MIGRATION AND DISTRIBUTION OF WHITE MARLIN AND BLUE MARLIN IN THE ATLANTIC OCEAN[1]

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ABSTRACT

Migration and distribution of white marlin, *Tetrapturus albidus* Poey, and blue marlin, *Makaira nigricans* Lacépède, in the Atlantic Ocean are discussed on the basis of tagging data (western North Atlantic, 1954-May 1970) and statistics of the Japanese Atlantic longline fishery (1956-67). White and blue marlins are widely distributed over the warmer waters of the Atlantic. Seasonal concentrations occur in certain areas, especially in the western Atlantic.

In the North Atlantic one group of white marlin summers off the U.S. middle Atlantic coast. In the fall fish of this group migrate offshore, then south to winter off the north coast of South America. In the spring these fish return north along or through the Antilles and the Bahamas. Tagged fish from this group were recaptured after up to 4 years at liberty; the returns suggest that the annual mortality is between 14% and 39%. There are apparently other groups of white marlin in the North Atlantic that move seasonally between various localities, but these movements have not been fully defined. An apparently separate population of white marlin concentrates in the eastern South Atlantic Ocean in winter and in the western part in summer.

Blue marlin concentrate in the Caribbean Sea, the Gulf of Mexico and the North Atlantic south of lat 30°N, from June through October, and in the western and central South Atlantic between lat 10° and lat 20°S from February through April. These concentrations probably represent distinct spawning populations.

The white marlin, *Tetrapturus albidus* Poey, and the blue marlin, *Makaira nigricans* Lacépède (family Istiophoridae), are distributed widely in the Atlantic Ocean. Their distribution and habits are of interest because they are important game fishes and because they are taken by commercial longline fisheries.

Few studies have been made of the migration and distribution of either species in the Atlantic Ocean. Gibbs (1957) described in detail the distribution of white marlin in the Gulf of Mexico from catch records of the U.S. exploratory fishing vessel *Oregon*. Squire (1962) described the distribution of white and blue marlins in the western North Atlantic, based on longline catches of exploratory fishing vessels. De Sylva and Davis (1963) reported on their studies of the white marlin sport fishery off the middle Atlantic coast of the United States. Nakamura, Iwai, and Matsubara (1968) gave a general review of the billfishes of the world.

Ueyanagi et al. (1970) described the distribution, spawning, and relative abundance of billfishes in the Atlantic Ocean; this comprehensive work is based mainly on the results of the Japanese longline fishery and of cruises by Japanese research vessels.

Other reports are based mainly on incidental collections or the results of scattered fishing activity (LaMonte, 1955, 1958a, b; Erdman, 1956, 1962; Krumholz, 1958; Krumholz and de Sylva, 1958; de Sylva, 1958, 1963; Rodriguez-Roda and Howard, 1962; and Talbot and Penrith, 1962).

Sportsmen participating in the Cooperative Game Fish Tagging Program of the Woods Hole

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Oceanographic Institution began tagging marlins and other pelagic fishes in the western North Atlantic in 1954. Preliminary results of the program, pertaining to marlins, were described by Mather (1960, 1967, 1969). In 1956, Japanese longline vessels began fishing for tunas and billfishes in the Atlantic Ocean; this fishery soon expanded to cover all of the tropical and temperate Atlantic. Tag returns and records of catches from the longline fishery have provided detailed data on the distribution, movements, and relative abundance of white and blue marlins in the Atlantic. The results of our study of these data are presented here.

SPORT FISHERY

Sport fishing for marlins and other big game fishes developed along the Atlantic coast of North America and off the Bahamas and Cuba during the 1930's (Figure 1). After 1945, fishing spread to the Gulf of Mexico, the Caribbean, and more distant areas. The growth of the fishery was aided by the widespread prosperity of the era and by improvements in fishing boats and equipment. More white marlin than blue marlin are taken by sportsmen; however, the comparative scarcity and the challenging size and power of blue marlin make them the more highly prized trophy.

White and blue marlins share a vast habitat in the Atlantic Ocean. The white marlin ranges farther into the temperate zones during the warm seasons and congregates seasonally in certain coastal areas in much greater numbers than does the blue marlin. Along the east coast of the United States, white marlin are abundant during the warm season from Cape Hatteras, N.C., north to Cape Cod, Mass., but blue marlin are rarely caught north of Cape Hatteras.

Fishing for white marlin off the middle Atlantic coast of the United States originated in Maryland in 1935, and spread to Cape Hatteras and Cape Cod. The greatest fishing effort and the largest catches are still made off Maryland, Delaware, and adjacent parts of New Jersey and Virginia. The major fishing centers are Ocean City, Md., and the New Jersey ports from Cape May northward to Atlantic City. The most productive fishing grounds are Baltimore and Wilmington Canyons. Boats from nearly all ports on or near the Atlantic Ocean from northern Virginia to Cape Hatteras take white marlin, but Oregon Inlet, N.C., is the major fishing center south of Ocean City. White marlin are relatively scarce in coastal waters off northern New Jersey and western Long Island, N.Y., but often provide good fishing at Hudson Canyon, and from eastern Long Island to Nantucket, Mass., the northeastern limit of their coastal range. As noted above, the occurrence of white marlin from Cape Hatteras to Cape Cod is generally limited to summer.

The first sport fishery for blue marlin off the U.S. coast developed at Hatteras, N.C., in the late 1930's. Another major center for blue marlin fishing off North Carolina is at Morehead City, also mainly in late spring and summer.

White and blue marlins are occasionally taken off southeastern Florida and the Florida Keys, usually by anglers seeking sailfish, but the number caught is small compared to the fishing effort. The best fishing for white marlin in the Florida area is in spring.

Marlin fishing developed off the northwestern Bahamas in the 1930's. Both species of marlin are fished from a number of localities in the Bahamas throughout the year—white marlin being most abundant in spring, blue marlin in late spring and early summer. Sport fishing for marlins has been excellent off Havana, Cuba, in seasons similar to those in the Bahamas, but this activity has diminished in the past decade.

White and blue marlins are available throughout the Caribbean Sea, and sport fishing facilities have been developed in many localities. The oldest and most important center is the Venezuelan coast in the vicinity of La Guaira, where marlin fishing became popular soon after 1945. Fishing is excellent for white marlin in late summer and early fall, and for blue marlin in winter and spring. Fishing facilities for marlin also exist at many other localities, including the Virgin Islands, Puerto Rico, and Jamaica. Blue marlin usually are more abundant than white marlin off these islands. The best seasons usually are fall for small blue marlin, spring and early summer for large.

