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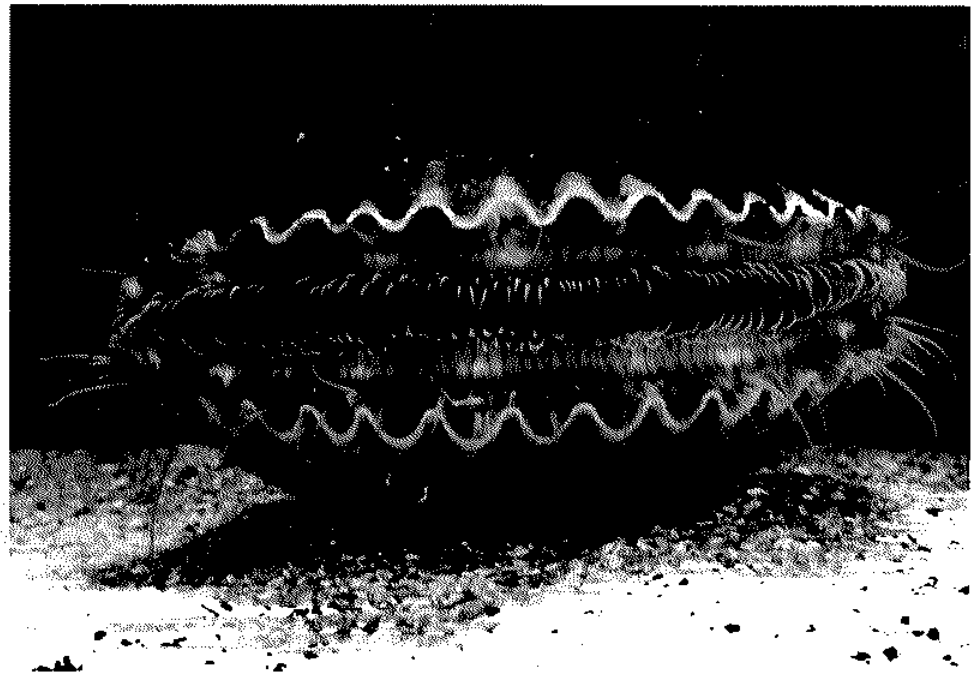

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Marketing Analysis

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and

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INTRODUCTION

Scallops have a high market value and are considered a delicacy in many parts of the world where either the entire meat is consumed or only the large adductor muscle is consumed. Over 35 species of scallops are harvested worldwide but wild stocks in many areas have declined either because of over-fishing or because of natural or man-induced environmental changes. One species, the American bay scallop (*Argopecten irradians*) is a commercially important species along the east coast of the United States but commercial fishing of wild stocks of the bay scallops is presently almost non-existent with harvests in New York alone declining from 500,300 lbs. of meats in 1982 to only 300 lbs. in 1988 (Wenczel, et al., 1992). The Florida Marine Fisheries Commission has banned the commercial harvest of the species from wild stocks in Florida and no previous attempts have been made to examine the aquaculture potential of the species in Florida.

Commercial aquaculture ventures have been started in the United States in Virginia, New York, and Massachusetts but until recently economic success with the species has been less apparent because the shucked adductor muscle meats of domestically grown scallops can't economically compete with the imported American bay scallop meats from China. However, in the past five years, a market has been created in the northeastern United States and Virginia (Oesterling and DuPaul, 1994) for the whole, unshucked product like clams and oysters. This new product is marketed at a premium price as a specialty item and local demand has exceeded production, making the economics of domestic aquaculture feasible (Oesterling and DuPaul, 1994).

The overall goal of this study was to develop a new fishery resource product through open-water aquaculture for the west coast of Florida that would compete as a non-traditional product through market development. Specific objectives were as follows:

1. To grow a minimum of 50, 000 juvenile scallops to a minimum market size of 40 mm in a cage and float system in the off-shore waters of Crystal River, Florida.
2. To determine the growth rate, survival, and time to market size for the individuals in this system and area to other similar projects like Virginia.
3. To introduce local fishermen and the aquaculture students at Crystal River High School to the hatchery, nursery, and grow-out techniques.
4. To determine the economic and financial characteristics of bay scallop culture in Florida and assess the sensitivity of projected costs and earnings to changes in key technical, managerial, and market related parameters.
5. To determine the market acceptability and necessary marketing strategy for whole bay scallop product in Florida.

BACKGROUND

Distribution of the Species

The bay scallop, *Argopecten irradians* (Lamarck), occurs in the shallow estuarine habitats along the east coast of the United states from Cape Cod, Massachusetts to Texas (Clarke, 1965). Three subspecies have been described based upon shell morphometrics (Waller, 1969). The northern subspecies, *Argopecten irradians irradians*, extends from Cape Cod to approximately New Jersey and Maryland where it may hybridize with the southern bay scallop, *Argopecten irradians concentricus* (Clarke, 1965). Harvestable populations of the southern bay scallop become discontinuous beginning about North Carolina. It is absent along the Georgia coast (Walker et al., 1991) and from the East Coast of Florida (unpub data). It reappears on the southwest coast of Florida where it again continues north

along the West Coast. Although not common, the southern subspecies reportedly is found as far west as Louisiana (Waller, 1969; Broom, 1976). The third subspecies, *Argopecten irradians amplicostatus*, occurs from Galveston to Laguna Madre, Texas (Waller, 1969). The degree to which these subspecies are physiologically different is not well understood (Bricelj et al., 1987) but Blake, et al. (1995) have shown that there are significant genetic differences..

Life History of the Florida Bay Scallop

Bay scallops are functional hermaphrodites which reproduce essentially once during their 12-24 month life span. Spawning is largely catastrophic, although the northern populations are more synchronous than the Florida subspecies (Barber and Blake, 1991). On the West Coast of Florida spawning begins in early August in the north (Sastry, 1961) and October in the south (Barber and Blake, 1983).

The planktonic larval stage of the Florida subspecies lasts 12-14 days (Sastry, 1965), and it is during this planktonic stage that the larval distribution and eventual recruitment may be controlled by the hydrodynamics of the estuary (Eckman, 1987). As the larvae metamorphose, the prodissoconchs (190 um) typically attach to blades of *Thalassia*. Growth during the winter is slow but by April scallops of 20-25 mm can be seen on the seagrass (Barber and Blake, 1983). By May scallops become unattached and settle to the bottom at which time growth becomes rapid. Scallops of 40-50 mm occur in July and may reach 60 mm by December (approximately 15 months of age). Growth is continuous in the Florida subspecies even at 33 °C , only 2°C below the upper lethal temperature of the adults (Sastry, 1961). Natural mortality after 12 months of age is high due to senescence, and only a few survive into the winter months of their second year.

The reproductive cycle of the species is well-understood (Sastry, 1963, 1966, 1968; Blake and Sastry, 1979; Barber and Blake, 1981, 1983, 1985). A complex relationship exists between a successful reproductive cycle and environmental factors, mainly food and temperature. A minimum threshold temperature and an abundance of food are required to initiate gametogenesis during the spring of the year. Cytoplasmic growth of oocytes in the Florida subspecies near Tampa Bay begins in June and July and requires continuation of adequate food and a water temperature of approximately 28°C (Barber and Blake, 1983). Spawning in the fall usually occurs with a rapid drop in water temperatures, although any environmental shock may trigger spawning. If water temperature and food supply are inadequate early in the reproductive cycle, then oocytes either stop developing and are resorbed or the mature ova become necrotic and any spawning event produces a large amount of non-viable ova. The latter may occur even though the gonadal tissue of the scallop may appear "ripe" macroscopically (Blake and Sastry, 1979).

Aquaculture of *Argopecten irradians*

The high market value of bay scallops combined with rapid growth and short life span of the species has led to the development and refinement of hatchery, nursery, and grow-out techniques (Castagna and Duggan, 1971; Castagna, 1975; Rhodes and Widman, 1980; Mann and Taylor, 1981; Karney, 1991; Oesterling and DuPaul, 1994; Lu and Blake, 1996). Using the information about the natural reproductive cycle investigators have used either artificial conditioning and various stimuli to spawn adults for larval production in a hatchery or relied upon the harvest of reproductively mature adults from the natural environment for spawning stock.

Embryonic and larval stages of marine invertebrates are often the most sensitive to the environmental conditions and extreme mortality of the embryos and larvae if a strict environment is not maintained in a hatchery. Temperature, salinity, and food supply appear to be the most important environmental variables regulating the growth and reproduction of the adults as well as the survival and

growth of the embryos and larvae. Tettelbach and Rhodes (1981) extensively studied the combined effects of temperature and salinity on the development of embryos and survival and growth of the larvae of the northern bay scallop, *A. irradians irradians*. Only embryos cultured at 20°C-25°/oo and 25°C-25°/oo showed a greater than 70% normal development. At salinities greater than or lesser than 25°/oo, normal development declined markedly. Larval survival of this northern subspecies for 2-5 days after fertilization occurred over a much wider temperature-salinity range with the optimal combination being 18.7°C and 28.1°/oo. Maximal larval survival at time of settlement occurred at 20°C-25°/oo. Lu (1996) has shown that this same temperature and salinity combination is optimum for the Florida bay scallop larvae and juveniles and that maximum growth of Florida bay scallop larvae and juveniles occurs when a food supply of *Isochrysis galbana* is maintained at a density of 10-20 cells per ml of culture.

A number of different techniques have been used in hatcheries to maintain larvae and early juveniles. These techniques have included static, aerated water tanks (Castagna and Duggan, 1971; Castagna, 1975; Karney, 1991; Oesterling and DuPaul, 1994; Lu and Blake, 1996) for early larval development. Sieves suspended in down-flowing aerated conicals (Karney, 1991), raceways or troughs fitted with inserts (Oesterling and DuPaul, 1994), and plastic strips suspended in aerated tanks (Lu and Blake, 1996) have been used for pediveliger and post-set animals. Flow-through upwelling systems (Oesterling and DuPaul, 1994) and nylon-meshed bags suspended in the natural environment (Lu and Blake, 1996) are two of the more commonly employed techniques for the nursery of early juveniles from 1-8 mm.

For grow-out, Castagna and Duggan (1971) used large pens in order to demonstrate that a market-sized scallop could be attained in 5-7 months. Early releases of juvenile scallops into the natural environment for commercial harvest proved unsuccessful due to heavy predation (Morgan, et al., 1980). Rhodes and Widman (1980,1984) utilized Japanese pearl nets and lantern nets to determine the optimum scallop density for maximum growth in Long Island Sound. Oesterling and DuPaul (1994) used polyethylene trays or plastic mesh cages placed directly on the bottom, placed on cinder blocks, or suspended in the water column on a rack system to demonstrate an optimum density of about 500-800 scallops per square meter for attaining a market-size scallop of 40mm in 7 months. More recently Oesterling (pers. com.) has employed a floating pen system to suspend the plastic cages in the water column.

Heavy mortalities can occur at all three points in the aquaculture process. Pathogens associated with scallop diseases have been reviewed by Leibovitz, et al.(1984). Pathogenic *Pseudomonas* can bloom on the solid surfaces of culture vessels and kill larvae or early juveniles but can be minimized with regular cleaning and water changes (Karney, 1991). In the nursery and grow-out stages fouling of the nets or cages can reduce flow rates which leads to reduced growth and increased mortality but this can also be minimized with frequent cleaning (Karney, 1991). In the final stages of grow-out, especially during the summer, mortality can occur for unknown reasons (Oesterling, pers. com.; Lu and Blake, 1996) although fouling of the shells by tunicates, barnacles and oysters may be one of the primary causes but frequent cleaning of the shells to decrease the degree of fouling may also lead to mortality.

The best success with the aquaculture of the species has been in China where in 1982, 26 individuals of *Argopecten irradians irradians* transplanted from the United states were spawned successfully (Fusui Zhang, Pers. Comm.). Using techniques largely developed in the U.S., the annual bay scallop production in China steadily increased to over 50,000 tons live weight in 1988. The shucked muscles are imported into the U.S. at $2.00/lb (Zhang, 1995). This success can be partially attributed to the low cost of abundant labor as well as to the legal utilization of the total marine habitat.

Methods

Collection and Maintenance of Spawning Stock

Juvenile scallops (150,000) measuring 17-20 mm in shell height were provided for growout in June 1997 and June 1998 by the scallop hatchery at the University of South Florida. The hatchery used the following protocol to produce these juveniles.

Adult scallops nearing reproductive maturity in late summer, 1996 and 1997 were collected from the wild population of the Florida subspecies in the vicinity of Crystal River, Florida. These scallops were maintained in the seawater system at the University of South Florida at a salinity of 24-30 °/oo and a temperature of 28-30°C. Their daily diet was supplemented with 200 ml of *Isochrysis galbana* per individual until they were brought to reproductive maturity. Algal cultures contained 1-4 million cells per ml (Castagna and Manzi, 1989). Scallops were allowed to spawn naturally on a seawater table containing 25 °/oo water at 20-23 °C. Approximately 3 million fertilized eggs were placed in a 500 liter fiberglass tank containing filtered, that had been sterilized by UV. The seawater was maintained at 25°C and 25°/oo
.

The embryos were allowed to develop unfed for 48 hr, by which time most D-shaped larvae developed. After 48 hours the D-shaped larvae were fed the unicellular algae *Isochrysis galbana* (10^6 cells/ml) at a rate of 30000 cells per ml of larval culture per day after each water change over a 6-8 hr period. The seawater was changed in the amount of 2/3 of the total volume per day. Development in the hatchery of the Florida subspecies to the pediveliger averages 8-10 days (Lu and Blake, 1996).

After 8 days, pieces of black plastic ribbon were suspended in the tanks as a substrate for settlement after 10-14 days. The settled spat were maintained as above for an additional 30 days at which time they were brushed off the black ribbon into 200 micron mesh nylon bags. Each bag contained between 10 and 15 thousand spat. The bags were suspended from the dock at the University of South Florida.

Fifty scallops from one of the bags were periodically measured for shell height to the nearest 0.1 mm. When the scallops exceeded 2 mm, an estimate was made of mortality by removing empty shells that were not attached to the sides of the bag.

In 1997 when the scallops reached 17-20 mm, they were transferred to Crystal River and some of the scallop were placed in 12 mm off-bottom-cages on racks. The bottom rack system was constructed of 0.5 in reinforcing bar and anchored to the bottom. The racks extended approximately 1.0 m off the bottom and each rack held 9 cages. A total of three racks were used although 2 of the racks were lost to shrimp trawlers in 1997. Other scallops were placed directly on the bottom in 12 mm plastic mesh cages. When they exceeded 25 mm, some of the scallops were transferred to 14 gauge plastic coated wire cages of either 0.5 inch mesh or 1 inch mesh at a density of 200-600 per m^2.

In April 1998 an aluminum raft-pen system was constructed by the Withlacoochee Technical Institute (Plate 1). The raft measures about 8 meters by 8 meters and the extruded aluminum pen extends one meter below the surface. The raft is permanently moored on 6 pilings in 5 meters of water 5 miles off Crystal River (Figure 1) on a 2 acre educational lease awarded by the Florida Department of Environmental Protection to Citrus County, Florida. Plastic coated wire mesh cages (13 mm) containing 300 scallops per m^2 were placed inside the pen. The pen will hold approximately 60 thousand caged scallops through growout. Fifty scallops from a selected cage were periodically measured for shell height

to the nearest 0.1 mm, the number of empty shells were counted, and the degree (low, moderate, heavy) of shell fouling was determined.

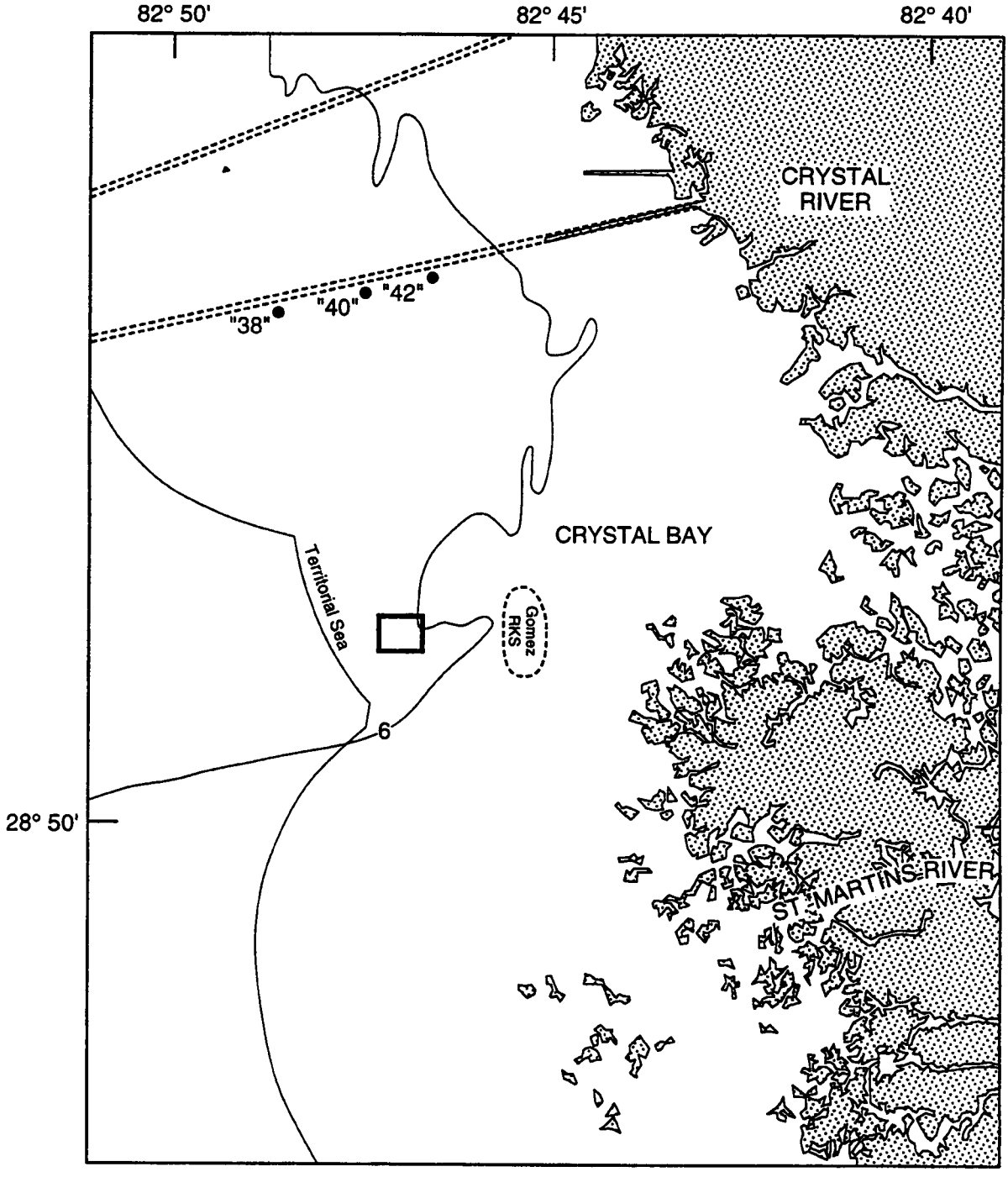

Figure 1. Location of 2 acre lease

Plate 1. Raft-Pen system for scallop aquaculture

Marketing

When the scallops reached commercial size in September and October, they were harvested and processed (cleaned, packaged, and refrigerated) at the Shrimp Landing of Crystal River. This product was then used as part of the marketing study in Florida (Attachment I). Determination of market acceptability and development of appropriate marketing strategies for whole bay scallops was achieved through a trade survey, a restaurant sales test, and consumer evaluations of several product forms. Because whole bay scallops are currently marketed in the Hampton Roads area of Virginia through upscale restaurants, managers and chefs of these outlets were identified and interviewed by telephone. These interviews were structured to provide a better understanding of marketing strategies used to establish bay scallops as a successful menu item. Particular emphasis was placed on product forms served, pricing strategy, and educational and promotional activities used.

