

## Digital ID tool for IOTC tuna and tuna-like species using ODK(Open Data Kit)

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### Abstract

The IOTC-OFCF Japan project has developed “ID tool for IOTC tuna and tuna-like species”(ID tool), a smartphone/tablet available digital tool which facilitates species identification of tuna and tuna-like IOTC target species. The tool utilizes Open Data Kit (ODK), a free and open-source platform that helps data collection using mobile phones or tablets.

### Introduction

Species identification (species ID) of IOTC target species has long been an issue in the IOTC, preventing data collection of catch statistics by species (IOTC 2024). A major challenge is enumerators to learn and memorize the key morphological characteristics to identify species and apply those knowledge on-site. To facilitate this process, a handy booklet (IOTC Species Identification Guides) has been developed so far. However, those booklets had constraints in translation to multiple languages and distribution (IOTC 2013, IOTC 2025). Workshops for training species ID have also been organized by the IOTC. However, there has been a limitation in the number of participants and dissemination of knowledge by the participants after the workshop. To overcome these difficulties confronted in the IOTC, a user friendly species ID supporting tool which is low cost and available anywhere is anticipated.

Development of digital tools could be one of the solutions. Internet connection is becoming ubiquitous worldwide, even available offshore (Raman et al. 2023). Use of smartphones and tablets for fisheries data collection were confirmed in 80% of the coastal states at the point of 2023, which could possibly become more common in the future (OFCF Japan 2023). If a user-friendly digital ID tool, practical and low cost for species ID would become available, it will make a significant improvement in the capacity to collect catch data by species in the IOTC area.

So far at the point of 2025, some AI based auto-species ID applications are available on smartphones and tablets (Fish Identifier, Fishial.AI, Picture Fish, FishVerify, etc.). However, the identification accuracy rate is not sufficient for statistical purposes. Some target species of the IOTC are similar in appearance, which needs careful observation of the morphological characteristics (such as species ID of Bullet tuna & Frigate tuna, medium size Yellowfin tuna & Bigeye tuna). Classical approach using taxonomic keys would be most reliable, such as following a sequence of alternative choices which concludes to one species (Fischer 2013). While some taxonomic keys are available online in a website (IOTC/CTOI 2022), something practical on-site for enumerators does not exist.

Platform to create web-based questionnaires can be applied to creation of digital taxonomic keys. Several platforms exist, which enables creation of sequences of alternative choices for data collecting purposes. Among such platforms, Open Data Kit (ODK) is free, open-source and flexible for customization.

In this paper we present a ODK based species ID tool which is applicable for Scombridae IOTC target species identification: “ID tool for IOTC tuna and tuna-like species”. We targeted 19 species in total, which consist of 11 IOTC target species and 8 Scombridae species co-occurring in the Indian ocean.

### Target species

To ensure the identification of IOTC target species, not only the identification among the target species, but also identification from other co-occurring species of the same family is important. The IOTC target species includes 11 Scombridae species. Table 1 shows the Scombridae species targeted for the development of the digital ID tool. We added Striped bonito (*Sarda orientalis*), Dogtooth tuna (*Gymnosarda unicolor*), Slender tuna (*Allothunnus fallai*), Blue mackerel (*Scomber australasicus*) and Indian mackerel (*Rastrelliger kanagurta*) considering the miss-identification risk with tuna like IOTC target species. We also added Wahoo (*Acanthocybium solandri*), Korean mackerel (*Scomberomorus koreanus*), Double-lined mackerel (*Grammatorcynus bilineatus*) considering the miss-identification risk with seerfish like IOTC target species. In total 19 species were targeted to develop a species ID tool for the IOTC.

Table 1 Scombridae species targeted for the development of the digital ID tool. The circle on the left indicates the IOTC target species.

English name	Species name	IOTC target species
Albacore	<i>Thunnus alalunga</i>	○
Bigeye tuna	<i>Thunnus obesus</i>	○
Yellowfin tuna	<i>Thunnus albacares</i>	○
Southern bluefin tuna	<i>Thunnus maccoyii</i>	○
Longtail tuna	<i>Thunnus tonggol</i>	○
Skipjack tuna	<i>Katsuwonus pelamis</i>	○
Bullet tuna	<i>Auxis rochei</i>	○
Frigate tuna	<i>Auxis thazard</i>	○
Kawakawa	<i>Euthynnus affinis</i>	○
Narrow-barred Spanish mackerel	<i>Scomberomorus commerson</i>	○
Indo-Pacific king mackerel	<i>Scomberomorus guttatus</i>	○
Wahoo	<i>Acanthocybium solandri</i>	
Striped bonito	<i>Sarda orientalis</i>	
Dogtooth tuna	<i>Gymnosarda unicolor</i>	
Double-lined mackerel	<i>Grammatorcynus bilineatus</i>	
Slender tuna	<i>Allothunnus fallai</i>	
Korean mackerel	<i>Scomberomorus koreanus</i>	
Blue mackerel	<i>Scomber australasicus</i>	
Indian mackerel	<i>Rastrelliger kanagurta</i>	

### Principle of species ID (Taxonomic keys)

Taxonomic keys for Scombridae species have been indicated by the IOTC/CTOI (2022) and Nakabo (2013). Regarding Yellowfin tuna and Bigeye tuna, detailed guides for species identification are given by Itano (2005) & Fukufuka and Itano (2006). While several references are available, there are cases where several morphological keys exist to make a choice of two distinct species groups. However, multiple choices can cause confusion for the users working on-site. Fig. 1-A ~ Fig. 1-E shows the taxonomic keys selected for the identification of the 19

target species indicated in Table 1. For simplification of the taxonomic keys, we carefully selected just one characteristic which is most prominent. We also modified the expression of some keys which were relative or qualitative into absolute or quantitative expressions.