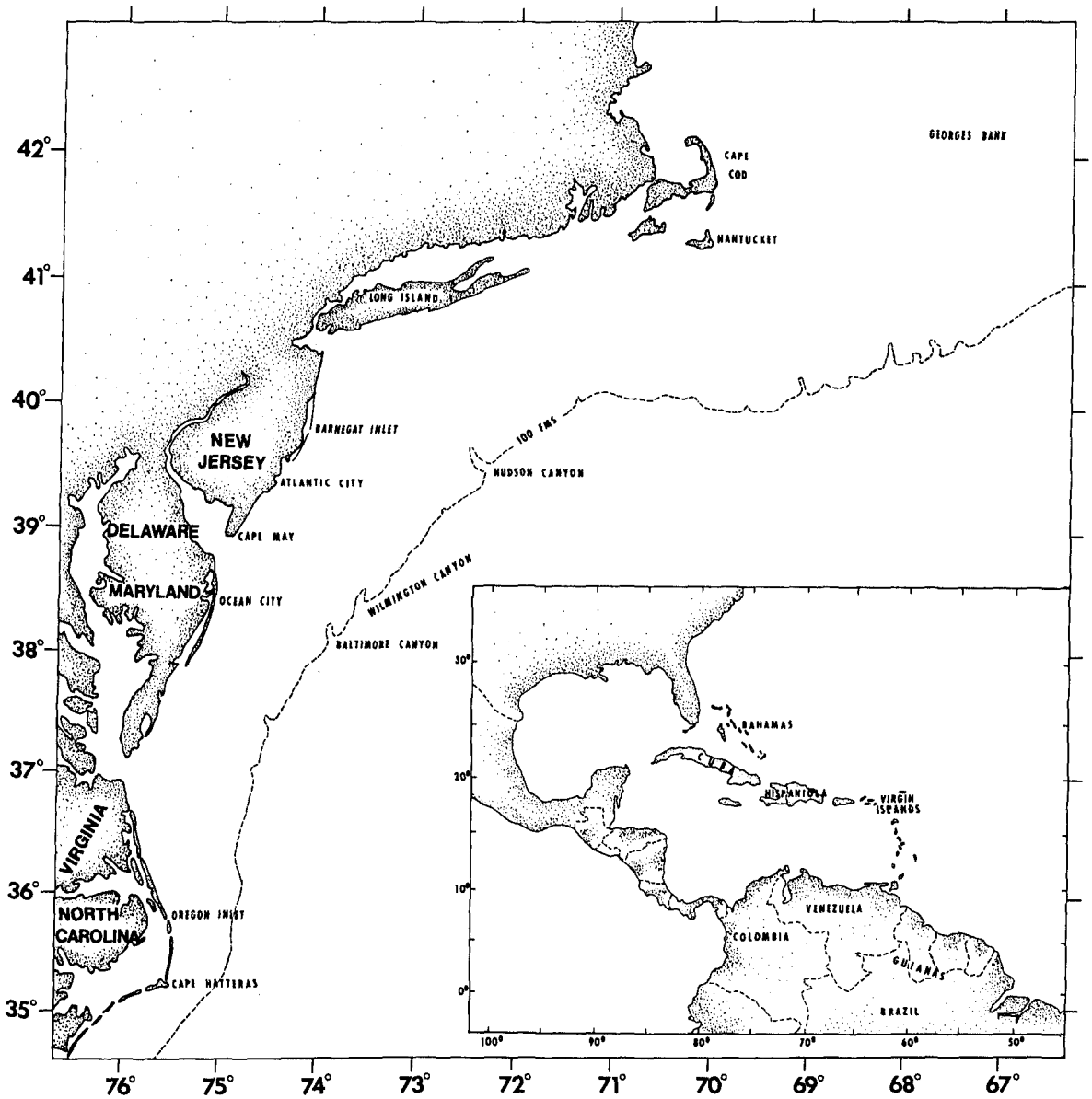

FIGURE 1.—The western North Atlantic Ocean, showing localities and areas of particular interest in the present study.

Marlin fishing in the Gulf of Mexico developed in the late 1950's off the Mississippi Delta, largely as a result of exploratory fishing catches of the Bureau of Commercial Fisheries vessel *Oregon*. The fishing season extends from early June into October, with a peak in July. In the late 1960's, a very productive area, centered on the De Soto Canyon in the northeastern Gulf, was fished from ports in western Florida and Alabama. This fishery also extends from June into October, but peaks in August. In 1969, some boats from Texas extended their operations farther offshore to the edge of the continental shelf and caught marlins consistently there for the first time.

Although most of the centers of sport fishing for marlin in the Atlantic are on the American coasts from Venezuela to Massachusetts, or on adjacent islands, there are several in other localities, such as Bermuda, the Azores, Rio de Janeiro in Brazil, and Cape Town in South Africa.

TAGGING STUDIES

METHODS

Cooperating fishermen marked white and blue marlins caught on rod and reel with dart tags as described by Mather (1963). Since this procedure does not require handling the fish or removing them from the water, their sizes were estimated. Tags and applicator poles were distributed to sportsmen by the Woods Hole Oceanographic Institution, either directly or through clubs and fishing tournament committees. Interest in tagging was stimulated by the press, radio, and television and also by clubs or tournament committees which offered incentives for tagging.

The tags carried the legend "reward" and the address of the Institution. (The fishermen often were more interested in receiving information on the tagged fish than in obtaining the $5 reward.) Posters were displayed where anglers gathered, and contact was maintained with fishery research agencies to which tags were apt to be returned. Some fishermen believed that the information gained from tagging hurt them and helped others. However, the volume of tagging and the percentage of returns increased over the years as more fishermen became aware of the program, and the mounting pressure by increased commercial fishing effort on the stocks demonstrated to fishermen the need for information on migratory patterns, population identity, and the effects of fishing.

WHITE MARLIN

A total of 6,590 white marlin were tagged and released in the western North Atlantic from 1954 through 1969; 65 tags have been returned as of June 1, 1970 (Table 1 and Appendix). Most releases (5,340) were made off the middle Atlantic coast of the United States from Cape Hatteras to Cape Cod. Other release sites were off southeastern Florida and the Bahamas, off Venezuela and in nearby waters, in the West Indies (Virgin Islands and Puerto Rico), in the northern Gulf of Mexico, and in the oceanic North Atlantic. Of the 65 tag recoveries, 41 were by commercial fishermen and 24 by sportsmen (Table 2). Before 1968, the Japanese longline fishery was the largest longline fishery in the Atlantic and covered nearly the entire ocean, but only 13 tags from white marlin have been returned from this

TABLE 1.—Releases (after slash) and returns (before slash) for white marlin tagged in the western North Atlantic Ocean by year and area of release.

Year	Area								Total	
	Hatteras to Chesapeake	Chesapeake to Barnegat	Barnegat to Cape Cod	Oceanic North Atlantic	SE Florida and W Bahamas	West Indies and vicinity	Gulf of Mexico	Venezuela and vicinity	Number	Percent
1954	--	--	0/4	--	--	--	--	--	0/4	0
1955	--	1/116	--	--	--	0/8	0/21	--	1/145	0.7
1956	--	1/402	--	--	--	0/3	0/8	--	1/413	0.2
1957	0/3	0/140	0/1	0/1	--	--	--	--	0/145	0
1958	0/1	0/39	0/1	--	--	--	--	--	0/41	0
1959	--	0/190	0/10	--	--	--	--	0/2	0/202	0
1960	--	0/96	0/2	--	0/4	0/1	0/4	0/4	0/111	0
1961	0/2	2/187	0/10	--	0/13	0/9	0/11	0/30	2/262	0.8
1962	0/30	4/294	0/18	--	0/41	--	0/4	--	4/387	1.0
1963	0/75	4/533	0/4	0/3	0/35	--	0/10	--	4/660	0.6
1964	4/182	8/258	0/1	0/5	1/67	--	0/13	--	13/526	2.5
1965	0/15	6/258	0/5	--	0/69	0/5	0/8	2/25	8/385	2.1
1966	1/36	7/172	1/64	0/6	1/54	0/4	0/23	1/149	11/508	2.2
1967	0/37	3/234	0/6	--	0/88	0/7	1/46	0/103	4/521	0.8
1968	1/100	8/569	0/32	--	0/94	0/16	0/56	0/16	9/883	1.0
1969	2/363	3/821	0/27	--	0/86	0/18	1/35	0/45	6/1,395	0.3
Unknown	1/1	1/1	--	--	--	--	--	--	2/2	
Total	9/845	48/4,310	1/185	0/15	2/551	0/71	2/239	3/374	65/6,590	

TABLE 2.—Returns from tagged white marlin, by fishery and nationality of recapturing vessel.

