A Compilation of Aquaculture Materials for the State of South Carolina

South Carolina Sea Grant Consortium
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A COLLECTION OF AQUACULTURE MATERIALS

FOR THE STATE OF SOUTH CAROLINA

Editor

Margaret A. Davidson

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FORWARD

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As a state agency whose mandate is to promote and help implement education, research, and advisory activities to assist in the wise use and development of South Carolina's coastal and marine resources, the Consortium is interested in diverse issues affecting those resources. One area of concern is that the State's natural productivity for aquaculture operations be assessed and addressed.

With its extensive marine, estuarine, and freshwater resources, South Carolina possessess the potential to parallel its lead in aquaculture research with a healthy aquaculture industry. Much information about aquaculture presently exists within the state: other needed information is being sought.

This collection of materials represents a cooperative effort to make available existing information. It is hoped that this proves to be a useful document.

There has been a rapid growth of interest in aquaculture in South Carolina: now is the time to build a solid foundation.

POTENTIAL FOR

DEVELOPMENT OF AQUACULTURE IN SOUTH CAROLINA

A Preliminary Discussion Paper

1. What is Aquaculture?

Aquaculture is "the propagation and cultivation of aquatic animals and plants for profit of social benefit" (1). Mariculture, the cultivation or organisms in salt brackish water, is one major type or subdivision of aquaculture.

II. Why is the Development of Aquaculture Important for South Carolina?

A. Status of Our Fisheries

Development of aquaculture is not the only way to provide protein for the people of the United States, but it is critical if our demand for traditional seafoods, such as shrimp, is to be met.

> "In the United States, most of our traditional fisheries resources are already being harvested at or near maximum sustainable yield levels. Imports have increased, but world demand is also expanding. This situation is expected to limit the amount of seafood available for export to the United States or to make it excessively expensive. Thus the U.S. demand for traditional seafoods will become critical during the next decade, resulting in physical shortages and increased prices for many products." (2)

While the value of the South Atlantic and South Carolina fisheries have been increasing over the last decade, the actual catch has been essentially stable (S.C. and Ga.) or declining (N.C. and Fla.) (3): the shrimp catch in the South Atlantic States (including South Carolina) has been essentially stable for the past 25 years (4,5), despite increasing fishing effort. Thus, there just are not that many more fish and shrimp to be caught, regardless of how many boats are put in the water. Already the U. S. imports over half of the seafood it consumes (6), and consumption of shrimp alone in this country should show an increase of one-third between 1975 and 1985 (2). Many knowledgeable people believe that the

only realistic way of improving supplies of traditional seafoods, both at the local and international level, is through intensive development of aquaculture.

B. What Can Aquaculture Do?

Several recent studies at the international (7), national (2,6,8) and state (1) level have concluded that aquaculture can add significantly to U. S. production of seafood, decrease our reliance on imports, increase domestic revenues, enhance recreational opportunities, create new jobs and improve our balance of payments situation. For South Carolina, significant opportunities in aquaculture exist in at least three major areas:

(1) commercial food production (e.g., farming of catfish, oysters, shrimp, etc.);

(2) commercial and public recreational fisheries (e.g., production of bait, fee fishing ponds, production and stocking of game and commercial fish, etc.); and

(3) public research and development activities (e.g., research and educational grants, regional, national and international aquaculture conferences, etc.).

South Carolina is already involved in aquaculture in all these areas, although at a relatively low level. For instance, with striped bass South Carolina has developed one of the most successful aquaculture-recreational fisheries programs in the country. However, actual food production by aquaculture is still small.

III. What Species Have the Most Potential for Aquaculture in South Carolina?

The following lists of species and recommendations are highly preliminary and possibly colored by a lack of knowledge in many areas. The list is not

meant to be all inclusive or definitive. Much more detailed assessments should be conducted before final recommendations are made.

Listed below are only those species or groups which may have high or medium potential for successful aquaculture in South Carolina in the relatively near future. However, these assessments and the lists of species/groups could change markedly with new research findings, development of new or expanded markets, or technological improvements. Species are listed in alphabetical order rather than assigned priorities.

1. Baitfish (minnows) - Culture of baitfish is already an established, although small, industry in South Carolina. Assistance is provided farmers by the USDA's Soil Conservation Service. Presumably this industry will grow as the demand for bait in the State's recreational fisheries grow. A Sea Grant research project is presently underway to identify baitfish needs and culture opportunities.

2. Carp and Tilapia - Private culture of these freshwater species is apparently conducted on a very small scale in South Carolina by Santee-Cooper Power Authority. Culture technology for these species is well developed, probably as well developed as any aquaculture technology. The major limiting factor in the United States appears to be the lack of significant markets.

3. Catfish - Private culture of catfish in South Carolina had declined significantly since 1974, partly in response to major increase in feed costs which generally were not accompanied by similar increases in market price; however, interest has recently been increasing. In South Carolina, research/development efforts need to be concentrated in the areas of marketing (especially) and production efficiency. Cheaper feeds are also needed, but their development is already being pursued by the industry.

4. Channel Bass (Red Drum) - Relatively little is known about culturing this species. It has been spawned successfully in the laboratory in Texas, Florida and Alabama and fingerlings have been reared in ponds. Despite the limited knowledge base, this species appears to be one of the few which has significant potential for cultivation in South Carolina's 70,000 or so acres of coastal impoundments. Research is needed in virtually all areas of its cultivation (hatchery, fingerling production, diseases and especially growout and feeds).

5. Clams - It has been demonstrated that clams have potential for commercial culture in S.C. A demonstration pilot scale project is underway to test the production systems with major private involvement.

6. Crawfish - Commercial culture is well developed in Louisiana, and some private citizens are beginning to grow crawfish in South Carolina. Crawfish have good potential for commercial culture in South Carolina and may be reared in slightly brackish as well as freshwater conditions. Significant research is underway on these animals in Louisiana; emphasis in S.C. should be placed on adapting results from Louisiana and developing local markets for the product.

7. Eel - Despite the fact that eel culture is commercially very successful in Japan, Taiwan and parts of Europe, it has met with very limited success to date in South Carolina. However, research conducted primarily in North Carolina indicate that eel culture may become successful in our area in the next 5-10: culture for bait purposes merits particular interest. Primary areas that must be addressed before commercial eel culture is likely to become a reality in South Carolina are pond management (including grading of eels), feeds, incidence of disease, supply of elvers

and regulations affecting the taking of elvers for culture.

8. Freshwater Prawns - Despite the fact that it is an introduced tropical species, the freshwater prawn (Macrobrachium rosenbergii) appears to have a reasonable potential for commercial culture, at least at the cottage industry level, in several areas of the southeastern United States, including South Carolina. The major factor limiting the development of commercial culture of prawns in South Carolina is not climate but a supply of low-cost seed for stocking; a second constraint is the lack of real-scale facilities for the development, testing and demonstration of improved production strategies and technology.

9. Mullet - Although mullet is quite abundant in South Carolina and apparently grows well in coastal impoundments, its real potential for true cultivation here is unknown. One reason that it is attractive for culture is that it eats predominantly plant materials and should not require expensive high protein feeds. Large quantities of juvenile mullet are available along the South Carolina coast during spring and could be captured for stocking seed. Controlled reproduction of some species of mullet has been accomplished in the laboratory, but the procedure is not yet ready for commercial application. Major limiting factors appear to be the generally low price that mullet commands in the market place, its relatively short shelf life, and the large amount of product potentially available from capture fisheries.

10. Oysters - From a peak production of over 30 million pounds in 1908, oyster harvests in South Carolina have decreased to only about 1 million pounds today. The primary reasons for this drastic decline are a lack of labor and mechanical means to harvest our predominantly intertidal,

low value oysters. Limited research indicates that subtidal culture of oysters, which produces a higher value product amenable to mechanical harvesting and shucking, appears to have some potential in South Carolina, especially in coastal impoundments and creeks. In addition, techniques for more intensive cultivation of oysters recently developed and under commercial testing in Hawaii may be adaptable for use here. Economic feasibility remains unknown.

11. Shrimp - Consumption of shrimp in the United States is expected to continue to increase but, as previously shown, harvests from our domestic fisheries are already at or near their maximum sustainable fields. Thus, it appears that there will be a good market in the U.S. for cultured shrimp. However, whether such culture can be accomplished commercially in South Carolina is not known at present, although private interest is increasing. Aquaculture of marine shrimp here faces the same temperature limitation as does that of freshwater prawns, despite the fact that the marine shrimp are native to the State. Further, the life cycle of marine shrimp is not yet under complete control, despite recent research breakthroughs. What is needed to evaluate marine shrimp culture for development in South Carolina are (a) a sufficient supply of seed stock (e.g., a hatchery) to support the various studies, (b) sufficient salt-water pond facilities for experimental purposes, and (c) a commitment to compare the various species (non-indigenous as well as native) to determine the most suitable species for cultivation here.

12. Soft Shell Blue Crabs - Production of soft shell crabs is "semi-aquaculture" since it involves the animals at only one stage of their lives.

It appears likely that soft shell crab production could become a small but significant seafood industry in coastal South Carolina over the next few years. Satisfactory technology for industrial use has been developed elsewhere and probably could be adapted for use here. Projects are needed to demonstrate and adapt soft crab production technology in South Carolina, to determine the availability and best means of capturing and handling peeler crabs, and technical assistance efforts to transfer the production technology and peeler crab harvest information to the crabbing industry.

