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Estimation of Reference Points and a Precautionary Harvest Strategy for the Razor Clam (*Siliqua patula*) Fishery at Haida Gwaii

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Beaches near Massett, Haida Gwaii have supported commercial fisheries for Razor Clams, *Siliqua patula*, for over 100 years and have been managed using a catch quota since 2001. Biomass has been surveyed annually since 1994 using hydraulic core sampling and a three-stage sampling design stratified by beach area and beach level. From 2001 to 2008 the fishery was managed using an annual 0.123 harvest rate (instantaneous fishing mortality 0.131 yr^{-1}) that was estimated based on a surplus production model and one year of data. Biomass estimates from 1994 to 2008 ranged from 560 to 1,853 t (mean 966 t). Sustainable yield reference points were estimated using a publicly available program, Yield 1.0, that simulates fishery yields and estimates fishery reference points for user-specified parameters. The input parameters included an estimate of instantaneous M, a Razor Clam growth relationship, and a Ricker stock-recruit relationship based on 15 years of data. The annual natural mortality rate M was estimated to be 0.23 yr^{-1} (coefficient of variation [CV] 0.4 and instantaneous M 0.26 yr^{-1}) based on catch curves constructed from the annual length frequency distribution and ages of clam shell samples. The instantaneous F_{MSY} reference point was estimated to be 0.35 (95% confidence limit [CL] 0.06–0.57), B_{MSY} as 574 t, and unexploited fishery biomass as 1,390 t. A limit reference point at 230 t (0.4 B_{MSY}) and an upper stock reference at 459 t (0.8 B_{MSY}) are recommended. The recommended annual harvest rate is 0.21 based on $F_{0.2}$ (instantaneous F 0.24, 95% CL 0.12–0.50). The analysis looks at trade-offs among harvest rate at specified reference points, average annual yield, and resulting biomass generated by equilibrium and transient analyses, the latter incorporating interannual recruitment variability. Parameter uncertainty played an important role in the analysis as demonstrated by the wide confidence limits for the various reference points.

INTRODUCTION

This paper summarizes the results of surveys of Razor Clams (*Siliqua patula*) on beaches near Massett, Haida Gwaii from 1994 to 2008 and estimates the sustainable harvest rate and a precautionary harvest strategy for the fishery. Beaches near Massett, Haida Gwaii have significant populations of Razor Clams that have supported a major commercial fishery since 1923 and a small but important non-commercial fishery. Commercial landings over this period have fluctuated widely depending on market demand, fishing effort, and fluctuations in populations (Figure A.1, Table A.1). There have been several assessments of Razor Clam populations in the past (Bourne 1969; Jones et al. 1998; Jones et al. 2001). Jones et al. (1998) estimated the sustainable annual harvest rate or fishing mortality, *F*, in the fishery to be 0.123 yr^{-1} (2/3 of maximum sustainable yield [MSY]) based on a surplus production model and one year of data (1994). The assessment by Jones et al. (2001) reviewed survey information collected over a seven year period and presented trends in abundance, biomass, and recruitment in the fishery but did not examine the sustainable harvest rate. The present analysis considers Razor Clam age data that was determined from analysis of shells over a 14 year period from 1994 to 2008.

The initial purpose of the review as stated in the Pacific Scientific Advice Review Committee (PSARC)[1] request for a working paper was:

1. to assess sustainable harvest rates and methods to determine quotas using recent data sets including annual age distributions for the population;
2. to assess recruitment trends and the accuracy of forecasts, i.e., comparison of forecasts and biomass in the following year;
3. to determine a framework for providing quota options to Resource Management including analyses of variability in recruitment estimates (biomass estimates already incorporate variability); and
4. a review of management decisions since 2001 when quotas were first established with recommendations in light of the above results.

This paper provides an analysis of reference points and recommends a precautionary harvest strategy for the fishery. Further analysis will be required to complete all the above objectives.

Another objective is to summarize historic data that could support a management strategy evaluation of the Haida Gwaii Razor Clam fishery. These historic data are referred to in the paper; however, figures and tables that were not essential to the analysis of sustainable yield reference points were placed in an Appendix. The management procedure recommended in an earlier draft of this paper has been used for management of the fishery since 2010, including a harvest rate of 0.22 yr^{-1}, a limit reference point of 255 t, and an upper stock reference of 590 t. Beginning about 2018, the Razor Clam stock declined and remained below the limit reference point, requiring development of a rebuilding plan that is in progress.

BACKGROUND AND LITERATURE REVIEW

Razor Clams are found on surf-swept sandy beaches from Pismo Beach, California to the Aleutian Islands in Alaska (Weymouth and McMillin 1930). There are eight major concentrations

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[1] PSARC was the process for seeking science advice for fisheries management decision-making in Pacific Region prior to the establishment of the Canadian Science Advisory Secretariat.

sufficient to support fisheries, one in Oregon (Hirschhorn 1962), one in Washington (Tegelberg 1964), two in British Columbia (Bourne 1969; Quayle and Bourne 1972), and four in Alaska (Nickerson 1975). The major stocks in British Columbia are located at beaches near Massett in Haida Gwaii with a smaller population at Long Beach on the west coast of Vancouver Island (Bourne 1969).

Razor Clams are characterized by a long siphon, a prominent muscular foot, and brittle elongated valves. Razor Clams can burrow at rates exceeding 20 cm per minute and are found up to 25 cm deep in the sand, making harvesting a challenge for an inexperienced clam digger. Adults left on the surface of the beach will quickly rebury. Lateral movement of adults is believed to be small, although juvenile clams have been found to move because of substrate instability (Nickerson 1975). Juvenile clams burrow to a lesser depth and may be washed out and moved because of scouring of the substrate. Although there have been numerous studies of intertidal populations, little is known about subtidal populations in the vicinity of major Razor Clam beaches (Bourne 1969).

Adult Razor Clams reach shell lengths up to 160 mm and ages of 18 years. Growth rates vary with latitude, with northern populations generally growing slower but reaching a greater age and maximum size (Weymouth and McMillin 1930). Northern populations can be aged by annual winter growth checks, although interpretation depends on ability to identify all the checks (Bourne and Quayle 1970; Nickerson 1975). Survival of intertidal Razor Clams is likely affected by availability of food, predators, and natural occurrences such as storms or disease. Predators on larger clams include gulls, ducks, crabs and a few fish species.

Razor Clams have separate sexes and are broadcast spawners. Age and size of sexual maturity varies with latitude, but most clams are sexually mature at 2 to 4 years of age and 97 to 103 mm in length (Weymouth et al. 1925). Time of spawning varies with location, but generally occurs from April to September, occurring later at northern latitudes. Spawning can be influenced by temperature, upwelling, tidal cycles, currents, food availability, and gonad maturity.

The life history follows a common bivalve pattern of release of gametes into the surrounding water, fertilization, development as a free-swimming pelagic larvae, settlement to the bottom as “spat”, and finally development as a sedentary organism. The larval period was estimated to be about 8 weeks in Washington (Weymouth et al. 1925). By the time of settlement, larvae can be widely distributed from the point of origin by currents and tides. In laboratory culture at 16.5°C, metamorphosis took place about 20–25 days after fertilization at a shell length of about 300 microns. After three months, juveniles reached a mean shell length of 5 mm (Breese and Robinson 1981). Bourne (1979) followed the growth of zero age clams by beach screening over 12 months and found that clams 2 to 6 mm in July reached 4 to 10 mm in September, 12 to 14 mm the following May and 18 to 20 mm the following June (Bourne and Quayle 1970). Relatively little is known about environmental factors contributing to survival of Razor Clams during the vulnerable larval and early juvenile stage of their life history.

Intertidal populations have been estimated using a variety of techniques including mark-recapture (Bourne 1969; Ayres and Simons 1988) and hydraulic core sampling (Szarzi 1991; Jones et al. 2001). Hydraulic core sampling has the advantages of providing an unbiased sample of the population and ease of sampling. Hydraulic sampling using a three stage sampling design has been used to monitor the population of Razor Clams on Massett beaches since 1994.

The commercial fishery is currently managed by a 90 mm size limit and catch limits that are set pre-season. Catch limits were first introduced in 2000 when an arbitrary catch ceiling of 235.8 t (520,000 pounds) was introduced (Table A.2). From 2001 to 2008 the catch ceiling was based on 12.3% of the forecast biomass estimated from hydraulic sampling, except in 2006 when a 15.0% harvest rate was used, and 2007 and 2008 when an estimate of recruitment was added to the biomass before the harvest was calculated. Commercial and recreational Razor Clam fisheries at North Beach are open year-round except for the occasional marine toxin (paralytic shellfish poison [PSP] or amnesic shellfish poisoning [ASP]) closures. Recreational clam diggers are limited to a daily catch of 75 clams and a possession limit of 150 clams. There is no recreational size limit.

The Haida Gwaii Razor Clam fishery is co-managed by the Council of the Haida Nation (CHN) and Fisheries and Oceans Canada (DFO) (Jones and Garza 1998). The details of the management arrangement are described in Schedule C of the 2023 Interim Fisheries Agreement between DFO and the Council of the Haida Nation. Provisions for co-management of the Razor Clam fishery were first negotiated through DFO's Aboriginal Fisheries Strategy in 1994 and were renewed with minor changes in subsequent years. Two joint Haida/DFO committees are responsible for implementing and monitoring the agreement. The Joint Shellfish Technical Committee is responsible for developing and recommending an annual management plan to a Cooperative Management Group, assessing sustainable harvest levels in the fishery, and monitoring, surveying, and enforcing the fishery. The Haida fishery is managed through a Communal Licence and the CHN issues designations to Haida participants. DFO issues licences to up to six individuals to participate in the fishery. DFO licences are personal and non-transferable and were limited in 1995. Under the Communal Licence, CHN is responsible for collecting and compiling fish slip data and collection of samples for marine toxin monitoring. The number of Haida participants under the Communal Licence is not limited.

Haida Gwaii Razor Clam landings, effort and value from 1995 to 2008 are shown in Table A.2. The number of licences and Haida participants in the commercial fishery during this period is shown in Table A.3.

METHODS

Methods to estimate Razor Clam overall abundance and biomass and year-class abundance and biomass on beaches near Massett, Haida Gwaii are fully described in Jones et al. (1998) and Jones et al. (2001), but are summarized below as an aid to interpreting the tables and figures. Parameters required to model the sustainable yield reference points were obtained from an analysis of survey data using a publicly available program, Yield 1.0. The input parameters are listed later and included an estimate of instantaneous natural mortality (M_i), a Razor Clam growth relationship, and a Ricker stock-recruit relationship based on 15 years of data.

HYDRAULIC SAMPLING AND SURVEY METHODS

From 1994 to 2008, Razor Clam populations in three beach sections were sampled using a three stage design, generally following the methods described in Jones et al. (1998).

The three main beaches near Massett are commonly called North Beach, South Beach and Agate Beach. The five sections of the beach sampled, referred to as North-1, North-2, South-1, South-2 and Agate are 7.3 km, 5.8 km, 4.6 km, 6.75 km and 2.17 km in length, respectively (Figure A.2). Beach sections were selected based on clam density, beach accessibility, and use as reported by commercial clam diggers.

In general, North-1 is the main focus of the commercial Razor Clam fishery. North-2 is a steeper beach and due to its inaccessibility is most frequently dug during the lowest tides. South-1 is occasionally dug commercially, but clam densities are lower and the distribution is spottier. South-2 is rarely dug. Agate Beach was rarely dug commercially in the early 1990s because truck access is difficult, but has been dug more frequently in recent years. Generally, sampled beaches have gentle slopes from the driftwood line, with 60 to 75 m of beach exposed per 1 m of elevation. North-1 is a uniform sand beach. South-1 and South-2 are mainly sand beaches interspersed with pockets of gravel. South-2 is more gravelly than South-1. The coarser beach material at South-1 and South-2 beaches are said by commercial diggers to make digging and retrieving clams more difficult. Many diggers won't fish East beach because vehicles tend to get stuck in the soft substrate. Landings have been monitored by beach section since 2001 (Table A.2).

The intertidal Razor Clam population was estimated using a three stage sampling design that was stratified by beach area and beach level. Transects were sampled during tides less than 1.0 m in height at the locations and dates shown in Table A.4. Commercial diggers generally only dig when tides are less than 1.2 m (4.0 feet). Representative samples of the population were collected by hydraulic sampling of sand cores with a 0.5 m^2 sampling tube. For example, in 1994, 14 transects in 3 beach areas were surveyed and samples were collected at 99 beach elevations. A total of 533 cores were sampled and 4,569 clams of all sizes were captured.

The equipment used was similar to that described by Szarzi (1991). A galvanized steel sampling ring (0.79 m diameter, 0.5 m^2 in area), was drilled throughout with 3 mm holes to allow easy drainage of water. Four additional oval holes (60 mm long covered with 5 mm wire mesh) were located near the top of the ring to allow further drainage. The sampling ring was forced into the sand to a depth of about 0.5 m. Seawater was pumped using a 4.0 HP Honda pump (Model GX-120) and injected into the sand using a wand (a steel pipe, 1.5 m in length, 38 mm in diameter) attached to the pump by a 51 mm diameter hose about 45 m in length. Upwelling water liquified the sand, dislodging the Razor Clams. Razor Clams were captured by straining the upwelling mixture with a coarse mesh (5 mm) dipnet followed by a fine mesh (<1 mm) dipnet.

Generally, the procedure requires about 3 to 5 minutes per sample with a five person crew. One person acted as a tender for the pump intake, one person worked the wand that fluidized the sand, two others strained the mixture, and one person supervised field activities and surveyed the beach elevations, providing assistance wherever necessary. Sampling continued until approximately one minute after the last clam was captured. At that time, all clams in the sample area were thought to be captured. A few broken clams were noted, likely due to pressure from the wand as it was inserted. Razor Clams from each sample were put into separate labelled bags. Length of individual clams was measured using calipers to the nearest mm after field sampling was completed. The wet weight of individual clams was measured using an Ohaus electronic balance. The length of all clams was measured but not all clams were weighed. Where clams were measured but not weighed, the wet weight was estimated using a length-weight regression. A small amount of breakage from handling clams in sample bags was recorded which occurred mostly for small clams, e.g., in 1994 broken clams averaged 2.5% of each sample of which 1.9% were <20 mm shell length. No correction was applied for breakage.

Transects locations were selected systematically with the first transect location randomly selected (except in 1994 when transects were selected randomly from a sample that was systematically selected), and located by driving a fixed distance from an access point as measured with a truck odometer. Distances on North-1, North-2 were measured east from Tow Hill. Distances on Agate Beach were measured from the east side of Agate Beach. Distances on South-1 and South-2 beach sections were measured in a westerly direction. Just before sampling, each transect was laid out perpendicular to the waterline using rebar marked with flagging tape. One transect was sampled per tide. Depending on daylight, sampling generally began 2–3 hours before the low tide and continued until approximately three hours after the low tide.

Beach elevations sampled within a transect were located systematically along the transect, with sampling starting at the surfline at the time of arrival. Horizontal distance between sampled elevations was generally 15 m (except in 1994 when the distance ranged from 10 to 25 m depending on number of core samples at each elevation and the rate of subsidence (or approach) of the tide). Each beach elevation was flagged with a metal rebar stake during sampling. For each transect, 4 to 16 beach elevations were sampled depending on the low tide level and time available.

At each beach elevation, the survey crew completed 3 core samples (except in 1994 when 3 to 9 core samples were taken). The sampling strategy after 1994 was changed to complete more elevations with fewer core samples per elevation as a means of improving the precision of estimates. Core samples were situated parallel to the surfline within about 7 m of the transect line with approximately the same number on each side of the transect line. If the tide was falling rapidly, then the survey crew moved to the next lower beach elevation and completed sampling at higher beach elevations on the rising tide.

Elevation was measured using a surveyor's level (Pentax Model AL.-240) and rod, using the tidewater level as the reference elevation. At a recorded time near low tide, a profile of the beach and the tidewater elevation relative to the sampled beach elevations was determined using the level and rod. Tidewater elevation above chart datum at the time of sampling was calculated using time and procedures described in Canadian Tide and Current Tables. For the purposes of the calculation, Bella Bella was the reference port and Wiah Point was the secondary port. There was a small random error in estimation of tidewater elevation because of ocean swells. Generally, tidewater elevation was estimated to be within ±0.1 m of the true value.

ABUNDANCE AND BIOMASS ESTIMATES

The estimates of the abundance and biomass were obtained using methods described in Szarzi (1991) and Babineau (2000) and adapted by Schwarz et al. (1995). This consists of two steps for each size class at each beach in each year.

Step 1. Estimate the total number of clams or biomass of clams in a 0.5 m strip along the transect

The total number (or biomass) of clams along a 0.5 m strip along the transect was estimated using an area-under-the-curve approach. The mean density at each sampling point along the transect is computed using the average of the samples taken at that distance. Then these points are joined by straight lines, and the area under the curve (i.e., a graph of clam density vs distance along the transect) is computed by summing the trapezoids formed by the sampling points and the mean densities, i.e., to estimate the total number

$$\hat{T}_i = \frac{\sum_{j=1}^{n_i-1} \left(\overline{Y}_{ij} + \overline{Y}_{i,j+1}\right) b_j}{2}$$

where

$\hat{T}_i$ is the estimated transect total,

$\overline{Y}_{ij}$ is the sample mean of the counts in transect *i* at sampling point *j*, and

b_j is the distance along the transect between the j^{th} and $j+1^{st}$ sampling points.

The beach above the highest sampling point and below the lowest sampling point are given a density of zero. [Note that in Babineau (2000), the curve was extrapolated down to zero above the highest elevation of the beach. Hence our results differ slightly from those presented in her thesis.].

Step 2. Estimate the total number and biomass of clams on the beach

Once the estimates of the total number of clams along the 0.5 m wide strip on the transect are found, the number of clams for each beach section is estimated according to the inflation method. The average density of clams in a transect is multiplied by an inflation factor, the number of possible transects on the beach (two times the length of the beach since each transect was assumed to be 0.5 m wide).

$$\hat{N}_{\inf} = N\frac{\sum_{i=1}^{n}\hat{T}_i}{n}$$

where additional parameters are defined below.

Again the precision of the estimates is calculated as outlined in Babineau (2000, Equation 2.24).

$$\hat{\text{v}}\text{ar}\left(\hat{N}_{\inf}\right) = N^2\left(\frac{s_T^2(1-f)}{n} + \frac{1}{n^2}\sum_{i=1}^{n}\hat{\text{v}}\text{ar}\left(\hat{T}_i\right)\right)$$

where

n is the number of transects sampled on the beach,

N is the number of possible transects on the surveyed beach having a width of approximately 0.5 m (e.g. length of the beach in m x 2), and

$f = n/N$

$$S_T^2 = \sum_{i=1}^{N}(T_i - \overline{T})/(N-1)$$

.

A similar calculation is performed to estimate the biomass density over the beach and the total biomass of clams ≥90 mm.

The weight of all clams in a core sample was calculated as the total of the weight of individual clams. If the length of a clam was available but not the weight, then it was estimated using a length-weight regression from 1994 sampling for clams >20 mm (n = 1,406) (Jones et al. 1998):

$$log_{10} W \quad = \quad 3.3058 \quad log_{10} L \quad - \quad 4.7813$$

where

W is the weight in grams,

L is the length in mm.

LENGTH-FREQUENCY AND BIOMASS BY LENGTH DISTRIBUTIONS

Length-frequency distributions of the population were constructed for all years by pooling samples from all transects and core samples (except 1994 when only transects sampled early in the season, March–May, were used) (Figure A.3). The weight and length of individual clams was also used to construct a biomass by length distribution (Figure A.4).

YEAR-CLASS ABUNDANCE AND BIOMASS

Abundance of Razor Clams by year-class was calculated using an age-length key (Gulland and Rosenberg 1992; Kutkuhn 1963). This technique uses an age sample and the length frequency distribution from a larger sample of the population to calculate the proportion of clams in each age-class. The number of clams of each age is then the product of the proportion and number of clams in the population.

The pooled length-frequency distribution for each year was assumed to be representative of the overall population. For each year, a random sample of shells was selected for aging using a target number of 10 or more clams for each 5 mm size class. Clams selected for aging were primarily from those transects that had the largest number and size range of shells, supplemented with large and small clams from additional transects to reach the target number.

The proportion of age *j* clams in the population was estimated using Equation (1) from Kutkuhn (1963):

Where

$$p_{j(st)} = \sum_{i=1}^{L} p_i p_{ij}$$

p_i is the proportion of clams in the *i*th length strata

p_{ij} is the proportion of age *j* clams in the *i*th length strata in the age sample.

$$var\left(p_{j(st)}\right) = \frac{n}{n-1} \sum_{i=1}^{L} \left[{p_i}^2 \ \frac{p_{ij} q_{it}}{m_i} + \frac{p_i\left(p_{ij} - p_{j(st)}\right) \ \ 2}{n} \right]$$

The variance in the estimate of the proportion of clams of age *j* was calculated using Equation 2 from Kutkuhn:

Where

n is the number in the length sample

m is the number in the age sample

m_i is the number of clams falling into the *j*th age group

The standard error (SE) of the number of clams of each age was calculated using Goodman’s formula (Goodman 1960), which assumes that the two multiplicands are independent.

The biomass of clams of each age was calculated in a similar manner. For each year, a distribution of biomass by length was compiled from the length and weight data for individual clams (see Figure A.4). The proportion of clams in each age-class is calculated by applying the age-length key to this distribution. The number of clams of each age is then the product of this proportion and total biomass of clams in the population.

SUSTAINABLE YIELD MODEL

Sustainable yield and reference points were calculated using the publicly available software package Yield Version 1.0 (Branch et al. 2000). The program is further described in MRAG

(2001), Hoggarth et al. (2006) and MRAG (2005). Help files are only available for versions of Windows up to Vista.

Yield Version 1.0 is a program for calculating fishery yields and stock biomasses, on an absolute or per-recruit basis, and for calculating biological reference points. The program is a good fit for the data available for the Haida Gwaii Razor Clam stock. The program utilizes biological parameters (e.g., growth, mortality, age at maturity, and stock-recruitment relationship) and fishery parameters (e.g., length at first capture, fishing season). For each parameter, either a single value can be entered, or a probability distribution can be specified to allow for uncertainty. When calculating yields and yields per recruit, the program takes explicit account of specified parameter uncertainties, presenting results of simulations in terms of line graphs or histograms that incorporate estimates of uncertainty. Transient projection and reference point calculations can also be made, once the extent of stochastic recruitment variability has been specified. The program is a simulation tool that uses fishery-specific parameters to estimate reference points based on the fishery mortality rate, e.g., F_{MSY}, $F_{0.1}$, $F_{0.2}$, etc. The program automatically generates outputs for a range of values of F_i based on a number of simulations as specified by the user.

A description of the input parameters is provided below (adapted from MRAG 2001).

Von Bertalanffy length-age relationship

The relationship between length and age was assumed to be described by the von Bertalanffy growth relationship that predicts the length of a fish of known age:

$$L = L_{\infty}(1 - e^{-K(t-t_0)})$$

where

L_{∞} is the asymptotic maximum length of fish in the population (units: cm)

K is a parameter describing the rate at which fish grow towards L_{∞} (units: yr^{-1})

t_0 is the theoretical age where the length of a fish is exactly zero (units: yr)

L = the length of the fish (units: cm)

t = the age of the fish (units: year).

Length-weight relationship

For the purposes of the Yield program, the relationship between length and weight was an exponential function of the form:

$$W = a\, L^{\beta}$$

where

W = the weight of the individual (units: g)

Alpha α is the multiplier

L = the length of the fish is the base (units: cm)

Beta β is the exponent.

Natural mortality, M_i

The natural mortality rate M_i is the instantaneous exponential rate at which fish in the population die from natural causes. The Yield program assumes that the natural mortality rate is constant over all ages and in all years. Consequently, in the absence of fishing, the number of fish of age t+1 (N_{t+1}) is related to the number of fish of age t by the equation.

$$N_{t+1} = N_t \, e^{-M}$$

Note that M is measured in units of yr^{-1}.

Size at maturity and first capture

Yield allows the user to enter either the length or age at maturity. Size at maturity was reported by Jones et al. 2001. Based on a sample of 531 clams ranging from 50 mm to 155 mm, no Razor Clams were mature at 80 mm shell length (SL), 50% were mature at 87 mm and all were mature at about 97 mm SL. From this, the length at maturity was estimated to be 87 mm with a coefficient of variation of 0.05 with a normal distribution. The program subsequently calculates the age at maturity from the length at maturity using the von Bertalanffy growth curve.

Length at first capture is assumed to be 90 mm, which is the legal size limit.

Spawning and fishing season

A monthly time step was assumed for the calculations. The spawning season was assumed to go from April to the end of August. The fishing season was assumed to last from February to September.

Stock-recruit relationship

Yield provides an option of using either Ricker or Beverton Holt stock-recruit relationships. In our case recruitment was estimated as the number of Age 2 clams. These clams will recruit to the fishery at ages 3 and 4. Clams in the size range of 0 to 20 mm are not aged so it was not possible to separate the number of Age 0 and 1 clams. The standard formulation for the Ricker curve was used:

$$R = \propto S e^{-\beta S}$$

where

S is the spawning stock biomass,

R is the recruitment arising from *S*,

Alpha α is a parameter that is related to the maximum recruitment, and

Beta β is a parameter that determines the shape of the curve.

The stock-recruitment relationship shows a distinct maximum in recruitment for biomasses between about 600 and 900 tonnes (see Figure 1). As a result, the Beverton Holt relationship was not a good fit to the data.

REFERENCE POINTS

The Yield 1.0 program provides the option of assessing a range of common fishery mortality and biomass based fishery reference points (see e.g., Hoggarth et al. 2006; Pew 2016). The following reference points were estimated for the Razor Clam fishery:

Equilibrium yield-per-recruit

Assuming that fishing occurs year-round and there is a knife-edge age at first capture t_c, then the equilibrium yield-per-recruit (YPR) for a given value of fishing mortality rate F is defined as

$$YPR = \int_{t_c}^{\infty} e^{-(F+M)t}\, W(t)dt$$

where

$$W(t) = \alpha L_{\infty}{}^{\beta}(1 - e^{-K(t-t_0)})^{\beta}$$

and

M is the natural mortality rate;

F is the fishing mortality rate;

L_{∞}, K, and t_o are the von Bertalanffy growth parameters;

Alpha and Beta are the parameters of the length-weight relationship;

t_c is the age at first capture; and

β is the exponent of the length-weight relationship.

F_{MSY}

This is the value of F that in an equilibrium population will result in taking the maximum sustainable yield.

$F_{0.1}$, $F_{0.2}$ and $F_{0.3}$

The $F_{0.1}$ and $F_{0.2}$ and $F_{0.3}$ reference points are, respectively, those values of F for which the slope of the YPR curve is 0.1, 0.2 and 0.3 times the slope at $F = 0$. An illustration is provided for $F_{0.1}$. (Figure 2). Along with F_{MSY} these would be considered potential removal references that DFO (2009) defines as the maximum acceptable removal rate of a stock that must be less than or equal to maximum sustainable yield.

Equilibrium SSB reference point ($0.2B_0$)

The equilibrium Spawning Stock Biomass (SSB) reference point allows the user to calculate the value of F_i that will ensure that the equilibrium SSB at that value of F_i is kept at a specified proportion of its unexploited level. For example, in a number of fisheries if the SSB falls below 20% of its unexploited level ($0.2B_0$), this is taken as a signal that future recruitment may be affected. This model run resulted in a harvest rate of 0.85, which is more than double F_{MSY}. It is not presented in this paper.

Equilibrium 50% fishable biomass

Another commonly used reference point is the level of fishing that will reduce the fishable biomass to around 50% of its unexploited level.

Transient SSB

Yield allows the user to investigate the effects of interannual variability in recruitment. This is important if the stock-recruit relationship is relatively weak. Simulations were run for four values of F_i: 0.131 yr^{-1} (equivalent to an annual F of 0.123 yr^{-1}, the management target from 2001-2008), 0.18 yr^{-1} equivalent to an annual F of 0.16 yr^{-1} ($F_{0.3}$), 0.24 yr^{-1} equivalent to an annual F of 0.22 yr^{-1} ($F_{0.2}$), and 0.35 yr^{-1} equivalent to an annual F of 0.30 yr^{-1} (F_{MSY}).

RESULTS

TRANSECT SAMPLING

The sampling dates and location of transects are shown in Table A.4. North-1 beach section was consistently sampled in all years. Sampling effort on South-1 and South-2 beach areas was variable, particularly on South-2 where there was no sampling in 1995 and only one transect in 1997. Sampling was more consistent after 2001. North-2 sampling started in 2001. Agate Beach sampling started in 2007.

ABUNDANCE

Estimates of the total number of clams for the surveyed beach sections by size fraction (4 mm+, 20 mm+ and 90 mm+) and year using the inflation method are shown in Table A.5. Harvestable clams (90 mm+ clams) on North-1 show a peak in 2000 and 2007 (Figure A.5a). On South-1 and South-2 there is no apparent trend in the number of harvestable clams. Estimates of harvestable clams on North-1, South-1 and South-2 are more variable than North-1 due to spottier distribution as well as fewer transects.