A second marketing research element was a restaurant sales test. Scallops produced in meeting objectives 1-3 of this proposal were made available to four upscale, white tablecloth restaurants within the Crystal River marketing region. Restaurants received the scallops at no charge in exchange for their participation in the study. Managers and chefs were provided with cooking information, serving suggestions and marketing suggestions related to serving sizes, price, and menu information. Investigators provided on-site training to managers, chefs, and their wait staffs prior to the product introduction.

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Consumer product evaluations were obtained from restaurant patrons buying whole bay scallops. Restaurant patrons were asked by wait staff to complete a brief questionnaire which obtained product evaluations and repurchase intentions. Socio-demographic data was obtained from each participant. Data from the consumer product evaluations were analyzed using several statistical techniques as appropriate, including tabular analysis (contingency tables, Chi-square analyses) and logit analysis. The marketing portion of the report is described in detail in Attachment I.

Economic Evaluation

The various inputs utilized in the experimental culture process were monitored carefully. Data describing operating inputs such as seed, labor, utilities, and repairs to nets, racks and floating pens was collected. Initial capital equipment and replacement requirements were estimated. Given that a typical commercial operation in Florida does not exist, a cost engineering approach was utilized. This technique is commonly applied to such analyses when a typical production does not exist. This method allowed the estimation of costs and earnings for a hypothetical bay scallop culture operation in Florida. Profitability, cost per scallop, and break-even levels of production was determined. Selected technical, management and market parameters were then varied across reasonable ranges to determine how sensitive profits are to these changes.

The findings are presented in the form of a set of pro-forma financial statements. Typical financial statements were produced, such as cash flow, income, balance, and enterprise budgets. In addition, a capital investment and replacement schedule was constructed for each phase of the culture process. The economic evaluation is described in Attachment II.

RESULTS AND DISCUSSION

Growth and Mortality of Caged Scallops

Adult scallops from the Crystal River population were used for spawning for both years in the shellfish hatchery at the University of South Florida on Bayboro Harbor in St. Petersburg. In 1996, a total of 40,000 juvenile scallops were produced in the hatchery and nursery for grow-out in Crystal River in 1997. In 1997 another 30,000 were produced. Growth rates for these two years from the time they were placed in the nursery in October-November to June were very similar as shown in Table 1. By June of both years the juvenile scallops had reached a mean shell height of 17-18 mm (Figure 2) with an overall growth rate of about 2.1 mm/month.

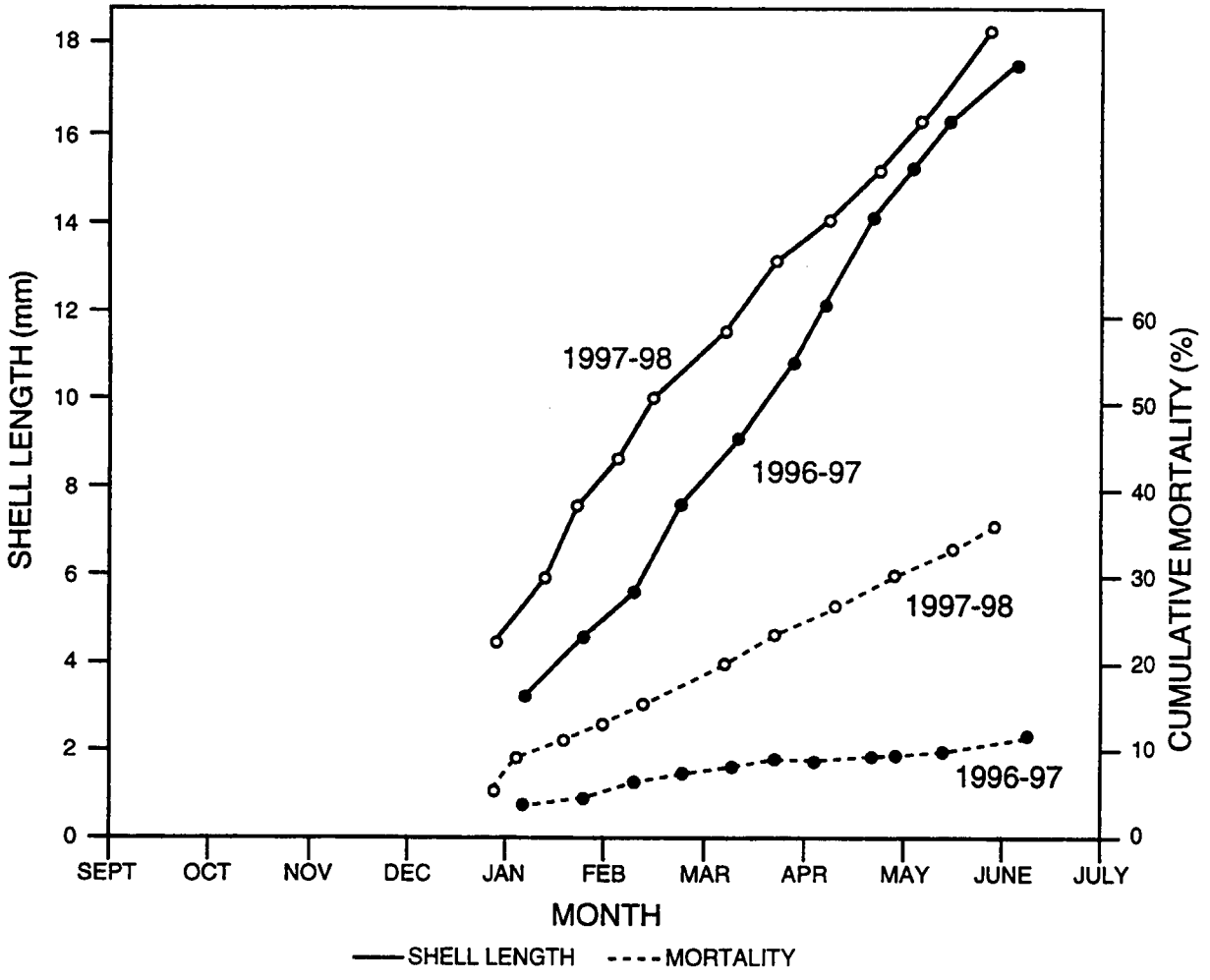

Figure 2. Growth and mortality of scallops in the nursery of Bayboro Harbor

In 1996-1997 cumulative mortality (Table 1) for nursery scallops in Bayboro Harbor was 10.3 % by June but in 1997-1998 cumulative mortality for the same time period was 34.7% (Table 2). Record rainfall occurred on the west coast of Florida during the fall and winter of 1997-1998 and salinities in Bayboro Harbor were under 10 ppt during much of the period. Scallops normally can not tolerate salinities below 20 ppt for extended periods and the low salinities were a contributing factor in the high mortality.

In 1997 bay scallops placed off Crystal River (Table 3) grew from a mean of 22.4 mm in June to a mean of 40.0 mm by October 30 (Figure 3) with an additional cumulative mortality of 40.0 %. In 1998 (Table 4) a similar growth was observed during the same time period (Figure 3) while the mortality was reduced to 22.5 %.

TABLE 1. Growth and mortality of juvenile bay scallops in Bayboro Harbor Nursery in 1996-1997.

DATE	NUMBER MEASURED	MEAN SHELL HEIGHT IN MM ± SE	CUMULATIVE PERCENT MORTALITY
10/12/96	50	0.3 ± .11	------
11/10/96	50	0.9 ± .12	------
12/08/96	50	1.8 ± .14	------
1/05/97	50	3.1 ± .14	2.7
1/28/97	50	4.2 ± .16	3.3
2/08/97	50	5.5 ± .17	4.3
2/25/97	50	7.4 ± .19	4.7
3/10/97	50	8.3 ± .19	5.3
3/18/97	50	10.2 ± .20	6.0
4/05/97	50	11.5 ± .22	6.3
4/25/97	50	13.6 ± .24	7.0
4/30/97	50	14.7 ± .28	8.3
5/14/97	50	15.8 ± .35	9.0
6/07/97	50	16.9 ± .40	10.3

TABLE 2. Growth and mortality of juvenile bay scallops in Bayboro Harbor Nursery in 1997-1998.

DATE	NUMBER MEASURED	MEAN SHELL HEIGHT IN MM ± SE	CUMULATIVE PERCENT MORTALITY
11/10/97	50	0.3 ± .01	------
11/30/97	50	1.9 ± .03	------
12/14/97	50	2.8 ± .06	------
12/30/97	50	4.2 ± .08	6.3
1/8/98	50	5.8 ± .11	10.3
1/25/98	50	7.3 ± .12	12.0
2/4/98	50	8.2 ± .14	14.0
2/15/98	50	9.5 ± .16	16.3
3/5/98	50	10.8 ± .16	20.3
3/20/98	50	12.3 ± .18	23.0
4/10/98	50	13.2 ± .22	27.3
4/25/98	50	14.5 ± .27	30.3
5/4/98	50	15.8 ± .29	33.0
5/29/98	50	17.8 ± .33	34.7

TABLE 3. Growth and mortality of caged bay scallops on a bottom rack off Crystal River, Florida in 1997.

DATE	NUMBER MEASURED	MEAN SHELL HEIGHT IN MM ± SE	CUMULATIVE PERCENT MORTALITY
6-19-97	50	22.4 ± .45	--------
7-15-97	50	26.1 ± .52	5.5
8-14-97	50	27.6 ± .67	13.0
9-10-97	50	33.6 ± .72	20.5
10-9-97	50	37.0 ± .74	32.5
10-30-97	50	40.0 ± .74	40.0

TABLE 4. Growth and mortality of caged bay scallops in the raft-pen off Crystal River, Florida in 1998.

DATE	NUMBER MEASURED	MEAN SHELL HEIGHT IN MM ± SE	CUMULATIVE PERCENT MORTALITY
6-11-98	50	21.0 ± .42	-------
6-19-98	50	22.3 ± .48	0.0
6-23-98	50	24.2 ± .62	0.0
6-30-98	50	26.0 ± .73	0.0
7-8-98	50	27.5 ± .85	0.0
7-15-98	50	30.2 ± .87	0.0
7-22-98	50	23.7 ± .94	0.0
8-4-98	50	34.2 ± .98	2.5
8-13-98	50	36.1 ± 1.00	3.5
8-20-98	50	37.1 ± 1.10	4.0
9-11-98	50	38.0 ± 1.12	4.5
10-2-98	50	40.2 ± 1.12	4.5
10-9-98	50	40.7 ± 1.15	5.5
10-30-98	50	40.8 ± 1.32	22.5

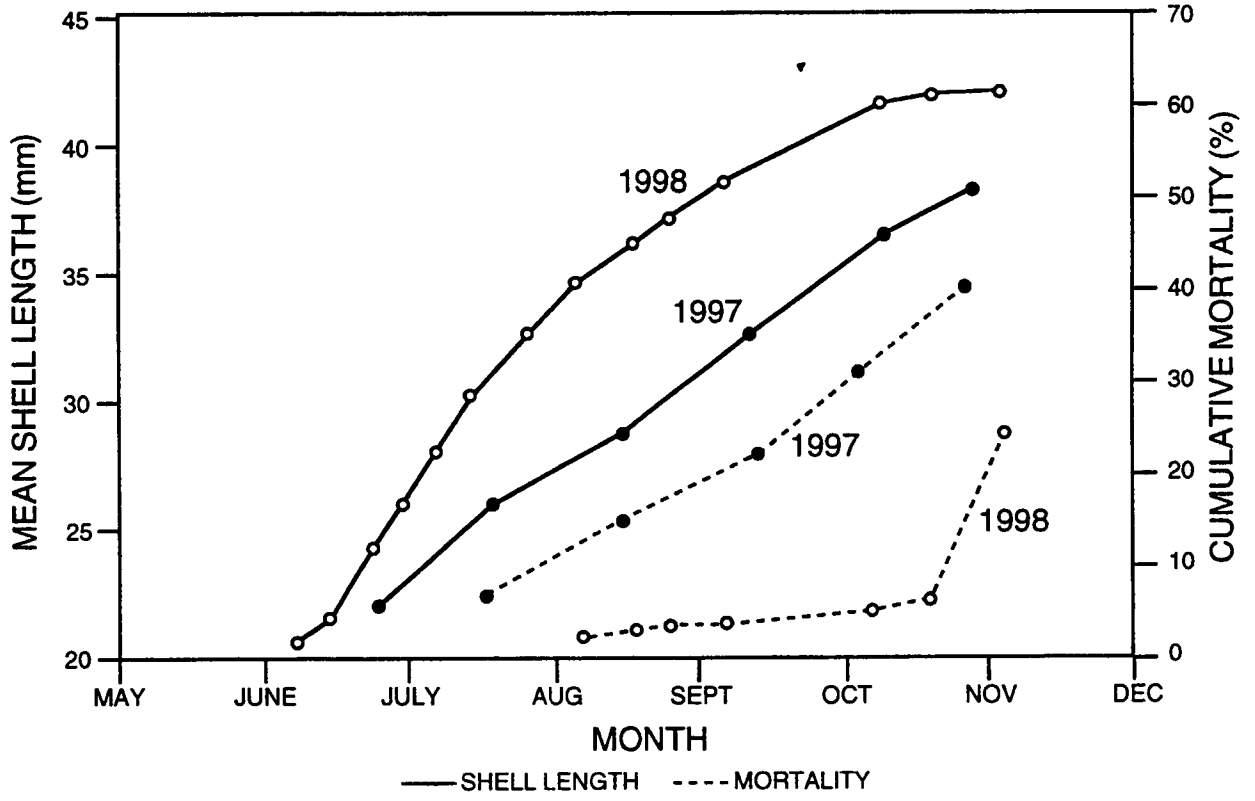

Figure 3. Growth and mortality of caged scallops off Crystal River, Florida

Growth and mortality were highly variable depending upon the type of cage used, the density of the scallops in the cages and the degree of fouling that occurred. In 1997 scallops were placed in 12 mm obc's and 25 mm wire cages with densities ranging from 200-600 m^2. Optimum density for maximum growth appears to be about 250-300 m^2. The large diameter obc's and wire cages are prone to attack by stone crabs which can easily cut through the large diameter plastic webbing and even bend the 16 gauge wire of the 25 mm cages. A large mortality occurred in some of these cages as a result of stone crab predation. This was alleviated in 1998 when 12 mm wire cages were employed in both the raft–pen system and on the bottom.

Fouling represents a serious problem in using caged scallops for growout. Main fouling organisms found on scallop were barnacles, oyster spat, tunicates and polychaete worms. The most extensive fouling started in May and became heavy throughout the whole summer (Plate 2). A scallop cage of about 10 pounds may be 30–50 pounds in just one month, mainly due to the growth of tunicates and oysters on both the scallops and cages. Scallop cages were cleaned or replaced every 3–4 weeks during the summer.

Plate 2. Severely fouled scallops from September, 1998

Fouling organisms affect the scallops in several other ways than just competing for space and food. Tunicates grow very fast. It was often seen that one tunicate can bind several scallops together, and some scallops were smothered. Oysters do the same; they outgrow scallops and often seal the scallop valves, thus either smothering the scallops or making it impossible for them to close their shells. Polychaete worms are common borers of scallop shells (Blake and Evans, 1973). They penetrate shells and produce black blisters in the inner shells of the scallops. In this study, one hundred percent of the live scallops were bearing such worms and blisters in later summer, coincident with the period of high mortality of the scallops. It seems that the heavy infection of polychaete worms and the blisters they produced contributed to slowed growth and mortality. The degree of fouling and possible fouling reduction techniques must be a primary consideration for any scallop aquaculture venture involving caged scallops.

Aquaculture Training Program

In November, 1998 a scallop aquaculture training program was initiated in cooperation with the Withlacoochee Technical Institute of The Citrus County School System. Fourteen fishermen displaced by the fishing net ban qualified for the course. The course (attachment III) includes lectures on biology, growout techniques; marketing and expected net profits, and lease availability. Each fisherman was provided with the necessary equipment to grow 2000 scallops which were provided by the USF scallop hatchery. The program will continue through the summer of 1999.

Marketing
See Attachment I.

Economic Evaluation
See Attachment II.

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Attachment I

Marketing Analysis

Aquaculture and Marketing of the Florida Bay Scallop in Crystal River, Florida

by
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Marketing Analysis of the Florida Bay Scallop Aquaculture in Crystal River, Florida

PREFACE

Aquaculture in the state of Florida is in the developmental stages and the Florida Legislature is developing new legislation to encourage commercial ventures like scallop aquaculture. Florida's Nature Coast which includes Crystal River, very much needs new commercial ventures for displaced fishermen. This project has all the elements for success since it includes the cooperation of Sea Grant Faculty with the local community. The project will benefit the local economy of Citrus County through the involvement of fishermen with scallop aquaculture and a specialized fishery product.

The conclusions and opinions expressed in the report are those of the authors and do not necessarily represent those of the grantors.

ABSTRACT

This study was undertaken to determine market acceptability and marketing strategies for whole bay scallops produced in aquacultural environments. Data for analyses were collected by surveying patrons of upscale, white tablecloth restaurants where seafood is a featured, but not exclusive, menu item. Freshly harvested whole bay scallops were prepared by chefs at four participating North Florida restaurants during September and October of 1997 and 1998, the peak harvest season for scallops. Survey respondents rated whole bay scallops favorably in regard to appearance, taste, texture, value and overall satisfaction. Ratings were generally very good. Over 85 percent indicated they would order whole bay scallops in the future.

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Special thanks also go to Dr. Charles Moss, for his assistance with the analysis utilizing information theory, and for writing the "Information Statistics" section. Gratitude is also expressed to Ms. Vivian Thompson for typing the final manuscript.

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EXECUTIVE SUMMARY

This study was undertaken to determine consumer acceptance of locally aquacultured Florida whole bay scallops.

The American bay scallop has been successfully cultured as a specialty product in areas along the east coast from Virginia to New England. Supply has been inadequate to meet demand in these areas.

Intensive harvesting and environmental pollution over the last 20 years have resulted in the decline of bay scallops in local Florida estuaries. As a result of this decline, the Florida Marine Fisheries Commission banned commercial harvest of the species and limited recreational harvest to areas north of the Suwannee River.

The Shellfish Biology Laboratory at the University of South Florida has developed techniques for growing the Florida Bay Scallop by aquacultural methods. Research indicates that commercial production may be feasible in locales with satisfactory water quality.

While American consumers traditionally enjoy eating the white fleshed, succulent adductor muscle of scallops, the small size of this muscle in Florida bay scallops makes aquaculture production for the muscle only infeasible.

An in-restaurant survey carried out during the peak scallop season of September and October of both 1997 and 1998 was utilized to determine consumer acceptance. During both seasons, scallops used in the study were relatively small, ranging in size from 1"-1_" (25-35mm) in diameter.

Four local moderately upscale restaurants participated in the study. These restaurants are well known for seafood specialties, but do not serve seafood exclusively. Professional chefs prepared the product and promoted it as a menu special.

Consumers rated specific product attributes of professionally prepared whole bay scallops. In addition, the consumers were asked if they would purchase the product again at the same price.

In addition to the restaurant patrons, a group of citizens participating in a community fund raising event were asked to evaluate the whole bay scallops. The results from this sample were not analyzed with the restaurant patrons due to the fact that their demographics were not comparable, they did not purchase the product as a separate menu item, and they were served undersized, late season specimens that were somewhat inferior to those served in the restaurants.

