DISTRIBUTION AND ABUNDANCE OF THE ADULT STONE CRAB, *MENIPPE ADINA*, IN MISSISSIPPI COASTAL AND OFFSHORE WATERS AND THE POTENTIAL FOR DEVELOPMENT OF A FISHERY

FINAL REPORT

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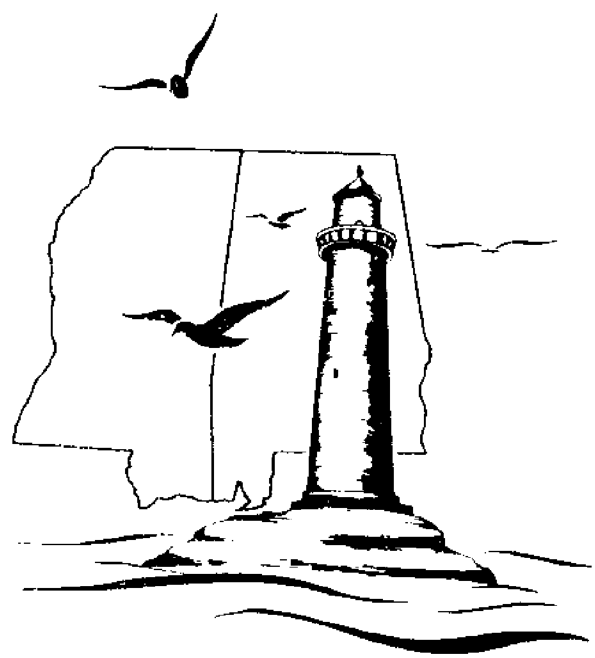

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Distribution and Abundance of the Adult Stone Crab, *Menippe adina*, in Mississippi Coastal and Offshore Waters and the Potential for Development of a Fishery

Final Report to the Mississippi-Alabama Sea Grant Consortium

for Calendar Year 1988

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Project Number R/LR-20-PD

Abstract

A study was conducted to determine the distribution and relative abundance of the stone crab, Menippe adina, in lower Mississippi Sound and associated offshore waters, and to assess the potential for development of a fishery. The study consisted of two phases. In phase one, stone crab traps were deployed at three stations located near barrier island passes and nine offshore stations. Traps were recovered from only seven of the original 12 stations sampled. Adult stone crabs were collected at each of these stations. Highest catches were recorded from the stations located near Horn Island and Dog Keys Passes. The catch of adult stone crabs from stations located more than two kilometers south of the barrier island passes was extremely low.

In phase two of the study, traps were fished for 24-hour periods at three stations located near barrier island passes and five offshore stations. Adult stone crabs were not collected from offshore stations where the water depth was greater than 12.0 meters. As in phase one, the most productive areas were near the barrier island passes; however, the catch per unit effort obtained from these areas was substantially higher during phase two. This difference was attributed primarily to the shorter soak period used during phase two. Estimates of weight of commercial size claws obtained per trap night from stations located near the barrier island passes ranged from 56.7 to 311.6 grams. Recommendations for development of a limited stone crab fishery in Mississippi are presented.

Introduction

There have been several studies conducted in the northern Gulf of Mexico on the life history and fishery potential for the stone crab Menippe adina. Powell and Gunter (1968), made observations on the natural history of stone crabs along the Texas coast. More recently, Perry et al. (1983) and Stuck and Perry (in manuscript) investigated aspects of the life history of M. adina in Mississippi coastal waters. Williams and Felder (1986) described M. adina as a morphologically distinct species from M. mercenaria, which is most common in southwestern Florida, and summarized the geographical distribution of both species. Stuck (1987) reported on population characteristics of M. adina, and gear efficiency in Mississippi Sound. The fishery potential for stone crabs has been evaluated in Louisiana (Horst and Bankston 1985), and Texas (Landry and Linton 1986) coastal waters.

