



DEVELOPMENT OF BILLFISH & SWORDFISH SPECIES IDENTIFICATION APP

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Purpose, expectation and action intended (select one or more and include corresponding text)

Feedback (to collect input and suggestions)

[The paper aims to explore new approaches for identifying Blue marlin and Striped marlin when they have been processed to a certain extent, as is commonly observed in coastal fisheries.

OFCF Japan would also like to call for cooperation in collecting photographs of identified billfish species for inclusion in the IOTC species photo library, as this would benefit all IOTC members.]



Development of Billfish & Swordfish species identification App

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Abstract

OFCE Japan has launched a new project from JFY2024 called “WEB based tool development for identification of IOTC species” under the IOTC-OFCE project in JFY2024. In JFY2026, OFCE Japan started developing a web application “ID tool for IOTC Billfish species” which is designed to facilitate species identification of Billfish and Swordfish species for field samplers/observers.

Concept of the “ID tool for IOTC Billfish species”

The web application “ID tool for IOTC Billfish species” is designed by ODK (Open Data Kit) and functions on smartphones and tablets where data connectivity is available. The ODK form is available on the “[Guide for identification of IOTC species](#)” website (www.iotcspecies.com). Android users can use the application offshore without data connectivity by installing ODK Collect and downloading the ODK forms in advance.

Table 1 shows the target species. The “ID tool for IOTC species” identifies species based on the taxonomic keys used in taxonomy. Taxonomic keys is a classical approach which follows a step-by-step process of choosing between pairs of contrasting morphological characteristics, each referring to traits of the organism, which finally guides the species (Fischer 2013). This step-by-step process was made available on smartphones/tablets by designing an ODK form (see details in [IOTC-2025-WPNT15-13](#)).

Table 1 Billfish and Swordfish species targeted for the development of the ID tool for IOTC Billfish species.

English name	IOTC code	Species name	IOTC target species
Black marlin	BLM	<i>Istiompax indica</i>	☐
Blue marlin	BUM	<i>Makaira nigricans</i>	☐
Striped marlin	MLS	<i>Kajikia audax</i>	☐
Indo-Pacific sailfish	SFA	<i>Istiophorus platypterus</i>	☐
Swordfish	SWO	<i>Xiphias gladius</i>	☐
Short-billed spearfish	SSP	<i>Tetrapturus angustirostris</i>	

Morphological characteristics used for species identification of Billfish and Swordfish species

Several publications and reference materials have described the morphological characteristics used for species identification of billfish (Collette & Graves 2019, Nakabo ed. 2013, IOTC/CTOI 2022). Table 2-7 summarizes the morphological characteristics that have been reported to date for species listed in Table 1.

Among the various diagnostic characteristics, the combinations used in taxonomic keys have been described by Nakabo ed. 2013 and IOTC/CTOI 2022. Figure 1 shows the taxonomic key described by IOTC/CTOI 2022.

Table 2 Key features for Black marlin identification

No	Features	References
1	Pectoral fin is rigid and cannot be folded to the body	Nakabo, T. ed. (2013) Collette, B. & Graves, J. (2019)
2	Body is not very compressed laterally	Collette, B. & Graves, J. (2019)

3	Nape is highly elevated	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013)
4	Body depth is greater than the height of the first dorsal fin	Collette, B. & Graves, J. (2019) IOTC/CTOI (2022)
5	2nd dorsal fin starts slightly anterior than the 2nd anal fin	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013)
6	Bill is short, round in cross section.	IOTC/CTOI (2022)
7	Body elongated & not very compressed	IOTC/CTOI (2022)
8	Body is black to dark blue on the back, silver white to white on belly with no spots.	IOTC/CTOI (2022)
9	Body has no spots, sometimes with light blue vertical stripes.	IOTC/CTOI (2022)
10	Membrane of first dorsal is blue black	IOTC/CTOI (2022)
11	Two caudal keels	IOTC/CTOI (2022)
12	Caudal fin is forked, symmetrical (homocercus) & rigid	IOTC/CTOI (2022)
13	Anal fin is brown with tinges of dark blue in some specimens	IOTC/CTOI (2022)
14	Pelvic fins are shortest of all Marlins	IOTC/CTOI (2022)
15	Pectoral fin is sickle shaped & rigid; cannot be folded flat to body	IOTC/CTOI (2022)