13. Striped Bass and Hybrids - Although the striped bass and its hybrids are considered strictly gamefish in South Carolina, in many other states they are valuable commercial food fishes. A research project is ongoing to determine the potential for producing pan-sized striped bass hybrids in net pens placed in our estuarine waters. Results of the preliminary experiments have been highly encouraging; cage culture of these fish in South Carolina holds great promise for developing into a viable, commercial enterprise. Major constraints at the present time appear to be regulations and the supply of juvenile fish. Additional research is needed on feeds,control of cannibalism, control of net fouling, diseases, economics, processing and marketing.

14. Sturgeon - The sturgeon fishery was a rather important fishery in South Carolina during the late 19th and early 20th centuries. However, it has since declined drastically. Successes in reestablishing sturgeon fisheries through artificial propagation and stocking, primarily in Russia, have prompted studies on the possibility of revitalizing the S.C. sturgeon fishery. Although very little information on the fishery, biology

or culture of our native sturgeon is available, the ultimate probability of success is quite high, as evidenced by projects elsewhere in the world and work with striped bass and salmon in our country.

15. Other Species - The State should continue to investigate the culture of other species, both native and non-indigenous, which may show potential for commercial cultivation here.

AQUACULTURE WORKSHOP
SUMMARY OF PRESENTATIONS

On December 4, 1981, the South Carolina Sea Grant Consortium held an Aquaculture Workshop focusing on the potential for aquaculture development within the State of South Carolina. A select panel of scientific, government, and industry experts from around the country presented discussions on the legal, institutional and business aspects of aquaculture to an audience comprised of state and local government officials, scientific researchers, and interested citizens. During the morning of December 5, 1981, a tour of Trident Sea Farms, a clam aquaculture facility, was arranged by the Consortium.

Opening Remarks were made by S.C. Representative Daniel E. Winstead, a member of the House Committee on Agriculture and Natural Resources. Following his remarks, which recalled the traditional importance of natural resources to the State of South Carolina and their economic value, presentations were made by the selected panel of aquaculture experts. The following is a synopsis of those presentations.

Introduction - Dr. Fred Conte (University of California-Davis)

Dr. Conte discussed the reasons for the increased interest in aquaculture development in the United States. These included:

a. Shellfish and finfish represent sources of food which have high protein content. Nutritionally, fish products contain higher protein levels than such foods as meat or fowl.

b. The United States has an important fishery industry. However, the Maximum Sustainable Yield (MSY) of the country's fisheries has remained relatively constant over the past several years, while consumer demand for fisheries products is increasing. Thus, the natural fisheries resources of the U.S. is limited; by the year 2015, the fishing pressure on the natural fisheries in the U.S. will exceed the supply (MSY). Currently, the United States imports about 67% of all fisheries products consumed domestically.

c. Aquacultural activities are more efficient economically than the traditional activities of fishing and gathering.

Emphasis, therefore, should be placed on developing aquaculture as a supplemental source of protein.

Dr. Conte reviewed aquaculture from a global perspective. World aquaculture production supplies 10% of all fisheries products. Currently, about 57% of this production is in finfish culture, while about 24% is in bivalve molluscs. A review of aquacultural species now being studied and developed was then presented. Dr. Conte divided this review into three categories:

a. Industrial/Institutional R&D - consists of those species being explored as aquaculture candidates;

b. Production/Pilot Phase R&D - consists of those species being cultivated via pilot and demonstration projects; and

c. R&D transition from pilot to commercial viability -consists of those

species which show great promise for commercial culture operations

Dr. Conte then presented a list of species which have or will show cultivating feasibility.

Institutional and Legal Frameworks

National Policy - Dr. Kent S. Price (Aquaculture Advisor to the National Office of Sea Grant)

Dr. Price stated that aquaculture has great economic potential in the United States. Currently, fisheries imports into the U.S. account for more than $20 billion towards the national trade deficit. In addition, only 2% of fisheries product consumption in the U.S. is from aquaculture operations.

Dr. Price then discussed the National Aquaculture Policy Act of 1980 (Public Law 96-362). The Joint Subcommittee on Aquaculture, although created prior to P.L. 96-362, is formally acknowledged as the entity responsible for the following:

a. to review the national needs for aquaculture research, transfer, and assistance;
b. to assess the effectiveness and adequacy of Federal efforts to meet those national needs;
c. to undertake planning, coordination, and communication among Federal agencies engaged in the science, engineering, and technology of aquaculture;
d. to collect, compile, and disseminate information on aquaculture;
e. to encourage joint programs among Federal agencies in areas of mutual interest; and
f. to recommend specific actions on issues, problems, plans, and programs in aquaculture.

March, 1982 is the deadline for the final draft of the National Aquaculture Development Plan. In its present draft form, the plan has addressed aquaculture development on a species-by-species basis, with priorities placed on those species for R&D. Dr. Price expanded on the specific make-up of the Plan.

In addition, Dr. Price reviewed the authorization of funds under P.L. 96-362. The Departments of Agriculture and Commerce each are authorized for appropriation

of $ 7 million for FY81, $ 10 million for FY82, and $ 12 million for FY83. The Department of Interior would receive $ 5 million for each of the fiscal years. However, under the current financial situation, no funds have been appropriated as of yet. Further, the Department of Commerce has made a tentative decision to eliminate funding for all non-salmonoid aquaculture. Dr. Price then discussed the opportunities for industry under P.L. 96-362. These include:

a. Industry is provided with an opportunity to comment on the National Aquaculture Plan during its development;

b. The Act provides for technical assistance and help for the emerging industry;

c. The Secretary of Commerce will conduct continuing assessments of the aquaculture industry;

d. The Secretary of Commerce will establish an Aquaculture Information Center;

e. The Act provides for facilitating access to capital by Industry; and,

f. The Act provides for reducing regulatory constraints to the conduct of aquaculture.

In summation, two recommendations were made for South Carolina:

a. Continue to seek to develop a State Aquaculture Plan, and

b. Work with the S.C. Legislative delegation in Washington, D.C. to have the U.S. Congress appropriate those funds authorized under the National Aquaculture Policy Act.

State Policy - Mr. Michael P. Mulvihill (Weyerhauser Company-Florida)

Mr. Mulvihill provided, from the industry perspective, comments on the policies that exist in Florida regarding aquacultural development. The Weyerhauser Company is now actively involved in freshwater shrimp aquaculture.

Problems were cited with federal, state, and local governments as Weyerhauser Company seeked to operate aquaculture facilities in Florida. At the federal level, the EPA required both an Environmental Impact Study and a NPDES permit. At the state level, the Florida Dept. of Natural Resources required permits for holding exotic species, and two permits because the activity was in a flood control district: one for well drilling and one for water use. Finally, at the county level, the County Division of Environmental Resources required a permit and an Environmental Impact Assessment and the Zoning Board required a variance permit. The variance was required because the counties do not recognize aquaculture as a land use; therefore, the Company had to locate on land zoned agriculture and obtain a variance.

Mr. Mulvihill cited four major variables in any aquaculture enterprise as being essential: feed, capital, product yield, and existing markets. Labor was also mentioned as important. An energy-efficient operation was stressed as another key element for commercial aquaculture. In Weyerhauser's case, the Company had to decide among the following if it was to start up a culturing operation in Florida:

a. Intensive Culture - which was decided to be too expensive;

b. Utilizing Heated Effluent - which limited the scale of the operation Weyerhauser desired; or

c. Dual Crop Culture - which was not feasible.

As a result, Weyerhauser has gone out of the country to do aquaculture, specifically in Brazil.

One of the final comments Mr. Mulvihill made was that Florida does not promote aquaculture as an industry, either verbally or financially, preferring instead to rely principally upon revenue from the tourist industry.

State Policy - Mr. R. Daniel Prentiss, Esquire (Rhode Island)

Mr. Prentiss reviewed the circumstances leading up to the passage of aquaculture legislation in Rhode Island. During the turn of the 20th century, the predecessor to the now Department of Environmental Management (DEM) leased out large tracts of Narragansett Bay for oyster cultivation, excluding its use by shellfishermen and others. By the 1930's, the oyster industry died out for many reasons. Interest in aquaculture has been rejuvenated during the past 10-15 years in Rhode Island, again pitting the cultivist against the traditional shellfishing industry. As a result aquaculture development was perceived as another conflicting use of Narragansett Bay.

Mr. Prentiss discussed the major state agencies involved in aquaculture permitting before the Rhode Island aquaculture law was passed. DEM had responsibility for granting leases of state waters; the Coastal Resources Management Council (CRMC) granted permits (experimental only) for aquaculture as it constituted a coastal activity; and the Marine Fisheries Council (MFC) had responsibility over shellfish and finfish regulations. An aquaculture bill was introduced in 1979, but was defeated because of the conflict over what agency would have lead agency status. However, the bill introduced in 1980 was passed with the following structure:

- CRMC is designated the lead agency and grants permits and leases for aquaculture operations
- DEM's leasing laws were transferred to CRMC. Both DEM and MFC present findings and recommendations to the CRMC for incorporation into its decision-making process. Each application is reviewed on a case-by-case basis.

In closing, Mr. Prentiss indicated that the major constraint to aquaculture development in Rhode Island is use conflicts which are increasing as Narragansett Bay becomes more utilized.

