1-1-1998

Bay Scallop Culture

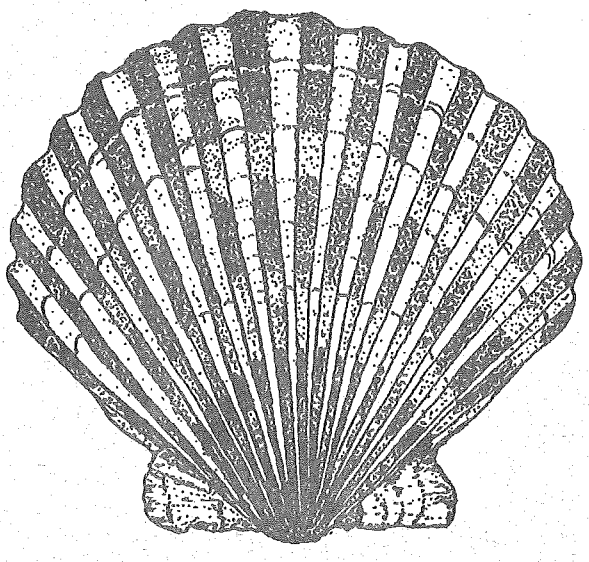
Michael J. Oesterling
Virginia Institute of Marine Science

BAY SCALLOP CULTURE

By

Michael J. Oesterling

VIRGINIA SEA GRANT MARINE ADVISORY PROGRAM
VIRGINIA INSTITUTE OF MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY
GLOUCESTER POINT, VIRGINIA



This document was published by
Virginia Sea Grant Marine Advisory Program
Virginia Institute of Marine Science
School of Marine Science
College of William & Mary
Gloucester Point, Virginia 23602

Virginia Sea Grant Marine Resource Advisory No. 67
VSG-97-10

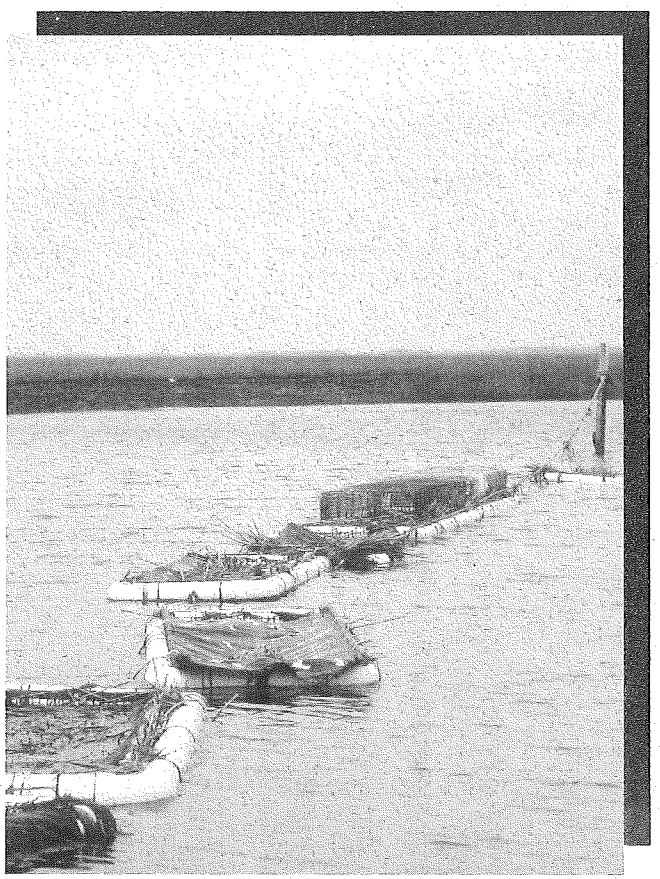
January 1998

Editor: Susan Waters
Design: Diana D. Taylor
Production Assistant and Design: John E. Olney, Jr.

This work is a result of research sponsored by NOAA Office of Sea Grant, U.S. Department of Commerce under Federal Grant No. NA56RG0141 to the Virginia Graduate Marine Science Consortium and the Virginia Sea Grant College Program. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that many appear hereon.