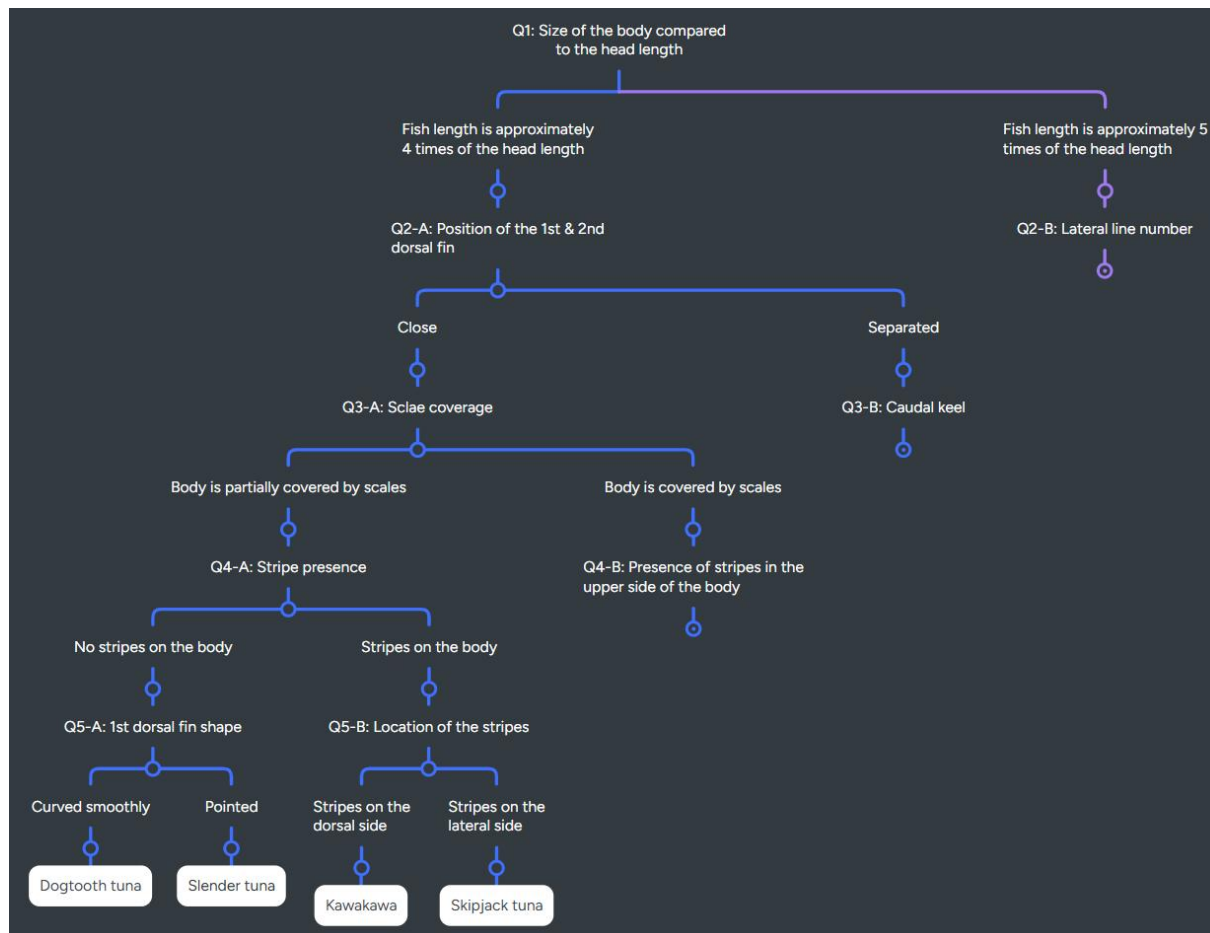


Fig. 1-A Overview of the taxonomic keys of the 19 species in the Scombridae family. Taxonomic keys after Q4-B are indicated in Fig. 1-B and Fig. 1-C. Taxonomic keys after Q3-B are indicated in Fig. 1-D. Taxonomic keys after Q2-B are indicated in Fig. 1-E.

