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Environmental and Economic Influences on the Oyster Fishery of Lower Barataria Bay, Louisiana.

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Environmental and Economic Influences on the Oyster Fishery of Lower Barataria Bay, Louisiana

A Dissertation

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ABSTRACT

A three year study, 1982-85, of eight oystermen bedding on 19 leases in lower Barataria Bay was designed to determine lease production, fuel, labor and energy inputs and the expenses to operate. The data was then incorporated into a bioeconomic model of the lower Bay.

Commercial yield ratios (sacks harvested:sacks bedded) per lease ranged from 0.03-1.68:1. The two lowest lease yields were the result of vandalism and poaching, respectively. A multiple linear equation developed from the data predicts that as salinity and water temperature increase, lease yields decrease. Utilization of the Bay's bedding leases are dependent on seed obtained from the public grounds. The lower-Bay oystermen harvested 87% of their seed from the public grounds.

Vessels consumed an average of 294 liters of diesel per day while bedding and 90 liters per day while harvesting for market. An average of 2.23 liters of diesel was consumed per sack sold (bed + harvest fuel). Oystermen spent an average of 69 man-days of labor bedding seed (based on a crew of 3) and 124 man-days of labor harvesting for market. An average of 76 sacks were harvested per day of labor (bed + harvest labor). The energy efficiency ratio (kcal oyster meat produced/kcal input) equaled 0.11:1.

Average daily expenses to operate were 18 percent higher while bedding than while harvesting for sale. Total variable expenses (bed + harvest) were separated into each expense category's

contribution: labor for two deckhands (59%), general maintenance of vessel and engine (18%), vessel fuel, oil an grease (14%), galley supplies and food (8%), and butane and ice (1%). An oysterman may see a net return of 75% above annual operating expenses (variable + fixed), before captain (owner) and vessel shares are taken out.
A profit can occur only when there are sufficient quantities of seed to bed.

Application of a bioeconomic model indicates that if lower-Bay oystermen wait until October to bed, potential lease yield increases. In addition, if an oysterman beds in upper Barataria Bay, where historical salinities are lower, lease production may increase significantly over bedding in the lower Bay.

1.0 INTRODUCTION

Louisiana consistently ranks among the top states in oyster production and presently leads the nation (NMFS 1988). Reported production has averaged 4.7 million kilograms (10.4 million pounds) of oyster meat annually from 1961-87 (Keithly and Roberts 1988). From 1983 to 1988 total state production has averaged over 5.7 million kilograms (12.5 million pounds) (Dugas 1988). In addition, the value of Louisiana's oyster harvest has been trending upward since 1961, and for the period 1981-87 averaged $22 million annually before deflation (Keithly and Roberts 1988).

Oysters bedded (planted) as seed on privately leased water bottoms and later harvested for market contribute significantly to the state's production (Perret and Chatry 1988). Leased oyster acreage in the state have produced 65 to 95 percent of the state's landings from 1962 to 1981 and has averaged 80 percent yearly (Pawlyk and Roberts 1986). However, the ratio of production from private leases to total state production has fallen since 1981 and now averages 74 percent (Keithly and Roberts 1988). This private production has come from over 121,408 hectares (300,000 acres) of leased water bottom from the state (Dugas 1988).

In addition to the privately leased acreage, the state manages over 728,450 hectares (1.8 million acres) of public grounds in five coastal parishes (Figure 1.1). Much of private production starts from harvesting seed from the public grounds and bedding it on

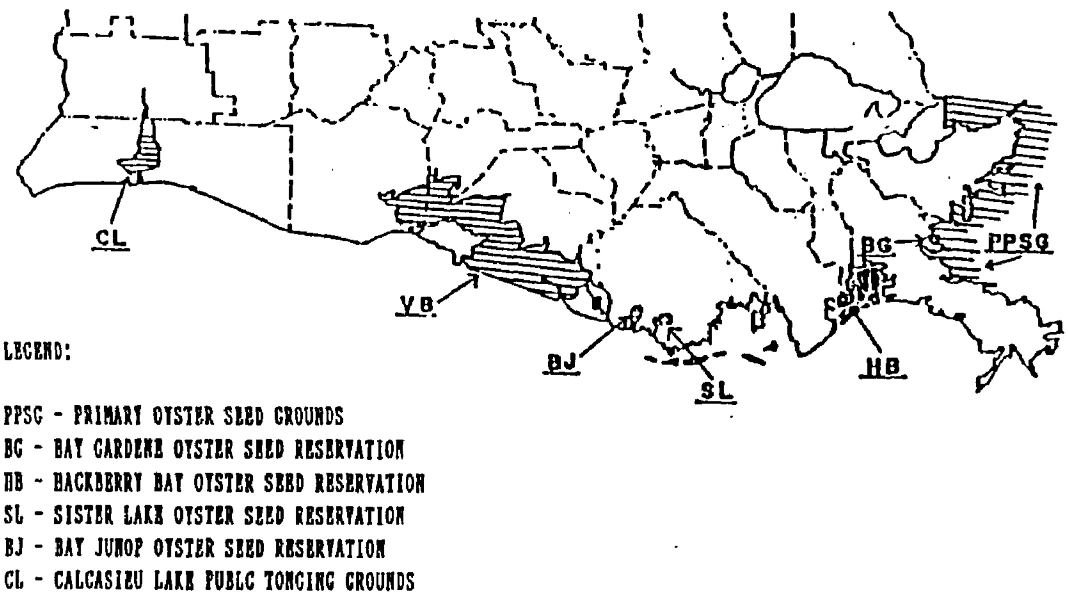

Figure 1.1. Location of Oyster Seed Grounds Managed by the Louisiana Department of Wildlife and Fisheries. (map courtesy of LDWF).

private beds for additional growth and fattening before being sold (Perret et al. 1971; Dugas 1988). The public reefs may also be fished for direct sale (sack) production when quantities of large-sized oysters exist (Perret and Chatry 1988).

The private-public relationship in Louisiana has been an important stabilizing element in the industry through the 20th century (Dugas et al. 1981; Perret and Chatry 1988). Private control of leases helps to prevent wide swings in oyster prices and allows an oysterman to market his product year-round (Pawlyk and Roberts 1986). This relationship, along with Louisiana's vast coastal marshes has produced the largest privately leased acreage in the nation (Chew 1981) and rivals any oyster fishery found in the world (Bardach et al. 1972).

The difference between a "bedding lease" and "lease" must be stated to eliminate confusion. A "bedding lease, as defined by Wicker (1979), is "suitable water bottom (firm substrate, sufficiently moving currents, little sedimentation, medium to high salinity, adequate food, etc.) where oysters are deposited either for temporary holding or for improving their quality (flavor, fatness, etc.)." In addition, a bedding lease refers to an area that is staked off with poles and oysters bedded (planted) within that area. In contrast, a "lease" refers to a parcel of water bottom leased by the acre from the state which may be the size of the bedding lease, or larger. Oystermen will lease extra acreage around a good bedding bottom as a buffer to keep others away.

The oysters that are bedded are called seed oysters and are traditionally 25-75mm in length, although larger oysters may be bedded (Dugas 1982). Public grounds refers to those water bottoms that are controlled-and-managed by the state for the production of seed.

BARATARIA BAY:

Perhaps there is no better area in Louisiana than Barataria Bay (Figure 1.2) for discussion of an oysterman's efforts versus the influence of the environment on oyster survival. The Bay is part of one of the most productive estuarine ecosystems in North America, Barataria Basin (Day et al. 1973). The Basin is a major oyster producing area for the state (Allen and Turner 1984).

Van Sickle et al. (1976) estimated that 3,329 hectares (8,223 acres) of water bottom were leased in Barataria Bay and its adjacent waters by the private sector in 1975. Barataria Bay, however, contributes only a small part to the Basin's total production (pers. observ.). This is because of its location and to the relatively high predator abundance (Melancon et al. 1987).

Many of the leases in lower Barataria Bay and its adjacent waters are, at present, not being used to bed seed because of a scarcity of oysters on the public grounds (pers. observ.). In addition, many oystermen have moved farther inland within the Basin and Bay where the waters are often not as salty, thereby reducing predator and disease problems (Van Sickle et al. 1976). Others use leases that are closer to the principal sources of seed on the

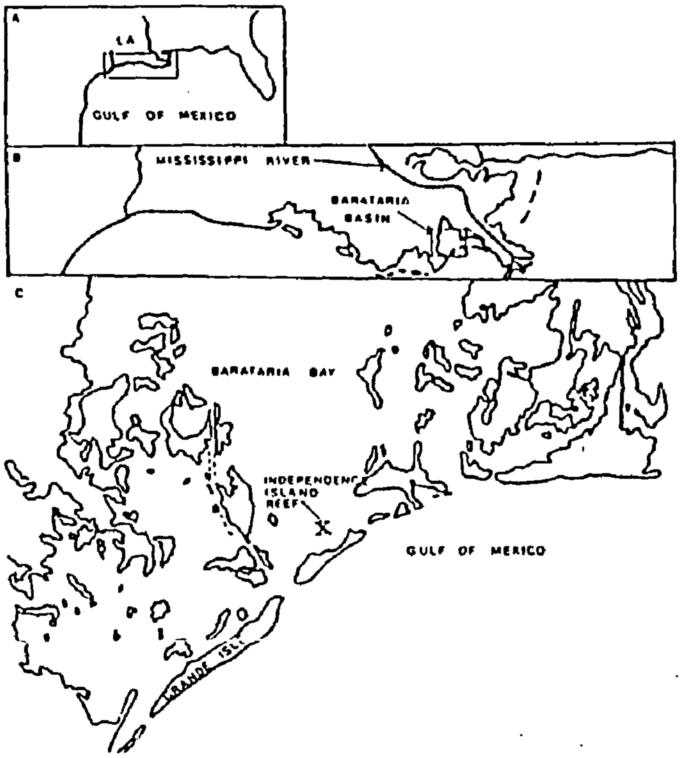

Figure 1.2. Location of Barataria Bay.

state's public grounds. A small number of oystermen, however, have remained in the lower Bay to bed their oysters and they do make a profit, but the costs may be high.

Oystermen using the lower Bay may number as many as 10 in a given year. The reason for the limited use of the lower-Bay leases appears to be due to the time, effort and associated environmental costs to the oystermen (Melancon and Condry 1988).

RATIONALE FOR SELECTING BARATARIA BAY FOR STUDY:

The private reefs of lower Barataria Bay are devoid of natural oyster populations and are only used for short periods for oyster fattening and growth (Owen 1953a). Such conditions make monitoring of bedding and harvesting activities easier since lease production is dependent on the volume of oysters bedded and the prevailing environmental conditions. Warm spring and summer water temperatures and relatively high salinities in the Bay combine to produce heavy oyster mortalities due to predation and disease (Mackin and Hopkins 1961). The Bay may actually magnify the associated problems of disease and predation (Owen 1953a; 1953b).

Few have looked at the effort and expenses involved in bedding and harvesting a lease. Many, however, state that the fishery is labor-intensive with production dependent on environmental conditions, which also affects an oysterman's profits (e.g., Owen 1953a; Mackin and Hopkins 1961, Van Sickle et al. 1976, and Dugas et al. 1981). Only one documented study exists, however, by Korringa (1976), that discusses production, environment and an oysterman's

labor and expenses. Korringa's paper, however, is more anecdotal than scientific and based on interviewing the owner of two vessels for one season in Barataria Bay. In addition, the only relatively complete itemized list of expenses for a Louisiana bedding lease dates back to 1928 (La. Dept. Conserv. 1931). It too is for a Barataria Basin lease.

Barataria Bay is centrally located on the southeastern Louisiana coast. Personal observations and interviews with state biologists and oystermen confirm that the Bay is the farthest practical distance an oysterman will usually travel to bed oysters that are collected from the public reefs. Since no data exists for comparison to other locations around the state, the Bay offers an opportunity to show fuel and labor costs that are near the highest in the state for bedding oysters.

Knowledge of an oysterman's efforts and expenses are limited not only in Louisiana but elsewhere in the United States (Kearney/Centaur 1988). Allen and Turner (1984) state that they could not find any published information documenting the time actually fished or fuel used in an oyster fishery in the Gulf of Mexico. Since Allen and Turner's study, Prochaska and Keithly (1986) have documented the harvesting efforts and associated expenses of the Franklin County (Pensacola), Florida oyster tong fishery. The Louisiana seed fishery, however, is a dredge fishery.

Information on the relationship of environment, private lease production, labor efforts and associated bedding and harvesting

costs are also limited in the Virginia and Maryland oyster fisheries (Mike Castagna, Va. Inst. Mar. Sci., pers. comm.). Production and effort are documented in the west coast oyster fishery in Washington state by Nickelson and Mathews (1975), but their study does not correlate production with environment.

No published oyster studies combining labor and fuel needs, environment, private lease production and economics could be found. Part of the reason for the lack of comparative data from elsewhere may be due to the relative uniqueness of Louisiana's strong state-private relationship. In addition, to obtain private production information requires the trust and total cooperation of the oystermen.

As state earlier, Barataria Bay is a marginal area for bedding oysters because of the distance one must travel to obtain seed and to the abundance of predators associated with high salinity waters. Therefore, the information derived from this study will give state managers and oystermen information on maximum environmental and bedding costs to the seed bedding fishery. In addition, the limited information that does exists on private leases in Louisiana was derived primarily from studies within the Basin and Bay. The information obtained in this study can be directly compared to historical data.

Knowledge that can not be shared is of limited value. Adam (1973) states that "any research which would isolate either biology or economics would be cut off from the feedback occurring in

reality. Any model used to describe reality will be false if it is divided into two isolated parts." Pausina (1988), a Louisiana oysterman, states, "We must also utilize the technology developed in the computer industry, particularly software for record keeping and rapid analysis of profit/loss as it pertains to various operations of the oyster business." Adam's and Pausina's philosophy was followed in this study.

OBJECTIVES:

(1) Document how environmental conditions affect lease production and develop a method to predict yield.

(2) Document the time, effort and fuel needs of a bedding lease and develop an energy profile of the fishery.

(3) Document the expenses associated with bedding oysters and develop an economic analysis of a seed fishery.

(4) Develop a production and cost model of a Bay seed fishery using the environmental and economic data generated from this study. Incorporate the data into a user-friendly, PC-compatible program and store on floppy disk.

2.0 HISTORICAL PERSPECTIVE

No one can truly understand or properly manage a fishery unless knowledgeable of its history. The oyster has been subjected to environmental and human influences throughout history. These historical and present day influences affect not only oyster survival, but government's role in management and an oysterman's ability to harvest a renewable resource.

The oyster industry is the oldest state-managed fishery in Louisiana. Steeped in a long history, the fishery is slow to change and many of the fishing practices of today were being used in the 1920s (Wicker 1979). The human and environmental demands on the fishery, however, continue to change. The fishery must respond to these changes if the industry is to survive into the next century (Perret and Chatry 1988).

STATE-PRIVATE RELATIONSHIP:

While there was limited transplanting of oysters before the Civil War (Wicker 1979), the first large-scale bedding (transplanting) occurred in the latter part of the 19th century. Theses oysters were removed from the more inland wild reefs and bedded in saltier waters at the end of the Delta, east of the Mississippi River, in Whale Bay (Mackin and Hopkins 1961) (Whale Bay no longer exists because of delta erosion).

Scientific investigations during the last part of the 19th and first part of the 20th century were aimed at mapping the state's

oyster resources. H.F. Moore, the assistant United States fish commissioner, was the first to put Louisiana's oyster resources into proper perspective. In 1897, the Federal Government sent him, at the request of the state legislature, to conduct a survey of Louisiana's oyster resources and to gather information on the biology of the animal.

Moore surveyed the oyster areas of coastal Louisiana from Mississippi Sound to the Atchafalaya River. After his survey, he made recommendations to the state (Moore 1898). Among his recommendations were, (1) stop all oyster harvesting on the public grounds from April 1 to October 1 to allow the oysters to spawn and the spat to attain a larger size before harvesting activities occurred on the reefs, (2) encourage oystermen to plant shell (cultch) to increase private lease habitat in areas suitable for oyster setting and survival, (3) make it illegal for oystermen to remove dead shell from public beds, (4) make it illegal for oystermen to harvest or sell oysters less than 75mm (3 inches) in total shell length from public and private grounds, (5) give permanent tenure of leased beds to an oysterman and increase the acreage available to him (10 acres at that time), and (6) increase and improve enforcement of state laws.

Some of Moore's recommendations were incorporated into the legislative acts that brought the industry into the 20th century; others were not. Wicker (1979) regards this period, 1902 to 1904, as a pivotal point for the expansion of the industry. Today, the

Louisiana Department of Wildlife and Fisheries (LDWF) has legislative authority to open the state's public oyster grounds in September, on the first Wednesday after Labor Day, and close anytime after January 1, but no later than April 1. In addition, the LDWF can keep any public area closed when necessary. This allows oysters the time to spawn and gives a degree of protection to the small recently set oysters (spat oysters). The LDWF, through its enforcement division, has the legislative power to enforce culling laws for reef shells harvested from the state grounds (Dugas 1982).

The state also partially responded to Moore's suggestion of permanent tenure of private lease by oystermen. Today, the state grants a 15-year agreement with the lessee getting first option for renewal. The state, in 1904, set the maximum acreage any one individual could lease at 1,000 acres. Initially, the annual lease fee paid to the state was $1 per acre per year. Later it was increased to $2 per acre per year, today's fee.

The most interesting recommendation made by Moore, that no oysters less than 3 inches (75mm) be removed from private or public reefs, was not incorporated into law. At the time of his recommendation, oyster transplanting was already occurring around the state and he acknowledged the strong opposition to passing such a law. The irony is that Moore was not against seed planting but rather against moving small oysters less than 75mm. His reason to leave oysters less than 75mm was to allow one spawn cycle before being harvested. In the fishery today, true seed-size oysters are

considered to be 25-75mm in length, the size Moore recommended not to be moved. A Louisiana oyster can attain a 75mm length in 12-15 months (Dugas 1982).

The state established a 3 inch law (75mm) for any oysters harvested from the public grounds and sold directly, but it did not apply to oysters that were to be transported and bedded on private leases. An oysterman had the legal right to harvest any size oyster from the public grounds if he transported and planted them on his lease. This created an incentive to harvest oysters in bulk and not cull 25-75mm oysters.

Oystermen were vigorously planting shell-for-cultch or seed oysters by the first quarter of this century (La. Dept. Conserv. 1931). The state responded, through the legislature, by requiring LDWF-employed biologists to manage the public grounds for seed production for the industry (Dugas et al. 1981). Now there was little incentive for oystermen to spend their own money for the purchase of shell or to harvest their own wild reefs for seed. The state was becoming the major source of seed for the industry. However, Perret and Chatry (1988) acknowledge that the more successful oystermen plant cultch and do not rely exclusively on the state for seed.

Economics were in favor of the oysterman who harvested all the oysters he could from the public reefs and bedded them on his own leases. He could protect the resource from other oystermen and wait until he had a better product to market to the canneries or shucking

sheds. The incidental shell he collected from the public reefs helped to build his private reefs.

As the industry expanded with the advent of motorized vessels by the early 1920s, the reliance on the state for seed and shell escalated. The state encouraged cultch planting, but the result was the removal of reef shell that made up the bedrock of a reef (La. Dept. Conserv. 1931). The state responded by issuing an edict requiring all packers (canneries) to return 10 percent of all shells harvested from state waters and bed them under state supervision (La. Dept. of Conserv. 1931). Later the percent that had to be returned was increased to 20 percent. With the collapse of the canning industry due to low cost imports, the amount of shell returned to the state dwindled to nothing by the late 1960s (Dugas 1982).

An oysterman does not have the responsibility to return shucked shell stock to state waters. A severance tax of $0.025 per barrel (= two sacks = $0.1m^3$) from private leases and $0.03 per barrel for oysters harvested from the public grounds is collected by the state. The tax is paid by the oyster sheds.

The state began to supplement its public grounds with shell-for-cultch plants of its own. The state's first shell plant was in 1917 in Sister Lake, Terrebonne Parish, and consisted of 16,238 barrels of oyster shell (Mackin and Hopkins 1961). Consistent, annual shell plants did not occur until the late 1920s (Dugas et al. 1981). Since 1926, the state has planted over 836,131 cubic meters

(1,000,000 yds^3) of cultch for the industry (Perret and Chatry 1988). Except one year, all funds from 1974 to 1984 for state shell plants came from federal sources (Dugas 1984). This reliance on federal assistance continues today (Ron Dugas, LDWF, pers. comm.).

The cultch that is planted by the state is not necessarily planted on top of existing reefs, but put on firm bottoms that may have little natural shell deposits. Shell plants become less of a reef rebuilding or rehabilitation process and more of a temporarily-created habitat. The temporary shell plants can exist for several years of fishing pressure (Bob Ancelet, LDWF, pers. comm.).

To insure the protection of good seed habitat, by the middle of the 20th century, four seed reservations were established on the public grounds of the delta (Chatry 1987). Two located west of Barataria Basin, one within the Basin, and one east of the Basin. Hackberry reservation, located within the Basin, has had limited success or use by the industry or state. Therefore, to bed public seed, Bay oystermen must travel outside of the Basin. The public grounds located east of the Mississippi River in Breton Sound have historically been the primary source of seed for the industry.

DEVELOPMENT OF THE LOWER BAY AS A SEED FISHERY:

Moore, with associate T.E.B. Pope, returned to Louisiana from 1906 to 1908 to conduct federally sponsored seed and shell planting experiments (Moore and Pope 1910). One area selected was Barataria Bay. Two seed and shell plants were made, one near the northern end of the Bay at Bayou St. Denise and the other in the southern part of

the Bay at Bayou Tambour (the bayou no longer exists). Their goal was to "develop a planting industry and to work out methods of rehabilitation of the moribund Barataria Bay industry" (Moore and Pope 1910).

The seed and shell-for-cultch planting was considered successful at Bayou St. Denise. However, oyster survival was reduced at the Bayou Tambour site because of predation in the higher salinity waters. However, they did show that seed oysters planted in the lower Bay grew faster and had an excellent meat yield and flavor. Moore and Pope (1910) considered the oysters of lower Barataria Bay "among the best produced on our entire coast." Lower Barataria Bay's seed planting industry had now become established.

The bedding industry in Barataria Bay and Basin expanded during the first quarter of the 20th century with the construction of the shipping locks at Empire on the west side of the Mississippi River and at Ostrica on the east side (Wicker 1979). Private bedding leases in the Basin first appeared near Empire because of its close proximity to Breton Sound and relatively large population of seed oysters. The Empire/Bay Adam area remains an area of intense bedding activity today.

In 1902 Barataria Bay and its adjacent waters had only six registered leases totaling 24.3 hectares (60 acres). The Bay acreage continued to increase from that small beginning and by the 1930s and 1940s was a principal area for bedding oysters. By 1941 the Bay had approximately 60 leases totalling 367 hectares (929

acres), most of which were in the southern half of the Bay (Van Sickle et al. 1976).

Expansion of new lease acreage after the 1940s occurred primarily in the northern half of the Bay. Salinity encroachment is cited as a primary reason for the northern Bay becoming a reliable area for natural spatfall (Van Sickle et al. 1976). However, Moore and Pope (1910) had shown that the northern Bay could support natural reefs by the beginning of the 20th century.

Perret et al. (1971) estimated that as much as 80 percent of the production in Barataria Basin was dependent on transplanting seed from the public reefs of Breton Sound. More recently, Allan and Turner (1984) have shown that the Basin's total production is significantly correlated with the state's total and has averaged 37 percent since 1963.

In 1959 the LDWF changed the management strategy of the seed reservations (Sister Lake, Bay Junop and Bay Gardene) and began opening them on alternate years. This allowed the seed oysters to grow larger before harvesting. It also gave the reservations a reprieve from yearly dredging activities (St. Amant 1961). The exception is when oysters are in abundance elsewhere on the public grounds, all reservations may be closed that year. Conversely, if oysters are scarce, all reservations may be opened (Perret and Chatry 1988).

This management scheme had a direct effect on the Barataria Bay oystermen. Bay oystermen found themselves traveling in a different

direction each year to harvest oysters from the reservations. The problem of distance makes it difficult to compete with oystermen who have leases closer to the reservations. More Recently, oystermen are traveling far to the west to the public grounds of Vermilion Bay to harvest seed oysters (pers. observ.).

In discussions I have had with Barataria Bay oystermen, many can remember bedding 30 or more loads of oysters, nearly all destined for the canneries. As the number of canneries and available public oysters declined, Bay oystermen and others reduced their number of oyster loads. Today, Dugas (1982) states that Louisiana oystermen may bed 20-25 loads, depending upon the seed supply. Perret and Chatry (1988) state that as many as 50 loads may be bedded by some oystermen, if seed supplies are available.

<u>ENVIRONMENTAL INFLUENCES</u>:

High salinity waters have always been equated with higher oyster predation. Many knew that the conch, <u>Thais haemostoma</u> was a major predator (St. Amant 1938) (early literature has the conch listed as the genus <u>Purpura</u> sp.). Essentially, the combination of drilling with its radula and a secretion of a paralytic substance is recognized as the gastropod's method of attack (Breithaupt and Dugas 1979). <u>Thais</u> can not withstand prolonged salinities below 10 parts per thousand (Galtsoff 1964) and are not found in concentration below 15 parts per thousand (Chapman 1955).

The oyster drill is a poikilothermal animal and therefore metabolizes according to water temperature. When water temperatures

and salinities are relatively high, the level of drill predation increases. The impact of drill predation is a function of its relative size and abundance. When drills are greater than 40mm in length and occur at densities of one or more per square meter, predation rates may increase and be unacceptable for the survival of the oyster population (Cake 1983). Gunter (1979) gives a good review of the biology and available literature on the oyster drill, for that period of time.

Van Sickle et al. (1976) and Wicker (1979) reviewed the methods employed by the Barataria oystermen as they tried to combat the destructive drill on their bedding leases. Today, those who bed on Bay leases take their chances with the prevailing environmental conditions and do not attempt to control snail predation, except when harvested incidentally during oyster dredging operations.

Spurred on by the petroleum needs of the world war, the state's oil and gas industry expanded rapidly into the coastal areas during the 1930s and 1940s. During this same period oystermen began to notice higher oyster mortalities, especially on their more coastal bedding leases. The relationship between the petroleum industry and the oyster fishermen had often been one of confrontation (Gowanloch 1934), but by 1946 the situation reached its peak. A group of oystermen (many from the Barataria Bay area) filed a $2 million law suit against several oil companies for damages.

The state responded to the concerns of the oystermen by hiring a consultant, H. Malcolm Owen, to investigate "undue oyster

mortalities in certain sections of our coastal waters" (McConnel 1947). Owen made five experimental oyster plants along the Louisiana coast, including one on Independence Island in the southern half of Barataria Bay (Independence Island was also used in this study).

Among Owen's findings submitted to the LDWF was that high temperature and salinity combine to increase predators which kill oysters. Predator and disease increases due to saltwater on the bedding leases were a principal reason for the excessive mortalities. Although not a new discovery, he later published some of his results showing the effects of planting oysters in high salinity areas (Owen 1953a; 1953b).

The petroleum industry also responded to the suit by initiating their own investigation. Principals among the companies were Humble Oil (Exxon) and the Texas Company (Texaco). Much of the scientific investigation was coordinated through Texas A&M University and its biological staff. Dr. S.H. Hopkins was director of the study and Dr. J.G. Mackin was field supervisor. Part of their work can be found in the 1961-62 volume of the "Publications of the Institute of Marine Science": Mackin (1961a), Mackin (1961b), Mackin and Hopkins (1961), and Mackin and Sparks (1961). The two principal Texas A&M studies were listed as projects 9 and 23.

An important discovery during the study was the identification of a protozoan parasite in the oyster. Its effectiveness as a parasite was correlated with water temperature, salinity and the age

of the oyster (Mackin et al. 1950). The parasite was initially identified as Dermocystidium marina, later renamed Labyrinthomyxa marinum and finally named Perkinsus marinus. The parasite is still often referred to by its original common name," dermo". Although found in other marine organisms, it is usually considered specific for the American oyster because of the large-scale mortalities often associated with its presence. Most oyster tissues harbor the parasite but the gills, rectum, mantle, and adductor muscle are the most infected areas (Overstreet 1978). It is not until the oyster has a moderate-to-heavy dermo infection that it begins showing any signs of weight loss or other visible characteristics (Ray et al. 1953). Young oysters do not develop dermo as readily or as severely as older oysters. It is not until the second or third summer of growth that many die from the parasite (Mackin 1961a). Humans who eat oysters infected with the parasite are not harmed.

