Distribution and Relative Abundance of Billfishes (Istiophoridae) of the Pacific Ocean

John K. Howard
Shoji Ueyanagi

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Distribution And Relative Abundance Of Billfishes (Istiophoridae) Of The Pacific Ocean

by

John K. Howard and Shoji Ueyanagi

Institute of Marine Science
July 1965
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ジョン・カー・ハワード

マイアミ大学海洋科学研究所

第二部 分布

ジョン・カー・ハワード

上柳昭治

南海区水産研究所
Distribution And Relative Abundance Of Billfishes (*Istiophoridae*) Of The Pacific Ocean

by

*John K. Howard and Shoji Ueyanagi*

*July • 1965*

Published by the University of Miami Press

_INSTITUTE OF MARINE SCIENCE_
In the last analysis, if it were not for the extraordinary farsightedness, initiative, and organizing ability of the great Japanese fishery companies, as well as the energy, high quality of seamanship and great technical fishing skill of their ships’ officers and crews, there would be no catches of istiophorid fishes from all over the world to serve so usefully in this distribution study.

—John K. Howard to Dr. F. G. Walton Smith, in Howard's proposal for work in Japan, dated February 22, 1962.
Preface

The billfishes, Family Istiophoridae, are gamefish aristocrats; at the same time they are species of high commercial value and demand over much of the world. They are eaten raw, steaked, made into fishloaf and processed into fish sausages. Recently published estimates announce that more than 1,000,000 lbs. of one species, the black marlin, are processed into sausages by the Japanese alone.

Despite this interest and the success of both the recreational and commercial harvest, knowledge of the billfishes has been gathered slowly and it has been only in the past decade that any degree of acceptance of specific identities of billfishes has been achieved. About population integrity, migrations, growth mechanisms and spawning virtually nothing is known. Why should this be? There are not many species, seven or eight, depending on one’s viewpoint about the sailfishes, and their characteristics pose no unusual problems.

The answer to this question has several facets. Those fish that were studied were few in number and of such size that they were not preserved. Study material did not accumulate. Those persons who did interest themselves in these gamefishes did so on a regional basis, ignoring work elsewhere or experiencing difficulty in evaluating the usually meager data because of differences in study techniques. Then, too, body characters of fishes often show dramatic changes in growth, a feature especially to be noted in billfishes. Different growth stages were allotted separate names.

In recent years scientists began to go where the billfishes were, often with the financial support of interested sports fishermen. Fishing tournaments provided opportunity to examine large numbers of specimens collected through the concentrated efforts of many anglers so that scientists were able to evaluate individual variation and variation due to growth changes. And scientists began to exchange information on these fishes so that information gained by one was to the profit of all. Species could be identified and data properly categorized.

No little bit of the success in gathering data and accumulating specimens was due to the enthusiasm, patience and prodding of the late Col. John K. Howard, American author of this present work. His correspondence with commercial and sports fishermen around the world was voluminous; each letter was culled for information, the information checked as thoroughly as possible and filed. Correspondents were hired in several foreign areas, including Japan, to scan and translate data and fisheries reports submitted by vessel captains. Japan, of course, has been the
leader in the development of commercial fisheries for the billfishes. Much of the advance in our information on geographic distribution, internal morphology and particularly the early development of billfishes, has been contributed by Japanese scientists.

Col. Howard and Dr. Ueyanagi combine their information and talents in this report. This summary of information on the billfishes in Pacific waters will provide an important basis for planning future studies. Careful evaluation of the monthly distribution charts will provide clues to migratory patterns and population integrity, and therefore fishing stocks. Some fishing clubs will find in this report more information about the early development of their sport fishery than is in their own files. Sports fishermen particularly can take pride in the accomplishments of one who came from their midst.

Col. Howard’s death occurred as this manuscript was being prepared for final typing. Changes to that point had been discussed both with Dr. Ueyanagi and with Dr. Robins. The editors, to insure that the viewpoints of the authors were as intended, have limited changes to those concerning journal style and matters which had been discussed with Col. Howard shortly before his death. Finally, the editors wish to acknowledge the *International Oceanographic Foundation* for financing this publication. — C. Richard Robins.
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DISTRIBUTION AND RELATIVE ABUNDANCE OF BILLFISHES (ISTIOPHORIDAE) OF THE PACIFIC OCEAN*

JOHN K. HOWARD
Institute of Marine Science, University of Miami

AND

SHOJI UEYANAGI
Nankai Regional Fisheries Research Laboratory

ABSTRACT

The billfishes (Istiophoridae) are important to man in several respects. They are the basis of certain locally important fisheries and are important adjuncts to other large fisheries, such as the Japanese longline fishery. At present, five species of Istiophoridae are recognized in the Pacific.

Istiophorid fishes were described in the Pacific as early as 1844. Since that time, many nominal species have been described. Many are based on a single specimen, or even second-hand information. As a result, there has been, and to some extent still is, considerable taxonomic and nomenclatural confusion.

Taxonomic methods and techniques that have been applied to Istiophoridae are restricted largely to morphometric and meristic characters. Internal characters and comparison of larval and juvenile development have been employed to a lesser extent, and biochemical characters still less. The need for further work employing modern techniques is pointed out.

Because of the interests and needs of sport and commercial fishermen, the English and Japanese common names have a long history and are now fairly well standardized.


It is felt there is insufficient phylogenetic evidence bearing on the question of higher taxonomic categories to construct a sound hierarchy. The best system based on present information is to divide the family into three genera (*Istiophorus*, *Tetrapturus* and *Makaira*) as proposed by Robins and de Sylva (1960: 403).

Istiophoridae occur over the entire Pacific between 40°N and 40°S latitudes, although the area occupied in greatest abundance differs for each species. Black marlin and sailfish have their greatest abundance near land masses and striped marlin, blue marlin and shortbill spearfish occur more commonly in the open sea.

The striped marlin is distributed in a horseshoe-shaped pattern. Those at the apex of the horseshoe, the Eastern Pacific, are believed to be closely

*Contribution No. 609 from the Marine Laboratory, Institute of Marine Science, University of Miami.
related to those of the South Pacific. Northern and southern populations appear distinct, though some interchange may occur.

The blue marlin is the most tropical species and is considered to belong to one population. It follows a seasonal north-south migration across the equator.

The black marlin is characterized by having its greatest density on the periphery of the area, the Indo-Australian area and the Eastern Pacific. It is sparse in open sea areas.

The sailfish is most abundant near the Solomon Islands, New Guinea, the Caroline Islands, in the Kuroshio Current and along the coast of Central America.

Data are scarce for shortbill spearfish. Its density appears highest in the areas where distributions of striped marlin and blue marlin overlap.

**PART I. INTRODUCTION**

**JOHN K. HOWARD**

**IMPORTANCE OF ISTIOPHORIDAE**

Fishes of the family Istiophoridae are important to the largest national commercial fishery in the world, the Japanese (Suda, Koto and Kume, 1963). They are also important either directly or as a by-product of tuna fishing to other commercial fisheries, some of which are relatively small, but which are important to a local economy. This is true in Cuba, Ecuador, Peru, Chile, Western Samoa, the New Hebrides, Taiwan, the Maldives, the Calabrian and Sicilian fisheries of Italy, and may become true of the U.S.S.R. (Sun, 1960, as translated by Klawe). It is also true in one state of the United States, Hawaii (Royce, 1957:497). Between 1955 and 1960, the F. A. O. records of commercially landed weight of Istiophoridae nearly doubled (Gertenbach, 1962:11). As the Japanese make cooperative arrangements to develop longline fisheries throughout the world, fishes of this family will become important to commercial fisheries of more countries and areas, such as Fiji, Malaya, and, undoubtedly, some of the African countries, where these fishes have always been eaten when accidentally caught.

Indirectly, these fishes are important to U. S. tuna canners, who depend on Japan for part of their raw material. Anyone who studies the Japanese tuna longline fishery will see that it could not produce tuna for sale to the U. S. industry at present prices, if at all, unless it had a market for the istiophorid fishes which are a significant part of the catch (Lima and Wise, 1963:1521).

Istiophoridae have always contributed to subsistence fisheries of certain undeveloped areas, such as Senegal, Liberia, the Ivory Coast of West Africa, and some of the Pacific islands, such as the Cook Islands. They could contribute far more if people of these areas were given some training.

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1 All subsequent footnotes are collected at the end of Parts I and II respectively.
in use of appropriate gear and techniques. In addition, American tuna canning companies, in particular, are actively stimulating development of new native fisheries for tuna in developing countries of the tropics (Chapman, 1962:14; Rosa (Ed.), 1963:53). Istiophorid fishes will be at least a by-product of such fisheries. The present and potential value of these fishes have therefore made them of interest to such international organizations as F.A.O., U.N.E.S.C.O., and the South Pacific Commission.

In certain areas, the industry supported by marine angling or sport fishing is of economic importance; in some cases, it is of greater value than commercial fishing. Sport fishing is economically important in many states of the U. S. (Idyll, 1952; Anonymous, 1961; Outdoor Recreation Resources Review Commission, 1962a, 1962b, 1962c), in Jamaica, Puerto Rico, Venezuela, Mexico, Panama, New Zealand, Australia, South Africa, Mozambique, Kenya and Mauritius; it is growing rapidly in many other places. In the marine sport fisheries of these areas, istiophorid fishes are the aristocracy of the catch, bringing to the industry an amount of money disproportionate to the comparatively small numbers caught, and in all cases, lending glamor to the fishery which brings many customers.

Istiophorid fishes are also important to the ecology of other fishes of commercial value. For instance, they compete for food with tunas and broadbill swordfish.³ They prey on young stages of those fishes and, in turn, their young enter into the food supply of both. For an understanding of the ecology of both tuna and swordfish, the ecology of the Istiophoridae must also be known (Nakamura, 1951; Schaefer, 1962:197).

Istiophorid fishes migrate great distances. Fisheries biologists are more and more recognizing the necessity of knowing more about the biology of those pelagic, far migrating fish which are objects of some of the largest commercial fisheries. This was brought out at the World Scientific Meeting on Biology of Tunas and Related Species held at La Jolla, California in July, 1962 (Collette and Gibbs, 1963:25). The point was made that, because such migrating species entered into catches of different fisheries, it is necessary to know more about them and their populations in order to manage the different fisheries rationally (Jones and Silas, 1964:1).

Finally, due to their widespread distribution and abundance, istiophorids have a potential importance as a protein food for an over-populated world (Fitch, 1960:31).

**Taxonomy**

*Introduction.*—In dealing with animals either from the scientific or the purely practical standpoint, it is usually essential and always desirable to know the natural entities involved. The most important of such entities is the species. At the present time, there is general agreement among taxonomists as to the species of Istiophoridae in the Pacific Ocean.

In studies dealing with the biology of a species, and for purposes of
fisheries management, however, another natural entity, the reproductive unit, also becomes important. Most widely distributed species are broken up into such units. A reproductive unit consists of a group of individuals which interbreed freely, and which do not interbreed as freely with individuals of other such groups of the same species. The result is that each group is more or less independent of the other from the standpoint of reproduction.

Such groups have been variously called breeding groups, populations, subpopulations, subspecies, stocks, groups, races, demes and other terms. Such terms have been used interchangeably in some cases, and with different meanings in others (Marr, 1957:1).

It will be desirable, then, for the purposes of the present paper, to define the terms used, and what criteria were used in deducing the existence of such groups.

A freely interbreeding group of animals will usually, though not always, show some genetic difference from other groups with which they do not freely interbreed. In pelagic fishes, such differences are usually ascertained by the statistical evaluation of characters of a morphometric or meristic nature. Biochemical differences, such as those involving blood proteins, are also being increasingly used. Biochemical methods, however, have not been applied to any extent to istiophorid fishes.

On the other hand, certain patterns appear in the distribution of various istiophorid fishes which suggest separate groups which probably function as reproductive units. If a group of fish, represented by high catch rates, remains separated from other such groups throughout the year by intervening areas of low or non-existent catches, Dr. Ueyanagi and I have called the group a population. Whenever possible, such suggestions were supported with additional data.

We fully realize the limitations of our data, but feel that the groups so termed probably do represent reproductive units.

Fisheries biologists apparently prefer the term subpopulation for the groups we call populations. However, with this usage population is then not adequately separated from species or subspecies. For this reason, and because it is a simpler term, we use population.

Presently Recognized Species in the Pacific.—It is generally recognized today that in the Pacific there is one species of sailfish, one species of spearfish, and three species of marlin. They can be more accurately identified by their standard English and Japanese (here Romanized) common names than by attempting to use scientific names, which presently vary greatly from country to country, and even within countries. Use of scientific names involves use of generic names in the binomens, about which there is perhaps less agreement than about specific names. Standardization of common names will be discussed later. The following standard common
names will be used now for identification of Pacific species of the Istiophoridae:

<table>
<thead>
<tr>
<th>English</th>
<th>Japanese (Romanized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Sailfish</td>
<td>Bashokajiki</td>
</tr>
<tr>
<td>Shortbill Spearfish</td>
<td>Furaikajiki</td>
</tr>
<tr>
<td>Striped Marlin</td>
<td>Makajiki</td>
</tr>
<tr>
<td>Blue Marlin</td>
<td>Kurokajiki</td>
</tr>
<tr>
<td>Black Marlin</td>
<td>Shirokajiki</td>
</tr>
</tbody>
</table>

It is believed the above represents the present position of English speaking taxonomists, including those of the U.S., New Zealand, Australia, and South Africa. It is believed that it is the present position of all Japanese taxonomists. Though accepted today by Dr. Hiroshi Nakamura, former director of the Nankai Regional Fisheries Research Laboratory (reired), he thinks it possible that in the Pacific the fish known as striped marlin, or makajiki, may be a composite of two species, one northern, the other southern (Kamimura and Honma, 1958; Honma and Kamimura, 1958). At present, he is treating them as one species (Personal conference John K. Howard with Dr. Hiroshi Nakamura, 21 August 1962).

In August, 1962, Dr. Nakamura’s reasons for thinking the northern and southern striped marlin, makajiki, may be two separate species were two. First, according to his records, southern fish have on the average a longer pectoral fin, and secondly, his data on catches of the Japanese longline fishery indicate a gap of occurrence in the Equatorial Pacific. In this family the pectoral fin shows allometric growth, and hence is of limited use as a specific diagnostic character. Dr. Kiyomatsu Matsubara of Kyoto University, and Dr. Tokiharu Abe of Tokyo University and Tokai Regional Fisheries Research Laboratory, both think the single character of length of pectoral fin is not enough on which to base a separation into two species (Personal conferences John K. Howard with Dr. Kiyomatsu Matsubara and Dr. Tokiharu Abe, September and October, 1962). Dr. Matsubara and Dr. Abe are two of the foremost taxonomists in Japan. Dr. Matsubara is the author of “Fish Morphology and Hierarchy,” 1955, the standard Japanese reference work on fish taxonomy, and many other scientific papers. Dr. Abe is the author of “One Thousand Species of Fishes Useful in Japan,” Volume II, 1957, and with Shigeho Tanaka, Volume I, 1955; also with I. Tomiyama, of the part Pisces, in Volume II of “Encyclopedia Zoologica,” 1958, and many other scientific papers. Dr. Nakamura acknowledged in August, 1962, that his data on catches were limited to the Western Equatorial Pacific, and now that Japanese longlining has extended into the Eastern Equatorial Pacific, the gap of occurrence between northern and southern striped marlin, makajiki, may disappear. The authors of Part II, Distribution, after an examination of much data not available to Dr. Nakamura in August of 1962, are of the opinion that there are not two species.
of the so-called striped marlin or makajiki in the Pacific (see Distribution, Striped Marlin).

For describing distribution of Istiophoridae in the Pacific, the authors shall use the above five species.

Present Status of Taxonomy of Pacific Istiophoridae.—History: It is believed the following are the first scientific reports of these species from the Pacific Ocean.

1. Sailfish by Temminck and Schlegel in 1844;
2. Black marlin by Macleay in 1854;
3. Striped marlin by Philippi in 1887;
4. Blue marlin by Jordan and Snyder in 1901;
5. Shortbill spearfish by Tanaka in 1914.

The question of priority for scientific nomenclatural purposes is not being considered here. It is believed three of these species were reported first from other oceans than the Pacific (see Scientific Nomenclature). Historically, however, these are the first descriptions of Pacific specimens of each species. No attempt will be made to outline later descriptions of specimens of the same species from the Pacific.

All these reports show the species were already known to fishermen, or that the specimens described were obtained from fishermen.

Taxonomic Methods and Techniques: Taxonomic work in the family Istiophoridae has been limited almost entirely to studies of morphometric and meristic characters. Little work on internal comparative anatomy has been done. One exception is the work of Nakamura from 1934 to 1937 in Taiwan and afterward. Some work has been done by American and European taxonomists. A very limited amount of work on comparative growth of parts has been done or has been used in determining species (Royce, 1957; Robins and de Sylva, 1961, 1963; Ueyanagi, 1963b). Genetics and embryology have not been employed. Comparison of postlarvae and young forms of the different species has been done mostly by Japanese workers, especially Yabe and Ueyanagi. Some work on young stages has also been done by American and other taxonomists, almost entirely on the sailfishes. There is great need for this work (Rosa [Ed.], 1963:21, 34).

Serological and immunological differentiation, or other modern biochemical or molecular biological techniques, such as determination of species-specific proteins or DNA, have not been employed to any extent. This is generally true of the taxonomic work on large pelagic fishes, such as tunas, though recently a start has been made in the case of these commercially important fish. In July, 1962, I met Dr. L. M. Sprague, chairman of the Blood Samples Working Group of the F.A.O. World Scientific Meeting on the Biology of Tunas and Related Species at La Jolla, California, 1962, and who was in charge of the temporary International Tuna Blood Group Center at the Bureau of Commercial Fisheries Biological Laboratory at
Honolulu. I inquired whether his group had applied these techniques to Istiophoridae. He said they had not done any such work. However, in Japan at the Nankai Regional Fisheries Research Laboratory, I found in August, 1962, a very active group of biochemists who had done a good deal of work on the Istiophoridae, but not from the taxonomic standpoint.

The need for improved methodology in taxonomic work on such fish was emphasized at the World Scientific Meeting on the Biology of Tunas and Related Species at La Jolla, California, in 1962, and at the Symposium on Scombroid Fishes at Mandapam Camp, India in 1962. Also see Myers (1952).

The need for clarification of the taxonomy of these large pelagic fish, and of obtaining some agreement among taxonomists throughout the world was also emphasized at the La Jolla meeting and the Mandapam Camp meeting. It seems obvious that taxonomists must bring themselves to an agreement on at least the species, and preferably also the genera, because of the use of the binomen in scientific nomenclature. Otherwise, confusion will continue, complicating collection of data which is necessary to both scientific ichthyology and practical problems of the world's fisheries.

Generally Recognized Diagnostic Characters of Presently Recognized Species of Pacific Istiophoridae.—It is not my intention to review here literature on diagnostic characters for various species of Pacific Istiophoridae. It will be necessary to comment on the controversies about some of these characters in the subsection Specific Scientific Names of the section Nomenclature, below. For reviews of such characters, see: Nakamura, 1938, 1955; Hirasaka and Nakamura, 1947; LaMonte, 1955; Royce, 1957; Howard, 1959 (interpreting other papers). Jordan and Evermann (1926), though including istiophorids, is, in my opinion, not helpful. Miss LaMonte's paper is restricted in its usefulness on the diagnostic characters of Pacific marlins, as at the time of writing the manuscript, she had not seen and had not identified blue marlin in the Pacific (pp. 331, 342 and Footnote 1). As the result of a talk with Dr. William F. Royce, who was then writing the manuscript for his 1957 paper, she added a footnote to the Key and made minor changes (e.g., pp. 342, 343, 344, 351) in the text, referring to blue marlin in the Pacific. However, she did not include any data from blue marlin taken in the Pacific in determining her diagnostic characters of that species.

At that time, she had not recognized the non-fully retractable pectoral fin as a diagnostic character of black marlin, or shirokajiki (p. 337). As a result, I believe, of this attitude on blue marlin and black marlin, she assigned (Key pp. 331, 333, 338-342, 351) the specific scientific name mazara (Jordan and Snyder) to the black marlin, or shirokajiki. This was the scientific name given in connection with the first description of blue marlin, or kurokajiki, from Pacific waters. If these facts are kept
in mind, however, her paper is most useful, particularly her synonymies and her discussions of them. Her original denial of the existence of blue marlin in the Pacific must be remembered, though, in connection with her discussion of synonymies, if she has used geographical distribution in her analysis of the facts.

For the most thorough and best analysis of morphometric characters of the Pacific Istiophoridae, see Royce (1957).

Taxonomy used in Determining Higher Categories (Genus to Family).—The taxonomic basis for taxa higher than species will be taken up later in the subsection on Hierarchical Classification and the Scientific Nomenclature of Higher Categories, of the section on Nomenclature.

Nomenclature

Introduction.—Few biologists, including taxonomists, like problems in scientific nomenclature. They accept them as a necessary evil. Perhaps the reason why the scientific nomenclature of most groups of fish is in such a mess is that many scientists try to avoid the nomenclatural problems. Even in such a small group as the family Istiophoridae there is a surprising disagreement as to proper scientific names for Pacific species of this family. But in order to communicate with fellow scientists and to record findings for the use of fellow scientists now and in the future, an unambiguous name or names must be attached to the taxon or taxa being talked or written about (Savory, 1962:vii, 3). This often poses a more difficult problem than the taxonomic one of determining the taxon or taxa. Due to this situation in this small family, in which there are few species, common names for species are more often than not used by two scientists talking to each other, and are used in much scientific, most commercial fisheries, and all sport fisheries literature. In fact, the English common names have become so generally used that even in papers published in foreign languages, such as French, the English common name may be quoted by the author in English (Cadenat, 1956:546-548); or it may be translated literally into French (Fourmanoir and Crosnier, 1964: 380, 381, 384). In the latter case, blue marlin was translated and used in the text as “marlin bleu” and striped marlin was translated as “marlin rayé” and black marlin was translated as “marlin noir.”

Because of this situation, there has been an effort for some years to standardize common names in certain languages. This will be spoken of later. The result is today, at least in the Istiophoridae, there really are three nomenclatures: (1) the vernacular or local common names (in several languages); (2) the standardized common names (in those languages which are most important in the study of the taxa involved—Japanese and English); (3) the scientific names.

English speaking countries use “common name” more often than
“vernacular name,” though the latter is sometimes used to distinguish a very restricted use of a non-scientific name from the broader use of one by most people of a country or even larger language group. Groups of interested zoologists have taken action of various kinds in an attempt to standardize the usage of common names within a country or a language group (Chute et al., 1948; Bailey et al., 1960).

**Standard English Common Names.**—**History:** The first report of a catch of an istiophorid fish in the Pacific by English speaking people, of which I know, is that of a black marlin in the *Illustrated Sydney News* [Australia] of 11 March 1854. The fish was caught by a Mr. William Newton, a fisherman of Port Jackson, on a hand line in Broken Bay. It was described by Macleay of the Australian Museum. It was given the scientific name of *Tetrapturus australis*. Its common name was given as Australian Swordfish. The swordfish (broadbill) had been so well known for so long throughout the world that when a large fish with a projection of the upper jaw was caught by English speaking people, it was generally at first called “swordfish”, with a qualifying word preceding it. There have been many fisheries for the broadbill since ancient times.

This usage has been perpetuated in the records of the oldest American angler’s club, and in the name of one of the other oldest clubs in the world, where istiophorid fishes have been caught for a long time by English speaking people. In all the publications of the Tuna Club of Avalon, Santa Catalina Island, California, the striped marlin of that area has always been, and still is (1964), recorded as “Marlin Swordfish.” This club was founded in 1898, and incorporated in 1901 (Holder, 1910:78). The Bay of Islands Swordfish Club of New Zealand was founded in 1924 as the Bay of Islands Swordfish and Mako Shark Club, taking over a former club founded about 1918 (Yearbook, 1958-59:5). But very generally today Istiophoridae as a group are called billfish. This usage has been recognized by the United Nations Food and Agriculture Organization in its proposed breakdown of group 16 of its Standard International Statistical Classifications of Aquatic Animals and Plants, by designating subgroups (n) Billfishes, and (m) Swordfishes (Gertenbach, 1962:2, 8).

