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OPEN ARTFISH AND THE FAO ODK MOBILE PHONE APPLICATION

A TOOLKIT FOR SMALL-SCALE FISHERIES ROUTINE DATA COLLECTION

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OPEN ARTFISH AND THE FAO ODK MOBILE PHONE APPLICATION

A TOOLKIT FOR SMALL-SCALE FISHERIES ROUTINE DATA COLLECTION

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Note:

FAO declines all responsibility for program maintenance and upgrading as well as for any damage that may arise from such activities. Users are, however, requested to report any OPEN ARTFISH errors or deficiencies to: Fish-Statistics-Inquiries@fao.org

FAO does not support any third party customization or provide fixes to issues that might arise due to modification or any OS related issues unless such solutions were directly made available by FAO.

FAO is not distributing any physical mobile phone devices. The mobile phone application is "ODK collect" that has to be downloaded from Google Play Store: https://play.google.com/store/apps/details?id=org.odk.collect.android

FAO does not support or provide fixes to issues that might arise from ODK application and server installations. Please refer to: https://forum.opendatakit.org/ for additional support.

PREPARATION OF THIS DOCUMENT

This document was prepared by FAO Fisheries and Aquaculture Statistics and Information Branch (FIAS). Its main aim is to put forward a toolkit for routine small-scale fisheries data collection, comprising a generic database (OPEN ARTFISH) and a mobile phone application. The document was prepared by Dr Gertjan de Graaf (Nefisco, the Netherlands) and Dr Constantine Stamatopoulos (International Consultant, Fisheries Statistics, Italy). Mr Tony Jarrett (FAO Fishery Data Officer, Italy) reviewed and modified the OPEN ARTFISH database where required.

ABSTRACT

Knowledge of the status and trends of capture fisheries, including socio-economic aspects, is a key factor for sound policy development, better decision-making and responsible fisheries management. Capacity building in data collection and fisheries statistics has always been a high priority for FAO, regional fisheries bodies and national fisheries authorities. The most recent effort by FAO was the development of this toolkit for routine small-scale fisheries data collection. The toolkit comprises a generic database (OPEN ARTFISH) and a mobile phone application. The toolkit's primary objective is to facilitate the implementation of cost-effective and sustainable routine data collection, storage and analysis of data, using the appropriate statistical procedures.

FAO. 2017. *OPEN ARTFISH and the FAO ODK mobile phone application: a toolkit for small-scale fisheries routine data collection.* Rome. Italy.

CONTENTS

FOREWORD

Among the major tasks of FAO is the promotion of improved approaches and techniques for the collection of data on agricultural statistics, including fisheries and forestry. The need for reliable and comprehensive statistics has always been extremely important, all the more so at the present time, as they provide the essential basis for planning sustainable harvesting and environmental protection within a precautionary approach.

Collection of basic data on catches, fishing effort and prices provides the primary data for a wide variety of statistical applications. In addition, more detailed data extracted from regularly conducted sample-based fishery surveys–notably those relating to fishing vessels, gear and operations; socio-economic data, etc–are an important source of fishery information with a broad scope and utility.

To help meet national needs for basic fishery data, FAO has been assisting countries in upgrading their data collection, processing and reporting capabilities. Technical assistance at the national and regional level is a significant component of the FAO technical units' work programme, which is responsible for the statistical development of fisheries and involves both normative and field programme activities.

FAO developed and made ARTFISH available to users in 1993. ARTFISH stands for Approaches, Rules and Techniques for Fisheries statistical monitoring. It has been developed as a standardized tool adaptable to most fisheries in developing countries. Its design was driven by the need to offer users robust, user-friendly and error-free approaches with computer software, and achieve the implementation of cost-effective statistical systems for fisheries with minimal external assistance.

A major step in fisheries data collection systems was the development of the "Strategy for improving information on status and trends of capture fisheries" (the Strategy). This Strategy was adopted by consensus at the Twenty-fifth Session of the FAO Committee on Fisheries (COFI) and endorsed by the One Hundred and Twenty-fourth Session of the FAO Council and by the United Nations General Assembly (UNGA) in 2003. The Strategy provides a practical framework for the improvement of knowledge, as well as an understanding of fishery status and trends.

During the implementation of a number of activities to support this strategy, it was recognized that a new, user-friendly version of ARTFISH was needed. With the support of FAO, tailor-made OPEN ARTFISH systems were developed in a number of African countries over the period 2011–2015. Furthermore, in 2015-2016 FAO successfully tested a mobile phone application for fisheries data collection and its inclusion in OPEN ARTFISH.

With this manual and accompanying software, FAO provides the generic version of OPEN ARTFISH and the FAO ODK mobile phone application.

Marc Taconet
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Statistics and Information Branch

ACKNOWLEDGEMENTS

The development of this toolkit was made possible thanks to a number of projects and collaborators. Mr Tony Jarrett (FAO) developed the first version of OPEN ARTFISH in 2011 for Burundian artisanal fisheries, during the Lake Tanganyika Integrated Regional Development Programme. Thereafter, with financial support from FAO, World Bank and African Development Bank projects, different tailor-made versions of OPEN ARTFISH were developed and tested for artisanal fisheries in the United Republic of Tanzania, Ghana, Cameroon, the Republic of the Congo, the Democratic Republic of the Congo, Sao Tome and Principe, and Zambia. The authors gratefully acknowledge the support and efforts of fisheries statistics staff in these countries. Particular thanks are reserved for Mr Luca Garibaldi (FAO), whose continuous support enabled the development of a generic version. Authors also thank Mr Aymen Charef (International Consultant, FAO) for the overall support, reviewing and finalizing this publication.

ABBREVIATIONS AND ACRONYMS

ARTFISH	Approaches, Rules and Techniques for Fisheries statistical monitoring
BAC	Boat Activity Coefficient
CAS	Catch Assessment Survey
CECAF	Fishery Committee for the Eastern Central Atlantic
COFI	FAO Committee on Fisheries
COREP	Regional Fisheries Committee for the Gulf of Guinea
CPUE	Catch Per Unit of Effort
CWP	Coordinating Working Party on Fishery Statistics
PAB	Probability Active Boat
FCWC	Fishery Committee for the West Central Gulf of Guinea
FIS	Fisheries Information System
GPS	Global Positioning system
SSF	Small-Scale Fishery
STF	Status and Trends in Capture Fisheries
SWIOFC	South West Indian Ocean Fisheries Commission
UNGA	United Nations General Assembly

INTRODUCTION

Knowledge of the status and trends in capture fisheries (STF), including their socio-economic aspects, is key to sound policy development, better decision-making and responsible fisheries management. At the national level it is necessary for the maintenance of food security and to describe the social and economic benefits of fisheries. Such information is also essential when assessing the validity of fisheries policy and in order to track the performance of fisheries management. With an increasing number of countries adopting a decentralized management of fisheries, more accurate and timely information should reach the community level and result in a better-informed public that supports efforts to manage fisheries and aquatic resources in a responsible manner.

However, a chronic insufficiency in the human and financial resources allocated to data collection has often resulted in poor-quality information, which has led to further non- or limited use of statistics for fisheries management and policy development. Consequently, the systematic improvement of national fishery data and information collection systems has only received dwindling support. There is an urgent need to end this vicious cycle. Concerned with such persistent deficiencies in fisheries data and information collection systems worldwide, FAO, at the request of the FAO Committee on Fisheries (COFI), developed the "Strategy for improving information on status and trends of capture fisheries". The strategy was adopted by consensus at the Twenty-fifth Session of COFI and endorsed by the One Hundred and Twenty-fourth Session of the FAO Council and by the United Nations General Assembly (UNGA) in 2003. The strategy provides a practical framework for the improvement of knowledge and understanding of fishery status and trends. It is a document that provides guiding principles for implementation arrangements, and it sets forth objectives, policies, programmes, actions and decisions which define who will do what and why.

Much has been written on the collection of fishery data. However, there have been several important developments in recent years:

- Experiences of successes and failures with data collection schemes have led to a renewed emphasis on the sustainability of systems through cost-effective–rather than ambitious–data-gathering methodologies.
- Computers with powerful data-handling tools have become widely available, thus increasing the level of detail that can be collected, stored and processed cheaply.
- Communications have improved and become cheaper, especially through the increasing coverage of mobile phone networks.
- There is increasing local capacity in the IT sector and database design.

The FAO FishCode-STF Project, the World Bank and regional and subregional fisheries organizations in Africa–the Regional Fisheries Commission for the Gulf of Guinea (COREP), the Fishery Committee for the West Central Gulf of Guinea (FCWC), and the South West Indian Ocean Fisheries Commission (SWIOFC)–are working on the strengthening of artisanal fisheries data collection. Experiences of the projects in a number of countries indicated that ARTFISH is appreciated and still used in some countries.

The introduction of ARTFISH in the mid-90s was a good development, as it provided the tools for the appropriate monitoring of the catches of artisanal fisheries. Limited local capacity in database design in the mid-90s directed ARTFISH towards a robust standardized tool for artisanal fisheries monitoring.

However, with increasing local IT capacity, this design directive became a constraint, given that ARTFISH functions as a "black box" whereby the users have a limited understanding of the statistical routines in ARTFISH, and cannot easily adapt them.

In 2010 FAO started the development of an international training course in fisheries statistics and data collection (de Graaf, 2014). This resulted in the establishment of a training course for English-speaking countries at the Legon University (Accra, Ghana) in 2010, and for French-speaking countries at the subregional Institute for Applied Economic Statistics (ISSEA, Yaoundé, Cameroon) in 2015 (French version: http://www.fao.org/3/a-i3639f.pdf).