All of the previous studies on M. adina in the northern Gulf of Mexico have been conducted in high salinity coastal areas such as bays and channels in close proximity to the Gulf. There is no information currently available on the abundance and distribution of M. adina in deeper open Gulf waters. Stuck and Perry (in manuscript) reported that a commercially harvestable population of stone crabs existed in lower Mississippi Sound, in the immediate vicinity of the barrier island passes. The offshore extent of this population was unknown. Horst and Bankston (1986) found that the catch of stone crabs in Barataria Bay, Louisiana, increased as water depth increased. A substantial fishery exists for M. mercenaria in the offshore waters of southwest Florida (Sullivan 1979).

The purpose of this study was to determine the distribution and abundance of adult M. adina in offshore waters and to further evaluate the feasibility of a directed fishery for this species in Mississippi. Areas in lower Mississippi Sound and offshore waters suitable for fishing stone crabs are identified and recommendations for development of a limited fishery are proposed.

Materials and Methods

The study consisted of two phases. During phase one, a group of five traps were deployed at each of 12 stations located in lower Mississippi Sound and offshore waters as originally specified in the project proposal (Figure 1). These stations were located near channel markers and bottom obstructions in water depths ranging from 6.2 to 22.9 meters (Table 1). Wooden south Florida style stone crab traps, each weighted with 20 kilograms of concrete were used. The traps were soaked for a minimum of one week prior to deployment. The traps were baited with whole mullet, Mugil cephalus, and were sealed using a plastic wire strap. The traps were fished for periods ranging from 8 to 22 days for approximately two months.

During phase two, traps were fished for 24-hour periods at selected stations (Table 2). The traps were presoaked, baited, and sealed as in phase one. While the traps were in the water, they were attended by project personnel to prevent loss or tampering.

During both phases, the catch of all species of crabs was recorded. Carapace width, handedness (side of the crab bearing the crusher claw), propodus length of both chela, sex, and reproductive condition of the females were recorded for all stone crabs collected. Bottom water samples were collected with a General Oceanics water sampler. Bottom water temperature was recorded with a hand thermometer and salinity with a AO refractometer.

Catch per unit effort (CPUE), expressed as number of crabs captured per trap night, was calculated from the catch data obtained from each station during both phases. Other parameters, such as mean carapace width and standard deviation, sex ratio, and percentage of "legal" claws (70 mm propodus length or greater) collected, were also calculated. Analysis of Variance with a Duncan's Multiple Range Test was used to determine significance between CPUE, carapace width, and sex ratios for M. adina collected from different stations.

RESULTS

Phase one

Traps were deployed during either the last week of May or the first week in June (Table 1). Within the first ten days of the study, traps were recovered from seven stations: 1, 2, 3, 8, 10, 11, and 12. The remaining traps from stations 4, 5, 6, 7, and 9, were lost. By the end of this two-month study, 15 of the 75 traps initially deployed were recovered. Traps remained at only three of the original 12 stations sampled.

Environmental parameters remained relatively constant throughout the study (Table 3). Bottom water salinities ranged from 26.0 to 32.0 ppt.. Temperatures ranged from 26.0 to 29.0°C. Highest salinities and lowest temperatures were recorded from the deep water offshore stations and inshore stations located in the eastern Sound. Menippe adina accounted for 77% of the total catch of crabs. The remaining 23% of the catch consisted of the blue crab Callinectes sapidus, the lesser blue crab C. similis, and the calico crab Hepatus epheliticus.

The catch per unit effort (crabs per trap night) was very low at Ship Island Pass and stations located south of the barrier islands (Table 4). Highest catches were recorded from Horn Island Pass (Station 11), and Dog Keys Pass (Station 12). Adult crabs collected ranged in size from 45 to 120 mm carapace width (CW) with a mean of 89.4 mm. There was no significant difference ($p > 0.05$) in size of crabs collected from different stations. The overall catch was dominated by female crabs; however, at four stations (1, 2, 10, and 11) males were collected in equal or greater numbers than females. Overall, 35% of the claws measured had a propodus length of 70 mm or greater, the minimum size for legally harvestable claws in Florida. The percentage of legal size claws collected at stations 3 and 12 was substantially lower than at other stations.