In all probability, the first use of English common names for istiophorid fish of the Pacific, after the 1854 use of Australian Swordfish, was that of G. Brown Goode. Goode, among other things, had been U.S. Commissioner of Fisheries. For some years, he collected material on Xiphiidae and Istiophoridae. Beginning in 1882, this resulted in publication of two papers and a chapter or section of a book about these fish (Goode, 1882; 1883; 1888). Goode distinguished between swordfish (*Xiphas gladius*), sailfishes (*Histiosphorus*), and a group which included the known spearfishes and marlins (*Tetrapterus*). For the latter, he used the English common names “Bill-Fish” or “Spear-Fish” (Goode, 1883:319), but objected to “Bill-Fish” because it was an English common name already being used for the Atlantic
white marlin, \textit{Tetrapturus albidus}, and recommended “Spear-Fish” for the marlins and spearfish as a group (Goode, 1883:293). Use of billfish as a specific common name for Atlantic white marlin has died out.

In the distribution of both sailfishes and spearfishes, Goode (1883:319) included sailfish “in the Pacific to Southwestern Japan, lat. 30° to 10°N,” and spearfishes in the Pacific to “New Zealand, lat. 40°S, and on the west coast of Chile and Peru.” From his papers, it is evident the common names which he proposed for Pacific Istiophoridae were not based on reports of catches, identifications, and usage of names by English speaking people, but because of his desire to straighten out not only taxonomy but English common nomenclature for fishes reported in languages other than English. Yet it is the first application of the English common name sailfish to the Pacific fish, of which I know.

When Jordan and Evermann prepared their “A Check-List of the Fishes and Fish-Like Vertebrates of North and Middle America” in 1895, they followed Goode’s use of English common names, but they do not refer in distribution to any species in the Pacific. They do, however, place sailfish and spearfish in a different family, the Istiophoridae, from the swordfish, Xiphiidae (Jordan and Evermann, 1896a). The same is true in their other papers of about this time (Jordan and Evermann, 1896b, 1902, 1916). It was at about the time of the first of these later publications that English speaking fishermen took over the coining of English common names from the scientists.

Probably the first real fishery by English speaking people for an istiophorid fish in the Pacific was the sport fishery for striped marlin which developed around the turn of the century out of Santa Catalina Island, California.

Mr. Charles F. Holder, the first fisherman to catch a bluefin tuna on rod and reel and the founder of the Tuna Club at Avalon, Santa Catalina Island, says in his “Salt Water Game Fishing,” 1914, on page 34, “The first \textit{tetrapturus} was taken with rod and reel by Mr. Llewellyn in 1896 . . .” Can Mr. Holder have made an error here? Various records of the Tuna Club show that the first marlin swordfish, \textit{Tetrapturus}, caught by a club member on rod and reel, was taken on 28 August 1903 by Edward Llewellyn (Tuna Club Yearbook, 1963:63). But according to Capt. Harry Willey of Hollywood, California, he was the first to catch a striped marlin on 25 August 1903. Capt. Willey claims that the Tuna Club at Avalon refused to weigh the fish and record it on the grounds he was a professional boatman (equivalent today to a charter boatman, fish guide, charter captain, etc.), and not an amateur. He states that Peter Reyes, the island’s photographer, weighed and recorded the fish at 182 pounds (\textit{Los Angeles Herald-Examiner}, Sunday, January 28, 1962, p. E-6. Copy given me by Joseph D. Peeler). Undoubtedly, these fish had been seen in the area before the 1903 catches. George C. Thomas, who with his father was an early fisherman at Santa Catalina, has written me that the late
Capt. George C. Farnsworth (one of the finest and most experienced of early Catalina professionals) told him the first time he (Capt. Farnsworth) saw striped marlin off the island was a year or so before the 1903 catches. Several boatmen, including himself, saw them feeding on mackerel or sauri. As they chased their food fish, they were brilliantly “lighted up, their stripes almost blazing and their pectorals that beautiful electric blue which we now know so well. No one seemed to know what they were, and they were referred to as Zebra Fish.” (Letter 24 January 1964.) Holder speaks of these fish as Santa Catalina Swordfish (Holder, 1913). As stated above, the earliest and latest (1964) publications of the Tuna Club call these striped marlin “Marlin Swordfish,” but by the summer of 1919, when Zane Grey wrote of fishing for these fish in these waters, he often referred to them as marlin, dropping the swordfish (Grey, 1919).14

By 1921, when Frank Gray Griswold wrote his “Some Fish and Some Fishing,” the fishing fraternity which fished Santa Catalina waters had come to distinguish between swordfish and striped marlin in the common names they used (Griswold, 1921:59-60). “The local names for swordfish are broadbill or flatbill to distinguish him from the marlin whose bill is round.” In this book, marlin is consistently used for striped marlin, not marlin swordfish, Catalina swordfish, or any other name.15 Griswold rhymes about the difference of the two fishes on pages 199 and 200:

THE SEA FISH OF CALIFORNIA

XIPHIAS GLADIUS is a class alone
And the only swordfish that is known,
Yet 'tis Avalon's most dear wish
To confound him with the Spearfish.
It seems an insult to the Creator
As well as to the nomenclator.

His snout is flat just like a sword,
His dorsal fin stiff as a board;
Strong pectoral fins give him the power
To fight the fisherman hour by hour;
Though gaffed he is not yours as hoped
Until his tail is safely roped.

The Spearfish, gamest of the game,
Has also Marlin for a name,
His snout is round just like a spike,
His stripes are purple, all alike;
Beautiful in the sea is he,
As graceful as a fish can be.
When once hooked he jumps about,
Shakes his head and waves his snout;
He dances hornpipes on his tail,
And leaves the seafoam as his trail.
A jumper, fighter strong is he,
The king game-fish of the Sea.

On 16 July 1926, the Board of Directors of the Tuna Club officially approved the name “marlin.” Evidently, however, they did not adopt it for their own publications.

There occurred in Santa Catalina waters only one species of marlin and no sailfish, so development of English common names for different Pacific species of marlin, and acceptance of Goode’s Pacific sailfish, had to await development of other fisheries by English speaking people.

Marlins were taken commercially, as well as by the sports fishermen of this Southern California area, as far back as 1918. In 1937, commercial capture of marlin was forbidden by law. The State of California kept catch statistics of this commercial fishery for marlin. Unfortunately, the catch was combined with that of swordfish for many years. But for 1918 and 1931 to 1937, the annual catch in pounds was reported separately. In 1918, 2,275 pounds were taken by the commercial fishery. In 1934, as high as 64,796 pounds were taken (California Bureau of Marine Fisheries, 1949:228).

Starting in about 1908, the west coast of the peninsula of Baja California and the Gulf of California were fished by a few English speaking California sports fishermen. The “History of the Tuna Club,” by Arthur N. Macrate, Jr., historian of the Tuna Club, published by the Tuna Club, 1948, on page 100 states as follows: “A cruise taken by Club Members and in a Club Member’s boat was that organized by C. G. Conn in 1908. With L. G. Murphy and Gilmour Sharp as guests and Captain George Farnsworth as skipper, the yacht “Comfort” left Catalina fishing grounds at San Diego on October 26, 1908, sailing to the extremity of the Club’s fishing limits, then down the coast of Lower California and into the Gulf of California.”

Charles F. Holder, in “Sport Fishing in California and Florida,” a paper delivered at the Fourth International Fishery Congress, held at Washington, D.C., September 22 to 26, 1908, published as “Bulletin of U.S. Bureau of Fisheries for 1908,” Volume XXVIII, 1910, speaks (page 203) of white sea bass being caught in the surf on the east coast of the Gulf of California, north of Tiburon Island. Holder must have had this information before September, 1908, in order to include it in his paper. This may mean there had been fishing cruises south earlier than that of the “Comfort” in October, November and December of 1908. On the other hand, it may mean some hardy Americans had penetrated to the northwestern portion of the Gulf.
from Arizona or California to fish before September 1908. By 1920, adventurous people from Arizona were taking holidays to Guaymas and Mazatlan on the Gulf of California, and, though I have no record of their catching sailfish or marlin, they must have seen both fish and undoubtedly recognized the sailfish as very close to its Atlantic cousin, and called it by the same name (Harold Steinfelt to John K. Howard, 15 April 1964; Tom Jamison, Fishing Director, Hotel Playa de Cortés, to John K. Howard, 22 April 1964). John Davidson, however, who went to Guaymas in 1910, states that the first to be actually taken was caught by Mr. G. B. Heincke on 20 April 1934, and the first marlin by Dr. Sutton of Milwaukee in 1935.

Mr. and Mrs. Keith Spalding, English speaking fishermen, went to this area in early summer of 1923. Mr. Spalding’s diary of this cruise in 1923, a copy of which Mr. Herbert L. Hahn has furnished me, shows that on May 29, 1923, he and his party, cruising from La Paz to Cape San Lucas, saw sailfish. Mr. Spalding identified these Pacific fish as sailfish and called them by that name in his diary.

But there is a record of sailfish being used earlier for the Pacific species. In “Galapagos: World’s End” (Beebe, 1924:60, 235, 237, 238), both Dr. Beebe and Mr. Robert McKay use sailfish for the Pacific species as early as March 1923. This is the earliest use of sailfish of which I have been able to find an actual record.

According to Mr. Gilbert Van Camp, Sr., the Van Camp Sea Food Company established in the spring of 1917 a small cannery, which later burned, at San Luis de Cabo, near Cape San Lucas. They had small vessels fishing for yellowfin tuna (W. M. Chapman to John K. Howard, 28 February 1964). Evidently, this was the start of tuna fishing by Americans in the area. Mr. DeWitt Gilbert, Editor of Pacific Fisherman, on the occasion of the Magazine’s Fiftieth Anniversary, researched the entire file of past issues and summarized it in five articles, each covering a decade. He states (DeWitt Gilbert to John K. Howard, 12 March 1964) that beginning on page 25 of the Anniversary Number, August 1952, is the following: “Extension of tuna operations down the Mexican coast—a development which was to have profound effect upon the future of the business—began in this year [1917], with the floating cannery JOHN G. NORTH operating at Magdalena Bay and Cape San Lucas.” “Return of peace in 1919 brought a flood of developments which we now conceive are of utmost importance.” “The floater JOHN G. NORTH, operated by the Van Camp interests, was sent south again in company with a refrigerator barge and eleven fishing boats. The barge was to take excess fish from the cannery, freeze it, and later ship it to California by tender. Gilbert Van Camp was in charge of the entire enterprise.” “Soon after the expedition started, the NORTH burned and ‘the cold storage plant sent down to Magdalena Bay is expected to revolutionize the tuna industry in Southern California’.”

This is the situation Zane Grey found at Cape San Lucas in March and
April, 1925. Grey’s conversations with Capt. Heston in 1925 (Grey, 1925:178, 179) prove that American tuna fishermen, who had been going south since 1917 to pick up northern migrating schools of yellowfin tuna, follow them up, and then go south with them again on their return migration, were still operating. According to Grey, there was a large schooner used for cold storage purposes and cannery tenders which took the frozen fish to California (page 179). These commercial fishermen undoubtedly had always seen sailfish surfacing and jumping on their trips along the west coast of Baja California and at Cape San Lucas.

From all the various data I have collected for fourteen years, sailfish appear to be in the area of the Gulf of California from Cape San Lucas, extending up into the Gulf and around to Mazatlan, from the end of May through October, with June, July and August the best months. This includes an analysis of catches reported by the airline Trans Mar de Cortes, S.A., from December 13, 1959, through September 2, 1961, the opinion of the International Game Fish Association (1952:55), and personal investigation by the author in Mazatlan and Guaymas.

The English speaking fishermen who fished in these parts of the Pacific where sailfish occurred, and the authors who wrote of their fishing, were unquestionably familiar with the Atlantic sailfish, which had been occasionally caught off Florida since about 1900, and regularly caught starting between 1905 and 1910. It is a natural name for any species of this genus, no matter where it occurs. Its great dorsal suggests the name. The equivalent has been used in many languages. Apparently the English common name sailfish was used for the Pacific species sometime between about 1908 and 1923, by either American commercial tuna fishermen or sports fishermen who visited Mexican waters. It is my opinion this usage probably started about 1908, and that it was the first application of an English common name to the Pacific sailfish.

Zane Grey, in his 1925 experience along the west coast of Mexico and Cape San Lucas, became aware some of the marlin he encountered were different from the marlin which he had known in Southern California waters about Santa Catalina since 1914 (Grey, 1926:97). Though he actually landed none of the species which was different from his Santa Catalina marlin, he saw them close to the boat both on the surface and jumping. His description of these fish in his 1925 book, “Tales of Fishing Virgin Seas,” gives all the most apparent characters of the black marlin, which are still good diagnostic characters of this species today, except for the semi-rigidity of the pectoral fin which could not be determined under such circumstances. He and his brother then and there christened this different species of marlin “black marlin.” This is the first record of the use of “black marlin” that I know.

In this book, Grey does not find it necessary to give a descriptive prefix to the name marlin which he had used for the fish he had known for years in California waters, except in the caption to a plate showing a photograph
of one of this species which his brother, R.C., caught off Cape San Lucas. He calls it “striped marlin.” This is the first published record of this common name of which I know. But this situation changed when he and Capt. Mitchell were fishing in New Zealand waters in 1926. Here they encountered more black marlin, and Capt. Mitchell actually caught two, each of which was in turn a world record for the species, and Grey himself took one. Grey also took a world record of the species which existed in California waters. These circumstances forced Grey to use a common name for both fish. He used the same name, “striped marlin,” as appeared in the caption of his 1925 book for the California fish. By January and February, 1926, Grey had come to a full recognition of the difference in these species, and was forced by circumstances to use both English common names, striped and black marlin.

By reference to the March 1926 number of Outdoor Life, referred to under Makaira marlina, No. 43, page 59 of Jordan and Evermann’s 1926 paper, it will be seen that the fish, of which a photograph was furnished by Mr. Hole to the authors, is the type for their marlina, and was caught off Cape San Lucas by Mr. Hole on 20 November 1925. In the account, “Record Sea Fishing in the Pacific,” by Capt. George C. Farnsworth, published in the March 1926 Outdoor Life, the author does not use the term black marlin, but on page 166, the caption to the lower left photograph is “The great head and sword of S. J. Hole’s record Black Marlin as it appeared over the rail in being hoisted on board the Yacht.” Question: Was this caption furnished after Zane Grey’s book “Tales of Fishing Virgin Seas,” in which he uses the term “black marlin”, was published in 1925?

Mr. George C. Thomas, now of Hawaii, who first fished out of Catalina in 1920, and whose father had fished there much earlier, wrote me 14 January 1964 as follows: “I first heard the term black marlin from Capt. Hugh MacKay, a charter boatman at Catalina, back in 1922. Where the name actually originated, I do not know, but MacKay told me these fish were much larger and darker in color than the common ‘striper.’” And later in a letter to me dated 24 January 1964, Mr. Thomas added, “I also remember having heard the name [black marlin] used by a few Tuna Club members around that time [1922].” Sometime between 1908 and 1925, sports fishermen, who were familiar with striped marlin of southern California waters, visited Mexican waters south of them and recognized one of the marlin which they saw or caught was different and much darker, and spoke of it as the black marlin. The name stuck.

Research indicates that prior to 1925, there were very few or no English speaking fishermen who fished from such ports as Guaymas, Mazatlan, La Paz and Acapulco, other than those mentioned above. The English speaking sport fisheries which now thrive at various places in the Gulf of California, such as Guaymas, Mazatlan and La Paz, and on the Pacific Coast of Mexico, such as Acapulco, started later. I believe the first was at Guaymas, described above.
I can find no earlier records of a fishery by English speaking people involving Pacific sailfish. The sport fishery at Panama Bay did not develop until about 1932. The Pacific Sailfish Club of Balboa was founded in May of 1932. I was in Balboa and Panama City in December of 1911. There was no such sport fishery then. Capt. William Gray, who was in the area on the 1931 George Vanderbilt Expedition, says there was no English speaking sport fishing for these fish at that time or before, because of lack of tackle and boats which could do such fishing (Personal conference John K. Howard with Capt. William Gray, 4 January 1964).

Also, I am informed by the Secretary of the Bay of Islands Swordfish Club in New Zealand, and by Capt. Francis Arlidge, who fished with Zane Grey in 1926 and 1927, that it was Zane Grey who brought the two English common names, black marlin and striped marlin, to New Zealand in 1925-26.

Blue marlin did not appear as an English common name in the Pacific until well after both striped and black marlin. Though Japanese fishermen had recognized the existence of three different marlin in the Western Pacific for a long time, their makajiki, kurokajiki and shirokajiki, this resulted in no English common name for their kurokajiki, the blue marlin. A Pacific specimen of this marlin was first described and scientifically named by Jordan and Snyder in 1901, but they gave no English common name for it (Jordan and Snyder, 1901:305). Neither Jordan and Evermann's 1926 paper, in which eight marlin (Makaira) are listed and named from the Pacific, nor the first scientific paper which named the three presently recognized marlin and gave recognizable scientific names for them (Barnhart, 1936) used the name blue marlin.

The first English speaking people to use the common name blue marlin for a Pacific fish were probably Australian sports fishermen. Mr. T. A. Bell of Victoria, a leading sport fisherman since the early days of big game fishing in Australia, and past president of the Australian Game Fish Association, stated that it was about 1938 when blue marlin was first used in Australia to designate a marlin which sports fishermen recognized as a different species from black and striped marlin (T. A. Bell to John K. Howard, 24 November 1956).

This was probably before the same thing happened in New Zealand. In 1939, when Gregory and Conrad, of the American Museum of Natural History, were in New Zealand with Mr. Michael Lerner, neither taxonomist nor the sports fishermen and boatmen had recognized that an occasional different third marlin was caught in New Zealand. In January of 1953, Fred Wilkins, a very well known fishing guide and boat owner with whom I was marlin fishing at Mayor Island, told me there was a third marlin caught in New Zealand waters, different from striped marlin and black marlin. He told me the sports fishermen and boatmen had recognized it for a good many years and called it blue marlin. He said these amateurs were so sure this was a third and different marlin that they had trucked
a fresh fish to the Auckland Institute and Museum in 1948 (Personal conference John K. Howard with Capt. Fred Wilkins, January 1953). I wrote to the Institute and received an answer from Dr. A. W. Powell saying that this specimen had been received from Mr. E. V. W. Anderson of Hastings, had been studied and measured, but not identified, and no report had been published. I know of no connection between the action of the sports fishermen in Australia and those in New Zealand. I doubt if there was any, because the period involved, 1938 to 1948, was mostly during the war or the immediate post-war period, when there was little travel for sporting purposes between the two.

The first published use of the common name blue marlin in either country, which I can find, was in the Bermagui Big Game Anglers Club's Bulletin of October, 1949. This reported on the fishing season from December, 1948, through April, 1949. In the catches the following appears: “Blue Marlin (believed); Weight, 223 lbs.: Caught by A. W. Stewart.” This is Australia. The first published use of this common name in New Zealand, of which I know, appears in the 1950 annual report of the Tauranga Big Game Fishing Club (Inc.), in the catches for the season 1949-1950 (Letter, P. F. Shirley to John K. Howard, 25 June 1954). This is followed by the use of this common name in the catch records of the Bay of Islands Swordfish Club for the season 1951-1952, published in its annual report.

No scientific notice of this third marlin in either Australia or New Zealand was published until some time after its existence had been accepted by the sports fishermen. In February of 1953, I landed in Sydney, Australia, to do some big game fishing, particularly for marlin. Thanks to Miss Francesca LaMonte, of the American Museum of Natural History, I met the big game fishermen on arrival: Clive Firth, Tom Bell, Max Lawson, Jack Kelley and Jim Cowell. At once, I heard of the third marlin—the blue marlin. A few days later, I met T. C. Roughley, Superintendent of the New South Wales Fisheries, former President of the Royal Society of New South Wales and of the Linnean Society of New South Wales, author of “Fish and Fisheries of Australia.” Shortly, I met Gilbert Whitley, then Curator of fishes of the Australian Museum.

Having become interested in this third marlin, the so-called blue marlin, I asked both if it existed. Roughley: “No, there are no blue marlin in the Pacific.” Whitley: “Never saw one. But we do not know what may be in our waters.” Early in March, I brought into the dock at Bermagui, New South Wales, a 402-pound marlin which several sports fishermen, including Tom Bell, Col. Bruce Steer, and several commercial fishermen (the only charter boatmen for sport fishing in that area), thought was one of the so-called blue marlin. The manager of a commercial fish handling firm and freezer, located about 28 miles from Bermagui, very kindly agreed to keep the specimen in his freezer until he could send it to Whitley in Sydney on one of his trucks in which fish, packed in ice, were being taken
to the Sydney market. The fish arrived in Sydney in very good condition. It was this specimen which Whitley described as *Istiompax howardi* (Whitley, 1954), the first description of a third marlin from Australian waters. Rivas identified this fish as a blue marlin (Rivas, 1956a:70, 71). I believe all the other ichthyologists who have studied Pacific Istiophoridae, including Whitley, agree.

In New Zealand, Moreland of the Dominion Museum, Auckland, finally in 1957 identified the species from New Zealand waters (Moreland, 1960: 247-250).

This leads to Rivas’s 1956 paper, mentioned above. In 1953, the late Mr. Al Pflueger, well known sport fisherman and taxidermist of Miami, told Prof. Luis R. Rivas, then of the Marine Laboratory of the University of Miami, that he had seen and had examined on the docks at Acapulco, on the Pacific coast of Mexico, marlin which he thought were the same as the Atlantic blue marlin. He also said he occasionally received heads, skins and fins of such marlin for mounting. He said that by comparison with the same material which he received from Bimini and Cat Cay, Bahamas, he could see little or no difference, especially in the peculiar lateral-line pattern of the Atlantic blue marlin. This resulted in Mr. Pflueger, Prof. Rivas and myself going to Acapulco on 28 February 1954. In the fifteen days we were at Acapulco, three out of the eleven specimens of marlin brought in, which we were able to see and measure, were neither the common striped marlin nor the occasional black marlin which had been reported from that area. Mr. Pflueger, though in possession of much basic ichthyological information, did not publish but took pleasure in aiding many taxonomists who did publish. This work resulted in Rivas’s 1956 paper mentioned above. It was the first scientific paper, of which I know, where the English common name blue marlin is used for the Pacific fish.

The last of the presently used English common names to come into use in the Pacific was “spearfish.” This fish has never, to my knowledge, been caught by a sports fisherman in the Pacific. No spearfish has ever been recorded as caught by a sports fisherman in either the International Game Fish Association lists or the record lists published in Australia or Africa.

The English speaking sports fishing community had accepted and used for this uncaught but hoped for fish an English name used by scientists for various groups of istiophorid fish, but which had been reduced in application by the adoption of other English common names for fish of the genus *Tetrapturus*, without its recently proposed broadening. (See mention of G. Brown Goode’s and Jordan and Evermann’s papers in the beginning of this Section.) Those are the fish we call spearfish today; the Mediterranean, the longbill of the Atlantic and the shortbill of the Pacific. There is only one of these fish in the Pacific, the shortbill or furaikajiki.

Jordan and Evermann (1926) recognized three genera in the family Istiophoridae, *Tetrapturus, Makaira* and *Istiophorus*. Their genus *Tetrapturus*...
includes all of those species which we today call spearfishes, except for the longbill of the Atlantic, which had not, at that time, been described. This included the Pacific species which had been described in 1914-1915 from Japan by Tanaka. They definitely called this genus “The Spearfishes” (Jordan and Evermann, 1926:28). They clearly divide this genus from their genus *Makaira*. Though they did not go the whole way as yet, they give “Marlin-spike Fishes” as their first common name, but add “Spearfishes” as second (Jordan and Evermann, 1926:50). The Marlin-spike Fishes were on their way to shortly being called Marlin, and over the next years to have more and more of the then recognized Pacific Istiophoridae called marlins of various sorts, leaving spearfish only for the shortbill spearfish of the Pacific, *Tetrapturus angustirostris*.

In 1935, Nichols and LaMonte say, “Somewhat intermediate forms between marlin and sailfish occur with a long black fin of moderate height. There are the spearfishes (genus *Tetrapturus*), but their relationships are least well-known, and they are of less immediate interest to anglers than the true marlins.” This was published in a popular magazine, “Natural History.” (Nichols and LaMonte, 1935:327.)

Again in 1941, LaMonte and Marcy speak of the genus *Tetrapturus* as spearfish. This was in the publication of a sport fisherman’s organization—the International Game Fish Association (LaMonte and Marcy, 1941:21). There was a tremendous growth in big game fishing at about this time, from the early thirties to the second World War. I can find no published evidence of when the common name spearfish was first used by sportsmen, but it must have been during this period at the latest.

**Effort to Standardize English Common Names:** Of course, every paper covering a group of fish such as Goode’s 1880-1883 papers on the billfish and swordfish, and every list of groups such as Jordan and Evermann’s many lists of the 1890’s and early 1900’s, where English common names were given, were indirect attempts to get the public to use the common names given and thus standardize them.