Clams less than 20 mm are mostly yearlings, although some young of the year may be sampled in transects later in the year. From aging work, clams in the 20 mm to 90 mm size range are 1 to 3 years of age that will recruit to the fishery in 1 to 2 years.

BIOMASS BY BEACH SECTION

B_{survey}, the survey estimate of biomass of harvestable clams (SL $\geq$90 mm), follows a similar trend as abundance on the three beach sections (Table A.6, Figure A.5b). The biomass at the start of 2008 ($B_{t)}$ was estimated to be 1,148 t (SE 131 t), which ranks the 4th highest in the last 14 years (Table 1).

FISHING MORTALITY

Annual fishing mortality (F) was estimated after adjusting the survey biomass, B_{survey} to account for the catch up to the mean date of each survey. B_{survey} was calculated by adding the biomass of all beach sections from Table A.6. The mean survey date was the average date considering all transects for that year. The adjusted catch, C_{adj}, was the catch up to the mean survey date estimated from Table 1 assuming that catch on each day of the month was equal. The sum of B_{survey} and C_{adj} provides an estimate of B_t, the biomass at the beginning of the year. Then F was estimated as C divided by B_t. F was found to range from 0.015 to 0.265 yr^{-1} with an average of 0.142 yr^{-1} from 1994 to 2008 (Table 4). The estimate of B_t includes recruitment, growth and mortality up to the mean survey date. Average annual fishing mortality for the fifteen year period was 0.142 yr^{-1} compared to the management target of 0.123 yr^{-1} due to difference between the preseason biomass and the estimate from the in-season survey. F averaged 0.151 yr^{-1} during the period of active management from 2001 to 2008.

Length-frequency distributions

Length-frequency distributions of clams from transects display incoming recruitment of age 2 and 3 clams that occur in the size range of 20–90 mm (Figure A.3). The length-frequency distribution of the commercial catch was previously found to be similar to the population >90 mm (Jones et al. 2001). In 2000 mean length of the catch sample (n = 559) was found to be 124.1 mm (SD 10.3 mm), compared to the mean length of clams >90 mm in the population sample (n = 927) of 124.1 mm (SD 14.0 mm).

Abundance at age and natural mortality

Table A.7 provides the annual age-length keys and the calculation of the number of clams in each age class for 1994 to 2008 that were used to estimate *M*. The number of clams in the 20 mm to 90 mm size range was also calculated as well as the proportion of Age 3 clams that are recruited to the fishery. The proportion of Age 3 clams recruited averaged 0.58 with a range of 0.45–0.75 not including an outlier of 0.15 in 1995.

Abundance trends by year and age are shown in Table 2. These values were used to estimate the annual natural mortality for age two to seven clams of M = 0.23 yr^{-1} (CV 0.40) that was converted to an instantaneous natural mortality M_i of 0.26 yr^{-1} used in the Yield model (Table 2). Catch curves are shown in Figure 3. The 2003 value of *M* was rejected since the slope resulted in a value that was less than the fishing mortality.

Stock-recruit parameters

Ricker stock-recruit parameters were estimated using the exploitable biomass B_t in Table 1 as the spawning stock and number of Age 2 recruits from Table 2. Recruitment in 2000 and 2001 was reduced by the proportion of the population that was on North-2, since North-2 was not included in the estimate of the spawning stock in 1998 and 1999. The stock recruit data that was used to fit the Ricker curve is compiled in Table 3 and the fitted curve is shown in Figure 1.

Biomass at age

Clam biomass by year and age is compiled in Table A.8 for all clams, clams 20–90 mm and 90+mm.

YIELD PARAMETERS

Parameters used in the Yield program to estimate potential sustainable yield reference points are provided in Table 4.

The results of the simulations are shown in Figures 4 to 14 and described briefly below. All simulations involved 500 runs using a monthly time interval. Generally, Yield allows the user to display results as absolute biomass, or as a ratio with the unexploited biomass. Since the age at maturity and the legal size limit are close to the same value, there is only a relatively small difference between spawning stock biomass, fishable biomass and total biomass in absolute terms and in the ratio of exploited biomass in the simulations.

EQUILIBRIUM YIELD-PER-RECRUIT

Figure 4 shows estimated equilibrium YPR as a fraction of unexploited biomass using Yield. The median value and 95% confidence limits are shown based on 500 runs with random selection of parameters based on the specified uncertainties. Figure 4a indicates that the yield-per recruit steadily increases with the rate of increase gradually declining up to the maximum value of F_i = 0.6 yr-1 that was specified. As shown in Figures 4b, c and d, the biomass per recruit as a ratio of unexploited values declines as *F* increases. As shown in 4b, fishable biomass-per-recruit approaches 50% of unexploited levels at about F_i = 0.2 yr^{-1} and 20% at F_i = 0.6 yr^{-1}. The 95% confidence limits indicate a high degree of uncertainty in the estimate of YPR. Equilibrium YPR estimates do not incorporate the stock recruitment relationship.

UNEXPLOITED STATE

Figure 5 shows the estimate of recruitment and biomass for the unexploited state (B_0). The median unexploited fishable biomass was estimated to be 1,390 tonnes (95% CL 209–

2,814 tonnes). This would indicate possible reference points of 278 tonnes for $0.2B_0$ and 690 tonnes for $0.5B_0$.

EQUILIBRIUM REFERENCE POINTS

Figures 6, 7, 8, 9, 10, and 11 show fishing mortality, YPR and biomass-per-recruit (relative to unexploited levels of SSB_0, Fishable B_0 and Total B_0) for six possible reference points: maximum YPR, F_{MSY}, $F_{0.1}$, $F_{0.2}$, $F_{0.3}$ and $0.5B_0$. These analyses assume equilibrium conditions. The results of each analysis are briefly described below.

Maximum YPR (Figure 6) results in very high estimates of F_{i} (median value of $F_{\mathrm{i}} = 0.84$ or $F = 0.64$ yr^{-1}). It results in high values of YRP (0.097 of the unfished YPR). Median biomasses are near or below $0.20B_0$ (ranging from 0.17–0.24 of YPR for unexploited fishable, spawning stock and total B_0. Given this the maximum YPR was not considered to be a reasonable reference point. DFO (2009) would not consider Maximum YPR to be a potential removal reference since it exceeds $\mathrm{F}_{\mathrm{MSY}}$.

The F_{MSY} (Figure 7) analysis estimated a median value of $F_{\mathrm{MSY}} = 0.35$ yr^{-1}. Median catch was 137 t. Median fishable biomass was 574 t (0.41 B_0). All values have a high degree of uncertainty.

The $F_{0.1}$ (Figure 8) analysis estimated a median value of $F_{0.1} = 0.36$ yr^{-1} similar to F_{MSY}. The YPR was still relatively high (0.088 of the unfished YPR). Median fishable biomass was $0.37B_0$.

The $F_{0.2}$ (Figure 9) analysis estimated a median value of $F_{0.2} = 0.24$ yr-^{1}. The median YPR ratio of 0.077 was somewhat lower than for $F_{0.1}$. Median fishable biomass was $0.48B_0$.

The $F_{0.3}$ (Figure 10) analysis estimated a median value of $F_{0.3} = 0.18$ yr^{-1}. The median YPR ratio of 0.067 was also a little lower than for $F_{0.2}$ and $F_{0.1}$. Median fishable biomass was $0.57B_0$.

The $0.5B_0$ (Figure 11) analysis estimated a median value of $F = 0.28$ yr^{-1}, which was a little higher than $F_{0.2}$. The median catch was estimated at 129 t. The median fishable biomass was 689 t ($0.50B_0$ as specified).

TRANSIENT ANALYSES

Transient analyses with 500 simulations each were run to examine the effects of recruitment variability for four values of F: 0.131 (the current management target); 0.18 ($F_{0.3}$ above); 0.24 ($F_{0.2}$ above); and 0.35 (F_{MSY} above).

As shown by comparing Figures 12 to 15, the median yield increases and median biomass decreases as F increases. During years 11 to 20 the average yield was estimated to increase from 121 t to 190 tonnes, respectively for the four candidate reference points. The mean fishable biomass decreased from an unfished value of about 1,300 tonnes, to a mean value of 942 (under the current policy). Biomass for the $F_{0.3}$, $F_{0.2}$ and $F_{0.1}$ reference points resulted in fishable biomasses of 850 ($0.61B_0$), 710 ($0.51B_0$) and 543 ($0.39B_0$) tonnes in years 11–20 respectively. There is significant uncertainty in biomass and potential yield as shown by the 80% confidence interval in the figures. The results illustrate the trade off between yield and biomass for the four potential harvest rates.

SUMMARY OF ANALYSES

Estimated fishing mortality, yield, and biomass for the current policy and potential reference points are provided in Table 5.

DISCUSSION

The survey methodology provides direct information that is needed to estimate sustainable harvest rate in the fishery using the program Yield 1.0. A variety of parameters and associated uncertainties were estimated for the fishery and utilized in the Yield 1.0 estimates of reference points.

Biological parameters were determined from the survey data. This includes parameters in the von Bertalanffy relationship between length and age (L_∞, K, t_0), and the relationship between length and age (Alpha and Beta). The CV for these parameters was assumed to be negligible compared to other parameters.

Annual natural mortality M for razor clams was estimated to be 0.23 yr^{-1} (CV 0.40) based on 15 years of data (Table 2). This is equivalent to an instantaneous value M_i of 0.26 yr^{-1}. The previously published estimate of M of 0.27 yr^{-1} was based on a surplus production model and a single year of data in 1994 (Jones et al. 1998). The variation in M is indicated by differences in the slope of the annual catch curves (Figure 2). M is assumed to be constant across all ages and all years but the annual estimates from catch curves varied significantly. Potential errors in Razor Clam aging likely had little effect on the analysis and conclusions. One anomaly mentioned earlier was that the proportion of Age 3 clams recruited in 1995 was outside the range of the other values. As well, the estimate of M in 2003 wasn't consistent with F (Table 2). But for both these years the catch curves that were derived from the age distribution seemed relatively consistent (Figure 1).

The stock recruitment relationship shows wide scatter around the best-fit Ricker curve. Recruitment was estimated as the number of two-year old clams since this age class was completely sampled. In actuality this age-class will recruit to the fishery in one to two years when they reach 90 mm shall length. The Ricker curve was a better fit to the stock recruitment data than Beverton-Holt since the recruitment declines at higher levels of the spawning stock biomass, which implies that recruitment is density dependent. One caution is that there were no data points for a biomass below 560 t. However, the Ricker relationship assumes a steady decline in recruitment below that level. The changes in sampling of beach sections to add sampling of North-2 and Agate Beach had the potential to overestimate recruitment for the transition years. As mentioned earlier, the Year 2 recruitment was adjusted by reducing it by the proportion of clams on the new beach sections.

The Yield program estimated the median value of the unexploited fishable biomass as 1,390 t (Figure 5). DFO's framework for the precautionary approach to fisheries defines a healthy zone, a cautious zone and a critical zone with an upper stock reference (USR) and a limit reference point (LRP) that defines the transition between the zones (DFO 2009). A provisional definition of these reference points is described as 80% of the biomass that gives maximum sustainable yield ($0.8B_{MSY}$) as the Upper Stock Reference (USR), 40% of B_{MSY} as the Limit Reference Point (LRP) ($0.4B_{MSY}$), and the fishing mortality that gives maximum sustainable yield (F_{MSY}) as the maximum allowable.

We had previously estimated the fishable biomass at maximum sustainable yield, B_{MSY}, as 574 tonnes (Figure 7e). Accordingly, the limit reference point would be 230 tonnes and the upper stock reference would be 459 tonnes. Fishing at F_{MSY} often leads to unsustainable fisheries (Larkin 1977, Pew 2016). Fishing at $F_{0.1}$, $F_{0.2,}$ or $F_{0.3}$ when fishable biomass is above the upper stock reference of 459 tonnes, would be consistent with this draft policy.

DFO identifies F_{MSY} as a maximum limit (i.e., a removal reference in the healthy zone). Hoggarth et al. (2006) identifies that using MSY as a target is dangerous because it can't be estimated precisely. In our case we see that $F_{0.1}$ and F_{MSY} have similar values. $F_{0.2}$ results in less yield over the long term than adopting $F_{0.1}$ or F_{MSY} . and the tradeoff will be higher average biomass (c.f., Fig. 14 for $F_{0.1}$ and Fig. 15 for F_{MSY}), although both may experience high biomass fluctuations. Similarly, $F_{0.3}$ would more conservative still with respect to yield.

The choice of harvest rate depends on goals for the fishery. Selecting a higher harvest rate will increase annual yield but may increase the probability of a fishery closure. While the model runs didn't estimate fishery closures, the wide confidence intervals around median yield and biomass indicate that biomass is expected to range widely and may periodically decline to very low levels, which would result in closures under a precautionary harvest policy.

The current annual harvest rate of 0.123 yr^{-1} resulted in catches ranging from 92 to 200 t from 2002 to 2008. Actual harvest rates exceeded the 12.3% target in five out of seven years due to differences between the pre-season biomass and a post-season reconstruction.

If $F_{0.1}$ is adopted catches will increase, but biomass is expected to be reduced and stay near a value of 0.37 fishable B_0 (Figure 8).

If $F_{0.2}$ is adopted there will be a benefit of increased catches above the current policy and biomass is expected to average about $0.48B_0$.

$F_{0.3}$ is a less common reference point that results in more catch than under the current policy and biomass is expected to average $0.61B_0$.

Parameter uncertainty has played an important role in the analysis as demonstrated by the wide confidence limits for the various reference points. Parameter uncertainty may be reduced over time as more data becomes available for the fishery. However, the main sources of uncertainty are in the natural mortality rate, recruitment, and stock recruit relationship. Better estimates of natural mortality and the stock recruit relationship may be possible with the passage of time but recruitment will continue to vary. Natural mortality has many possible sources including winter storms, predations or disease. Episodic washups of clams have been observed in the winter every few years when windrows of clams blow up on the beach and contributes to the variability.

Further investigation is needed of methods to forecast recruitment to the fishery. An age structured model is likely necessary to account for growth, mortality and recruitment and could be developed and support a future management strategy evaluation of the fishery.

RECOMMENDATIONS

The allowable annual harvest rate for the Razor Clam fishery can be increased from $F = 0.123$ yr^{-1} to a maximum of 0.29 yr^{-1} (equivalent to the value of both F_{MSY} and $F_{0.1}$). A lower maximum harvest rate is expected to result in a higher average biomass over the long term, but the tradeoff would be a lower average yield. Our recommendations are provided in Table 6 and are as follows:

1. An annual harvest rate of 0.21 ($F_{0.2}$) is recommended, equivalent to an F of 0.24 yr^{-1}. This is expected to provide an average yield of 170 t and maintain average biomass at about $0.48B_0$ based on the transient and equilibrium analysis respectively (Figures 9 and 14). The current policy ($F = 0.123$ yr^{-1}) results in median yield of 121 t and $0.68B_0$ (Figure 12 and calculation based on $B_0 = 1390$ t).
2. A limit reference point of 230 t ($0.4B_{MSY}$) and an upper stock reference at 459 t ($0.8B_{MSY}$) are recommended.

The fishery hasn't experienced biomasses below 560 t in the 15 years that the fishery has been monitored (Table 4). The proposed policy would be more conservative than the current policy when the biomass falls below 361 t as the harvest rate would be decreased linearly from

F = 0.123 to 0 at the limit reference point of 230 t. Above 361 t the harvest rate would gradually increase until reaching the target harvest rate of F = 0.21.

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FIGURES

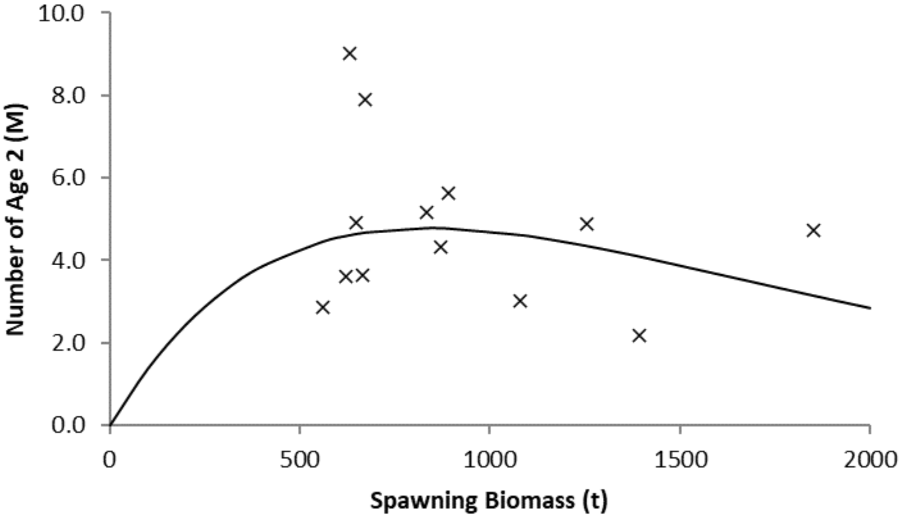


Figure 1. Ricker stock recruit relationship for Haida Gwaii Razor Clams.

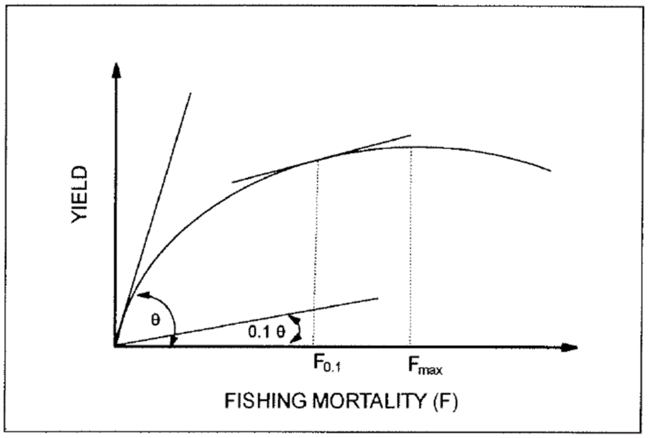


Figure 2. An illustration of $F_{0.1}$ from Caddy and Mahon (1995).

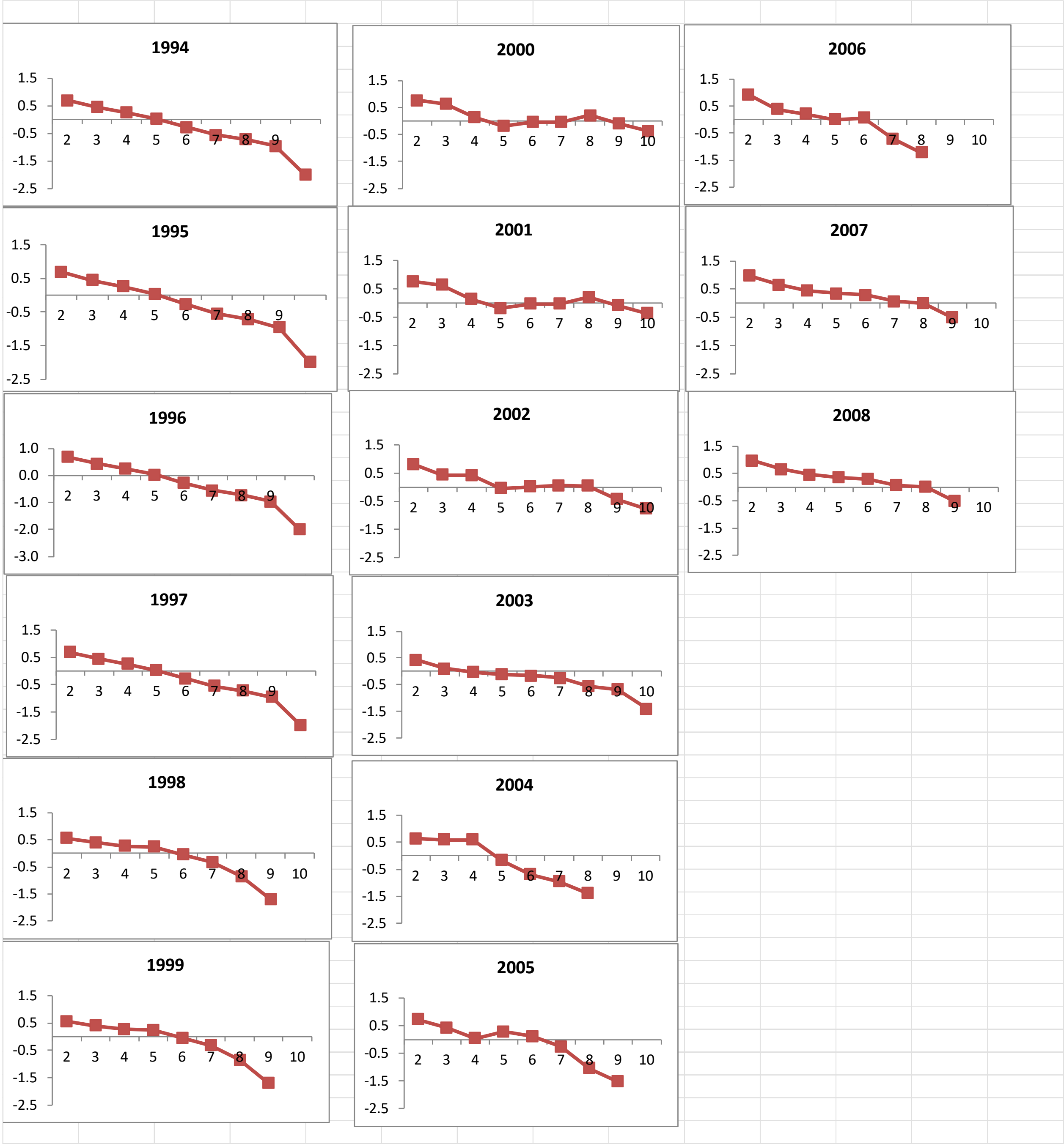


Figure 3. Catch curves, $\log_{10}N$ vs Age (yr), by year.

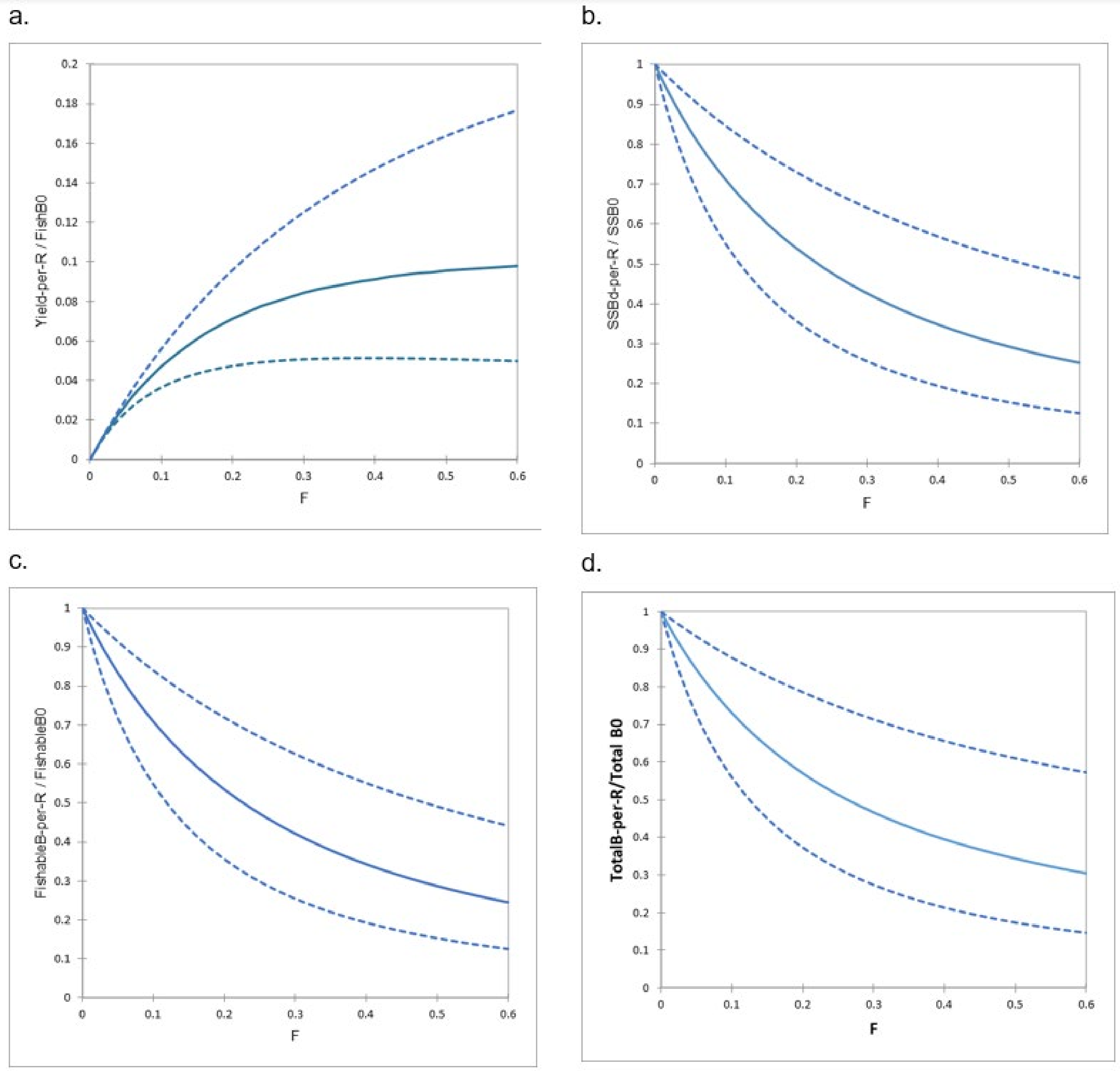
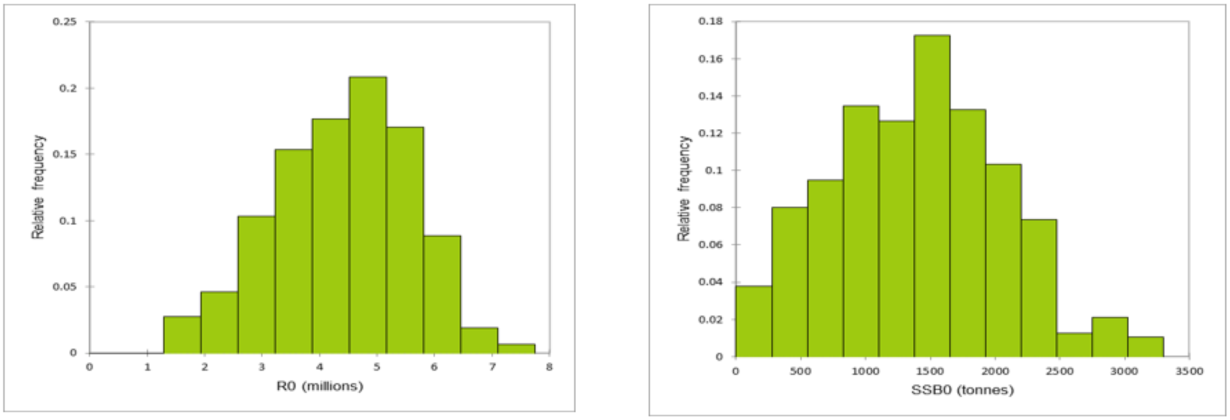
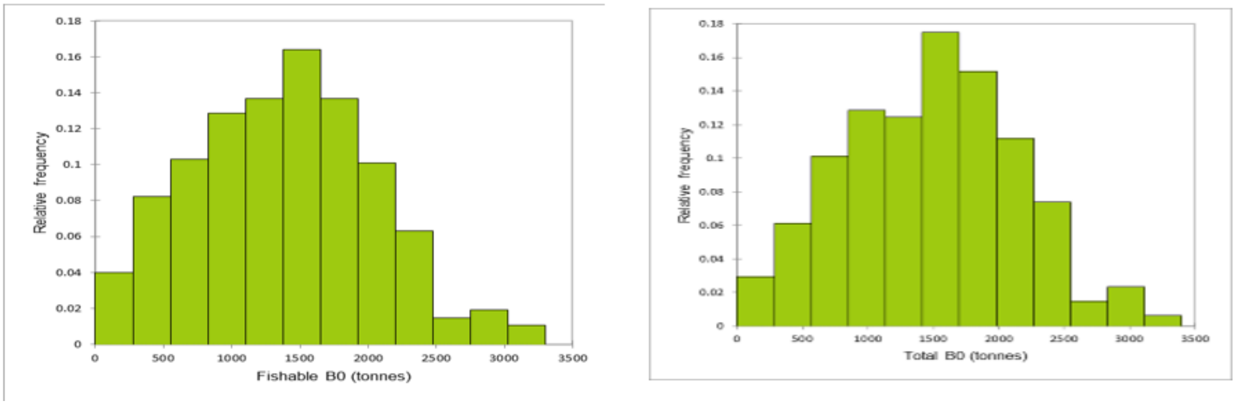


Figure 4. Equilibrium Yield-Per-Recruit: a. Yield-per-recruit / Unexploited Fishable Biomass ($FishB_0$) vs F (fishing mortality); b. Spawning stock Biomass-per-Recruit / Unexploited SSB_0 vs F; c. Fishable biomass-per-recruit/ Fishable B_0 vs F; and d. Total Biomass-per-Recruit vs Unexploited Total biomass. Dashed lines are the 95% confidence interval. (500 simulations).



a. R_{median} 4.5 M; 95% CL 1.8–6.5 M

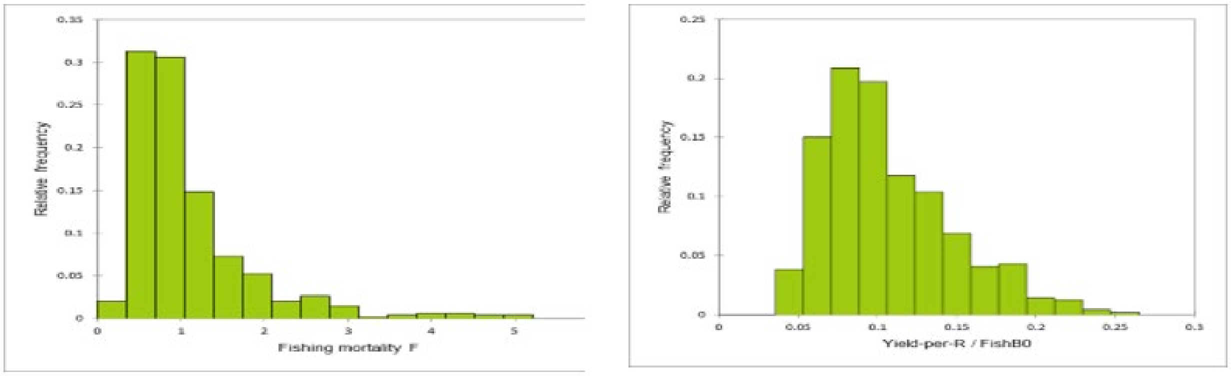
b. SSB_{median} 1415 t; 95% CL 195–2860 t



c. Fishable $B_{0median}$ 1390t; 95%CL 209–2814

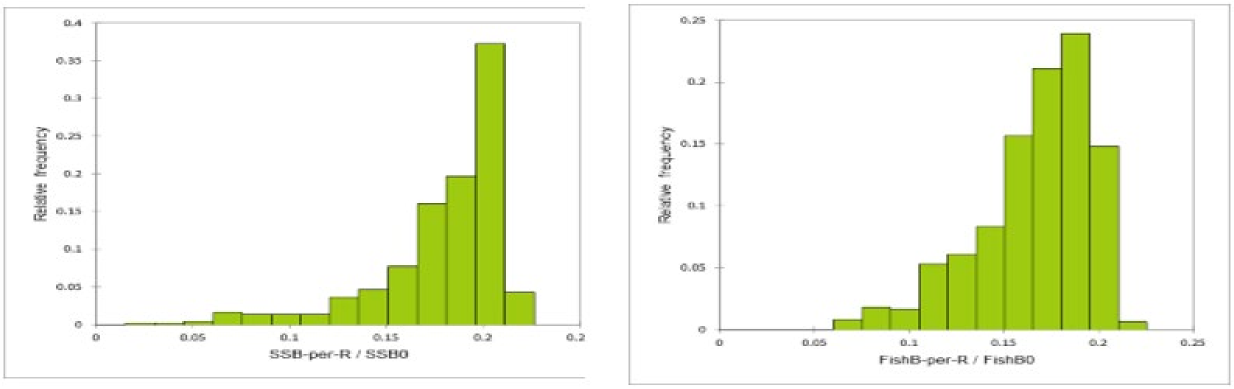
d. Total $B_{0median}$ 1490 t; 95%CL 250–2921

Figure 5. Razor Clam conditions in the unexploited state: a. Recruitment; b. Spawning stock biomass; c. Fishable biomass; and d. Total biomass. (500 simulations) a. R_{median} 4.5 M; 95% CL 1.8–6.5 M.



