An Analysis of the Sportfishery For Billfishes in the Northeastern Gulf of Mexico During 1971

EUGENE L. NAKAMURA[1]
and
LUIS R. RIVAS[2]

ABSTRACT

Data were obtained on the sportfishery for billfishes off South Pass, Louisiana, and off northwest Florida in 1971. These data included: dates and times of raises, hookups, and catches by species; locations of raises; areas fished; baits used; water color; surface conditions; boat characteristics. A total of 99 blue marlin *(Makaira nigricans)*, 284 white marlin *(Tetrapturus albidus)*, and 318 sailfish *(Istiophorus platypterus)* was caught and recorded during 11,107 hours of fishing in the northeastern Gulf of Mexico. White marlin was most abundant in July and August, while sailfish was most abundant in the latter half of September off northwest Florida. Similar periods of abundance for these two species were not evident off South Pass. Blue marlin did not have an especially abundant period in either area. White marlin and sailfish were more abundant off northwest Florida than off South Pass, whereas the reverse was true for blue marlin. The hours of greatest relative abundance for all species of billfishes combined were between 1000 and 1200 and again between 1300 and 1500 off South Pass. A similar pattern was found off northwest Florida (1000-1100 and 1400-1500). Results indicated that the bluer the water, the greater the relative abundance of each of the three species. Off South Pass more billfishes were raised along lines and rips than in any other surface condition, whereas off northwest Florida, more billfishes were raised in open water than in any other surface condition. Moon phase appeared not to have any significant effect on billfishing. Neither did the length of the fishing boats. However, of the boats in the 40 to 49 ft length category, those with twin screws raised more billfishes than those with single screw. Off northwest Florida, blue marlin preferred mullet *(Mugil cephalus)* over ballyhoo *(Hemiramphus* sp.) and bonito *(Euthynnus alleteratus)* strip as bait; white marlin showed no preference; while sailfish preferred bonito strip. Off South Pass, data on bait preference were insufficient to allow conclusions.

The sportfishery for billfishes in the northeastern Gulf of Mexico began in the mid-1950's. Although sailfish *(Istiophorus platypterus)* were occasionally caught in nearshore waters, the sportfishery for big game fishes did not get underway until blue marlin *(Makaira nigricans)* and white marlin *(Tetrapturus albidus)* were discovered in offshore waters of the Gulf of Mexico by the research vessel *Oregon* of the U.S. Fish and Wildlife Service (Bullis, 1955). Impressive longline catches of blue marlin and white marlin had been made off South Pass at the mouth of the Mississippi River by the crew of the *Oregon*. Following this discovery, a sportfishery for big game fishes began off the Mississippi delta. The first catches of white marlin, blue marlin, and yellowfin tuna *(Thunnus albacares)* by sportfishermen were made off South Pass in June, 1956 (Kalman, 1970).

In the years that followed, the sportfishery for billfishes expanded, so that sportboats from Pensacola, Destin, and Panama City (all ports in northwest Florida) were also participating in the

[1]NOAA, National Marine Fisheries Service, Gulf Coastal Fisheries Center, Panama City Laboratory, Panama City, FL 32401

[2]NOAA, National Marine Fisheries Service, Southeast Fisheries Center, Miami, FL (present duty station, Panama City Laboratory, Panama City, FL 32401).

FROM Shomura, R. S., and F. Williams (editors), Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, 9-12 August 1972. Part 2. Review and contributed papers. NOAA Technical Report NMFS SSRF-675, 1974.

sportfishery. In Destin, sailfish had been caught as early as 1955, but the first white marlin was landed in 1959 and the first blue marlin in 1962. In 1964, at least 33 marlin (blue and white combined) and 98 sailfish had been caught. The early history and development of the sportfishery for billfishes in the northeastern Gulf of Mexico was reported by Siebenaler (1965).

Boats of various characteristics are used in the sportfishery. Boat lengths vary from less than 20 ft (6.1 m) to over 60 ft (18.3 m). Either gas or diesel engines are used. The number of lines fished from a boat may vary from two to four; however, most boats fish four lines, the two outer lines generally trailing out from outriggers. Most boats also use "teasers," devices trolled at short distances astern to attract fish. Soft drink bottles, bunched-up strands of colored nylon or other synthetic material, and other devices are used as teasers. Generally, two, one on each side of the stern, are used.

Analyses of data on sportfisheries for billfishes are rare, probably owing to lack of record keeping. The best analysis made to date was of the sportfishery for sailfish off Kenya during 1958-68 by Williams (1970). Data from a sportfishery for billfishes combined with data from the commercial fishery were used by Strasburg (1970) for his analysis of the Hawaiian fishery. A report to anglers by Nakamura (1971) presented the results of an analysis of data kept by the New Orleans Big Game Fishing Club for the area off the Mississippi River Delta during the period 1966-70. A subsequent similar report for anglers for the year 1971 was expanded to include the northwest Florida area (Nakamura and Rivas, 1972).

Our report presents the results of studies made on the sportfishery for billfishes in 1971 in the northeastern Gulf of Mexico. This study was initiated in 1970 at the Panama City Laboratory (known then as the Eastern Gulf Marine Laboratory) of the National Marine Fisheries Service in Panama City, Florida. Much data were provided to us by sportsmen and boat captains and members of big game fishing clubs and charter boat associations in New Orleans, Mobile, Pensacola, Destin, and Panama City.

SOURCE AND TREATMENT OF DATA

Two distinct areas were fished (Fig. 1). One was the area off South Pass at the mouth of the Mississippi River. This was fished by members of the New Orleans Big Game Fishing Club. The other was the area offshore of northwest Florida. This was fished by boats out of Pensacola (both the Mobile Big Game Fishing Club and the Pensacola Big Game Fishing Club), Destin (Destin Charter Boat Association), and Panama City (Panama City Charter Boat Association). Because these two areas did not overlap, we separated their respective data in our analyses.

The data supplied by sportfishermen and boat captains were recorded on logs (Fig. 2). The New Orleans Big Game Fishing Club had a chart of the South Pass area on the reverse side of its logs, while the other clubs and associations had a chart of the northwest Florida area on the reverse side of their logs.

The charts of the two areas were divided into 10-minute squares (Fig. 1). Each square was alphabetically and numerically labeled, so that locations of fish sightings and catches could easily be identified. Bottom contour lines were also drawn on the charts. The New Orleans Big Game Fishing Club also added compass headings on its chart. In most instances, the anglers drew their tracks from the start to the end of fishing on the charts and marked the locations of fish sightings along their tracks.

The kinds of data recorded on the logs (Fig. 2) included dates and hours of fishing; areas fished; locations and times of raises, hookups, and catches by species; baits used; water color; surface conditions; and boat characteristics. Morphometric and biological data were obtained on specimens after obtaining permission from the angler or boat captain. The only biological data presented in this report are sex ratios. The morphometric data are presented in another paper (Lenarz and Nakamura, 1974).

Our analyses were made for blue marlin, white marlin, and sailfish. Data for all three plus unidentified billfish were combined for billfishes in general. In some instances, we made analyses only for total billfishes, as data by species involved very small numbers, or zeros.

Three distinct events occur while billfishing: first, a fish is raised, that is, a billfish comes up to a bait from below, or comes over to a bait from a lateral zone, and while the fish may investigate one or several of the offered baits, it may or may not take one; second, the fish may be hooked, and it may be fought for varying lengths of time, and subsequently, either lost or boated; and third, the fish

