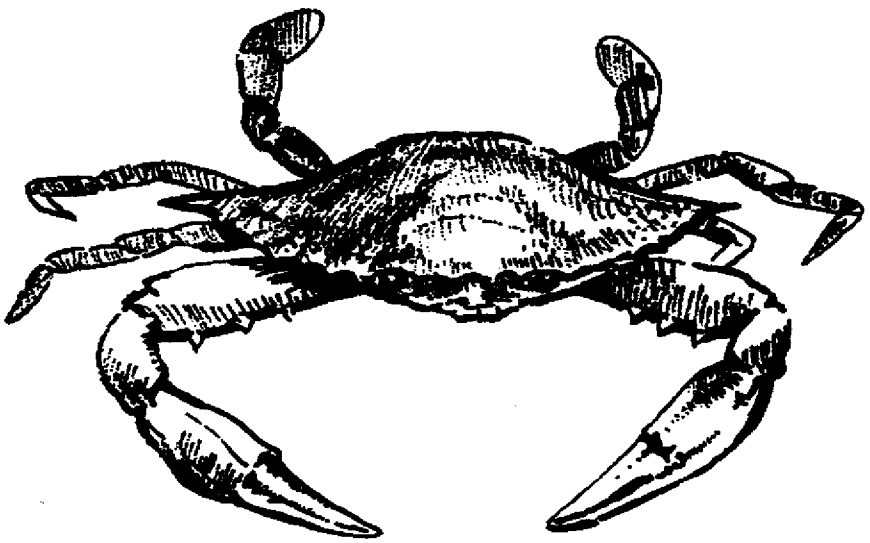
Summary of Proceedings

COASTAL FISHING '97:

Use of Louisiana's Blue Crab Resource



Summary of Proceedings

COASTAL FISHING '97:

Use of Louisiana's Blue Crab Resource

MAY 1997

Prepared by

Kenneth J. Roberts
Louisiana Cooperative Extension Service

Vince Guillory
Louisiana Department of Wildlife and Fisheries

Sponsored by

Louisiana Sea Grant College Program
Louisiana Cooperative Extension Service
Louisiana Department of Wildlife and Fisheries

PREFACE

The contents of this report include information presented at seven meetings of crabbers held in March 1997. Over 200 crabbers attended the meetings to receive material on the situation in Louisiana's blue crab industry. The Louisiana Department of Wildlife and Fisheries and the Louisiana Cooperative Extension Service's Sea Grant Project cooperatively developed the material and meetings.

Topics include the status of the blue crab resource, results of a mail survey of crabbers, a summary of crab regulations, crab management programs in other states, a description of crab gear licenses by category, a report on activities of the Louisiana Crab Task Force, a guide to the 1997 legislative dates of interest, and the way to access the Louisiana Legislature via the Internet.

Comments by attendees were numerous. Many dealt with the pervasive problem of undersized crab harvest, eroding of processed crab meat markets by picking of crabs at uninspected locations, using more traps than necessary to take the harvest and escape rings in traps. This report can serve as a reference for deliberations to deal with means to resolve related problems.

Sea Grant
Louisiana State University

Louisiana State University
Agricultural Center
Louisiana Cooperative Extension Service

TABLE OF CONTENTS

LIST OF FIGURES

STATUS OF THE LOUISIANA BLUE CRAB RESOURCE

Vincent Guillory
Louisiana Department of Wildlife and Fishereis

Introduction

The blue crab (*Callinectes sapidus* Rathbun) commercial fishery in Louisiana, one of the largest US crab fisheries in terms of biomass, displayed rapid growth in fishing effort and harvest levels during the 1980s. However, by the mid 1990s the fishery exhibited declining catch rates per fisherman and decreased commercial landings, and the blue crab resource was perceived by some industry personnel to have serious biological problems. Blue crab workshops sponsored by Louisiana State University Sea Grant as part of their "Coastal Fishing" series provided an opportunity to assess the status of the blue crab resource in Louisiana.

This manuscript is partially based upon papers presented at "The Blue Crab Fisheries of North America" symposium (Guillory and Perret, in press; Guillory et al., 1996) as well as blue crab species and fishery (Guillory et al., 1996) and management (Guillory, 1996) profiles. In this report, long-term trends in commercial and recreational fisheries and in Louisiana Department of Wildlife and Fisheries (LDWF) 16-foot trawl samples are described, potential factors affecting blue crab populations are reviewed, and the status of the blue crab resource is assessed.

Recreational Fishery

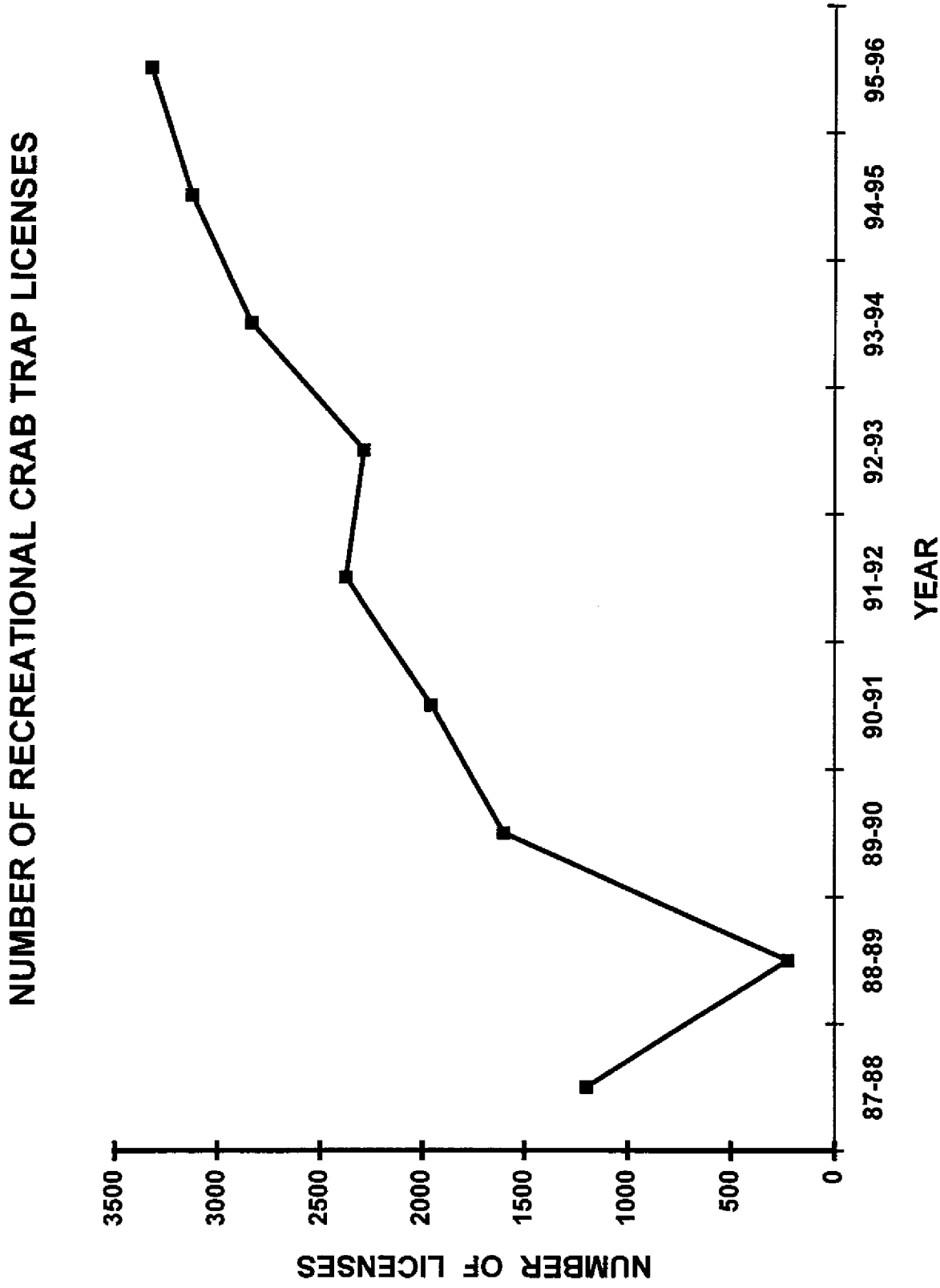
The only available long term harvest or effort data for the recreational blue crab fishery are recreational crab trap gear license records since 1987. Recreational crab trap gear licenses have increased dramatically from 224 in the 1988-1989 license year to 3,328 in the 1995-1996 license year (Figure 1). In addition, 1,542 traps attached to trotlines were licensed to 190 different fishermen during the 1995-1996 license year. The number of recreational crab fishermen using gear other than traps has probably also increased.

Several marine recreational surveys (Davidson and Chabreck, 1983; Titre et al., 1988; Guillory, in press) documented the importance of the recreational blue crab fishery in Louisiana. Approximately 40% of interviewed boaters in the Mississippi River deltaic wetlands (Titre et al., 1988) and one-third of Terrebonne Parish saltwater fishing license holders (Guillory, in press) participated in recreational crabbing. Mississippi Delta boaters averaged 1.3 to 1.7 crabbing trips per year while Terrebonne Parish saltwater fishing license holders averaged 5.8 to 7.6 trips per year. Overall Terrebonne Parish recreational crab harvest from all fishing modes was 395,000 pounds, which equaled 4.1% of the reported commercial crab harvest (Guillory, in press). Assuming a stable recreational harvest at 4.1% of reported commercial production, the annual recreational harvest would have averaged approximately 1,760,000 pounds during the 1990s.

Commercial Soft Crab Fishery

There are no long term data on number of soft crab shedders; however, several one-time estimates of soft crab operators are available — 425 in 1985 (Manthe, 1985); from 228-300 in 1991 (Caffey et al., 1993); and, 185 in 1996 according to soft crab shedder license records.

Figure 1


NUMBER OF RECREATIONAL CRAB TRAP LICENSES
NUMBER OF LICENSES
3500
3000
2500
2000
1500
1000
500
0
87-88
88-89
89-90
90-91
91-92
92-93
93-94
94-95
95-96
YEAR

Soft crab production is greatly underestimated because of the proliferation of "mom-and-pop" operations that market product directly through unreported channels (Roberts and Thompson, 1982; Horst, 1985; Caffey et al., 1993; Supan, in press). Caffey et al. (1993) and Supan (in press) concluded that in recent years, actual soft crab production was 14 to 19 times greater than reported production.

Recognizing the limitations of soft crab production data, historic trends can be presented. Production exhibited erratic annual fluctuations during the 1970s and early 1980s before declining during the mid-1980s (Figure 2). Production increased after 1984 until 200,000 pounds or more were produced from 1990-1992, and declined thereafter. Production averaged 158,000 pounds during the 1990s, although after 1992, production fell below the 20-year mean of 145,430 pounds. Decreased soft crab production after 1992 was apparently related to either reduced peeler crab supply, the primary limiting factor in the soft crab fishery, or reduced number of active shedders.

Commercial Hard Crab Fishery

Landings gradually but erratically increased from the early 1970s through the early 1980s, and then increased dramatically during the mid-1980s, with five successive harvest records set from 1984 through 1988 (Figure 3). There were several relatively poor years (1989, 1990, 1994, 1995, and 1996) after 1986 when fishing effort peaked and then stabilized; however, annual landings during this period were all above the 20-year mean of 32.7 million pounds. Landings averaged 42.9 million pounds during the 1990s.

The transition of a trotline-drop net fishery to the more efficient trap fishery in the early 1970s plus later increased market demand and processing capacity gradually increased landings through the early 1980s. The dramatic increase during the mid- to late-1980s was attributed to increased numbers of fishermen. Blue crabs are currently harvested almost exclusively (>99% of landings) by wire traps. The number of crab trap gear licenses ranged between 751 and 832 from 1978 to 1981, increased until a peak of 3,019 was reached in 1989, decreased slightly and stabilized (2,503 to 2,807) from 1990-1994, and then increased sharply to 3,482 in 1995 and 2,948 in 1996 (Figure 4). The dramatic increase in 1995 was attributed to new legislation that established eligibility criteria (ie., purchase of the same license during either 1993, 1994, or 1995) for a 1996-1998 crab trap gear license moratorium.

The estimated number of traps per fishermen according to the National Marine Fisheries Service (NMFS) increased from 140 in 1970 to 228 in 1987 and then declined to between 129 and 163 in the 1990s (Figure 5); however, Guillory and Perret (in press) concluded and commercial fishermen have indicated that the average number of traps continued to increase after 1988.

Interannual fluctuations in landings increased after 1986 (Figure 6). Earlier fluctuations were partly attributed to economic conditions that drove the fishery (Lyles, 1976; Moss, 1982). More recent fluctuations were related to increased fishing effort; as a fishery matures and fishing effort increases, a larger proportion of the population is harvested and changes in stock abundance will result in greater variability in landings (Caddy, 1984). The fishery has apparently become more dependent upon one year class rather than multiple year classes as suggested by Rogers et al (1990) for the blue crab population in Georgia. This also increases interannual variability.

Annual catch per unit effort (CPUE) by trap fishermen was calculated for the

Figure 2

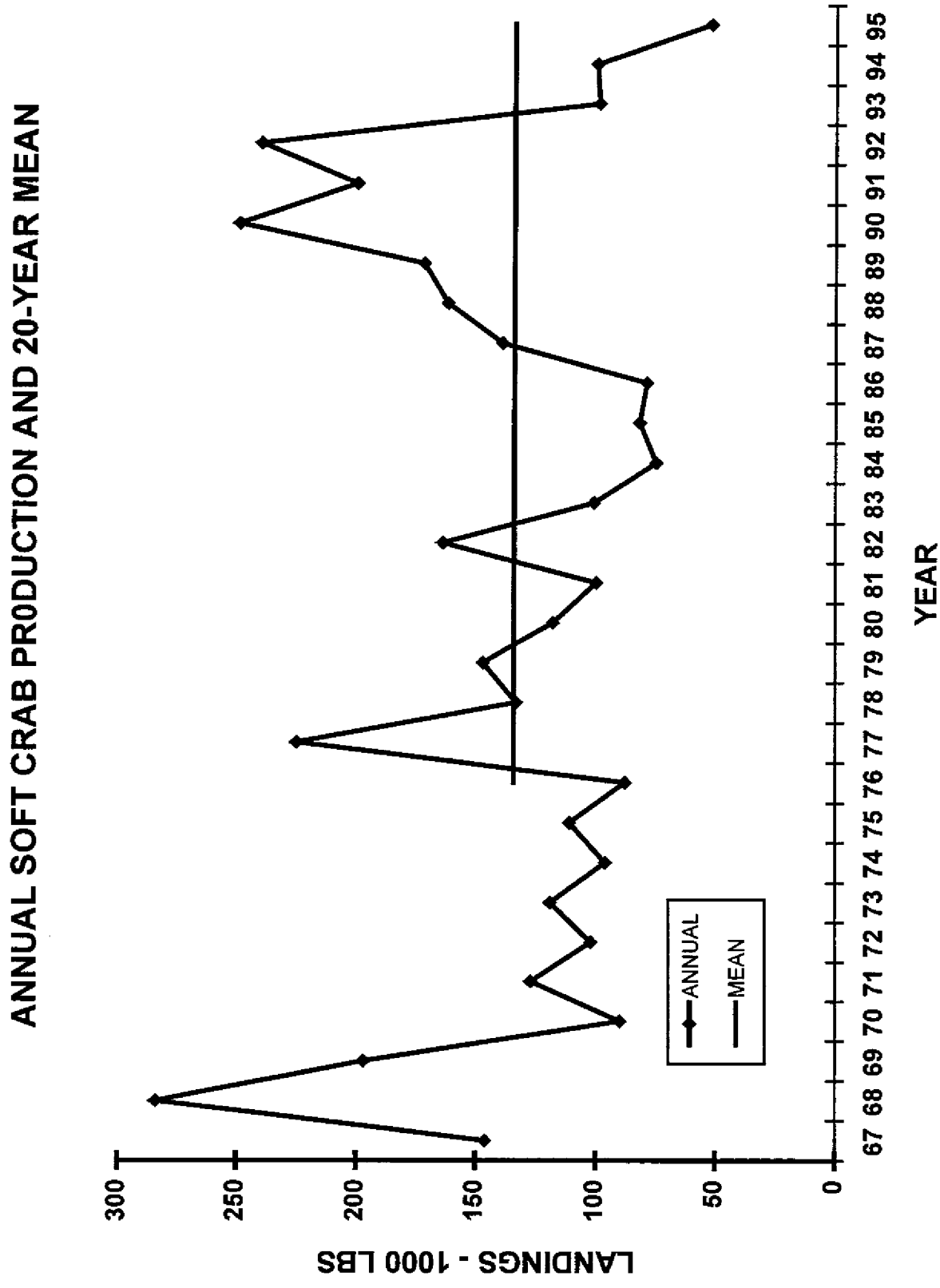

ANNUAL SOFT CRAB PRODUCTION AND 20-YEAR MEAN
LANDINGS - 1000 LBS
300
250
200
150
100
50
0
67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95
YEAR
ANNUAL
MEAN