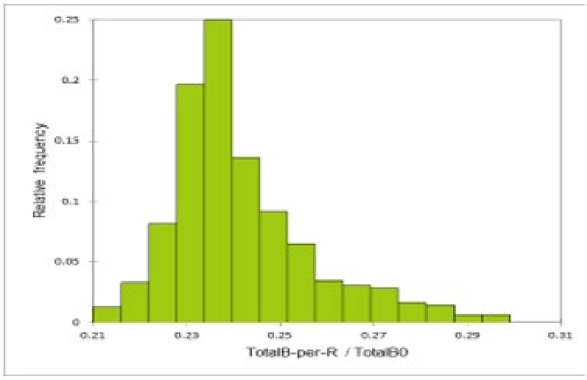
a. median F = 0.85; 95% CL 0.35–3.62

b. median 0.097



c. median 0.19

d. median 0.17

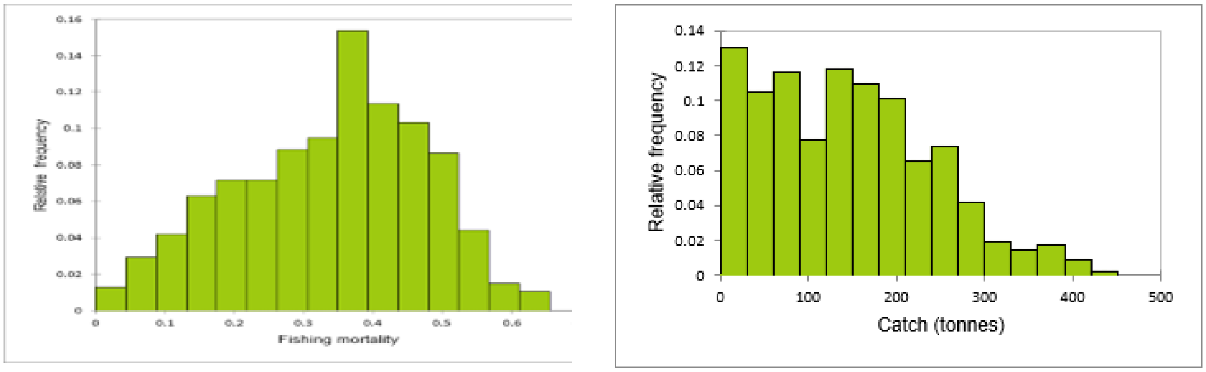


e. median 0.24

Figure 6. Maximum Yield-per-recruit: a. Fishing mortality distribution; b. Frequency of yield-per-recruit / Fishable B_0; c. Frequency of Spawning stock biomass-per-recruit / SSB_0; d. Frequency of Fishable Biomass-per-recruit / Fishable B_0; and e. Frequency of Total biomass-per-recruit / B_0. (500 simulations; 7 infinite or not possible).

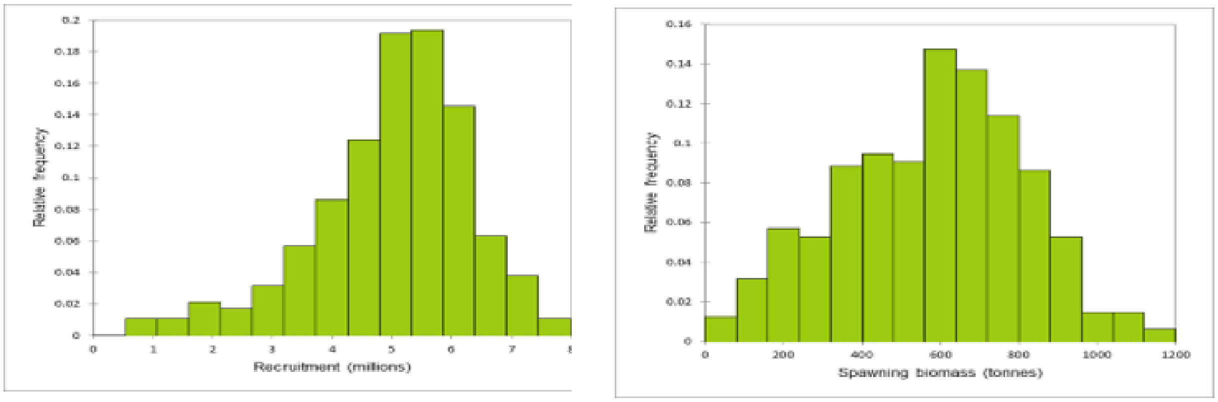
a. Median *F* = 0.35; 95% CL 0.06–0.57

b. median catch 137 t 95% CL 4–361 t



c. median recruitment 5.23 M

d. median spawning biomass 605 t



e. median fishable biomass 574 t

f. median total biomass 696 t

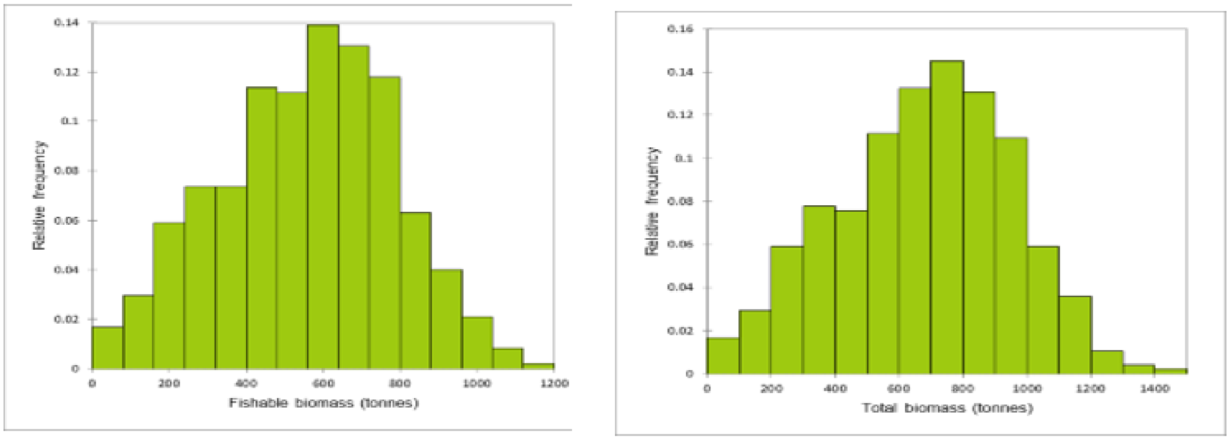
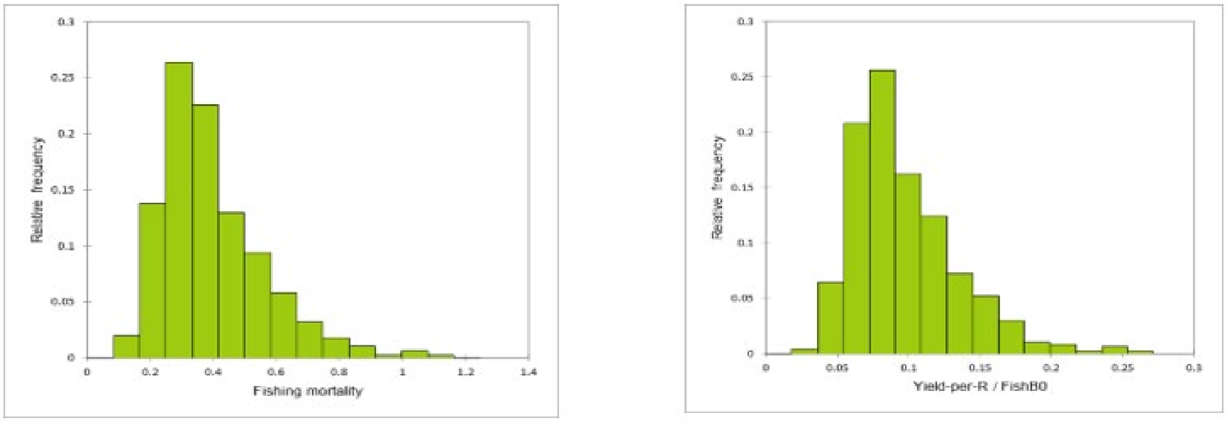


Figure 7. Maximum sustainable yield using absolute biomass: a. Fishing mortality; b. Catch; c. Recruitment; d. Spawning stock biomass; Fishable biomass; and f. Total Biomass. (500 simulations; 25 infinite or not possible).

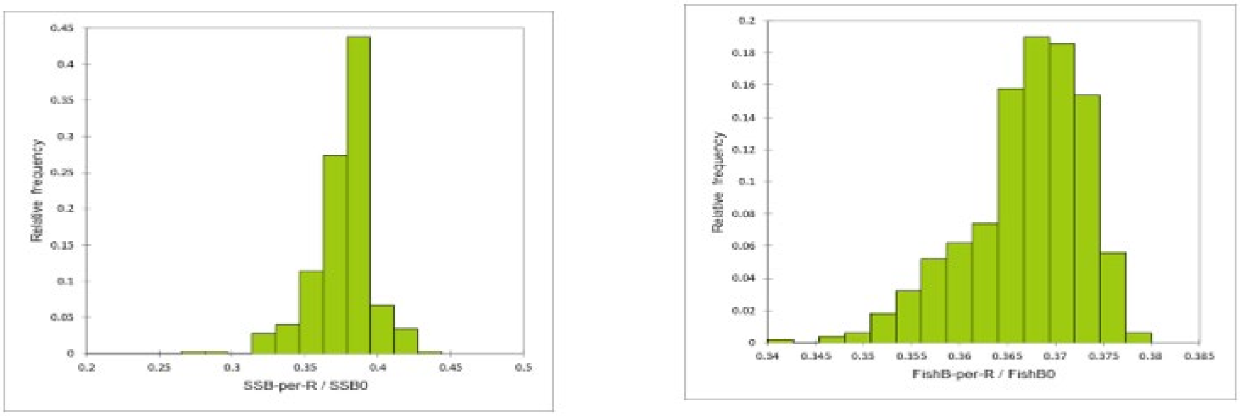
a. median F = 0.36; 95% CL 0.17–0.79

b. median 0.88



c. median 0.38

d. median 0.37



e. median 0.42

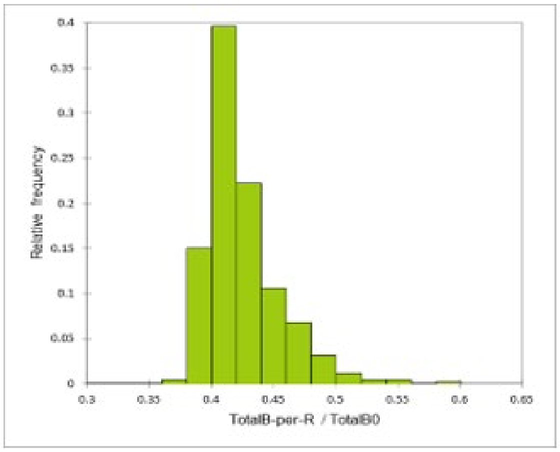
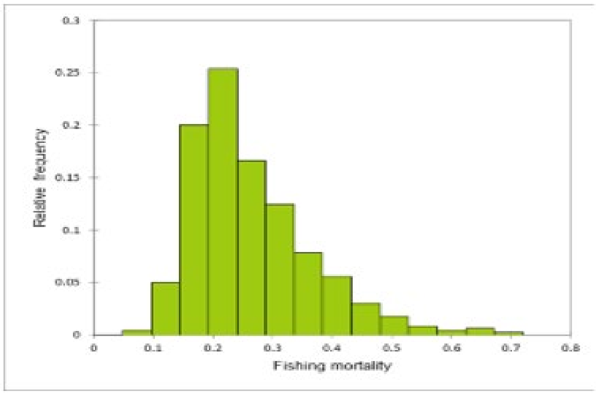
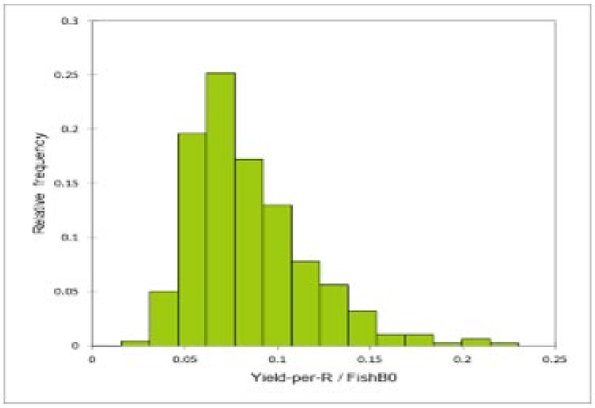


Figure 8. $F_{0.1}$ reference point: a. Fishing mortality distribution; b. Frequency of yield-per-recruit / Fishable B_0; c. Frequency of Spawning stock biomass-per-recruit / SSB_0; d. Frequency of Fishable Biomass-per-recruit / Fishable B_0; and e. Frequency of Total biomass-per-recruit / Total B_0. (500 simulations).

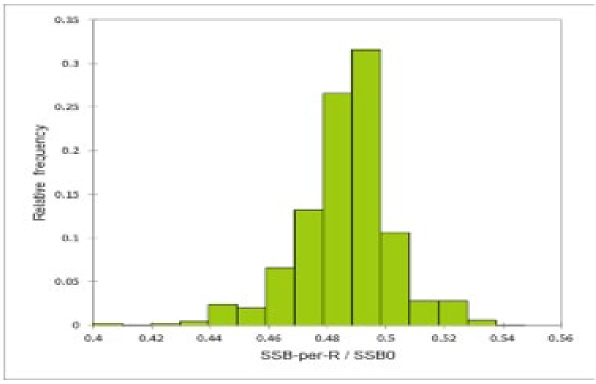
a. median F = 0.24; 95% CL 0.12–0.50



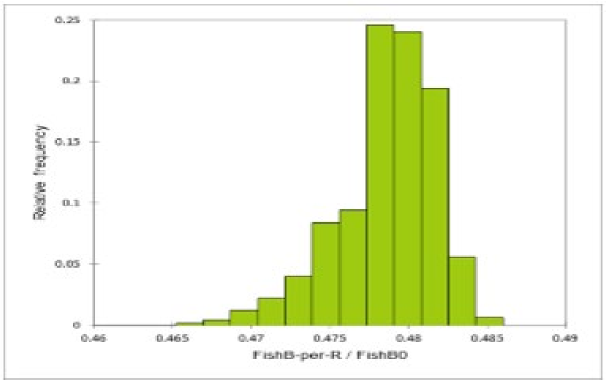
b. median 0.77



c. median 0.49



d. median 0.48



e. median 0.52

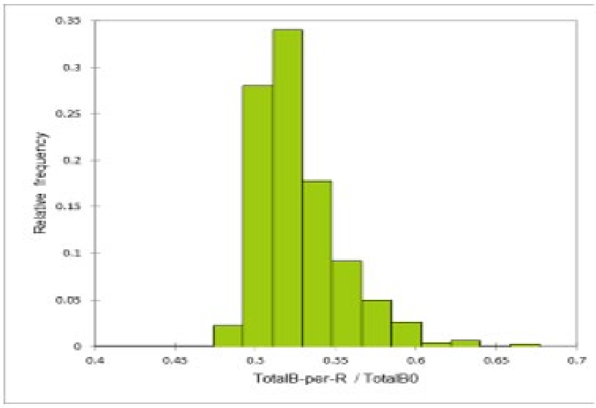
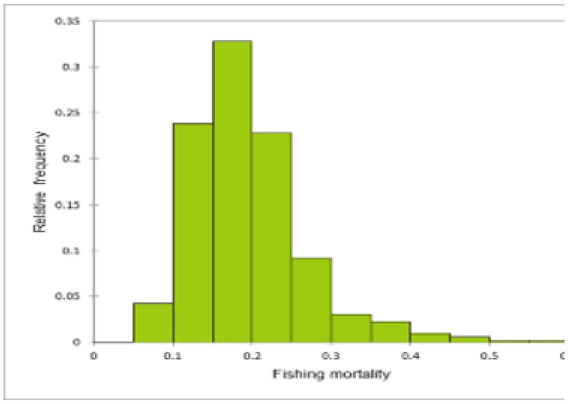
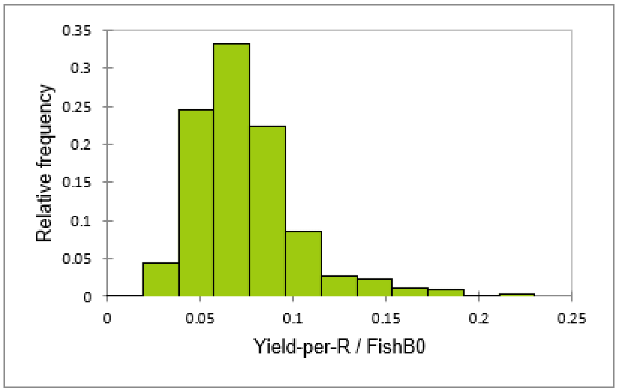


Figure 9. $F_{0.2}$ reference point: a. Fishing mortality distribution; b. Frequency of yield-per-recruit / Fishable B_0; c. Frequency of Spawning stock biomass-per-recruit / SSB_0; d. Frequency of Fishable Biomass-per-recruit / Fishable B_0; and e. Frequency of Total biomass-per-recruit / Total B_0. (500 simulations).

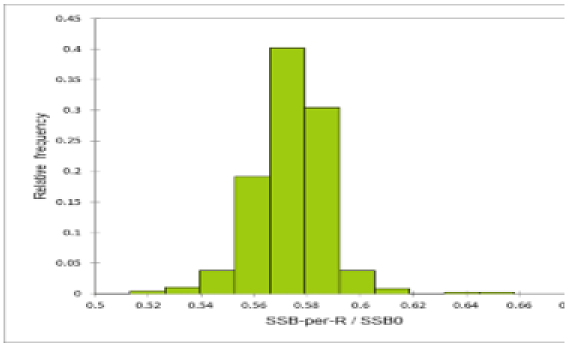
a. median F = 0.18; 95% CL 0.09–0.38



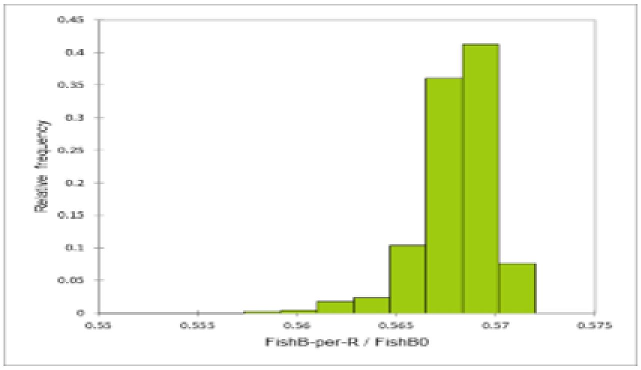
b. median 0.067



c. median 0.57



d. median 0.57



e. median 0.60

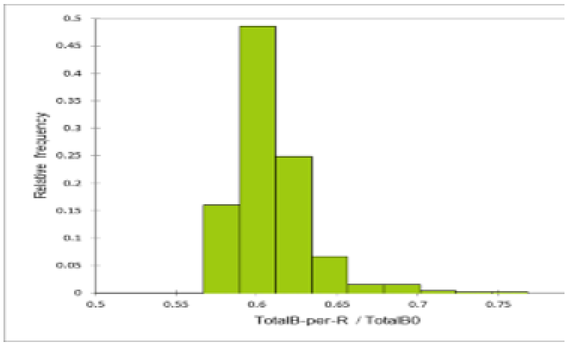
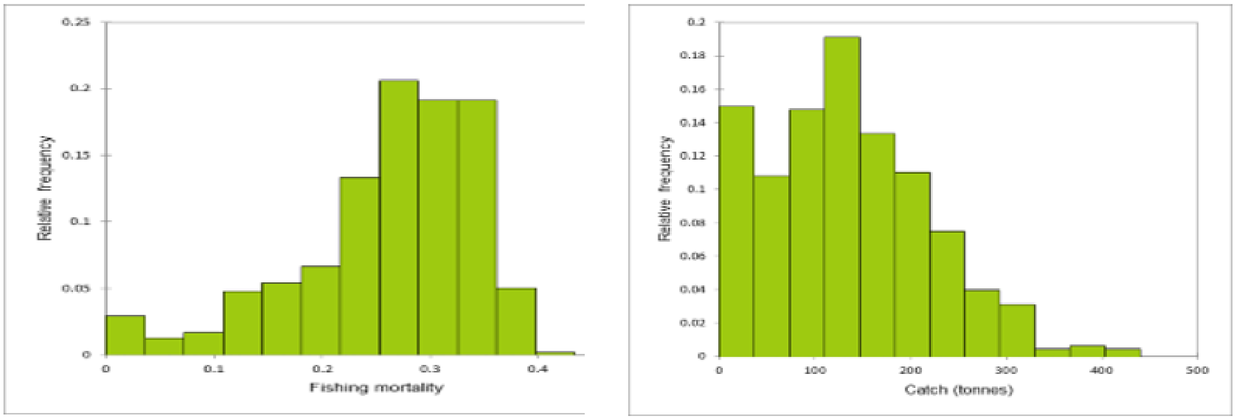


Figure 10. $F_{0.3}$ reference point: a. Fishing mortality distribution; b. Frequency of yield-per-recruit / Fishable B_0; c. Frequency of Spawning stock biomass-per-recruit / SSB_0; d. Frequency of Fishable Biomass-per-recruit / Fishable B_0; and e. Frequency of Total biomass-per-recruit / Total B_0. (500 simulations).

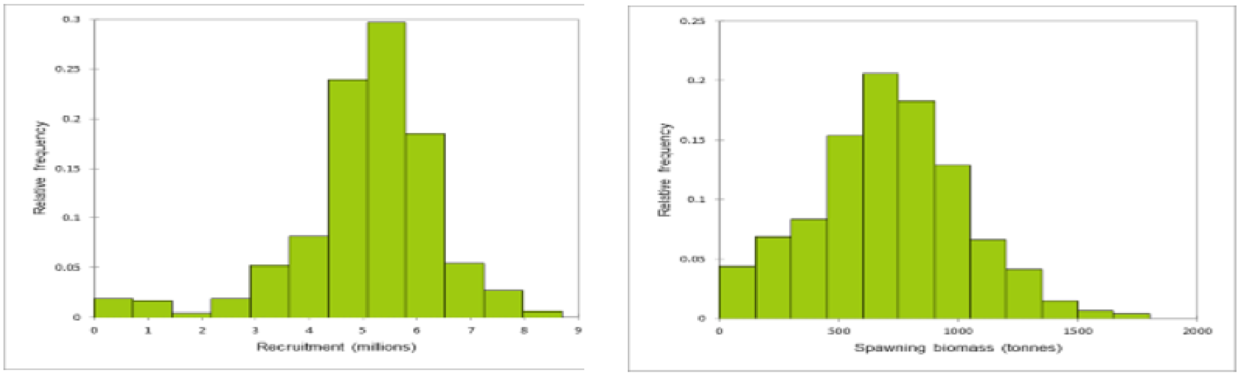
a. median *F* = 0.28; 95% CL 0.03–0.38

b. median catch 129 t



c. median recruitment 5.2 M

d. median spawning biomass 704 t



e. median fishable biomass 689 t

f. median total biomass 817 t

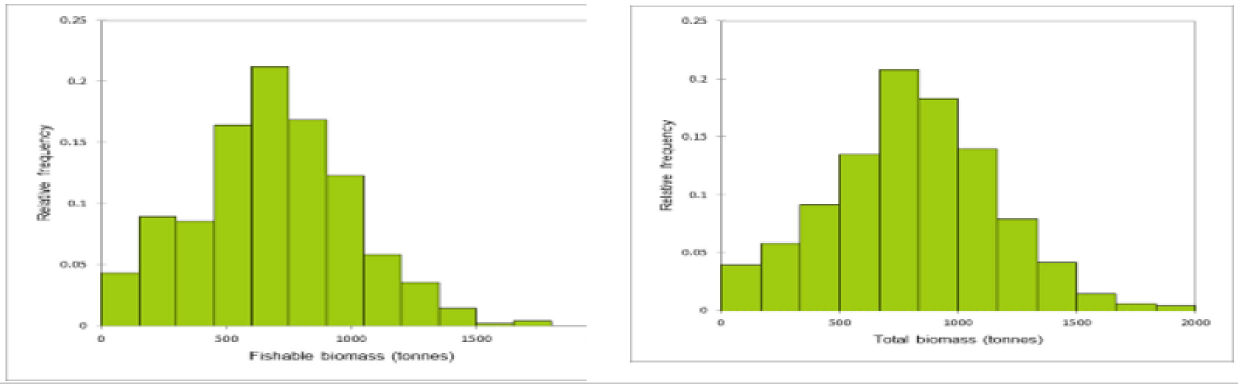
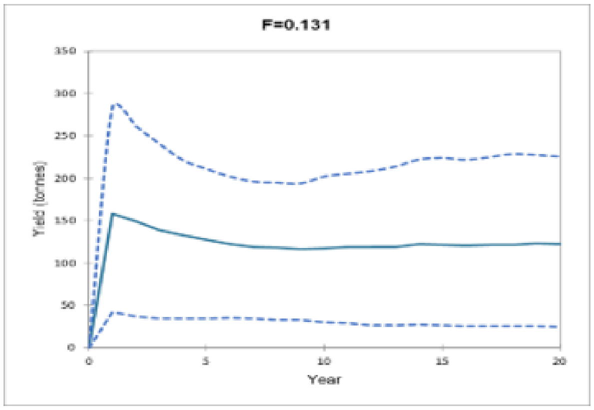
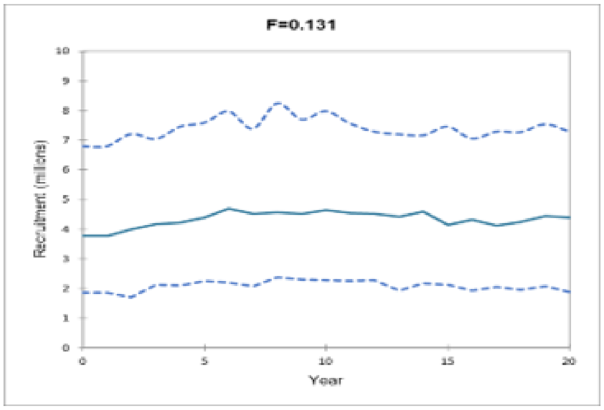


Figure 11. 0.5B_0 reference point: a. Fishing mortality distribution; b. Frequency of Catch; c. Frequency of recruitment; d. Frequency of spawning stock biomass; e. Frequency of fishable biomass; and f. Frequency of total biomass. (500 simulations).

