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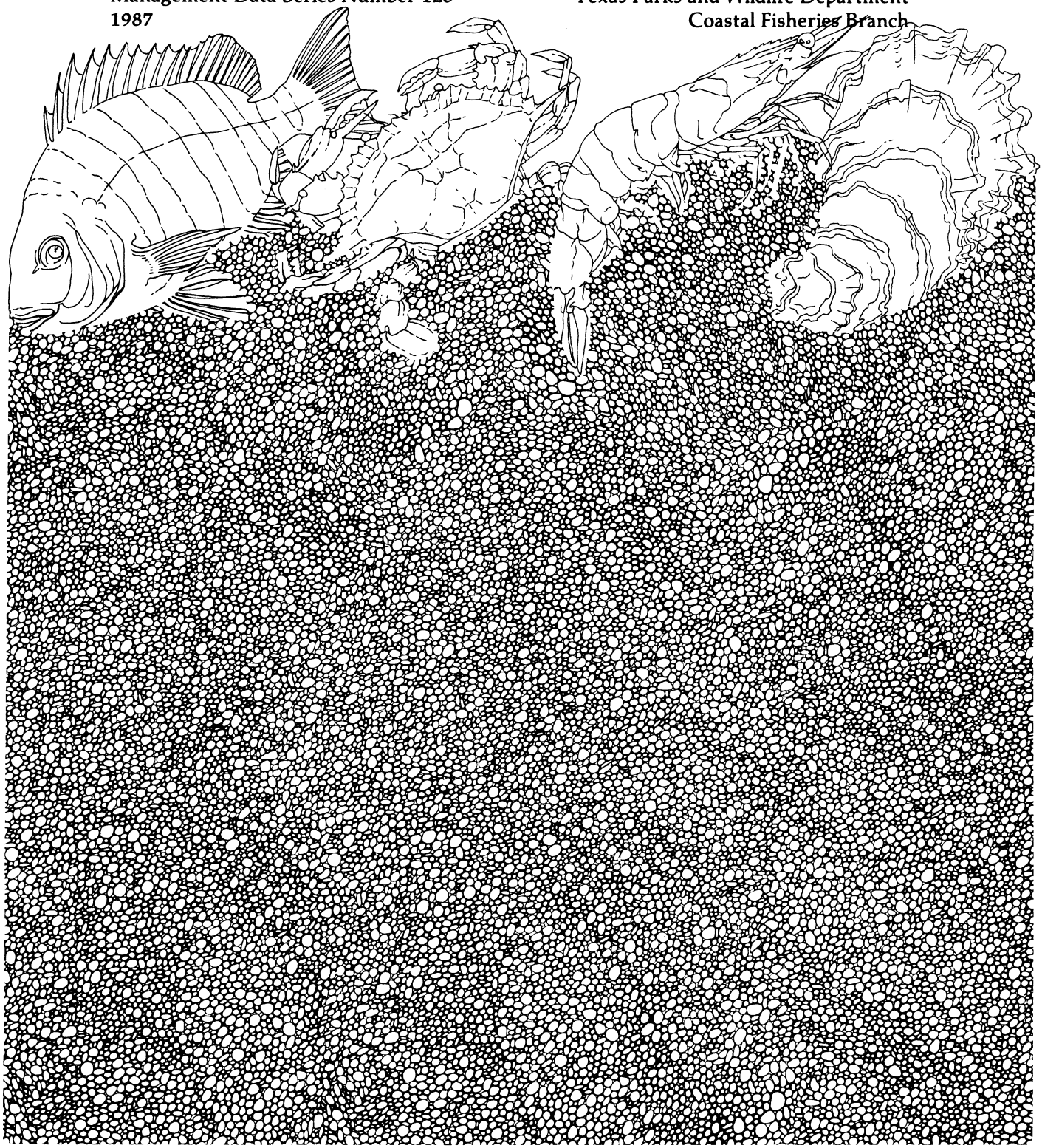

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ABSTRACT

Using the Delphi Technique, the Texas Parks and Wildlife Department (TPWD) staff decided a sampling program would be developed to routinely monitor the saltwater commercial fisheries. This program would estimate commercial Texas saltwater landings made during daylight hours by commercially licensed fishermen using commercially licensed vessels. This program would require physical inspection of landings to estimate number, species and size compositions of the landings. Effort information would be primarily obtained from the fishermen by interview. However, this information would possibly be supplemented with special studies based on independent observations (i.e., aerial surveys). This approach would permit the resource agency to control accuracy and precision of estimates through survey design and sampling intensity. It should eliminate problems of non-reporting and inaccurate reporting which occur in self-reporting systems and remove much of the ability of fisherman to misrepresent what they land.

INTRODUCTION

Managing a fishery within the concept of optimum yield requires accurate biological, social and economic information (Roedel 1975) since catch data from commercial fishermen are biased (Radovich 1975). The Texas Parks and Wildlife Department (TPWD) has implemented a fishery-independent sampling program (McEachron and Green 1984) to provide stock abundance, biological and environmental information. A coastal recreational fishing survey (Heffernan and Green 1977, Osburn and Ferguson 1986) provides information on recreational fishing activity, economic value and fishing mortality (landings). However, no program presently provides reliable and detailed information about commercial fishing mortality by area, fishing activity or economic value of the saltwater fishery.