Dermo is endemic in Gulf coast waters and becomes significantly more active during elevated summer temperatures (Quick and Mackin 1971), especially when in the presence of high salinity water (Soniat 1985). Cake (1983) considers dermo to be "the most prevalent and lethal oyster pathogen in the Gulf of Mexico." It is the primary cause of what is colloquially referred to as "summer mortalities". Although dermo was first identified in the late 1940s, historical records and data suggest that it was present in the early part of this century (Mackin 1961a). The reason for its possible increase during the late 1940s is not known. Dermo has

significant economic implications. Oystermen know that leaving bedded oysters on the more saline reefs through late summer could mean substantial financial losses.

With an increased awareness of the cause of summer mortality, the industry shifted its bedding practices. Oystermen now bedded primarily from September to December and harvested before the end of the first summer (McConnel 1950). The seed industry was shifting more to an annual fishery, especially in the more saline areas along the coast. This change did not occur overnight but spanned a period of 10 to 15 years (McConnel 1950).

Oystermen were now looking for a larger seed oyster to bed since growing time on a lease had been reduced (St. Amant 1955). Owen (1953b) confirmed the need to use large seed in the more saline areas since larger oysters have a better chance of survival from various predators. Today, lower-Bay oystermen prefer 50-60mm seed oysters for planting (Melancon et al. 1987).

Although Moore in 1898 suggested that no oysters less than 3 inches be removed from the state's public grounds, such a philosophy today is not warranted for many areas. An increase in predators due to salinity encroachment onto the state's seed grounds, especially east of the Mississippi River, necessitates that most oysters that are one year old or older be harvested before the next year (Dugas 1977). For example, it has been estimated that the primary seed grounds of Breton Sound have lost as much as 60 percent of their capacity to produce oysters because of predators on the historically

productive reefs (Korringa 1976).

Predators associated with high salinity waters have caused partial or total failures of yearly spat survival for eight of ten years from 1974-83 on the public grounds (Chatry 1987). This trend of reduced spat survival continues today (Bob Ancelet, pers. comm.). By leaving oysters to grow in the more saline areas for more than one year, predators have a better chance of getting the oyster before the oysterman. If salinities can be reduced, for example through properly-managed freshwater diversion from the Mississippi River, then state management can respond (Chatry and Chew 1986). State biologists should manage the resource for maximum survival and production. At present, maximum survival often means allowing oysters to be moved off of the public grounds by one year after setting.

3.0 ENVIRONMENTAL INFLUENCES ON LEASE PRODUCTION

Field studies in Barataria Bay on bedding leases have not occurred in 30 years (e.g., St. Amant 1958). In addition, during this 30 year period Barataria Bay and the Louisiana coast have changed considerably due to erosion of barrier islands and marsh losses (Boesch 1982) . As an example of the limited data on oyster production, the lease yield estimates of Mackin and Hopkins (1961) were used by Day et al. (1973) as an example of lease productivity in Barataria Bay. In turn, Dugas (1977) also used Mackin and Hopkin's data to estimate an average bedding lease yield for the state. Although published in 1961, Mackin and Hopkins data was collected in the 1940s and 1950s. Their work focused extensively on oysters placed in cages and on the results of two experimental plantings made by Menzel and Hopkins (1952). No data prior to this study exists that is applicable to today's environmental influences on commercial bedding leases. In addition, little data exists (Korringa 1976) that documents yield from any commercially bedded lease in Louisiana.

The objectives of this chapter are: (1) document yields from commercial bedding leases, (2) document if the potential of Barataria Bay to produce oysters has changed from historical estimates, and (3) quantify the influence of the Bay environment on commercial oyster production.

METHODS:

Eight captains along with their vessels and crews were monitored between 1982 and 1985. Three captains remained in the study for all three fishing seasons while the others were involved for one or two seasons. The eight captains and their crews bedded on 19 leases during the study. The leases were located in the southern half of Barataria Bay near Independence Island (II), which has eroded away, Middle Bank Reef (BD), and in the adjoining Bay Des Illette (Figure 3.1).

All leases except L-4 were sampled for oysters and associated organisms prior to bedding with a 0.6 meter (2 ft) wide, 12-tooth oyster dredge pulled behind a small boat (Table 3.1). Lease L-4 was added by an oysterman just before the opening of oyster season on the public grounds with no opportunity for me to survey it before oysters were planted.

A minimum of two leases were sampled each fall within one month after bedding was completed with the small dredge. The samples were used to check for oyster mortality caused by bedding activities, to document the sizes of oysters and to check for snails (oyster drills) and dermo (Table 3.1). No leases were sampled again until the spring when harvesting began (Table 3.1). Oystermen believe that "disturbing" a lease during the fall and winter, unless ready to harvest, will attract the black drum fish, Pogonias cromis, a predator of the oyster (Dugas 1986). The lease activities of oystermen are governed by this belief and this limited the number of

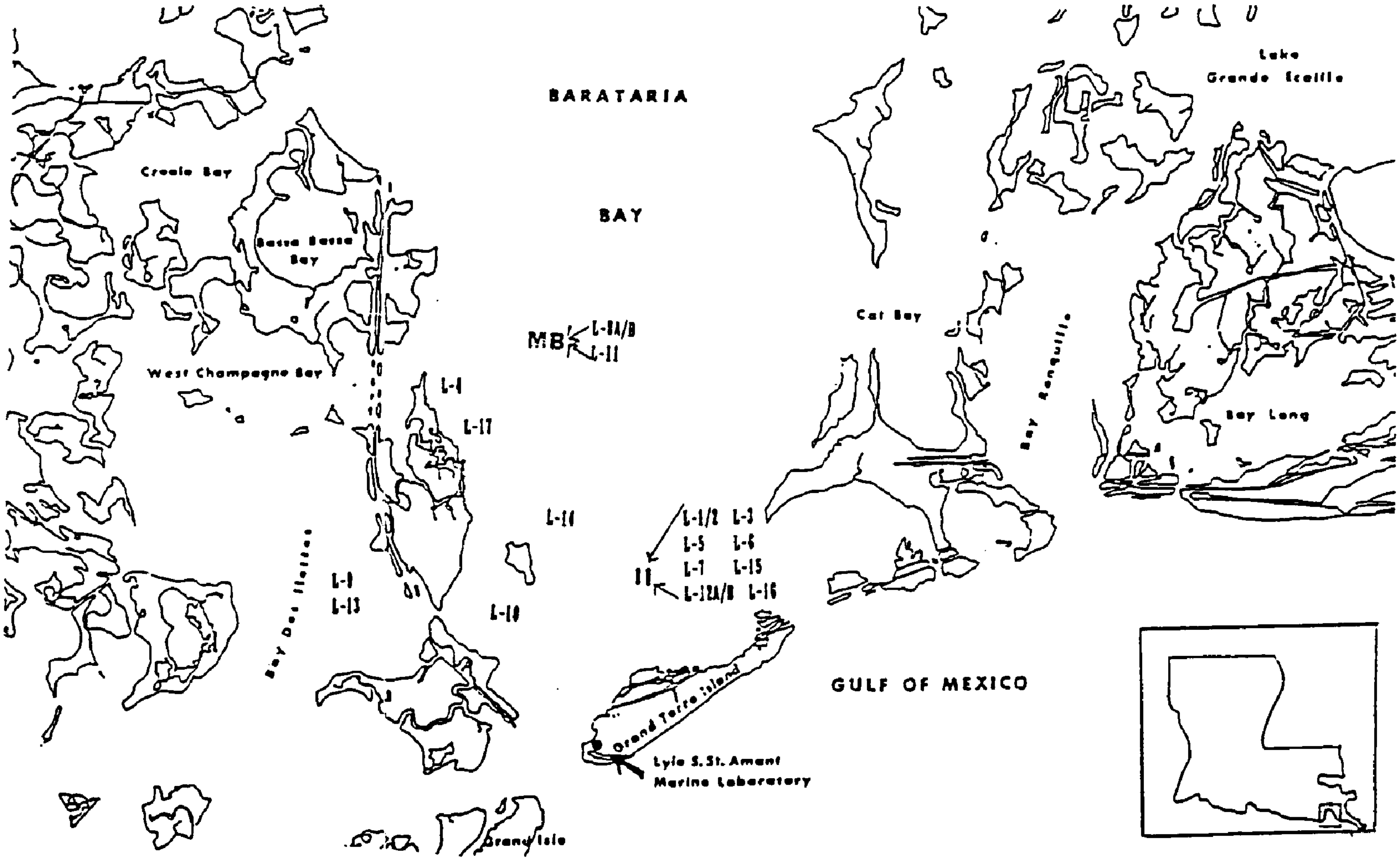

Figure 3.1. The Location of Bay Bedding Leases.

Table 3.1. Sampling Schedule for Leases in Barataria Bay, 1982-85.

	Month											
LEASE	S	O	N	D	J	F	M	A	M	J	J	A
1982-83												
L-1/2	D	S					S	S	S	S	S	S
L-3	D	D						V	V		V	V
L-4							V	—	—	—	—	—
L-5	D							V	V	—	—	—
L-6	D							V	V	V	—	—
L-7	D	D						V	V	V	—	—
1983-84												
L-8a/b	D	S						S	S	S	S	S
L-9	D				V	—	—	—	—	—	—	—
L-10	D	D					V	V	V	—	—	—
L-11	D							V	V	V	V	—
1984-85												
L-12a/b	D	S							S	S	S	S
L-13	D		D	V	V	—	—	—	—	—	—	—
L-14	D	D						V	V		V	—
L-15	D						V	V	V	—	—	—
L-16	D								V	—	—	—
L-17	D					V	V	V	—	—	—	—

D = samples taken with a small hand operated oyster dredge.
S = samples taken with small dredge, scuba and tongs.
V = leases visited, captain and crew interviewed.
(-) = harvest completed.

leases that were sampled in the fall. Their belief in attracting predators also made it impossible to sample during the winter months.

One lease each fall was selected as representative for that year (L-1/2, L-8a/b, and L-12a/b, respectively) and monitored through the harvest season (Table 3.1). To confirm that the lease was representative, a minimum of monthly visits were made to the other leases during harvest, the vessel boarded and the oystermen interviewed.

The representative leases were sampled with the small dredge and by hand using SCUBA and a 0.5 meter square aluminum frame randomly thrown on the lease (Table 3.1). The number of fall SCUBA samples taken per lease ranged from 10 each on leases L-1 and L-2 to 20 on lease L-8a/b and 24 on lease L-12a/b. The number of SCUBA samples per lease was limited because of the oystermen's concern about the drum fish. The SCUBA samples were added to the dredge samples to obtain mortality and oyster size data.

In the spring and summer of each year the representative lease was sampled with dredge and SCUBA a few days before harvest began and monthly thereafter throughout the harvest season (Table 3.1). SCUBA samples, taken randomly, ranged from 4-6 each month. The collected data were used to determine oyster size frequency distributions and to check for dead oysters, oyster drills and dermo.

Oysters were considered dead if gaping or if hinged and empty

(box oyster). Dead oysters were categorized as a recent mortality, within 1 month, if the inner nacreous layer of the shell was clean or only slightly fouled with attached epifauna (Mackin and Sparks 1961).

Oyster length measurement was taken from the hinge to the most distant edge of the bill. Thais length was measured from the shell apex to the outermost lip of the shell. A piece of mantle and gill tissue was taken from 20-50 randomly selected 66mm or larger oysters each month and tested for dermo (Ray 1966). The level of infection was scored from 0-6 according to the method of Quick and Mackin (1971). Weighted incidence (WI) was determined according to Mackin (1961), as follows:

(WI = sum of disease code numbers/number of oysters)

Oysters were initially placed in cages during the Fall of 1982 to monitor dermo and oyster mortality. The cages and oysters were placed on the Bay bottom near the Independence Island leases. They were stolen five days later. No other attempt was made to put out oyster cages. Oyster growth between fall and spring was determined by observing the shifts in size frequencies.

Weekly Bay bottom temperature and salinity data were obtained from personnel stationed at the LDWF's Lyle S. St. Amant Marine Laboratory on Grand Terre Island. Temperature and salinity data for 1982-83 and 1984-85 were from the LDWF's Independence Island station. Data for 1983-84 were from the LDWF's Middle Bank station (Figure 3.1). The stations were selected because of their close

proximity to the oyster leases.

The quantity of oysters bedded on a lease each season was recorded by the captain keeping a ship log for the study (Figure 3.2). Harvest information was obtained from each vessel captain by obtaining daily harvest receipts from the oyster shed.

The quantity of incidental shell bedded with the live oysters was measured indirectly by general observations of dredge loads before planting, by interviewing the captains, by observing the volume of shell collected in the small dredge and by SCUBA samples before and after bedding. The vessels arrived in the Bay at different times, usually at night, and bedded at daylight, making it impossible to systematically sample for incidental shell by any other means.

Area measurement of 10 of the 19 leases were taken in the fall. Most leases were similar in size and the leases measured reflect the largest, which were usually the double-sized, and the smallest. Measurements were taken with an optical ranging rangefinder model 620, (accuracy ± 12 meters at 180 meters distance; Forestry Suppliers, Inc.). The area of each lease was rounded to the nearest half acre because of the limitations of the rangefinder and the difficulty in taking measurements from a small boat. The captains, whose leases had been measured, were also asked to estimate the size of their lease to the nearest half acre.

Statistical tests were performed on a ZENITH ZM-248-40 12mhz 80286 microcomputer using PCSAS Release 6.03 (SAS Institute, Inc.).

Figure 3.2 Sample of type of ship log used by Captains during the Three-Year Study.

DATE	LOCATION	NO. MEN WORKING	TIME BEGIN	TIME END	BARRELS (SACKS)	COMMENTS (FUEL,GROC., WEATHER,ETC)

RESULTS:

BEDDING ACTIVITIES:

No live oysters were found on any of the leases when sampled by dredge prior to bedding. Empty hinged oyster shells (boxes), heavily fouled with epifauna, were occasionally found but easily broke apart when handled. Bedding and harvest records, therefore, were not biased by additional live oysters or old boxes present on the leases before bedding.

Oystermen obtained most of their seed oysters, 87 percent, from the public reefs of the Primary Seed Grounds (PSG), the Grand Pass-Cabbage Reef area (GP), Bay Gardene reservation (BG), and Sister Lake reservation (SL) (Figure 3.3). Seed oysters bedded from the private reefs came from leases near Sister Lake and from the Primary Seed Grounds.

Size frequency distributions show that many of the oysters bedded each September were greater than 75mm and legally harvestable for direct sale, i.e., sack oysters (Figure 3.4). In 1982, 48 percent of the oysters planted were seed size and 43 percent greater than 75mm and directly marketable. In 1983, 52 percent of the oysters were seed and 44 percent were greater than 75mm. In 1984, 55 percent were seed and 39 percent were greater than 75mm. The 1982-84 composite totaled 52 percent as seed, 42 percent as sack oysters and 6 percent less than 25mm (spat).

The mean size of the oysters planted in 1983 was 65mm (±25mm), in 1984 74mm (±28mm), and in 1984 68mm (±25mm). Owen (1953b)

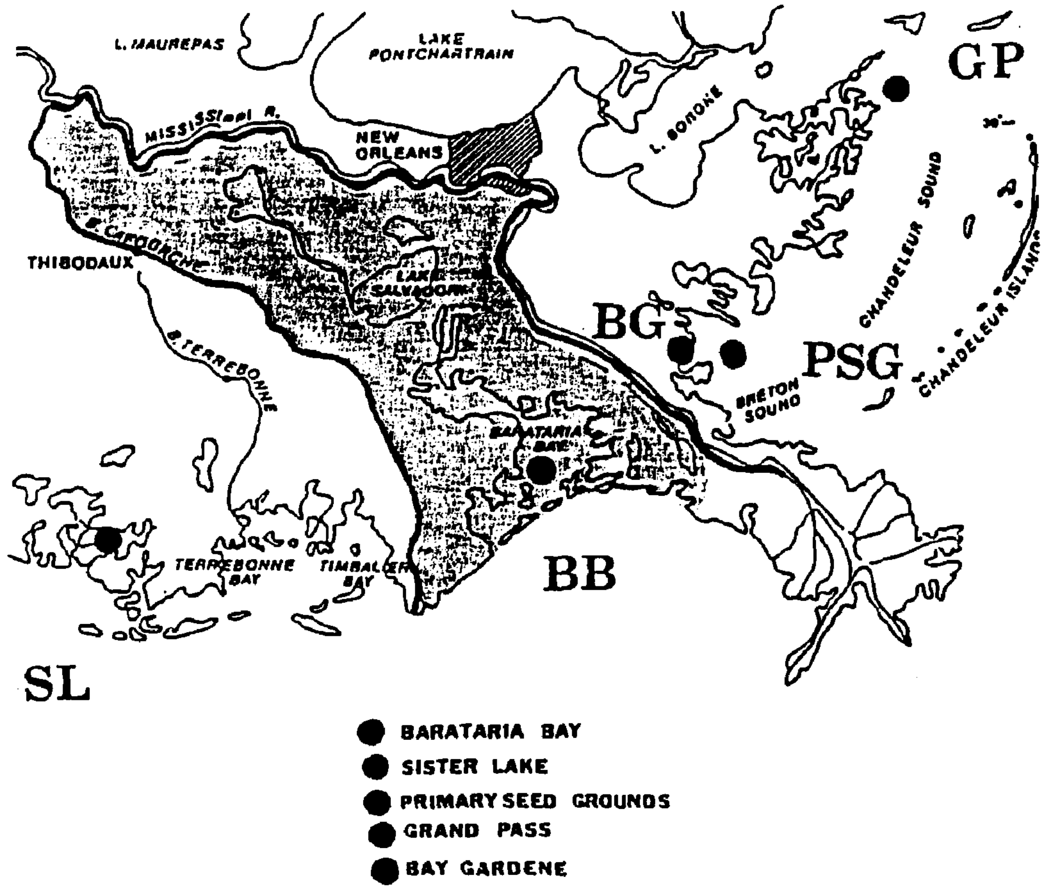

Figure 3.3. Location of Public Seed Grounds Fished During Study. (Barataria Basin and Bay shaded).

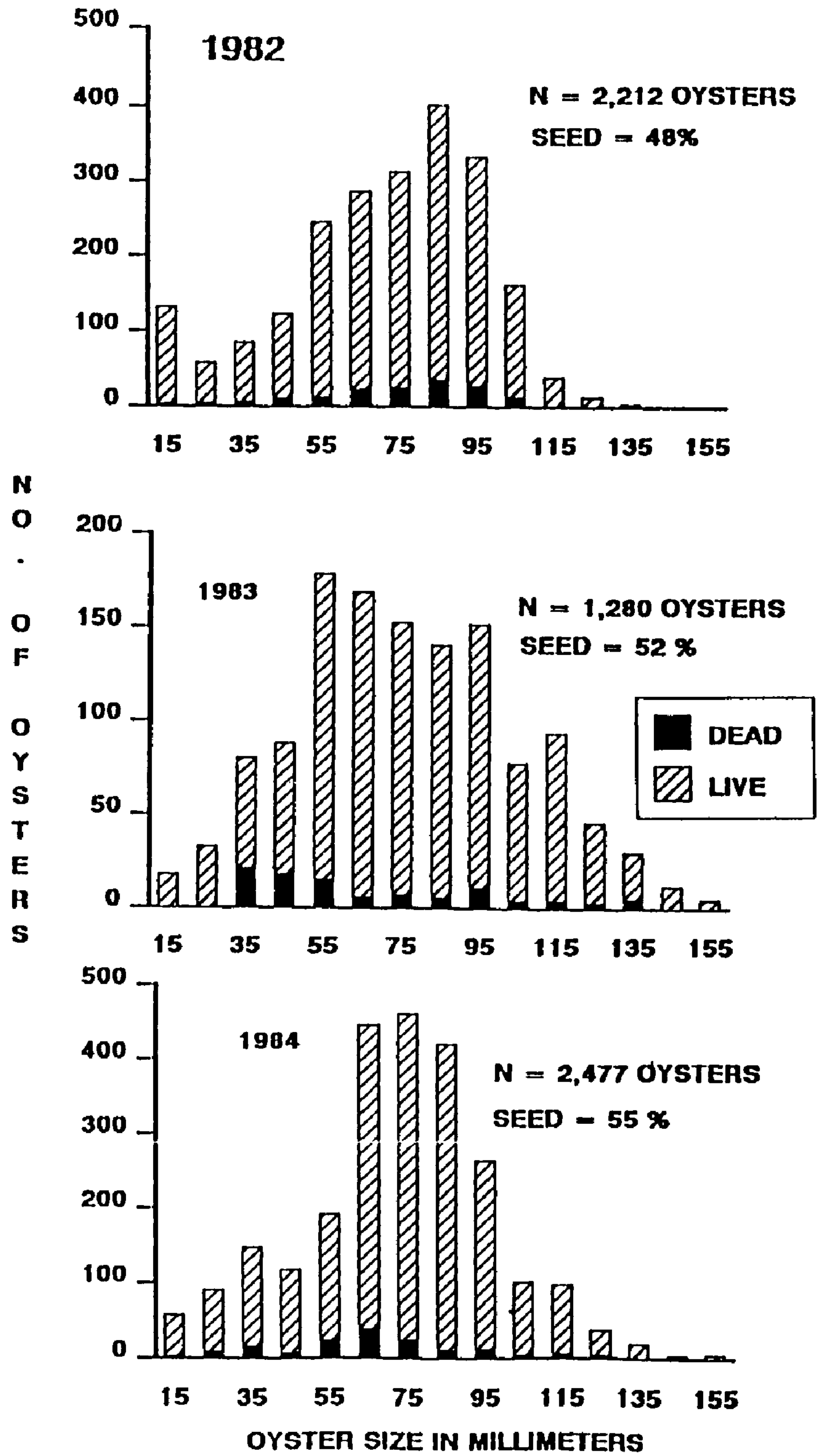

Figure 3.4. Size Frequency of Oysters Bedded in the Fall of each Year. (Black=dead, Hashed=live).

calculated the number of oysters in a sack. Using his calculation, In 1982 there were approximately 850 oysters per planted sack, in 1983 there were 600 oysters per sack, and in 1984 there were 750 oysters per sack.

Size frequency distributions of fall bedded oysters were tested in 10mm groups with a chi-square test for independence (SAS, Inc.) (Table 3.2). Seed size frequencies were independent of leases in 1982 ($P>.80$) and in 1983 ($P>.99$). However, in the fall of 1984 lease size frequency distributions were significantly different ($P<.001$). This indicated that the planted oysters on each sampled lease came from areas that had significantly different seed sizes within their respective population. To reduce the possibility of bias in testing due to too many size groups (13 groups), the 1984 size data was combined into 5 sizes of 25mm increments and again tested with chi-square (Table 3.2). Chi-square remained significant ($P<.001$).

Oyster deaths were minimal after bedding (Figure 3.4). Total dead after bedding was 7.4 percent for 1982, 7.8 percent for 1983, and 6.5 percent for 1984. The three year average mortality after bedding was 7.1 percent of the oysters. Mortality due to transporting and bedding activities was estimated to be no more than 1.0 percent for 1982, 1.3 percent for 1983, and 2.2 percent for 1984. The three year average mortality due to transporting and bedding activities was estimated at 1.6 percent. Drills were present on the leases after the oysters were bedded, and any

Table 3.2. Chi Square Values for Size Frequency Tests of Oysters Bedded in the Fall of each Year.

Year	Leases Tested	Size Range (mm)	Size Increment (mm)	d.f.	Chi Sq. Value	Prob.
1982	L1*L3*L7	1-125	10	22	15.71	P > .83
1983	L8*L10	1-135	10	12	3.26	P > .99
1984	L12*L13*L14	1-135	10	24	233.47	P < .0001
	L12*L13	1-135	10	12	40.34	P < .0001
	L12*L14	1-135	10	12	132.59	P < .0001
	L13*L14	1-135	10	12	57.57	P < .0001
	L12*L13*L14	1-125	25	8	107.59	P < .0001

file: chichart

mortality due to their activity could not be separated from the transporting and bedding mortality estimates.

Surveys using SCUBA, and by sounding with a pole, revealed that the oysters were not distributed evenly across the leases but were piled up in a wind-row like fashion. The mean density of oysters on lease L-1 was $42/m^2$ ($\pm 25/m^2$), on lease L-2, $103/m^2$ ($\pm 46/m^2$), on lease L-8a/b, $44/m^2$ ($\pm 30/m^2$), and on lease L-12a/b, $120/m^2$ ($\pm 73/m^2$). The wind-row effect was due to the planting method used by the oystermen. They bed their oysters by using a high pressure water hose to push the oysters overboard while the vessel circles across the lease. Some oysters were piled 0.3-0.6m (1-2ft) high. The water currents encountered while sampling the leases were always strong indicating that although piled high the oysters could survive in such a crowded situation, even in summer with its characteristic lower tides.

Oystermen bedded not only seed but incidental shells dredged up with the oysters. The amount of incidental shell varied with each load of oysters. It was estimated that as much as 20 percent of a load was incidental shell. The quantity was dependent on where the seed was collected. The least amount came from the seed reservations of Sister Lake and Bay Gardene. Incidental shell included single-valve reef shell and empty oyster boxes. Reef shell alone, therefore, accounted for approximately 13 percent during the three years, when all oyster boxes are excluded (7 percent).

The average size of a measured lease was 5.4 acres (2.2 hectares) within a range of 1.5 acres to 12.0 acres for a double

size lease (Table 3.3). In all cases, the captain of each lease over estimated the acreage he bedded. Sacks bedded per lease averaged 763/acre (314/hectare).

HARVESTING ACTIVITIES:

The 1983-84 yields were the highest during the study while yields for 1984-85 were the lowest (Table 3.4). The two lowest yields for 1984-85, from leases L-16 and L-17, were not due to natural causes, but due to human intervention. Lease L-16 had chunks of sulfur dumped on it and no shed would buy their oysters. It was never proven who dumped the sulfur. Lease L-17 was poached. The lowest yields in 1982-83 and 1983-84 came from the two leases which were harvested the earliest. In contrast, the highest yield in 1984-85 came from lease L-13, which was harvested the earliest. The three year average yield ratio was 1.10:1. If a 20 percent adjustment due to incidental shell is made, the three year average yield ratio increases to 1.38:1.

Sacked oysters ranged in size from 66-155mm during the study. Oystermen were asked to estimate the average size and number of oysters they were harvesting in each sack. Estimates ranged from 180-240 oysters per sack at an average size of 90-115mm. Using Owens' (1953b) estimate of the number of oysters in a sack, the quantity of oysters per sack was approximately 200 (based on 105mm oysters). Therefore, by subtracting the number of oysters harvested from the number of oysters bedded, the percent of bedded oysters that were lost due to death and dredge inefficiency in harvesting

Table 3.3. Size of Bedding Leases in Barataria Bay, 1982-85.

LEASE	MEASURED ACREAGE	FISHERMAN'S ESTIMATE	SACKS BEDDED
L-1/2	12.0 (double lease)	14.0	6,780
L-5	1.5	3.0	2,000
L-8a/b	13.5 (double lease)	15.0	10,300
L-11	8.0	10.0	5,400
L-12a/b	11.5 (double lease)	13.0	9,317
L-14	4.5	6.0	4,200
L-15	2.5	4.0	3,200
AVERAGE	5.4 acres (2.2 hectares)	6.5 acres (2.6 hectares)	763/acre (314/hectare)

double lease bedded by two boats working together.
2 sacks = 1 barrel of oysters

file:lacreage

Table 3.4. Harvest Statistics for the leases bedded in Barataria Bay.

Season	Vessel	Lease	No. of Weeks on Lease	No. of Sacks Bedded	No. of Sacks Harvested	Sack Yield Ratio (Harvested:bedded)
1982-83	A+B	L-1/2	50	6,780	8,333	1.23:1
	C	L-3	51	4,400	5,138	1.17:1
	D	L-4	30	2,000	819	0.41:1
	D	L-5	38	2,000	2,505	1.25:1
	E	L-6	42	3,720	4,168	1.12:1
	F	L-7	41	4,880	5,777	1.18:1
	Total			23,780	26,740	1.12:1
1983-84	A+B	L-8a/b	51	10,300	13,871	1.35:1
	C	L-9	17	2,100	1,672	0.80:1
	C	L-10	36	4,100	6,874	1.68:1
	D	---------------	Decided not to Bed	---------------		
	E	---------------	Opted out of study	---------------		
	F	L-11	44	5,400	7,445	1.38:1
	Total			21,900	29,862	1.36:1
TWO YEAR YIELD RATIO				45,680	56,602	1.24:1
1984-85	A+B	L-12a/b	48	9,317 *	6,963	0.75:1
	C	L-13	15	1,900	1,636	0.86:1
	C	L-14	47	4,200	2,753	0.66:1
	F	---------------	Opted out of study	---------------		
	D+G	L-15	35	3,200	2,729	0.85:1
	D+G	L-16	--	3,400	95	0.03:1
	H+I	L-17	--	8,160	2,321	0.28:1
	Total			30,177	16,497	0.55:1
				(18,617)	(14,081)	(0.75:1) **
THREE YEAR YIELD RATIO				75,857	73,099	0.96:1
				(64,297)	(70,683)	(1.10:1)

* The total number of sacks bedded by vessels "A and B" in 1984 doesn't include 713 sacks of oysters oysters sold directly from public grounds but hauled with seed.