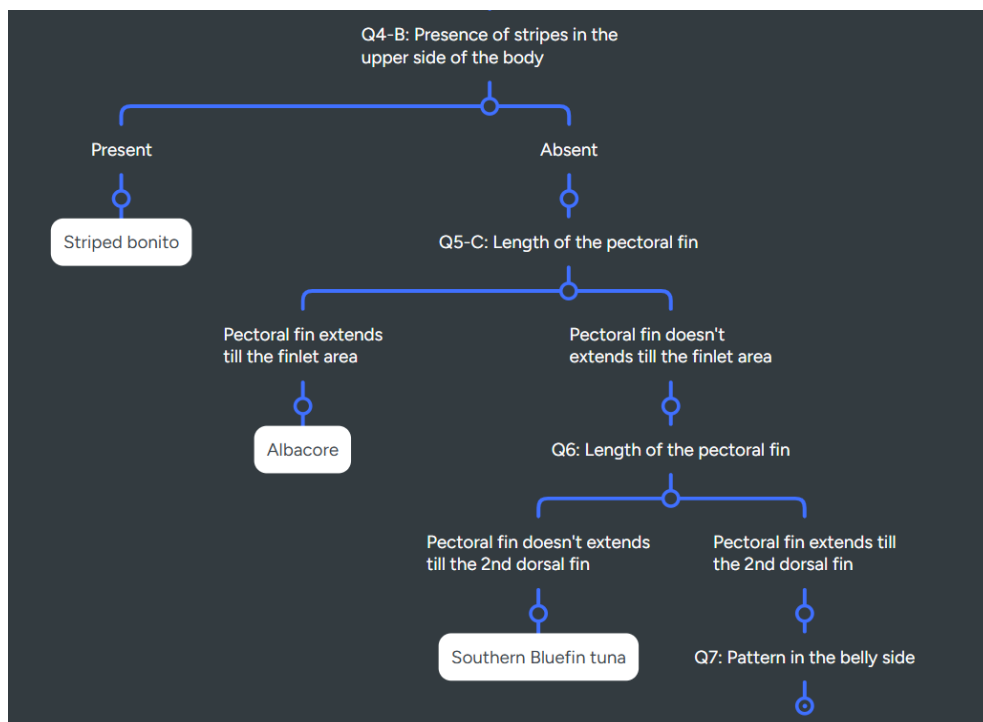


Fig. 1-B Overview of the taxonomic keys of the 19 species in the Scombridae family. Taxonomic keys after Q4-B (see Fig. 1-A) are indicated. Taxonomic keys after Q7 are indicated in Fig. 1-C.

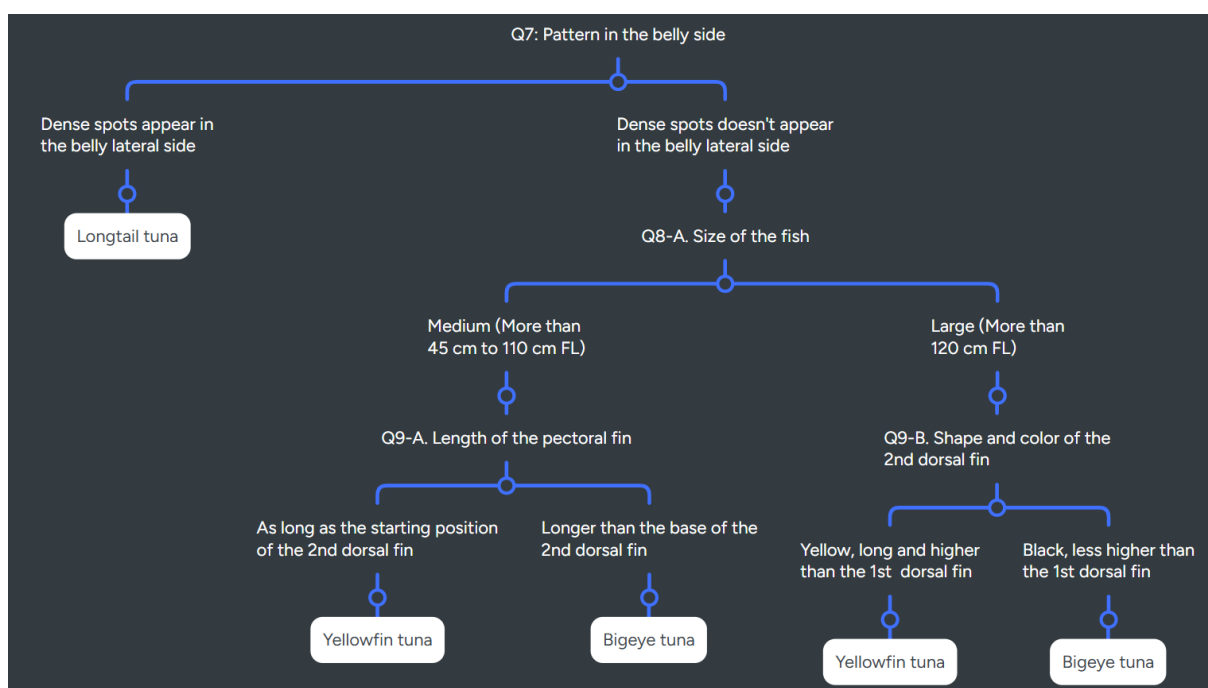


Fig. 1-C Overview of the taxonomic keys of the 19 species in the Scombridae family. Taxonomic keys after Q7 (see Fig. 1-B) are indicated.

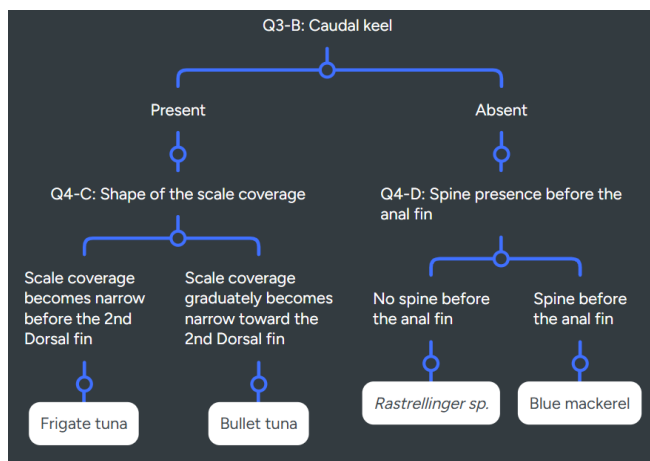


Fig. 1-D Overview of the taxonomic keys of the 19 species in the Scombridae family. Taxonomic keys after Q3-B (see Fig.1-A) are indicated.

