Billfishes of the Central Pacific Ocean

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
BIOLOGICAL LABORATORY
HONOLULU, HAWAII 96812

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By

DONALD W. STRASBURG

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ABSTRACT

The billfishes are found in all warm seas. In the central Pacific, the striped and blue marlins are common or abundant; the black marlin is uncommon; the Pacific sailfish, broadbill swordfish, and shortbill spearfish are rarely caught. These fishes feed broadly on fish, squid, crustaceans, and other foods available on the high seas. In commercial catches of blue marlin in Hawaii, males and females appear in about equal numbers; but on a short-term basis, one sex can predominate. During the Hawaiian International Billfish Tournaments, which are held during the summer, more males are usually caught than females. In the commercial catch, the heaviest blue marlin (300-500 pounds) were taken in the spring, the lightest in the summer. Striped marlin show two peaks of abundance through part of the year. Blue marlin are most abundant in the summer. Striped marlin tend to occur in large numbers just when the blue marlin are least abundant. The longest migration recorded in the central Pacific was 3,000 miles, by a striped marlin that was tagged off Baja California, Mexico, later caught near the Hawaiian Islands.

Billfishes of the Central Pacific Ocean

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INTRODUCTION

The word billfish is a collective term embracing the various kinds of marlin, spearfish, sailfish, and the broadbill swordfish. These large fishes, some exceeding 1,000 pounds, are found in all warm seas. Despite their size, game qualities, and commercial potential, they are poorly known biologically.

The data used in compiling this report were obtained from the records of HIBT (Hawaiian International Billfish Tournament), the Hawaii State Division of Fish and Game, and the scientific literature. It is a pleasure to acknowledge the aid of those HIBT anglers who provided data and permitted me to examine their fish.

Species

Both the scientific and common names of the billfishes have been changed repeatedly, but in the last few years scientists have agreed on the terminology for the marlins and spearfishes at least. The currently accepted names of the billfishes found in central Pacific waters are as follows:

Common name	Scientific name
Blue marlin	Makaira nigricans
Black marlin	Makaira indica
Striped marlin	Tetrapturus audax
Shortbill spearfish	Tetrapturus angustirostris
Pacific sailfish	Istiophorus orientalis
Broadbill swordfish	Xiphias gladius

[1/] This report is adapted from a longer scientific paper on the same subject. The author's present address is Electric Boat Division, General Dynamics Corporation, Groton, Conn. 06340.

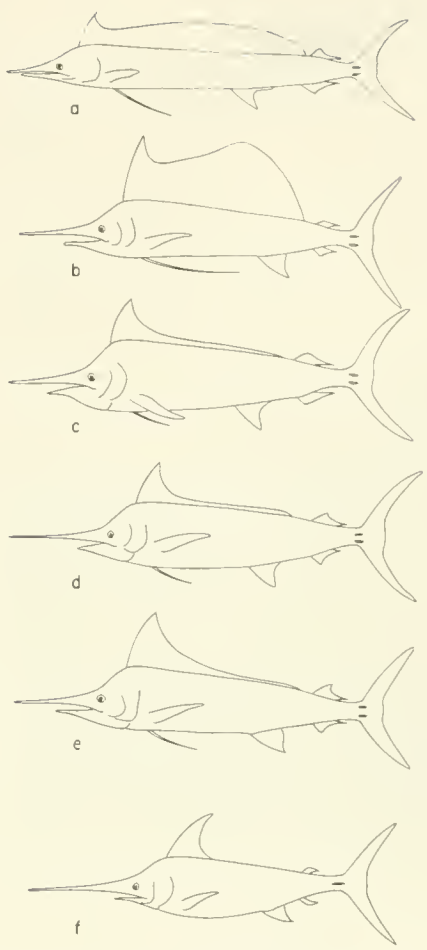

Figure 1 Billfishes of the central Pacific Ocean include (a) shortbill spearfish, (b) Pacific sailfish, (c) black marlin, (d) blue marlin, (e) striped marlin, and (f) broadbill swordfish. (Drawings adapted by permission from Gosline, William A, and Vernon E Brock, "Handbook of Hawaiian fishes," copyright 1960 by the University of Hawaii Press, fig 258)

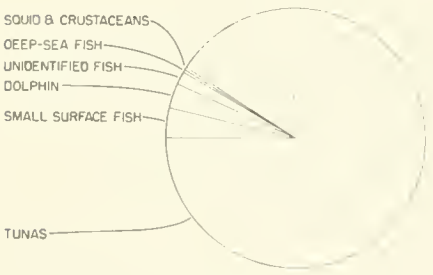

Figure 2. Volumetric percentage occurrence of foods in the stomachs of 16 blue marlin caught by trolling.