Survey results indicated that the product was very well received. Appearance, taste, texture, value and overall satisfaction generally received very good ratings. Taste received the highest ratings while value received the lowest. Written comments indicated that the value was rated lower because of the small size of the scallops.

There seemed to be little apprehension regarding eating the whole bay scallop among survey participants. However, the chefs indicated that local residents and older people that were more likely to be familiar with the muscle-only scallop were not well represented among survey respondents because the chefs felt these people avoided the whole scallop. They would have likely rated their hesitation to purchase the product more highly.

- Eighty-seven percent of the restaurant patrons indicated that they would purchase the product again at the same price, indicating a high degree of acceptance of the product.

- Promotional efforts emphasizing the "locally-grown," "environmentally friendly" "aquacultured" product aspects can be utilized by restaurants serving whole bay scallops. Menu specials, recommendations by chefs or serving staff and table-tent style advertising can be effective marketing techniques.

- Although consumer evaluations were generally positive, several product attributes need to be improved. Consumers' and chefs' perceptions of value could be improved by providing larger sized scallops, about 1 ½ "-1 ¾ " (35-45mm) in diameter. Further, the chefs also expressed a preference for scallops with cleaner shells; many of the scallops had heavily fouled shells, which were difficult or impossible to clean.

- Finally, commercial market development will require stable, reliable supplies of scallops and bi-weekly deliveries because of the product's limited shelf life.

INTRODUCTION

More than 35 species of scallops are harvested world wide and many of these species are the focus of intense aquaculture. The American bay scallop has been one species that has been aquacultured in China and the meats enter the US market as a relatively inexpensive frozen product. However, in several places in New England, New York and Virginia, the species is now cultured and sold whole in the shell as a specialty product. Remarkably, market demand has exceeded production.

Intensive harvesting and environmental pollution over the last 20 years have resulted in the decline of bay scallops in local Florida estuaries. As a result of this decline, the Florida Marine Fisheries Commission banned scallop harvest for recreation south of the Suwannee River and totally banned the commercial harvest of the species from wild stocks. Since 1990, the Shellfish Biology Laboratory at the University of South Florida has developed the techniques for growing the Florida Bay Scallop for restoration of the species for recreational purposes. Bay scallop aquaculture research indicates that commercial production may be feasible in locales with satisfactory water quality.

Traditionally, American consumers have only eaten the white fleshed, succulent adductor muscle of scallops. However, the small size of this muscle in Florida bay scallops makes aquaculture production for the muscle only economically impractical. The successful development of commercial culture of bay scallops in Florida is therefore not only dependent on a successful culturing process, but on the marketability of the whole bay scallop. Further, a new specialty product such as whole bay scallops must have a marketing strategy for timely delivery of desired quantities of the product to the retail market. Product acceptability and overall market potential of the product requires evaluation. This study has been undertaken to determine consumer acceptance of the whole bay scallop produced under local conditions.

OBJECTIVES

The primary objective of this study is to determine market acceptability and marketing strategies for whole bay scallops produced in aquacultural environments in Florida. Specific objectives included 1) determining how consumers rate specific product attributes of Florida whole bay scallops including appearance, taste, texture, value and overall satisfaction with the product when prepared by professional chefs in an upscale restaurant setting, 2) measuring consumers' reactions to the thought of eating a whole bay scallop, and 3) determining if consumers were satisfied enough with the product to purchase it again.

PROCEDURES

The Virginia Experience Investigated

During the period of June 16-18, 1997, eight chefs representing six upscale restaurants in the Williamsburg/Yorktown/Virginia Beach, Virginia areas were interviewed. All eight chefs had participated in a pilot marketing program for cultured whole bay scallops initiated several years earlier by the Virginia Institute of Marine Sciences (VIMS), College of William & Mary. Most were general menu, white tablecloth restaurants that typically offered several seafood appetizers and entrees. However, two were upscale seafood specialty restaurants.

The general marketing environment in the Williamsburg/Yorktown/Virginia Beach areas of Virginia shares many of the same attributes as north central Florida which make them both positive marketing environments for seafood products. Tourism, mild climates, beaches, and a reputation for abundant seafood make the two markets comparable in many ways. Because of these similarities, it was anticipated that the Virginia chefs' experiences and suggestions for marketing acquacultured scallops could be readily adapted by many north central Florida restaurants.

Insight gained from the Virginia chefs' interviews was used to identify restaurants in North Florida with a high probability of successful marketing of whole bay scallops. In addition, comments regarding successful preparation techniques from the Virginia chefs were relayed to the participating Florida chefs to aid with their preparation decisions.

In-Restaurant Consumer Evaluation Experiment In North Florida

Four upscale, white tablecloth restaurants in North Florida, known for their excellent seafood items, were willing to prepare whole bay scallops for the in-restaurant consumer evaluation survey. These restaurants, while known for excellent seafood, were not exclusively seafood restaurants. During September and October of both 1997 and 1998, the peak season for scallop harvest in North Florida, whole bay scallops were harvested on Thursday afternoons by research personnel, chilled to approximately 45-F overnight, and delivered to the cooperating restaurants on Friday afternoons.

Immediately after harvest, the scallops were taken to a commercial seafood wholesaler where they were placed in a polyethylene-lined expanded styrene shipping box. The scallops were usually placed in four layers of 25 each, for a total of 100 per box except for weeks when only 70 were packed. Each layer was separated by moist newspapers. Two chilled gel-packs were placed inside each box to maintain temperatures in the 45-- 50-F range during the one to two hours they were in transit to the restaurants. All boxes were tagged with shellfish harvest permits in compliance with Florida's Department of Environmental Protection's rules for fresh shellstock.

A "daily discard" form was affixed to the lid of each container so that daily mortality rates could be determined. However, reliable estimates of scallop mortality could not be obtained because the limited supplies of scallops available to each restaurant (70 to 100 per week) were usually exhausted within 24 to 48 hours after delivering. The only exception was the very first week; combined data from three restaurants showed losses of two percent during the first 24 hours, and two restaurants had a cumulative loss of about 22 percent after 72 hours. Initially, it was anticipated that restaurants would receive shipments of scallops each week. However, inclement weather prevented harvest on numerous occasions, and limited quantities of marketable sizes also reduced product availability during both the 1997 and 1998 season. The chefs prepared the whole bay scallops as menu specials and recommended them to customers.

To gain the cooperation of the chefs, no restrictions were placed on the preparation or cooking methods. However, wait staff was required to record the type of dish each respondent had eaten so that consumer evaluations could be analyzed by type of dish. All four restaurants served the scallops as some type of appetizer; these appetizers ranged from chioppini (fisherman's stew) to scallops Rockefeller to simple lemon-shallot butter or garlic butter sauce. The appetizers ranged in price from $4.95 to $7.95. Only one restaurant used the scallops as an ingredient in a main entree; scallops and smoked trout were incorporated into a pasta dish that was priced at $14.95. Approximately 6 to 8 scallops were served in each dish, depending on the size of scallops available. Analyses of respondents willingness to buy scallops again by type of dish eaten revealed no significant differences among the various dishes.

A total of 106 restaurant patrons completed questionnaires, far short of the initial goal of 400 observations. A copy of the questionnaire is found in Appendix A. According to the chefs, approximately 50 percent of the patrons ordering whole bay scallops completed questionnaires. This was corroborated by analyzing the numbers of scallops delivered to the restaurants and the numbers of scallops served in each dish. As mentioned previously, the number of consumer observations was severely restricted by product availability. The wait staff was instructed to promote the product and given instructions as to how to administer the questionnaire. A copy of the instructions to the wait staff is also found in Appendix A. Chefs were given an incentive of $5.00 for each completed questionnaire; in most cases, the chef gave the entire incentive to the wait staff.

In addition to the restaurant patrons, citizens participating in a community fundraising event were asked to evaluate the whole bay scallops. These "fund-raisers" were given samples of the whole bay scallops which had been prepared by a chef associated with one of the restaurants participating in the formal study. It should be noted that data from the "fund-raiser" sample were not analyzed in combination with the restaurant patrons due to demographic differences and the fact that the fund-raisers did not have to purchase the product. Further, the whole bay scallops sampled by the fund-raisers were not comparable to the product served to the restaurant patrons. They were late season scallops that were smaller than those used in the restaurant evaluations.

Statistical analyses were conducted on the various product attributes and respondents' demographic characteristics. While some relationships between demographic characteristics and the responses were hypothesized, none could be found statistically significant based on Chi-square analyses because of the limited sample sizes and the nonnormal distribution of both the response variables and the independent variables (Snedecor and Cochran, 1967). However, informational statistics were employed to ascertain the relative amount of information a given characteristic contributed to the various survey responses (Cover & Thomas, 1991). An overview of the information statistics procedure is found in Appendix B. In order to effectively utilize the Information Statistics technique, the five-point semantic differential scale was collapsed into three categories, i.e., "excellent" and "very good" into "positive"; "good" became "neutral" and "fair" and "poor" were categorized as "negative". Tabular results of statistical analyses and discussion of the survey responses and respondents' demographics follows. These results provide valuable insights for developing market development strategies for whole bay scallops.

FINDINGS

Respondent Attributes

Of the 106 restaurant patrons completing the survey, 62 were male and 44 were female (Table 1). Fourteen percent were under age 35, and 37 percent were between 35 and 49 years of age. About 36 percent were between 50 and 64, and 12 percent were 65 years of age or older. Roughly half, 50 respondents, reportedly dined at moderately upscale restaurants in moderation, that is more than once per month but less than once per week. Thirty-six (34 percent) were classified as "infrequent" patrons of upscale restaurants, dining out once per month or less. Nineteen (18 percent) were classified as "frequent" patrons of upscale restaurants, dining at such restaurants once per week or more. There were 40 restaurant patrons (38 percent) that reported eating shellfish infrequently, that is less than once a month. Thirty-eight (36 percent) were classified as moderate consumers of shellfish, indicating that they ate shellfish more than once per month but less than once per week. Twenty-six (25 percent) were frequent shellfish consumers, indicating that they ate shellfish at least once a week.

Table 1. Demographic and behavioral characteristics of the restaurant sample.

Characteristic	Restaurant Patrons	
	Number	Percent
Gender		
male	62	58.5
female	44	41.5
Totals	106	100.0
Age category		
under 35	14	14.1
35 - 49	37	37.4
50 - 64	36	36.4
65+	12	12.1
Totals	99	100.0
Frequency of dining out		
infrequent (once per month or less)	36	34.3
moderate (more than once per month, less than once per week)	50	47.6
frequent (at least once per week)	19	18.1
Totals	105	100.0
Frequency of shellfish consumption		
infrequent (once per month or less)	40	38.5
moderate (more than once per month, less than once per week)	38	36.5
	26	25.0
frequent (at least once per week)	104	100.0
Totals		

Restaurant Patrons' Reasons for Trying

Respondents were asked why they selected whole bay scallops. Multiple answers were allowed, with possible responses being 1) Familiarity with product, 2) Suggested by staff or chef, 3) Menu special, 4) Price and 5) Curiosity. Nearly two-thirds (63.5 percent) of the restaurant patrons indicated that their decision to select whole bay scallops was influenced by wait staff or the chef (Table 2). Thirty-four (33 percent) noticed whole bay scallops were a menu special and similar numbers were simply curious. Thirty-two were familiar with the product and six cited price as an influencing factor.

Table 2. Restaurant patrons' reasons' for trying whole bay scallops.

Reasons	Restaurant Patrons	
	Number	Percent[a]
Suggested by staff or chef	66	63.5
Menu special	34	32.7
Curiosity	34	32.7
Familiar with product	32	30.8
Price	6	5.8

a Percentages are based on 104 responses and do not add to 100 since each respondent was permitted to cite more than one reason.

Initial Reaction to the Thought of Eating a Whole Bay Scallop

Most respondents in the restaurant sample had few qualms about eating whole bay scallops. The initial reaction to the thought of eating a whole bay scallop was not one of hesitation for most of the restaurant patrons (Table 3). On a rating scale of one to nine, where one was not hesitant at all and nine was extremely hesitant, the average response was 2.2. None of 105 respondents answering the question indicated a nine. Only eighteen scored their hesitation as five to eight, which could be interpreted as having reservations about eating the scallops whole. Sixty-nine, almost two-thirds, were not hesitant at all. Females rated their hesitancy slightly higher than males, and respondents 65 and older were the least hesitant. Those respondents eating out more often were slightly more hesitant than others and those respondents eating shellfish at least once per week were the least hesitant. Information measures were not calculated because of zeroes at the various rating levels.

Attributes of Whole Bay Scallops Rated by Survey Participants

The restaurant patrons were asked to rate the whole bay scallops with regard to attributes of appearance, taste, texture, value and their overall satisfaction with the product using a five-point semantic differential scale. Respondents assigned a value of excellent, very good, good, fair or poor to each attribute.

Summaries of the respondents' ratings for appearance, taste, value and overall satisfaction appear below. In general, restaurant patrons' evaluations were positive, with nearly 80 percent of the respondents rating appearance and taste as "excellent" or "very good". Texture and overall satisfaction were rated "excellent" or "very good" by 73 and 76 percent of the restaurant patrons, respectively. Value received the lowest evaluations, with only 58 percent rating it as "excellent" or "very good" (Table 4).

The evaluations by the fund-raisers were not as favorable as those of the restaurant patrons. Percentages of fund-raisers rating appearance, taste and texture as "excellent" or "very good" were about 35 points below the comparable ratings given by restaurant patrons. Only 31 percent of the fund-raiser sample rated overall satisfaction as "excellent" or "very good". In contrast, about 45 percent rated overall satisfaction as "fair" or "poor" (Table 5). Detailed evaluations by the fund-raiser sample are found in the Appendix C.

Table 3. **Initial reaction to the thought of eating a whole bay scallop**, rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating									Mean Rating	Total Responding
	1	2	3	4	5	6	7	8	9		
	(Not hesitant at all----------Extremely hesitant)									no.	no.
Gender											
male	37	11	4	1	2	1	2	3	0	2.1	61
female	32	0	1	1	3	1	1	5	0	2.4	44
Age category											
under 35	8	1	0	1	0	0	1	2	0	2.8	13
35 - 49	24	4	2	1	2	0	1	3	0	2.2	37
50 - 64	23	4	2	0	1	2	1	3	0	2.4	36
65+	9	2	1	0	0	0	0	0	0	1.3	12
Frequency of dining out											
infrequent (once per month or less)	24	4	1	1	3	0	1	2	0	2.1	36
moderate (more than once per month, less than once per week)	36	3	4	0	1	2	0	3	0	2.0	49
frequent (at least once per week)	8	4	0	1	1	0	2	3	0	2.8	19
Frequency of shellfish consumption											
infrequent (once per month or less)	26	5	2	1	1	1	1	2	0	2.1	39
moderate (more than once per month, less than once per week)	24	3	2	0	4	0	2	3	0	2.5	38
frequent (at least once per week)	18	3	1	1	0	1	0	2	0	2.0	26
All characteristics	69	11	5	2	5	2	3	8	0	2.2	105

Table 4. Attribute ratings for whole bay scallops by restaurant patrons.

Attribute	Rating										Total	No Response
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Appearance	47	44.3	35	33.0	12	11.3	9	8.5	3	2.8	106	0
Taste	51	48.6	31	29.5	15		7	6.7	1	1.0	105	1
Texture	42	40.0	35	33.3	14	13.3	12	11.4	2	1.9	105	1
Value	34	35.4	22	22.9	26	27.1	13	13.5	1	1.0	96	10
Overall Satisfaction	48	45.3	33	31.1	14	13.2	8	7.5	3	2.8	106	0

Table 5. Attribute ratings for whole bay scallops by the fund-raiser respondents.

Attribute	Rating										Total	No Response
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Appearance	12	27.3	6	13.6	13	29.5	6	13.6	7	15.9	44	0
Taste	8	18.2	11	25.0	12		10	22.7	3	6.8	44	1
Texture	10	22.7	6	13.6	14	31.8	12	27.3	2	4.5	44	1
Value	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Overall Satisfaction	9	21.4	4	9.5	10	23.8		26.2	8	19.0	42	0

There are several possible reasons for the markedly different product ratings by the restaurant patrons and the fund-raisers. One obvious reason was the restaurant patrons represented a "self selected" group of consumers that made a conscious decision to purchase the product because of persuasion of the chef or wait staff, innate curiosity, or familiarity with the product. Thus, this group would have contained individuals with a high propensity to like the product; those that may have had a predisposition to dislike the product opted to not purchase it. On the other hand, the fund-raiser respondents made no conscious purchase decision; they received a serving of the product for evaluation whether or not they anticipated liking it, consequently the evaluations of this group were lower. Because the fund-raisers represented a somewhat atypical group of consumers, detailed analyses of their product ratings are relegated to the Appendix. The following sections focus on product evaluations by various demographic subgroups of the restaurant patron sample. Sparse numbers of observations in demographic and ratings categories precluded rigorous statistical analyses. However, the five-point semantic differential scale was aggregated into "positive", "neutral" and "negative" categories to facilitate use of the information statistics technique.

Appearance

The appearance of whole bay scallops was rated highly, with 44.3 percent of the 106 restaurant patrons rating appearance "excellent" and 33 percent rating appearance "very good" (Table 6). Roughly 20 percent rated appearance "good" or "fair" and only 2.8 percent (three respondents) said the appearance was "poor". More women rated appearance as "excellent" (50 percent of women, 40 percent of men). The under age 35 and the over age 65 categories seemed slightly more critical of appearance than the 35-64 groups. Respondents that dined out most frequently rated appearance slightly lower than other diners, while those that consume shellfish most often were slightly more impressed with the product's appearance.

The positive, neutral and negative ratings provide the relative information measure for the total characteristic contribution and for each level of the given characteristic. The highest informational content was found in the "frequency of shellfish consumption" characteristic. Age was the second greatest contributing characteristic, while gender and "frequency of dining out" provided relatively smaller amounts of information (Table 7).

Taste

Taste was rated "excellent" by 48.6 percent of the restaurant patrons and almost 30 percent rated taste as "very good" (Table 8). Slightly over 14 percent rated taste as "good." Seven respondents (6.7 percent) rated taste as "fair" and only one rated taste as "poor." Ratings for taste by male and female respondents were very similar. Respondents between 50 and 64 years of age rated taste lowest, while the other three age categories rated taste higher. Respondents that consume shellfish moderately were slightly less impressed with taste than either the light or heavy shellfish consumers.

The highest informational statistic referring to restaurant patrons' evaluation of taste was found for the age variable (Table 9). Note that the under age 35 and the 35-49 age categories were combined to eliminate zeroes from analysis. Moderate and frequent diners, and moderate and frequent shellfish consumers were also combined to eliminate zeroes. The resulting relative information measures showed that frequency of shellfish consumption, gender of the respondent, and the frequency of dining out each contributed relative information totaling about .02, compared to .07 for the age characteristic.

Table 6. **Appearance** of whole bay scallops rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%		no.
Gender												
male	25	40.3	21	33.9	7	11.3	6	9.7	3	4.8	2.0	62
female	22	50.0	14	31.8	5	11.4	3	6.8	0	0.0	1.8	44
Age category												
under 35	6	42.9	3	21.4	2	14.3	2	14.3	1	7.1	2.2	14
35 - 49	19	51.4	13	35.1	4	10.8	1	2.7	0	0.0	1.6	37
50 - 64	13	36.1	12	33.3	4	11.1	5	13.9	2	5.6	2.2	36
65+	6	50.0	4	33.3	1	8.3	1	8.3	0	0.0	1.8	12
Frequency of dining out												
infrequent (once per month or less)	17	47.2	12	33.3	4	11.1	2	5.6	1	2.8	1.8	36
moderate (more than once per month, less than once per week)	22	44.0	16	32.0	6	12.0	6	12.0	0	0.0	1.9	50
frequent (at least once per week)	8	42.1	7	36.8	1	5.3	1	5.3	2	10.5	2.1	19
Frequency of shellfish consumption												
infrequent (once per month or less)	16	40.0	17	42.5	6	15.0	1	2.5	0	0.0	1.8	40
moderate (more than once per month, less than once per week)	16	42.1	9	23.7	5	13.2	6	15.8	2	5.3	2.2	38
frequent (at least once per week)	14	53.8	9	34.6	1	3.8	1	3.8	1	3.8	1.7	26
All characteristics	47	44.3	35	33.0	12	11.3	9	8.5	3	2.8	1.9	106

Table 7. Measure of information content of socio-demographic characteristics of restaurant patrons in regard to their evaluation of the **appearance** of whole bay scallops.