** the numbers in parentheses exclude leases 16 and 17.

ranged from 30 to 88 percent (Figure 3.5).

The three year average size of bedded oysters was 69mm. This is approximately 720 oysters per bedded sack (Owen 1953b). Using the three year average seed size and an average lease yield of 1.10 sacks harvested for each sack bedded, and assuming 20 percent incidental shell, the percent of oysters lost while on the leases averaged 68 percent during the three year study. Accordingly, as individual lease yield increased, the percent of oysters lost while on the bedding leases decreased.

ENVIRONMENTAL INFLUENCES:

Salinity varied more than temperature (Figure 3.6; appendix). During the spring and summer of 1983 and 1984 Bay water temperature increased while salinity remained depressed. Summer salinities in 1985, however, were significantly higher than the previous two years. Salinity began to climb in spring and remained high throughout the summer. When salinity and temperature were combined as a single factor, the year and season differences became more evident (Figure 3.6).

The weekly measurements of temperature and salinity (appendix), and the temperature X salinity factor, were tested using the general linear model procedures (GLM) for an unbalanced ANOVA (SAS Inst., Inc.) (Table 3.5). The temperature X salinity factor was the only one that was significant for all three ANOVA sources (year, season, and year X season). August temperatures and salinities were not included in the ANOVA tests because in all cases except two, L-1/2

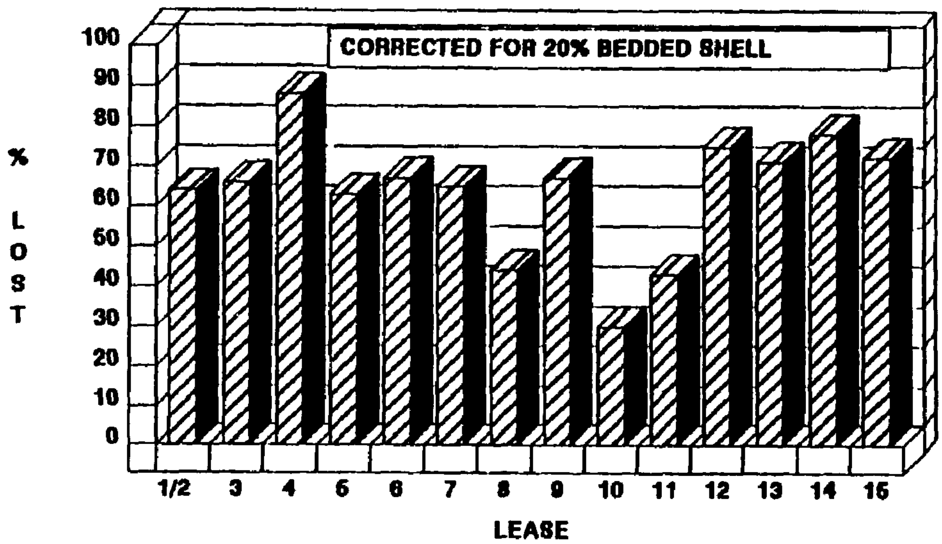

Figure 3.5. Oysters Estimated Lost to Harvest while Bedded in the Bay.

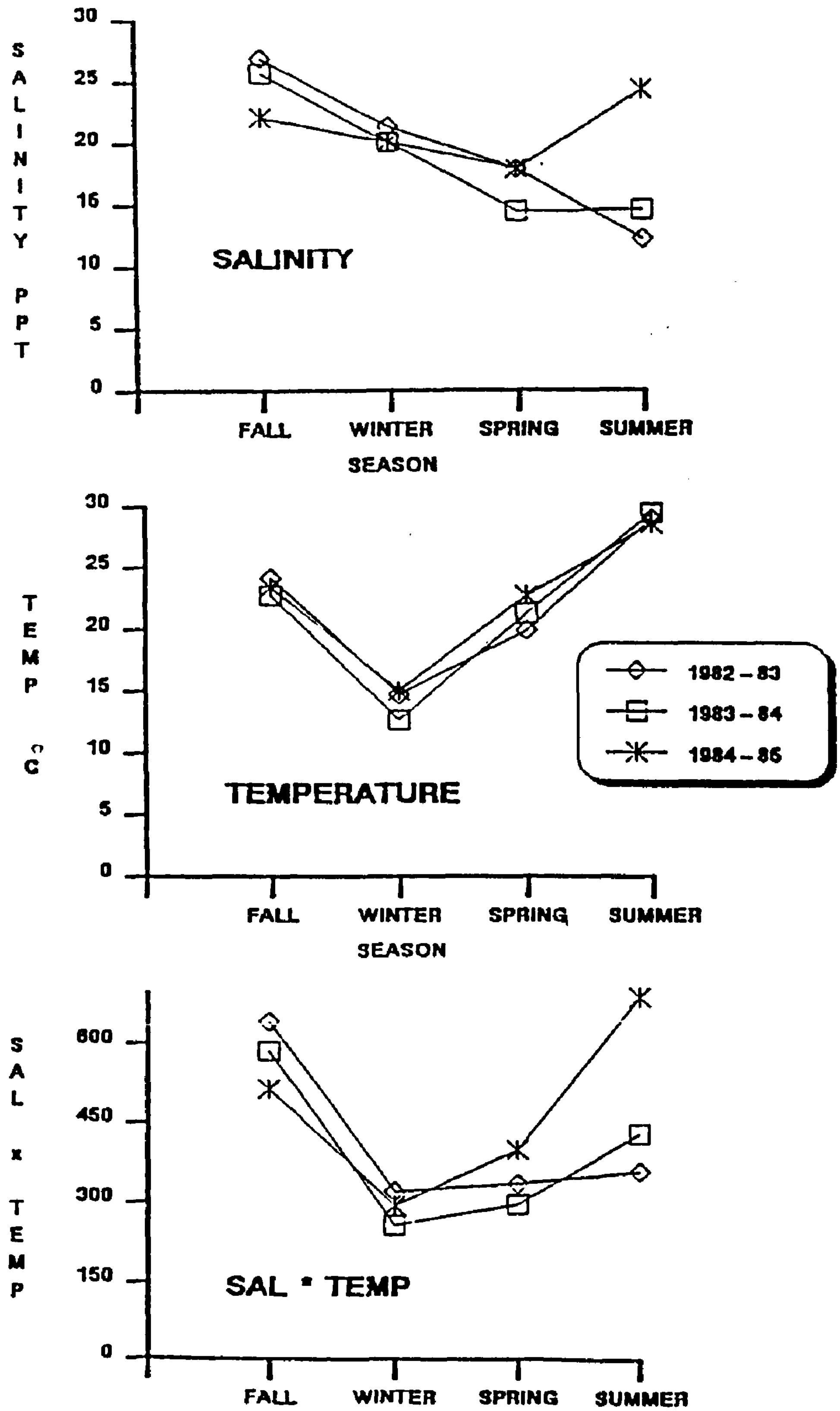

Figure 3.6 Mean Water Temperature and Salinity for each Year by Season.

Table 3.5. Year-Season Factorial Results using GLM Procedures for an Unbalanced ANOVA.

Source	Parameter		
	Temperature	Salinity	Temp * Sal
Year	$P<.05$	--	$P<.01$
Season	$P<.0001$	$P<.0001$	$P<.0001$
Year * Season	--	$P<.0001$	$P<.0001$

file: ANOVA1

and L-3, harvests were completed before or during the first week.

No drills were found on the leases in September of each year before bedding commenced (Table 3.6). However, after bedding was complete drills were present on all the leases surveyed. Drills were observed being transported in with the seed and also migrating onto the leases from the Bay during bedding activities.

Thais' occurrence and density was low, 0.6-3.6/m^2 during the spring and summer of 1983 and 1984 (Table 3.6), but relatively high during the same period in 1985, 2.0-9.6/m^2. The decrease in snail density for June 1985 was due to their incidental harvest with the oysters and the oystermen not returning them to the water. Snails ranged in size from 8-73mm.

Dermo was not a problem in the fall of each year (Table 3.7), although water temperatures and salinities remained high until the end of October. Dermo was present in October of 1984, but the incidence, eight percent, and degree of infection, WI = .18, were low. Dermo had a higher occurrence during the spring and summer months of each year (Table 3.7). The highest occurrence, 52 to 94 percent, and the highest weighted incidence, WI = 0.76 to 2.72, were recorded in the spring and summer of 1985.

Each representative lease was checked for dead oysters in the spring (Figure 3.7). The percent of dead oysters in the smallest category, 1-65mm, increased each year from early spring in March-April to late May. The most significant increase occurred in 1985 where oyster deaths of 1-65mm oysters increased from 10 percent in

Table 3.6. Number of snails by size, location, and density for each year in Barataria Bay.

Location	Date	Snail Size (mm)	Tot. No. Samples	Tot. No. Snails	mean Density Meter Squared	Fishermen's Opinion For Year
All Leases	9-1-82	---	D*	0	0	
Lease 3	10-1-82	29,35,43	D	3	---	
Lease 7	10-1-82	13,32,45,60	D	4	---	
Lease 1/2	10-1-82	21,42	20	2	0.2	
"	3-29-83	---	5	0	0	
"	4-28-83	---	6	0	0	
"	5-20-83	28,52	6	2	0.6	
"	6-30-83	---	5	0	0	Light
All Leases	9-3-83	---	D	0	0	
Lease 10	10-29-83	10,23,36,38,42,45,66,72	D	8	---	
Lease 8a/b	10-29-83	28,32,36,38,45,45,52,60, 63,63,66,66,68,69,72,73, 76	21	17	1.6	
"	3-31-84	---	8	0	0	
"	4-26-84	---	5	0	0	
"	5-29-84	58	5	1	0.4	
"	6-29-84	14,17,22,23,32,39,51	4	7	3.6	Light
All Leases	9-4-84	---	D	0	0	
Lease 13	11-3-84	43,45,56,63	D	4	---	
Lease 14	10-5-84	34,50	D	2	---	
Lease 12a/b	10-5-84	26,38,45,48,63,68,73	21	7	0.6	
"	March	No samples taken	--	--	--	
"	4-24-85	26,26,27,32,32,41,52,73	8	8	2.0	
"	5-31-85	26,27,28,29,32,32,36,41, 41,42,45,45,47,48,52,52, 56,57,57,61,62,64,71,72	5	24	9.6	
"	6-27-85	8,13,21,40,46,52,58,64	7	8	2.2	Moderate/Heavy

D = Samples taken with a small hand operated dredge pulled across the leases by boat.

file: tsnail

Table 3.7. Weighted Incidence (WI) and Percent of Oyster Population Infected with Dermo in Barataria Bay, 1982-85.

			MONTH				
SEASON	LOCATION	PARAMATER	OCT	APR	MAY	JUN	JUL
1982-83	Lease 1/2	Pop. Freq.	---	63%	45%	80%	35%
		WI		1.34	0.65	1.75	0.60
		No. Oysters		20	20	20	20
1983-84	Lease 8a/b	Pop. Freq.	0%	16%	14%	28%	60%
		WI	0.0	0.28	1.08	0.73	1.44
		No. Oysters	50	50	50	40	25
1984-85	Lease 12 a/b	Pop. Freq.	8%	52%	84%	---	94%
		WI	0.18	0.76	2.54		2.72
		No. Oysters	50	50	50		50

file: dermosum

Weighted Incidence Scale:

0 = no infection by parasite
1 = light infection
2 = light to moderate infection
3 = moderate infection
4 = moderate to heavy infection
5 = heavy infection
6 = very heavy infection

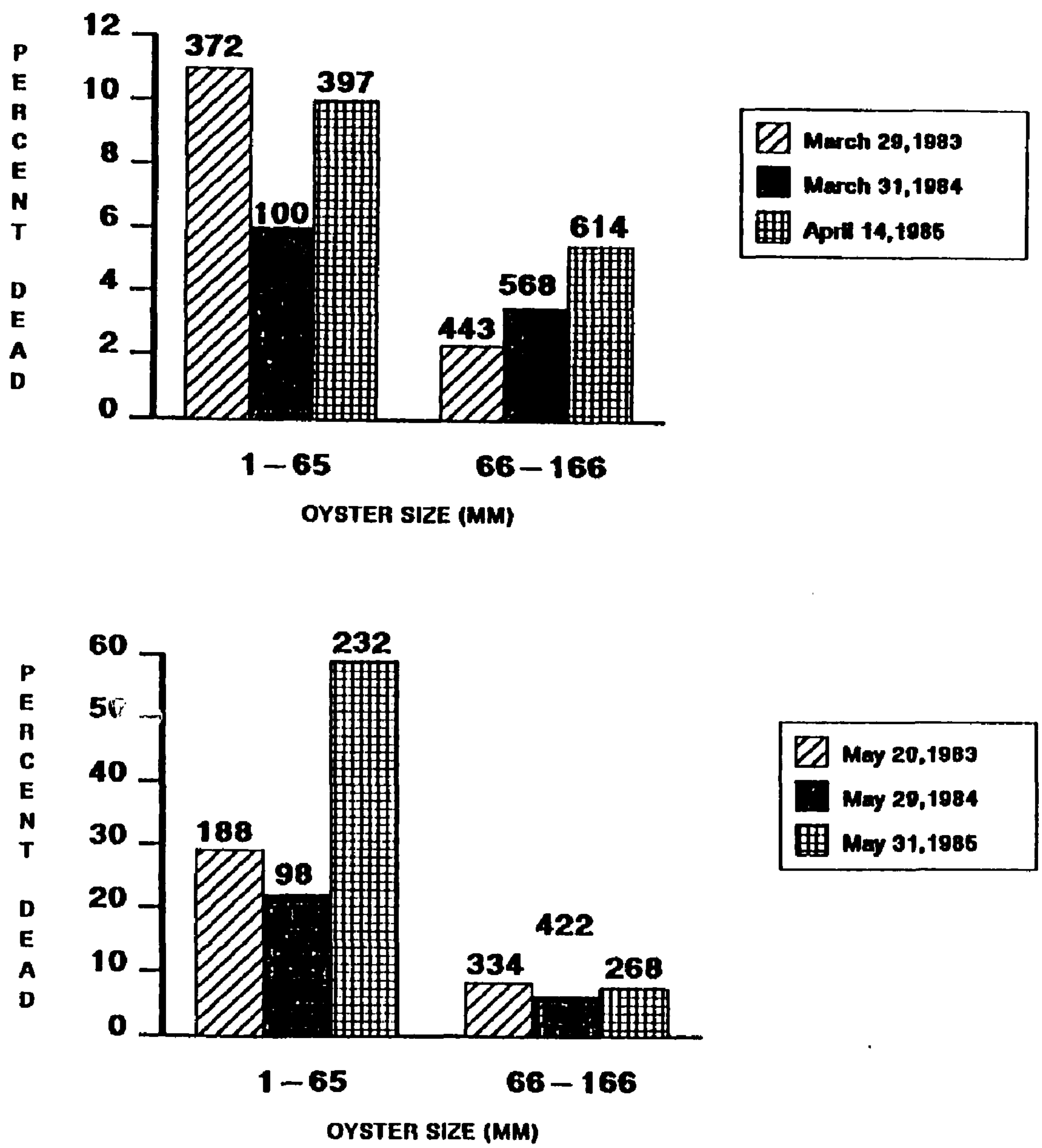

Figure 3.7. Spring Oyster Mortality from Representative Leases. (Number above bar represents the number of oysters measured in each size group).

April to 59 percent by the end of May. The increase in deaths of 1-65mm oysters coincided with an increase in drill abundance (Table 3.5). Most of the mortality was skewed toward the smaller oysters, 20-40mm in length.

Deaths of marketable size oyster, i.e., those greater than 65mm in length, remained relatively low and evenly distributed each May, 6.2-8.4 percent. This occurred even though in May 1985 the presence of dermo was higher than in the previous two years (Table 3.7). No oyster mortality data was collected after May of each year because oystermen were harvesting from all areas of a lease, making accurate estimates impossible. Interviews with oystermen and personal observations indicated that after May in 1985, more marketable size oyster were dying than in the previous two summers during the same months.

Oyster size frequency changes from fall to spring indicate that growth did occur each year (Figure 3.8). A relatively strong fall recruitment, 1-35mm oysters, was evident in 1982-83 and 1984-85. Recruitment occurred after the oysters were bedded, but did not increase lease production of marketable-size oysters. Shifts in oyster sizes indicated that a 20-30mm average increase in shell length occurred by April of each year.

Oysters continued to grow after March and April, but the combination of increasing oyster mortalities and the harvest of the larger oysters obscured any additional monthly interpretation of growth. Growth of oysters is partially dependent on the length of

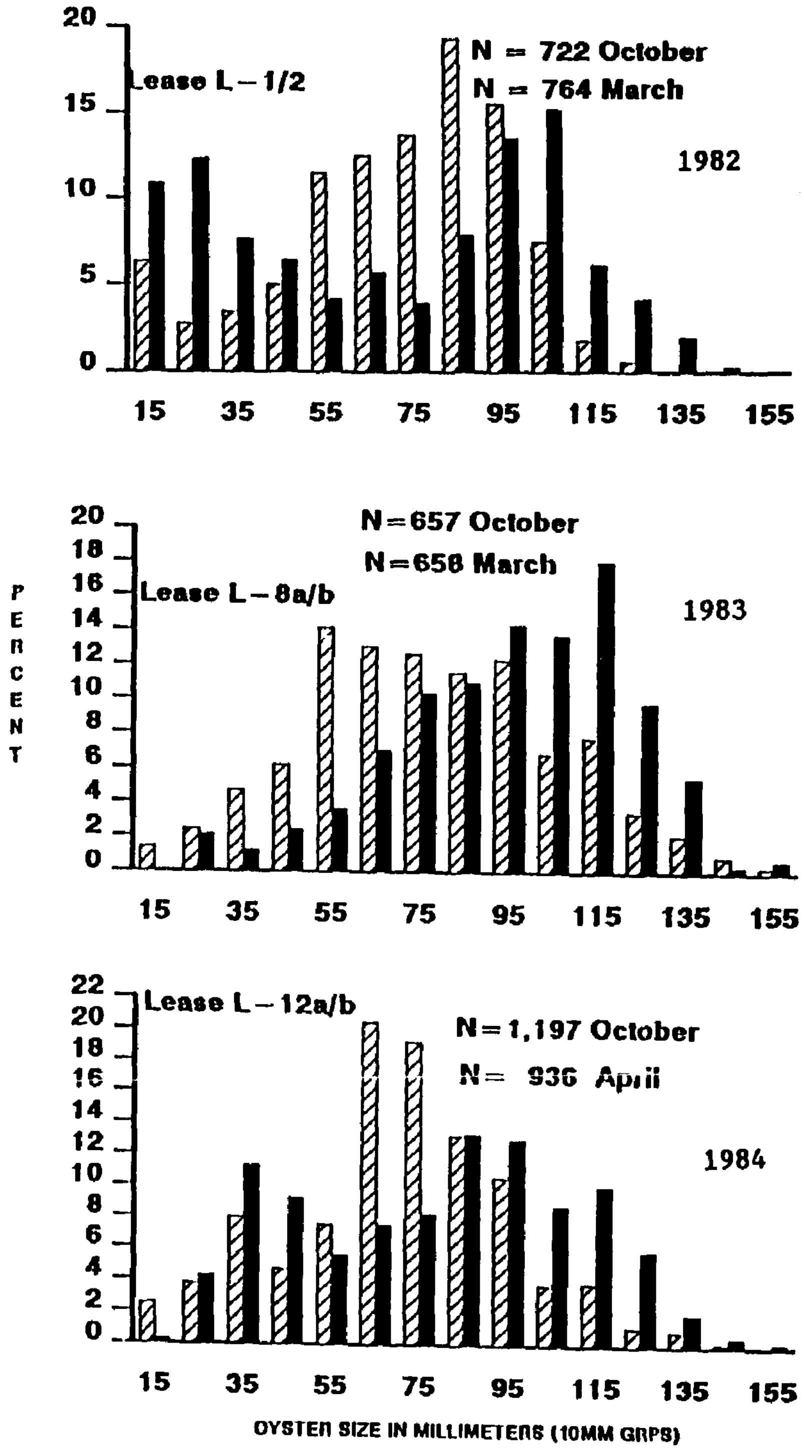

Figure 3.8. Growth of Bedded Oysters from Fall to Spring for each Year of Study.

time oysters remain on a bedding lease. Oysters remained on the leases from 17 to 51 weeks before harvest was completed (Table 3.4).

PREDICTED YIELD:

The salinity, temperature, time and sack production information collected from the Bay leases were used in all possible combinations to construct eight multiple linear equations (Table 3.8). The models were developed using the maximum R-squared method within stepwise regression procedures (SAS, Inc.). The criteria used for choosing the best model were: (1) the smallest number of independent parameters, p, that produced the largest R-squared value, (2) all model parameters significant at the P<.05 level, and (3) where the model produced the lowest total squared error term, C(p), and a low "C(p)-p" value (Neter and Wasserman 1974). The following model was chosen using the above criteria: (Table 3.8)

(model, $P<.0001$, $R^2 = .92$)

	SYIELD = 14440.5	+ 1.11(SBD)	- 33.48(YST)
(standard error)	(3831.0)	(0.11)	(8.52)
	P<.01	P<.0001	P<.01

Temperature did not vary much from year to year and steadily increased through spring and summer, thereby increasing the potential for a high YST value and lowering lease production. Salinity was more variable and unpredictable and was depressed during the spring and summer of 1983 and 1984. Accordingly, actual and predicted lease yields for 1982-83 and 1983-84 were significantly higher than yields for 1984-85 (Figure 3.9).

Table 3.8. Models Developed Using the Maximum R-Squared Method within Stepwise Regression Procedures.

Models Developed :	R-Squared	C(p)	C(p)-p	All Parameters Significant (P<.05)
1. SYIELD = 14440.5+1.11(SBED)-33.48(TST)	.92	3.06	1.06	YES
2. SYIELD = -3296.8+.93(SBED)-16.59(SST)+237.43(TIME)	.94	4.00	1.00	YES
3. SYIELD = 23762+1.07(SBED)-634.10(TSAL)-504.78(TTEMP)	.91	4.26	1.26	NO
4. SYIELD = 307.90+0.92(SBED)-303.83(SSAL)	.88	3.18	1.18	NO
5. RYIELD = 0.26-.003(SST)+.044(TIME)	.68	3.00	1.00	NO
6. RYIELD = 0.93-.06(SSAL)+.05(STEMP)	.57	3.21	1.21	YES
7. RYIELD = 6.06-.15(TSAL)-.09(TTEMP)	.53	3.86	1.86	YES
8. RYIELD = 3.92-.007(TST)	.51	4.10	3.10	YES

SYIELD = lease yield in number of sacks harvested.
RYIELD = lease yield ratio (e.g., when ratio is 1.1:1 , then RYIELD = 1.1).
SBED = number of sacks bedded on a lease in the fall.
TST = mean of the weekly Bay temperature and salinity product (TxS) for a lease; from the time it is first bedded to the end of harvest.
SST = mean of the weekly Bay temperature and salinity product (TxS) for the spring and summer from the first week in March to the end of lease harvest.
TIME = number of weeks oysters are on a lease from the first day of planting to the end of harvest.
TSAL = mean of the weekly Bay salinity from the time the oysters are planted on a lease to the end of harvest.
TTEMP = mean of the weekly Bay temperature from the time the oysters a planted on a lease to the end of harvest.
SSAL = mean of weekly Bay salinity from the first week in March to the end of harvest on a lease.
STEMP = mean of weekly Bay temperature from the first week in March to the end of harvest on a lease.

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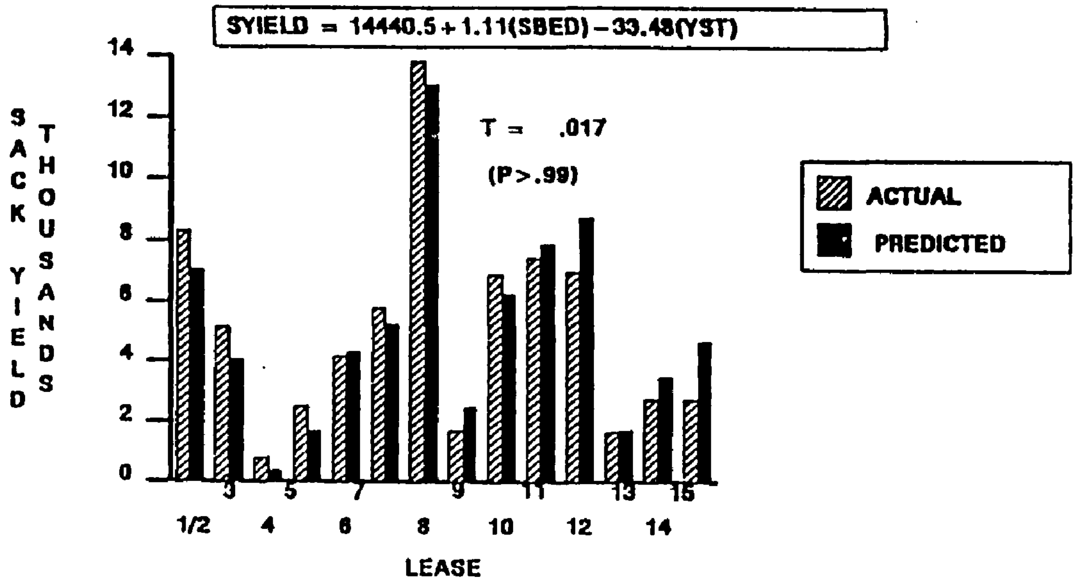

Figure 3.9 Paired Comparisons of Actual and Predicted Sack Yields by Lease.

The predicted results were not always as close as L-13 (Figure 3.9). The predicted and actual yields were tested using the paired comparison procedures (SAS Institute, Inc.). The results of the test indicate that there were no significant differences (P>.99) between the actual and predicted mean yields (Figure 3.9).

DISCUSSION:

Bay lease yields have not changed from that of historical estimates. Yield ratios are within the range reported during the late 1940s to the early 1950s by Mackin and Hopkins (1961), who estimated yields between 0.89:1 and 1.52:1. Korringa (1976) estimated an average Bay lease yield of 0.83:1. In addition, Dugas suggested that a reasonable conversion ratio for all Louisiana waters is 1.21:1. Mackin and Hopkins (1961), reporting on data collected by Menzel and Hopkins (1952), stated that maximum production of oysters bedded at Bay St. Elaine, near Barataria Bay, could expect no better than a 1.0-1.3:1 yield when planted in October and harvested by the following April. Perret and Chatry (1988) estimated that yields in some areas of Louisiana may reach as high as 3.0-4.0:1.

The multiple regression equation takes into account oyster mortality and growth indirectly. The longer the oysters are exposed to changing salinity and temperature, the more chance for predation while growth is occurring. The model indicates that, within the limits of this data set, temperature and salinity will always be negative factors on production. The model is also significantly

dependent on the quantity of oysters bedded.

Leases L-1/2 and L-13 can be used to demonstrate the influence of the Bay environment on lease yield (Figure 3.9). Lease L-1/2 had 6,780 sacks bedded (=SBD) with an average salinity-temperature product of 446 (=YST). The regression produced an estimated yield of 7,034 sacks of oysters (actual lease yield = 8,333 sacks). Lease L-13 had 1,900 sacks bedded (=SBD) and an average salinity-temperature product of 444 (=YST). The predicted yield was 1,684 sacks while the actual yield was 1,636 sacks.

Interesting scenarios can be created using the above regression equation. For example, if mean temperature is held constant, e.g., at 20° C, and mean salinity is increased by 1ppt, e.g., from 18ppt to 19ppt, the decrease in yield from a lease where 2,000 sacks of oysters are bedded is equal to 670 sacks of oysters (5,718 sacks - 5,048 sacks). Additional use and interpretation of the regression can be found in chapter 7.

The three year average of bedded oysters lost to harvest, 68 percent, was the same as that estimated by Day et al. (1973). Chamber et al. (1981) on bedding reefs in Maryland, estimated a 60-75 percent lose to harvest over a two to three year growing period. Losses can be reduced by bedding in areas where predators and disease are not as prevalent.