State Policy - Mr. John Jensen (Auburn University, Alabama)

Mr. Jensen stated that the Farm Pond Program is the real basis for aquaculture development in Alabama. The private sector (farmers) instigated aquaculture in these ponds. State policies on culturing activities were not required or needed in this situation; therefore, those aquaculture policies that do exist are fragmented and nebulous.

Processing in Alabama has been the key to successful culturing activities, of which the major species is catfish. Mr. Jensen noted that there are two types of processors found:

a. LARGE-SCALE PROCESSORS - there are three large-scale processors and they generally use out-of-state markets; and

b. SMALL-SCALE PROCESSORS - there are 25 small-scale processors and they generally use local markets.

With processing capabilities as these, Alabama's catfish culturing industry can grow and expand as markets have been found and developed. Mr. Jensen stated that a great recreational use also exists for catfish.

Auburn, as the Land Grant Institution, has and does provide much of the technical assistance and advisory services needed by the pond owners. However, the state of Alabama, notes Jensen, provides little financial assistance for aquaculture; that which exists is for extension work, not research.

Mr. Jensen reviewed some of the governmental bodies that assist in aquacultural activities:

a. Soil Conservation Service - gives technical assistance in pond construction and soils;

b. Farmer's Home Administration)
c. Production Credit Administration) provide financial assistance

d. Alabama Department of Conservation and Natural Resources - is not involved in aquaculture at all, but does control imports of exotic species;

e. Tennessee Valley Authority - conducts aquaculture programs;

f. Alabama Farm Bureau - has a Catfish Commodity Division; and

g. Alabama Dept. of Public Health - determines standards for processing.

Mr. Jensen made two basic recommendations based on his experiences. First, develop an aquaculture plan written by industry (aquaculture) with input from governmental officials. Second, the state should continue to provide financial support for Research & Development in aquaculture.

South Carolina Policy - Dr. H. Wayne Beam (Executive Director, S.C. Coastal Council)

Dr. Beam made a brief presentation which focused on two aspects relating to aquaculture. First, the Coastal Council is reviewing its policies on the leasing of state lands for aquaculture and other uses. This review includes the examination of instituting user fees for any private activity requiring the use of state lands. Second, the Coastal Council is reviewing its policies on Impoundments. To date, wetland areas, including those which were at one time impounded, are off limits to any type of developmental activity. Now, Dr. Beam states, the Council is studying the costs, benefits, and impacts which would result from permitting impoundment projects. Both of these issues are now under study and the results could have an important impact on aquaculture development in South Carolina.

South Carolina Policy - Dr. Paul Sandifer (Assistant Director, MRRI)

Dr. Sandifer emphasized the state's support for aquaculture development. This included a discussion of the new Aquaculture Research and Development Center being planned for Beaufort, S.C. where construction should start in 1982. Dr. Sandifer also reviewed the R&D species that have potential in South Carolina. These species include-striped bass, hybrid bass, sturgeon, soft shell crabs (primitive culture), crawfish, clams, prawns, and shrimp. Each species was discussed as to its progress and potential as a viable aquacultural species.

South Carolina Policy - Associate Dean John Montgomery (USC Law School)

Mr. Montgomery made several points which highlighted his discussion:

a. A review of which state agencies are involved in aquaculture and how they are involved must be conducted.

b. A review is needed of the types of use conflicts which will result from increased aquacultural activity.

c. Aquaculture will have to be looked at as a separate and distinct activity in state and private waters.

d. The questions of classifying aquaculture as industry or as agriculture has to be answered. There is a difference in terms of zoning ordinances and tax structures.

South Carolina Policy - Mr. Jack Kendree (Georgetown County Development Commission)

Mr. Kendree discussed the avenues Georgetown County is taking in order to develop aquaculture to boost Georgetown's economy. These are as follows:

a. Georgetown County has asked Horry-Georgetown Technical School to establish a vocational training program for aquaculture technicians. This will be done with input from various institutions. It is expected that a class will graduate in April, 1982;

b. A Landowner's Association is being created. This may lead to the creation of Co-ops or Granges in Georgetown to reduce costs;

c. Georgetown County is also identifying financial resources for its proposed aquacultural activities; and

d. The county is studying what primary and secondary businesses may result from the development of aquaculture.

Mr. Kendree did recommend the following:

a. The State needs a coherent policy on the question of property rights on lands below mean high water; and

b. The State should develop an Aquaculture Plan or Policy document.

The Business of Aquaculture (Panel)

Aquaculture Business - Mr. Harry Clawson (Trident Sea Farms, Inc.)

Mr. Clawson discussed various aspects of his commercial Pilot Clam Mariculture operation. His interest in clam aquaculture stemmed from the fact that demand for clams is on the increase, and natural supplies cannot meet those demands. Further, the price for littleneck (cherrystone) clams has been increasing by 15% per year.

Almost 1½ years ago, Trident Sea Farms, Inc. reached a cooperative agreement with the S.C. Wildlife and Marine Resources Department (SCWMRD) to start up a commercial pilot clam mariculture operation. The Trident Company now provides all of the financial support for structures, facilities and seed clams. The SCWMRD provides research staff with funding from the S.C. Sea Grant Consortium and the State for needed research into areas such as economics and survivability studies.

The combination of industry, government, and academia has proven to be of extreme help to this clam mariculture operation. After 1½ years of the commercial pilot program, the results are extremely favorable for expanding the clam mariculture operation. Mr. Clawson points out that as part of the cooperative agreement, all data generated is available for the public and all concerned.

Mr. Clawson did state that, in order for his operation to be successful commercially, he needs a good and reliable source of seed clams, which is now a problem. However, Trident Seafarms is now actively seeking financial assistance so that they may build a hatchery for these seed clams.

Aquaculture Business - Dr. Ken Roberts (LSU Extension Program)

Dr. Roberts concentrated his remarks on crawfish farming. Crawfish culture is probably the most profitable kind of aquaculture operations in the U.S. today, mainly due to low culture costs. Although faster production rates can be obtained by culturing crawfish in rice fields, ponds with planted or

natural vegetation are good culturing areas. Most crawfish farms generally range in size from 50 to 150 acres of ponds.

Dr. Roberts then reviewed various harvesting equipment, including traps, used in crawfish aquaculture. Further discussion centered on the processing of live crawfish from harvest to market. Dr. Roberts concluded by discussing briefly Louisiana's experimental crawfish farm operating under the direction of Larry DeLabretonne.

Dr. Roberts stressed the point that Louisiana and South Carolina contain very similar topographic and geographic qualities which makes South Carolina a prime location to conduct crawfish aquaculture. He strongly suggested that people in S.C. seriously consider starting crawfish farms, and offer assistance through the extension program to that end.

Aquaculture Business - Mr. Jon Lindbergh (Domsea, Inc.)

Mr. Lindbergh discussed his company's activities in aquaculture with salmon per culture, salmon ranching, and striped bass per culture.

Salmon Per Culture - Domsea, Inc. harvested salmon averaging 3/4 lb. from their net per culture operation. However, this could only occur after the resolution of several problems - predation, disease, and feed conversion errors. This operation also required the services of the University of Washington Sea Grant Program in conducting salmon genetic research. This involved "selective breeding" of those families of salmon which exhibited fast growth rates in the particular environment which Domsea chose to conduct the culturing operation.

Salmon Ranching: Involves the rearing of salmon in hatcheries located near natural spawning routes. Once reared, the salmon are put into the sea and they remain there for 2-3 years. Ideally, the salmon return to the same area where a corral is set up (usually a river mouth) and the salmon are harvested. A return rate of 1% of the number of salmon released initially is required for a worthwhile operation. Domsea, Inc. established their salmon ranch in Chile.

Striped Bass Pen Culture: Several problems were addressed by Mr. Lindbergh. First, a feed problem was apparent; cannibalism occurred because the feed mixture was not liked by the fish. By developing a new feed mixture, the cannibalism rate was reduced to almost 0%. Second, a disease problem (vibriosis) occurred. A vaccine was developed and reduced the rate of disease considerably. Third, it was determined the hybrids of striped bass were better candidates for pen culture than striped bass, primarily because they exhibit faster growth rates. Growout time for hybrids is currently one year.

Mr. Lindbergh suggested that hybrid bass, dolphin fish, eels, and clams are the species that have the highest potential for South Carolina.

Aquaculture Business - Mr. Durwood Dugger (C.S.C.I.)

CSCI operations in south Texas are based upon developing closed and semi-closed controlled environment tank systems, pond systems for the commercial production of both freshwater and marine shrimp, and the carrying on of research relating to the development of the commercial aquaculture of such.

The CSCI's location was chosen based on several factors:

1. The largest marine shrimp industry infrastructure in the world was in the area (processing, packaging, storage, brokerage, etc.).
2. The area is an alluvial flood plain producing large tracts of flat coastal land of tight clay soils that are ideal for pond construction.
3. The proximity of Mexico produces large amounts of "green card" farm laborers at prices comparable to Central American labor prices.
4. While coastal sites are limited, there are sites suitable for freshwater aquaculture throughout the area with reasonable land prices.
5. The sub-tropical climate allows eight months of 80°F. water temperatures and frost only occurs once every three years with water temperatures rarely below 60°F.