Figure 3

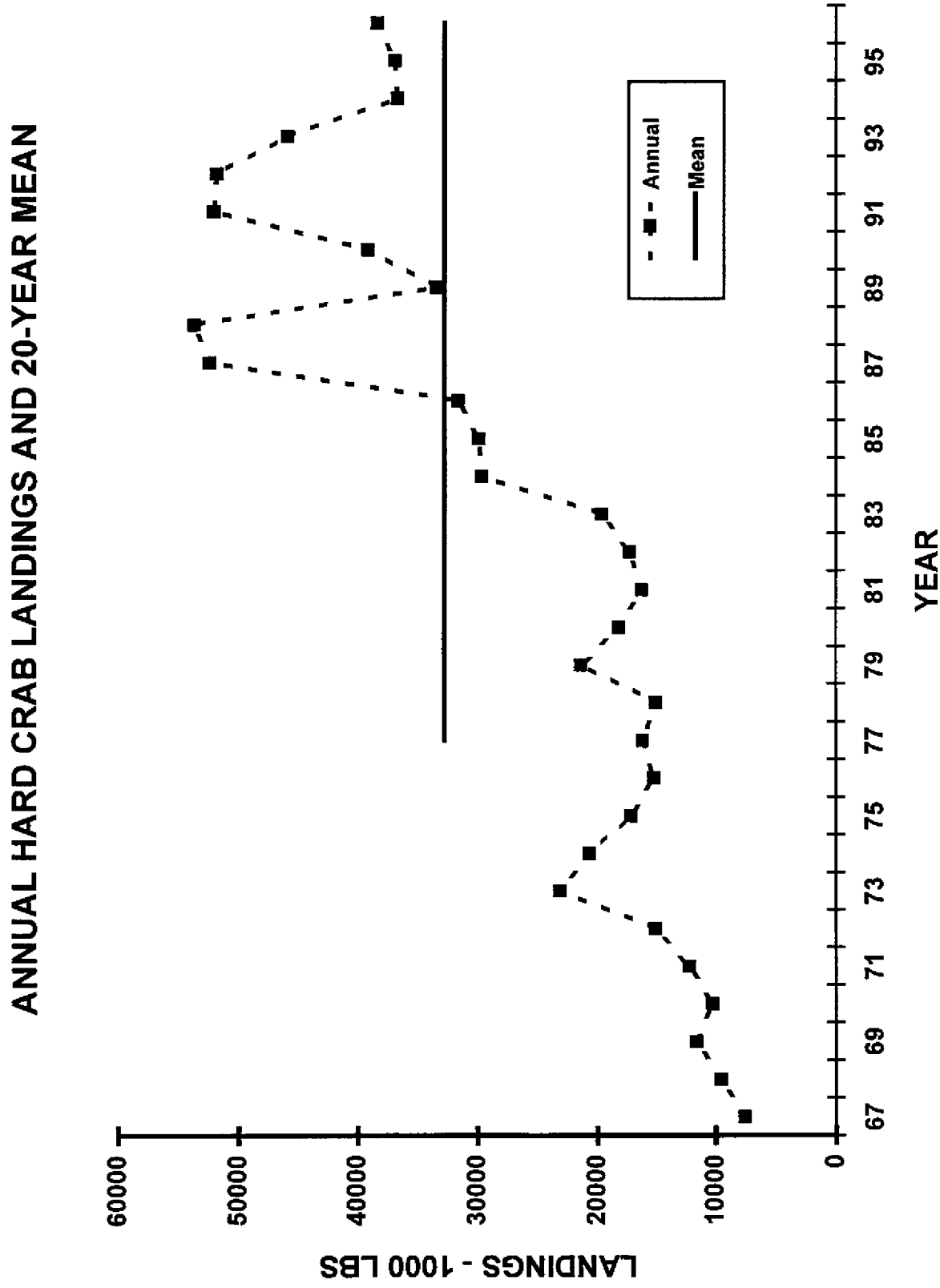

ANNUAL HARD CRAB LANDINGS AND 20-YEAR MEAN
LANDINGS - 1000 LBS
60000
50000
40000
30000
20000
10000
0
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
YEAR
Annual
Mean

Figure 4

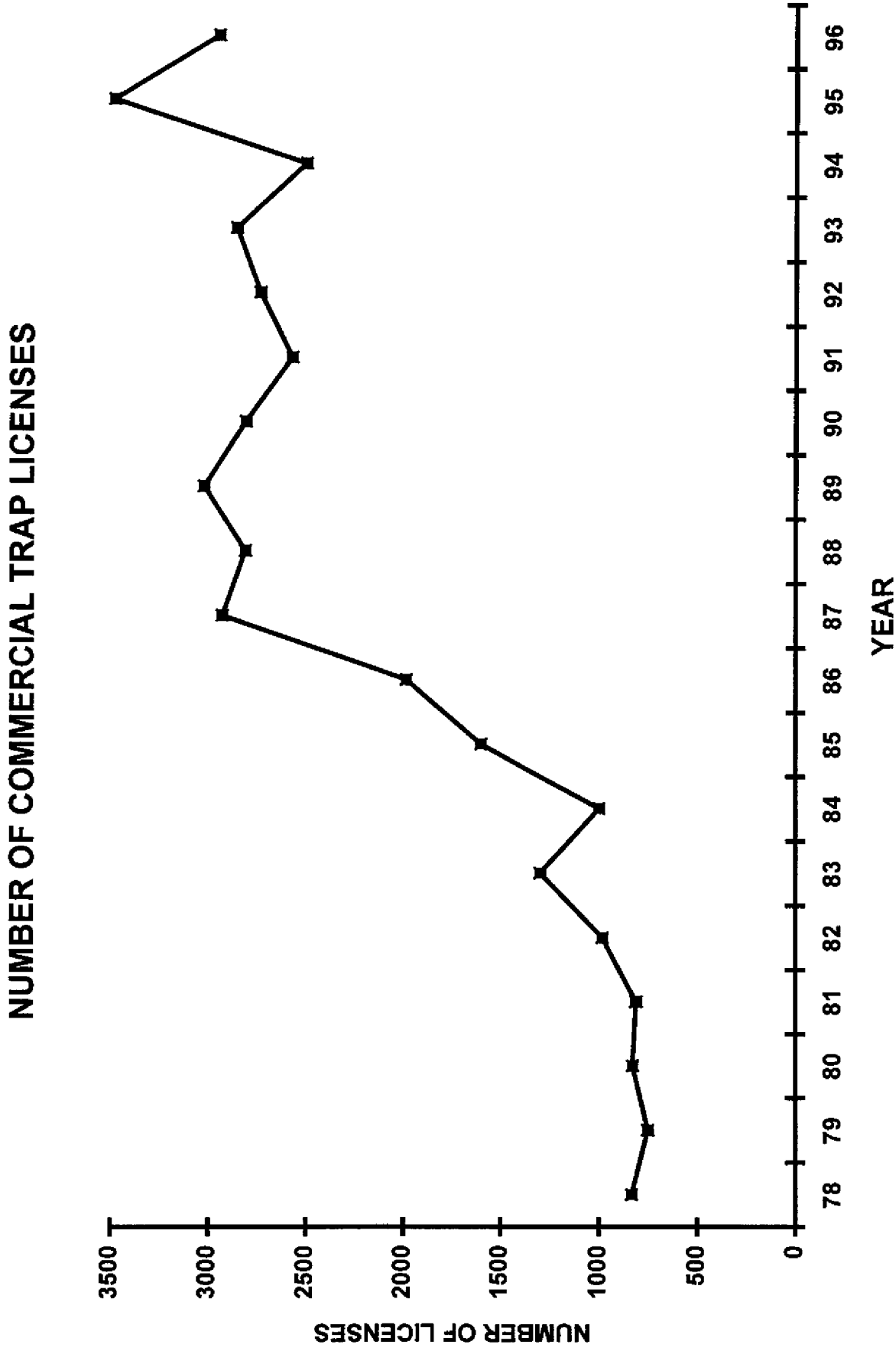

NUMBER OF COMMERCIAL TRAP LICENSES
NUMBER OF LICENSES
3500
3000
2500
2000
1500
1000
500
0
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
YEAR

Figure 5

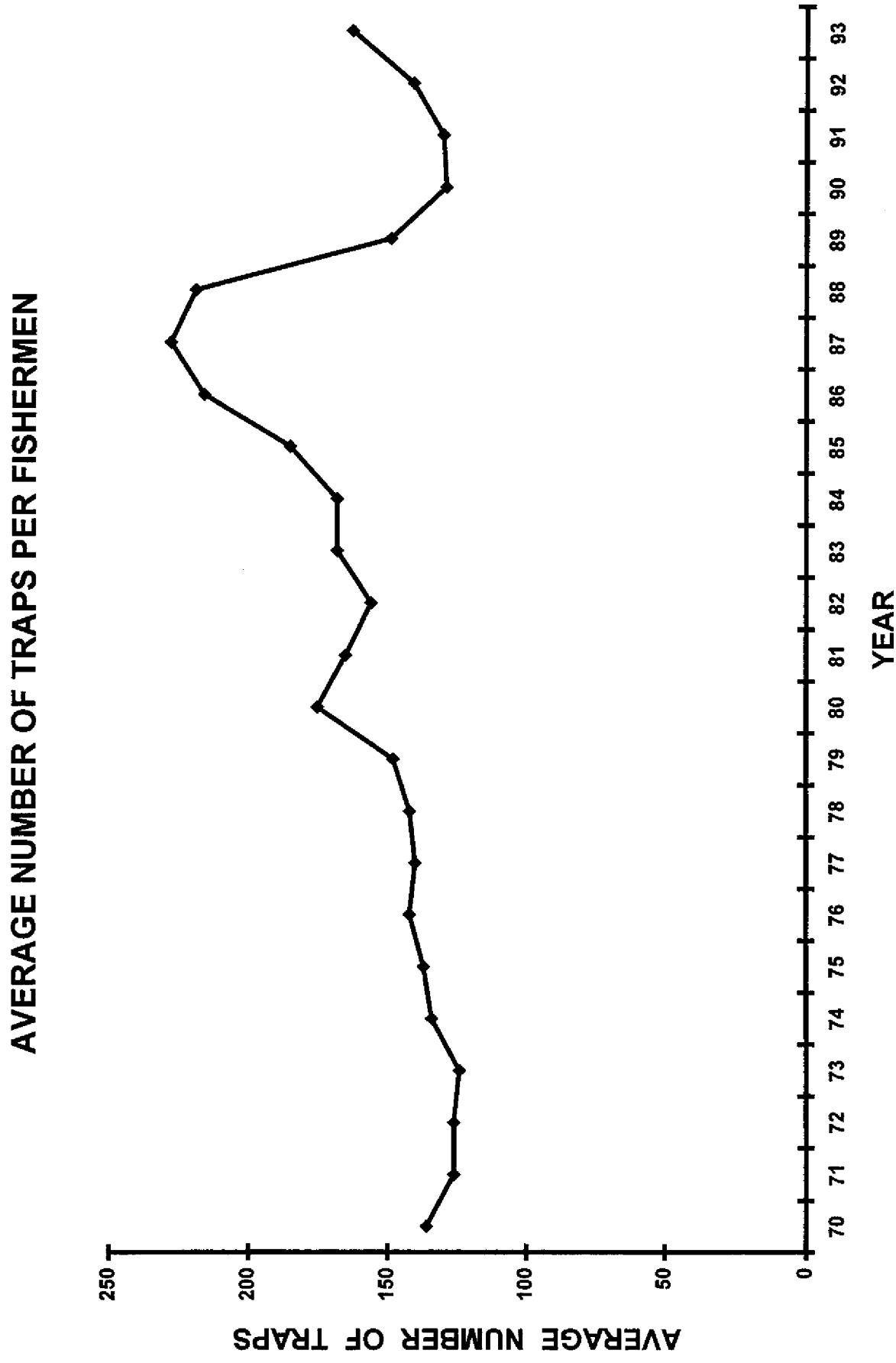
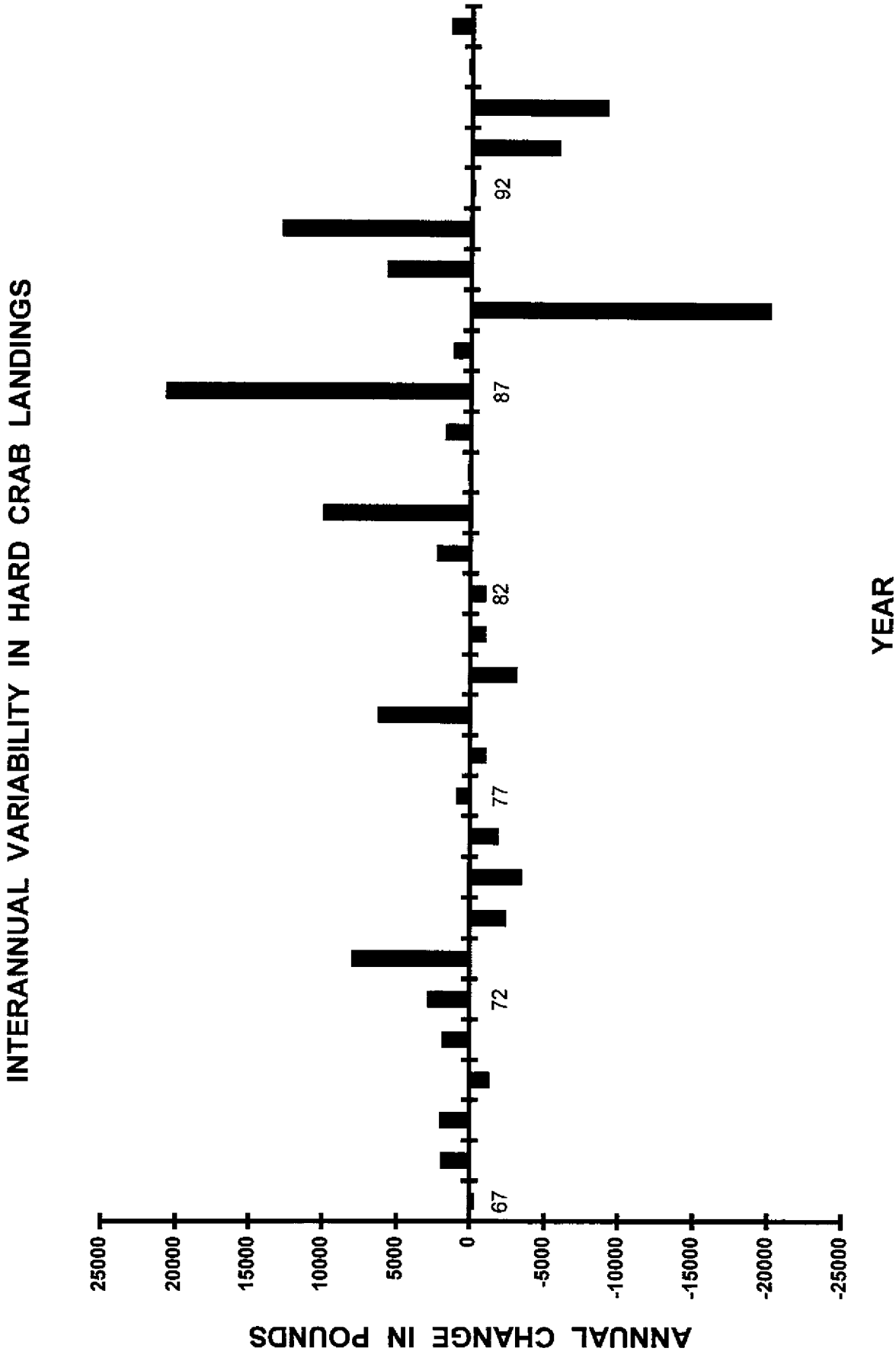