All of the oysters lost to Bay harvest were not due to death by predator, disease or harvesting activities. At the end of harvest there were a some live (large and small) oysters, and incidental

reef shell and boxes remaining on the leases. The economic inefficiency of trying to harvest every oyster was the primary reason oysters remained. However, the leases were not left with the accumulated resource. Near the end of the harvest season, Bay oystermen began dredging up the oyster shells and oysters, a process called "scraping a lease". The leases in Barataria Bay have a hard shell and mud bottom and any excess shell left on the leases would hinder future bedding and harvesting activities. While some oystermen discarded the scraped material into the Bay, many transported it to other leases in fresher waters to build or enhance their other leases. In other bedding areas of the state, where the lease bottoms are not as hard as that of lower Barataria Bay, the excess shell and oysters are often not scraped but left to enhance reef firmness (Phil Bowman, LDWF, pers. comm.).

The relative abundance of the drill, Thais, and the parasite, dermo, correlated well with the prevailing spring and summer Bay salinities. For example, the reduced snail abundance during the spring and summer of 1983 and 1984 may have been due to the environmental barrier of depressed and fluctuating salinities (St. Amant 1958; Garton 1978). Oyster deaths skewed to the smaller oysters, 1-65mm, each spring were not unexpected since the shells are thinner and easier for Thais to penetrate (St. Amant 1938). The abundance of small oysters probably kept many of the snails from attacking the larger commercial oysters.

The potential synergistic effect of high water temperature and

salinity for increasing dermo activity (Soniat 1985) did not occur in the spring and summer of 1983 and 1984. Dermo responded by having a relatively low incidence in the oyster population. For comparison, the spring and summer of 1985, had the highest dermo and snail activity during consistently high water temperatures and salinities.

Oyster growth alleviated some of the effects mortality by increasing the shell volume of those that survived to harvest. For example, those oysters that were harvested early from leases L-4 and L-9 produced the lowest yields for their respective years; there was less time for shell growth. Ironically, in 1985 the lease with the highest yield, L-13, was harvested the earliest. Unfortunately, the positive aspect of an extended period for oyster growth on the other 1985 leases was reduced by the negative effects of higher predation and disease problems in the spring and summer.

Oyster growth from September to April was similar to the growth of oysters bedded on experimental plots by Owen (1953b) and in trays by Mackin and Sparks (1961). Owen planted 60mm oysters in December in southern Barataria Bay and by April they had grown to 80mm, a 20mm increase. Mackin and Sparks placed oysters in trays from January to September and recorded shell growths that ranged from 14.7-31.4mm.

Oyster growth is not only dependent on the Bay environment, but also on the initial size of the oyster bedded. The significant chi-square for the seed oysters bedded in 1984 reflects the lack of a

single major location for seed, which did occur in 1982 and 1983. In 1984, the oystermen had to travel in many different directions all across the deltaic region to find adequate quantities seed to bed.

Perret and Chatry (1988) state that when oysters are abundant on the public grounds, oystermen will bed marketable oysters with the smaller seed. This was true not only for the relatively good years of 1982 and 1983, but also for 1984, which was not considered as good a year as the previous two (Chatry 1987).

Bay oystermen seldom culled their seed of marketable oysters or shell. Competition for seed made it difficult for an oysterman to take the added time to cull. The inability to cull because of the competitive nature of the fishery on the public grounds resulted in reef shell being transported from the public grounds to private reefs. The oystermen of Barataria Bay actually do not want this excess reefshell and try to keep the quantity to a minimum. Some other oystermen in the state are not as reluctant as Bay oystermen to haul shell to improve their lease firmness and depletion of the public reef beds is a concern. The state has laws that address this problem but were not enforced on the Bay oystermen during this study.

Oyster bedding mortality is influenced by lease firmness. For example, oyster mortality after bedding had been completed was minimal because of the firmness of the relic oyster reefs and hard sandy clay bottoms that comprised the leases. By contrast, oysters

that are bedded on softer bottoms may experience excessive mortality due to burial and suffocation (John Supan, LCES, pers. comm.). Oysters that were transported from the farthest areas were out of the water for a maximum of three days, and air exposure apparently had little effect on bedding mortality.

The average lease size of 5.4 acres (2.2 hectares) with 763 sacks of oyster seed bedded per acre (382 barrels per acre) is intermediate between Korringa's (1976) estimate of 600 sacks per acre and Day et al.'s (1973) estimate of 900 sacks per acre. Owen (1953b) in planting experiments on Independence Island, bedded small plots that had an equivalent density of 1,300 sacks per acre.

The potential of the Bay to produce oysters has not improved. Bay salinity is still dependent on the prevailing climatic conditions in the Basin which change seasonally and yearly (Wiseman and Swenson 1987). When an oysterman has only a limited quantity of seed to bed he will be reluctant to bed in an area where although shell growth, meat yield and flavor are considered excellent, seasonal salinities, with its associated predators and diseases, seriously impact summer lease production. The irony is that the northern Bay and Basin, where Van Sickle et al. (1976) have shown that many oystermen have moved, is also unpredictable for salinity, but for the opposite reason of too much rainfall (Dugas and Rousell 1983). The degree of unpredictability in the upper Bay is, however, less (LDWF historical salinity data for St. Mary's Point located in the northern pat of the Bay).

4.0 FUEL, LABOR AND ENERGY PROFILE

The consumption of fossil fuel directly influences the productivity of the nation's fisheries. For example, the Gulf of Mexico shrimp fleet is one of the most vulnerable to increases in fuel prices and scarcity of supply (Veal et al. 1981). The Louisiana oyster fishery is no exception. Oystermen must travel relatively long distances to dredge, transport and bed seed oysters. Knowledge of fuel costs for oystermen and government managers will enable more efficient resource management. In addition, such knowledge may help to reduce expenses and increase the fisheries energy efficiency (Veal et al. 1981).

Coupled with the fuel needs of a fishery is a fisherman's labor. We have little information on how an oysterman manages his time or how much effort is needed to bed and later harvest his lease. For example, Dugas (1982) outlined a typical yearly fishing strategy for a Louisiana oysterman, but he does not give specific data on fuel and labor inputs. Korringa (1976) followed the fishing patterns of two vessels in Barataria Basin for one season, but both vessels were owned by the same individual making a comparison difficult and biased. Wicker (1979) stated how labor intensive the oyster fishery was in the nineteenth and early twentieth century, but the fishery has changed since then to motorized vessels. Allen and Turner (1984) developed a model to predict Louisiana oyster production but were hindered by not having available information on

labor efforts in the fishery.

The objectives of this chapter are: (1) document the fuel and labor needed to bed and harvest a Barataria Bay lease, and (2) develop an energy profile.

METHODS:

Oystermen kept a log, developed for this study, of time and fuel spent fishing along with the quantity of seed bedded and harvested (Figure 3.2, chapter 3). Frequent interviews with captains and crews were also conducted, especially for those who had difficulty completing the log sheets.

Vessel fuel consumption was determined by the captain recording the quantity of fuel purchased at the dock when replacing the fuel burned during the bedding or harvesting activity. Vessel fuel tanks were topped off and the quantity of fuel replaced used as the recorded volume.

Labor was expressed in total number of work days per vessel and in man-days of work per vessel. The number of work days used in the analyses do not include vessel breakdown days at port, but only account for those days when the crews were away from port. If any part of a day was worked it was included as a whole day. A work day began at 0001 hrs and ended at 2400 hrs. The number of man-days of labor was calculated by adding the number of men working each day by the total number of days worked.

The quantity of seed hauled per vessel was expressed in barrels (1 bbl = 3 Louisiana bushels = two sacks of oysters = or 0.1 m^3).

The barrels of seed hauled per trip to the Bay were recorded by the captain on each vessel. To reduce the chance of error in estimating barrels hauled and planted, the same oysterman on a vessel was used each year during the study. The number of sacks harvested from a lease was obtained from daily sales slips.

The oyster vessels used in this study had a hull constructed of either cypress or steel and were powered by a diesel engine (Table 4.1). The oyster dredges used on the vessels were 122cm (48in) in width with 20 to 22 teeth.

Energy analysis of the Bay fishery followed the methods of Nickelson and Mathews (1975). Primary (fuel and labor) and secondary (vessel and equipment) energy inputs were converted to equivalent kilocalories and compared to kilocalories of oyster meat produced. A Louisiana sack of harvested oyster contained 3.41 kg (7.51 lbs) of meat (National Marine Fisheries Service data for 1983-85 average pounds of meat from private leases in spring). The energy efficiency ratio used to described the Bay fishery is:

(Ratio= kilocalories Output/kilocalories Input)

where, output = oyster meat harvested and input = fuel + labor + vessel.

Statistical analyses were performed on a ZENITH ZM-248-40 12mhz 80286 microcomputer using PCSAS Release 6.03 (SAS Institute, Inc.).

RESULTS:

FUEL AND LABOR:

All oystermen began bedding in September of each year when the

Table 4.1. Descriptions of the oyster vessels used in this study.

Vessel	Dimensions LxW (meters)	Hull Type	Year Built	Engine Hp	Owner – Operator
A	18.3 x 6.1	steel	1974	165	yes/no *
B	15.8 x 5.5	steel	1981	165	yes/no *
C	18.3 x 6.1	steel	1981	165	yes
D	16.5 x 5.5	cypress	1954	165	yes
E	17.1 x 5.8	cypress	1972	165	yes
F	18.3 x 5.5	cypress	1950	165	yes
G	16.2 x 6.1	cypress	1972	165	yes
H	15.8 x 5.5	cypress	1969	165	no
I	12.2 x 4.0	steel	1983	80	no

* The owners of vessels "A" and "B" one summer hired a captain to take their place.

** All engines, but that of vessel "I", were Detroit Diesel 671-N engines. Vessel "I" had a 254 Ford Diesel engine.

state's public seed grounds opened (Figure 4.1). Two captains continued to bed into October. Captains on vessels "A" and "B" freighted oysters independently but bedded on the same double sized lease each year. One vessel at a time harvested the double lease the following spring and summer. The crews of vessels "D" and "G" shared seed freighting responsibilities for 9 of 13 loads in 1984; vessel "G" was used to harvest the following spring and summer. The crew of vessel "H" bedded seed oysters and vessel "I" was used to harvest; both are owned by the same oysterman.

Oystermen harvested seed from east and west of Barataria Bay between 1982 and 1984. The routes traveled often crossed much open water and through several locks on the Mississippi River (Figure 4.2). When weather and water conditions were too severe, alternate routes were used that were longer, but offered better protection. The alternate routes were seldom used during this study.

The distance of Barataria Bay (BB) from seed sources is a significant influence on travel time (Table 4.2). The closest public seed reefs are the Primary Seed Grounds (PSG) of Black Bay, Bay Crab and American Bay and the Bay Gardene (BG) seed reservation. They are approximately 65 kilometers distance by water (Figure 4.2) and took an average of 8.7 hours to travel. The farthest public seed are from the Grand Pass-Cabbage Reef (GP) area, approximately 154 Kilometers distance. Grand Pass took 16.2 hours to travel, an 86 percent increase over the Primary Seed Grounds. Sister Lake (SL) seed reservation, located west of the Basin, is approximately 120

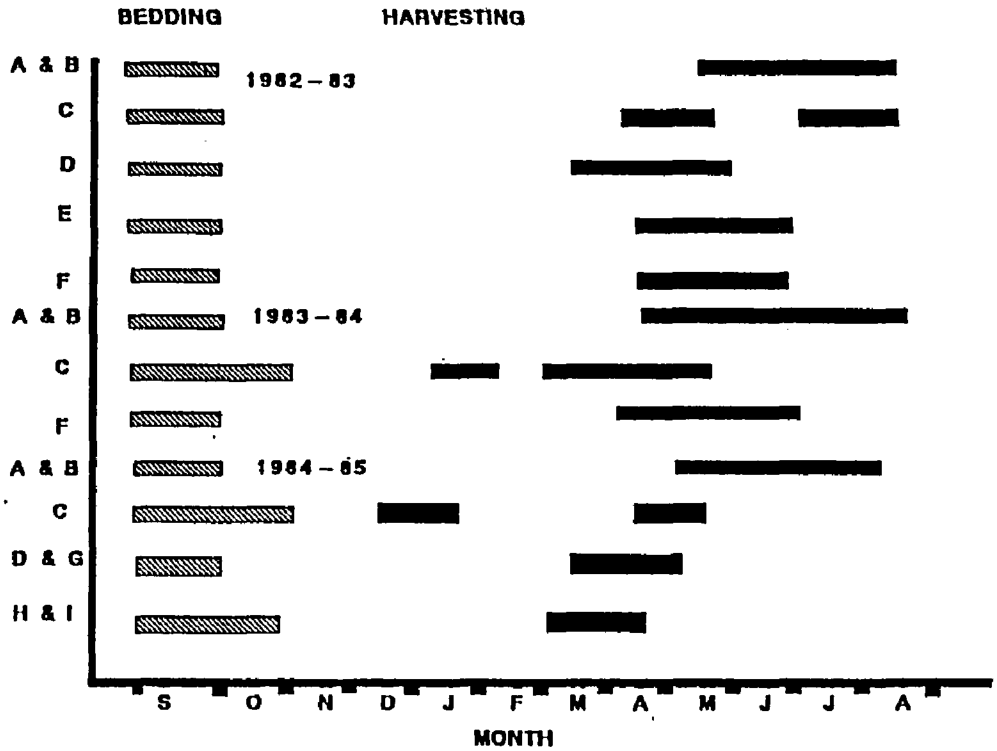

Figure 4.1. Fishing Activity for the Bay Fleet by Vessel and Year. (bedding=hashed; harvesting=solid).

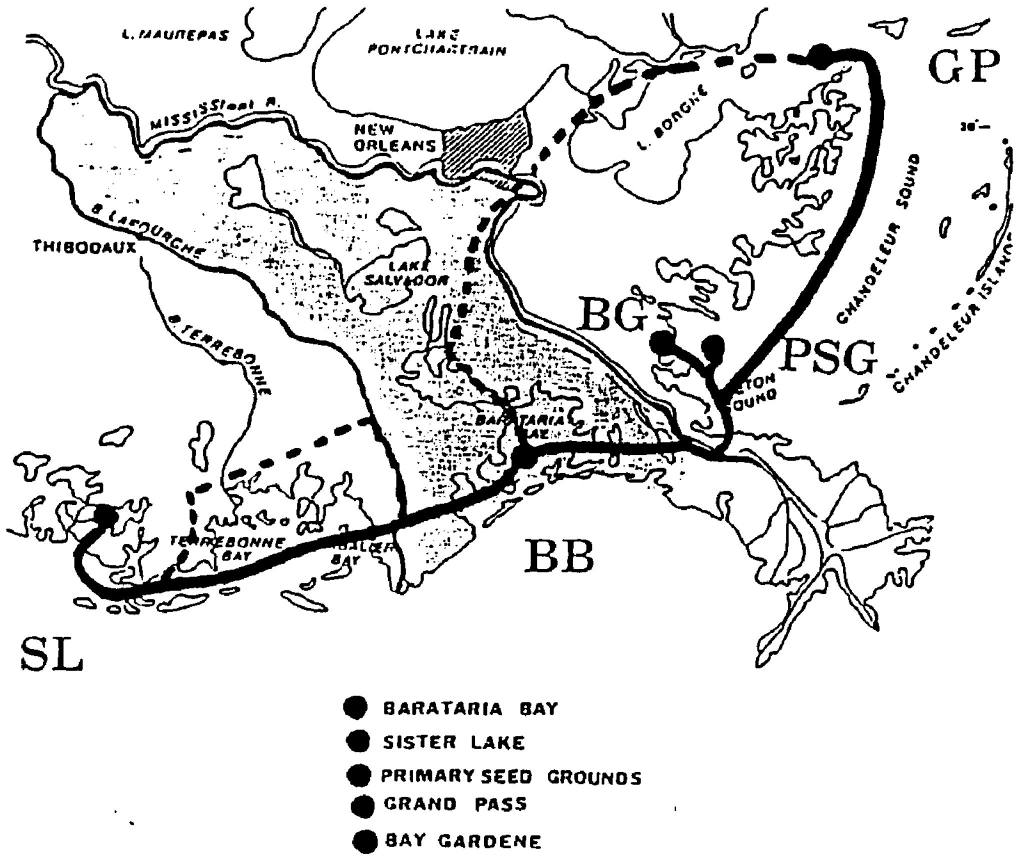

Figure 4.2. Routes taken by the Bay Fleet while Bedding Seed Oysters. (Solid=primary routes; dashed=alternate routes).

Table 4.2. Vessel Travel Time to Barataria Bay from Seed-Source Location while Loaded with Oysters. Times are for One-Way.

SEED LOCATION	N	@ DISTANCE TRAVELED (ONE-WAY)	TRAVEL TIME RANGE (HRS)	TRAVEL TIME MEAN (HRS) (± S.D.)
Grand Pass Area	27	154 Km	(13.5-18.0)	16.2 ± 1.2
Sister Lake Reserv.	6	95 Km	(9.5-15.5)	11.9 ± 2.5
Primary Seed Grnds	39	65 Km	(6.5-12.0)	8.7 ± 1.3
Private Leases *	15	60 Km	(6.5-12.5)	7.4 ± 2.0

* all private leases with useable time records were located east of the Mississippi River near the Primary Seed Grounds.

kilometers distance and took 11.9 hours to travel. The private reefs used as seed sources were near the Primary Seed Grounds (private east = PE) and Sister Lake (private west = PW).

The time needed to bed the seed, once oystermen reached the Bay, ranged between 1-2 hours. The return trip from Barataria Bay, unloaded, was 7.7 hours (± .8 hrs;N=23) to the Primary Seed Grounds, and 15.4 hours (± 1.4 hrs;N=27) to the Grand Pass-Cabbage Reef Area. No return logs were filed for Sister Lake, but interviews with the oystermen indicate that one hour less travel time, 11 hours, when unloaded is a good estimate. Therefore, for every round trip to the Bay, while a vessel's engine was running, oystermen were dredging 36 percent of the time when bedding from the Primary Seed Grounds, 26 percent of the time from Sister Lake, and 23 percent of the time from Grand Pass-Cabbage reef.

The amount of time actually dredging for seed at each location was a significant contrast to travel time (Table 4.3). Very little difference between seed locations was noted. However, the locations that were fished for seed each year changed (Figure 4.3). The Primary Seed Grounds, exclusive of Bay Gardene, was the principal source of seed in 1982, accounting for 96 percent of the total bedded. The private lease seed for 1982 came from leases located near the Primary Seed Grounds. In 1983, the seed reservation in Bay Gardene accounted for 17 percent of the seed while the Primary Seed Grounds' contribution dropped from 96 percent to one percent. The majority of 1983 seed, 61 percent, came from the Grand Pass-Cabbage

Table 4.3. Average Time Dredging for each Seed Load transported to Bay 1982-84.

LOCATION	N	DREDGE TIME RANGE (HRS)	DREDGE TIME MEAN (HRS) (± S.D.)
Primary Seed Grnds	29	(6.0-14.5)	9.8 ± 2.6
Grand Pass Area	41	(6.0-16.5)	9.8 ± 3.3
Bay Gardene Reserv.	8	(6.0-11.5)	8.8 ± 1.8
Sister Lake Reserv.	8	(4.5-14.5)	8.5 ± 3.3
Private Leases	13	(6.0-12.5)	7.8 ± 2.1
Subtotal (Public only)	86		9.6 ± 2.9
Total	99		9.3 ± 2.9

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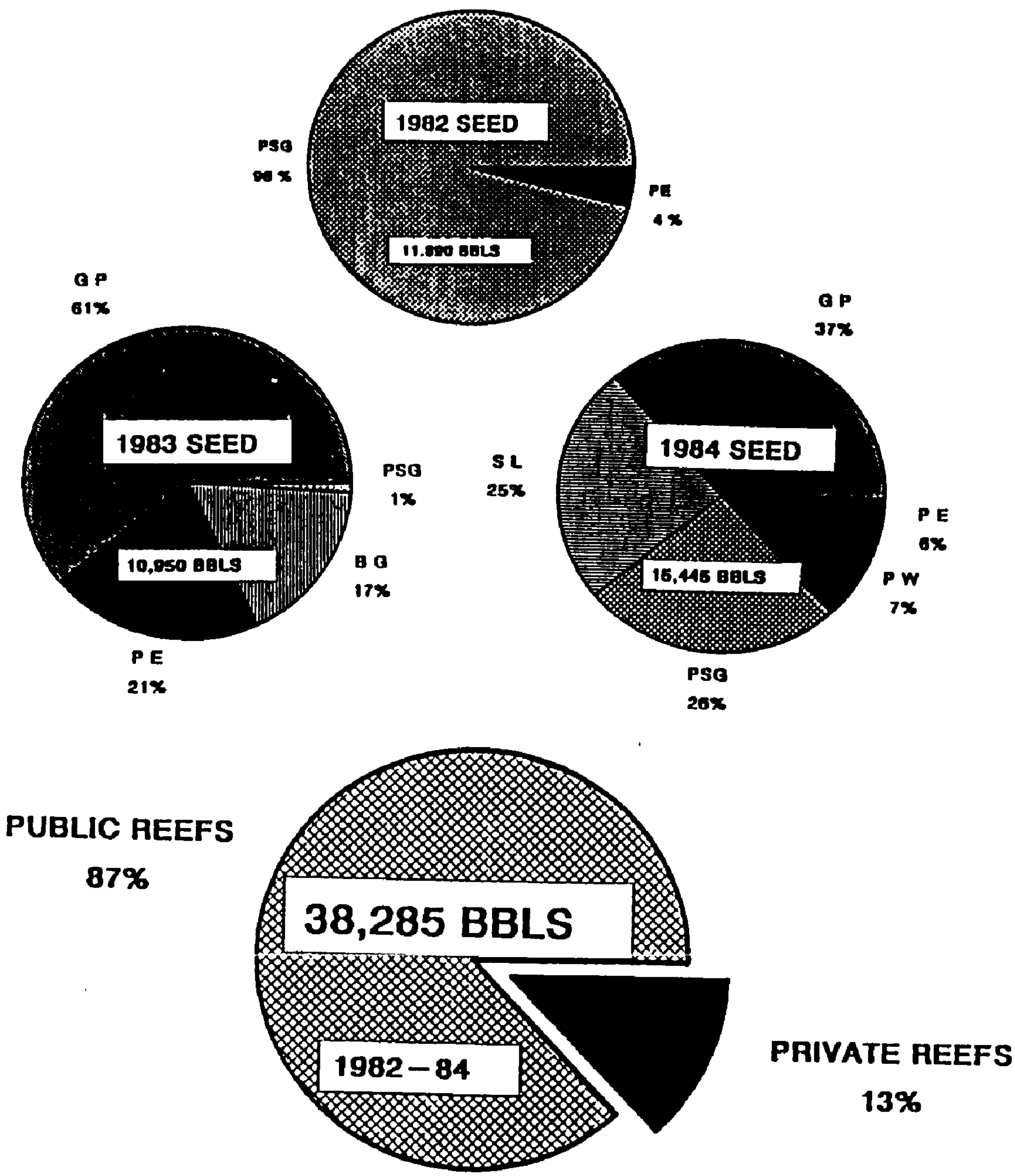

Figure 4.3. Quantities and Locations of Seed Oysters Harvested and Transported to the Bay, 1982-84.

Reef area. The private lease seed for 1983 came from the same reefs fished in 1982.

In 1984, oystermen scattered in many directions looking for seed. They began their 1984 season in Sister Lake and harvested 25 percent of their total volume bedded in the Bay. The Primary Seed Grounds, exclusive of Bay Gardene, increased its contribution from its 1983 level to 26 percent, but the Grand Pass area still contributed the largest volume of seed, 37 percent. The private lease seed came from reefs located near Sister Lake and the Primary Seed Grounds.

The public reefs contributed 87 percent of the seed bedded in the Bay during the three year study. Only three oystermen had private reefs that could be used as seed sources. The remaining oystermen had some private leases, but not enough natural production on them to consider transplanting oysters to the Bay. Those leases were used as another source of income during the winter months.

There was a difference in the quantity of seed harvested per trip from the various locations (Table 4.4). The public area of Grand Pass-Cabbage Reef and the private leases had the highest average volume of seed harvested each trip while the Primary Seed Grounds had the lowest. The average number of barrels bedded per trip also varied by year, especially in 1982, where most came from the heavily fished Primary Seed Grounds (Table 4.4).

The amount of labor involved in bedding a lease increased from year to year (Table 4.5). The labor increases were the result of

Table 4.4. Seed Locations and the Average Quantitiy of Seed Transported to the Bay for Bedding, 1982-84.

LOCATION	N*	RANGE (BBLS/LOAD)	MEAN (BBLS/LOAD) (± S.D.)
Primary Seed Grnds	54	(125-300)	212 ± 38
Grand Pass Area	49	(150-360)	257 ± 56
Bay Gardene Reserv.	8	(150-250)	218 ± 36
Sister Lake Reserv.	12	(150-350)	228 ± 64
Private Leases	19	(150-300)	252 ± 50
Three-Year Average	142		237 ± 54

* Total number of useable records to obtain means and ranges.

file: 1flbbls

Table 4.5. Labor Inputs to Bedding Seed Oysters in Barataria Bay.

	SEASON AVERAGE			THREE-YEAR
	1982-83	1983-84	1984-85	AVERAGE
Labor Days/Lease	18	23	25	22
Range	(10-25)	(16-25)	(16-42)	
Men on Vessel	3	3	3	3
Range	(3-4)	(3-4)	(2-4)	
Man-Days Labor/Lease	60	67	78	69
Range	(30-100)	(32-80)	(48-126)	
Trips Bedding/Lease	8	9	9	9
Range	(4-11)	(5-10)	(6-14)	
Bbls Bed/Trip	210	249	246	237
Range	(125-255)	(150-360)	(150-350)	

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increased effort in trying to locate adequate quantities of seed and the distances traveled. The increase in effort to bed a lease, however, was not completely reflected by the total days worked (Figure 4.4), but rather in the number of hours worked per day (Table 4.2). Oystermen compensated for the longer trips by working more hours during a 24-hour period.

The quantity of vessel fuel used while bedding was an indication of the distances the oystermen had to travel to obtain their seed (Table 4.6). The 1983 season, with most seed coming from the Grand Pass-Cabbage Reef area, had the highest average fuel use. The 1982 season, with oystermen dredging the closest public reefs on the Primary Seed Grounds had the lowest fuel use. If all vessels in 1984 had freighted independently, that year would have produced the highest average fuel consumption. Oystermen in 1984 were traveling in many direction while trying to find adequate concentrations of seed.

Using the Primary Seed Grounds as the benchmark for travel time per round trip, 27.2 hours (fishing + traveling + planting), a seed load from Sister Lake increases the average time per round trip by 24 percent and from Grand Pass by 56 percent. Fuel costs would also increase by that amount if engine RPMs remained the same for each trip from each location. Engines ran 1400-1600 RPMs while traveling and approximately 800 RPMs while dredging. The Bay oyster fleet spent an average of 16 percent of their time actively dredging for seed during fall bedding while away from port.

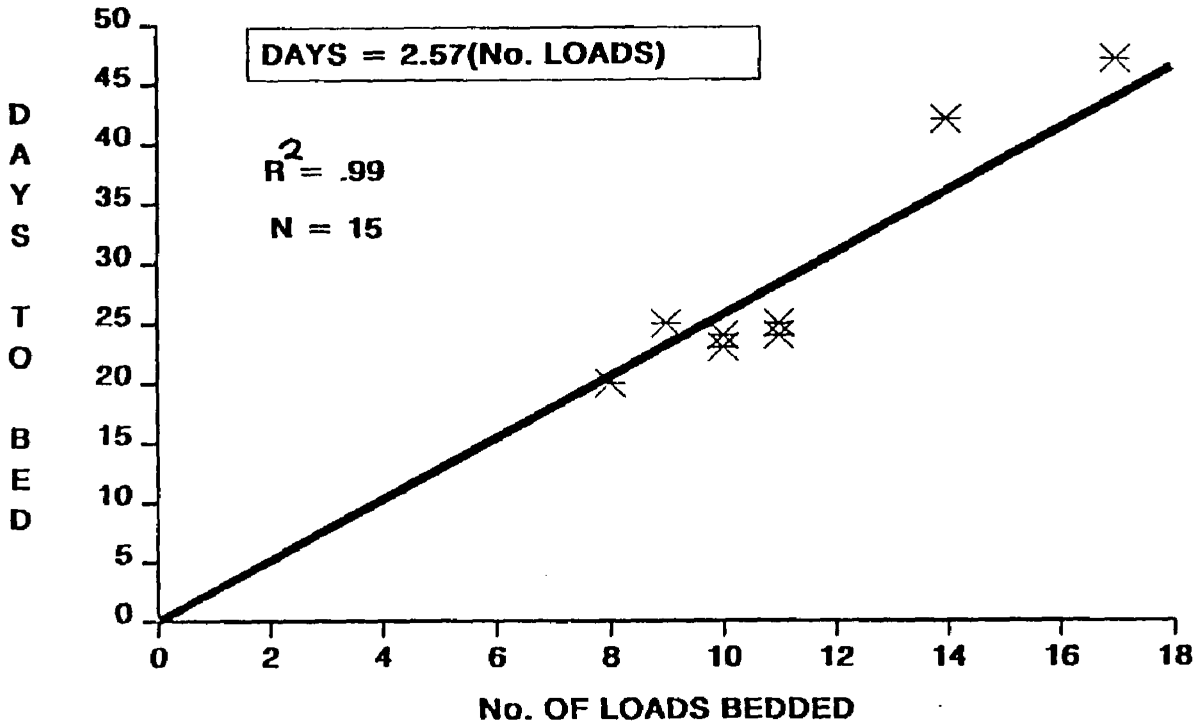

Figure 4.4 . Regression showing Number of Days Needed to Bed Seed Oysters in the Bay as a Function of Seed Loads Bedded.