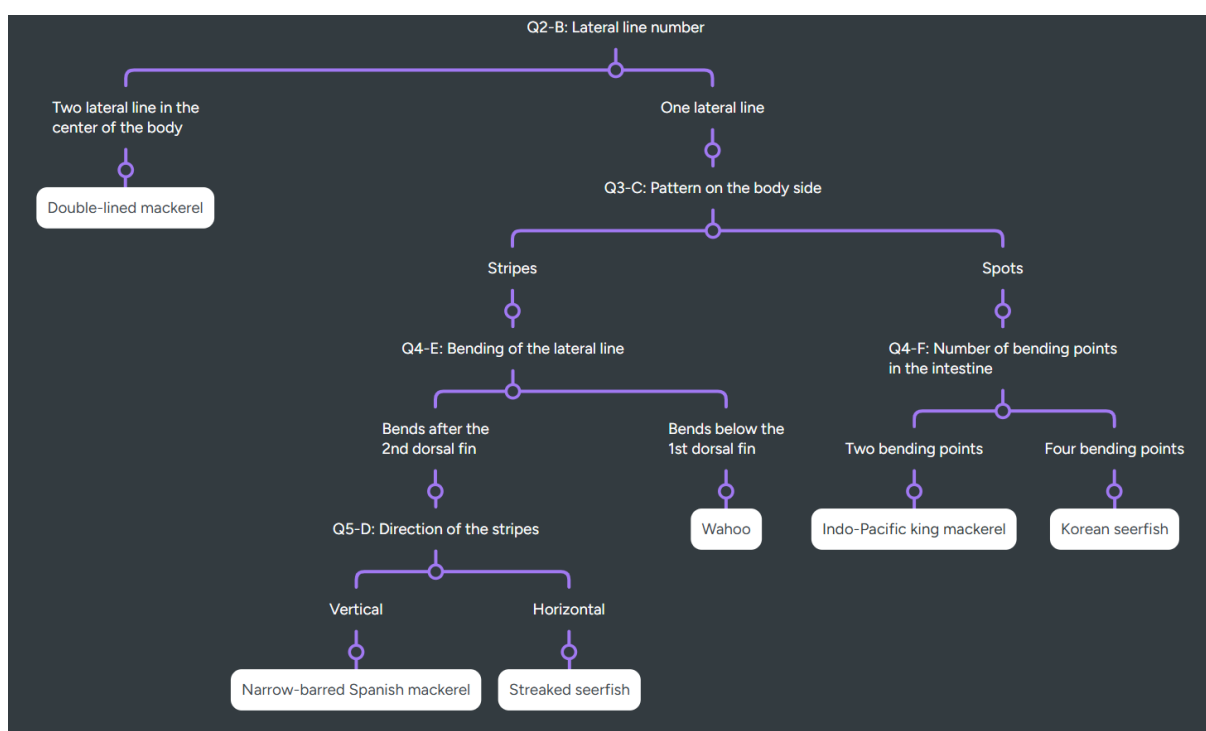


Fig. 1-E Overview of the taxonomic keys of the 19 species in the Scombridae family. Taxonomic keys after Q2-B are indicated (see Fig.1-A).

## Conversion of the taxonomy keys into Open Data Kit (ODK) question form

### Basics of ODK

Open Data Kit (ODK) is a free, open-source platform which enables the creation of digital data collection forms, such as questionnaires. The structure of the questionnaire is similar to a taxonomic key; creating specific questions depending on the answer of the user.

Fig. 2 shows the steps to create the ODK question form. First, questions settings need to be defined in an XLS file. By uploading the XLS file in a web-service which converts XLS files to ODK, a question form is created with an unique URL.