AVERAGE NUMBER OF TRAPS PER FISHERMEN
AVERAGE NUMBER OF TRAPS
250
200
150
100
50
0
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
YEAR

Figure 6


INTERANNUAL VARIABILITY IN HARD CRAB LANDINGS
ANNUAL CHANGE IN POUNDS
25000
20000
15000
10000
5000
0
-5000
-10000
-15000
-20000
-25000
67
72
77
82
87
92
YEAR

1978-1996 period (Figure 7). [In order to reduce the effect of holding a gear license speculatively (in anticipation of a license moratorium), numbers of license holders in 1995 and 1996 were conservatively assumed equal to those in 1994]. A significant downward trend over time in CPUE by fisherman (r^2=0.30, P=0.01) was found. The downward trend in CPUE by fishermen was probably dampened by an increased number of traps per fishermen and perhaps by improved documentation of landings. Periodic peaks in CPUE were evident, after which CPUE gradually declined for several years before abruptly increasing to another peak.

Fishery Independent Monitoring

The 1967-1996 inshore 16-foot trawl bottomfish/shrimp assessment and monitoring program of the LDWF Marine Fisheries Division has provided one of the longest and largest blue crab data bases in existence. Long term trends in blue crab abundance and size were derived from this data set. Annual blue crab CPUE is plotted in Figure 8; no significant long term trend in overall CPUE was present. However, CPUE by size class reveals some long term trends with important implications. Annual mean CPUE of recruit (<40 mm CW) in Figure 9 shows blue crabs increased significantly with time (r^2=0.30, P=0.0019), while there were no significant long term trends in early juvenile (40-99 mm CW) or late juvenile (100-125 mm CW) CPUE. Annual mean legal (≥125 mm CW) CPUE, however, significantly decreased (r^2=0.42, P=0.0001) with time (Figure 10).

Status of the Fishery and Resource

Before evaluating the status of the blue crab resource, the productivity of Louisiana's estuaries must be acknowledged. Louisiana blue crab production averaged 72.7% of total Gulf of Mexico production during the 1990s. It led the nation in 1987, 1988, 1991, and 1992. Lindall and Hall (1970) suggested that Louisiana would produce an annual blue crab yield of more than 100 million pounds if production per acre was similar to Chesapeake Bay. Actual crab production may have approached or exceeded 100 million pounds if production was historically underestimated by a factor of two to three as previously noted (Lindall and Hall, 1970; Adkins, 1972; Roberts and Thompson, 1982; Keithly et al., 1988). The high fisheries productivity of Louisiana's estuaries was attributed to several factors by Day et al. (1973): near subtropical climatic regime and abundant rainfall; the large input of freshwater and nutrients by the Mississippi River; the low coastal wave activity; daily tidal flushing; and, the broad, near sea-level coastal plain. Thomas et al. (1990) suggested that more marsh edge, lower tidal amplitudes, and longer periods of tidal inundation accounted for the higher abundance of blue crabs in the northern Gulf of Mexico than along the Atlantic Coast.

Larval recruitment or number of spawning females is apparently not a limiting factor for blue crab abundance in the Gulf of Mexico (Steele and Perry, 1990). The blue crab is considered a "r-selected species" (Van Engel, 1987), with certain life history traits (ie., high fecundity, high interannual variation in abundance, rapid growth, early reproductive maturity, high natural mortality rates, and relatively short life span) suggestive of a density-independent spawner-recruit relationship.

Fishery independent and dependent monitoring data supports the contention that there is no stock-recruitment problem with the Louisiana blue crab resource. First, there has been an upward trend in blue crab

Figure 7

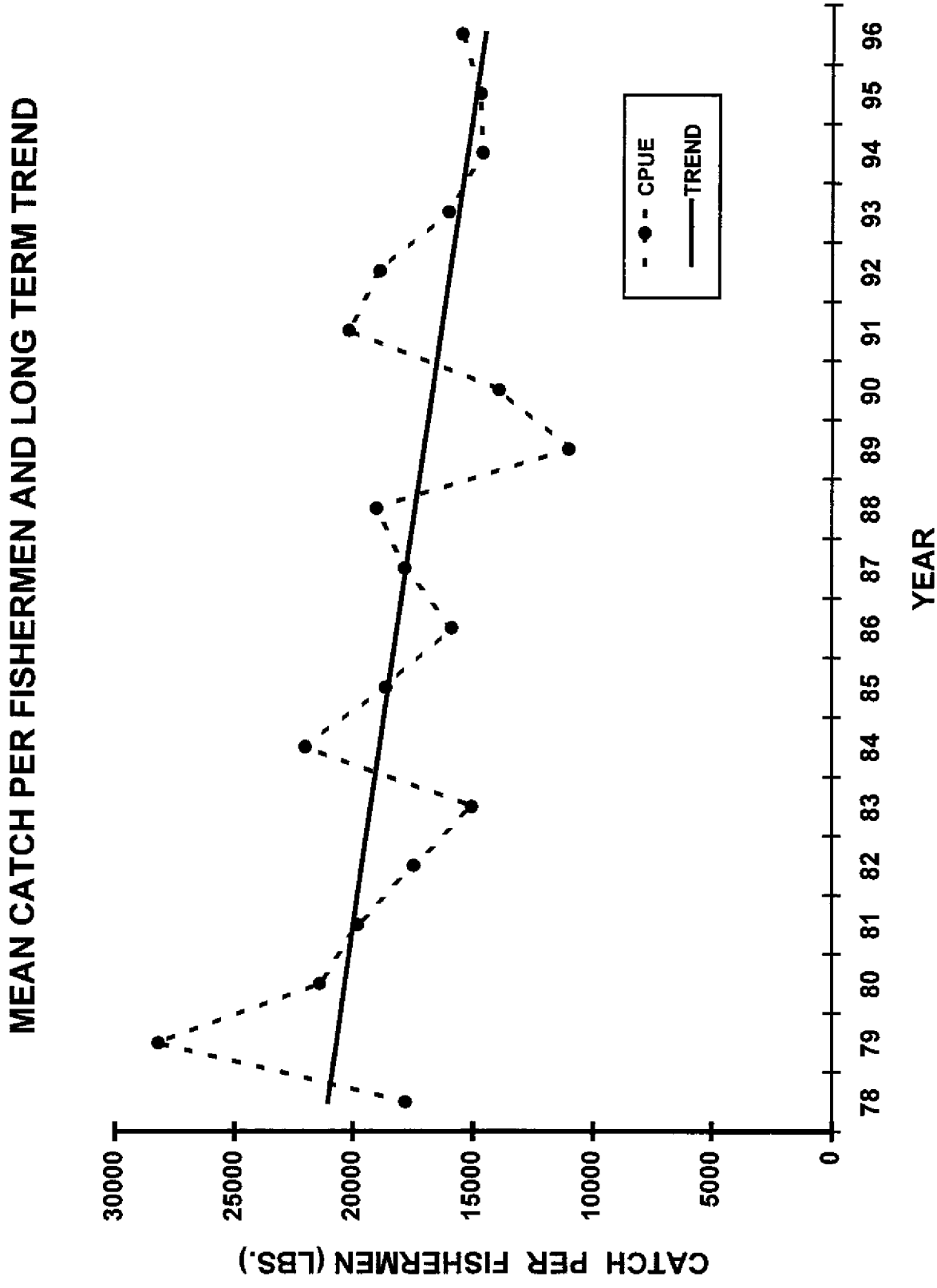

MEAN CATCH PER FISHERMEN AND LONG TERM TREND
CPUE
TREND
CATCH PER FISHERMEN (LBS.)
30000
25000
20000
15000
10000
5000
0
YEAR
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96