Table 4.6. Average Fuel Inputs to the Barataria Bay Seed Fishery, During Bedding Activities.

	AVERAGE			THREE-YEAR
	1982-83	1983-84	1984-85	AVERAGE
BEDDING SEED:				
LITERS/DAY	216	392	286	294
Range	(182-252)	(323-464)	(202-366)	
LITERS/LOAD	483	997	794	742
Range	(363-563)	(874-1,113)	(532-1,018)	
LITERS/BBL PLANT	2.3	3.8	3.2	3.1
Range	(2.0-2.8)	(3.8-4.3)	(2.0-5.3)	

FILE: LFLFUEL

Consistency in daily vessel fuel consumption and time away from port while harvesting the Bay was a sharp contrast to the inconsistency seen each year while bedding seed (Table 4.7). Bay leases were only a few kilometers from the Bayou Rigaud dock on Grand Isle. Oystermen left at daylight from port and returned to dock at approximately the same time each afternoon to unload their day's harvest to waiting trucks. Round trip travel time to and from the leases ranged from 1-2 hours each day. The average time dredging a Bay lease was 6.9 hours (± 0.5;N=82). Therefore, crews were fishing from 78 to 87 percent of their time while away from port, excluding a lunch break (0.5-1 hour).

Vessel fuel consumed per sack harvested was dependent on lease production (Table 4.7). The highest sack production, and therefore lowest fuel consumption per sack, was in the spring and summer of 1984. The 1985 season, with the lowest sack production of the three year study, produced the highest fuel consumption for each sack harvested.

The number of work days needed to harvest the Bay oysters was a function of production (Table 4.7). The highest number of labor days were in 1984 when total sack production was the highest (Table 4.6). Accordingly, as production increased, the number of required harvest days also increased (Figure 4.5).

Different conditions, economic as well as environmental, while bedding and harvesting the Bay leases, affected the final fuel and labor costs in harvesting a sack of oysters (Table 4.8). Production

Table 4.7. Yearly Average of Labor and Fuel to Harvest the Bay Oysters

	SEASON AVERAGE			THREE-YEAR
	1983	1984	1985	AVERAGE
Labor Days/Lease	35	46	27	35 (36)
Range	(8-56)	(23-57)	(1-41)	
Men on Vessel	3	4	3	3
Range	(2-4)	(3-5)	(2-4)	
Man-Days Labor/Lease	108	170	86	116 (124)
Range	(24-127)	(69-246)	(3-118)	
Sacks/Day	110	132	87	116
Range	(81-141)	(73-152)	(56-118)	
Liters/Day	87	92	82	87 *
	(78-101)	(75-111)	(57-112)	
Liters/Sack	0.79	0.70	0.93	0.79
Range	(.59-.98)	(.62-1.23)	(.73-1.36)	

* average liters per day increases to 90 if vessel "I" with its smaller engine is ommitted.

() excluding leases L-16 and L-17.

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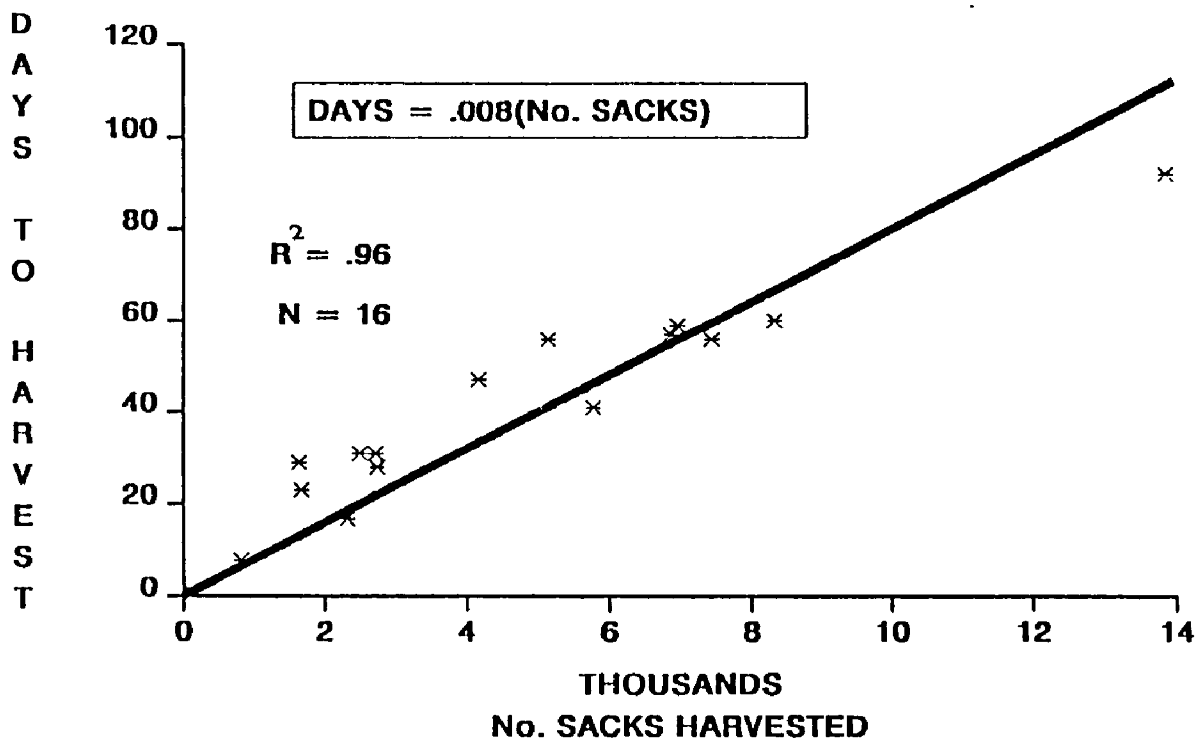

Figure 4.5 . Regression showing Number of Days Needed to Harvest Sack Oysters from the Bay as a Function of Lease Yield.

Table 4.8. Summary of Bedding and Harvesting Activities per Lease, 1982-85.

(Season) Lease	Total Labor Days	Total Fuel (liters)	Avg. No. of Sacks Harvested Per Day Of Labor	Avg. No. of Liters Consumed Per Sack Harvested
(1982-83)				
1/2	96	14,576	87	1.75
3	90	10,848	57	2.11
4,5	59	7,335	56	2.21
6	67	7,294	62	1.75
7	66	8,558	88	1.48
Average	54	8,565	71	1.82
(1983-84)				
8a/b	138	29,499	101	2.13
9,10	121	19,599	71	2.29
11	80	15,660	93	2.10
Average	68	12,952	88	2.17
(1984-85)				
12a/b	109	23,733	64	3.41
13,14	104	20,245	42	4.61
15,16 *	65	9,371	43	3.32
17 *	83	11,367	28	4.90
Average	52	9,251	46	3.92
	(53)	(11,005)	(53)	(3.88)
TOTAL	1078	178,125		
	(930)	(157,387)		
AVERAGE	57	9,375	68	2.44
	(58)	(9,837)	(76)	(2.23)

* lease L-16 was not harvested due to sulfur chunks found on Lease. Lease L-17 was poached and harvest was reduce.

() excluding leases L-15, L-16 and L-17.

per lease again played an important role in determining the total labor inputs needed to harvest a sack of bedded oysters. The 1982-83 season, however, with less average production per lease than 1983-84, showed the highest fuel efficiency per sack harvested. This was due to the closeness of the Primary Seed Grounds.

An average of 2.23 liters were consumed per sack produced during the three year study (Table 4.8). In addition, an average of 76 sacks were harvested per vessel day (bedding + harvesting).

ENERGY PROFILE:

Average production from a lower-Bay oyster fishery was also expressed in terms of kilocalories (Table 4.9) (Nickelson and Mathews 1975). The energy efficiency ratio (kcal output:kcal input) for an average Bay lease producing 4,400 sacks of oysters from 4,000 sacks bedded is .11:1. An average of 2,778 kilograms of oyster meat was produced from an acre of bedded water bottom (based on a 5.4 acre staked lease). This is equivalent to 2,333,644 kcal of oyster meat produced per bedded acre.

DISCUSSION:

ENERGY:

Energy Comparisons to other similarly-assessed Pacific northwest fisheries (Nickelson and Mathews 1975) indicate that the lower Bay oyster fishery has a low energy efficiency ratio (Figure 4.6). This is due to the relatively large quantity of diesel consumed by the vessel during bedding operations. Nickelson and Mathews also found diesel to be the largest single input to a

Table 4.9. Energy Inputs and Output for a 5.4-Acre Bay Oyster Lease.

Item	Amount Required	Kcal Energy Per Unit *	Total Kcal of Energy **
Labor (Bed+Harvest)	193 man-days	3,110/day	600,230
Diesel Fuel	10,700 liters	9,154/1	98,594,582
Oyster Vessel (steel) and Equipment	48 gross tons	1,014,450/T/yr	16,231,200
Oyster Meat Produced per Lease (4,400 s)	15,002 Kgs	0.84 Kcal/gram	12,601,680
RATIO (Kcal output/ Kcal input)	=	0.11	

* energy units from Nickelson and Mathews (1975).

** The gross tonnage of vessel "A" was used. Only 33 percent of a yearly contribution was used to reflect actual time in the Bay fishery when compared to year-long fishing activities. Vessel was depreciated over a 20 year period according to methods used by Nickelson and Mathews (1975).

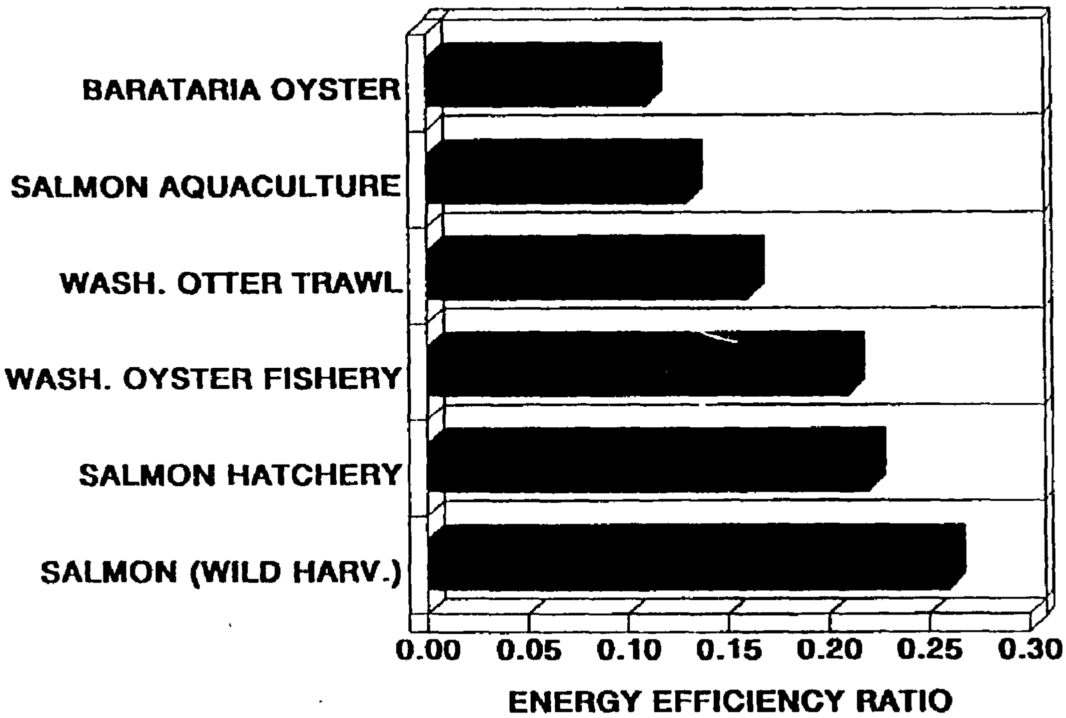

Figure 4.6 . Energy Efficiency Ratio for the Bay Fishery and Comparison to U.S. West Coast Fisheries.

Washington state oyster fishery.

The energy efficiency of other fisheries have been reported (Rawitscher and Mayer 1977). Rawitscher and Mayer, used an indirect method of calculating energy coefficients by using data from the U.S. Department of Commerce's publication, Census of Manufacturers, and the 1977 price of fuel paid by the boat owner. They developed energy profiles for 12 U.S. ocean fisheries using as inputs the kilocalories of energy needed (primary and secondary) to harvest a kilogram of seafood (Figure 4.7). Rawitscher and Mayer did not include labor as an input. Sardines produced the lowest energy inputs, 580 kcal per kilogram harvested, ocean perch was the next to lowest at 1,330 kcal per kilogram, and shrimp fishing produced the highest, 74,800 kcal per kilogram harvested. The Bay oyster fishery, excluding labor, used an average of 7,654 kcal to harvest one kilogram of oyster meat. The Bay estimate may be somewhat deflated for comparison because Rawitscher and Mayer included vessel repair costs in their calculations. Besides the sardine and ocean perch fisheries the Bay oyster fishery used more harvesting energy (kilocalories) than the pink salmon, cod, flounder and blue crab fisheries. In contrast, the Bay oyster fishery used less harvesting energy than the halibut, king salmon, lobster, tuna and haddock fisheries.

Rawitscher (1979) also estimated the energy inputs for three east coast oyster fisheries using the same methods as stated earlier. She found that a Connecticut raft culture operation

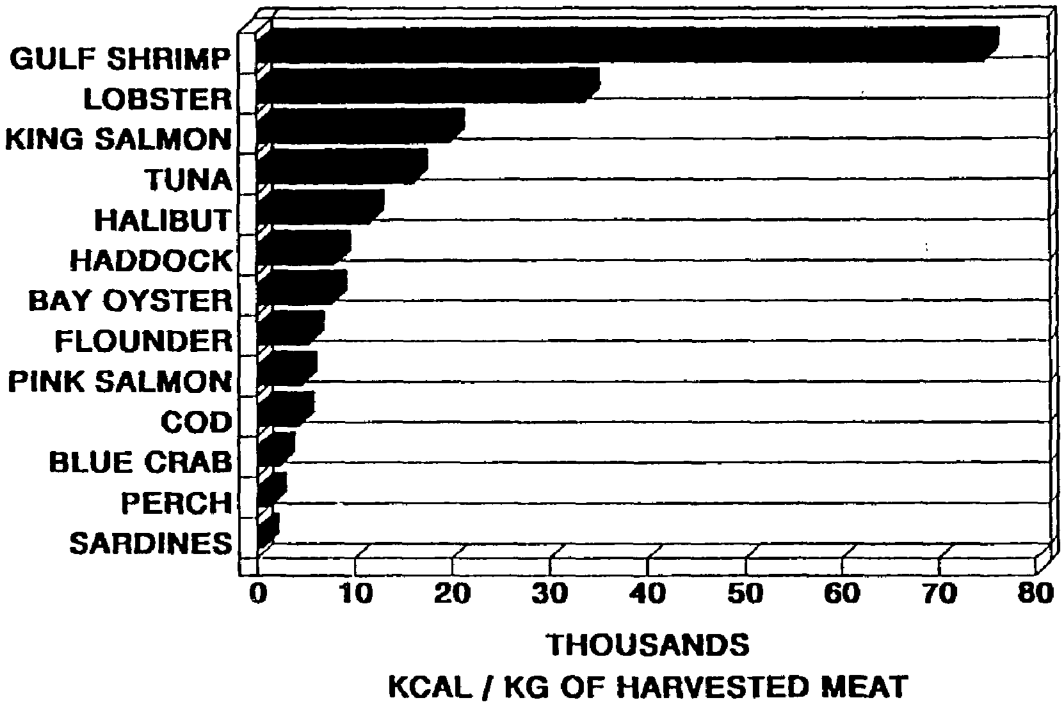

Figure 4.7. Energy Inputs to the Bay Fishery and Comparison to other U.S. Fisheries.

required 5,423 kcal input per kilogram of oyster meat while a Connecticut bottom culture operation required 50,000 kcal. A Delaware raft culture oyster fishery required 26,900 kcal input per Kilogram of oyster meat. Again, labor was not included in her calculations.

Krantz (1981) estimated that private bedding leases in Maryland can produce from 50 to 500 bushels per acre of harvestable oysters at 3.04 kg (6.7 lbs) of meat per bushel. This is equivalent to 127,764 to 1,277,640 kcal of harvestable oyster meat per acre. A Bay bedding lease produced an average of 2,333,644 kcal of meat per acre, 1 to 18 times more than a Maryland lease.

Leach (1976) calculated the fuel needed to harvest a kilogram of edible meat for several fisheries from around the world. The Malta fisheries needed an average of 67,200 kcal per kilogram of edible fish while the Adriatic fisheries needed 182,000-318,000 kcal per kilogram of edible fish. The shrimp fleet of the Gulf of Mexico had the highest input, 552,000 kcal per kilogram of edible shrimp. The Barataria Bay fleet needs an average of 30,883 kcal of fuel per kilograms of oyster meat harvested, a significantly lower energy cost.

Gosselink et. al (1974) estimated an acre of oyster bottom in South Carolina produces 817.2 kg of meat per acre for "moderately intensive culture", for a hatchery and leased water bottom operation on the east coast, 2,043 kg of meat per acre, and in Japan with intensive raft culture, 7,945 kg of meat per acre. The per acre

production (staked area) from an average lower Barataria Bay bedding lease is higher than all but the intensive raft culture. It is interesting to note that if the Bay's sack yield ratio increases to 2:1, the production is close to that of Japanese raft culture. Perret and Chatry (1988) state that 3:1 ratios are possible in some areas of the state. Such a potential yield is possible from a bedded Bay lease because oystermen plant oysters very dense.

FUEL AND LABOR:

Lamb (1981), as reported by Veal (1981), states that the production of shrimp in the Gulf of Mexico ranged from 120-204 grams per liter of diesel fuel consumed. In contrast, the Bay oyster fleet produced an average of 1.53 kg of oyster meat per liter of diesel fuel consumed, 7.7 to 12.8 times more than offshore shrimping in the Gulf of Mexico. The difference in fuel consumption is due to the larger vessels and engines needed for an offshore shrimp fleet. In addition, the oysters are concentrated on the private bedding leases and fuel expenditures while harvesting for sale are minimal.

Matthiessen (1970) and Dugas (1977) advocate that a commercial fisherman is a hunter, and his most productive time is while actively fishing. The intensity and determination with which the Bay oystermen searched for and harvested seed stock for transplanting supported Matthiessen's and Dugas' claim. In contrast, the daily routine during spring and summer harvest in the Bay was slower-paced. This was due to oysters being concentrated in one location, privately held, and daily production somewhat limited

by the oyster shed's needs.

Pawlyk and Roberts (1986) have shown that on the state's public grounds oystermen will concentrate in locations where oysters are in abundance. The oystermen of Barataria Bay were no different and moved from place to place within and between years. For example, Chatry and Millard (1985) found the only significant concentration of public seed in the Grand Pass-Cabbage Reef area in 1983, and the Bay oystermen were willing to travel the extra distance. This is further seen in the differences in yearly contributions from the various state seed grounds fished during this study. The Primary Seed Grounds were fished hard in the fall of 1982 and little remained the following year as seed (Bob Ancelet, LDWF, personal communication).

Veal et al. (1981) found that the Gulf of Mexico shrimp fleet spent 51 percent of its time actively fishing while away from port. The average fishing time for the Bay fleet was 29 percent while away from port (bedding + harvesting). The sharp contrast in fishing time between shrimping and oystering is the round trip travel time to bed in the Bay and return to the seed reefs to harvest another load. Furthermore, once shrimpers reach their fishing grounds, they will continue to fish for long periods before returning to home port (Veal et al. 1984). However, the increase in harvest per liter of fuel in the Bay oyster fishery more than compensates for the reduced time oystermen fish while away from port.

The influence of seed location significantly influenced a

vessel's fuel consumption and the labor needed to harvest and transport the seed to the Bay. The distances to the Grand Pass and Sister Lake seed grounds did not necessarily increase the number of days working but significantly increased the number of hours worked within each 24-hour period. Furthermore, as long as an oyterman was working, his vessel's engine was also running and burning fuel.

The oyster vessels used in the study are the typical larger luggers used for moving large quantities of seed at one time over long distances. In addition, the average volume of oysters moved per trip and the weeks spent bedding and harvesting were typical for a Louisiana oyster fishery (Dugas 1982). However, the average number of bedding trips to the Bay leases was not consistent with Dugas' (1982) description of a typical oyster fishery. The average number of trips to a Bay lease was approximately half the number of trips he considered typical. This difference is due to Bay oystermen needing a minimum of two days for a round trip from the Primary Seed Grounds, whereas oystermen who bed in the Basin nearer the Mississippi River can make a round trip in one day (personal observations).

Perret et al. (1971) and Allen and Turner (1984) have shown that the Basin's yearly production is significantly correlated with seed abundance on the Primary Seed Grounds. Therefore, the less time an oysterman has to travel to bed his load, the better his chances of beating his competition to harvest of a usually limited seed resource.

To help reduce expenses while bedding, vessels "D" and "G" in 1984 freighted oyster jointly. One freighted while the other dredged the public grounds for seed. Joint freighting was the exception during the study. Dugas et al. (1981) state that independent freighting is considered the general rule for most seed oystermen in the state. That practice was followed by the Bay oystermen.

The Bay has a history of producing quality oysters (Moore and Pope 1910), but that alone will not sustain or increase the utilization of the lower Bay leases by the oystermen. The Bay fishery is very dependent on seed from the state's public oyster grounds and oystermen will have to compete with others to obtain their seed. For the Bay fishery to survive and perhaps increase in utilization, the Primary Seed Grounds of Breton Sound must be maintained and enhanced for oyster production. The state-federal water diversion project under construction at Caernarvon, Louisiana is predicted to help the Primary Seed Grounds of Breton Sound. This will also benefit the Bay oystermen since they use less fuel and labor when bedding from Breton Sound.

5.0 PRODUCTION EXPENSES

The labor and distance traveled to obtain wild seed, bed, and later harvest for market can be substantial (Van Sickle et al. 1976, Korringa 1972, Chapter 4 of this dissertation). Consequently, operating expenses are high and there is no monetary return on investment until later in the season when the oysters are ready for market. In addition, lease yield is correlated with spring and summer salinities, further impacting an oysterman's investment.

Presently, there are no published data on expenses and profits associated with a private oyster-dredge fishery. Kearney/Centaur (1988), in a report prepared for the National Marine Fisheries Service, did an "exhaustive search" of the available literature and were able to document expenses and profits for 100 U.S. fisheries. The only documented oyster fishery was the tong fisheries of Mississippi, Alabama and Florida. Centaur Associates (1984), contracted by the Gulf and South Atlantic Fisheries Development Foundation, could not find any data on an oyster dredge fishery in the Gulf of Mexico. They extracted information from other fisheries to estimate a Gulf of Mexico oyster dredge fishery.

The objective of this chapter is to document production expenses (cost) and profits of a Bay seed fishery.

METHODS

QUESTIONNAIRE:

Daily expenses to operate an oyster vessel came from a

questionnaire developed for this study (Figure 5.1). Captains were personally interviewed at their home and on their vessel. To make the expense information more current and timely, and to increase the level of anonymity, the captains were interviewed for 1988. The expense data is therefore reported in 1988 dollars. Average daily expenses along with high and low values are reported.

Although an aging Bay fleet, Captains were asked to estimate the value of their vessel. Regardless of age and length of time in service, the average value for estimating depreciation was computed using all eight vessels. The low value was calculated as $ 0 to assume a fully depreciated vessel. Vessel depreciation is calculated using a straight line method over 10 years (Etzold 1975).

Insurance was added to the fixed costs, although three out of the eight owners did not carry any vessel or crew insurance. The average cost of insurance is computed on only those oystermen that reported insurance payments (5 of 8 oystermen). A value of $ 0 is used as the low estimate to represent those oystermen who do not carry insurance.

Van Sickle et al. (1976) estimated the average size lease in Barataria Bay to be approximately 34 acres and that was the acreage used for calculating the average and high rental fees to the state. Three oystermen did not have bedding leases in the Bay but were allowed to use leases of other oystermen, at no charge. Therefore, the low rental was calculated at $ 0.

The information from the questionnaire was summarized into

Figure 5.1. <u>BUDGET QUESTIONNAIRE</u>

Boat Name ______________________________

Electrical Equipment: (radar,loran,AC,refrigerator,TV,etc.)
purchase costs?______________Repair costs?________

Dredges __________size_____ chains etc. costs?__________
how long can use? _____ repair costs?______________

Boat Repairs:(excluding engine)
dry dock __________________ How often?____________
routine repairs and hardware(shackles,shovels,etc)?_______
deck changed how often?__________ cost to change?________
age of vessel?___________ value of vessel? ____________

Engine Repairs: (Routine repairs)
minor engine repairs and maint./yr(not oil)?___________
how old engine?______
generator? ______ repairs to gen?________________

Fishing Costs:
Labor/day:
no. men on vessel while Bed?_______while Harv?_________
any unpaid crew members?________
captain salary/day?_____ deckhand salary/day?_________
bedding and harvesting salaries differ?_____________
Fuel:
yearly oil and grease bill?_____________________
how often change?________ oil per change? ____________
Groceries and Miscellanous supplies:
yearly costs?_________or per month?______________
how much per day while bed?_____ while harv. Bay?______
Ice?__________ how often? _______price/block?__________
Butane?____________ How often?______price?____________
Lease poles:
number per year?______ costs?______ no/bay lease?_____
source of poles?__________________________
Insurance? ________________

Estimated total costs per day
to bed seed?(excluding fixed costs) ______________

Estimated total costs per day
to harvest Bay oysters?(excluding fixed costs) ______

expense categories similar to those developed by Centaur Associates (1984) for the Gulf and South Atlantic Fisheries Development Foundation.

DEVELOPMENT OF A LOWER-BAY SEED FISHERY:

The daily expense data generated from the questionnaire was incorporated into a hypothetical seed fishery for lower Barataria Bay. This further insured the anonymity of the participants in this study.

The fishery was developed from data generated in chapters 3 and 4. This included the number of labor days needed to bed and harvest, the quantity of seed bedded per lease, the number of sacks harvested, the amount of diesel fuel consumed by a vessel, and the average size of a crew, two deckhands. The bedding lease is assumed to be 2.2 hectares (5.4 acres) in size. The expenses reported in this study were water-related expenses. Ancillary equipment and expenses associated with any land-based operations were not included.

The average barrels of seed bedded per lease during 1982-85 was 1,993 ± 738 (rounded to 2,000 barrels). Furthermore, the average barrels of seed hauled per trip equaled 237 ± 54. Therefore, an average of 8.4 (=9) bedding trips (loads) were made to the bedding lease. The days needed to bed was based on the equation, (see chapter 4)

Days of Labor to Bed = 2.57(9 loads)

As a result, 23.13 (=24) labor days are needed to bed 2,000 barrels.

The labor days needed to harvest the Bay lease is dependent on the number of sacks harvested. The average yield (production) from a Bay lease in 1982-85 was 1.1 ± .3 sacks harvested for each sack bedded (a ratio of 1.1:1). Therefore, when 2,000 barrels (4,000 sacks) of seed are bedded, 4,400 sacks will be harvested to produce a 1.1:1 yield ratio.

The time needed to harvest the lease was based on the equation, (see chapter 4)

Days of Labor to Harvest = .008(4,400 sacks)

Therefore, it will take 35.2 (=36 days) to harvest 4,400 sacks of oysters.

Average vessel fuel consumption while bedding from 1982-84 was 267 ± 68 liters per day. The low and high estimates of fuel consumption while bedding were based on the lowest and highest yearly average, 219 liters per day in 1982 and 282 liters per day in 1983. Average vessel fuel consumption while harvesting from 1983-85 was based on a daily average of 90 ± 15 liters per day. The low and high harvesting fuel estimates were based on the lowest and highest yearly average, 82 liters per day in 1985 and 92 liters per day in 1984.

The combined bedding and harvesting days for a Bay lease was 60. Through interviewing the oystermen and personal observations, an oysterman spends between 180 to 240 days a year on the water in oyster-related work. As a result, a Bay oysterman is working approximately 25 to 33 percent of his water time on a Bay lease when

Table 5.1. Summary of Expenses Associated with Bedding and Harvesting in Barataria Bay. Expenses are given in 1988 Dollars.