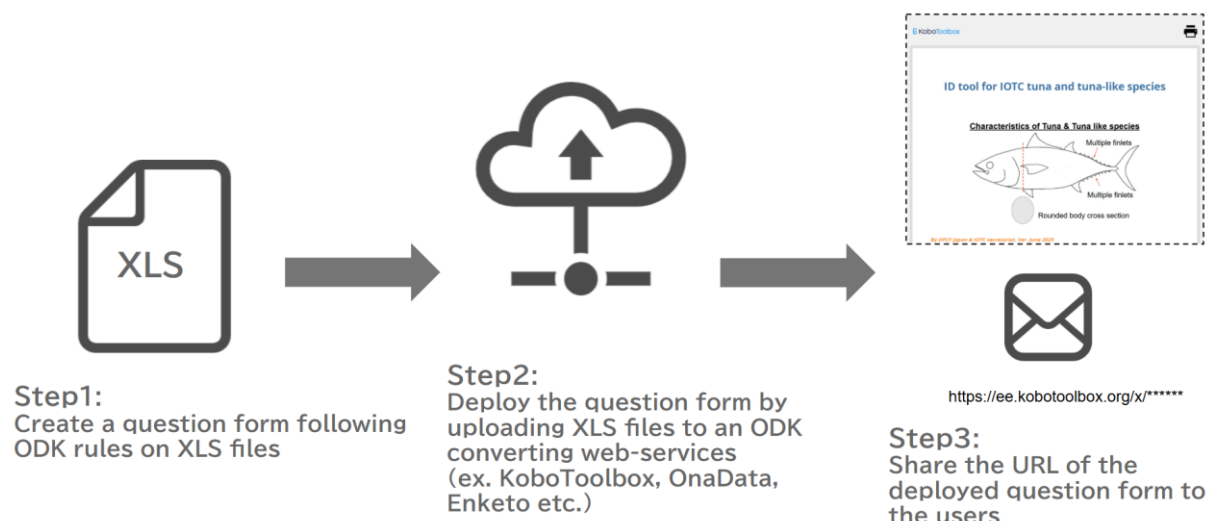


Fig. 2 Steps to create an ODK question form

### Creation of an XLS file

The ODK acceptable XLS files require three types of sheets inside; “Survey sheet”, “Choices sheet” and “Settings sheet”. Fig. 3, 4 and 5 show the example of each sheet.

“Survey sheet” is the main component where the question form is designed (Fig. 3). In this sheet, multiple question types can be used (see question types in the [ODK website](#)). In the case of the present species ID question form, “select\_one” which allows only one answer selection from multiple choice questions is mainly used. “Choices sheet” is where the choices are defined (Fig. 4), which correspond to the multiple choice question type such as “select\_one” in the “Survey sheet” (Fig. 3). “Settings sheet” defines the title of the questionnaire and other information for management purposes (Fig. 5).

	A	B	C	D
1	type	name	label::English	relevant
2	select_one bodyshape1	bodyshape1	Select the body shape	
3				
4	select_one dorsalfin1	dorsalfin1	Is the 1st & 2nd dorsal fin close?	\${bodyshape1}="bodyshape1-1"
5				
6	select_one pattern1	pattern1	What is the pattern on the body side?	\${bodyshape1}="bodyshape1-2"
7				

Fig. 3 Example of the “Survey sheet”. In the “A” column, the type of question (“select one”) is defined with names corresponding to “B” column (“select one bodyshape1”). In the “C” column, “label” shows how the question sentence will be shown on the screen. In the “D” column, “relevant” defines what question will popup depending on the previous chosen answer.

	A	B	C
1	list_name	name	label::English
2	bodyshape1	bodyshape1-1	Rounded
3	bodyshape1	bodyshape1-2	Elongated
4			
5	dorsalfin1	dorsalfin1-1	Close
6	dorsalfin1	dorsalfin1-2	Separated
7			
8	pattern1	pattern1-1	Stripes
9	pattern1	pattern1-2	Spots
10			

+    ≡    1 survey ▾    choices ▾    settings ▾

Fig. 4 Example of the “Choices sheet”. In the “A” column, the name corresponding to the “Survey sheet” “B” column (see Fig. 3) is indicated. In the “B” column, code for identifying the answer is defined. The “C” column indicates how the choice sentence will be shown on the screen.

	A	B	C
1	form_title		
2	Species ID flow (Example)		
3			

+    ≡    1 survey ▾    choices ▾    settings ▾

Fig. 5 Example of the “Setting sheet”. In the “A” column, the name which comes on the top of the question form is indicated.

### Deploying the XLS file

Fig. 6 shows the example of the process to deploy the XLS form using the “Kobo-toolbox” service. The deployment process is simple, following the popup screen in the web-service.