The broadbill swordfish is considered to be in a family by itself (the Xiphiidae); the other billfishes listed above are members of the family Istiophoridae. Drawings of these species appear as figure 1.

The blue marlin and the broadbill swordfish are circumtropical, whereas the other species have more restricted distributions. The striped and blue marlins are common or abundant in the central Pacific, the black marlin is uncommon; the Pacific sailfish, broadbill swordfish, and shortbill spearfish are rarely caught.

Diet

The billfishes feed broadly on fish, squid, crustaceans, and other foods available on the high seas. Diets differ between the species as well as between populations of the same species. The striped marlin feeds on several fishes, including tuna, in the central Pacific. Stomachs of blue marlin in the central Pacific contain mostly tunalike fish (especially skipjack tuna). Less is known about the food habits of the black marlin. Specimens have been taken containing ocean sunfish, skipjack, yellowfin, albacore, and bigeye tuna. Squid seems to be the major food of central Pacific sailfish and shortbill spearfish.

In terms of volume, small tunas, such as skipjack (aku), little tunny (kawakawa), frigate mackerel (keokeo), and young albacore (ahipalaha) are very important in the diet of Hawaiian blue marlin (fig. 2). These fish also eat small deep-dwelling squirrelfish (alaihi), 3-inch specimens of which have been seen in large schools from a submarine at 600 feet depth. Billfish probably forage regularly at considerable depth.

Is the spear of billfishes used in feeding? Numerous reports state that billfishes often stun their prey with a slashing movement of the bill, then return to seize and eat the stunned victim. Vernon E. Brock, University of Hawaii, observed a billfish at the surface of the water near Kona, Hawaii, with a dolphin (fish) impaled on its bill. Observers aboard the Bureau of Commercial Fisheries research vessel Geronimo in the Atlantic Ocean also reported seeing a dolphin impaled on the bill of a marlin. The marlin splashed in an apparent attempt to dislodge the dolphin, then sounded and was not seen again.

Tuna with apparent spearmarks on the body are occasionally found in marlin stomachs. A 1,500-

pound black marlin captured south of Hawaii by the Bureau of Commercial Fisheries research vessel John R. Manning had in its stomach a 157-pound yellowfin tuna which had been speared through its body twice before being eaten. During the 1967 Hawaiian International Billfish Tournament a blue marlin was caught with a 63-pound bigeye tuna in its stomach. On the tuna's flank were several wounds which may have been inflicted by the marlin's bill. The marlin, including the tuna, weighed 748 pounds.

Thus there is no doubt the fish have used their bills to spear prey. Whether this spearing is intentional is another question. It has been argued that these stabbings are probably accidental, since most billfish prey are not stabbed.

Sex Ratio and Sexual Dimorphism

Data on sex ratio and sexual dimorphism (i.e., differences in size between the sexes) are adequate only for the blue marlin. In Honolulu, the commercial catch of blue marlin consists of males and females in about equal numbers. A random sample of 694 blue marlin taken between 1960 and 1962 consisted of 48 percent males and 52 percent females. On a short-term basis, however, one sex may dominate the catch. The following sex ratios were obtained at recent Hawaiian International Billfish Tournaments, which were held at varying times from June through August:

Year	Number of males	Number of females	Ratio males to females
1962	16	7	2.3:1
1963	13	6	2.2:1
1964	14	12	1.2:1
1965	35	8	4.4:1
1966	16	8	2.0:1
1967	51	13	3.9:1
1968	24	10	2.4:1

The sex ratio approached the expected 1:1 condition only in 1964; in the other years the fish were either segregated by sex or the males were more susceptible to the fishing gear and techniques used.