There are several existing methods of statistical fisheries data collection. However, because fisheries are dominated by large and dispersed small-scale fleet, data have to be collected through sample-based surveys. Estimates of annual catches therefore depend heavily on samples of catches and fishing effort from fish landings. However, any sampling design must be achieved at the lowest possible cost; this means that any sampling scheme must be designed to minimize sampling error for a given cost.

The primary objective of this course is to illustrate sampling methods in order to improve routine data collection; doing so can provide the desired precision of estimates at the lowest possible cost, and yet offer a higher degree of accuracy. The design techniques are based on international standards, illustrated with the collection of fisheries statistics and analysis from the region.

The basic statistical procedures presented in this training course were subsequently employed on a number of projects to develop appropriate data collection systems and OPEN ARTFISH databases for artisanal fisheries in Burundi, Ghana, Gabon, Cameroon, Sao Tome and Principe, the United Republic of Tanzania, the Republic of the Congo, the Democratic Republic of the Congo, and Zambia.

In 2015-2016 FAO successfully tested a mobile phone application for fisheries data collection and its inclusion in OPEN ARTFISH.

In 2016 FAO decided to develop a generic, distributable version of OPEN ARTFISH; this document presents the toolkit for small-scale fisheries data collection, which encompasses OPEN ARTFISH and the FAO ODK mobile phone application.

OPEN ARTFISH is based on statistical procedures presented in the training course (de Graaf *et al*, 2014) which provides guidance on the design of the national sample based data collection system. However, expertise in statistics is required to design such system. When funds are available, FAO provides support to the development of the national data collection system, otherwise the national experts have to rely on the documentation and training made available online.

BASIC STATISTICAL PROCEDURES AND SAMPLING FOR SMALL-SCALE FISHERIES

What is sampling

Globally, fisheries are dominated by large and dispersed small-scale fleet, which in most cases can only be monitored by means of sample-based surveys. Details of statistical procedures and sampling for small-scale fisheries can be found in de Graaf *et al*. (2014) and in the bibliography contained therein. The basics are summarised in this chapter.

Data collection is the recording of one or more data variables (catch, value, fishing duration, etc.) from members of a population of "data units" (the population of fishing vessels, fishers, etc.). Two basic data collection approaches are possible:

- by complete enumeration, where **all members** of the whole population are measured;
- by sampling, where only a **proportion of members of the whole population** is measured.

Very large populations, such as small-scale fisheries, can only be sampled. A complete enumeration-based survey is often preferred for certain types of data solely because it is expected that it will provide complete statistical coverage over space and time. However, a well-designed, sample-based survey can often provide good estimates of important parameters at a fraction of the cost.

The basics of sample-based approaches can be summarized as follows:

- sampling is used if it is impossible, difficult or expensive to observe all the elements of a target population;
- sample surveys can operate on selected subsets of the target population and by making a number of assumptions regarding the distribution of the population;
- sample-based surveys provide estimates of the parameters being studied, as well as the sample error;
- a well-designed sampling and appropriately implemented survey can often produce accurate and reliable estimates at a much lower cost than complete enumeration.

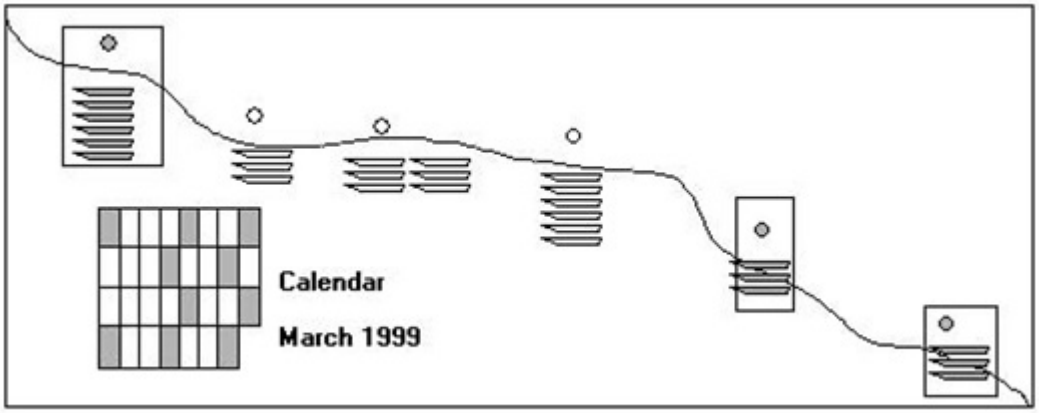
The sustainability of sample-based surveys should be a major point of attention during their design. Sample-based surveys can be sustainable if:

- their design is robust enough to permit continuity when changes occur to the fisheries being statistically monitored;
- training of field and office staff is appropriate and regular so that data collection and processing/analysis are safeguarded against staff changes and turnover;
- they have minimal or no dependence on external technical assistance.

Sampling strategy

Sampling in space and in time is usually the typical sampling approach in many countries. Only a limited number of landing sites can be covered during a certain number of days (Figure 1).

FIGURE 1
Sampling in space and in time



Source: Stamatopoulos 2002.

However, if minor strata (or logical or statistical strata) are well defined, and the sample sizes for the individual strata are sufficient, then this approach will provide reliable results.

Landing surveys

Landing surveys are conducted at landing sites with the purpose of collecting sample data on total catch and species composition, associated effort, and other secondary data such as prices and, in particular:

- catch of all species
- associated fishing effort
- overall catch per unit of effort (CPUE)
- catch by species
- first-sale prices.

The primary objective is to estimate, on a sample basis, fishing days, overall CPUEs and species proportions for each minor stratum and fishing unit.

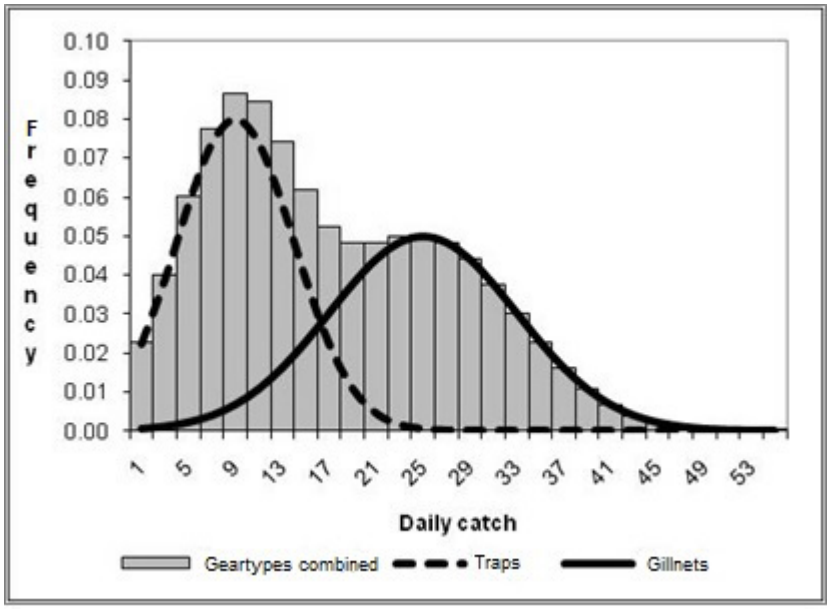
Stratification

Stratification is a rather generic term describing the partitioning of the population being studied into smaller subpopulations. There are "conventional" stratification schemes which are dictated by administrative requirements (such as regions and provinces in a large geographical context) or technical ones (i.e. separating fishing zones or separating fleet segments that are clearly too different to be examined as one entity).

Stratification reduces the error in sample estimates by systematically removing as much data variability as possible through the sampling design. This is achieved by dividing the sample population into homogenous groups or strata. For example, industrial vessels would probably be treated as a separate stratum to artisanal vessels; another option might be to consider the different fishing units within artisanal fisheries as different strata.

FIGURE 2

An example of large variation in collected data if two types of gears are sampled simultaneously



The major practical aim of stratification is to reduce variability in the sampled data,[1] which will improve the reliability of the collected data; however, too much stratification can significantly increase the cost of the data collection system and could make the scheme unsustainable.

This is explained in Figure 2. If we sample an artisanal fleet that is using traps and gillnets as major gear types, and do not differentiate between the two gear types, then we will obtain an average daily catch of about 17 kg, with a catch range from 0 kg to 53 kg, while the real daily catches for traps and gillnets are 9 kg and 25 kg, respectively. The results would be improved if we sampled gillnets and traps separately, i.e. if we made two strata. But costs will increase, as we have to sample 50–75 gillnet operators per month and 50–75 trap operators per month.

Stratification thus is done through:

Major strata: subdivisions based on administrative criteria, which are imposed on the data collection programme for reporting purposes and are therefore not under the control of the survey designer. Normally major strata are provinces, districts, etc.

Minor strata: within a major stratum there are usually subdivisions based on criteria that are chosen by the designer for the sole purpose of increasing the accuracy of the derived estimates and the subsequent setup of the sampling scheme. The estimation of total catch will take place at the minor strata level. Estimates of population parameters are always calculated at minor stratum level. Totals at the major stratum level are simply aggregations of estimates and counts from the minor strata involved.

[1] In strictly statistical terms, stratification has as its primary objective the reduction of risks of bias, namely systematic underestimation (negative bias) or overestimation (positive bias) of catch and fishing effort. The reduced variance then comes as a bonus.