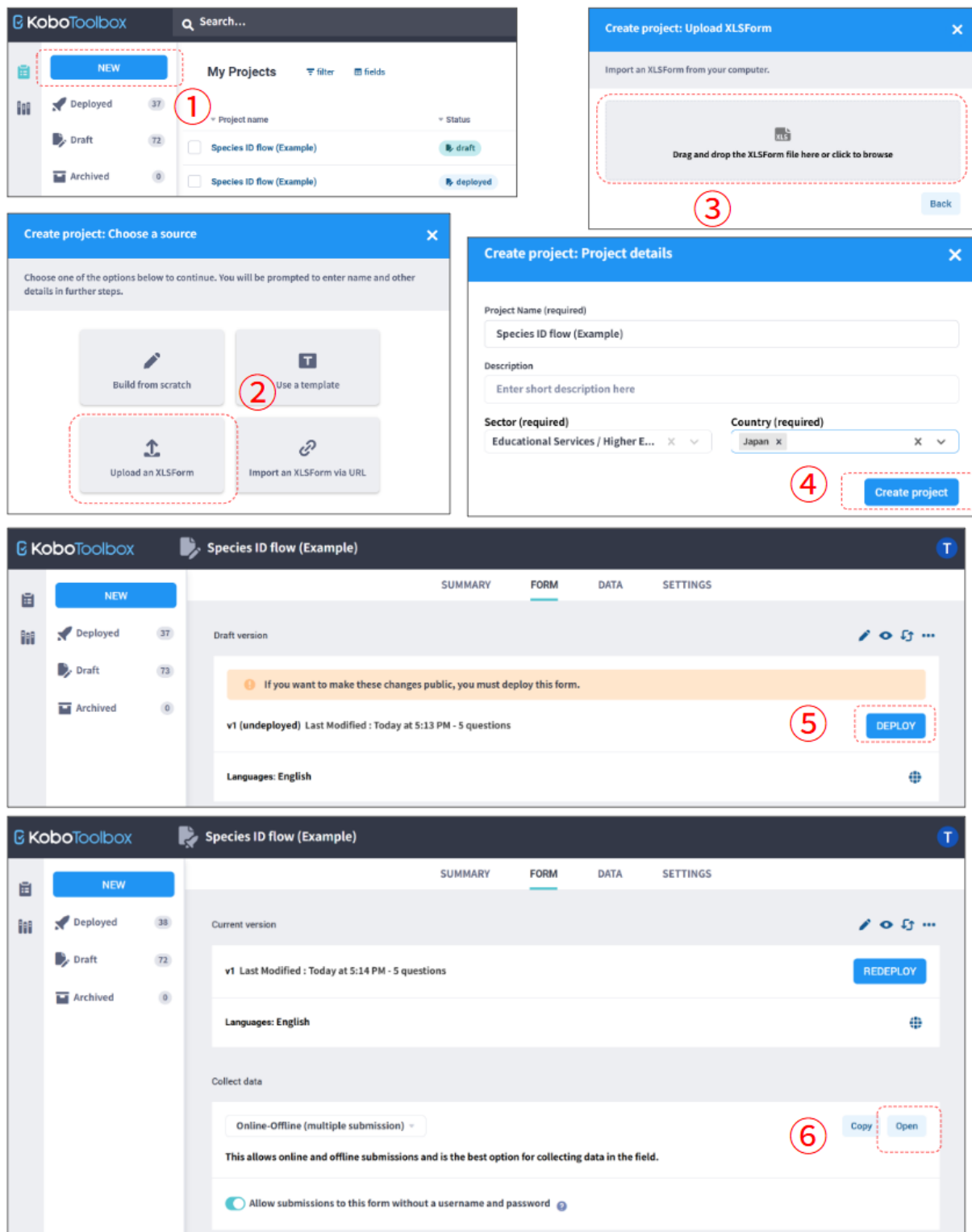


Fig. 6 Example of deploying XLS files for ODK using Kobo-toolbox. After logging in the “Kobo-toolbox” website, Click “NEW” (①) and upload the prepared XLS file for ODK(②,③). After making an arbitrary settings (④), a new screen will be displayed. Once the conversion of the XLS file is successful, a “DEPLOY” button will be shown (⑤). By clicking the “DEPLOY” (⑤) and “Open” button (⑥), ODK question form will be displayed (see Fig. 7).



### Deployed ODK question form

Example of a deployed ODK question form using the XLS file example indicated in Fig. 3, 4, and 5 is shown in Fig. 7. By making choices on the first screen, consecutive questions will popup digitally. Note that users can either submit their answers or close the ODK without submitting the form.

Fig. 7 Example of deployed ODK question form when converting XLS file indicated in Fig. 3, 4 and 5, using “Kobo-toolbox”. Title of the question form is corresponding to the settings in Fig. 5 “A” column. The Question sentence corresponds to the “C” column in Fig. 3, and the selection sentence corresponds to the “C” column in Fig. 4. Once selection is made (“Rounded”, right figure), the next question corresponding to the previous selection popup (“Is the 1st & 2nd dorsal fin close?”, left figure) following the “D” column settings in Fig. 3

### Development of ODK for species identification of Scombridae IOTC species

Following the design of taxonomic keys indicated in Fig. 1-A ~ Fig1-E, ODK question form has been created with an XLS file and deployed using “KobotoolBox”. Several improvements and updates have been conducted since the initial version was deployed in April 2024.

The improvement and updates were mainly based on two tests conducted with enumerators, officers, and researchers in the Indian Ocean. The first test was conducted with enumerators and officers of Seychelles Fisheries Authority (SFA) in July 2024 (Fig. 8 left). The second test was conducted with enumerators and researchers of the National Aquatic Resources Research and Development Agency (NARA, Sri Lanka) in Dec. 2024 (Fig. 8 right). Both tests were conducted using smartphones and tablets, by observing photos of several Scombridae species. The correct answer rate of the test was calculated, and questions where testers made mistakes were identified.

At the first test conducted in SFA, the correct answer rate at the first attempt was 21% (3/14). The low correct answer rate was due to the mistake made at the first choice, selection of the body shape (Q1 in Fig. 1-A). At the second test in NARA, the correct answer rate at the first attempt was 50 % (12/24, 50.0%). Mistakes made with the selection of the first choice have decreased significantly, and the majority of the mistakes were due to scale coverage choice, which was difficult to confirm from photos.

Given the results of the two tests, improvements were made on the expression of the question sentence and illustrations. Fig. 9 shows the example of improvement made for the selection of the body shape (Q1 in Fig. 1-A). Sentence and illustration was converted to a clear and quantitative expression, to avoid confusion of the users. Although some challenges are left with the user to carefully read the questions, the revised version is expected to achieve a high correct

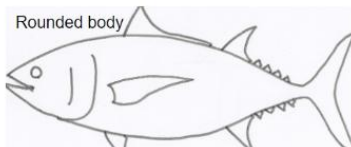
answer rate, if a real fish is observable in front.



Fig.8 Scene of the first test of ODK question form for species ID. Test conducted at the Seychelles Fisheries Authority in July 2024 (left). Test conducted at the National Aquatic Resources Research and Development Agency in Dec. 2024 (right).

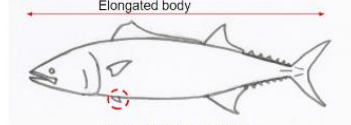
How does the body shape and size of the pectoral fin looks like?