There is a marked difference in the size attained by male and female blue marlin. Over a 3-year period in which 694 blue marlin were examined, nearly all of the males weighed between 100 and 200 pounds, whereas most females were between 200 and 500 pounds. Furthermore, males never became as heavy as females. The largest male sampled weighed only 293 pounds; females have been taken at weights greater than 1,600 pounds. As a rule of thumb, a blue marlin heavier than 300 pounds is a female.

Although the data are few, the black marlin resembles the blue marlin in its sexual dimorphism. The largest known male weighed only 322 pounds, whereas the world's record black marlin, a female, weighed 1,560 pounds. In the striped marlin the weight distributions of the sexes are about the same; 400 pounds is about the upper limit.

Weight

The blue marlin not only displays fluctuations in sex ratio and great sexual differences in weight; fish

captured from 1949 to 1951 in Hawaiian waters also showed large fluctuations in weight distribution between successive months. The weight distribution in January was broad, with 100- to 300-pound fish dominating the catch. By April the distribution shifted toward heavier fish, 300- to 500-pounders, which were presumably females. By June the lightweight fish appeared in numbers, and judging by the Billfish Tournament data, they were males. These light fish dominated the summer catch, reached their peak in September, and then slowly declined. By December the situation was similar to that in January.

The weight-frequency distribution of Hawaiian striped marlin has two peaks through part of the year. From January through August striped marlin in the 20- to 60-pound and 80- to 120-pound sizes are common. During the rest of the year, most striped marlin are 60 to 120 pounds. Furthermore, the number of fish caught is not uniform but is very low in summer. The catch improves in autumn, when the fish are heavier than those taken in spring. Whether the modes are related to the temporary abundance of one sex, as in blue marlin, is unknown.

Seasonal Occurrence

Figure 3 illustrates the seasonality of the occurrence in Hawaii of blue and striped marlin. Blue marlin are most abundant in the summer and least abundant in the winter. Striped marlin tend to occur

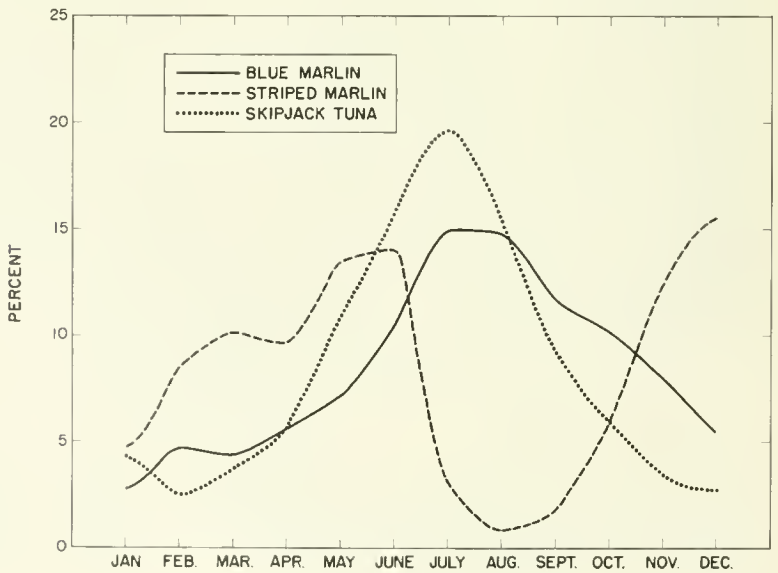

Figure 3 Seasonal occurrence of blue marlin, striped marlin, and skipjack tuna in Hawaii, 1958-67, based on commercial fishery landings.

in large numbers just when the blue marlin are least abundant. Striped marlin show a tendency to have more than one annual peak in abundance.

There are several explanations for the fact that the abundance of these two predators is generally complementary. Perhaps they respond differently to some environmental factor, such as temperature. Another explanation concerns the food supply of the two species. As shown earlier, blue marlin feed largely on tuna whereas striped marlin eat a variety of small fish. The seasonal abundance of skipjack tuna is also shown in figure 3. The similarity of the curves for blue marlin and skipjack tuna indicates that fluctuations in blue marlin may be related to the presence of their prey.