Type of fishery	Country	Number of returns
Sport fishery (rod and reel)	United States	24
Total		24
Commercial fishery (longline)	Canada	1
	Cuba[1]	14
	France	1
	Japan	13
	Norway	2
	South Korea	2
	United States	1
	Venezuela	7
Total		41
Grand total		65

[1] Some of the fish recaptured near Havana were caught by drift fishing from small boats with "criollo" lines. These usually consist of three interconnected lines with floats, each fishing at a different depth.

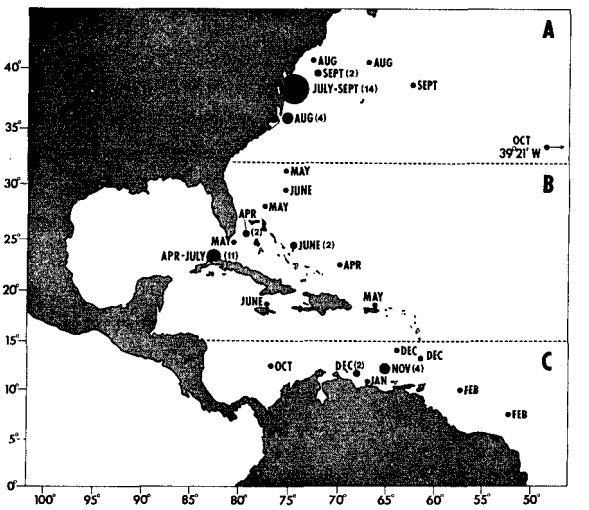

FIGURE 2.—Location of recaptures of white marlin tagged in the western North Atlantic Ocean north of lat 32°N between Cape Hatteras, N.C., and Cape Cod, Mass., in summer. The month of recapture is shown adjacent to each recapture site. The number of recaptures at each site is indicated by the number in parentheses (if more than 1) and by the size of the dot.

fishery. The Cuban and Venezuelan longline fisheries, though small compared to the Japanese fishery, accounted for 21 returns (14 and 7, respectively).

Tag recoveries from white marlin have been confined to the western North Atlantic. Of the 65 recoveries, 58 were from fish tagged off the middle Atlantic coast of the United States; we divided these into three groups on the basis of the area of recovery (Figure 2, Appendix):

Area A — North of lat 32°N

Area B — lat 15°N to lat 32° N

Area C — South of lat 15°N

In area A, 23 tagged marlin were recaptured in July through September and 1 in October; in area B, 22 were taken in April through July; and in area C, 12 were caught in October through February. The recaptures in the three areas are discussed below.

Area A

Of the 24 fish recaptured in area A, 14 were recaptured in coastal waters between Maryland and New Jersey. Twelve of these fish had been tagged locally (within 120 nautical miles of the point of recovery) and two had been tagged off Cape Hatteras. Of the fish tagged locally in July or August, three were recaptured in July or August of the same year; nine were recaptured in July or August of subsequent years. Time between tagging and recapture ranged from 9 days to 48 months. The 10 remaining fish tagged and recaptured in area A were recaptured in August, September, and October and at distances greater than 120 miles from the point of tagging. Some returns disclosed that in summer white marlin migrate along the east coast of the United States (Figure 3). Two fish tagged off Maryland and New Jersey were recaptured off North Carolina (150 and 200 miles distant) in 17 and 21 days, respectively. One white marlin traveled 500 miles, from off North Carolina to Georges Bank (off Cape Cod), in 12 days.

Two returns from considerable distances offshore showed that white marlin which range along the middle Atlantic coast in summer move offshore in the fall. One fish released off Maryland moved 580 miles eastward in 60 days, and the other, tagged in September 1966, was recaptured 25.3 months later at lat 33°15'N, long 39°21'W, about 1,800 miles east of Cape Hatteras.

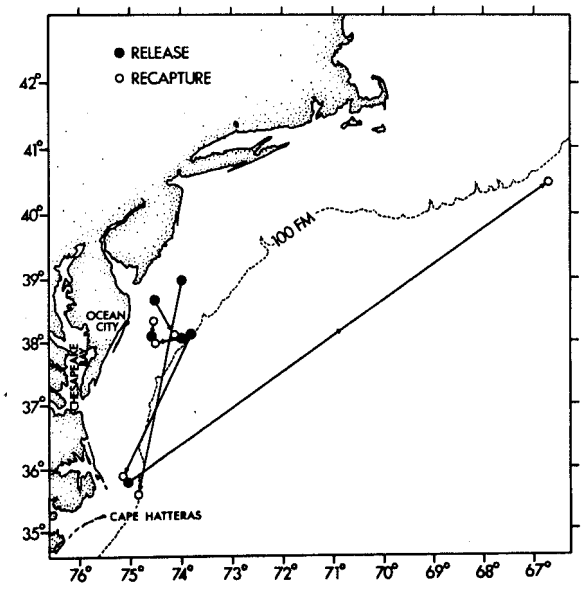

FIGURE 3.—Movements of tagged white marlin along the middle Atlantic coast of the United States, July-October. Recaptures were in the same year as releases.

Area B

Of the 22 white marlin recaptured in area B in April through July, 14 were taken in the Straits of Florida, 4 off the eastern Bahamas and eastern Greater Antilles, 3 were well off the southeast coast of the United States (between lat 28°N and lat 31°N), and 1 north of Jamaica.

Area C

Of the 12 tagged white marlin recaptured in area C, 1 was recovered in late October off Colombia, 9 were recovered in November, December, and January off Venezuela and the Lesser Antilles, and 2 in February off the Guianas.

The tagging results show clearly that white marlin in the western North Atlantic Ocean migrate seasonally. Fish tagged off the U.S. middle Atlantic coast apparently move offshore in late summer and fall from their summer grounds in coastal waters. They probably winter off the north coast of South America and move northward in spring back to the summer grounds. The large number of returns off Havana, Cuba, and the single return from north of Jamaica suggest that many move north through the Caribbean Sea and the Yucatan Channel. Four recoveries north of Puerto Rico and Hispaniola and east of the Bahamas indicate that white marlin also follow the Antilles Current[4] northward.

The nonrandom distribution of recoveries in areas A, B, and C reflects to some degree the seasonal nature of both the sport and commercial catches in those areas. In the Straits of Florida, however, tagged white marlin have been recaptured only in April through July even though the species is caught there throughout the year. Off the north coast of South America, white marlin are caught throughout the year by commercial and sport fishermen; yet tagged fish have been recaptured only in October through February.