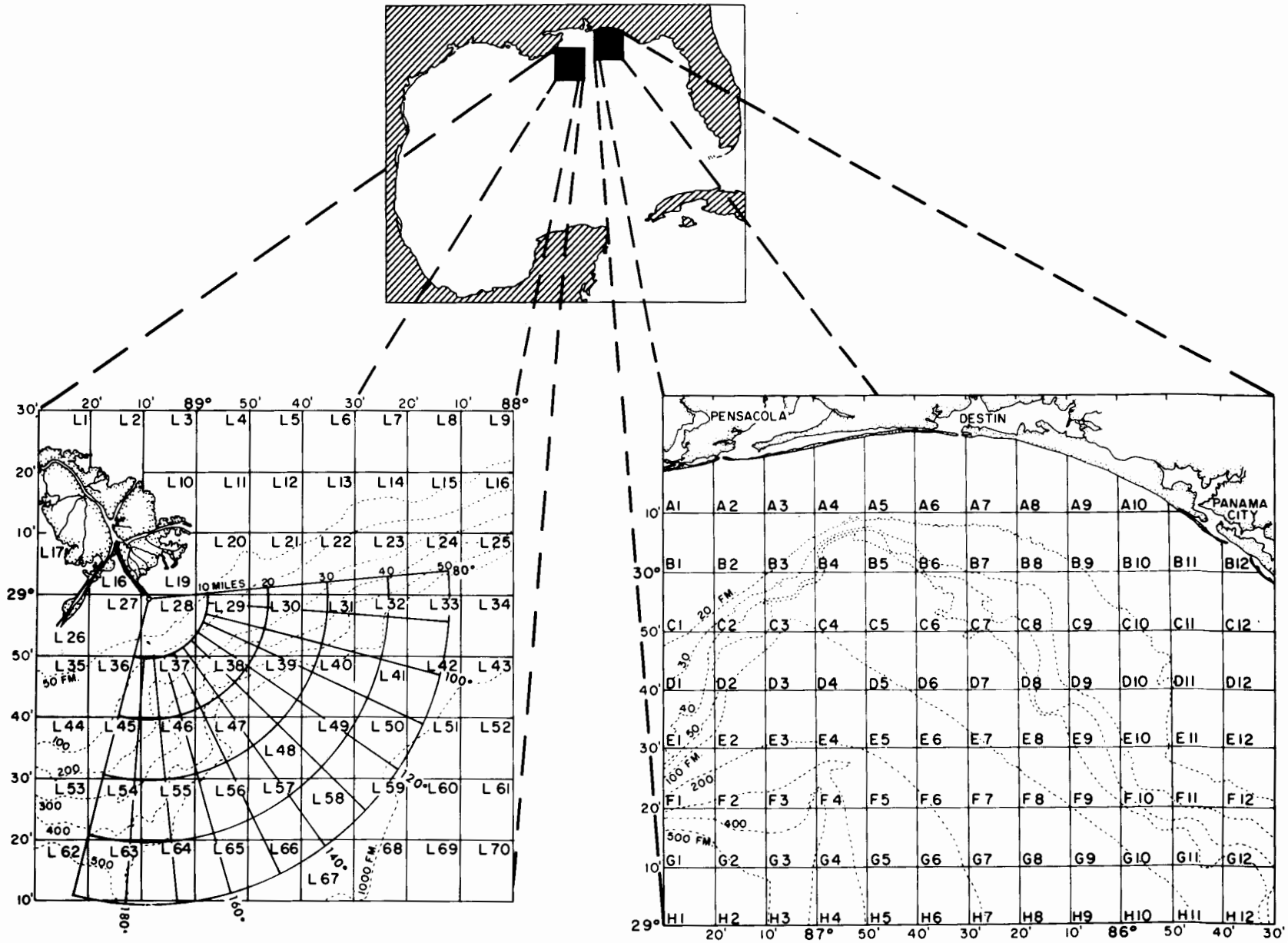

Figure 1.—The two fishing areas in the northeastern Gulf of Mexico.

DAILY BOAT LOG

Date_____ Boat_____ Captain_____

No. Lines Fished_____ Areas Fished_____

Fishing Time: Start_____ End_____

Angler_____ Phone_____

Address_____
Street or P.O. Box City State Zip Code

Species	Time				Bait	Location	Water color	Along rip, sargassum line, in open water, etc.	Weight	Length			Girth	Sex
	Raised	Hooked	Boated	Released						Total	Bill tip (upper jaw) to fork	Lower jaw to fork		

Remarks - Line weight, Reel size:

Figure 2.—Daily boat log used by big game fishermen in the northeastern Gulf of Mexico.

is boated, that is, it is either brought aboard, or brought up to the boat and released.

In determining relative abundance, the number-of-fish-RAISED-per-hour-of-fishing (raises-per-hour) was used as an index in most instances rather than the number-of-fish-CAUGHT-per-hour-of-fishing (catch-per-hour). We felt that the former was much less affected by the skill of the angler than the latter. If a fish were hooked and lost, it would not be included in the catch-per-hour, but it would in the raises-per-hour. Use of raises-per-hour offered an additional advantage: much more data were available. The disadvantages were the possibility of the same fish being raised more than once, and the possibility of misidentification of the species. We felt that the advantages outweighed the disadvantages.

In determining the number of hours fished, we deducted the time spent fighting a fish. Whenever a fish is hooked, all lines except the one with the hooked fish are reeled in. Thus, if a fish were hooked at 1000 h and boated (or lost, or released) at 1130 h, 1½ h were deducted from the total fishing time, which was derived by subtracting the time the lines were put in the water from the time the lines were pulled out preparatory to returning to port.

The number of lines trolled was not considered, as we felt that this factor had little influence on whether or not a fish was raised. Most boats trolled four lines, although a few of the small boats trolled only two or three lines.

Sailfish were often caught while trolling inshore for king mackerel *(Scomberomorus cavalla)*, Spanish mackerel *(Scomberomorus maculatus)*, and cobia *(Rachycentron canadum)*. Since the fishing method for these smaller game fishes is different from big game fishing, all sailfish caught and the effort expended for this type of fishing were disregarded.

Where data were insufficient or lacking to permit the use of raises-per-hour, other indices of relative abundance were used. Catch-per-hour, hookups-per-day, and percentages were used in some of our analyses. True estimates of abundance could not be obtained. Therefore, the term *abundance* when used in this paper refers to relative abundance. Data for years prior to 1971 for South Pass are presented for historical comparison in some tables of this paper. These data were taken from Nakamura's mimeographed report (1971).

We believe that we obtained data from more than 90% of the total effort expended in offshore sportfishing for billfishes in the eastern half of the Gulf of Mexico (from the mouth of the Mississippi River to

the west coast of Florida). The amount of billfishing occurring between Panama City, Florida, and the southern tip of Florida is negligible (less than 5% of the total in the eastern half of the Gulf of Mexico, we believe). Billfishing other than from South Pass and the three ports in northwest Florida (Pensacola, Destin, and Panama City) in the northeastern gulf coast is also negligible (also less than 5% of the total in the eastern half of the Gulf of Mexico).

We do not have any measures of the reliability of the data provided by the sportfishermen. We can report that almost all the sportfishermen appeared to be very sincere and genuinely interested in helping and cooperating with us. Data that were obviously erroneous were discarded; data that were questionable were disregarded.

Further details of the method of analyses are presented in the following sections of this paper.

CATCH, RAISE, AND EFFORT STATISTICS

The number of billfishes raised, hooked, and boated by months for both the South Pass and northwest Florida areas are presented in Tables 1 and 2. Although a few trips were taken as early as April, the fishing season essentially lasts from May through October.

If the percentages at the bottom of Tables 1 and 2 may be considered as indices of the proficiency of anglers, an obviously significant difference can be seen between the two areas for white marlin. In the South Pass area, only 37.1% of the 167 raised white marlin were hooked; of the 167, only 10.8% were boated; and of the 62 hooked white marlin, 29.0% were boated. Comparable percentages for white marlin in the northwest Florida area were 61.0, 39.0, and 63.9. Little difference between areas is seen for the other two species.

Table 1.—Billfishes raised (R), hooked (H), and boated (B, includes releases) off South Pass, 1971.

Species	Blue Marlin			White Marlin			Sailfish			Unidentified Billfish	
Event	R	H	B	R	H	B	R	H	B	R	H
Apr.	0	0	0	1	1	0	0	0	0	0	0
May	13	9	6	6	2	0	0	0	0	2	2
June	32	15	8	18	9	4	4	3	2	0	0
July	60	31	9	40	17	6	12	7	3	0	0
Aug.	68	25	9	86	27	8	32	23	16	5	0
Sept.	26	12	2	11	4	0	2	1	0	0	0
Oct.	4	1	0	5	2	0	2	1	0	0	0
Total	203	93	34	167	62	18	52	35	21	7	2
% of Raised		45.8	16.7		37.1	10.8		67.3	40.4		28.6
% of Hooked			36.6			29.0			60.0		

Table 2.—Billfishes raised (R), hooked (H), and boated (B, includes releases) off northwest Florida, 1971.

Species	Blue Marlin			White Marlin			Sailfish			Unidentified Billfish	
Event	R	H	B	R	H	B	R	H	B	R	H
May	2	2	1	4	3	1	2	2	1	0	0
June	51	37	18	52	29	13	38	16	11	1	1
July	52	32	8	289	167	104	114	68	49	10	2
Aug.	79	44	23	212	126	84	194	123	81	15	1
Sept.	42	18	2	40	27	20	362	197	123	2	0
Oct.	63	36	13	85	64	44	98	49	32	4	2
Total	289	169	65	682	416	266	808	455	297	32	6
% of Raised		58.5	22.5		61.0	39.0		56.3	36.8		18.8
% of Hooked			38.5			63.9			65.3		

Although we are unable to provide any factual information to explain the greater percentages of hooked and boated white marlin in the northwest Florida area, we can provide some conjecture. One is that many more boats from northwest Florida are captained by professional fishermen (charter boat captains), whereas most of the boats from South Pass are captained by sportfishermen. Second, white marlin are much more abundant in northwest Florida, thus providing more experience with this species to the fishermen from this area.

A comparison of the catch, effort, and catch-per-hour of billfishes in the two areas is presented in Tables 3 and 4. Catch-per-hour is used here, as data on raises were not available prior to 1971.

For South Pass, the total number of billfishes (73) caught in 1971 was the second lowest. Fewer white marlin were caught in 1971 than any previous year of record. The catch-per-hour indicated that 1971 was in general a below average year: about average for blue marlin, lowest of any year for white marlin, and below average for sailfish.

More than twice as much effort was expended off northwest Florida (7,890 h) than off South Pass

Table 3.—Catch, effort, and catch-per-hour of billfishes off South Pass, 1966-71.

Year	1966	1967	1968	1969	1970	1971
Number caught						
Blue marlin	57	42	72	25	19	34
White marlin	151	113	95	38	22	18
Sailfish	42	46	30	12	20	21
Total hours fished	—	2,339	5,801	4,139	2,603	3,217
Catch-per-hour						
Blue marlin	—	0.018	0.012	0.006	0.007	0.011
White marlin	—	0.048	0.016	0.009	0.008	0.006
Sailfish	—	0.020	0.005	0.003	0.008	0.007

(3,217 h) in 1971. Of the effort expended in northwest Florida, boats from Destin accounted for 69% of the total.

Blue marlin were more abundant off South Pass than off northwest Florida in 1971, as indicated by the catch-per-hour (0.011 versus 0.008), whereas white marlin (0.034 versus 0.006) and sailfish (0.038 versus 0.007) were more abundant off northwest Florida (Tables 3 and 4).

When raises-per-hour were compared (Table 5), the same conclusions of relative abundance were reached. The reciprocals of raises-per-hour, that is, hours-to-raise-1-fish, are also presented in Table 5. Fewer hours were spent trolling off South Pass to raise a blue marlin (15.9 versus 27.0), whereas fewer hours were spent off northwest Florida for white marlin (11.6 versus 19.2) and for sailfish (9.8 versus 62.5).