The interest of sports fishermen in national and world records, and the action taken to keep records, has been a standardizing influence on the common names of game fishes. The fish were recorded under common names which were sooner or later adopted by the fishermen in their conversation and publications. Lists of World’s Record Fish, both fresh and saltwater, were compiled and published by *Field & Stream* first in July of 1920 and continued intermittently until February of 1939 (Letters, Mike Ball to John K. Howard, March 5 and March 18, 1964). On June 7, 1939, the International Game Fish Association was organized with headquarters in New York. From then on it was this international organization which passed on applications for records of salt water fish, recorded them, and kept appropriate lists (International Game Fish Association, 1943: 103). It was not until after 1946 that I.G.F.A. started publishing and
distributing its annual lists (Telephone conference John K. Howard with Mrs. Anne H. Schiehl, April, 1964). Most foreign big game fishermen seek to record their possible records with I.G.F.A. It is a truly international organization and has had a great influence in standardizing English common names for the kinds of fish for which it keeps records.

But a much more definite attack on this problem was made in the thirties. In 1933, the American Fisheries Society adopted a resolution to form a permanent Committee “to prepare and submit for publication a list of common names of fishes corresponding to the accepted scientific name.” (Chute et al., 1948:3.) The Committee was appointed. The Committee reported its list of “accepted common names” to the Society at its annual meeting in Denver, Colorado, September 10-12, 1947. It was adopted and published by the Society as “Special Publication No. 1.”

The lapse of 14 years between resolution and report (in spite of three and one-half years of war) is perhaps indicative of the difficulty of obtaining agreements on such questions. Not considering one of the Istiophoridae eliminated on taxonomic grounds, all five of the common names are still used as standard for the species, whereas only one of the five specific scientific names is still used (Chute et al., 1948:14). This fact is perhaps an indication of the stability of the common names as against the scientific names.

The Committee on Names of Fishes of the American Fisheries Society was a permanent Committee and continued its work after its report to the Society at Denver in 1947.

Another effort at standardization has been the “Standard Check List of Common Names for Principal American Sport Fishes” compiled by the Outdoor Writers Association of America, Inc. The first edition appeared in 1945, and subsequent revised printings in 1949, 1954, 1958 and 1962. The last edition conforms to the standard English common names. This check list influences a group, the outdoor writers, who are close to, and, consequently, may have greater influence with the actual anglers, who compose one of the big groups using common names.

The greatest difficulty in obtaining standardization arose about 1950 because of the establishment in Hawaii by the United States Fish and Wildlife Service of its Pacific Oceanic Fisheries Investigations Program.

This resulted in two exceptions to the acceptance of standard English common names for the Istiophoridae in Hawaii and Japan. Both were caused by the usage of commercial fishermen. The Hawaiian Territorial Division of Fish and Game (now the Division of Fish and Game, State of Hawaii) used in its publications, black marlin for the fish known as the blue marlin of the Pacific, and silver or white marlin for the fish known as the black marlin. The Division reported the commercial catches of the Hawaiian “flag-line” (longline) fishery under these common names. This fishery was started by Japanese who came to Hawaii. It has always been, and still is, manned by men of Japanese extraction. These fishermen used
the Japanese common names for the fish which they caught; kurokajiki for the blue marlin, and shirokajiki for black marlin. The Division in their reports used, as English translations of the Japanese common names, black marlin and silver or white marlin respectively. In this way, these English common names unused anywhere else, crept into use in Hawaii. The Division of Fish and Game have agreed to use, in their Annual Report and other reports, the usual standard English common names with a footnote setting out the older unusual names. This exception to the general use has, therefore, been eliminated (Personal conference, John K. Howard with Michio Takata, Director, Division of Fish and Game, State of Hawaii, November 1962).

When the U. S. Fish and Wildlife Service established its Pacific Oceanic Fishery Investigation (POFI) in Hawaii in 1950 to investigate high seas fishery resources of the Tropical and Sub-Tropical Pacific Ocean, it adopted for its publications the usage of the Territorial Division of Fish and Game, using “black marlin” as the English common name of the blue marlin of the Pacific, and “white” or “silver marlin” for the black marlin. The Honolulu Biological Laboratory of the Bureau of Commercial Fisheries, the successor of POFI, has now agreed to change and use the generally adopted English common names, Pacific blue marlin for the kurokajiki, and black marlin for the shirokajiki. (Personal conferences, John K. Howard with Donald W. Strasburg and W. G. Van Campen, November 1962.)

When I was at the Nankai Regional Fisheries Research Laboratory in August of 1962, Dr. Hiroshi Nakamura, then the Director, agreed to stop translating kurokajiki into English as “black marlin” and shirokajiki as “white marlin,” and use the generally accepted English common names blue marlin and black marlin respectively. He also told me they had followed POFI of Hawaii in their former usage.

Many other Japanese fisheries institutions, including the Kanagawa Prefectural Fisheries Experimental Station, and the publishers of the monthly Tuna Fishing, which publish papers including data on the Istiophoridae, and which followed the Nankai Laboratory’s usage of the English translation of kurokajiki and shirokajiki, have agreed to change.

In September of 1956, this usage by the U. S. Fish and Wildlife Service in some of its publications first came forcibly to my attention. I wrote to the editor of the Special Scientific Reports in Washington. This letter was forwarded by Dr. Howard E. Eckles, Chief of Section of Marine Fisheries, to POFI for answer, but evidently with no instructions for action. I heard from Dr. Garth I. Murphy under date of October 4, 1956. This led to a long controversial correspondence between Dr. Murphy and myself. As there was no sign of any action by POFI, in March of 1957 I took the matter up again with Washington. As a result of this, POFI agreed to abide by the decision of the Joint Committee on Common Names of the American Fisheries Society and the American Society of Ichthyologists and
Herpetologists (Letter, Dr. L. A. Walford, Chief Branch Fishery Biology, to John K. Howard, 2 April 1957). The Committee, not having announced its decision on the common names for the Istiophoridae by March of 1958, Dr. Murphy wrote me, “Now that Dr. Royce’s paper has been issued, we are planning to utilize those names, together with an appropriate reference, as an interim measure until such time as the American Fisheries Society completes its deliberation.” (Letter, Dr. Garth Murphy to John K. Howard, 12 March 1959.)

Dr. William F. Royce, a member of the staff of POFI, had written his fine manuscript on the Central Pacific Istiophoridae, and submitted the manuscript to the U. S. Fish and Wildlife Service in the fall of 1955. On page 496 and at the head of each section about a species, he gives the English common names. These are the same as the presently used standard names, with the exception of shortnose instead of shortbill spearfish (Royce, 1957).

As stated above, the Committee on Names of Fishes of the American Fisheries Society, was a permanent Committee and continued its work after the publication of its Special Publication No. 1 in 1948. This resulted in Special Publication No. 2, a second edition of No. 1, in 1960. It lists as the English common names those which are generally used as the standard common names today (Bailey et al., 1960).

In spite of these two publications, the Honolulu Biological Laboratory of the Bureau of Commercial Fisheries, successor to POFI, still used the old black for blue marlin and white for black marlin in mid-1962 in translations of the Japanese kurokajiki and shirokajiki. It was for that reason that I had the November 1962 conference on the question at that Laboratory. Let us hope that they will mend their ways and do as agreed.

Contrary to the general influence for standardization of the International Game Fish Association’s World Records Lists, spoken of above, the inclusion of silver marlin had a bad influence on Hawaii until finally silver marlin was removed from these lists in the 1964 annual publication.

In 1962, after I had returned from Japan, the publishers of Tuna Fishing asked me to write a paper on the standardization of the English common names; this I did, and it was published in English as I had written it, with a Japanese introduction and followed by a complete Japanese translation (Howard, 1963).

Today Japanese publications are conforming to the use of the standard English common names.

**Standard Japanese Common Names—History:** With my limited access to Japanese literature and limited ability to read it, the earliest records which I have been able to find, of the use of the five Japanese standard common names are as follows:

- **Makajiki** - striped marlin - Jordan and Snyder, 1901
- **Kurokajiki** - blue marlin - Jordan and Snyder, 1901

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Shirokajiki - black marlin - Jordan, Tanaka and Snyder, 1913
Bashokajiki - sailfish - Jordan, Tanaka and Snyder, 1913
F(H)uraikajiki - shortbill spearfish - Tanaka, 1914-1915

Though these are the earliest reports of the use of these names, undoubtedly they had been used by the fishermen for many years before being reported by the scientists. I believe that some Japanese scholars know of much earlier records in the literature of these names. As I have become interested in this history, I would be very glad to hear from anyone having such information.

Actually, fishes of this family have been known to the Japanese fishermen for centuries. Istiophorid bones have been found associated with artifacts such as fish-hooks, harpoon heads and boats, in shell mounds or kitchen middens and caves, which have been dated as belonging to a period between four and five thousand years ago, known as the early Jomon culture of Japan (Kishinouye, 1911; Kaneko, 1958). Any catches were probably accidental, but unquestionably coastal dwellers in Japan have known the fish of this family from very ancient times.

Kazuo Yamaguchi (1947), in his “History of Japanese Fisheries,” says that in the Edo Period, in addition to bluefin tuna, yellowfin, albacore and bigeye, billfishes were also caught (page 160). This does not fix a very definite date, as the Edo Period was from about 1600 to the mid-nineteenth century. By examining some information of when those types of fishing which would catch billfish originated, we can narrow down this statement to more definite dates. The author, (page 176) says it is considered that the tuna longline, which would certainly catch billfish, was first used at the fishing village of Mera, near the tip of the Boso Peninsula, in the Enkyo Era (1744-47), and that by the Horeki Era (1751-63), the catch was already considerable. This was over 200 years ago. On the following pages (177-178), Yamaguchi says that in the Edo Period billfishes were taken with harpoons; and that the billfish harpoon fishery, in old times in the province of Awa, Chiba Prefecture, was called atembo. He reports that in a document from the village of Wada in Awa dating from the Kambun Era (1661-62), he found a reference to “atembo boat” (Awa-gun Suisan En-kakushi Shoshu). This seems to place the taking of billfish as early as the beginning of the Edo Period, 300 years ago (Yamaguchi, 1947).

Dr. Hiroshi Nakamura confirms the early use of longline gear in the Boso area, placing it, when writing in 1949, at well over 200 years ago (Nakamura, 1951:11, 1954:21).

Temminck and Schlegel were the first to describe and name an istiophorid species from the Pacific, the sailfish (Temminck and Schlegel in von Siebold, 1944:103). Dr. Marinus Boeseman, Curator of Fishes at the Museum of Natural History of Leiden, the Netherlands, who has access to the material used by Temminck and Schlegel in preparing this description, states that their descriptions were based on notes, a plate, and a manuscript
written by Bürger which was never published, all sent by Bürger to the Museum in Leiden from Japan. Boeseman says of this particular species: "We have no Japanese specimens of this species. According to Temminck and Schlegel, these authors never received such a specimen and consequently founded their species on Bürger's data and plate only. The plate in 'Fauna Japonica' is an exact reproduction of an original Japanese plate in Bürger's collection. In his manuscript, Bürger gives a description (No. 195) of this species." (Boeseman, 1947:97).

Dr. Boeseman kindly sent me a copy of that part of Bürger's manuscript containing the description of species No. 195, and an English translation of the Dutch. The translation of the last section, "Remarks," is as follows: "... is captured sometimes during the autumn in large dragnets with the Thynnus species along the S. W. coast of Japan, where its meat is much esteemed as a special kind of delicacy." Allowing time for publication by Temminck and Schlegel, and the writing and transmittal of Bürger's manuscript, the latter must have been written in the early eighteen thirties. Two recent students of Bürger's life place the sending of the manuscript to Holland on or before 1835 (van Steenis-Kruseman, 1962:500).

Bürger, in this unpublished manuscript, gives the fish described in No. 195 the scientific name "Istiophorus Heiwo," followed by two sets of characters, one Chinese ( ), and one Japanese ( ). The Chinese set of characters when pronounced gives the sound "HIUWO NO RUI," the Japanese set, "HEIWO." (Personal conference John K. Howard with Dr. Shoji Ueyanagi, April, 1964.) The use of two such sets of characters has been customary in Japanese writing when the Chinese characters are difficult to pronounce, but it is becoming less so today. Because of the peculiarities of the Japanese system of writing, including the use of Chinese characters, it is often not practicable to exactly indicate in writing how colloquial words are pronounced. The sound systems of the Japanese and Chinese languages are entirely different, so that fitting Chinese characters to Japanese words is not exact in many cases. "HIUWO" and "HEIWO" are about as close as the Japanese usually get in matching a sound phonetically to a character (Letter, W. G. Van Campen to John K. Howard, 30 September 1964). It is likely that the Japanese fishermen called the fish "HIUWO", which Bürger put into the proper Chinese characters, and the nearest thing he could come to in a Japanese character. The "NO RUI" simply means "a kind of." Bürger used the then Japanese common name as it sounded to him as the specific name in his binomen.

Temminck and Schlegel included in their description: "Les japonais désignent ce poisson sous le nom de Heiwo." (Temminck and Schlegel in von Siebold, 1844:104.)

Goode (1883:309) says that Temminck and Schlegel say the Japanese name is "Herivo," evidently a clerical error, as the reference from which
he is quoting is the above paper, which is properly quoted in the above paragraph.

Nakamura (1949:61) gives Japanese characters which could sound HAOU or HAUWO as one of the common names for the sailfish, *Istio- phorus orientalis*. Van Campen translates this as HAOU (Nakamura, 1952:58).

Dr. Tokiharu Abe, of the University of Tokyo and the Tokai Regional Fisheries Research Laboratory, writes me that, though at Nagasaki, where Burger collected the information about sailfish, bashokajiki is now used, at Fukue, Goto Island, west of Nagasaki, the word “hya-yo” or “hiaa-yo” is still most used to designate the billfish, including the broadbill.

It is clear that by March, 1913, the Japanese common name being used the most for sailfish had changed, bashokajiki alone being given as the common name by Jordan, Tanaka and Snyder (1913:125). This is the earliest published use of which I know, of the presently accepted Japanese standard common name.

The next paper following that of von Siebold (Temminck and Schlegel) in which Japanese common names are recorded for istiophorid fish, of which I know, is that of Jordan and Snyder (1901:304, 306), in which are given makajiki for striped marlin, and mazaara and kurokajiki for blue marlin. The use of makajiki was not universal, as is shown by the fact ascertained by the authors that at Matsushima Bay these fish were called by the fishermen baisen or kajiki-maguro—i.e., the billed tuna—a very ancient name for all the billfish (Jordan and Snyder, 1901:305).

Nakamura (1951:33; 1954:37) says that it is very doubtful whether the fish named *Makaira mazara* and reported as a new species by Jordan and Snyder was a kurokajiki; he inclines to the opinion that it was not. However, he says he would employ in this paper the presently accepted scientific specific name *mazara*. He says the specific scientific name *mazara* was derived from the common name mazaara used in the Boshu region. The specimen was caught in Sagami. Sagami Nada (Gulf) borders on the Boso Peninsula of Chiba Prefecture. I am informed that Boshu is an old name for the present Chiba Prefecture, the lower part of which is known as the Boso Peninsula (Personal conference John K. Howard with Shoji Ueyanagi, April, 1964). This is the fish to which Nakamura later gives the scientific name of *Eumakaira nigra*, retaining the Japanese common names of kurokajiki or kurokawa (Hirasaka and Nakamura, 1947:16; 1952:65). Dr. Nakamura gives no reasons for his doubt that the specimen described by Jordan and Snyder was a kurokajiki or mazaara (Boshu region). The specimen described by Jordan and Snyder (1901:306) as *Tetrapturus mazara*, Japanese common name mazaara or kurokajiki, was a very large fish, ten feet long without a spear, and weighed 1080 pounds (Jordan and Evermann, 1926:54). This is too large for a striped marlin. It must have been a black or a blue marlin. From our study of the fisheries which might, in Sagami Nada in 1901, have caught a large marlin and landed it at the mar-
ket in Misaki, both Dr. Ueyanagi and I feel that this fish was much more likely to have been a blue marlin than a black marlin. Also, we have the fact recorded by Jordan and Snyder that the fishermen called it a mazaara or kurokajiki, which names since before 1901 have always been used by the fishermen of the area for blue, not black marlin. Also see the stripes mentioned in the descriptions in both Jordan’s papers referring to this fish (Jordan and Snyder, 1901:305; Jordan and Evermann, 1962:53).

The first mention of the presently used Japanese common name for the third marlin of the Pacific, the black marlin or shirokajiki, which I have found is in 1913 (Jordan, Tanaka and Snyder, 1913:125). But the authors did not distinguish between the two marlins, the blue and the black, applying both kurokajiki and shirokajiki to Jordan and Snyder’s 1901 *Tetrapturus mazara*, the blue marlin. The authors simply give kurokajiki as the common name for the Misaki area and shirokajiki for the Tokyo area. Tanaka (1933:163) again mentions the fish known as shirokajiki at Tokyo, but in connection with saying that there may be a species different from the striped marlin, makajiki, which in Tokyo is called kurokajiki and shirokajiki. He not only does not distinguish black marlin, shirokajiki, from blue marlin, kurokajiki, but is not even sure that there is any more than the one species, the striped marlin, makajiki. A search of the Japanese scientific literature reveals no description and naming of this third marlin until Nakamura’s 1938 paper (Nakamura, 1938:20; 1955:29). In this paper, Nakamura identifies his shirokajiki with Jordan and Hill’s black marlin by adopting their scientific name *Makaira marlina* (Jordan and Evermann, 1926:59).

Though Jordan and Hill say in the 1926 publication that their black marlin is “a distinct species, apparently allied to *Makaira mazara,*” they do not include Japan in its distribution. They give no Japanese common name for it. Also in their 1926 description of *Makaira mazara* (Jordan and Snyder), page 53, Jordan and Evermann give as the Japanese common names kurokajiki, mazaara and kuroka. There is no mention of shirokajiki. They also say, page 54, “A species which seems distinct (*Makaira marlina*) is recorded by Zane Grey and other anglers as occurring off the coast of southern Lower California, where it is called Black Marlin . . .”

But during all this time, at least from 1913 and probably a great deal earlier, fishermen and marketmen recognized a special kajiki, which they called among other Japanese names, shirokajiki. Nakamura (1938) synonomizes this marlin with the black marlin of English speaking people.

The last of the presently recognized species of istiophorid fish for which I can find a recorded Japanese common name is the shortbill spearfish. This species was first described and given a scientific name by Tanaka in 1914-1915 (Tanaka, 1914:pl. 88; 1915:324). In both publications, Tanaka gives the Japanese common name in Chinese characters, which can be Romanized as furaikajiki or huraikajiki (Tanaka, 1915:324; 1935:324).
As stated above, it is hoped that some Japanese scholars have better knowledge of this history, and will communicate it to the author.

**Standardization**: It is apparent from several of Dr. Hiroshi Nakamura's publications that there had been no standardization of the Japanese common names used by the Japanese fishing industry before or during the second world war (Nakamura, 1938:15-21; 1949:57-69; 1952:54-66; 1955:24-30).

Several influences have led to a very high degree of standardization of the Japanese common names since the rebirth and tremendous growth of the Japanese fisheries, and particularly the tuna longline fishery, since the war. The very greatness of the growth of the latter from local Japanese fisheries through a very large national fishery to perhaps the largest and certainly the most widely spread international fishery in the world, has of itself necessitated a standardization of the names of the fish which form its catch. No statistics for the fishery could be kept without such standardization. No government support could have been given to the reviving industry, or intelligent direction to its growth by the Japanese government without analysis of the fishery from time to time, and of its annual production, which necessitated standardization of the names of the fish in its catch. Because the basic data for such statistics must come from the fishermen, marketmen, etc., it was naturally the Japanese common names printed in Japanese characters which had to be standardized, not Romanized Latin scientific names.

In August, 1947, a basic survey of the fishing industry was made; in 1948, the Fisheries Bureau of the Ministry of Agriculture and Forestry was elevated to the Fisheries Agency; and in March, 1949, the first fisheries census was conducted (Anonymous, 1957:3; Anonymous, 1960:Preface, 10). Evidently, this section, during the ten year's experience to 1960, clearly developed an objective to standardize the Japanese common names for the species of fish involved in the catch statistics which it collected: “Once species to be classified in the survey are selected, the following names should be sought for each species: (i) The common name in terms of the national language [a standard common name] should be determined if it is not yet available in the country. After tabulating the survey results, the same name will be officially used in any statistical publication. (ii) The scientific name adopted in taxonomy should be sought from the biologists. . . .” This appears in instructions on how to plan and conduct statistical surveys (Anonymous, 1960:126).

This section's report forms being employed in 1962, which I obtained in Japan, were using the standard Japanese common names. In the most basic report of all, that made out by the captain or master fisherman of a tuna boat, there were four columns for reporting the catch of Istiophoridae. One column combined the catch of sailfish and shortbill spearfish. At the head of this column were printed the Japanese characters for bashokajiki.
and furaikajiki; at the head of one appeared the characters for makajiki; and the other two for kurokajiki and shirokajiki, but in each case followed by a parenthesis containing respectively kurokawa and shirokawa. As I have said, these forms, left at the fishermen's local cooperatives, are the basic data for the Ministry of Agriculture and Forestry's fisheries catch statistics. These same standard Japanese common names are used in all other statistical reports of the ministry.

I have been unable to discover the date of the adoption of this basic statistical form, but have been told that though there have been some minor changes, the adoption of these standard Japanese common names came very early in the setting up of the system for collecting data by the Fisheries Statistics Section, which was in 1950.

The fact that the "boats' logs," day-to-day records of catches, etc., must be kept in terms of these standard Japanese common names for inclusion in the Fisheries Statistical Section's form to be filed in port, and the fact that all statistical reports of that section list catches in terms of these same standard Japanese common names, necessarily made everyone engaged in the fishery and the marketing of its products very familiar with these names. This must have been a big influence in the standardization of the Japanese common names within the industry.

In 1949, the central government's fisheries research effort was completely reorganized. The operations of the Central (formerly Imperial) Fisheries Experimental Station of Tokyo (and its branches) were decentralized into nine institutions or laboratories (Anonymous, 1947:12,21; Anonymous, 1957:127). Dr. Hiroshi Nakamura was appointed the director of the Nankai Regional Fisheries Research Laboratory, and this laboratory was given the mission of serving the open ocean tuna fishery and particularly the long-line fishery. The Nankai Laboratory was formally inaugurated at Kochi on 1 June 1949 (Anonymous, 1956), but the personnel did not actually move to Kochi until 1950. The group was organized under Dr. Nakamura, as director, but continued working in Tokyo at the former Central Experimental Station (Personal communication John K. Howard with Shoji Ueyanagi, May, 1964).

During the war, Nakamura was writing papers on the Istiophoridae in Formosa. Four of these papers written in 1944 show that he used the presently accepted standard Japanese common names, and only them, for the five Pacific istiophorid species (Nakamura, 1944a, 1944b, 1944c, 1944d).

One of the first publications emanating from the new laboratory was "Contributions of Nankai Regional Fisheries Research Laboratory No. 1." This was a collection of 49 papers written by members of the staff of that laboratory published in 1953. Of these papers, many of which were reprints of papers published between 1950 and 1953, seven referred to the Istiophoridae. Of these, six were written by the fisheries biologists. In these six papers, all five standard Japanese common names were used, and they
were the only Japanese common names used. The seventh paper, by Asakawa, Naguchi, and Menoto, is written by three biochemists. In this paper, though all but furaikajiki of the standard names were used, kurokawa and kurokawakajiki were used in addition to kurokajiki; shirokawa in addition to shirokajiki; and bashokajiki is shortened to basho, particularly in some of the tables.

The istiophorid papers in this collection are truly scientific papers written for other scientists. In 1954, the laboratory sponsored a work which was written by members of its staff for the longline fishery, and was published by the Nippon Katsuo-Maguro Gyogyokumiai Rengokai. This was “Average Year's Fishing Condition of Tuna Long-Line Fisheries for 1952.” In its writing and editing in 1954, the laboratory chose one of the Japanese common names for each of the istiophorid fish it covered, and stuck to it. In fact, all of the presently used Japanese common names were used except furaikajiki. This was a publication prepared for the industry and published by the industry.

From the apparent facts, it seems probable to me that Dr. Nakamura came to the opinion sometime between about 1938 and 1954 that it would be advantageous to the fishery industry to standardize the Japanese common names used in the industry. He first standardized the use by the staff of his own laboratory, and then in 1954 made a direct effort with the industry.

In 1959, the laboratory again wrote, edited and prepared for publication by the industry the “Average Year's Fishing Condition of Tuna Long-Line Fisheries, 1958.” Here again the same Japanese common names were used as in 1954: makajiki, kurokajiki, shirokajiki and bashokajiki, furaikajiki being the only presently recognized standard name not used.

