AMENDMENT NUMBER 2
AND
ENVIRONMENTAL ASSESSMENT
AND
REGULATORY IMPACT REVIEW
AND
INITIAL REGULATORY FLEXIBILITY ANALYSIS
TO
THE FISHERY MANAGEMENT PLAN
FOR THE
RED DRUM FISHERY OF THE GULF OF MEXICO

MARCH, 1988

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I. Introduction

Red drum are an important component of both recreational and commercial fisheries in the Gulf of Mexico. Total landings of red drum have ranged from approximately 8 million pounds to 17 million pounds during the period 1979-1986. Historically, both the recreational and commercial fisheries were primarily in the estuarine areas.

Beginning about 1984, commercial fishermen began targeting schooling adult red drum in the exclusive economic zone (EEZ) and landed nearly a million pounds during that year. Landings from this predominantly purse-seine fishery increased to 3.5 million pounds in 1985 and to 8.2 million pounds by mid-1986 (Table 12-1, Amendment 1 to the FMP). This accelerated effort raised concerns over the ability of the stock to withstand uncontrolled harvest. The Secretary of Commerce (Secretary), therefore, took action to manage the resource in the EEZ.

Fish landed from this purse-seine fishery in Alabama were randomly sampled for measurements of length (Figure 1). Fish for collection of otoliths for aging were non-randomly sampled to obtain approximately equal numbers of all size groups. Age at maturity was computed to be 72 cm or approximately age 4 (ADCNR, 1986). Approximately one percent of the purse-seine caught fish measured in the random sample were smaller than 72 cm (28.4 inches).

On June 25, 1986, the Secretary promulgated an emergency rule to limit commercial harvest from the EEZ to one million pounds while National Marine Fisheries Service (NMFS) prepared a fishery management plan (FMP) for the fishery. The FMP was implemented on December 19, 1986, and prohibited directed commercial harvest from the EEZ for 1987. The FMP provided for a recreational bag limit of one fish per person per trip, and an incidental catch allowance for commercial net and shrimp fishermen. Total harvest was estimated at 625,000 pounds; 300,000 by the commercial sector, and 325,000 by the recreational sector. The stock assessment sections of the FMP documented high inshore (state waters) fishing mortality on juvenile red drum (less than 30 inches total length) and provided analyses that indicated significant long-term risks to the spawning stock biomass (SSB) associated with reduced juvenile recruitment to the adult population and with continued exploitation of adults.

The Gulf of Mexico Fishery Management Council (Council) prepared Amendment 1 to the FMP, which was implemented on October 16, 1987. The amendment continued the prohibition of a directed commercial EEZ fishery, but converted the commercial and recreational estimated catch allowances into quotas that were restricted to EEZ waters off Louisiana, Mississippi, and Alabama (the primary area); harvest was prohibited from the EEZ off Florida and Texas (secondary areas). The Council also requested that the states implement rules within their jurisdictions that would provide for an escapement rate of juvenile fish to the SSB equivalent to 20 percent of those that would have escaped had there been no inshore fishery. Such an escapement rate was judged as necessary to maintain a SSB level that would prevent recruitment failure and collapse of the fishery.

II. Description of Fishery and Utilization Patterns

The fishery and utilization patterns are described in Sections 5.0 through 11.0 of the FMP with updated landings and other current information presented in Amendment 1 to the FMP. Subsequent to publication of those documents many of the states modified their rules regulating the fishery (Table 1). More recently, the Secretary implemented an emergency rule to prohibit harvest of red drum in the EEZ effective January 1, 1988 through June 28, 1988. Louisiana rules (1) prohibiting the commercial harvest of red drum from January 15 through August 31, 1988, was implemented when the annual commercial of 1.7 million pounds was exceeded and (2) prohibiting recreational harvest from February 15, 1988, through June 1, 1988, was implemented. A Florida rule prohibited all red drum harvest from state waters effective January 1, 1988. During these closures the states will develop rules to increase escapement of juveniles.

III. Statement of the Problem

As provided for in Amendment 1 to the FMP, the NMFS prepared by October, 1987, a detailed stock assessment report for the fishery (Goodyear, 1987). The Council convened a scientific stock assessment group to review the report and recommend an acceptable biological catch (ABC) from which the Council could specify a total allowable catch (TAC) for the primary area (EEZ off Alabama/Mississippi/ Louisiana).

The stock assessment report indicated that current (1983-1986 period) mortality rates of juvenile red drum from state waters continued to be excessively high, and indicated that annual escapement rates of juveniles to the adult stock for this period were less than two percent for all areas examined. The report also observed recent results of length-frequency and aging studies indicated mature red drum under 12 years of age are poorly represented in the present spawning stock (Figure 2).

The severity of the problem documented by the stock assessment (Goodyear, 1987) is illustrated in Figure 3 and Table 2. Figure 3 is but one example of the many analyses of disappearance rate (D)[1/] contained in the stock assessment. These figures indicate a constant disappearance rate between age classes (i.e., the relation is linear) and show the age-classes exploited in that particular fishery. For the Everglades National Park fishery (Figure 1) D was equal 1.28 and the fishery was harvesting red drum that were 1 to 4.5 years of age.

Table 2 summarizes these analyses from the stock assessment (Goodyear, 1987) and indicates the problem is a Gulf-wide problem. Goodyear (1987) utilized disappearance rates (D) analyses rather than total mortality rates (Z) because of incomplete data to compute fishing and natural mortality (F and M, respectively). D includes F + M and emigration from the fishery. Generally, it is assumed that emigration is negligible, i.e., D = Z = F + M. He further points out that the technique used to compute D is known to be biased in such a way that it understates the true value of D and that fishing mortality alone may be greater than estimated D. He also indicates the pooled estimate developed from the NMFS Marine

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1/ Disappearance rates (D) may also be utilized to assess the success of regulatory actions to achieve higher escapement levels and in restoration of the stock(s) (Figure 4, also see Table 1). This figure indicates the reduction of D achieved through regulatory actions of the Texas Parks and Wildlife Department.

Recreational Fishing Survey for 1986 suggests that annual F is on the order of 2.0 (see first data set in Table 2 for comparison). He points out if F was only half as high (1.0) the corresponding escapement rates would be in the range of 0.6 to 1.8 percent, far below the escapement goal of 20 percent established under Amendment 1. Overall for the Gulf escapement rates are much less than 2 percent.

Goodyear (1987) concluded that given the high mortality rate associated with the fishery on juveniles, it is likely that any significant increase in fishing mortality on adults would endanger recruitment inshore. This would be the result of both lowering the number of spawners and compression of the age distribution of spawners into the first few reproductive ages. He also concluded that a 20 percent spawning stock biomass per recruit ratio (SSBR)[2/] was a reasonable goal for maintaining the spawning stock but that the 20 percent escapement goal of Amendment 1 was incompatible with this stock goal because of natural and fishing mortality on the adults.

Based on information in the stock assessment report, the Council's scientific stock assessment group (scientific group) recommended that ABC for the EEZ be set at zero and that escapement rates of juveniles from state waters be increased to 30 percent to assure a 20 percent SSBR ratio, the level considered necessary to prevent recruitment overfishing.

In December 1987, the Council adopted the report of the scientific group (Condrey et al., 1987), and instructed its staff to initiate Amendment 2 to the FMP to set TAC at zero. The Council also requested each state to adopt rules that eventually would result in an escapement rate of 30 percent. They requested the Regional Director, NMFS, to institute an emergency action under Section 305(e) of the Magnuson Act to reduce TAC to zero and simultaneously recommend that each state implement a compatible closure of its waters while developing rules to increase escapement. The emergency rule would reduce mortality on the SSB in the EEZ until Amendment 2 is implemented.

2/ Spawning stock biomass per recruit (SSBR) is defined as follows:

At each age, the number alive times the fraction mature times the weight of an individual represents the spawning stock biomass of the cohort for that age. The total contribution of a cohort to the spawning stock biomass (SSB) over its lifetime is found by summing the cohort's contributions at each age. This total value can then be scaled by the original number of recruits (R), as SSBR, to provide a general case regardless of the absolute number of recruits. Maximum spawning stock biomass per recruit is obtained under conditions of no fishing mortality. Combinations of instantaneous fishing mortality (F) and the average age at which a cohort becomes subjected to fishery exploitation (t_c) give rise to lower levels of spawning stock biomass per recruit; all of these can be expressed as percentages of the maximum.

IV. Proposed Action

The actions proposed in this Amendment of the FMP consist of the following revisions of existing measures or sections.

- o Objective 1 is modified to specify a new escapement goal.
- o The statement of optimum yield is modified to specify a new escapement goal.
- o The procedure for specifying total allowable catch is modified.
- o Total allowable catch (TAC) and specific harvest levels for the primary area are set at zero.
- o The section on recommendations to the states is modified.
- o The FMP section describing the habitat of the stock is revised.

ACTION 1: MANAGEMENT OBJECTIVES

Section 12.4 is revised by modifying Objective 1 as follows (change underlined):

12.4 Management Objectives

1. Cooperatively with the states provide at least a 30 percent level of escapement of juvenile red drum to the offshore spawning stock, and control offshore fishing mortality to assure optimum recruitment and enhancement of the inshore and offshore populations.
2. Establish, implement, and maintain research and data gathering programs to ensure that appropriate data will be available to formulate management measures and monitor the condition of the stock.
3. If a total allowable catch (TAC) is determined which provides for an EEZ catch, then the TAC will be fairly allocated between EEZ users of the resource.
4. Maximize the economic and social benefits of the resource to the nation.
5. Identify and encourage actions resulting in the conservation, restoration, and enhancement of red drum habitat.

Rationale: All of the objectives, other than Objective 1, still appear to be viable objectives for the FMP. Objective 1 is modified to specify an escapement level of 30 percent, rather than 20 percent, to be consistent with the scientific group's recommendation and the Council's recommendation to the states. Goodyear (1987) in the stock assessment indicated that a 20 percent spawning stock per recruit ratio could not be maintained through a 20 percent level of escapement of juveniles because of natural and fishing mortality on the adults. The scientific group (Condrey et al., 1987) recommended the escapement level be raised from 20 to 30 percent which would allow for a 3-5 percent annual mortality of adults, accounting for the existing limited state harvests of adults (Table 3) and unavoidable adult mortality through incidental bycatch. The Council adopted this recommendation and has requested the states take regulatory actions to achieve the 30 percent escapement rate.