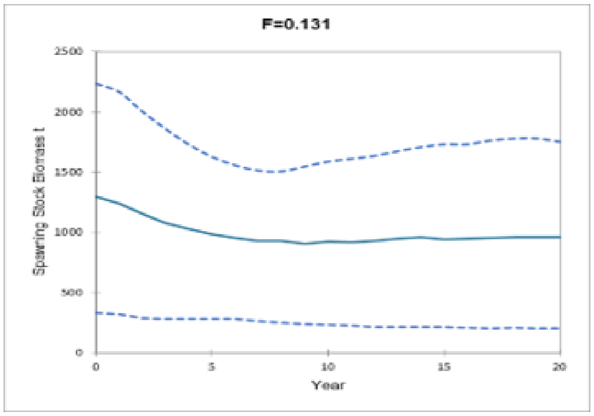
a. Mean yield years 11–20 = 121 t



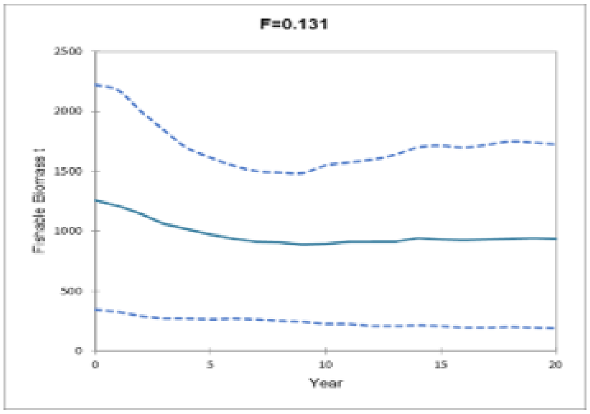
b. Mean recruitment years 11–20 = 4.38 M



c. Mean SSB years 11–20 = 948 t



d. Mean fishable biomass years 11–20 = 942 t



e. Mean total biomass years 11–20 = 1053 t

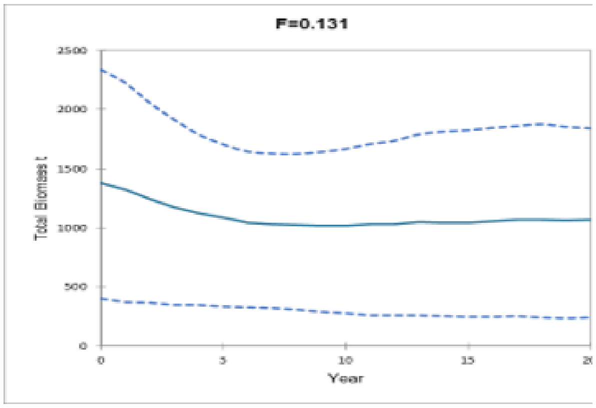
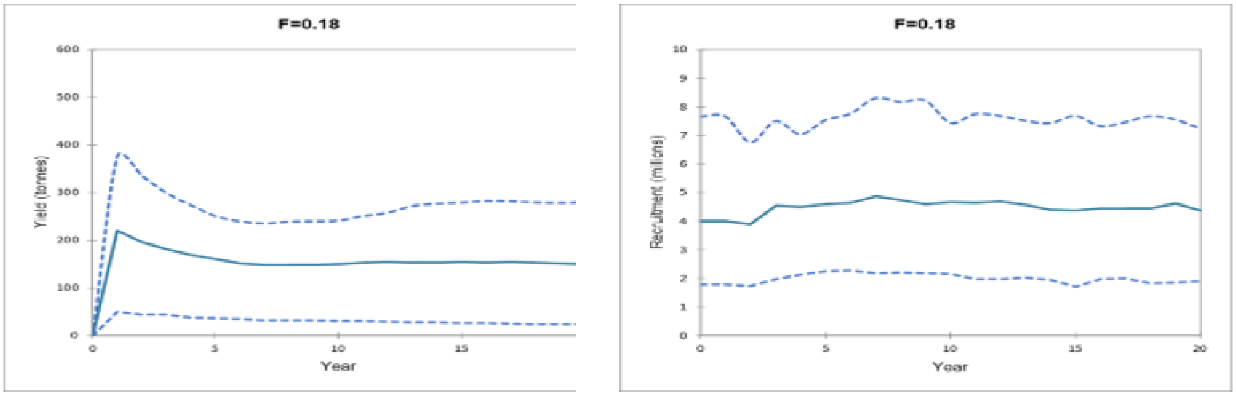
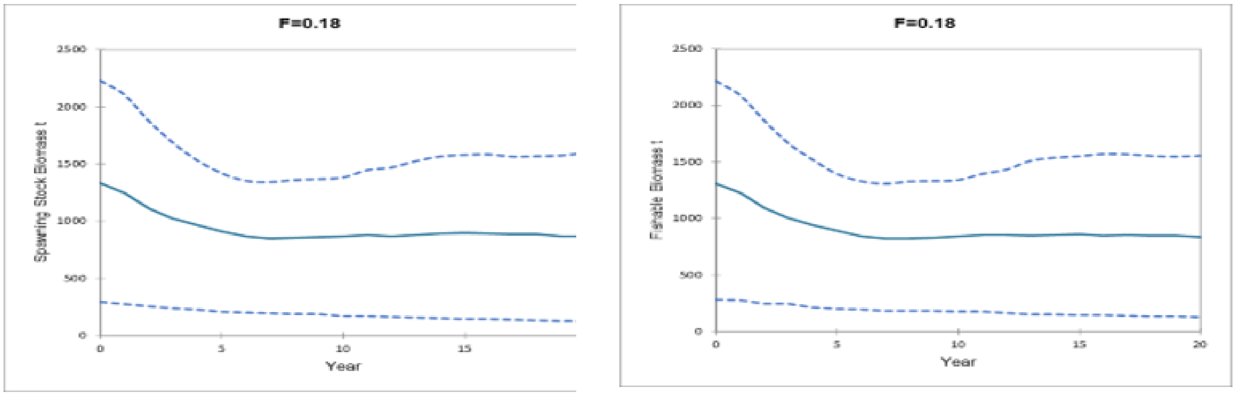


Figure 12. Transient projections for F = 0.131 and variable recruitment. a. Yield; b. Recruitment; c. Spawning stock biomass; d. Fishable biomass; and e. Total biomass. Dashed lines are 80% confidence interval. (500 simulations).



a. Mean yield year 11–20 = 153 t

b. Mean recruitment years 11–20 = 4.50 M



c. Mean SSB years 11–20 = 881 t

d. Mean fishable biomass = 850 t

e. Mean total biomass 974 t

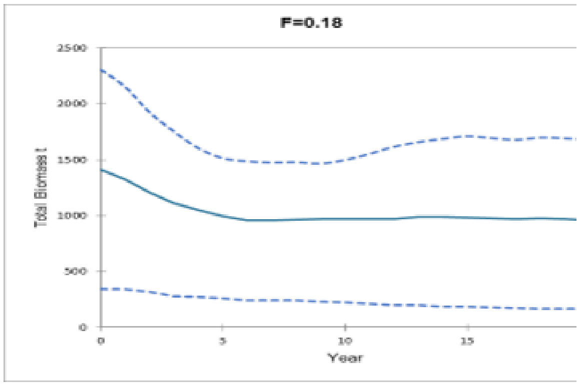
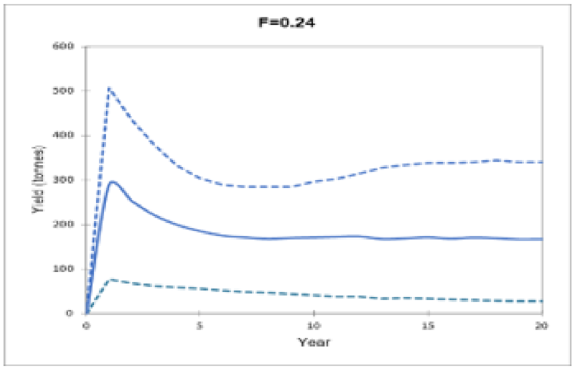
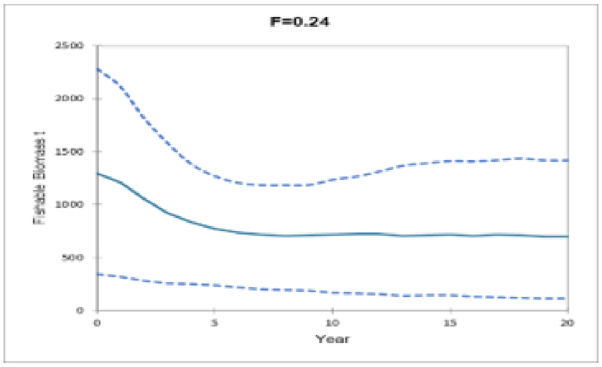


Figure 13. Transient projections for F = 0.18 and variable recruitment. a. Yield; b. Recruitment; c. Spawning stock biomass; d. Fishable biomass; and e. Total biomass. Dashed lines are 80% confidence interval. (500 simulations).

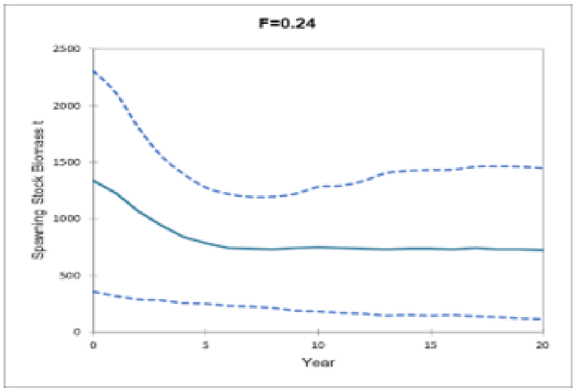
a. Mean yield years 11–20 = 170 t



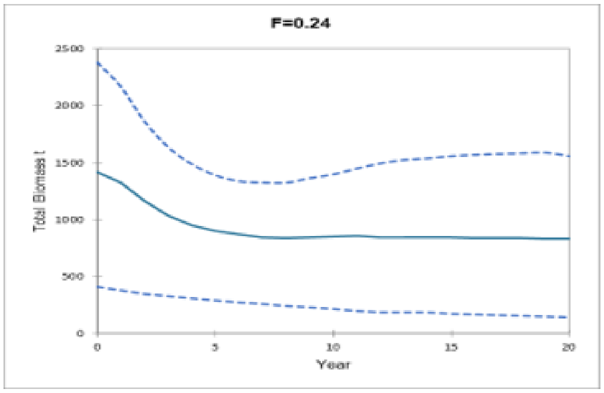
b. Mean recruitment years 11–20 = 4.52 M



c. Mean SSB years 11–20 = 735 t



d. Mean fishable biomass years 11–20 =710 t



e. Mean total biomass years 11–20 = 843 t

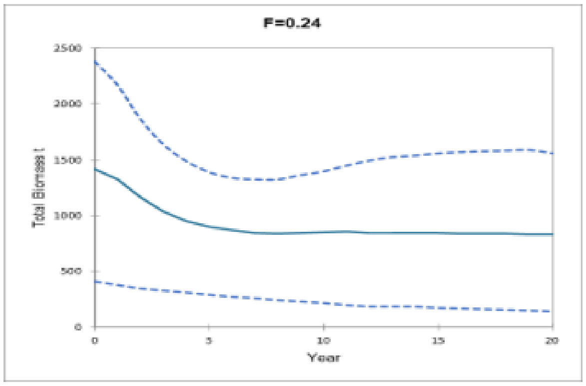
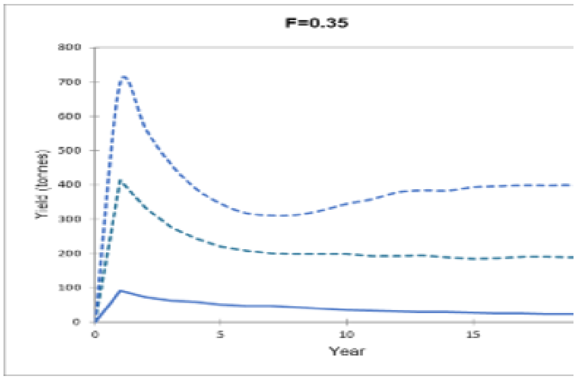
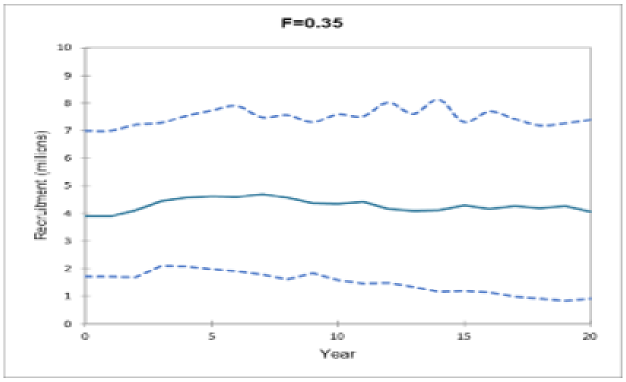


Figure 14. Transient projections for F = 0.24 ($F_{0.2}$) and variable recruitment. a. Yield; b. Recruitment; c. Spawning stock biomass; d. Fishable biomass; and e. Total biomass. Dashed lines are 80% confidence interval. (500 simulations).

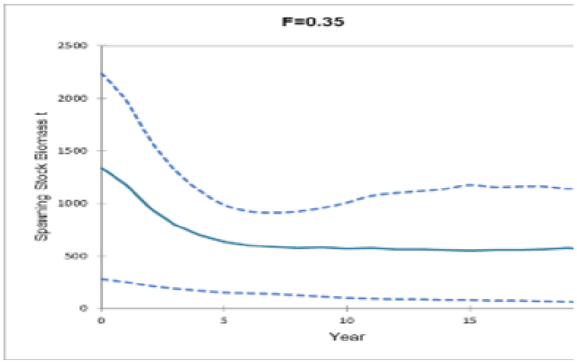
a. Mean yield years 11–20 = 190 t



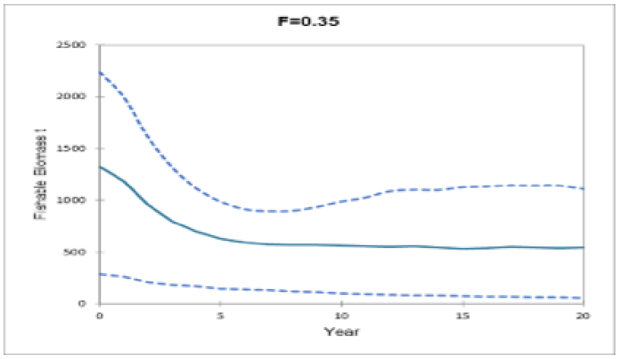
b. Mean recruitment years 11–20 = 4.21 M



c. Mean SSB years 11–20 = 560 t



d. Mean fishable biomass years 11–20 = 543 t



e. Mean total biomass years 11–20 = 661 t

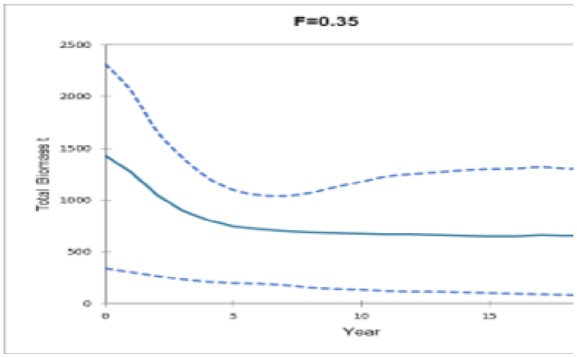


Figure 15. Transient projections for F = 0.35 (F_{MSY}) and variable recruitment. a. Yield; b. Recruitment; c. Spawning stock biomass; d. Fishable biomass; and e. Total biomass. Dashed lines are 80% confidence interval. (500 simulations).

TABLES

Table 1. Catch and annual fishing mortality (F) 1994–2008. From 2005–2008 adjusted catch was estimated for each beach section separately based on transect survey dates and monthly catch. Prior to 2005 it was estimated for all beaches combined based on the mean survey date.

Year	B_{survey} t	SE t	Catch, *C* t	Mean survey date	C_{adjusted} t	B_t t	*F* y^{r-1}
1994	619	102	105	7-Jun	54	673	0.156
1995	527	72	131	5-Jul	120	647	0.202
1996	620	70	75	20-Jun	46	666	0.118
1997	451	80	109	15-Jun	80	560	0.195
1998	612	101+	40	26-May	20	632	0.058
1999	1129	193	78	26-Jun	64	1254	0.063
2000	1676	163	237	2-Jul	177	1853	0.128
2001	1231	244	167	20-Jul	163	1394	0.120
2002	943	141	157	16-Jun	138	1081	0.145
2003	517	113+	164	31-May	103	620	0.265
2004	810	208+	93	22-Jun	80	890	0.I05
2005	692	91	151	4-July	142	834	0.181
2006	740	102	137	29-Jun	131	871	0.157
2007	1353	22	20	10-Jun	9	1362	0.015
2008	977	131	205	23-Jun	171	1148	0.179

Table 2a. Data for catch curves and natural mortality calculations. Population by age calculated using age-length keys (Table A.7). See Figure 3 for catch curves: Log10(N) vs Age.

Age Class	Number of Clams (Millions)														
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	3.82	1.94	1.67	3.37	1.70	1.38	0.35	0.94	3.1	0.35	1.35	3.24	6.42	7.89	2.24
2	4.91	6.50	7.91	4.92	3.65	2.85	9.01	5.72	6.47	2.74	4.34	5.31	8.31	9.45	5.30
3	2.79	4.43	1.95	1.65	2.52	2.52	2.24	4.34	2.75	1.30	3.85	2.64	2.37	4.52	2.64
4	1.78	2.00	1.37	2.04	1.87	3.07	0.98	1.37	2.64	0.95	3.83	1.08	1.61	2.83	2.14
5	1.07	1.29	1.20	1.05	1.74	2.16	1.34	0.65	0.90	0.77	0.68	1.94	0.99	2.25	2.64
6	0.53	0.86	0.66	1.40	0.90	1.39	2.56	0.92	1.04	0.70	0.20	1.31	1.16	1.97	1.65
7	0.28	0.21	0.13	0.35	0.47	0.66	2.18	0.93	1.15	0.56	0.11	0.55	0.19	1.18	0.92
8	0.19	0.11	0.00	0.08	0.14	0.17	2.01	1.60	1.11	0.28	0.04	0.09	0.06	1.01	0.60
9	0.11	0.04	0.00	0.04	0.02	0.00	0.81	0.81	0.37	0.21	0.00	0.03	0.00	0.31	0.02
10	0.01	0.01	0.01	0.00	0.00	0.00	0.93	0.43	0.17	0.04	0.00	0.00	0.00	0.00	0.01
Age Class	**Log10(N)**														
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
2	0.691	0.813	0.898	0.692	0.562	0.455	0.955	0.757	0.811	0.438	0.637	0.725	0.920	0.975	0.724
3	0.446	0.646	0.290	0.217	0.401	0.401	0.350	0.637	0.439	0.114	0.585	0.422	0.375	0.655	0.422
4	0.250	0.301	0.137	0.310	0.272	0.487	-0.009	0.137	0.422	-0.022	0.583	0.033	0.207	0.452	0.330
5	0.029	0.111	0.079	0.021	0.241	0.334	0.127	-0.187	-0.046	-0.114	-0.167	0.288	-0.004	0.352	0.422
6	-0.276	-0.066	-0.180	0.146	-0.046	0.143	0.408	-0.036	0.017	-0.155	-0.699	0.117	0.064	0.294	0.217
7	-0.553	-0.678	-0.886	-0.456	-0.328	-0.180	0.338	-0.032	0.061	-0.252	-0.959	-0.260	-0.721	0.072	-0.036
8	-0.721	-0.959	-	-1.097	-0.854	-0.770	0.303	0.204	0.045	-0.553	-1.398	-1.046	-1.222	0.004	-0.222
9	-0.959	-1.398	-	-1.398	-1.699	-	-0.092	-0.092	-0.432	-0.678	-	-1.523	-	-0.509	-1.699
10	-2.000	-2.000	-2.000	-	-	-	-0.032	-0.367	-0.770	-1.398	-	-	-	-	-2.000

Table 2b. Natural mortality calculations from catch curves (cont.).

Year	Slope (Age 2–7) = m	Survival 1-Z=10^m yr^{-1}	Total Mortality Z yr^{-1}	Fishing Mortality *F* yr^{-1}	Natural Mortality *M* yr^{-1}
1994	-0.246	0.568	0.432	0.156	0.276
1995	-0.279	0.526	0.474	0.202	0.272
1996	-0.297	0.505	0.495	0.118	0.377
1997	-0.178	0.663	0.337	0.195	0.142
1998	-0.166	0.682	0.318	0.058	0.260
1999	-0.117	0.763	0.237	0.063	0.174
2000	-0.079	0.833	0.167	0.128	0.039
2001	-0.180	0.661	0.339	0.120	0.219
2002	-0.157	0.697	0.303	0.145	0.158
2003	-0.124	0.751	0.249	0.265	-0.016*
2004	-0.360	0.437	0.563	0.105	0.458
2005	-0.159	0.693	0.307	0.181	0.126
2006	-0.267	0.541	0.459	0.157	0.302
2007	-0.163	0.687	0.313	0.015	0.298
2008	-0.124	0.752	0.248	0.167	0.081
Mean	-0.193	0.651	0.349	0.138	0.211

* N.B. Rejected negative value of *M* in 2003

Corrected Mean M	0.227
Std. Dev.	0.091
CV	0.401

Table 3. Spawning stock and Age 2 recruitment (see plot in Figure 4).

Year	Biomass (tonnes)	Age 2 Recruitment by Year (Millions of clams)
1994	673	7.91
1995	647	4.92
1996	666	3.65
1997	560	2.85
1998	632	9.01
1999	1254	4.88
2000	1853	4.73
2001	1394	2.74
2002	1081	4.34
2003	620	5.31
2004	890	8.31
2005	834	9.45
2006	871	5.30

Table 4. Parameters used in the Yield program to estimate potential sustainable yield reference points.

Yield parameter	**Description**
Van Bertalanffy parameters	
L_∞	Mean 15.4; CV 0.025; normal distribution
K	Mean 0.29; CV 0.025; normal distribution
t_0	0.46
Length-weight parameters	
Alpha	0.033457
Beta	3.3058
Instantaneous Natural Mortality M	Mean 0.26 CV 0.4; log-normal distribution
Length at Maturity	Mean 8.7 cm; CV 0.05; normal distribution
Length at First Capture	Mean 9.0 cm
Spawning and Fishing Seasons	
Time step interval	Monthly
Spawning season	April-August
Fishing season	February-September
Stock recruit relationship	
Ricker Parameters	Alpha = 18,600; CV 0.1; normal distribution Beta = 0.0012; CV 0.1; normal distribution CV for annual recruitment 0.35

Table 5. Estimated fishing mortality, yield, and biomass for the current policy and potential reference points.

Reference Point or Policy	**Instantaneous Fishing Mortality F_i, yr^{-1} (Equilibrium analysis)**		**Yield t (Equilibrium analysis)**	**Yield t (Yr 11–20 mean from transient analysis)**	**Fishable Biomass t (Yr 11–20 mean from transient analysis except as noted)**
	Median	95% CL			
Maximum YPR	0.85	0.35–3.62	–	–	236 equilibrium
F_{msy}	0.35	0.06–0.57	137	–	574 equilibrium
$F_{0.1}$	0.36	0.17–0.79	–	190	543
$F_{0.2}$	0.24	0.12–0.50	–	170	710
$F_{0.3}$	0.18	0.09–0.38	–	153	850
Equil 50% fishable biomass	0.28	0.03–0.38	129	–	689 equilibrium
Current HR Policy	0.131	–	–	121	942

Table 6. Policy if $F_{0.2}$ is adopted as the harvest rate:

Reference Point	**Harvest Rate *F***
≤230 t	0
230–459 t	0–0.21*
≥459 t	0.21

** Harvest rate = 0.21*(B_t–230)/229 where B_t is in tonnes*

APPENDIX

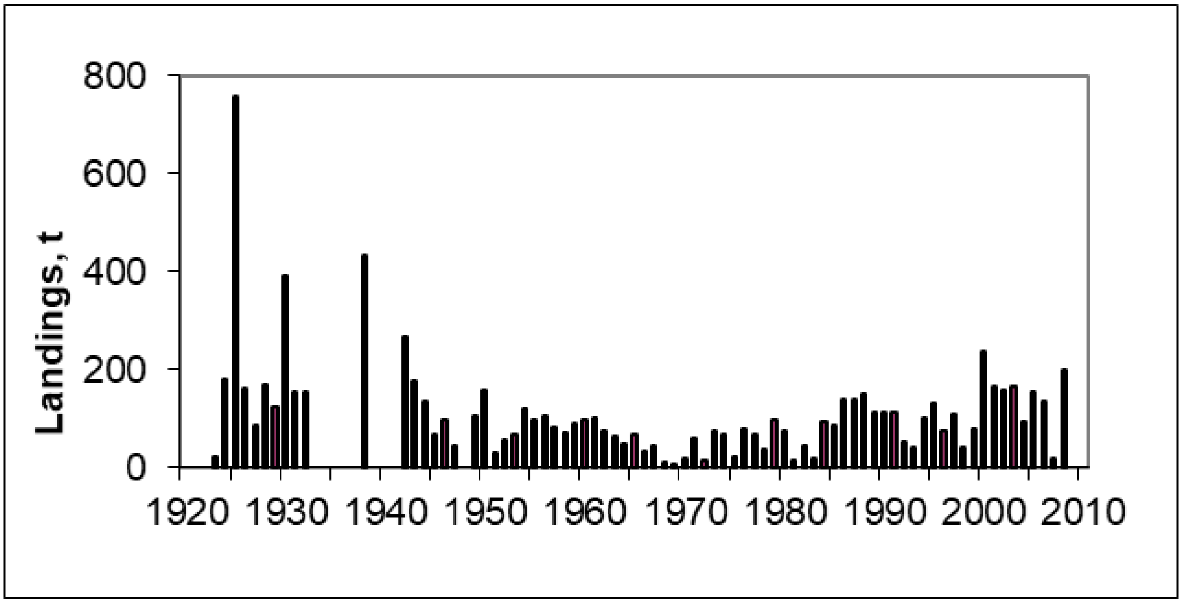


Figure A.1. Razor Clam landings 1923–2008.