By the usage of the fishermen and officers of the boats fishing in the Atlantic, makajiki had been generally adopted and used for the Atlantic white marlin. This is the standard name used by the industry for the striped marlin in the Pacific and Indian Oceans, a different species. This could cause statistics based on the combined catches in the Atlantic and any other ocean to be false and misleading. The propriety of the use of makajiki for the Atlantic white marlin had first been questioned by the captain of the Japanese tuna boat, “Sagami Maru,” fishing in the Atlantic in 1957 (Wakao, 1958:19). Seeing Capt. Koichi Wakao’s article in Tuna Fishing, the author on 28 March 1958 wrote to the Kanagawa Prefectural Fisheries Experimental Station, which prepares Tuna Fishing for publication by The Investigative Society of Tuna Fishery, suggesting that their organization and the Investigative Society of Tuna Fishery check with Dr. Hiroshi Nakamura or some other Japanese ichthyologist, who had studied the two Atlantic marlins and compared them with those of the Indo-Pacific, as to whether the Atlantic blue marlin and white marlin were the same fish as the kurokajiki and makajiki of the Indo-Pacific area. This was done. In Tuna Fishing No. 49, May, 1958, a statement appears, of which the
following is a translation: From the information reviewed above, there seems to be little doubt that kurokawa and the makajiki of the Atlantic respectively differ from the same named fishes of the Pacific at the subspecific level. But considering that proper common names cannot be given to the Atlantic’s kurokawa and makajiki until their taxonomic positions are clarified, and also that the terms kurokawa and makajiki are commonly used by fishermen, the Kanagawa Prefectural Fisheries Experimental Station and the Nankai Regional Fisheries Research Laboratory have decided to temporarily use the terms Taiseiyo-san Kurokawa (Atlantic kurokawa) and Taiseiyo-san Makajiki (Atlantic makajiki) to designate the two Atlantic marlins in question (Nakagome, 1958a:21-22).

In my letter of 28 March 1958, I suggested the use as the English common names of white marlin for the Atlantic makajiki, and blue marlin (not black marlin, as then used in Japan) for the Atlantic kurokajiki. See Standard English Common Names, Standardization, above, concerning the latter.

Nothing had happened on these common name questions by July of 1962, when I visited Japan. So during my stay in Japan I discussed these questions with the Kanagawa Laboratory, the Nankai Laboratory, and especially with Dr. Hiroshi Nakamura and Dr. Kiyomatsu Matsubara, Director of the Marine Laboratory of Kyoto University, the two foremost Japanese taxonomists who had worked on the Istiophoridae. Happily, this gave me the opportunity to meet and get to know some of the younger men working with Dr. Nakamura and Dr. Matsubara, and the very active group of younger men working at the Kanagawa and Nankai Laboratories, including Dr. Shoji Ueyanagi, my co-author in Part II of this paper. These meetings resulted in an acceptance by these institutions of the English common names proposed and claimed by me to have been standardized by English speaking people. See Standard English Common Names, Standardization, above.

In 1958, Dr. Nakamura initiated an annual meeting of all those interested in the tuna fishery. It was intended that this meeting would give an opportunity for scientists, both academic and fisheries, people from the staffs of central government, prefectural and private institutions, fisheries high schools, and corporations which might be interested in any phase of the tuna fishery, the boat captains, fishermen, and representatives of fishermen’s organizations, such as cooperatives, to get together. The meeting was open to all comers. It was held in Kochi, organized by the Nankai Laboratory, and held under its auspices. The meeting in February, 1964, held at Shizuoka, was the first held away from Kochi. The official name of the meeting has been Maguro-Gyogyo Kenkyo-Kyogi Kai, or Tuna Fisheries Research Council. At these meetings, Dr. Nakamura and the staff of the Nankai Laboratory have always used the standard Japanese common names of the tuna and billfish in their talks, papers, discussions, etc. This
must have been influential in obtaining the use of the same common names by the leaders of all branches of the industry.

At the Tuna Fisheries Research Council's meeting in February, 1963, following my visit to Japan, Dr. Shoji Ueyanagi made a "Proposal for Standard Common Names of Billfishes." The "Proceedings" of this meeting were published by the Nankai Laboratory in April, 1963. In these "Proceedings," pages 26-36 cover Dr. Ueyanagi's Proposal for Standard Common Names of Billfish. It also includes some of the discussion which followed the proposal, which resulted in the appointment of a committee to study the questions and report back to the general session of the meeting. It also includes the recommendations of this committee, which were adopted. Dr. Ueyanagi translated these pages of the "Proceedings," and the Institute of Marine Science of the University of Miami had this translation mimeographed and sent to some of those interested.

The adopted recommendations included two new Japanese common names for the white marlin and longbill spearfish of the Atlantic, Nishimakajiki and Kuchinagafuri respectively. The English common names of the Indo-Pacific Istiophoridae, as recommended by Dr. Ueyanagi, were also adopted, changing the Japanese usage from black marlin to blue marlin, white marlin to black marlin, and shortnose spearfish to shortbill spearfish.

I have not seen any Japanese papers dealing with the three Atlantic billfish since this meeting. The changes in use of English common names for Indo-Pacific billfish have, I believe, been generally adopted. See English Common Names, Standardization, above.

Scientific Nomenclature—General: In the first paragraph of this section on Nomenclature, I said there was a surprising disagreement as to proper scientific names for the five Pacific species of the Istiophoridae. Let us actually look at the situation. Last year, 1964, the papers given at a symposium on scombroid fishes of the Indian Ocean were published (India. Marine Biological Association, 1964). The Indian Ocean species of Istiophoridae are the same five species as those of the Pacific, therefore, the scientific names of these five Indian Ocean taxa should be the same as those for the five species of Pacific Istiophoridae. Twenty different scientific names for the species of Istiophoridae appear in that publication. This situation will be set out in detail in the next subsection on Specific Scientific Names. Think of the problems of a librarian or other person trying to file or list scientific papers so that they can be useful to workers in these taxa. In these same papers when English common names are used, in all cases except one paper authored by a Japanese scientist, the standard English common names are used. In his present papers, this Japanese author is using only the English standard common names.

Specific Scientific Names: To list the actual scientific names presently being used in publications for the five species of Pacific Istiophoridae, the
best start is to list the twenty names used in the papers in the publication referred to in the last paragraph (India. Marine Biological Association, 1964). They follow. The taxa, for which they were used, are identified by their standard English and Japanese common names.

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<th>English Common Names</th>
<th>Japanese Common Names</th>
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<td>Indo-Pacific Sailfish</td>
<td>Bashokajiki</td>
<td><em>Istioforthus orientalis, I. gladius, I. ludibundus.</em></td>
</tr>
<tr>
<td>Shortbill Spearfish</td>
<td>Furaikajiki</td>
<td><em>Tetrapturus angustirostris, T. brevirostris.</em></td>
</tr>
<tr>
<td>Striped Marlin</td>
<td>Makajiki</td>
<td><em>Makaira audax, M. mitsukurii, M. zelandica, Tetrapturus audax, Marlina audax zelandica.</em></td>
</tr>
<tr>
<td>Indo-Pacific Blue Marlin</td>
<td>Kurokajiki, Kurokawa</td>
<td><em>Makaira nigricans, M. mazara, M. mazara howardi, Eumakaira nigra.</em></td>
</tr>
<tr>
<td>Black Marlin</td>
<td>Shirokajiki</td>
<td><em>Makaira indica, M. xantholineata, Marlina marlina, Istiompax indicus.</em></td>
</tr>
</tbody>
</table>

Currently there are two scientific names that cannot be indentified: *Istiompax dombraini* and *Tetrapturus tenuirostratus*. They probably represent the young one of the five generally recognized Pacific species, very likely the black marlin, shirokajiki.

This makes a total of twenty scientific names for five taxa. Only two of these names can be attributed to taxonomic differences of opinion as to the species in the Indo-Pacific. In addition to this, the following scientific names, which were not mentioned in this 1964 publication, have been, to the author’s knowledge, used in responsible publications of the following dates:

<table>
<thead>
<tr>
<th>Pacific Sailfish</th>
<th><em>Istiophorus greyi</em> (1964)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Striped Marlin</td>
<td><em>Kajikia mitsukurii</em> (1957)</td>
</tr>
<tr>
<td>Blue Marlin</td>
<td><em>Makaira ampla</em> (1964)</td>
</tr>
<tr>
<td></td>
<td><em>M. nigricans mazara</em> (1963)</td>
</tr>
<tr>
<td>Black Marlin</td>
<td><em>Istiompax marlina</em> (1964)</td>
</tr>
</tbody>
</table>

This is an additional five scientific names being used contemporaneously for the five istiophorid species of the Pacific, a total of twenty-five.

Until recently, the practice was to describe species on the basis of a single, or at best, very few specimens, generally from the same area. This has led to the designation of forms from different populations of the same species, or even of different variants of the same population as different species with different scientific names (Mayr, Linsley and Usinger, 1953:9, 11, 15, 16). Dr. W. M. Chapman put this well in reference to the tax-
onomy of the tunas: “In essence the tuna have been more migratory than the scientists.” (Chapman, 1963:1100). This has led to the great number of synonyms in scientific nomenclature, and the confusion in the taxonomy on which they are based (Royce, 1957:498). Correction of this taxonomic confusion is becoming more possible as more and better data are made available to taxonomists. The advent of the fisheries biologist, with his practical problems, his different objectives, and his consequently different approach and methods to taxonomic questions, is bringing about a change in this situation. The result is that today many taxonomists working on fisheries problems are effectively working to straighten out the tangle left by the classical taxonomists, and many sound taxonomic findings on large pelagic fishes are coming from them (Marr, 1955:23-24). A thorough re-study of all groups, using sufficiently large samples, is one of the most needed jobs for modern taxonomy.

As the reasons for the practice of describing species on the basis of a single specimen or an illustration have largely disappeared or have been discouraged for most fishes, there has been little correction in the Istiophoridae. The reason is undoubtedly that fishes of this family are so large they have not lent themselves to methods of the classical taxonomist (Morrow, 1956b:1; 1957b:88; Collette and Gibbs, 1963:24). They are difficult to collect, transport, and preserve in collections. This is a different reason than that for the proliferation of nominal species resulting from the work of classical taxonomists (Nichols and LaMonte, 1935:327; Nakamura, 1955:3; LaMonte, 1955:323).

**Categories Higher than Species:** This refers to all scientific names above the specific, including generic names, which are necessary to the specific binomen. Taxonomists have felt that in the choice of taxa, higher than the species, taxonomic problems were much more a matter of personal opinion than in the determination of species, provided there was not overbearing phylogenetic evidence. In the Istiophoridae, there is no good phylogenetic evidence between family and species.

Therefore, as stated above, taxonomists and classifiers have felt that the categories of genera and above are divisions of man, not creations of nature, and consequently, that they are entitled to the freer exercise of their own opinions about the existence of such categories. Actually, because of the necessity of internationally recognizable names for species and present general acceptance of the binomen of the Code of the International Congress of Zoologists for that name, it becomes particularly important that all zoologists agree on the genus to which any species belongs. The nomenclature follows the taxonomy.

To my mind, who came to training and practice of zoology after an academic graduate training in law and 44 years of practical experience in the practice of law, the conduct of business, and the various experiences of participation in two world wars, the present practice of zoographical
classifiers in determining genera often indicates a lack of discipline which smacks of immaturity. I wonder if the classification necessary to general international usefulness of scientific names, which is the objective of the zoological code, will be realized until zoologists recognize the necessity of using more discipline in indulging their own personal opinions, for the benefit of their "discipline" as a whole. Can zoologists afford to neglect the necessity of international agreement on the matter of nomenclature of the species?

A search of literature referring to the Istiophoridae, though perhaps not complete, indicates that eighteen nominal genera have been created. They are:

- Histiophorus
- Pseudohistiophorus
- Istiophorus
- Istiompax
- Makaira
- Eumakaira
- Machaera
- Marína
- Kajikia
- Tetraplurus
- Tetraperus
- Skeponopodus
- Scheponopodus
- Tetrapterurus
- Lamontella
- Xiphias

All but three have been placed in synonymy by most modern taxonomists. The three presently generally recognized genera in the family Istiophoridae are: Istiophorus, Tetrapterus and Makaira. Istiompax is also recognized by some workers who wish to place the black marlin in a separate genus. Recently no new genera have been proposed.

Unfortunately, while this clearing process has been going on, taxonomists have been transferring species from one genus to another. This process is still going on. It results in changes of the binomen. Where there is such little phylogenetic evidence bearing on this question, is it not possible for fish taxonomists who are interested in the Istiophoridae to meet together and compromise most of their taxonomic and nomenclatural differences so as to get a practical, working scientific nomenclature, at least to the generic level?

I feel like saying, "Take your choice; I will rely on the common names." But then in doing so, I would be as impractical as the people who have created this situation. Because in this case, to me, the choice of the generic element in the binomen depends on first coming to a decision on the proper hierarchical classification, I will discuss this below.

**Phylogeny and Hierarchical Classification:** As stated above, there is no good phylogenetic evidence to indicate relationships between the species and family levels in the Istiophoridae. Palaeontological, biochemical, genetic and embryological evidence are lacking. Not enough is known of the life histories and behavior of these fish from which to deduce any useful evidence. There has been no analysis of their world-wide distribution from which pertinent biogeographical evidence could be drawn. In Part II of this paper, my co-author and I are making the first attempt to fix the distribution of istiophorid fishes in an entire ocean.

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It is true that in the time which has elapsed between the appearance of
the ancestral istiophorid stock or stocks and today, certain groups of these
fish have developed internal and external anatomical characters, some of
which taken together clearly indicate separate species. It is those characters
which are common to more than one species and not possessed by other
species, which might indicate a generic relationship. Which of these
characters have any phylogenetic significance, and how much, is the
question. I am led to believe there are no general rules applying to all
families or groups; such characters may indicate closer ancestral relations­
ships in one case, and not in the next (Simpson, 1961).

In the family Istiophoridae, morphometric and meristic characters
overlap between species and a combination of these ranges must be used
to identify a specimen as belonging to one or another species. But there
is one meristic character, the vertebral count, which never varies within
the species, and the total vertebral count never varies in the family.
A certain group of species has 12 + 12 = 24, and another group has
11 + 13 = 24. There are other characters which are exclusively common
to each of these groups of species.

This difference between two different groups was first given recognition
taxonomically in a proposed hierarchical classification by Hirasaka and
Nakamura in 1947. In their hierarchy it was recognized on a subfamily
level, Tetrapurturinae (12 + 12 = 24) and Marlinae (11 + 13 = 24). Even
if adjusted to a world-wide basis, including all presently recognized species,
this hierarchy would still have the subfamily Marlinae composed of two
genera of one species each. This hierarchy has, on a world-wide basis,
two subfamilies and five genera (on the basis of albida, the Atlantic white
marlin, being included in the genus Kajikia) between the species and the
family, a total of seven taxa (Hirasaka and Nakamura, 1947).

Another hierarchy using subfamilies is that proposal by J. L. B. Smith
in 1956. He proposes three subfamilies: Tetrapurturinae, Makairinae and
Istiophorinae (Smith, 1956:25). Smith’s basis for creating the subfamilies
is not the difference in vertebral count and accompanying characters. I
see no particular use in his hierarchy, and it follows no particular lines of
cleavage based on characters which appeal to me. In his latest paper he
retains the three subfamilies (Smith, 1964:167). He introduces them
with the following: “For convenience they [Istiophoridae] are divided into
three subfamilies . . .” I see no convenience.

Robins and de Sylva in both their 1961 and 1963 papers on the Istio­
phoridae approve and adopt from Nakamura’s hierarchy the division of the
family by the vertebral counts and accompanying characters. They added
to the number of accompanying characters (Robins and de Sylva, 1961:
402, 403, 404), but say on page 403: “We agree with the basic dichotomy
suggested by Nakamura although the divisions need not be designated
subfamilies.” In their 1963 paper, they again adopt and confirm Naka­
mura’s subdividing the family, but again reject his division on the subfamily
basis. “This dichotomy actually dates from the work of Hirasaka and Nakamura (1947). These subdivisions are natural, but need not be accorded subfamily rank, although some ichthyologists will choose to do so. It was not our intent in our earlier paper to suggest such ranking for in small families like the Istiophoridae subfamilies are unnecessary and serve no important purpose.” (Robins and de Sylva, 1963: 101, 102.) They put the new species *pfluegeri* in the genus *Tetrapturus*, saying: “The delineation of *belone* and *pfluegeri* now makes smoother the transition from that type of *Tetrapturus* represented by the white and striped marlins (*albidus* and *audax*) to *Tetrapturus* of the *angustirostris* type.” (Robins and de Sylva, 1963:100.)

An important reason for all classification is the practical purpose of creating a useful orderliness. Where there is little or no phylogenetic evidence, this purpose assumes greater importance in making choices. Simplicity is one of the greatest attributes of usefulness. By adopting Robins and de Sylva’s classification, the hierarchy has only three genera (taxa) between the species and the family, as against seven taxa for Hirasaka and Nakamura’s hierarchy. It gives recognition to Nakamura’s subdivision of the family into two subdivisions and the reasons therefore, provided all species except sailfish with vertebral count of 12 + 12 = 24 are placed in the genus *Tetrapturus*.

Dr. Shoji Ueyanagi, my co-author of Part II of this paper, examined the growth of various parts of the Pacific species of Istiophoridae from postlarval to adult stage. He found that growth of the snout and the first dorsal fin divided between the species on the same basis as the division into the above groups, adding two more characters to those which I have called accompanying characters to the vertebral count. *Istiophorus* and *Tetrapturus* have negative allometric growth of the snout; *Makaira* has positive allometric growth. *Istiophorus* and *Tetrapturus* carry the high juvenile form of first dorsal fin from the postlarval stage through the immature, to the adult stage. The species of *Makaira* have the first dorsal fin markedly reduced in height with growth (Ueyanagi, 1963b:151).

After all, Nakamura’s divisionary characters may have some phylogenetic values. It seems to me that Robins and de Sylva’s hierarchy is the most usable and practical offered so far, and takes into consideration the only presently known characters which may have phylogenetic significance. It is, therefore, my choice of a hierarchical classification.

With the generic element fixed in the above way, the following are my choice for the binomens for the five species of Istiophoridae of the Pacific Ocean:

<table>
<thead>
<tr>
<th>Indo-Pacific Sailfish</th>
<th>Bashokajiki</th>
<th><em>Istiophorus gladius</em>²⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortbill Spearfish</td>
<td>Furaikajiki</td>
<td><em>Tetrapturus angustirostris</em> Tanaka</td>
</tr>
<tr>
<td>Striped Marlin</td>
<td>Makajiki</td>
<td><em>Tetrapturus audax</em> Philippi²⁷</td>
</tr>
<tr>
<td>Blue Marlin</td>
<td>Kurokajiki</td>
<td><em>Makaira nigricans</em> Lacépède²⁸</td>
</tr>
<tr>
<td>Black Marlin</td>
<td>Shirokajiki</td>
<td><em>Makaira indica</em> (Cuvier)²⁹</td>
</tr>
</tbody>
</table>
SUMMARY OF PART I

In the introduction, the importance of a study of the distribution of the Istiophoridae is discussed, followed by a history and an outline of the present status of the taxonomy of the family. The lack of application and need for the use of the most modern taxonomic techniques is pointed out. The general recognition of the five species of Istiophoridae in the Pacific by scientists, the fishing industry, and fishermen, both commercial and sport, is stated: 1 sailfish, 1 spearfish and 3 marlins.

Next, nomenclature is considered. It is pointed out that in this family of few species there has been a general acceptance (standardization) of both the English and Japanese common names: whereas, the same is not true of the scientific names. The standard English and Japanese common names, with some of the presently used scientific names of the five species, are given as:

| Pacific Sailfish       | Bashokajiki | Istiophorus orientalis,  
|                        |             | I. gladius, I. greyi.  
| Shortbill Spearfish    | Furaikajiki | Tetrapturus angustirostris.  
| Striped Marlin         | Makajiki    | Makaira audax, M. mitsukurii,  
| Blue Marlin            | Kurokajiki  | M. zelandica, Tetrapturus audax.  
| Black Marlin           | Shirokajiki | Makaira nigricans, M. n. mazara,  
|                        |             | M. ampla, Istiompaxhowardi.  

It is felt that there is insufficient phylogenetic evidence bearing on the question of taxonomic categories higher than the species. Therefore, their scientific nomenclature and their systematic classification into a hierarchy is uncertain. There are certain ontogenetic, physiological, and morphometric likelihoods which should be considered in the ordering of the individual species into a hierarchy between species and family. It is felt that dividing the family into three genera (Istiophorus, Tetrapturus and Makaira) is the simplest method of doing justice to the ontogenetic, physiological, and morphometric likelihoods, provided all of the species other than the sailfish, with a vertebral count of 12+12, are put in the same genus, Tetrapturus, as proposed by Robins and de Sylva (1960:403).

FOOTNOTES

1—No attempt has been made to cite all papers in the literature in support of any statement in this paper. Only some of the best known or most recent papers are cited.
4—Nakamura, 1952:34-38, 1955:3, 11-22, pls. 1, 3, 4, 5, 7, 8, 9, 10, 11, figs. 1, 5.
5—Cuvier and Valenciennes 1831; Brühl, 1847; Knox, 1870; Lütken, 1877; Goode, 1883; Regan, 1909; Gregory, 1933; Gregory and Conrad, 1937; Morrow, 1956a, 1956b, 1957b, 1962; LaMonte, 1958.  
7—Günther, 1873-4; Lütken, 1880; Beebe, 1941; LaMonte and Marcy, 1941; Voss, 1953; Gehringer, 1956; Jones, 1959a, 1959b; Sun, 1960; Cadenat, 1961:121; Caldwell, 1962; Jones and Kumaran, 1962, 1964a, 1964b.  
14—Grey, 1919: 43, 75, 82, 84, photographs opposite pp. 245, 248, 251, 252, 259.  
15—Anyone interested in checking this statement is referred to pp. 7, 9, 10, 55, 58, 59, 77, 78, plate opposite 82, 83, 85, 87-91, 99, 100, 108, 109, 121, 123, 177, plate opposite 184, 187, 188.  
16—Outdoor Life contemporarily ran material on salt water fishing records in February of four successive years, 1936 to 1939. Just why this was done for these four successive years and never done again, I do not know. The information of these world records which appears in
Outdoor Life was compiled by Thomas Aitken, who was then the Outdoor Life Fishing Editor.

17—Nippon Gyogyo Shi (A history of Japanese fisheries). 349 pp. Publ. by Seikatsu-sha, 2-5 Surugadai, Kanda, Chiyoda-ku, Tokyo. Mr. Wil- van G. Van Campen kindly studied this book for the author and wrote a two-page memorandum on its contents pertaining to Istiophoridae. The statements regarding this reference in the present paper are based on that memorandum, as the author has not seen the original publication.

18—In reading Van Campen's translation of Japanese papers, it must be remembered that until recently he used literal translations of Japanese common names into English, rather than using the generally accepted English common names as follows: "black marlin" for kurokajiki instead of blue marlin; and "white marlin" for shirokajiki instead of black marlin. His translation of makajiki was inconsistent, using striped marlin, the generally accepted English common name, rather than the literal translation "true spearfish." See Standard English Common Names section.

19—There is one exception to this exclusive use of the chosen common name. In some of the headings to columns in tables in the section, Total Catch, kurokawa is used instead of kurokajiki (see tables 11, 24 and 32). Dr. Shoji Ueyanagi, who wrote the section on the striped marlin, makajiki, commented that these tables were probably prepared by some young member of the staff who had not grasped the laboratory's policy of standardizing the use of Japanese common names, and that these exceptions were not picked up in the editing.


22—Ueyanagi, 1957b.

23—Hawaii. Division of Fish & Game, 1964 (June).

24—Ueyanagi, 1963a.

25—Hawaii. Division of Fish & Game, 1964 (June).

26—The first two scientific reports of sailfish were Marcgrave's guebucu from Brazil (Marcgrave, 1648: 171-172 of reprint, 1941) and Broussonet's voilier (Broussonet, 1788). Broussonet's specimen came from seas of India, "les mers des grandes Indes." Unfortunately, neither report created a scientific name for the sailfish of any ocean. It is unfortunate, as Broussonet's description is good and the specimen which he described is still in the British Museum, Natural History, London. There is no mention of gladius in the text.

As many, if not most, writers have credited gladius, as applied to the sailfish, to Broussonet, Dr. James E. Morrow checked three
different copies of Histoire de L'Academie Royal Des Science—Annee DCCLXXXVI; one in the British Museum, one at Yale and one in the New York public libraries. He was unable to find *Scomber gladius* in any part, such as a separated note or the index, of the three copies of the publication (Letter Dr. James E. Morrow to John K. Howard, 14 April 1959). It is really hard to understand how this mistaken credit to an author could have happened in the first place, and have been carried on for so long. The error, though persisting, is being recognized and more nomenclaturists are crediting *gladius* to Bloch (Fowler, 1928: 136; Jones and Silas, 1964: 71; Morrow, 1964: 433, 438, 439; Williams, 1964: 127, 128).