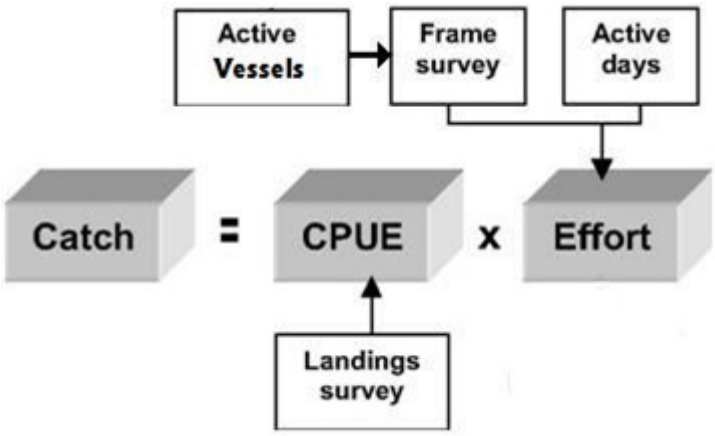
Fishing units: a fishing unit is defined by, "vessel characteristics and its major gear", for example: i) non-motorised dugout canoe with gillnets; ii) motorised planked canoe with gillnets; iii) motorised planked canoe with hook and line, etc. The selection of fishing units should be coherent with data available from frame surveys or vessel registers/licensing. In some countries frame survey data are gear-based, which greatly complicates sampling and reduces the reliability of sampling schemes. It is strongly advisable not to implement gear-based data collection schemes.

Estimation of total catch

With a sample-based approach, an estimation of total catch would use the mean catch per fishing day from a landings sample and the mean number of fishing days per fishing unit from a fishing effort survey: multiplied together, these would give the mean catch per fishing unit. The total catch can then be obtained by multiplying this by the total number of fishing units (a raising factor) obtained from a frame survey or a fishing unit register.

The generic formula for this estimation is as shown in Figure 3.

FIGURE 3
Generic formula for estimating total catches using a sample-based approach



To estimate total catch, we need to collect data on three variables:

1. CPUE, from landings or a catch assessment survey (CAS);
2. the total number, classification and distribution of the fishing units; in principle, this is the fishing capacity, and the data are collected through a frame survey or through registration/licensing systems;
3. active fishing days: the number of days the fishing units actually go fishing, or the number of fishing trips made by the fishing unit each month. This information can be collected through a CAS (PAB-horizontal sampling) or through a separated effort survey (BAC-vertical sampling).

Estimation of total catch is done monthly, for each fishing unit (fu) and for each minor stratum and mathematical; the generic formula can be described as:

Total monthly catch$_{fu}$ = Total number of fishing units × averageFishingdays$_{fu}$ × averageCPUE$_{fu}$

The total monthly catch will be the sum of the monthly catches of all minor strata and fishing units; the annual catch will be the sum of all monthly catches.

Estimation of total catch by species

In a second phase of the ongoing estimation process the monthly catch by fishing unit and species is estimated through:

1. Estimation of the overall monthly species composition, as a percentage of total catch of the fishing units in each minor stratum.
2. The total catch by species is then calculated by multiplying–for each fishing unit and for each minor stratum–the total catch obtained with the proportion of the species.

$$\textbf{Total monthly catch}_{\text{fu-species}} = \textbf{Total monthly catch}_{\text{fu}} \times \textbf{Proportion}_{\text{fu-species}}$$

Reliability of estimates and sample sizes

A common misconception is that the number of samples required is related to the size of the fishing fleet, i.e. you have to sample 5 percent of the fleet, or 10 percent of the fleet, etc.

However, in sample-based statistics there is absolutely no direct relation between the number of fishing units and the number of samples needed monthly!

The number of samples needed is related to the variability in the daily catches of the fishing unit: if the variability is high, large sample sizes are needed; if the variability is low, low sample sizes are needed.

The precision of the estimates is expressed by the "confidence limits" of the "estimated sample mean". In statistics manuals, the confidence limits are often indicated as:

- 90 percent confidence limit = 1.64 $s/\sqrt{n}$ or 1.64 × Standard error of the mean
- 95 percent confidence limit = 1.96 $s/\sqrt{n}$ or 1.96 × Standard error of the mean
- 99 percent confidence limit = 2.58 $s/\sqrt{n}$ or 2.58 × Standard error of the mean

However, in fisheries data collection we often deal with small sample sizes that are not distributed absolutely normal and therefore the confidence limits are calculated by making use of the t-distribution, which makes corrections for small sample sizes (details are presented in Annex 2).

Confidence limits = $\pm t_{n-1}\ s/\sqrt{n}$

Where:

s = standard deviation of the sample[2];

t_{n-1} = is the upper critical value of the t-distribution with n-1 degrees of freedom or the t fractiles from t-distribution tables at probability levels of 90, 95 or 99 percent;

$s/\sqrt{n}$ is also called the standard error of the mean (sem) and we could write:

Confidence limits = $\pm t_{n-1}$*sem

[2] From a statistical point of view it should be noted that the standard deviation for small target population should be corrected with $\sqrt{(N-n)/(N-1)}$ where N = size target population and n = sample size. But in practice this correction factor approaches almost always 1

The 90 percent upper and lower confidence limits mean that we are 90 percent sure that the true target population mean lies somewhere between the upper and lower limits, within the confidence interval.

The confidence limits are expressed in absolute values. Dividing the confidence limit by the sample mean gives the relative error, which is expressed as a percentage of the mean:

Relative error = $\varepsilon = CL/\bar{x} = (t_{n-1}\ s)/(\sqrt{n}\ \bar{x})$

Relative error allows the comparison of the reliability of estimated values of fishing units with differences in the estimated means.

A relative error of 20 percent calculated with a 90 percent probability level indicates that we are 90 percent sure that the **true mean** deviates no more than 20 percent from the value of **estimated mean**. In principle, we are aiming at a relative error that is less than 15 percent, calculated with a probability level of 90 percent. The value of the relative error is determined by:

- the variance in the target population;
- the sample size.

This is explained with two examples presented in Figure 4.

We have two different target populations:

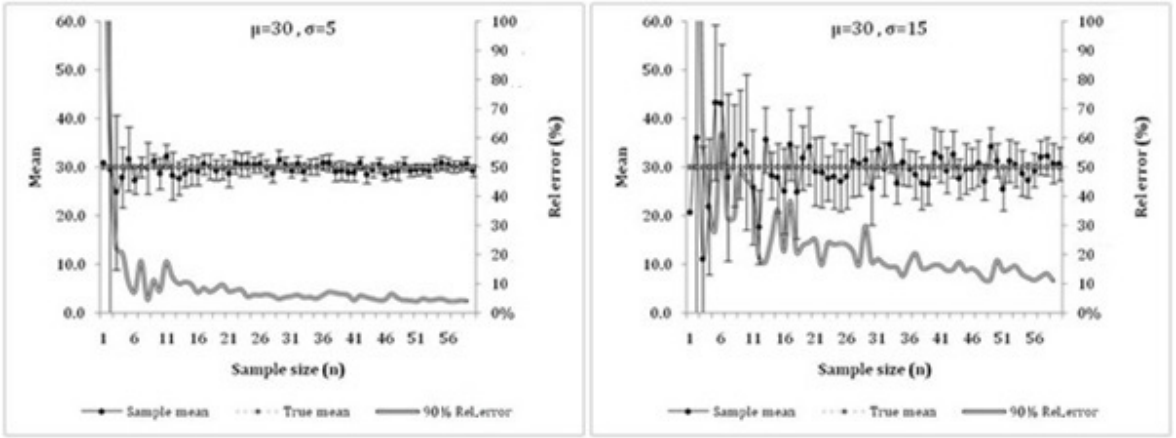
- 1 000 canoes operating very similar gears and number of gears, which results in very similar daily catches, or a low variance of catches in the target population. The mean daily catch of the target population is 30 kg.
- 800 canoes operating different gears, which results in very different daily catches or a high variance of catches in the target population. The mean daily catch of the target population is 30 kg.

We start sampling both target populations, gradually increasing the sample size, and the results are presented in Figure 4.

For the first group, with a low variance in the target population, we see that the confidence limits of the estimated sample mean are relatively low and decrease when the sample size increases. Moreover, it is clear that a relative error of about 15 percent is reached once about 10 canoes are sampled each month.

FIGURE 4

Relative error for samples obtained from two different target populations



For the second group, with a high variance in the target population, we see high confidence limits at a low sample size, which gradually decrease when the sample size increases. However, they still remain high at large sample sizes and we see that the relative error does reach the required value of 15 percent at about 50 samples.

Often the relative error of CPUE is used as an indicator for the reliability of the estimated catch, this is because the greatest variability is often found in daily catches.

To obtain a relative error of 15–20 percent for CPUE at a 90 percent probability level, about 50–75 samples have to be taken for each fishing unit and for each minor stratum per month.

A more correct approach would be to calculate the compound relative error for total catch. It is a compound because it includes the variability of **fishing days** and the variability **CPUE**, both used to estimate total catch. This can be done by:

1. Calculating confidence limits for monthly fishing days;
2. Calculating confidence limits for CPUE;
3. Calculating max fishing days = average fishing days + confidence limit fishing days;
4. Calculating max CPUE = average CPUE + confidence limit CPUE;
5. Calculating max monthly catch = number in frame * max fishing days * max CPUE;
6. Calculating confidence limit for catch = max monthly catch-average monthly catch;
7. Calculating Rel. Error monthly catch = confidence limit catch/average monthly catch.