The remaining 7 of the total of 65 returns were from 1,235 white marlin released from sport fishing centers in southeast Florida and the Bahamas (551 releases), the Gulf of Mexico (239), Venezuela (374), and the West Indies (71) (Table 1, Figure 4). Two white marlin tagged off Venezuela in August and September were recaptured after 3 to 4 months at large—one in November in the release area and the other in December off the coast of the Guianas. A third fish, tagged off Venezuela in October, was recaptured 20 months later (June) off South Carolina, probably en route to the U.S. middle Atlantic coastal region. Two white marlin tagged in the Bahamas were recaptured: one tagged in March was recaptured in June of the same year off St. Augustine, Fla., and the other, tagged in January, was recaptured in July in the Gulf of Mexico. Two white marlin tagged in July in the northern Gulf of Mexico were recaptured in the same area—one within a month and the other a year after tagging.

The two returns from off the eastern United States in June (from fish tagged in the Bahamas and off Venezuela) fit well with the indicated

[4] Names of currents are from Neumann and Pierson (1966).

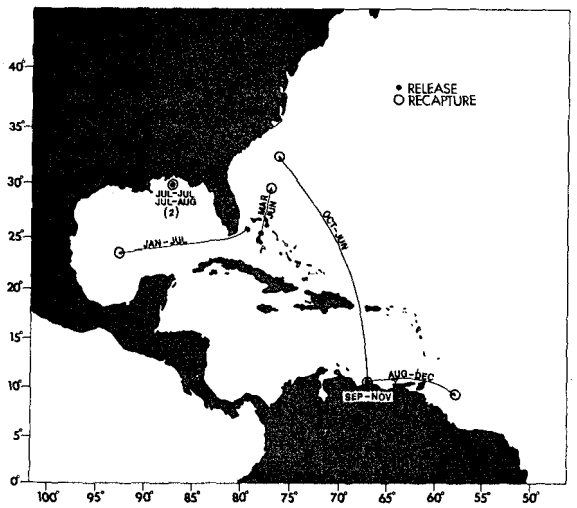

FIGURE 4.—Location of releases and recaptures of white marlin tagged in the western North Atlantic Ocean south of lat 32°N. The months of release and recapture are shown in that order for each return. The number of recaptures at each site (if more than 1) is indicated in parentheses.

migratory pattern, but the remaining five do not. We do not now understand the relation between the nearly simultaneous summer and early fall concentrations of white marlin off the U.S. east coast and in the northern Gulf of Mexico. An interchange of fish between these two areas has not been demonstrated. None of the white marlin released in the Gulf of Mexico have been recaptured elsewhere, but a white marlin tagged in the Straits of Florida in January was recaptured in the Gulf of Mexico the following July. This recapture indicates that white marlin found off the northwestern Bahamas in winter may be a component of the summer concentration in the Gulf of Mexico. If this indication is correct, white marlin from the Bahamas could be migrating westward through the Straits of Florida while others en route to the U.S. middle Atlantic coast from the Caribbean are passing through the Straits to the east. White marlin are caught throughout the winter in the Bahamas, but fish tagged off Cape May-Cape Hatteras appear to migrate through the region only from early April to mid-July.

Tag returns indicate that white marlin off Venezuela in August and September remain off the north coast of South America into November and December, and that they are then joined by fish from the U.S. middle Atlantic coast. We are not sure how the marlin in the summer and early fall concentration off Venezuela are otherwise related to those in the summer and early fall concentrations in the Gulf of Mexico and off the U.S. middle Atlantic coast.

Early opinions that white marlin and other billfishes are short-lived and grow rapidly (Voss, 1956) are apparently true for Atlantic sailfish, *Istiophorus platypterus* (de Sylva, 1957), but de Sylva and Davis (1963) pointed out that white marlin may be long-lived. Their opinion was based on the weight-frequency distributions of fish in the U.S. sport fishery and the recovery of a tagged fish which had been at liberty for 4 years (Mather, 1960). The more recent information gained from tagging supports the belief of de Sylva and Davis (1963). Six tagged white marlin have been recaptured after 3 to 4 years at liberty. A comparison of sizes at release (estimated) and recapture does not indicate rapid growth after recruitment into the fishery.

We estimated the mortality rate of white marlin from tag-return data, using returns from white marlin tagged north of lat 32°N only (most fish were tagged in this area; those tagged in other areas might have had different migratory patterns). Moreover, we confined our consideration to returns from fish tagged in 1961 through 1965, because only two fish tagged before 1961 were recaptured and because returns from fish tagged after 1965 were incomplete. When the data were platted from white marlin recaptured from less than 1 month to more than 48 months after tagging, the recovery rates approximated an exponential relationship. The tag returns were grouped into time periods such as 0-12 months and 12-24 months, in view of a preliminary analysis which indicated that the returns within the first 6 months were in accord with the general pattern of returns

(Table 3, Figure 5). The indicated mortality rate was 27% per year, with 95 percent confidence limits of 14% and 39% (Z, the coefficient of instantaneous total mortality = 0.32 ± 0.17).

TABLE 3.—Summary of recaptures of tagged white marlin (to December 31, 1969). Dashed lines enclose data used for mortality estimates.

Year	Number tagged	Number recaptured[1]	Months at large				
			0-12	12-24	24-36	36-48	>48
1954	4						
1955	145	1					1
1956	413	1	1				
1957	145						
1958	41						
1959	202						
1960	111						
1961	262	2			1	1	
1962	387	4		2		2	
1963	660	4	2	1	1		
1964	526	12(13)	6(7)	2	3	1	
1965	385	6(8)	3(4)	2(3)	1		
1966	508	9(11)	4(6)	3	1	1	
1967	521	3(4)	1	(1)	2		
1968	883	9	6	3			
1969	1,395	5(6)	5(6)				
Unknown	2	2					
Total	6,590	58(65)	28(33)	13(15)	9	5	1
Total, 1961-65 only			11(13)	7(3)	6	4	

[1] Number recaptured are for groups A-C (see Appendix); numbers for groups A-D, if different, are shown in parentheses.

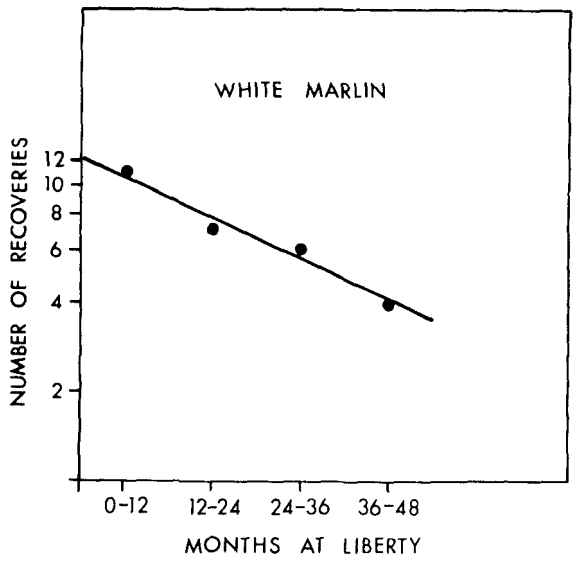

FIGURE 5.—Number of returns of white marlin tagged from 1961 to 1965 in waters north of lat 32°N, plotted by time at liberty.

BLUE MARLIN

Since 1954, 486 blue marlin have been tagged in the western North Atlantic; 3 have been recovered, all near their respective release points. One blue marlin released off Chub Cay, Bahamas, in August 1968, was recaptured off nearby Andros Island the following December; one released off La Guaira, Venezuela, in August 1966, was recaptured in the same area in October 1968; and one released off Biloxi, Miss., in June 1969, was recaptured 5 months later off Sabine Pass, La., 350 miles to the west. The returns indicate that meaningful information about blue marlin can be obtained if sufficient numbers are tagged.