Phase two

During phase two, additional data on the distribution of adult M. adina, particularly from offshore areas, was collected. This study was designed to eliminate the problem of trap loss experienced in phase one. All traps deployed during this study were recovered untampered.

Three stations, (1, 11, and 12) in Mississippi Sound near the barrier island passes and five stations (3, 6, 8, 9, and 10), located in offshore waters were sampled (Table 5). Bottom water salinities ranged from 27.0 to 32.0 ppt., and temperatures ranged from 26.0 to 28.5°C. Menippe adina accounted for 31% of the total catch of crabs. Other species, including: Callinectes sapidus, C. similis, Hepatus ephelliticus, the swimming crabs Portunus gibbesii and P. spinimanus, and the spider crab Libinia dubia accounted for the remainder of the catch.

Adults of Menippe adina were not collected from the offshore, deep water stations 6, 8, and 9 (Table 6). Highest catches were recorded from stations located nearest the barrier island passes. The adult M. adina collected ranged in size from 45 to 113 mm carapace width, with a overall mean of 89.4 mm. The catch from Dog Keys Pass (Station 12) recorded in July 1987 was significantly greater ($p < .05$) than the catch from all other stations. The M. adina collected from Station 12 in May, 1988, were significantly smaller than the adults collected from other stations. Females dominated the catch at all stations from which adult stone crabs were collected. Overall, 26% of the claws collected were of "legal" size.

Using measurements of claw size recorded in the field for all crabs collected, the CPUE of "legal" size claws (70 mm propodus length of greater) expressed as weight of claws per trap night, can be calculated using the regression equation $Y=43.781 + 0.439X$ (Stuck and Perry, in manuscript). During phase two, CPUE estimates for weight of claws from stations where stone crabs were collected, ranged from 56.7 grams per trap night (Station 3), to 311.6 grams per trap night (Dog Keys Pass, July 1987). The average overall catch from these stations was 114.8 grams per trap night.

Discussion

Distribution and Abundance

The pattern of distribution and abundance of adult Menippe adina observed during both phases of this study were similar. Highest catches were recorded in the immediate vicinity of the barrier island passes. Stations located in offshore waters beyond a distance of one to two kilometers south of the passes and in depths greater than 12.0 meters were least productive. The trapable population of stone crabs in such offshore areas appears to be very small.

There is no other trapping data on offshore populations of M. adina currently available for comparison with the present study. Researchers using SCUBA to study the fish populations associated with offshore reefs have reported sighting stone crabs in water depths of up to 25 meters (Mr. John Cirino, Gulf Coast Research Laboratory, personal communication,). Traps fished in these same areas during the present study were not productive. Shrimp trawlers working in offshore waters in depths of 20 to 30 meters have also reported occasionally catching stone crabs.

In contrast to results from the present study for M. adina, M. mercenaria in southwest Florida is relatively abundant in offshore waters. Williams (1984) reported that M. mercenaria can be found in offshore waters to depths of 51 meters. Bender (1971) reported the highest catch per unit effort recorded during his study of the Cedar Key area of Florida, was from offshore waters. Sullivan (1979) investigated movement of stone crabs between inshore and offshore areas. Bert et al. (1978) reported that fishermen in southwest Florida place stone crabs pots in water depths up to 18 meters, but the size and extent of the deep water population of stone crabs is unknown.

Harvest Potential

The CPUE (catch per unit effort) estimates for stone crabs were substantially different between phase one and phase two of the study. The CPUE for stone crabs calculated from individual stations during phase one, when soak periods ranged from 8 to 22 days, was much lower than

CPUE estimates using the 24-hour soak periods during phase two. The total catch of "other species" of crabs was also greatly reduced when longer soak times were used.