Introduction

In the mid-1960s the bay scallop, *Argopecten irradians*, was identified by scientists at the Virginia Institute of Marine Science (VIMS) as having culture potential for Virginia waters. Mike Castagna at the VIMS Wachapreague Laboratory demonstrated the biological feasibility of culturing bay scallops from egg to market size within a one year period. At that time, culture for scallop meat production was not economically favorable and the need for better grow-out technology precluded further development of this industry in Virginia. With the change in marketing towards a whole, in-the-shell product and improved or alternative grow-out technology, bay scallop culture activities were resurrected in Virginia in 1990. The following publication is a compilation of the information gained in all the VIMS bay scallop culture activities over the past 30 years.



For successful bay scallop culture, five things are needed:

- availability of seed;
- a growing area;
- grow-out technology;
- a market;
- and, learned skills and dedicated growers (usually referred to as moving up the learning curve).

Each of these items has its own set of considerations for success. In site selection, both biological and sociological factors must be considered. Seed can either be purchased or produced in one's own hatchery. There are several choices for grow-out depending upon specific situations. Marketing is as important as the actually growing and must be carefully investigated. And, only time and hard-work will move you up the learning curve!

Biological Considerations

Bay scallops are "upper end" salinity animals, but do tolerate mid-range salinities as adults. Because of their inability to completely close their shells, bay scallops do not tolerate low salinities or freshwater for more than very short exposures. Bay scallop larval development is best above 25 parts per thousand (ppt) salinity. The growth of juvenile bay scallops slows as salinity decreases below 20 ppt.

Bay scallops tolerate a wide range of water temperatures. For eggs/larvae, best survival and growth occurs above 20° C (68° F), with optimal development around 26° C (79° F). Bay scallops have been observed to continue to grow even when water temperatures declined to 7° C (45° F); below this temperature, growth stopped. As water temperatures approach 30° C (86° F), juvenile growth rates decrease dramatically.

Bay scallops are filter-feeders and can filter large volumes of water; average pumping rate for scallops approximately 40-mm (1.6 inches) in shell height is 3.26 liters per hour (0.86 gallons per hour, or almost 21 gallons per day). Areas with good water exchange will be required for culture and good growth. However, water current velocity must not be so excessive that scallops are moved around within culture gear. There is some evidence that bay scallops actually reduce their feeding or show no growth in water currents exceeding 12.4 cm/sec (0.4 ft/sec). Phytoplankton removal (feeding) is most efficient at slower current speeds. Besides the impact on feeding, high water currents can cause physical damage to bay scallops.

Bay scallops are hermaphroditic, possessing both male and female reproductive organs. At any spawning event, one or both portions of the gonad can produce gametes (eggs or sperm). Normally, the bay scallop releases sperm first, rests a short time, then releases eggs. In nature, self-fertilization most likely does not occur; however, this has been accomplished in the laboratory. Natural gametogenesis, or ripening, is initiated at water temperatures between 10 and 15° C (50 to 59° F), depending upon food availability. For Virginia, the beginning of natural spawning is towards the end of April. Bay scallops can mature within the first year of life.

Egg Production and Larval Culture

Hatchery spawning of bay scallops can be induced using standard bivalve culture methods of water temperature manipulation and the use of sperm infusions. When ambient water temperatures approach 16° C (61° F), visual inspection of gonads will signal whether or not spawning can be induced. The female portion of the gonad should be orange; the male portion should be creamy white. Once gonads are ripe, water temperature increases of 10° C (18° F) can initiate spawning. Sperm infusions can help the process if spawning is slow.

At the VIMS Wachapreague Laboratory, bay scallops are spawned in static water troughs, with eggs collected periodically. To illustrate potential egg production and thus be able to calculate the number of spawners necessary to achieve a desired production level, Table 1 documents bay scallop egg production at Wachapreague for 1991 to 1994.