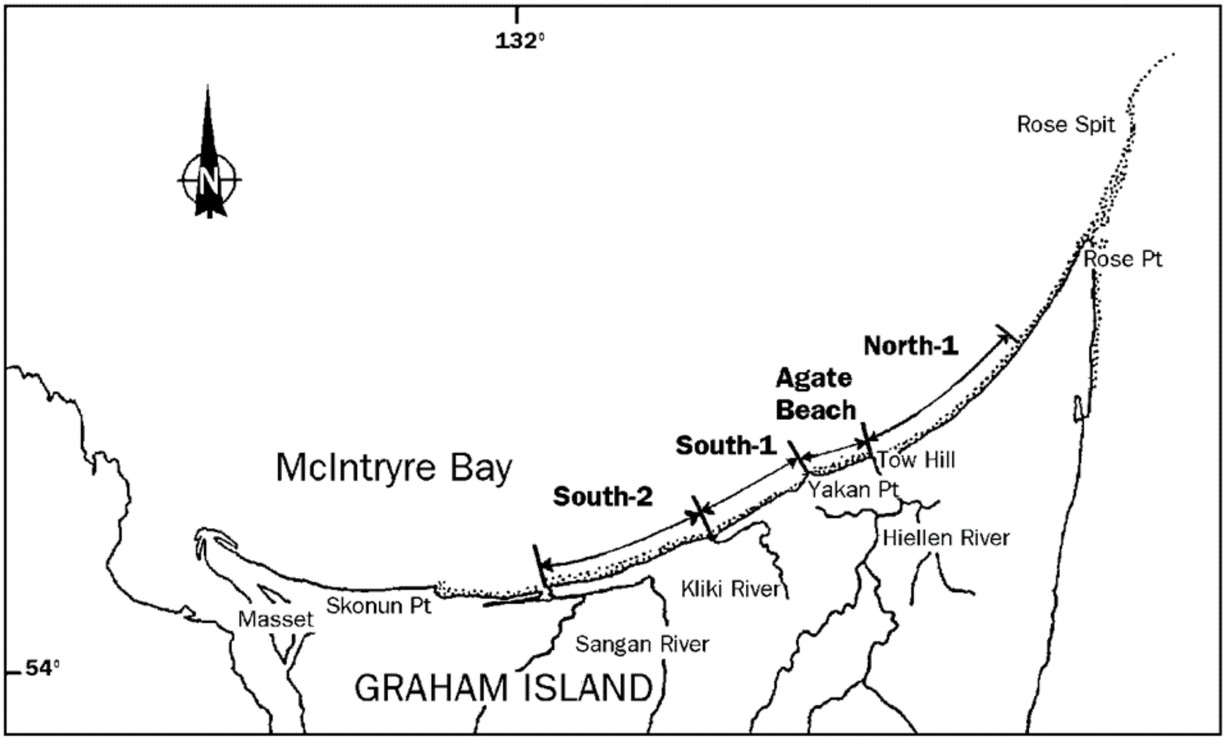


Figure A.2. Location of Razor Clam beach sections.

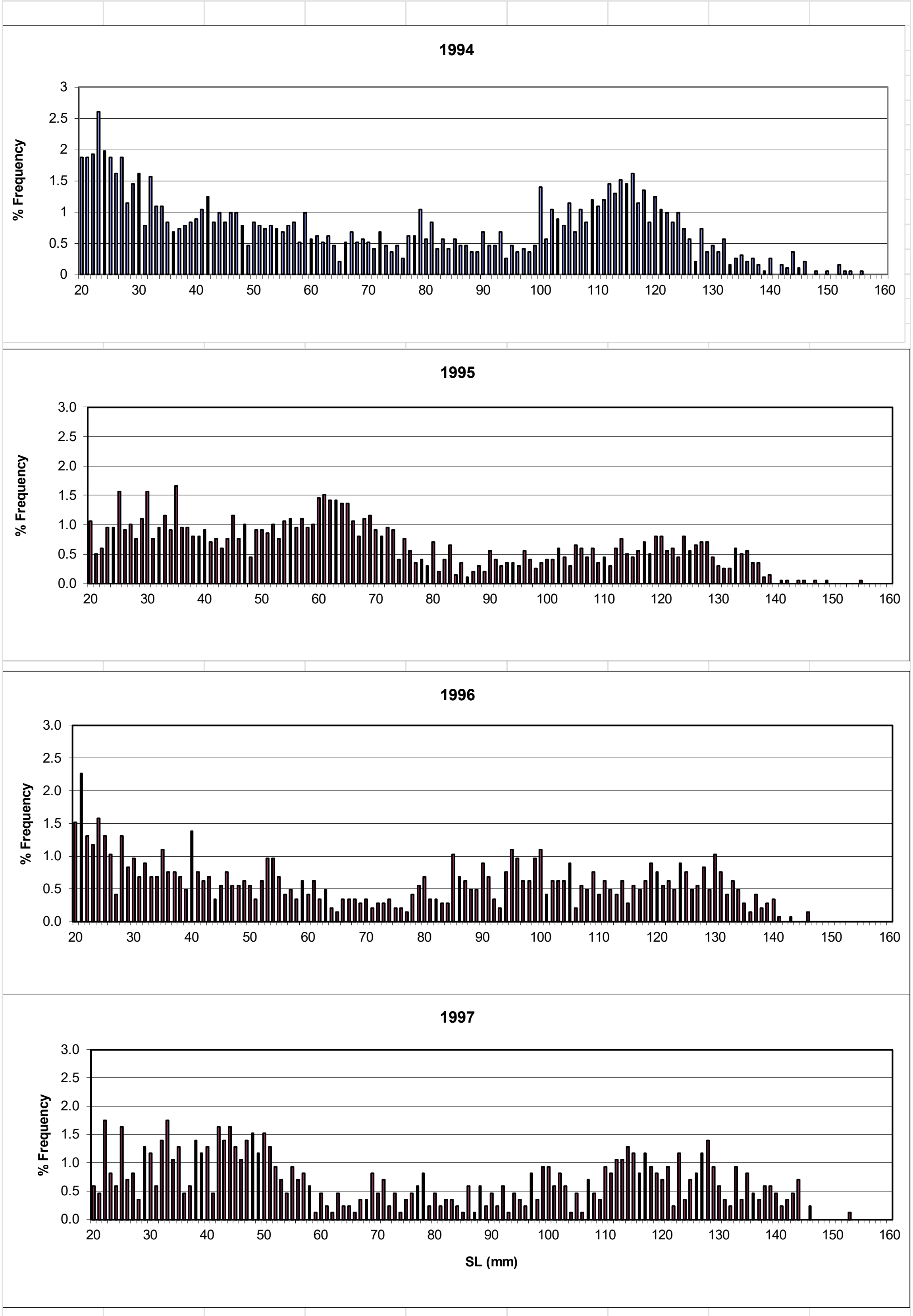


Figure A.3a. Length-frequency distribution of the population 1994–2008.

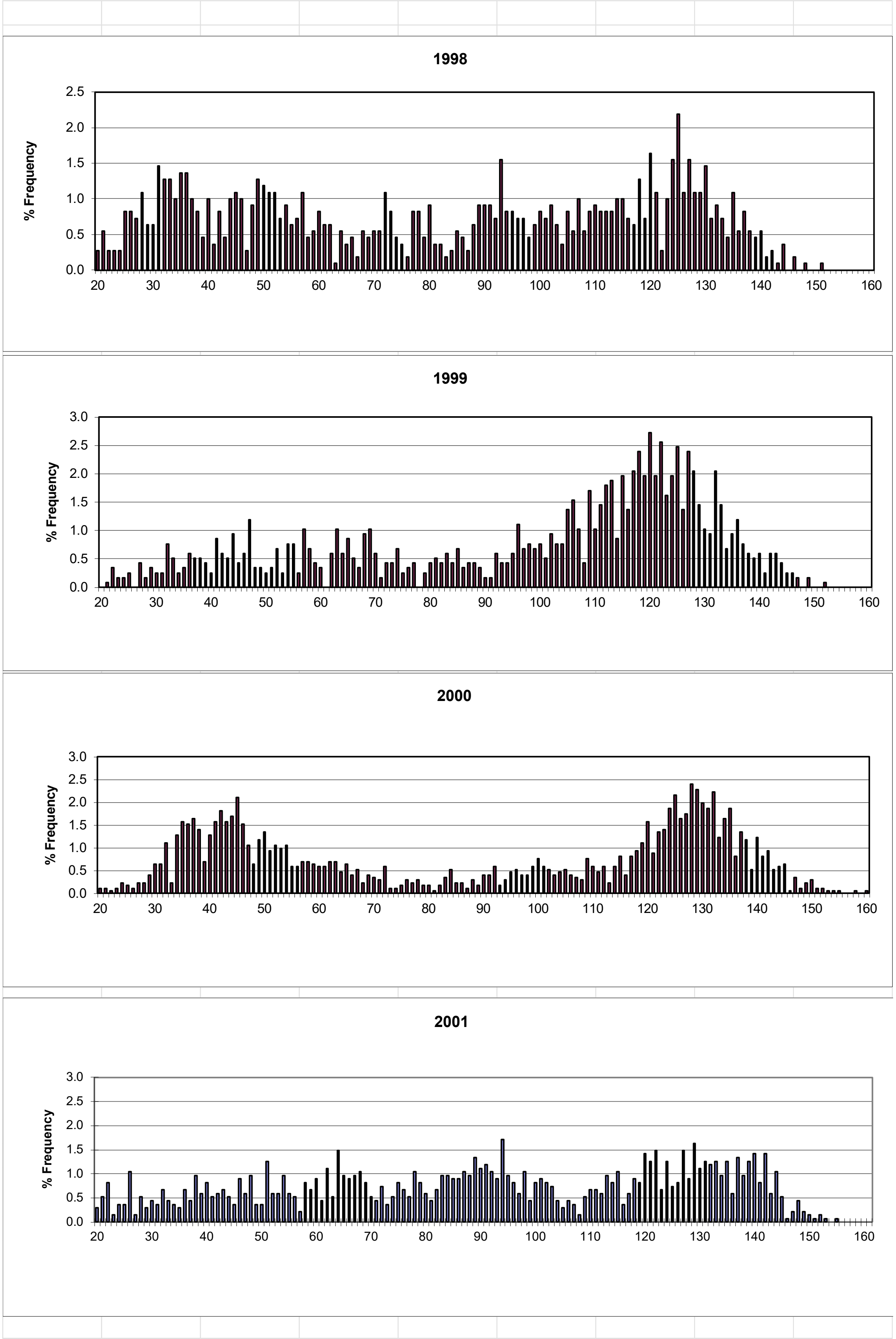


Figure A.3b. Length-frequency distribution of the population 1994–2008 (cont.).

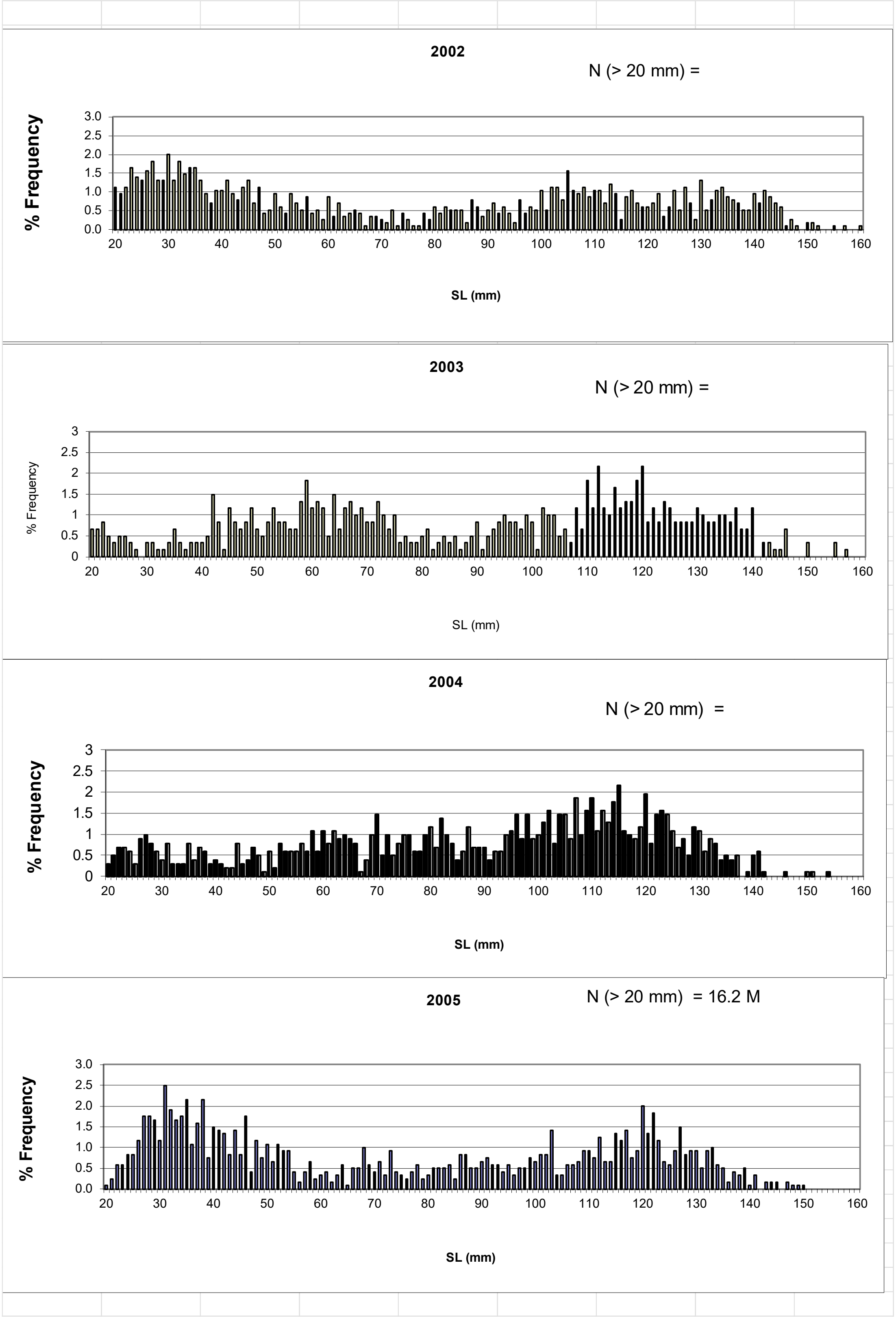


Figure A.3c. Length-frequency distribution of the population 1994–2008 (cont.).

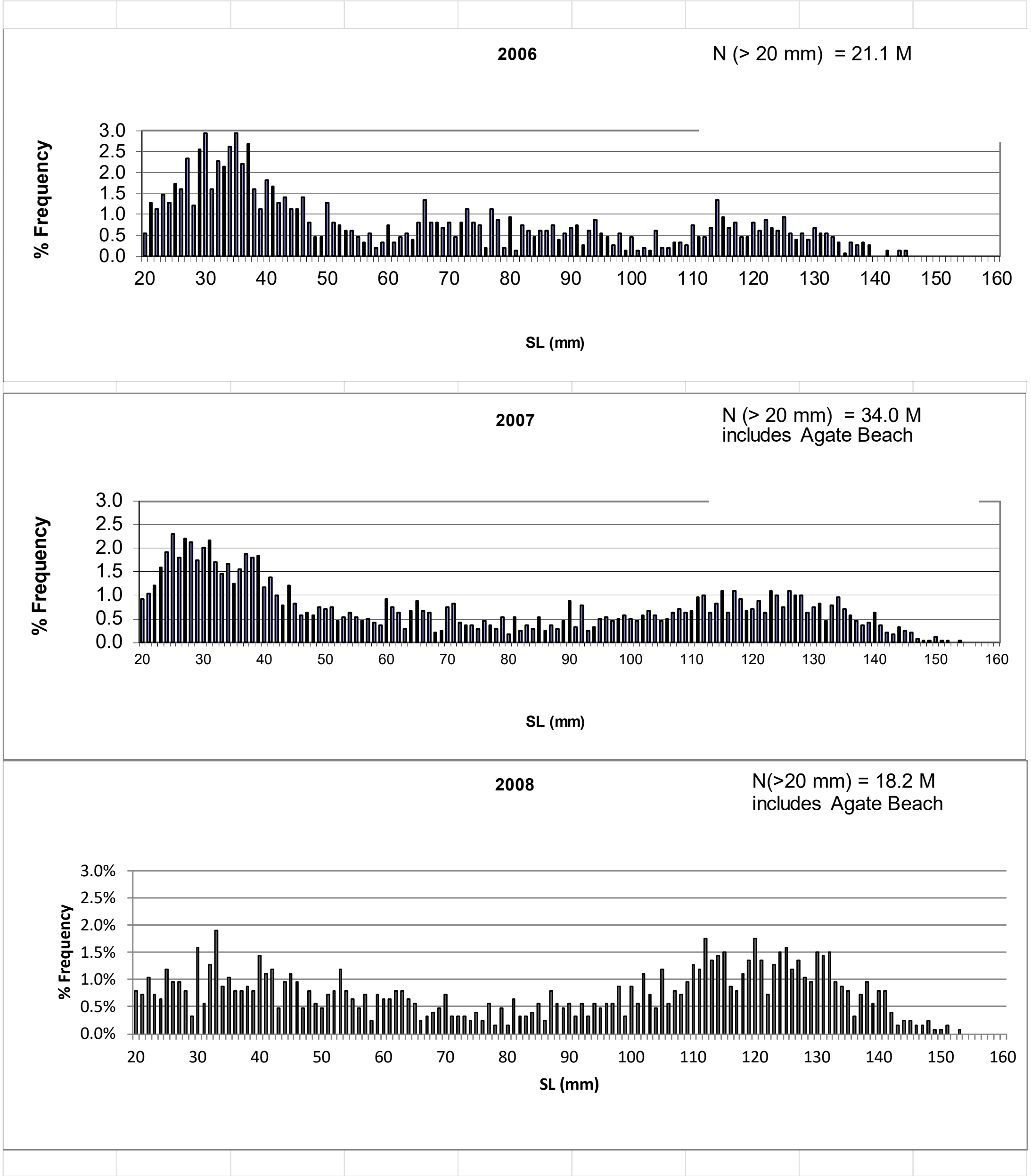


Figure A.3d. Length-frequency distribution of the population 1994–2008 (cont.).

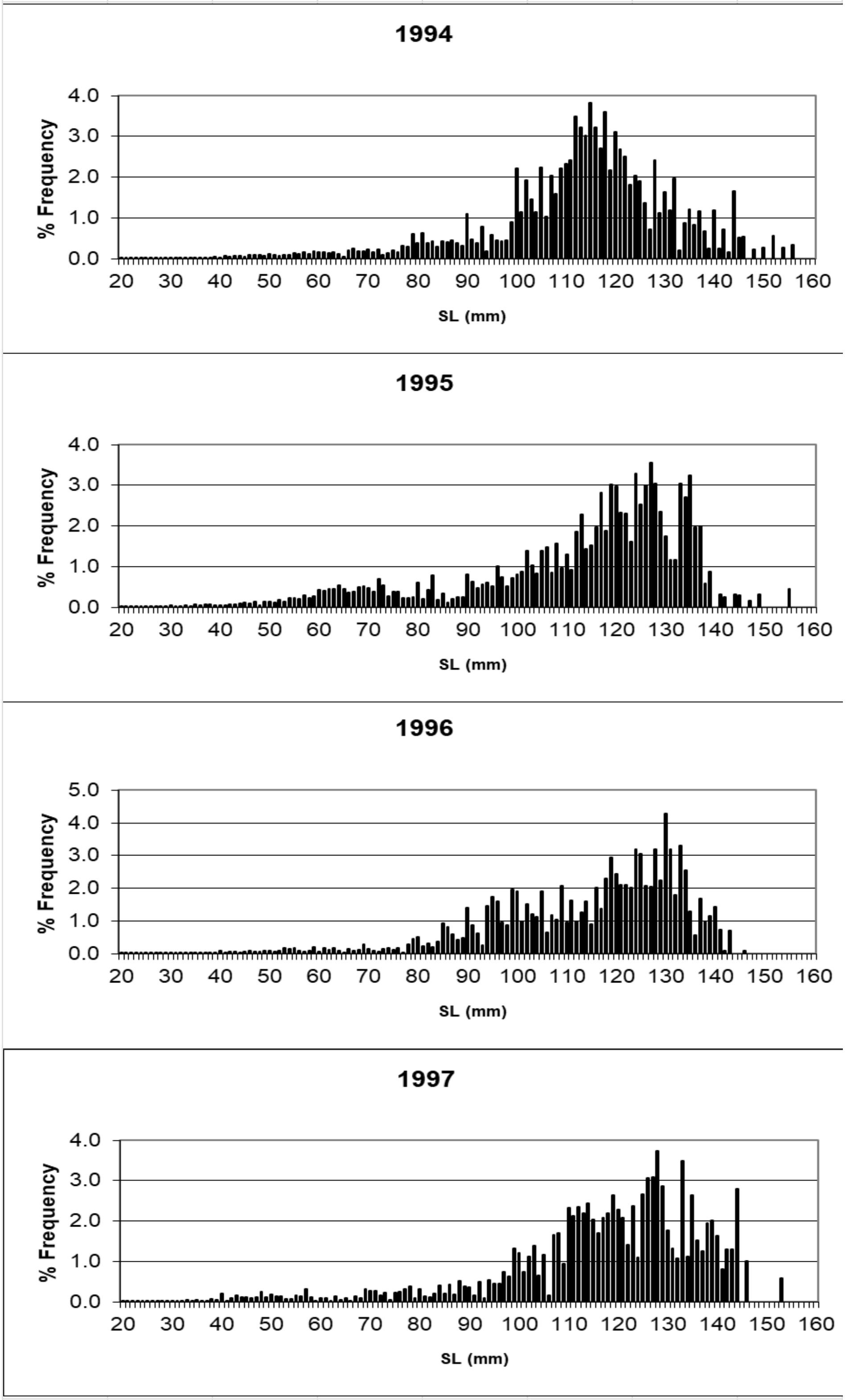


Figure A.4a. Distribution of Razor Clam biomass by shell length 1994–2008.

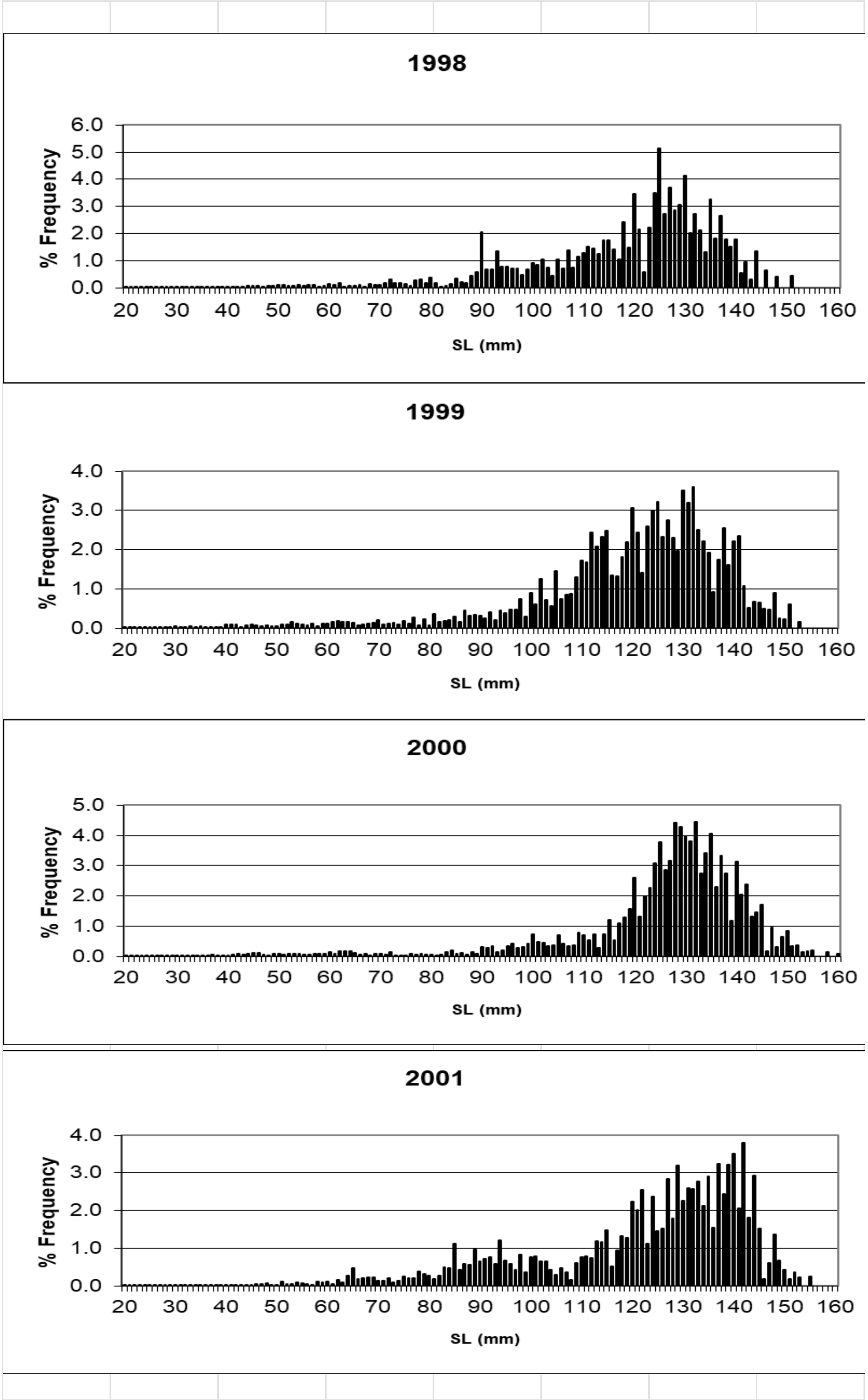


Figure A.4b. Distribution of Razor Clam biomass by shell length 1994–2008 (cont.).

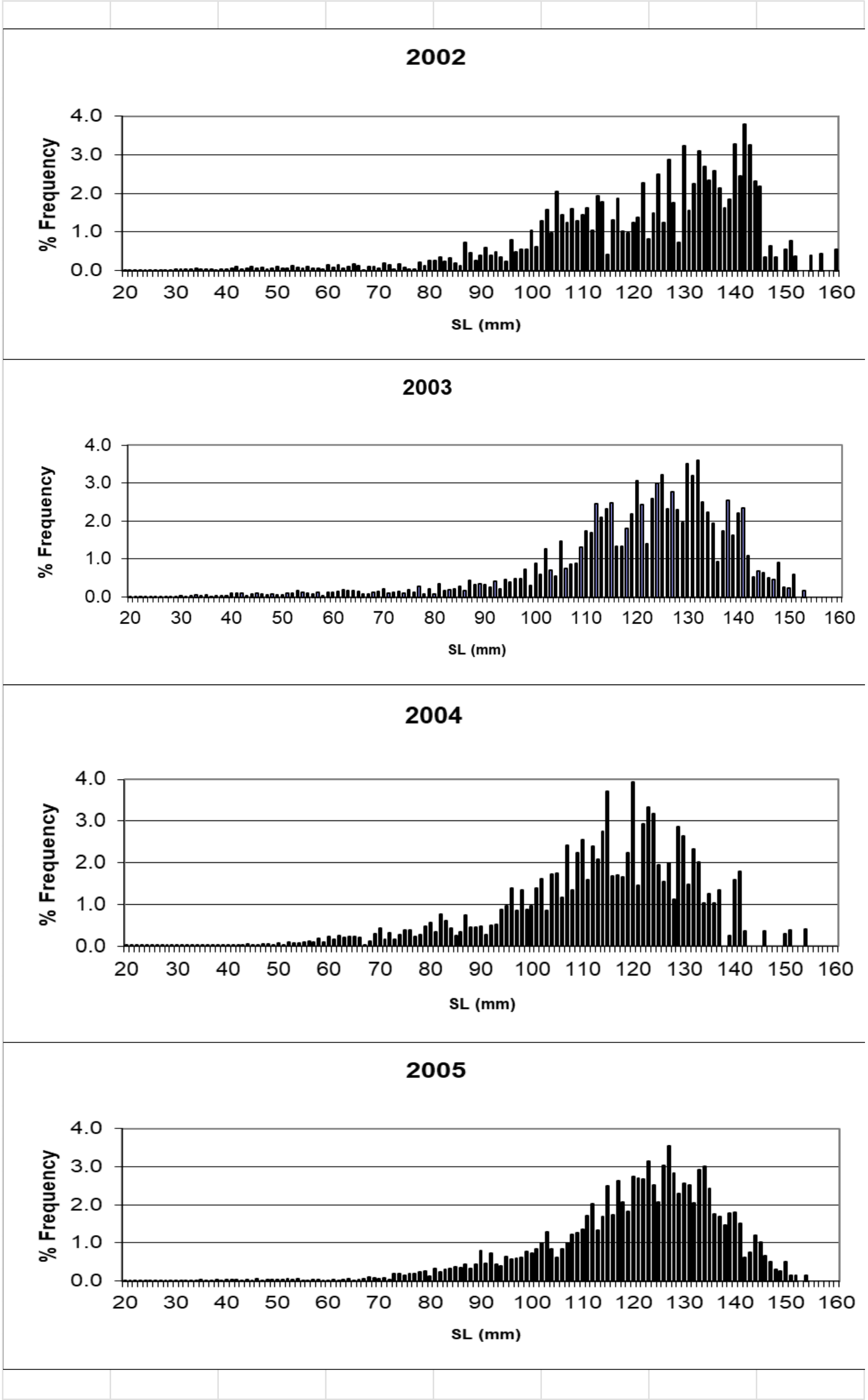


Figure A.4c. Distribution of Razor Clam biomass by shell length 1994–2008 (cont.).