Figure 8

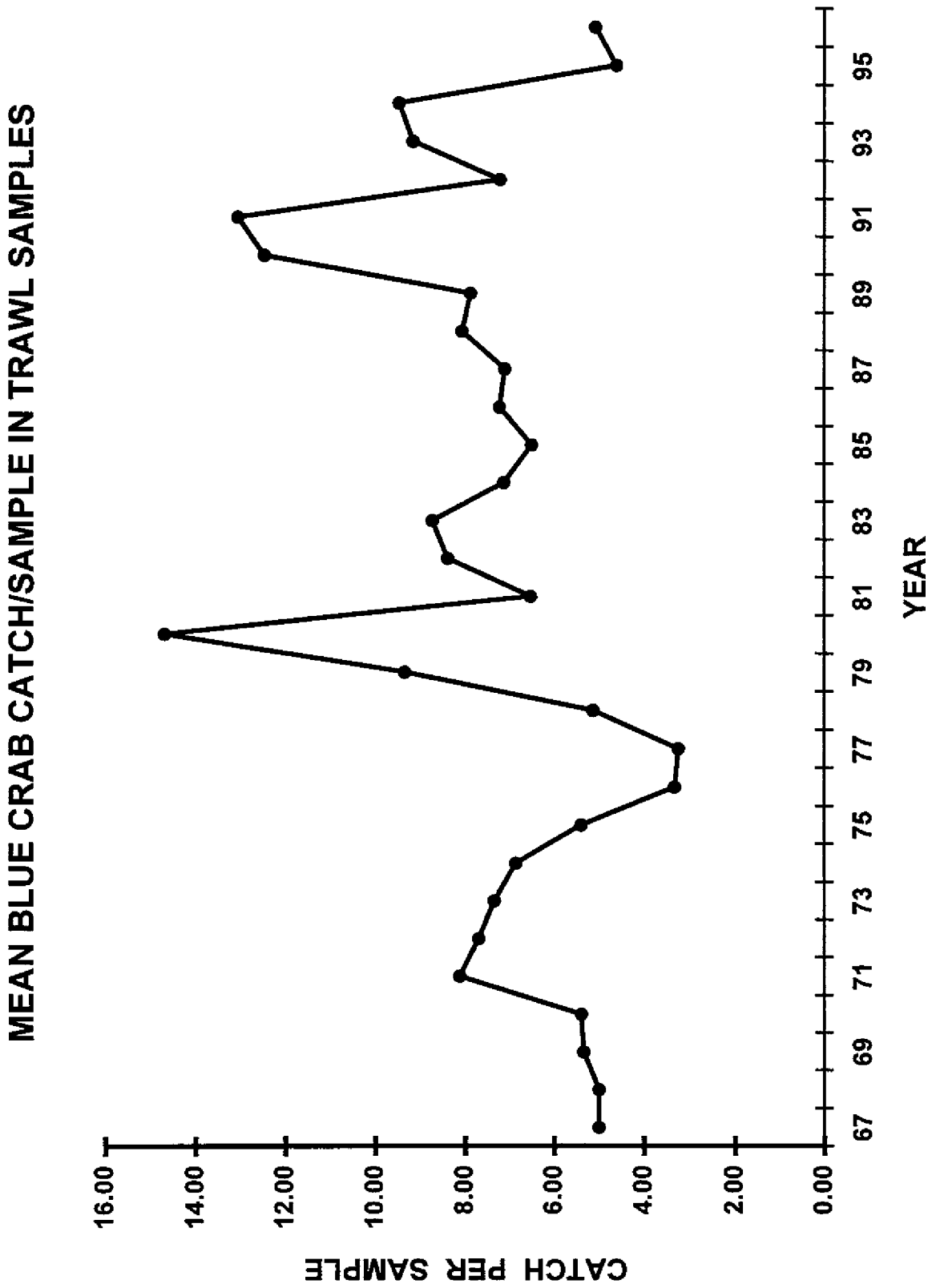

MEAN BLUE CRAB CATCH/SAMPLE IN TRAWL SAMPLES
CATCH PER SAMPLE
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
YEAR

Figure 9

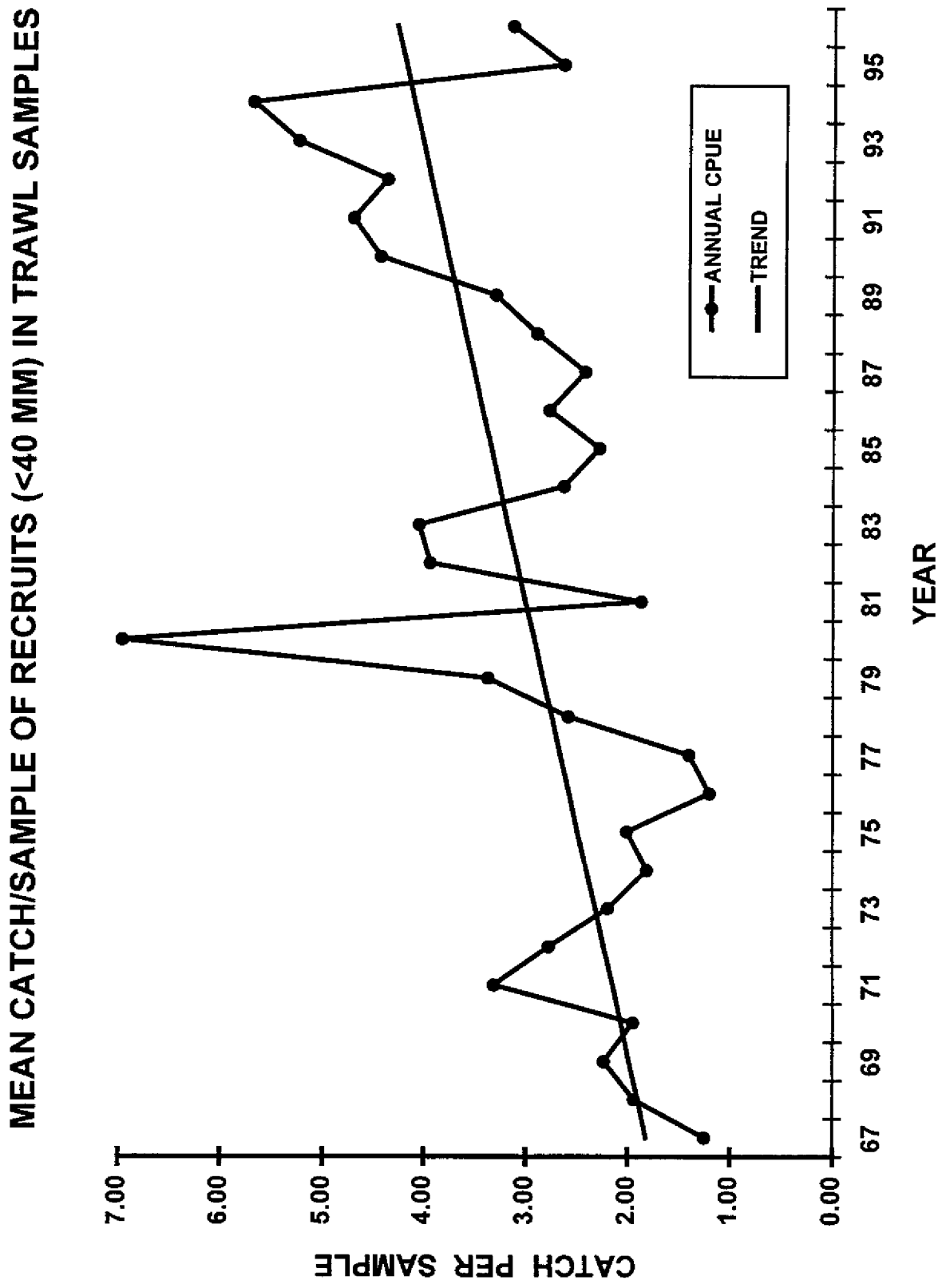
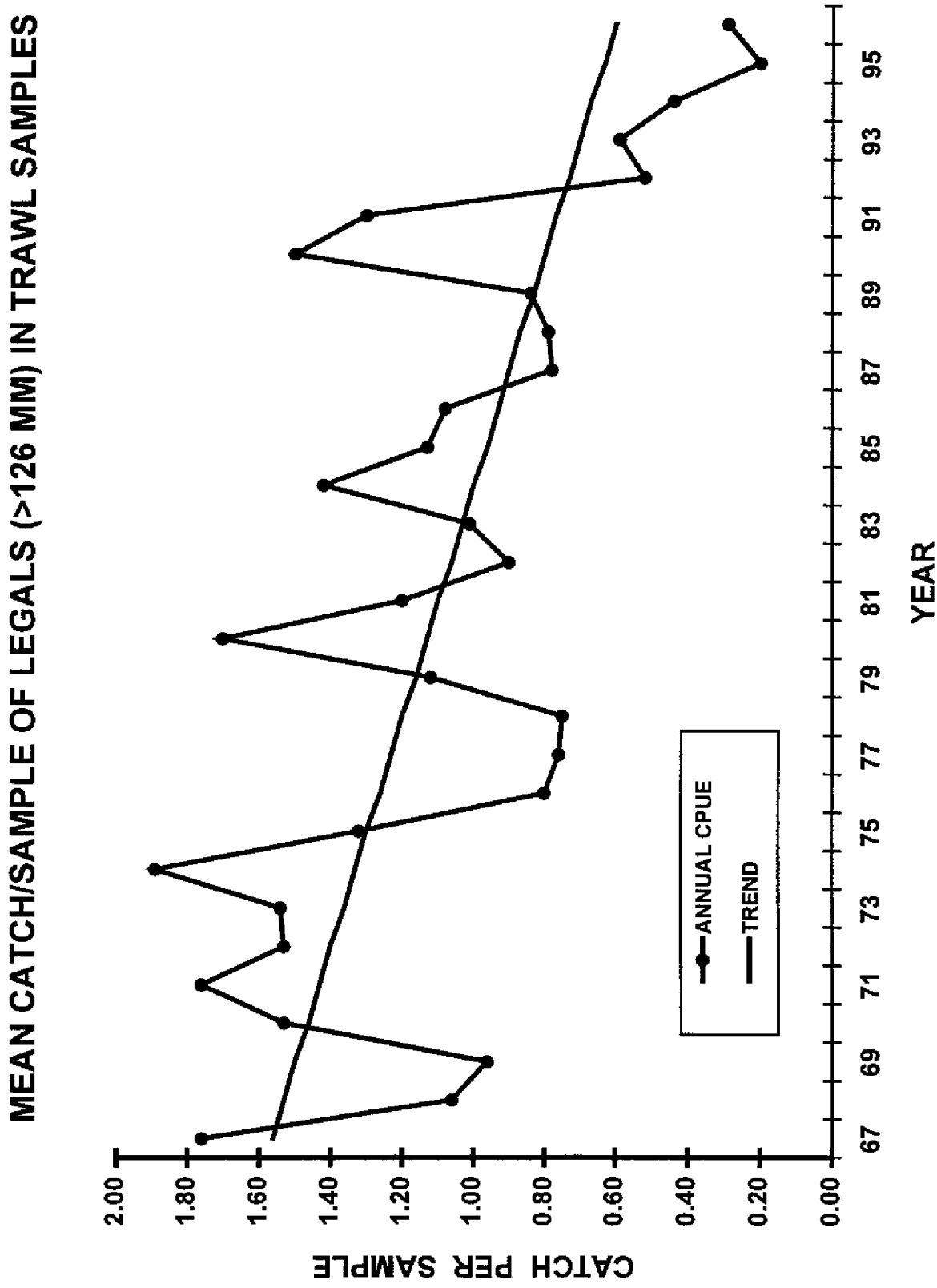

MEAN CATCH/SAMPLE OF RECRUITS (<40 MM) IN TRAWL SAMPLES
CATCH PER SAMPLE
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
YEAR
ANNUAL CPUE
TREND

Figure 10


MEAN CATCH/SAMPLE OF LEGALS (>126 MM) IN TRAWL SAMPLES
CATCH PER SAMPLE
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
YEAR
ANNUAL CPUE
TREND

recruit (<40 mm CW) CPUE in LDWF 16-foot trawl samples over the 1967-1996 period. Second, megalopae are 10-100 times more abundant in northern Gulf of Mexico estuaries than along the Atlantic Coast (Heck and Coen, 1995; Van Montfrans et al., 1995). Third, blue crab populations have exhibited wide fluctuations despite protection of egg-bearing females in four of five Gulf states, suggesting that density-independent factors are of greater importance (Guillory et al., in press).

Variability in juvenile blue crab mortality rates and estuarine carrying capacity, not the number of recruits, appear to be the primary determinants of adult blue crab population levels. Van Montfrans et al. (1995) suggested that blue crab populations in the Gulf of Mexico, in contrast to Chesapeake Bay, are limited in part by post-settlement processes. This thesis is also supported by fishery independent trawl data showing that high initial densities of early juvenile blue crabs do not necessarily result in elevated levels of later-stage juveniles or adults (Perry et al. in press; Guillory and Prejean, unpublished data).

Literature on various biological, environmental, physical, and fishery-related factors potentially affecting juvenile and adult blue crab populations are reviewed in Appendix 1. Based upon an analysis of this literature and the life history characteristics of the blue crab, annual variability and long term trends in interrelated factors have probably influenced adult blue crab populations and subsequent commercial fishermen catch rates. Some of these influencing trends include population cycles of unknown cause, population abundance of predators, indirect effects of environmental factors (temperature, salinity, and river discharge) on distribution of predators, effects of habitat quality (marsh loss and associated habitat changes, salinity intrusion) on estuarine carrying capacity of blue crabs, water quality (eutrophication in mid- and upper-estuaries, toxicant/pollutant levels), increased fishing effort leading to higher fishing mortality of legal blue crabs, illegal harvest of sublegal crabs, and, incidental mortalities (capture and handing mortalities from traps and shrimping gear, ghost fishing mortality). To rank these identified factors, it would be speculative because both the population dynamics of blue crab and the relative contribution of each factor to overall mortality rates are poorly known. In addition, these factors are probably complexly intertwined so that the suppressive effects of some factors may be decreased if another is increased.

However, it is appropriate to point out two important observations. (1) Habitat quality is undoubtedly most important when considering the long-term health of the resource. (2) The effects of illegal or sublegal harvest and incidental fishery-related mortalities may have the most obvious effect on harvestable blue crab populations because juveniles approaching legal size are generally impacted.

A number of conclusions can be made concerning the Louisiana blue crab resource and fishery. The blue crab resource is viable with no stock-recruitment or biological problems. The blue crab is capable of sustaining high levels of fishing effort and harvest because it is a short-lived, rapidly growing, highly fecund species with high natural mortality rates (Van Engel, 1987). However, the fishery is fully exploited and is displaying the classical symptoms of excessive fishing effort (ie., beyond that needed to reach maximum harvest levels) — declining catch rates per fisherman, increased fluctuations in annual landings, increased harvest of sublegal crabs, and increased number of traps per fisherman. Marine biologists generally

acknowledge that estuarine carrying capacity will eventually decline, or may have already begun to decline, as marsh loss continues and habitat quality declines. Population abundance can fluctuate dramatically from year to year; at present exploitation levels, the fishery is largely dependent upon a single year class and can be considered an "annual crop" for all practical purposes. Variability in juvenile blue crab mortality rates from a combination of factors and estuarine carrying capacity apparently determines adult population levels available to the fishery.

Literature Cited

Adkins, B. G. 1972. Study of the blue crab fishery in Louisiana. La. Wildl. Fish. Comm., Tech. Bull. No. 3.

Adkins, G. B. 1993. A comprehensive assessment of bycatch in the Louisiana shrimp fishery. La. Dep. Wildl. Fish., Tech. Bull. No. 42.

Arcement, G. and V. Guillory. 1993. Ghost fishing in vented and unvented blue crab traps. Proc. La. Acad. Sci. 56:1-7.

Ary, R. D., Jr., C. K. Clemer, K. Bartell, and M. A. Poirrer. 1987. The effects of chelotomy on molting in the blue crab, *Callinectes sapidus*. J. Shellfish Res. 6:103-108.

Browder, J. A., L. N. May, Jr., A. Rosenthal, J. G. Gosselink, and R. H. Baumann. 1989. Modeling future trends in wetland loss and brown shrimp production in Louisiana using thematic mapper imagery. Remote Sensing Envir. 28:45-59.

Brown, R. S. and N. Caputi. 1983. Factors affecting the recapture of undersize western rock lobster (*Panulirus longipes cygnus* George). Proc. Indo-Pac. Fish. Council 14:139-154.

Brown, R. S. and N. Caputi. 1986. Conservation of recruitment of the western rock lobster (*Panulirus cygnus*) by improving survival and growth of undersize rock lobsters captured and returned by fishermen to the sea. Can. J. Fish. Aq. Sci. 43:2236-2247.

Byersdorfer, S. and L. J. Watson. 1992. A summary of biological data collected during the 1991 Bristol Bay red king crab tagging study. Ala. Dep. Fish Game, Reg. Info. Rep. 4K93-24.

Caddy, J. F. 1984. An alternative to equilibrium theory for management of fisheries. FAO Fish. Rep. 289 (Suppl. 2):173-214.

Caffey, R. H., D. D. Culley, and K. J. Roberts. 1993. The Louisiana soft-shelled crab industry. A profile. La. Sea Grant Coll. Prog., Rep.

Casey, J. 1990. A study of biodegradable escape panels in crab pots. Md. Dep. Nat. Resour., Rep.

Casey, F. C. and B. Daugherty. 1989. Evaluation of information on ghost (lost/abandoned) crab pots and methods of mitigating their effects on the resource. Md. Dep. Nat. Resour., Rep.

Chapman, C. J. 1981. Discarding and tailing *Nephrops* at sea. Scott. Fish. Bull. 46:10-13.

Chesapeake Bay Program. 1996. Chesapeake Bay blue crab fishery management plan. Chesapeake Bay Program, Rep.

Copeland, B. J. and T. J. Bechtel. 1974. Some environmental limits of six Gulf Coast estuarine organisms. Contrib. Mar. Sci. 18:169-204.

Costlow, J. D., Jr. 1967. The effect of salinity and temperature on survival and metamorphosis of megalops of the

blue crab, *Callinectes sapidus*. Helgol. Wiss. Meeresunters. 15:84-97.

Costlow, J. D., Jr. and C. G. Bookhout. 1959. The larval development of *Callinectes sapidus* Rathbun reared in the laboratory. Biol. Bull. (Woods Hole) 116:58-66.

Couch, J. A. and S. Martin. 1982. Protozoan symbionts and related diseases of the blue crab, *Callinectes sapidus* Rathbun, from the Atlantic and Gulf coasts of the United States. Pages 71-80 in H. M. Perry and W. A. Van Engel, editors. Proceedings of the Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Darnell, R. 1961. Trophic spectrum of an estuarine community, based on studies of Lake Pontchartrain, Louisiana. Ecology 42(3):553-568.

Davidson, R. B. and R. H. Chabreck. 1983. Fish, wildlife, and recreational values of brackish water impoundments. Pages 89-114 in R. J. Varnell, editor. Water Quality and Wetland Management Conference Proceedings.

Day, R. H., R. K. Hol, and J. W. Day. 1990. An inventory of wetland impoundments in the coastal zone of Louisiana, USA: historical trends. Envir. Manage. 4(2)229-240.

Day, J. W., Jr., W. G. Smith, P. R. Wagner, and W. C. Stowe. 1973. Community structure and carbon budget of a salt marsh and shallow bay estuarine system in Louisiana. La. St. Univ., Cent. Wetland Resour. Publ. LSU-SG-72-04.

Deegan, L. A., J. W. Day, and J. G. Gosselink. 1986. Relationships among physical characteristics, vegetation distribution and fisheries yield in Gulf of Mexico estuaries. Pages 83-100 in D. Wolfe, editor. Estuarine Variability. Academic Press.

Defur, P. L. and R. McMahon. 1978. Respiratory responses of *Cancer productus* to air exposure. Amer. Zool. 18:605.

Eldridge, P. J., V. G. Burrell, Jr., and G. Steele. 1979. Development of a self-culling blue crab pot. Mar. Fish. Rev. 41(1):21-27.

Gagliano, S. M. and J. L. Van Beek. 1975. An approach to multiuse management in the Mississippi Delta system. Pages 223-228 in M. L. Broussard, editor. Deltas, Models for Exploration. Houston Geol. Soc.

Gray, E. M. and C. L. Newcombe. 1938. The relative growth of parts in the blue crab *Callinectes sapidus* Rathbun. Growth 2(3):235-246.

Guillory, V. 1993. Ghost fishing in blue crab traps. N. Am. J. Fish. Manage. 13(3):459-466.

Guillory, V. 1996. A management profile of blue crab in Louisiana. La. Dep. Wildl. Fish., Fish. Manage. Plan Ser. No. 5, Part 3.

Guillory, V. (in press). A survey of the recreational blue crab fishery in Terrebonne Parish, Louisiana. in S. J. Jordan, editor. The Blue Crab Fisheries of North America: Research, Conservation, and Management.

Guillory, V., M. Bourgeois, P. Prejean, J. Burdon, and J. Merrell. 1996. A biological and fisheries profile of the blue crab, *Callinectes sapidus*. La. Dep. Wildl. Fish., Fish. Manage. Plan Ser. No. 5, Part 1.

Guillory, V. and S. Hein. (In press). An evaluation of square and hexagonal mesh blue crab traps with and without

escape rings. in S. J. Jordan, editor. The Blue Crab Fisheries of North America: Research, Conservation, and Management.

Guillory, V. and W. E. Perret. (in press). Management, history, and status and trends in the Louisiana blue crab fishery. in S. J. Jordan, editor. The Blue Crab Fisheries of North America: Research, Conservation, and Management.

Guillory, V., H. M. Perry, P. Steele, T. Wagner, P. Hammerschmidt, S. Heath, and C. Moss. (in press). The Gulf of Mexico blue crab fishery: historical trends, status, management, and recommendations. in S. J. Jordan, editor. The Blue Crab Fisheries of North America: Research, Conservation, and Management.

Guillory, V. and P. Prejean. (in press). Blue crab trap selectivity studies: mesh size. Mar. Fish. Rev.