Aquaculture Business - Mr. John Jensen (Auburn University)

Mr. Jensen discussed several specific points evolving from his experience with catfish farming operations.

a. Aquaculture is agriculture - nothing more, nothing less

b. There are profits to be made in catfish culture and the culture of other species. However, profit margins are not excessive and in some cases, are narrow.

c. The aquaculture of catfish is generally conducted by farmers seeking to supplement their income from traditional farming

d. Economice of Scale play a very important role in aquaculture The profit margin on lone-acre pond may be $0; but the margin may reach $100-$200 per acre if a series of one-acre ponds are used for aquaculture.

e. There is now a catfish "glut" in the Alabama area. The reason is that production increased almost 100% over the previous year, taxing the existing processing and marketing systems which have had trouble handling this increase. Mr.Jensen suggested that this problem will work itself out by 1983.

Use Conflicts - Mr. Duncan Newkirk (Permitting Director, S.C. Coastal Council)

Mr. Newkirk first briefly discussed the agencies who will be involved in the permitting process for aquaculture activities.

a. Army Corps of Engineers - has toissue a permit which involves input from the EPA, NMFS, and the U.S. Fish and Wildlife Service. There are two types of permits: one is a permit to conduct activities in navigable waters; the other permit is needed for dredge and fill operations

b. S.C. Coastal Council - has to issue a permit for any activity within the "Critical Areas" as designated by the S.C. Coastal Zone Management Plan. The Coastal Council must certify any activity not located

After three years of operation, the biggest problems have been:

1. Site permitting - The U.S. Fish and Wildlife Agency appears to have a definite policy against coastal zone aquaculture development, particularly if those sites are less than five feet above mean high tide, which means that no development will take place on any land within their jurisdiction.
2. Financing is almost impossible to get from traditional institutions such as banks, SBIC, insurance companies, etc. Unless aquaculture is afforded the same financial support that is given to terrestrial farmers, the commercial fisherman, and livestock producers this country can not hope of having self-sufficiency of fishery products, ever.

The state of Hawaii has set an example and a precedent for all of the U.S. in their promotion and development of their freshwater prawn industry: to encourage aquaculture, Hawaii has done the following;

1. Provided free seed stock initially for farmers to get started with.
2. Provided free technical guidance and training for farmers.
3. Streamlined permitting bureaucratic regulatory requirements.
4. Expended considerable effort educating and courting financial institutions to provide financing for aquaculture projects.
5. They have courted venture capital in the form of new venture projects from large corporations such as Castle & Cook, AMFAC, Coca Cola, etc.

In conclusion, CSCI believes that aquaculture, particularly prawn culture, is viable in the continental U.S. but it requires support both financially and legally if it is to be a significant industry that will contribute to the national economy.

within but affecting the Critical Area.

c. S.C. Water Resources Commission - has to issue a certification for the use of the public water supply.

d. S.C. Department of Health and Environmental Control - has permitting authority over several aspects of aquaculture, including water quality, post-harvest activities relating to shellfish (i.e., processing, marketing, sale), toxic chemicals (i.e., utilized for predator control) and others.

e. S.C. Wildlife and Marine Resources Department - is responsible for granting leases of submerged lands for oyster operations. The Department also requires licenses, permits and/or fees for a number of activities relating to aquaculture such as boat licenses, shellfish licenses, dealer and processor licenses, etc.

f. Other Agencies - such as the S.C. Department of Archives and History and the S.C. Department of Archeology, may be required by law to participate and, in some cases, certify a particular coastal activity.

Mr. Newkirk feels that there are two major issues that must be addressed before commercial aquaculture can be feasible throughout South Carolina:

a. Impoundments - The redyking of pre-existing rice field wetlands. Two problems must be answered: first, a study of the environmental impacts to the wetland area from impoundments must be conducted; and, two, a review of the complex legal questions, primarily ownership questions, must be completed.

b. Introduction of Structures into Public Waters - This has not been a problem as of yet; however, there are no provisions in S.C. law for the use of the water column for private activities, including aquaculture. The leasing of public lands (waters) for private use is an issue that the S.C. Coastal Council is now reviewing. User fee requirements are being examined as a means of leasing these areas.

Conclusions and Recommendations (Panel)

- Dr. Fred Conte (University of California-Davis)

-Aquaculture has developed through, and despite, the numerous regulatory agencies.

-Technology changes will make sites conducive to aquaculture which are not presently.

-The permitting process should be consolidated by the use of general permits, for example.

-There exists a need for a promotional agency to act as the lead agency - not the regulatory agency; e.g. the State Agriculture Department.

-Develop a statewide aquaculture plan with equal input from industry and government.

-Study other existing state aquaculture plans for possible applicability to the South Carolina experience.

-The industry should form an Aquaculture Association to provide aquaculturists a forum for lobbying efforts aimed at the State Legislature.

-Research and Development operations should continue at the same levels or higher as commercial aquaculture becomes more of a reality, this would include technical assistance programs.

-Marketing strategies must be studied during the development of aquaculture plans. It is important to develop these strategies before production occurs.

-Disease diagnostic capabilities must be developed and maintained to support the growing aquaculture industry.

-The aquaculture industry must develop good working relationships with the regulatory agencies.

-Dr. Conte suggests that the industry must "court" the state legislators - all of them - but recognize that legislators have to support other constituencies.

-Dr. Conte suggests that the regulatory agencies must keep the industry honest.

- Mr. John Montgomery (USC Law School)

-The state has to look at designating a lead agency responsible for aquaculture activity permitting and regulation. This agency should have general permitting authority and act as the "coordinator" through which other agencies take action on aquaculture development.

-The state must develop a methodology to provide general permits for aquaculture. This would reduce the necessity for multiple permits for each and every action an aquaculturist proposes.

- Mr. Dan Prentiss (Rhode Island)

-The opponents of and special interests against aquaculture should be identified before aquaculture development occurs. Both sides should discuss their differences and work out solutions which would eliminate future problems.

-The Economics of aquaculture must be addressed before large-scale aquaculture development, especially the question of market competition with naturally-harvested fisheries products.

-Finally, conflict areas (use conflicts) must be identified and solutions developed to ensure the acceptance of aquaculture as a legitimate use of coastal resources.

- Dr. Ken Roberts (LSU Extension)

-Aquaculture development in S. C. should build on the talents of the individual landowners. They have credit lines established, business ties, etc., which are beneficial to accelerating the development process.

-Aquaculture programs should be selected and developed which lend themselves to large public support and the establishment of constituencies.

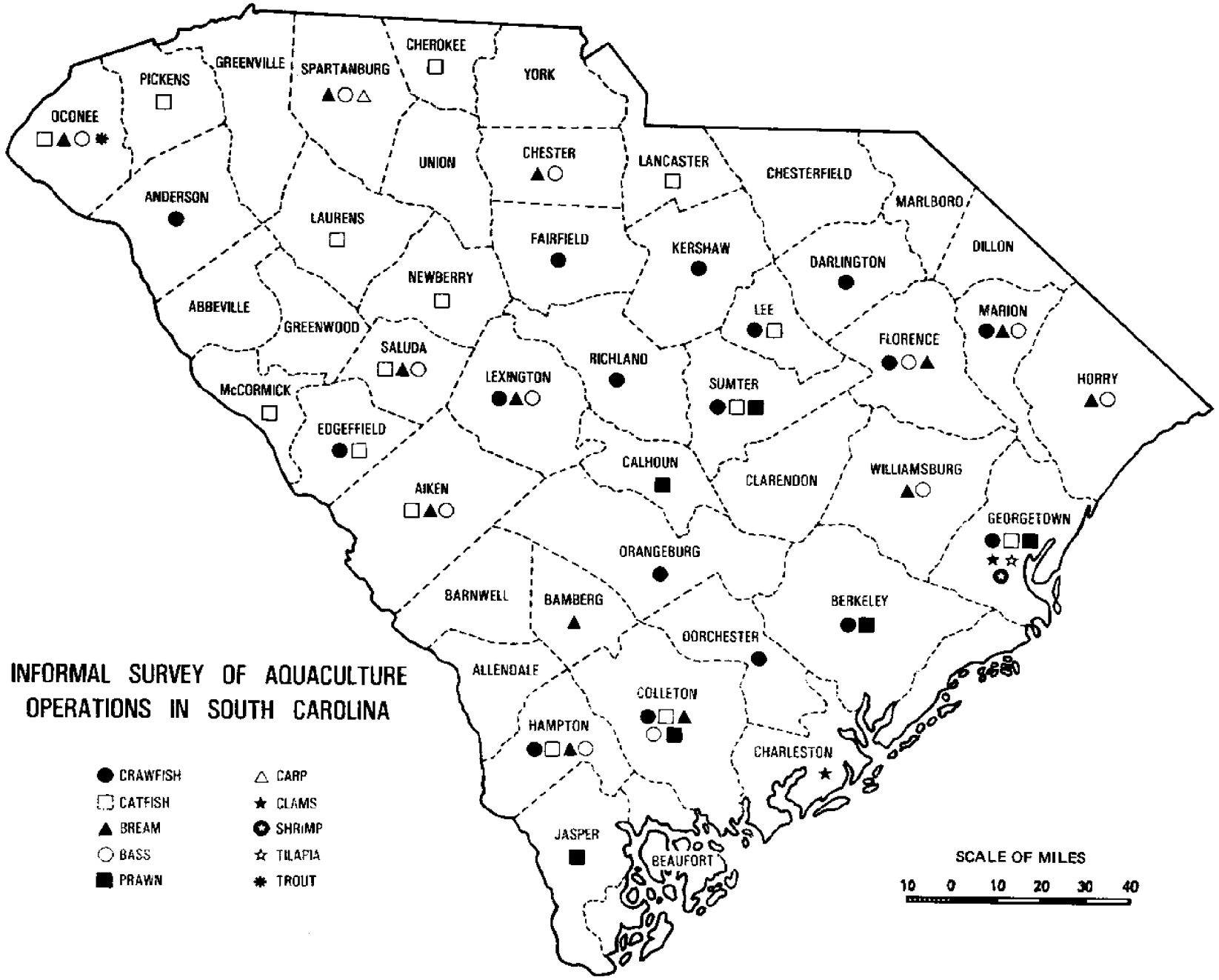
-The type of aquaculture activity chosen should attract capital and allow for the establishment of good credit.