LONGLINE CATCHES

METHODS

Data on the catch of marlins by the Japanese longline fishery in the Atlantic Ocean have been published by Shiohama, Myojin, and Sakamoto (1965) and by the Fisheries Agency of Japan (1966, 1967a, b, 1968, 1969). Catches of white and blue marlins, and those of other billfishes and tunas, are listed in those publications by 5°-quadrangles for each month, beginning in June 1956. Although catches in the categories "black marlin" and "striped marlin" also are listed, systematists do not presently recognize that black marlin, *Makaira indica*,[5] and striped marlin, *Tetrapturus audax*, occur in the Atlantic Ocean. We do not know whether those catches were misidentified or whether these species do, in fact, occur in the Atlantic. The catches listed in the two categories were too few to affect the conclusions of our study even if they were really white or blue marlin.

For each species, the catch per unit of effort (CUE), in fish per 100 hooks, was calculated for each 5°-quadrangle-month stratum in the period 1956-67 for which data were available. These CUE's were computed by dividing the number of fish caught in each such stratum by 1% of the number of hooks fished in it. To show seasonal distribution, average (unweighted)

[5] Ueyanagi et al. (1970) report occasional catches of *M. indica* in the equatorial and southeastern Atlantic.

CUE's for each 5°-quadrangle-month stratum were obtained by summing its yearly CUE's and dividing by the number of years.

The Japanese longline fishery in the Atlantic Ocean is directed primarily toward catching yellowfin tuna, *Thunnus albacares*, and albacore, *T. alalunga*, (Wise and Le Guen, 1969). Since marlins form only a small part (<3%) of the total catch of scombroid fishes, fishermen probably do not select specific fishing areas for marlins or adapt their fishing gear to catch marlins more effectively than other species. Possibly the catch rates for marlins are influenced by variations in the availability or the catchability of the fish, but the effects of such variations cannot be distinguished on the basis of the available data. We believe, therefore, that the catch rates by the longline fishery represent reasonably well the relative apparent abundance of marlins in the areas and seasons of intensive fishing. On this basis, we discuss distribution of white marlin and blue marlin in the Atlantic Ocean in the next sections.

WHITE MARLIN

The catches of the wide-ranging Japanese longline fishery show that white marlin are distributed over a much broader area than that indicated by returns from fish tagged in the sport fishery in the western North Atlantic Ocean. White marlin have been caught in all consistently fished areas of the Atlantic Ocean from lat 40°N to lat 40°S (Figure 6). The available data indicate that white marlin are scarce in both the north and south temperate zones in their respective winters (December-February and June-August).

Catch rates above 0.5 fish per 100 hooks are reported more often in the western than in the eastern Atlantic Ocean. We therefore conclude that although the distribution of white marlin is oceanwide, the species is more abundant in the western Atlantic. Sport fishermen report that white marlin are often concentrated at the edge of the continental shelf. Data from the longline fishery support this conclusion, inasmuch as the catch rates are generally higher in 5°-quadrangles adjacent to, or including, the edge of the shelf than in quadrangles in mid-ocean. No evidence has been found to date to suggest that the relative apparent abundance of white marlin in the Atlantic Ocean has been markedly affected by the longline fishery (Wise and Le Guen, 1969).

North Atlantic

In winter (December-February) white marlin are concentrated in the eastern Caribbean Sea and off the north coast of South America as far south as the equator. In spring some of these fish move northward into the Antilles Current beginning in March, and others move westward into the western Caribbean beginning in May and June. The northward movement of the first group conforms to the migrational pattern deduced previously from tag returns, but the second group appears to move into the northern and western Gulf of Mexico in summer, a pattern not supported by tagging data.

High catch rates in October, 300 to 1,200 miles off the east coast of the United States, support the hypothesis derived from tag returns —that white marlin summering off the U.S. mid-Atlantic coast move offshore in fall. In the Gulf of Mexico, however, white marlin are relatively abundant through October.

South Atlantic

In summer (December-February) white marlin are concentrated in the central South Atlantic Ocean and off the coast of Brazil. In the latter area, catch rates are among the highest known, occasionally reaching 3.8 white marlin per 100 hooks. In autumn (March-May) catch rates are generally lower than in summer and the marlin are not caught as far south. Because large areas of the South Atlantic are not fished in the autumn, catch rate data may not reflect a true picture of distribution. From June through September white marlin in the South Atlantic are concentrated in the South Equatorial Current and off the southwest coast of Africa. This season is the only one in which white marlin apparently are concentrated along the coast of Africa. From September through November,