SIZE AND SEX RATIO

The range of weights and the average weights for each species for the two areas are presented in Tables 6 and 7. The largest blue marlin, 492.0 lb (223.6 kg), caught in 1971 was off South Pass; the largest white marlin, 86.0 lb (39.1 kg), and the largest sailfish, 67.0 lb (30.5 kg), were caught off northwest Florida by boats from Destin. For South Pass, the range and average for blue marlin was not unusual; neither was the average for sailfish. However, the largest specimens of white marlin, 84.0 lb (38.2 kg), and of sailfish, 58.5 lb (26.6 kg), were smaller than the largest specimens of each species caught in any previous year of record. And the average weight of white marlin, 61.3 lb (27.9 kg), in 1971 was the highest ever.

Females of all three species of billfishes dominated the catches. Sex ratios for the years 1967-71 for South Pass and for 1971 for northwest Florida are presented in Table 8. Only those specimens were examined for which permission was granted.

Table 4.—Catch, effort, and catch-per-hour of billfishes off northwest Florida, 1971.

Port	Pensacola	Destin	Panama City	All Three Ports
Number caught				
Blue marlin	17	43	5	65
White marlin	41	195	30	266
Sailfish	18	265	14	297
Total hours fished	1,834	5,425	631	7,890
Catch-per-hour				
Blue marlin	0.009	0.008	0.008	0.008
White marlin	0.022	0.036	0.048	0.034
Sailfish	0.010	0.049	0.022	0.038

The predominance of females in the blue marlin caught off northeastern Gulf of Mexico is contrary to that in blue marlin caught off Puerto Rico and the Virgin Islands (Erdman, 1962, 1968). There, an equal male-female ratio was found during July and August, the months of spawning. In September, the ratio changed to 4.5:1 in favor of males. The annual average for catches of blue marlin from 1950-66 was 4:1 in favor of males.

Sex ratios of white marlin caught off New Jersey and Maryland, like those caught in the northeastern Gulf of Mexico, also favored females. In 1959, the male-female ratio was 1:2.4; in 1960, it was 1:1.2 (de Sylva and Davis, 1963).

RELATIVE ABUNDANCE BY TIME

The number of raises per hour was determined for weekly periods and hourly periods. Each week began on a Wednesday and ended on the following

Table 5.—Relative abundance of billfishes in the northeastern Gulf of Mexico, 1971.

Area	South Pass	Northwest Florida
Raises-per-hour		
Blue marlin	0.063	0.037
White marlin	0.052	0.086
Sailfish	0.016	0.102
Hours-to-raise-1-fish		
Blue marlin	15.9	27.0
White marlin	19.2	11.6
Sailfish	62.5	9.8

Table 6.—Weights in pounds (kilograms in parentheses) of billfishes caught off South Pass, 1966-71.

Year	1966	1967	1968	1969	1970	1971
Blue marlin						
Range	65.0-565.0 (29.5-256.8)	62.0-565.0 (28.2-256.8)	77.0-465.0 (35.0-211.4)	133.5-686.0 (60.7-311.8)	90.5-535.0 (41.1-243.2)	83.0-492.0 (37.7-223.6)
Average	219.7 (99.9)	299.0 (135.9)	252.0 (114.5)	273.4 (124.3)	273.7 (124.4)	279.4 (127.0)
White marlin						
Range	29.0-100.0 (13.2-45.5)	30.0-134.0 (13.6-60.9)	32.0-85.0 (14.5-38.6)	39.0-86.0 (17.7-39.1)	36.0-85.0 (16.4-38.6)	33.0-84.0 (15.0-38.2)
Average	48.9 (22.2)	46.5 (21.1)	50.0 (22.7)	59.6 (27.1)	53.3 (24.2)	61.3 (27.9)
Sailfish						
Range	27.0-80.0 (12.3-36.4)	25.0-75.0 (11.4-34.1)	36.0-78.0 (16.4-35.5)	35.0-66.0 (15.9-30.0)	25.0-67.0 (11.4-30.5)	37.0-58.5 (16.8-26.6)
Average	45.5 (20.7)	46.4 (21.1)	40.1 (18.2)	51.7 (23.5)	40.3 (18.3)	43.1 (19.6)

Tuesday, so that a weekend was not split. Each hour began on the hour and ended 1 min before the next hour.

The results of our analyses of raises per hour by weekly periods are presented in Figure 3. For the South Pass area, blue marlin were most abundant in late September; white marlin were most abundant in early August; sailfish did not appear to be especially abundant during any week (only 52 sailfish were raised during the entire year). For the northwest Florida area, the highest peak in relative abundance of blue marlin was the week 29 Sept. to 5 Oct., but the weekly variations were not as great as for the other two species; for white marlin the pronounced period of abundance was in mid-July; sailfish were especially abundant during the latter half of September.

Several prominent differences in raises-per-hour by weekly periods are evident between the two areas (Fig. 3). For example, peaks of abundance for white marlin and sailfish in the South Pass area are not as pronounced as in the northwest Florida area. Also, blue marlin are more abundant off South Pass, whereas white marlin and sailfish are more abundant off northwest Florida.

The results of our analyses of raises-per-hour by time of day are presented in Figure 4. The numbers of fish raised and numbers of hours trolled are tabulated in Tables 9 and 10. The early morning (0600 h) peak for South Pass and late afternoon (1800 h) peak for northwest Florida should be regarded cautiously, as these are based on small amounts of effort.

The patterns of abundance by time of day for each species in each area (Fig. 4) show a pre-noon and a post-noon peak, with some showing two pre-noon peaks (blue marlin and white marlin off northwest Florida) and some showing two post-noon peaks (white marlin off northwest Florida, blue marlin and white marlin off South Pass). All show a midday drop in abundance.

When data for all three species from both areas are combined (Fig. 5), a multimodal distribution is seen, the most prominent peak at 1000 h and smaller peaks at 1400 and 1800 h.

Table 7.—Weights in pounds (kilograms in parentheses) of billfishes caught off northwest Florida, 1971.

Port	Pensacola	Destin	Panama City	All Three Ports
Blue marlin				
Range	32.0-481.5 (14.5-218.9)	46.0-426.0 (20.9-193.6)	128.0-253.0 (58.2-115.0)	32.0-481.5 (14.5-218.9)
Average	266.9 (121.3)	180.7 (82.1)	189.1 (86.0)	207.5 (94.3)
White marlin				
Range	40.5-83.5 (18.4-38.0)	31.0-86.0 (14.1-39.1)	42.0-80.0 (19.1-36.4)	31.0-86.0 (14.1-39.1)
Average	56.0 (25.5)	54.9 (25.0)	52.9 (24.0)	54.8 (24.9)
Sailfish				
Range	30.5-43.0 (13.9-19.5)	5.5-67.0 (2.5-30.5)	11.0-50.0 (5.0-22.7)	5.5-67.0 (2.5-30.5)
Average	36.8 (16.7)	37.9 (17.2)	38.1 (17.3)	37.6 (17.1)

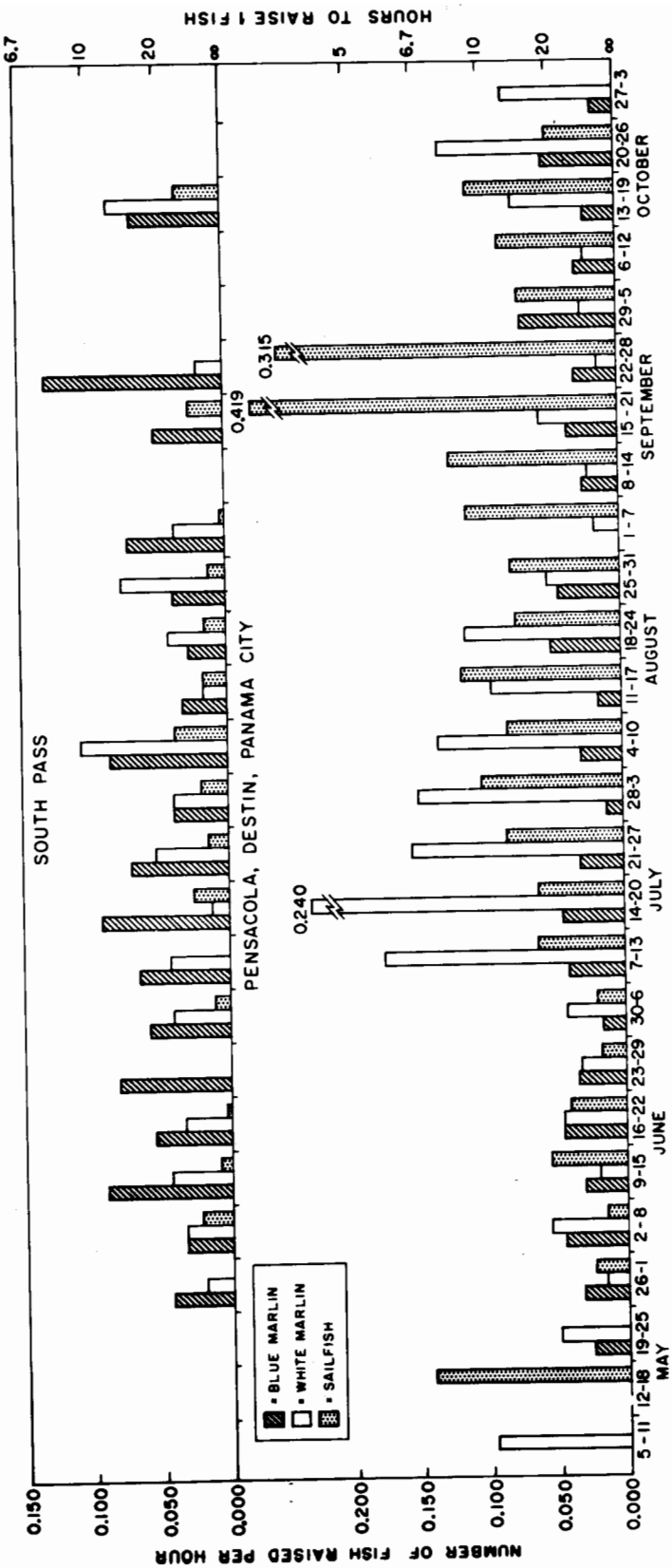

Figure 3.—Relative abundance of billfishes by weekly periods for South Pass and northwest Florida, 1971.