Fishing effort surveys

In principle, fishing effort is made up of three components:

- the total number of fishing units (F);
- the total number of active vessels;
- the number of fishing days for each vessel (A).

Fishing effort can be described as:

Total fishing effort (total number of fishing days) = F x AC × D

Where:

AC is the activity coefficient indicating how many vessels are active in a month or how many times a fishing unit goes fishing;

F is total number of vessels;

D is the number of days in a month or the maximal number of fishing days in a month.

The activity of the fishing units can be either estimated through the boat activity coefficient (BAC, vertical sampling) or through the fishing activity coefficient (PAB, horizontal sampling). The estimation for both is expressed as:

Total fishing effort (number of fishing days) =F x BAC ×D

or

Total fishing effort = F x PAB × D

Where:

F is total number of vessels in the frame survey;

BAC or PAB is boat or fishing activity coefficient;

D is the maximum number of fishing days in a month for BAC or the total number of days in a month for PAB.

Horizontal sampling (PAB). The easiest way to collect information on the average number of fishing days is to include a few questions on this in the CAS. The fishers know how many days they went out in the previous week, so simply asking them if they went fishing yesterday, before yesterday and how many days they went fishing in the previous week will suffice[3]. This is called horizontal sampling for fishing effort The term "horizontal" is conventional and derives from the fact that the monthly fishing trips of a vessel are usually charted horizontally.

Then:

PAB= (Today=1+Yesterday (yes=1)+Before yesterday (yes=1)+number last week)/10

This system is the cheapest as only one survey is being implemented further; this system is essential for gear-based sampling systems.

Vertical sampling (BAC). In vertical sampling, a separate fishing effort data collection system is designed. Throughout the month, on a daily basis, the total number of fishing units that go fishing, and the total number of fishing units at the landing sites are registered. The term "vertical" is conventional and derives from the fact that the daily activity status of fishing vessels is usually marked vertically on the same column of a chart.

Then**:**

BAC= Total active fishing units/Total fishing units examined

This system is slightly more complicated and marginally more expensive. It can work well in a vessel-based sampling scheme but is highly unreliable in gear-based sampling schemes as it is difficult to find out how many gears went out fishing, given that the number of gears used differs between fishers/canoe owners.

Alternatively, the BAC can be determined on a monthly basis by interviewing key informants at the landing sites. The number of vessels under repair or not functioning is often known if the landing sites are not too large, but using key informants often conflicts with random sampling.

However, the total number of vessels and the active number of vessels can be complicated if the vessels migrate: in other words, if they move from one landing site to another in order to follow resources. They may even move from one country to another, as is the case in some West African countries. If migration is high, then the only solution is to carry out monthly frame surveys at **all landing sites**. This can be done through mandatory reporting.

[3] The authors are aware that horizontal sampling has some bias, as only active vessels are sampled, but the advantages of horizontal sampling outweighs this bias.

WHAT IS OPEN ARTFISH?

OPEN ARTFISH stands for Open Approaches, Rules and Techniques for Fisheries statistical monitoring. It is a generic database which estimates the total catch and value by species for sampling schemes of small-scale fisheries. OPEN ARTFISH uses the appropriate statistical procedures and sampling design, as described both in the previous chapter and in more detail by Stamatopoulos (2002) and de Graaf *et al*. (2014).

OPEN ARTFISH replaces ARTFISH,[4] which FAO made available in 1993.

OPEN ARTFISH is "Open" because it can be easily adapted to local requirements and more specific outputs/reports can easily be added while maintaining the appropriate statistical procedures. Furthermore, OPEN ARTFISH provides an indication of the reliability of the estimates through the relative error of CPUE and the relative error of total catch.

OPEN ARTFISH is deliberately developed in MS Access because:

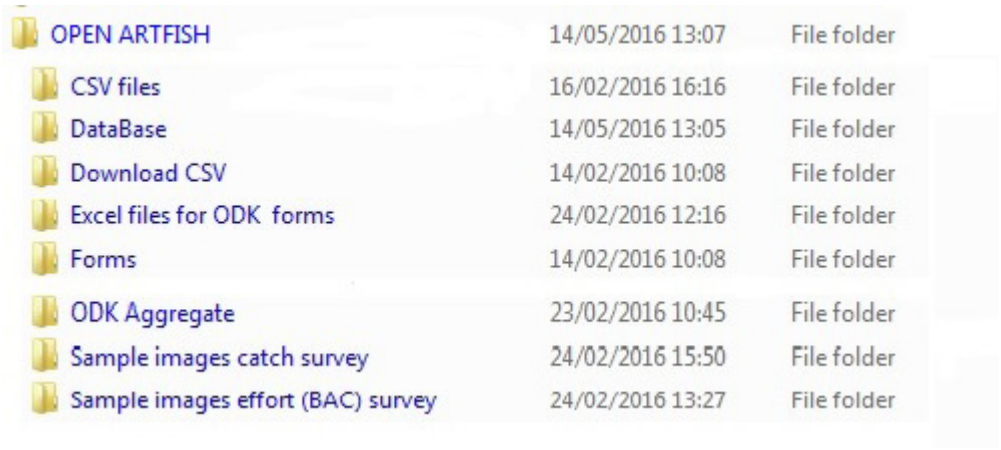
- MS Access is widely distributed and easy to use;
- All estimation procedures can be based on queries, which facilitate the understanding of the estimation process;
- MS Access programmers can be found easily.

The design structure of OPEN ARTFISH is provided in Annex 1.

[4] The version of ARTFISH currently available (www.fao.org/fishery/topic/16081/en) is not compatible with Windows 7 or higher.

OPEN ARTFISH INSTALLATION

Before you start using OPEN ARTFISH, it is recommended to set up the OPEN ARTFISH directory and subdirectories as presented on the figure below



CSV files: The subdirectory to store the Comma Separated Values files from mobile phone applications.

DataBase: The subdirectory to store the OPEN ARTFISH data base.

Download CSV: The subdirectory with the ODK software to download mobile phone data.

Excel files for ODK forms: the subdirectory to store the excel files to make an ODK form created by OPEN ARTFISH.

Forms: The subdirectory with the ODK forms and software to convert them.

ODK Aggregate: The subdirectory for ODK aggregate.

Sample images catch survey: The subdirectory to store images for the catch survey on the mobile phone application.

Sample imaged effort (BAC) survey: The subdirectory to store images for the fishing effort survey on mobile the phone application.

Details will be provided in a later stage.

HOW TO USE OPEN ARTFISH

OPEN ARTFISH will run on Ms Access 2010 or higher. Once you downloaded OPEN ARTFISH, store it in the subdirectory "***DataBase".***

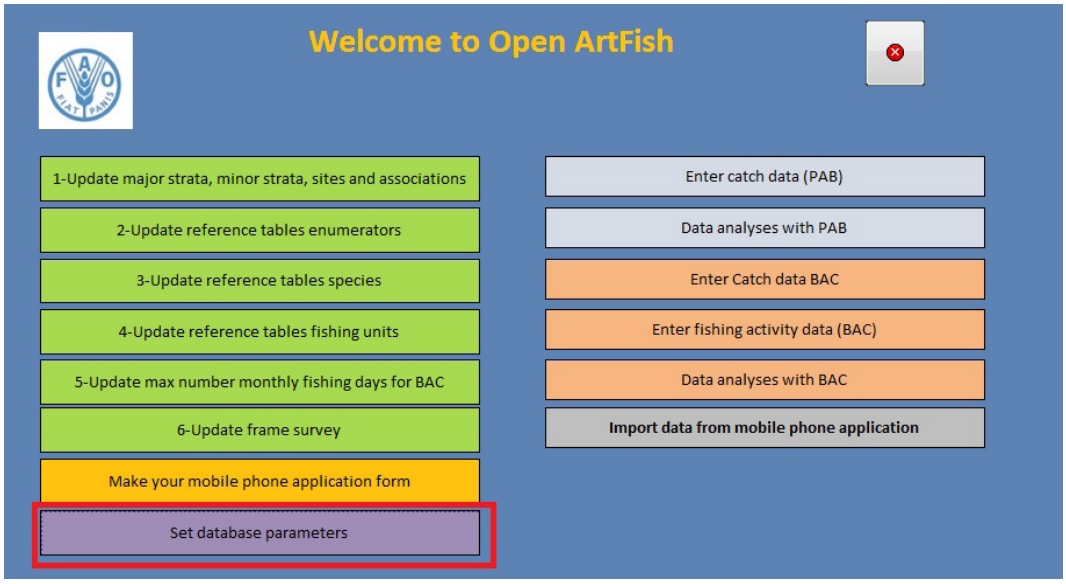
When you open OPEN ARTFISH for the first time you have to "**Enable Content"** on the message bar and you see the welcome screen with different options to select.

Set up of OPEN ARTFISH

Setup the language

First you have to setup your language. OPEN ARTFISH has an English, French, and Spanish and there is an option to make your own language version. The default setting is English, so the opening screen the first time will always be in English.

Click on **"Set database parameters"**

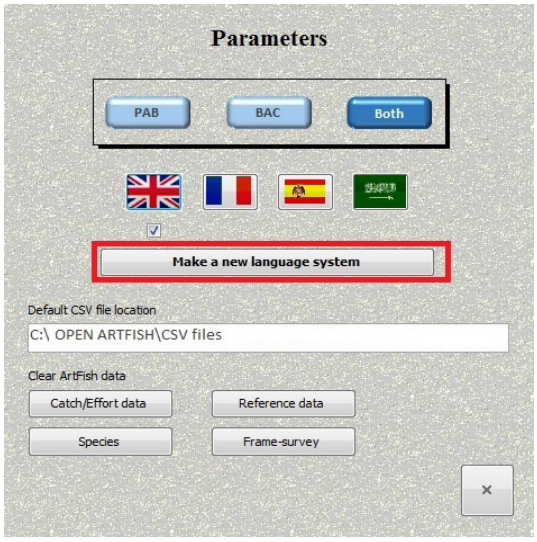


The parameter screen opens and you can select your language by clicking on the flag and closing the screen (the X in the right bottom corner).