The differences in CPUE estimates between the two phases of the study are undoubtedly the result of an increase in the rate of escapement with increasing soak time. Bert (1981) reported that the proportion of stone crabs escaping from traps steadily increased with increasing soak time. She found that 33% of the stone crabs initially captured in traps escaped within 3 days. In the present study, it appeared that stone crabs and a variety of other species of crabs were actively attracted to freshly baited traps. Once the traps contained a large number of crabs and the bait was depleted, which normally occurred in 48 to 72 hours, the rate of escapement increased, accounting for the low CPUE estimates obtained during phase one. The smaller, more motile species such as the Calico crab, Hepatus epheliticus, and the swimming crabs of the genus Callinectes and Portunus easily escaped from the traps. During phase one of the study, such species accounted for only 22% of the total catch compared to 69% during phase two when the traps were fished for shorter periods.

The overall CPUE by weight of commercial size claws obtained from stations 1, 3, 10, 11, and 12 during phase two was 114.8 grams per trap night. Assuming an average dock-side price of claws of $4.50 per pound, ($9.92 per Kg), each trap would yield $2.56 per trap night. The highest estimate was obtained from Dog Keys Pass in July, ($6.08 per trap night) and the lowest was from Station 3, offshore from Ship Island ($1.24 per trap night). Stuck and Perry (in manuscript) reported and average CPUE of claws by weight from Dog Keys Pass of 46.8 grams per trap night which would yield $1.02 per trap night. Horst and Bankston (1985) estimated a yield of $1.12 to $1.68 per trap for a 7-day fishing period for M. adina from Barataria Bay, Louisiana. The much higher estimates obtained in the present study may be attributed in large part to the short fishing period used during phase two.

Recommendations for Fishery Development

The distribution and abundance of adult Menippe adina in Mississippi coastal and offshore waters and the potential for fishery development can now be summarized from the results of this and previous studies (Perry et al. 1983, Stuck 1987, Stuck and Perry, in manuscript). Adult stone crabs can be found throughout Mississippi Sound wherever salinities above 13.5 ppt. are maintained. Commercially harvestable populations of large adults are found only in the vicinity of the barrier island passes. The extent of these populations appears to be limited to a distance of one to two kilometers offshore and three to four kilometers inshore from the passes. Firm mud bottoms in the deep channels associated with tidal passes are the most productive areas for stone crabs. Any directed fishery for stone crabs should be concentrated in these areas.

Fishing for stone crabs in Mississippi coastal waters is difficult due to several factors. The commercially harvestable populations are concentrated in areas of high water traffic. Loss of traps due to boats inadvertently cutting trap buoys, theft, and tampering, are significant problems when trapping in such high traffic areas. The barrier island passes, where stone crabs are most abundant, are characterized by strong tidal currents; it is difficult to maintain traps in such areas. To prevent traps from drifting out of the area, they must be weighted with a minimum of 20 kilograms of concrete, making the traps difficult to handle and restricting the number of traps that can be carried by small fishing vessels typically used to fish crabs in Mississippi. The trapable population of stone crabs in Mississippi coastal waters appears to be dominated by females, which are of less commercial value than the larger clawed males. Sustained fishing pressure on females may also seriously reduce the reproductive potential of the population. Loss of traps to shrimp trawlers is another serious problem. Adult stone crabs are present in greatest numbers when the shrimp trawling season is open in Mississippi Sound. The high rate of trap loss to shrimp trawlers, as experienced in this and previous studies, would make development of a fishery economically unfeasible.

The development of a directed fishery for stone crabs in Mississippi may be economically feasible using the following techniques and procedures:

1. Wooden south Florida style traps weighted with a minimum of 20 kilograms of concrete should be used.

2. The traps should be pulled and rebaited at least two or three times a week. Whole fish, such as mullet, <u>Mugil cephalus</u>, or Croaker, <u>Micropogonius undulatus</u> appears to be an effective bait.

3. Traps should be fished over firm mud bottoms in the immediate vicinity of the barrier island passes and along the deep channels in the lower Sound leading to the passes.

4. To minimize trap losses to shrimp trawlers, traps should be deployed in early April when substantial numbers of stone crabs first begin to appear, and fished until the opening of trawling season, during the first or second week of June. Traps may be again deployed in late September and fished through November. During this time period, trawling activity is reduced and the abundance of stone crabs, especially large males, is highest.