Characteristic	Response								Relative Information Measure[a]
	Positive		Neutral		Negative		Total		
	no.	%	no.	%	no.	%	no.	%	
Gender									
male	46	74.2	7	11.3	9	14.5	62	58.5	0.002617
female	36	81.8	5	11.4	3	6.8	44	41.5	0.005651
Total characteristic contribution									**0.008268**
Age category									
under 35	9	64.3	2	14.3	3	21.4	14	14.1	0.006311
35 - 49	32	86.5	4	10.8	1	2.7	37	37.4	0.030307
50 - 64	25	69.4	4	11.1	7	19.4	36	36.4	0.008861
65+	10	83.3	1	8.3	1	8.3	12	12.1	0.001432
Total characteristic contribution									**0.046911**
Frequency of dining out									
infrequent (once per month or less)	29	80.6	4	11.1	3	8.3	36	34.3	0.001876
moderate (more than once per month, less than once per week)	38	76.0	6	12.0	6	12.0	50	47.6	0.000244
frequent (at least once per week)	15	78.9	1	5.3	3	15.8	19	18.1	0.006028
Total characteristic contribution									**0.008149**
Frequency of shellfish consumption									
infrequent (once per month or less)	33	82.5	6	15.0	1	2.5	40	38.5	0.034364
moderate (more than once per month, less than once per week)	25	65.8	5	13.2	8	21.1	38	36.5	0.013905
frequent (at least once per week)	23	88.5	1	3.8	2	7.7	26	25.0	0.015552
Total characteristic contribution									**0.063821**
All characteristics	82	77.4	12	11.3	12	11.3	106	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value, the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

Table 8. **Taste** of whole bay scallops rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Gender												
male	29	46.8	20	32.3	9	14.5	3	4.8	1	1.6	1.8	62
female	22	51.2	11	25.6	6	14.0	4	9.3	0	0.0	1.8	43
Age category												
under 35	7	50.0	4	28.6	3	21.4	0	0.0	0	0.0	1.7	14
35 - 49	20	55.6	11	30.6	4	11.1	1	2.8	0	0.0	1.6	36
50 - 64	14	38.9	10	27.8	6	16.7	5	13.9	1	2.8	2.1	36
65+	8	66.7	2	16.7	1	8.3	1	8.3	0	0.0	1.6	12
Frequency of dining out												
infrequent (once per month or less)	15	42.9	13	37.1	5	14.3	2	5.7	0	0.0	1.8	35
moderate (more than once per month, less than once per week)	27	54.0	10	20.0	7	14.0	5	10.0	1	2.0	1.9	50
frequent (at least once per week)	9	47.4	7	36.8	3	15.8	0	0.0	0	0.0	1.7	19
Frequency of shellfish consumption												
infrequent (once per month or less)	18	45.0	14	35.0	6	15.0	2	5.0	0	0.0	1.8	40
moderate (more than once per month, less than once per week)	19	51.4	7	18.9	6	16.2	5	13.5	0	0.0	2.2	37
frequent (at least once per week)	13	50.0	10	38.5	3	11.5	0	0.0	0	0.0	1.7	26
All characteristics	51	48.6	31	29.5	15	14.3	7	6.7	1	1.0	1.8	105

Table 9. Measure of information content of socio-demographic characteristics of restaurant patrons in regard to their evaluation of the **taste** of whole bay scallops.

Characteristic	Response						Total		
	Positive		Neutral		Negative				
	no.	%	no.	%	no.	%	no.	%	Relative Information Measure[a]
Gender									
male	49	79.0	9	14.5	4	6.5	62	59.0	0.017195
female	33	76.7	6	14.0	4	9.3	43	41.0	0.007298
Total characteristic contribution									**0.024493**
Age category[b]									
under 50	42	84.0	7	14.0	1	2.0	50	51.0	0.061766
50 - 64	24	66.7	6	16.7	6	16.7	36	36.7	0.005797
65+	10	83.3	1	8.3	1	8.3	12	12.2	0.009481
Total characteristic contribution									**0.077044**
Frequency of dining out[b]									
infrequent (once per month or less)	28	80.0	5	14.3	2	5.7	35	33.7	0.012484
moderate (more than once per month, less than once per week) and frequent (at least once per week)	53	76.8	10	14.5	6	8.7	69	66.3	0.011160
Total characteristic contribution									**0.023644**
Frequency of shellfish consumption[b]									
infrequent (once per month or less)	32	80.0	6	15.0	2	5.0	40	38.8	0.016172
moderate (more than once per month, less than once per week) and frequent (at least once per week)	49	77.8	9	14.3	5	7.9	63	61.2	0.012843
Total characteristic contribution									**0.029015**
All characteristics	51	68.9	15	20.3	8	10.8	74	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value, the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

[b]The under age 35 and the 35-49 age categories were combined into the "under 50" category to eliminate zeroes. Frequent and moderate diners were combined to eliminate zeroes. Frequent and moderate shellfish consumers were combined to eliminate zeroes.

Texture

Overall, restaurant patrons rated texture of the whole bay scallops as "excellent" (40 percent), "very good" (33.3 percent) and "good" (13.3 percent) (Table 10). Another 12 restaurant patrons rated the product's texture "fair" (11.4 percent) and two patrons rated texture as "poor" (1.9 percent). Females were slightly more positive in their overall ratings of texture. Respondents over age 65 and those aged 35-49 rated texture more highly than those in the under 35 and the 50-64 categories. Those dining out a moderate number of times rated texture only slightly lower than the others. Those eating shellfish at least once per week were most favorable in regard to texture. Light and moderate diners rated texture slightly lower.

Age and gender contributed more relative information regarding restaurant patrons' evaluations of the texture of whole bay scallops (Table 11). The information measures were all very small, but could be ranked in order of importance as age, gender, frequency of dining out and frequency of shellfish consumption.

Value

Restaurant patrons were asked to rate the value of whole bay scallops in the context of product received at the menu price paid. Value was rated "excellent" by 34 (35.4 percent), less often than appearance, taste, texture or overall satisfaction (Table 12). A rating of "very good" was given by 22 restaurant patrons and "good" by 26. Value was rated "fair" by 13 and "poor" by one. Men rated the value of the whole bay scallops slightly higher than the women. Respondents ages 35-49 rated the value the lowest with those in the other age categories rating value slightly better or roughly the same. Those dining out most often rated the value of the whole bay scallops slightly higher than those eating out less often. Those consuming shellfish at least once a week rated value higher than those that consumed shellfish less often. Many respondents provide written comments which provide insights on their product evaluations. The small size of the scallops was a recurring comment which undoubtedly (and negatively) affected their perceptions of value.

Information measures pointed to frequency of shellfish consumption as the most explanatory demographic variable regarding the rating of the value of whole bay scallops (Table 13). Age was the second most explanatory variable. Gender and frequency of dining out provided much smaller measures of relative information.

Table 10. **Texture** of whole bay scallops rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean rating	Total responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%		
Gender												
male	23	37.7	21	34.4	6	9.8	9	14.8	2	3.3	2.1	61
female	19	43.2	14	31.8	8	18.2	3	6.8	0	0.0	1.9	44
Age category												
under 35	4	28.6	7	50.0	2	14.3	1	7.1	0	0.0	2.0	14
35 - 49	16	43.2	13	35.1	5	13.5	2	5.4	1	2.7	1.9	37
50 - 64	15	41.7	9	25.0	4	11.1	7	19.4	1	2.8	2.2	36
65+	6	50.0	3	25.0	2	16.7	1	8.3	0	0.0	1.8	12
Frequency of dining out												
infrequent (once per month or less)	12	33.3	15	41.7	6	16.7	3	8.3	0	0.0	2.0	36
moderate (more than once per month, less than once per week)	21	42.9	13	26.5	7	14.3	7	14.3	1	2.0	2.1	49
frequent (at least once per week)	8	42.1	7	36.8	1	5.3	2	10.5	1	5.3	2.0	19
Frequency of shellfish consumption												
infrequent (once per month or less)	17	42.5	13	32.5	6	15.0	3	7.5	1	2.5	2.0	40
moderate (more than once per month, less than once per week)	13	34.2	12	31.6	4	10.5	9	23.7	0	0.0	2.2	38
frequent (at least once per week)	11	44.0	10	40.0	4	16.0	0	0.0	0	0.0	1.7	25
All characteristics	42	40.0	35	33.3	14	13.3	12	11.4	2	1.9	2.0	105

Table 11. Measure of information content of socio-demographic characteristics of restaurant patrons regarding the **texture** of whole bay scallops.

Characteristic	Response						Total		
	Positive		Neutral		Negative				
	no.	%	no.	%	no.	%	no.	%	Relative Information Measure[a]
Gender									
male	44	72.1	6	9.8	11	18.0	61	58.1	0.007219
female	33	75.0	8	18.2	3	6.8	44	41.9	0.013237
Total characteristic contribution									**0.020457**
Age category									
under 35	11	78.6	2	14.3	1	7.1	14	14.1	0.003313
35 - 49	29	78.4	5	13.5	3	8.1	37	37.4	0.005883
50 - 64	24	66.7	4	11.1	8	22.2	36	36.4	0.009489
65+	9	75.0	2	16.7	1	8.3	12	12.1	**0.020676**
Total characteristic contribution									
Frequency of dining out									
infrequent (once per month or less)	27	75.0	6	16.7	3	8.3	36	34.6	0.005689
moderate (more than once per month, less than once per week)	34	69.4	7	14.3	8	16.3	49	47.1	0.002052
frequent (at least once per week)	15	78.9	1	5.3	3	15.8	19	18.3	0.008641
Total characteristic contribution									**0.016382**
Frequency of shellfish consumption[b]									
infrequent (once per month or less)	30	75.0	6	15.0	4	10.0	40	38.8	0.002397
moderate (more than once per month, less than once per week) and frequent (at least once per week)	46	73.0	8	12.7	9	14.3	63	61.2	0.000298
Total characteristic contribution									**0.002696**
All characteristics	77	73.3	14	13.3	14	13.3	105	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

[b]Moderate and frequent shellfish consumers were combined to eliminate zeroes.

Table 12. **Value** of whole bay scallops rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Gender												
male	15	27.3	17	30.9	15	27.3	7	12.7	1	1.8	2.1	55
female	19	46.3	5	12.2	11	26.8	6	14.6	0	0.0	2.3	41
Age category												
under 35	7	50.0	2	14.3	2	14.3	3	21.4	0	0.0	2.1	14
35 - 49	10	29.4	13	38.2	8	23.5	3	8.8	0	0.0	2.1	34
50 - 64	10	30.3	5	15.2	10	30.3	7	21.2	1	3.0	2.5	33
65+	4	50.0	0	0.0	4	50.0	0	0.0	0	0.0	2.0	8
Frequency of dining out												
infrequent (once per month or less)	11	33.3	8	24.2	9	27.3	5	15.2	0	0.0	2.2	33
moderate (more than once per month, less than once per week)	15	34.1	10	22.7	13	29.5	5	11.4	1	2.3	2.3	44
frequent (at least once per week)	8	44.4	4	22.2	4	22.2	2	11.1	0	0.0	2.0	18
Frequency of shellfish consumption												
infrequent (once per month or less)	12	31.6	10	26.3	14	36.8	2	5.3	0	0.0	2.2	38
moderate (more than once per month, less than once per week)	7	22.6	8	25.8	7	22.6	9	29.0	0	0.0	2.6	31
frequent (at least once per week)	14	56.0	4	16.0	5	20.0	2	8.0	0	0.0	1.8	25
All characteristics	34	35.4	22	22.9	26	27.1	13	13.5	1	1.0	2.2	96

Table 13. Measure of information content of socio-demographic characteristics of restaurant patrons regarding the **value** of whole bay scallops.

Characteristic	Response: Positive		Response: Neutral		Response: Negative		Total		
	no.	%	no.	%	no.	%	no.	%	Relative Information Measure[a]
Gender									
male	32	58.2	15	27.3	8	14.5	55	59.1	0.000185
female	24	63.2	8	21.1	6	15.8	38	40.9	0.004721
Total characteristic contribution									**0.004905**
Age category[b]									
under 35	9	64.3	2	14.3	3	21.4	14	15.7	0.010296
35 - 49	23	67.6	8	23.5	3	8.8	34	38.2	0.007742
50+	19	46.3	14	34.1	8	19.5	41	46.1	0.015075
Total characteristic contribution									**0.033114**
Frequency of dining out									
infrequent (once per month or less)	19	57.6	9	27.3	5	15.2	33	34.7	0.000312
moderate (more than once per month, less than once per week)	25	56.8	13	29.5	6	13.6	44	46.3	0.000564
frequent (at least once per week)	12	66.7	4	22.2	2	11.1	18	18.9	0.002458
Total characteristic contribution									**0.003334**
Frequency of shellfish consumption									
infrequent (once per month or less)	22	57.9	14	36.8	2	5.3	38	40.4	0.024264
moderate (more than once per month, less than once per week)	15	48.4	7	22.6	9	29.0	31	33.0	0.021789
frequent (at least once per week)	18	72.0	5	20.0	2	8.0	25	26.6	0.011009
Total characteristic contribution									**0.057062**
All characteristics	56	58.9	26	27.4	13	13.7	95	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value, the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

[b]The 50-64 and 65+ age categories were combined to eliminate zeroes.

Overall Satisfaction

Overall satisfaction with the whole bay scallops was rated "excellent" by 48 (45.3 percent) of the restaurant patrons and "very good" by 33 (33.1 percent). Only 14 respondents (13.2 percent) rated overall satisfaction as "good", and eight (7.5 percent) rated overall satisfaction as "fair" and three (2.8 percent) rated overall satisfaction with the purchase as "poor." Thus, it appears that the overwhelming majority of the restaurant patrons were very satisfied with the whole bay scallops (Table 14). Thus, nearly 80 percent of the respondents appeared to be very satisfied with the product. Females indicated slightly more overall satisfaction than men. The age categories' mean ratings of overall satisfaction were similar for the under 35, 35-49, and over 65 age groups and slightly less satisfaction was indicated by the 50-64 age group. The respondents eating out moderately often were slightly less satisfied than the infrequent diners and the frequent diners were slightly more satisfied with their purchase than the others. Light and heavy shellfish consumers indicated equivalent overall satisfaction with the moderate shellfish consumers indicating slightly less overall satisfaction (Table 14).

Frequency of shellfish consumption contributed the most information relative to restaurant patrons' overall satisfaction with whole bay scallops (Table 15). The second most relevant demographic variable was age, followed by frequency of dining out and then gender.

Table 14. **Overall satisfaction** with whole bay scallops rated by restaurant patrons, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Gender												
male	27	43.5	21	33.9	7	11.3	4	6.5	3	4.8	2.0	62
female	21	47.7	12	27.3	7	15.9	4	9.1	0	0.0	1.9	44
Age category												
under 35	6	42.9	5	35.7	3	7.1	2	14.3	0	0.0	1.9	14
35 - 49	19	51.4	12	32.4	4	10.8	2	5.4	0	0.0	1.7	37
50 - 64	13	36.1	10	27.8	7	19.4	4	11.1	2	5.6	2.2	36
65+	7	58.3	3	25.0	1	8.3	0	0.0	1	8.3	1.8	12
Frequency of dining out												
infrequent (once per month or less)	14	38.9	15	41.7	4	11.1	3	8.3	0	0.0	1.9	36
moderate (more than once per month, less than once per week)	25	50.0	11	22.0	8	16.0	3	6.0	3	6.0	2.0	50
frequent (at least once per week)	9	47.4	7	36.8	1	5.3	2	10.5	0	0.0	1.8	19
Frequency of shellfish consumption												
infrequent (once per month or less)	18	45.0	16	40.0	5	12.5	1	2.5	0	0.0	1.7	40
moderate (more than once per month, less than once per week)	16	42.1	8	21.1	5	13.2	7	18.4	2	5.3	2.2	38
frequent (at least once per week)	13	50.0	9	34.6	4	15.4	0	0.0	0	0.0	1.7	26
All characteristics	48	45.3	33	31.1	14	13.2	8	7.5	3	2.8	1.9	106

Table 15. Measure of information content of socio-demographic characteristics of restaurant patrons on **overall satisfaction** with whole bay scallops.

Characteristic	Response						Total		
	Positive		Neutral		Negative				
	no.	%	no.	%	no.	%	no.	%	Relative Information Measure[a]
Gender									
male	48	77.4	7	11.3	7	11.3	62	58.5	0.001163
female	33	75.0	7	15.9	4	9.1	44	41.5	0.001427
Total characteristic contribution									**0.002590**
Age category									
under 35	11	78.6	1	7.1	2	14.3	14	14.1	0.003783
35 - 49	31	83.8	4	10.8	2	5.4	37	37.4	0.008889
50 - 64	23	63.9	7	19.4	6	16.7	36	36.4	0.013295
65+	10	83.3	1	8.3	1	8.3	12	12.1	0.002104
Total characteristic contribution									**0.028070**
Frequency of dining out									
infrequent (once per month or less)	29	80.6	4	11.1	3	8.3	36	34.3	0.001807
moderate (more than once per month, less than once per week)	36	72.0	8	16.0	6	12.0	50	47.6	0.002414
frequent (at least once per week)	16	84.2	1	5.3	2	10.5	19	18.1	0.008289
Total characteristic contribution									**0.012510**
Frequency of shellfish consumption[b]									
infrequent (once per month or less)	34	85.0	5	12.5	1	2.5	40	38.5	0.028314
moderate (more than once per month, less than once per week)	46	71.9	9	14.1	9	14.1	64	61.5	0.004299
frequent (at least once per week)									
Total characteristic contribution									**0.032613**
All characteristics	81	76.4	14	13.2	11	10.4	106	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value, the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

[b]Moderate and frequent shellfish consumers were combined to eliminate zeroes.

Willingness to Order Whole Bay Scallops in the Future at the Same Price

When asked whether or not they would buy whole bay scallops again, most restaurant patrons responded favorably (Table 16). Eighty-seven (84.5 percent) said they were willing to buy whole bay scallops in the future at the same price. A logistic analysis of the data indicated that no demographic characteristics were significant for predicting a given restaurant patron's willingness to buy whole bay scallops, although slightly larger percentage of women were willing to order whole bay scallops in the future at the same price. The percentage of respondents 65 or older willing to order the scallops again was also higher than younger age categories. All but one of the heaviest shellfish consumers (96.2 percent) indicated a willingness to order whole bay scallops in the future, while 10 (27 percent) of the more moderate shellfish consumers would not order them again. Only four (10.5 percent) of the infrequent shellfish consumers indicated that they would not purchase whole bay scallops again (Table 16).

The frequency of shellfish consumption provided by far the most information regarding restaurant patrons' willingness to buy whole bay scallops again in the future relative to the other demographic and behavioral variables (Table 17). The age category provided a moderate amount of information, but the gender of the respondent and the frequency of dining out added little information regarding willingness to buy whole bay scallops again.

Table 16. Restaurant patrons' **willingness to order whole bay scallops in the future** at the same price, by gender, age category, frequency of dining out and frequency of shellfish consumption.