Rejected Alternative to Action 1

a. Retain Objective 1 as currently specified (No Action)

Rationale: Although the states have not attained the current escapement goal of 20 percent, it would be inconsistent with the Council's management objectives to retain the existing objective.

ACTION 2: STATEMENT OF OPTIMUM YIELD

Section 12.5.1.2 is revised as follows (change underlined):

12.5.1.2 Optimum Yield (OY)

OY is defined as:

- All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations, under a goal of allowing 30 percent escapement of the juvenile population.

- All red drum commercially or recreationally harvested from the Primary Area of the EEZ under the TAC level and allocations specified under the provisions of the FMP , and a zero retention level from the Secondary Areas of the EEZ.

Rationale: This change is necessary for the same reasons stated for the preferred alternative of Action 1.

Rejected Alternative to Action 2

a. No Action, retain current statement of OY

Rationale: Same as for rejected alternative of Action 1.

ACTION 3: PROCEDURE FOR SPECIFYING TAC

Subsections 1 and 2 of Section 12.6.2 are revised as follows (language added underlined):

12.6.2 Procedure for Specification of TAC in the Primary Area and for Allocations

1. Prior to October 1 each year the SEFC will: a) update the stock assessment for red drum; b) reassess the MSY level; c) specify the best estimate of the standing stock and its age composition; d) re-examine the spawning stock requirements and specify escapement levels needed to achieve these requirements; e) specify the geographical variations in stock abundance, mortality, juvenile escapement and recruitment, and summarize current and historical information on migratory movements of the stock; and f) analyze social and economic data available in the fishery.

2. The Council will convene a scientific stock assessment group, appointed by the Council, that will review the SEFC report(s), current harvest statistics, economic,

social, and other relevant data and who will prepare a written assessment report to the Council specifying a range of acceptable biological catch (ABC) for the Primary Area. The report will set forth a risk analysis showing the probabilities of adversely impacting the spawning stock biomass (SSB) through fishing at each level of ABC and the economic and social impacts of those levels. Such a report shall include consideration of the fishing mortality rate(s), abundance relative to the spawning stock goal or threshold, trends in recruitment and whether overfishing [3/] is occurring for the stock as a whole or upon a portion of the stock for any geographical area. The specification of ABC shall separately identify that quantity of the offshore population in excess of the spawning stock goal or threshold and in excess of annual surplus production that may be harvested. Such report will, when requested by the Council, include information on the levels of bag limits, size limits, specific gear harvest limits, and other restrictions required to attain the escapement goal or prevent a user group from exceeding their allocation or quota under a TAC specified by the Council for the Primary Area, along with the economic and social impacts of such restrictions.

Rationale: Subsections 1 and 2 are editorially revised to be more consistent with the stock assessment procedures and recommendations of the scientific group (Condrey et al., 1987) which were adopted by the Council. In subsection 1, subpart d is revised as underlined. Currently this language reads: "d) re-examine and specify the level of offshore standing stock necessary to optimize larval recruitment to the inshore fishery." This change was recommended by Dr. Goodyear, who pointed out to the scientific group and documented in the stock assessment (Goodyear, 1987) that subpart d cannot be achieved because first the size of the standing stock that would have existed had no fishing occurred must be determined and then the spawner-recruit relationship must be determined to specify that portion which optimizes recruitment. As pointed out by the scientific group (Condrey et al., 1987) to determine the latter relationship would require intensive measurements of fishery parameters without error while allowing the stock to be fished to a point where larval recruitment was depressed. At that time the SSB would be so reduced the stock may collapse.

Currently, the scientific group and Council have selected as the "spawning stock requirements" a "spawning stock goal or threshold" of a 20 percent spawning stock biomass per recruit (SSBR) ratio relative to an unfished population. The procedure as modified in subsection 1 would result in the SEFC assessment examining the effectiveness of this goal or threshold each year and suggesting modifications if necessary, as well as, respecifying the required escapement levels.

3/ Overfishing is defined as a fishing mortality that prohibits attaining the spawning stock goal or threshold which is currently set at a 20 percent SSBR ratio.

Subsection 2

Several editorial technical changes were included in Subsection 2. First "spawning stock goal or threshold" was inserted to replace more generic and technically undefinable wording relating to "optimum" SSB and "optimum" recruitment. For this amendment the "spawning stock goal or threshold" is defined as the 20 percent SSBR ratio, which is a technically measurable quantity. The phrase "relative to $F_{0.1}$ or F_{MSY}" was deleted as these values were not applicable concepts in relation to overfishing in this fishery. These values were improperly included in the procedure which was a modification of that for the Mackerel FMP. Overfishing in the red drum fishery should be defined as noted in the footnote (Goodyear, NMFS, personal communication).

Subsections 3 through 5 of the procedure providing for Council action in setting TAC were judged as adequate and were not revised for the purposes of this Amendment but may be revised by subsequent amendment.

ACTION 4: ALLOWABLE HARVEST LEVELS FOR PRIMARY AREA

Section 12.6.3 is revised as follows:

12.6.3 Harvest Levels for the Primary Area of the EEZ

The primary area shall remain closed to all harvest of red drum until the spawning stock goal or threshold (currently set at 20 percent SSBR) is attained and until such time as a TAC is specified that provides for harvest. Retention or possession of red drum from the EEZ is prohibited.

Rationale: The 1987 stock assessment and scientific stock assessment group's report accepted by the Council provide for a spawning stock goal or threshold of a SSBR level of 20 percent or greater in order to assure that there is adequate recruitment to maintain the spawning stock. Consistent with this goal is the need for an escapement rate of juveniles of approximately 30 percent which has been recommended by the Council to the states. Reopening the EEZ fishery to harvest is conditional on first attaining a SSBR level greater than 20 percent, a SEFC stock assessment that indicates that this goal has been achieved and that a portion of the SSB may be harvested from the EEZ, a stock assessment group report specifying an ABC range and the risks associated with harvest at each level, and finally specification of a TAC level acceptable to the Council considering such risks.

The Council's reason for setting TAC to zero in the primary area (harvest in the secondary areas was already prohibited) was based on information from the stock assessment (Goodyear, 1987) and the scientific group report (Condrey et al., 1987) which are summarized under Section III, Statement of the Problem. These analyses, based on current data from 1983-1986, conclusively demonstrated that mortality and disappearance rates were excessively high on juveniles throughout the range of the fishery (Table 2) and that escapement of juveniles has been and is inadequate (much less than 2 percent) to maintain the SSB over the long-term. Because of this conclusion the scientific group recommended an ABC equal to zero and the Council is proposing TAC be set at zero through this Amendment as required by the criteria for selecting TAC in the amended FMP. The Council also requested the Secretary take emergency interim action to set TAC equal to zero and the Secretary has complied with this request. Upon

the recommendation of the Council, the Regional Director, NMFS, also requested the states concurrently prohibit harvest in their waters "until such time as state management programs are implemented that will allow an acceptable rate of juvenile escapement" (see Table 1). All of these actions were taken or are proposed to be taken because of concern over the long-term reduction of the number of adults in the SSB. Data from the stock assessment indicate adults in age classes 11 or younger have already been significantly reduced (Figure 2). The action proposed by this Amendment would reduce to the maximum possible extent mortality on adults in the EEZ. This proposed federal action is consistent with that of the states which all have rules that prohibit or greatly reduce retention of adults with maximum size limits or who have closed their fisheries (Table 1). Future regulatory actions by the states to increase escapement levels (see Action 5) are anticipated and required to more significantly reduce or completely prohibit harvest of adults in their jurisdictions and avoid eventual collapse of the fishery.

Even with implementation of these actions some mortality of adults will continue to occur as a result of fish caught incidentally by recreational and commercial fishermen targeting other species in the EEZ and catching red drum in state jurisdictions (see Table 3). The proposed action will minimize this mortality to the maximum extent possible in the federal jurisdiction.

Economic Impact

The proposed action will prohibit the harvest and landing of red drum from the EEZ by all recreational and commercial fishermen. Under the FMP (as amended effective 10/16/87) recreational fishermen were limited to one fish per person per trip and an annual quota of 325,000 pounds. Persons on commercial shrimp vessels were allowed to land up to 200,000 pounds of incidental bycatch of red drum and persons on other commercial boats up to 100,000 pounds. Thus, the proposed action will prevent an annual loss of up to 625,000 pounds of adults compared to the no-action alternative (see rejected alternative below). The spawning stock conserved by this action will contribute several more recruitment years to the inshore fishery, thus extending the time that fishery can be prosecuted and representing a gain in fish caught inshore, assuming no further action on the part of the states and that the fishery will eventually collapse. If, as expected, the states take action to reduce inshore mortality sufficiently to create a harvestable surplus offshore, then the FMP has an annual procedure by which the Council can set an allowable harvest and reopen the fishery.

Based on 1986/87 data, the principal impact of the proposed action would be on recreational fishermen. NMFS data on commercial bycatch landings of red drum caught in the EEZ during the period December 23, 1986, through October 15, 1987, totaled 27,800 pounds, of which 8,100 was by shrimp vessels and 19,700 was by net vessels. This amount is considerably less than the allowable harvest level of 300,000 pounds and further restrictions would appear to have no measurable marginal impact on the commercial offshore fishery. Data are not available to compute the loss in consumer surplus associated with the removal from the marketplace of this amount of red drum. However, large red drum from the EEZ destined for the institutional market as "blackened redfish" appear to have good substitutes, e.g., tuna, indicating a highly elastic demand curve and small loss in consumer surplus from a reduction in supply. Assuming no change in states' actions, this loss would be permanent and, compared to the no-action alternative, would simply mean a small loss during the years leading up to the complete collapse of the fishery.

The proposed action will impact recreational fishermen fishing the primary area of the EEZ off Louisiana, Mississippi and Alabama (retention of fish is already prohibited in secondary areas). Both private vessels and charter vessels catch red drum from the primary area and will be required to reduce their retention of red drum by the 325,000 pound quota currently allowed. Estimates of the loss in recreational consumer surplus associated with this reduction are not available.