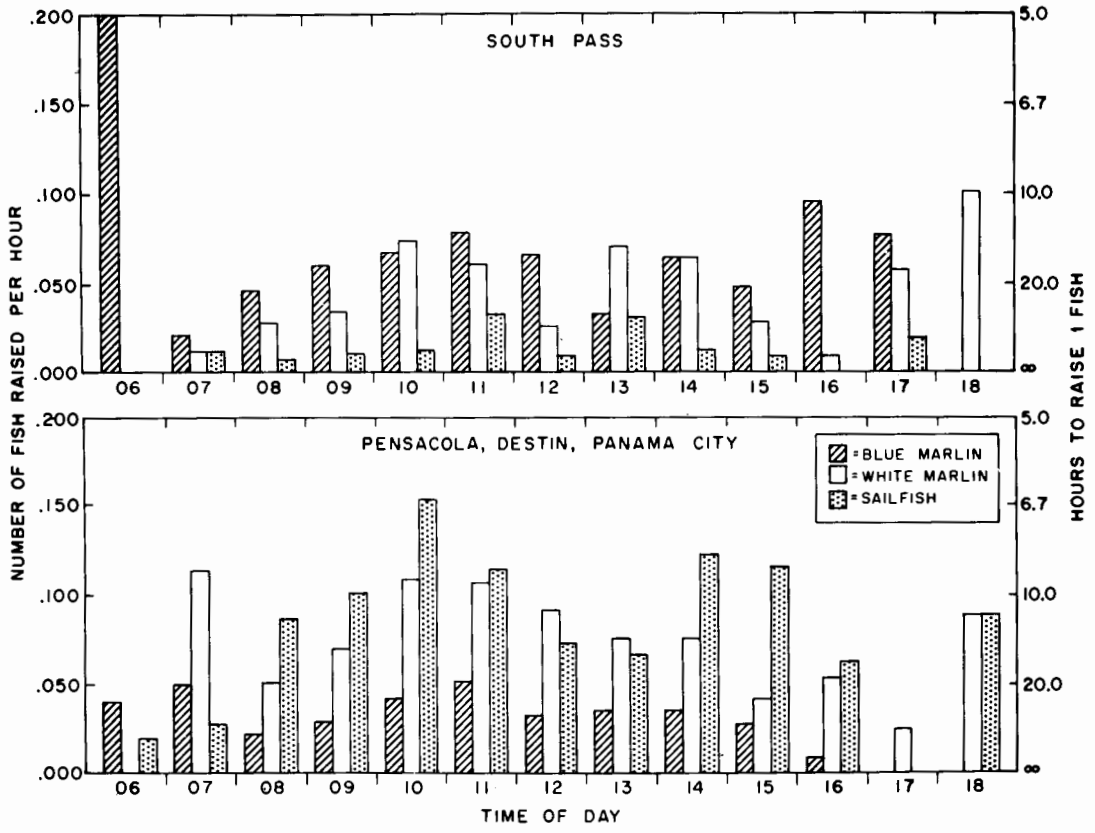

Figure 4.—Relative abundance of billfishes by time of day for South Pass and northwest Florida, 1971.

RELATIVE ABUNDANCE BY TEN-MINUTE SQUARES

To determine the relative abundance of billfishes by ten-minute squares, the data were analyzed by calculating the number of fish raised per hour of fishing within each square during biweekly periods. For South Pass, the biweekly periods were begun on 26 May and were ended 28 September. Effort before and after this period was very low and sporadic. For northwest Florida, the biweekly periods were begun on 26 May and were ended on 9 November for the same reason.

The data for all species combined for the two areas are illustrated in Figures 6 and 7. The data for

Table 8.—Sex ratios of billfishes caught off South Pass, 1967-71, and off northwest Florida, 1971 (no. of males versus no. of females in parentheses).

Area	South Pass					NW Florida
Year	1967	1968	1969	1970	1971	1971
Blue marlin	1:5.6 (5:28)	1:7.7 (6:46)	1:4.8 (4:19)	1:8.0 (2:16)	1:3.3 (7:23)	1:3.1 (12:37)
White marlin	1:2.3 (20:46)	1:3.9 (15:59)	1:6.2 (4:25)	1:4.0 (4:16)	1:4.0 (3:12)	1:4.3 (28:120)
Sailfish	1:2.0 (10:20)	1:3.6 (5:18)	1:8.0 (1:8)	1:1.4 (8:11)	1:2.4 (5:12)	1:2.5 (63:159)

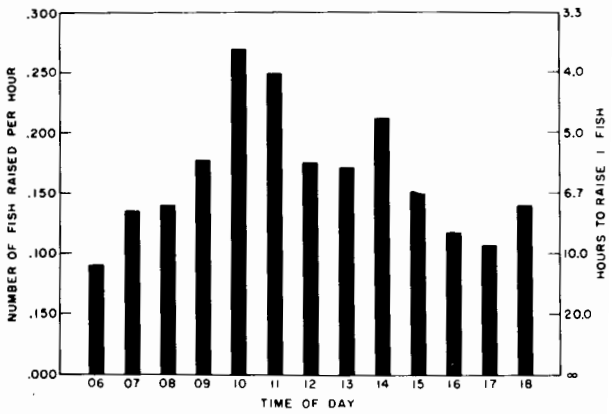

Figure 5.—Relative abundance of billfishes by time of day, South Pass and northwest Florida combined, 1971.

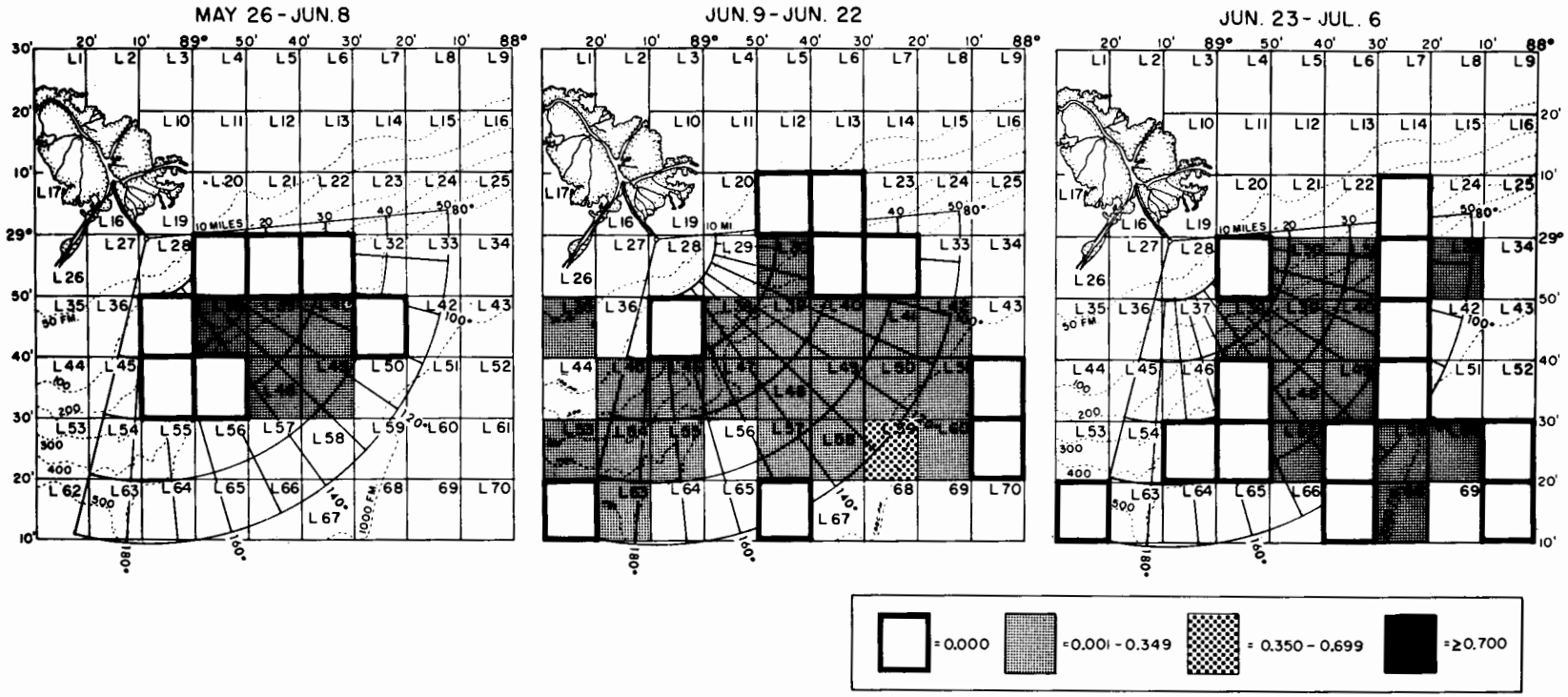

Figure 6.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, South Pass, 1971.