Texas commercial landings data have been collected under various authorities since 1887. The TPWD and National Marine Fisheries Service (NMFS) intermittently contacted seafood dealers for volunteered landings information until 1935 (Perrett et al. 1980). The 1934 Texas legislature mandated Texas seafood dealers to submit a monthly report of all seafood purchases to the fisheries agency (Article 978f-1; Texas Penal Code). The Texas legislature emphasized the mandatory reporting of shrimp landings by passing the Texas Shrimp Conservation Act in 1959. In 1956, the U.S. Congress authorized NMFS to collect shrimp landings data through dealer reports and shrimp boat crew interviews (Prytherch 1980). The NMFS has been collecting shrimp landings and effort data in Texas since 1956 while TPWD has collected finfish, oyster and crab landings data. This sharing of data collection responsibilities was affirmed and formalized in an interagency agreement in March 1985. Under the current program, seafood dealers are required to submit a Monthly Marine Products Report (MMPR) to the TPWD by the 10th of every month (Osburn et al. 1985). Although the MMPRs list weight of finfish, crabs and oysters purchased by fish house operators during the previous month, the current program does not provide accurate estimates of total commercial landings, sizes of fish landed, effort or catch per trip, or areas of catch (Green and Thompson 1981). Therefore, accurate economic information such as the value of total commercial landings is also not available.

TPWD collected commercial landings data by trip in 1977 through the Individual Sales Transaction program (IST). Comparisons of data from this and the MMPR program showed no difference between total landings or species composition (Green and Thompson 1981). However, trip information collected through the IST program was inaccurate. Since trip information was supposed to be the major improvement, the IST program was discontinued. The MMPR program has been maintained in the interim.

Unfortunately, self-reporting systems are not providing data required to manage the fishery. Two reasons for this failure are non-reporting or inaccurate reporting by seafood dealers and fishermen and flaws in reporting system design. Although failure to acurately report landings is punishable by fine and possible loss of licenses, these penalties have not been severe enough to eliminate inaccurate reports (Green and Thompson 1981; Ferguson 1986). For the period 1981 through 1985 at least 50 - 60% of all Texas licensed wholesale seafood dealers did not report each month (Matlock 1983). Some noncompliance may be unintentional; however, seafood dealers have testified under oath that mandatory reports were not submitted because doing so was not in their best financial interest (Cunningham

vs. TPWD 1980). Insufficient communication between TPWD and the dealers has also caused problems and is an example of faulty design. A 2 to 3 month lag exists before the Statistical Field Agent receives notice of new dealer licensure and the dealers are provided proper reporting forms and instructions. Feedback mechanisms do not exist for informing the agency that a business has been discontinued. The NMFS' system is flawed by non-uniformity of data collection. The NMFS' "Shrimp Data Collection Form" may be completed by dealers or Fisheries Reporting Specialists. However, the data collection method is not identified on the form. Thus unknown magnitudes of reliability and possible bias can be introduced into this self-reporting system by differences in data collection procedures.

Even if the current reporting requirements were met, estimates of fishing mortality attributed to landings and the value of the fishery would be in error because neither TPWD's or NMFS's commercial landings monitoring systems have a complete census. These systems do not monitor landings consumed by the fisherman and his family or sold to restaurants, unlicensed consumers, unlicensed dealers, many retail truck dealers and most bait dealers. The magnitude of these missed landings are not determinable by present systems, but it may be considerable. A recent study of the marketing of blue crabs (Callinectes sapidus) in Texas stated that a significant portion of crabs landed in 1980 were sold through non-reporting channels (Miller and Nichols 1985).

The objective of this study was to target for development a technically sound routine monitoring program that would increase the accuracy of TPWD's information on commercial saltwater fishing mortality, value of the fishery and fishermen activity. This program was to be free from willful distortion of the quantity or value of aquatic organisms taken and it was to estimate as much of the fish mortality as technology and economics would allow.

METHODS

The TPWD staff used an approach similar to the Delphi technique to decide what type of routine commercial saltwater fisheries monitoring program should be developed. Three meetings were conducted to consider monitoring three different levels of fishing mortality (catch, gross catch and landings). Experts in Texas fisheries were used, feedback on each monitoring proposal was immediately available, and a consensus on the final decision was reached through an interactive process (Zuboy 1981). Summaries of each meeting were also provided to each staff member for his additional comment. This approach did not provide anonymity for staff members and the decision being reached concerned concepts not quantities.

Three different monitoring methods were considered: census, simulation and sampling. Within each method three different data collectors were considered: an on board observer who would accompany vessels from launch to landing, a roving observer who would intercept and board vessels at sea, and a land-based observer who would intercept vessels when they landed. Direct observation of the catch was preferred because of the non-reporting and inaccurate reporting problems associated with a self-reporting system (Green and Thompson 1981, Ferguson 1986). The bases for evaluating each monitoring method were: technical and economic feasibility, the availability of catch for observation, and whether information unavailable for observation could be collected first-hand or by hearsay (i.e., asking a fisherman versus a fish house operator where the catch

occurred). Each meeting was structured by an agenda but any previously discussed topic from current or past meetings was subject to recall by any member. All points of criticism were discussed until a consensus of opinion or at least acquiescence was achieved.

Since many of the terms used by fishery managers were not explicitly defined the meetings began with formulating a set of explicit definitions for critical terms to facilitate discussions. To derive new definitions, specific fishing and catch definitions were presented to the group and each term was discussed, changed and rediscussed until unanimity or acquiescence prevailed. Discussions about fishing and fishermen were seeded with terms from the Texas Parks and Wildlife Laws (Anonymous 1985). Discussions about catch and harvest focused on terms from FAO's 1981 Yearbook of Fishery Statistics. Terms were not created or retained if standard definitions would work (Merriam-Webster 1979). Throughout the discussions each definition was modified to relate logically to all other definitions.