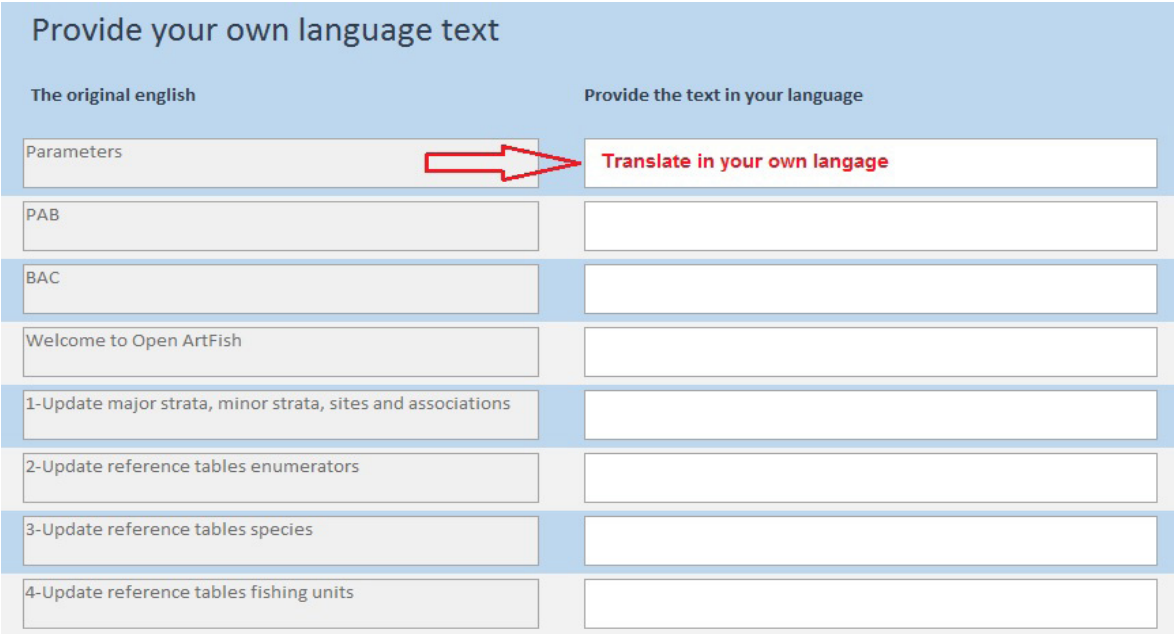
Make your own language version

OPEN ARTFISH has three standard language settings: English, French and Spanish.

You can however make your own languages setting by clicking on **"Make a new language setting"**.



The screen below will open. In the left hand column the English text is visible and you provide your translation in the right hand column. This translation will not have change the database settings of OPEN ARTFISH, it will only result in having all the headings, texts and choices in your own language.



Set up your data collection system

There are three other buttons:

PAB: Select "PAB" if your data collection system uses horizontal sampling for fishing effort (see pages 9 & 10).

BAC: Select "BAC" if your data collection system uses vertical sampling for fishing effort (see pages 9 & 10).

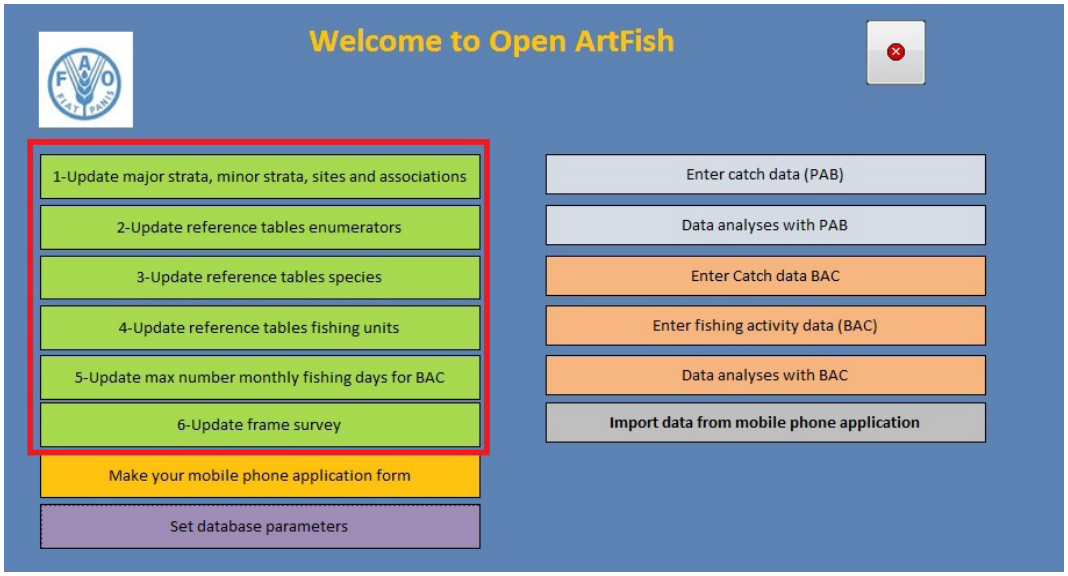
Both: Select "Both" if you are using both systems for sampling of fishing effort.

In the box **"Default CSV files location" you** enter the path for the location of the subdirectory where the CSV files of the mobile phone application are stored.

Fill the reference tables

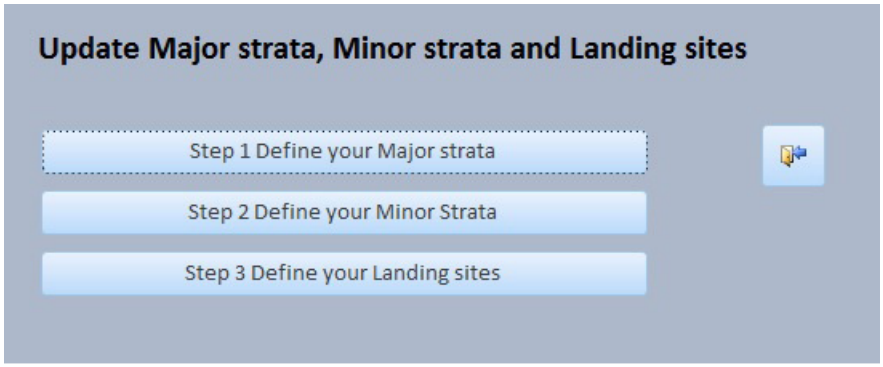
OPEN ARTFISH works with reference tables i.e. there is no free data entering. All names for major strata, species, enumerators, etc., are entered, through **"Pop up lists**" which are linked to reference tables.

To fill the reference tables click on one of the green buttons in the opening screen. Note you have to start with **"No 1 Update major strata, minor strata, sites and association"** as they will be needed in the next reference tables.



Major strata, minor strata and sites

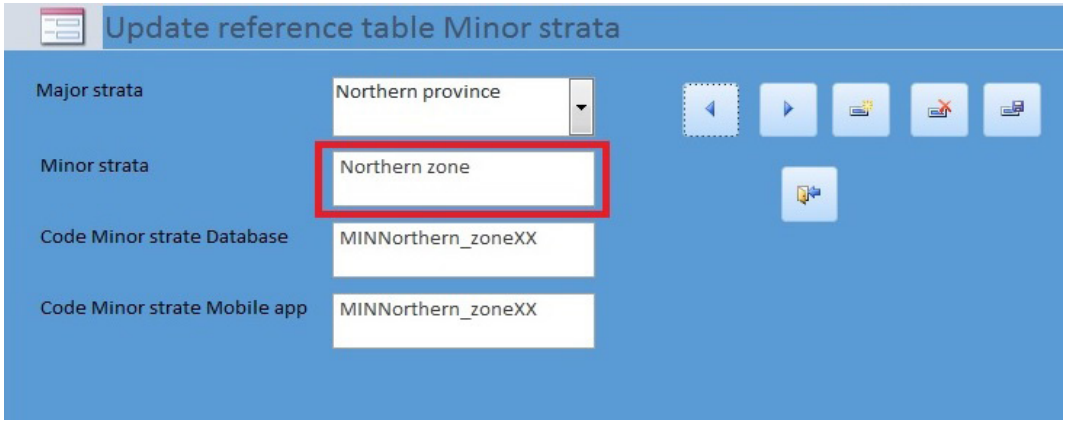
Click on ***"1-Update major strata, minor strata, sites and associations"*** and the screen presented below will open.



Click ***"Step 1 Define your Major strata".***

Provide the names of your major strata, the codes are generated automatically once you entered all the major strata, close the form. You will return to the first screen and click ***"Step 2 Define your Minor Strata"***.