Spawning

The data on billfish reproduction are few. Male blue marlin with freely flowing milt (sperm) were captured in the central Pacific from February through October. Specimens of striped marlin in the central Pacific had enlarged gonads in February and March. Sailfish spawn in July off Hainan, and from April to August in Formosan waters. The shortbill spearfish is reported to spawn in November and throughout the year but most actively in winter. The broadbill swordfish is thought to reproduce in the tropics, and it is possible that the adults normally inhabit waters cooler than the spawning grounds. Black marlin apparently spawn between June and November in broad areas of the Indo-Pacific.

Early Life History and Growth

The young of the billfishes have received enough attention recently to make it possible to distinguish the postlarval and juvenile stages of the several species. Figure 4 is a reproduction of a Japanese scientist's drawings of young billfishes.

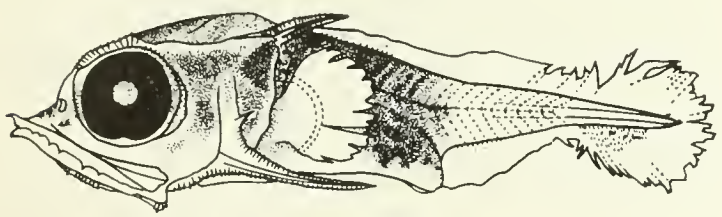

Figure 4. This drawing shows a blue marlin larva less than 1/4 inch long. It is adapted from "Methods for identification and discrimination of the larvae of five istiophorid species distributed in the Indo-Pacific," by the Japanese scientist Shoji Ueyanagi.

Striped marlin have been estimated to grow 30 pounds a year. Age and growth of other central Pacific billfishes have not been studied.

In the Atlantic, growth of Atlantic sailfish is rapid and the lifespan short. Fish hatched in June were 56 inches long and weighed 7 pounds by November. At the end of a year they measured 72 inches long and weighed 21 pounds; at 3 years they were 92 inches long and weighed 63 pounds. Few fish attained 4 years of age.

Migrations

As do several other high seas species, billfishes undertake large-scale migrations. Evidence for these movements has been inferred from seasonal changes in abundance and from the recapture of individuals tagged in various ways. Because of the size and armament of billfish, most tagging has been done by harpoons fitted with detachable dart-tag heads. This method precludes measuring or weighing the fish.

Striped marlin and Pacific sailfish have been tagged off southern California and Mexico. In 1967, 1,279 striped marlin, 491 sailfish, 23 blue marlin, 3 black marlin, and smaller numbers of other fishes (total, 1,839 fish) were tagged and released. Tag returns included 20 striped marlin and 2 Pacific sailfish, according to the Tiburon Marine Laboratory of the U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. These recoveries, and others made in the Cooperative Game Fish Tagging Program, indicate that in spring and summer some of the marlin move from near the Gulf of California around the tip of Baja California and are moving northward when they are again captured; in the fall some of the fish are moving south, but some are near the mouth of the Gulf all year. The longest distance traveled by any of the tagged fish was about 3,000 miles--a striped marlin tagged off the tip of Baja California was taken by a fishing vessel 200 miles southwest of the Hawaiian Islands. It had been tagged in mid-February and was recovered in mid-May. According to previous records, skipjack tuna tagged off Baja California also have migrated to Hawaii, but the interval between tagging and recapture was more than a year, rather than 3 months, as with the striped marlin.

Evidence on the migrations of billfish in the central Pacific Ocean is being sought by the Bureau of Com-

mercial Fisheries Biological Laboratory, Honolulu. On a cruise in January and February 1968 off Kona and off Johnston Island, 65 fish were caught, tagged, and released; 44 were striped marlin, 10 were shortbill spearfish, 7 were yellowfin tuna, and 1 each were blue marlin, albacore, bigeye tuna, and wahoo. The fish were tagged with a tubular yellow plastic tag that was inserted in the back of the fish just below the dorsal fin. The tags were serially numbered and bore the name and return address of the Laboratory. It is hoped that fishermen who land the tagged fish will return the tag to the Laboratory, along with information on the date, location, and size of the fish.