☒ Rounded



Rounded body

☐ Elongated with small pelvic fin compared to the body size

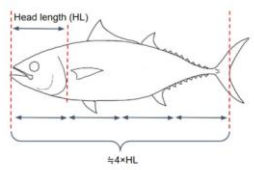


Elongated body

Relatively small pelvic fin

Size of the body compared to the head length

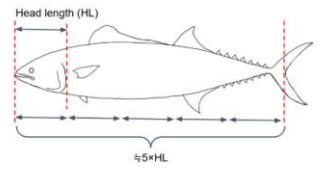
☐ Fish length is approximately 4 times of the head length



Head length (HL)

$4 \times HL$

☐ Fish length is approximately 5 times of the head length



Head length (HL)

$5 \times HL$

Fig.9 Improvement of questions and illustrations made for the body shape selection (Q1 in Fig. 1-A). Initial version used qualitative expressions such as “Rounded” & “Elongated” (left). Initial version also used relative expressions such as “Relatively small” (left). The present version uses quantitative expressions such as “Fish length is approximately 4 times of the head length” (right). The present version also excludes relative expressions such as “Relatively small”.

### Users guide “ID tool for IOTC tuna and tuna-like species”

The latest version of the ODK question form is available in the following website: <https://iotcofcf.wixsite.com/speciesid/idtool> (see Fig.10 for the QRcode). The name of the tool ODK question form for Scombridae IOTC target species was defined as “ID tool for IOTC tuna and tuna-like species” (ID tool) based on the discussion of OFCF Japan and IOTC secretariat.



<https://iotcofcf.wixsite.com/speciesid/idtool>

Fig. 10 QR code access for the latest ID tool for IOTC tuna and tuna-like species.

The ID tools requires the following three points to accomplish correct species identification;

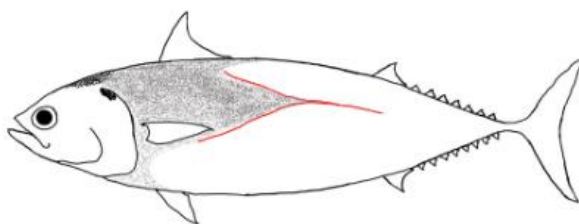
**1. Carefully read the question, and observe the fish**

Question and illustration is made as clear as possible, however users need to carefully read the questions and observe the fish. Sometimes there are only subtle differences between the two choices (Example shown in Fig. 11). Choices where mistakes are frequently made are indicated with red colors, to recall attention for the users.

**Shape of the scale coverage**

***Check the shape of the red lined area***

☐ Scale coverage becomes narrow before the 2nd Dorsal fin



☐ Scale coverage gradually becomes narrow toward the 2nd Dorsal fin

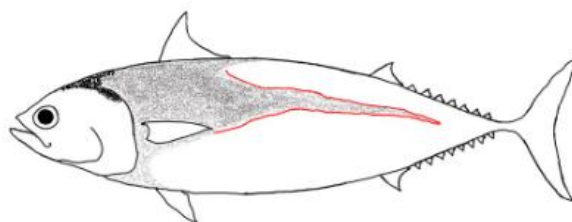


Fig. 11 Example of choices where careful observation is needed. The example shows the difference in the shape of the scale coverage area in Bullet and Frigate tuna (Fig. 1-D, Q4-C). Attention for users are recalled in red characters.

**2. Check the results (Compare the photo and the appearance of your fish)**

Always check if the appearance of the fish coincides with the appearance of the fish in the result. Every result has a hyperlink in the species name, so that users can check robust keys for species identification, such as countable characteristics of the fish (Fig. 12). If those countable characteristics are different, there is a high possibility that choices made by the user were not correct.

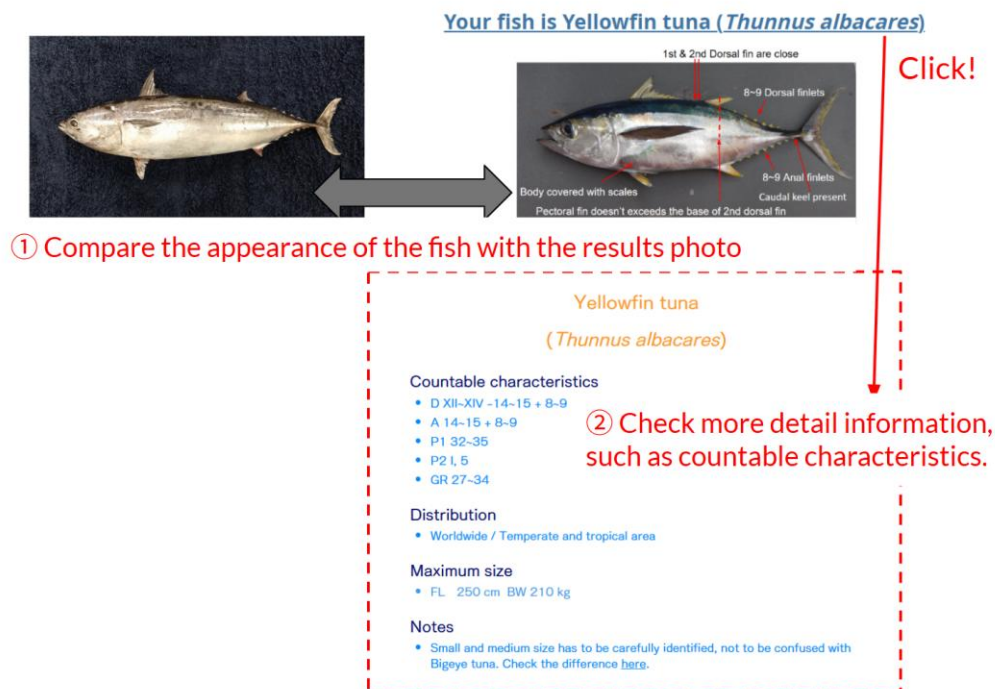


Fig.12 Example of checking the results. Once you have the results, compare the photo and the appearance of your fish. If you have doubts in the results, click the hyperlink in the species name, which leads you to more detailed information. If differences in countable characteristics are found, there may be a high possibility that your species identification was not correct.

