Hats (Lower)	CL	8	3.563	4.429	4.500
	CL	18	4.714	3.100	4.860
	CL	20	3.231	2.583	3.357
Veneer Rings (Outer)	RO	2	5.213	n/a	n/a
	RO	3	4.705	n/a	n/a
	RO	7	3.000	n/a	n/a
Veneer Rings (Inner)	RI	2	4.655	n/a	n/a
	RI	3	4.950	n/a	n/a
	RI	7	5.107	n/a	n/a