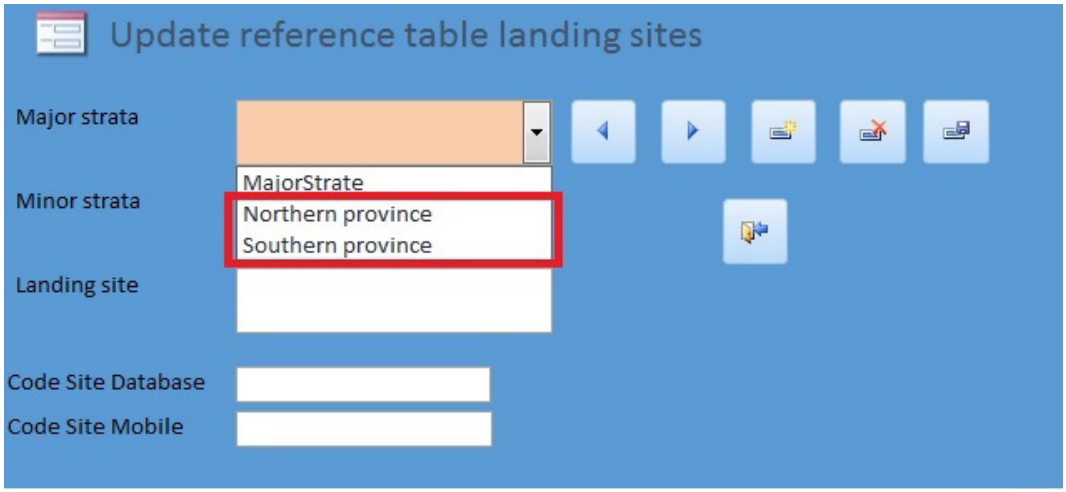
Select in the popup menu the major stratum for which you want to provide the names of the minor strata.



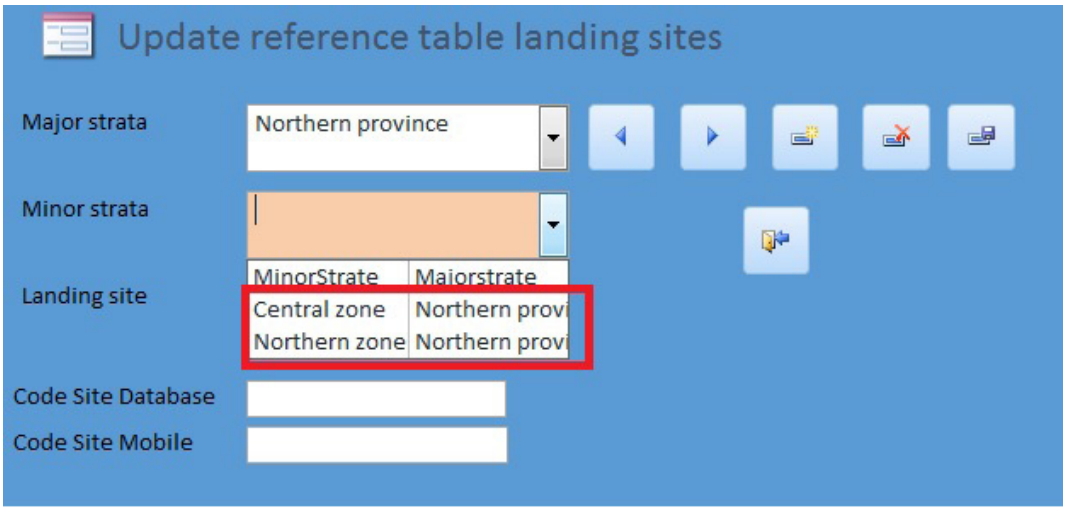
Enter the name of the minor strata. You will see that the codes are generated automatically.

Once you have provided the names of all minor strata for all major strata, you click on close the form.

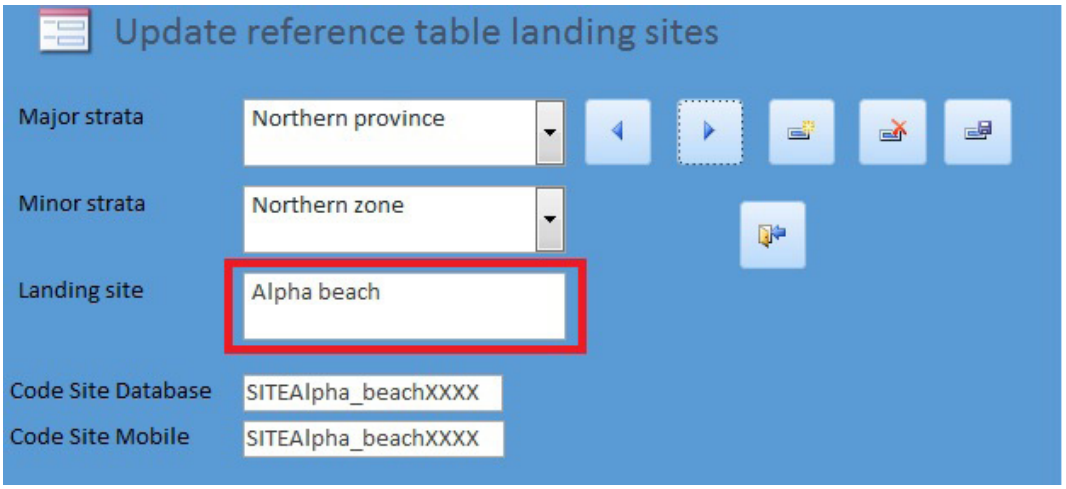
You will return to the first screen and click ***"Step 3 Define your landing sites".***



Select in the popup menu the major stratum for which you want to provide the name of the landing site.



Then select in the popup menu the minor stratum for which you want to provide the name of the landing site.

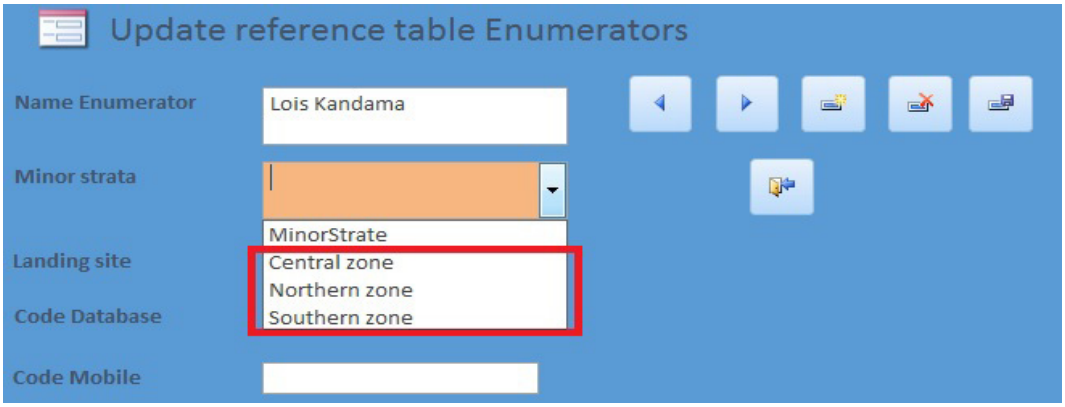


Then enter the name of the landing site, and again you see that the codes are generated automatically.

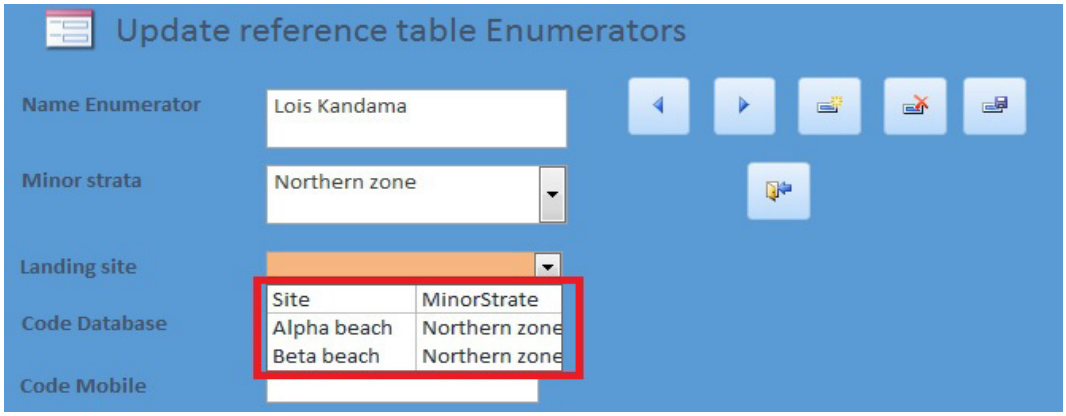
Once you have provided the names of the landing sites (for all major and minor strata), close the form, and go back to the opening screen.

Enumerators

In the main menu click on **"2-Update reference tables enumerators"**.