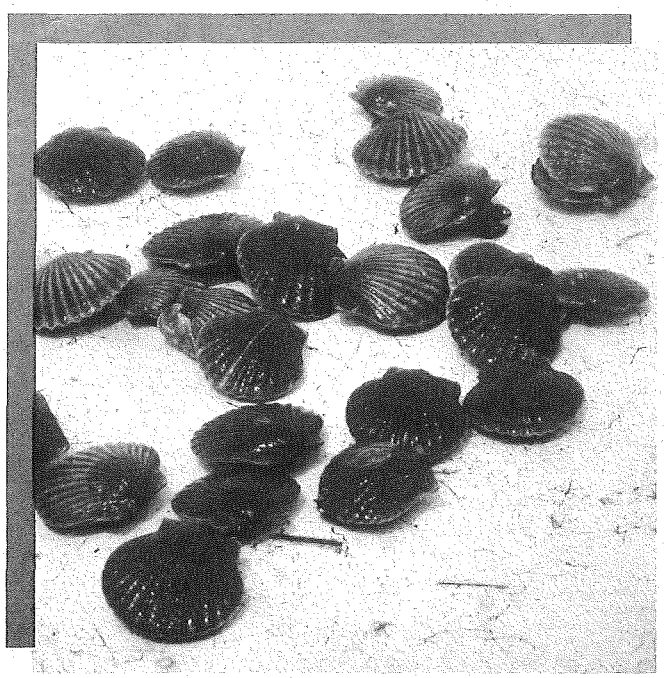
Spawned eggs are collected on a 25-micron screen and washed through a 153-micron screen to remove debris. At the Wachapreague Laboratory, only about 50% of all eggs produced hatch into viable larvae.

Bay scallop spawning at Wachapreague has always relied upon naturally conditioned animals. Conditioning for out of season spawning has been reported in the literature as feasible.

Larval culture is conducted in static water, conical bottom tanks, with gentle aeration to help keep larvae suspended in the water column. Water is exchanged every other day. In the past, different feeding strategies have been used. Naturally bloomed phytoplankton water, referred to as "brown water," has been used at the time of water exchanges to provide larval food. Additionally, algal paste from the VIMS Gloucester Point hatchery has been used to augment the feeding of the larvae. Commercial shellfish hatcheries have used cultured unicellular algae to successfully raise larval bay scallops. Prior to metamorphosis (setting), larval culture of bay scallops is essentially the same as for hard clams and oysters. Larval bay scallops will be ready to set after 10 to 14 days.

Table 1

Year	Date	# Of Spawners	Total Eggs	Eggs/Spawned
1991	16 Apr	184	128,955,000	700,842
1992	28 Apr	202	211,275,000	1,045,916
1993A	27 Apr	150	111,690,000	744,600
1993B	11 May	90	55,850,000	620,555
1994	25 Apr	158	110,760,000	710,013
	Average	**157**	**123,706,000**	**764,360**



Average sizes for different larval stages:
Eggs - 60-microns
Trochophore - 101-microns
Veliger - 122-microns
Pediveliger, ready to set - 190-microns

Nursery and Juvenile Production

At setting, bay scallop culture begins to differentiate from hard clam and oyster culture. Bay scallops attach to a substrate by means of a byssal thread. The byssal thread is capable of detaching and reattaching many times, unlike oysters. Several different methods have been used to set bay scallops. At the Wachapreague Laboratory, for many years, troughs with vertical, plastic inserts have been used for bay scallop setting. The inserts increase the surface area available for the scallops to attach. Following settlement, the troughs are supplied with flowing seawater filtered through a 50-micron bag filter for food delivery and waste removal. Bay scallops have also been set in large tanks into which bags of mesh netting have been hung. The mesh netting serves as the substrate for attachment. While both of these methods work, they both have drawbacks. The trough system can experience siltation problems and is still space limited; the mesh bag system is labor intensive and requires more handling of the animals. Commercial bay scallop hatcheries have set animals directly into downwellers with good success. Setting in downwellers is the most practical method. Once set, and without augmented feeding, growth to the 1-mm size takes about 1 month.

Juvenile bay scallops grow quickly! The sooner they can be put into the natural environment the better. In downwellers, small animals can quickly outgrow the confines of the downweller, covering the sides and bottom of the cylinder. In one case, mean shell height went from 3.2-mm to 6.4-mm in 13 days. Following a period in downwellers, juvenile bay scallops can be moved to upwellers, where growth can be equally impressive. Because the bay scallop can detach and reattach its byssal thread, upweller overflows must be screened; if not, the scallops will escape out the overflow. Upweller growth has been as high as 3-mm per week. Pearl nets suspended in the water column have also been used for early growth. Pearl net mesh sizes used were 1-, 3-, and 6-mm. Equally impressive growth can be achieved with pearl nets; however, obtaining proper permits for water column use may be problematic and handling is increased. At shell heights of 8- to 12-mm, bay scallops are large enough for stocking into final grow-out gear.

Prior to seed stocking size, high mortalities can occur during all stages. However, once bay scallops exceed 8-mm, mortalities should be minimal.