The results of this and previous studies conducted in Mississippi waters indicate that commercially harvestable numbers of stone crabs are present in lower Mississippi Sound. The extent of this harvestable population appears to be limited to a relatively small area. The limited harvest area and the slow growth rates characteristic of the species may lead to a rapid depletion of the population under the pressure of a sustained directed fishery. Indiscriminate harvesting of stone crabs in Mississippi Sound could also result in a rapid depletion of the population. There are currently no state regulations governing the harvest of stone crabs in Mississippi. Such regulations should be established before harvesting of stone crabs in Mississippi coastal waters is encouraged.

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Table 1. Stations, sampling dates and number of traps recovered during phase one of the study.

Station	Area description	Depth meters	Date deployed	Dates sampled	Number of traps recovered
1	Gulfport ship channel between bouys 35 and 37.	8.3-9.4	5-27-87	6-3-87 6-24-87 7-9-87 7-31-87	5 5 5 5
2	Gulfport ship channel bouy 5.	9.8	5-27-87	6-3-87 6-24-87	5 0
3	Gulfport ship channel "Farewell" bouy.	11.6	5-27-87	6-3-87 6-24-87 7-9-87 7-31-87	5 5 5 5
4	Sunken Hopper Barge 4.1 km south of Camelle Cut.	11.6	6-2-87	6-16-87	0
5	Sunken Hopper Barge 3.2 km south of West Ship Island.	12.7	6-2-87	6-16-87	0
6	Sunken Liberty Ships 6.1 km south of West Horn Island.	16.3	6-2-87	6-16-87	0
7	Sunken Liberty Ships 20.3 km south of West Horn Island.	21.8	6-2-87	6-16-87	0
8	Sunken Barges 17.6 km south of East Horn Island.	22.9	6-2-87	6-16-87 6-16-87	4 0
9	Pascagoula Ship Channel "Farewell" bouy.	14.5	6-2-87	6-16-87	0
10	Pascagoula Ship Channel bouy 1.	10.9	6-2-87	6-16-87 6-29-87 7-31-87	5 5 5*
11	Pascagoula Ship Channel between bouys 15 and 17.	6.2-6.8	6-2-87	6-16-87 6-29-87	1 1
12	Dog Keys Pass bouy 3.	10.5	5-26-87	6-2-87 6-10-87 6-24-87	10 5 0

Total number of traps recovered: 81

* all traps were tampered with, crabs removed.

Table 2. Stations, sampling dates and number of traps deployed and recovered during phase two using 24-hour soak periods.

Station	Date deployed	Number of traps fished
1	7-10-87	20
3	8-4-87	10
6	7-30-87	20
8	8-20-87	20
9	8-20-87	10
10	8-20-87	10
11	6-30-87	20
12	7-24-87	20
12	5-8-88	40

Total number of traps pulled: 170

Table 3 . Summary of enviromental and catch data obtained during phase one of the study. Only those stations and dates from which traps were recovered are reported.

Station	Sampling date	Salinity (ppt.)	Temp. (°C)	Number of crabs collected. *M. adina*	Other species
1	6-3-87	26.0	28.5	0	2 *C. similis*
1	6-24-87	27.0	29.0	3	0
1	7-9-87	27.0	28.5	5	2 *C. similis*
2	6-3-87	26.0	28.0	13	0
3	6-3-87	28.0	27.5	8	0
3	6-24-87	27.0	28.0	18	0
3	7-9-87	29.0	28.5	8	2 *C. sapidus*
3	7-31-87	29.5	28.0	11	0
8	6-16-87	30.0	26.0	1	22 *H. epheliticus*
10	6-16-87	31.0	27.5	12	29 *H. epheliticus*
10	6-29-87	32.0	27.0	17	3 *C. sapidus* 1 *H. epheliticus*
10	7-31-87	32.0	27.0	10	0
11	6-16-87	31.0	28.0	16	0
12	6-2-87	29.0	28.0	56	0
12	6-10-87	30.5	28.5	29	0
	Total number of crabs collected:			207	61

Table 4. Catch per unit effort (CPUE), carapace width (CW), sex ratio and % "legal" claws (70 mm propodus length or greater) for stations from which traps were recovered during phase one. The range, mean, and standard deviation are calculated for CPUE and CW.