Contrasted to the proposed action of this Amendment, the actions taken by and recommended to the states for arresting the trend in reduction of adults in the SSB will result in more significant short-term adverse economic impacts affecting a great many more participants in the fishery (i.e., complete and partial closures, reduction in harvest limits, and in size classes that may be harvested, etc.). However, these actions, like that of the proposed action in this Amendment, will result in a long-term benefit to the resource by assuring that the SSB is restored and maintained and that yield from the fishery is increased, thereby benefiting all participants in the fishery.

The principal long-term benefit of the proposed action of this Amendment alone is in contributing to the cooperative state/federal action by reducing to the absolute minimum, fishery induced mortality on the SSB. This could result in approximately 50,000 adults not being subject ot harvest annually and therefore able to spawn. Due to the longevity of the fish (30-40 years), this benefit would be cumulative over time (minus M). Most of these fish are expected to survive through a combination of this proposed action and that requiring TEDs on shrimp vessels (i.e., most unavoidable kill occurred in trawls).

The proposed action will not change the federal enforcement cost (Suzanne Montero, NMFS personal communication), i.e., enforcement of bag and bycatch limits from EEZ are no different than enforcing the closure).

Impact on Small Businesses

As noted above, there is expected to be minimal impact resulting from prohibiting the commercial landings of red drum bycatch. Some 5,000 shrimp vessels, all small businesses, could potentially be involved in landing the 200,000 pound bycatch quota, thus facing an annual loss of 40 pounds of red drum per vessel. The number of shrimp vessels involved in landing the 8,100 pound bycatch from 1987 is unknown but a significant impact on the industry is not likely to have occurred. Approximately 11 purse seiners were involved in the fishery (19,200 pound "other" bycatch in 1987) and could potentially have landed 100,000 pounds. The industry impact is not believed to be significant.

It should be recognized that these commercial landings of bycatch occurred under the rules of the Secretarial FMP before Amendment 1 was implemented (10/16/87) amending these rules. Under the rule for the Secretarial FMP, such bycatch could be landed without being limited by state landing or possession laws. Amendment 1 amended these rules requiring that landings of such bycatch conform to state landing and possession laws. The regulatory impact review (RIR) of Amendment 1 indicated this rule change would probably result in a reduction in such bycatch landed. The Secretarial FMP through its rules defining bycatch as 5 percent by weight of total vessel catch apparently limited such landings for 1987, and the Amendment 1 rule (effective 10/16/87) would probably limit the landings even further. Effective March 1, 1988, under Endangered Species Act rules, all shrimp vessels larger than 25 feet that fish the Gulf of Mexico must be equipped with turtle excluder devices (TEDs) when

fishing the offshore waters from the shoreline to 15 miles offshore. This requirement applies all year for the Southwest Florida area and from March through November for the remainder of the Gulf. The TEDs will extrude from the trawls adult red drum along with turtles and other large fish; thereby greatly reducing, if not eliminating, red drum bycatch by these vessels. Therefore, the economic impact of the total prohibition of this proposed action would be negligible on the commercial industry and individual participants (vessel owners and crews).

There will be a monetary impact on charter vessel operators by the proposed action. Many of the fish caught by charter vessels are undoubtedly incidental catch taken when targeting other species in the EEZ and requiring their release would have minimal adverse monetary impact. However, charter vessels in Louisiana and Mississippi (Swingle et al., 1984) seasonally or occasionally target red drum. Under the rules of the FMP (as amended) recreational fishermen fishing the primary area have been limited to a 325,000 pound quota. Data from the NMFS Marine Recreational Fishery Statistics Surveys (MRFSS) for 1983 through 1986 indicated that charter vessels took an average of 57 percent of the catch landed by weight from the EEZ (almost entirely from the primary area) and that these fish averaged 14.3 pounds. Fifty-seven percent of the quota would be 185,250 pounds or 12,954 fish. Data from NMFS survey of charter vessels (E. Nakamura, personal communication) indicate that charter trips targeting red drum averaged well over eight fish per trips (the limit under Amendment 1 for a charter of six passengers and two crew.) Assuming that the entire 12,954 fish caught by charter trips were taken by directed trips at eight fish per trip, then 1,619 directed charter trips for red drum could be affected. The number actually affected is believed to be much fewer. Data for 1983-1985 from NMFS survey of charter vessels (Nakamura, personal communication) indicate that charter trips to the EEZ where catch was over 50 percent red drum were from only Mississippi (3.3 percent of May-August trips and 15.3 percent of total September-December trips averaging 11 fish per trip) and Louisiana (1.3 percent of total September-December trips).

Texas A&M University is conducting a survey of the charter vessels operating out of the three states affected by the proposed closure, i.e., Alabama, Mississippi, and Louisiana. Currently there are 98 vessels operating an average of 105 trips annually of which 80 percent are full-day trips at a fee of $403.78 per trip and 20 percent are half-day trips at a fee of $236.83 per trip (John Stohl, Texas A&M, personal communication). Approximately six passengers and two crew members are aboard the vessels. These data may be used to calculate a maximum potential gross economic impact on these vessels. If this action caused directed red drum charter trips to be lost (and not substituted by trips targeting other species or employing hook and release tactics) then the loss would be 1,619 trips to the industry or 16.5 trips per vessel. Assuming all the trips into the EEZ were full-day trips ($403.78 per trip) the annual loss to each vessel would be $6,662 and to the industry $653,000. (This represents the maximum potential annual direct loss to the industry). The actual loss is estimated to be much less. Data from Stohl indicate that 18 Mississippi charter vessels made 93 charter trips per year at an average revenue of $387.50 per trip. The 45 Louisiana charter vessels each made 111 trips per year valued at $383.75 per trip. Data from the NMFS charter boat survey indicate that 72 percent of the Mississippi trips occur during May-August (1213 trips) and 21 percent occur during September-December (353 trips) while the Louisiana charter vessels made 34 percent of their trips during September-December (1684 trips). Assuming that trips targeting red drum were those with 50 percent or more of the catch being red drum and applying the percentages of targeted red drum trips to the trips by area and value reveals that the 18 Mississippi charter vessels could lose 94 trips valued at $36,417 and the 45 Louisiana charter vessels could

lose 22 trips valued at $8,400 for a total loss by the 63 vessel charter industry in Mississippi and Louisiana of 116 trips valued at $44, 817. Coupled with this potential annual industry loss is the impact on supporting industries (bait, tackle, fuel, etc.) and on the local economies (motels, restaurants, etc.). Data to compute these impacts and their contributions to the overall annual loss are not available.

The actual loss would be less than the potential maximum for the following reasons. Many of the fish available under the quota are taken on trips targeting other species thus reducing the number of fish that could be targeted and thereby reducing the number of trips used in the analysis (e.g., charterboat data indicate no Alabama trips targeted red drum). For many fishermen a satisfactory trip may involve hooking and releasing red drum thereby reducing the economic impact. Charter vessels may shift their activities to targeting other species or targeting smaller red drum in state jurisdictions.

Part of this potential impact will occur as a result of the emergency rule implemented by the Secretary (1/1/88 through 6/28/88) prohibiting harvest of red drum from the EEZ. This impact will be continued by the proposed action.

Rejected Alternative to Action 4

a. No Action - retain existing harvest levels as follows:

12.6.3 Harvest Levels for the Primary Area of the EEZ

12.6.3.1 Commercial Harvest

The primary area of the EEZ shall remain closed to directed commercial harvest until such time as the states bordering the primary area have attained a goal which provides a minimum aggregate level of escapement of juveniles of 20 percent of the number that would have escaped had there been no inshore fishery. The incidental bycatch quota for the non-directed commercial fishery (excluding shrimp vessels) of 100,000 pounds established by the FMP is maintained, but such fish must be landed in conformance with state laws. The incidental bycatch quota for shrimp vessels of 200,000 pounds established by the FMP is maintained and also must be landed in conformance with state laws. Incidental bycatch in the shrimp and non-directed commercial fishery is defined as not exceeding 5 percent by weight of the total catch landed for each trip.

12.6.3.2 Recreational Harvest

The Council, after reviewing public testimony and AP, SSC, and NMFS comments on alternative bag limits, has selected a recreational bag limit for the primary area of the EEZ of one fish per person per trip. The Council is further proposing as measures of the Amendment that sale of fish caught under the bag limit be prohibited and such fish be landed in conformance with laws of the state where landed.

Rationale: This alternative was rejected because the Council felt that it was necessary to reduce, to the extent possible, all fishing mortality on adult red drum for the reasons stated under the preferred alternative. If this alternative were selected the short-term economic impacts of the preferred alternative which principally effects the charter boat industry would be avoided. However, the long-term impact on the industry and all user groups would certainly be more severe. Unless the trend in reduction of adults in the SSB is reversed, the long-term impact would be collapse of the fishery.

Summary of Benefits and Costs

The analysis was conducted under the assumption that no additional actions would be taken by the states to increase escapement to the EEZ and thus replenish the existing spawning stock. If no federal action is taken, the entire fishery (inshore and offshore) will collapse as the offshore spawning stock dies of fishing and natural mortality. It is difficult to say at what point the present spawning stock will be reduced to a level that will cause recruitment failure. Removing the fishing mortality on the spawning stock represented by the incidental catch allowance will extend the point of stock collapse by some number of years, thus ensuring several more years of the valuable inshore fishery and allowing several more years for the states to take the actions necessary to increase escapement to the offshore stock. The magnitude of the short-term loss in consumer surplus cannot be estimated as cannot the gain in consumer surplus from the extra years of inshore fishing, but the latter is expected to outweigh the former. Minimizing mortality on the existing offshore stock reduces the risk of year class failures during the recovery period and the risk of economic loss to the inshore fishery, and hastens the time when reopening the fishery on the offshore stock can be considered.

ACTION 5: RECOMMENDATIONS TO THE STATES

Section 12.7.1 is editorially revised to be consistent with the Council's current recommendations to the states to read as follows:

12.7.1 Increased Escapement to Spawning Stock Biomass (SSB)

The Gulf Council, acting in compliance with the provisions of Amendment 1 to the Fishery Management Plan FMP for Red Drum, reviewed the 1987 stock assessment prepared by NMFS (Goodyear, 1987) and the report of the red drum scientific stock assessment group (Condrey et al., 1987). The data and conclusions in these documents indicated that current (1983-1986 period) mortality and disappearance rates of juvenile red drum from state waters continued to be excessively high and indicated that annual escapement rates of juveniles to the adult stock were less than two percent for this period.