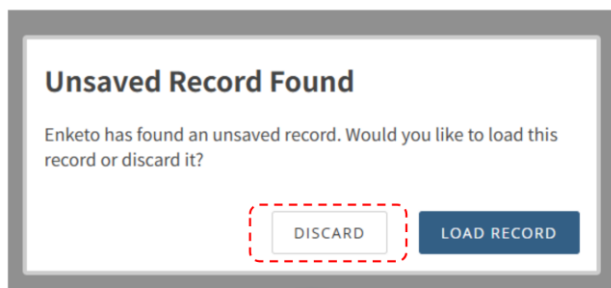
### 3. Rewind, if the results seems to be incorrect

If the results seem not correct through the 2. process, rewind the question until you find points that your choice seemed to be incorrect. After identifying the choice which is not correct, try a different choice and check the results.

### Tips

#### "Unsaved Record Found"

"Unsaved Record Found" message will frequently come up, whenever the previous user of the ID tool exists (see Fig.13). In such cases, simply choose "DISCARD" to continue.



Choose "DISCARD"

Fig.13 "Unsaved Record Found" message. Simply choose "DISCARD" to continue using the ID tool.

### How to add the ID tool to home screen

The ID tool is functionable by accessing its unique URL, however accessing the URL each time will be bothersome. Adding the ID tool to the smartphone home screen will be convenient for frequent users. Fig. 14 shows how to add the ID tool to the home screen (Android).

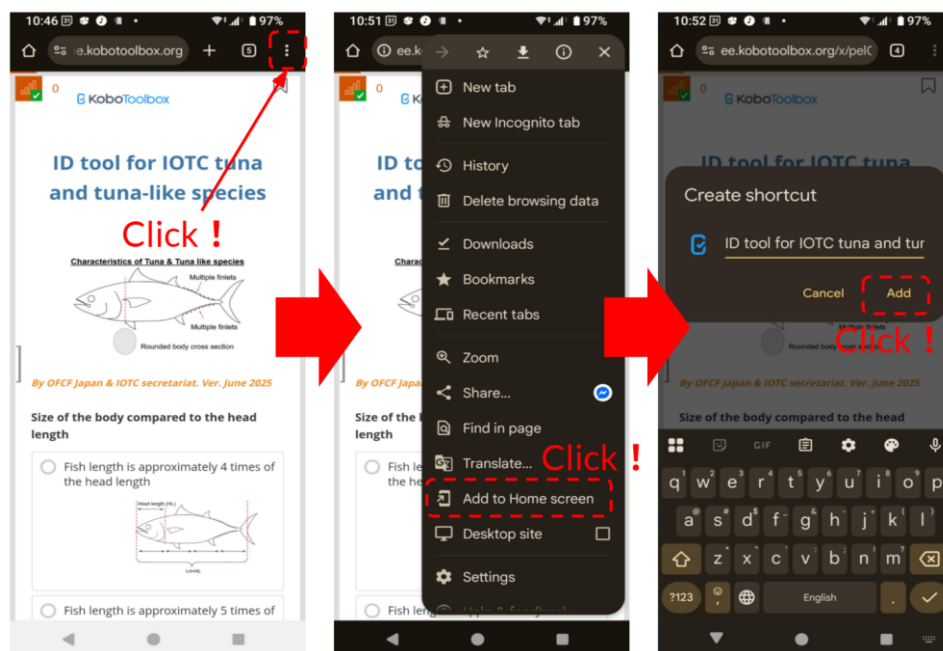


Fig. 14 Example of how to add the ID tool to home screen (Android)

#### Running cost (in case of data submission)

ODK is originally a platform developed for data collection purposes where “Submit” (See Fig. 7) of data is a prerequisite. Depending on ODK deploying services, there are different conditions on the extent of free data submission. At the point of June 2025, "KobotoolBox" accepts 5,000/month submission in a free account service. OnaData allows 500/month submission in a free account service.

The present ID tool assumes no data submission, hence the running cost is basically free. However, in case the person or institute aims to collect data on what species have been identified by enumerators or observers, paid services can be an option depending on the expected number of submissions per month.

#### Copyrights

The present ID tool is designed by the OFCF Japan, but open to all users interested. Translation, modification, customization is open for the users without copyright concerns. Illustration used in the ID tools is made by Tadanori Fujino, Fisheries Expert of OFCF Japan, and users may utilize it without copyright concerns as well. Note that photos include copyright marks, hence we ask the users not to modify or delete the copyright marks.

#### Multilingual support

Language transformation can be easily made by translating the “label” (“C” column in Fig. 2 and 3) in the XLS files, then deploying the form. Note that characters inside images need to be edited separately if language transformation is needed. Editable images files, and technical support is available by contacting OFCF Japan (ofcf.fujino@gmail.com).

**Acknowledgement**

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