Heck, K. L., Jr. and L. D. Coen. 1995. Predation and the abundance of juvenile blue crabs: a comparison of selected east and Gulf Coast (USA) studies. Bull. Mar. Sci. 57(3):877-883.

Heck, K. L., Jr. and T. A. Thoman. 1981. Experiments on predator-prey interactions in vegetated aquatic habitats. J. Exp. Mar. Biol. Ecol. 53:125-134.

Herke, W. H. 1979. Some effects of semi-impoundment on coastal Louisiana fish and crustacean nursery usage. Pages 325-346 in J. W. Day, Jr., D. D. Culley, Jr., R. E. Turner, and A. J. Mumphrey, Jr., editors. Proceedings of the Third Coastal Marsh and Estuary Management Symposium. La. St. Univ. Div. Cont. Educ.

Herke, W. H. and B. D. Rogers. 1989. Threats to coastal fisheries. Pages 196-212 in W. G. Duffy and D. Clark, editors. Marsh Management in Coastal Louisiana: Effects and Issues - Proceedings of a Symposium. U. S. Fish Wildl. Serv., Biol. Rep. 89(22).

Heukelem, W. F. Van. 1991. Blue crab, *Callinectes sapidus*. Pages 6-1 in S. L. Funderburk, J. A. Mihursky, S. J. Jordan, and D. Riley, editors. Habitat Requirements for Chesapeake Bay Living Resources. Ches. Bay Prog.

Hines, A. H., R. N. Lipcius, and A. M. Haddon. 1987. Population dynamics and habitat partitioning by size, sex, and molt stage of blue crabs *Callinectes sapidus* in a subestuary of central Chesapeake Bay. Mar. Ecol. Prog. Ser. 36:55-64.

Hines, A. H. And G. M. Ruiz. 1995. Temporal variation in juvenile blue crab mortality: nearshore shallows and cannibalism in Chesapeake Bay. Bull. Mar. Sci. 57(3):884-901.

Holland, J. S., D. V. Aldrich, and K. Strawn. 1971. Effects of temperature and salinity on growth, food conversion, survival and temperature resistance of juvenile blue crab, *Callinectes sapidus* Rathbun. Texas A & M University, Sea Grant Publ. TAMU-SG-71-222.

Horst, G. 1985. Status of the Louisiana soft shell crab fishery. Pages 102-103 in H. M. Perry and R. F. Malone, editors. National Symposium on the Soft-shelled Blue Crab Fishery. Gulf Coast Res. Lab.

Hunt, J. H. and F. S. Kennedy, Jr. 1986. Factors affecting growth and maturation of spiny lobsters, *Panulirus argus*, to the south Florida fishery. Can. J. Fish. Aq. Sci. 43:2243-2247.

Hurt, P. R., L. M. Libby, L. J. Pandolfi, L. H. Levine, and W. A. Van Engel. 1979. Periodicities in blue crab population of Chesapeake Bay. Clim. Change 2:75-78.

Johnson, P. T. 1978. Viral diseases of the blue crab, *Callinectes sapidus*. Mar. Fish. Rev. 40(10):13-15.

Keithly, W. R., Jr., K. J. Roberts and A. W. Liebzeit. 1988. Louisiana blue crab production, processing, and markets. La. St. Univ., Sea Grant Coll. Prog. Rep.

Laughlin, R. A. 1979. Trophic ecology and population distribution of the blue crab, *Callinectes sapidus* Rathbun, in the Apalachicola estuary, (North Florida, U.S.A.). Doctoral Dissertation. Florida State University, Tallahassee.

Lindall, W. N., Jr. and J. R. Hall. 1970. Fishery resources: report of the commercial fishery work unit. St. Petersburg NMFS Biol. Lab., Rep.

Lipcius, R. N. and W. A. Van Engel. 1990. Blue crab population dynamics in Chesapeake Bay: variation in abundance (York River, 1972-1989) and stock-recruit functions. Bull. Mar. Sci. 46(1):180-194.

Lyles, C. H. 1976. A management plan for Mississippi's marine fisheries. Miss. Mar. Cons. Comm., Rep.

Lynch, M. P. and K. L. Webb. 1973. Variations in serum constituents of the blue crab, *Callinectes sapidus*: glucose. Comp. Biochem. Physiol. 45(A):127-139.

Mahood, R., M. McKenzie, D. Middaugh, S. Bollar, J. Davis, and D. Spitsbergen. 1970. A report on the cooperative blue crab study - south Atlantic states. Ga. Game Fish Comm., Coast. Fish. Contrib. Ser. No. 19.

Manthe, D. P. 1985. The impact of Sea Grant activities on the soft shell crab industry. La. St. Univ., Dep. Civil Eng., Rep.

McKenna, S. and J. T. Camp. 1992. An examination of the blue crab fishery in the Pamlico River estuary. N. Car. Dep. Envir., Health, Nat. Resourc., Rep. No. 92-08.

McKenzie, M. D. 1970. Fluctuations in abundance of blue crab and factors affecting mortalities. S. Car. Wildl. Resour. Dep., Tech. Rep. No. 1.

McMahon, B. R., P. J. Butler, and E. W. Taylor. 1978. Acid base changes during recovery from disturbance and during long term hypoxic exposure in the lobster, *Homarus vulgaris*. J. Exp. Zool. 205:361-370.

Messick, G. A. and C. J. Sindermann. 1992. Synopsis of principal diseases of the blue crab, *Callinectes sapidus*. U. S. Dept. Comm., NOAA Tech. Memo. NMFS-F/NEC-88.

Meeter, D. A., R. J. Livingston, and G. C. Woodsum. 1979. Long-term climatological cycles and population changes in a river dominated estuarine system. Ecol. Proc. Coast. Mar. Sys. 10:315-338.

Moody, M. 1982. Zoonotic diseases. Pages 65-69 in H. M. Perry and W. A. Van Engel, editors. Proceedings of the Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Moss, C. G. 1982. The blue crab fishery of the Gulf of Mexico. Pages 93-104 in H. M. Perry and W. A. Van Engel, editors. Proceedings of the Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Murphy, M. L. and G. H. Kruse. 1995. An annotated bibliography of capture and

handling effects on crabs and lobsters. Ala. Fish. Res. Bull. 2(1):23-75.

Newman, M. and C. W. Ward, Jr. 1973. An epizootic of blue crabs, *Callinectes sapidus*, caused by *Paramoeba perniciosa*. Jour. Invert. Pathol. 22:329-334.

Orth, R. J., K. L. Heck, and J. van Montfrans. 1984. Faunal communities in seagrass beds: a review of the influence of plant structure and prey characteristics on predator-prey relationships. Estuaries 7:339-350.

Orth, R. J. and J. van Montfrans. 1990. Utilization of marsh and seagrass habitats by early stages of *Callinectes sapidus*: a latitudinal prespective. Bull. Mar. Sci. 46(1):126-144.

Overstreet, R. 1982. Metazoan symbionts of the blue crab. Pages 81-87 in H. M. Perry and W. A. Van Engel , editors. Proceedings of the Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Pearson, J. C. 1948. Fluctuations in the abundance of the blue crab in Chesapeake Bay. U. S. Fish Wildl. Serv., Res. Rep. 14.

Perry, H. M., J. Warren, C. Trigg, and T. VanDevender. (in press). The status of the blue crab fishery in Mississippi. in S. J. Jordan, editor. The Blue Crab Fisheries of North America: Research, Conservation, and Management.

Prochaska, F. J. and T. G. Taylor 1982. Cyclical and seasonal effort-yield functions for the Florida west coast blue crab fishery. Pages 187-194 in H. M. Perry and W. A. Van Engel, editors. Proceedings Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Rabalais, N. N., Q. Dortch, D. Justic, M. B. Kilgen, P. L. Klerks, P. H. Templet, and R. E. Turner. 1995. Status and trends of eutrophication, pathogen contamination, and toxic substances in the Barataria-Terrebonne estuarine system. Barataria - Terrebonne Nat. Est. Prog., BTNEP Publ. 22.

Roberts, K. J. and M. E. Thompson. 1982. Economic elements of commercial crabbing in Lake Pontchartrain and Lake Borgne. La. St. Univ., Sea Grant Publ. LSU-TL-82-001.

Rogers, B. D. and W. H. Herke. 1985. Estuarine dependent fish and crustacean movements and weir management. Pages 201-219 in C. F. Bryan, P. J. Zwank and R. H. Chabreck, editors. Proceedings of the Fourth Coastal Marsh and Estuary Management Symposium. La. Coop. Fish. Res. Unit Contrib. No. 38.

Rogers, S. G., J. D. Arredondo, and S. N. Latham. 1990. Assessment of the effects of the environment on the Georgia blue crab stock. Ga. Dep. Nat. Resourc., S-K Proj. No. NA90AA-H-SK018 Final Rep.

Ruiz, G. M., A. H. Hines, and M. H. Posey. 1993. Shallow water as refuge habitat for fish and crustaceans in nonvegetated estuaries - an example from Chesapeake Bay. Mar. Ecol. Prog. Ser. 99(1-2):1-16.

Sandoz, M. and R. Rogers. 1944. The effect of environmental factors on hatching, molting, and survival of zoea larvae of the blue crab *Callinectes sapidus* Rathbun. Ecology 25:216-228.

Smith, E. M. and P. T. Howell. 1987. The effects of bottom trawling on American lobster, *Homarus americanus*, in Long Island Sound. Fish. Bull. 85(4):737-744.

Smith, L. D. 1990. The frequency and ecological consequences of limb autotomy in the blue crab, *Callinectes sapidus* Rathbun. Doctoral Dissertation. Univ. Md., College Park.

Steele, P. and H. M. Perry (eds.). 1990. The blue crab fishery of the Gulf of Mexico United States: a regional management plan. Gulf St. Mar. Fish. Comm., Publ. 21.

Stevens, B. G. and R. A. MacIntosh. 1993. Modified lobster traps for catching crabs and keeping lobsters out. Jour. Fish. Res. Bd. Can. 32(12):2515-2520.

Supan, J. (in press). Advisory and industry activities of the Louisiana soft crab fishery. in Second National Soft Shelled Crab Symposium. Va. Inst. Mar. Sci.

Sykes, J. S. and C. S. Manooch, III. 1978. Estuarine predator-prey relations. Pages 93-101 in H. Clepper, editor. Predator-Prey Systems in Fisheries Management. Sport Fishing Institute.

Tagatz, M. 1968. Growth of juvenile blue crabs, *Callinectes sapidus* Rathbun, in the St. JohnsRiver, Florida. Fish. Bull. 67(2):281-288.

Tagatz, M. E. 1969. Some relations of temperature acclimation and salinity to thermal tolerance of the blue crab, *Callinectes sapidus*. Trans. Am. Fish. Soc. 98(4):713-716.

Thomas, J. L., R. J. Zimmerman, and T. J. Minello. 1990. Abundance patterns of juvenile blue crabs (*Callinectes sapidus*) in nursery habitats of two Texas bays. Bull. Mar. Sci. 46(1):115-125.

Titre, J., Jr., J. E. Henderson, J. R. Stoll, J. C. Bergstrom, and V. L. Wright. 1988. Valuing wetland recreational activities on the Louisiana coast. U. S. Army Corps Engr., Final Rep.

Turner, R. E. 1977. Intertidal vegetation and commercial yields of penaeid shrimp. Trans. Am. Fish. Soc. 106(5):411-416.

Turner, R. E. 1979. Louisiana's coastal fisheries and changing environmental conditions. Pages 363-367 in J. W. Day, D. D. Culley, Jr., R. E. Turner, and A. J. Mumphrey, Jr., editors. Proceedings: Third Coastal Marsh and Estuary Management Symposium. La. St. Univ. Div. Cont. Educ.

Van Engel, W. A. 1982. Blue crab mortalities associated with pesticides, herbicides, temperature, salinity, and dissolved oxygen. Pages 187-94 in H. M. Perry and W. A. Van Engel, editors. Proceedings Blue Crab Colloquium. Gulf St. Mar. Fish. Comm., Publ. 7.

Van Engel, W. A. 1987. Factors affecting the distribution and abundance of the blue crab in Chesapeake Bay. Pages 179-209 in S. K. Majundar, L. W. Hall, Jr., and H. M. Austin, editors. Contaminant and Management of Living Chesapeake Bay Resources. Penn. Acad. Sci.

Van Montfrans, J., C. E. Epifanio, D. M. Knott, R. N. Lipcius, D. J. Mense, K. S. Metcalf, E. J. Olmi, M. H. Posey, E. L. Wenner, and T. L. West. 1995. Settlement of blue crab postlarvae in western North Atlantic estuaries. Bull. Mar. Sci. 57(3):834-854.

Vermeer, G. K. 1987. Effects of air exposure on dessication rate, hemolymph chemistry, and escape behavior of the spiny lobster, *Panulirus argus*. Fish. Bull. 85:45-51.

Wassenberg, T. J. and B. J. Hill. 1989. The effect of trawling and subsequent

handling on the survival rates of the by-catch of prawn trawlers in Moreton Bay, Australia. Fish. Res. 7:99-110.

West, D. R. 1981. Predictions of blue crab yields for the northern Gulf of Mexico. Master's Thesis. La. St. Univ. , Baton Rouge.

Wilber, D. H. 1994. The influence of Apalachicola River flows on blue crab, *Callinectes sapidus*, in north Florida. Fish. Bull. 92:180-188.

Williams, A. B. and T. W. Duke. 1979. Crabs (Arthropoda: Crustacea: Decapoda: Brachyura). Pages 171-237 in C. W. Hart, Jr. and S. L. H. Fuller, editors. Pollution Ecology of Estuarine Invertebrates. Academic Press.

Williams, A. H., L. Coen, and M. Stoelting. 1990. Seasonal abundance, distribution, and habitat selection of juvenile *Callinectes sapidus* (Rathbun) in the northern Gulf of Mexico. J. Exp. Mar. Biol. Ecol. 137:165-183.

Winget, R. R., C. E. Epifanio, T. Runnels, and P. Austin. 1976. Effects of diet and temperature on growth and mortality of blue crab, *Callinectes sapidus*, maintained in a recirculating culture system. Proc. Nat. Shellfish. Assoc. 66:29-33.

Winkler, P. 1987. Effects of handling on the in situ oxygen consumption of the American lobster (*Homarus americanus*). Comp. Biochem. Physiol. 87-69-72.

Zimmerman, R. J., T. J. Minello, M. C. Castiglione, and D. L. Smith. 1990a. Utilization of marsh and associated habitats along a salinity gradient in Galveston Bay. U.S. Dept. Comm., NOAA Tech. Memo. NMFS-SEFC-250.

Zimmerman, R. J., T. J. Minello, D. L. Smith, and J. Kostera. 1990b. The use of *Juncus* and *Spartina* marshes by fisheries species in Lavaca Bay, Texas with reference to effects of floods. U.S. Dept. Comm., NOAA Tech. Memo. NMFS-SEFC-251.

APPENDIX 1. POTENTIAL HABITAT, BIOLOGICAL, AND FISHERY RELATED FACTORS

Habitat Quality Factors

Marsh Loss/Habitat Changes

Annual marsh loss is approximately 25 square miles in Louisiana. Studies have found a significant relationship between production of blue crabs (Orth and Montfrans, 1990) or other estuarine species (Turner, 1977 and 1979; Deegan et al., 1986) and total vegetated habitat among Gulf states. The impact of marsh loss on blue crab production may not be evident because biological productivity increases temporarily in deteriorating marshes (Gagliano and Van Beek, 1975), possibly due to increased shallow marsh-water interface habitat and increased detrital input associated with deteriorating marshes. Drop net sampling data (Thomas et al., 1990; Zimmerman et al., 1990a and 1990b) and tethering experiments on blue crab and other crabs (Heck and Thoman, 1981; Ruiz et al., 1993; Hines and Ruiz, 1995) have verified the importance of the shallow marsh-water interface, perhaps by providing an abundant source of food and a refuge from predation. Biological productivity, however, will eventually decrease as the conversion of marsh to open water continues and edge habitats in suitable salinity regimes declines below a "critical point." Browder et al. (1989) postulated that land-water interface in the Terrebonne-Barataria estuaries would begin to decline by the mid-1990s, after which brown shrimp (*Penaeus aztecus*) production would decline sharply.