-Cooperation in the development of aquaculture in S.C. will be the key to a successful program. However, controversy that occurs during plan development is healthy and helps in problem solving.

-Aquaculture should be utilized for recreation as well as food production.

-The state should consider establishing a state hatchery for aquaculture.

-In developing aquaculture, the state should plan for the future - 5 to 10 years hence and utilize the great pool of expertise which exists in the state.


INFORMAL SURVEY OF AQUACULTURE OPERATIONS IN SOUTH CAROLINA
CRAWFISH
CATFISH
BREAM
BASS
PRAWN
CARP
CLAMS
SHRIMP
TILAPIA
TROUT
SCALE OF MILES
10 0 10 20 30 40
OCONEE
PICKENS
GREENVILLE
SPARTANBURG
CHEROKEE
YORK
ANDERSON
LAURENS
UNION
CHESTER
LANCASTER
CHESTERFIELD
MARLBORO
ABBEVILLE
GREENWOOD
NEWBERRY
FAIRFIELD
KERSHAW
DARLINGTON
DILLON
SALUDA
LEE
MARION
McCORMICK
EDGEFIELD
LEXINGTON
RICHLAND
SUMTER
FLORENCE
HORRY
AIKEN
CALHOUN
CLARENDON
WILLIAMSBURG
GEORGETOWN
ORANGEBURG
BARNWELL
BAMBERG
BERKELEY
DORCHESTER
ALLENDALE
COLLETON
HAMPTON
CHARLESTON
JASPER
BEAUFORT

SUMMARY TABLE OF SOUTH CAROLINA LAWS

ACCESSION NUMBER	TITLE	CITATION		NATURE OF LAW
S.C. 1	Division of Marine Resources	S. C. Code et seq.	50-5-10	Shellfish Propagation
S.C. 2	Restrictions on Fishing Generally	S. C. Code et seq.	50-13-10	Private Pond Rules
S.C. 3	Use of Nets, Seines, etc.	S. C. Code et seq.	50-13-510	Private Pond Rules
S. C. 4	Sale and Traffic in Fish	S. C. Code et seq.	50-13-1610	Fish Importation, Sale
S. C. 5	Fish Hatcheries and Sanctuaries, Propagation	S. C. Code 1910 et seq.	50-13-	Hatchery and Sanctuary Operation
S. C. 6	Nongame and Endangered Species Conservation	S. C. Code 10 et seq.	50-15-	Endangered Species Protection
S. C. 7	Importation of Wildlife	S. C. Code 10 et seq.	50-16-	Fish Importation
S. C. 8	Coastal Fisheries Laws	S. C. Code 10 et seq.	50-17-	Fishery Conservation
S. C. 9	Saltwater-Freshwater Dividing Lines on Coastal Rivers	S. C. Code 35	50-17-	Water Jurisdiction
S. C. 10	Coastal Fisheries: Licenses and Taxes	S. C. Code 310 et seq.	50-17-	Coastal Fishing Licenses
S. C. 11	Leases of Shellfish Bottoms	S. C. Code 710 et seq.	50-17-	Leasing of Submerged Lands
S. C. 12	Coastal Fisheries; Use of Nets, etc.	S. C. Code 1010 et seq.	50-17-	Method of Fish Harvesting
S. C. 13	Shellfish	S. C. Code 1210 et seq.	50-17-	Shellfish Provision
S. C. 14	Removal of Naturally Occurring Shell Deposits	S. C. Code 1430	50-17-	Dredging/Filling

ACCESSION NUMBER	TITLE	CITATION	NATURE OF LAW
S. C. 15	Terrapin and Sea Turtles	S. C. Code 50-17-2510 et seq.	Species Protection
S. C. 16	Nonfood Fish	S. C. Code 50-17-2710 et seq.	Fish Harvesting
S. C. 17	Sanitation Regulations for Commercial Fisheries	S. C. Code 50-17-3010 et seq.	Fish Product Sanitation
S. C. 18	Committee to Investigate Oysters	S. C. Sess. Law R624, S1063	Shellfish Leasing
S. C. 19	Using Baskets for Nongame Fish, etc.	S. C. Code 50-19-1760	Method of Fish Harvesting
S. C. 20	Construction in Navigable Waters	S. C. Code 1-5-4 et seq.	Alteration of Navigable Waters
S. C. 21	Water Resources Planning and Coordinating Act	S. C. Code 49-3-10 et seq.	Water Management
S. C. 22	Groundwater Use Act	S. C. Code 49-5-10 et seq.	Water Management
S. C. 23	Soil and Water Conservation District Law	S. C. Code 48-9 - 10 et seq.	Land Management
S. C. 24	Low Country Resources Conservation and Development	S. C. Code 48-15-10 et seq.	Land Management
S. C. 25	Crossroads of History Resource Conservation	S. C. Code 48-17-10 et seq.	Land Management
S. C. 26	Coastal Tidelands and Wetlands: Coastal Management	S. C. Code 48-39-10 et seq.	Coastal Zone Management
S. C. 27	Department of Health and Environmental Control	S. C. Code 44-1-10 et seq.	Product Sanitation
S. C. 28	Pollution Control Act	S. C. Code 48-1-10 et seq.	Water Pollution
S. C. 29	Pollution and Poisoning of Waters; etc.	S. C. Code 50-13-1410 et seq.	Water Pollution

ACCESSION NUMBER	TITLE	CITATION		NATURE OF LAW
S. C. 30	Treatment of Agricultural Real Property, etc.	S. C. Code	12-43-230	Mariculture Tax Treatment
S. C. 31	Penalties for Violation of Occupational Health Standards	S. C. Code	41-15-320	Worker Health/Safety
S. C. 32	Sea Grant Consortium	S. C. Code 10 et seq.	48-45-	Scientific Research and Development

SC. 1
Division of Marine Resources
S. C. Code 50-5-10 et seq.
Division of Marine Resources
1924

Key Provisions:

50-5-20. Jurisdiction.
50-5-50. Experimental propagation of shellfish; reports.
50-5-110. Rules and regulations; penalties for violation.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 2

Restrictions on Fishing Generally
S. C. Code 50-13-10 et seq.
Wildlife and Marine Resources Dept., Division of Commercial Fisheries
1952

Key Provisions:

50-13-270. Creek limits not applicable to private ponds. (1959)
50-13-350. Unlawful to fish or trespass in private artificial ponds used to breed fish or oysters. (1872)

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 3
Use of Nets, Seines, Traps, and Like Devices
S. C. Code 50-13-510 et seq.; Amended S.C. Sess. Laws, 1980, R347, S136
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1936

Key Provisions:

50-13-510. Pond owners must have permit to catch fish therein with traps or nets; regulations.
50-13-520. Use of nets, traps or other devices to catch nongame fish.
50-13-570. Seizure and forfeiture of seines, nets or similar devices used illegally.
50-13-690. Use of nets or other devices to take nongame fish from private ponds in Chesterfield County.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Permit to use traps or nets in private ponds game fish breeder's license.

SC. 4
Sale and Traffic in Fish
S. C. Code 50-13-1610 et seq.
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1939

Key Provisions:

50-13-1610. Sale or traffic in certain game fish unlawful.
50-13-1630. Importing, possessing or selling certain fish unlawful; special permits for research; Department shall issue rules and regulations.
50-13-1640. Owners may draw ponds and dispose of fish.
50-13-1650. Transportation of game fish out of state unlawful.
50-13-1660. Searches, seizures and forfeitures.
50-13-1670. Shipments of certain fish and fish eggs originating and terminating outside of the state.
50-13-1680. Sale of marked trout from privately owned hatcheries.
50-13-1690. Information to be marked on trout before sale or shipment.
50-13-1720. Reports on trout sold or imported into the state.

50-13-1730. Rules and Regulations on selling or shipping trout.
50-13-1750. Game fish breeder's license.

Implementing Regulations:

Wildlife and Marine Resources Dept., License Application for the Propagation and Sale of Gamefish for Stocking Purposes.

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Permit to import, possess or sale certain fish for scientific research.
Permit to import or export fish or fish eggs.
Game fish breeder's license.