Critical information (data necessary for the management of a fishery) were identified by obtaining a consensus on the answer to seven different questions: 1) who made the catch, 2) what was the catch, 3) where was the catch made, 4) when was the catch made, 5) how was the catch made, 6) what was the disposition of the catch and 7) what was the monetary value of the catch. The TPWD staff was required to explain how each data type that was collected could be used to manage the fishery. In addition, the availability of each data type to an observer for direct observation as first-hand information or hearsay (one of the criteria for judging program acceptability) was identified.

RESULTS AND DISCUSSION

The TPWD staff decided the routine commercial fishing monitoring program should be developed as a sampling program which would estimate commercial Texas saltwater landings (Table 1) made during daylight hours by commercially licensed fishermen using commercially licensed vessels landed in Texas. This program would require observers to physically inspect all landings made by commercially licensed vessels at a specific site and time period picked at random (Table 2). Number, size and species composition of the landings would be determined from observed fish. Effort information would be collected on a self-reporting basis from commercial fishermen as vessels docked. Aerial surveys could be developed to augment and substantiate times and places of intense fishing activity. The collection of information on catch and gross catch would have to be addressed through special targeted studies (McEachron et al. 1986, Bryan et al. 1982, Baxter 1973, Berry and Benton 1969). Commercial fishermen not using a vessel (shrimpers using cast nets and push nets, finfish fishermen using hook and line, gigs, etc.) could be periodically monitored by the TPWD recreational fishing survey.

Definitions

To understand why estimating landings by sampling was chosen, it was necessary to understand the relationships between fishing mortality and catch, gross catch, landings and harvest. Unfortunately, standard definitions or usage for these terms do not exist. The Magnuson Act passed in 1976 contains definitions which use catch, landings and harvest

to define other terms but does not include definitions for these terms. The Fisheries Management Plan for Shrimp in the Gulf of Mexico (Gulf of Mexico Fishery Management Council 1980) has a section of operational definitions but also does not define catch, landings and harvest. This deficiency may similarly be found in the Council's Environmental Impact Statement for reef fish (Gulf of Mexico Fishery Management Council 1981). Most technical texts (Ricker 1975, Gulland 1977, Steele 1977, Lackey and Nielsen 1980) use catch in the sense that the Food and Agriculture Organization of the United Nations (FAO) defines gross catch (FAO 1981). Although these authors acknowledge there is a difference between landings (what is brought to shore) and catch (what is captured by the gear), they account for these differences by assuming a landing is a constant proportion of the catch.

The TPWD staff began discussions of these definitions with the premise that fishing directly affects aquatic populations through the temporary or permanent removal of organisms from the populations (Fig. 1). The total number of organisms temporarily or permanently removed was defined as the catch (Table 1). Gross catch was defined as the number of organisms which the fisherman possessed (i.e., those that could be willfully retained or discarded). Harvest or fishing mortality was then defined as the portion of the catch permanently removed from the population, either before possession (caused by gear or vessel striking the fish or lost gear that has entrapped fish) or after possession (gross catch). This concept basically differs from the one presented by FAO (1981) in that the numbers of organisms rather than biomass and the effects on aquatic populations rather than on fishery markets are emphasized. Landings, meaning all organisms initially brought to land from water, comprised a subset of both gross catch and catch since not all organisms possessed by a fisherman are landed (Roelofs 1950, Berry and Benton 1969, Baxter 1973, Purvis and McCoy 1974, Bryan et al. 1982). The common definition of land was modified to include barges or vessels anchored to land as an extension of land. Salt waters were any waters south and east of proclaimed boundaries in Texas (Fig. 2) (Anonymous 1986). Therefore, Texas saltwater landings were all aquatic organisms caught in salt water within Texas, other states, countries, territorial seas, the Fisheries Conservation Zone, and international waters and landed in Texas.

Precise definitions for fishermen were developed based on activity rather than income levels to avoid ambiguity. As an example, Newlin and Prytherch (1982) defined four types of fishermen. They defined a commercial fisherman as anyone who sold all or part of his catch. A full-time commercial fisherman derived more than 50% of his income from catching and selling living organisms from inland or marine waters, while a part-time commercial fisherman derived less than 50% of his annual income from commercial fishing activities. However, their definition for a recreational fisherman also permitted income from occasional sales of their catch. It is not clear when this income should qualify a recreational fisherman as a part-time commercial fisherman. TPWD revised these definitions as follows (Table 1): a fisherman was defined as any person who attempts to catch aquatic organisms; a commercial fisherman was any fisherman who sold, bartered or exchanged any or all of his catch or who was paid for attempting to catch aquatic organisms; and a recreational fisherman was any fisherman who was not a commercial fisherman. A fish guide was a person who was compensated for accompanying or transporting a recreational

fisherman. A fish guide became a commercial fisherman if any or all of his catch or the catch derived from his services was sold.

Ambiguity from use of the term income also affected development of definitions to describe commercial value and marketing pathways. Newlin and Prytherch (1982) defined ex-vessel price as the price received at the dock for aquatic organisms. This approach was inadequate because marine organisms may leave the boat without exchange of money at dockside. Further, dockside cash exchange does not reflect the entire economic value since landings are sometimes traded for alternative forms of payment (i.e., supplies at dealer cost, delayed payments, property exchange). However, the Newlin and Prytherch (1982) definition for ex-vessel price was retained and targeted for future clarification. The TPWD staff created the term "primary buyer" to monitor the initial sale of organisms by commercial fishermen and to establish when landings became commercial without excluding landings where no cash exchange occurred. The term was needed to track the initial purchase and marketing of commercial landings.