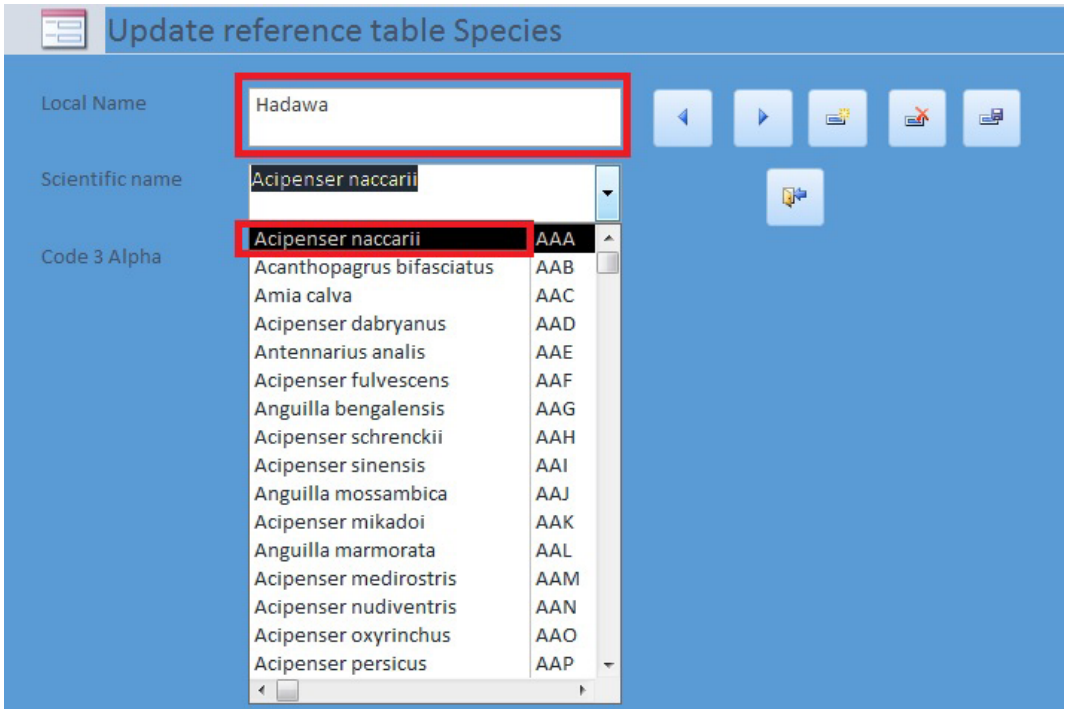
First enter the name of the enumerator, then select in the popup menu the minor strata where the enumerator works.



Then select in the popup menu the landing site where the enumerator works, again you see that the codes are automatically generated. Close the form once you entered all the names of the enumerators.

Species

In the main menu click on **"3-Update reference tables species"**.

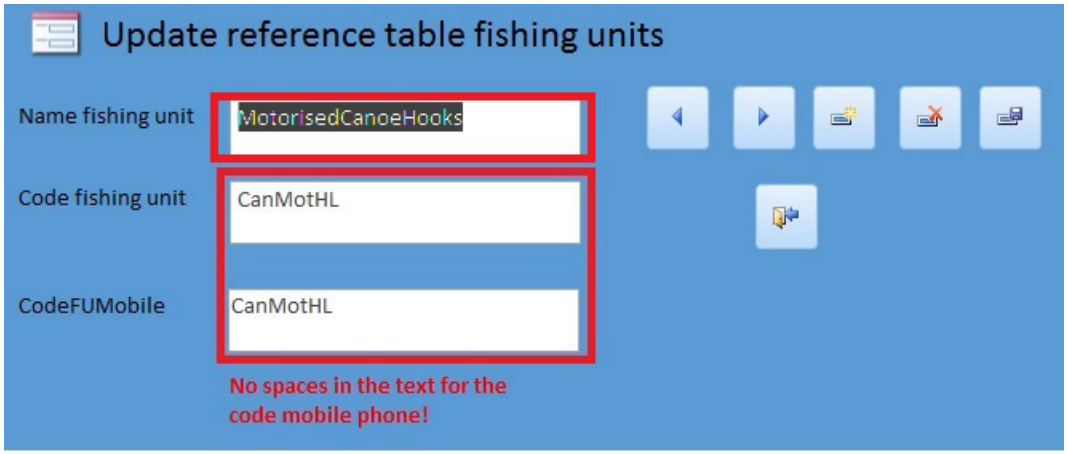


Enter the local name of your species. In the Scientific name popup select the scientific name[5]. After you selected the scientific name, you see that the **"3alpha code"** is automatically provided.

Once you have provided the all the local and scientific names, you close the form, and go back to the opening screen.

Fishing units

In the main menu click on **"2-Update reference tables fishing units"**.

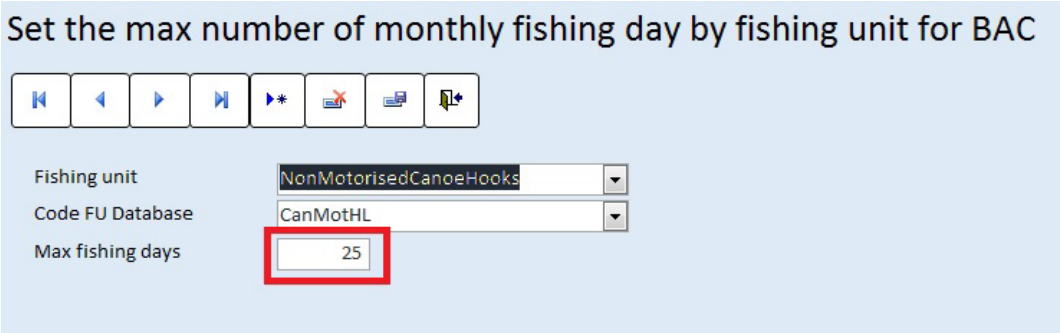


[5] This is the ASFIS list of 2015 in alphabetical order, with 12 500 species names.

- Provide the name of the fishing unit (Note a fishing unit is a type of canoe with its major gear).
- Then provide the codes for the fishing units (They will **not** be generated automatically, and be aware that the code for the mobile phone cannot have spaces in the text).
- Once all fishing units are provided, close the form and return to the main menu.

Number of fishing days for BAC

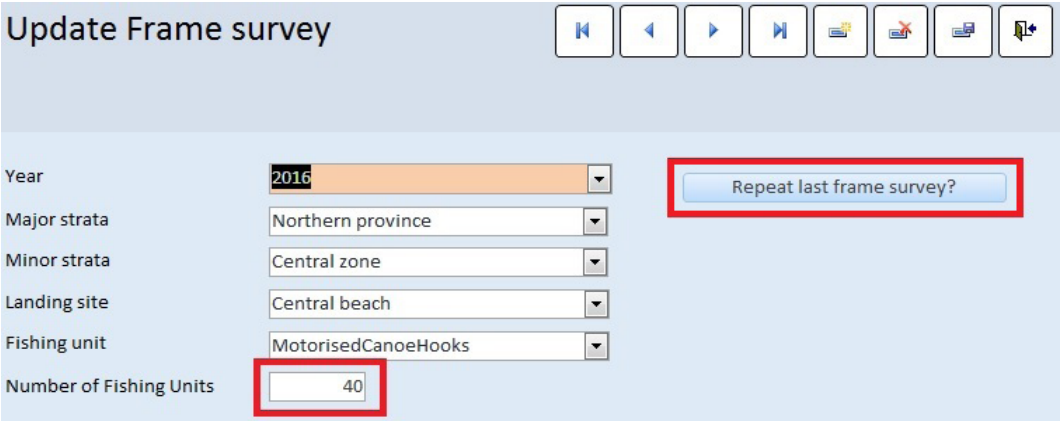
You have to set for each fishing unit the maximum monthly number of fishing days, if your data collection works with the Boat Activity Coefficient (BAC). Click on **"5-Update max number of monthly fishing days for BAC".**



Select the fishing unit, Select the Code and provide the maximum number of monthly fishing days.

Frame survey

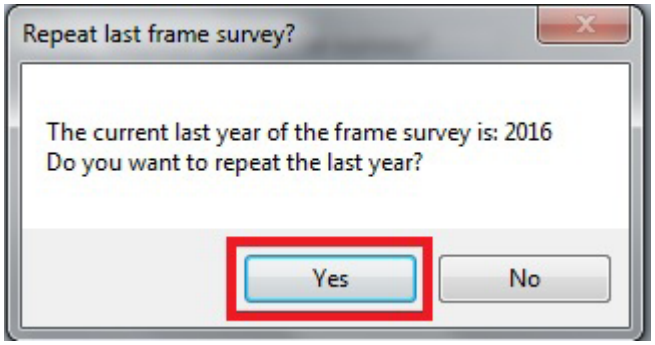
The frame survey provides the basic information to raise the samples towards total catch.
You can enter the frame survey data by clicking on **"6-Update frame survey"**.

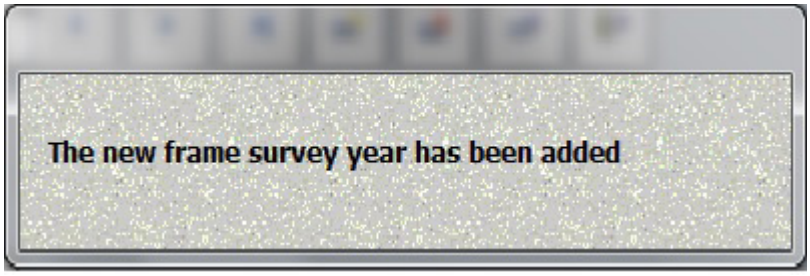


Select the year, the major stratum, the minor stratum, the landing site and the fishing unit with the pop up menu and enter the value of the number of fishing units. Repeat this till all fishing units are entered.

Frame surveys are implemented at regular intervals (3-5 years) but OPEN ARTFISH estimates the total catch on an annual basis. Therefore you have to repeat the last frame survey for the years where no frame survey is implemented by clicking on **"Repeat last frame survey".**

Click **"Yes"** in the popup and you will see a message that the frame survey is added.