*Scomber gladius* was first used by Marcus Elieser Bloch in his German paper published in 1793 in Berlin. An examination of this paper shows that the description is a compilation of descriptions of earlier writers, including both Marcgrave’s *guebucu* and Broussonet’s *voilier* (Bloch, 1793). The scientific name was therefore given to what today we tentatively consider two separate species, the Atlantic and the Indo-Pacific sailfish. An examination of Bloch’s 1797 paper reveals that it is a French translation of his 1793 paper. In no way does it alter the situation (Bloch, 1797). In Bloch and Schneider’s 1801 paper, an attempt to change the nominal species represented by *gladius* from the genus *Scomber* to genus *Xiphias* necessitated the use of another specific name, because *gladius* was already occupied for the swordfish, *Xiphias gladius*. Therefore, *velifer* was used as the specific name for the nominal species, but again the description is based not only on Marcgrave’s *guebucu*, but on Bloch’s *Scomber gladius*, therefore compounding the composite nature of the description (Bloch and Schneider, 1801).

Article 24 of the International Code of Zoological Nomenclature (Stoll, et al., 1961: 25) provides, “If . . . identical names for different taxa, are published simultaneously . . . in the same . . . work(s), their relative priority is determined by the action of the first reviser.

“(i) The expression “first reviser” is to be rigidly construed.”

A search for the first reviser of Bloch’s 1793 use of *Scomber gladius* shows that in Brown Goode’s papers, 1882 and 1883, and his chapter on the Istiophoridae in his 1888 book, he does not accept the grouping together of the Atlantic sailfish with that of the Indo-Pacific under the scientific name and nominal species *Istiophorus gladius*. He approves for the Atlantic sailfish *Istiophorus americanus*, which is now recognized as a junior synonym of *Istiophorus albicans* (Latreille). By publication date his 1882 paper would take precedence, followed by his other two papers chronologically. All three papers are somewhat different in wording and phraseology. I feel that the 1882 paper satisfies the conditions necessary under the Inter-
national Code to establish Goode as the first reviser for the nominal species *Istiophorus gladius* (Bloch). He synonomyzes Marcgrave's guebucu with *Histiophorus americanus*, thereby restricting *gladius* to the Indian Ocean sailfish.

In his 1882 paper, pages 425, 426, Goode says: “Strange as it may seem, the American species of *Histiophorus* has never been studied by an ichthyologist, and no attempt has ever been made to describe it, or to compare it carefully with the similar species occurring in the Indian Ocean. The identity of the two has been assumed by Dr. Günther, but since no American specimens have ever been seen by this authority, I hesitate for the present to follow his lead.” Page 423, “A single species in the United States, *Histiophorus americanus*, Cuvier.”

There seems to be no doubt that Goode intended to separate the Atlantic sailfish from the nominal species *gladius*, leaving the Indian Ocean sailfish as the sole taxon in the nominal species, of which Broussonet's stuffed specimen in the British Museum was the type specimen.

The matter of the proper scientific names for the Atlantic and Indo-Pacific sailfishes and the question of Goode's qualification as first reviser currently are before The International Commission. Col. Howard's treatment of these questions will need modification in accordance with the Commission's decisions when they appear.—Editor.

*Istiophorus gladius* (Bloch) of 1793 predated *Istiophorus orientalis* (Temminck and Schlegel) of 1844.

27—Some Japanese taxonomists have felt that there are two species of striped marlin, makajiki. The present author with his co-author of Part II, after a thorough study of the situation, came to the conclusion that there is only one. See Distribution of Striped Marlin section.


29—For the specific name I follow Morrow (Morrow, 1960).
PART II. DISTRIBUTION
JOHN K. HOWARD AND SHOJI UEYANAGI

INTRODUCTION

A knowledge of the distribution of a species of fish is basic to any type of study of that species (Walford, 1963:67), such as life history, migrations, availability for fisheries, and even many taxonomic questions. Due to the Japanese longline fishery today, we have very good coverage of the distribution of fishes of the family Istiophoridae in the Pacific Ocean. There are a few areas where catches from fisheries other than the Japanese longline, help to fill in gaps.

The American author has for some years kept a map of the world on which he has placed pins with heads of different colors to indicate the locations of reports of catches of sailfishes, spearfishes and marlins. In the Pacific, geographic coverage in time—i.e. seasonal, is surprisingly complete. There are substantial exceptions to this, particularly in the extreme eastern and southeastern Pacific. The coverage of the Indian Ocean has been filling out rapidly in the last two or three years, as the result of catch reports received of the commercial and experimental fishing by the Japanese longline fleet in this ocean. This is partially true of the Atlantic, but here this commercial fishery is almost entirely restricted to equatorial waters.

We must define the area of distribution, the Pacific, about which we are talking in the present paper. There is no difficulty about the boundary between the Pacific and Atlantic Oceans. Perhaps the latest and best definition of boundaries between the Pacific Ocean and the Indian Ocean is given by Wyrtki (1961), although we do not follow his suggestions entirely. We do follow this paper in placing the South China Sea, Sulu Sea, Celebes Sea, Molucca Sea, Java Sea, Bali Sea, Flores Sea and Banda Sea in the Pacific. We do not include the Arafura Sea, the Timor Sea or the Savu Sea as part of the Pacific. For our purposes, we consider the latter three as part of the Indian Ocean. We use the delineations of these seas as set out by the International Hydrographic Bureau (1953: 27-30).

Perhaps the most striking feature revealed by the map, which has been kept by the American author, is restriction of distribution of the family as a whole between approximately latitudes 40° north and 40° south, but with a very wide longitudinal distribution between these limits. There are minor exceptions to this. Fish of this family have occurred at times north and south of these two limits. Timing of these occurrences indicates that such appearances come at the time of year when some warm current is exerting its greatest effect on the waters involved, coupled with the fact that all waters of the particular ocean in the particular hemisphere are at that time at their warmest.
Figure 1. Dominant distribution pattern of Istiophoridae in the Pacific Ocean (excluding shortbill spearfish).
Each species is distributed over the whole area of the Pacific but density of occurrence varies greatly throughout the area and shows large seasonal fluctuation. Generally speaking, it appears from the data available to us that the area which each species occupies in greatest abundance at any one time is geographically different from those similarly occupied by the other species, as illustrated in Figure 1, and possesses its own special ecological characteristics.

Briefly, there are three Pacific species which are distributed in off-shore waters: (1) striped marlin; (2) blue marlin; and (3) shortbill spearfish. The other two Pacific species, (4) black marlin and (5) sailfish, are found in near-shore waters—i.e. close to land masses. Blue marlin are most abundant in the tropical area; striped marlin in subtropical and temperate areas. We do not have adequate data to locate definitely the areas occupied by the shortbill spearfish, but our studies indicate this species to be distributed along transitional areas between blue marlin and striped marlin. Sailfish are distributed in abundance in warm currents (Kuroshio in the west and Equatorial Counter-Current in the east). Longline data indicate black marlin to be distributed in abundance in the southwestern-most part of the Pacific, the area of the East Indian Archipelago and Australia. We have other evidence which indicates this species also occurs in abundance at certain times of year in the inshore area roughly from Cape San Lucas, Lower California, to below Cabo Blanco, Peru in the Eastern Pacific. More is said about this below in Distribution by Species, Black Marlin.

Except for the black marlin, there is no evidence as yet of any substantial movement of istiophorid fishes between Pacific and Indian Oceans, or vice versa. The Pacific has been fished by the Japanese longline fishery for centuries (see Japanese Common Names, History, above), and parts are presently more completely fished than any other ocean, so that data available to us are most complete for this ocean. The authors have, therefore, except for the black marlin, chosen to limit this paper to a description of distribution of Istiophoridae in the Pacific. It is hoped this publication will be followed by additional papers on distribution of istiophorid fishes in the Indian Ocean and Atlantic Ocean. [Because of the death of John K. Howard, and by prior agreement with him, these reports will be completed by Walter A. Starck, II.—Editor.]

In some species, striped marlin, for example, distribution varies by size; if it is important, we will describe this difference in distribution in our discussion of individual species.

In analysis of data in certain cases we have used body length. Our body length data have all come from Japanese reports. Body length used by the Japanese is in almost all cases straight line length from the posterior margin of the orbit to the tip of the central caudal rays. This measurement should not be confused with body length as defined by Rivas (1956: 20-22) and used by Robins and de Sylva (1961, 1963).
In using the term migration in this paper, the authors use it in the sense of a movement in space from one geographical area to another distinct geographical area. These movements may be either direct or indirect in space, and quick or slow in time.

Striped Marlin

Distribution of striped marlin in the Pacific was described generally in the two Average Year's Fishing Conditions of Tuna Long-line Fisheries. The volume for 1952 was published in 1954, and the volume for 1958 was published in 1959. It was edited by the Nankai Fisheries Research Laboratory and published by the Federation of Japan Tuna Fishermen's Co-operative Association. Both publications are in Japanese. Citations from these works in the present paper were translated by the Japanese author. The Introduction and Albacore sections of the 1954 publication were translated into English in U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries. No. 169. The Introduction to the 1959 paper was translated into English and made available in mimeographed form through the Honolulu Biological Laboratory, Bureau of Commercial Fisheries, Honolulu, Hawaii. We will refer to these publications after this as 1952 AYFC and 1958 AYFC, except when referring to specific sections of the 1958 AYFC having specific authors. The 1952 AYFC is anonymous and will be referred to only as 1952 AYFC. In the 1958 AYFC, Ueyanagi and Watanabe (1959: 235-244); Furukawa and Koto (1959: 249-251); Kamimura and Honma (1959: 332-334) have dealt with striped marlin.

Information obtained since those publications, and recently accumulated data, make us feel there is a necessity for reexamining the distribution pattern of this fish in the Pacific, and adding to conclusions of the above works.

In the 1952 AYFC, knowledge about distribution of this fish was mostly restricted to the Northwestern Pacific. There was only fragmentary information about distribution in the South Pacific.

In the 1958 AYFC, distribution of this fish in the South Pacific was described, based upon information available up to that time. Regarding the relationship between North Pacific and South Pacific striped marlin, it was postulated they were of separate and distinct populations, because of the big gap in distribution between the two groups, as shown by a gap in catches in the intermediate area often fished (Kamimura and Honma, 1958; Honma and Kamimura, 1958). Later, because of year by year extension of fishing area by Japanese longline vessels to the Eastern Pacific, it was discovered striped marlin occurred abundantly in the Tropical Eastern Pacific. Therefore, we consider it necessary to re-examine the distribution pattern of striped marlin on a Pacific-wide basis.

Probably by now the areas covered by Japanese commercial fishing boats and by Japanese and United States research vessels include almost the whole range of distribution of striped marlin in the Pacific, except possibly
part of the Eastern South Pacific (see Introduction to Distribution, above).

As we describe the general distribution pattern of this species, we shall attempt to identify separate populations as well.

**Distribution.**—As illustrated in Figure 2, general distribution of this fish is shown to form a horseshoe-shaped pattern. That is, the area of distribution of striped marlin in the North Pacific seems to be connected with that of the South Pacific by the distribution shown in the Tropical Eastern Pacific. This pattern is characteristic of this species only.

As mentioned in the Introduction to Part II, the distribution of striped marlin is markedly different from that of blue marlin, Figure 1. Distribution patterns of marlins can be compared with distribution patterns of various species of tuna. For example, patterns of striped marlin and albacore are alike in that they are abundant in subtropical and temperate waters, which is in contrast to other tunas and billfishes. However, distribution patterns of striped marlin and albacore differ in the Eastern Pacific (east of 110°W). That is, the horseshoe-shaped pattern reaching between both hemispheres is a characteristic peculiar only to striped marlin among all species of tuna and billfishes.

The reason why distribution of striped marlin shows this pattern is unknown. However, the distribution falls generally within surface water temperatures of a range of about 20° to 25°C. (Figure 2).

Ueyanagi and Watanabe (1959: 235-244) describe relationship between distribution of these fish and surface temperature in the Western North Pacific. Close correlation between boundaries of fishing grounds (area where catch rates are high) and isotherms of 20° and 25°C., and their seasonal movements, was recognized. A similar phenomenon to that of the Western Pacific is also recognizable in the Central and Eastern Pacific.2

Careful examination of distribution of striped marlin shown on the charts in the Appendix, and Figure 2, reveals that the horseshoe-shaped distribution pattern does not seem to be perfectly continuous from north to south in its closed end in the Eastern Pacific. Several characteristics of the horseshoe pattern, as illustrated in Figure 2, will now be noted and briefly discussed.

In the North Pacific Ocean, there appears to be a continuous distribution from westernmost waters to approximately 140°W longitude. This west-east distribution band shifts north and south seasonally. We shall call this the Northern Pacific Group.

The area from 140°W to 120°W, north of 20°N in the North Pacific shows an almost complete absence of fish.

East of 120°W, distribution stretches from the northern into the southern hemisphere. We shall call this the Eastern Pacific Group. In latitudinal areas higher than about 20°N and 20°S, density increases with the coming of the warm seasons. Between approximately 20°N and 20°S, fish occur throughout the year. The occurrence of a heavy concentration of striped marlin between about 17°N to 30°N in the eastern inshore waters is known.

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Figure 2. Distribution of striped marlin in the Pacific Ocean, and limits of isotherm from 20°C to 25°C (numerals indicate fishing months, coastal areas marked by diagonal lines are sport fishing areas).
In the South Pacific Ocean, there appears to be a continuous distribution from the westernmost area to around 120°W. We shall call this the Southern Pacific Group. This west-east band shifts northward with coming of the cold season, and southward with return of the warm season. At about 120°W, the Southern Pacific Group is contiguous with the Eastern Pacific Group mentioned above.

There appears to be a gap in distribution, or an area having a very low density of fish, within the center of this horseshoe-shaped figure. This area of low density lies west of 140°W, between about 15°N and 15°S latitudes.

At about 140°W to 120°W by about 15°N to 20°S, there is an area of much lower density than that which occurs in the Northern, Eastern or Southern Pacific Group areas. However, density of this same area is higher than the equatorial area west of about 140°W (the center of the horseshoe) mentioned in the preceding paragraph.

The Eastern Pacific Group and the Southern Pacific Group appear closely related, and appear to be separate from the Northern Pacific Group. Seasonal activity of each of these three groups is discussed in the next section.

**Seasonal Occurrence.**—**Northern Pacific Group:** Ueyanagi and Watanabe (1959: 235-244) deal only with waters west of 180°, due to lack of information for waters east of 180°. In the present study, seasonal north-south movement of this species east of 180° was also studied, and found to be similar to that west of 180°. This is considered to be a common characteristic of this species for the entire Northern Pacific Group.

From the charts, seasonal occurrence of fish is shown to be as outlined below. Fish are scattered south of 30°N from December to February. Hook-rates tend to be higher between 20°N and 26°N in March. This is considered to be proof of an accumulation of fish in these waters. In April, this tendency becomes more evident, and the high density area moves about one or two degrees northward. In May, density is highest, and is extensive throughout waters between 22°N and 30°N. In June, the high density area moves further northward. The southern boundary is around 25°N, and the northern boundary is beyond 30°N. The western boundary extends to the East China Sea. The northward migration is observed along the Japanese mainland around 140°E. South of 30°N, density becomes low from 150°E eastward, and a tendency toward scattered northward migration is observed during this period. However, scattered northward migration of the fish is not observed east of 180°. The eastern boundary of distribution lies around 150°W. As will be mentioned later, progress of the development of the migration from July on is noticeably different west and east of 180°. The east-west high density area (fishing grounds) during the previous months of April through June has almost disappeared in July. The season of scattered northward migration is presumed to be in this month. In the northern waters west of 180°, fish appear in the vicinity of 40°N in some density, but in eastern high latitudinal waters, because of
water temperature conditions, fish do not appear as abundantly as in the west. Concentrations are seen between 150°E-170°E and 37°N-42°N in August. Fish appear in the waters of the Saishu Islands in the westernmost Pacific. Harpoon fishing is carried out in the waters of the Sanriku area (the coastal waters of the Japanese main island, Honshu, west of 145°E and around 40°N). East of 180°, between 28°N and 35°N, a tendency toward high density and accumulation of fish is noticed. The peak of the northward migration season of fish is in August and September throughout the North Pacific area. Fishing grounds tend to expand eastward in waters east of 180° during these months. The number of fish in the western concentration tends to increase month by month; and, density of distribution is remarkably high in October between 34°N-40°N, and 150°E-165°E. However, the general southward migrations also commence during this month. When we compare October to September, the high density area west of 180° has moved south, and that to the east of 180° shows a lower density. In November, the southward migration is remarkable. The previously densely populated area north of 30°N and east of 180° has disappeared, and that west of 180° also shows clearly a lowering of density. The fish have dispersed to southern waters. In December, density decreases markedly throughout the North Pacific waters north of 30°N, except for the Saishu Islands area, which is west of 130°E.

These trends become more obvious in January, and in February the fish have mostly disappeared north of 30°N in their southern migration.

The above seasonal north-south migration coincides with shifts of the 20° and 25°C isotherms. Conceivably, differences of distribution pattern during the summer-autumn season (July through November) in eastern and western longitudes are partly related to temperature, as mentioned previously.

A gap in distribution is noticed in the vicinity of 180°, but the reason for this is not clear.

Concerning size composition of fish in the area west of 180°, as described by Ueyanagi and Watanabi (1959: 239-240), sizes range between 90-200 cm in body length. (The definition of body length as used in this paper is the distance between the posterior margin of the orbit to the tip of the center rays of the caudal fin.) Size compositions vary characteristically from north to south, as shown in Figure 3. Although eastern waters have not been thoroughly surveyed, size composition of fish found there seems to be the same in general as those in the western region. However, in the area east of 180°, there is a tendency for individual fish to be larger in comparison with those to the west of 180°.

Size composition of Hawaiian fish is shown in Figure 4 (Royce, 1957: 530-531). This region shows the same size composition as in western waters on the same latitudinal level with the Hawaiian waters, as shown in Figure 3 (b and c). The size composition consists of groups of large and small sized fish. The group of small fish, around 30 pounds, appears in
catches in the winter season, and they grow to 50 or 60 pounds in May and June while in this area. They disappear from these waters during summer. This indicates the fish migrate to northern waters during this time. There the fish stay several months, and grow. Then they migrate back to Hawaiian

Figure 3. Latitudinal differences in size composition for striped marlin in the area west of 180°. (Ueyanagi and Watanabe, 1959: 239.)
waters where they become part of the group of larger fish in the next year. These growth and migration patterns seem to be the same as those west of 180°, according to Ueyanagi and Watanabe (1959: 235-244). This is considered a proof of continuity of the Northern Pacific Group throughout its east and west regions. However, whether there is extensive mixing within the Northern Pacific Group from east to west should be further studied because, as previously mentioned in relation to seasonal occurrence, the distribution pattern is shown to be not entirely uniform from east to west.

**Southern Pacific Group:** Similar seasonal north-south movements of fish as in the Northern Pacific Group are observed here. But the seasons of southward and northward migration are in reverse to those of the Northern Pacific Group.

Kamimura and Honma (1959: 332-334) relate that the fish migrate toward the north from south of 30°S during August through November. Then they begin to migrate back to the area south of 30°S starting in November, which is the turning point of migration.

From the charts, we note the following: density is very low north of 30°S from February to June, whereas this is the best fishing season for this species in Australian and New Zealand coastal waters. The peak of the season is from February to April (Tables 1 and 2). Therefore, fish are assumed to be distributed south of 30°S in this season. Fish disappear from New Zealand coastal waters after June, and density begins to increase between 20°-30°S. The tendency toward increased density, month by month, is noticeable after August as fish accumulate in these waters. The highest peak is in October and November, and the northern limit of the high density area reaches to 16°S. Later in November, the turning point, density starts to decrease, and fish appear to migrate to the south of 30°S. In January, except for eastern Australian coastal waters, density decreases remarkably north of 30°S. Southward dispersion of fish now becomes evident.

Concerning east-west movement of fish, Kamimura and Honma (1959: 334) state, “Referring to the distribution charts, generally the hook-rate tends to be high in the western waters and low in the eastern waters. This has been observed constantly every month. Therefore, it is hard to assume that these tendencies are caused by the exchange of fish between the east and west . . .”

However, as will be subsequently mentioned, the population structure cannot be explained without considering the relationship with the Eastern Pacific Group in light of recent data. Interchange of fish between east and west is considered probable.

Referring to the charts, a gradual increase in density toward western waters from the area around 120°W can be noted month by month from May to September, which is the northward migration period. This can be interpreted as the westward movement of marlin.
NUMBER OF FISH

Yr. Mo. NO. FISH Caught
1949 1 268
2 1387
3 647
4 605
5 480
6 351
7 116
8 16
9 22
10 186
11 276
12 450
1950 1 256
2 858
3 1058
4 479
5 375
6 837
7 256

BODY WEIGHT BY POUNDS
Figure 4. Weight frequency distribution of striped marlin in Hawaiian waters, January 1949 - February 1952. (Adapted from: Royce, 1957: 530.)
**TABLE 1**

**CATCH STATISTICS OF STRIPED MARLIN IN THE NEW ZEALAND AREA.**

(Bay of Island Swordfish Club. 1955-1963. *Annual Report.*)

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* December of previous year

**TABLE 2**

**CATCH STATISTICS OF STRIPED MARLIN IN THE NEW ZEALAND AREA.**


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<tr>
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Concerning size composition of striped marlin in the area west of 160°W, Kamimura and Honma (1959: 334) mention the population consists of very large individuals, and modal size is around 200 cm (Figure 5). This size composition is far different from the Northern Pacific Group. According to the latest information, the same phenomenon is seen in fish found in the area of 140°-130°W, which is farther east than the former (Figure 6). Hence, this is considered a common character of size composition in the Southern Pacific Group.

The possibility of small and medium-sized fish being recruited by the above mentioned group of large-sized fish from waters south of 30°S, cannot be considered because New Zealand fish are known to also consist of large individuals, as shown in Figure 13. Locations of small and medium-sized fish of the Southern Pacific Group has been a question. However, as will be mentioned later, existence of these fish has been observed in Eastern Pacific waters.
EASTERN PACIFIC GROUP: It is difficult to discuss in detail the seasonal occurrence of the Eastern Pacific Group, with the few data available. From the charts, the following deductions can be made:

a) Striped marlin occur throughout the year east of 105°W, and from 15°N-15°S. Density is high around the Galapagos Islands, and in the area around 10°S, 100°W.

b) Seasonal north-south movement is in accordance with changes of sea conditions. Northward migration is generally considered to be from April to September, and southward migration from October to March.

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Figure 5. Size composition of striped marlin in the South Pacific (west of 160°W).

Figure 6. Size composition of striped marlin in the South Pacific (140°W - 130°W).
January and February show the most southerly extension of distributional area, to as far south as 30°S. From this area north to approximately 15°N, near 110°W, there is still apparently active fishing.

Around April, the fish start to move northward. Density of distribution becomes high north of 20°S in May and June. In July, the area of high density has moved as far north as 20°N, and in August and September, they appear in southern California waters. Because of water temperature distribution, it is presumed that during this period the fish disappear south of 20°S. In this time of northward migration, there are also tendencies of a westward migration between 10°S and 30°S, as mentioned in the section on the Southern Pacific Group.

Southward migration starts in October and continues in November and December. During this period, a tendency is seen for fish to accumulate around 10°S and 100°W. They seem to extend south of 20°S in January.

c) Fish seem to be in some numbers in coastal waters of Ecuador and northern Chile from December to June. During the opposite season (July to November), distribution tends to expand in a westerly direction in offshore waters between 10°N to 10°S.

These phenomena of seasonal occurrences of fish in coastal and offshore waters seem to be reflected in shifts of the 25°C. and 20°C. isotherms, which are considered to be normal temperature indicators of striped marlin habitats.

d) The fishing season along the Mexican coast, north of about 17°N, is said to be from December to June. Fish have disappeared from this area from about July to October, due to high water temperature.

Figure 7 shows that the Eastern Pacific Group is composed of a majority of small and medium-sized fish, as well as some large-sized fish. In comparison, the Southern Pacific Group's size composition (Figures 5, 6 and 13) is composed of a majority of large individuals. It is presumed small and medium-sized fish move into the Southern Pacific at the same time as they are growing, thereby explaining dominance of one size fish in one

![Figure 7. Size composition of striped marlin in the Eastern Pacific (east of 120°W).](image-url)
Figure 8. Localities of capture of postlarval striped marlin in the Pacific. (Adapted from: Ueyanagi, 1963a: 146.)
Figure 9. Localities of capture of ripe female striped marlin (numerals indicate month of capture). (Adapted from: Ueyanagi, 1964: 518.)
area and another size fish in the other area. This interchange between the Eastern Pacific Group and the Southern Pacific Group is further suggested by seasonal fluctuation seen in the striped marlin charts. Therefore, we consider these two groups to be actually the same population, and we call it the Southern-Eastern Group.