Table 3 Key features for Blue marlin identification

No	Features	References
1	Body depth is greater than the height of the first dorsal fin	Nakabo, T. ed. (2013) Collette, B. & Graves, J. (2019)
2	Pectoral fins can be folded into the body	IOTC/CTOI (2022) Collette, B. & Graves, J. (2019)
3	Pectoral fins are almost straight, not sickle shape, when folded to the body	IOTC/CTOI (2022)
4	Body is not very compressed laterally	Nakabo, T. ed. (2013) Collette, B. & Graves, J. (2019)
5	2nd anal fin starts slightly anterior than the 2nd dorsal fin	Collette, B. & Graves, J. (2019)
6	Pelvic fins are shorter than the pectoral fin	Collette, B. & Graves, J. (2019)
7	Nape is highly elevated	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013)
8	Bill is Round in cross section	IOTC/CTOI (2022)
9	Body is blue-black on dorsal surface and white silver below with approximately 15 vertical stripes	IOTC/CTOI (2022)
10	Body thick in cross section with greyish-white meat	IOTC/CTOI (2022)
11	Lateral line has a network of interconnecting canals	IOTC/CTOI (2022) Nakabo, T. ed. (2013)
12	Two caudal keels	IOTC/CTOI (2022)
13	Caudal fin is forked, symmetrical (homocercus) & rigid	IOTC/CTOI (2022)

14	Anal fin is brown, bases with a tinge of silvery white	IOTC/CTOI (2022)
15	Pelvic fins are shorter than the pectoral fin	IOTC/CTOI (2022)

Table 4 Key features for Striped marlin identification

No	Features	References
1	Anterior lobe of the first dorsal fin is pointed and higher than the remainder of the fin, the height decreasing gradually backward	Collette, B. & Graves, J. (2019)
2	Height of the first dorsal fin is greater than the body depth	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013) IOTC/CTOI (2022)
3	Anus is situated near the origin of the first anal fin, the distance between them less than half of the first anal fin height	Collette, B. & Graves, J. (2019)
4	Tips of the pectoral fins are pointed	Collette, B. & Graves, J. (2019)
5	Tips of the anal fins are pointed	Collette, B. & Graves, J. (2019)
6	Bill is long, thin, and sharp	IOTC/CTOI (2022)
7	Body back is dark blue and belly is silvery	IOTC/CTOI (2022)
8	Membrane of first dorsal blue black without dark spots	IOTC/CTOI (2022)
9	Lateral side of the body has about 20 bluish stripes	IOTC/CTOI (2022)
10	Laterally compressed, not rounded, much thinner than blue or black marlins	IOTC/CTOI (2022) Nakabo, T. ed. (2013)
11	First dorsal has thin membrane easily torn	IOTC/CTOI (2022)
12	Two caudal keels	IOTC/CTOI (2022)
13	Caudal fin is forked, symmetrical (homocercus) & rigid	IOTC/CTOI (2022)
14	Anal fin bases with a tinge of silvery white	IOTC/CTOI (2022)
15	Pelvic fins are long. Longest of all marlins	IOTC/CTOI (2022)
16	Pectoral fins are falcate & flexible	IOTC/CTOI (2022)
17	Lateral line is straight	Nakabo, T. ed. (2013)

Table 5 Key features for Indo-Pacific sailfish identification

No	Features	References
1	The first dorsal fin is sail-like and much taller than the body depth	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013) IOTC/CTOI (2022)
2	The pelvic fins are very long, with well-developed membranes, and reach nearly to the anus	Collette, B. & Graves, J. (2019) IOTC/CTOI (2022)
3	Bill is round in cross section	IOTC/CTOI (2022)
4	Body back dark with about 20 bluish vertical bars	IOTC/CTOI (2022)
5	Belly is pale silver	IOTC/CTOI (2022)
6	Membrane of first dorsal fin blue- black with numerous dark spots	IOTC/CTOI (2022)
7	Two caudal keels	IOTC/CTOI (2022)
8	Pectoral fins are long, stiff, falcate in shape, with 18 to 20 rays.	IOTC/CTOI (2022)

Table 6 Key features for Swordfish identification

No	Features	References
1	The bill is extremely long but flat and sword-like in cross section, unlike the rounded bill of istiophorid billfishes	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013) IOTC/CTOI (2022)
2	No teeth in the jaws	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013)
3	Pelvic fins are absent	Collette, B. & Graves, J. (2019) IOTC/CTOI (2022) Nakabo, T. ed. (2013)
4	Single keel on the caudal peduncle	Collette, B. & Graves, J. (2019) IOTC/CTOI (2022)
5	No scale	Nakabo, T. ed. (2013)
6	Head almost flat from bill to base of dorsal	IOTC/CTOI (2022)
7	Large eyes	IOTC/CTOI (2022)
8	Dark blue/black on the dorsal surface fading gradually to a steel grey / white ventrally	IOTC/CTOI (2022)
9	First & second dorsal fin widely separated (except if <100 cm)	IOTC/CTOI (2022)
10	Large broad caudal relative to other billfish. Similar color to dorsal surface.	IOTC/CTOI (2022)
11	First anal fin is long, almost half length of dorsal & pectoral fins	IOTC/CTOI (2022)
12	First anal fin leading edge slightly curved	IOTC/CTOI (2022)
13	Second anal fin short and indistinct & slightly anterior to second dorsal	IOTC/CTOI (2022)
14	Pectoral fin Placed low on body	IOTC/CTOI (2022)