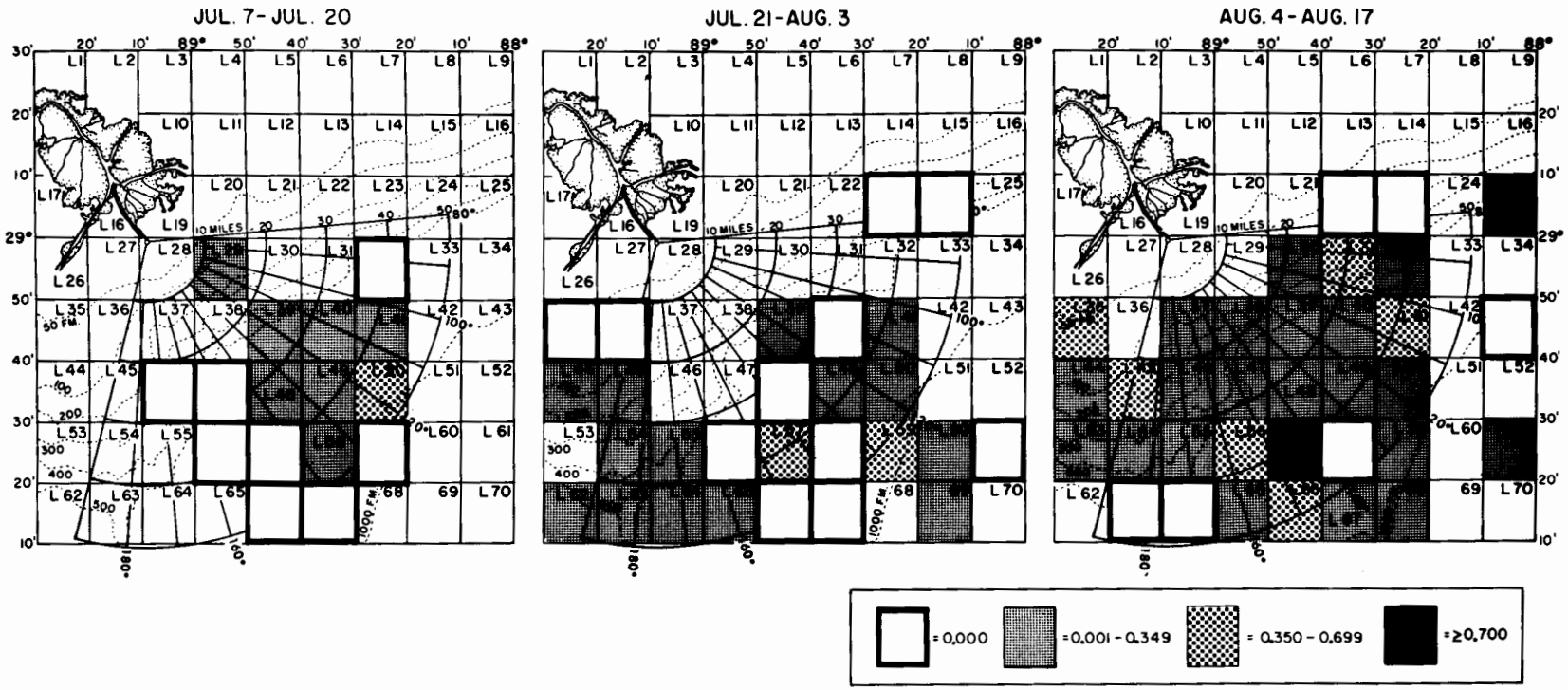

Figure 6.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, South Pass, 1971.—continued.

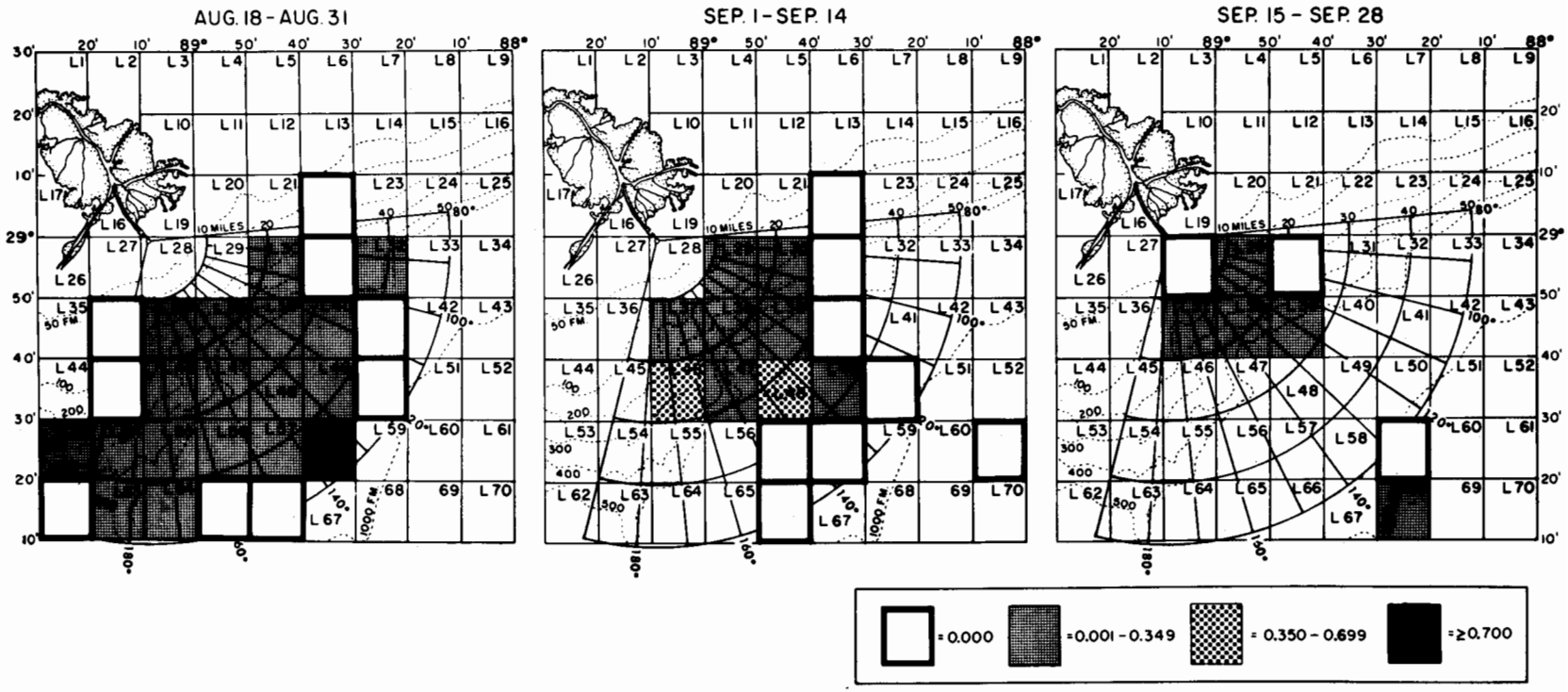

Figure 6.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, South Pass, 1971.—continued.

each species have not been presented, as no particular ten-minute square was consistently high in abundance.

The biweekly periods 9 June-22 June and 4 Aug.-17 Aug. for South Pass, and 23 June-6 July and 4 Aug.-17 Aug. for northwest Florida were the periods with the widest dispersement of fishing effort. Because of this, probably, these periods showed the widest dispersement of billfishes.

The "Nipple," named for the curvature of the 100-fathom line in square C3 (Fig. 7) off northwest Florida, is a favorite fishing site for big game fishermen. It was not especially abundant with billfishes. July was the month during which billfishes were most abundant in the "Nipple" area. As the season progressed, most of the high-abundance squares appeared in the southern sectors in and to the sides of the De Soto Canyon in squares F3, F4, G3, and G4 (Fig. 7).

EFFECT OF WATER COLOR

Water color where billfishes were raised was categorized as blue, blue-green, and green. The few reports stating water color as "dirty water" were excluded.

The results indicate that the bluer the water, the greater the abundance of all three species. As shown in Table 11, the number of fish raised per hour decreased and the number of hours to raise a fish increased from blue to blue-green and again from blue-green to green for each species, except for sailfish. In South Pass, sailfish abundance was about equal in blue-green and green waters and least in blue water, whereas in northwest Florida, it was about equal in blue and blue-green waters and least in green.

EFFECT OF SURFACE CONDITION

Visible surface conditions under which billfishes were raised were categorized as open water, lines or rips, scattered grass, grass patches, and others. The term open water was selected for surface conditions when tide lines or rips, sargassum, and floating objects were not present. Tide rips, tide lines, and lines of sargassum were classed as lines or rips. When sargassum was scattered over the surface and not in large clumps, the condition was classified as scattered grass. When sargassum appeared in clumps or patches, the term grass patch was used.

The number of hours fished in each category

Table 9.—Numbers of billfishes raised and hours trolled by time of day, South Pass, 1971.

Time of day	0600-0659	0700-0759	0800-0869	0900-0959	1000-1059	1100-1159	1200-1259	1300-1359	1400-1459	1500-1559	1600-1659	1700-1759	1800-1859
Blue marlin	1	2	13	23	28	34	28	13	22	12	12	4	0
White marlin	0	1	8	13	31	26	11	28	22	7	1	3	1
Sailfish	0	1	2	4	5	14	4	12	4	2	0	1	0
Unidentified billfish	0	0	1	2	2	1	0	0	0	0	0	0	0
All billfish	1	4	24	42	66	75	43	53	48	21	13	8	1
Hours trolled	5.00	94.50	282.50	384.25	418.75	434.25	425.25	400.50	341.75	253.75	126.00	52.75	10.00

Table 10.—Numbers of billfishes raised and hours trolled by time of day, northwest Florida, 1971.