Morrow (1957b) discussed races of this species based upon a morphological analysis, and concluded that fish from Peru and from northern New Zealand represent separate populations. However, our opinion differs from his, as stated above, though we think it is necessary to clarify further the problem of whether the Southern-Eastern population is divided into various subgroups.

Discussion of Population Construction.—From distribution patterns, seasonal occurrences and size composition, we think there are two distinct populations in the Pacific Ocean; that is, the Northern Pacific Group and the Southern-Eastern Pacific Group. This hypothesis seems to be supported by facts which we know about spawning, as mentioned below.

The occurrences of larvae and mature ripe striped marlin are shown in Figures 8 and 9. From these, it is noticed that spawning grounds are located in the North Pacific and South Pacific separately, and very far apart. Moreover, the main spawning season is thought to be May and June in the North Pacific, and November and December in the South Pacific, each being different by half a year from the other (Ueyanagi, 1959: 141-144; Honma and Kamimura, 1958: 17-18; Ueyanagi, 1963a: 146-147). Spawning of Eastern Pacific fish is not well known. However, from information now available, we find spawning activity may be rather low year round in the Eastern Pacific. If spawning does take place in the Eastern Pacific, it is probably not intensive.

Reproduction of the Southern-Eastern population we believe to be carried out mainly in the area of 20°S-30°S, west of 120°W in the South Pacific.

Various situations can exist regarding relationships between two separate and distinct populations. For example, two populations may be almost completely separated, and interchange of fish belonging to either population will not be indicated from the data. In another case, there may be interchange of fish to some extent, as a part of the distribution areas of both populations overlap. In the case of the Northern Pacific Group and the Southern-Eastern Pacific Group, we will examine this problem of a possible interchange of fish in light of the available information:

1) We have obtained the following tagging and recovery records of striped marlin in the Pacific. (These are only three cases but are interesting records, especially the first. It suggests that fish which appear in waters off the central coast of Mexico have a relation with fish distributed in the eastern equatorial area. It is also interesting that the first tagged fish was heading south and not north, because it is thought they are normally migrating northward at this season):
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<td></td>
<td>Information Source:</td>
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</table>

|     | Date:    |          |
| 2   | February 21, 1964 | April 20, 1964 |
|     | Locality: |          |
|     | 17°28'N | 22°15' N |
|     | 101°38'W | 108°30' W |
|     | Recovery Ship: | NUMBER 10 TOSUI MARU |
|     | Program Sponsor: | Woods Hole Oceanographic Institution |
|     | Information Source: | Mather, Frank J., III, personal communication June 1964 with John K. Howard |

|     | Date:    |          |
| 3   | May 2, 1964 | May 15, 1964 |
|     | Locality: |          |
|     | 24°22'N | 23°33' N |
|     | 109°33'W | 108°26' W |
|     | Recovery Ship: | NUMBER 2 KYOWA MARU |
|     | Program Sponsor: | California State Fisheries Laboratory |
|     | Information Source: | personal communication June 1964 with Shoji Ueyanagi |

2) It is supposed that from the distribution pattern discussed early in this section, an interchange between the Northern population and the Southern-Eastern population is carried out to some extent through the area of lower density on margins of the two populations (tropical Pacific west of 110° W) as shown in Figure 2.

3) Migration of fish from the Southern-Eastern population to the Hawaii area, which is the easternmost part of the Northern population, is suggested from the following phenomenon:
Figure 10. Weight frequency of striped marlin by year in southern California waters. (Balboa Angling Club, 1957-1964.)
A group of small-sized fish appears in Hawaii in the summer season (Figure 4). This group is considered to be different from the group of small-sized fish which appears in the winter season, the latter comprising a major part of fish in the Hawaii area.

Taking into consideration the time lag of half a year between spawning seasons of the two populations, the group of small-sized fish which appears in summer is assumed to belong to the Southern-Eastern population.

4) It is known that striped marlin appear in Southern California from July to October, with the period of greatest abundance being the time of warmest sea water temperatures, August and September. Although it has not yet been determined as to where these fish come from, we have developed several possibilities from information at our disposal.

a) In a letter dated 12 March 1964 from Robert L. Wisner of Scripps Institution of Oceanography at La Jolla, California, addressed to John K. Howard, the following was stated:

“As to where all these fish [of Southern California] come from—no one knows. We feel that they come in from the open Pacific rather than migrate northward from Panama past Acapulco and Mazatlan. However, we cannot prove it. There may be a migration from the Cape to San Diego with warming water, but only the time sequence supports this theory. Our research vessels are in the intervening area several times from January through September but have seldom reported the sighting of even one marlin. It may be that our San Diego fish move in from the open Pacific well to the northward of the southern, or even central Baja coast. We just do not know.”

To supplement Wisner's comment, recall the description from the section on Seasonal Occurrence of a tendency for an eastern expansion of the fishing ground (west of southern California) in August and September.

b) Also it is to be noted in the previous section, Seasonal Occurrence, that an inspection of striped marlin charts for this area shows a northern movement in summer. Therefore, it would seem reasonable to assume that fish also come to southern California from the south. The hypothesis that striped marlin appearing in southern California waters are part of the Southern-Eastern population may further be supported by the following phenomenon.

Figures 10 and 11 show annual size composition of southern California fish for the years 1956 through 1963. Size compositions are similar through 1957, showing a modal size of from 140 pounds to 150 pounds (figures for 1955 and earlier are omitted because they are similar to figures for 1956 and 1957). However, occurrence in 1958 of remarkably numerous small fish caused a large change in size composition. Size composition for 1959 is somewhat greater than 1958, but being affected by the 1958 introduction of so many small fish, still shows a modal size of only 115 pounds to 125 pounds. Size compositions for the year 1960 and onward have again become similar to those for the years 1956 and 1957, at least
Figure 11. Weight frequency of striped marlin by year in southern California waters. (The Marlin Club, San Diego, 1957-1964.)
FIGURE 12. Length frequency of striped marlin by year in the South Pacific in the area of New Caledonia (18° - 30° S, west of 170° W). (Data for years 1954 and 1955 from: Kamimura and Honma, 1959: 334.)
to the extent that it is no longer dominated by smaller sized fish, though the figure of 1962 is not clear because of lack of data.³

Further, it is very interesting to note from Figures 12 and 13, the following concerning size of striped marlin at New Caledonia and New Zealand, which are, of course, included within the Southern-Eastern population. A tendency appears for size composition in both areas to become smaller than average beginning in 1960.

Utilizing Koto's study of growth of Northwest Pacific striped marlin (Koto, 1963), we see striped marlin of the 85 pound modal size group in southern California waters are two years younger than striped marlin in the South Pacific. Fluctuation of size composition in California, New Caledonia and New Zealand, and the approximately two year difference in age between California fish and fish from New Caledonia and New Zealand suggests an interchanging among these areas.

In summary, let us say that in sections (a) and (b) above we have given two hypotheses concerning the origin of fish found in the waters of southern California. However, we believe both hypotheses may be partially correct, and are not mutually exclusive; and, that there is a mixing of Northern and Southern-Eastern populations in this area because southern California waters are located in a peripheral region of both populations.

Southern California is perhaps a more difficult area than many to analyze, for it is peripheral for both populations in high latitudes, where water temperature is a factor limiting occurrence and abundance of striped marlin. Notice the fluctuation shown in Figure 14, in which is depicted the number of fish caught during the fishing seasons of the years 1945 through 1963. Drastic decreases in captures of individual striped marlin for the years 1953 through 1955 parallels encroachment of colder than average waters for months around August in this area (Johnson, MS; Johnson, 1961). The rather sudden decrease in striped marlin catches first observable from 1960 through 1961 and reaching a low point in 1962 is closely correlated with encroachment of colder than normal waters into this area for these years during August and surrounding months. The increase in catch from 1962 to 1963 parallels a rise of water temperature in this area (U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, California, 1959-1963).

Let us examine the above presumptions regarding relationship between the two populations by consideration of pectoral-fin length. Pectoral-fin length is used because Kamimura and Honma (1958) have found a remarkable difference in length of pectoral fin between fish from the North Pacific and fish from the South Pacific. Partly based upon this finding, Kamimura and Honma (1958), and Honma and Kamimura (1958) state that striped marlin from the North Pacific and South Pacific belong to separate populations.

Isolation of spawning area and spawning season may cause and maintain such a morphological difference as the difference in pectoral-fin
Figure 13. Weight frequency of striped marlin by year in the South Pacific in the area of New Zealand. (Bay of Islands Swordfish Club, 1955-1963.)
length between the Northern population and Southern-Eastern population. Figure 15 shows areas from which measurements of pectoral-fin length have been obtained.\(^4\) If one accepts the distribution pattern of this species as discussed in the previous section, we may accept area A (A\(_1\), A\(_2\)) as the Northern Pacific population, and area B (B\(_1\), B\(_2\), B\(_3\), and B\(_4\)) as the Southern-Eastern Pacific population. Data from A and B are plotted in Figure 16. In this figure, difference of pectoral-fin length between the A group and the B group, as reported previously by Kamimura and Honma (1958) is clearly confirmed.\(^5\) The boundary lines for the A group are drawn as a and a', and for the B group as b and b'. These four lines are broken at the point of 185 cm body length. In Figures 17 through 21 we plot data for groups C, D, E, F and G, and overlay them with the four boundary lines of the A group and the B group. There follows an examination of distribution of these plottings of groups C through G as they fall within the area of the four boundary lines of a, a', b and b'.

Group C: data, as represented by dots, are distributed primarily in the a — a' section. However, a few are distributed in the a' — b' section. These seem to belong to the B group.

Group D: data are distributed in the b — b' section, and are considered to belong primarily to the B group.

Group E: data are distributed widely in the a — b' section, indicating mixing of the A and B groups.

Group F: data are distributed primarily in the b — b' section; therefore, most specimens appear to belong to the B group.
Figure 15. Areas from which measurements of striped marlin pectoral fin length have been obtained. Explanation is given in text.

Figure 16. Relations between pectoral-fin length and body length. Black dots are North Pacific (Areas A₁ and A₂). Circles are Southern-Eastern Pacific (areas B₁, B₂, B₃, and B₄).
Group G: from distribution of data, mixing of the A and B group is indicated. But the majority of fish under 180 cm body length seem to belong to the A group.

From these observations we have drawn several deductions. In the tropical area, there may be an interchange of fish between the Northern Pacific population and the Southern-Eastern Pacific population. In the western tropical area, the proportion of fish from the Northern population is higher than from the Southern-Eastern population. In the central to eastern tropical area, the situation is opposite and the proportion of fish from the Southern-Eastern population is higher than from the Northern population. The Hawaiian area probably contains fish which have come from the Southern-Eastern population. Most fish of Mexican waters may belong to

![Figure 17. Relations between pectoral-fin length and body length, Western Tropical Pacific (area C).](image)

![Figure 18. Relations between pectoral-fin length and body length, Western Tropical Pacific (area D).](image)
the Southern-Eastern population. While fish which appear in the Southern California area apparently come from both the Northern population and the Southern-Eastern population, fish from the Northern population seem to dominate.

These deductions from pectoral-fin length seem to coincide closely with previous deductions from other evidence, which we shall briefly review:

1. An interchange of fish is carried out between the Northern and Southern-Eastern populations through intermediate areas—western tropical and eastern tropical areas and northeastern temperate and subtropical waters.

2. Fish of Mexican waters belong to the Southern-Eastern population.

3. Fish which appear in southern California waters are derived from both Northern and Southern-Eastern populations.
For the present, we wish to point out that although the Northern population and the Southern-Eastern population are well segregated from one another, there appears to be an interchange of fish at a marginal area of distribution where these two populations overlap.

Honma and Kamimura (1958) point out that the average size attained by striped marlin in the South Pacific is greater than that of striped marlin in the Northern Pacific. This difference, together with the fact that the area occupied by the Southern-Eastern population is larger than the area inhabited by the Northern population, suggests that the total Southern-Eastern population is greater than the Northern population.

Further evidence of difference in these two populations is the difference in relative location of the areas of spawning and areas of growth. In the Northern population the growth area is located north of the spawning area. However, in the Southern-Eastern population, the growth area is not located south (in higher latitudes) of the spawning area, but to the east in low latitudes of the Tropical Eastern Pacific.

It will take further analysis to give a more accurate picture for the whole population structure including the inconsistencies mentioned.

**Blue Marlin**

_Distribution._—Blue marlin are the most tropical of all marlins, and are densely distributed in low latitudinal areas (Royce, 1957:533-534; 1952-AYFC; Ueyanagi and Watanabe, 1959:231-233; Yabuta and Yukinawa, 1959:269, 271; Kamimura and Honma, 1959:334-337). In the Eastern Pacific, east of 120° W, however, density as shown by the charts is not high as compared with the western area.
The distribution pattern changes clearly by season, and high density areas shift north or south seasonally. They are found in highest latitudes in the summer season of both hemispheres. Density of distribution also varies from east to west, as seen on the charts. (This will be mentioned in more detail in the following section.)

Smaller fish (100-120 cm) are found abundantly in the Caroline Island and Marshall Island area (Ueyanagi, 1957a:92), and the Tuamoto Archipelago area in the South Pacific (Enokida, 1959).

Occurrence of postlarvae and young (10-50 cm) is shown in Figures 22 and 23. These are found to be widely dispersed in the North and South Pacific, and are not found beyond 30° N and 30° S latitude.

From occurrence of larvae, conditions of gonads, and sex ratio, spawning of this species is assumed to take place in the low latitudinal area (between about 20° N to 10° S) throughout the year; and in higher latitudinal areas (bounded by 30° N and 30° S) during summer seasons (Nakamura, Yabuta and Ueyanagi, 1953; Enokida, 1958, 1959; Kamimura and Honma, 1959:336; Ueyanagi and Yabe, 1959:166-168). In this species the fish spends its whole life cycle, from egg to adult, in the same area—subtropical and tropical (which is in contrast with the striped marlin) with the exception of large adult female fish which scatter sparsely beyond 30° N and 30° S.

Seasonal Occurrence.— The seasonal change in distribution is clear. High density areas are in the South Pacific from November through March, and in the North Pacific from May through September, with peaks in January and in July or August respectively. April and October are respectively transitional months.

Ueyanagi and Watanabe (1959:231, 232); Yabuta and Yukinawa (1959:269, 271, 279); Kamimura and Honma (1959: 334-337) described seasonal occurrences in detail for the North Pacific, Equatorial Pacific and South Pacific. We are summarizing these findings, and adding new information.

North Pacific (10° N — 30° N): Throughout this area, high density appears in general from May through October. However, there is a tendency for season of highest density to progress from west to east, as follows: June and July in the area west of 140° E; July and August between 140° E to 160° E; August and September between 160° E to 180°. In the Hawaii area, a high concentration of fish occurs from July through October (Otsu, 1954:5; Hawaii. Division of Fish and Game, 1954-1964).

This phenomenon is considered to be related to rising sea temperature in summer, which progresses in direction from west to east in this area, as shown in monthly sea temperature (isotherm) charts (U. S. H. O. pub. No. 225, 1944).

Equatorial Pacific (10° N — 10° S): Fish are distributed with fairly high density throughout the year in the whole area. However, the season
Figure 22. Occurrence of postlarval blue marlin in the Pacific. (Ueyanagi, 1963a: 147.)
Figure 23. Occurrence of young blue marlin (10-50 centimeters) in the Pacific.

showing highest density differs, and tends to come later in the eastern area.

In describing the seasonal occurrence of fish in the Equatorial Pacific, we are dividing areas north and south of the equator into two parts.

a) North Area (10° N — 0°)

West of 180°: Density is high almost all year round except in December and January.

East of 180°: High concentration appears in May and June in the area 180° — 170° W, and tends to shift progressively in an easterly direction (to 130° W) until October.

In July and September, high concentration is found in the area 160° E to 160° W. From November, density decreases obviously, and this continues through March.

b) South Area (0° — 10° S)

West of 180°: Density becomes low in July, and stays low through September.

East of 180°: Density tends to be low from June through September,
and becomes high from November through April.

**South Pacific (south of 10° S):** High density appears in this area from November through March, which is the exact opposite of the high density season in the North Pacific. Throughout the season, fish are in far greater concentration east of 160°W than to the west (Kamimura and Honma, 1959:335-336).

The reason for difference in density of fish between areas west and east of 160°W has not yet been ascertained. But it is interesting that the area of high concentration coincides with the Tubuai (Austral) Islands, Cook Islands, Society Islands and Tuamotu Archipelago area. There may be some relationship between high concentration and topography.

This concentration does not extend farther east than about 120°W, and the density abruptly decreases east of this. This phenomenon is explainable when taking into account temperature distribution in these areas (U.S.H.O.pub. No. 225, 1944).

It is supposed that spawning of this species takes place extensively in the Tuamotu Archipelago area (Enokida, 1958, 1959).

**Migration.**—From seasonal occurrence of fish in the North, Equatorial and South Pacific, it is supposed that the fish follow a north-south migration pattern, density of distribution becoming high in northern and southern hemispheres during summer seasons (Nakagome, 1958b; Anraku and Yabuta, 1959; Kamimura and Honma, 1959:334-337).

Anraku and Yabuta (1959) discussed this north-south movement of fish on the basis of seasonal abundance of fish in various areas. They state that the northward movement of blue marlin generally tends to follow a northwesterly direction, while the southward movement is inclined to take a southeasterly course. (The passing of the equator by the northward moving groups is effected in the area centering between 150°E—180°, while the group moving southward passes the equator in the area centering between 160°E—170°W). This general tendency can be noticed from the charts.

It is also reported by Anraku and Yabuta (1959) that groups of fish taking part in this seasonal movement are generally limited in size to between 140-180 cm, and few large fish of over 200 cm take part in it.

This phenomenon is suggestive of differential migration by sex, migration activity being greater among males than females. Males and females differ in size in general accordance with the size ranges above mentioned, males being smaller (Ueyanagi, 1953; Nakamura, Yabuta and Ueyanagi, 1953; Nakgome, 1958b).

The north-south migration of fish in the North and South Pacific is considered to indicate shift of the habitat of this species in accordance with seasonal change of sea conditions, and also to be related to spawning.

Yabuta and Yukinawa (1959:275) report that size of fish in equatorial areas tends to increase progressively in an easterly direction (Figure 24). Similar tendencies are found in the North Pacific area (10°N—30°N), and the South Pacific area (10°S—20°S), as shown in Figure 25.
Figure 24. Size composition of blue marlin in the Equatorial Pacific. (Yabuta and Yukinawa, 1959: 276.)
Figure 25. Size composition of blue marlin in the South Pacific 10°S - 20°S (from November to March). (Kamimura and Honma, 1959: 336.)
Geographical difference in size composition may be attributed to movement of fish eastward to mid-ocean as they grow older. On the other hand, difference in size composition by areas may indicate that, although they interchange in north-south migration, this interchange is not carried out uniformly throughout the west and east areas.

We have described and summarized distribution and migration patterns of this species as shown on the charts. A general picture has emerged. However, to get a more complete and accurate picture, further analysis should be made, taking into consideration the geographical differences of both distribution and size composition, and the related differences of distribution and migration patterns by sex, spawning habits, etc.

**Black Marlin**

*General Distribution.*—This species, like other Istiophoridae, is distributed widely in warmer parts of the Pacific Ocean. But the distribution pattern is characterized by the greatest density of occurrence being on the periphery of distribution of the family in the Pacific, such as (1) the East China Sea; (2) East Indian Archipelago, south of Java and the Lesser Sunda Islands, and off northwestern Australia; (3) eastern coast of Australia and Coral Sea; and (4) west coast of Mexico, Central America and northern South America. In open seas areas, distribution is sparse. In tropical open seas areas, distribution is very scattered but continuous, whereas in temperate open seas areas, there is almost no occurrence of this species. In tropical open seas areas, there is a tendency for fish to occur in the vicinity of islands (Nakamura, 1954:37; Royce, 1957:525; Koto, Furu-kawa and Kodama, 1959b; Ueyanagi, 1963b:156-157).

Of the peripheral concentrations in the Pacific, the one of the Eastern Pacific; that in the Coral Sea and east coast of Australia; and that of the East Indian Archipelago and south of Java and the Lesser Sunda Islands and off northwestern Australia, we consider three different populations. But we do not consider the concentration in the East China Sea a separate population. This will be commented on later.

Very few details are known about concentrations along the Mexican, Central American, and South American coasts. No proper catch statistics have been kept by any sport fisheries, or small commercial and subsistence fisheries of the area. So it is difficult to compare this population with other known populations in the Western Pacific and Eastern Indian Oceans. But it seems probable to us the population along the American coast is not as big as populations along the Asian coasts. Apparently occurrence of black marlin in open ocean areas of the Indian Ocean is much more dense than in the same areas in the Pacific Ocean. We feel this is related to larger size of Western Pacific populations compared to the smaller population along American coasts.

Accordingly, we have included in the Appendix Atlas a chart of the distribution of this species in the Indian Ocean for the month of Decem-
ber; and we have extended our distributions on the charts for other months into the Eastern Indian Ocean. We will describe these Indo-Pacific patterns presently. In all other species of this family, there does not appear to be a sufficient relationship between the populations of the Pacific and the Indian Ocean to necessitate considering the Indian Ocean in this paper.

**Indian Ocean and Western Pacific Group.**—**SPAWNING:** Nothing is known about the distribution of young black marlin. However, we do have some knowledge about spawning. Though a single postlarva of this species has been taken in the open ocean of the Tropical Western Pacific, evidence of occurrence of postlarvae, data on condition of adult gonads, and abundance of distribution of adults, suggests important spawning areas for the Pacific, North and South, and the Indian Ocean, are the Coral Sea and the East Indian Archipelago, including waters south of Java and the Lesser Sunda Islands and off northwestern Australia. Furthermore, based on more complete data for the Coral Sea than for other areas, we have found very intensive spawning to occur in the northwestern area of the Coral Sea, and that spawning activity here is greatest during October and November (Ueyanagi, 1960a), as shown in Figure 26.

**Seasonal Occurrence and Migration Pattern:** The charts indicate a general tendency of fish to move northward beginning in April, and to move southward beginning in October. This tendency is probably caused by changes in sea conditions.

In the 1958 AYFC, seasonal occurrence of this species was described in detail for the following areas: Northeast coast of Australia (Coral Sea); East China Sea; East Indian Archipelago, south of Java and the Lesser Sunda Islands and off northwestern Australia.

We are summarizing these findings, and are adding new information. From this, we will consider migration patterns and relationships between geographical groups of fish.

1. Northeastern Area of Australia (Coral Sea).

Kamimura and Honma (1959:337-340) described seasonal occurrence of fish in this area, chiefly the concentration along the coastal areas. Our description includes not only coastal areas, but also the area east to 170°W, and as far north as the Solomon Islands.

Distribution along the coastal area is not clear in July and August because data are scarce. From data available, fish seem to appear in September. During this month, in the offshore area below 20°S, the hook-rate throughout the area is less than 0.1, as compared to higher hook rates in earlier months. This indicates September is the month of heaviest northward migration.

In October, black marlin appear abundantly along the coastal area (10°S — 20°S, within 250 miles from the shore). High abundance continues through December. However, they tend to move southward begin-
ning in October (see Figure 27). This tendency is also evident in the offshore area.

From December to January, the concentration of fish in the coastal area abruptly decreases until they have entirely disappeared. The majority of fish in this concentration is thought to move south along the coast of Australia, the remainder diffusing offshore during their southward movement.

In the 1950's, a small commercial fishery for marlin developed off the Queensland coast from Cairns to about Townsville, in connection with the mackerel fishery. The Queensland Fish Board, which runs all markets for this area, kept statistics for poundage of marlin sold in the markets. These statistics show marlin appeared in July or August, increased in numbers through December, with peak occurrence in October and November, and disappeared after December (Correspondence with the Fish Board, in the office of John K. Howard).

Though longline data give us no hint of where these fish go after the movements described above, experience of the sport fishery which has existed south along the coast of New South Wales for some years, and has caught marlin since 1933 (Roughley, 1951:267), indicates that at least some fish in the coastal concentration, and possibly some offshore fish, move south along the east coast of Australia, as stated above. Catches of black marlin along this stretch of coast occur between September and May, with best catches in January, February and March (D’Ombrain, 1957:65-72, 141, 185). John K. Howard fished this coast in 1953 from Green Island, Queensland, to Eden, New South Wales, and has been in touch with this sport fishery ever since. His personal investigation and correspondence with fishermen, their clubs and associations, confirms D’Ombrain’s statements.