Station	CPUE range, (mean) and S.D.	CW mm range, (mean) and S.D.	sex ratio M:F	% legal claws
1	0.0-(0.03)-0.07 S.D.=0.03	70-(92.1)-110 S.D.=12.2	1.0:1.0	47
2	0.11	62-(93.5)-114 S.D.=17.9	1.2:1.0	56
3	0.11-(0.15)-0.22 S.D.=0.05	68-(89.0)-112 S.D.=11.0	1.0:10.0	20
8*	0.02	89.0	0:1.0	50
10	0.17-(0.22)-0.26 S.D.=0.06	50-(85.5)-112 S.D.=14.2	1.8:1.0	42
11	1.14+	69-(90.8)-112 S.D.=11.8	1.0:1.0	55
12	0.50-(0.66)+-0.73	45-(90.3)-120 S.D.=12.8	1.0:2.5	30
	Overall:	45-(89.4)-120 S.D.= 13.0	1.0:1.8	35

* Only one animal collected.
\+ Significant difference (ANOVA; $p < 0.05$)

Table 5. Catch and enviromental data from phase two using 24-hour soak periods.

Station	Date Sampled	Salinity (ppt.)	Temp. (°C)	Number of crabs collected.	
				M. adina	Other species
1	7-10-87	27.5	28.0	35	62 C. similis
					5 C. sapidus
3	8-24-87	28.0	28.5	10	8 C. similis
					1 P. spinimanus
6	7-30-87	30.0	27.5	0	146 C. sapidus
					6 C. similis
					2 P. gibbesii
					2 H. epheliticus
					1 L. dubia
8	8-20-87	32.0	27.0	0	7 C. sapidus
					2 C. similis
					34 P. spinamanus
					138 H. epheliticus
9	8-20-87	32.0	27.5	0	12 C. sapidus
					2 C. similis
					60 H. epheliticus
					2 P. spinamanus
					1 L. dubia
10	8-20-87	32.0	27.5	16	8 C. sapidus
					2 C. similis
					200 H. epheliticus
					2 L. dubia
11	6-30-87	29.0	27.5	56	5 C. sapidus
					17 C. similis
					1 H. epheliticus
12	7-24-87	30.0	28.0	178	6 C. sapidus
					6 C. similis
					1 H. epheliticus
12	5-8-88	27.0	26.0	40	8 C. sapidus
					2 C. similis
Total number of crabs collected:				335	749

Table 6. Catch per unit effort (CPUE), carapace width (CW), sex ratio, and % "legal" claws (70 mm propodus length or greater) for all stations sampled during phase two. The range, mean, and standard deviation are calculated for CPUE and CW.

Station	CPUE crabs	CW mm range, (mean) and S.D.	sex ratio M:F	% legal claws	CPUE claws in grams[1]
1	1.75	46-(91.3)-112 S.D.=14.5	1.0:4.0	25	82.2
3	1.00	74-(89.7)-104 S.D.=9.31	1.0:9.1	40	56.7
6	0	---	---	---	---
8	0	---	---	---	---
9	0	---	---	---	---
10	1.60	77-(89.4)-97 S.D.=7.27	1.0:1.6	44	107.7
11	2.80	63-(92.7)-102 S.D.=9.62	1.0:7.0	20	73.7
12 (July 1987)	8.90[+]	45-(89.4)-110 S.D.=11.2	1.0:6.1	23	311.6
12 (May 1988)	1.00	53-(84.4)-113 S.D.=14.1	1.0:1.7	32	57.0
	Overall:	45-(89.4)-120 S.D.=13.0	1.0:4.6	26	114.8[*]

[+] Significant difference (ANOVA; $p < 0.05$)

[1]Estimated weights were obtained using the regression equation: $Y = 43.781 + 0.439X$ (Stuck and Perry, in manuscript).

[*]Calculated using CPUE data from stations 1, 3, 10, 11, and 12.