Approximately 30% of the total wetland area in the Louisiana coastal zone was intentionally impounded before 1985 (Day et al., 1990), and leveed, impounded marsh management units with weirs or other water control structures will probably increase in the future (Herke and Rogers, 1989). Impoundment of marshes usually has short-term detrimental effects on estuarine dependent species such as blue crab because of interference with migratory cycles (Herke, 1979; Rogers and Herke, 1985; Herke and Rogers, 1989).

Salinity levels have probably increased in coastal Louisiana in association with marsh loss. The blue crab utilizes all salinity regimes of an estuary, with various life cycle stages occupying specific salinity regimes (Guillory et al., 1996). Disruption of these salinity gradients could have adverse impacts on blue crabs (Guillory, 1996). Increased salinities would reduce the critical low salinity nursery habitats.

Conclusion: Marsh loss and associated habitat changes may have already impacted blue crab populations. Evidence strongly suggests that productivity or carrying capacity of estuarine-dependent species such as blue crab will eventually decline, or may have already begun to decline.

Contaminants/Water Quality

Potential sources of toxic contaminants (pesticides, herbicides, heavy metals, and other organics) into Louisiana estuaries include urban and agricultural runoff, drilling fluids and produced water from the petroleum industry, oil spills, and other industries. Some life history characteristics make the blue crab more susceptible to accumulation of toxins (preference for feeding on bottom-dwelling organisms, such as filter feeding bivalve mollusks, and burying into sediments in extremely cold weather) while the short life span and migratory habits render the species less susceptible (Williams and Duke, 1979; Chesapeake Bay Program, 1996). Although

the effects of various pollutants/toxins under laboratory conditions have been documented (Guillory et al., 1996; Heukelem, 1991), and data shows that there have been mortalities of blue crabs along the Atlantic Coast due to Kepone, DDT, or other pesticides (Newman and Ward, 1973; Van Engel, 1982) during the 1950s and 1960s, there are insufficient data to assess the impacts of these toxicants on blue crabs in Louisiana estuaries.

Eutrophication, a natural process resulting from the addition of nutrients, has been greatly accelerated by human activity. Eutrophication in the mid- and upper-reaches of Louisiana estuaries, critical nursery grounds for juvenile blue crabs, has been documented, and there is evidence that eutrophication has increased in recent decades in the Barataria and Terrebonne estuaries (Rabalais et al., 1995). Eutrophic waters are characterized by frequent algal blooms and periodic hypoxia, or low levels of dissolved oxygen.

Conclusion: Although there is insufficient data to quantify the effects of toxins and eutrophication on blue crabs or other estuarine species, the potential for deleterious effects exists.

Biological/Other Factors

Food Supply

Juvenile and adult blue crabs have been characterized as opportunistic benthic omnivores, detritovores, cannibals, and scavenger, with food habits determined by local abundance and availability of prey (Darnell, 1961; Laughlin, 1979; Guillory et al., 1996). Laughlin (1982) concluded that it is difficult to place blue crabs in one trophic level.

Conclusion: Since starvation is less likely in species with opportunistic feeding habits than in species with specialized feeding habits, supply may or may not be significant.

Parasites and Diseases

Several comprehensive reviews (Johnson, 1978; Overstreet, 1982; Couch and Martin, 1982; Moody, 1982; Van Engel, 1987; Messick and Sinderman, 1992) have indicated that there have been no significant mortality impacts from parasites and diseases in Gulf of Mexico estuaries.

Conclusion: There is little impact from parasites and disease on wild populations of blue crabs.

Predation

The impact of predation on the distribution and abundance of blue crabs has been alluded to on numerous occasions. Orth and van Montfrans (1990) and Heck and Coen (1995) suggested that documented higher predation rates along the Gulf Coast than along the Atlantic Coast negates the effects of increased postlarval abundance and greater area of marsh and seagrass beds. Heck and Coen (1995) further elaborated that the greater diversity of predators and warmer temperatures would result in higher predation rates in the Gulf of Mexico than along the Atlantic Coast, and that a slight increase in the predation rate could have fairly dramatic effects on blue crab populations. Yearly variability in blue crab predation rates was documented by Hines and Ruiz (1995), who found more than a twofold range in mortality of tethered blue crabs over a five-year period. Orth and van Montfrans (1990) concluded that predator diversity and respective predator densities must be considered in analyzing temporal patterns of blue crab abundance because predation could have a major role in determining blue crab post-settlement mortalities and thus population size. Predation from larger conspecifics and fishes have been reported to influence the local distribution and abundance of juvenile blue crabs (Laughlin, 1979; Hines et al.,

1987; Orth and Montfrans, 1984 and 1990; Thomas et al., 1990; Williams et al., 1990).

In recent years, red drum (*Sciaenops ocellatus*) have been blamed for declining catches of blue crab and the blue crab-red drum predator prey relationship has become a controversial fisheries issue in Louisiana. The apparent preference for blue crab as prey, high population size, relatively large size, and co-occurrence with blue crabs in a wide variety of physical habitats and salinity regimes probably makes the red drum the dominant piscine predator of juvenile and adult blue crabs (Guillory, unpublished). While predation undoubtedly influences blue crab populations, a taxonomically and ecologically diverse and abundant array of species utilize blue crab as prey, and it is premature to assess blame to a single predator for recent declines in blue crab catch rates. Guillory (unpublished) identified at least 58 fish species that prey upon juvenile and adult blue crabs. Predator-prey interactions in the dynamic estuarine ecosystem are very complex (Sykes and Manooch, 1978) and, based upon existing data, it is difficult to separate the influence of red drum predation relative to other predators.

Conclusion: Predation is probably the largest single source of natural mortality on juvenile blue crabs, but data is insufficient to identify a single prey species or describe the extent of effect of particular prey species.

Environmental Factors

Salinity, water temperature, and other environmental factors may affect juvenile and adult blue crab survival. While hatching and larval development occur successfully under a relatively narrow range of salinities and water temperatures (Sandoz and Rogers, 1944; Costlow and Bookout, 1959; Costlow, 1967), juvenile or adult blue crabs can tolerate a wide range of salinities and water temperatures under laboratory conditions (Tagatz, 1969; Holland et al., 1971; Mahood et al., 1970; McKenzie, 1970; Winget et al., 1976). In addition, juvenile and adult blue crabs have been collected over a wide range of temperature (0 to 40 °C) and salinity (0 to 40 ppt) conditions (Copeland and Bechtel, 1974).

Laboratory data on tolerance limits and occurrence of juvenile blue crabs over a wide range of environmental conditions suggest that physicochemical factors such as salinity and water temperature do not appear to be a major cause of mortality; however, several studies have alluded to relationships between environmental conditions such as river discharge, salinity, summer/early fall temperatures, cooling days, and wind stress and blue crab landings or abundance (Pearson, 1948; Turner, 1979; West, 1981; Rogers et al., 1990; Wilbur, 1994). The relationship between one environmental variable, river discharge, and commercial landings was positive in some studies and negative in others, suggesting that river discharge indirectly affects blue crab populations through biotic mechanisms. Meeter et al. (1975) and Laughlin (1979) found that blue crab landings and recruitment were unpredictable based upon environmental factors and suggested that biotic factors (food supply, abundance and distribution of predators) were more important. Laughlin (1979) suggested that increased juvenile blue crab survival could result from exclusion of predators (blue crab, finfishes) from the estuary due to low salinities and/or temperatures.

Conclusion: Environmental factors probably have indirect effects on blue crab populations by influencing distribution of predators or through other biotic effects.

Population Cycles

Population abundance of blue crabs appears to be cyclic, with peaks usually followed by years of declining abundance

and then an abrupt increase to another peak. A two-year cycle in juvenile blue crab Chesapeake Bay abundance (Lipcius and Van Engel, 1990), a five-year cycle in Florida west coast commercial landings (Prochaska and Taylor, 1982), and 18, 10.7, and 8.6 year cycles in Chesapeake Bay commercial landings (Hurt et al., 1979) have been identified. Factors associated with blue crab population cycles are largely unknown.

Conclusion: Although unexplainable, population cycles have significant effects on blue crab population trends.

Fishery Related Factors

Illegal and Incidental Fishing Mortality

Sublegal Harvest. The capture and subsequent sale of sublegal crabs have probably become more prevalent in recent years, and continue to be the most conspicuous enforcement problems in the crab industry (Guillory, 1996). Increased sublegal crab catches in recent years may be attributed to: (a) increased fishing effort, (b) expansion of fishing areas into freshwater areas and shallow marsh ponds where sublegal crabs dominate, (c) adoption of traps constructed with 1.5-inch square mesh wire, which retain significantly higher numbers of sublegal crabs (Guillory and Hein, in press; Guillory and Prejean, in press), and (d) removal of dealer and processor liability for sublegal crab violations due to a change in statutes.

Trap Capture and Handling. For many years there was widespread acceptance that culled sublegal blue crabs caught in traps were released unharmed. However, recent scientific literature suggests that injuries that occur in the trap or during culling, and physiological stress from air exposure results in delayed mortalities or reduced future growth rates in many decapods (see comprehensive bibliography of Murphy and Kruse, 1995). Exposure to air and sunlight has resulted in gill dehydration, eye damage, and physiological changes (increased pumping rates, decreased oxygen uptake, and increased hemolymph-lactic acid and ammonia levels) in various decapod species (Lynch and Webb, 1973; Defur and McMahon, 1978; McMahon et al., 1978; Vermeer, 1987; Winkler, 1987). In North Carolina, there was an average 7% delayed mortality of trap-caught blue crabs (McKenna and Camp, 1992), with no significant differences in mortality of crabs caught in the spring, summer, or fall. Delayed handling mortalities of other trap-caught decapods ranged from 3-15% (Chapman, 1981; Brown and Caputi, 1986; Hunt and Kennedy, 1986; Byersdorfer and Watson, 1992; Stevens and MacIntosh, 1993). In blue crabs, multiple limb loss (Smith, 1990) or chelotomy (Ary et al., 1987) significantly reduced the growth increment at molting. Damaged appendages were documented in 57% (Eldridge et al., 1979) and 25% (McKenna and Camp, 1992) of trap-caught blue crabs. While severe injuries and stress may directly result in mortalities, aberrant defensive and escape behavior resulting from secondary physiological damage after exposure-induced stress (Vermeer, 1987) and limb loss (Brown and Caputi, 1983; Smith, 1990) may also contribute to delayed mortalities in decapods. Small blue crabs may suffer high immediate mortality rates in traps due to conspecific predation by larger individuals (Chesapeake Bay Program, 1996).

Blue Crab Bycatch. The cumulative total of blue crabs captured in shrimp gear is significant. Results from a Texas bycatch study have indicated that 85 million blue crabs are captured annually in the Texas inshore shrimp fishery (Paul Hammerschmidt, Texas Parks and Wildlife Department, unpublished data). Based upon an estimated 1989 bycatch of 227.8 million pounds in the Louisiana shrimp

fishery and the percentage by weight (9.0%) of blue crab (Adkins, 1993), the annual Louisiana blue crab bycatch would have been approximately 20.5 million pounds. Considering that much smaller individuals are captured in trawls, skimmer nets, and wingnets than in crab traps, the number of blue crabs captured in the shrimp fishery exceeds the number harvested by crab fishermen.

Research has indicated that capture in shrimp gear and subsequent culling have significant effects on blue crab survival. The average mortality rate of blue crabs captured in trawls was 36% overall, 26% during the winter months, and 80% during the summer (McKenna and Camp, 1992). Delayed mortalities of trawl bycatch may vary because of differences in temperature, exposure time, amount and level of physical injury, and total catch biomass (Smith and Howell, 1987; Wassenberg and Hill, 1989). Two studies have concluded that blue crab survival was more affected by tow time and culling time than by salt box exposure (Tom Wagner, Texas Parks and Wildlife Department, pers. comm.; Steve Heath, Alabama Department of Conservation, pers. comm.).

Ghost Traps. Overall, ghost trap mortality is substantial when the mortality rate per trap and number of ghost traps are considered. Crab mortalities in unvented ghost traps in Louisiana averaged 25.8/trap for one year (Guillory, 1993) and 17.3/trap for three months (Arcement and Guillory, 1993). Casey and Daugherty (1989) reviewed several ghost trap studies in Chesapeake Bay that yielded the following mortalities — 7.7/trap (100% mortality) from January to March; and, 7.5/trap (33% mortality) in August and September. Blue crab mortality in unvented ghost traps was 3.2 times greater than in vented traps (Arcement and Guillory, 1993). Casey (1990) estimated that annual trap loss in the Chesapeake Bay blue crab fishery was generally in the 10-30% range. The number of ghost traps added each year in Louisiana may be as high as 45,000, if a conservative annual trap loss estimate of 10% and total trap number of 450,000 (Guillory and Perret, in press) is assumed.

Conclusions: Directed fishing mortalities from illegal harvest of sublegal blue crabs and indirect fishing mortality (capture and handling mortalities from traps and shrimp gear, ghost trap mortalities) have important management implications because many larger juveniles approaching legal size are impacted, and probably results in reduced catch of larger, legal crabs. Large juvenile crabs are more likely to reach harvestable size than smaller juveniles because of the probable reduced natural mortality rate. Most trap-caught sublegal crabs will soon attain legal size, since they will increase in carapace width approximately 30% at their next molt (Gray and Newcombe, 1938) and will probably molt within 30-40 days during the spring through fall (Tagatz, 1968).

Excessive Fishing Effort

Excessive fishing effort is defined as fishing effort beyond that needed to reach maximum harvest levels. Total landings in an open access fishery generally increase, but at a decreasing rate, with successive unit increases in effort until reaching a point where no further increase in landings is realized. Consequently, catch (and revenue) per fisherman will eventually decrease in an expanding fishery.

Conclusion: Excessive fishing effort in the Louisiana commercial blue crab fishery is suggested from long term trends in both fishery dependent and independent data: declining commercial fisherman CPUE, increased numbers of traps per fishermen, and decreased legal blue crab CPUE in 16-foot trawl samples.

CHARACTERISTICS OF COMMERCIAL CRAB TRAP GEAR LICENSE HOLDERS

Vincent Guillory
Louisiana Department of Wildlife and Fishereis

The Louisiana Department of Wildlife and Fisheries (LDWF) recently completed a mail survey of commercial crab trap gear license holders and personal interviews with commercial crab fishermen to obtain data on demographics, vessels/gear, fishing effort, fishing practices, economics, and problems/issues in the fishery. Information will be presented on a portion of the mail survey data pertaining to crabbing and overall fishing or trapping income and participation in other fisheries/trapping and nonfisheries activities.

A packet containing the cover letter, questionnaire, and a self-addressed stamped envelope was mailed to 293 individuals, or each tenth 1996 commercial crab trap gear license holder. A follow-up letter was mailed the following week to thank early respondents and to remind nonrespondents to complete and return the questionnaire. The fourth week after the initial mailing, all nonrespondents were sent a second follow-up letter encouraging license holders to participate in the survey and an additional questionnaire and self-addressed stamped envelope.