It appears that fish begin to move northward in the coastal and offshore area from sometime around April, in accordance with changes in sea conditions.

Fish caught by longline on fishing grounds along the coast range in size from 130-300 cm, as shown in Figure 28. Sex is a determining factor in size; the female reaches a larger size than the male. These fish in the coastal fishing grounds constitute a spawning group (Ueyanagi, 1960a).

2. East China Sea.

Seasonal movement of fish in this area is clear. Fish move northward from spring through summer, and southward from autumn through winter (Furukawa and Koto, 1959:251-253; Koto, Furukawa and Kodama, 1959b; Morita, 1960). This north-south migration is traceable in the Appendix Charts and Figure 29.

In southern waters of this area, density of fish tends to increase in May, and as the months advance the area of high density moves northward. In July, highest density occurs around 30° N, and in August and September
Figure 26. Areas of capture of postlarval black marlin. Shaded portions indicate fishing grounds. (Ueyanagi, 1960a: 93.)
around the Saishu Islands. This is the northernmost area to which the fish migrate.

During October, they begin their southward migration, and this movement becomes more evident in November. In December, density has decreased considerably in the entire area, except for southernmost waters. By February, fish have nearly disappeared from this area on their southward migration to other areas. However, a few individuals remain in southernmost waters of the East China Sea during winter.

According to Koto, Furukawa and Kodama (1959b: 113-115), seasonal changes in body size composition are clearly drawn. Smaller fish, ranging in size from 130-170 cm, appear in the area from June through September. In this season size composition is smallest. It tends to become larger month by month until May. Consequently, the change from May to June in body size composition is most evident. (See Figure 30.) It is considered that these fish in the East China Sea constitute a feeding group (Morita, 1960).

3. East Indian Archipelago and Associated Areas.

Mimura and Nakamura (1959:401-404) found seasonal occurrence of fish in this area to be clear, and described it. We here comment on their deductions on the basis of our additional data.

A. Arafura Sea—Banda Sea
Fish seem to be distributed in this area throughout the year. However, greater density of occurrence is from January through April.

B. Timor Sea
Data for this area are rather scarce, but density of black marlin seems to increase around April and October.

C. South of Java and the Lesser Sunda Islands
In this area, density increases from May through September. In May
and June, distribution is mostly concentrated between 110° E — 120° E. From July to September, fish tend to move westward. In October, density begins to increase, and from November through March, is very low. During April, it begins to increase.

D. Waters off Northwestern Australia

<table>
<thead>
<tr>
<th>%</th>
<th>YEAR</th>
<th>No. of BOATS</th>
<th>NO. FISH MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1954</td>
<td>8</td>
<td>690</td>
</tr>
<tr>
<td>8</td>
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<td>5</td>
<td>681</td>
</tr>
<tr>
<td>6</td>
<td>1956</td>
<td>16</td>
<td>4550</td>
</tr>
<tr>
<td>4</td>
<td>1957</td>
<td>22</td>
<td>2764</td>
</tr>
</tbody>
</table>

**Figure 28.** Annual length frequency distribution of black marlin in the South Pacific (10°S - 20°S and west of 150°E). (Kamimura and Honma, 1959: 339.)
Figure 29. Seasonal fluctuation of hook-rate of black marlin by areas in the East China Sea (June, 1952 - May, 1954). (Koto, Furukawa and Kodama, 1959b: 112.)
Density is high from November through March. In April it begins to decrease. Data for this area are scarce from May through July, but density is presumed to become low during this period. In August and September, available data indicate low density. In October it begins to increase.

Mimura and Nakamura (1959:401-404) described seasonal change of body size composition of fish in the Arafura Sea and Banda Sea (A area), Text Figure 31, and south of Java and the Lesser Sunda Islands (B area). Small fish, ranging in size from about 130-160 cm, dominate both areas from April through September. Larger fish compose the major part of this concentration from October through March in both areas.

**Relationship Observed Among Concentrations:** Koto, Furukawa and Kodama (1959b: 119-121) discussed relationship between fish groups of the East China Sea and the South China Sea. They recognized the possibility of both groups being related, based upon an analysis of seasonal pattern of body size composition.

Mimura and Nakamura (1959: 403-404) presumed possible relationship between the group of the Arafura Sea and Banda Sea, with the one south of Java and the Lesser Sunda Islands.

It is difficult to clarify migration patterns of these fish by our present
Figure 31. Length frequency of black marlin.
A area: Banda Sea and Flores Sea.
B area: north of 15°S, 100°E - 120°E.
(Mimura and Nakamura, 1959: 403.)
knowledge of seasonal occurrence. However, some indication will be given below.

Time of highest density of concentration for each area is shown in Figure 32. Symbols are used as follows:
- E—East China Sea
- D—South China Sea
- A—Arafura Sea and Banda Sea
- T—Timor Sea
- B—Waters South of Java and the Lesser Sunda Islands

Figure 32. Areas of concentration of black marlin in the Western Pacific, and their relationships. (Letters correspond to areas discussed in the text. Numerals mean months of highest density.)
C—Northwestern Area of Australia  
S—Coral Sea  

Seasons of high concentration in B area and C area are exactly opposite. Fish are believed to migrate north and south in accordance with changes in sea conditions. In October, fish are found south of Java and the Lesser Islands, B area. From November through March, fish move south to C area; from May through September, fish move north to B area. The distribution pattern for April and October, as shown on the monthly charts, indicates that these two months are seasons of transition.

January through April is the season of highest concentration for A area. This is the general period of time when fish migrate southward. Mimura and Nakamura (1959: 403-404) considered a relationship between A area and B area possible. Because of currents, they presumed the high density in A area is affected by seasonal movement from B area. We do not agree entirely with their explanation, because of the known tendency of fish to migrate southward in this season. We think it more likely that a relationship with E area explains the high concentration in A area during this season. Seasons of highest concentration in E area and A area are exactly opposite. We postulate that fish migrating southward from E area cause the high density in A area during these months (January-April).

A area has a connection with B and C areas, with T area occupying an intermediate position. In T area, density increases in April and October. This may indicate a seasonal movement through T area from C to A area in April, and from A to C area in October.

In regard to size composition, small fish dominate from April through September in both A and B areas. These small fish are also known to appear in numbers in E area from June through September.

From these phenomena, fish which appear in E area, and those of A area, we consider to be closely related. Also, there appears to be a relationship between E area and the B-C areas, with A area intervening.

Decrease in density in A area from May on, may indicate a northward movement of fish from this area.

From the distribution pattern in May and June in T and B areas, movement of fish from these areas to A area can be postulated. These fish are not accumulating in A area, but may be passing through it as they move northward.

The distribution pattern in D area is not clear because of scarcity of data. However, Kikawa and Anraku (1959: 257-258) reported that density has a slight tendency to increase from June through August. It seems therefore that fish pass through this area rather quickly, and are not stationary during the periods of northward and southward movements.

As for the course of interchange of fish between E and A areas, there is the possibility that fish take to the open seas east of the Philippine Islands.
and Formosa, in addition to passing through D area. However, it is difficult
to deduce such north and south movements of fish from the charts.

Turning now to the probability of some interchange between the Indian
Ocean group and the East Australian group, we may tentatively state that
a few fish from the East Australian group move from S area through the
Bismarck Sea to north of New Guinea, and join the Indian Ocean group in
A area, and vice-versa.³ Probably because of low water temperature in
higher latitudes, movement of fish south of the continent of Australia
into the Indian Ocean, and vice-versa, does not occur. (See below.)

Further interchange between S area and A area may occur when larvae
and eggs are carried by currents that move in a westerly direction during
September and October across the Great Barrier Reef, and through the
Torres Strait along the southern shores of New Guinea (Ueyanagi, 1960a:
95).

There have been some reports of istiophorid fish occurring south of
Australia, on the east in Tasmanian waters, and on the west, east of Cape
Leeuwin to the Great Australian Bight as far east as Esperance. On the
west, all of these fish were stranded specimens which had come ashore
dead. This could indicate they were strays which had wandered from the
environment which they can tolerate, and became sick and stranded.
John K. Howard personally investigated this situation in 1953 and 1954,
and has kept in touch with it for about eleven years through scientists,
commercial and sport fishermen, and government officials in Tasmania,
Victoria, South Australia and West Australia. He knows of no occurrence
of istiophorid fish south of Australia, except as here set out.

In the east, the first report of an istiophorid fish was that of R. M.
Johnson, of a stranded fish which he found in the sand in 1887. This was on
Forestier Peninsula on the southeastern coast of Tasmania. He reported
the fish under the scientific name Histitrophorus herschelli (Gray). It was
probably an istiophorid and not Xiphias gladius, the broadbill swordfish.

Aside from the above case of a stranded fish, we know of five cases of
marlin reported seen off the southeast corner of Tasmania between 1956
and 1958. In only one case does any corroborative evidence exist. In
January, 1958, eleven miles southeast of Tasman Island, off southeast
Tasmania, Mac Foster, owner of the schooner BRILLIANT, saw a fight
between a “spearfish” and a shark, which ended in the death of the
“spearfish.” This was reported by C. I. Cutler, Hon. Sec. of the Tasman
Game Fishing Association (Letter, C. I. Cutler to John K. Howard, 21
May 1959), who also sent copies of ten 35 millimeter colored transparen-
cies of the fight, taken by Mac Foster. From these transparencies, the
authors identify the “spearfish” involved in this fight as a broadbill,
Xiphias gladius. Walter A. Starck, II, made the same identification in
1959, when the transparencies were first received.

The Commonwealth Scientific and Industrial Research Organization
(CSIRO), between September 1959 and June 1961, conducted with the
DERWENT HUNTER, experimental longline fishing off the east coast of Australia from about 32°S to about 44°S. On three sets south of the mainland of Australia (i.e., excluding Tasmania), three marlin were caught off the east coast of Tasmania as follows: one in March 1961 at 41°-42°S, 149°-150°E; one in February 1960 at 42°-43°S, 148°-149°E; and one in March 1961 at 42°-43°S, 150°-151°E. In 1959, 1960 and 1961, sets were made off the southeast coast of Tasmania, and in 1960 off the south and southwest coast of the island. No marlin were caught on these sets (Davies, 1961).

On the southwestern side of Australia, east from Cape Leeuwin to the Great Australian Bight as far as Mississippi Bay, east of Esperance, "swordfish" have been reported. Swordfish is used for both broadbill and any species of marlin in this ichthyologically unsophisticated area. The American author has collected five reports between 1948 and 1953. All five fish had washed ashore and been found dead on the beach. We have poor photographs of two of these fish. Gilbert Whitley, the ichthyologist of the Australian Museum, who has studied the Istiophoridae and Xiphiidae of Australia, identified one fish as a black marlin from a photograph. We understand it is the same photograph as the one we have. Both authors think the photograph shows clearly it is an istiophorid, not a broadbill. The other photograph which we have is clearly of a broadbill.

The latest occurrence of such a fish being found was reported in the "West Australian" of 29 January 1963 in an article datelined Albany. The fish was found dead in Princess Royal Harbour and showed no signs of physical injury. It was 13 feet six inches long and weighed about 1,000 pounds. It was identified as a black marlin by Albany fisheries inspector B. Carmichael.

Whether these fish were Istiophoridae or Xiphias gladius is, we believe, immaterial. The latter's tolerance for cold water undoubtedly is greater than that of the Istiophoridae. The number of these fish which have come ashore dead or dying in this area indicates they had been carried around the southwest corner of Australia and into water beyond their tolerance level. There appears to be no other explanation than temperature.

D'Ombrain, who has made a long study of Australian game fish, says, "It appears that marlin do not move around the southern part of Australia." (D'Ombrain, 1957: 191.) The only news report known to the American author of a marlin in South Australia turned out to be of a broadbill.

Coupling up this absence of any occurrence of Istiophoridae between the Tasman Sea and the Indian Ocean with the reports set out above, it is our belief that the Istiophoridae are barred by water conditions from passing south of Australia from one ocean to the other.

According to our present knowledge, it seems appropriate to assume that the two groups, those of the Indian Ocean and East Australia, are different populations, except for interchange of a few fish as noted above. East Pacific Group.—As stated above, we lack detailed information of
black marlin, shirokajiki, in the Eastern Pacific, especially consecutive catch statistics over a considerable length of time. We do have, however, the accumulated experience over a number of years of subsistence fishermen, sport fishermen, and in several cases, of small commercial fisheries, for determination of comparative abundance of these fish in different areas, and of seasonal variation in individual area.

We feel the following information derived from such sources, collected by the American author for about ten years, is accurate, though we cannot demonstrate it by catch statistics. The range of black marlin in inshore waters of Mexico, Central America, Colombia, Ecuador, Peru and northern Chile is from about Cape San Lucas and the north center of the Gulf of California in the north to the Iquique-Tocopilla area of Chile in the south. A few fish, which we consider stragglers, have been reported farther north and farther south.

The center of this group of black marlin appears to be in the Gulf of Panama. Here they appear to be abundant during the whole year. There is some feeling they are more abundant during the dry season, middle of November to middle of May, than the rainy season, middle of May to middle of November. Though the months given are the usual periods of the dry and rainy seasons, there is some variability in this. But we have seen carefully kept angling records of trips taken in summer months, the rainy season, with very many black marlin hooked and caught. We wonder if the impression of this seasonal difference is really more the result of less fishing pressure than less abundance of fish.

The closest area to this center of concentration for which we have considerable data, is off the coast of Ecuador from north of the port of Manta south to La Plata Island, and Salinas. The density of fish in this area decreases from north to south, the greatest concentration being from Manta southwest to La Plata Island. Season of abundance appears to be June to October, with lesser abundance from November to May.

Going south, the next area for which we have information is in northern Peru, from the southern Gulf of Guayaquil, past Cabo Blanco to Paita. This includes the famous gamefishing area around Cabo Blanco, where a number of black marlin of over 1,000 pounds have been taken by both commercial harpooners and sport fishermen, and from which came the rod and reel world's record of 1,560 pounds. Here the season of abundance appears to be June to November, the best month being August. Black marlin have been taken in this area year round.

South from this area of northern Peru, we have a long stretch of Pacific coast with no records of occurrence of black marlin. This may be at least partially the result of lack of a type of fishery which would catch such fish. Information about their being taken again occurs in the Iquique-Tocopilla area of northern Chile. In this area, the small harpoon commercial fishery has occasionally taken black marlin. They appear never to be abundant. One scientist who has studied the coastal waters of South America for
many years, Dr. Erwin Schweigger of the Compañía Administradora del Guano, thinks that these fish may appear in inshore waters when tongues of warmer oceanic water penetrate to the coast. (Letter, Dr. Schweigger to John K. Howard, 30 April 1954; Schweigger, 1957: 801-816.) One of the best summaries of information about this southern area from Ecuador to Chile up to 1955 was the Preliminary Report-1954-Lou Marron-University of Miami Pacific Billfish Expedition (University of Miami, 1955).

To the north of the center of this Eastern Pacific group of black marlin in the Gulf of Panama, our information is even poorer than to the south. But they have been known and distinguished from the commoner marlin of the area, the striped marlin, for many years. In fact, the first use of the English common name black marlin was in the 1920's, for fish seen and caught around Cape San Lucas. (See section on Nomenclature.) Also the first time a specimen of this species from the Eastern Pacific was described scientifically, it was a fish caught in the Cape San Lucas area (Jordan and Hill in Jordan and Evermann, 1926: 59-60). Except that it has been occasionally caught, little or nothing is known of occurrence or seasons of abundance of black marlin along the coast of Central America below Acapulco, Mexico. Black marlin never appear to be abundant from Acapulco to the northern limit of their range. They are reported occasionally from Zihuatanejo (where Zane Grey and his party first encountered them in March of 1925, and recognized them as being different from striped marlin), Manzanillo, Mazatlán and Guaymas on the mainland coast, and La Paz, Muertos Bay, Buena Vista-Bahía Las Palmas, San José del Cabo and Cape San Lucas on the Baja California side of the Gulf of California. The striped marlin in contrast appear to be more abundant in this area from the end of December to June. Obtainable records indicate a greater abundance of black marlin in March, April and May. But these records also show catches of black marlin in June, July, August and October. Records are so few that we feel they are of little or no value as evidence of seasonal abundance.

To the authors, it seems clear there is a group of black marlin, shiro-kajiki, in the Eastern Pacific which is a population separate from any of those of Asiatic coasts. They must leave the answer to the question of whether black marlin of northern Chile are connected with this group or are stragglers from the open seas distribution, perhaps from the vicinity of the Society Islands, Marquesas or Tuamotu Archipelago, to the time when more data are available.

Even taking into consideration the continuity of distribution of this species across vast stretches of the Pacific, we must conclude the Indian Ocean and Western Pacific groups, and the Eastern Pacific group of fish, are distinct and separate populations, because their areas of concentration are so distant (Royce, 1957: 525). Further, the characteristic distribution pattern of this species near land masses supports this thesis.

Because of our limited knowledge, we cannot discuss whether or not
fish distributed in the open seas have a relationship with fish distributed in the Western Pacific and Eastern Pacific. However, it must be noted that at least one black marlin was caught in Piñas Bay area of the Gulf of Panama which had an old Japanese longline hook in its jaw. Any Japanese fishing would have been in the open sea. This was in May of 1964. But we need more data. (Letter, Ruth B. Krziza, Secretary of the Panama Marlin Club, to John K. Howard, 1 July 1964.)

Sailfish

Western Pacific Distribution.—This species appears to be distributed densely near land masses. Nakamura says it often enters into coastal waters (Nakamura, 1949: 62). Royce (1957: 522) states that the sailfish is widespread in the Tropical Pacific. In reporting upon distribution of sailfish in the West Pacific, Koto, Furukawa and Kodama (1959a) say that density is high near the land masses of New Guinea, Caroline Islands, Solomon Islands, Banda Sea, Timor Sea, East China Sea, the sea east of Formosa, and seas of the southwestern area of Japan. They state further that density is low in open sea areas, especially in higher latitude areas. Koto, Furukawa and Kodama state that fish migrate to Japanese waters and enter into Kagoshima Bay of Kyushu Island. This also occurs in the Eastern Pacific at Panama Bay as mentioned later (Farrington, 1942: 100). Coming so close to land is unique to this species.

The sailfish is not generally an important object of commercial fisheries. Therefore, catch statistics are not numerous enough to be placed on monthly distribution charts, as was done for striped marlin, blue marlin and black marlin. We have prepared a single chart for the entire year for this species, as we have done with shortbill spearfish. As a source of catch rate data in the Pacific Ocean west of 180°, we have relied largely upon the map prepared by Koto, Furukawa and Kodama (1959a: 89). In addition to this source, Japanese tuna longline catch reports, both published and unpublished, have been a source for catch rate data of sailfish in the Eastern and Western Pacific Ocean. (See Preface to Atlas.)

Both sailfish and black marlin show high density areas near land masses. In the Timor Sea and Banda Sea, these areas of high density for the two species overlap (Koto, Furukawa and Kodama, 1959a: 89-90, 1959b: 109-110). However, from our charts we note that while black marlin show high density in the northwestern areas of Australia, sailfish density is not high in those areas. For inshore areas this may possibly be due to lack of data.

Only a few sailfish are found in the Torres Strait. Many more are taken along the Barrier Reef area, from around Flinders Entrance, at the top of the Barrier Reef. Evidently more exist along the Barrier Reef than anywhere else in eastern Australia. We have fewer records of them than of marlin because fishermen keep marlin, whereas they tend to discard sailfish.
These comments apply as far south as to around Capricorn Channel. We have no actual catch statistics, but the American author has been in touch with people who fish along that area and they have reported sailfish to him. Many of these people are mackerel fishermen who catch these fish by accident. Sports fishermen also have caught them.

Sailfish are also caught along the coast of New South Wales, although in very small numbers, even as far south as 35°S. If fishing were done specifically for sailfish, the results might be different. Sailfish are densely distributed in areas around the Solomon Islands, the northern and parts of the southern waters of New Guinea. In these waters, the density of black marlin is not high.

There seems to be a close relationship between the Kuroshio Current and distribution of sailfish in the Western Pacific Ocean. Not only adult fish, but also young fish migrate to the coastal waters of southern Japan, where they are found in the Kuroshio Current as it passes southern Japan. This is the only species of which both adult and young appear in coastal

Figure 33. Occurrence of the postlarvae of sailfish in the Western Pacific. Arrows indicate Kuroshio Current; chain line indicates 100-fathom curve. (Ueyanagi, 1959: 144.)
waters of southern Japan. Postlarvae are also known to occur abundantly in the area of the Kuroshio Current (Yabe, 1953a; Ueyanagi, 1959: 143-144). See Figure 33.

**Eastern Pacific Distribution.**—In the Gulf of California, sailfish occur as far north as about Puerto Lobos on the mainland side, and San Luis Island on the peninsular side of the Gulf—that is, to about 30°N. These fish do not appear to migrate north in the Pacific to California waters as do the striped marlin. Very few have ever been reported, on the Pacific side, north of Cape San Lucas, about 21°N. The southern limit of their range on the western coast of the Americas is about Talara, Peru, about 5°S.

The species is present all the year in much of its range. Seasonal change in density is, however, marked in much of the area. The species shares its range with striped marlin, but frequently peaks of density of the two species appear to be different. There is some evidence of a north-south movement of the species in the area north of the Gulf of Panama.

In the Gulf of Panama, the fish are distributed nearly throughout the Gulf, allowing for the tendency of this species to stay fairly close to land, including the Bay of Panama (Taboquilla and Taboga Islands). They are present all year round, but are more abundant from April or May to November or December, with the peak of abundance from June to September (Hunt, 1935; Gray, 1935; Farrington, 1949: 163; International Game Fish Association, 1952: 53; personal communications between the American author and many who have fished the area, including Dr. and Mrs. Webster Robinson of Key West, Florida; Mr. Ross H. Walker of Richmond, Virginia; Mr. Morton D. May of St. Louis, Missouri; Mr. Edward (Luke) Gorham and Mr. Edward S. Corlett, III, of Miami, Florida).

The only report of cruising up the coast of Central America, known to us, is that in Zane Grey’s “Tales of Fishing Virgin Seas” (1925: 115-130). This report tells of seeing sailfish all along the coast of Central America: northern Panama, Costa Rica, Honduras, San Salvador, Guatemala, and southern Mexico. The number of fish counted by this party after reaching Mexican waters was extraordinary. About two days’ and a night’s cruise below Zihuatanego Bay, 77 were sighted in one day. This must have been not far south of Acapulco. Twelve in one morning are recorded as seen about off the Gulf of Tehuantepec. The number seen, considering the method of observation, indicates to the authors a high density of fish in the northern part of this area covered. This was in the first two weeks of March, 1925.

Capt. Bob Byrnes made several trips to the Cocos Islands, off the coast of Costa Rica, in the early 1930’s. Miss Peggy Hardwick took a contemporary women’s world’s record, 165 pounds, there in 1931. Capt. Byrnes told Mr. Al Pflueger of Miami, that on no trip to the Cocos Islands did his party catch fewer than 25 sailfish, and that they generally took up to
The abundance of sailfish at these islands is confirmed by S. Kip Farrington twenty years later (Farrington, 1953: 121). In the area of Acapulco, sailfish are in good numbers all year round, with perhaps greater abundance in winter months (Farrington, 1953: 124; American author’s investigation at Acapulco).

Proceeding north, Zane Grey’s party saw many sailfish at Zihuatanejo. Grey and Farrington report many sailfish at the White Friar Islands and Las Tres Marias Islands (Farrington, 1942: 113). The season of abundance was reported as winter, November through May (Farrington, 1949: 165).

From Mazatlán and Cape San Lucas north, we enter the Gulf of California. From about here, to the northernmost range in the Gulf, seasonal variation in density of occurrence becomes more marked. The period of greater abundance is from May to October, though fish may show as early as March and stay as late as December (International Game Fish Association, 1952: 55; personal investigation, American author, in Mazatlán and Guaymas).

South of the Gulf of Panama, we have almost no information for the coast of Colombia. But we find sailfish are present off Ecuador all year, with greatest abundance from the end of November through March (University of Miami, 1955: 20, 28, 46, 48; International Game Fish Association, 1952: 29).

They are present every month of the year off northern Peru, with summer, November to March, showing slightly more fish, but there are always fewer fish than off Ecuador. Density appears to grow less progressively from the Gulf of Panama south (University of Miami, 1955: 23, 38; Morrow, 1957a: 44). The Mancora commercial fleet appears to take more sailfish than the fleets of Cabo Blanco and Talara, showing the same decrease in occurrence from north to south within the northern Peruvian area of occurrence.