Other scientists have deduced the nature of billfish migrations by less direct means. Striped marlin show a general poleward migration in warm weather, followed by movement toward the Equator in winter. Although the northern and southern populations of Pacific striped marlin are thought to be discrete, there may be an influx of small southeast Pacific fish into the Hawaiian fishery in the summer. It is also possible that the striped marlin that appear in southern California in the summer come from the south.

William F. Royce in 1957 summarized the available information on blue marlin movements with the statement, "Thus, north of the equatorial area the seasonal occurrence suggests a summer movement northward followed by a return south in the late autumn."[2/] A similar conclusion was drawn by other authors, who also suggested a differential migration by sex in which males have greater migrational activity than females. They suggested further that the migrations may be related to sea conditions and to spawning.

Estimating Billfish Weight

Graphs have been constructed that allow one to estimate a fish's weight simply by measuring its length. Three are included in this report (figs. 5, 6, 7). To estimate the weight of a blue marlin of 175

[2/] Royce, William F. 1967. Observations on the spearfishes of the central Pacific. U.S. Fish Wildl. Serv., Fish. Bull. 57: 497-554.

inches fork length,[3] for example, enter the blue marlin graph (fig. 5) from the bottom scale at 175 inches. At the point where the 175-inch line intersects the weight-length curve, read across to the left (weight) scale--here, 1,140 pounds. These graphs are derived from hundreds of specimens, but some fish, especially very large ones, may fall at some distance from the curve.

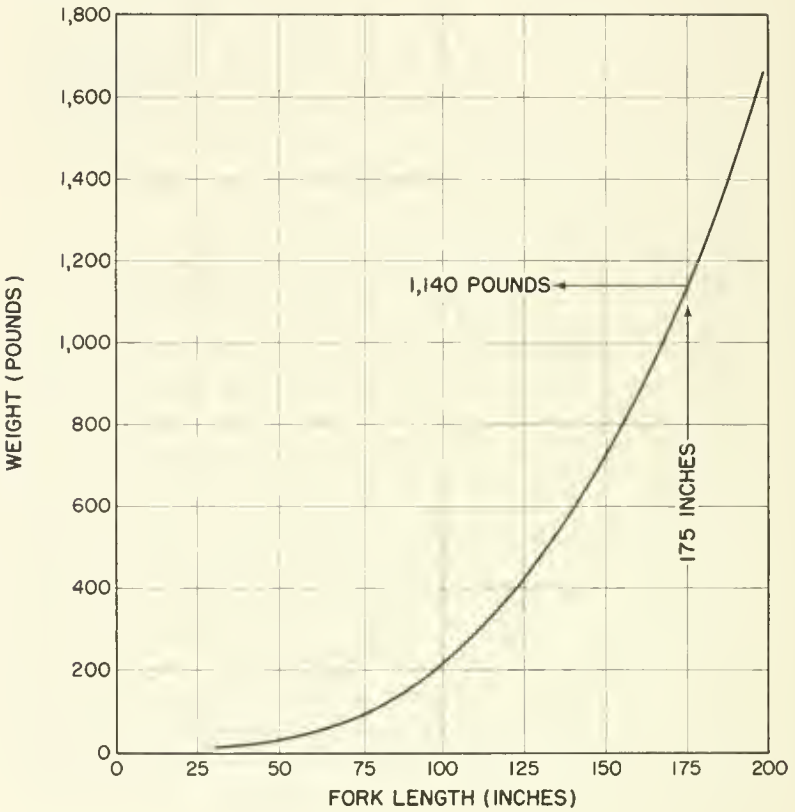

Figure 5. Length-weight relation for blue marlin.

[3] Fork length here is defined as the distance between the tip of the bill and the middle of the notch in the rear edge of the caudal fin.