Evaluation of Monitoring Strategies

Catch could not be routinely monitored using a census of fishermen, simulation of a fishery, or by sampling. A portion of the catch is always lost underwater before it is brought on board a vessel (FAO 1981). Quantification of underwater losses due to escapement and gear loss would require special equipment with excessive operating costs in terms of time and money (i.e., scuba divers, diving equipment, retrieval gear). Therefore, quantifying catch within a fishery would require short-lived intensive special studies (McEachron et al. 1986).

Gross catch could not be routinely monitored by census, simulation or sampling because of excessive costs and formidable logistical problems (Table 3). A census of gross catch would require observers on board every fishing vessel every fishing day. Based on TPWD's issuance of 10,688 fishing vessel licenses by July 1985, a census would cost $85 million in salaries (Anonymous 1982) alone for the 5,344 required observers (each on board observer working 1920 hours per year to cover 80 hours of fishing/vessel/month, and receiving $16,000 per year). Since TPWD's entire budget for Coastal Fisheries in Fiscal Year 1986 was $3.7 million (Anonymous 1985), the shortfall eliminated this method from additional consideration. Projected equipment purchases of $1.3 million, salaries and operational costs of $0.6 million eliminated routine simulation from contention, since the additional expense could only be met by dropping other programs. TPWD would have to hire 23 people and purchase 9 trawlers, 9 skiffs and 26 different kinds of fishing gear. These personnel would have to fish the 26 gears in each bay system at least twice a month. But this effort would probably not mimic all conceivable variations used by commercial fishermen. Furthermore, an auxiliary program would be required to allow estimation of total fishing effort for each fishery and fishing method. These estimates would be applied to catch rates from the simulations to estimate gross catch. Thus the projected costs of simulation would increase with the addition of this auxiliary program, making simulation more unattractive. Logistical problems eliminated the possibility of monitoring gross catch by sampling. It would be impossible to determine when fishing trips would be initiated during a specific time period and an observer could not randomly select a vessel for sampling since he would not have a complete sampling frame.

Vessels not docking in Texas but fishing Texas waters would have to be included in the sample frame. Even if a nonrandom sampling scheme were devised, significant problems remained in using either on board or roving observers. These problems were: retrieval of an employee who has been returned to a port different from the one he left (especially if it were a foreign port), danger to employees during transfer between vessel at sea, work shift conflicts with state and federal labor laws, and liability costs due to employee injury while a passenger on a privately owned vessel. These reasons were deemed sufficient to remove sampling from additional consideration.

Texas saltwater landings could be estimated by sampling with land based observers, but could not be determined with census or simulation methods. TPWD could not hire enough people to watch 3,799.3 km of shoreline (Matlock and Ferguson 1982) 24 hours a day, so a census of saltwater landings was impossible. Simulation of landings would cost at least as much as simulation of gross catch, with the need for an auxiliary program which would determine the comparability of TPWD's simulated landings with commercial fishermen's. Sampling could not be eliminated on the basis of cost or logistical problems. TPWD presently samples recreational fishing coastwide. Green and Thompson (1981) suggest that reasonable numbers of man-hours would be required to sample commercial landings. The only immediate logistical problem was night sampling. Sampling at night in some areas may be too dangerous without police protection, but after the daylight sampling program is operational, nighttime studies would be considered.

Essential Data Types

Information essential to management within optimum yield was classified under four broad categories: fisherman characteristics, catch, effort, and economics (Table 2). Commercial fishermen's residency, number, participation level, license type, ethnic group, number of dependents and age were information needed to allocate fishery resources among users and to evaluate the impact of proposed regulations. The critical catch information included species, number of organisms, sex and size compositions and tag return information. This information would be used to determine MSY and to evaluate the effectiveness of regulations (Meador and Green 1986). Effort information encompasses location, time and methods. Geographic area identified by latitude/longitude would establish exactly where gross catches and landings were made. Seasonal and daily effort patterns (time of landing) could be used to establish strategies for regulation and allocation. Method of capture, including gear and vessel type, dimensions, number of gear units, fishing method and length of time fished would be used to formulate MSY, regulations and allocation of fisheries resources. Additionally, data with respect to the economics of fishing and fish marketing need to be collected in a systematic manner. This type of data would include but not necessarily be limited to: expenditures, profit/loss, trip time and the ultimate user. Continuously collecting this standard economic data would be extremely useful in devising and then evaluating the impacts of regulations.

Conclusion

Estimating Texas saltwater landings by commercially licensed vessels with a routine sampling program would represent a better estimate of fishing mortality than the current MMPR system. The sampling program would be based on all organisms brought to dock including products sold to unlicensed dealers, used for home consumption or discarded after being brought to land. This approach will still not represent mortality incurred before organisms are brought on board a vessel or any organisms disposed of before the vessel lands. The program will potentially miss some night landings and landings landed outside Texas. However, inclusion of a sampling routine that samples a specific site 2 days in a row could potentially trap some night landings if the site is adjacent to a fish house and there are fish in the fish house in the morning that were not there the day before. The accuracy and precision of estimates would be subject to the control of TPWD through survey design and sampling intensity. This would eliminate problems of non-reporting and inaccurate reporting and remove much of the ability of fishermen to misrepresent what they land.