According to correspondence with Mr. W. L. Klawe, juveniles of this species are known to occur in coastal waters of North America. Mr. Klawe has reported that during SCOT Expedition at station 54 (5°33’N latitude, 87°23’W longitude), on May 15, 1958, he encountered a school of young sailfish about 15 inches long. During the same SCOT Expedition at station 54, a postlarval *Istiophorus* was obtained (Holmes and Blackburn, 1960).

Mr. Klawe states that the following juvenile sailfish are in the collection of Scripps Institution of Oceanography: two specimens obtained 28 February 1949, 65 miles SSW off Champerico, Mexico; three specimens obtained 7 February 1951, 25 miles off Pt. Burica, Costa Rica; one specimen obtained 1 December 1958 off “White Friars & Pompanoa,” Mexico; and one specimen obtained during the night of 8-9 April 1951, 20 miles off Cabo Blanco, Costa Rica (Letter, W. L. Klawe to John K. Howard, 18 February 1959). Beebe mentions two specimens of juvenile sailfish. One was obtained 1 March 1938, at 9°03’N latitude, 84°06’W longitude, 23
miles west of Uvita Point, Costa Rica. The other was obtained 23 November 1937, at 17°38'N latitude, 102°W longitude, 23 miles west of Zihuatanejo, Guerrero, Mexico (Beebe, 1941: 210, 213).

Eleven juvenile sailfish of 110 to 213 mm body length (as defined by Rivas, 1956b) were taken in the Gulf of Panama (7°10'N, 79°03'W) at a nightlight station on September 14, 1961 by the Alfred C. Glassell—University of Miami Marine Laboratory ARGOSY Expedition.

Spawning.—From occurrence of postlarval sailfish (Figure 34), spawning seems to take place in the vast subtropical and tropical areas, being less active, however, in open sea areas.14 Nakamura reported that from an investigation of gonad maturity, spawning takes place from April through August in the eastern area of Formosa (Nakamura, 1951b: 31). Nakamura (1932, 1940) also stated spawning may take place throughout the year in warmer areas. Yabe (1953a), in an investigation of postlarval distribution in the southwestern Sea of Japan, discussed spawning of this
species. He reported there was a low density of adult fish in the south-western Sea of Japan during the season in which a large number of post-larvae were collected. Therefore, Yabe suggested that perhaps the post-larvae were carried north from the spawning area in the south by the Kuroshio Current. Yabe agreed with Nakamura that spawning may take place throughout the year in warmer areas.

**Seasonal Occurrence.**—Seasonal occurrence of sailfish in coastal waters of North and South America is described in the previous section, Eastern Pacific Distribution.

In the Hawaiian area, no clear seasonal change is indicated by the data, but there does seem a tendency for a small increase in sailfish for several months around May (Hawaii. Division of Fish and Game, 1954-1964). Nakamura (1949: 52) stated sailfish occur most abundantly for several months around June in the Kuroshio Current area east of the Philippine Islands and Formosa. These months around June correspond with the spawning season for this species (as mentioned in the preceding section). In the eastern area of Papua-New Guinea, time of greatest density is apparently from September through December, with October being the peak period (Letter, J. H. Kemsley to John K. Howard, 30 March 1963).

Seasonal occurrence of sailfish in the East China Sea is described in detail by Koto, Furukawa and Kodama (1959a), and may be summarized as follows: sailfish migrate north from May through September, and south from October to March. However, density of distribution for the whole sea decreases from May through August. From November through April, density is high in the southern area (25°N to 28°N). This may indicate sailfish remain in the south area during winter. Size of sailfish in the East China Sea ranges from 105 cm to 240 cm in body length. Size composition shows sailfish ranging from 165 cm to 190 cm compose approximately sixty percent of this East China Sea group. Change in size composition is clear in Figure 35. It is smallest in June and becomes larger month by month, reaching largest size in March, April and May. Consequently, the most remarkable change in size composition occurs from May to June. From the shift in size composition from May through July, Koto, Furukawa and Kodama have concluded that smaller sailfish (under 160 cm) enter the East China Sea from other areas during these months, and fish over 160 cm leave the East China Sea to move southward (presumably for spawning) in this season.

**Migration.**—It is difficult to discuss the migration pattern or interchange of sailfish between high latitude and low latitude areas, because of our limited knowledge. But we have some facts which may be pertinent to this problem.

Nakamura et al., (1955) reported that sailfish, as well as other species of the Istiophoridae and Thunnidae, which were contaminated by radio-activity, began to occur throughout the entire western Pacific Ocean several months after the nuclear bomb test explosions at Bikini in 1954. They also
stated that percentage of occurrence of contaminated fish of all species was found to be highest in the North Equatorial Current area, and also high in the North Pacific Current area. They believed this was due to the effect of the Kuroshio Current and Ogasawara Current, which are directly related to the North Equatorial Current. Nakamura et al., (1955) reported
sailfish showed the highest percentage of occurrence of contamination among all species of istiophorids and tuna.

The above phenomena may indicate migration and interchange of fish between low latitude and high latitude areas, provided appearance of contaminated fish in a wide range of sea area can be considered principally attributable to movement of fish. No reason is known why sailfish should have the highest percentage of occurrence of contamination in the Istiophoridae and Thunnidae.¹⁵ However, the following is suggestive: density of distribution of this species is known to be high in the Kuroshio Current area, and areas under influence of the North Equatorial Current.

Koto, Furukawa and Kodama (1959a: 100-105) discussed relationship between the group of the East China Sea and that of the Okinawa area (which is adjacent to the East China Sea) from the standpoint of seasonal occurrence of contaminated fish. They found contaminated fish appeared from May through July in the Okinawa area, and from August through November in the East China Sea. They presumed from these phenomena that the extent of interchange between the two groups differs seasonally, being active in the season of southward movement of fish, and less active in the season of northward movement in the East China Sea. From this, and from seasonal size composition mentioned in the previous section, they postulated that the largest number of small fish appearing in the East China Sea in June and July may not come from the open Pacific Ocean, but from the South China Sea.

Of course, further analysis based on more data must be made in order to clarify the migration pattern.

**Shortbill Spearfish**

According to publications, this pelagic fish does not occur in coastal areas and enclosed areas. These fish are widely dispersed throughout tropical and subtropical areas of the Pacific. But throughout, density of occurrence is always low, except in the Northwestern Pacific between 15°N-30°N, where density of occurrence appears to become higher from about November through February (Nakamura, 1954: 35; Royce, 1957: 521; Ueyanagi, 1963b: 154).

The reason for scarce catch statistics on this species is because it is unimportant commercially. Consequently, catch data, though sometimes originally recorded, are not retained in a usable form. For this reason, we are not able to make monthly charts as we have done for striped, blue and black marlin. We have prepared, therefore, a single chart for the whole year for this species. This chart confirms the distribution pattern as set out in the papers cited above. In addition, the chart indicates some new facts about the distribution of this species. One additional fact is a great density of distribution in the Marquesas area (5°S-10°S and 130°W-
Figure 36. Localities of capture of young and postlarval shortbill spearfish in the Pacific.
- Postlarvae from Ueyanagi, 1963a: 146.
- Young from Watanabe and Ueyanagi, 1963.
Figure 37. Areas of shortbill spearfish with ripe ovaries (numeral indicates the month of capture). (Ueyanagi, 1962: 187.)
140°W). Our catch statistics indicate an average of about five to ten fish caught for each set of the longline (hook-rate 0.2-0.5). This species can be ranked either first or second among istiophorid fishes in the number caught per set in this area. This includes 72 longline sets (Wakayama Prefectural Fisheries Experimental Station, catch of kajiki by the NACHI MARU fisheries investigation and guidance ship of the Wakayama Prefectural Fisheries Experimental Station [Sept. 14, 1961-Nov. 4, 1961]: 4 pp. Unpublished, Tanabe, Japan).

The two areas of greatest density of occurrence of shortbill spearfish appear to correspond with the overlapping borders of distribution of striped and blue marlin, so we may speculate whether, if more data were available, the same might be found for all such areas of overlap between the distribution of striped and blue marlin. Data from the Eastern Pacific are especially limited, consisting of two records from California and one from Chile.

We do not have enough data to indicate with any accuracy seasonal changes in occurrence of this species throughout the Pacific. But, as stated in the first paragraph, it is known that in the Northwestern Pacific area this species appears more densely from November to February. This increase in density of occurrence is said to be correlated with spawning (Nakamura, 1954: 35; Ueyanagi, 1962: 186-188).

The Japanese author, in his investigations of postlarvae and of ripe, mature spearfish, came to the conclusion this species spawned throughout the year in the above area, though more intensely in winter. He also came to the conclusion that spawning occurred throughout the year in a very wide area of tropical and subtropical Pacific. (Figure 36 and 37.)

We have some data on the occurrence of juveniles of this species. One young specimen, about 40 cm in length (total length about 60 cm), was obtained from the area around 20°N, 142°E (Figure 36), (Watanabe and Ueyanagi, 1963: 133-136). On voyages of the TAISEI MARU of Mie Prefectural Fisheries Experimental Research Station, in the years 1957, 1958, 1959, 1960 and 1961, in the Tropical Eastern Pacific, it was recorded that immature fish of this species of less than 1 m body length were caught.17

The data indicate, as in the case of blue marlin, shortbill spearfish larvae, young fish and adults all exist in the same areas. In other words, the spawning area does not seem to be separated from growth areas, as they are for striped marlin.

**Preface for Appendix Charts**

*General.—* The charts in APPENDIX I show distribution patterns of Pacific Istiophoridae by species; that is, seasonal changes of abundance for the three species of marlin, as well as extent of distribution and density
of distribution by area for all Pacific istiophorids. To determine density of
distribution, we have used the following formula:

\[
\frac{\text{number of fish} \times 100}{\text{number of hooks or hook-rate}} = \text{fish per 100 hooks,}
\]

This formula is the same as that used in the 1958 AYFC Appendix Atlas. To make
these charts as graphic as possible, we have not published actual
hook-rate figures per 1° square of latitude and longitude, but have divided
hook-rate into five ranges, each of which is presented on the charts by a
different symbol placed in the 1° squares. Normally a one month period
is used as a unit of time for calculation of hook-rate and for monthly
charts. As done in the 1958 AYFC Appendix Atlas, the 1° square is used
as an area unit. However, because basic data for certain areas are originally
filed in 5° by 5° squares, there is some variation on our charts. When
data originally treated in 5° by 5° squares are recorded on the charts, it
is depicted by the same five symbols as used in the 1° by 1° squares, but
the symbols are centered in 5° squares, which are included within heavier
lines than the 1° squares.

At the Equator, the one degree squares are approximately 60 by 60
nautical miles. Because of the convergence of meridians, they are approximately 60 by 50 nautical miles at 35°N or S latitude. Longline gear
frequently extends more than 60 miles, and hence will span more than
one 1° square. The catch rate is assigned to a particular square, however, by the position given by the ship which is usually a noon position near the
center of the longline. For convenience, we have used the projection used
by the Japanese in their reports. This projection makes all 1° squares the
same size.

The data discussed in the preceding paragraph all come from operation
of longline fisheries in the open sea. The method of capture in inshore
areas is quite different from the tuna longline fishery, and the catches are
therefore presented on the charts in another manner.

During the past three or four years, Japanese tuna longline vessels have
fished far into the Eastern Equatorial Pacific Ocean. Now they are fishing
new areas extending north and south of eastern equatorial waters, and
south of eastern equatorial waters. We have tried to include as much
available recent data as possible in these new areas in preparing our charts.

Sources of Data.—An important source of data has been the Nankai
Regional Fisheries Research Laboratory. This Laboratory computes each
year's average catch rate, combines them, and calculates an overall average.
For the Pacific Ocean west of 180°, we have used data published in the
1958 AYFC Appendix Atlas, which includes collected catch rates from
before World War II up to March 1956. For the Pacific east of 180°, we
have used data of the Nankai Laboratory which includes collected catch
rates up to March 1956 as published in the 1958 AYFC Appendix Atlas,
and new data from March 1956 up to December 1961. In the case of
black marlin, however, we used data of the Nankai Laboratory for the Eastern Pacific and Western Pacific, which includes collected catch rates up to March 1956 as published in the 1958 AYFC Appendix Atlas, and new data from March 1956 up to December 1961.

Another important source of data, for those areas where tuna were not available to us on the 1° square level, has been Tuna Fishing magazine. We have utilized catch rates of fishing from January 1960 (published in Tuna Fishing No. 74, November 1960) through April 1963 (published in Tuna Fishing No. 12 [102], January 1964). We have also used recent unpublished data for May 1, 1963 through August 10, 1963 (now published in Tuna Fishing magazine). Data from this magazine are expressed in 5° squares, and are treated as follows: (A) If data for an area cover only one year, and there are a small number of operations, and the hook-rate is unusual, the data have been discarded. If, however, the hook-rate is in keeping with the hook-rates of the surrounding area, these data have been retained. (B) Where the data for an area include that for the same month from two or more years, we have adopted the average hook-rate, after noting the number of operations involved for each year (naturally the larger the number of operations, the more realistic the hook-rate figure), and figures reported for the surrounding area.

In those areas for which there is little or no information from the Nankai Laboratory, or from Tuna Fishing magazine, we have sought data from individual cruise reports from U.S. research vessels (University of California Scripps Institution of Oceanography; California Department of Fish and Game; and the U.S. Fish and Wildlife Service), Japanese research vessels, and Japanese commercial fishing boats, and cruises of the Division of Fisheries and Oceanography of Australia.

The purpose of the Appendix Charts is to illustrate the distribution pattern as indicated by catches of Pacific Istiophoridae. In the Western and Central Pacific Ocean, these charts may be taken to represent the average years' catch rate, for data have been accumulated over many years. In the Eastern Pacific, some figures are averaged from several years' accumulation; but others are for only one year. Therefore, these latter figures do not always represent averages.

Sources of Inshore Data.—Data for inshore areas have been taken from correspondence with fisheries officers, boatmen, commercial fishermen, sport fishermen, officers of big game fishing clubs, etc., in Japan, New Zealand, Australia, California, Mexico, Panama, Ecuador, Peru and Chile. Also, data have been taken from publications for sport fishermen, such as magazines and club yearbooks, for the same areas. Because of the variability of fishing effort represented in the information obtained from these sources, these data have been treated on the charts in a very general way. Two symbols, different from the category symbols of more specific data, have been used. One, simple diagonal lines shading the areas fished, repre-
sents average fishing. The second, cross-hatched lines within the areas, indicates good fishing—more fish caught per boat per day.

**Shortbill Spearfish and Sailfish Charts.**—There is one chart for shortbill spearfish showing location of capture in 1° squares, but neither number captured nor the months of capture. There is one chart for sailfish in which the number of fish caught per one set of longline has been divided into four range categories which are presented on the charts by symbols. Months of capture has been omitted. The open ocean data for the sailfish chart have all come from longline fisheries.

As with marlin, along inshore areas the method of capture is quite different from the tuna longline fishery, and is presented on the charts by cross-hatched lines for dense fishing areas (variation of occurrence and density is discussed for sailfish in the text). These inshore areas are Papua-New Guinea, Japan, Hawaii, Central America and South America.

The appendix charts were prepared by Mrs. Jean Yehle and Mr. Richard Marra.

**Summary of Part II**

In Part II, the distribution of Istiophoridae in the Pacific is considered and described.

The area in the Pacific where Istiophoridae occur extends generally between 40° N and 40° S latitudes, although the area where each species occurs in most abundance is geographically different from those occupied by the other species (as illustrated in Figure 1). In other words, the entire distributional area of the family is shown to be divided by the specific habitats of each species. Striped marlin, blue marlin and shortbill spearfish are distributed in offshore waters, while the distribution of black marlin and sailfish is most dense in waters close to land masses.

The general distribution of striped marlin forms a horseshoe-shaped pattern. This is characteristic of this species. It is postulated that the fish which occur in the Eastern Pacific, namely in the area which lies in the apex of the horseshoe-shape of distribution, are closely related to the fish of the South Pacific, and it is also suggested that the northern population (fish which are distributed in the North Pacific) and the southern population (fish distributed in the Eastern Pacific and South Pacific) are separate and distinct from one another, although there may be some interchange of fish between the two populations.

The blue marlin is the most tropical of all the marlin. In the Pacific they are considered to belong to one population, and are believed to follow a seasonal north-south migration, supposedly for spawning, across the equator.

The distribution of black marlin is characterized by the greatest density of occurrence on the periphery of the distributional area of the family; the East China Sea, East Indian Archipelago area, eastern coast of Australia and Coral Sea on the western side of the Pacific, and the west coast of
Mexico and Central America on the eastern side of the Pacific. The distribution is sparse in open-sea areas. The fish which are distributed in the East China Sea are believed to be closely related to those of the East Indian Archipelago area.

In sailfish, the density of distribution is high near the land masses of the Solomon Islands, New Guinea, Caroline Islands, and the Kuroshio Current area in the Western Pacific, and also in the coastal area between Mexico and Panama.

The distribution pattern of shortbill spearfish is not known in detail because of scarcity of data. Generally speaking, however, the density of this species is likely to be high in areas where the distributions of striped and blue marlin overlap.

要 約

第一部では、カジキ類（カジキ科魚類）の分類学的研究の歴史や現状について述べ、ついでカジキ類の命名に関する問題—名称の標準化の経緯、学名の問題等——について論述した。

太平洋に分布するカジキ類は次の5種類であることが、漁業関係者（研究者、漁業者、企業、漁漁者等）によって一般にまとめられており、それぞれの種類に標準的な和名や英名が与えられている。学名については統一されていないので、現在用いられている若干のものを示した。

**Pacific Sailfish**
*Istiophorus orientalis*
*I. gladius*  
*I. grayi*

**Shortbill Spearfish**
*Tetrapturus angustirostris*

**Striped Marlin**
*Makaira audax*  
*M. mitsukurii*  
*M. zelandica*  
*Tetrapturus audax*

**Blue Marlin**
*Makaira nigricans*  
*M. n. mazara*  
*M. ampla*  
*Istiompax howardi*

**Black Marlin**
*Makaira indica*  
*Istiompax indica*  
*I. marlina*
種よりも高次の分類段階の問題、それらの命名法や系統的な分類体系の問題を考えるには、それらに関連させて考えられるよう系統発生的証拠がまだ充分でないようにと思われる。しかし、種類の間、個体発生的、生態学的、形態学的な若干の類似性がみられ、これらの点に基づき、種と科の中間の段階における種類の分類が可能のように考えられる。即ち、カジキ類を三つの属—_Istiophorus, _Tetrapturus, _Makaira_—に分けること（Robins & de Sylva
(1960)によって提案されたいようにパシユカジキ以外の12＋12の脊椎動物を持つ種類を全て _Tetrapturus_に含めることとして）が、上記の類似性に則した最も簡明な分類方式と思われる。

第二節では、太平洋のカジキ類の分布について考察した。

カジキ類の分布は全体として南北凡そ4°N～4°Sに及ぶが、種類によりそれぞれ大要な分布域が異なり、硬適的にみて、全体としての分布域を各種類で適当に分隔した（概略分けた）ような分布状況を示している。（第1図参照）。パシユカジキ、シロカジキは島嶼に近い海域に分布密度が高く、マガキ、クロカジキ、フライカジキは外洋域に分布する。

マガキは、南北太平洋にあたり馬蹄形状の分布をすることが特徴的である。
（第2図）。馬蹄形の頂部に当る東太平洋に分布する魚群が南太平洋に分布するものの関連が深いこと、また北太平洋に分布する魚群と、東太平洋から南太平洋にかけて分布する魚群とは、両者の間にある程度の交流は考えられるがそれぞれ別のポピュレーションに属することが想定された。

クロカジキは、カジキ類中最も熱帯性の種類である。太平洋に分布するものは一つのポピュレーションと考えられ、南北半球にまたがる大きな塩分囲（海洋に関連した）を行っていることが想定される。

シロカジキは、太平洋の西の端（東支那海、豪印諸島海域、珊瑚海）と東の端（中央アメリカ沿岸）に主要な分布域があり、中間の外洋域では分布が稀薄であることが特徴的である。東支那海の魚群は、豪印諸島海域の魚群と関連があることが考えられる。

パシユカジキは、西太平洋ではソロモン群島海域、ニューギニア沿岸、カロリン諸島水域、また黒潮流路等に分布密度が高く、東太平洋ではメキシコからパナマにかけての沿岸域に多い。108
FOOTNOTES

1—In reaching this conclusion, they also considered the following: differences of spawning area and seasons; differences in average maximum size of fish; possible differences in the adaptation to environment during different growth stages; and differences in pectoral fin lengths.

2—Some inconsistency is shown in the Eastern Pacific (5°N-20°N), in that surface temperatures are higher in this area of distribution. However, this seems to be explainable if we consider that this area is characterized by the existence of a shallow thermocline.

3—The lack of data is caused by scarcity of fish coming to these waters. See discussion and Figure 13.

4—$A_1$, $A_2$, $C$ and $B_1$ Kamimura and Honma, (1958: 8-11).


D and E Royce (1957: 543, 549).


5—However, using more pectoral-fin length data than were available to Kamimura and Honma (1958), we have found relative growth of pectoral-fin length to body length to be allometric with an inflection point occurring at approximately 180-190 cm body length. For this reason we cannot apply to our findings the regression line for the South Pacific and North Pacific as drawn by Kamimura and Honma.

6—Modal size of fish is shown as about 160 cm (125 pounds) in the area west of 180° (Ueyanagi and Watanabi, 1959: 231-232), and about 170 cm (150 pounds) in the Hawaii area (Royce, 1957: 535).
7—Kamimura and Honma (1959: 331-337) emphasized the big difference of the size composition of fish between the areas west and east of 160°W, coupled with the difference in density of distribution in these areas.


9—We have well authenticated reports of occurrence of both marlin and sailfish in Torres Strait. We believe these reports indicate occasional occurrences of these fish in that strait, and not regular migrations in numbers from the Pacific to the Indian Ocean, or vice-versa. Data of occurrence in this area are so difficult to obtain, however, that our deduction may be erroneous (Letter, B. J. Whit-taker, Cairns, Queensland, to John K. Howard, 23 September 1956; letter, J. S. Hynd, C.S.I.R.O. Fisheries Laboratory, Thursday Island, Queensland, to John K. Howard, 25 February 1957.

10—Koto, Furukawa and Kodama made a map (1959a: 89) to illustrate geographical distribution of the sailfish (Western Pacific, east to 160°W). In this figure, density of sailfish is represented by catch rate (number of fish caught per single operation in 1° unit squares).

11—These sailfish are the object of a coastal fishery which operates from August through November in Kagoshima Bay (Tamari and Tanoue, 1955).

12—Sailfish do have value in the tuna longline fishery in the East China Sea (Koto, Furukawa and Kodama, 1959a: 89).

13—Gilbert Whitley, in his “Sailfish Ahoy” (1955), in a table captioned “Chronological List of Records of Sailfish from Australia,” page 381, lists nine sailfish from off Queensland, six from off New South Wales, and several others from elsewhere in Australia, and discusses these fish in detail in the text.

14—According to the Japanese author, many net tows for larvae have been carried out in subtropical and tropical open sea areas of the Western Pacific resulting in only a small number of postlarval sailfish. There were greater numbers of blue marlin postlarvae collected.

15—This may be attributed partly to a possible difference in food (feeding) habits or swimming layer of this species from those of other Istiophoridae and Thunnidae.

16—The Japanese author states that unpublished data show that the shortbill spearfish does not attain sexual maturity until 120 cm in body length.

17—Information given to the American author on a visit to the Mie Prefectural Fisheries Experimental Station in September, 1962.

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MIE PREFEKTURAL FISHERIES EXPERIMENTAL STATION  


Mimoto, Koichi and Shichiro Higasa

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Miyagi Prefectural Government Fisheries Section

Moreland, J.

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Nankai Regional Fisheries Research Laboratory


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O. R. S. T. O. M.


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U. S. HYDROGRAPHIC OFFICE
van Steenis-Kruseman, J. J.

Voss, Gilbert L.

Wakao, Kōichi

Wakayama Prefectural Fisheries Experimental Station

Walford, Lionel A.

Watanabe, Hisaya

Watanabe, Hisaya and Shoji Ueyanagi

Whangarei Deep Sea Anglers’ Club

Whitley, Gilbert P.

Williams, F.

Wyrtki, Klaus
Yabe, Hiroshi

Yabe, Hiroshi, Shoji Ueyanagi, Shoji Kikawa, and Hisaya Watanabe

Yabe, Hiroshi, and Shoji Ueyanagi

Yabe, Hiroshi, Yoichi Yabuta, and Shoji Ueyanagi

Yabuta, Yoichi and Mori Yukinawa

Yamaguchi, Kazuo