SC. 5
Fish Hatcheries and Sanctuaries; Propagation
S. C. Code 50-13-1910 et seq.
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1951

Key Provisions:

50-13-1940. Distribution of fish raised in hatchery in Greenville County.
50-13-1950. Establishment of fish sanctuaries.
50-13-1960. Designation and marking of fish sanctuaries in rivers and streams.
50-13-1970. Designation of fish sanctuaries in lakes and ponds.
50-13-1980. Operation and posting of fish sanctuaries
50-13-1990. Penalties for fishing or trespassing upon fish sanctuaries; jurisdiction of magistrates.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 6
Nongame and Endangered Species Conservation Act
S. C. Code 50-15-10 et seq.
Wildlife and Marine Resources Dept.
1974

Key Provisions:

50-15-40. Endangered species shall be listed; review and amendment of list; unlawful to take, deal in, or transport species on Commission or Federal lists.
50-15-70. Regulations.
50-15-80. Penalties.
50-15-90. Chapter not retroactive; certain importation not prohibited.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

Joint Resolution to Approve Regulations of Department of Wildlife and Marine Resources Relating to Endangered Species List R521, H3800.

Permits:

N/A

SC. 7
Importation of Wildlife
S. C. Code 50-16-10 et seq.
Wildlife and Marine Resources Dept.

Key Provisions:

50-16-10. "Wildlife" defined.
50-16-20. Permit requirement.
50-16-50. Exceptions to permit requirement.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 8
Coastal Fisheries Laws: General Provisions
S. C. Code 50-17-10 et seq.
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1924

Key Provisions:

50-17-40. Certain coastal waters common for people of State.
50-17-50. Minimum permissible size of fish or sold; exception for bait.
50-17-80. Protection of marine mammals.
50-17-110. Commercial fishing boats shall cooperate with law-enforcement officers.
50-17-130. Penalties.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 9
Saltwater-Freshwater Dividing Lines on Coastal Rivers
S. C. Code 50-17-35, S. C. Sess. Laws, 1980, R445, H3636
Wildlife and Marine Resources Dept.
1980

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 10
Coastal Fisheries: Licenses and Taxes
S. C. Code 50-17-310 et seq.
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1924

Key Provisions:

50-17-310. Imposition and amounts of fisheries tax.
50-17-320. Tax on exported seed oysters.
50-17-330. Licenses required to engage in certain fishing industries; fees.
50-17-350. Licenses on floating equipment for taking shellfish for market; fees.
50-17-360. License taxes on fishing appliances.
50-17-440. Suspension or revocation of fishing industries, licenses for violating shrimp and prawn laws.
50-17-450. Licenses for dealers and processors of fish or fishery products; fees.
50-17-470. Licenses for wholesale dealers and wholesalers; fee; exceptions.
50-17-480. Shipping certificates shall accompany transport of fish or fishery products.
50-17-490. Licenses for selling marine fisheries products as bait; fee.
50-17-500. Licenses for certain powerboats engaged in commercial fishing.
50-17-510. Licensees shall be furnished copies of fisheries rules, regulations and laws.

Implementing Regulations:

Rules and Regulations, Tax Commission, Rule 117-174.87. (Fisheries)

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Licenses to engage in certain fishing industries.
Licenses on floating shellfish taking equipments.
Fishing appliances' license.
Fish dealers and processors' licenses.
Wholesale dealers or wholesalers' licenses.
Powerboat licenses.

SC. 11
Leases of Shellfish Bottoms
S. C. Code 50-17-710 et seq.
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1924

Key Provisions:

50-17-710. Authorization to lease state owned or controlled bottoms.
50-17-730. Leases granted with preference given to riparian owners.
50-17-790. Planting of shell or seed oysters by lessees; replanting after harvesting.
50-17-800. Gathering seed oysters for replanting by lessees.
50-17-820. Transfer of leases.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Lease for water bottoms.

SC. 12
Coastal Fisheries: Use of Nets, Seines and Like Devices
S. C. Code 50-17-1010 et seq.; Amended, S.C. Sess. Laws, 1980, R347, S136
Wildlife and Marine Resources Dept., Div. of Commercial Fisheries
1924

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 13
Shellfish
S. C. Code 50-17-1210 et seq.
Wildlife and Marine Resources Dept.
1920

Key Provisions:

50-17-1220. Workers employed to handle shellfish must have health certificates.
50-17-1240. Open and closed seasons for removal of shellfish. Possession out of season prima facie evidence of violation.
50-17-1250. Bottoms owned by state deemed oyster beds; permissible leases; effect of grant, lease, or conveyance.
50-17-1280. Cultivation of seed oysters for market.
50-17-1290. Selling and marketing oysters; taxes and licenses thereon.
50-15-1310. Shellfish records.
50-17-1330. Commercial harvesting of shellfish in Georgetown County unlawful.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Lease of oyster beds.

SC. 14
Removal of Naturally Occurring Shell Deposits; Fees; Penalties
S. C. Code 50-17-1340
Wildlife and Marine Resources

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 15
Terrapin and Sea Turtles
S. C. Code 50-17-2510 et seq.
Division of Marine Resources
1924

Key Provisions:

50-17-2540. Terrapin illegally taken constitutes contraband and shall be returned to water.
50-17-2550. Unlawful to destroy or offer for sale sea turtles or sea turtle eggs.

Implementing Regulations:

Rules and Regulations, Marine Resources Division, 123-150 (Designation of Certain Marine Turtles as Threatened Species).

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 16
Nonfood Fish
S. C. Code 50-17-2710 et seq.
Division of Marine Resources
1922

Key Provisions:

50-17-2710. Use of purse nets and seines.
50-17-2720. Manufacture into fertilizer or other commercial products.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 17
Sanitation Regulations for Commercial Fisheries in Horry County
S. C. Code 50-17-3010 et seq.
Dept. of Health and Environmental Control, County Health Dept.
1953

Key Provisions:

50-17-3030. Building specifications for commercial fisheries.
50-17-3040. Approval of location of fisheries permits.
50-17-3050. Suspension or revocation of permits.
50-17-3060. Location of nets or seines.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Fisheries Location permit.

SC. 18
Joint Resolution to Create a Committee to Investigate Existing Oysters and Clam Shellfish Leasing System
V R624, S1063 S. C. Sess. Laws, 1980

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 19
Using Baskets for Nongame Fish; Classification of Certain Persons as Commercial Fisherman
S. C. Code 50-19-1760
Wildlife and Marine Resources Dept.
1960

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 20
Construction of Navigable Waters
S. C. Code 1-5-40, 1-11-70, 49-1-10
Budget and Control Board, Secretary of State
1853

Key Provisions:

1-5-40. Public property under charge of Secretary.
1-7-70. Lands subject to Board's control.
49-1-20. Permitting logs and the like to obstruct or interfere with navigation of rivers or harbors.

Implementing Regulations:

Article 6, S.C. Rules and Regulations, Budget and Control Board (Permits for Construction in Navigable Waters).
River and Harbor Act, as amended (33 U.S.C. 401 et seq.)
Federal Water Pollution Control Act, 404 (303 U.S.C. 1411).

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Permit for construction in navigable waters

SC. 21
Water Resources Planning and Coordinating Act
S. C. Code 49-3-10 et seq.
Water Resources Commission
1967

Key Provisions:

49-3-20. Water Resources Commission created.
49-3.30. Responsibility of Commission for Program to implement legislative policy.
49-3-40. Powers and duties of Commission.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 22
Groundwater Use Act of 1969
S. C. Code 49-5-10 et seq.
Water Resources Planning and Coordinating Commission
1969

Key Provisions:

49-5-40. Delineation and Modification of capacity use areas.
49-5-50. Regulation of use of groundwaters in capacity use areas.
49-5-80. Maps, drawings, descriptions or combinations thereof defining boundaries of capacity use areas.
49-5-120. Law as to use of surface water not affected.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 23
Soil and Water Conservation Districts Law
S. C. Code 48-9-10 et seq.; Amended S.C. Sess. Laws, 1980, R 536, S1019
State Land Resources Conservation Commission
1937

Key Provisions:

Art. 3. State Land Resources Conservation Commission.
Art. 5. Creation of Soil and Water Conservation Districts.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 24
Low Country Resources, Conservation and Development Authority
S. C. Code 48-15-10 et seq.
Low Country Resources, Conservation and Development Authority 1968

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 25
Crossroads of History Resource Conservation and Development Authority
S. C. Code 48-17-10 et seq.
Crossroads of History Resource, Conservation and Development Authority
1970

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 26
Coastal Tidelands and Wetlands: The South Carolina Coastal Management Act
S. C. Code 48-39-10 et seq.
South Carolina Coastal Council
1977

Key Provisions:

48-39-40. Creation of South Carolina Coastal Council; members; terms.
48-39-50. Powers and duties of Council.
48-39-80. Development of coastal management program.
48-39-100. Plan development in cooperation with local governments.
48-39-120. Beach erosion control policy.
49-39-130. Permits required to utilize critical areas.
48-39-140. Submission of development plans; application for permits.
48-39-190. Lands not affected by chapter.
48-39-200. Restriction of Council's regulatory authority.
48-39-210. Council only state agency authorized to permit or deny alterations or utilizations within critical areas.
48-39-220. Legal actions to determine ownership to tidelands.

Implementing Regulations:

Chapter 30, S.C. Rules and Regulations, Consumer Affairs Department, (South Carolina Coastal Council).

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

Permit to utilize critical coastal tidelands.

SC. 27
Department of Health and Environmental Control
S. C. Code 44-1-10 et seq.
Department of Health and Environmental Control
1973

Key Provisions:

44-1-140. Department may promulgate and enforce rules and regulations for public health
44-1-150. Penalty for violating rules of Department.