Development of a sampling program to monitor Texas saltwater landings will be approached by first defining a sampling frame. The universe of shore in Texas where saltwater landings may be made will be enumerated. Each site will be inventoried for accessibility to boat ramps, docks, roads and seafood processing facilities. Next, existing data will be analyzed to provide primary estimates of means and variances for possible stratification. Development of measuring and recording techniques will be implemented and evaluated. Finally, this information will be used to develop a 2-mo. pilot during which actual data will be collected to test data collection and estimating procedures. Final recommendations and initial tuning will be done based on the results from the pilot study.

LITERATURE CITED

Anonymous. 1982. Budget Estimates - fiscal years 1984 and 1985. Texas Budget and Planning Office and Legislative Budget Office. Austin, Texas, USA.

Anonymous. 1985. Coastal fisheries plan 1985-1986. Tex. Pks. Wildl. Dep., Coast. Fish. Branch Rep. No. 3400-56. 38 p.

Anonymous. 1985. Parks and Wildlife Laws, State of Texas 1985-1986. West Publishing Company, St. Paul, Minn. 427 p.

Anonymous. 1986. Statewide Hunting and Fishing Proclamation 1986-87. Tex. Pks. Wildl. Dep., Austin, Tx. 41 p.

Baxter, K. N. 1973. Shrimp discarding of the commercial fishery in the Western Gulf of Mexico. Mar. Fish. Rev. 35:26.

Berry, R. J. and R. C. Benton. 1969. Discarding practices in the Gulf of Mexico shrimp fishery. FAO Fish. Rep. 57:983-999.

Bryan, C. E., T. J. Cody, and G. C. Matlock. 1982. Organisms captured by the commercial shrimp fleet. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Tech. Ser. No. 31. 26 p.

Cunningham, F. J., et al. vs. TPWD. 1980. District Court of Travis County, Texas. 250th Judicial District. No. 311, 474. Volume I and II. Austin, TX.

FAO. 1981. Yearbook of fishery statistics. Food and Agriculture Organization of the United Nations, Vol. 52. Rome, Italy. 357 p.

Ferguson, M. O. 1986. Characteristics of red drum and spotted seatrout commercial fishermen in Texas. N. Am. J. Fish. Manage. 6:344-358.

Green, A. W. and K. L. Thompson. 1981. Comparison between reported and estimated commercial finfish landings from the central Texas coast. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 20. 18 p.

Gulf of Mexico Fishery Management Council. 1980. Management Plan and Final Environmental Impact Statement for the Shrimp Fishery of the Gulf of Mexico, United States Waters. Tampa, Fl. 200 p.

_____, 1981. Environmental impact statement and fishery management plan for the reef fish resources of the Gulf of Mexico. Tampa, Fl. 239 p.

Gulland, J. A. 1977. Fish population dynamics. Food and Agriculture Organization of the United Nations. Rome, Italy. 372 p.

Heffernan, T. L. and A. W. Green. 1977. Survey of finfish harvest in selected Texas bays, a completion report. Tex. Pks. Wildl. Completion Report 3000-133. Austin, TX. 61 p.

Lackey, R. T., and L. A. Nielsen. 1980. Fisheries management. John Wiley and Sons. New York, NY. 422 p.

Matlock, G. C. 1983. A basis for the development of a management plan for red drum in Texas. Ph.D. dissertation, Tex. A&M Univ., College Station, Tx. 291 p.

_____, and M. F. Ferguson. 1982. Shallow water surface areas and shoreline distances on the Texas coast. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 82. 10 p.

McEachron, L. W., and A. W. Green. 1984. Assessment of annual relative abundance and mean length of six marine fishes in Texas coastal waters. Proc. 37th Annu. Conf. Southeastern Assoc. Fish Wildl. Agencies. 38:506-519.

_____, A. W. Green, and G. C. Matlock. 1986. Evaluation of the commercial trotline fishery in the Laguna Madre during fall 1984. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 93. 25 p.

Meador, K. L., and A. W. Green. 1986. Effects of a minimum size limit on spotted seatrout recreational harvest. N. Am. J. Fish. Mngmnt. 6:509-518.

Merriam-Webster. 1979. Webster's new collegiate dictionary. G. & C. Merriam Co. Springfield, MD. 1,532 p.

Miller, C. L., and J. P. Nichols. 1985. Economics of harvesting and market potential for the Texas blue crab industry. Tex. A&M Univ. Sea Grant Publ. TAMU-SG-86-201. 118 p.

Newlin, K., and H. Prytherch. 1982. A general overview of the statistical surveys division's fisheries data collection activities in the southeastern region of the United States. U. S. Dep. Comm., NOAA, NMFS. Miami, FL. 82 p.

Osburn, H. R., and M. O. Ferguson. 1986. Trends in finfish landings by sport boat fishermen in Texas marine waters, May 1974-May 1985. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 90. 448 p.

Osburn, H. R., G. E. Saul, and C. L. Hamilton. 1985. Trends in Texas commercial fisheries landings, 1977-84. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 84. 95 p.

Perrett, N. S., J. E. Weaver, R. O. Williams, P. L. Johansen, T. D. McIlwain, R. D. Paulerson, and W. M. Tatum. 1980. Fishery profiles of red drum and spotted seatrout. Gulf States Mar. Fish. Comm. Rep. No. 6. 60p.

Prytherch, H. F. 1980. A directory of fishery data collection activities conducted by the Statistical Survey Division in Southeast Region of the United States. U. S. Dep. Comm., NOAA, Tech. Mem. NMFS-SEFC-16. Miami, Fl. 91 p.