The Council concluded that total allowable catch from the EEZ should be set at zero to minimize mortality on the remaining adult spawning stock. They also concluded that the escapement goal of 20 percent, previously recommended to the states, was inadequate to assure the spawning stock biomass (SSB) will remain at the 20 percent SSB per recruit (SSBR), a level critical to assuring that there are adequate spawners to maintain the stock and allow limited continuation and eventual expansion of the fishery. In order to achieve a goal of 20 percent SSBR in the adult population, they requested that the states strive to achieve a goal of 30 percent escapement of juveniles (fish smaller than 30 inches) to provide an escapement level that will assure an adequate spawning stock. The Council provided recommendations and technical analyses (from Condrey et al., 1987) on alternative actions that could be taken by states to reach this goal that is critical to maintain and restore the stock and fisheries.

In order to achieve a 30 percent escapement rate to the spawning stock, the states should consider appropriate action for waters under their jurisdiction. There are two general ways in which the states can increase escapement of juvenile fish to the adult stock. The first involves reducing the rate of fishing mortality (Figure 5). Such actions

recommended by the scientific group that could be used for this purpose include but are not limited to the following:

- o gear restrictions
- o closed seasons
- o closed areas
- o quotas
- o bag limits

In addition to the measures recommended by the scientific group, the states could reduce mortality or increase survival and escapement through such actions as the following:

- o encouraging catch and release programs
- o commercial trip limits
- o stocking programs
- o increased license fees or limitations
- o increased fines and sanctions for red drum rule violations

The second involves a combination of minimum and maximum size restrictions (i.e., fishing windows) that would reduce the length of time the fish are exposed to fishing activity. Figure 6 provides information for determining such measures.

ACTION 6: DESCRIPTION OF HABITAT OF STOCK(S)

Section 6.0 of the FMP is updated and editorially revised to provide descriptions and analyses required by amendment of the Magnuson Act. The revised text is appended to this document.

V. Environmental Consequences

The actions proposed in this Amendment will have no impact on the physical environment.

The effect of these actions is to prohibit any harvesting of red drum from the primary area of the EEZ to reduce fishing mortality on adult fish of the SSB to an absolute minimum to assist in maintaining and restoring the SSB. The actions will have both short-term and, especially, long-term benefits on the resources which data and analyses indicate the resource has already been subjected to a significant reduction in adults in the SSB that are age 11 or younger. The resource is in danger of recruitment overfishing and stock collapse unless recruitment of juveniles to the SSB is increased over the long-term. The states are presently taking other regulatory actions to reverse this trend (Table 1) and are expected to take additional actions (see Action 5).

The proposed actions will have a short-term adverse impact on the human environment, especially on the charter vessel industry, but the long-term impact will be beneficial to this industry as well as all participants in the fishery. Short-term impacts on other recreational and commercial participants in the fishery and governmental entities are expected to be negligible or result in no change. The annual gross economic impact on the charter industry is estimated to be $44,847. This short-term adverse impact is overshadowed by the long-term benefit of

assuring the stock does not collapse and through increased production from the resource with associated economic benefits (see Action 4).

The proposed actions of the Amendment have no anticipated impact on threatened or endangered species or on marine mammals or on vessel safety.

VI. Conclusions

- Mitigating Measures Related to the Proposed Action

  No significant environmental impacts are expected, therefore, no mitigating actions are proposed.

- Unavoidable Adverse Effects

  Some adult fish will continue to be killed when taken incidentally by commercial or recreational fishermen targeting other fish.

  Continuation of a seasonal short-term impact on charter vessels in Mississippi and Louisiana.

- Relationship Between Local, Short-term Use of the Resources and Enhancement of Long-Term Productivity

  Short-term utilization of the resources by recreational fishermen (limit one fish per person per day) and commercial vessels incidentally taking red drum as bycatch has been prohibited by the emergency rule of the Secretary and will be continued through this proposed action. Significant long-term benefits in enhancing productivity are expected from the action.

- Irreversible or Irretrievable Commitment of Resources

  Federal enforcement commitment is unchanged.

RECOMMENDATIONS

Having reviewed the environmental assessment and available information relating to the proposed action, I have determined that there will be no significant environmental impact resulting from the proposed actions.

Approved: _____ _____
Title Date

RESPONSIBLE AGENCIES

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5401 West Kennedy Boulevard
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(813) 228-2815

LIST OF AGENCIES AND PERSONS CONSULTED

Gulf of Mexico Fishery Management Council
- Red Drum Advisory Panel
- Scientific and Statistical Committee
- Special Red Drum Scientific Committee
- Scientific Stock Assessment Group

National Marine Fisheries Service
- Southeast Fishery Center
- Miami Laboratory
- Southeast Regional Office

State Coastal Zone Programs
- Florida
- Alabama
- Mississippi
- Louisiana

LIST OF PREPARERS

Gulf of Mexico Fishery Management Council
- Wayne E. Swingle, Biologist
- Paul J. Hooker, Ph.D., Economist

Southeast Fishery Center, NMFS
- Phillip Goodyear, Ph.D., Stock Assessments

LOCATIONS AND DATES OF PUBLIC HEARINGS

Public hearings were held from 7:00 p.m. to 10:00 p.m. on the following dates:

February 22, 1988

Mobile Municipal Auditorium
401 Auditorium Drive
Mobile, Alabama

February 23, 1988

Biloxi Cultural Center
Assembly Room
217 Lameuse
Biloxi, Mississippi

February 24, 1988

Landmark Motor Hotel
2601 Severn
Metairie, Louisiana

February 24, 1988

Holiday Inn - University Center
316 West Tennessee Street
Tallahassee, Florida

February 25, 1988

Jury Assembly Room
Courthouse
722 Moody
Galveston, Texas

LITERATURE CITED

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Swingle, W., T. Leary, C. Davis, V. Blomo, W. Tatum, M. Murphy, T. Taylor, G. Adkins, T. McIlwain and G. Matlock. 1984. A profile of red drum. GMFMC and GSMFC. 161p.

Figure 1.

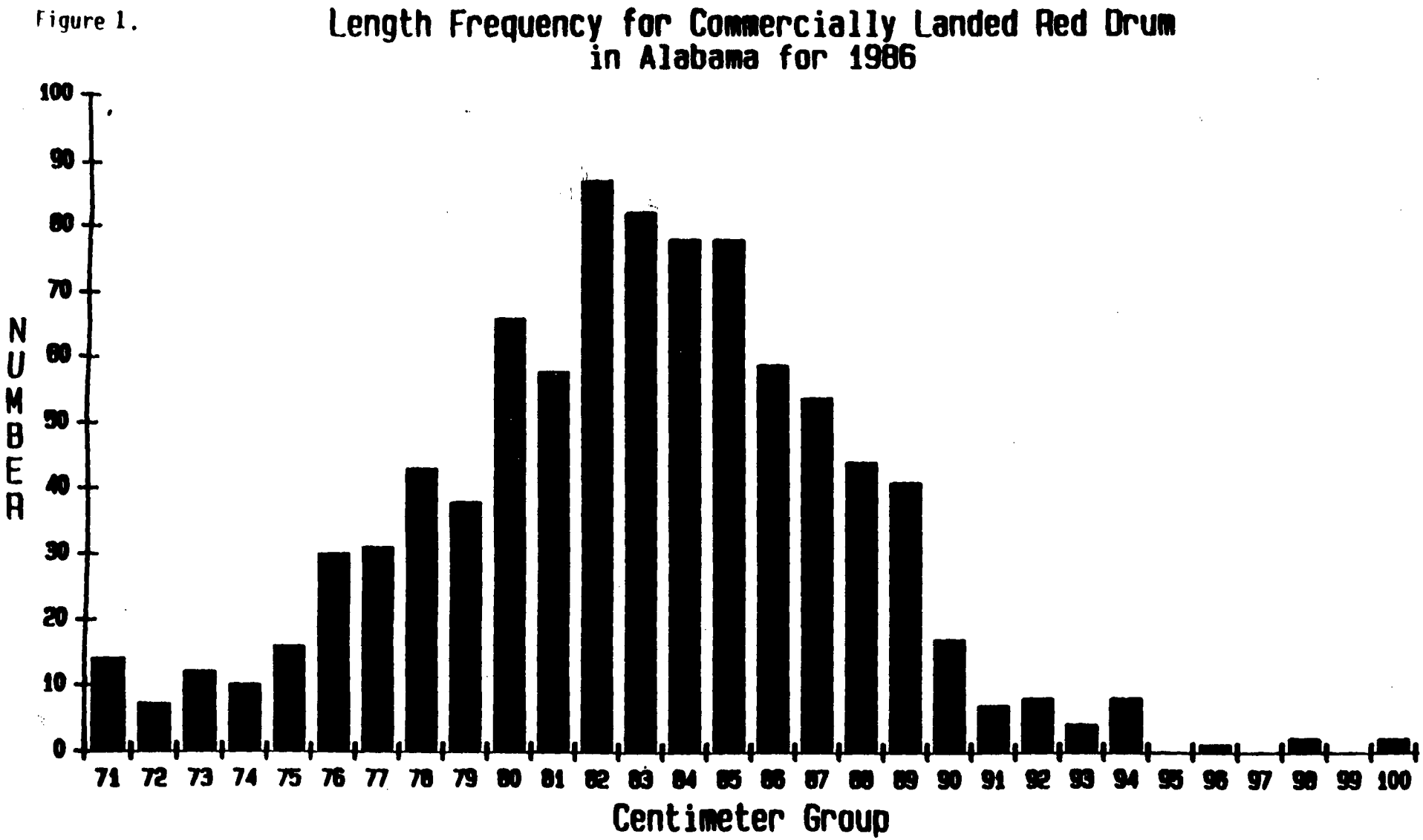

Length Frequency for Commercially Landed Red Drum
in Alabama for 1986
NUMBER
0
10
20
30
40
50
60
70
80
90
100
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
Centimeter Group