	Response				
	Yes		No		Total
Characteristic	Number	Percent	Number	Percent	Number
Gender					
male	50	83.3	10	16.7	60
female	37	86.0	6	14.0	43
Age category					
under 35	12	85.7	2	14.3	14
35 - 49	30	83.3	6	16.7	36
50 - 64	28	80.0	7	20.0	35
65+	10	90.9	1	9.1	11
Frequency of dining out					
infrequent (once per month or less)	30	83.3	6	16.7	36
moderate (more than once per month, less than once per week)	40	85.1	7	14.9	47
frequent (at least once per week)	16	84.2	3	15.8	19
Frequency of shellfish consumption					
infrequent (once per month or less)	34	89.5	4	10.5	38
moderate (more than once per month, less than once per week)	27	73.0	10	27.0	37
frequent (at least once per week)	25	96.2	1	3.8	26
All characteristics	87	84.5	16	15.5	103

Table 17. Measure of information content of socio-demographic characteristics of restaurant patrons on the **willingness to order whole bay scallops in the future**.

Characteristic	Response				Total		
	Yes		No				
	no.	%	no.	%	no.	%	Relative Information Measure[a]
Gender							
male	50	83.3	10	16.7	60	58.3	0.0002741
female	37	86.0	6	14.0	43	41.7	0.0004213
Total characteristic contribution							**0.0006954**
Age category							
under 35	12	85.7	2	14.3	14	14.6	0.0000906
35 - 49	30	83.3	6	16.7	36	37.5	0.0001765
50 - 64	28	80.0	7	20.0	35	36.5	0.002417
65+	10	90.9	1	9.1	11	11.5	0.0024214
Total characteristic contribution							**0.0051055**
Frequency of dining out							
infrequent (once per month or less)	30	83.3	6	16.7	36	35.3	0.0001661
moderate (more than once per month, less than once per week)	40	85.1	7	14.9	47	46.1	0.0000737
frequent (at least once per week)	16	84.2	3	15.8	19	18.6	0.0000046
Total characteristic contribution							**0.0002443**
Frequency of shellfish consumption							
infrequent (once per month or less)	34	89.5	4	10.5	38	37.6	0.0044405
moderate (more than once per month, less than once per week)	27	73.0	10	27.0	37	36.6	0.0137419
frequent (at least once per week)	25	96.2	1	3.8	26	25.7	0.0276422
Total characteristic contribution							**0.0458247**
All characteristics	87	84.5	16	15.5	103	100.0	

[a]A relative information measure is a positive value. It is not predictive. The larger the value, the more information that particular demographic characteristic contributes to the response. See Appendix B for further explanation.

Reaction of Chefs in the Florida Experiment

Overall, the chefs in the participating restaurants were very pleased with the whole bay scallops and were willing to include them on their menus in the future. Chefs cited the appeal of a "local" product that was "farm-raised." The chefs indicated that aquacultured products are easy to promote because they combat the perception of over-fishing in the area. They also suggested that table tents would be an acceptable and effective means of promoting the product.

The chefs noted that those ordering the new menu item tended to be middle-aged, 40-55 years old, and probably upper-middle class. Scallop dishes were not of interest to children. It was also noted that "old timers" and "locals" who were not accustomed to eating whole scallops were not inclined to order them. The chefs had the perception that visitors from other geographic areas were more accepting of the idea of eating whole scallops.

Although the whole scallops had a non-traditional appearance, the chefs welcomed another type of shellfish to add diversity to their menus. Slight fouling, such as the barnacles encountered in the 1997 season, was acceptable to chefs and patrons alike. The chefs observed that the slight fouling gave the product a "natural" look. However, the heavier fouling that was common during the 1998 season detracted from the products's appearance, especially in pasta dishes. When served on the half-shell, the fouling posed no serious problems because the top half of the shell was removed. The chefs also suggested that a wholesale price of about 25 cents each would be acceptable, "like clams, but maybe a little higher." They observed that at a wholesale cost of 25 cents each, the ingredient cost of scallops would be about $1.50 per dish, in line with other appetizers that retailed for $4.95 to $5.95.

While scallops that were received on Friday were usually sold out by Monday, the chefs estimated that shelf life may be from three to five days. However, the chefs stressed that the shell stock should be "tempered" to maximize shelf life. Cooling shellfish harvested in 80%F waters to refrigeration temperatures too quickly results in damage and short shelf life. Comments regarding packaging indicated that damp excelsior would be both effective and acceptable.

CONCLUSIONS

This study showed that whole bay scallops, when professionally prepared and presented, can be a successful part of full-service, white table cloth restaurant menus. Restaurant patrons ordering whole bay scallops rated the attributes of appearance, taste, texture, value and overall satisfaction quite highly. Further, many restaurant patrons were curious and few were apprehensive about whole bay scallops, even though eating the whole animal is not the common practice in the U.S. Taste was rated more highly than the other attributes which bodes well for future success in marketing the product. Value was rated a bit lower than the other characteristics, and based on written comments from the respondents, this may have been a result of the product size. The small size was the most prevalent negative comment from the survey respondents (Appendix D). The perception of value could be enhanced by including more scallops per serving, lowering the retail price, or doing both.

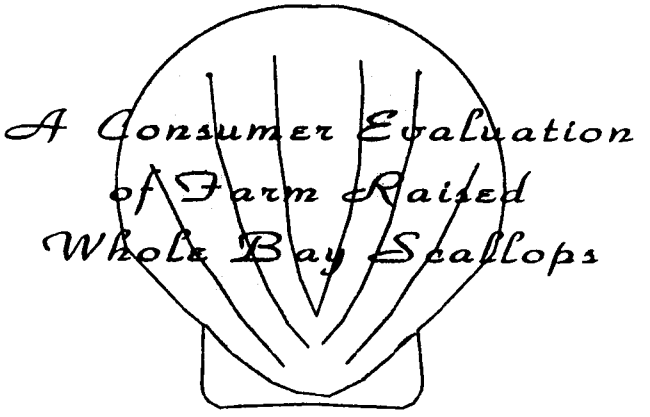
Informational statistics showed that frequency of consuming shellfish provides the greatest relative amount of information regarding restaurant patrons' evaluation of product characteristics and willingness to order whole bay scallops in the future; frequent consumers of shellfish appear to be the most favorably impressed with whole bay scallops. In addition, the participating chefs indicated that middle-aged patrons were most likely to order the product. The chefs also observed that locals and older patrons familiar with traditional scallop dishes (adductor muscle only) were not as likely to order whole scallops. On a positive note, although a small number of whole bay scallops were delivered to the participating local restaurants, the demand outstripped supply quickly, with all the product delivered on Friday being sold before Monday morning. Thus, it appears that markets could be readily developed if adequate supplies of reasonably-sized whole bay scallops were forthcoming.

Successful marketing efforts will require careful professional preparation. Satisfaction with whole bay scallops is probably most dependent on preparation and presentation. Chef or serving staff recommendations appear effective in directing restaurant patrons' interest in dishes which includes whole bay scallops, but their efforts could be enhanced through the use of table tents. These marketing materials could include information promoting the product as a locally grown, aquacultured species. This message would appeal to those concerned with overfishing and environmental preservation issues. The whole bay scallop can also be promoted as a "local" novelty dish to tourists. In addition, the local population may become more accustomed to the whole bay scallop product as opposed to the traditional muscle-only product given time and educational efforts.

Questions or concerns regarding this research may be also directed to
The University of Florida
UFIRB Office
Box 112250
Gainesville, FL 32611-2250

UNIVERSITY OF FLORIDA

A Consumer Evaluation of Farm Raised Whole Bay Scallops



a market research project

of

The Florida Agricultural Market Research Center

Dr. R. L. Degner, Director
Dr. C. M. Adams, Professor
1-800-4UF-POLL
(1-800-483-7655)

The bay scallops you just ate were grown under controlled conditions near Crystal River by the University of South Florida. The University of Florida is researching the marketability of whole bay scallops.

We'd like to know what you thought about them. This questionnaire will take about two minutes to complete. We can't compensate you for your time, but you'll have the satisfaction of knowing that your opinion counts!

You do not have to answer any question you do not wish to answer. Your responses will be confidential to the extent provided by law.

1. **Why did you select whole bay scallops? (check all that apply).**

   ____ **Familiar with product** ____ **Menu special** ____ **Curiosity**
   ____ **Suggested by staff or chef** ____ **Price**

2. **How would you rate the scallops on: (Place an "X" in the boxes to indicate your ratings)**

	Excellent	Very Good	Good	Fair	Poor
Appearance					
Taste					
Texture					
Value					
Overall satisfaction					

3. **Please indicate your initial reaction to the thought of eating a whole scallop.**

1	2	3	4	5	6	7	8	9
Not hesitant at all								Extremely hesitant

4. **Would you order this product again at the same price? ___ Yes ___ No**

5. **How many times per month or per year do you dine at a moderately upscale/upscale restaurant? Times per month _____ OR Times per year _____.**

6. **How many times per month do you eat shellfish such as oysters, clams or scallops? Times per month _____ OR Times per year _____.**

7. **Are you..... _____ Male _____ Female**

8. **In what year were you born? _____**

Comments:

[For survey validation only --- About 10 percent of all participants will be called to verify personal completion of this questionnaire]

Last Name _____ Phone (____)_____

Thank You!

University of Florida
SCALLOP STUDY

A Note To The Wait Staff

We appreciate all your help in getting your customers to try the whole bay scallops and to complete the brief questionnaire. As you probably know, reaction to the whole bay scallops has been very positive.

We plan to conduct this consumer research a few more weeks, but our supplies of scallops are very limited. Please make every serving count by doing the following:

* Continue to promote them -- let's sell' em, not smell' em!

* Check questionnaires for completeness while the customer is present, if possible. If they have overlooked a question, please get them to answer it. Try hard to get phone numbers!

* Please list the menu item, the price, and your initials on the back of the form.

* Some people have been leaving the rating for "value" blank. Value simply means "at the price you were charged, were the whole bay scallops a good deal?"

* On question 3, a few customers are placing a check or "x" between the numbers. If you spot one marked in this manner, please get them to circle a single number.

Overall, we are very pleased with the way the study is going. Thank you very much for your help!

Bob Degner Chuck Adams

1-800-4UF-POLL

APPENDIX B

Information Statistics

Technical Note on Information Statistics

Most statistical applications examine the relationship between two normally distributed variables. Statistical causality is inferred if when the independent variable is higher than average, the dependent variable is also higher than its average. The statistical significance of this relationship can be tested using statistical inference based on the normal distribution function. In the current study, if statistical deviations of demographic characteristics are correlated with higher levels of a given response such as willingness to buy whole bay scallops, we conclude that the demographic characteristics determine the willingness to buy. The test statistics based on the normal distribution function are then t-tests or Chi-square statistics.

However, the traditional mechanics of analysis under normality represent a subset of statistical measures of inference. A more basic notion of statistical inference can be derived from the concepts of statistical information. Theil (1967) develops one such measure of information based on the relative probability of a given event. Let p_i be the probability of event i and q_i be the probability of the same event given some other piece of information. For example, let p_1 be the probability of buying whole bay scallops and p_2 be the probability of not buying whole bay scallops. These probabilities represent the proportion of the total population that would be willing or unwilling to buy scallops. Next assume that we observe the share of people who are willing to buy scallops who enjoy frequently eating shellfish. Let these relative probabilities be q_1 and q_2, respectively. The question typically asked of the analyst is: What is the effect of frequent shellfish consumption on the probability of buying whole bay scallops again in the future? To answer this question, we examine the relative difference in probabilities using Theil's information measure

$$I = \sum_{i=1}^{N} p_i \ln\left(\frac{p_i}{q_i}\right)$$

If the probability of buying whole bay scallops when one is a frequent shellfish consumer is close to the general probability of buying whole bay scallops, the ratio of the probabilities is close to one and the information index approaches zero. If the probability of buying whole bay scallops is different (either higher or lower) then the ratio becomes different than one and the information index becomes larger.

APPENDIX C

The Fund-raiser Sample

FINDINGS: THE FUND-RAISER SAMPLE

The questionnaire used for the fund-raiser sample was identical to that used for the restaurant sample. Thus, discussions of fund-raisers' attributes and their evaluations of whole bay scallops follow the same general outline as used for the restaurant patrons.

Respondent Attributes

Of the 44 participants from the fund-raiser group, half were male and half female (Appendix Table 1). Five were under 35 years of age, 14 were 35-49, 12 were 50-64 and nine were over 65. Thirteen (30 percent) dined at upscale restaurants infrequently, 19 (43 percent) moderately often, while 10 (23 percent) patronized upscale restaurants at least once per week. Eleven (25 percent) consumed shellfish at least once per week, 23 (52 percent) ate shellfish moderately often, and six ate shellfish infrequently.

Fund-raisers' Reasons for Trying

Respondents were asked why they selected whole bay scallops. Multiple answers were allowed, with possible responses being 1) Familiarity with product, 2) Suggested by staff or chef, 3) Menu special, and 4) Curiosity. Note that price did not apply to participants from the fund-raiser group because these respondents had been provided scallops as part of a fund-raiser/dinner at a fixed price instead of as an a la carte menu item.

Suggestion by wait staff or the chef influenced 18 (43.9 percent) participants of the fund-raiser group to try the whole bay scallops. Fifteen (37 percent) tried them because they were listed as a menu special, and 10 (24 percent) because of curiosity. Four respondents, about 10 percent, said they tried the whole bay scallops because they were familiar with them (Appendix Table 2).

Appendix Table 1. Demographic characteristics of the fund-raiser sample.

Characteristic	Fund-raiser Sample	
	Number	Percent
Gender		
male	22	20.8
female	22	20.8
Totals	44	41.5
Age category		
under 35	5	5.1
35 - 49	14	14.1
50 - 64	12	12.1
65+	9	9.1
Totals	40	40.4
Frequency of dining out		
infrequent (once per month or less)	13	12.4
moderate (more than once per month, less than once per week)	19	18.1
frequent (at least once per week)	10	9.5
Totals	42	40.0
Frequency of shellfish consumption		
infrequent (once per month or less)	6	5.8
moderate (more than once per month, less than once per week)	23	22.1
frequent (at least once per week)	11	10.6
Totals	40	38.5

Appendix Table 2. Fund-raisers' reasons for trying whole bay scallops.

Reasons	Fund-raisers	
	Number	Percent[a]
Suggested by staff or chef	18	43.9
Menu special	15	36.6
Curiosity	10	24.4
Familiar with product	4	9.8
Price	n.a.	n.a.

Initial Reaction to the Thought of Eating a Whole Bay Scallop

Fund-raisers indicated more hesitancy than the restaurant patrons with an average rating of 3.5 on the one to nine scale where "one" indicated "not hesitant at all" and "nine" represented "extremely hesitant" (Appendix Table 3). Six out of the 43 (14 percent) fund-raisers rated their hesitation a nine. However, 21, nearly half, indicated no hesitation at all. Females rated their hesitation higher than males, and respondents 65 years old or more rated their hesitancy higher than any other age group. The most frequent diners and the most frequent shellfish consumers indicated more hesitation than the others. These results are consistent with the perceptions voiced by the chefs, i.e, that local residents that typically eat the adductor muscle only, would be more averse to eating the whole animal.

Attributes of Whole Bay Scallops Rated by Survey Participants

Fund-raisers were asked to rate the whole bay scallops with regard to appearance, taste, texture, value and overall satisfaction using a five-point semantic differential scale. Respondents assigned a value of excellent, very good, good, fair or poor to each attribute. Since members of the fund-raiser group did not purchase whole bay scallops as a separately priced menu item, their ratings of value were not analyzed.

Appearance

Of the 44 fund-raisers, 27.3 percent rated appearance of the whole bay scallops "excellent" and 13.6 percent "very good" (Appendix Table 4). About 30 percent rated appearance "good," but 13.6 percent rated appearance "fair" and 16 percent rated appearance as "poor." An even number of men and women (six of each) rated appearance as "excellent" but men rated appearance slightly lower overall. The 35-49 age category rated appearance higher than the other categories and the over 65 age category averaged the lowest rating on appearance. The infrequent diners at upscale restaurants rated appearance highest and the more frequent diners lowest. Those respondents eating shellfish at least once a week rated appearance slightly higher than the infrequent and moderately frequent shellfish consumers.

Taste

Only eight (18.2 percent) of the fund-raisers rated taste as "excellent" (Appendix Table 5). Ratings of "very good," "good" and "fair" were reported by 11 (25 percent), 12 (27.3 percent) and 10 (22.7 percent), respectively. Three rated taste as "poor." Equal numbers of men and women rated taste as "excellent." Overall, women rated taste slightly higher than men. Those respondents under age 35 and over age 65 rated taste lower overall than those in the middle age groups. Those dining out most often in upscale restaurants rated taste lowest and those dining out once per month or less rated taste the highest. Respondents eating shellfish once per month or less rated taste higher than those consuming shellfish moderately or often or frequently.

Appendix Table 3. **Initial reaction to the thought of eating a whole bay scallop**, rated by fund-raisers, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating									Mean Rating	Total Responding
	1	2	3	4	5	6	7	8	9		
	(Not hesitant at all----------								----------Extremely hesitant)		
Gender											
male	13	2	1	0	1	0	0	1	3	2.9	21
female	8	2	0	2	3	2	0	2	3	4.1	22
Age category											
under 35	2	0	0	1	1	0	0	1	0	3.8	5
35 - 49	9	0	0	0	2	0	0	0	2	2.8	13
50 - 64	7	1	0	0	1	0	0	2	1	3.2	12
65+	2	2	0	0	0	2	0	0	3	5.0	9
Frequency of dining out											
infrequent (once per month or less)	8	1	0	1	1	1	0	0	1	2.6	13
moderate (more than once per month, less than once per week)	10	1	1	0	2	0	0	3	2	3.5	19
frequent (at least once per week)	3	2	0	0	1	1	0	0	2	4.0	9
Frequency of shellfish consumption											
infrequent (once per month or less)	5	0	0	0	1	0	0	0	0	1.7	6
moderate (more than once per month, less than once per week)	11	4	1	0	1	2	0	1	2	3.0	22
frequent (at least once per week)	3	0	0	1	2	0	0	2	3	5.5	11
All characteristics	21	4	1	2	4	2	0	3	6	3.5	43

Appendix Table 4. **Appearance** of whole bay scallops rated by fund-raisers, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%		no.
Gender												
male	6	27.3	1	4.5	9	40.9	2	9.1	4	18.2	2.9	22
female	6	27.3	5	22.7	4	18.2	4	18.2	3	13.6	2.7	22
Age category												
under 35	1	20.0	0	0.0	3	60.0	1	20.0	0	0.0	2.8	5
35 - 49	5	35.7	2	14.3	4	28.6	1	7.1	2	14.3	2.5	14
50 - 64	3	25.0	1	8.3	5	41.7	2	16.7	1	8.3	2.8	12
65+	2	22.2	2	22.2	0	0.0	1	11.1	4	44.4	3.3	9
Frequency of dining out												
infrequent (once per month or less)	5	38.5	2	15.4	3	23.1	2	15.4	1	7.7	2.4	13
moderate (more than once per month, less than once per week)	4	21.1	4	21.1	7	36.8	2	10.5	2	10.5	2.7	19
frequent (at least once per week)	3	30.0	0	0.0	3	30.0	0	0.0	4	40.0	3.2	10
Frequency of shellfish consumption												
infrequent (once per month or less)	2	33.3	1	16.7	1	16.7	1	16.7	1	16.7	2.7	6
moderate (more than once per month, less than once per week)	6	26.1	4	17.4	6	26.1	2	8.7	5	21.7	2.8	23
frequent (at least once per week)	3	27.3	1	9.1	5	45.5	1	9.1	1	9.1	2.6	11
All characteristics	12	27.3	6	13.6	13	29.5	6	13.6	7	15.9	2.8	44

Appendix Table 5. **Taste** of whole bay scallops rated by fund-raisers, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	no.
Gender												
male	4	18.2	4	18.2	7	31.8	5	22.7	2	9.1	2.9	22
female	4	18.2	7	31.8	5	22.7	5	22.7	1	4.5	2.6	22
Age category												
under 35	0	0.0	2	40.0	1	20.0	2	40.0	0	0.0	3.0	5
35 - 49	3	21.4	4	28.6	3	21.4	3	21.4	1	7.1	2.6	14
50 - 64	1	8.3	5	41.7	5	41.7	1	8.3	0	0.0	2.5	12
65+	3	33.3	0	0.0	1	11.1	3	33.3	2	22.2	3.1	9
Frequency of dining out												
infrequent (once per month or less)	5	38.5	2	15.4	5	38.5	1	7.7	0	0.0	2.2	13
moderate (more than once per month, less than once per week)	1	5.3	8	42.1	5	26.3	4	21.1	1	5.3	2.8	19
frequent (at least once per week)	2	20.0	1	10.0	2	20.0	3	30.0	2	20.0	3.2	10
Frequency of shellfish consumption												
infrequent (once per month or less)	2	33.3	3	50.0	0	0.0	1	16.7	0	0.0	2.0	6
moderate (more than once per month, less than once per week)	4	17.4	3	13.0	9	39.1	4	17.4	3	13.0	3.0	23
frequent (at least once per week)	1	9.1	4	36.4	3	27.3	3	27.3	0	0.0	2.7	11
All characteristics	8	18.2	11	25.0	12	27.3	10	22.7	3	6.8	2.8	44

Texture

Nearly one-fourth of the fund-raisers rated texture as "excellent" (22.7 percent). Other texture ratings were "very good" (13.6 percent), "good" (31 percent), "fair" (27.3 percent) and "poor" (4.5 percent) (Appendix Table 6). Equal numbers of number of men and women rated texture as "excellent" or "very good". Overall, females were just slightly more positive regarding the scallop texture than males. Respondents over 65 rated texture the lowest and those 50-64 rated more positively than the those in other age categories. The more frequent diners rated texture slightly lower than either infrequent or moderate diners. Those consuming shellfish at least once a week rated texture the highest (Appendix Table 6).