ITEM VARIABLE COSTS	AVERAGE COST	RANGE LOW	 HIGH
BEDDING EXPENSES FOR 24 DAYS			
Labor to Bed	3,484	3,427	3,713
Groceries and Galley Supplies	552	408	960
Fuel Consumed while Bedding	1,200	881	1,599
Oil and Grease for Engines	140	140	140
Butane and Ice	75	0	108
HARVESTING EXPENSES FOR 36 DAYS			
Labor to Harvest	5,226	5,141	5,569
Groceries and Galley Supplies	684	360	1,440
Fuel Consumed While Harvesting	551	502	563
Oil and Grease for Engines	105	105	105
Butane ane Ice	144	0	206
OTHER EXPENSES (1/3 of yearly)			
Hull and Equipment Maintenance	2,307	1,523	3,317
Engine Maint. (exc. oil & grease)	330	67	667
SUBTOTAL	$ 14,798	$ 12,554	$ 18,387
FIXED COSTS (1/3 of yearly)			
Wilow Poles to Mark Lease Boundary *	54	0	75
Vessel and Engine Depreciation	2,896	0	4,166
Rental of Bay Leases from State *	68	0	68
Vessel and Crew State Licenses **	47	30	53
Vessel and Crew Insurance	2,360	0	3,000
SUBTOTAL	$ 5,425	$ 30	$ 7,362
TOTAL	$ 20,223	$ 12,584	$ 25,749

* annual expenses for willow poles and state lease.

** for 1988 state assessment of vessel and crew fees and licenses

60 days are needed.

Where only annual expenses could be given, a daily expense breakdown was calculated by taking one-third of the annual expense and dividing by 60 days, the days needed to bed and harvest the hypothetical lease.

As a check, captains were asked to estimate their daily operating expenses (exclusive of fixed costs) to bed and to harvest. Their response was compared to the average daily bedding and harvesting expenses developed using the methods of the questionnaire and hypothetical fishery.

RESULTS

A deckhand's salary ranged from $60 to $65 dollars per day and averaged $61. Nineteen percent for social security, unemployment and workers compensation taxes was added to the deckhand's daily wage. Total labor costs, excluding the captain as owner, totaled $8,710, 59 percent of the variable costs and 43 percent of the total costs (Table 5.1). Labor was the highest single expense.

Additional expenses of a hired captain and an extra deckhand would have increased the costs to operate. A hired captain's salary averaged $90 per day, within a range of $80-$100. A hired captain would have added an average of $6,426 to lease expenses. Some captains like to hire an additional deckhand, especially during bedding season. An additional deckhand will add an average of $4,428 per lease.

Vessel and engine maintenance (1/3 of yearly) totaled $2,637,

18 percent of variable costs and 13 percent of total costs (Table 5.1). Maintenance was the second highest expense after labor.

The price of fuel the oystermen were paying in 1988 averaged $0.17 per liter ($0.63/gal). Fuel expenses totaled $1,751, 12 percent of the variable costs and nine percent of total costs (Table 5.1). Fuel was the third highest expense.

Grocery and galley expenses (Table 5.1) were next after fuel. Groceries and miscellaneous galley supplies totaled $1,236, eight percent of variable costs and six percent of total costs.

Oil and grease expenses were equal for all vessels. All captains stated that the oil was changed and the engine and parts greased regularly every 100 hours of running time. Each engine oil change and grease, including filter change, cost approximately $35. Oil and grease expenses totaled $245, 2 percent of variable costs and one percent of total costs.

For fixed expenses, an oyster vessel with its equipment and engine were considered as a single unit. The average age of the vessels in 1988 was 18 years. The wooden-hulled vessels were the oldest, averaging 25 years of age while the steel-hulled vessels averaged eight years of age (refer to chapter four for a description of the vessels). Although initially more expensive to purchase, steel hulled vessel required fewer drydocks than a wooden vessel. Vessel depreciation (1/3 of yearly) totaled $2,896, 14 percent of expenses.

Insurance premiums amounted to $2,360, 12 percent of the

total costs (Table 5.1).

Daily operating expenses, incorporating average daily maintenance expenses, were calculated (Table 5.2). Expenses to bed averaged $271 per day and to harvest, $230 per day. Average daily variable expenses (bed + harvest) were $247. When fixed costs were added, total daily expenses increased 36 percent to $337.

Each oysterman stated that daily bedding expenses were higher than daily harvesting expenses. Oystermen's estimate of daily bedding expenses (variable costs only) averaged $300 ± 54 per day. Their estimate of daily harvesting expenses in the Bay (variable costs only) was $244 ± 46 per day. Combining daily estimates of bedding and harvesting expenses produced an average expense of $276 ± 54 per day. This is in relatively close agreement, 12 percent difference, with the calculated estimate, $247 per day (Table 5.2).

Production costs for a 5.4 acre bedding lease, where 4,000 sacks are bedded (2,000 barrels) and 4,400 sacks of oysters harvested, is $3,745 per acre.

The cost of harvesting a sack of oysters from a bedding lease is dependent on lease yield and the average daily expenses to operate (Figure 5.2). As yield increases the average cost of harvesting a sack decreases. In fact, costs decrease rapidly as yield increases because bedding expenses are recouped quickly and expenses become dependent on the costs of daily harvesting activities. For example, if an oysterman beds 2,000 barrels during 24 days of work and only gets a return of 400 sacks during 4 days of

Table 5.2. Summary of Expenses per Day while Bedding and Harvesting a Barataria Bay Lease. Expenses are given in 1988 Dollars.

VARIABLE EXPENSES	AVERAGE	LOW	HIGH
Direct Bedding Costs Per Day	271	246	316
Direct Harvesting Costs Per Day	230	214	263
Total Variable Costs Per Day	247	209	306
VARIABLE AND FIXED EXPENSES			
Total Costs Per Day	337	210	429

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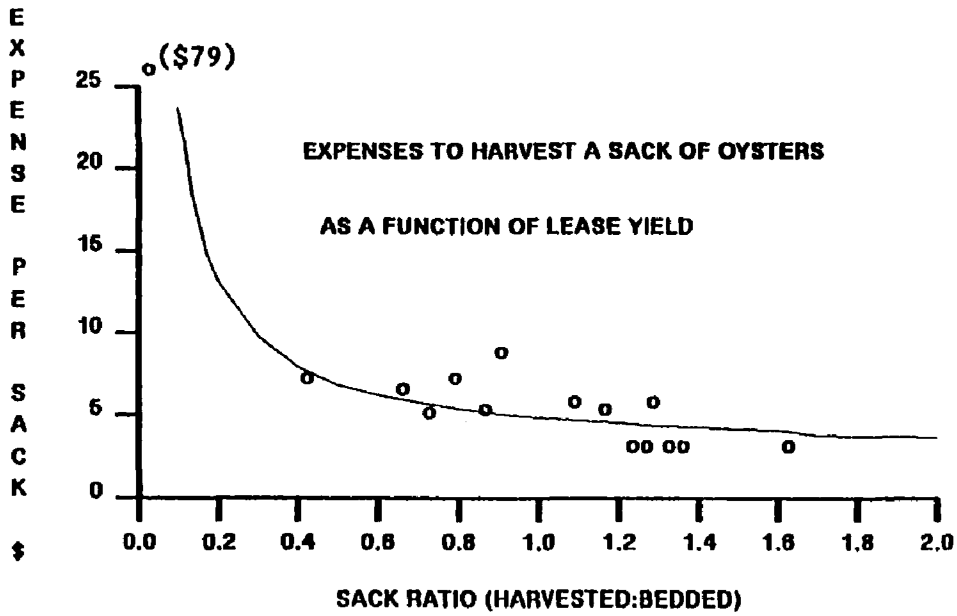

Figure 5.2. Expense to Harvest a Sack of Oysters from Lower Barataria Bay as a Function of the Lease Yield Ratio (No. Sacks Harvested:No. Sacks Bedded). (O = actual lease yield ratios from the study and subjected to an average daily operating costs of $337 per day). (line = represents bedding 4,000 sacks of oysters and varying the lease yield ratio).

harvest, his yield ratio will be 0.1:1. Such a low yield would cost an oysterman an average of $23.59 to harvest a sack (table 5.2). Conversely, if a lease yields 4,400 sacks (1.1:1 ratio) then it will take 36 days to harvest, but the average costs per sack is reduced to $4.60.

DISCUSSION

Profit from a bedding lease is dependent on the expenses to operate and the dockside price per sack (exvessel price). Using a dockside price of $18 per sack for 1988, an oysterman would not get a positive return on a lease yield of 0.1:1, but show an average loss of -$2,236 for his bedding and harvesting efforts (based on 24 days to bed 4,000 sacks of seed and 4 days to harvest at an average cost of $337 per day). It is certainly better to harvest something than not harvest at all, but bedding and harvesting expenses would not be fully recovered. In contrast, a lease yield of 1.1:1 would generate an average of $58,977 above annual expenses, a 75 percent return above operating expenses. Subtracted from the 75 percent return would be a salary for a captain (owner), a vessel's share for any major repairs, etc., and an extra deckhand if applicable.

The monetary return above expenses on a lease yield ratio of 1.1:1, and bedding 4,000 sacks of oysters, is equal to $10,921.67 per bedded acre (staked area), before an owner's salary and vessel's share are taken out (based on 5.4 acres). If the entire lease is considered, 34 acres (Van Sickle et al. 1976), then the return is reduced to $1,734.62 per acre, before owner and vessel shares are

taken out.

Monetary returns to an oysterman are dependent on the prevailing environmental conditions on the bedding lease and on the ability to avoid poaching and vandalism. For example, lease L-16 was vandalized by someone putting chunks of sulfur on top of the lease and no shed would buy the oysters. In 1988 dollars, this would have cost the oysterman of lease L-16 an estimated $44,190 in gross revenue. In another example, lease L-17 was poached, and in 1988 dollars, the oysterman would have lost an estimated $68,040 in gross revenue.

A bedded lease is an artificial situation, with per acre production very high. For example, a 34 acre bedding lease with 5.4 acres of it staked and planted, and producing an average of 15,002 kg (33,044 lbs) of oyster meat (4,400 sacks at 7.51 lbs per sack), is 32 times more productive than the 13.6 kg (30 lbs) per acre average produced from the state's private leases as a whole. The average production of 13.6 kg of oyster meat per acre is based on 311,000 leased acres in the state producing an average of 4,199,500 kg (9,258,313 lbs) of meat annually (Dugas 1988; Keithly and Roberts 1988).

Oystermen, when not operating in the Bay, are fishing either private leases with natural oyster populations or the public grounds. Consequently, the income from a bedding lease may be a substantial part of an oysterman's earnings for the year. As a result, when expenses and income are spread over a year, average

daily profits may become much reduced. Nonetheless, annual return above operating expenses for a lower-Bay seed lease, exclusive of other fishing activities during the year, can be compared to other U.S. shellfisheries (Figure 5.3). Such a return above operating expenses is possible because once the seed are bedded, there is little work or effort on the Bay lease until ready to harvest the following spring and summer.

The oystermen of lower Barataria Bay are very dependent on the public grounds for seed to transplant. During the the 1982-85 study as many as 10 oystermen were bedding oysters in the lower Bay. By 1988, the number of oystermen had decreased to three because of low supplies of seed available from the public grounds. When there are no oysters to bed, leases are left fallow and profits from an acre of bedding lease become $0.

The only other relatively complete and published itemized record of bedding expenses for a state lease is from Barataria Basin in 1927-28 (Table 5.3) (McConnel 1930). A 1928 seed fishery centered around one lease that was worked for an entire season. Net return above annual operating expenses were estimated to be $9,149 in 1928. This was a 61 percent return above annual investment.

The relative expenses (variable + fixed) between 1928 and 1988 are remarkably comparable (based on bedding 4,000 sacks of seed and getting a yield ratio of 1.1:1 in 1988). Labor in 1928 accounted for 49 percent of expenses, while in 1988 it accounted for 43 percent. Fuel expenses in 1928 were eight percent and nine percent

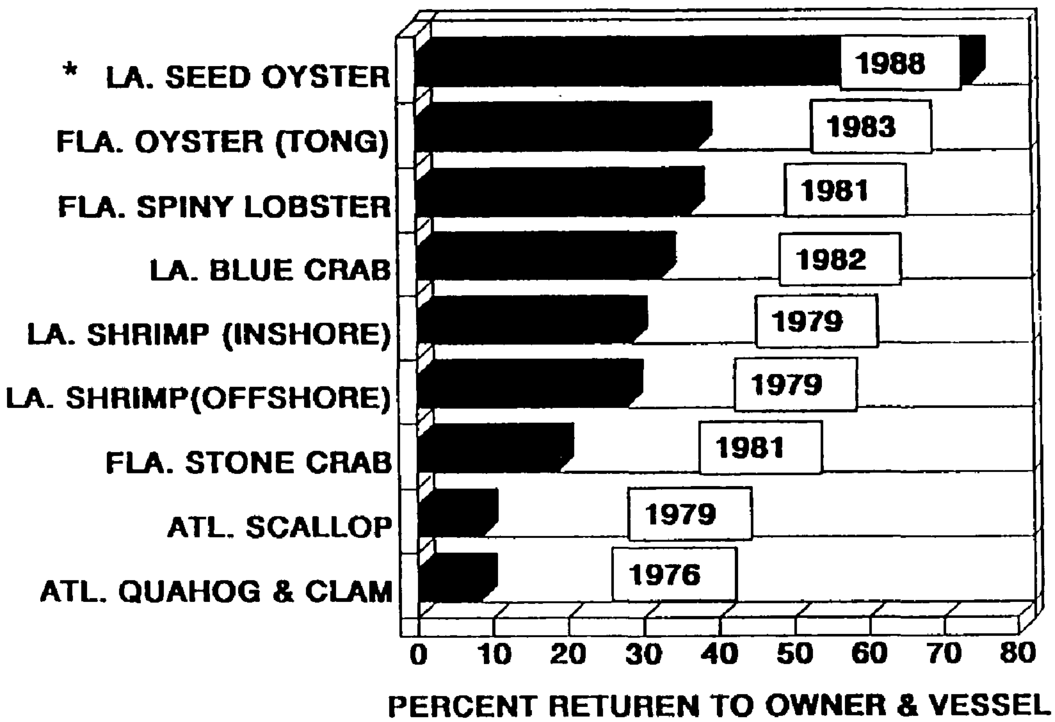

Figure 5.3. Annual return above investment to the vessel and the captain as owner. (date in block = data of study from Kearney/Centaur 1988).

* The lower-Bay seed fishery represents an annual return on fishing activities in the Bay only. It does not represent annual returns on all aspects of an oysterman's year when he is fishing elsewhere.

Table 5.3. Expenses and Profits of a 1928 Barataria Basin Seed Lease, 8 Acres in Size. (data from McConnell 1930).

EQUIPMENT	INITIAL COST	DEPRECIATION	MAINTENANCE
52 ft gas boat	$ 7,500	10%	$ 750.00
two oyster skiffs	450	10%	45.00
cabin and equip.	500	10%	50.00
misc. tools, equip.	100	100%	100.00
fencing	128.50	100%	128.50
posts	50	50%	25.00

OPERATING EXPENSES

salary for 3 men for 8 months at $120/month	2,880.00
food and tobacco for 8 months at $75/month	600.00
fuel - for 20 trips to natural reefs for seed	480.00
canal fees for 20 trips	520.00
insurance - fire, tornado, liability	200.00
survey of bedding lease by state	11.00
rental fee from state for 8 acres	8.00
tonnage license from state	3.50
dredging license from state	50.00
TOTAL EXPENSES =	$ 5,851.00

PRODUCTION = 15,000 SACKS AT $ 1.00 PER SACK

GROSS PROFITS = $ 15,000.00

NET PROFITS = $ 9,149.00

in 1988. Groceries expenses were 10 percent in 1928 and six percent in 1988. Insurance premiums increased from three percent in 1928 to 11 percent in 1988. Lease rental fees doubled from $1 to $2 per acre and accounted for 0.1 percent in 1928 and 0.3 percent in 1988.

A few operating expenses for Barataria Bay were also documented by Korringa (1976). Although his costs are aggregated over an entire year for two cypress hull vessels, two comparisons can be made. First, annual yearly maintenance for each vessel averaged $3,641 in 1972. In 1988 annual maintenance averaged $7,911 per vessel, a 117 percent increase. Korringa also did not include any major overhaul or repair costs to the engine or hull in his estimate of maintenance expenses. The 1988 maintenance estimate for a Bay bedding lease may be low because the demand on engine and vessel performance is at maximum while bedding. In addition, costly major repairs, which may happen, were not included. For example, an engine overhaul can exceed $10,000.

Second, in 1972 each deckhand was paid $400-$500 per month, including social security payments, with the employer paying an additional $750 per year for compensation insurance. In 1988, deckhands were paid $1,300-$1,500 per month (based on 22 work days per month), excluding the employer's share of federal and state taxes (19 percent). This is a 300-400 percent increase from 1972.

Oystermen are working virtually non-stop while bedding and food and galley supplies are often used more rapidly. In contrast, during harvest season in the Bay many of the crew members lived

close to port and went home each night. Five of the eight captains had lower daily grocery costs while harvesting the leases.

The location of the seed to transplant will determine the bedding expenses. The data presented here reflects a composite of several locations, exclusive of the public grounds in Vermilion Bay, which were fished for seed over a three season period (refer to chapter 4). Most of the locations harvested for seed were east of the Mississippi River in Breton and Mississippi Sounds. Any seed, bedded in the Bay during 1988, would have cost $3.35 per barrel to transport (range = $2.95 to $3.79). This is equivalent to $1.08 per Louisiana bushel (range = $0.98 to $1.26). An average bushel bedded in the Bay during the study contained 480 oysters that averaged 69mm in size.

In Virginia, oystermen in 1989 paid $2.00 per Virginia bushel for "seed rock" delivered to their bedding lease (Mike Castagna, Virginia Institute of Marine Science, pers. comm.). A Virginia bushel has a volume 1.40 times greater than a Louisiana bushel. Therefore, an equivalent Louisiana volume would decrease cost to $1.43 per bushel. This is 32 percent higher than the estimated cost to haul a bushel of seed to Barataria Bay in 1988. Virginia seed oysters number 800-2,000 per Virginia bushel and range up to 50-60mm in size, but most are usually much smaller (Mike Castagna, pers. comm.).

In Maryland, oystermen in 1985 were paying $3.50 per 1,000 hatchery seed that ranged in size from 12-25mm (Webster and Merrit

1985). Maryland prices paid by an oysterman in 1985 for natural-set seed delivered to his private bedding lease ranged from $3.30 to $6.45 per bushel, depending on the size of the oysters (Webster and Merrit 1985). A Maryland bushel is 1.3 times larger than a Louisiana bushel. Therefore, an equivalent Louisiana volume would cost $2.54 to $4.96 per bushel. This is 135 to 359 percent higher than the estimated cost to haul a bushel of seed to Barataria Bay in 1988.

Sack production per day is not constant. As the sack yield per day decreases toward the end of the season, an oysterman must decide when it was time to quit. Oystermen continued to work until harvest was down to 8-20 sacks per day. The dock-side price per sack and the necessity to repair the vessel before the opening of the fall season on the public grounds influenced that decision. In contrast, oystermen could easily harvest 200-250 sacks per day at the beginning of the summer, depending on the oyster shed's daily demand. Korringa (1976) stated that a Bay crew (2-3 men) could, on a good day, harvest 100 sacks from a bedding reef. The Bay oystermen during this study easily harvested over 100 sacks a day at the beginning of the season. Oysters were concentrated on a relatively small area of water bottom and the dredge was easily filled.

6.0 SYNTHESIS: PRODUCTION AND COST MODEL

The preceding chapters discuss the biological, environmental and economic factors which influence production on an oyster bedding lease in Barataria Bay. This chapter integrates those findings.

The objectives of this chapter are: (1) develop a bioeconomic model which describes how salinity and temperature influence bedding lease production and daily expenses to operate, and (2) use the model to assess the impact of various management desicions and environmental conditions on potential lease yield and costs.

METHODS

CONCEPTUAL MODEL:

The data presented in the preceding chapters were used to construct a conceptual model of activities on a Barataria Bay bedding lease (Figure 6.1). Daily operating expenses to bed are dependent on the location and quantity of seed transported to the Bay. The farther away the seed source, the more expensive it becomes to operate as fuel demands increase. In addition, the quantity of seed bedded will determine how many trips will be needed to the Bay, which in turn affects labor and vessel maintenance expenses.

Harvesting expenses are dependent on the volume of oysters that can be produced on a lease and the daily harvest limits set by the shucking shed. Production, in turn, is dependent on the prevailing salinity and temperature in the Bay. The scrape material

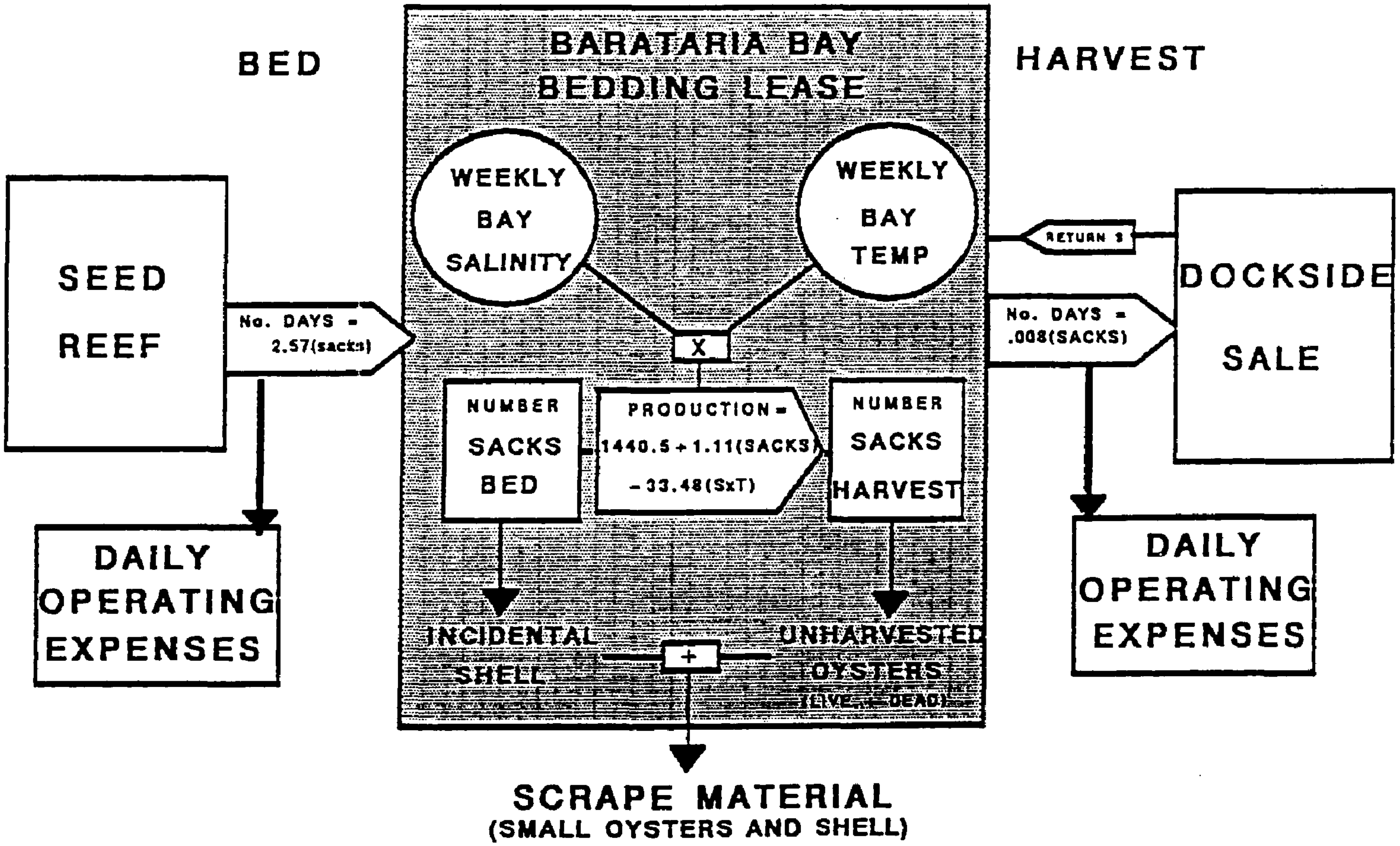

Figure 6.1. Conceptual Model Depicting Bedding and Harvesting Activities and Environmental Influences on Lease Productivity.

(incidental shell, plus the oysters that die while on the bedding lease and any spat recruitment that may occur) must be removed at the end of the season to keep the hard-bottom leases clean of any excess shell.

PRODUCTION MODEL:

The driving forces of the model are the three linear equations that are used to predict the number of days needed to bed a given quantity of oysters, the total lease production as a function of temperature and salinity, and the number of days needed to harvest that production.

Although the conceptual model depicts the importance of the scrape material, it is not measured directly in the computer model. The model was constructed from the data generated in this study. Therefore, the incidental shell, dead oysters, and small oysters left on a bedding lease at the end of a season are a function of the final production figures for each lease of this study.

The model includes the daily bedding and harvesting expenses to operate in the Bay. As potential lease production increases, the days needed to harvest also increase, affecting total operating expenses.

The model does not calculate the profit per sack to an oysterman. Profit per sack is dependent on the dockside selling price, which will fluctuate seasonally. Therefore, users of the model will have to determine profits independently.

COMPUTER PROGRAM:

Once the production model was developed, a computer program was written around the equations using turbo basic language (Table 6.1). The program was stored on a 3.5 inch floppy disk (PC compatible), and a copy attached to this dissertation. Mr. Jimmy Landry, Associate Professor of electrical engineering at Nicholls State University, assisted in the writing of the program.

The computer program is user-friendly (see floppy disk) and allows a person to change the input data of temperature, salinity, daily expenses, month of bedding, and the number of sacks hauled per load (Table 6.2). Included in the daily expense information is a miscellaneous category which allows the user to enter any expenses that are not categorized in the program.

Added to the floppy disk are historical salinity data for Barataria Bay (historical Bay salinity data courtesy of LDWF through Debbie Fuller, LSU). This allows the user to look at environmental data other than that generated in this study and how it may affect lease production.

MODEL UTILIZATION

The information generated from the preceding chapters is used as the default data in the model (Table 6.2). The model was first run changing only the date when bedding began, from September to October (Figures 6.2 and 6.3). Both bedding months have historical significance. Oystermen have traditionally bedded in the fall from September to November (Dugas 1982), with September and

Table 6.1. Program Selections as They Appear on Computer Screen.

```
        1. Salinity & Temperature data
        2. Cost data
        3. Directory
        4. Plot
        5. Video Mode Select <EGA>
    Press <Esc> =  exit to DOS




Select Plot:  Sal   Temp   (S x T)   Yield & Cost   eXit
```

Table 6.2. Default Data from Study, 1982-85.

Default Values	Variable Cost Per Day	
	Bedding	Harvesting
Labor	145.17	145.17
Groceries & Galley Supplies	23.00	19.00
Fuel	50.00	15.30
Oil & Grease for Engines	5.83	2.92
Butane & Ice	3.13	4.00
	Other Expenses (Per Day)	
Hull & Equipment Maintenance	38.45	
Engine Maintenance	5.50	
Miscellaneous	0.00	
	Fixed Cost	
Willow Pole Markers	54.00	
Vessel and Engine Depreciation	2896.00	
Rental of Bay Leases from State	68.00	
Vessel and Crew State Licenses	47.00	
Vessel and Crew Insurance	2360.00	
(One Barrel = Two Sacks)	OYSTER SEED VOLUME	
Avg. No. Barrels Bedded Per Load	237.00	

Select: Edit Save Load Print eXit

Barataria Bay
Salinity and Temperature Weekly Averages

Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp
1	22	27	14	17	16	27	17	17	40	19	27
2	21	28	15	18	15	28	18	19	41	12	28
3	24	28	16	20	13	29	18	17	42	13	28
4	29	29	17	29	16	30	19	19	43	12	30
5	27	25	18	23	9	31	21	20	44	20	29
6	26	26	19	22	13	32	18	20	45	15	31
7	26	25	20	20	13	33	20	21	46	20	30
8	23	22	21	19	12	34	14	23	47	23	30
9	26	25	22	25	12	35	12	26	48	21	28
10	28	21	23	20	14	36	18	24	49	17	30
11	24	17	24	21	14	37	14	27	50	16	30
12	29	20	25	14	13	38	9	27	51	19	32
13	23	17	26	18	18	39	20	20	52	19	30

WEEK 1 = FIRST WEEK OF SEPT.