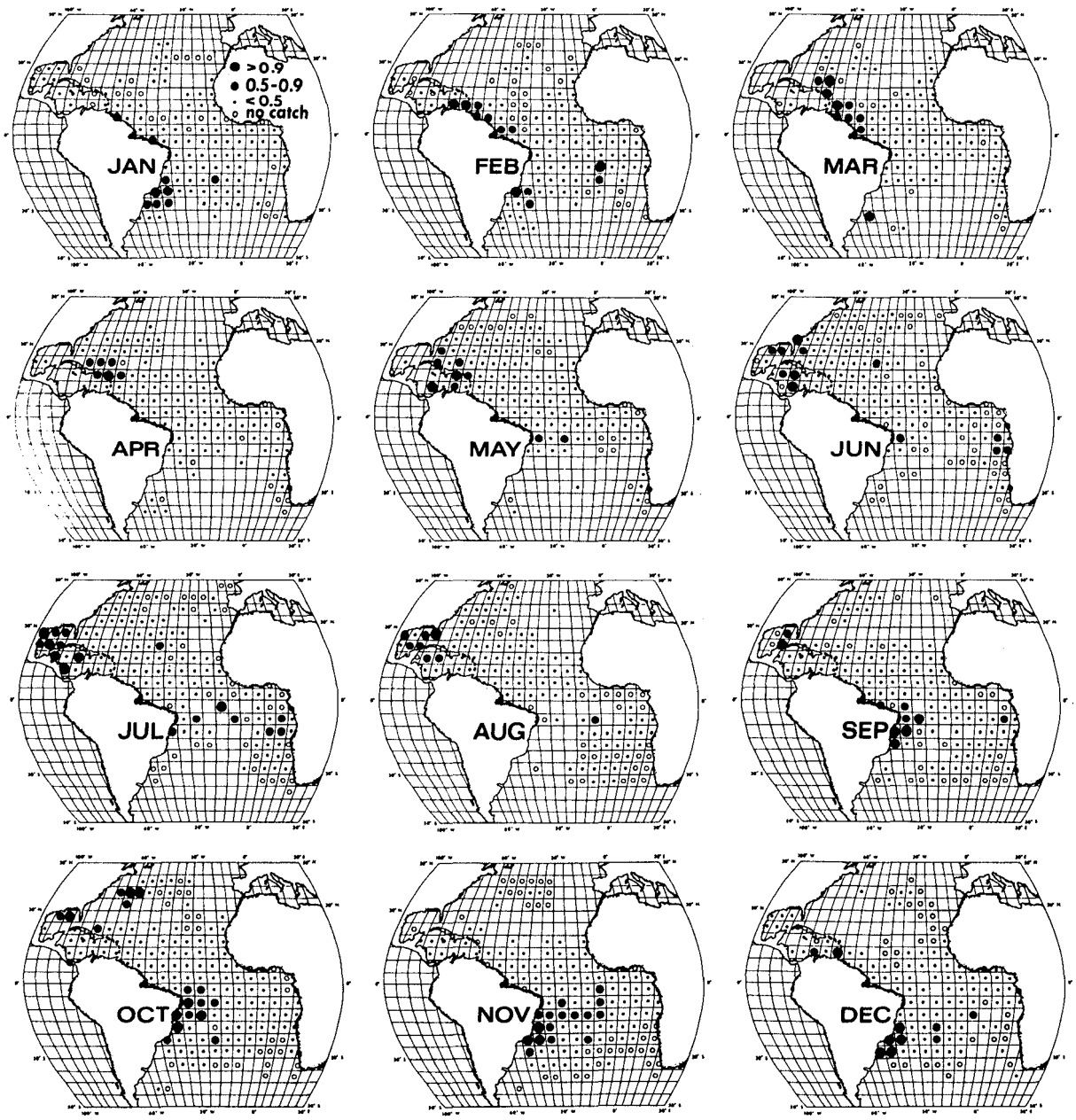

FIGURE 6.—Distribution and apparent relative abundance of white marlin in the Atlantic Ocean. Data are from records of the Japanese longline fishery, 1956-67. The catch per unit of effort (CUE) for each month in the rectangle is the arithmetic mean of the CUE of each month that the area in the rectangle was fished in the 12-year period. CUE is the number of fish caught per 100 hooks.

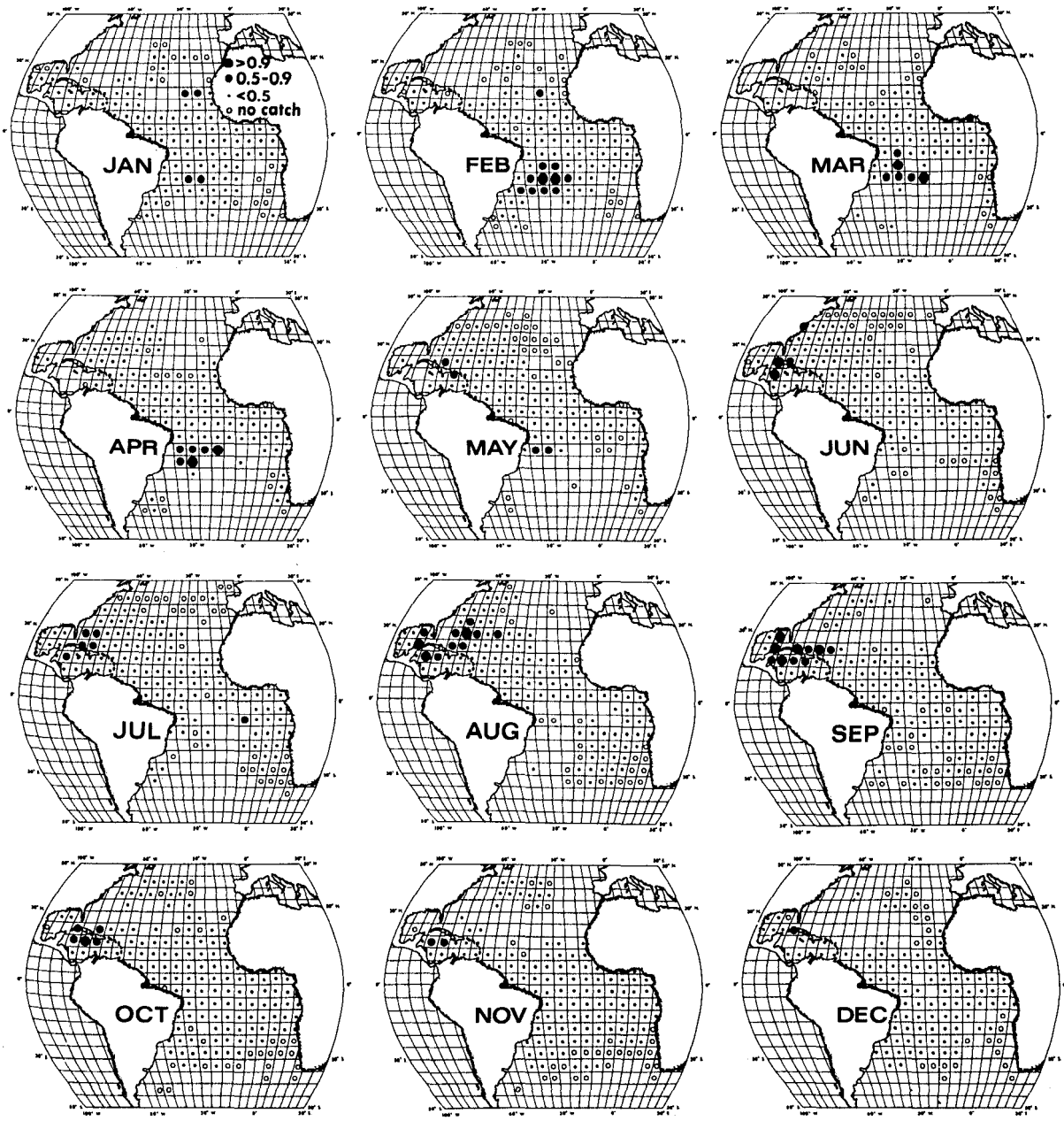

FIGURE 7.—Distribution and apparent relative abundance of blue marlin in the Atlantic Ocean. Data are from records of the Japanese longline fishery, 1956-1967. The catch per unit of effort (CUE) for each month in the rectangle is the arithmetic mean of the CUE of each month that the area in the rectangle was fished in the 12-year period. CUE is the number of fish caught per 100 hooks.

white marlin again are concentrated in the western South Atlantic off Brazil and in the South Equatorial Current.

We hypothesize that there are no major migrations of white marlin between the North and South Atlantic Oceans because the areas of concentrations of white marlin in the two oceans are generally separated by areas of low catch rates for white marlin and because not a single fish tagged in the North Atlantic has been recaptured in the South Atlantic. The North and South Atlantic groups of white marlin may be separate populations; Kamimura and Honma (1958a, b) believe that the closely related striped marlin of the Pacific Ocean has separate populations in the northern and southern hemispheres.

BLUE MARLIN

Monthly distribution of catches of blue marlin by Japanese longliners reveals two major seasonal concentrations in the Atlantic Ocean (Figure 7). In the Caribbean Sea, Gulf of Mexico, and the western North Atlantic Ocean south of lat 35°N, blue marlin are most abundant in the longline fishery from June through October. In the western and central South Atlantic Ocean, between lat 10° and lat 20°S, blue marlin are most abundant in February, March, and April. Possible migratory routes between the two areas are fished by the Japanese during all months of the year, but longline catches have produced no evidence that blue marlin move between the two oceanic regions. There may be two populations of blue marlin in the western Atlantic which are relatively unavailable to the longline fishery at certain seasons of the year, or there may be a single population which is unavailable to the fishery while the fish are migrating between the two areas. We believe that the two widely separated concentrations of blue marlin represent separate spawning populations. The evidence suggests that blue marlin in the North Atlantic spawn mainly from July through September and those in the South Atlantic spawn in February and March. It is unlikely that a single population of blue marlin would spawn at two widely separate locations at different times of the year. Eschmeyer and Bullis (1968) examined four larvae of blue marlin from the western North Atlantic captured in July and September, and Gehringer (1957) reported three larvae from the western North Atlantic and Gulf of Mexico in spring and summer, which were later identified as blue marlin by Ueyanagi and Yabe (1959). Caldwell (1962) reported on two postlarvae of blue marlin captured off Jamaica in September. Erdman (1968) concluded from his studies of gonad development and sex ratio that the peak spawning season for blue marlin off Puerto Rico was in July and August. In the South Atlantic, Bartlett and Haedrich (1968) reported on 85 larvae of blue marlin captured off the coast of Brazil in February and March. The size range was from 4.9 to 32.0 mm.