Overall Satisfaction

Fund-raisers were also asked to rate overall satisfaction, but results should be regarded in light of the fact that these respondents did not purchase the product and may have had a pre-existing aversion to whole bay scallops.

Out of 42 respondents providing from fund-raiser group, nine (21.4 percent) rated their overall satisfaction with the product as "excellent" (Appendix Table 7). An additional four (9.5 percent) rated overall satisfaction as "very good" and ten (23.8 percent) rated it "good." Overall satisfaction ratings of "fair" or "poor" were indicated by 11 (26.2 percent) and eight (19 percent) of the fund-raisers, respectively. Women rated overall satisfaction higher than men. The average rating of overall satisfaction was around three, with the over 65 age group slightly less satisfied with a mean rating of satisfaction of 3.5. Respondents eating out least often were more satisfied with the product.

Appendix Table 6. **Texture** of whole bay scallops rated by fund-raisers, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%		no.
Gender												
male	5	22.7	3	13.6	6	27.3	7	31.8	1	4.5	2.8	22
female	5	22.7	3	13.6	8	36.4	5	22.7	1	4.5	2.7	22
Age category												
under 35	1	20.0	0	0.0	3	60.0	1	20.0	0	0.0	2.8	5
35 - 49	2	14.3	3	21.4	4	28.6	5	35.7	0	0.0	2.9	14
50 - 64	3	25.0	3	25.0	3	25.0	3	25.0	0	0.0	2.5	12
65+	3	33.3	0	0.0	2	22.2	2	22.2	2	22.2	3.0	9
Frequency of dining out												
infrequent (once per month or less)	5	38.5	2	15.4	4	30.8	2	15.4	0	0.0	1.2	13
moderate (more than once per month, less than once per week)	2	10.5	4	21.1	7	36.8	6	31.6	0	0.0	1.0	19
frequent (at least once per week)	3	30.0	0	0.0	2	20.0	3	30.0	2	20.0	1.6	10
Frequency of shellfish consumption												
infrequent (once per month or less)	2	33.3	2	33.3	1	16.7	1	16.7	0	0.0	1.2	6
moderate (more than once per month, less than once per week)	5	21.7	2	8.7	6	26.1	8	34.8	2	8.7	1.3	23
frequent (at least once per week)	2	18.2	1	9.1	6	54.5	2	18.2	0	0.0	1.0	11
All characteristics	10	22.7	6	13.6	14	31.8	12	27.3	2	4.5	2.8	44

Appendix Table 7. **Overall satisfaction** with whole bay scallops rated by, by gender, age category, frequency of dining at an upscale restaurant, and frequency of shellfish consumption.

Characteristic	Rating										Mean Rating	Total Responding
	Excellent		Very Good		Good		Fair		Poor			
	no.	%	no.	%	no.	%	no.	%	no.	%		no.
Gender												
male	4	18.2	2	9.1	5	22.7	7	31.8	4	18.2	3.2	22
female	5	25.0	2	10.0	5	25.0	4	20.0	4	20.0	3.0	20
Age category												
under 35	1	20.0	0	0.0	2	40.0	2	40.0	0	0.0	3.0	5
35 - 49	3	23.1	1	7.7	4	30.8	4	30.8	1	7.7	2.9	13
50 - 64	2	16.7	2	16.7	3	25.0	3	25.0	2	16.7	3.1	12
65+	2	25.0	1	12.5	0	0.0	1	12.5	4	50.0	3.5	8
Frequency of dining out												
infrequent (once per month or less)	3	25.0	3	25.0	3	25.0	2	16.7	1	8.3	2.6	12
moderate (more than once per month, less than once per week)	4	22.2	0	0.0	6	33.3	6	33.3	2	11.1	3.1	18
frequent (at least once per week)	2	20.0	1	10.0	1	10.0	2	20.0	4	40.0	3.5	10
Frequency of shellfish consumption												
infrequent (once per month or less)	0	0.0	2	33.0	2	33.3	2	33.3	0	0.0	3.0	6
moderate (more than once per month, less than once per week)	4	18.2	2	9.1	5	22.7	6	27.3	5	22.7	3.3	22
frequent (at least once per week)	3	30.0	0	0.0	3	30.0	2	20.0	2	20.0	3.0	10
All characteristics	9	21.4	4	9.5	10	23.8	11	26.2	8	19.0	3.1	42

APPENDIX D

Restaurant Patrons' and Fund-raisers' Comments

Comments from Restaurant Patrons

1. Nothing exceptional, very bland. Tastes more like an oyster than a scallop. Naturally raised scallops are better.

2. The cook did an outstanding job. It was not fishy. Appearance was great, taste excellent. Keep up the great work!

3. Familiar with bay & sea scallops. Compares favorably with Long Island scallops.

4. Well prepared by Decembers'.

5. Fantastic product. Very familiar with farm raised clams. I am happy to see scallops being done. Scallops were tender and succulent.

6. The stew these scallops were served in was extremely complimentary to the scallop meat. Very tasty. Exceptional quality.

7. The scallops were wonderful. They would taste great over rice.

8. Great idea; but....

9. Excellent sauce.

10. I thought they were excellent. The size of the portion (8) was appropriate. The sauce they're served in is superb.

11. They were very tasteful! I could hardly tell the difference between these and natural ones.

12. Very good!

13. A pleasant change from the original version.

14. Preparation and presentation were well above average. Quality of the product was excellent.

15. Hopefully, as production increases they well become a better value.

16. Wonderful!

17. Surprisingly excellent, since I have always eaten bay scallops "cleaned" but I really enjoyed it and would definitely order it again!

18. Scallops are Great! Next to stone crab they are my favorite seafood.

19. Surprised at the appearance. I thought they would look like sea scallops which I've eaten and seen in the past. The first bite - a little "too fishy." Sauce was excellent. I wonder

how I would like it without sauce. When I think of sea scallops, I think of a "sweet taste".

20. They were so tiny we all laughed.

21. The were smaller than I expected. Eight scallops for $5.95 is a tad bit pricey. They did have good texture and flavor. Good idea to raise instead of harvest "native."

22. The scallops were smaller than I expected. The preparation was excellent. Garlic, butter and parsley I expect.

23. Good taste.

24. Let the scallops grow bigger.

25. Delicious dish!

26. The scallops had a rather "fishy" taste.

27. Somewhat gritty.

28. Need a little more time to purge- - some grit.

29. Garlic and butter sauce were great with the scallops.

30. There was more "fish" flavor than bay scallops I have purchased in the past. This appealed to me. I would definitely order again. Are they safer health wise? Environmentally? I would be even more interested if I knew ordering these reduced over-harvesting of natural sources. Do you control the water quality?

31. Glad to see this type of research!

32. Very good!

33. Somewhat gritty, but very tasty!

34. We gather scallops in the Keaton Del area each July.

35. Great.

36. The concept is there, but "cleaned" scallops - even if consumers didn't know they were cleaned, have a natural sweet taste that was missed in whole scallops.

37. Very pleasant. I don't know why, but scallops have never been served to me in their shells. Why not? I suspect the large ones I have been served before were not scallops?

38. Delicious.

39. Very good texture (not stringy). Good flavor.

40. A bit undersized. A large scallop would make a better presentation. Crackers take away the taste. Perhaps bread instead. In addition, garnish the plate for a better presentation. Especially in upscale restaurants.

41. They were great.

42. They looked small. Taste wasn't excellent.

43. Without the barnacles they would be perfect.

44. Just great, but a little small.

45. A dozen for the price would be a better deal. Good stuff though.

46. Too small!!

47. I thought it was wonderful. It looked very appealing and tasted great.

Fund-raiser Comments

1. Scallops were very small!!

2. The scallops were too small but very good. I am a scallop nut.

3. Love scallop muscle but not whole scallop!

4. I love raw oysters - but eating anything but the muscle of the clam is not too pleasing.

5. Fishy.

6. Small.

7. Too small.

8. Too small.

9. Scallops were very small - very difficult to eat - let them get bigger.

10. They need to be bigger.

11. These scallops were great, they just need to grow up. Too small.

12. Super grub.

13. Great food.

14. Excellent.

15. The scallops were way too small but the flavor and presentation were excellent.

16. Beautiful but small.

17. Scallops were harvested too small!

18. Excellent.

19. Scallops are delicious, but the whole animal is pretty disgusting before it is separated from its shell.

20. Samples were very small.

21. Too small.

22. Product was too small physically and quantitatively to evaluate...but as is obvious, the wine had a good effect!!!

23. I love the taste of all shellfish.

24. They were too small and I prefer the white meat only. Larger wild scallops are much sweeter. Of course that may be due to the way they were prepared. I do however hope this project is successful and has commercial success. No comparison to farm raised clams.

25. I'd rather eat clams! They were too small to evaluate. They might be good, but too small. We needed more to eat.

26. Wonderful.

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Economic Evaluation

Aquaculture and Marketing of the Florida Bay Scallop in Crystal River, Florida

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Submitted to Florida Sea Grant
Final Report on Project R/LR-A-20

Table of Contents

THE ECONOMIC FEASIBILITY OF SMALL-SCALE, COMMERCIAL CULTURE OF BAY SCALLOPS

Introduction

The purpose of this analysis is to examine the feasibility of the small-scale culture of bay scallops intended for the fresh, whole market in Florida. Potential investors in bay scallop culture need to know the expected costs and earnings of the culture process in order to make a wise investment decision. The following analysis provides a pro forma assessment of the financial characteristics of a hypothetical culture operation. This approach is dictated since no commercial bay scallop culture operations currently exist in Florida. The analysis examines only the financial characteristics of the nursery and growout components of the culture process. An assessment of the hatchery process is omitted since the methods employed for the bay scallop hatchery process are very similar to those utilized for hard clams. Previous studies have examined the financial characteristics of a hard clam hatchery (Adams and et. al. 1991; Adams and Pomeroy 1992). Thus, for the purpose of this analysis, the cost of the hatchery is included only as the cost of bay scallop seed. In contrast, the methods suggested by this study for the nursery and growout of bay scallops differ considerably from those currently being utilized for hard clam nursery and growout (Adams and van Blokland 1998). Thus, the analysis focuses only on those two phases of the production process.

The following discussion initially describes the alternative production processes utilized in the analysis. Then, the basic underlying production and financial assumptions regarding the analysis are outlined. Next, the financial characteristics of each production method are described, which includes initial capital investment requirements, capital replacement needs, annual operating expenses, average annual net returns, and cash flow characteristics. Finally, a financial sensitivity analysis examines the changes in net returns resulting from changes in market price of whole bay scallops, overall survival rate, growout stocking density, marketability of harvested scallops, cost of seed, and cost/expected life of growout cages.

Description of Nursery and Growout Production Systems

Two different hypothetical production methods were examined: (a) rack system and (b) longline system. These production systems were identified as potential methods for producing bay scallops in the Crystal River, Florida region. Although commercial attempts to culture bay scallops have not occurred to date in Florida, the production trials during this study suggest that these two systems hold promise as viable methods that a commercial operation may employ. The scale of operation was assumed to be 100 growout cages. This scale was deemed appropriate given the uncertainty associated with near-term commercial seed availability and the logistics (in particular, labor requirements) of actually operating the production system. In addition, a maintained assumption in the study was that the small-scale culture process should be intended as a supplemental source of income, at least until the culture technology, seed availability, and market potential is more fully developed and better understood.

Both systems serve nursery and growout functions. The seed scallops are initially placed in nursery bags constructed of soft, 3mm, nylon mesh material. These nursery bags are placed within the wire growout cages (two bags in each cage) to protect against predation. Each growout cage has dimensions of approximately 2'X2'X6" and is constructed of plastic-coated 0.5" wire mesh. The seed scallops remain within these bags until they reach the appropriate size to be stocked directly into the growout cages. The growout cages are continually monitored and the scallops are harvested when market size is obtained.

Rack System

The "rack" system consists of a series of rebar frames, or racks, each of which are designed to hold 10 growout cages. These racks are very similar to those utilized for holding nursery bags and growout cages for oyster culture in Levy County, Florida, during Project OCEAN. Each rack would be designed with the dimensions necessary to hold at least 10 growout cages. The racks would be constructed of 0.5", #4-grade welded rebar. The individual cages would slide into shelves within the rack frame and be held in place with plastic ties, or some other attachment means. Given the scale assumption of 100 cages, the 10 racks could be placed in a single line, all attached to each other by a single 3/8" poly rope (**Figure 1**). A trap float would be attached with a single 1/4" poly rope to the top center of each rack to allow for easy location on the lease site. Placement and servicing of the racks would require the use of a boom and winch apparatus, as well as a small boat with a wide enough beam to provide the necessary stability. The racks and cages would periodically be hoisted to the surface and placed aboard the boat for inspection, cleaning, harvesting, restocking, maintenance, etc. Alternatively, the racks could be accessed with either snorkel or scuba gear after initial placement on the lease site, and each cage removed from the rack and brought to the surface individually.

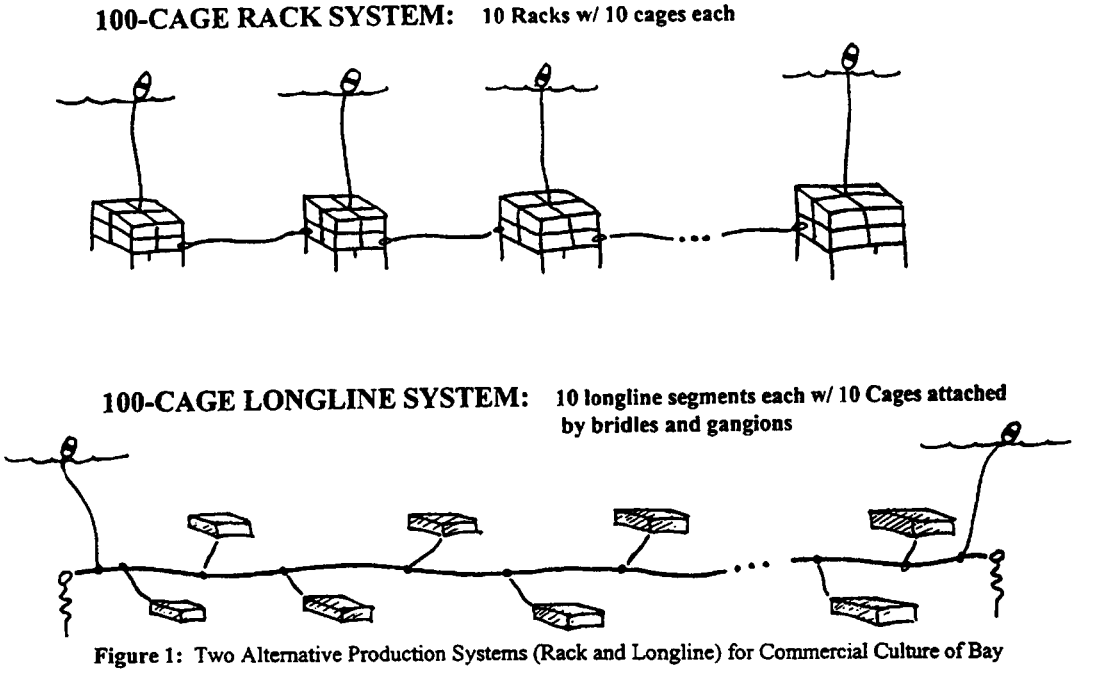

Figure 1: Two Alternative Production Systems (Rack and Longline) for Commercial Culture of Bay Scallops in Florida

Figure 1: Alternative Bay Scallop Production Systems

Longline System

The longline system consists of a series of mainline segments, each with growout cages individually attached to the mainline (**Figure 1**). Each mainline is a 130-foot length of 1/4" poly rope, with each end attached to the bottom with a 4-foot screw anchor. Each mainline has 10 cages spaced 10 feet apart. The cages are each clipped to the mainline with a 9-foot, 1/4" poly rope gangion and bridle.

The gangion/bridle length being shorter than 10 feet will minimize the amount of entangling among cages. The distance from each anchor to the adjacent cage is 20 feet. Each mainline is weighted with 2-ounce "clamp-on" weights attached in 7-foot intervals. Each end of a mainline is marked with a trap buoy. Given that the operation will consist of 100 cages, there will be 10 mainline segments required. The cages can be accessed by lifting the buoy rope on either end of the mainline so that the mainline itself can be placed in a guide on the side of the boat. The boat can then move along the mainline, lifting each gangion to within reach in succession. Each cage can then be lifted from the water for inspection, cleaning, etc. Use of the longline system will eliminate the need for a winch and boom apparatus.

Baseline Assumptions of the Analysis

The following set of production and financial assumptions are held during the analysis. Some are relaxed when the sensitivity analysis is performed.

Production Assumptions

* Stocking sizes: - into the nursery bags at 3mm shell length
  - directly into the growout cages at 17-18mm shell length
* Production period length:
  - the nursery phase requires approximately 4 months (February - May)
  - the growout phase requires approximately 5 months (June - October)

Stocking densities:
- nursery bags at a density of 500 per bag
- growout cages at a density of 200 per cage ($50/ft^2$)

* Survival:
  - 75% during the nursery phase
  - 80% during the growout phase
  - 60% during the total production period
* Scallops are harvested when a 40-45mm shell length size is achieved
* All harvested scallops are of the same size

Financial Assumptions

* Seed prices are $10 / 1000
* Market price for a 40-45 mm shell length scallop is $0.25 ea.
* All sales are directly from the owner-operator to a local restaurant
* All equipment, seed, supplies, etc. prices reflect current retail values
* Straight-line depreciation, with zero salvage value, is utilized
* A six-year planning horizon is utilized
* Taxes and the cost of the owner-operator's labor have not been included. Thus, all returns are to the owner-operator's labor, management skills, and taxes. All labor is supplied by the owner-operator and family
* The small scale operation is intended to provide supplemental income only
* No loans are obtained. All capital and operating costs are borne entirely by the owner-operator.
* The owner-operator has a previously owned boat, motor, and truck, the capital cost of which is not included in the analysis
* A suitable submerged lease site is available in a location that minimizes access costs, risk of theft, water quality degradation, etc.