Discounting the nine questionnaires with invalid addresses, an overall return rate of 64.0% was obtained. Crabbing and overall fisheries/trapping incomes of crab trap gear license holders are shown in Table 1. Approximately 30% of license holders did not crab commercially and only 10% crabbed full-time (i.e., 100% of their income from crabbing). Most (35.2%) license holders got 20-59% of their incomes from crabbing. In contrast, 59.1% of license holders had 100% fisheries or trapping income while 26.2% had no income or no income from crabbing fisheries or other trapping activities. Only 15% of license holders had fisheries or trapping income from 1-99%.

Of license holders who did not crab commercially, 44.2% were merely holding a license (possibly because of speculation associated with a license moratorium), 34.6% crabbed recreationally but apparently wanted to use more than 10 traps (the maximum allowed with a recreational trap license), 13.5% had medical problems, and 7.7% were commercial shrimp trawlers who purchased a trap license because of potential enforcement violations associated with holding crab traps on their boat.

Discounting those with no crabbing income, most (85%) license holders also participated in other commercial fishing or trapping activities. Some (17.4%) of the active commercial crab fishermen also had income sources other than fisheries or trapping. License holders with crabbing income participated primarily in seven other fisheries or trapping activities, with shrimp and finfish being most frequent (Table 2); most of these fishermen participated in one or two other activities and a small percentage (<5%) were involved in four or five.

Data obtained from the mail survey clearly indicate that there is no typical crab trap gear license holder or crab fisherman. However, crab trap gear license holders can be classified into several different categories: individuals who did not crab commercially for various reasons; secondary crab fishermen with other nonfisheries

income; secondary crab fishermen with most of their income from other fisheries or trapping activities; primary crab fishermen with lower other fisheries or trapping income; and, full-time crab fishermen with 100% crabbing income.

Table 1. Percentages of crabbing and total fisheries/trapping income to total income of crab trap gear license holders.

***Example to read this table: 9.5% of those holding a crabbing license got 100% of their annual income from crabbing and 59.1% of those holding crab gear licenses and other fisheries/trapping licenses got 100% of their annual income from fishing and trapping.**

Percentage of Total Income from License-Related Work	Crabbing License	Fisheries/Trapping License
0	29.7	26.2
1-19	8.8	3.6
20-39	19.4	3.0
40-59	15.8	4.8
60-79	7.7	1.8
80-99	9.5	1.2
100*	9.5	59.1

Table 2. Percent participation in type and number of other income producing activities of crab trap gear license holders who crabbed commercially.

***For example: 61% of those with crab trap gear licenses obtained income from shrimping and 47.7% of crab trap gear license holders had income from one other fishing and trapping source besides crabbing.**

	Percent of Total
Other Income-Producing Activities	
Shrimp*	61.1
Finfish	31.4
Fur	9.9
Alligator	9.1
Oysters	7.4
Crayfish	3.3
Bait minnows	0.8
No. of Other Fisheries/Trapping Activities Participated In	
One*	47.7*
Two	37.5
Three	7.9
Four	4.5
Five	2.2

LEGISLATIVE AND COMMISSION CRAB REGULATIONS

Vincent Guillory
Louisiana Department of Wildlife and Fishereis

[NOTE: This is not a legal document; please consult Title 76 (Wildlife and Fisheries legislative acts) or Title 56 (Commission promulgations) for original verbiage. Listed regulations are current as of March 1997.]

Gear

R.S. 56:8. "Crab dropnet" means any device constructed with vegetable, synthetic or metal fibers and without flues or throat, attached to a wire frame that forms a net basket and is used for the purpose of taking crabs. This device must be operated solely by hand and fished in a stationary, passive manner.

"Crab trap" means a cube-shaped device with entrance funnels and either a bait box or materials providing cover or shelter for peeler crabs, which is used for the sole purpose of taking crabs. This device must be fished in a stationary, passive manner.

"Trotline" means any set line with hoop drops tied at various intervals.

"Work box" means a standard crab crate as used by a commercial crab fisherman aboard the vessel to sort or cull undersized crabs from the harvest in order to obtain a legal catch.

R.S. 56:320(B)(3). Crabs may be taken with any legal crab trap, crab dropnet, trawl, trotline, handline, bushline, dip net, or cast net. Dredges cannot be used for the intentional taking of crabs.

R.S. 56:332(A). Crabs of legal size may be taken using any gear identified in R.S. 56:320(B)(3); however, harvest of crabs by trawls in inside waters is permitted only during the open season for shrimp and with a legal commercial mesh size.

R.S. 56:551. In private artificial earthen reservoirs, except in Orleans Parish, crabs of any species may be harvested with seines or tackle selected by the owner.

Commission Action 76:345/R.S. 56:332(D). Each crab trap shall be marked with a 1/2 inch stainless steel self-locking tag containing the fisherman's license number attached to the center of the trap ceiling.

Possession and Size Limits

R.S. 56:326(A). Blue crabs of legal size may be taken in unlimited quantities, provided there is compliance with all other requirements of the law.

Any blue crab less than the minimum prescribed commercial size must be returned immediately to the waters from which it was taken without avoidable injury. Blue crabs less than the commercial legal size may be taken from privately owned ponds, impoundments, or waters and sold to other persons only for purposes of stocking private waters, ponds, or impoundments.

The minimum commercial size limit is five inches in carapace width, except when held for later processing as soft crabs or sold to a processor for making of crabs.

Premolt crabs less than five inches in width held by a commercial fisherman for later processing as softshell crabs must be identifiable as premolt crabs and must be held in a separate container marked "peelers" or "busters." Premolt "buster" or "peeler" stage crabs must be no further from molting than having a white line on the back paddle fin.

R.S. 56:326(B). If more than 10 percent of crabs in a fifty-crab random sample are less than the minimum commercial size limit, the entire number of crabs in that crate or group of crabs equivalent to one crate is in violation.

Crabs in a work box are not subject to the minimum commercial size limits for hardshell crabs while held aboard the vessel. Each fisherman may have one work box, if not using a grader, or two work boxes under the grader, if using a grader.

R.S. 56:326(F). If the wholesale or retail dealer can identify the commercial fisherman who harvested the undersized crabs, only the latter is subject to undersize crab violations.

Commission Action. Twelve dozen crabs per boat or vehicle per day are allowed in Rockefeller Wildlife Refuge (76:309), Marsh Island Wildlife Refuge (76:310), Pointe-au-Chien Wildlife Management Area (76:312), and Salvador Wildlife Management Area (76:313).

Time Restrictions

R.S. 56:332(C). The baiting, tending, checking, or removing of crab traps, the contents of crab traps or their lines, buoys, or markers is prohibited in public waters from one-half hour after sunset until one-half hour before sunrise.

R.S. 56:332(E). Crab traps which are no longer serviceable or in use must be removed from the water.

R.S. 56:410.3. Requires the Commission to set times and days for the recreational and commercial taking of crabs during the inshore shrimp season in Sabine Lake.

Commission Action. Recreational crabbing is allowed from official sunrise to sunset in Rockefeller Refuge (76:309) and Marsh Island Wildlife Refuge (76:310) and from 1 1/2 hours before sunrise to 30 minutes after official sunset on Pointe-au-Chien and Salvador Wildlife Management Areas. Portions of Rockefeller Refuge are further restricted from March 1 to December 1.

Area Restrictions

R.S. 56:332(G). Crab traps cannot be set in navigable channels or entrances to streams.

R.S. 56:332(I). The taking of crabs with legal crab traps, crab pots, nets, and lines shall be permitted in the Lake Catherine and Lake Pontchartrain Sanctuary.

R.S. 56:332(J). Metal tackle or metal crab traps shall not be used in any of the public waters north of the Intracoastal Canal in the Calcasieu River or in any body of water comprising the Calcasieu River System north of the Intracoastal Canal, or in the waters of Vermilion Bay from Cypremort Point one mile offshore to Blue Point.

R.S. 56:405(A). The use of seine, nets, webbing or traps of any and all types is prohibited in the Tchefuncte River.

R.S. 56:410.3. The Commission shall designate areas in Sabine Lake where crab traps or other legal crab gear may be used.

Commission Action. Commercial gear (trawl, trotline, traps) or commercial fishing is not allowed from the Grand Isle shoreline out to the one fathom curve (76:305) or on the following wildlife management areas or refuges: Rockefeller Wildlife Refuge (76:309), Marsh Island Wildlife Refuge (76:310), Pointe-au-Chien Wildlife Management Area with the exception of Wonder Lake and Cut Off Canal (76:312), and Salvador Wildlife Management Area (76:313).

Other Restrictions

R.S. 56:331(A). No person may take diamondback terrapins by traps of any kind.

R.S. 56:332(B). No person can keep or sell adult female crabs in the berry, or egg, stage. All crabs in the berry stage taken by any means must be returned immediately to the waters. However, a legally licensed commercial crab fisherman may have in his workbox an incidental take of crabs in the berry stage in an amount equal to not more than two percent of the total number of crabs in his possession.

R.S. 56:332(E). No person may intentionally damage or destroy crab traps, floats or lines, or remove the contents thereof, other than the licensee or his agent.

R.S. 56:326(F). Commercial fishermen must tag or mark any crabs sold with their commercial fisherman's license number, name, and date harvested.

Licensing Requirements

R.S. 302.3. In addition to the basic recreational fishing license, a recreational fisherman must purchase the appropriate gear license. Gear fees for residents are: $10 for up to 10 crab traps; for traps attached to a trotline, the fee is $1 per trap; $25 for a trawl not exceeding 16 ft. in length. The gear fee for nonresidents is double that of residents.

Any citizen of the state on active military duty shall not be required to purchase a recreational gear license.

R.S. 56:303. All commercial crab fishermen must possess a commercial fisherman's license in his own name ($55 for residents, $200 for nonresidents).

R.S. 56:304. A vessel engaged in commercial crabbing or in possession of crabs for resale in saltwater areas must be licensed in the name of the vessel owner ($15 for residents and $60 for nonresidents).

R.S. 56:305. A commercial crab fisherman must possess an appropriate commercial gear license. Commercial license fees are as follows:

	resident	nonresident
crab trap	$25	$100
crab trap/trotline (per trap up to 25)	$ 1	$ 4
trotline/bushline	$25	$100

R.S. 56:305.6. From January 1, 1996 through December 31, 1998, no person shall be issued a commercial crab trap gear license unless that person possessed a valid commercial crab trap gear license for the year 1993, 1994, or 1995.

R.S. 56:306. A person buying, acquiring, or handling any crabs for resale must purchase a wholesale/retail dealer's license, which is valid for only one place of business.

Wholesale/retail dealer license fees are as follows:

	resident	nonresident
business	$105	$405
vehicles	$105	$405
restaurants/ retail groceries	$30	----

R.S. 56:307. Operators and drivers of any commercial transport except common carriers (ie., person transporting for hire) carrying crabs shall have in their possession one of the following: a commercial fisherman's license, a wholesale/retail dealer's license or a transport license ($30).

R.S. 56:309. An operator of a soft shell crab shedding facility is required to obtain a soft shell crab shedder's license costing $100 for residents and $400 for non-residents.

Reporting Requirements

R.S. 56:309.4. A soft shell crab shedder shall on or before the tenth of each month file a report to the Department detailing the quantity and prices of premolt or buster crabs acquired and soft shell crabs sold.

R.S. 56:345(A). Any wholesale or retail dealer buying crabs from anyone other than a licensed wholesale/retail dealer shall on or before the tenth of each month file a report to the Department detailing the volume and average price per pound purchased.

R.S. 56:345(B). Any commercial crab fisherman selling to anyone other than a resident wholesale/retail dealer shall on or before the tenth of each month send a report to the Louisiana Department of Wildlife and Fisheries.

CRAB TASK FORCE

Vincent Guillory
Louisiana Department of Wildlife and Fishereis

The Louisiana Crab Task Force began in 1989 when Concerned Crabbers of Louisiana sent a letter to Governor Buddy Roemer requesting that a Crab Task Force be formed to address problems in the industry. The Governor directed Virginia Van Sickle, Secretary of the Louisiana Department of Wildlife and Fisheries (LDWF), to assist the group. The Crab Task Force was never officially reauthorized with changes in governors, but it has continued to present.

The Crab Task Force is presently made up of:

a. voting members - 4 dealer/ processors; 2 soft crab shedders; and 7 hard crab fishermen;

b. nonvoting members - marine biologist, LDWF; LSU fisheries agent; enforcement representative, LDWF; economist, LSU; and attorney, LSU Sea Grant.

At its inception, the Crab Task Force recognized some of the major problems/ issues in the blue crab fishery and attempted to resolve them:

Possession of Undersize Crabs

1992 - Successfully sponsored legislation to eliminate an undersize crab loophole. To require that peeler crabs held for shedding must be placed in a separate, marked container.

1995 - Submitted several bills that did not pass:

1. Dual liability for possession of undersize crabs. Provided that both the fishermen and whoever is in possession of the crabs would be in violation of undersize crab laws.
2. Clarification of peeler crab exemption from undersize crab violation. Reworded the exemption for peeler crabs from undersize crab laws in order to close a loophole.
3. Crab strike force. Provided for a special crab harvesters license ($100), with the money dedicated to an enforcement crab strike force.

1996 - Is considering legislation that will subject flagrant (i.e., twice the maximum percentage of allowable undersize crabs) offenders to increased penalties.

Trap and Crab Theft

1991- Recommended a trap marking system to the Wildlife and Fisheries Commission.

1995 - Submitted legislation that did not pass: crab strike force.

1996 - Considered legislation that would subject trap and crab theft offenders to increased penalties.

Limited Entry

1990 - Assisted with the commercial fishery-wide limited entry program proposal.

1995 - Successfully sponsored legislation for a crab trap gear license moratorium. Provided for a license moratorium for crab trap gear licenses—no one could purchase a crab trap gear license from 1996 to 1998 unless they had purchased one in either 1993, 1994, or 1995.

1996 - Discussed limited entry in the crab fishery after the 1996-98 license moratorium expires.

The Crab Task Force has also discussed trap limits, but has not acted upon it.

Other states have enacted various limited entry programs for the blue crab fishery:

1. License moratorium — Alabama, Delaware, Maryland, North Carolina, New Jersey, Virginia
2. Trap limits — Delaware, Maryland, New Jersey, Texas, Virginia
3. Income requirement - Florida

Ghost Traps

1995-96 - Senate Concurrent Resolution No. 175 in 1995 directed the Crab and Shrimp Task Forces to jointly discuss "ghost traps," or lost/abondoned crab traps. The Crab Task Force formed a ghost trap committee to discuss ghost traps and ways to reduce their number. The Task Force plans to sponsor legislation or request the Commission to implement some of their recommendations.

The following measures were approved:

1. Use of a nonfloating or weighted buoy line
2. Minimum buoy size of 7 in. diameter (or equivalent); plastic jugs/bottles not allowed
3. Minimum buoy line size of __ inch, a size to be determined by regulatory agency
4. Education pamphlet for recreational boaters

Other measures that were discussed include:

1. Dated trap tags
2. Definition of ghost trap
3. Disposal sites for ghost traps
4. Crab trap weight specifications

Inadequate Soft Crab Production Data

1996 - Successfully sponsored legislation for a soft crab shedders license. Provided for all soft crab shedders to purchase a shedders license and to report on production.

User Group Conflicts

1992 - Met with the Shrimp Task Force to help resolve shrimper/crabber conflicts in Vermilion Bay.

1996 - See Ghost Traps

Soft Crab Minimum Size Limit

1992 - Successfully sponsored legislation to repeal the 4.5 inch minimum size law; Louisiana was the only state with a soft crab minimum size restrictions.

Crab Gear

1991 - Successfully sponsored legislation to define crab traps, to define legal crab gear, and to exclude the use of crab dredges to harvest crabs.