Implementing Regulations:

Rules and Regulations, Dept. of Health and Environmental Control, Ch. 61-47 (Shellfish), Ch. 61-48 (Polluted Oyster Replanting Control Procedures), Ch. 61-49 (Crabmeat).
Rules and Regulations for the Sanitary Control of Blue Crab Meat Production in South Carolina Ch. 61-71 (Wells and Springs)

Proposed Regulations:

Rules and Regulations for the Sanitary Control of Shrimp and Blue Crab Meat Production in South Carolina, Dept. of Health and Environmental Control (Draft).

Pending Legislation:

N/A

Permits:

N/A

SC. 28
Pollution Control Act
S. C. Code 48-1-10 et seq.
Dept. of Health and Environmental Control
1950

Key Provisions:

48-1-40. Adoption of standards for water and air.
48-1-80. Classification and standards for water.
48-1-90. Causing or permitting pollution of environment prohibited; remedies.
48-1-140. Revision or modification of NPDES or final compliance date for stationary source or class or sources of air-pollution.
48-1-270. Availability of records, reports and information to the public; confidentiality of trade secrets.

Implementing Regulations:

Rules and Regulations, Dept. of Health and Environmental Control
Ch. 61-9 (NPDES permits)
Ch. 61-68 (Water Classification Standards System)
Ch. 61-69 (Stream Classifications), Approved,
S. C. Sess. Laws, 1980, R399, S869

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

NPDES permit.

SC. 29
Pollution and Poisoning of Waters: Use of Explosives
S. C. Code 50-13-1410 et seq.
Wildlife and Marine Resources Dept.
1925

Key Provisions:

50-13-1410. Pollution of waters so as to injure fish and shellfish unlawful; enforcement.
50-13-1420. Poisoning waters, or producing electric currents or physical shocks to catch fish unlawful.
50-13-1440. Using explosives to take fish unlawful.
50-13-1460. Penalty for conviction of use of explosives to take fish.

Implementing Regulations:

N/A

Permits:

N/A

SC. 30
Treatment of agricultural real property and mobile home; Commission shall prescribe regulations
S. C. Code 12-43-230
Tax Commission
1975

Key Provisions:

12-43-230. Mariculture included in definition agricultural real property.

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 31
Penalties for Violation of Occupational Health and Safety Standards
S. C. Code 41-15-320, Amended, S. C. Sess. Laws, 1980, R520 H3748.
Department of Labor
1971

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

Pending Legislation:

N/A

Permits:

N/A

SC. 32
South Carolina Sea Grant Consortium
S. C. Code 48-45-10 et seq.
South Carolina Sea Grant Consortium
1978

Key Provisions:

N/A

Implementing Regulations:

N/A

Proposed Regulations:

N/A

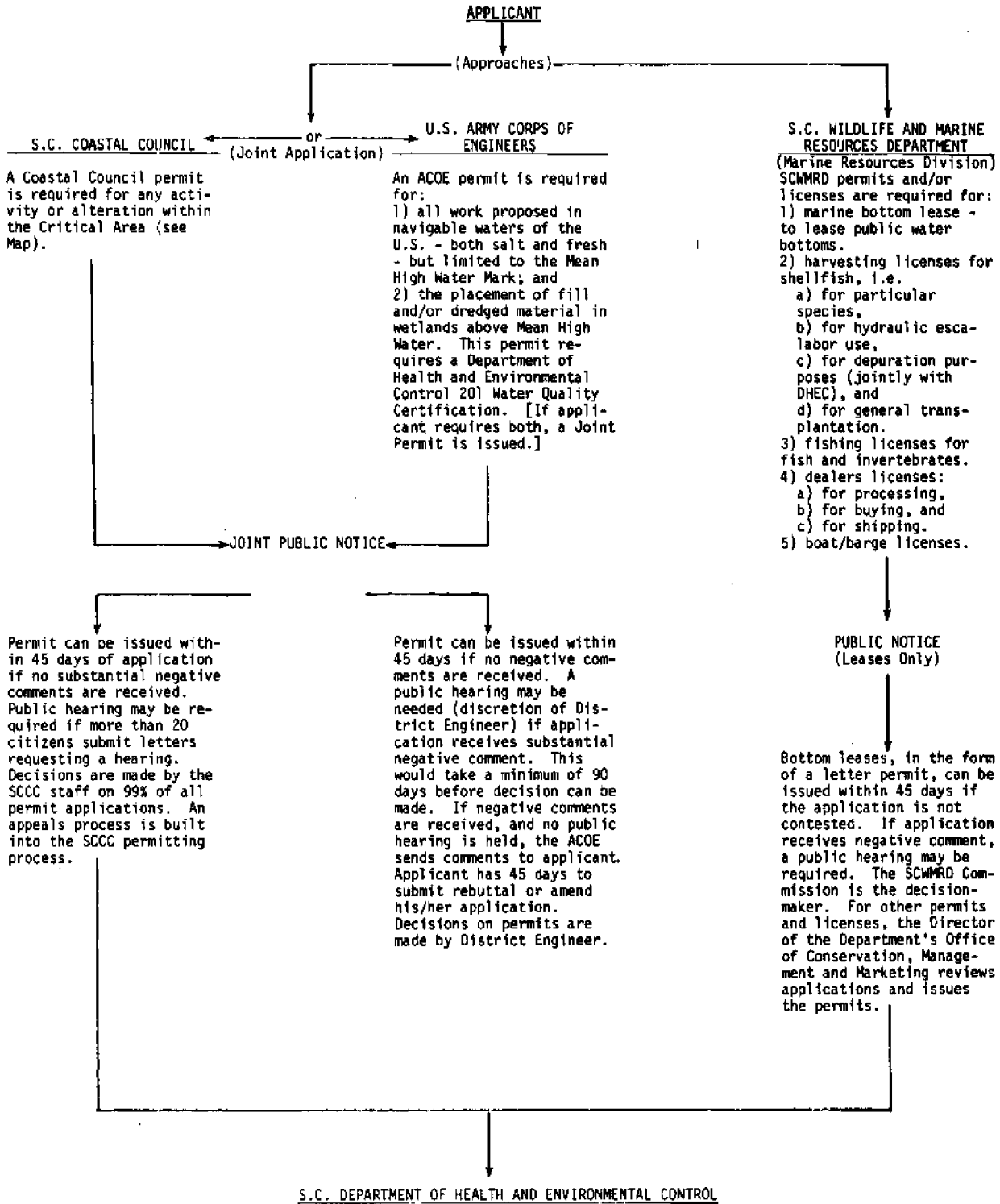
Pending Legislation:

N/A

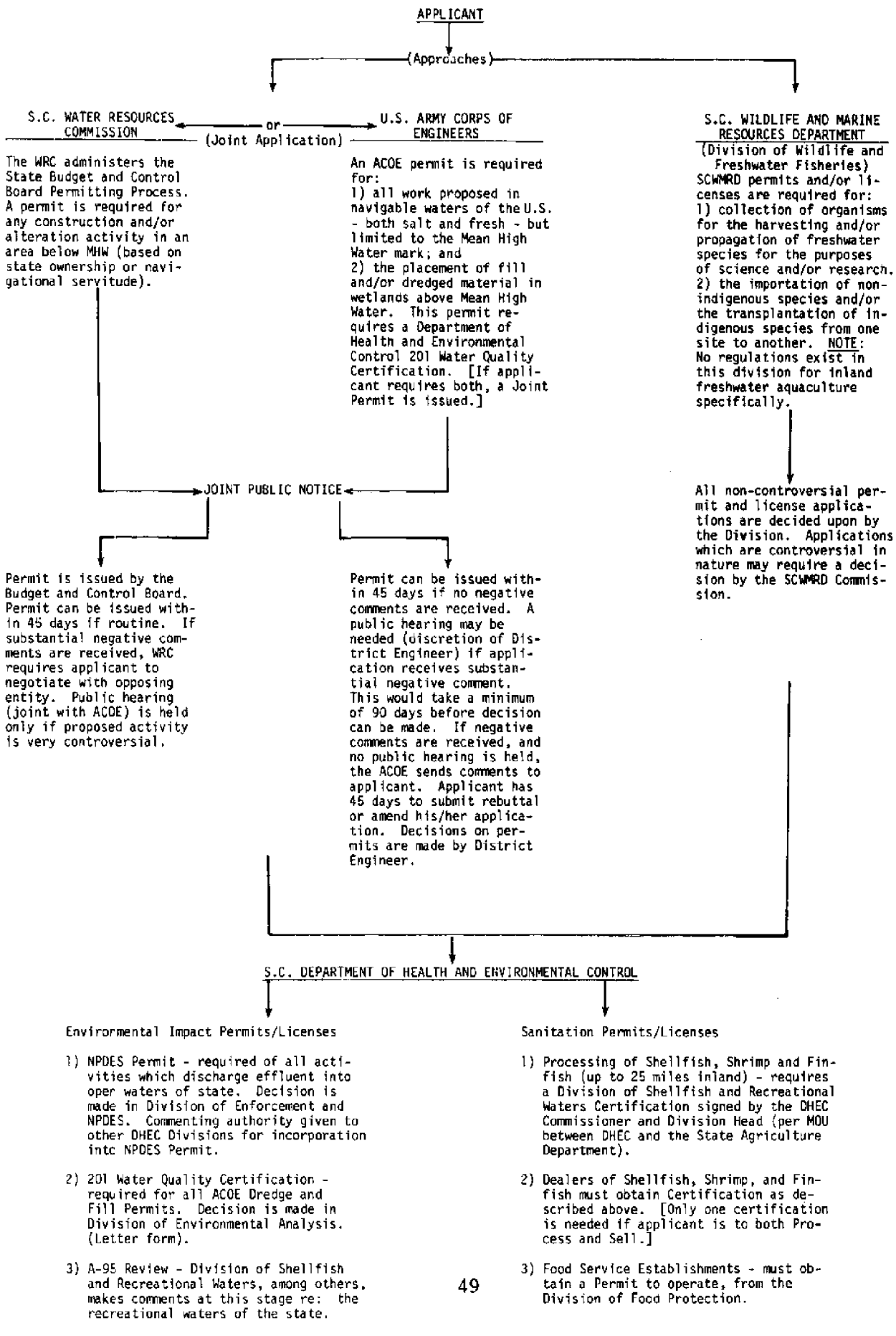
Permits:

N/A

AQUACULTURE PERMITTING PROCESS FOR ACTIVITIES WITHIN THE "CRITICAL AREA"



AQUACULTURE PERMITTING PROCESS FOR ACTIVITIES OUTSIDE THE "CRITICAL AREA"



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GLOSSARY

Adult	any animal that has attained full growth or is sexually mature.
Aquaculture	raising plants or animals in fresh, brackish, or salt water.
Bedding oysters	small oysters, usually under about 50 millimetres (2 inches) long, suitable for rearing to maturity.
Brackish water	any mixture of sea water and fresh water with a salinity of less than 30 parts per thousand.
Brine shrimp	(Artemia salina) a small crustacean which can be easily reared as a food for early stages of fishes and shellfishes.
Bubble fence (screen)	a continuous stream of bubbles emitted from a sunken hose perforated at intervals through which compressed air is released. Acts as a fence by restricting movement of some fish species.
Chitin	a horny, living substance forming the chief component of the exoskeletons of crustaceans.
Commensalism	association between species which is clearly to the advantage of one member without seriously inconveniencing the other member.
Competition	struggle between organisms of the same or different species for necessities of life.
Copepods	small crustaceans; some species serve as food for many aquatic animals, other species are parasitic on the skin, scales, and gills of fish.
Crustaceans	mainly aquatic arthropods that are characterized by an exoskeleton of chitin divided into head, thorax, and abdomen. Examples: shrimps, lobsters, copepods, etc.
Cultch	tiles, old oyster shells, or any material used by oyster farmers to collect the young of oysters (spat).
Cultivate	To raise crops through labour and care. On oyster beds: to stir up oysters and remove pests, to break up clusters of oysters.

Culture	the practice of cultivating, as of the soil or water. Raising plants and animals with a view to their improvement.
Diatom	microscopic unicellular or colonial algae with silica skeletons.
Disease	a deranged condition of an organism which may be inherited or caused by parasites, dietary deficiencies, or by physical and chemical factors in the environment.
Ecology	the study of the relations of organisms to their environment.
Elver	a young eel.
Embryo	early stages of an animal's development, usually before hatching from an egg.
Endemic	peculiar to an area, as an endemic species of fish.
Epizootic	disease attacking a large number of animals, nearly simultaneously (as an epidemic).
Estuary	generally areas of high productivity in bays or semi-enclosed areas where fresh water rivers and streams enter.
Exoskeleton	an external covering of animals such as scales of fishes or shells of crustaceans.
Eutrophication	state of a water body with a good supply of nutrients and hence a rich organic production. Has come to mean adverse or undesirable enrichment of a body of water.
Fathom	a unit of length equal to 6 feet (about 1.8 metres).
Finfish	cold-blooded lower aquatic vertebrates possessing fins, and, usually, scales.
Fiord(fjord)	an arm of the sea extending inland, usually long and narrow and bordered by steep cliffs.
Fishery biologist	a person educated in biology of fishes and the management of fisheries.
Fishery economist	a person educated in economics who studies ways to best utilize exploited fish populations from a monetary basis.
Food web (food chain)	transfer of food energy through a series of organisms with many stages of eating and being eaten (eg., plants are eaten by shrimps, shrimps are eaten by fishes, and so on).

Gonads	reproductive organs of animals in which eggs and sperm are produced.
Gravid	pregnant or ripe, ready to spawn.
Host	organism on or in which a parasite lives and from which it receives required metabolic products.
Hybrid	offspring of two plants or animals which are from different species or varieties.
Inbreeding	mating of related individuals. This practice may improve races or strains of plants or animals.
Intertidal zone	area on the foreshore between lower low water and higher high water.
Invertebrates	lower animals: without backbones.
Juveniles	young stages of animals, usually between the post-larval stages up to the time they become sexually mature.
Larva	an immature stage of an animal which differs greatly in appearance and behaviour from adults.
Lesions	sores or open wounds: may be caused by parasites.
Littoral zone	shallow, inshore areas, usually depths down to 200 fathoms.
Mariculture	see sea farming.
Metric ton	2,204.6 pounds, or about 1.1 times larger than a short ton (avoirdupois).
Molluscs	animals with soft body coverings with limey shells of 1 to 8 parts or sections. In some species the shell is lacking or reduced.
Moult	periodic shedding of the outer covering, such as the ex-oskeleton in the Arthropoda (shrimps, crabs, lobsters, and so on).
Monosex culture	raising a single sex in an impoundment to prevent breeding. Sexes may have to be sorted or bred from hybrids which produce young of a a single sex.
Mutations	changes in genes which cause new characters to appear in a species.

Pathogenic	causes disease.
Parasite	an organism that lives part or all of its life in or on another organism called a "host" and is dependent on the host for its metabolism.
Pesticide	a chemical substance used to kill pests.
pH	a scale numbered from 0 to 14 which indicates the acidity and alkalinity of solutions. A value of 7 is neutral. Numbers less than 7 are acid; those above are alkaline.
Phytoplankton	plants primarily microscopic, largely diatoms, that drift with the currents, and, together with zooplankton, make up the plankton. They are the basic synthesizers of organic matter.
Plankton	the passively drifting or weakly swimming organisms in fresh water and the sea. Members of the group include many microscopic plants and animals, but some large jellyfish are included. Plant plankton is called phytoplankton and animal plankton, zooplankton.
Pollution	specific impairment of water quality by sewage, pesticides, and industrial waste; may create a hazard to public health.
Postlarvae	past the larval stages: stages which resemble the juvenile but are still lacking some characters.
Predation	the act of an animal eating another (prey) of a different, and usually smaller, species.
Prey	an animal that is hunted and eaten by predatory animals.
Propagation	to multiply plants and animals by any method from parent stock.
Raft culture	growing oysters or mussels on shells or other materials suspended from rafts or floats. The term is sometimes used to describe any method of hanging culture.
Raising (rearing)	to cause or promote the growth of crops (plants or animals).
Rearing	to care for and support up to maturity, as to raise shrimp to adults.
Re-lay	collecting oysters, clams, or mussels in one location and planting them in another to obtain better growth or better quality meats.

Resistant	able to withstand adverse environmental conditions or ward off diseases.
Riparian rights	rights, belonging to a person who owns land bordering on a watercourse or other body of water, concerning its bank, bed, or waters.
Salinity	a measure of the quantity of dissolved salts in sea water. It is formally defined as the total amount of dissolved solids in sea water in parts per thousand (0/00) by weight when all the carbonate has been converted to oxide, the bromide and iodide to chloride, and all organic matter is completely oxidized. These qualifications result from the chemical difficulty in drying the salts in sea water. In practice, salinity is not determined directly but is computed from chlorinity, electrical conductivity, refractive index, or some other property whose relationship to salinity is well established.* Salinity in the open ocean varies about 33 to 37 parts per thousand. Estuaries receiving fresh water runoff will have reduced salinities.
Sea farming	to promote or improve growth and hence production of marine and brackish water plants and animals by labour and attention, at least at some stage of the life cycle, on areas leased or owned. Usually intended as a profit-making venture.
Seed	young animals, generally oysters, clams, or mussels, used to stock ponds.
Sessile	stationary or attached animals such as mussels or sponges.
Sea water	water usually with salinity of 30 to 35 parts per thousand, as found in the open oceans. The salinity of estuarine waters usually varies around this value.
Shellfishes	aquatic invertebrates possessing a shell or exoskeleton, usually molluscs or crustaceans.
Shuck	to remove shells from oysters, clams, etc., for market, or in preparation for eating.
Spat	young oysters just past the veliger stage which have settled down and become attached to some hard object.
Spat-fall	the settling or attachment of young oysters which have completed their larval stages.

*U.S. Naval Hydrographic Office definition.

Subtropical	area just outside the tropics ($23\frac{1}{2}$ degrees north and south of the Equator) with the climate similar to that of the tropics.
Temperate	region from $23\frac{1}{2}$ degrees north and south of the Equator to the respective polar regions; areas with definite seasons.
Turbidity	a cloudy condition of water, usually caused by impurities. May result from wave action stirring up bottom sediments.
Upwelling	a process by which nutrient-rich bottom waters of the sea are brought near the surface.
Vertebrates	higher animals with backbones (vertebra).
Wet lands (tidal marshes)	areas near the sea that are alternately flooded and drained by tidal action.
Zooplankton	animal plankton such as crustaceans and jellyfishes that drift with the currents. They consume phytoplankton and in turn serve as food for large animals.