Financial Characteristics

An awareness of the financial characteristics of bay scallop culture is necessary for a potential investor to make a wise investment decision. A potential investor in bay scallop culture needs to be

aware of the initial investment and annual operational costs of a small-scale, culture operation. Knowledge of both the type and magnitude of these costs is required. The investor also needs to know what the expected annual net returns would be. Knowledge of the cash flow provided by the operation will allow an investor to determine how soon the initial investment costs can be recovered and when a positive net return to cash costs can be expected. An annual budget will provide an investor with the expected net returns for a typical year in the planning horizon of the business. The budget can also be used to determine the total cost per harvested scallop, the minimum market price that must be received, and the maximum level of mortality that can be tolerated. These annual financial characteristics of the hypothetical small-scale, bay scallop culture operation are discussed in the following section. The baseline assumptions are adhered to in this analysis. The sensitivity analysis will allow these assumptions to vary.

Initial Capital Investment Requirement

The largest single investment for either the rack or longline system are the growout cages. The total cost of the growout cages for each system is $2,300, which represents 58% and 65% of the total investment cost for the rack and longline systems, respectively (**Tables 1 and 2**). The collective cost for boat gear required with the rack system is $930, most of which is associated with the lifting apparatus required to hoist the racks from the water (e.g., boom, pulley, power winch, and rope). The longline system doesn't require the racks, boom and winch, but does require a longline (i.e., mainline, gangions, and bridles) which costs about $420. The other costs for each systems are similar. A pump and hoses/fittings are required for power washing the cages on a periodic basis. Other costs include nursery bags, a screen for sorting out undersize scallops, coolers for transporting the harvested scallops, and miscellaneous supplies. The total investment cost for the rack and longline systems is $3,326 and $3,508, respectively.

As the gear becomes obsolete due to corrosion, wear, etc., capital replacement costs must be anticipated. Some capital items can be expected to have a longer economic life than others. For example, the rebar racks may last as long as 10 years, whereas the nursery bags and pump can be expected to last no more than 3 years. The average annual capital replacement cost can be approximated by computing the annual depreciation cost. The annual non-cash cost of depreciation is $849 and $807 for the rack and longline system, respectively. The actual timing of replacement is related to the economic life assigned to each capital item (**Tables 3 and 4**). And although depreciation is a *non-cash* cost for accounting purposes, the replacement cost which it approximates **is** a *cash expense*. The largest capital replacement cash cost occurs in Year 6 as the growout cages are replaced. These important cash costs will have an impact on the cash flow characteristics of the business and must be anticipated accurately by the investor.

Table 1. Initial Investment for a 100-Cage (10-rack), Bay Scallop Culture Operation					
Item	Number	Unit Price	Initial Investment	Years of Life	Annual Depreciation
Cages (1/2" coated mesh)	100	$ 23	$2,300	5	$ 460
Racks (1/2" #4 grade rebar)	10	$ 10	$ 100	10	$ 10
Nursery Bags (3 mm mesh)	54	$ 4	$ 216	3	$ 72
Rigging (polyrope, clips, floats, etc)	1	$ 60	$ 60	3	$ 20
Boat Gear:					
Boom	1	$ 250	$ 250	10	$ 25
Pulley	1	$ 80	$ 80	5	$ 16
Power Winch	1	$ 300	$ 300	5	$ 60
Rope	1	$ 50	$ 50	3	$ 17
Pump (1 hp)	1	$ 200	$ 200	3	$ 67
Hoses / fittings, etc.	--	$ 50	$ 50	2	$ 25
Sorting screen	1	$ 20	$ 20	2	$ 10
Coolers	2	$ 200	$ 200	3	$ 67
Miscellaneous supplies (gloves, knives, ties, calipers, brushes, etc.)	--	$ 100	$ 100	1	--
TOTAL INITIAL INVEST.	--	--	$3,926	--	--
TOTAL ANNUAL DEPREC.	--	--	--	--	$ 849

Table 2. Initial Investment for a 100-Cage, Longline, Bay Scallop Culture Operation

Item	Number	Unit Price	Initial Investment	Years of Life	Annual Depreciation
Cages (1/2 " coated mesh)	100	$23	$2,300	5	$460
Nursery Bags (3 mm mesh)	54	$ 4	$ 216	3	$ 72
Rigging for longline (polyrope, clips, floats, weights, anchors, etc)	1	$ 422	$ 422	4	$ 106
Pump (1 hp)	1	$ 200	$ 200	3	$ 67
Hoses/fittings/sprayer, etc.	--	$ 50	$ 50	2	$ 25
Sorting screen	1	$ 20	$ 20	2	$ 10
Coolers	2	$ 200	$ 200	3	$ 67
Miscellaneous supplies (gloves, knives, ties, calipers, brushes, etc.)	--	$ 100	$ 100	1	--
TOTAL INITIAL INVEST.	--	--	$ 3,508	--	--
TOTAL ANNUAL DEPREC.	--	--	--	--	$ 807

Table 3: Capital Replacement Schedule for a 100-Cage (10 - rack), Bay Scallop Culture Operation (purchases made at *beginning* of each year)						
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cages	$2,300					$2,300
Racks	$ 100					
Nursery Bags	$ 216			$ 216		
Rigging (polyrope, clips, floats, etc)	$ 60			$ 60		
Boat Gear:						
Boom	$ 250					
Pulley	$ 80					$ 80
Power Winch	$ 300					$ 300
Rope	$ 50			$ 50		
Pump	$ 200			$ 200		
Hoses / fittings, etc.	$ 50		$ 50		$ 50	
Sorting screen	$ 20		$ 20		$ 20	
Coolers	$ 200			$ 200		
Miscellaneous supplies (gloves, knives, ties, brushes, calipers, etc.)	$ 100	$ 100	$ 100	$ 100	$ 100	
Total Annual Cost	$3,926	$ 100	$ 170	$ 826	$ 170	$2,680

Table 4: Capital Replacement Schedule for a 100-Cage, Longline, Bay Scallop Culture Operation (purchases made at *beginning* of each year)						
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cages (1/2 " coated mesh)	$2,300					$2,300
Nursery Bags (3 mm)	$ 216			$ 216		
Rigging for longline (polyrope, clips, floats, weights, anchors, etc)	$ 422				$ 422	
Pump (1-hp)	$ 200			$ 200		
Hoses / fittings, etc.	$ 50		$ 50		$ 50	
Sorting screen	$ 20		$ 20		$ 20	
Coolers	$ 200			$ 200		
Miscellaneous supplies (gloves, knives, ties, calipers, brushes, etc.)	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100
Total Annual Cost	$3,508	$ 100	$ 170	$ 716	$ 592	$2,400

Annual Operating Expense

Operational expenses are typically expressed in two distinct categories: variable costs and fixed costs. Variable costs are those that are vary directly with the level of production (i.e., number of cages or scallops stocked). Fixed costs are often referred to as "overhead" and typically do not change with the level of production. The estimated variable and fixed costs for both production systems are presented in **Tables 5 and 6**. Total annual operating expenses for the rack and longline systems are $2,159 and $2,117, respectively.

Table 5: Total Annual Operating Expenses (Cash and non-Cash) for a 100-Cage (10-rack), Bay Scallop Culture Operation			
Item	Number	Unit Price	Total Expense
Variable Costs			
Seed scallops (4-5 mm)	27,000	$10 (per 1000)	$ 270
Fuel / oil (pump, boat, truck)	--	--	$ 500
Repair / maintenance:			
rigging system	--	--	$ 50
pump, winch, boat, motor, truck	--	--	$ 100
Supplies / expendables	--	--	$ 100
Packing materials	--	--	$ 200
Labor and wages	--	--	--
Total Variable Costs			$1,220
Fixed Costs			
Insurance	--	--	--
Interest	--	--	$ 0
Permits and licenses			
Submerged lease fee	--	--	$ 40
DACS certificate	--	--	$ 50
Bookkeeping / accounting fee	--	--	$ 0
Taxes	--	--	--
Total Fixed (Cash) Costs	--	--	$ 90
Depreciation	--	--	$ 849
Total Fixed Costs			$ 939
TOTAL ANNUAL COSTS			$2,159

Table 6: Total Annual Operating Expenses (Cash and non-Cash) for a 100-Cage, Longline, Bay Scallop Culture Operation

Item	Number	Unit Price	Total Expense
Variable Costs			
Seed scallops (4-5 mm)	27,000	$10 (per 1000)	$ 270
Fuel / oil (pump, boat, truck)	--	--	$ 500
Repair / maintenance:			
longline system	--	--	$ 50
pump, boat, motor, truck	--	--	$ 100
Supplies / expendables	--	--	$ 100
Packing materials	--	--	$ 200
Labor and wages	--	--	--
Total Variable Costs			$1,220
Fixed Costs			
Insurance	--	--	--
Interest	--	--	$ 0
Permits and licenses			
Submerged lease fee	--	--	$ 40
DACS certificate	--	--	$ 50
Bookkeeping / accounting fee	--	--	$ 0
Taxes	--	--	--
Total Fixed (Cash) Costs	--	--	$ 90
Depreciation	--	--	$ 807
Total Fixed Costs			$ 897
TOTAL ANNUAL COSTS			$2,117

Variable Costs - The largest variable costs for the two systems is fuel, scallop seed and packaging materials. The fuel cost is associated with the boat and pump motors. Fuel for the boat will be determined by the location of the lease site, size of motor, frequency of trips to lease site, etc. A scallop farmer who also is a commercial crabber, may be able to visit the lease site while on a trip to check crab traps, thereby prorating some of the fuel cost to the crab business. A lease site located a considerable distance from the home dock, in a location where the threat of theft is high, or in waters which create excessive fouling may require longer runs or more frequent visits to the lease site. In these cases, fuel costs may be higher than the $500 budgeted in the analysis. Fuel will also be required to run the on-board pump for the pressure washing of the cages while at the lease site.

Seed scallops are assumed to be available from a commercial source for $10 per 1,000. The seed are assumed to be 4-5 mm in size. Assuming that the growout cages are to be stocked with 200 scallops each, a total of 27,000 seed are required to stock the nursery bags. Note that the survival rate assumed for the nursery process is 75%. Other variable costs include repair and maintenance for equipment, supplies / expendables, and packing materials. The cost associated with packing materials includes plastic bags, styrofoam boxes and gel-pacs required to hold the harvested scallops for delivery to a local restaurant. The scallops are assumed to be packed 100 to each container for delivery. The boxes and gel-pacs can be

reused. A conservative estimate of approximately $1, including vehicle fuel for transportation, is assigned to the cost of transporting each 100-scallop shipment to a restaurant. Total cost for packing materials is $200. The total labor requirement for the hypothetical systems is unknown at present. Thus, labor costs have not been included. It is anticipated, however, that the labor required to operate a small-scale bay scallop culture operation could be supplied by the owner/operator and family. The total variable cost per year is $1,220. This cost is assumed to be the same for both the rack and longline system.

Fixed Costs - Typical fixed costs for a business would include salaries, insurance, bookkeeping fees, taxes, interest/principal on loans, depreciation and various annual permits and licences. Given the hypothetical nature of the proposed systems, the analysis only attempts to provide cost estimates for permits/licenses and depreciation. A annual fee for a 2-acre submerged lease is included ($20 per acre). In addition, the FDACS aquaculture permit fee is incurred ($50 annually). Since small-scale culture of scallops is currently intended only as a supplemental income, costs such as insurance and bookkeeping may be allocated to another business enterprise. Thus, these costs have not been included. No loan costs are incurred since the initial capital investment and operating costs for Year 1 is assumed to be owner financed. Obtaining a loan for a startup business such as scallop culture, with no financial performance history in the region, would be unlikely. With the exception of depreciation, all fixed costs are identical for both the rack and longline systems. The annual depreciation costs are the same as those found in **Tables 1 and 2**. Total fixed costs for the rack and longline systems are $939 and $987, respectively.

Enterprise Budget

The enterprise budget provides insight into the average costs (cash and non-cash) and earnings associated with a specific business operation. In this case, annual costs and earnings are averaged over a six-year planning horizon for both the rack and longline production systems. The budgets provide estimates for total revenue, total costs, net returns, and break-even values for two key management variables (**Tables 7 and 8**).

The total number of scallops originally stocked is 27,000. Assuming a 60% overall survival rate (i.e., 75% for the nursery, then 80% of the remainder during growout), a total of 16,000 scallops are eventually harvested (i.e., 200 scallops stocked in each of 100 cages, of which 80% survive for harvest). These are assumed to all be of the same size at the time of harvest (i.e., 40-45mm shell length) and sold directly to a local restaurant for $0.25 each. Total revenue from sales of scallops is estimated to be $4,000 annually.

Sales of most molluscan shellfish (e.g., oysters, clams, and mussels) must pass through a certified shellfish dealer, as required by law (U.S. Dept. Of Health and Human Services 1997). The National Shellfish Sanitation Program (NSSP) specifies within a model ordinance format the various criteria by which molluscan shellfish can be harvested, handled, and distributed within the U.S. These criteria include, for example, water classification rules where harvest can occur, wholesale sale, handling, and shipping methods. These criteria apply to the inter and intrastate shipment of molluscan shellfish. However, these criteria do not apply to the whole scallops in Florida. Currently, the state of Florida does not have the legal authority to enforce these criteria for scallops. This exception only applies, however, to shipments within the state. Any shipments of whole, cultured bay scallops out of the state would invoke those criteria as established by the NSSP. Therefore, the analysis will assume the grower can sell directly to a retail buyer at a higher resulting price than if sold to a wholesale buyer. This assumption may only be valid for the near term, as the state may some day begin enforcing NSSP criteria if significant quantities of whole, cultured scallops begin appearing in local markets. If this happens, the market price realized by a grower, if that grower is not also a certified shellfish dealer, may be lower than that achieved by selling directly into the retail market.

The variable and fixed costs found in the enterprise budget are identical to those found in the discussion of operational expenses (**Tables 5 and 6**). When total costs are deducted from total revenue, annual net returns are estimated to be $1,841 and $1,883 for the rack and longline systems, respectively. Recall that owner labor and taxes have not been included in the analysis. Thus, returns are to owner labor, management skills, and taxes. If these costs are included, estimated net returns would be less.

The enterprise budget provides other values that are useful in describing basic performance standards for the business. The cost per harvested scallop (or break-even market price) is determined by dividing the total annual cost ($2,159) by the total number of scallops harvested annually (16,000). The resulting value ($0.135) is the cost per scallop, or the market price that must be achieved to "break-even" (just cover the costs of production). A market price below 13.5 cents will render the operation unprofitable. The break-even level of survival can also be estimated. This estimate is computed by dividing total cost ($2,159) by the prevailing market price ($0.25). The resulting estimate is then divided by the total number of scallops initially stocked (27,000). The result provides an estimate of the level of overall survival that must be achieved to just cover the total costs of production. Given the set of assumptions utilized in the analysis, any overall survival rate below 32% will render the operation unprofitable. A similar approach would allow break-even survival rates to be estimated for the nursery and growout stages of production.

Table 7: Pro Forma Average Annual Enterprise Budget for a 100-Cage (10-rack), Bay Scallop Culture Operation

Revenue Expense Category	Number	Unit Price	Total Amount
Revenue			
Scallops are harvested at 40-50mm (Survival: 75% N; 80% G; 60% Total)	16,000	$0.25	$4,000
Variable Costs			
Seed scallops (4-5 mm)	27,000	$10 / 1,000	$ 270
Fuel / oil (pump, boat, truck)			$ 500
Repair / maintenance:			
Rigging system			$ 50
pump, winch, boat, motor			$ 100
Supplies / expendables			$ 100
Packing materials			$ 200
Labor and wages			--
Total Variable Costs			$1,220
Fixed Costs			
Insurance			--
Interest			$ 0
Permits and licenses			
Submerged lease fee			$ 40
DACS certificate			$ 50
Bookkeeping / accounting fee			$ 0
Taxes			--
Total Fixed (Cash) Costs			$ 90
Depreciation			$ 849
Total Fixed Costs			$ 939
Total Costs			$2,159
Net Returns to Owner Labor, Management, and Taxes			$1,841
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Cost per harvested scallop and Break-even Market Price (*total cost / number harvested*)			$0.135
Break-even Survival Rate (*total cost / market price / number stocked*)			32 %

Table 8: Pro Forma Average Annual Enterprise Budget for a 100-Cage, Longline, Bay Scallop Culture Operation

Revenue/Expense Category	Number Unit Price	Total	Amount
Revenue			
Scallops are harvested at 40-50mm (Survival: 75% N; 80% G; 60% Total)	16,000	$0.25	$4,000
Variable Costs			
Seed scallops (4-5 mm)	27,000	$10 / 1,000	$ 270
Fuel / oil (pump, boat, truck)			$ 500
Repair / maintenance:			
longline system			$ 50
pump, boat, motor			$ 100
Supplies / expendables			$ 100
Packing materials			$ 200
Labor and wages			--
Total Variable Costs			$1,220
Fixed Costs			
Insurance			--
Interest			$ 0
Permits and licenses			
Submerged lease fee			$ 40
DACS certificate			$ 50
Bookkeeping / accounting fee			$ 0
Taxes			--
Total Fixed (Cash) Costs			$ 90
Depreciation			$ 807
Total Fixed Costs			$ 897
Total Costs			$2,117
Net Returns to Owner Labor, Management, and Taxes			$1,883
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Cost per harvested scallop and Break-even Market Price (*total cost / number harvested*)			$0.132
Break-even Survival Rate (*total cost / market price / number stocked*)			31 %

Cash Flow

The cash flow analysis provides information on cash income and expenses for each year in the planning horizon of the firm (**Tables 9 and 10**). Non-cash costs, such as depreciation and reductions in inventory value, are not included. The cash flow allows a prospective bay scallop culturist to determine (1) when the initial capital investment can be recovered, (2) how long before cash receipts exceed cash expenses, (3) in what year the initial positive cumulative cash position occurs, and (4) the cumulative cash position be at the end of the planning horizon.

The annual cash receipts ($4,000) and cash outflow estimates are the same as those found in the annual enterprise budgets (**Table 7 and 8**), with one exception. The capital investment estimates reflect the scheduled capital replacement costs as found in **Tables 3 and 4**. These cash costs replace the annualized non-cash depreciation estimates found in the enterprise budgets. The Total Cash Outflow estimate is the sum of the variable costs, fixed costs, and capital investment/ replacement costs for a given year. The Annual Cash Position represents the difference between the Cash Receipts and the Total Cash Outflow values for a given year. The Ending Cash Balance is the summation of the Beginning Cash Balance (cash remaining from the previous year) and the Annual Cash Position. This latter value reflects the cash remaining for the year and serves as the Beginning Cash Balance for the next year in the planning horizon. The Ending Cash Position is negative for Year 1. Although the initial capital investment is paid off in Year 1, the operational expenses are not totally recovered. Thus, the business does not "cash flow" until Year 2, when all costs, and the negative cash balance carried over from Year 1, are exceeded by cash receipts realized in Year 2. The Ending Cash Balance for Years 2-6 are positive, with an Ending Cash Balance in Year 6 of $8,293. Recall that certain costs, such as labor and taxes, have not been included. If these costs are included as annual expenses, the Ending Cash Balance for each year would be less, possibly delaying an initial positive Ending Cash Balance until Year 3 or later. Also, the number of years required to pay back the initial capital investment would be increased.