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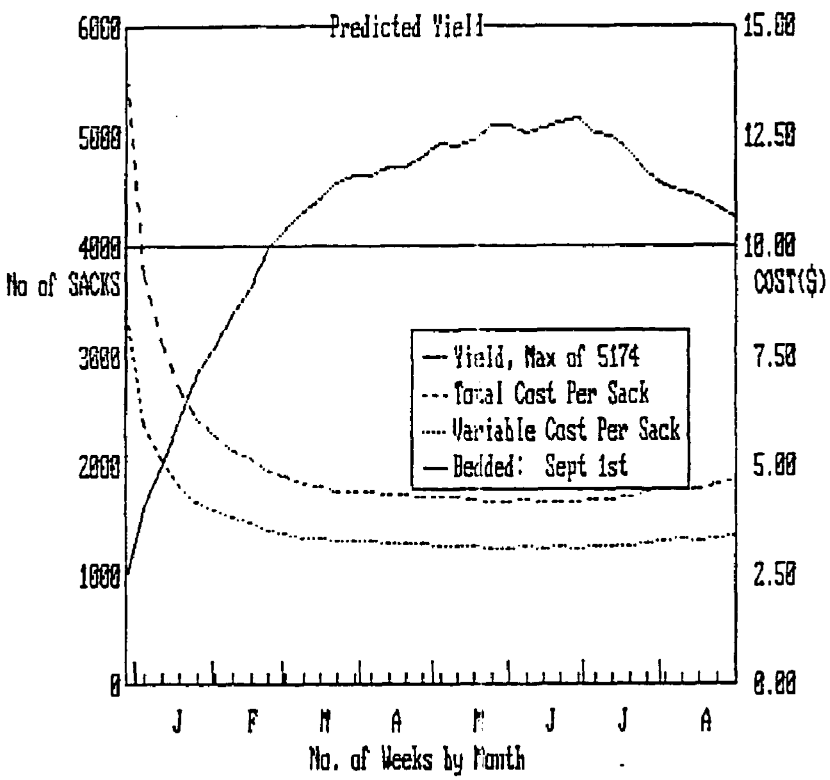

Figure 6.2. Default Graph and Data on Weekly Production, Sack Costs, and Days needed to Bed and Harvest 4,000 Sacks of Oysters in September. 1982-85.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Sept 1st
Days needed to bed: 24

Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J 17	988	13.94	8.45	8
18	1597	9.34	5.95	13
19	2003	7.80	5.09	16
20	2412	6.76	4.51	19
F 21	2832	6.08	4.17	23
22	3105	5.70	3.95	25
23	3384	5.36	3.76	27
24	3619	5.14	3.64	29
M 25	3986	4.84	3.48	32
26	4142	4.72	3.41	33
27	4329	4.57	3.31	34
28	4440	4.50	3.28	35
29	4585	4.41	3.23	36
A 30	4658	4.39	3.23	37
31	4663	4.39	3.22	37
32	4731	4.32	3.18	37
33	4734	4.32	3.17	37
M 34	4833	4.28	3.16	38
35	4936	4.24	3.14	39
36	4921	4.25	3.15	39
37	4956	4.22	3.13	39
38	5109	4.14	3.08	40
J 39	5119	4.13	3.07	40
40	5033	4.20	3.12	40
41	5097	4.15	3.08	40
42	5135	4.16	3.11	41
J 43	5174	4.13	3.08	41
44	5044	4.19	3.12	40
45	5006	4.22	3.14	40
46	4871	4.25	3.13	38
A 47	4677	4.37	3.21	37
48	4563	4.43	3.24	36
49	4507	4.49	3.28	36
50	4473	4.47	3.26	35
51	4356	4.54	3.29	34
52	4268	4.63	3.36	34

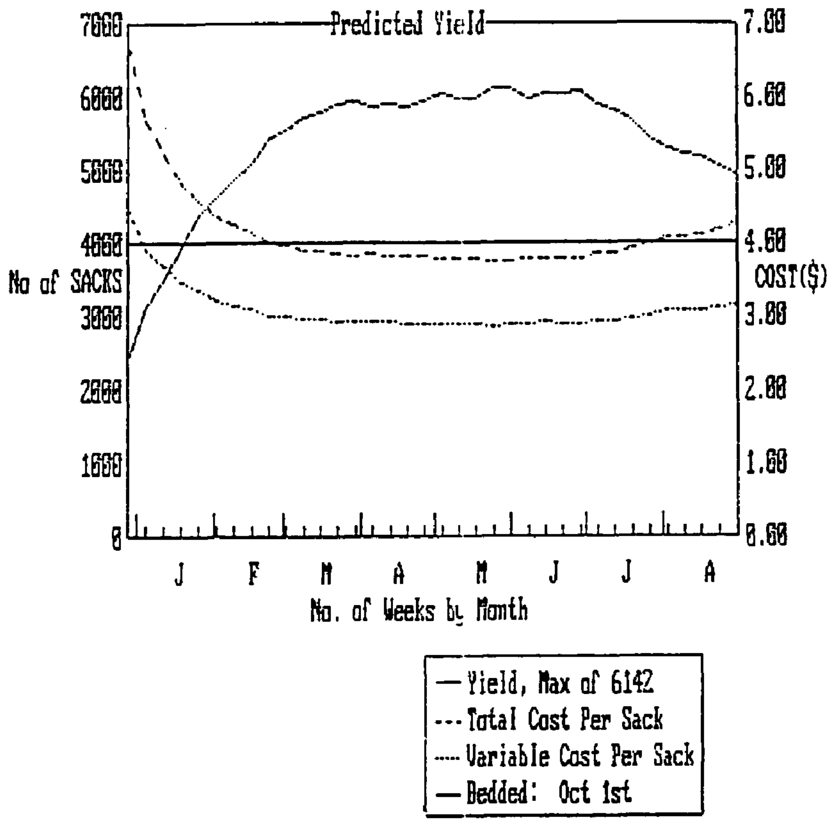

Figure 6.3. Defalut Graph and Data on Weekly Production, Sack Costs, and Days needed to Bed and Harvest 4,000 Sacks of Oysters in October. 1982-85.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Oct 1st
Days needed to bed: 24

Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J 17	2424	6.73	4.49	19
18	3104	5.70	3.95	25
19	3518	5.23	3.68	28
20	3934	4.85	3.47	31
F 21	4364	4.58	3.34	35
22	4612	4.38	3.21	36
23	4870	4.25	3.13	38
24	5078	4.16	3.10	40
M 25	5445	4.01	3.01	43
26	5563	3.97	2.99	44
27	5721	3.90	2.95	45
28	5793	3.89	2.95	46
29	5906	3.85	2.93	47
A 30	5940	3.83	2.92	47
31	5899	3.86	2.94	47
32	5932	3.84	2.92	47
33	5894	3.82	2.90	46
M 34	5967	3.81	2.90	47
35	6047	3.80	2.90	48
36	5996	3.80	2.89	47
37	6003	3.79	2.89	47
38	6142	3.74	2.86	48
J 39	6124	3.75	2.87	48
40	6001	3.79	2.89	47
41	6045	3.80	2.91	48
42	6062	3.79	2.90	48
J 43	6082	3.78	2.89	48
44	5916	3.85	2.93	47
45	5853	3.85	2.92	46
46	5685	3.92	2.97	45
A 47	5454	4.00	3.01	43
48	5312	4.07	3.05	42
49	5234	4.08	3.05	41
50	5181	4.13	3.08	41
51	5040	4.20	3.12	40
52	4931	4.24	3.14	39

October being the two most heavily fished months on the public grounds (Pawlyk and Roberts 1986). The model indicates that by waiting until October to bed, maximum predicted lease yield increases by 968 sacks of oysters and the yield ratio increases from 1.29:1 to 1.54:1, a 19 percent increase. In addition, as lease yield increases the costs to harvest a sack of oysters decreases (Figures 6.2 and 6.3). The decrease in costs per harvested sack is due to the increase in total production, although more labor days are added to harvest.

The model was next run changing only the weekly salinity data from the default values to historical Bay salinity data. The historical average weekly salinity values near the barrier island, Grand Terre were used in the model (Table 6.3). Grand Terre is located at the southern end of the Bay adjacent to the Gulf of Mexico (Figure 6.4). The Grand Terre data spanned the years 1959-80. The results indicate that the lower Bay, with its higher average salinities could produce a maximum of 4,657 sacks of oysters when 4,000 sacks are bedded in September, a yield ratio of 1.16:1 (Figure 6.5). The model was again run using the same data, except bedding began in October (Figure 6.6). The results indicate by waiting to bed in October, potential maximum lease yield can increase to 5,356 sacks of oysters. An October bedding date can increase lease production by 15 percent. In the lower Bay at Grand Terre, oysters should be harvested by the beginning of June to attain maximum production. As salinity and temperature increase

Table 6.3. Historical Average Salinity Data for Grand Terre. Temperature Data is from this study for period 1982-85.

Barataria Bay
Salinity and Temperature Weekly Averages

Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp
1	20	27	14	26	16	27	21	17	40	16	27
2	20	28	15	25	15	28	22	19	41	16	28
3	22	28	16	24	13	29	22	17	42	17	28
4	21	29	17	24	16	30	22	19	43	17	30
5	23	25	18	24	9	31	21	20	44	19	29
6	23	26	19	23	13	32	19	20	45	20	31
7	25	25	20	23	13	33	18	21	46	22	30
8	24	22	21	23	12	34	16	23	47	22	30
9	25	25	22	21	12	35	17	26	48	22	28
10	25	21	23	21	14	36	17	24	49	21	30
11	26	17	24	22	14	37	18	27	50	21	30
12	26	20	25	23	13	38	17	27	51	21	32
13	26	17	26	22	18	39	17	20	52	21	30

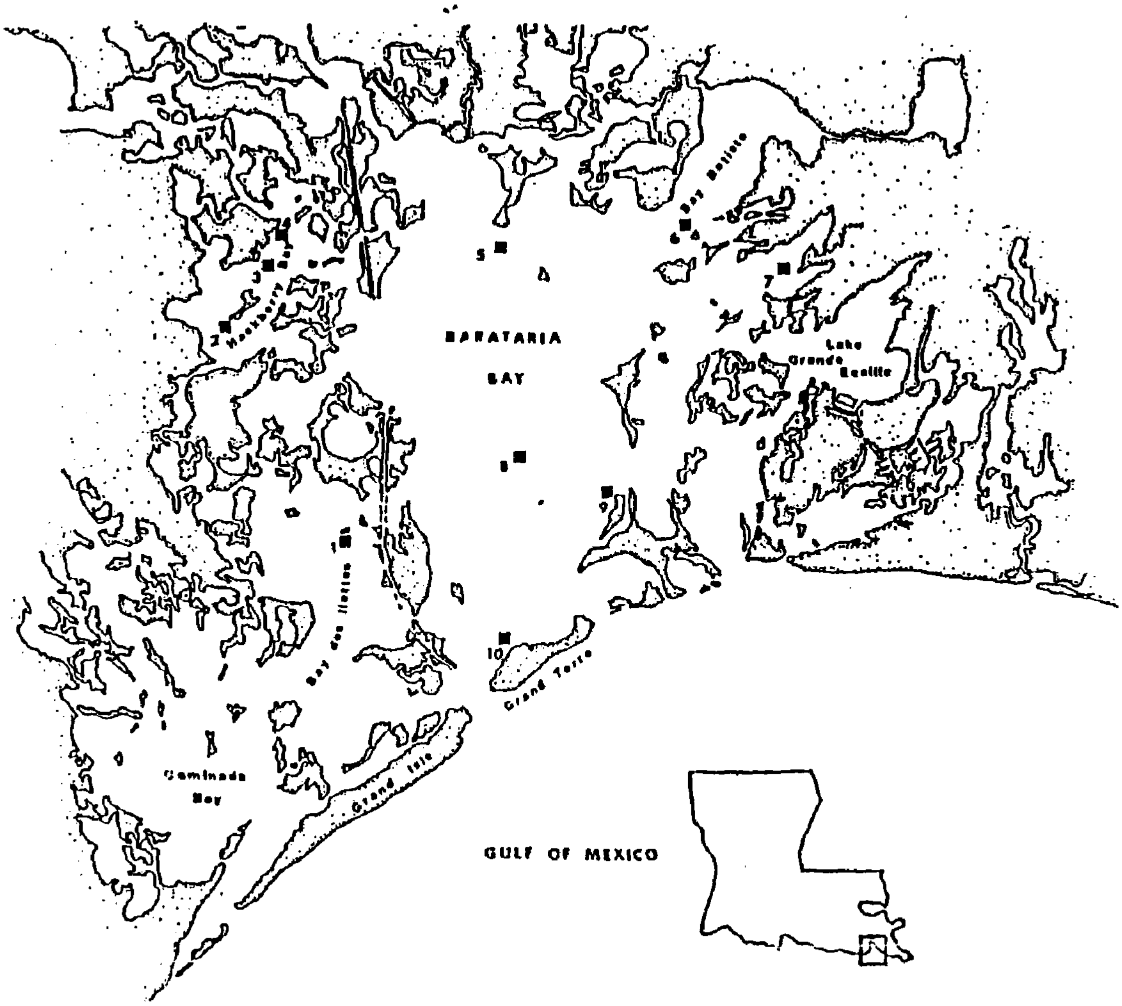

Figure 6.4. Location of Bay Stations Sampled Weekly for Temperature and Salinity by the LDWF. Station 10 = Grand Terre, Station 5 = St. Mary's Point. (Map courtesy of LDWF)

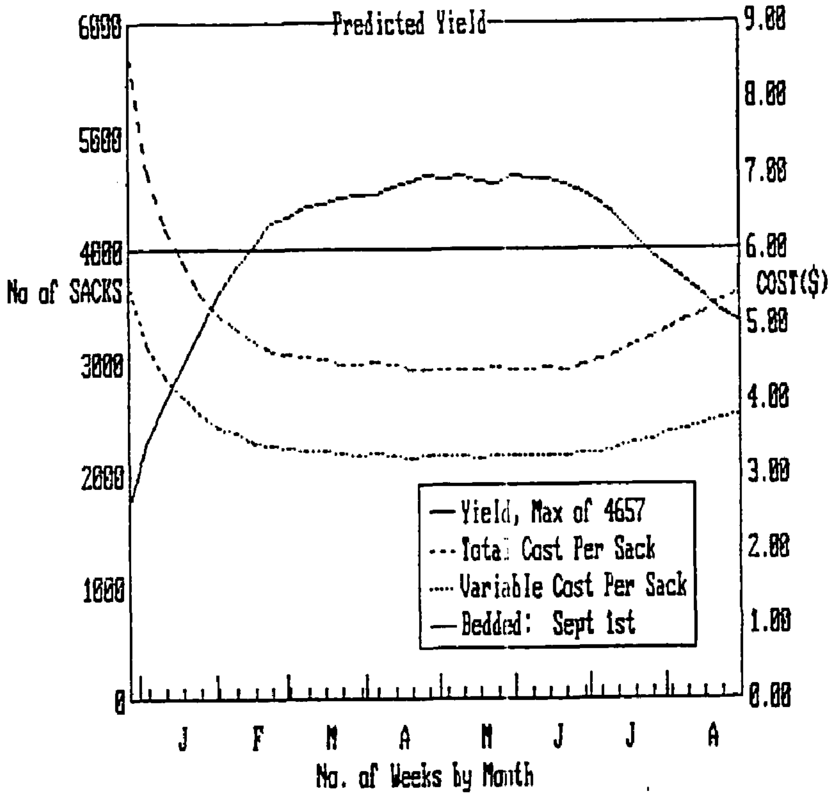

Figure 6.5.

Predicted Sack Production and Costs to Bed 4,000 Sacks in September at Grand Terre.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Sept 1st
Days needed to bed: 24

Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J 17	1762	8.60	5.52	14
18	2312	7.05	4.71	19
19	2657	6.31	4.27	21
20	2967	5.88	4.06	24
F 21	3285	5.45	3.80	26
22	3611	5.15	3.65	29
23	3847	4.96	3.55	31
24	4043	4.77	3.43	32
M 25	4236	4.66	3.38	34
26	4290	4.61	3.34	34
27	4387	4.56	3.32	35
28	4405	4.54	3.31	35
29	4473	4.47	3.26	35
A 30	4486	4.46	3.25	35
31	4497	4.50	3.29	36
32	4549	4.45	3.25	36
33	4600	4.40	3.22	36
M 34	4657	4.39	3.23	37
35	4641	4.41	3.24	37
36	4657	4.39	3.23	37
37	4602	4.39	3.22	36
38	4573	4.42	3.24	36
J 39	4648	4.40	3.23	37
40	4642	4.41	3.24	37
41	4624	4.42	3.25	37
42	4584	4.41	3.23	36
J 43	4519	4.48	3.27	36
44	4426	4.52	3.29	35
45	4286	4.61	3.35	34
46	4123	4.74	3.42	33
A 47	3967	4.81	3.44	31
48	3848	4.96	3.55	31
49	3724	5.06	3.60	30
50	3606	5.16	3.66	29
51	3464	5.31	3.74	28
52	3355	5.41	3.79	27

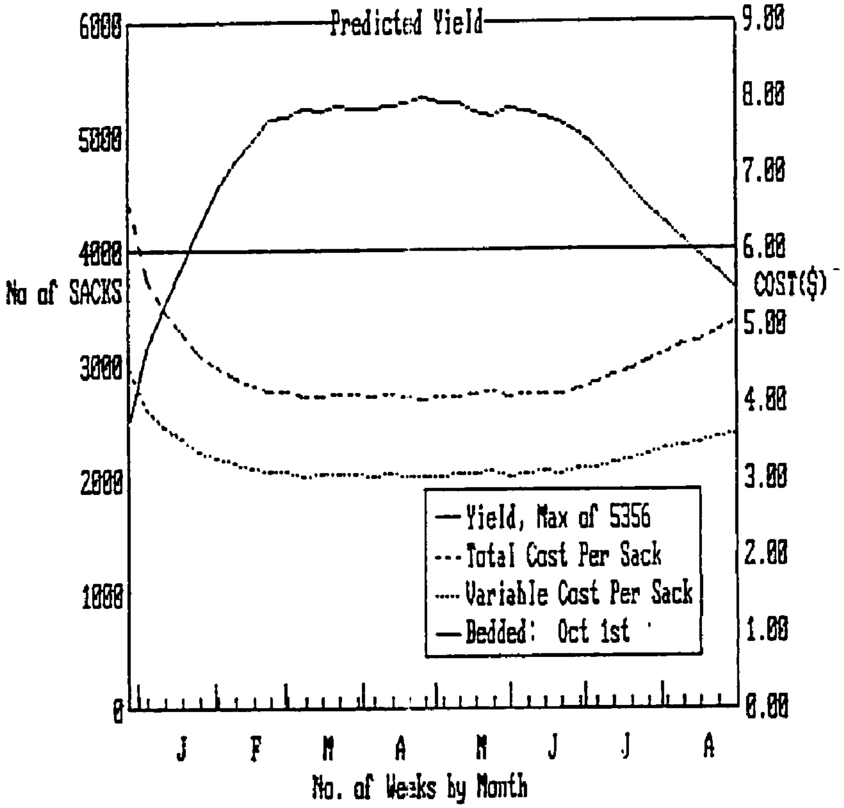

Figure 6.6.

Predicted Sack Production and Costs to Bed 4,000 Sacks in October at Grand Terre.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Oct 1st
Days needed to bed: 24

	Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J	17	2483	6.66	4.48	20
	18	3138	5.64	3.91	25
	19	3520	5.22	3.68	28
	20	3854	4.95	3.54	31
F	21	4195	4.66	3.36	33
	22	4542	4.45	3.26	36
	23	4778	4.33	3.19	38
	24	4968	4.21	3.12	39
M	25	5154	4.15	3.09	41
	26	5175	4.13	3.08	41
	27	5251	4.07	3.04	41
	28	5236	4.08	3.05	41
	29	5281	4.09	3.06	42
A	30	5266	4.10	3.07	42
	31	5249	4.07	3.04	41
	32	5282	4.09	3.06	42
	33	5314	4.07	3.04	42
M	34	5356	4.03	3.02	42
	35	5315	4.07	3.04	42
	36	5312	4.07	3.05	42
	37	5230	4.09	3.05	41
	38	5179	4.13	3.08	41
J	39	5246	4.07	3.04	41
	40	5223	4.09	3.05	41
	41	5186	4.12	3.08	41
	42	5127	4.12	3.07	40
J	43	5042	4.19	3.12	40
	44	4927	4.24	3.14	39
	45	4761	4.34	3.21	38
	46	4571	4.42	3.24	36
A	47	4390	4.55	3.32	35
	48	4251	4.65	3.37	34
	49	4107	4.76	3.43	33
	50	3970	4.80	3.44	31
	51	3808	4.95	3.52	30
	52	3683	5.05	3.58	29

after June, production decreases.

The model was again run using the weekly salinity data from St. Mary's Point located at the very northern end of the Bay (Table 6.4). The data spanned the years 1973-80. The model produced a significant contrast to the Grand Terre salinity data with potential lease production increasing substantially. Maximum production if bedded in September increased to 10,478 sacks with a yield ratio of 2.62:1 (Figure 6.7). This is a 125 percent increase above the maximum production potential estimated for oysters bedded in September near Grand Terre. If bedding began in October, the maximum potential lease yield increases to 10,947, a 4.5 percent increase over September (Figure 6.8). The smaller increase from September to October at St. Mary's Point, when compared to Grand Terre, is due to the lower historical salinities in September in the northern part of the Bay (Tables 6.3 and 6.4).

The energy efficiency ratio for bedding 4,000 sacks of oysters in September at St. Mary's Point was estimated to be .21:1. This is equivalent to that for a Washington-State oyster fishery (see chapter 4).

The model indicates that in the saltier areas of lower Barataria Bay it is best to wait until October to bed. This will increase yield and produce a more efficient utilization of the resource. In contrast, the upper Bay did not produce a significantly higher yield by waiting to bed in October. Some oystermen bed more than one lease and, if one begins bedding in

Table 6.4. Historical Average Salinity Data for St. Mary's Point. Temperature Data is from this study for period 1982-85.

Barataria Bay
Salinity and Temperature Weekly Averages

Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp	Week	Sal	Temp
1	16	27	14	15	16	27	13	17	40	6	27
2	14	28	15	17	15	28	12	19	41	4	28
3	13	28	16	17	13	29	14	17	42	5	28
4	13	29	17	15	16	30	14	19	43	5	30
5	14	25	18	13	9	31	18	20	44	7	29
6	14	26	19	11	13	32	10	20	45	10	31
7	16	25	20	12	13	33	11	21	46	11	30
8	18	22	21	11	12	34	10	23	47	13	30
9	20	25	22	12	12	35	9	26	48	12	28
10	21	21	23	11	14	36	7	24	49	13	30
11	18	17	24	13	14	37	9	27	50	13	30
12	18	20	25	13	13	38	6	27	51	11	32
13	18	17	26	13	18	39	6	20	52	13	30

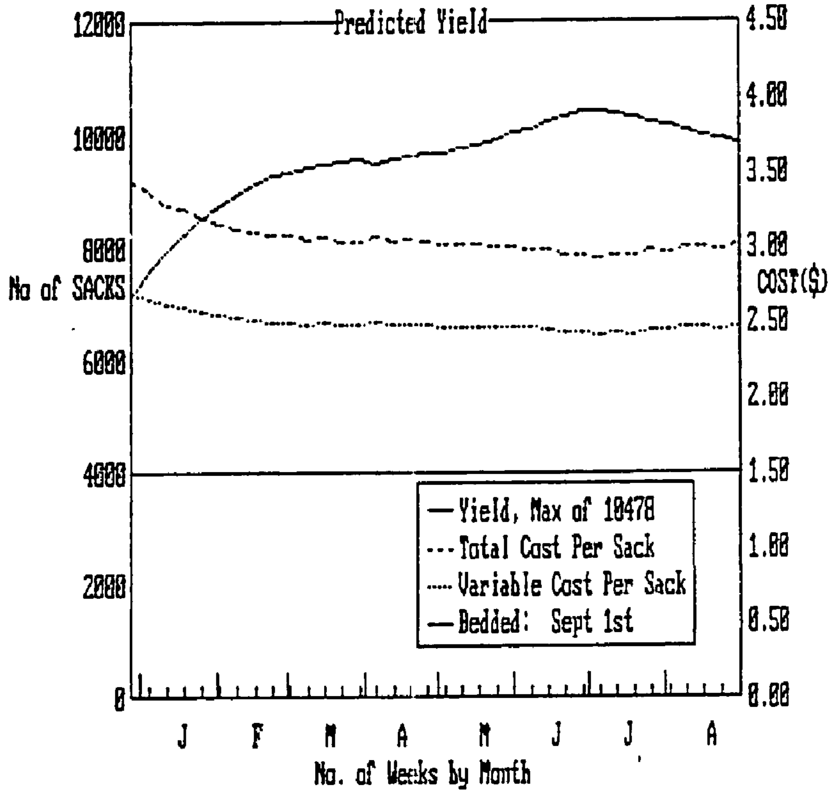

Figure 6.7.

Predicted Sack Production and Costs to Bed 4,000 Sacks in September at St. Mary's Point.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Sept 1st
Days needed to bed: 24

	Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J	17	7174	3.46	2.70	56
	18	7607	3.39	2.67	60
	19	7948	3.30	2.62	62
	20	8234	3.27	2.61	65
F	21	8530	3.21	2.57	67
	22	8782	3.17	2.55	69
	23	8997	3.14	2.54	71
	24	9155	3.11	2.52	72
M	25	9317	3.09	2.50	73
	26	9384	3.09	2.51	74
	27	9461	3.06	2.49	74
	28	9525	3.07	2.50	75
	29	9573	3.05	2.48	75
A	30	9586	3.05	2.48	75
	31	9497	3.08	2.50	75
	32	9581	3.05	2.48	75
	33	9629	3.06	2.49	76
M	34	9674	3.04	2.48	76
	35	9714	3.03	2.47	76
	36	9812	3.02	2.47	77
	37	9837	3.02	2.46	77
	38	9933	3.01	2.46	78
J	39	10059	3.00	2.46	79
	40	10144	2.99	2.46	80
	41	10266	2.98	2.45	81
	42	10359	2.95	2.43	81
J	43	10440	2.95	2.43	82
	44	10478	2.94	2.42	82
	45	10434	2.95	2.43	82
	46	10377	2.95	2.42	81
A	47	10280	2.98	2.45	81
	48	10225	2.97	2.44	80
	49	10135	3.00	2.46	80
	50	10049	3.00	2.46	79
	51	9991	2.99	2.45	78
	52	9911	3.02	2.47	78

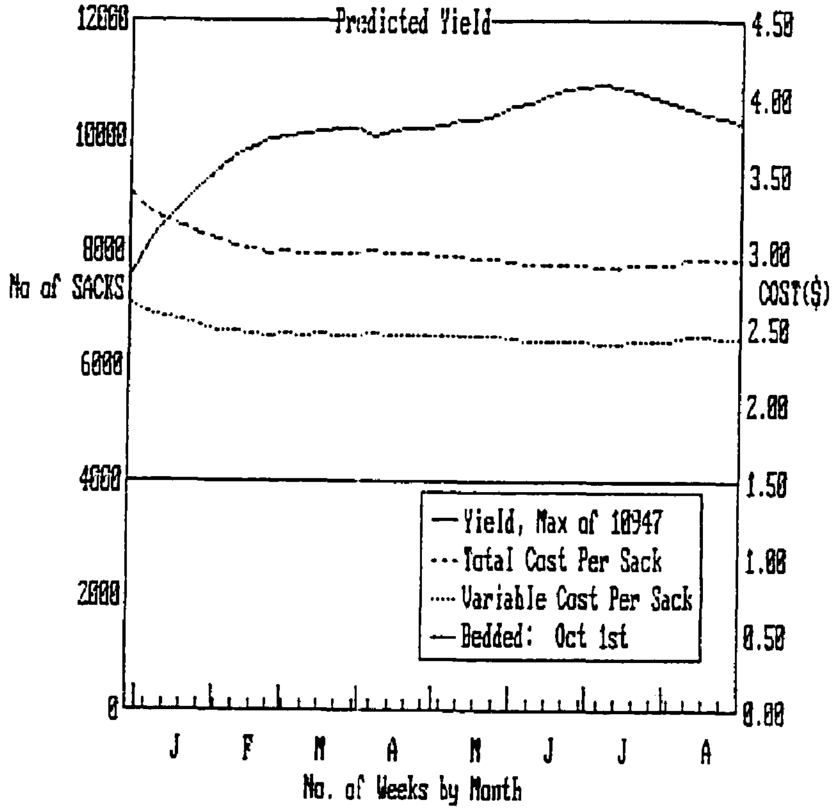

Figure 6.8.