Time of day	0600-0659	0700-0759	0800-0859	0900-0959	1000-1059	1100-1159	1200-1259	1300-1359	1400-1459	1500-1559	1600-1659	1700-1759	1800-1859
Blue marlin	2	7	13	31	48	60	37	39	34	12	1	0	0
White marlin	0	16	30	75	125	124	104	82	72	18	6	1	1
Sailfish	1	4	51	108	176	132	84	72	117	50	7	0	1
Unidentified billfish	1	1	3	3	5	5	5	6	3	3	1	1	0
All billfish	4	28	97	217	354	321	230	199	226	83	15	2	2
Hours trolled	49.75	140.50	587.50	1,069.75	1,143.00	1,150.75	1,128.00	1,074.50	953.50	429.25	111.75	40.75	11.25

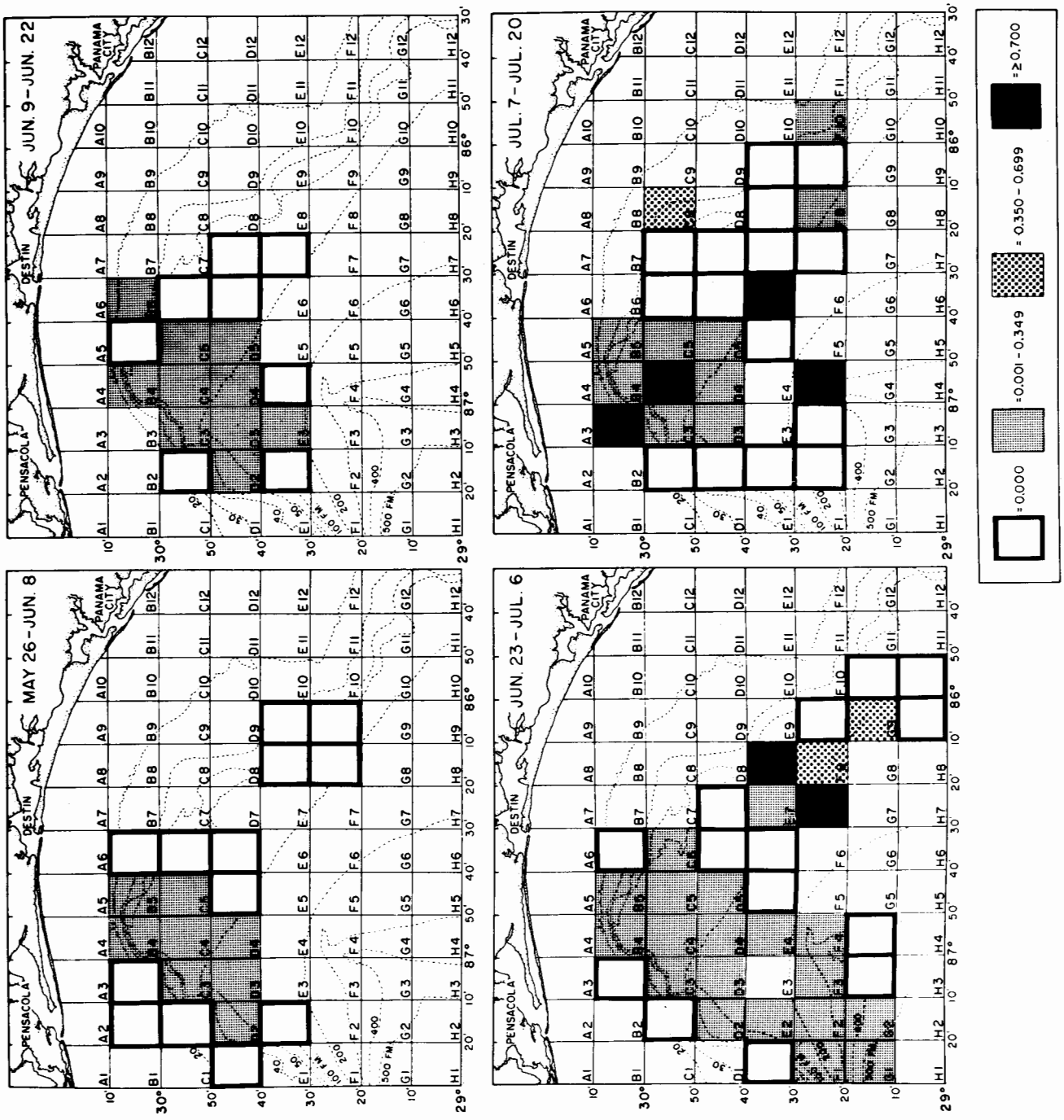

Figure 7.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, northwest Florida, 1971.

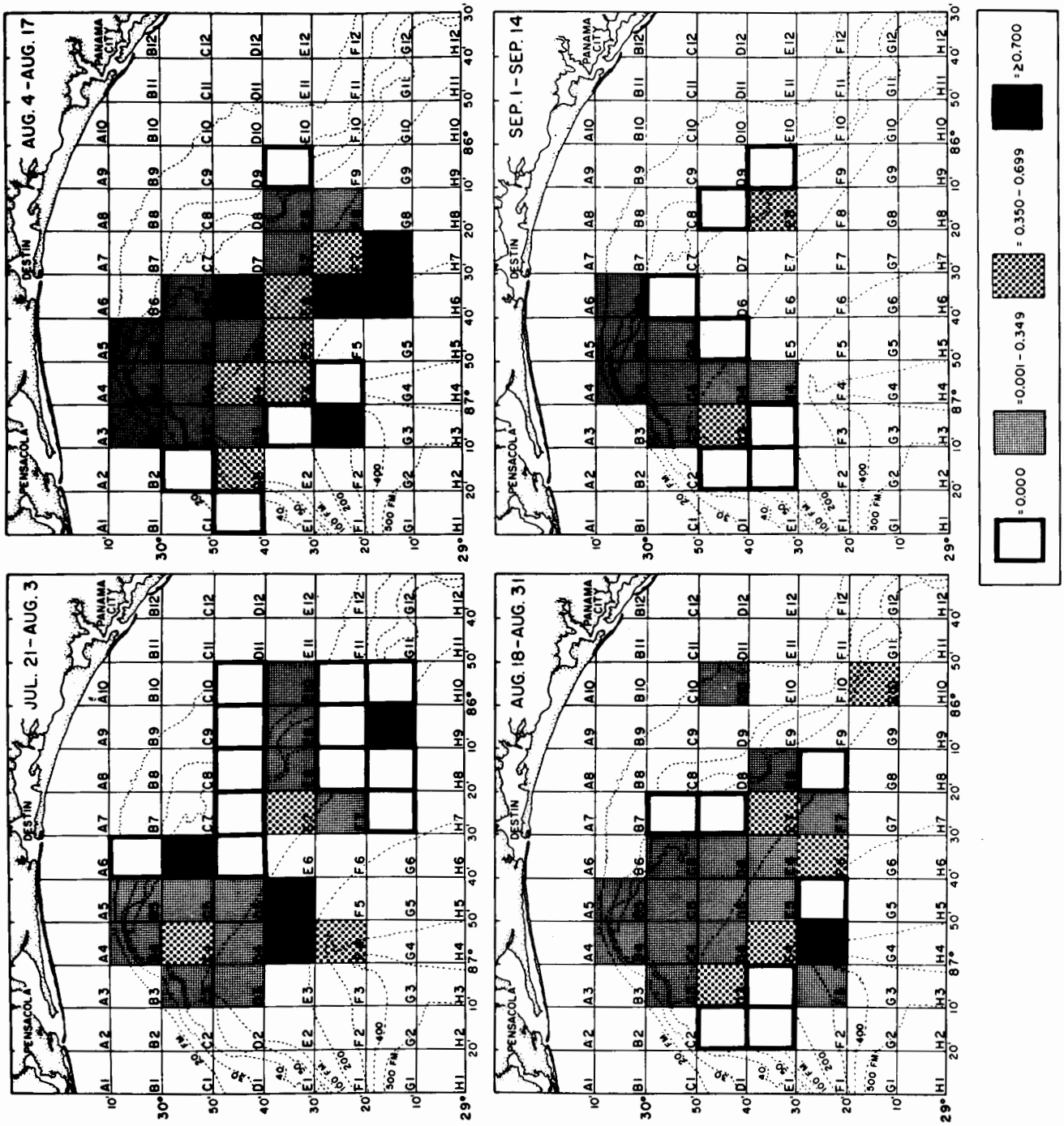

Figure 7.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, northwest Florida, 1971.—continued.