Purvis, C. E., and E. G. McCoy. 1974. Pink-brown shrimp discard studies in the Core-Pamlico Sound area. N. Carolina Dep. Nat. and Econ. Res., Div. Comm. and Sports Pub. No. 26. Raleigh, NC. 19 p.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Board Canada, Bull. No. 191. 382 p.

Radovich, J. 1975. Application of optimum sustainable yield theory to marine fisheries p.21-28. In P.M. Roedel, Ed. Optimum sustainable yield as a concept in fisheries management. Spec. Publ. No. 9. Amer. Fish. Soc., Wash., D.C.

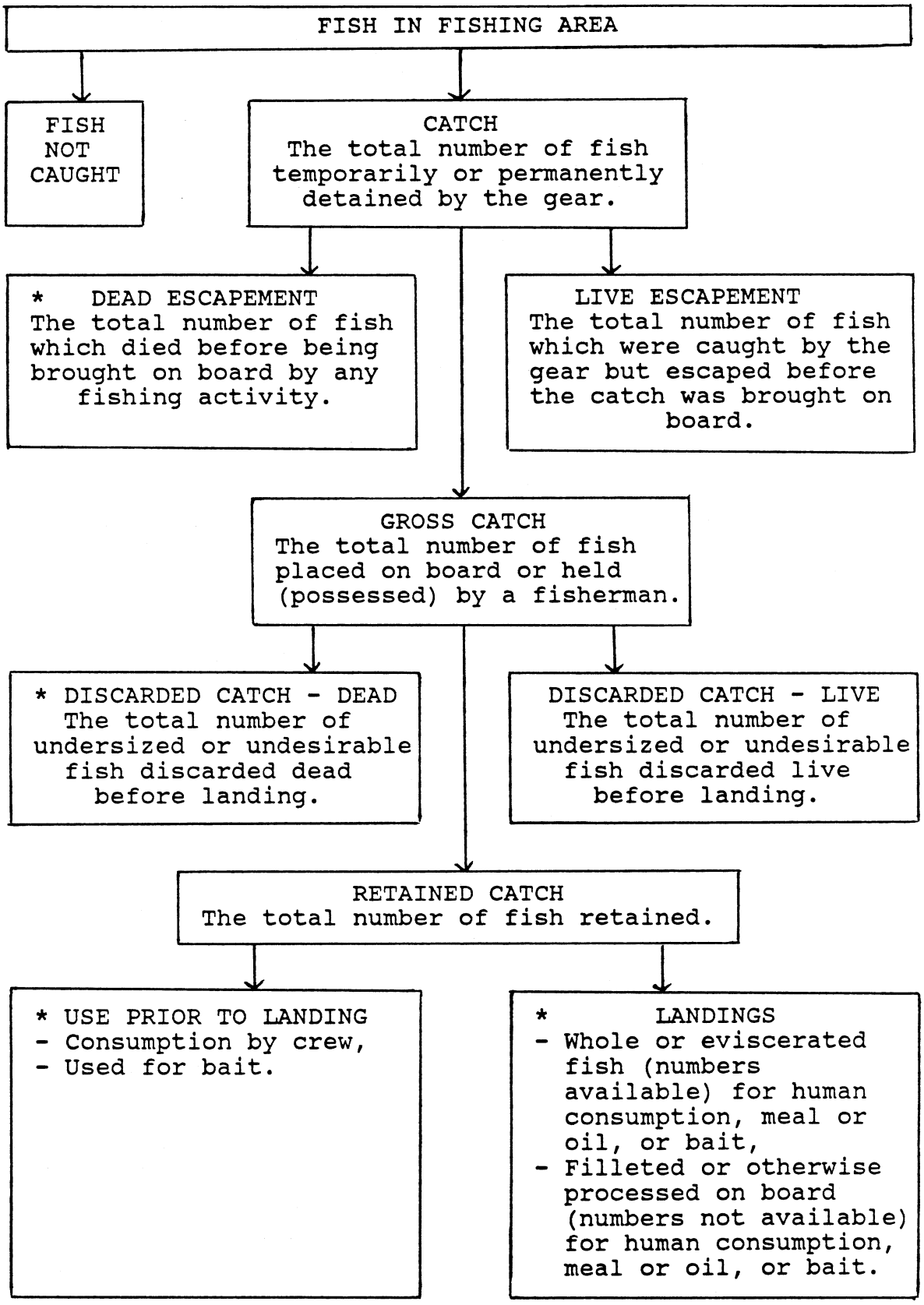
Roedel, P. M., Ed. 1975. Optimum Sustainable Yield as a concept in fisheries management. Spec. Publ. No. 9. Amer. Fish. Soc., Wash., D.C. 89 p.

Roelofs, E. W. 1950. Releasing small fish and shrimp from trawl nets. Comm. Fish. Rev. 12:1-11.

Steele, J. H. 1977. Fisheries mathematics. Academic Press. New York, N.Y. 198 p.

Zuboy, J. R. 1981. A new tool for fishery managers: The Delphi technique. N. Am. J. Fish. Mngmnt. 1:55-59.

Figure 1. Components of catch and their relation to fishing and fishing mortality (harvest).



* The sum of these quantities is total fishing mortality (harvest).

Figure 2. Saltwater boundaries in Texas.