FIGURE 2

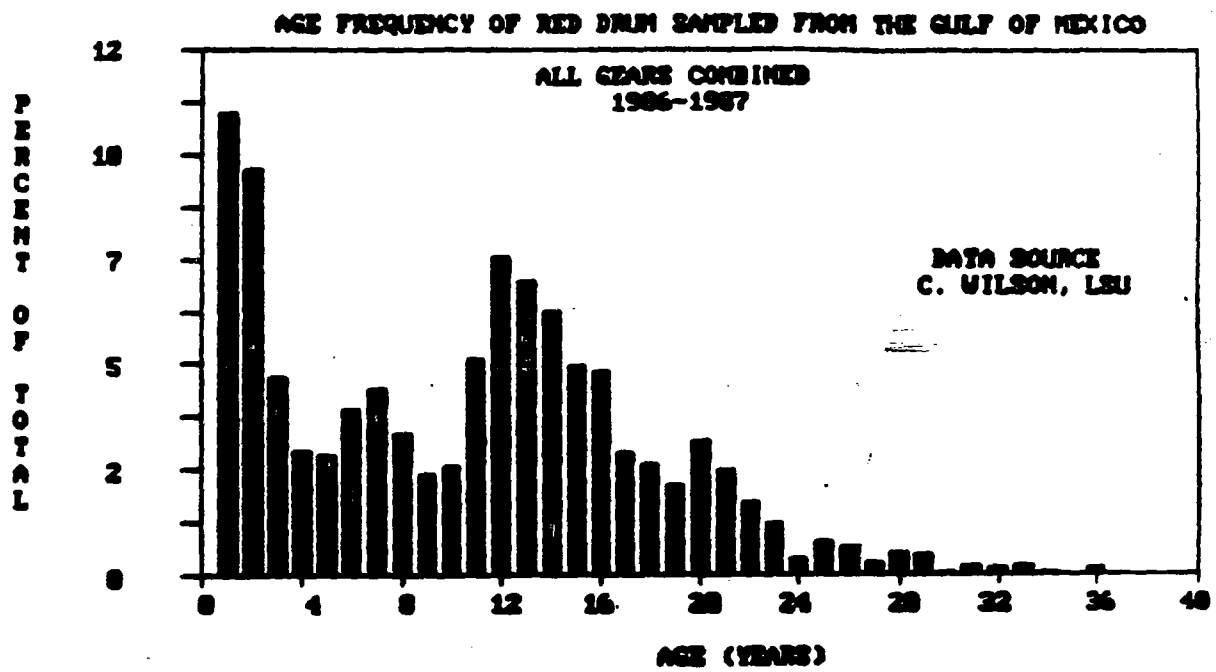

AGE FREQUENCY OF RED DRUM SAMPLED FROM THE GULF OF MEXICO
ALL GEARS COMBINED
1986-1987
DATA SOURCE
C. WILSON, LSU
PERCENT OF TOTAL
12
10
7
5
2
0
0
4
8
12
16
20
24
28
32
36
40
AGE (YEARS)

FIGURE 3

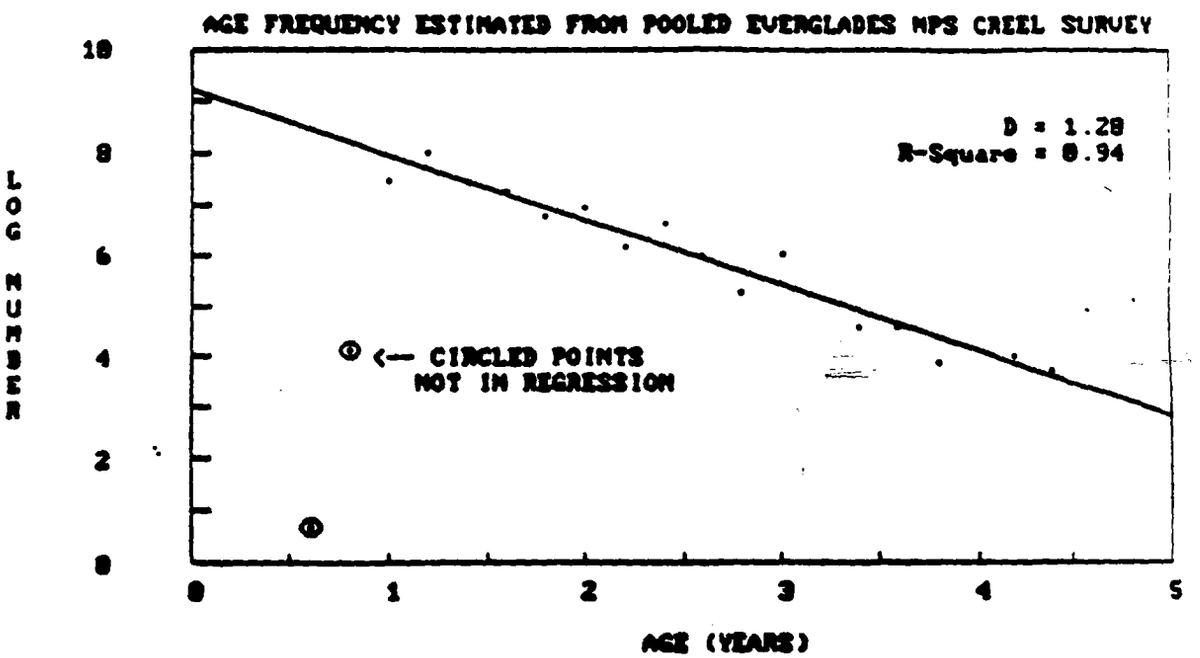
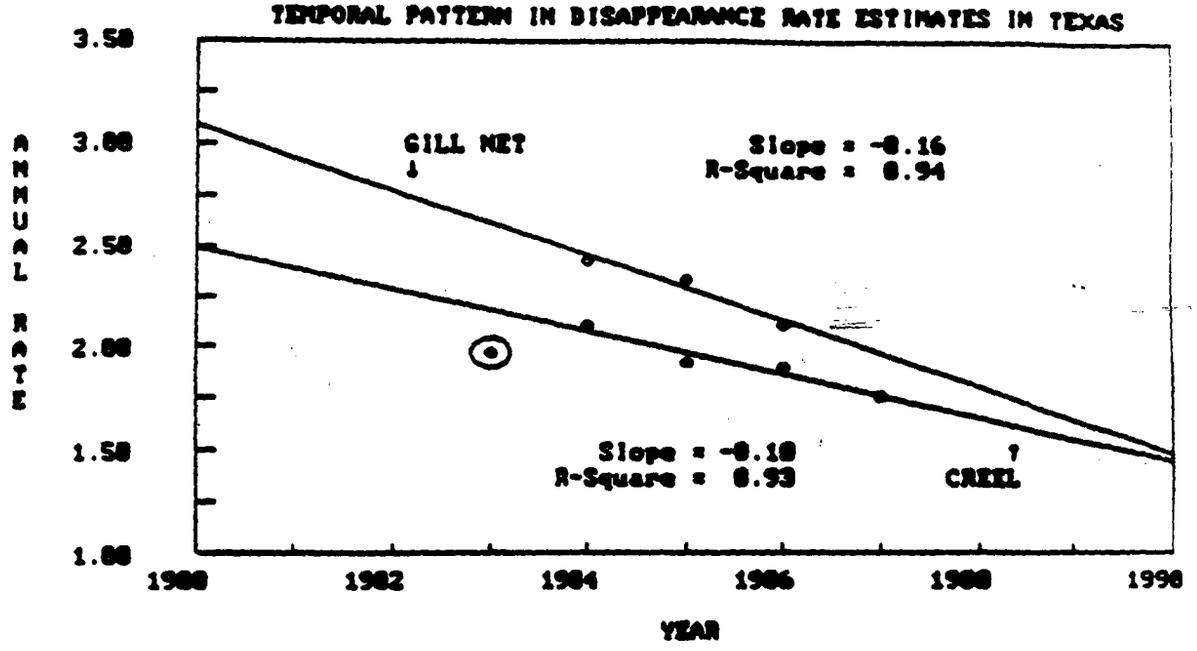

AGE FREQUENCY ESTIMATED FROM POOLED EVERGLADES NPS CREEL SURVEY
D = 1.28
R-Square = 0.94
⊙ <— CIRCLED POINTS
NOT IN REGRESSION
LOG NUMBER
AGE (YEARS)
10
8
6
4
2
0
0
1
2
3
4
5

FIGURE 4


TEMPORAL PATTERN IN DISAPPEARANCE RATE ESTIMATES IN TEXAS
3.50
3.00
2.50
2.00
1.50
1.00
ANNUAL RATE
GILL NET
Slope = -0.16
R-Square = 0.94
Slope = -0.10
R-Square = 0.93
CREEL
1980
1982
1984
1986
1988
1990
YEAR