The blue marlin is apparently the only[6] billfish in the Atlantic whose abundance has been significantly affected by longline fishing. Wise and Le Guen (1969) showed significant rates of decline in relative apparent abundance of blue marlin in the two areas of major concentrations shown in Figure 7. They stated that these declines were associated with the intensive fishing for albacore and yellowfin tuna in the same areas. Ueyanagi et al. (1970) also reported a drastic decline in the apparent abundance of blue marlin in the Atlantic with the level of apparent abundance in 1965 only about one-fourth of that of 1962.

SUMMARY

WHITE MARLIN

1. Tag returns indicate that one group of white marlin moves from the middle Atlantic coast of the United States in summer to the north coast of South America in winter. The route appears to be initially offshore from the summer grounds, then south to the wintering area. The return is north in the vicinity of the Antilles and the Bahamas, including the Yucatan Channel and the Straits of Florida.

2. Longline catches support the above hypothesis but also indicate that a second group of

[6] Recent unpublished data suggest that the abundance of broadbill swordfish and white marlin in the Atlantic may also have been reduced by longline fishing.

white marlin moves from the wintering area off the coast of South America to summer grounds in the Gulf of Mexico. The relation between these two groups, which have different summering areas but similar wintering areas, is not clear, nor is their relation to a third group of white marlin which summers off Venezuela.

3. White marlin in the South Atlantic are separate from those in the North Atlantic and migrate from the eastern South Atlantic in winter to the western South Atlantic in summer.

4. White marlin appear to be relatively long-lived. An annual mortality of 27% was estimated from tag return data.

BLUE MARLIN

1. Only three tag returns have been recorded for blue marlin; all were relatively near the points of release.

2. Analysis of Japanese longline catch records for blue marlin reveals concentrations during summer and early autumn on the western side of the North and South Atlantic Oceans. In winter these concentrations disperse, and no pattern of distribution is apparent.

3. The two populations appear to be separate. We believe that spawning takes place in spring and summer for each group.

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The tagging results were made possible by the thousands of anglers, captains, and mates who have tagged and released many of their catches, and the clubs and tournament committees which have encouraged tagging. We regret that space does not permit individual acknowledgments here; the major participants are listed in the informal progress reports on the Cooperative Game Fish Tagging Program which are issued periodically by the WHOI. The press and the broadcasting media have also done much to encourage tagging and the return of tags.

[7] National Sea Grant Program, National Oceanic and Atmospheric Administration, Department of Commerce.

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APPENDIX

Release and recapture data for white marlin tagged in the western North Atlantic Ocean, 1954-69, are given in four Appendix Tables. Tagged fish are grouped by areas of release and recapture in order of recapture date. Data in parentheses were estimated by anglers at time of tagging. Although anglers estimated lengths in inches and weights in pounds, we have converted them to metric units.

APPENDIX TABLE 1.—Group A: White marlin tagged and recaptured north of lat 32°N.

Release data					Recapture data							Months at liberty
Date	Locality		Estimated size		Date	Locality		Size		Gear[1]	Flag	
	Lat N	Long W	Length	Weight		Lat N	Long W	Length	Weight			
			cm	*kg*				*cm*	*kg*			
July 11, 1955	(38°10′	74°45′)	(220)		July 18, 1959	37°31′	74°44′		(25.0)	RR	U.S.	48.2
July 31, 1962	(38°10′	74°45′)	(200)		Aug. 18, 1963	38°07′	74°52′	234	29.0	RR	U.S.	12.6
Aug. 7, 1961	37°53′	74°42′		(20)	Aug. 7, 1964	35°47′	75°05′	201	21.8	RR	U.S.	36.0
July 17, 1963	37°48′	74°41′		(12)	Aug. 9, 1964	(38°10′	74°45′)			RR	U.S.	12.8
July 30, 1964	35°47′	75°05′	(230)		Aug. 11, 1964	40°31′	66°45′		(16.8)	LL	Can.	0.4
July 27, 1964	(38°10′	74°45′)		(27)	Aug. 26, 1964	38°20′	74°38′			RR	U.S.	1.0
July 12, 1964	(38°10′	74°45′)		(18)	Sept. 10, 1964	38°40′	62°10′		(18.2)	LL	Jap.	2.0
July 28, 1962	37°50′	74°57′	(200)		Aug. 15, 1965	38°04′	74°47′	218		RR	U.S.	36.6
Aug. 7, 1965	38°42′	74°32′		(36)	Aug. 16, 1965	38°10′	74°10′	195	24	LL	Nor.	0.3
Aug. 2, 1964	36°05′	75°12′	(200)		Aug. 25, 1965	38°38′	74°25′	221	30.4	RR	U.S.	12.8
Aug. 26, 1963	(38°10′	74°45′)		(27)	Sept. 16, 1965	39°40′	72°20′			LL	Nor.	24.7
July 23, 1965	(38°51′	74°30′)	(200)		Aug. 4, 1966	40°45′	72°21′	226	30.4	RR	U.S.	12.4
July 17, 1966	38°58′	74°00′		(20)	Aug. 7, 1966	35°28′	74°52′	208	18.2	RR	U.S.	0.7
Aug. 24, 1964	(38°10′	74°45′)		(14)	Aug. 14, 1966	39°07′	74°25′	193	16.8	RR	U.S.	23.7
Aug. 18, 1964	36°00′	74°56′	(210)		Sept. 10, 1966	37°58′	74°55′	213	22.7	RR	U.S.	24.6
July 12, 1965	37°50′	74°57′	(210)	(18)	Sept. 13, 1966	39°31′	71°40′		31.8	LL	U.S.	14.1
July 9, 1968	(38°11′	74°00′)		(45)	Aug. 17, 1968	38°02′	74°35′	208	20.4	RR	U.S.	1.3
Sept. 13, 1966	38°30′	73°30′		(24)	Oct. 22, 1968	33°15′	39°21′	180		LL	S.K.	25.3
July 22, 1968	38°15′	73°50′	(220)		July 18, 1969	37°56′	74°40′	221	29.4	RR	U.S.	11.8
July 22, 1968	38°15′	73°50′		(20)	Aug. 4, 1969	38°15′	73°50′			RR	U.S.	12.4
Aug. 11, 1968	38°42′	74°25′		(18)	Aug. 6, 1969	36°12′	75°00′	(211)	(20.4)	RR	U.S.	11.8
July 21, 1968	37°26′	75°06′	(210)	(27)	Aug. 7, 1969	38°04′	74°10′	211	25.0	RR	U.S.	12.6
Aug. 13, 1969	38°13′	73°51′		(18)	Aug. 30, 1969	35°52′	75°12′	(203)	(25.0)	RR	U.S.	0.6
July 14, 1967	38°10′	74°32′		(23)	Aug. 31, 1969	37°31′	74°22′		(21.3)	RR	U.S.	25.6

[1] RR, rod and reel; LL, longline; CL, criollo line.