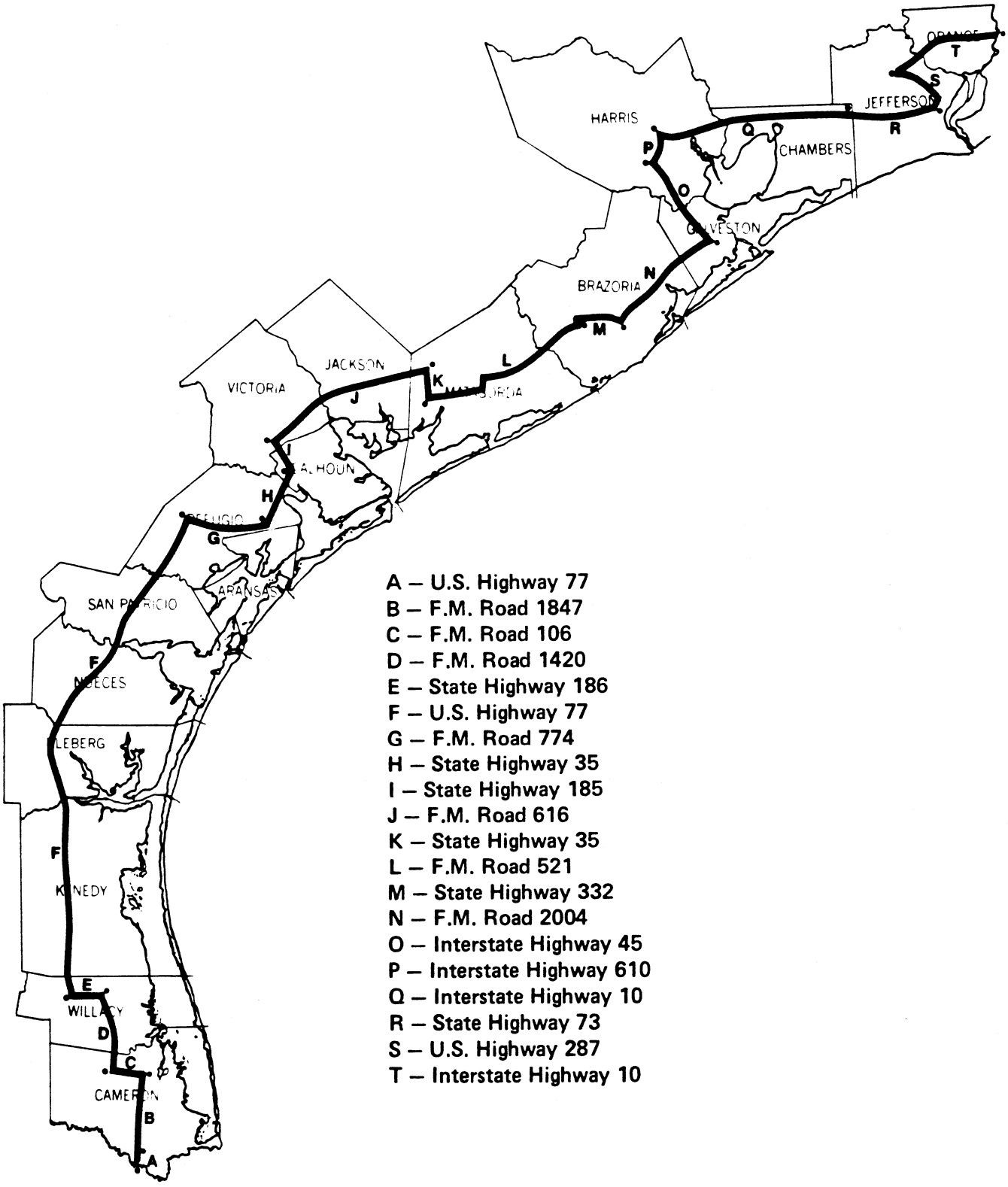

HARRIS
CHAMBERS
JEFFERSON
BRAZORIA
VICTORIA
JACKSON
CALHOUN
ARANSAS
SAN PATRICIO
NUECES
KENEDY
WILLACY
CAMERON
A – U.S. Highway 77
B – F.M. Road 1847
C – F.M. Road 106
D – F.M. Road 1420
E – State Highway 186
F – U.S. Highway 77
G – F.M. Road 774
H – State Highway 35
I – State Highway 185
J – F.M. Road 616
K – State Highway 35
L – F.M. Road 521
M – State Highway 332
N – F.M. Road 2004
O – Interstate Highway 45
P – Interstate Highway 610
Q – Interstate Highway 10
R – State Highway 73
S – U.S. Highway 287
T – Interstate Highway 10

Table 1. Fishing terms as defined by Texas Parks and Wildlife Department Coastal Fisheries staff.

Term	Definition
Catch	The total number of aquatic organisms temporarily or permanently removed from a population.
Commercial Fisherman	Any fisherman who sells, barters, or exchanges any or all of his catch or who is paid for attempting to catch aquatic organisms.
Commercial Saltwater Landings	Saltwater landings by commercial fishermen.
Ex-vessel Value	The total economic value received by a fishermen from a primary buyer for any or all of his catch.
Fisherman	Any person who attempts to catch aquatic organisms.
Fish Guide	A person who is compensated for accompanying or transporting a recreational fisherman. A fish guide is a commercial fisherman if he sells any or all of his catch or the catch derived from his services.
Gross Catch	All aquatic organisms possessed by a fisherman.
Harvest	The total number of aquatic organisms permanently removed from a population.
Land	The solid part of the earth's surface not covered by water. Barges or vessels anchored to land are an extension of land.
Primary Buyer	The initial person, firm, or corporation who acquires the catch of a commercial fisherman through pay, barter, or exchange.
Recreational Fisherman	Any fisherman not a commercial fisherman.
Saltwater	In Texas, any state waters south and east of proclaimed boundaries.
To catch	To temporarily or permanently remove aquatic organisms from a population.
To harvest	To permanently remove aquatic organisms from a population.
To land	To initially bring aquatic organisms to land from water.