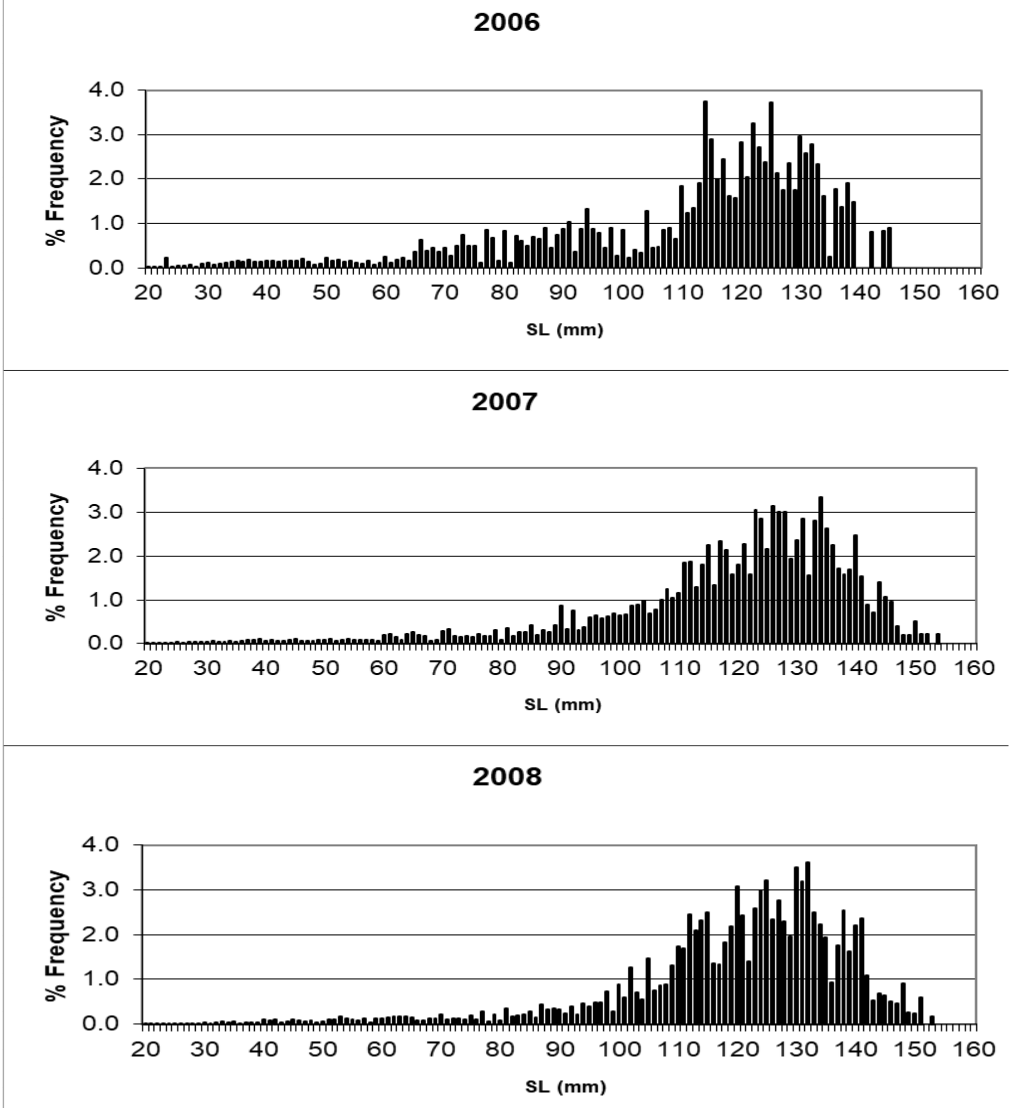


Figure A.4d. Distribution of Razor Clam biomass by shell length 1994–2008 (cont.).

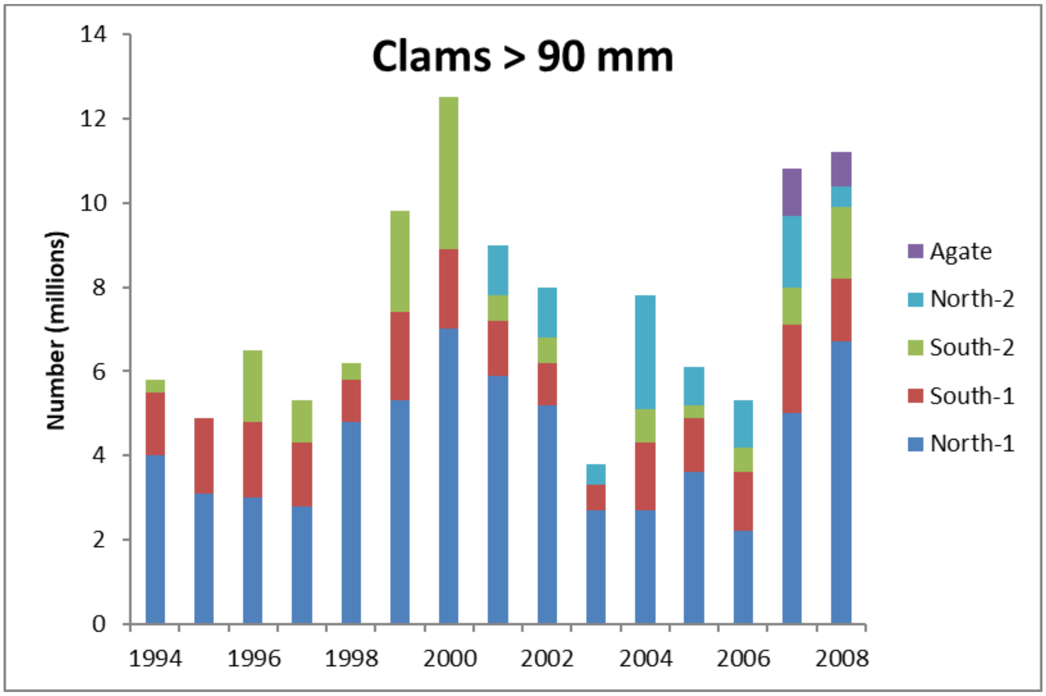


Figure A.5a. Abundance by beach section 1994–2008.

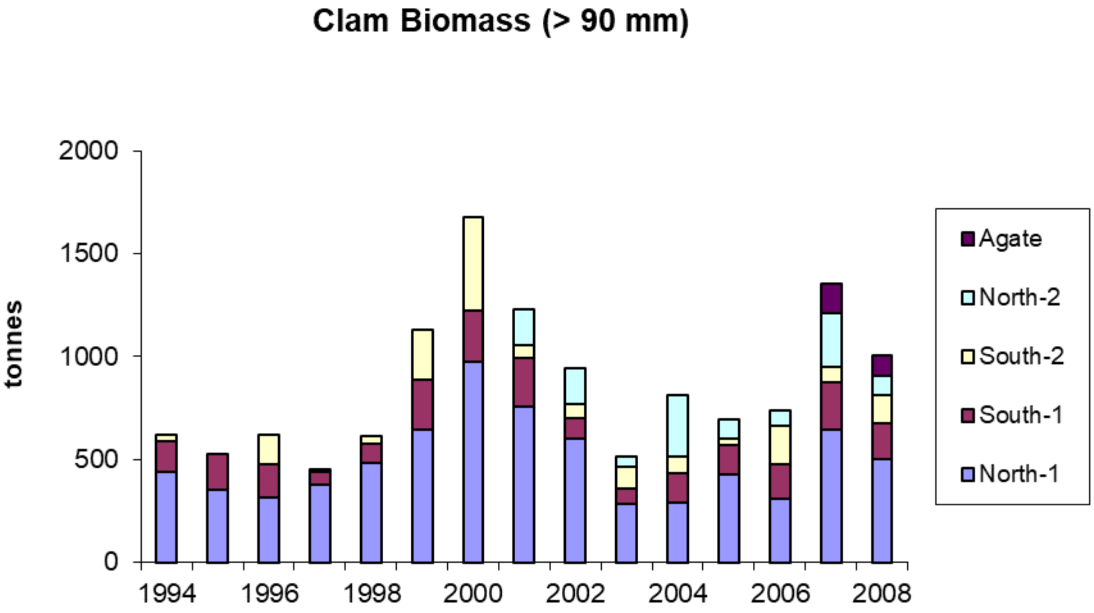


Figure A.5b. Biomass by beach section 1994–2008.

Table A.1. Razor Clam landings 1923–2008.

Year	Landings t	Year	Landings t
1920	–	1966	34.1
1921	−	1967	45.5
1922	−	1968	11.6
1923	22.4	1969	7.9
1924	181.4	1970	17.7
1925	757	1971	60.4
1926	161.9	1972	16.4
1927	87.1	1973	74.2
1928	169.2	1974	68
1929	122.3	1975	24
1930	393.9	1976	80
1931	155.4	1977	68
1932	153.4	1978	38.2
1933	−	1979	98
1934	−	1980	73.5
1935	−	1981	16.1
1936	−	1982	46.6
1937	−	1983	20.1
1938	433.1	1984	93.3
1939	−	1985	88
1940	−	1986	139
1941	−	1987	138.6
1942	267.7	1988	152.3
1943	176.8	1989	114.1
1944	135.3	1990	112
1945	65.7	1991	114.5
1946	98.2	1992	54.2
1947	44.6	1993	42.7
1948	–	1994	103.3
1949	104.1	1995	130.9
1950	159.8	1996	75.2
1951	28.5	1997	108.8
1952	55.8	1998	39.9
1953	68.7	1999	78.1
1954	120.8	2000	237
1955	97	2001	166.9
1956	106	2002	157.1
1957	83.5	2003	164.0
1958	71.8	2004	92.5
1959	88.7	2005	153.2
1960	98.5	2006	137.1
1961	101.9	2007	19.9
1962	75	2008	200.3
1963	65.4		
1964	47.3		
1965	66.7		

Table A.2. Razor Clam landings by beach section, effort and value 1995–2008.

Year	North Beach-1 (pounds)	North Beach-2 (pounds)	South Beach-1 (pounds)	South Beach-2 (pounds)	Agate Beach (pounds)	East Beach (pounds)	Total Catch (pounds)	Catch Ceiling (pounds)	Effort (Digger Days)	Value ($)
1995	–	–	–	–	–	–	288,528	none	1,246	$230,822
1996	–	–	–	–	–	–	165,761	none	943	$137,226
1997	–	–	–	–	–	–	239,826	none	2,928	$200,040
1998	–	–	–	–	–	–	87,938	none	817	$79,381
1999	–	–	–	–	–	–	171,841	none	1,454	$127,272
2000	–	–	–	–	–	–	237,033	none	1,772	$465,038
2001	211,520	74,818	47,551	12,445	21,775	0	368,109	520,000	3,733	$364,338
2002	280,313	25,894	22,227	8,266	9,723	0	346,423	377,000	3,755	$320,330
2003	257,233	77,011	15,142	4,801	7,443	0	361,630	366,000	4,119	$388,533
2004	116,184	65,653	8,157	9,290	4,749	0	204,033	200,000	2,672	$234,001
2005	220,258	38,199	47,529	11,075	20,758	84	337,903	350,000	4,620	$445,679
2006	168,278	36,124	51,928	14,692	31,228	0	302,250	300,000	4,193	$347,903
2007	8,101	10,008	16,111	7,525	2,088	0	43,832	330,000	294	$33,344
2008	322,805	48,854	33,135	11,201	25,633	0	441,628	457,000	2,992	$350,120

Table A.3. Razor Clam fishing effort and Haida participation.

Year	Number of Commercial Licences	Number of Haida Designations
1995	6	214
1996	6	143
1997	6	150
1998	6	94
1999	6	155
2000	6	269
2001	6	249
2002	6	263

Year	Number of Commercial Licences	Number of Haida Designations
2003	5	279
2004	5	236
2005	5	275
2006	5	267
2007	5	144
2008	5	238

Source: Number of licences was provided by DFO licensing branch. Number of designations was provided by the Haida Fisheries Program.

Table A.4. Location and dates of transection 1994–2008.

Year	Beach Section									
	North-1		North-2		South-1		South-2		Agate	
	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)
1994	July 26	1.3	–	–	April 29	0.4	Aug. 10	1.7	–	–
	April 26	2.7			April 27	0.8	Aug. 8	3.0		
	April 28	4.0			Aug. 9	1.4	July 25	4.4		
	March 29	4.8			May 27	3.6				
	May 24	4.9								
	May 25	5.5								
	May 28	7.6								
1995	June 14	0.6	–	–	July 13	0.8	–	–	–	–
	June 16	1.8			Aug. 11	2.0				
	July 11	3.0			July 14	3.2				
	June 12	4.3			July 12	4.4				
	June 17	5.4								
	June 14	6.6								
	Aug. 10	7.2								

Year	Beach Section									
	North-1		North-2		South-1		South-2		Agate	
	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)
1996	June 1	0.9	–	–	July 1	0.3	Aug. 29	0.6	–	–
	June 5	2.0			July 4	0.6	July 5	2.6		
	June 2	3.1			June 30	1.5				
	June 3	4.2			July 2	3.9				
	May 7	5.3								
	June 4	6.4								
1997	Aug. 21	0.3	–	–	June 5	2.1	June 6	0.6	–	–
	May 8	1.4			July 21	3.3	July 22	3.6		
	July 20	2.5								
	May 6	4.7								
	May 7	5.8								
	May 9	6.9								
1998	June 25	0.4	–	–	May 28	0.8	June 26	2.7	–	–
	Apr. 29	1.4			May 26	2.4				
	May 25	2.4			May 27	3.4				
	June 24	4.0								
	Apr. 27	5.2								
	Apr. 28	6.4								
1999	May 16	1.4	–	–	June 16	1.0	June 15	0.6	–	–
	May 15	2.5			May 17	2.1	July 12	1.6		
	Aug 11	3.6								
	Aug 12	3.0								
	July 15	4.7								
	July 14	5.8								
2000	June 4	1.1			July 4	0.6	July 30	0.9		
	July 2	2.2			Aug. 1	1.7	Aug. 2	2.4		
	June 3	3.3			June 2	2.2				
	July 31	4.4			June 5	3.9				
	July 1	5.5								
	July 3	6.6								

Year	Beach Section									
	North-1		North-2		South-1		South-2		Agate	
	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)
2001	June 21 June 24 July 20 July 21 July 22 Aug. 20	6.9 4.0 4.0 3.1 1.4 1.3	June 23 July 24 Aug. 18	11.7 12.6 13.0	June 25 July 23 Aug. 23	0.6 1.8 1.1	May 24 Aug. 19 Aug. 21	0.3 5.6 9.5	–	–
2002	April 27 April 28 May 27 July 12 Aug. 8	2.5 1.1 1.8 5.7 3.0	May 28 Aug. 10	8.5 11.5	July 11 Aug. 9	2.6 1.6	April 26 April 29 June 25 July 10	0.5 5.0 4.6 7.8	–	–
2003	April 18 May 15 May 17 June 14 June 17 July 13	4.9 6.1 3.1 2.1 0.5 3.9	June 16	9.6	May 19 June 13 July 15	3.2 2.7 1.5	April 17 May 16	7.4 5.9	–	–
2004	May 5 May 6 June 2 June 4 June 5 June 6	1.0 3.4 2.2 4.6 5.8 7.0	Aug. 1 Aug. 2	10.9 12.9	July 1 July 3 Aug. 3	0.9 2.4 3.9	July 4 July 5	5.1 6.3	–	–
2005	May 24 May 25 May 26 June 22 June 23 June 24	2.0 4.4 6.6 3.2 5.6 0.8	June 25 July 21 Aug 19	11.6 9.6 7.6	May 23 July 22 Aug. 20	3.7 0.7 2.2	July 23 July 24 Aug. 21	7.5 5.1 6.3	–	–

Year	Beach Section									
	North-1		North-2		South-1		South-2		Agate	
	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)	Date	Location (km)
2006	April 28	0.7	July 12	6.5	April 27	0.3	May 26	10.3	–	–
	May 27	1.9	Aug 9	8.0	Aug 10	3.9	July 11	8.0		
	May 28	5.5	Aug 12	12.3			Sep 7	12.3		
	June 13	3.1								
	July 13	6.7								
	July 14	4.3								
2007	April 17	1.9	April 19	11.4	April 20	1.3	May 19	8.7	July 30	0.5
	April 18	5.5	July 14	9.4	May 18	4.3	June 17	6.9	July 31	1.2
	May 16	0.7	July 15	7.4	July 16	2.8	July 15	5.1	Aug 1	1.9
	May17	6.7								
	June 14	4.3								
	June 15	3.1								
2008	May 5	0.5	June 5	12.9	May 8	3.5	Jun 2	5.5	Aug 1	0.3
	June 3	1.7	July 4	9.1	June 7	1.9	Aug 29	7.1	Aug 2	1.0
	July 7	2.9	July 5	11.1	July 31	0.4			Aug 3	1.74
	June 4	4.1								
	May 6	5.3								
	June 6	6.5								

Table A.5a. Razor clam population estimate by size class using the inflation method 1994–2008. Dashes (–) indicate no samples taken or no estimate of precision could be determined because only a single transect was taken.

Size Class, Shell Length ≥	Year	Beach Section														
		North-1			North-2			South-1			South-2			Agate		
		No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE
4 mm+	1994	7	30.9	6.6	–	–	–	4	5.9	2.8	3	2.6	1.7	–	–	–
	1995	7	15.5	1.4	–	–	–	4	4.8	0.6	–	–	–	–	–	–
	1996	6	13.7	1.6	–	–	–	4	3.7	0.4	2	2.2	0.6	–	–	–
	1997	6	12.5	1.4	–	–	–	2	5.2	0.4	3	1.7	0.9	–	–	–
	1998	6	11.2	1.1	–	–	–	3	2.2	1.1	1	0.5	–	–	–	–
	1999	6	51.3	20.9	–	–	–	2	2.9	1.7	2	2.7	1.0	–	–	–
	2000	6	27.1	4.8	–	–	–	4	3.9	1.6	2	5.2	0.5	–	–	–
	2001	6	124.1	17.4	3	20.9	1.9	3	10.8	5.2	3	4.2	2.9	–	–	–
	2002	5	133.0	92.3	2	113.8	105.7	2	6.9	3.7	4	1.7	1.1	–	–	–
	2003	6	5.6	1.2	1	3.0	–	3	1.8	0.5	2	0.0	0.2	–	–	–
	2004	6	8.1	1.0	3	43.2	13.4	3	2.8	1.0	2	1.1	1.1	–	–	–
	2005	6	9.6	1.3	3	24.3	9.9	3	3.7	1.8	3	1.2	0.3	–	–	–
	2006	6	24.5	7.8	3	23.1	5.1	2	3.5	0.4	3	2.4	0.8	–	–	–
	2007	6	16.6	2.8	3	17.8	5.4	3	4.8	0.6	3	1.3	0.9	3	2.8	1.5

N.B.
Clams of SL ≥90 mm are fully available to the commercial fishery. Clams recruit to the fishery at 3 to 4 years of age.
Clams of SL ≥20 mm include clams 20 to 90 mm SL that recruit to the fishery in 1–2 years (these clams are 1–3 years of age).
Clams of SL ≥4 mm include clams 4 to 20 mm SL that recruit to the fishery in 2–3 years (these clams are 0-1 years of age).

Table A.5b. Razor clam population estimate by size class using the inflation method 1994–2008 (cont.).

Abundance of clams >20 mm

Year	Beach Section															All	
	North-1			North-2			South-1			South-2			Agate				
	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	Total	SE
1994	7	11.5	1.5	–	–	–	4	3.3	0.5	3	0.7	0.4	–	–	–	15.5	1.6
1995	7	12.7	1.7	–	–	–	4	4.7	0.6	–	–	–	–	–	–	17.4	1.8
1996	6	9	1.5	–	–	–	4	3.7	0.9	2	2.2	1.1	–	–	–	14.9	2.1
1997	6	8.4	0.8	–	–	–	2	4.9	0.4	3	1.6	0.9	–	–	–	14.9	1.3
1998	6	10.3	1.1	–	–	–	3	2.2	1.1	1	0.5	–	–	–	–	13.0	1.6
1999	6	8.7	0.9	–	–	–	2	2.8	1.6	2	2.7	0.9	–	–	–	14.2	2.0
2000	6	15	1.1	–	–	–	4	3.1	1	2	4.9	0.5	–	–	–	23.0	1.6
2001	6	12.2	1	3	2.6	2	3	2.1	0.9	3	0.8	0.4	–	–	–	17.7	2.4
2002	5	9.5	1.6	2	5.3	1.6	2	3.4	0.4	4	1.5	0.8	–	–	–	19.7	2.4
2003	6	4.6	0.7	1	1.6	–	3	1.7	0.5	2	0	0.1	–	–	–	7.9	0.9
2004	6	6.1	0.9	3	4.4	2.5	3	2.8	1	2	1.1	1.1	–	–	–	14.4	3.0
2005	6	8	0.9	3	5.2	0.7	3	2	0.9	3	1	0.3	–	–	–	16.2	1.5
2006	6	9.4	1.1	3	6.9	2.3	2	3	0.8	3	2.2	0.9	–	–	–	21.5	2.8
2007	6	11.2	1.8	3	15.4	6	3	3.2	1.4	3	1.6	0.9	3	2.1	1.4	33.5	6.6
2008	6	6.9	0.8	3	3.3	1.5	3	2.6	0.4	2	4.0	0.3	3	1.4	0.7	18.2	1.9

Abundance of clams >90 mm

Year	Beach Section															All	
	North-1			North-2			South-1			South-2			Agate				
	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	No. of transects	No. of clams x 10^6	SE	Total	SE
1994	7	4.0	0.8	–	–	–	4	1.5	0.4	3	0.3	0.1	–	–	–	5.8	0.9
1995	7	3.1	0.5	–	–	–	4	1.8	0.3	–	–	–	–	–	–	4.9	0.6
1996	6	3.0	0.4	–	–	–	4	1.8	0.4	2	1.7	0.5	–	–	–	6.5	0.8
1997	6	2.8	0.3	–	–	–	2	1.5	0.2	3	1.0	0.9	–	–	–	5.3	1.0
1998	6	4.8	0.7	–	–	–	3	1.0	0.4	1	0.4	–	–	–	–	6.2	0.8
1999	6	5.3	0.5	–	–	–	2	2.1	1.3	2	2.4	0.6	–	–	–	9.8	1.5
2000	6	7.0	0.7	–	–	–	4	1.9	0.6	2	3.6	0.4	–	–	–	12.5	1.0
2001	6	5.9	0.8	3	1.2	1.1	3	1.3	0.7	3	0.6	0.4	–	–	–	9.0	1.6
2002	5	5.2	0.7	2	1.2	0.6	2	1.0	0.2	4	0.6	0.4	–	–	–	8.0	1.0
2003	6	2.7	0.5	1	0.5	–	3	0.6	0.1	2	0.0	0.0	–	–	–	3.8	0.5
2004	6	2.7	0.7	3	2.7	1.6	3	1.6	0.5	2	0.8	0.9	–	–	–	7.8	2.0
2005	6	3.6	0.6	3	0.9	0.4	3	1.3	0.6	3	0.3	0.1	–	–	–	6.1	0.9
2006	6	2.2	0.5	3	1.1	0.5	2	1.4	0.2	3	0.6	0.1	–	–	–	5.3	0.7
2007	6	5.0	0.7	3	1.7	1.0	3	1.6	0.2	3	1.0	0.5	3	1.1	0.6	10.4	1.5
2008	6	6.7	0.4	3	0.5	0.3	3	1.2	0.2	3	1.9	0.4	3	0.8	0.5	11.1	0.8

Table A.6. Razor Clam exploitable biomass using the inflation method 1994–2008. Dashes (–) indicate no samples taken or no estimate of precision could be determined because only a single transect was done.

Biomass of clams >20 mm

Year	Beach Section															All	
	North-1			North-2			South-1			South-2			Agate				
	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	Total	SE
1994	7	508	85	–	–	–	4	167	40	3	34	14	–	–	–	709.0	95.0
1995	7	439	66	–	–	–	4	211	43	–	–	–	–	–	–	650.0	78.8
1996	6	361	52	–	–	–	4	181	31	2	157	45	–	–	–	699.0	75.4
1997	6	412	73	–	–	–	2	71	37	3	19	13	–	–	–	502.0	82.9
1998	6	539	88	–	–	–	3	106	49	1	46	–	–	–	–	691.0	100.7
1999	6	691	59	–	–	–	2	251	160	2	248	104	–	–	–	1190.0	199.7
2000	6	1035	123	–	–	–	4	262	88	2	473	50	–	–	–	1770.0	159.3
2001	6	869	125	3	197	177	3	254	133	3	64	36	–	–	–	1384.0	256.8
2002	5	633	91	2	193	97	2	126	25	4	74	41	–	–	–	1026.0	141.4
2003	6	305	44	1	73	–	3	92	19	2	116	113	–	–	–	586.0	122.7
2004	6	338	81	3	328	195	3	155	51	2	82	84	–	–	–	903.0	232.9
2005	6	474	53	3	122	42	3	148	66	3	34	11	–	–	–	778.0	95.1
2006	6	307	64	3	173	40	2	181	65	3	79	22	–	–	–	740.0	102.0
2007	6	705	116	3	312	182	3	205	41	3	92	56	3	151	71	1465.0	237.6
2008	6	530	104	3	103	54	3	153	38	2	194.0	23	3	105	59	1085.0	138.5

Biomass >90 mm

Year	Beach Section															All	
	North-1			North-2			South-1			South-2			Agate				
	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	No. of transects	Biomass (t)	SE	Total	SE
1994	7	442	94	–	–	–	4	150	39	3	27	12	–	–	–	619.0	102.5
1995	7	353	59	–	–	–	4	174	42	–	–	–	–	–	–	527.0	72.4
1996	6	315	48	–	–	–	4	159	31	2	146	41	–	–	–	620.0	70.3
1997	6	375	73	–	–	–	2	63	32	3	13	11	–	–	–	451.0	80.5
1998	6	485	84	–	–	–	3	91	42	1	36	–	–	–	–	612.0	93.9
1999	6	647	61	–	–	–	2	241	155	2	241	97	–	–	–	1129.0	192.8
2000	6	974	129	–	–	–	4	248	85	2	454	51	–	–	–	1676.0	162.7
2001	6	757	122	3	177	164	3	237	128	3	60	34	–	–	–	1231.0	243.6
2002	5	600	87	2	171	102	2	104	23	4	68	38	–	–	–	943.0	141.2
2003	6	285	43	1	53	–	3	75	15	2	104	104	–	–	–	517.0	113.5
2004	6	289	80	3	295	173	3	146	50	2	80	82	–	–	–	810.0	213.4
2005	6	428	56	3	88	34	3	142	62	3	34	11	–	–	–	692.0	90.9
2006	6	261	20	3	117	50	2	152	33	3	57	19	–	–	–	587.0	66.0
2007	6	645	110	3	257	171	3	185	39	3	85	60	3	145	72	1317.0	227.3
2008	6	499	106	3	62	34	3	139	35	2	165	22	3	99	56	964.0	131.3

Table A.7.1994a. Age-length keys and number of clams by age in 1994. Total estimated clams on the beach = 15.5 M, se = 1.6 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	163	0.0977
25	2	0	0	0	0	0	0	0	0	0	2	135	0.0809
30	1	0	0	0	0	0	0	0	0	0	1	113	0.0677
35	0	3	0	0	0	0	0	0	0	0	3	68	0.0408
40	0	5	0	0	0	0	0	0	0	0	5	85	0.0510
45	0	2	0	0	0	0	0	0	0	0	2	70	0.0420
50	0	9	0	0	0	0	0	0	0	0	9	49	0.0294
55	0	5	0	0	0	0	0	0	0	0	5	50	0.0300
60	0	4	0	0	0	0	0	0	0	0	4	31	0.0186
65	0	4	1	0	0	0	0	0	0	0	5	34	0.0204
70	0	1	1	0	0	0	0	0	0	0	2	37	0.0222
75	0	1	0	0	0	0	0	0	0	0	1	52	0.0312
80	0	2	1	0	0	0	0	0	0	0	3	58	0.0348
85	0	3	1	0	0	0	0	0	0	0	4	37	0.0222
90	0	2	5	0	0	0	0	0	0	0	7	41	0.0246
95	0	0	1	0	0	0	0	0	0	0	1	45	0.0270
100	0	0	4	0	0	0	0	0	0	0	4	86	0.0516
105	0	0	3	3	0	0	0	0	0	0	6	85	0.0510
110	0	0	4	4	1	1	0	0	0	0	10	110	0.0659
115	0	0	0	14	10	3	0	0	0	0	27	110	0.0659
120	0	0	0	12	13	0	0	1	0	0	26	87	0.0522
125	0	0	0	2	9	5	3	0	0	0	19	42	0.0252
130	0	0	0	1	0	4	3	1	0	0	9	31	0.0186
135	0	0	0	0	0	2	2	1	1	0	6	19	0.0114
140	0	0	0	0	0	0	0	1	1	0	2	17	0.0102
145	0	0	0	0	0	0	1	0	0	0	1	7	0.0042
150	0	0	0	0	0	1	0	1	0	0	2	5	0.0030
155	0	0	0	0	0	0	0	0	0	**1**	**1**	1	0.0006
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1668	1.0000