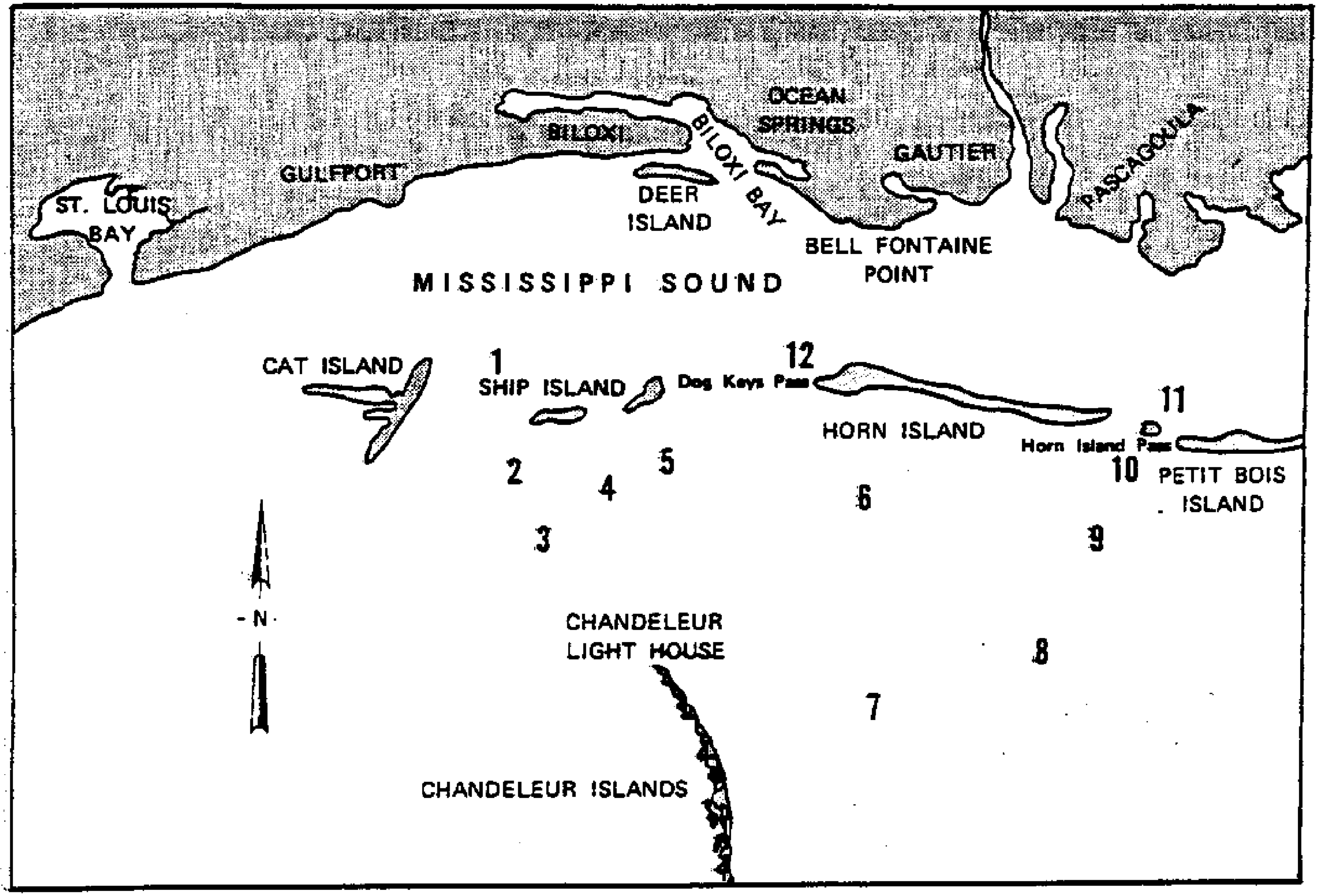

FIGURE 1. LOCATION OF STATIONS SAMPLED DURING PHASE ONE AND PHASE TWO OF THE STUDY.