Table 1. (Cont'd.).

Term	Definition
Texas Saltwater Landings	All aquatic organisms caught in saltwater within Texas, other states, countries, territorial seas, the FCZ and international waters and landed in Texas.

Table 2. Data types essential to the management of a fishery, assessed as to whether the data items can be directly observed (verified) with regard to three different observer types and generally why each data type is important.

Item	Observer type			Importance of information provided by data
	Onboard	Roving Onboard[a]	Land based[b]	
Fishermen characteristics (who)				
Residence (state, county if Texas)	V	V	V	Allocation, Impact
Fishermen (number)	V	V	V	of regulations, Description
Participation (part-time, full-time)	S	S	S	of participants
Licenses (Type and number)	V	V	V	
Ethnic group	S	S	S	
Dependents (Number)	S	S	S	
Age	S	S	S	
Catch information (what)				
Species	V	V	V	MSY, Allocation, Impacts
Organisms (Number)	V	V	V	of regulations
Size composition	V	V	V	
Sex composition	V	V	V	
Tag returns	V	V	V	
Effort (where, when, how)				
Geographic area of caught and landed aquatic organisms indicated by lat/long	V V	V S	S V	MSY per area, Allocation, Regulations, Marketing
Time caught (date and time of day)	V	V	S	Regulations, Allocation, MSY
Time landed	V	S	V	
Gear and vessel				MSY, Regulations, Allocations
type	V	V	S	
dimensions	V	V	S	
number	V	V	S	
method fished	V	V	S	
length of time fished	V	V	S	

Table 2. (Cont'd).

Item	Observer type			Importance of information provided by data
	Onboard	Roving Onboard[a]	Land based[b]	
Economic (value)				
Expenditures	S	S	S	Allocation,
Profit/loss	S	S	S	Regulations,
Trip time	V	S	S	Marketing,
Ultimate user	S	S	S	Fisheries development

V = verifable by direct observation for gross catch or landings
a = information verifiable on gross catch but not landings
b = information verifiable on landings only
S = available only as self-reported data

Table 3. Key problems associated with trying to determine gross catch or Texas saltwater landings by census, sumulation or sampling using three different observer types.

	Gross catch			Landings		
Monitoring method	Onboard	Roving onboard	Land based	Onboard	Roving onboard	Land based
Census	Not technically or economically feasible to record all fishing trips every month for > 10,000 commercial fishing vessel licenses.	Same problems as for Onboard Observers. Dangers in boarding vessels at sea.	Gross catches on commercial fishing vessels are seldom brought to land.	Same problems as for Gross Catch/Onboard Observer.	Never see landings unless observer stays with vessel after boarding.	Not technically or economically feasible to record all landings made by > 10,000 commercial fishing vessel licenses. Cannot observe 3,799.3 km of Texas shoreline 24 hours a day, every day of each month.
Simulation	Too expensive to simulate commercial fishing monthly in nine major bay systems on four major fisheries. Program necessary to determine how commercial fishermen deploy fishing gear. Need to know total fishing effort by commercial fishermen by gear type.	Same problem as for Onboard Observers, Dangers in boarding vessels at sea. Need to know total fishing effort by gear type.	Gross catches on commercial fishing vessels are seldomly brought to land. Need to know total fishing effort by gear type.	Same problems as for Gross Catch/Onboard Observer. Need to know total fishing effort by gear type.	Never see landings unless observer stays with vessel after boarding. Need to know total fishing effort by gear type.	Same problems as for Onboard/ Simulation. Need to know total fishing effort by gear type.

Table 3. (Cont'd.)

	Gross catch			Landings		
Monitoring method	Onboard	Roving onboard	Land based	Onboard	Roving onboard	Land based
Sampling	May not reliably locate commercial fishing vessels that are not fishing. Vessels may not return to Texas - may fish in Texas waters but never dock in Texas. Observers bias commercial fishing operations. Dangers to observers and liability problems.	Same problems as for Onboard Observers. Dangers in boarding vessels at sea.	Gross catches on commercial fishing vessels are seldomly brought to land.	Same Problems as for Gross Catch/Onboard Observer.	Never see landings unless observer stays with vessel after boarding.	Dangers to observers at night.

Appendix A. Participants in the planning of a routine monitoring program for the Texas saltwater commercial fisheries.

Table A.1. Texas Parks and Wildlife Department employees who participated in the three meetings and meeting reviews which determined what approach would be used to monitor the Texas saltwater commercial fisheries.

Employee	Dates[a] 25-26 October 1983	2-3 October 1985	11 November 1985
C. E. Bryan	X	X	X
R. L. Benefield	A	X	A
T. J. Cody	A	A	X
J. F. Doerzbacher	A	X	A
O. R. Farley[b]	A	A	X
M. O. Ferguson	X	A	X
A. W. Green	X	X	X
C. L. Hamilton	X	A	A
P. C. Hammerschmidt	A	X	X
T. L. Heffernan	X	X	A
R. A. Lahr	A	X	X
G. C. Matlock	X	X	X
L. W. McEachron	X	X	X
H. R. Osburn	X	X	X
G. E. Saul	X	X	X

[a] X = attended A = absent
[b] National Marine Fisheries Service Coordinator

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PWD-RP-3400-003-5/87