Table 7 Key features for Shortbill spearfish identification

No	Features	References
1	Bill is very short, usually less than 15% of the body length	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013) IOTC/CTOI (2022)
2	Pectoral fins are narrow and short, less than 15% of the body length	Collette, B. & Graves, J. (2019) Nakabo, T. ed. (2013)
3	Distance between the anus and the origin of the anal fin is nearly equal to the anal fin height	Collette, B. & Graves, J. (2019) IOTC/CTOI (2022) Nakabo, T. ed. (2013)
4	Body is dark blue with brown along the sides and silvery-white below	IOTC/CTOI (2022)
5	First dorsal fin is long and dark blue	IOTC/CTOI (2022)
6	Inner surfaces of the caudal fin is black and the outer surface is white	IOTC/CTOI (2022)
7	Anal fin is white	IOTC/CTOI (2022)
8	Pelvic fins are longer than pectoral	IOTC/CTOI (2022)
9	Pectoral fins have black inner surfaces and the outer surface is white	IOTC/CTOI (2022)

Figure1. Taxonomy key approach for billfish in PORTSTATE MEASURES Species Identification Guide for fisheries inspectors

I. Pelvic fins presence

- Absent: SWO
- Present: BLM, BUM, MLS, SFA, SSP (Go to II)

II. Dorsal fin shape¹

- Sail-like: SFA
- Not sail-like: BLM, BUM, MLS, SSP (Go to III)

III. Dorsal fin shape²

- Anterior part of dorsal is continuously relatively high: SSP
- Only anterior part is high: BLM, BUM, MLS (Go to IV)

IV. Pectoral fins mobility

- Pectoral fixed: BLM
- Pectoral mobile: BUM, MLS (Go to V)

V. Pectoral fins shape

- Leaf shape: MLS
- Half sickle shaped: BUM

Morphological characteristics used for “ID tool for IOTC Billfish species”

Taxonomy key shown in Figure 1 can be used for onboard observers who are able to observe the fish in fresh, unprocessed conditions. However, Billfish and Swordfish are often landed with their viscera, fins, heads, and bills removed, meaning that field samplers must identify species under these on-site conditions (Figure 2).

Figure 2 Landing condition of billfish in Negombo port, Sri Lanka. A) Indo-Pacific sailfish, B) Swordfish C) Blue marlin and Striped marlin



A)

B)

C)

Figure 3 shows the taxonomy key used in the “ID tool for IOTC Billfish species” (ver. 28 Aug. 2026). The “ID tool for IOTC Billfish species” utilizes morphological characteristics that can be assessed from the fish body alone, such as scales, the position of the anus, and the relative positions of the fin bases. The tool also incorporates the body aspect ratio and body coloration based on our own observations, including coloration changes associated with reduced freshness. These characteristics enable the identification of billfish specimens even when their fins and/or head have been removed.

Figure 3. Taxonomy key approach for billfish proposed by OFCF Japan, for field samplers

I. Scale presence

- Absent: SWO
- Present: BLM, BUM, MLS, SFA, SSP (Go to II)

II. Body shape (Body aspect ratio)

- Body approximately 5 times or more of the body depth: SFA, SSP (Go to III)
- Body approximately 4 times of the body depth: BLM, BUM, MLS (Go to IV)

III. Anus proximity to the anal fin

- Anus positioned close to the anal fin: SFA
- Anus positioned apart from the anal fin: SSP

IV. Relative position of the 2nd dorsal and 2nd anal fins

- Second dorsal fin starts slightly anterior than the 2nd anal fin: BLM
- Second anal fin starts slightly anterior than the 2nd dorsal fin: BUM, MLS (Go to V)

V. Lateral side body color

- Silver color based, stripes remaining: MLS
 - Dark grey, stripes hard to observe: BUM
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Future works

The “ID tool for IOTC Billfish species” uses body aspect ratio and body coloration as diagnostic characteristics. However, these characteristics are expected to vary among individuals. Therefore, it is necessary to evaluate whether species can be identified consistently despite such individual variation. Currently, with the cooperation of the Department of Fisheries and Aquatic Resources (DFAR) and the National Aquatic Resources Research and Development Agency (NARA) of Sri Lanka, we plan to conduct observations of billfish in Sri Lanka in October 2026. During this survey, we aim to examine a large number of individuals and evaluate the effectiveness of these characteristics for species identification.

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