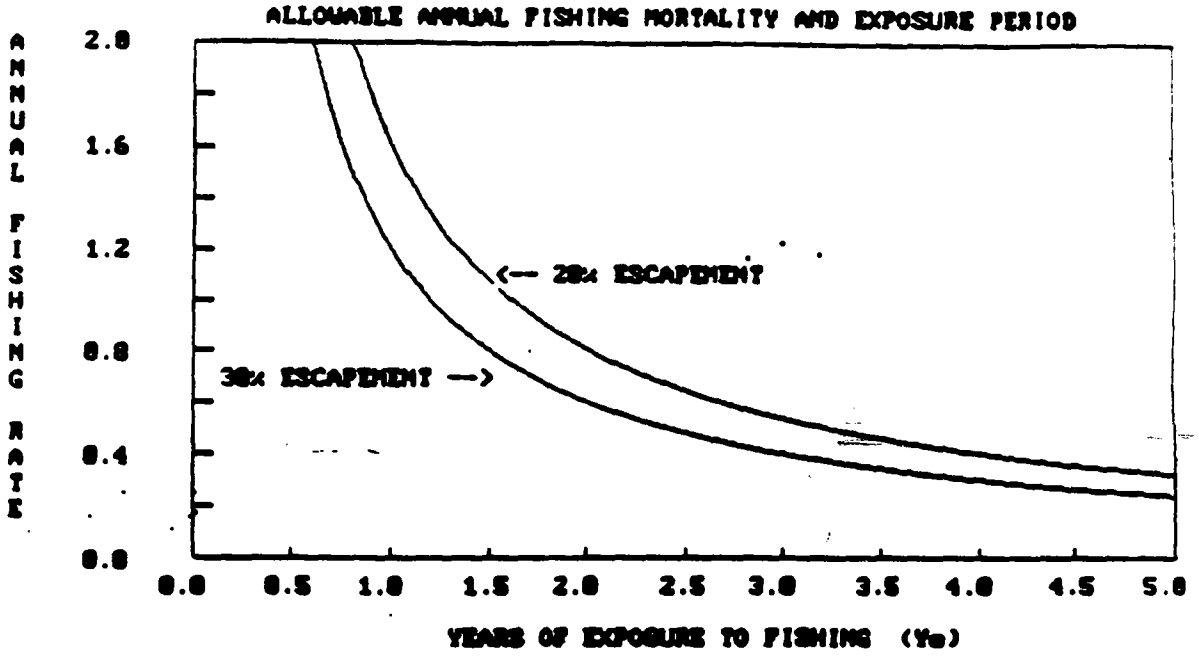


Figure 5. Relation between the allowable annual instantaneous fishing mortality rate and the number of years which a cohort of red drum may be exposed to fishing to achieve escapement rates of 20% and 30%. The relation is determined as Fa=Fcum/Ye, in which Fa is the annual fishing mortality rate, Fcum is the cumulative allowable total fishing mortality for the escapement goal, and Ye is the length of time (in years) that the fish are exposed to fishing. Fcum is 1.61 for an escapement goal of 20% and 1.20 for an escapement goal of 30%.

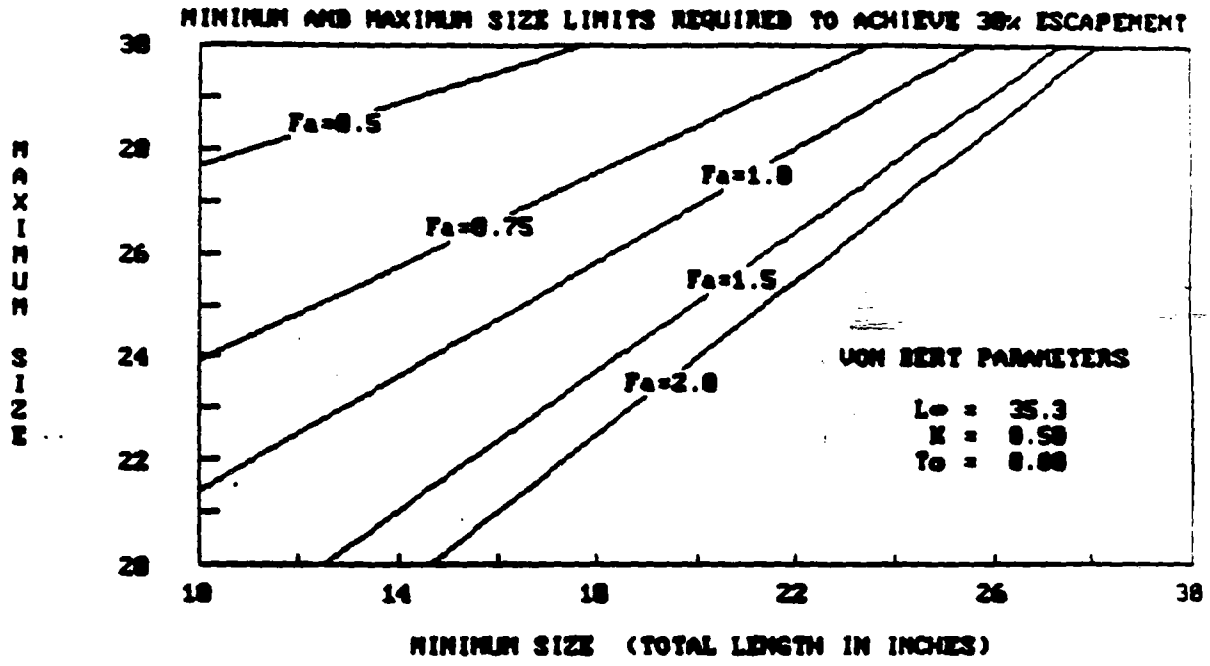


Figure 6. Maximum sizes required to achieve 30% escapement as a function of minimum sizes for several different levels of fishing mortality. The maximum size for a given minimum size and fishing mortality rate is determined by computing the mean age of the fish at the minimum size from the von Bertalanffy growth equation. The length of time (years) that the fish may be harvested is then estimated as Ye=Fcum/Fa where Fcum is 1.20 (see Figure 1 caption). The allowable harvest period is then added to the age for the minimum size to obtain the maximum harvest age. The upper size limit is then estimated from the maximum harvest age from the von Bertalanffy growth equation.

Table 1. Changes in State Red Drum Rules 4/86 to 11/87

State	As of April, 1986	As of November, 1987
Alabama	Bag Limit = 15/day	Bag Limit = 5/day
	Minimum Size = 14"	- Same -
	Maximum Size = two fish over 36"	Maximum Size = two fish over 32"
	No-sale of fish from state waters	- Same -
Florida[1/]	Bag Limit = none	Bag Limit = 1/day
	Minimum Size = 18"	- Same -
	Maximum Size = one fish over 32"	Maximum Size = no fish over 27"
	Commercial Harvest = no limit	Commercial Harvest = 5/vessel/day
Mississippi	Bag Limit = 10/day (w/five undersize)	- Same -
	Minimum Size = 14" (commercial)	Minimum Size = 14" (all)
	Maximum Size = two fish over 30"	- Same -
	Commercial Harvest = 200,000 pound quota	- Same -
	Commercial Season = no fishing 9/15 - 11/15	- Same -
	Closed area = no netting with one mile of barrier islands	- Same -
Louisiana [2/]	Bag Limit = 50/day[3/]	- Same -
	Minimum Size = 16" (commercial)	Minimum Size = 18" (commercial)
	Minimum Size = none (recreational)	Minimum Size = 14" (1987) = 15" (1988) = 16" (1989)
	Maximum Size = two fish over 36"	Maximum Size = two fish over 30"
	Commercial Harvest = no limit	Commercial Harvest = 1.7 million pound quota
Texas	Bag Limit = 5/day	- Same -
	Minimum Size = 18"	- Same -
	Maximum Size = no fish over 30"	- Same -
	No-sale of fish from state waters[4/]	- Same -

1/ Florida's fishery will be closed 1/1/88 for indefinite period while rules are developed.

2/ Louisiana's fishery will be closed 1/15/88 until 9/1/88 for commercial fishermen and closed to recreational fishermen from 2/15/88 until 6/1/88 while rules are developed.

3/ Aggregate possession limit for red drum and spotted sea trout.

4/ Or landed by state registered vessels.

Table 2. Summary of Disappearance Rate Analyses Included in Stock Assessment (Goodyear, 1987)

Fishery	Area	Period/ Year	Age Classes in Fishery	D	Annual Percent Remaining	Percent[4] Remainin to Escap
Recreational - MRFSS	LA/MS/AL/FL	1986	1-4	2.31	9.9	0.10
Recreational - TX Creel	TX	1983-1986	1-4	2.09	12.4	0.19
Gill Net [1]	TX	1984-1986	1.5-4	2.32	9.8	0.30
Gill Net	TX	1985	2-4.5	2.33	9.7	0.29
Gill Net	TX	1986	1-4	2.10	12.2	0.18
Recreational - TX Creel	TX	1983	1-5	1.97	13.9	0.03
Recreational - TX Creel	TX	1984	2-5	2.10	12.2	0.18
Recreational - TX Creel	TX	1985	1.5-5	1.92	14.7	0
Recreational - TX Creel	TX	1986	2-5	1.90	14.9	0.33
Recreational - TX Creel	TX	1987	1.5-4.5	1.76	17.2	0.51
Recreational - MRFSS [2]	LA	1986	1-4	1.95	14.2	0.28
Recreational - MRFSS [3]	LA	1986	1-4	2.56	7.7	0.05
Gill Net [2]	MS	1986-1987	1-3	3.14	4.3	0.19
Gill Net [3]	MS	1986-1987	1-3	4.55	1.1	0.01
Recreational - NPS	Everglades Park	1974-1985	1-5	1.28	27.8	0.60

[1] Gill nets were used as fishery independent survey of status of fish stocks
[2] Best case scenario
[3] Worst case scenario
[4] Percentage of one-year old fish which had not disappeared upon attaining the maximum age class level in the fishery, i.e., annual survival (% remaining) is compounded for number of years in fishery.

Table 3 Percent of Red Drum Measured in MRFSS From State Waters Which Are Adults [1]

	Florida	Alabama	Louisiana	Mississippi	Texas	Gulf [3]
1980	0	3.6	1.1	19.5	8.7	4.8
(n=)	(164)	(28)	(462)	(77)	(127)	(658)
1981	0.7	0	1.2	5.4	1.0	1.3
(n=)	(154)	(12)	(82)	(37)	(111)	(396)
1982	4.5	4.2	0.2	0	3.1	1.0
(n=)	(88)	(24)	(472)	(53)	(32)	(669)
1983	4.8	25.0	0.5	0	0	2.2
(n=)	(125)	(8)	(203)	(27)	(50)	(413)
1984	9.9	33.3	0.8	0	1.5	2.8
(n=)	(131)	(27)	(362)	(26)	(202)	(748)
1985	3.3	0	0.3	23.1	0	1.1
(n=)	(61)	(23)	(347)	(13)	(98)	(542)
Yearly Average [2]	3.9	11.0	0.7	8.0	2.4	5.2 [4]
State Average [3]	3.6 (723)	4.9 (122)	0.6 (1,928)	8.6 (233)	2.6 (620)	2.2 (3,626)

[1] Fish greater than 750 mm (29.5 inches) in length

[2] Unweighted average over years

[3] Weighted average for fish measured

[4] Unweighted average over states

APPENDIX

(Revised FMP Section 6.0)

6.0 DESCRIPTION OF HABITAT OF THE STOCK(S)

Red drum occur in a variety of habitats, distributed over a geographical range from Massachusetts on the Atlantic coast to Tuxpan, Mexico (Simmons and Breuer 1962). In the Gulf of Mexico red drum occur in habitats ranging from offshore to very shallow estuarine waters. They can tolerate salinities ranging from freshwater to highly saline, but optimum salinities for the various life stages have not been determined. Types of habitat occupied depend upon the life stage of the fish. Spawning occurs in deeper water near the mouths of bays and inlets, and on the Gulf side of the barrier islands (Pearson 1928; Simmons and Breuer 1962; Johnson 1978; Perret et al. 1980). The eggs hatch mainly in the Gulf and larvae are transported into the estuary where the fish mature before moving back to the Gulf (Perret et al. 1980; Reagan 1985). Adult red drum use estuaries, but tend to spend more time offshore as they age. Schools of large red drum are common in deep Gulf waters.