Table A.7.1994b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.750	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.286	0.714	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.400	0.400	0.100	0.100	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.519	0.370	0.111	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.462	0.500	0.000	0.000	0.038	0.000	0.000
125	0.000	0.000	0.000	0.105	0.474	0.263	0.158	0.000	0.000	0.000
130	0.000	0.000	0.000	0.111	0.000	0.444	0.333	0.111	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.333	0.333	0.167	0.167	0.000
140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.500	0.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1994c. Overall proportion and estimated standard error SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.24640	0.31704	0.18026	0.11484	0.06903	0.03410	0.01816	0.01256	0.00699	0.00060	1.00000
var pt 1	0.00000	0.00021	0.00042	0.00029	0.00011	0.00008	0.00002	0.00002	0.00002	0.00000	first term of equation 2
var pt ii	0.00011	0.00011	0.00006	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	second term of equation 2
se	0.01055	0.01787	0.02176	0.01759	0.01120	0.00903	0.00474	0.00520	0.00420	0.00060	overall standard error

Table A.7.1994d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	3.82	4.91	2.79	1.78	1.07	0.53	0.28	0.19	0.11	0.01	15.5
se	0.43	0.58	0.44	0.33	0.20	0.15	0.08	0.08	0.07	0.01	–

Table A.7.1994e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.821.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.24640	0.31002	0.03230	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	3.82	4.81	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.1995a. Age-length keys and number of clams by age in 1995. Total estimated clams on the beach = 17.4 M, se = 1.8 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class:												**Length distribution**		
Length class (mm)	**Age in years**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Length**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	20	81	0.0484
25	1	0	0	0	0	0	0	0	0	0	1	25	106	0.0633
30	0	1	0	0	0	0	0	0	0	0	1	30	106	0.0633
35	0	1	0	0	0	0	0	0	0	0	1	35	103	0.0615
40	0	1	0	0	0	0	0	0	0	0	1	40	74	0.0442
45	0	3	0	0	0	0	0	0	0	0	3	45	85	0.0508
50	0	2	2	0	0	0	0	0	0	0	4	50	91	0.0544
55	0	4	2	0	0	0	0	0	0	0	6	55	102	0.0609
60	0	3	7	0	0	0	0	0	0	0	10	60	142	0.0848
65	0	2	7	0	0	0	0	0	0	0	9	65	109	0.0651
70	0	3	8	0	0	0	0	0	0	0	11	70	79	0.0472
75	0	3	4	0	0	0	0	0	0	0	7	75	47	0.0281
80	0	7	1	2	0	0	0	0	0	0	10	80	42	0.0251
85	0	1	4	6	0	0	0	0	0	0	11	85	23	0.0137
90	0	0	4	5	0	0	0	0	0	0	9	90	39	0.0233
95	0	0	6	5	0	0	0	0	0	0	11	95	37	0.0221
100	0	1	4	4	1	0	0	0	0	0	10	100	43	0.0257
105	0	0	1	8	1	0	0	0	0	0	10	105	53	0.0317
110	0	0	1	7	2	0	0	0	0	0	10	110	52	0.0311
115	0	0	0	5	4	1	0	0	0	0	10	115	60	0.0358
120	0	0	0	0	6	3	0	0	0	0	9	120	64	0.0382
125	0	0	0	1	4	4	0	0	0	0	9	125	61	0.0364
130	0	0	0	0	2	5	2	1	0	0	10	130	38	0.0227
135	0	0	0	0	1	3	4	1	1	0	10	135	30	0.0179
140	0	0	0	0	0	1	1	1	1	0	4	140	3	0.0018
145	0	0	0	0	0	0	0	1	0	0	1	145	3	0.0018
150	0	0	0	0	0	0	0	0	1	0	1	150	0	0.0000
155	0	0	0	0	0	0	0	0	0	**1**	**1**	155	1	0.0006
160	0	0	0	0	0	0	0	0	0	**1**	**1**	160	0	0.0000
											Total:	–	1674	1.0000

Table A.7.1995b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.300	0.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.222	0.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.273	0.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.429	0.571	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.700	0.100	0.200	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.091	0.364	0.545	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.444	0.556	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.545	0.455	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.100	0.400	0.400	0.100	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.100	0.800	0.100	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.100	0.700	0.200	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.500	0.400	0.100	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.667	0.333	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.111	0.444	0.444	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.200	0.500	0.200	0.100	0.000	0.000
135	0.000	0.000	0.000	0.000	0.100	0.300	0.400	0.100	0.100	0.000
140	0.000	0.000	0.000	0.000	0.000	0.250	0.250	0.250	0.250	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1995c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

Age in years											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.11171	0.37384	0.25434	0.11482	0.07430	0.04970	0.01216	0.00630	0.00224	0.00060	1.00000
var pt 1	0.00000	0.00064	0.00069	0.00014	0.00014	0.00010	0.00002	0.00001	0.00000	0.00000	first term of equation 2
var pt ii	0.00006	0.00009	0.00005	0.00003	0.00002	0.00001	0.00000	0.00000	0.00000	0.00000	second term of equation 2
se	0.00770	0.02710	0.02729	0.01306	0.01270	0.01067	0.00428	0.00301	0.00179	0.00060	overall standard error

Table A.7.1995d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	1.94	6.50	4.43	2.00	1.29	0.86	0.21	0.11	0.04	0.01	17.4
se	0.24	0.82	0.66	0.31	0.26	0.21	0.08	0.05	0.03	0.01	–

Table A.7.1995e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.153.

Age in years											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.11171	0.37127	0.21538	0.01251	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	1.94	6.46	3.75	0.22	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.1996a. Age-length keys and number of clams by age in 1996. Total estimated clams on the beach = 14.9 M, se = 2.1 M. Left out one clam 170 mm, age 11. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	81	0.0484
25	1	0	0	0	0	0	0	0	0	0	1	106	0.0634
30	0	1	0	0	0	0	0	0	0	0	1	106	0.0634
35	0	1	0	0	0	0	0	0	0	0	1	103	0.0616
40	0	1	0	0	0	0	0	0	0	0	1	74	0.0442
45	0	1	0	0	0	0	0	0	0	0	1	85	0.0508
50	0	1	0	0	0	0	0	0	0	0	1	91	0.0544
55	0	1	0	0	0	0	0	0	0	0	1	102	0.0610
60	0	1	0	0	0	0	0	0	0	0	1	142	0.0849
65	0	2	0	0	0	0	0	0	0	0	2	109	0.0652
70	0	4	2	0	0	0	0	0	0	0	6	79	0.0472
75	0	5	5	0	0	0	0	0	0	0	10	47	0.0281
80	0	0	10	0	0	0	0	0	0	0	10	42	0.0251
85	0	0	8	2	0	0	0	0	0	0	10	23	0.0137
90	0	0	10	5	0	0	0	0	0	0	15	39	0.0233
95	0	0	8	2	0	0	0	0	0	0	10	37	0.0221
100	0	0	6	4	0	0	0	0	0	0	10	43	0.0257
105	0	0	3	7	0	0	0	0	0	0	10	53	0.0317
110	0	0	2	6	1	0	0	0	0	0	9	52	0.0311
115	0	0	0	5	6	0	0	0	0	0	11	60	0.0359
120	0	0	0	2	7	1	0	0	0	0	10	64	0.0383
125	0	0	0	0	7	3	0	0	0	0	10	61	0.0365
130	0	0	0	0	2	7	0	0	0	0	9	38	0.0227
135	0	0	0	0	0	6	4	0	0	0	10	30	0.0179
140	0	0	0	0	1	2	0	0	0	1	4	3	0.0018
145	0	0	0	0	0	0	1	0	0	0	1	3	0.0018
150	0	0	0	0	0	0	0	0	1	0	1	0	0.0000
155	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1673	1.0000

Table A.7.1996b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.300	0.700	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.222	0.667	0.111	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.455	0.545	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.200	0.700	0.100	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.700	0.300	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.222	0.778	0.000	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.600	0.400	0.000	0.000	0.000
140	0.000	0.000	0.000	0.000	0.250	0.500	0.000	0.000	0.000	0.250
145	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1996c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.11178	0.53088	0.13096	0.09207	0.08081	0.04409	0.00897	0.00000	0.00000	0.00045	1.00000
var pt 1	0.00000	0.00010	0.00018	0.00013	0.00011	0.00006	0.00001	0.00000	0.00000	0.00000	first term of equation 2
var pt ii	0.00006	0.00014	0.00004	0.00002	0.00003	0.00001	0.00000	0.00000	0.00000	0.00000	second term of equation 2
se	0.00770	0.01551	0.01473	0.01244	0.01156	0.00850	0.00323	0.00000	0.00000	0.00047	overall standard error

Table A.7.1996d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	1.67	7.91	1.95	1.37	1.20	0.66	0.13	0.00	0.00	0.01	14.9
se	0.26	1.14	0.35	0.27	0.24	0.16	0.05	0.00	0.00	0.01	–

Table A.7.1996e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.497.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.11178	0.53088	0.06589	0.00275	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	1.67	7.91	0.98	0.04	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.1997a. Age-length keys and number of clams by age in 1997. Total estimated clams on the beach = 14.9 M, se = 1.3 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class:												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	36	0.0479
25	1	0	0	0	0	0	0	0	0	0	1	41	0.0545
30	1	0	0	0	0	0	0	0	0	0	1	51	0.0678
35	1	0	0	0	0	0	0	0	0	0	1	42	0.0559
40	0	1	0	0	0	0	0	0	0	0	1	55	0.0731
45	0	4	0	0	0	0	0	0	0	0	4	55	0.0731
50	0	2	0	0	0	0	0	0	0	0	2	42	0.0559
55	0	1	0	0	0	0	0	0	0	0	1	27	0.0359
60	0	1	0	0	0	0	0	0	0	0	1	13	0.0173
65	0	4	0	0	0	0	0	0	0	0	4	16	0.0213
70	0	11	0	0	0	0	0	0	0	0	11	17	0.0226
75	0	9	3	0	0	0	0	0	0	0	12	21	0.0279
80	0	1	7	0	0	0	0	0	0	0	8	14	0.0186
85	0	4	6	0	0	0	0	0	0	0	10	14	0.0186
90	0	0	9	1	0	0	0	0	0	0	10	16	0.0213
95	0	0	8	2	0	0	0	0	0	0	10	23	0.0306
100	0	0	4	6	0	0	0	0	0	0	10	26	0.0346
105	0	0	3	7	0	0	0	0	0	0	10	18	0.0239
110	0	0	2	7	1	0	0	0	0	0	10	44	0.0585
115	0	0	0	7	1	1	0	0	0	0	9	42	0.0559
120	0	0	0	1	6	2	0	0	0	0	9	29	0.0386
125	0	0	0	0	3	7	1	0	0	0	11	43	0.0572
130	0	0	0	1	3	6	0	0	0	0	10	21	0.0279
135	0	0	0	0	1	5	3	1	1	0	11	24	0.0319
140	0	0	0	0	2	4	3	0	0	0	9	19	0.0253
145	0	0	0	0	0	0	0	1	0	0	1	2	0.0027
150	0	0	0	0	0	0	1	0	0	0	1	1	0.0013
155	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	752	1.0000

Table A.7.1997b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.750	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.125	0.875	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.300	0.700	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.200	0.700	0.100	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.778	0.111	0.111	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.111	0.667	0.222	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.273	0.636	0.091	0.000	0.000	0.000
130	0.000	0.000	0.000	0.100	0.300	0.600	0.000	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.091	0.455	0.273	0.091	0.091	0.000
140	0.000	0.000	0.000	0.000	0.222	0.444	0.333	0.000	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1997c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.22606	0.32992	0.11077	0.13722	0.07025	0.09365	0.02365	0.00556	0.00290	0.00000	1.00000
var pt 1	0.00000	0.00003	0.00014	0.00021	0.00020	0.00019	0.00006	0.00001	0.00001	0.00000	first term of equation 2
var pt ii	0.00023	0.00028	0.00008	0.00009	0.00003	0.00005	0.00001	0.00000	0.00000	0.00000	second term of equation 2
se	0.01525	0.01742	0.01469	0.01755	0.01503	0.01556	0.00820	0.00339	0.00283	0.00000	overall standard error

Table A.7.1997d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	3.37	4.92	1.65	2.04	1.05	1.40	0.35	0.08	0.04	0.00	14.9
se	0.37	0.50	0.26	0.32	0.24	0.26	0.13	0.05	0.04	0.00	–

Table A.7.1997e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.689.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.22606	0.32992	0.03444	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	3.37	4.92	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.1998a. Age-length keys and number of clams by age in 1998. Total estimated clams on the beach = 13.0 M, se = 1.6 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	18	0.0172
25	10	0	0	0	0	0	0	0	0	0	10	45	0.0431
30	10	2	0	0	0	0	0	0	0	0	12	62	0.0593
35	4	6	0	0	0	0	0	0	0	0	10	55	0.0526
40	0	10	0	0	0	0	0	0	0	0	10	40	0.0383
45	0	10	0	0	0	0	0	0	0	0	10	50	0.0478
50	0	11	0	0	0	0	0	0	0	0	11	55	0.0526
55	0	11	0	0	0	0	0	0	0	0	11	38	0.0364
60	0	10	0	0	0	0	0	0	0	0	10	30	0.0287
65	0	7	2	0	0	0	0	0	0	0	9	22	0.0211
70	0	2	7	0	0	0	0	0	0	0	9	38	0.0364
75	0	4	6	0	0	0	0	0	0	0	10	29	0.0278
80	0	0	9	0	0	0	0	0	0	0	9	23	0.0220
85	0	0	10	0	0	0	0	0	0	0	10	31	0.0297
90	0	0	10	0	0	0	0	0	0	0	10	54	0.0517
95	0	0	7	3	0	0	0	0	0	0	10	37	0.0354
100	0	0	3	6	0	0	0	0	0	0	9	38	0.0364
105	0	0	1	9	0	0	0	0	0	0	10	41	0.0392
110	0	0	0	7	2	0	0	0	0	0	9	48	0.0459
115	0	0	0	4	5	0	0	0	0	0	9	48	0.0459
120	0	0	0	3	5	2	0	0	0	0	10	61	0.0584
125	0	0	0	0	8	2	0	0	0	0	10	77	0.0737
130	0	0	0	0	2	5	2	0	0	0	9	47	0.0450
135	0	0	0	0	0	4	4	1	0	0	9	38	0.0364
140	0	0	0	0	0	1	7	3	0	0	11	16	0.0153
145	0	0	0	0	0	0	0	6	1	0	7	3	0.0029
150	0	0	0	0	0	0	0	0	**1**	0	1	1	0.0010
155	0	0	0	0	0	0	0	0	0	**1**	1	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	1	0	0.0000
											Total:	1045	1.0000

Table A.7.1998b. *Estimate of the proportion of clams in each age class for every length class.*

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.833	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.778	0.222	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.222	0.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.333	0.667	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.100	0.900	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.778	0.222	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.444	0.556	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.300	0.500	0.200	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.222	0.556	0.222	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.444	0.444	0.111	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.091	0.636	0.273	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.857	0.143	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1998c. *Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.*

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.13078	0.28085	0.19379	0.14383	0.13385	0.06895	0.03590	0.01068	0.00137	0.00000	1.00000
var pt 1	0.00011	0.00016	0.00013	0.00024	0.00031	0.00023	0.00008	0.00002	0.00000	0.00000	first term of equation 2
var pt ii	0.00009	0.00016	0.00012	0.00007	0.00006	0.00002	0.00001	0.00000	0.00000	0.00000	second term of equation 2
se	0.01400	0.01781	0.01551	0.01767	0.01921	0.01599	0.00968	0.00472	0.00106	0.00000	overall standard error

Table A.7.1998d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	1.70	3.65	2.52	1.87	1.74	0.90	0.47	0.14	0.02	0.00	13.0
se	0.28	0.50	0.37	0.32	0.33	0.23	0.14	0.06	0.01	0.00	–

Table A.7.1994e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.477.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.13078	0.28085	0.10129	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	1.70	3.65	1.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.1999a. Age-length keys and number of clams by age in 1999. Total estimated clams on the beach = 14.2 M, se = 2.0 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	1	0	0	0	0	0	0	0	0	0	1	9	0.0078
25	5	0	0	0	0	0	0	0	0	0	5	14	0.0121
30	3	0	0	0	0	0	0	0	0	0	3	24	0.0208
35	6	0	0	0	0	0	0	0	0	0	6	28	0.0242
40	4	3	0	0	0	0	0	0	0	0	7	37	0.0320
45	4	6	0	0	0	0	0	0	0	0	10	34	0.0294
50	1	9	0	0	0	0	0	0	0	0	10	27	0.0234
55	0	10	0	0	0	0	0	0	0	0	10	37	0.0320
60	0	10	0	0	0	0	0	0	0	0	10	30	0.0260
65	0	4	1	0	0	0	0	0	0	0	5	43	0.0372
70	0	4	3	0	0	0	0	0	0	0	7	27	0.0234
75	0	4	3	0	0	0	0	0	0	0	7	15	0.0130
80	0	5	4	0	0	0	0	0	0	0	9	28	0.0242
85	0	4	4	0	0	0	0	0	0	0	8	26	0.0225
90	0	2	3	0	0	0	0	0	0	0	5	21	0.0182
95	0	1	7	1	0	0	0	0	0	0	9	45	0.0389
100	0	1	5	4	0	0	0	0	0	0	10	44	0.0381
105	0	0	3	4	0	0	0	0	0	0	7	71	0.0614
110	0	0	3	8	1	0	0	0	0	0	12	82	0.0709
115	0	0	2	2	3	0	0	0	0	0	7	114	0.0986
120	0	0	0	5	3	1	0	0	0	0	9	127	0.1099
125	0	0	0	2	6	2	1	0	0	0	11	114	0.0986
130	0	0	0	1	2	6	0	0	0	0	9	72	0.0623
135	0	0	0	0	0	5	5	0	0	0	10	47	0.0407
140	0	0	0	0	0	1	6	2	0	0	9	29	0.0251
145	0	0	0	0	0	1	0	2	0	0	3	10	0.0087
150	0	0	0	0	0	0	1	1	0	0	2	1	0.0009
155	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1156	1.0000

Table A.7.1999b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	2	3	4	5	6	7	8	9	10
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.571	0.429	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.100	0.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.571	0.429	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.571	0.429	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.556	0.444	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.111	0.778	0.111	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.100	0.500	0.400	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.429	0.571	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.250	0.667	0.083	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.286	0.286	0.429	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.556	0.333	0.111	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.182	0.545	0.182	0.091	0.000	0.000	0.000
130	0.000	0.000	0.000	0.111	0.222	0.667	0.000	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.111	0.667	0.222	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.333	0.000	0.667	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.1999c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.09727	0.20096	0.17746	0.21600	0.15243	0.09766	0.04645	0.01177	0.00000	0.00000	1.00000
var pt 1	0.00006	0.00021	0.00068	0.00107	0.00096	0.00041	0.00013	0.00002	0.00000	0.00000	first term of equation 2
var pt ii	0.00006	0.00009	0.00004	0.00005	0.00003	0.00003	0.00002	0.00000	0.00000	0.00000	second term of equation 2

se	0.01108	0.01730	0.02683	0.03339	0.03160	0.02105	0.01214	0.00471	0.00000	0.00000	overall standard error

Table A.7.1999d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	1.38	2.85	2.52	3.07	2.16	1.39	0.66	0.17	0.00	0.00	14.2
se	0.25	0.47	0.52	0.64	0.54	0.35	0.19	0.07	0.00	0.00	–

Table A.7.1999e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.746.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.09727	0.18556	0.04502	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	1.38	2.64	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2000a. Age-length keys and number of clams by age in 2000. Total estimated clams on the beach = 22.4 M, se = 1.9 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	2	0	0	0	0	0	0	0	0	0	2	0	0.0000
25	4	0	0	0	0	0	0	0	0	0	4	14	0.0082
30	2	8	0	0	0	0	0	0	0	0	10	28	0.0164
35	1	11	0	0	0	0	0	0	0	0	12	83	0.0485
40	0	12	0	0	0	0	0	0	0	0	12	112	0.0655
45	0	11	0	0	0	0	0	0	0	0	11	150	0.0877
50	0	12	0	0	0	0	0	0	0	0	12	98	0.0573
55	0	11	0	0	0	0	0	0	0	0	11	79	0.0462
60	0	12	0	0	0	0	0	0	0	0	12	55	0.0321
65	0	7	0	0	0	0	0	0	0	0	7	53	0.0310
70	0	4	0	0	0	0	0	0	0	0	4	33	0.0193
75	0	1	4	0	0	0	0	0	0	0	5	22	0.0129
80	0	4	10	0	0	0	0	0	0	0	14	20	0.0117
85	0	0	9	0	0	0	0	0	0	0	9	23	0.0134
90	0	0	14	0	0	0	0	0	0	0	14	21	0.0123
95	0	0	11	1	0	0	0	0	0	0	12	33	0.0193
100	0	0	10	2	0	0	0	0	0	0	12	46	0.0269
105	0	0	4	5	0	0	0	0	0	0	9	43	0.0251
110	0	0	2	8	1	0	0	0	0	0	11	41	0.0240
115	0	0	0	3	8	2	0	0	0	0	13	46	0.0269
120	0	0	0	0	7	4	0	0	0	0	11	83	0.0485
125	0	0	0	0	0	8	1	1	0	0	10	131	0.0766
130	0	0	0	0	1	2	6	1	0	0	10	172	0.1005
135	0	0	0	0	0	2	1	9	2	2	16	151	0.0883
140	0	0	0	0	0	0	3	4	2	2	11	87	0.0508
145	0	0	0	0	0	0	2	1	3	3	9	60	0.0351
150	0	0	0	0	0	0	1	0	2	2	5	18	0.0105
155	0	0	0	0	0	0	0	0	0	**1**	**1**	7	0.0041
160	0	0	0	0	0	0	0	0	0	**1**	**1**	2	0.0012
											Total:	1711	1.0000

Table A.7.2000b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.083	0.917	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.286	0.714	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.917	0.083	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.833	0.167	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.444	0.556	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.182	0.727	0.091	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.231	0.615	0.154	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.636	0.364	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.800	0.100	0.100	0.000	0.000
130	0.000	0.000	0.000	0.000	0.100	0.200	0.600	0.100	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.125	0.063	0.563	0.125	0.125
140	0.000	0.000	0.000	0.000	0.000	0.000	0.273	0.364	0.182	0.182
145	0.000	0.000	0.000	0.000	0.000	0.000	0.222	0.111	0.333	0.333
150	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.000	0.400	0.400
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2000c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.01550	0.40245	0.09996	0.04368	0.05965	0.11416	0.09725	0.08974	0.03617	0.04143	1.00000
var pt 1	0.00002	0.00003	0.00004	0.00005	0.00016	0.00037	0.00040	0.00033	0.00012	0.00012	first term of equation 2
var pt ii	0.00001	0.00013	0.00004	0.00001	0.00002	0.00003	0.00002	0.00002	0.00000	0.00001	second term of equation 2
se	0.00495	0.01268	0.00918	0.00778	0.01319	0.01984	0.02043	0.01866	0.01132	0.01145	overall standard error

Table A.7.2000d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	0.35	9.01	2.24	0.98	1.34	2.56	2.18	2.01	0.81	0.93	22.4
se	0.11	0.82	0.28	0.19	0.32	0.49	0.49	0.45	0.26	0.27	–

Table A.7.2000e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.679.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.01550	0.40245	0.03208	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	0.35	9.01	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2001a. Age-length keys and number of clams by age in 2001. Total estimated clams on the beach = 17.7 M, se = 2.4 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	9	0	0	0	0	0	0	0	0	0	9	29	0.0215
25	8	0	0	0	0	0	0	0	0	0	8	32	0.0238
30	2	4	0	0	0	0	0	0	0	0	6	31	0.0230
35	0	7	0	0	0	0	0	0	0	0	7	40	0.0297
40	0	9	0	0	0	0	0	0	0	0	9	42	0.0312
45	0	10	0	0	0	0	0	0	0	0	10	43	0.0319
50	0	10	0	0	0	0	0	0	0	0	10	51	0.0379
55	0	10	0	0	0	0	0	0	0	0	10	38	0.0282
60	0	10	0	0	0	0	0	0	0	0	10	60	0.0446
65	0	10	0	0	0	0	0	0	0	0	10	63	0.0468
70	0	10	0	0	0	0	0	0	0	0	10	35	0.0260
75	0	6	4	0	0	0	0	0	0	0	10	52	0.0386
80	0	2	7	0	0	0	0	0	0	0	9	49	0.0364
85	0	0	10	0	0	0	0	0	0	0	10	69	0.0513
90	0	0	10	0	0	0	0	0	0	0	10	80	0.0594
95	0	0	10	1	0	0	0	0	0	0	11	52	0.0386
100	0	0	8	2	0	0	0	0	0	0	10	50	0.0371
105	0	0	4	6	0	0	0	0	0	0	10	24	0.0178
110	0	0	5	5	0	0	0	0	0	0	10	50	0.0371
115	0	0	0	10	0	0	0	0	0	0	10	50	0.0371
120	0	0	0	0	6	4	0	0	0	0	10	82	0.0609
125	0	0	0	0	0	6	4	2	0	0	12	75	0.0557
130	0	0	0	0	0	0	5	5	0	0	10	78	0.0579
135	0	0	0	0	0	0	0	6	4	1	11	73	0.0542
140	0	0	0	0	0	0	1	4	3	2	10	71	0.0527
145	0	0	0	0	0	0	0	1	6	3	10	20	0.0149
150	0	0	0	0	0	0	0	0	1	3	4	6	0.0045
155	0	0	0	0	0	0	0	0	0	**1**	**1**	1	0.0007
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1346	1.0000

Table A.7.2001b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.333	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.222	0.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.909	0.091	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.600	0.400	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.500	0.333	0.167	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.364	0.091
140	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.400	0.300	0.200
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.600	0.300
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.750
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2001c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.05300	0.32300	0.24501	0.07736	0.03655	0.05223	0.05282	0.09043	0.04558	0.02402	1.00000
var pt 1	0.00002	0.00008	0.00014	0.00008	0.00009	0.00015	0.00017	0.00025	0.00013	0.00007	first term of equation 2
var pt ii	0.00003	0.00015	0.00011	0.00004	0.00002	0.00002	0.00001	0.00002	0.00001	0.00000	second term of equation 2
se	0.00729	0.01510	0.01567	0.01056	0.01022	0.01301	0.01342	0.01671	0.01175	0.00878	overall standard error

Table A.7.2001d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	0.94	5.72	4.34	1.37	0.65	0.92	0.93	1.60	0.81	0.43	17.7
se	0.18	0.82	0.65	0.26	0.20	0.26	0.27	0.36	0.23	0.16	–

Table A.7.2001e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.612.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.05300	0.32300	0.09503	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	0.94	5.72	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2002a. Age-length keys and number of clams by age in 2002. Total estimated clams on the beach = 19.7 M, se = 2.4 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	6	0	0	0	0	0	0	0	0	0	6	72	0.0624
25	4	2	0	0	0	0	0	0	0	0	6	84	0.0729
30	3	5	0	0	0	0	0	0	0	0	8	95	0.0824
35	3	8	0	0	0	0	0	0	0	0	11	65	0.0564
40	0	11	0	0	0	0	0	0	0	0	11	60	0.0520
45	0	10	0	0	0	0	0	0	0	0	10	47	0.0408
50	0	11	0	0	0	0	0	0	0	0	11	42	0.0364
55	0	9	0	0	0	0	0	0	0	0	9	30	0.0260
60	0	11	0	0	0	0	0	0	0	0	11	31	0.0269
65	0	8	0	0	0	0	0	0	0	0	8	20	0.0173
70	0	2	1	0	0	0	0	0	0	0	3	17	0.0147
75	0	1	4	0	0	0	0	0	0	0	5	13	0.0113
80	0	0	7	0	0	0	0	0	0	0	7	31	0.0269
85	0	0	9	0	0	0	0	0	0	0	9	28	0.0243
90	0	0	8	0	0	0	0	0	0	0	8	31	0.0269
95	0	0	3	5	0	0	0	0	0	0	8	29	0.0252
100	0	0	3	4	0	0	0	0	0	0	7	53	0.0460
105	0	0	3	6	0	0	0	0	0	0	9	64	0.0555
110	0	0	0	5	3	0	0	0	0	0	8	57	0.0494
115	0	0	0	3	4	0	0	0	0	0	7	40	0.0347
120	0	0	0	0	2	5	2	0	0	0	9	37	0.0321
125	0	0	0	2	0	1	4	1	0	0	8	42	0.0364
130	0	0	0	0	0	2	4	1	0	0	7	55	0.0477
135	0	0	0	0	0	0	1	5	0	0	6	39	0.0338
140	0	0	0	0	0	2	0	2	1	0	5	49	0.0425
145	0	0	0	0	0	0	0	0	1	0	1	12	0.0104
150	0	0	0	0	0	0	0	0	0	**1**	**1**	5	0.0043
155	0	0	0	0	0	0	0	0	0	**1**	**1**	2	0.0017
160	0	0	0	0	0	0	0	0	0	**1**	**1**	3	0.0026
											Total:	1153	1.0000