Table 9: Pro Forma Annual Cash Flow for a 100-Cage (10-rack), Bay Scallop Culture Operation

	YEAR					
Cash Item	1	2	3	4	5	6
Beginning Cash Balance	$ 0	($1,236)	$1,379	$3,899	$5,763	$8,283
Cash Receipts	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000
Cash Outflow						
Variable Costs	$1,220	$1,220	$1,220	$1,220	$1,220	$1,220
Fixed Costs (excl. deprec.)	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90
Capital Investment/ Replacement	$3,926	$ 75	$ 170	$ 826	$ 170	$2,680
Total Cash Outflow	$5,236	$1,385	$1,480	$2,136	$1,480	$3,990
Annual Cash Position	($1,236)	$2,615	$2,520	$1,864	$2,520	$ 10
Ending Cash Balance	($1,236)	$1,379	$3,899	$5,763	$8,283	$8,293

Note: The cash flow assumes that unit costs and market prices remain constant over the five-year planning horizon. The Annual Cash Position reflects cash returns to owner labor, management, and taxes. As with many of the costs estimated in this analysis, these costs will vary considerably by individual and site location of the operation. As a result, owner labor costs and taxes ***have not been included.*** Thus, the Ending Cash Position should be adjusted for individual labor and management payment expectations, and tax costs (federal income and self-employment taxes, if applicable). This will result in a lower Ending Cash Balance each year and may delay payback of initial investment.

Table 10: Pro Forma Annual Cash Flow for a 100-Cage, Longline, Bay Scallop Culture Operation						
	YEAR					
Cash Item	1	2	3	4	5	6
Beginning Cash Balance	$ 0	($ 818)	$1,772	$4,292	$6,266	$8,364
Cash Receipts	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000
Cash Outflow						
Variable Costs	$1,220	$1,220	$1,220	$1,220	$1,220	$1,220
Fixed Costs (excl. deprec.)	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90
Capital Investment/ Replacement	$3,508	$ 100	$ 170	$ 716	$ 592	$2,400
Total Cash Outflow	$4,818	$1,410	$1,480	$2,026	$1,902	$3,710
Annual Cash Position	($ 818)	$2,590	$2,520	$1,974	$2,098	$ 290
Ending Cash Balance	($ 818)	$1,772	$4,292	$6,266	$8,364	$8,654

Note: The cash flow assumes that unit costs and market prices remain constant over the five-year planning horizon. The Annual Cash Position reflects cash returns to owner labor, management, and taxes. As with many of the costs estimated in this analysis, these costs will vary considerably by individual and site location of the operation. As a result, owner labor costs and taxes ***have not been included***. Thus, the Ending Cash Position should be adjusted for individual labor and management payment expectations, and tax costs (federal income and self-employment taxes, if applicable). This will result in a lower Ending Cash Balance each year and may delay payback of initial investment.

Sensitivity Analysis

A major source of risk in an aquacultural operation where the technology and market are not well developed includes unanticipated changes in market conditions, input prices, yield, and costs. This may be particularly true for the culture and marketing for whole, bay scallops in Florida. An understanding of how sensitive profit is to such change can allow the manager to focus attention on controlling those factors that have the greatest influence on the financial performance of the culture operation. A sensitivity analysis was performed on market price, overall survival, growout stocking density, size distribution at time of harvest, seed cost, capital cost (i.e., cages), and useful life of the cages. In a real world setting, several of these factors may be changing simultaneously, which would likely compound their individual effects. In this analysis, however, at most only two factors were allowed to change simultaneously, while all other baseline assumptions were held constant. The sensitivity analysis reports the change to annual net returns resulting from a decrease and/or increase in the respective factor(s). The incremental changes by which each factor is changed was confined to a range deemed to be reasonable based on the current knowledge of the market and culture technology.

Market Price and Survival (Table 11)

Market Price - Market price is allowed change from $0.15 to $0.30 per each scallop harvested in the 40-45mm size range (with overall survival being held at 60%). Note that the baseline assumption price is $0.25, which generates an annual net return of $1,840. As market price is reduced to $0.20 and $0.15 (and holding overall survival at 60%), net returns decrease to $1,040 and $646, respectively. As market price increases to $0.30, net returns increase to $2,640. A decrease in market price may be applicable if, for example, growers are no longer allowed to sell directly to restaurants or the demand for whole, bay scallops by local chefs is weak and the quantity demanded is easily met by a small quantities of product. Alternatively, a stronger than anticipated demand by retail consumers may bid up the price of cultured bay scallops, particularly if the product can be provided on a consistent basis, in terms of size, quantity, and quality.

Survival - Overall survival (nursery and growout) is allowed to vary from 30% to 80%. Recall that the baseline assumption is 60% and results in an annual net return of $1,840 (with market price given as $0.25). As overall survival is decreased to 50%, 40%, and 30% (while market price is held to $0.25), net returns decrease to $1.250, $610, and -$30, respectively. If overall survival increases to 70% and 80%, net returns increase to $2,540 and $3,170, respectively. Overall survival may vary considerably, given changes in growing conditions, predation levels, and skill of the culturist. It is anticipated that a bay scallop culturist will be confronted with a "learning curve", which will characterize the production process with increased overall scallop survival as the grower becomes more efficient with the nursery and growout techniques. Increases in overall survival may occur as the culturist becomes more skilled with the culture techniques. A positive change in overall survival will result in greater revenues, but will cause packaging costs, transportation costs, and labor to also increase since a greater number of scallops will need to be packed for shipping.

Market Price and Survival Combined - Overall survival and market price may actually change from year to year as growing conditions and market conditions vary. These factors may change simultaneously. When lower survival rates are combined with lower market prices, relatively low to negative net returns result. The opposite occurs when increased market prices are coupled with increased overall survival rates. If a minimum net return threshold of approximately $1,000 is required by the potential investor at the current scale of production (i.e., 100 cages), the analysis suggests which market price:survival rate combinations would be sufficient. For example, the following price:survival combinations would provide at least the minimum net returns required - $0.15:80%, $0.20:70%, $0.20:60%, $0.25:50%, and $0.30:40%. If the grower cannot achieve at least 30% survival, no reasonable price will produce the threshold revenue level. Note that this finding is corroborated by the minimum survival rate estimated on the annual enterprise budget (**Tables 7 and 8**).

Table 11: Effect on Net Returns Resulting from Changes in Survival and Market Price						
Market Price per scallop	Survival (cumulative % and number harvested)					
	30 % (8,100)	40 % (10,800)	50 % (13,500)	**60 % (16,000)**	70 % (18,900)	80 % (21,600)
$ 0.15	($ 840)	($ 470)	($ 100)	$ 240	$ 646	$1,010
$ 0.20	($ 440)	$ 70	$ 570	$1,040	$1,590	$2,090
$ 0.25	($ 30)	$ 610	$1,250	**$1,840**	$2,540	$3,170
$ 0.30	$ 370	$1,150	$1,920	$2,640	$3,480	$4,250

Stocking Density and Marketability (Table 12)

Stocking Density - Initial production trials suggest the most effective growout stocking density for bay scallops is between 50-75/ft^2. This is also supported by bay scallop research conducted in the mid-Atlantic region (Oesterling 1998). However, most of the research done in the current study has utilized a growout stocking density of 50/ft^2, which corresponds with a stocking rate of 200 scallops per growout cage. This value was utilized as a baseline production assumption in the economic analysis. When also assuming that all harvested scallops are of the desired market size, net returns are estimated to be $1,840. If 100% marketability is held constant, net returns per cage increases to $2,770 and $3,711 for stocking densities of 250 (62/ft^2) and 300 (75/ft^2) per cage, respectively. Net returns do not increase by the same proportion as the stocking density since an increase in operating expenses equal to the cost of the additional seed clams in incurred. Additional packing and transportation costs are also incurred

Percent Marketable - Initial production trials from the current study suggest that a distribution of sizes will be found among the bay scallops in each cage at time of harvest. However, insufficient data are available to provide a clear assessment as to the appropriate size distribution to be expected. This will likely vary by growing conditions and stocking densities. Similar relationships between size distribution at time of harvest and other factors, including stocking densities, general growing conditions, location of lease site, etc., were experienced with the development of the hard clam culture technology (Adams and van Blokland 1998). One method to capture this uncertainty associated with size distribution is to simply impose a range of marketability percentages on the total number of harvested scallops. The marketability percentage was allowed to range from 100% (baseline assumption) to 70% in increments of 10 percentage points. The remaining portion of the harvested scallops was assumed to be unmarketable, even after restocking. If stocking density is held to 200 per cage, net returns decrease from $1,840 for 100% marketable to $640 for 70% marketability. A decrease in marketability will cause a decrease in revenues, but also a decrease in packaging costs, as fewer scallops are packed for shipment.

Stocking Density and Percent Marketable Combined - Experience from the hard clam culture industry suggests that as stocking densities in growout bags increase, the size distribution of harvested clams will also increase (i.e., more undersize clams in each harvested batch). This may also hold true for bay scallop culture. Thus, as stocking densities for bay scallops are increased to 250 or 300 per growout cage, a lower percent of marketable scallops may be realized. Note that the revenue losses due to a 90% marketability is offset by the 250 per cage stocking density. However, any further reductions in marketability results in a net return that is less than the baseline assumption case (i.e. $1,840). In contrast, a stocking density of 300 per cage more than offsets any revenue losses from reduced marketability, at least within the range examined (i.e., all net returns estimates for 90%, 80%, and 70% marketability levels exceed the baseline estimate).

Table 12: Effect on Net Returns from Changes in Growout Stocking Density and Percent Marketable

Percent Marketable (from total harvested)	Growout Stocking Density		
	200 Per Cage ($50/ft^2$)	250 Per Cage ($62/ft^2$)	300 Per Cage ($75/ft^2$)
100 %	**$1,840**	$2,770	$3,711
90 %	$1,440	$2,270	$3.110
80 %	$1,040	$1,770	$2,510
70 %	$ 640	$1,270	$1,910

Growout Cages: Cost and Economic Life (Table 13)

Cost - The largest single initial capital cost item is growout cages. The cages for the study were constructed on a custom basis by a local commercial trap producer. The initial cost of each cage was $23, including materials and labor. The cages were constructed from plastic-coated "wire mesh" with a single, hinged door located on the top. The door was held in place with a small, elastic cord and hook. A prospective scallop culturist may be able to reduce the initial capital investment by building the cages, thereby potential reducing the labor cost, and thus the total cage cost, significantly. The per each cost of the growout cages was reduced from $23 to $20, $15, and $10. Given the baseline assumption of a five-year life for each cage, net returns increase to $1,900, $2,000, and $2,100 for the $20, $15, and $10 unit cage cost, respectively. As can be seen, the reduction in the per unit cage cost does not have a significant impact on net returns. However, this cost reduction does serve to decrease the initial capital investment, which has been identified as one of the most common barriers to entry in the Florida aquaculture industry.

Economic Life - The economic life of a growout cage may be increased by exercising appropriate care, such as periodic cleaning and attaching a small zinc anode to each cage (the latter cost was not included in the analysis). However, the harsh environment, fouling, and periodic handling may still result in a lower average economic life for the cages. The life of the cages was reduced from 5 to 3

years. Note that for a $23 cost per cage, the annual net returns decrease to $1,540. This is due to an increase in the replacement cost of the cages (i.e., they have to be replaced more frequently which results in a higher average annual depreciation).

Cost and Economic Life Combined - Even with a reduction in per each cage costs to $15 or $20, the increased replacement costs associated with a 3-year life results in net returns equal to or less than the baseline case. Only until cage costs are reduced to $10 will the 3-year cage life provide for increased net returns relative to the baseline estimate.

Table 13: Effect on Net Returns from Changes in the Cost of Growout Cages and the Years of Life for the Cages

Years of Life for Cages	Per Each Cost of Cages			
	$10	$15	$20	**$23**
5 Years	$2,100	$2,000	$1,900	**$1,840**
3 Years	$1,970	$1,880	$1,630	$1,540

Cost of Scallop Seed (Table 14)

Currently, there are no commercial sources of bay scallop seed in Florida. For the purposes of this study, commercial sources of seed were contacted in the mid-Atlantic and New England states. Price lists for seed were obtained from four commercial sources. In addition, a projected price list was obtained from the Harbor Branch Oceanographic Institute in Ft. Pierce, FL. Prices per 1,000 seed clams were solicited for several size categories. Prices varied considerably, depending on the anticipated demand, volume purchased, etc. The baseline price of $10 per 1,000 seed scallops represents a conservative cost estimate. Until a consistent demand for seed scallops develops in Florida, the per 1,000 price may be higher. Studies by the University of Florida have shown that the cost of producing seed clams is indirectly related to the scale of the hatchery operation (Adams and Pomeroy 1992). Since a similar technology would be used to produce seed scallops, the same relationship may hold for a scallop hatchery. Given the absence of such a commercial source of seed in the southeast U.S., the actual per 1,000 price for scallop seed may be higher than the baseline assumption of $10. Thus, per thousand seed prices were allowed to vary upward to $15 and $20 from the baseline assumption. Net returns would be expected to decrease with an increase in total seed cost, which represents one of the major operational expenses of the business. Net returns decreased to $1,700 and $1,570 as seed prices increased to $15 and $20 per thousand.

Table 14: Effect on Net Returns from Changes in the Cost of Scallop Seed

Cost per Thousand for 3-5 mm Bay Scallop Seed		
$10 / 1000	$15 / 1000	$20 / 1000
$1,840	$1,700	$1,570

Summary and Discussion

This analysis suggests that the net returns for a 100-cage, bay scallop culture system would be approximately $1,800. This estimate does not include cost for labor or taxes. Initial investment of 100-cage rack or longline system is $3,900 or $3,500, respectively. Average annual operating costs are approximately $2,100 for either system. Average cost per scallop is about 13 cents, excluding labor and

taxes. The initial investment is paid back during the first year of the investment, but a positive cash flow does not occur until Year 2. Including labor and tax costs will likely delay the initial occurrence of a positive cash flow until Year 3 or later.

Net returns are found to be most sensitive to market price, overall survival rate, and stocking density. In addition, the size distribution of the harvested scallops effects net returns in a manner similar to survival rate (given under the assumption that no restocking of undersize scallops occurs).

Although the amount of labor involved in the culture process has not been measured, a labor bill based on the current national minimum wage ($5.65/hr) would allow for 319 man hours during the 9-month production process, or 35 hours per month (9 hours per week) on average. Thus, if the culturist spends an average of 9 hours per week managing the bay scallop lease site, and values each hour at the minimum wage rate of $5.65, the operation would break even. In other words, the labor cost would approximately equal the estimated net returns.

The impact of scale on the financial performance of the hypothetical production systems was not examined. However, the marginal financial performance (i.e., approximately break even) may improve with facility size. This may be particularly true for the rack system, which does have some capital costs (e.g., the rack lifting apparatus) that could be reduced on average through increased production levels (i.e., number of cages). The same is not true for the longline system, the capital costs of which are almost linearly related to the number of cages. Refining the production system to allow increased stocking densities up to 75/ ft^2 would also increase the net returns of the system. In addition, finding ways to minimize labor requirements, enhance market price, increase the percentage of harvested scallops that are marketable, extend the life of all capital equipment, or share the costs of a boat (i.e., fuel, repair and maintenance, etc.) with another culturist would enhance the profitability of the operation.

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Attachment III

PROJECT B.A.Y.
(Bay Scallop Aquaculture Yield)
CURRICULUM

Attachment III

PROJECT B.A.Y.
(Bay Scallop Aquaculture Yield)
CURRICULUM

Organizers

Dr. Norman J. Blake, University of South Florida
Leslie Sturmer, Florida Cooperative Extension Service
Don Sweat, Florida Sea Grant Extension Program

The Project BAY curriculum combines hands-on nursery and growout training with a series of topics introduced through classroom sessions. Those participants who successfully complete the minimum requirements of the retraining program will be issued a certificate of completion.

"Hands-on" Bay Scallop Growout Training

- Each participant will receive scallop seed and the necessary culture equipment to field nurse and growout a crop of shellfish on a training plot in the Gulf of Mexico. The growout training will be conducted over a 6-month period and headquartered at the Project BAY Office and Training Area in Crystal River.

- Knowledge and skills acquired through introductory seminars and in-water training experiences will include the following:

* bay scallop biology
* shellfish handling protocol for various scallop sizes
* culture equipment operation and maintenance
* stocking or planting densities for field nursery and growout systems
* volumetric and sub-sampling measurement methods
* sieving and sorting procedures
* record keeping and inventory
* survival and growth determinations
* predator protection techniques
* harvesting and marketing methods

"Hands-on" Bay Scallop Nursery Training

- Each participant will receive smaller scallop seed and utilize several systems (suspended bags and raceways) to nurse seed in a land-based facility. The nursery training will be conducted over a 6 to 8-week period and headquartered at the Community-based Nursery Facility.

- Knowledge and skills acquired through introductory seminars and hands-on training experiences will include the following:

* shellfish handling protocol for various scallop sizes
* nursery systems operation and maintenance
* stocking densities for land-based nursery systems
* volumetric and sub-sampling measurement methods
* sieving procedures
* record keeping and inventory work sheets
* survival and growth determinations
* predator protection techniques
* equipment development and systems design

Bay Scallop Aquaculture Classroom Sessions

- The classroom curriculum is designed to compliment the concurrent "hands-on" training. The following classes will be offered to Project BAY participants at a Citrus County classroom location:

* Introductory Class - Basic biology of bay scallops is introduced and a review of scallop culture practices occurring worldwide.

* Scallop Aquaculture Business Class - Basic business management and decision making skills will be introduced and potential economic and financial considerations of a scallop commercial operation will be reviewed.

* Lease Site Selection Class - Criteria for evaluating submerged land sites for scallop culture, outline of the state aquaculture lease process, and information on possible aquaculture lease sites off of Citrus County will be provided.

* Lease Application Class - Provisions in the Department of Environmental Protection (DEP) lease application and instrument (contract) will be reviewed. In addition, other required state licenses and permits for shellfish aquaculture activities and leases will be explained.

* Culture Equipment Demonstration - A session will be offered in which manufacturing of scallop nets and other culture equipment will be demonstrated. Also, information on vendor sources, prices, and aquaculture equipment catalogs will be complied and provided.

* Marketing Class - Market trends, state sponsored marketing efforts, current regulatory procedures, and quality assurance for scallops will be presented by representatives from various state agencies and institutions.

* Hatchery Tour - A tour of the scallop hatchery on the University of South Florida, St. Petersburg campus will be offered.

PROJECT BAY
ATTENDANCE REQUIREMENTS

1. Introductory Class - **Required**

2. In-Water Classes (2) - **Required**

3. Field Nursery Training - **Mandatory**
   Minimum once per month

4. Growout Training - **Mandatory**
   Minimum once per month

5. Move Product from Training Site to Lease - **Required**

6. Business Management Class (1) - **Required**

7. Site Selection Class - **Required**

8. Lease Application Class - **Required**

9. Other Optional Training Opportunities:
   a. Land Based Nursery Training
   b. Shellfish Marketing Class
   c. Equipment Manufacturing Demonstrations
   d. Security/Surveillance Class

Notification Procedures (Field Nursery/Growout Training):

1. One month after minimum attendance requirement, notify by mail.

2. If do not respond after an additional two weeks, contact personally by telephone or visit.

3. If do not attend after another two weeks or total of two months past the minimum requirement, will be terminated from training program.

Science Serving Coastal Florida

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