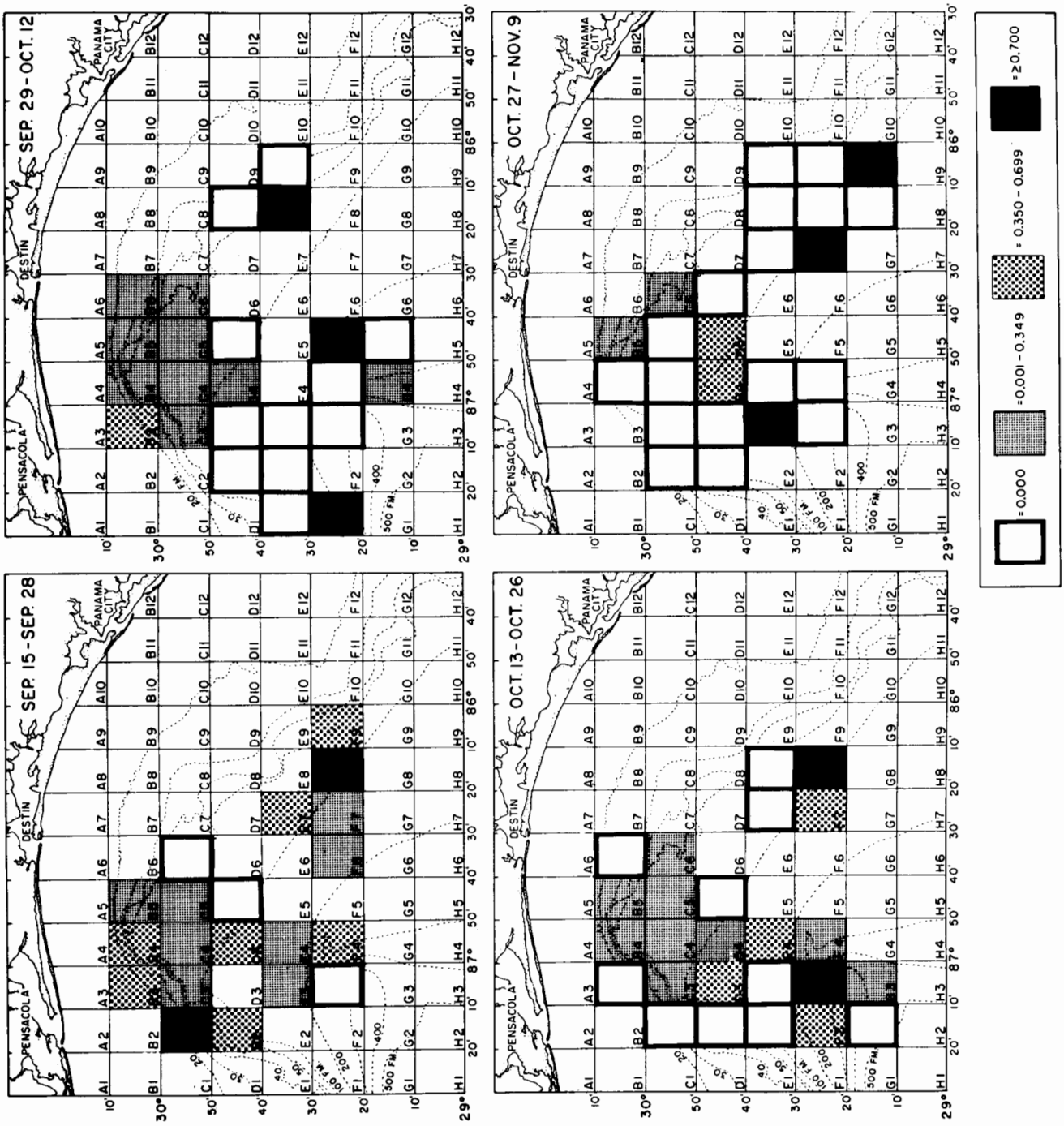

Figure 7.—Relative abundance of all billfishes by ten-minute squares for biweekly periods, northwest Florida, 1971.—continued.

Table 11.—Relative abundance of billfishes by water color for South Pass, northwest Florida, and the two areas combined, 1971. (BM=blue marlin, WM=white marlin, SF=sailfish).

Water color	Blue Water			Blue-Green Water			Green Water		
Species	BM	WM	SF	BM	WM	SF	BM	WM	SF
South Pass									
No. of fish raised	72	62	10	80	69	26	36	23	13
No. of hours trolled	877.1	877.1	877.1	1,185.4	1,185.4	1,185.4	653.7	653.7	653.7
Fish raised per hour	0.082	0.071	0.011	0.067	0.058	0.022	0.055	0.035	0.020
Hrs. to raise 1 fish	12.2	14.1	90.1	14.9	17.2	45.5	18.2	28.6	50.0
Northwest Florida									
No. of fish raised	230	489	593	21	58	118	7	6	14
No. of hours trolled	4,554.9	4,554.9	4,554.9	886.5	886.5	886.5	312.5	312.5	312.5
Fish raised per hour	0.050	0.107	0.130	0.024	0.065	0.133	0.022	0.019	0.045
Hrs. to raise 1 fish	20.0	9.3	7.7	41.7	15.4	7.5	45.5	52.6	22.2
Both areas									
No. of fish raised	302	551	603	101	127	144	43	29	27
No. of hours trolled	5,432.0	5,432.0	5,432.0	2,071.9	2,071.9	2,071.9	966.2	966.2	966.2
Fish raised per hour	0.056	0.101	0.111	0.049	0.061	0.070	0.045	0.030	0.028
Hrs. to raise 1 fish	17.9	9.9	9.0	20.4	16.4	14.3	22.2	33.3	35.7

could not be determined from the logs. Therefore, since we could not determine the number of fish raised per hour of trolling, we decided to use the percentage of the total number of fish raised as a measure of relative abundance. The data are presented in Table 12.

As the percentages show, the most productive surface condition off South Pass was along lines or rips. Nearly half of each species was raised along lines or rips. Off northwest Florida, open water was the most productive surface condition, the percentages ranging from 52% to 67%. Open water was second best off South Pass, while scattered grass was second best off northwest Florida. In the scattered grass, grass patches, and others categories, the percentages for blue marlin and white marlin were about equal. Sailfish were twice as abundant along scattered grass off northwest Florida area than off South Pass.

When the data for the two areas were combined, open water appeared as the best condition, scattered grass second, and lines or rips third.

Table 12.—Surface conditions and billfishing off South Pass, northwest Florida, and the two areas combined, 1971. (BM=blue marlin, WM=white marlin, SF=sailfish).

Surface condition	Open Water			Lines or Rips			Scattered Grass			Grass Patches			Others			Total No. Raised		
Species	BM	WM	SF	BM	WM	SF	BM	WM	SF	BM	WM	SF	BM	WM	SF	BM	WM	SF
South Pass																		
No. of fish raised	51	45	14	87	67	23	36	30	10	6	6	1	9	2	0	189	150	48
Percent of total no. raised	27%	30%	29%	46%	45%	48%	19%	20%	21%	3%	4%	2%	5%	1%	—	—	—	—
Northwest Florida																		
No. of fish raised	168	436	406	20	68	31	65	125	322	7	6	17	6	15	6	266	650	782
Percent of total no. raised	63%	67%	52%	8%	11%	4%	24%	19%	41%	3%	1%	2%	2%	2%	1%	—	—	—
Both areas																		
No. of fish raised	219	481	420	107	135	54	101	155	332	13	12	18	15	17	6	455	800	830
Percent of total no. raised	48%	60%	51%	24%	17%	6%	22%	19%	40%	3%	2%	2%	3%	2%	1%	—	—	—

EFFECT OF MOON PHASE

Dates of the moon phases were obtained from the 1971 Nautical Almanac. Because the beginning of each quarter phase did not occur at the same hour (for example, new moon in one month would begin at 2255 h and in the next month at 0949 h), data for a 3-day period for each moon phase were compiled, namely, data for the day before, day of, and day after the beginning of each moon phase. For example, new moon for July began at 0915 h on the 22nd; data for the new moon period for July were obtained for the 21st, 22nd, and 23rd. The data for all species were combined, as data for each species were sparse.

For the period May through October, the data for South Pass and northwest Florida are presented in Table 13. Full moon appeared to be the best period for South Pass, whereas new moon appeared to be the best for northwest Florida. When the data for the two areas were combined, no particular moon phase appeared to be especially favorable.

EFFECT OF BOAT SIZE AND TYPE OF SCREW

For this study, boats were categorized into 10-ft lengths, that is, 10-19 ft long, 20-29 ft long, and so on. Then the numbers of hours fished by boats in each category and the numbers of billfish raised by these boats were compiled. Then the average and the reciprocal, the hours-to-raise-one-billfish, were computed for each boat-length category.

Preliminary examination of some data obtained at tournaments in Pensacola and South Pass seemed to indicate that larger boats were more successful. When the South Pass data for the entire year were analyzed, the results still indicated that this was so. As shown in Table 14, the raises-per-hour increased with boat size, and conversely, the hours-to-raise-one-billfish decreased with boat size.

However, when the data for the three Florida ports were combined, as shown in Table 14, the results were not so clear. Results from combining the data for South Pass and the Florida areas did not allow us to conclude that larger boats were more successful.

When the data in Table 14 were broken down by species, no trends were evident. We could not conclude that boat size had any effect on success in raising fish.

Another aspect we examined was the effect of single and twin screws of a boat. For this analysis, the only set of data providing sufficient information was that for the 40-49 ft boats in Destin. The results showed that 40-49 ft boats with twin screws were more successful than 40-49 ft boats with single screw for each species of billfish. The data are summarized in Table 15. More data are needed to corroborate these results, especially with boats of different sizes.

BAIT PREFERENCE

The number of hours fished with the various kinds of bait could not be determined with our data.

Table 13.—Relative abundance of billfishes by moon phase off South Pass, northwest Florida, and the two areas combined, 1971.

Moon phase	New Moon	First Quarter	Full Moon	Last Quarter
South Pass				
No. hrs. trolled	721.3	99.2	742.9	113.5
No. billfish raised	77	16	153	7
Fish raised per hour	0.107	0.161	0.206	0.062
Hrs. to raise 1 fish	9.3	6.2	4.9	16.1
Northwest Florida				
No. hrs. trolled	842.6	809.8	620.4	738.0
No. billfish raised	312	212	135	183
Fish raised per hour	0.370	0.262	0.218	0.248
Hrs. to raise 1 fish	2.7	3.8	4.6	4.0
Both areas combined				
No. hrs. trolled	1,563.9	909.0	1,363.3	851.5
No. billfish raised	389	228	288	190
Fish raised per hour	0.249	0.251	0.211	0.223
Hrs. to raise 1 fish	4.0	4.0	4.7	4.5

Table 14.—Relative abundance of billfishes by boat size for South Pass, northwest Florida, and the two areas combined, 1971.