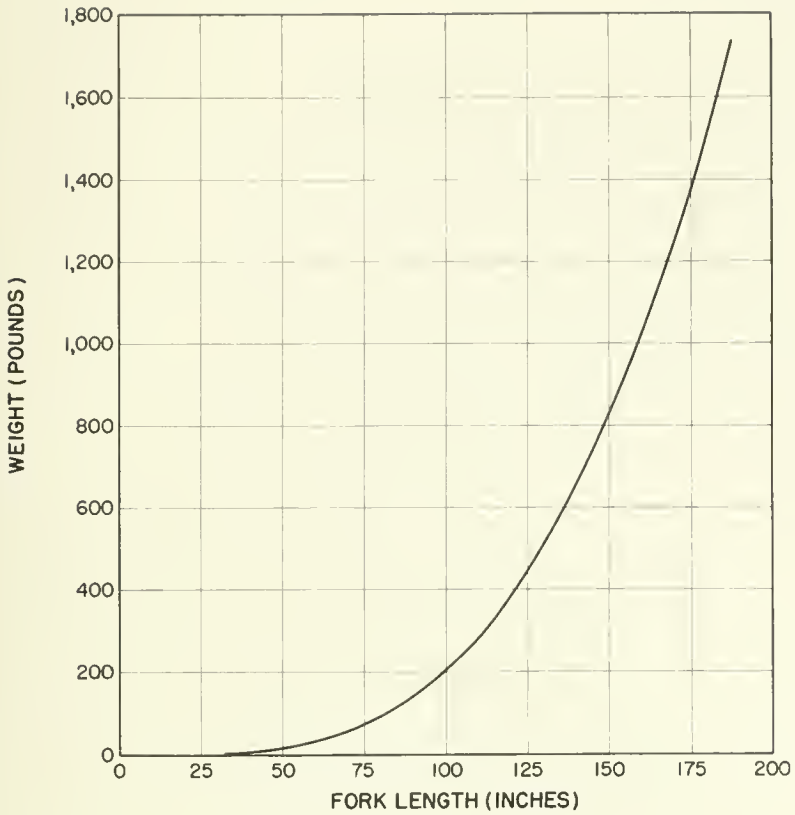

Figure 6. Length-weight relation for black marlin

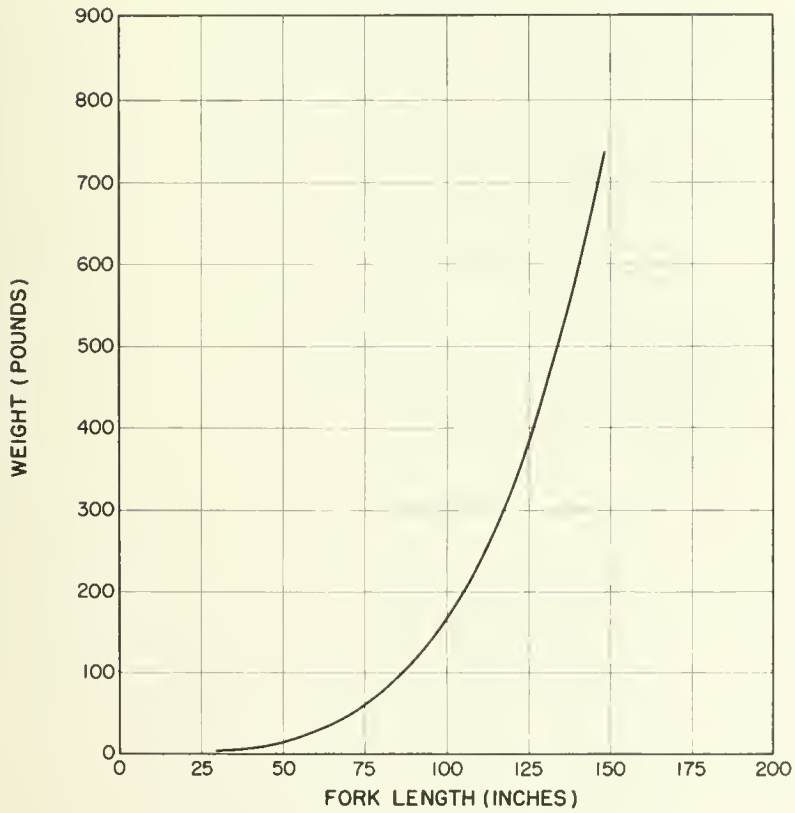

Figure 7. Length-weight relation for striped marlin.

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