Predicted Sack Production and Costs to Bed 4,000 Sacks in October at St. Mary's Point.

Barataria Bay
Yield (Sacks) and Cost per Sack ($)
4000 Sacks bedded beginning Oct 1st
Days needed to bed: 24

Week	Pred. Yield	Total Cost	Variable Cost	Days Needed to Harvest
J 17	7603	3.39	2.67	60
18	8129	3.28	2.61	64
19	8526	3.21	2.57	67
20	8847	3.17	2.56	70
F 21	9177	3.11	2.52	72
22	9448	3.07	2.49	74
23	9674	3.04	2.48	76
24	9829	3.02	2.47	77
M 25	9991	2.99	2.45	78
26	10039	3.00	2.46	79
27	10101	2.98	2.45	79
28	10149	2.99	2.46	80
29	10180	2.98	2.45	80
A 30	10172	2.98	2.45	80
31	10048	3.00	2.46	79
32	10124	2.98	2.44	79
33	10160	2.99	2.45	80
M 34	10194	2.98	2.45	80
35	10221	2.97	2.44	80
36	10316	2.97	2.44	81
37	10329	2.96	2.44	81
38	10421	2.96	2.44	82
J 39	10548	2.94	2.43	83
40	10629	2.92	2.41	83
41	10750	2.91	2.41	84
42	10841	2.91	2.41	85
J 43	10918	2.91	2.41	86
44	10947	2.90	2.40	86
45	10888	2.89	2.40	85
46	10815	2.91	2.41	85
A 47	10699	2.92	2.42	84
48	10629	2.92	2.41	83
49	10522	2.95	2.44	83
50	10420	2.96	2.44	82
51	10350	2.96	2.43	81
52	10255	2.96	2.43	80

September, it would be better to bed the lower salinity leases first and wait to bed on the saltier leases in October or later.

MODEL LIMITATIONS:

The model's production equation predicts that an increase in water temperature and salinity will always produce a decrease in oyster production. The production equation is governed by the quantity of seed bedded and the interaction of salinity and temperature. No salinity limits were incorporated into the model. However, for the model to work properly, the limits should remain within the historical salinity range of the Bay.

The model is developed exclusively from data in this dissertation. Only one oysterman began his lease harvest before January, and the model reflects this by limiting production predictions until after January.

The model also has a range limitation on the number of sacks bedded per lease. This range is closely tied to the range of sacks bedded on the leases during the study. For the model to work with realistic results, the lower limit of sacks that can be bedded per lease is approximately 2,000. The upper limit may exceed 6,000, but this is not recommended.

The predicted production for St. Mary's Point has not been tested for accuracy since no leases in this study were located that far north in the Bay.

The model, for all its limitation, does give an oysterman the ability to determine when is the best time to bed and harvest. It

also gives an oysterman the opportunity to compare his expenses and potential profits using various scenarios.

7.0 SUMMARY AND CONCLUSIONS

(1) Relatively high water temperature and salinity in Barataria Bay continue to significantly increase predators which impact lease yield and monetary returns. In contrast, the firm lease bottoms used in the Bay, composed of old oyster reef and hard clay muds, are an excellent bedding substratum and kept oyster planting mortality very low.

(2) A bedding lease is an artificial situation where oyster are planted in dense concentrations and temporarily held before being sold at market.

(3) According to the model, oystermen who bed in lower Barataria Bay, an historically high salinity area, should not bed oysters before October. In addition, they must complete harvest before June of the following year for maximum production. For example, if bedding 4,000 sacks of seed oysters in lower Barataria Bay, one can increase production by as much as 19 percent if he waits to bed in October.

(4) According to the model, an oysterman who beds in upper Barataria Bay, an historically intermediate salinity area, may increase production significantly over bedding in lower Barataria Bay. For example, bedding 4,000 sacks of seed oysters in September

in upper Barataria Bay near St. Mary's Point may increase production by 125 percent when compared to lower Barataria Bay. The predicted yield for upper Barataria Bay has not been tested in the field.

(5) According to the model, an oysterman who beds in October instead of September in upper Barataria Bay will increase production, but not by the magnitude experienced in lower Barataria Bay. For example, bedding 4,000 sacks of seed at St. Mary's Point in October instead of September increases production by 4.5 percent. The significantly smaller increase is due to historical salinities being lower at St. Mary's Point in September.

(6) According to the model, to increase a bedding lease's production potential, using the state's seed resources, consideration should be given to moving the opening date of oyster season from the first Wednesday in September after Labor Day to an opening date in October. This is not a new recommendation. Moore (1898) made this recommendation to the state at the turn of the century.

(7) Oystermen can make a substantial return on annual investment by bedding oysters in Barataria Bay. For example, bedding 4,000 sacks of oysters in lower Barataria Bay and harvesting 4,400 sacks by the following summer (a 1.1:1 yield ratio), an oysterman can make as much as 75 percent return on annual investment, before taking out

owner and vessel shares (in 1988 dollars and an exvessel price of $18 per sack). This is two to nine times the return on annual investment for other reported U.S. shellfisheries. High monetary returns are an incentive for oystermen to bed, even in high salinity areas with higher predator and disease abundance.

(8) Oystermen will not see a return on their investment until it is time to harvest. Furthermore, lease yield will determine the expense to harvest each sack of oysters. For example, bedding 4,000 sacks of oysters in September in lower Barataria Bay and harvesting by the first week in June, an oysterman will spend an average of $4.13 per sack to harvest (in 1988 dollars). In contrast, if the oysterman waits to harvest by the end of July, the costs to harvest a sack increases to $4.37, a six percent increase.

(9) The income derived from bedding oysters in the Bay was the bulk of income for five of the eight oystermen in the study. The rest of the year they were considered by me to be "subsistence-oystermen", i.e., just making enough money to keep operating until ready to return to the Bay to harvest the bedded oysters. Consequently, when Bay profits are averaged out over an entire fishing year, daily profits are probably reduced significantly.

(10) The Bay fleet worked 180-240 days on the water between 1982-85. All of this time was not spent in the Bay fishery, but spanned all

aspects of the yearly fishery, including harvesting sacks from the public grounds for direct sale and from other private leases with natural oyster stocks. An average of one-third of their time was spent working in the Bay.

(11) Oystermen during the study, 1982-85, bedded a total of 75,570 sacks of seed oysters. The state's public seed grounds contributed 87 percent of the total. The sizes of oysters bedded in the Bay were 52 percent as true seed, 25-75mm in shell length, 42 percent greater than 75mm in length and directly marketable, and 6 percent less than 25mm. The three year average size of bedded oysters was 69mm.

(12) The computer program that has been designed around the production model allows an oysterman or other person to change daily operating expenses, the total number of sacks bedded, and the prevailing water temperature and salinity on the lease. Therefore, an oysterman can put in data that is specific for his lower-Bay seed fishery and estimate sack expenses, optimum production potential and best time to harvest.

(13) The daily variable expenses (1988 dollar values) to an oysterman while bedding and harvesting are $247 per day,using a crew of two deckhands. When fixed costs are added, daily expenses are $337 per day, a 36 percent increase.

(14) The average size of a staked area on a Bay bedding lease during the study was 5.4 acres (2.2 hectares) and had 4,120 sack of seed oysters bedded on it.

(15) The production potential of a lease bedded with seed has not changed from historical estimates for lower Barataria Bay. Yield ratios ranged from 0.03:1 to 1.68:1. The two lowest yield ratios were due to vandalism and poaching. The seasons, 1982-83 and 1983-84, had reduced spring and summer salinities and together produced an average yield ratio of 1.24:1. The three year average ratio was 1.10:1.

(16) Any remaining oyster shell on the hard-bottom Bay bedding leases must be removed at the end of the season (referred to as scraping a lease). The excess shell (scrape material) will interfere with future bedding and harvesting operations. This shell resource is discarded into the Bay by some oystermen while traveling to port. Others use it to enhance the firmness of their oyster leases located in less saline areas, where the bottoms may be softer.

(17) During the study, Bay oystermen hauled as much as 30 percent incidental shell (reef halfshells and empty hinged boxes) with their loads of seed. The Bay oystermen did not intentionally harvest this shell. Incidental shell hauled with the seed cuts down on a Bay

oysterman's profit and interferes with dredging for market.

(18) This incidental shell is the bedrock of the wild public seed reefs and should not be removed from the state grounds. Seed loads should be culled of reef shell on the public grounds before transport. The state prohibits the removal of incidental shell, but the laws were not enforced on the Bay oystermen during this study.

(19) Each oysterman is competing for a limited seed resource that is harvested on a first come basis. If an oysterman culls he loses time and his competition may get more of the resource. Unless equally enforced on all oystermen, culling will probably not occur voluntarily.

(20) Labor efforts while bedding and harvesting are relatively high. A captain and his crew spent an average of 22 days, virtually non-stop, bedding his lease. They dredged an average of 9.6 hours for each load transported to the Bay. Oystermen spent an average of 6.9 hours dredging the oysters for market the following spring and summer.

(21) Travel time to the Bay while bedding (loaded with seed) was dependent on the location of the seed. The Primary Seed Grounds and the Bay Gardene seed reservation were the closest public reefs requiring an average of 8.7 hours travel time, one-way. The

farthest reefs in the Grand Pass-Cabbage Reef area required nearly twice as much travel time, 16.2 hours. The Sister Lake seed reservation was intermediate at 11.9 hours. The Bay fleet spent an average of 16 percent of their time while away from port actively dredging for seed to bed.

(22) The volume of diesel fuel used by each oyster vessel was a function of the distance traveled to bed or harvest. Fuel consumption while bedding was relatively high, averaging 294 liters per day. However, while harvesting the Bay leases for market, oysters vessels consumed an average of 90 liters per day. An average of 2.23 liters were consumed per sack sold (bedding + harvesting activities). This is equivalent to 1,529 grams of oyster meat per liter of diesel fuel consumed.

(23) An energy efficiency ratio of 0.11:1 (Kcal oyster meat/Kcal input) indicates that the lower bay is not as energy efficient as some other U.S. fisheries. However, compared to the Gulf of Mexico shrimp fishery it is six to seven times more energy efficient.

(24) The data in this study is specific for lower Barataria Bay and has not been compared to any other locations around the state. No data sets for other locations around the state are known to exist.

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9.0 APPENDIX

Table 9.1. Data Used to Devlop Lease Yield Regression Models.

Lease	yield ratio	sack yield	sacks bedded	mean Sp & Su salinity	weeks oysters bedded	mean Sp & Su temp.	mean yearly salinity	mean yearly temp.	mean yearly S x T	mean Sp & Su S x T
1/2	1.23:1	8333.00	6780.00	16.30	50.00	24.80	20.00	22.90	446.00	391.00
3.00	1.17:1	5138.00	4400.00	16.80	51.00	25.20	20.20	23.10	456.00	412.00
4.00	0.41:1	819.00	2000.00	22.80	30.00	15.60	24.40	19.60	487.00	351.00
5.00	1.25:1	2505.00	2000.00	17.90	38.00	19.90	22.10	20.20	448.00	337.00
6.00	1.12:1	4168.00	3720.00	15.80	42.00	21.30	20.90	20.90	427.00	307.00
7.00	1.18:1	5777.00	4880.00	16.90	41.00	20.70	21.60	20.50	438.00	324.00
8a/b	1.35:1	13871.00	10300.00	14.10	51.00	25.40	18.80	19.80	382.00	335.00
9.00	0.80:1	1672.00	2100.00	—	17.00	—	23.70	17.40	428.00	—
10.00	1.68:1	6874.00	4100.00	12.40	36.00	20.10	21.10	16.30	381.00	207.00
11.00	1.38:1	7445.00	5400.00	14.10	44.00	23.30	19.70	18.10	375.00	293.00
12a/b	0.75:1	6963.00	9317.00	20.60	48.00	25.20	20.80	22.80	479.00	527.00
13.00	0.86:1	1636.00	1900.00	—	15.00	—	21.50	20.50	444.00	—
14.00	0.66:1	2753.00	4200.00	20.10	47.00	25.00	20.50	22.70	468.00	507.00
15.00	0.85:1	2729.00	3200.00	17.20	35.00	22.00	19.70	20.40	398.00	372.00

file: regdata

Table 9.2. Bottom Water Temperature and Salinity Data for Independence Island Station, 1982-83.

Week	Date	(c) Temp.	(ppt) Sal.	Week	Date	Temp.	Sal.
1	NA	NA	NA	27	NA	NA	NA
2	9-14-82	28.9	21.1	28	3-15-83	16.6	20.2
3	9-21-82	28.0	23.6	29	3-24-83	14.1	27.4
4	9-28-82	25.2	28.7	30	3-29-83	16.0	20.7
5	10-05-82	25.8	30.1	31	4-6-83	20.2	22.6
6	10-14-82	24.6	25.3	32	4-13-83	20.0	11.2
7	10-18-82	22.7	27.5	33	4-20-83	17.9	22.6
8	10-26-82	19.6	26.0	34	4-27-83	19.8	12.8
9	11-01-82	24.4	27.6	35	NA	NA	NA
10	NA	NA	NA	36	NA	NA	NA
11	11-18-82	18.5	32.0	37	5-19-83	25.4	13.0
12	NA	NA	NA	38	5-25-83	29.0	10.8
13	12-01-82	21.0	26.4	39	NA	NA	NA
14	NA	NA	NA	40	NA	NA	NA
15	12-16-82	14.0	18.1	41	6-14-83	27.6	7.4
16	NA	NA	NA	42	6-21-83	28.1	5.0
17	NA	NA	NA	43	6-28-83	28.2	7.3
18	NA	NA	NA	44	7-6-83	29.8	12.3
19	NA	NA	NA	45	7-13-83	30.0	12.4
20	NA	NA	NA	46	7-20-83	30.3	12.4
21	1-18-83	12.0	18.0	47	7-26-83	29.9	28.8
22	1-25-83	11.7	21.6	48	8-3-83	28.5	17.4
23	NA	NA	NA	49	8-9-83	30.9	20.3
24	2-8-83	13.5	23.6	50	8-16-83	29.8	25.3
25	NA	NA	NA	51	8-23-83	31.4	25.3
26	2-24-83	16.0	20.5	52	8-30-83	31.4	19.6

NA = no data available.

Table 9.3. Bottom Water Temperature and Salinity Data for Middle Bank Reef Station, 1983-84.

Week	Date	(C) Temp.	(PPT) Sal.	Week	Date	(C) Temp.	(PPT) Sal.
1	9-7-83	26.4	23.7	27	3-8-84	13.7	19.3
2	9-14-83	27.6	20.6	28	3-15-84	18.3	17.4
3	NA	NA	NA	29	3-21-84	19.4	11.6
4	9-28-83	24.2	28.8	30	3-27-84	20.0	18.6
5	10-5-83	27.3	25.9	31	NA	NA	NA
6	10-12-83	25.5	28.0	32	4-10-84	19.5	17.9
7	10-19-83	25.2	29.4	33	NA	NA	NA
8	10-25-83	21.2	23.2	34	4-25-84	22.2	17.0
9	11-3-83	23.5	29.6	35	5-1-84	25.2	10.2
10	11-9-83	20.7	28.4	36	5-9-84	22.8	12.2
11	11-17-83	16.0	20.1	37	5-18-84	26.3	12.3
12	11-22-83	19.6	28.9	38	5-23-84	25.2	8.1
13	11-29-83	15.1	21.8	39	NA	NA	NA
14	12-7-83	16.1	16.1	40	6-5-84	27.3	11.2
15	12-14-83	15.0	17.0	41	6-14-84	29.0	10.0
16	12-19-83	13.1	19.6	42	6-20-84	28.9	10.5
17	12-28-83	15.9	28.8	43	NA	NA	NA
18	1-4-84	9.0	23.0	44	7-4-84	28.9	21.0
19	1-12-84	10.4	23.0	45	7-11-84	31.8	14.0
20	1-19-84	13.1	19.6	46	7-18-84	29.8	21.0
21	1-24-84	9.5	20.1	47	7-26-84	30.6	14.5
22	2-1-84	10.9	26.6	48	8-3-84	26.1	12.8
23	2-8-84	16.6	20.0	49	8-7-84	27.9	12.3
24	2-15-84	14.9	18.3	50	8-15-84	29.3	6.6
25	2-22-84	8.4	8.9	51	8-22-84	30.3	18.1
26	NA	NA	NA	52	8-29-84	29.1	18.3

NA = no data available.

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Table 9.4 Bottom Water Temperature and Salinity Data for Independence Island Station, 1984-85.

Week	Date	(C) Temp	(PPT) Sal.	Week	Date	(C) Temp.	(PPT) Sal.
1	9-6-84	27.6	20.2	27	3-6-85	20.0	14.1
2	NA	NA	NA	28	3-12-85	22.4	15.6
3	NA	NA	NA	29	3-19-85	17.6	16.3
4	NA	NA	NA	30	3-27-85	21.4	17.9
5	10-3-84	22.4	26.1	31	4-3-85	20.3	25.4
6	10-11-84	26.5	22.8	32	4-11-85	20.4	23.8
7	10-17-84	26.5	21.9	33	4-17-85	23.7	18.0
8	10-24-84	26.0	20.9	34	4-24-85	25.4	11.0
9	10-30-84	27.2	21.1	35	4-29-85	26.8	12.8
10	NA	NA	NA	36	5-8-85	25.4	23.4
11	11-14-84	15.8	21.2	37	5-15-85	28.7	16.8
12	NA	NA	NA	38	NA	NA	NA
13	11-29-84	15.5	22.2	39	5-29-85	19.8	19.8
14	12-2-84	15.2	18.8	40	6-3-85	26.7	26.7
15	NA	NA	NA	41	6-12-85	26.5	19.9
16	NA	NA	NA	42	6-18-85	27.1	23.0
17	NA	NA	NA	43	6-26-85	30.0	17.3
18	NA	NA	NA	44	7-2-85	29.2	28.0
19	1-10-85	15.4	21.2	45	7-11-85	30.5	18.3
20	NA	NA	NA	46	7-18-85	28.9	26.8
21	1-22-85	14.1	18.8	47	7-23-85	29.6	26.9
22	1-30-85	12.5	28.0	48	7-30-85	28.6	31.8
23	2-6-85	11.5	20.0	49	8-8-85	29.7	17.4
24	NA	NA	NA	50	NA	NA	NA
25	2-20-85	17.0	18.8	51	8-21-85	35.5	14.3
26	2-27-85	19.5	14.8	52	NA	NA	NA

NA = no data available

Table 9.5. Location and Quantity of Seed Harvested, Number of Loads, and Average Barrels per Load by Vessel, 1982-83 Season.

Vessel	SEED LOCATION (no. loads)	% OF SEED FROM EACH LOCATION	TOTAL BARRELS HARVESTED	AVG. BARRELS PER LOAD (Range)
A	BB (7) PE (1)	86% 14%	1,810	226 (185 - 250)
B	BB (7) PE (1)	87% 13%	1,580	198 (180 - 200)
C	BB (11)	100%	2,200	200 (NA)
D	BB (8)	100%	2,000	250 (250 - 250)
E	BB (9) BC (1)	93% 7%	1,860	180 (125 - 250)
F	BB (10) BC (1)	92% 8%	2,440	216 (200 - 255)
TOTAL	BB (52) BC (2) PE (2)	92% 4% 4%	11,890	212

Primary Seed Grounds consists of: BB=Black Bay, BC=Bay Crab, AB=American Bay, and BG=Bay Gardene Seed Reservation.
GP=Grand Pass and Cabbage Reef Seed Grounds.
PE=Private seed reefs located east of the Mississippi River.
PW=Private seed reefs located west of the Mississippi River and Barataria Bay.

Table 9.6. Location and Quantity of Seed Harvested, Number of Loads, and Average Barrels per load by vessel, 1983-84 Season.

Vessel	SEED LOCATION (No. of Loads)	% OF SEED FROM EACH LOCATION	TOTAL BARRELS HARVESTED	AVG. BARRELS PER LOAD (Range)
A	GP (6) BG (2) PE (2)	68% 16% 16%	2,840	284 (200 - 360)
B	PE (8) BG (2)	78% 22%	2,310	231 (150 - 280)
C	GP (12) BG (2)	89% 11%	3,100	221 (150 - 250)
D	--------------Decided not to bed--------------			
E	--------------Opted out of study--------------			
F	GP (7) BG (2.5) BB (0.5)	76% 20% 04%	2,700	270 (200 - 310)
Total	GP (25) PE (10) BG (8.5) BB (0.5)	61% 21% 17% 01%	10,950	249

BB=BlackBay;BC=Bay Crabe;AB=American Bay;SL=Sister Lake;GP=Grande Pass area;PE=private leases east of Miss. River;PW=Private leases west of Barataria Bay and Basin. BG=Bay Gardene.

Table 9.7. Location and Quantity of Seed Harvested, Number of Loads, and Average Barrels per load by Vessel, 1984-85 Season.

Vessel	SEED LOCATION (No. of Loads)	% OF SEED FROM EACH LOCATION	TOTAL BARRELS HARVESTED	AVG. BARRELS PER LOAD (Range)
A	GP (4) PE (2) SL (2) AB (1)	49% 26% 17% 08%	2,585 *	265 (180 - 325)
B	GP (5) SL (3) PE (1)	56% 32% 12%	2,430	270 (150 - 350)
C	GP (11) BB (3) SL (3)	66% 18% 16%	3,050	179 (150 - 250)
D + G	AB (7) SL (4) BB (2)	49% 36% 15%	3,300	254 (200 - 400)
F	--------------Opted out of study--------------			
H	GP (5) PW (4) AB (4) SL (1)	37% 29% 27% 7%	4,080	291 (220 - 300)
TOTAL	GP (25) SL (13) AB (12) BB (5) PW (4) PE (3)	37% 25% 18% 08% 07% 06%	15,445	246 *

BB=Black B;BC=Bay Crabe;AB=American Bay;SL=Sister Lake;GP=Grande Pass area;PE=Private leases east of Miss. River;PW=Private leases west of Barataria Bay and Basin. BG=Bay Gardene.

* Vessel "A" had 200 barrels of seed loaded onto it for freighting by another vessel. It is not included in the average barrels hauled per trip column.

Table 9.8. Labor per Vessel while Bedding Seed to Barataria Bay, 1982-84.

Season	Vessel	Lease Number	Work Days	No. Men On Vessel (wrk days)	Total Man-Days	Barrels Per Man-Day	Barrels Per Work-Day
1982-83	A	1,2	18	4	72	25.1	100.6
	B	1,2	18	3	54	29.3	87.8
	C	3	24	3	72	30.6	91.7
	D	4,5	20	3	60	33.3	100.0
	E	6	20	3	60	31.0	93.0
	F	7	25	4	100	24.4	97.6
	Average		21	3	70	28.4	95.1
1983-84	A	8 a/b	24	3 (17) 4 (7)	79	35.9	118.3
	B	8 a/b	23	3	69	33.5	100.4
	C	9,10	41	3 (23) 2 (17)	103	29.8	75.6
	D	Decided not to bed					
	E	Opted out of study					
	F	11	24	3 (16) 4 (8)	80	33.8	112.5
	Average		28	3	93	33.0	97.8
1984-85	A	12 a/b	25	3 (7) 4 (18)	93	25.6	95.4
	B	12 a/b	25	3 (7) 4 (18)	93	26.1	97.2
	C	13,14	47	2 (3) 3 (44)	138	22.6	64.9
	D + G	15,16	33	3	99	33.3	100.0
	F	Opted out of study					
	H	17,18	42	3	126	32.4	97.1
	Average		34	3	109	28.3	89.8
TOTAL			409		1,300		
AVERAGE			27.3	3	81	29.5	93.6

Table 9.9. Labor per Vessel while Harvesting Sacks from Bay, 1983-85.

Season	Vessel	Lease	No. Labor Days Per Lease	No. Men On Vessel	No. Man-Days Per Lease	Avg. No. Sacks Per Labor Day	Avg. No. Sacks Per Man Day
1982-83	B	1,2	30/30	4	240	139	35
	C	3	56	2 (41) 3 (15)	217	92	41
	D	4	8	3	24	102	34
	D	5	31	3	93	81	27
	E	6	47	2 (22) 3 (25)	119	89	35
	F	7	41	2 (2) 3 (8) 4 (31)	152	141	38
	Average		35	3	108	110	35
1983-84	A+B	8 a/b	46/46	4	364	152	38
	C	9	23	3	69	73	24
	C	10	57	3	171	121	40
	F	11	56	3 (9) 4 (16) 5 (31)	246	133	30
	Average		46	4	170	132	35
1984-85	A+B	12 a/b	30/29	4	236	118	30
	C	13	29	3	87	56	19
	C	14	28	3	84	98	33
	G	15	31	3	93	88	29
	G	16	1	3	93	95	32
	I	17	41	2 (19) 3 (22)	102	57	28
	Average		27 [29]	3	86	87	27
Average			35 [36]	3	116 [124]	116	33

[ ] = excluding leases L-16 and L-17. See text, chapter 3, for explanation.

Table 9.10. Fuel Consumed By Oyster Vessels while Bedding Seed, 1982-84. (Liters)

(SEASON) VESSEL	TOTAL FUEL (LITERS) CONSUMED BEDDING	AVG LITERS CONSUMED PER DAY BEDDING	AVG LITERS CONSUMED ROUND TRIP BEDDING	AVG LITERS CONSUMED PER BARREL PLANTED
(1982-83)				
A	4,500	250	563	2.5
B	4,020	223	503	2.5
C	6,056	252	551	2.8
D	4,061	203	508	2.0
E	3,630	182	363	2.0
F	5,140	206	467	2.1
AVG	4,568	216	483	2.3
(1983-84)				
A	11,128	464	1,113	3.9
B	8,743	380	874	3.8
C	16,029	323	946	4.3
F	10,734	447	1,073	4.0
AVG	11,659	392	997	3.8
(1984-85)				
A	9,160	366	1,018	3.8
B	8,100	324	900	3.3
C	16,029	341	943	5.3
D*	3,475	217	579	2.2
G*	3,437	202	491	2.0
H	9,035	215	645	2.2
AVG	9,847 *	286	794	3.2
TOTAL AVG	8,009 *	294	742	3.1

* vessels "D" and "G" fuel combined as one vessel since they alternated freighting 9 of 13 loads to the Bay in 1984.

Table 9.11. Fuel Consumed by Oyster Vessels while Harvesting Sacks, 1983-85.

Season	Vessel	Lease	Total Fuel Consumed	Avg. Fuel Consumed Per Day	Avg. Fuel Consumed Per Harvested Sack
1982-83	B	1,2	6,056	101	0.72
	C	3	4,792	86	0.93
	D	4,5	3,274	84	0.98
	E	6	3,664	78	0.88
	F	7	3,418	83	0.59
	Total		21,204	87	0.79
1983-84	A*	8	2,650	111	0.79
	B*	8	6,976	105	0.68
	C	9	2,055	89	1.23
	C	10	4,296	75	0.62
	F	11	4,924	88	0.66
	Total		20,901	92	0.70
1984-85	A*	12	4,035	112	0.79
	B*	12	2,456	107	1.21
	C	13	2,218	76	1.36
	C	14	1,998	71	0.73
	G	15,16	2,460	77	0.87
	I	17	2,332	57	1.00
	Total		15,499	82	0.93
Grand Total			57,604	87	0.79

* Vessels "A" and "B" fished the same leases but at different times.

file:harvfuel

VITA

Earl J. Melancon, Jr. was born in Thibodaux, Louisiana on January 28, 1951. He graduated from Edward Douglass White Catholic High School. After high school, he attended Nicholls State University in Thibodaux and graduated with a B.S. in Marine Biology in 1973. In May 19, 1973 he married Pam Knox of Thibodaux.

Earl entered Louisiana State University in September 1973. He graduated with a M.S. in Fisheries (Aquaculture) in May 1975. His thesis was titled: 'Construction and Use of a Flowthrough Bioassay System for Determining the Oxygen Tolerance of Juvenile Red Swamp Crawfish, *Procambarus clarkii*'.

Upon graduating from L.S.U., he was employed as a research assistant with Nicholls State University and stationed at the Port Fourchon Marine Laboratory. In 1978 he became an instructor in the Biology Department at N.S.U., and in 1985 was promoted to Assistant Professor.

Earl and Pam are the parents of three children, Ben age 14 years, Katie age 12 years, and Emily age 2 years.

In 1980 Earl returned to graduate school on a part-time basis and enrolled in the doctoral program in the Department of Marine Sciences.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Earl Joseph Melancon, Jr.

Major Field: Marine Sciences

Title of Dissertation: Environmental and Economic Influences on the Oyster Fishery in Lower Barataria Bay, Louisiana

Approved:

Richard Condrey
Richard Condrey
Major Professor and Chairman

F. Glen Hanby
Dean of the Graduate School

EXAMINING COMMITTEE:

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Date of Examination:

April 26, 1990