LOUISIANA LICENSES FOR BLUE CRAB USE

Ken Roberts
Louisiana Cooperative Extension Service
Louisiana Sea Grant College Program

The use of blue crab involves many people. There are harvesters inclusive of commercial and recreational users. Residents and non-residents harvest blue crab. They can use various gear types such as traps and crab traps on trotlines. Recreational harvesters can use the same gear as commercial crabbers.

The following tables demonstrate that:

1. The three year moratorium on commercial crab licenses passed in 1995 by the legislature resulted in a surge of new licenses. Note in the table that between 1994 and 1995 the number of commercial crab trap gear licenses increased from 2,503 to 3,423. People purchased licenses in 1995 when it was apparent moratorium legislation could pass. Note that in 1996 the number dropped to 2,905. Purchase in 1996 was not necessary to preserve the option of purchasing a license once one was bought in either of the base years 1993, 1994 or 1995.
2. The crab industry involves harvesters relying on other fisheries. These include shrimping with trawl, skimmer or butterfly gear. Over 300 were also involved in the gill net fishery. In the Spring of 1996 this gear became illegal. Strike netting is a technique of gill net use in the mullet fishery. Approximately 275 crabbers relied on the mullet strike net fishery. Crabbers not having access to gill-net-derived income will increase effort in the crab trap fishery or other fisheries for which they are licensed.
3. There were more recreational crabbers licensed in 1996 to use crab traps (limited to 10 traps each) than were commercially licensed. The same was true for the crab-trap-on-trotline gear license. Legislative or agency action focusing on use of crab traps will impact more recreational crabbers than commercial crabbers unless a distinction is made between regulations applicable to recreational in contrast to commercial crabbers.
4. The participation of non-resident harvesters is low. This is unlike the shrimp fishery and marine finfish harvest industries.
5. The blue crab processing industry in Louisiana is in economic stress. The number of firms with at least some of their production as blue crab increased but product weight and value per plant is decreasing.

License Categories
Crab trap - any legal number • resident • non-resident Crab trap on trotline • resident Recreational crab trap • resident • non-resident

Commercial Resident Crab Trap

	1995	1996
	3,423 licenses	2,905 licenses
	3,387 people	2,876 people
crab trap gear license+:		
shrimp trawl: per trawl	1,369	1,252
skimmer: per net	726	704
butterfly: per net	383	330
gillnet	337	323
mullet permit	284	262
oyster harvester	139	150

Crab Trap - Any Legal Number

	resident (licenses)	non-resident (licenses)
1985	1,600	
1986	1,985	
1987	2,927	
1988	2,809	
1989	3,019	
1990	2,807	
1991	2,571	
1992	2,734	
1993	2,854	
1994	2,503	
1995	3,423	65
1996	2,905	43

Data not available for non-resident licenses before 1995.

Commercial Crab Trap on Trotline

1995	25 people	321 traps
1996	21 people	298 traps

Recreational Crab Trap and Trotline

	trap (max. 10 traps)	trotline
1995		
resident	2,797 people	164 people 1,295 traps
non-resident	12 people	5 people
1996		
resident	3,152 people	175 people 1,410 traps
non-resident	17 people	5 people

CRAB MANAGEMENT ELSEWHERE

Ken Roberts
Louisiana Cooperative Extension Service
Louisiana Sea Grant College Program

Vincent Guillory
Louisiana Department of Wildlife and Fisheries

East Coast

New Jersey

Trap Limits: 600 in Delaware Bay and 400 in all other areas.

Trap/Buoy Tags: None, although the license number must be displayed on both sides of the boat in numerals not less than 12 inches high and of a color contrasting with the background.

License Limits: To qualify for a 1994 commercial crab pot license, an applicant must have held the same license in 1991, 1992, or 1993 prior to July 9; in subsequent years, the applicant must provide a copy of a previously valid commercial crab pot license for the previous year. Exceptions were provided for persons on active military duty during the period of qualification.

The Department will issue additional (not more than 20% of the number of 1993 licenses) licenses by a lottery system from a pool of applicants between July 9, 1993 and April 20, 1994. No additional licenses will be issued until the number licenses decreases below the number issued in 1991.

A similar license system for crab dredges is in effect, except that no additional crab dredge licenses will be issued until the number of licenses issued decreases below the number issued in 1993 plus 20%. Commercial licenses are non-transferable except that a license holder may transfer the license at any time to a spouse, son, or daughter.

Delaware

Trap Limits: 200 pots. No more than three commercial crab pot licensees may list the same vessel and the maximum number of crab pots that these three licensees may use is 500.

Trap/Buoy Tags: Each buoy will be colored a specific color combination as assigned. The crabbing vessel must display the same color code on a panel measuring at least two feet by two feet.

License Limits: After March 1990, no new crab pot and dredge licenses will be issued until the number drops to 82 or below and to 18 or below, respectively, as of October 31 of any year; at that time, a lottery will be held by the Department to allow the number to increase to 100 pot and 21 dredge licenses.

A crab pot or dredge license may be transferred at any time, including posthumously, to the immediate family (parent, child, sibling, or spouse). A commercial pot license may also be transferred to a designee [Up to two designees may be listed on the license; a designee is authorized to set and tend crab pots in the absence of the license holder] provided that the designee has been listed as same on the license for at least two consecutive years and such license has not been previously transferred to a designee on or after July 1995. No license may be transferred to someone less than 16 years of age. No person will buy, offer to buy, sell,

offer to sell, barter, trade, or otherwise transfer for value a license or the privilege of being designated a designee.

Maryland

Trap Limits: 300 per commercial crab license, with the following exception: for the license year ending August 1994, a licensee who previously held a commercial crab license may set and fish 300 additional crab pots for each additional crew member authorized on the license, but not more than 600 additional crab pots.

Trap/Buoy Tags: Each buoy will be marked with the identification number of the licensee in letters at least two inches high.

License Limits: After April 1996, criteria for a primary candidate for a commercial crabbing license include: a) at least 12 years of age; b) is a current tidal fish licensee who has a license for another fishing activity; c) has been a crew member for at least two years in any commercial fishery as certified by three licensed fishermen; and, d) has a commercial fish license from another state.

Separate waiting lists of primary and secondary candidates, in order of the date and time that applications are received, are maintained. A family member (spouse, child, step child, son- or daughter-in-law, sibling, parent or grandparent, or father- or mother-in-law) who meets the above criteria will be placed at the waiting list of primary candidates. A secondary candidate for a commercial crabbing license is any applicant who is at least 12 years of age and who cannot qualify as a primary candidate.

A license may be transferred to a family member if the person is currently on the commercial crab license primary candidate list or, upon death of the licensee, if the licensee had indicated that person's name on the license application on file with the Department. The license, with the Department's approval, may be transferred for 30 to 90 days regardless of whether the transferee is on a waiting list. A person may not transfer a license in exchange for any type of remuneration.

Virginia

Trap Limits: 500 total, but with no more than 300 in Chesapeake Bay tributaries. Individuals will be limited to the number of hard crab pots they held previously. Individuals who did not hold a 1995 hard crab pot license, but who are licensed under other provisions, will be limited to 100 hard crab pots in 1996.

Trap/Buoy Tags: None. [Proposed but not passed: All pot buoys must be marked with a serially numbered tag issued by the Commission; the tags may not be transferred to another person.]

License Limits:

Crab dredge

The total number of dredge licenses issued beginning in the 1994-1995 season will be limited to the number of 1993-1994 licenses and will be based upon the following: a) any person who held a 1993 or 1994 dredge license and who did not harvest crabs during the 1993-94 dredge season will not be eligible to participate beginning in the 1994-1995 dredge season; b) no new dredge licenses will be issued to any applicant after March 31; c) no new crab dredge licenses will be issued to any new applicant until the number of dredge licenses drops to 220 or below as of December 10 of any year.

The Commission may grant exceptions to the above limitations based on scientific, economic, biological, sociological, and hardship factors. A person may transfer his/her license to a member of his/her immediate family (father, mother, daughter, son, brother, sister, or spouse) or to the buyer of

his/her boat and dredge gear provided that the buyer holds a current commercial registration license.

Crab trap

Sale of hard crab or peeler pot licenses for the calendar year 1996 will be limited to the following: (a) any registered commercial fisherman who held a 1995 hard crab pot (or peeler pot) license; (b) any registered commercial fishermen who held one or more of the following licenses: crab pot, hard crab pot, peeler pot license, during at least two years of the calendar years 1990 through 1994 and who is in compliance with all provisions of Regulation 4 VAC 20-610-10 pertaining to harvest reporting; and, c) any registered commercial fishermen who can document to the satisfaction of the Commissioner that he was regularly employed as a mate or crew member on a vessel engaged in the commercial pot fishery.

Exceptions may be granted by the Commission if a significant hardship exists; an exception cannot be granted solely on economic hardship. A person may transfer his/her license to a member of his/her immediate family (father, mother, daughter, son, brother, sister, or spouse) providing that the family member holds a current commercial registration license or to the buyer of his/her boat and gear provided that the buyer holds a current commercial registration license.

North Carolina

Trap Limits: 150 traps per crabber in Newport River but no limits elsewhere.

Trap/Buoy Tags: Each buoy must have the fishermen's name and license number. It is unlawful for traps to remain in the water for more than 10 consecutive days although there is an allowance for hardship that includes mechanical breakdown.

License Limits: In 1994 the North Carolina General Assembly passed a two-year moratorium on the issuance of **all** new commercial fishing licenses. It established the North Carolina Fisheries Moratorium Steering Committee. The Committee was to develop recommendations for new ways to manage marine fisheries. A series of reports were completed in 1996. The General Assembly received the reports and began debate on proposed legislation. As of March 1997 it appears **license limitation** may not be voted on directly. Rather the approach may be to establish or require Fishery Management Plans which would deal with license limitations.

South Carolina

Trap Limits, Trap/Buoy Tags, License Limits: None.

Georgia

Trap Limits: None.

Trap/Buoy Tags: Each buoy must be marked with an alphanumeric identification code issued by the Department; each letter or number must be at least one inch in height, of a color which contrasts with the color of the float, of block character, and spaced so as to be readable from left to right.

License Limits: From April 1, 1995 through June 30, 1997, a commercial crab license will be issued only to those individuals who: a) was in possession of a valid 1994-1995 license year commercial fishing license; b) was listed as an owner or a captain on a valid 1993-1994 or 1994- 1995 non trawler commercial fishing boat license; and, c) can provide evidence satisfactory to the Department that they sold crabs ex-vessel during the 1993-1994 or 1994-1995 license years.

The Department may issue a commercial crabbing license to an individual who

because of hardship reasons was unable to obtain a commercial fishing license during the 1994-1995 license year.

In 1996 Georgia Department of Natural Resources sponsored nine workshops on limited entry for the crab fishery. The specific parts of such a program were in need of more examination. A one year extension of the license moratorium set to expire June 30 could be approved. Log books are also being considered.

Gulf Coast

Florida

Trap Limits: None.

Trap/Buoy Tags: Each buoy must have the license number of the commercial fisherman in letters at least two inches high and the buoy color and license number permanently and conspicuously displayed on the boat. A recreational trap fisherman must have a "R" at least two inches high on the buoy and their name and address permanently affixed to the trap.

License Limits: To purchase a commercial blue crab license, a person must have earned $5,000 per year or 25% of their income from commercial fishing.

The 1995 Legislature declared a 4 year moratorium on stone crab trap permits. Only permits issued during the 1994-95 fiscal year could be renewed. There were 6,270 permits issued during 1994-95. Of those permits, 5,935 were renewed by December 31, 1995 and 5,163 permits were renewed in 1996.

The Marine Fisheries Commission in 1997 issued a directive that the **stone crab** industry begin developing a limited entry plan or the Commission will develop its own plan. The basis of the limited entry consideration is that the number of traps are increasing faster than production is increasing. Consequently, catch per trap is declining. They will compare license limitation and a trap certificate program. The trap certificate program could be similar to the spiny lobster system. It directly tries to reduce the number of traps being fished.

Alabama

Trap Limits, Trap/Buoy Tags, License Limits: None.

Mississippi

Trap Limits/License Limits: Mississippi has no-trap zones in which commercial crabbers cannot place traps.

Trap/Buoy Tags: Traps must be visibly marked with the license number of fishermen, or have a registered color code on the buoy.

Louisiana

Trap Limits: None.

Trap/Buoy Tags: Each crab trap ceiling must be tagged with a stainless steel, self-locking tag containing the fishermen's license number.

License Limits: From January 1, 1996 through December 31, 1998, no person may purchase a commercial crab trap gear license unless that person possessed a valid commercial crab trap gear license for the year 1993, 1994, or 1995. A license reduction proposal is being evaluated by the Crab Task Force.

Texas

Trap Limits: 200 per person

Trap/Buoy Tags: A dated tag with the owner's name and address must be placed on each buoy and replaced every 30 days. Each crab trap must also have a trap tag, costing $1.50 and issued by the State.

License Limits: None at present. However, a bill to establish a commercial crab fishery license management program is in the Texas Legislature. A vote is expected by the end of May 1997. The Texas Parks and Wildlife Department (TPWD) held a series of public meetings before developing the bill. It is somewhat similar to the 1995 Texas Bay & Bait Shrimp Fishery Limited Entry Plan, however, this bill empowers the TPWD to implement a crab license management program in accordance with the crab management plan adopted by the Texas Parks and Wildlife Commission. The Commission will: 1) define licenses, 2) set the maximum number of licenses, 3) set license renewal requirements, 4) allow an auction or lottery to issue new licenses when needed, 5) establish the length of time a license is valid, 6) set conditions for license transfer, 7) set fees, 8) establish an industry funded license buyback program, 9) establish an appeals board, etc.

The stated purpose of the license management program is to promote efficiency and economic stability in the crabbing industry and to conserve economically important crab resources.

A GUIDE TO THE LEGISLATURE

Jim Wilkins
Louisiana Sea Grant Legal Program
Louisiana State University

Services of the Louisiana Legislature

To obtain information on bills throughout the legislative session there are several options:

A. Pulse Line

The phone numbers below will put you in touch with a legislative staff researcher. You can obtain information on bill content, number, sponsor, and status in the legislative process.

1. If you do not know a bill number, but want to find out if there are any bills dealing with crabs, for example, the researcher can do a key word search to find any bills pertaining to that topic. However, due to limitations of their computer system, they may not be able to do a thorough keyword search during periods of heavy usage or if the computers are down.
2. If you already have a bill number, the researcher can provide information more easily. (504-342-2456 / 800-256-3793)
3. The phone number below will connect you to an automated information system which will give you the status of a bill, but you must have the bill number. (504-342-0769)
4. To obtain copies of bills from the legislature, use the following phone numbers (the legislature charges $0.25 per page for copies):

Before the session:

- Senate Docket - 342-2365
- House Docket - 342-6458

During the session:

- Bill Room - 342-2192

Information Available over the Internet

A. For the first time, the full text of proposed legislation will be available over the Internet. The prefiled House Bills are now on the Louisiana Legislature's Internet site, and the Senate Bills are supposed to be put on the site the week of March 10th. Amendments will also be available as they are proposed. Since this is a new service, expect some bugs in the system. The main Internet address is: http://www.state.la.us/state/legis.htm

1. If you already know the bill number, use: http://www.house.state.la.us/97hbills/hb(Bill # here).htm
2. If you want to search for bills by author, use: http://www.house.state.la.us/reps/aut_indx.htm

Services Available from the Louisiana Sea Grant Legal Program

A. The staff of the Sea Grant Legal Program tracks wildlife and fisheries and natural resource related legislation and provides information and copies of bills to the public. We will probably be able to provide copies of the bills faster than the legislature's bill room. (504-388-5931)

You can also contact us by email:
sglegal@unix1.sncc.lsu.edu

Our home page is at:
http://www.lsu/edu/~sglegal/