Boat length (ft)[1]	10'-19'	20'-29'	30'-39'	40'-49'	50'-59'	60'-69'
South Pass						
Hours trolled	20.0	296.1	1,046.2	862.2	—	68.5
No. billfish raised	1	26	142	127	—	14
Fish raised per hour	0.050	0.088	0.136	0.147	—	0.204
Hrs. to raise 1 fish	20.0	11.4	7.3	6.8	—	4.9
Northwest Florida						
Hours trolled	42.1	695.3	1,092.8	4,142.5	1,163.8	60.0
No. billfish raised	3	130	182	1,049	278	4
Fish raised per hour	0.071	0.187	0.167	0.253	0.239	0.067
Hrs to raise 1 fish	14.1	5.3	6.0	4.0	4.2	14.9
Both areas						
Hours trolled	62.1	991.4	2,139.0	5,004.7	1,163.8	128.5
No. billfish raised	4	156	324	1,176	278	18
Fish raised per hour	0.064	0.157	0.152	0.235	0.239	0.140
Hrs. to raise 1 fish	15.6	6.4	6.6	4.3	4.2	7.1

[1]Meters = ft×0.3048.

We were able to determine the days during which various baits were used. Therefore, the only measure of effort we could use was the number of days each bait was used. Since the bait to which a billfish was raised was seldom recorded, and since a billfish will often raise to one bait and then go over to another, we decided that the bait the billfish took would be the best data to use for a study of bait preference. Therefore, for this analysis, our unit of measure for bait preference was the number of fish hooked per day with each bait. The results of our analysis are presented in Table 16.

Table 15.—Comparison of billfishes raised between boats 40'-49' long with single screw and with twin screws, Destin, 1971.

Type of screw	Single	Twin
Hours trolled	686.5	2,965.3
Blue marlin		
No. raised	19	108
No. raised per-hour	0.028	0.036
Hrs. to raise 1 fish	35.7	27.8
White marlin		
No. raised	36	267
No. raised per hour	0.052	0.090
Hrs. to raise 1 fish	19.2	11.1
Sailfish		
No. raised	96	436
No. raised per hour	0.140	0.147
Hrs. to raise 1 fish	7.1	6.8
All billfish[1]		
No. raised	151	821
No. raised per hour	0.220	0.277
Hrs. to raise 1 fish	4.5	3.6

[1]Includes unidentified billfish.

Various natural and artificial baits were fished but only the three most frequently used, mullet *(Mugil cephalus)*, ballyhoo *(Hemiramphus* sp.), and bonito *(Euthynnus alleteratus)* strip, provided sufficient data for analysis. Under the category of "others" are included a wide variety which were used very infrequently and sporadically such as dusters, jigs, spoons, Kona heads, pork rind, ladyfish, strip dolphin, Spanish mackerel, croaker, cigar minnow, squid, needlefish, etc.

Because mullet is such a favored bait in the South Pass area, data for ballyhoo and bonito strip are sparse. Although the numbers of billfishes hooked per day using "other" baits are very similar to the rates using mullet as bait, conclusions regarding bait preference can not be made owing to the large assortment of baits lumped together in the "others" category.

In the northwest Florida area, the three types of baits were used frequently enough to permit conclusions. Blue marlin preferred mullet over ballyhoo and bonito strip as indicated by the respective hook rates (0.138, 0.090, and 0.080). The three types of baits were about equally effective for hooking white marlin (0.290, 0.278, 0.279). But sailfish very decidedly preferred bonito strip over mullet and ballyhoo (0.532 versus 0.226 and 0.228).

When the data for the two areas were combined, as shown at the bottom of Table 16, the results reinforced the conclusions reached for the northwest Florida area.

Table 16.—Bait preference of billfishes for South Pass, northwest Florida, and the two areas combined, 1971.

Bait	Mullet	Ballyhoo	Bonito Strip	Others
South Pass				
No. of days bait used	330	25	3	47
Blue marlin				
No. hooked	74	1	0	11
No. hooked per day	0.224	0.040	—	0.234
White marlin				
No. hooked	44	5	1	6
No. hooked per day	0.133	0.200	0.333	0.128
Sailfish				
No. hooked	24	4	0	3
No. hooked per day	0.073	0.160	—	0.064
Northwest Florida				
No. of days bait used	465	421	376	231
Blue marlin				
No. hooked	64	38	30	26
No. hooked per day	0.138	0.090	0.080	0.113
White marlin				
No. hooked	135	117	105	46
No. hooked per day	0.290	0.278	0.279	0.199
Sailfish				
No. hooked	105	96	200	40
No. hooked per day	0.226	0.228	0.532	0.173
Both areas				
No. of days bait used	795	446	379	278
Blue marlin				
No. hooked	138	39	30	37
No. hooked per day	0.174	0.087	0.079	0.133
White marlin				
No. hooked	179	122	106	52
No. hooked per day	0.225	0.274	0.280	0.187
Sailfish				
No. hooked	129	100	200	43
No. hooked per day	0.162	0.224	0.528	0.155

CONCLUSIONS

To summarize our study for 1971, the following results and conclusions were obtained:

1. A total of 701 billfishes was caught by sportfishermen in offshore waters of the northeastern Gulf of Mexico during 1971. Of the total, 99 were blue marlin, 284 were white marlin, and 318 were sailfish. To catch these, 11,107 hours of fishing were spent by the anglers.
2. During the same 11,107 hours, 492 blue marlin, 849 white marlin, and 860 sailfish, and 39 unidentified billfish were raised.
3. Off northwest Florida, white marlin were most abundant in July, sailfish were most abundant during the latter half of September, while blue marlin did not have an especially abundant period. Off South Pass, the variability of relative abundance from week to week was greater, making determinations of periods of abundance very uncertain.
4. Blue marlin were more abundant off South Pass than off northwest Florida. White marlin and sailfish were more abundant off northwest Florida.
5. Hours of greatest relative abundance for all billfishes were between 1000 and 1200 h and again between 1300 and 1500 h.
6. The bluer the water, the greater the relative abundance of billfishes.
7. Off South Pass, billfishes were most abundant along tide lines and rips, whereas off northwest Florida, they were most abundant in open water.
8. Effect of moon phase on billfishing was not significant.
9. Effect of lengths of boats on billfishing was not significant.
10. Boats 40 to 49 ft long raised more billfisnes if they had twin screws than single screw.
11. Off northwest Florida, blue marlin preferred mullet as bait, sailfish preferred bonito strip, and white marlin showed no preference.

The results from 1971 represent only the beginning of this study. In 1972, the area west of the mouth of the Mississippi River to the Mexican border will be included. Thus, future reports will cover the entire U.S. coast of the Gulf of Mexico. As data for the next few years are collected and analyzed, some of the conclusions reached for 1971 may be altered, and where no conclusions were reached in

1971, definitive results may be obtained or trends may be discerned.

ACKNOWLEDGMENTS

We are indebted to many people for helping us obtain the data on which this report is based. First, we very much appreciate the help given us by the officers of the cooperating organizations, namely, the New Orleans Big Game Fishing Club (H. Prager, Jr., President), Mobile Big Game Fishing Club (C.M.A. Rogers, III, Past President, and G. Cabanis, Jr., President), Pensacola Big Game Fishing Club (F. Neth, President), Destin Charter Boat Association (B. Bacon, President), and the Panama City Charter Boat Association (R. Stone, President). We are especially indebted to H. Howcott, who unselfishly spent much time and effort in helping us get our program underway and in advising us after the program was started. Some others who were extremely helpful in various ways were L. Ogren, G. Maddox, J. Yurt, R. Metcalfe, J. Ogle, J. Lockfaw, R. Schwartz, R. Brunson, T. Eastburn, K. Scales, III, F. Hubbard, C. Hughes, J. Dunlap, K. Reed, L. Freeman, F. Jones, and R. Martin. Finally, we owe much to all boat captains and anglers who provided us with data.

LITERATURE CITED

BULLIS, H. R., JR.
1955. Preliminary report on exploratory long-line fishing for tuna in the Gulf of Mexico and the Caribbean Sea. Part I.-Exploratory fishing by the *Oregon*. Commer. Fish. Rev. 17(10):1-15.

DE SYLVA, D. P., and W. P. DAVIS.
1963. White marlin, *Tetrapturus albidus*, in the Middle Atlantic Bight, with observations on the hydrography of the fishing grounds. Copeia 1963:81-99.

ERDMAN, D. S.
1962. The sport fishery for blue marlin off Puerto Rico. Trans. Am. Fish. Soc. 91:225-227.
1968. Spawning cycle, sex ratio, and weights of blue marlin off Puerto Rico and the Virgin Islands. Trans. Am. Fish. Soc. 97:131-137.

KALMAN, P.
1970. South Pass. New Orleans, July issue, p. 16-21, 37, 43-46, 58.

LENARZ, W. H., and E. L. NAKAMURA.
1974. Analysis of length and weight data on three species of billfish from the western Atlantic Ocean. *In* Richard S. Shomura and Francis Williams (editors), Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, 9-12 August 1972, Part 2. Review and Contributed Papers. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-675, p. 121-125.

NAKAMURA, E. L.
1971. An analysis of the catches and the biology of big game fishes caught by the New Orleans Big Game Fishing Club, 1966-70. East Gulf Sport Fish. Mar. Lab., Panama City, Fl., mimeo. rep., 13 p., 33 tables.

NAKAMURA, E. L., and L. R. RIVAS.
1972. Big game fishing in the northeastern Gulf of Mexico during 1971. National Marine Fisheries Service, Panama City, Florida, mimeo. rep., 20 p. 37 pages of tables and figures.

SIEBENALER, J. B.
1965. A new sport fishery in the northeastern Gulf of Mexico. *In* Proceedings of the Ninth International Game Fish Conference, Runaway Bay, Jamaica, November 20-21, 1964, p. 63-65. Int. Oceanogr. Found., Miami, Fl.

STRASBURG, D. W.
1970. A report on the billfishes of the central Pacific Ocean. Bull. Mar. Sci. 20:575-604.

WILLIAMS, F.
1970. The sport fishery for sailfish at Malindi, Kenya, 1958-1968, with some biological notes. Bull. Mar. Sci. 20:830-852.