APPENDIX TABLE 2.—Group B: White marlin tagged north of lat 32°N and recaptured between lat 15°N and lat 32°N.

Release data					Recapture data							Months at liberty
Date	Locality		Estimated size		Date	Locality		Size		Gear[1]	Flag	
	Lat N	Long W	Length	Weight		Lat N	Long W	Length	Weight			
			cm	*kg*				*cm*	*kg*			
(Summer 1956)	(38°10′	74°45′)			Apr. 30, 1957	23°12′	82°05′		27.2	CL	Cuba	
Aug. 26, 1962	37°40′	74°54′	(210)		Apr. 8, 1964	23°11′	82°23′	218	25.0		Cuba	19.4
Sept. 6, 1961	38°14′	73°53′			May 5, 1964	23°14′	82°20′				Cuba	32.0
Aug. 29, 1963	38°02′	74°04′			May 8, 1964	23°13′	82°22′		22.7	CL	Cuba	8.3
Aug. 19, 1964	(38°10′	74°45′)			June 14, 1965	29°32′	75°13′			LL	Jap.	9.8
Aug. 1, 1964	38°30′	73°30′	(180)		June 27, 1965	24°23′	74°04′	(120)		LL	Jap.	10.9
Aug. 17, 1964	37°51′	74°58′		(18)	July 2, 1965	23°17′	82°21′		22.7		Cuba	10.5
July 1965	38°22′	74°30′		(36)	Apr. 2, 1966	25°42′	79°21′	234	40.9	RR	U.S.	(8.6)
(Aug. 1962)	(38°10′	74°45′)			Apr. , 1966	25°42′	79°21′		25.0	RR	U.S.	(43)
July 23, 1965	37°56′	74°40′		(32)	June 14, 1966	(23°15′	82°17′)		18.2		Cuba	10.7
July 21, 1966	(38°10′	74°45′)		(32)	May 5, 1967	31°10′	75°10′	220	30	LL	Cuba	9.5
July 4, 1966	38°30′	73°30′	(160)	(18)	May 28, 1967	23°05′	83°13′	200	25.0	CL	Cuba	10.8
Aug. 12, 1966	(39°18′	74°00′)		(20)	May 10, 1968	(23°05′	82°45′)	213	25.0	CL	Cuba	20.8
Aug. 9, 1966	40°52′	71°44′		(40)	May 18, 1968	18°38′	66°07′	234	40.9	RR	U.S.	21.2
July 17, 1965	38°09′	74°30′		(25)	June 20, 1968	23°14′	82°22′		35.8	CL	Cuba	35.1
Sept. 3, 1966	35°49′	74°56′	(200)		July 11, 1968	23°14′	81°55′	228	15.9	LL	Cuba	22.2
Aug. 18, 1964	38°47′	74°17′	(200)		July 20, 1968	23°10′	82°30′		15.0	CL	Cuba	47.0
Sept. 24, 1968	38°22′	73°41′		(27)	Apr. 27, 1969	22°40′	69°50′		23	LL	S.K.	7.0
Sept. 17, 1967	38°15′	73°50′			(May 15, 1969)	28°06′	77°16′		15	LL	Cuba	(20.5)
July 25, 1967	38°44′	74°29′	(230)	(27)	May 31, 1969	24°49′	80°29′	206	19.1	RR	U.S.	22.2
July 13, 1968	38°00′	74°00′		(18)	June 7, 1969	24°30′	74°40′	180	22.5	LL	Jap.	10.8
Aug. 23, 1968	35°47′	74°40′	(190)	(19)	June 21, 1969	18°45′	77°04′	170	20.0	LL	Jap.	9.9

[1] RR, rod and reel; LL, longline; CL, criollo line.

APPENDIX TABLE 3.—Group C: White marlin tagged north of lat 32°N and recaptured south of lat 15°N.

Release data					Recapture data							Months at liberty
Date	Locality		Estimated size		Date	Locality		Size		Gear[1]	Flag	
	Lat N	Long W	Length	Weight		Lat N	Long W	Length	Weight			
			cm	*kg*				*cm*	*kg*			
Aug. 8, 1963	38°50′	74°30′			Dec. 10, 1963	13°15′	61°30′		18.2	LL	Fr.	4.1
Aug. 20, 1964	35°50′	75°00′	(200)	(20)	Dec. 12, 1966	12°05′	67°55′		25.0	LL	Ven.	27.8
July 27, 1966	37°58′	74°38′		(18)	Jan. 2, 1967	10°55′	67°00′			LL	Ven.	5.2
Aug. 31, 1964	37°47′	74°49°		(17)	Feb. 15, 1967	07°25′	52°20′			LL	Ven.	29.5
Unknown	(36°00′	75°00′)			Nov. 8, 1968	12°30′	65°25′					
(Aug. 1, 1968)	38°15′	73°50′			Feb. 13, 1969	10°02′	57°22′	157	20.5	LL	Ven.	(6.6)
Aug. 4, 1969	36°12′	75°12′		(28)	Oct. 29, 1969	12°40′	76°53′		25			2.8
Aug. 12, 1969	(38°15′	73°50′)		(23)	Nov. 13, 1969	12°07′	64°50′		(17)	LL	Jap.	3.1
Unknown	(38°15′	73°50′)			Nov. 25, 1969	11°58′	65°14′		(20)	LL	Jap.	
July 24, 1966	37°59′	74°44′		(27)	Nov. 28, 1969	11°58′	65°14′		(20)	LL	Jap.	39.2
Aug. 18, 1969	(35°57′	75°01′)	(200)	(18)	Dec. 14, 1969	14°00′	64°00′	140	(15)	LL	Jap.	3.9
July 18, 1969	37°54′	74°36′		(20)	Dec. 16, 1969	11°25′	68°12′		(17)	LL	Jap.	5.0

[1] RR, rod and reel; LL, longline; CL, criollo line.

APPENDIX TABLE 4.—Group D: White marlin tagged south of lat 32°N.

Release data					Recapture data							Months at liberty
Date	Locality		Estimated size		Date	Locality		Size		Gear[1]	Flag	
	Lat N	Long W	Length	Weight		Lat N	Long W	Length	Weight			
			cm	*kg*				*cm*	*kg*			
Jan. 18, 1964	25°43′	79°20′		(23)	July 25, 1964	23°37′	92°37′		2.2	LL	Jap.	6.2
Aug. 21, 1965	(10°50′	66°55′)		(30)	Dec. 28, 1965	09°15′	57°50′	250	14.2	LL	Jap.	4.2
Mar. 24, 1966	(25°20′	77°58′)		(18)	June 3, 1966	29°35′	76°50′	210	20	LL	Jap.	2.3
Sept. 4, 1966	10°47′	66°57′		(20)	Nov. 25, 1966	10°55′	67°00′	160	22	LL	Ven.	2.7
Oct. 16, 1965	(10°50′	66°55′)		(25)	June 14, 1967	32°27′	76°00′	193	16	LL	Cuba	19.9
July 3, 1967	29°55′	86°46′	(210)	(27)	July 31, 1968	29°49′	87°17′	234		RR	U.S.	12.9
July 31, 1969	29°55′	87°05′	(200)	(20)	Aug. 13, 1969	29°51′	86°48′	201	25.0	RR	U.S.	0.4

[1] RR, rod and reel; LL, longline; CL, criollo line.