Estuarine wetlands are especially important to larval red drum. Yokel (1966) concluded that abundance of red drum varied directly with the estuarine area (habitat). He also reported that, in general, landings within a state varied with the amount of that state's suitable habitat. Davis (1980) also discussed red drum occurrence in the Everglades National Park, and suggested that recorded changes in species and size distribution resulted from increased salinities from drainage control. An abundance of juvenile red drum has been reported around the perimeter of marshes in estuaries (Perret et al. 1980; Jackson 1972). Young fish are found in quiet, shallow, protected waters with grassy or slightly muddy bottoms (Simmons and Breuer 1962; Loman 1978). Shallow bay bottoms or oyster reef substrates are especially preferred by subadult and adult red drum (Miles 1950). Based largely on such observations the Fish and Wildlife Service (FWS) developed a habitat suitability index model for larval and juvenile red drum (Buckley 1984). The model indicates that shallow water (1.5 to 2.5 meters deep) with 50 to 75 percent submergent vegetation growing on mud bottoms and fringed with emergent vegetation provides optimum red drum habitat. The model, however, needs to be further refined and estuaries in the Gulf need to be surveyed for habitat and optimum environmental conditions available for red drum production.

6.1 HABITAT CONDITION

Red drum occupy offshore waters in the Gulf of Mexico as adults and require estuaries as nursery grounds. Tidal passes provide migration routes from Gulf waters to the estuaries and waters near tidal passes are likely spawning grounds.

Offshore areas used by adults appear to be the least affected by habitat alterations and water quality degradation. Currently, the primary threat to habitat comes from oil and gas development and production, offshore dumping of dredged material, disposal of

chemical wastes, and the discharge of contaminants by the river systems, such as the Mississippi River (Baylin 1971), which empty into the Gulf. However, no studies are available indicating that these activities have adversely affected red drum in their offshore habitat.

Nearshore areas as a whole appear to be in good condition, but local problem areas exist. For example, water quality may be reduced in areas affected by the plumes of major rivers. Local disturbances occur during construction related to periodic beach nourishment, dredged material disposal, and dredging. Some areas also are affected by thermal effluents and sewage outfalls. An additional problem occurs in the northern Gulf, mainly off Louisiana, where large areas of oxygen depleted waters have been observed.

The estuarine nursery areas appear to be the most impacted of the habitats used by red drum. Natural and man-induced alterations of the fragile environment have altered freshwater inflow and removed much of the area that would be considered suitable habitat. The amount of remaining wetlands suitable for red drum production in the Gulf of Mexico has not been quantified. However, it is estimated that only about 2.6 million acres of salt marsh, a wetland type preferred by red drum, remain (Alexander et al. 1986). This represents about 30 percent of the wetlands of these types that remain in the coterminous United States. The overall rate of wetland losses similarly is not known since adequate mapping programs and baseline data are not available. However, Alexander et al. (1986) estimated that for the last 25 years, coastal wetlands have been depleted at an average rate of 20,000 acres per year. This rate may be even higher in the Gulf. For example, Gagliano (1984) has estimated that natural and man-induced forces in Louisiana contribute to a yearly land loss, including marsh, of more than 50 square miles. The estuaries also have been the most impacted by water quality degradation. Numerous pollution-related reports and publications exist, but there still is no complete list of chemical contaminants, their concentrations, or effects. A comprehensive inventory to assess how seriously the Gulf's estuaries are polluted also is needed.

Habitat areas of particular concern are all of those habitats required during the life cycle of the species, but especially the estuarine nursery grounds. Other areas of specific concern are barrier islands in each state, as these structures are vital to maintain estuarine conditions needed by red drum during their larval and juvenile stages. Passes from the Gulf into estuaries are of equal importance, as the slow mixing of sea water and fresh water is generally regarded as being of prime importance in the productivity of any estuary. A rapid exchange may cause environmental stresses too great for many estuarine organisms to withstand.

6.2 HABITAT THREATS

The quantitative relationship between red drum production and habitat has not been determined. Accordingly, the degree that habitat alterations have affected red drum is unknown. Turner and Boesch (1987) assembled and examined the accumulating evidence of the relationship between the extent of wetland habitats and the yield of fishery species dependent on coastal bays and estuaries. They discussed evidence of stock losses following wetland losses and stock gains following wetland gains. While most of the studies related to shrimp production, other fisheries, such as for red drum also were discussed. Accordingly, a significant threat facing red drum production is the loss of habitat. Natural wetland losses result from forces such as erosion, sea level rises, subsidence, and accretion. According to Lindall et al. (1979) the major man-induced activities that impact environmental gradients in the estuarine zone are:

1. construction and maintenance of navigation channels;
2. discharges from wastewater plants and industries;
3. dredge and fill for land use development;
4. agricultural runoff;
5. ditching, draining, or impounding wetlands;
6. oil spills;
7. thermal discharges;
8. mining, particularly for phosphate, and petroleum;
9. entrainment and impingement from electric power plants;
10. dams;
11. marinas;
12. alteration of freshwater inflows to estuaries;
13. saltwater intrusion; and
14. non-point-source discharges of contaminants.

All of the Gulf's estuaries have been impacted to some degree by one or more of the above activities. These may be industrial as in Mississippi (Etzold and Christmas 1979), residential as in Florida, or petroleum related similar to that in Louisiana (Adkins and Bowman 1976). Another problem area is the reduction of freshwater inflow into estuaries because of channelization and/or pumping to redistribute desirable freshwater supplies for other users (Davis 1980). Restricting access to nursery grounds also limits the amount of nursery area available to red drum. Impoundment of wetlands for various reasons such as spoil and waste containment, roadways and causeways, aquaculture, mosquito control, and so forth occurs to varying degrees.

Management of water levels and exchange in tidal marshes often severely restricts the accessibility of that marsh to juvenile red drum when water levels are stabilized during the waterfowl and fur harvesting seasons in the fall and early winter. National Marine Fisheries Service (NMFS) data reveal that in Louisiana over 591 square miles of marshes were proposed or permitted for some form of water level control from 1981 through

1987, with many water management proposals being for waterfowl or fur production. Studies by Rogers and Herke (1985 a and b) have shown that most of the juvenile red drum migration to and from the marsh occurs in fall and winter. Therefore, impoundment of water in and around tidal marshes during waterfowl harvesting and wintering or fur harvesting could adversely impact red drum production.

Natural wetland losses are difficult to control since often major environmental manipulations are required, for example, rediverting Mississippi River flows over marshes that are deteriorating. Another method of control involves mitigation of wetland losses by restoration, generation, or enhancement of habitat (Lindall et al. 1979). Mitigation, however, often may not be desirable since some of the mitigation technologies are poorly understood. Wetland creation technology is an emerging science that requires more development before it can be routinely applied (Mager and Thayer 1986). Moreover, optimum habitat and environmental conditions must be determined by estuary so that the best habitat and conditions can be created when the methodologies are adequately developed.

The amount and rate of man-induced wetland losses have not been quantified, but can be controlled by state and/or federal regulatory agencies. The Environmental Protection Agency (EPA) for example, has the responsibility to regulate wastewater discharges and the Corps of Engineers (COE) manages a program that regulates physical wetland alterations (dredging, filling, impounding, etc.). The amount of red drum habitat affected by EPA's program is unknown, but data on the effect of the COE's regulatory program in the Southeast is available. Tables 1 and 2 summarize five years of NMFS data on the COE's program; providing proposed alterations by state and by habitat type (Mager and Thayer 1986.) For the Gulf States, almost 174,000 acres of wetland losses were proposed by more than 4,000 projects. Mager and Keppner (1987) showed that 6,354 permit applications and federal projects between 1981 and 1986 proposed the alteration of almost 278,000 acres of wetlands in the Southeast. This provides an indication of the significance of the COE's program and the potential cumulative nature of wetland losses.

Water quality degradation also is a threat to red drum habitat. This results from the discharge of petrochemicals, sewage, heavy metals, and other chemicals in industrial and chemical wastes and from non-point-source discharges such as from septic tanks and parking lots. Urban and agricultural runoff can be laden with toxic substances such as petrochemicals, pesticides, heavy metals, and herbicides. The aerial spraying of large areas for mosquito control in Florida and elsewhere results in the addition of pesticides to estuarine waters. These pesticides are extremely toxic to larval aquatic organisms. Thermal effluent from steam and nuclear generating facilities using "once-through" cooling can raise the temperature of estuarine waters making them less suitable or uninhabitable, especially during summer. The

discharge of sewage also can create problems for the organisms that reside in the estuaries where the discharge occurs.

6.3 HABITAT PROTECTION

Federal environmental agencies such as the NMFS, the FWS, and the EPA analyze projects proposing wetland alterations for potential impacts on resources under their purview. This is similar to the function of the GMFMC's Habitat Committee. Recommendations resulting from these analyses are submitted to the COE where they are included in a public interest review that determines whether or not a permit would be issued for a proposed alteration. NMFS data reveal that implementation of its recommendations on more than 4,000 projects in the Gulf States would have resulted in the conservation of about 128,000 acres and the restoration and generation of more than 109,000 acres of wetlands (Mager and Thayer 1986). Most of these wetlands would provide suitable red drum habitat.