Table A.7.2002b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.375	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.273	0.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.375	0.625	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.429	0.571	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.333	0.667	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.625	0.375	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.429	0.571	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.222	0.556	0.222	0.000	0.000	0.000
125	0.000	0.000	0.000	0.250	0.000	0.125	0.500	0.125	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.286	0.571	0.143	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.833	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.400	0.000	0.400	0.200	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2002c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.15729	0.32834	0.13963	0.13386	0.04549	0.05301	0.05824	0.05655	0.01891	0.00867	1.00000
var pt 1	0.00045	0.00047	0.00019	0.00031	0.00013	0.00020	0.00017	0.00017	0.00006	0.00000	first term of equation 2
var pt ii	0.00007	0.00015	0.00007	0.00005	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	second term of equation 2
se	0.02296	0.02489	0.01621	0.01910	0.01220	0.01467	0.01371	0.01400	0.00825	0.00273	overall standard error

Table A.7.2002d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	3.10	6.47	2.75	2.64	0.90	1.04	1.15	1.11	0.37	0.17	19.7
se	0.59	0.93	0.46	0.49	0.26	0.31	0.30	0.31	0.17	0.06	–

Table A.7.2002e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.534.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.15729	0.32834	0.06511	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	3.10	6.47	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2003a. Age-length keys and number of clams by age in 2003. Total estimated clams on the beach = 7.9 M, se = 0.9 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**(Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	3	0	0	0	0	0	0	0	0	0	3	18	0.0299
25	1	0	0	0	0	0	0	0	0	0	1	9	0.0150
30	0	1	0	0	0	0	0	0	0	0	1	8	0.0133
35	0	3	0	0	0	0	0	0	0	0	3	11	0.0183
40	0	10	0	0	0	0	0	0	0	0	10	20	0.0332
45	0	11	0	0	0	0	0	0	0	0	11	28	0.0465
50	0	10	0	0	0	0	0	0	0	0	10	24	0.0399
55	0	10	0	0	0	0	0	0	0	0	10	32	0.0532
60	0	10	0	0	0	0	0	0	0	0	10	34	0.0565
65	0	11	0	0	0	0	0	0	0	0	11	32	0.0532
70	0	6	4	0	0	0	0	0	0	0	10	28	0.0465
75	0	2	8	0	0	0	0	0	0	0	10	15	0.0249
80	0	0	8	0	0	0	0	0	0	0	8	13	0.0216
85	0	0	7	0	0	0	0	0	0	0	7	11	0.0183
90	0	0	11	0	0	0	0	0	0	0	11	18	0.0299
95	0	0	6	5	0	0	0	0	0	0	11	26	0.0432
100	0	0	7	3	0	0	0	0	0	0	10	25	0.0415
105	0	0	1	8	0	0	0	0	0	0	9	20	0.0332
110	0	0	0	8	2	0	0	0	0	0	10	44	0.0731
115	0	0	0	0	7	2	0	0	0	0	9	44	0.0731
120	0	0	0	0	5	6	1	0	0	0	12	38	0.0631
125	0	0	0	0	0	8	2	0	0	0	10	27	0.0449
130	0	0	0	0	0	1	9	1	0	0	11	29	0.0482
135	0	0	0	0	0	0	4	6	0	0	10	26	0.0432
140	0	0	0	0	0	0	0	1	3	0	4	12	0.0199
145	0	0	0	0	0	0	0	0	3	0	3	5	0.0083
150	0	0	0	0	0	0	0	0	1	0	1	2	0.0033
155	0	0	0	0	0	0	0	0	0	2	2	3	0.0050
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	602	1.0000

Table A.7.2003b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	2	3	4	5	6	7	8	9	10
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.545	0.455	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.111	0.889	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.000	0.778	0.222	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.417	0.500	0.083	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.800	0.200	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.091	0.818	0.091	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.600	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.750	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2003c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	2	3	4	5	6	7	8	9	10	Check
Overall	0.04485	0.34684	0.16462	0.12009	0.09777	0.08806	0.07092	0.03528	0.02658	0.00498	1.00000
var pt 1	0.00000	0.00006	0.00015	0.00018	0.00027	0.00024	0.00013	0.00008	0.00002	0.00000	first term of equation 2
var pt ii	0.00007	0.00035	0.00017	0.00012	0.00008	0.00007	0.00006	0.00003	0.00004	0.00001	second term of equation 2

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
se	0.00844	0.02032	0.01783	0.01715	0.01869	0.01740	0.01393	0.01036	0.00744	0.00287	overall standard error

Table A.7.2003d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	0.35	2.74	1.30	0.95	0.77	0.70	0.56	0.28	0.21	0.04	7.9
se	0.08	0.35	0.20	0.17	0.17	0.16	0.13	0.09	0.06	0.02	–

Table A.7.2003e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.524.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.04485	0.34684	0.07841	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	0.35	2.74	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2004a. Age-length keys and number of clams by age in 2004. Total estimated clams on the beach = 14.4 M, se = 3.0 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class											**Length distribution**	
Length class (mm)	**Age in years**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	10	0	0	0	0	0	0	0	0	0	10	28	0.0274
25	11	0	0	0	0	0	0	0	0	0	11	36	0.0353
30	10	8	0	0	0	0	0	0	0	0	18	21	0.0206
35	5	6	0	0	0	0	0	0	0	0	11	28	0.0274
40	4	6	0	0	0	0	0	0	0	0	10	19	0.0186
45	0	10	0	0	0	0	0	0	0	0	10	20	0.0196
50	0	10	0	0	0	0	0	0	0	0	10	28	0.0274
55	0	11	0	0	0	0	0	0	0	0	11	37	0.0362
60	0	10	0	0	0	0	0	0	0	0	10	49	0.0480
65	0	10	0	0	0	0	0	0	0	0	10	32	0.0313
70	0	7	4	0	0	0	0	0	0	0	11	43	0.0421
75	0	9	1	0	0	0	0	0	0	0	10	42	0.0411
80	0	6	4	0	0	0	0	0	0	0	10	51	0.0500
85	0	1	9	0	0	0	0	0	0	0	10	36	0.0353
90	0	2	8	0	0	0	0	0	0	0	10	33	0.0323
95	0	0	10	0	0	0	0	0	0	0	10	59	0.0578
100	0	0	6	0	0	0	0	0	0	0	6	62	0.0607
105	0	0	2	1	0	0	0	0	0	0	3	69	0.0676
110	0	0	0	3	0	0	0	0	0	0	3	77	0.0754
115	0	0	0	5	0	0	0	0	0	0	5	64	0.0627
120	0	0	1	9	1	0	0	0	0	0	11	74	0.0725
125	0	0	0	8	1	0	0	0	0	0	9	44	0.0431
130	0	0	0	2	7	1	0	0	0	0	10	38	0.0372
135	0	0	0	0	5	3	1	1	0	0	10	15	0.0147
140	0	0	0	0	2	4	3	0	0	0	9	12	0.0118
145	0	0	0	0	0	1	1	0	0	0	2	1	0.0010
150	0	0	0	0	0	0	1	1	0	0	2	3	0.0029
155	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1021	1.0000

Table A.7.2004b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.556	0.444	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.455	0.545	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.636	0.364	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.100	0.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.091	0.818	0.091	0.000	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.889	0.111	0.000	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.200	0.700	0.100	0.000	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.500	0.300	0.100	0.100	0.000	0.000
140	0.000	0.000	0.000	0.000	0.222	0.444	0.333	0.000	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2004c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.09402	0.30164	0.26715	0.26568	0.04739	0.01384	0.00735	0.00294	0.00000	0.00000	1.00000
var pt 1	0.00003	0.00017	0.00052	0.00045	0.00010	0.00002	0.00001	0.00000	0.00000	0.00000	first term of equation 2
var pt ii	0.00007	0.00016	0.00014	0.00016	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	second term of equation 2

se	0.00992	0.01813	0.02562	0.02465	0.01086	0.00499	0.00298	0.00197	0.00000	0.00000	overall standard error

Table A.7.2004d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	1.35	4.34	3.85	3.83	0.68	0.20	0.11	0.04	0.00	0.00	14.4
se	0.31	0.94	0.88	0.87	0.21	0.08	0.05	0.03	0.00	0.00	–

Table A.7.2004e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.734.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.09402	0.29517	0.07114	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	1.35	4.25	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2005a. Age-length keys and number of clams by age in 2005. Total estimated clams on the beach = 16.2 M, se = 1.5 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	15	0	0	0	0	0	0	0	0	0	15	28	0.0233
25	8	2	0	0	0	0	0	0	0	0	10	86	0.0715
30	7	2	0	0	0	0	0	0	0	0	9	108	0.0898
35	7	5	0	0	0	0	0	0	0	0	12	93	0.0773
40	0	17	0	0	0	0	0	0	0	0	17	78	0.0648
45	1	9	0	0	0	0	0	0	0	0	10	59	0.0490
50	0	10	0	0	0	0	0	0	0	0	10	56	0.0466
55	0	12	0	0	0	0	0	0	0	0	12	23	0.0191
60	0	9	1	0	0	0	0	0	0	0	10	22	0.0183
65	0	7	3	0	0	0	0	0	0	0	10	32	0.0266
70	0	6	4	0	0	0	0	0	0	0	10	33	0.0274
75	0	9	2	0	0	0	0	0	0	0	11	22	0.0183
80	0	5	5	0	0	0	0	0	0	0	10	29	0.0241
85	0	3	8	0	0	0	0	0	0	0	11	35	0.0291
90	0	0	10	0	0	0	0	0	0	0	10	36	0.0299
95	0	0	8	1	1	0	0	0	0	0	10	32	0.0266
100	0	0	10	1	0	0	0	0	0	0	11	49	0.0407
105	0	0	5	3	3	0	0	0	0	0	11	37	0.0308
110	0	0	1	7	5	0	0	0	0	0	13	51	0.0424
115	0	0	0	3	5	3	0	0	0	0	11	67	0.0557
120	0	0	0	2	5	3	0	0	0	0	10	84	0.0698
125	0	0	0	0	6	3	2	0	0	0	11	57	0.0474
130	0	0	0	0	2	6	4	0	0	0	12	47	0.0391
135	0	0	0	0	0	11	5	1	0	0	17	23	0.0191
140	0	0	0	0	0	0	7	3	1	0	11	9	0.0075
145	0	0	0	0	0	0	4	5	1	0	10	6	0.0050
150	0	0	0	0	0	0	0	0	1	0	1	1	0.0008
155	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0.0000
											Total:	1203	1.0000

Table A.7.2005b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.778	0.222	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.583	0.417	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.100	0.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.818	0.182	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.273	0.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.800	0.100	0.100	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.909	0.091	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.455	0.273	0.273	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.077	0.538	0.385	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.273	0.455	0.273	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.200	0.500	0.300	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.545	0.273	0.182	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.167	0.500	0.333	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.647	0.294	0.059	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.000	0.636	0.273	0.091	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.500	0.100	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2005c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.20029	0.32759	0.16279	0.06673	0.11994	0.08096	0.03402	0.00566	0.00201	0.00000	1.00000
var pt 1	0.00038	0.00045	0.00013	0.00020	0.00032	0.00024	0.00006	0.00000	0.00000	0.00000	first term of equation 2
var pt ii	0.00009	0.00012	0.00007	0.00001	0.00003	0.00002	0.00001	0.00000	0.00000	0.00000	second term of equation 2

se	0.02170	0.02382	0.01413	0.01479	0.01866	0.01601	0.00857	0.00209	0.00119	0.00000	overall standard error

Table A.7.2005d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	3.24	5.31	2.64	1.08	1.94	1.31	0.55	0.09	0.03	0.00	16.2
se	0.46	0.62	0.33	0.26	0.35	0.29	0.15	0.03	0.02	0.00	–

Table A.7.2005e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.648.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.20029	0.32759	0.05732	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	3.24	5.31	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2006a. Age-length keys and number of clams by age in 2006. Total estimated clams on the beach = 21.1 M, se = 2.9 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	10	0	0	0	0	0	0	0	0	0	10	85	0.0568
25	11	0	0	0	0	0	0	0	0	0	11	141	0.0943
30	10	0	0	0	0	0	0	0	0	0	10	173	0.1156
35	3	8	0	0	0	0	0	0	0	0	11	158	0.1056
40	0	10	0	0	0	0	0	0	0	0	10	109	0.0729
45	2	8	0	0	0	0	0	0	0	0	10	64	0.0428
50	0	11	0	0	0	0	0	0	0	0	11	60	0.0401
55	0	11	0	0	0	0	0	0	0	0	11	28	0.0187
60	0	10	0	0	0	0	0	0	0	0	10	37	0.0247
65	0	9	0	0	0	0	0	0	0	0	9	66	0.0441
70	0	10	0	0	0	0	0	0	0	0	10	60	0.0401
75	0	8	2	0	0	0	0	0	0	0	10	47	0.0314
80	0	5	5	0	0	0	0	0	0	0	10	43	0.0287
85	0	1	9	1	0	0	0	0	0	0	11	43	0.0287
90	0	0	9	1	0	0	0	0	0	0	10	47	0.0314
95	0	0	10	0	0	0	0	0	0	0	10	29	0.0194
100	0	0	7	3	0	0	0	0	0	0	10	23	0.0154
105	0	0	8	2	1	0	0	0	0	0	11	20	0.0134
110	0	0	0	8	1	0	0	0	0	0	9	55	0.0368
115	0	0	0	8	3	0	0	0	0	0	11	50	0.0334
120	0	0	0	1	6	3	0	0	0	0	10	53	0.0354
125	0	0	0	1	4	5	0	0	0	0	10	42	0.0281
130	0	0	0	0	0	8	2	0	0	0	10	38	0.0254
135	0	0	0	0	0	7	2	1	0	0	10	19	0.0127
140	0	0	0	0	0	2	2	1	0	0	5	4	0.0027
145	0	0	0	0	0	0	2	3	0	0	5	2	0.0013
150	0	0	0	0	0	0	0	0	**1**	**0**	**1**	0	0.0000
155	0	0	0	0	0	0	0	0	**0**	**1**	**1**	0	0.0000
160	0	0	0	0	0	0	0	0	**0**	**1**	**1**	0	0.0000
											Total:	1496	1.0000

Table A.7.2006b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.273	0.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.200	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.091	0.818	0.091	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.727	0.182	0.091	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.889	0.111	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.727	0.273	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.100	0.600	0.300	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.100	0.400	0.500	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.800	0.200	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.700	0.200	0.100	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.400	0.400	0.200	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.600	0.000	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2006c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.30407	0.39380	0.11232	0.07614	0.04690	0.05495	0.00922	0.00261	0.00000	0.00000	1.00000
var pt 1	0.00023	0.00027	0.00006	0.00008	0.00009	0.00006	0.00001	0.00000	0.00000	0.00000	first term of equation 2
var pt ii	0.00012	0.00013	0.00005	0.00003	0.00001	0.00002	0.00000	0.00000	0.00000	0.00000	second term of equation 2

se	0.01880	0.02011	0.01070	0.01026	0.00987	0.00896	0.00384	0.00150	0.00000	0.00000	overall standard error

Table A.7.2006d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	6.42	8.31	2.37	1.61	0.99	1.16	0.19	0.06	0.00	0.00	21.1
se	0.97	1.22	0.40	0.31	0.25	0.25	0.08	0.03	0.00	0.00	–

Table A.7.2006e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.607.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.30407	0.39380	0.04417	0.00261	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	6.42	8.31	0.93	0.06	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2007a. Age-length keys and number of clams by age in 2007. Total estimated clams on the beach = 34.0 M, se = 6.5 M. Bolded clam numbers are assumed values.

Length class (mm)	Number of clams by age in each length class											Length distribution	
	Age in years												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	9	0	0	0	0	0	0	0	0	0	9	160	0.0670
25	10	0	0	0	0	0	0	0	0	0	10	244	0.1021
30	10	1	0	0	0	0	0	0	0	0	11	216	0.0904
35	0	10	0	0	0	0	0	0	0	0	10	199	0.0833
40	0	10	0	0	0	0	0	0	0	0	10	133	0.0557
45	0	10	0	0	0	0	0	0	0	0	10	81	0.0339
50	0	10	0	0	0	0	0	0	0	0	10	74	0.0310
55	0	9	1	0	0	0	0	0	0	0	10	55	0.0230
60	0	4	6	0	0	0	0	0	0	0	10	78	0.0326
65	0	3	7	0	0	0	0	0	0	0	10	63	0.0264
70	0	6	6	0	0	0	0	0	0	0	12	66	0.0276
75	0	7	3	0	0	0	0	0	0	0	10	47	0.0197
80	0	4	6	0	0	0	0	0	0	0	10	39	0.0163
85	0	4	5	1	0	0	0	0	0	0	10	46	0.0193
90	0	1	8	0	0	0	0	0	0	0	9	62	0.0260
95	0	1	8	2	0	0	0	0	0	0	11	62	0.0260
100	0	0	3	7	0	0	0	0	0	0	10	67	0.0280
105	0	0	2	6	1	0	0	0	0	0	9	70	0.0293
110	0	0	2	7	2	0	0	0	0	0	11	98	0.0410
115	0	0	0	2	5	2	0	0	0	0	9	105	0.0440
120	0	0	0	1	7	1	1	1	0	0	11	103	0.0431
125	0	0	0	1	2	6	1	0	0	0	10	107	0.0448
130	0	0	0	0	0	6	2	3	0	0	11	91	0.0381
135	0	0	0	0	0	0	4	4	0	0	8	61	0.0255
140	0	0	0	0	0	1	4	2	4	0	11	41	0.0172
145	0	0	0	0	0	0	3	3	4	0	10	15	0.0063
150	0	0	0	0	0	0	1	0	1	0	2	6	0.0025
155	0	0	0	0	0	0	0	0	0	**1**	1	0	0.0000
160	0	0	0	0	0	0	0	0	0	**1**	1	0	0.0000
											Total:	2389	1.0000

Table A.7.2007b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	Age in years									
	1	2	3	4	5	6	7	8	9	10
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.909	0.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.300	0.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.400	0.500	0.100	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.111	0.889	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.091	0.727	0.182	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.300	0.700	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.222	0.667	0.111	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.182	0.636	0.182	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.222	0.556	0.222	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.091	0.636	0.091	0.091	0.091	0.000	0.000
125	0.000	0.000	0.000	0.100	0.200	0.600	0.100	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.545	0.182	0.273	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.091	0.364	0.182	0.364	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.300	0.300	0.400	0.000
150	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.500	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Table A.7.2007c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.25130	0.30082	0.14382	0.09008	0.07153	0.06290	0.03747	0.03208	0.01001	0.00000	1.00000
var pt 1	0.00006	0.00016	0.00016	0.00015	0.00016	0.00013	0.00008	0.00007	0.00001	0.00000	first term of equation 2
var pt ii	0.00008	0.00007	0.00003	0.00002	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000	second term of equation 2

se	0.01171	0.01505	0.01365	0.01308	0.01299	0.01204	0.00918	0.00833	0.00309	0.00000	overall standard error

Table A.7.2007d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	8.54	10.23	4.89	3.06	2.43	2.14	1.27	1.09	0.34	0.00	34.0
se	1.68	2.02	1.04	0.73	0.64	0.57	0.39	0.35	0.12	0.00	–

Table A.7.2007e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.447.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.25130	0.29558	0.07949	0.00193	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	8.54	10.05	2.70	0.07	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.7.2008a. Age-length keys and number of clams by age in 2008. Total estimated clams on the beach = 18.2 M, se = 1.9 M. Bolded clam numbers are assumed values.

Number of clams by age in each length class												**Length distribution**	
Length class (mm)	**Age in years**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Count**	**% Freq**
20	4	2	0	0	0	0	0	0	0	0	6	49	3.90%
25	7	4	0	0	0	0	0	0	0	0	11	53	4.22%
30	6	4	0	0	0	0	0	0	0	0	10	78	6.22%
35	4	6	0	0	0	0	0	0	0	0	10	54	4.30%
40	2	7	0	0	0	0	0	0	0	0	9	65	5.18%
45	1	9	0	0	0	0	0	0	0	0	10	49	3.90%
50	0	9	1	0	0	0	0	0	0	0	10	50	3.98%
55	0	10	0	0	0	0	0	0	0	0	10	35	2.79%
60	0	10	0	0	0	0	0	0	0	0	10	44	3.51%
65	0	8	2	0	0	0	0	0	0	0	10	25	1.99%
70	0	7	5	0	0	0	0	0	0	0	12	24	1.91%
75	0	6	4	0	0	0	0	0	0	0	10	23	1.83%
80	0	0	10	0	0	0	0	0	0	0	10	23	1.83%
85	0	0	9	1	0	0	0	0	0	0	10	33	2.63%
90	0	0	7	3	0	0	0	0	0	0	10	29	2.31%
95	0	0	8	2	0	0	0	0	0	0	10	35	2.79%
100	0	0	8	2	0	0	0	0	0	0	10	47	3.75%
105	0	0	3	6	2	0	0	0	0	0	11	53	4.22%
110	0	0	0	6	4	0	0	0	0	0	10	88	7.01%
115	0	0	0	4	6	1	0	0	0	0	11	71	5.66%
120	0	0	0	1	4	1	1	0	0	0	7	83	6.61%
125	0	0	0	0	6	2	1	0	0	0	9	77	6.14%
130	0	0	0	0	0	4	1	1	0	0	6	79	6.29%
135	0	0	0	0	0	7	4	2	0	0	13	42	3.35%
140	0	0	0	0	0	1	4	4	0	0	9	30	2.39%
145	0	0	0	0	0	0	3	7	0	1	11	11	0.88%
150	0	0	0	0	0	0	1	2	2	0	5	4	0.32%
155	0	0	0	0	0	0	0	0	0	**1**	1	0	0.00%
160	0	0	0	0	0	0	0	0	1	**0**	1	0	0.00%
165	0	0	0	0	0	0	0	0	0	**1**	1	1	0.08%
170	0	0	0	0	0	0	0	0	0	**1**	1	0	0.00%
											Total:	1255	100.0%

Table A.7.2008b. Estimate of the proportion of clams in each age class for every length class.

Length class (mm)	**Age in years**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
20	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.636	0.364	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.400	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.222	0.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.100	0.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	0.000	0.583	0.417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	0.000	0.900	0.100	0.000	0.000	0.000	0.000	0.000	0.000
90	0.000	0.000	0.700	0.300	0.000	0.000	0.000	0.000	0.000	0.000
95	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.800	0.200	0.000	0.000	0.000	0.000	0.000	0.000
105	0.000	0.000	0.273	0.545	0.182	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.600	0.400	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.364	0.545	0.091	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.143	0.571	0.143	0.143	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.667	0.222	0.111	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.667	0.167	0.167	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	0.538	0.308	0.154	0.000	0.000
140	0.000	0.000	0.000	0.000	0.000	0.111	0.444	0.444	0.000	0.000
145	0.000	0.000	0.000	0.000	0.000	0.000	0.273	0.636	0.000	0.091
150	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.400	0.400	0.000
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000

Table A.7.2008c. Overall proportion and estimated standard error. SE is found using equation (2) from Kutkuhn.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Overall	0.12282	0.29136	0.14522	0.11776	0.14528	0.09087	0.05071	0.03312	0.00127	0.00080	0.99920
var pt 1	0.00030	0.00033	0.00012	0.00035	0.00046	0.00035	0.00025	0.00012	0.00000	0.00000	first term of equation 2
var pt ii	0.05157	0.13443	0.08225	0.03772	0.05719	0.03456	0.00995	0.01022	0.00051	0.00007	second term of equation 2
se	0.22773	0.36709	0.28700	0.19512	0.24010	0.18683	0.10098	0.10171	0.02256	0.00851	overall standard error

Table A.7.2008d. Estimated number of clams in each age class. Goodman's (JASA 1961) formula used to estimate standard error.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Clams (M)	2.24	5.30	2.64	2.14	2.64	1.65	0.92	0.60	0.02	0.01	18.2
se	4.13	6.67	5.20	3.54	4.35	3.39	1.83	1.84	0.41	0.15	–

Table A.7.2008e. Proportion and estimated number of clams between 20 and 90 mm. Proportion of Age 3 clams recruited = 0.551.

	Age in years										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Check**
Prop.	0.12282	0.29136	0.06526	0.00263	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	–
Clams (M)	2.24	5.30	1.19	0.05	0.00	0.00	0.00	0.00	0.00	0.00	–

Table A.8. Trends in Razor Clam biomass (t) by year and age 1994–2008.

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
All Clams															
1	2.3	1.1	1.1	2.6	1.5	3.1	1.0	0.8	2.7	0.3	1.7	1.7	12.2	6.2	4.0
2	63.2	47.0	30.1	37.3	19.9	53.7	67.2	72.5	35.3	33.5	70.5	28.8	107.7	68.4	43.7
3	168.3	91.2	142.2	72.0	87.4	180.4	145.5	249.8	128.9	67.9	223.0	125.9	144.2	144.1	119.5
4	171.4	156.0	147.3	146.3	133.1	338.5	102.4	139.2	209.9	90.1	425.0	101.4	186.5	198.6	175.9
5	113.5	160.5	180.7	100.4	181.7	289.0	236.8	86.3	83.4	95.5	105.3	218.9	147.1	211.2	279.9
6	65.3	126.1	144.0	146.1	114.1	230.9	464.7	132.9	160.3	105.3	35.2	193.7	217.9	229.4	228.7
7	39.2	36.6	15.8	40.2	68.3	122.5	328.7	156.0	164.7	106.5	20.9	119.6	42.0	165.8	135.5
8	29.4	18.4	0.0	10.4	22.1	35.9	286.6	297.7	192.1	58.1	8.3	29.2	13.5	141.5	99.2
9	18.1	7.0	0.0	4.8	3.8	0.0	103.8	167.8	70.4	49.4	0.0	14.7	0.0	51.8	4.4
10	2.2	3.0	4.9	0.0	0.0	0.0	116.2	91.1	33.3	13.5	0.0	0.0	0.0	0.0	2.8
Total	673.0	647.0	666.0	560.0	632.0	1254.0	1853.0	1394.0	1081.0	620.0	890.0	834.0	871.0	1217.0	1093.6
Clams 20–90 mm															
1	2.3	1.1	1.1	2.6	1.5	3.1	1.0	0.8	2.7	0.3	1.7	1.7	12.2	6.2	4.0
2	57.5	43.8	30.1	37.3	19.9	33.9	67.2	72.5	35.3	33.5	65.8	28.8	107.7	61.4	43.7
3	12.3	47.9	33.2	13.5	25.9	15.8	21.8	77.6	41.0	21.7	33.5	21.6	40.6	42.7	35.2
4	0.0	7.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.0	1.7
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	72.2	99.8	68.7	53.4	47.4	52.8	90.0	150.9	79.0	55.5	101.1	52.2	163.2	112.3	84.6
Clams 90+ mm (calculated from the above two sections)															
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5.7	3.2	0.0	0.0	0.0	19.8	0.0	0.0	0.0	0.0	4.7	0.0	0.0	7.0	0.0
3	156.0	43.3	109.0	58.5	61.5	164.6	123.7	172.1	87.9	46.2	189.5	104.2	103.6	101.4	84.3
4	171.4	149.0	143.0	146.3	133.1	338.5	102.4	139.2	209.9	90.1	425.0	101.4	183.8	196.7	174.2
5	113.5	160.5	180.7	100.4	181.7	289.0	236.8	86.3	83.4	95.5	105.3	218.9	147.1	211.2	279.9
6	65.3	126.1	144.0	146.1	114.1	230.9	464.7	132.9	160.3	105.3	35.2	193.7	217.9	229.4	228.7
7	39.2	36.6	15.8	40.2	68.3	122.5	328.7	156.0	164.7	106.5	20.9	119.6	42.0	165.8	135.5
8	29.4	18.4	0.0	10.4	22.1	35.9	286.6	297.7	192.1	58.1	8.3	29.2	13.5	141.5	99.2
9	18.1	7.0	0.0	4.8	3.8	0.0	103.8	167.8	70.4	49.4	0.0	14.7	0.0	51.8	4.4
10	2.2	3.0	4.9	0.0	0.0	0.0	116.2	91.1	33.3	13.5	0.0	0.0	0.0	0.0	2.8
Total	600.8	547.2	597.3	506.6	584.6	1201.2	1763.0	1243.1	1002.0	564.5	788.9	781.8	707.8	1104.7	1009.0