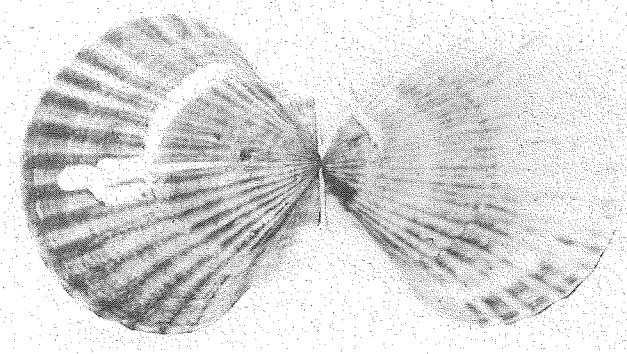
Field Grow-Out

Several methods have been used for final grow-out. Some of the more successful include ADPI-type plastic mesh cages on racks held off-bottom, ADPI cages in surface floats ("Taylor" oyster floats), plastic mesh cages suspended from barges, and lantern nets (25-mm stretch mesh) in suspended culture. They all work; they all have drawbacks. The lantern nets are relatively expensive, require "deeper" water, and will have permitting problems. The plastic mesh cages foul and need to be cleaned regularly or changed, necessitating additional gear. However, of all the methods, the ADPI options are the best for right now. Whatever method is employed, the bay scallops should be held off-bottom.

Stocking density for final grow-out should be between 50 and 100 animals per square foot of bottom surface in the gear (even though the scallops may utilize sides and tops). Stocking densities around 70 per square foot appear to be the best utilization of space. For ADPI cages, animal counts of 300 represent a stocking density of 66 per square foot.

If 8 mm to 12 mm seed bay scallops are stocked by mid- or late-July, whole, in-the-shell market-sized animals can be obtained in 3 to 4 months (October to November). This will permit harvest prior to winter and no need to overwinter small animals. If overwintering is necessary, expect increased mortalities.

The best culture time-line for bay scallops in Virginia would be:
- *spawn the end of April
- *set by the second week of May
- *1-mm animals by mid-June
- *field planting size (~8-mm) by mid-July
- *market size (>40-mm)by October or November.



Market Considerations

Cultured bay scallops have been promoted as a whole, in-the-shell product and not as a shucked meat product. Prices for imported shucked bay scallops are so low as to make competition with them in the market place impractical. However, white table cloth restaurants where presentation and preparation are emphasized should be targeted as the primary final user for whole bay scallops. Part of the 1990s bay scallop project at VIMS was to assess restaurant acceptability for whole bay scallops. To this end, upscale restaurants in the Norfolk-Williamsburg region were supplied whole bay scallops. The chefs were encouraged to be creative and serve the bay scallops whole. Patrons that ordered the dishes were then asked to respond to several questions designed to indicate future marketability for whole bay scallops. The chefs themselves were also questioned. Patron responses were overwhelmingly favorable towards the product, in some cases even indicating a willingness to pay more for the dishes. The chefs' impressions of the bay scallops were generally favorable, indicating that the animals were easy to work with and very adaptable to recipes.

In the past, a minimum market size of 40-mm shell height (1.6 inches; measured from hinge to bill) has been acceptable for whole, in-the-shell animals. However, animals between 45- and 55-mm (1.8 to 2.2 inches) have a much better "eye appeal." Animals over 60-mm (2.4 inches) can have a bitter taste due to the large digestive gland and should not be marketed as a whole product. Prices received by the grower for whole bay scallops have ranged from $0.15 to $0.25 per animal.

A major concern when marketing whole bay scallops is their shelf life. Because of their inability to completely close their shells like hard clams and oysters, whole bay scallop shelf life is much shorter than for clams or oysters. For live storage, under standard refrigeration, shelf life is only 3 to 5 days. In refrigerated storage, live bay scallops should always have a moist covering and be kept out of direct air flow to prevent drying.

Some attempts have been made to IQF (individually quick freeze) bay scallops in the shell and market them frozen. The IQF process is very acceptable and produces an attractive product when a water glaze is applied. Marketing attempts have not been very successful with this product, perhaps due to the lack of effort or product necessary for large-scale distribution.

Regardless of the condition, bay scallops can not be sold the same way hard clams or oysters are marketed. **They must be marketed carefully to ensure a quality product.**