It is evident that the conservation of red drum habitat heavily relies on whether the recommendations of agencies such as the NMFS, the FWS, the EPA and the GMFMC's Habitat Committee are incorporated into permitting decisions. Although granted input under Section 404 statutes, the NMFS, FWS, GMFMC, and state regulatory and management agencies are not granted veto power in the permitting process. The NMFS, FWS, and the state fish and wildlife agencies are, however, granted commenting authority on applications for federal agency permits pursuant to the federal Fish and Wildlife Coordination Act. Mager (in press) surveyed 857 projects where permits had been issued by COE Districts in the Southeast to find out the degree that NMFS recommendations had been incorporated by the COE into issued permits. While treatment varied by district, NMFS recommendations were fully accepted 50 percent, partially accepted 24 percent, and rejected 26 percent of the time. In terms of habitat, 22,054 acres of wetlands were proposed for alteration by the 857 projects sampled, the NMFS accepted alterations in 9,061 acres, and the COE issued permits to alter 11,617 acres or 2,556 acres more than recommended by NMFS. This indicates that if red drum habitat is to be conserved as much as possible, greater weight must be given to the recommendations of the NMFS and other environmental agencies in the COE public interest review. This review determines whether or not a permit to alter wetlands would be granted.

Other agencies also are involved in habitat matters that may affect red drum. The Soil Conservation Service assists owners of coastal wetlands in developing management plans to stabilize and/or freshen coastal marshes. These plans may result in some restriction of access to nursery areas in the resulting semi-impounded marshes. NOAA's Office of Ocean and Coastal Resource Management may aid in establishing standards for approval to designate estuarine sanctuaries. The National Park Service also may establish coastal and nearshore national parks and monuments,

such as Everglades National Park. The EPA has the authority to regulate the discharge of pollutants and the COE regulates dredging, construction, and the discharge of spoil and disposal materials in wetlands covered under their programs.

Most states (Louisiana, Mississippi, Alabama, and Florida) have federally approved Coastal Zone Management programs. Texas has completed a revised Coastal Zone Management Program, but has not submitted it for federal approval. These programs allow for state input and/or regulation of activities within its boundaries, although this process is quite variable among states. Most, if not all, Gulf coast states have permitting and regulatory programs which are used when reviewing various applications for approval to alter wetlands. Recently, the Louisiana Coastal Protection Task Force recommended that seven million dollars from the Coastal Environment Protection Trust Fund be approved to combat coastal erosion in six particular areas along the Louisiana coast (Rives 1982). Louisiana Act 41, which became law on November 23, 1981 (Rives 1982), also provides monies to long- and short-range programs designed to combat coastal erosion, salt water intrusion, and subsidence.

Section 3 of the Mississippi Coastal Program (1980), includes three separate objectives for habitat protection. These are: (1) habitat degradation, which determines safe concentrations of toxicants and regulation of discharge at allowable levels; (2) habitat destruction, which includes regulation of ditching and draining, dredging and filling, dam construction, alteration of barrier islands, etc., and (3) habitat creation, which provides for marsh creation from dredged spoils, artificial reef construction, and creation of seagrass beds.

Some habitat improvements and/or enlargements also have been initiated or noted in coastal areas. Gary Matlock (Texas Parks and Wildlife Department, personal communication) has noted some improvement in coastal Texas. Examples are the cleaning and restoring, at least partially, of the Houston Ship Channel water quality and the dredging of a special fish pass channel between the Gulf Intracoastal Waterway in the Laguna Madre and the "Graveyard" (a large water basin where fish become trapped and die during extended low water periods). It is further noted that the NMFS has recommended or accepted mitigation, as a stipulation of COE permit applications reviewed between 1981 and 1986, that would create, restore, generate, or enhance more than 109,000 acres of wetlands in Gulf estuaries. Additionally, banning of some types of pesticides (e.g., DDT), regulations affecting the discharge of industrial wastes, and dumping of municipal sewage and runoff into riverine systems has afforded some protection to aquatic organisms inhabiting estuaries receiving runoff from these rivers.

Pursuant to an agreement between the Department of the Army and the National Oceanic and Atmospheric Administration, the NMFS and COE initiated a pilot study to investigate the potential for the

creation of wetlands using existing authorities and funding. The Southeast Region of the NMFS has been selected as one of the two regions nationwide where the studies would be carried out. Two study sites are located in the Gulf of Mexico's Galveston Bay estuary, Texas. Marsh plants have been planted at both sites on emergent dredged material. Plans are underway to construct channels in the planted areas to create creeks and to monitor the results. This is a cooperative effort between the Galveston District COE and the NMFS Regional Office and Southeast Fisheries Center's Galveston Laboratory.

6.4 HABITAT RECOMMENDATIONS

Recognizing that all species are dependent on the quantity and quality of their essential habitats, it is the policy of the Gulf of Mexico Fishery Management Council (GMFMC) to protect, restore, and improve habitats upon which commercial and recreational marine fisheries depend, to increase their extent and to improve their productive capacity for the benefit of present and future generations. (For purposes of this policy, habitat is defined to include all those things physical, chemical, and biological that are necessary to the productivity of the species being managed.)

This policy shall be supported by three objectives which are to:

(1) Maintain the current quantity and productive capacity of habitats supporting important commercial and recreational fisheries, including their food base (This objective may be accomplished through the recommendation of no loss and minimization of environmental degradation of existing habitat;)

(2) Restore and rehabilitate the productive capacity of habitats which have already been degraded; and

(3) Create and develop productive habitats where increased fishery productivity will benefit society.

To achieve these goals the GMFMC has formed a Habitat Committee and Advisory Panels for the Gulf states. The purpose of the Committee is to bring to the Council's attention activities that may affect the habitat of the fisheries under their management. The GMFMC, pursuant to the Magnuson Act, will use its authorities (through its Habitat Committee) to support state and federal environmental agencies in their habitat conservation efforts and will directly engage the regulatory agencies on significant actions that may affect red drum habitat. The goal is to insure that red drum habitat losses are kept to the minimum and that efforts for appropriate mitigation strategies and applicable research are supported. For example, based on information gathered by the Advisory Panels in 1987, the Habitat Committee convinced the GMFMC to recommend measures that would conserve wetlands to the appropriate federal regulatory and construction agencies. In Louisiana the GMFMC recommended a moratorium on

authorizing and designing marsh management plans until an environmental impact statement and related studies are completed to identify design and operational measures that would provide unrestricted access to nursery areas used by marine organisms such as red drum. In Texas the GMFMC recommended that the Trinity River and its delta not be dammed at Wallisville and questioned the proposed deepening and widening of the Houston Ship Channel across Galveston Bay because of anticipated damage to fish habitats.

Wetland protection depends upon a combination of federal and state laws, and whether land is publicly or privately owned. Section 10 of the River and Harbor Act, the Fish and Wildlife Coordination Act, and Section 404 of the Clean Water Act provide for widespread input to modification of wetlands. At the federal level, the COE and the EPA manage regulatory programs that can control the amount of man-induced wetland alterations in the Gulf. Almost all Gulf states have provisions for protecting the habitat, but implementation of these provisions is different in each state. Therefore, these agencies should make every effort to conserve wetlands upon which red drum production depends. Controllable wetland losses (e.g., those affected by state and federal regulatory programs) must be minimized by permitting authorities. Giving greater consideration to recommendations of fisheries agencies for projects involving wetland alterations, restoration of altered habitat, and generation of new red drum habitat also should be considered.

The following research needs relative to red drum habitat are provided so that state, federal, and private research efforts can be focused on those areas that would allow the GMFMC to develop measures that best manage red drum and their habitat:

1. Identification of optimum red drum habitat and environmental conditions;
2. The quantitative relationships between red drum production and habitat;
3. Effects of water quality degradation on red drum production;
4. Identification of areas of particular concern for red drum;
5. Determination of habitat conditions that limit red drum production;
6. Methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production; and
7. Determination of overall rate of wetland loss and the reasons for the wetland loss.

Table 1.-Number of proposed projects and acres of habitat by state proposed for dredging, filling, draining, and impounding based on NMFS habitat conservation efforts from 1981 through 1985*.

State	No. of permit applications	Acreage proposed by applicants	Acreage NMFS did not object to	Acreage potentially conserved	Mitigation recommended by NMFS
LA	1,229	149,875	38,932	110,943	103,386
TX	684	16,644	3,694	12,950	4,462
MS	94	578	307	211	44
AL	206	960	280	680	47
FL	1,806	5,879	2,846	3,033	1,241
GA	194	1,106	204	902	247
SC	576	5,610	450	5,160	109
NC	547	3,119	1,673	1,446	576
PR	42	347	33	314	159
VI	7	129	81	48	134
Total	5,385	184,187	48,500	135,687	110,405

*Modified from Mager and Thayer (1986)

Table 2.-Acres of habitat by habitat type involved in NMFS habitat conservation efforts from 1981 through 1985*.

	PROPOSED	ALLOWED	CONSERVED	MITIGATED
Black mangrove	324	93	231	155
White mangrove	348	132	216	128
Red mangrove	662	16	646	562
Saltgrass	1,781	105	1,676	2,315
Freshwater marsh	10,357	7,119	3,238	32,796
Freshwater unvegetated	237	238	-1	31
Freshwater submerged vegetation	473	132	341	612

Table 2 Continued

	PROPOSED	ALLOWED	CONSERVED	MITIGATED
Hardwood swamp	3,507	1,234	2,273	2,641
Black needlerush	1,627	68	1,559	141
Other marsh	7,480	1,141	6,339	4,584
Smooth cordgrass	5,027	446	4,581	6,227
Saltmeadow cordgrass	14,538	1,211	13,327	37,904
Shoalgrass	192	13	179	80
Halophila	2	2	0	0
Widgeongrass	366	111	255	1,564
Manateegrass	20	4	16	2
Turtlegrass	85	20	65	111
Eelgrass	2	1	1	2
Algae	1,123	28	1,095	10
Clay	63	55	8	0
Mud	106,868	30,161	76,707	19,795
Miscel-laneous	19,973	329	19,644	40
Oyster beds	56	31	25	10
Rock	377	12	365	64
Sand	7,301	4,520	2,781	629
Shell	101	7	94	2
Silt	1,297	1,271	26	0
Total	184,187	48,500	135,687	110,405

*Modified from Mager and Thayer (1986)

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