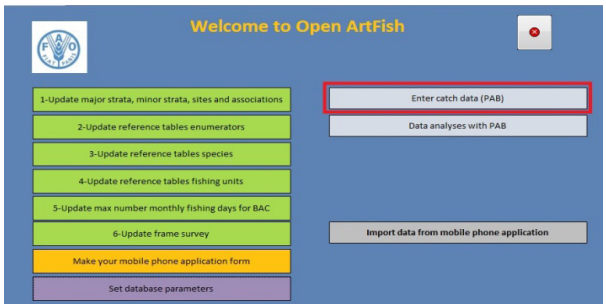


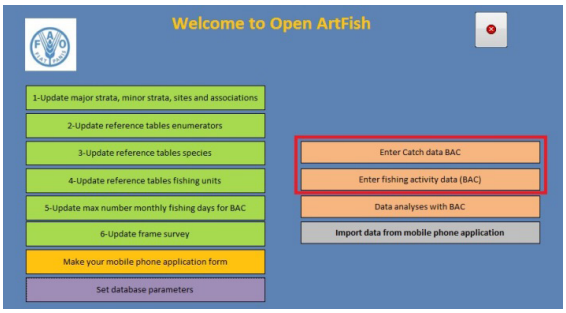


Enter your data from paper forms

Once you have set up all the reference tables you can start enter the data manually into OPEN ARTFISH. But please remember there are two options for data collection;

1. Data collection using horizontal sampling for fishing effort (PAB).
2. Data collection using vertical sampling for fishing effort (BAC).





Depending on the set up of your system (page 10 & 11) you will have two[6] different opening screens.

[6] Data entry for both PAB and BAC is an exception.

The right hand screen is for PAB and you can only enter catch data, these as effort data are included in the PAB catch assessment form.

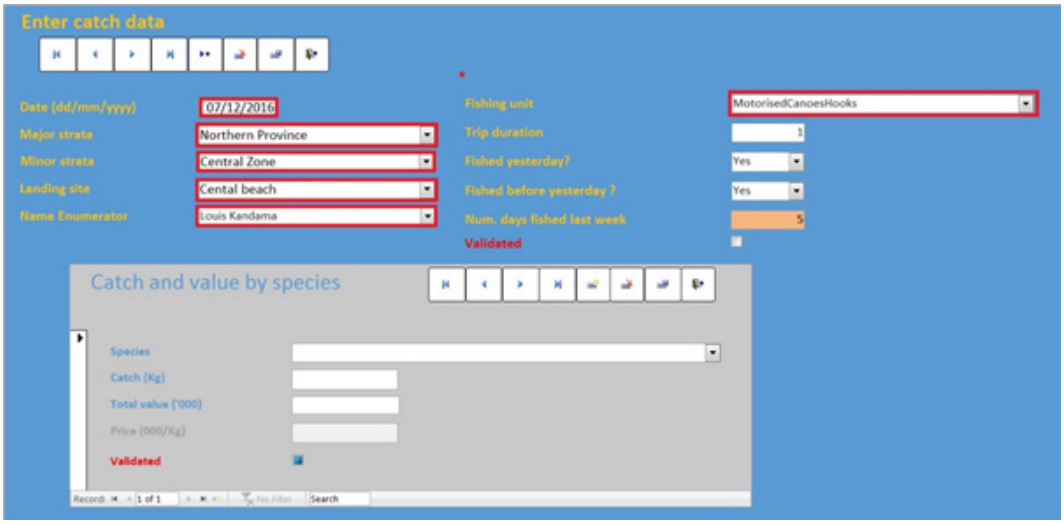
The left hand screen is for BAC. Here you have two data entry forms; i) Enter catch data for BAC and ii) enter fishing activity data (BAC).

Data entry for PAB

When you open the data entry form for PAB by clicking on **"Enter catch data PAB",** you will see that the screen is divided in two parts[7];

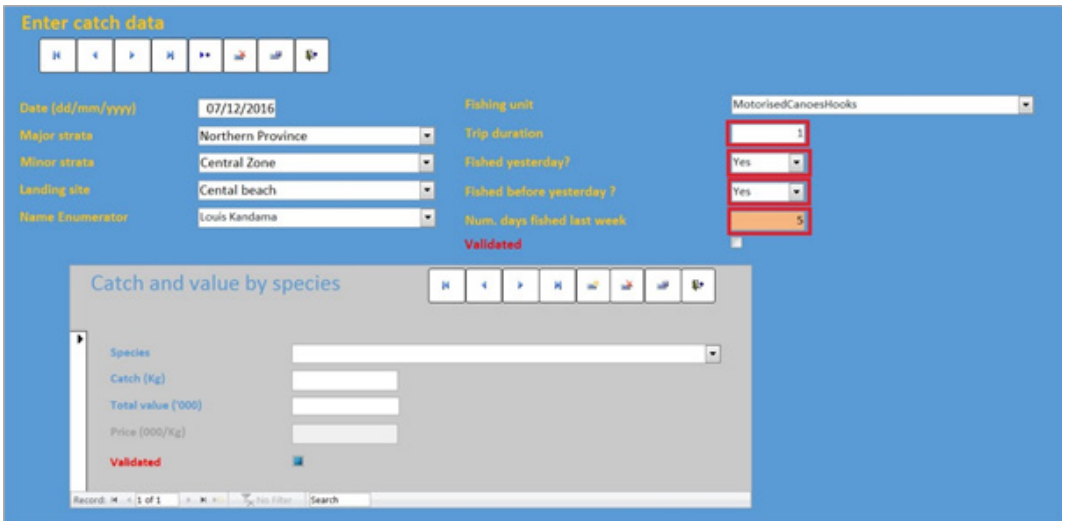
1. The upperpart where you enter the information of the sampled canoe.
2. The lower part where you enter the catch data by species of the sampled canoe.

First, with the popup menus enter the date, select the major strata, the minor strata, the landing site, the name of the enumerator and the fishing unit.

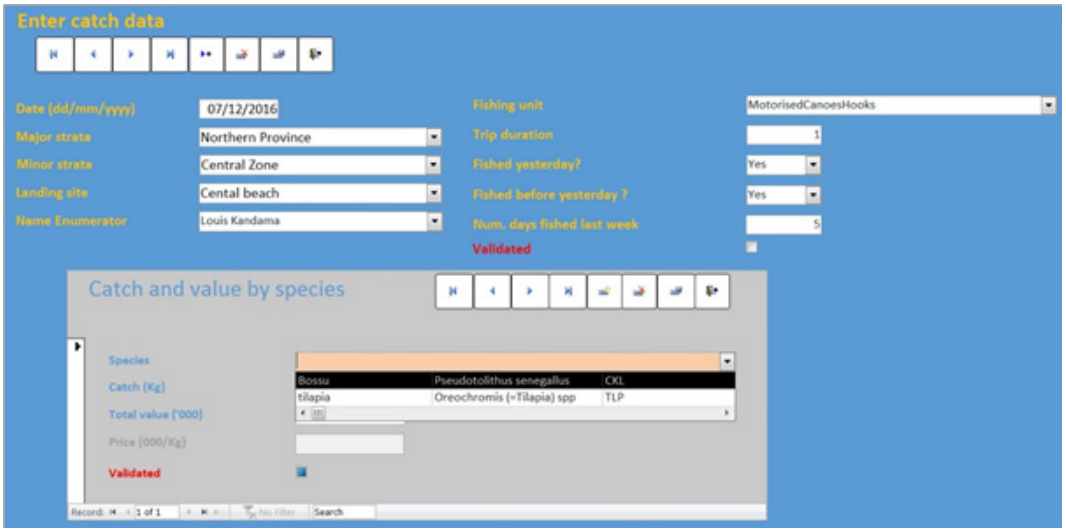


[7] The one to many relationship.

Then enter the data for fishing effort (horizontal sampling): trip duration, fished yesterday?, fished before yesterday? and the number of fishing days last week.

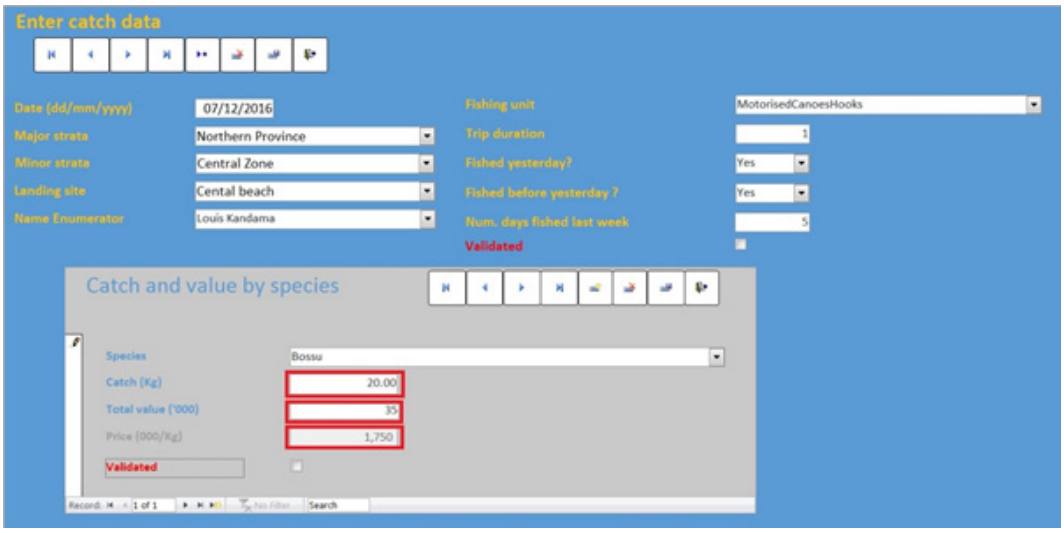


In the next step, select in the second screen the species for which catch and price data are collected[8].



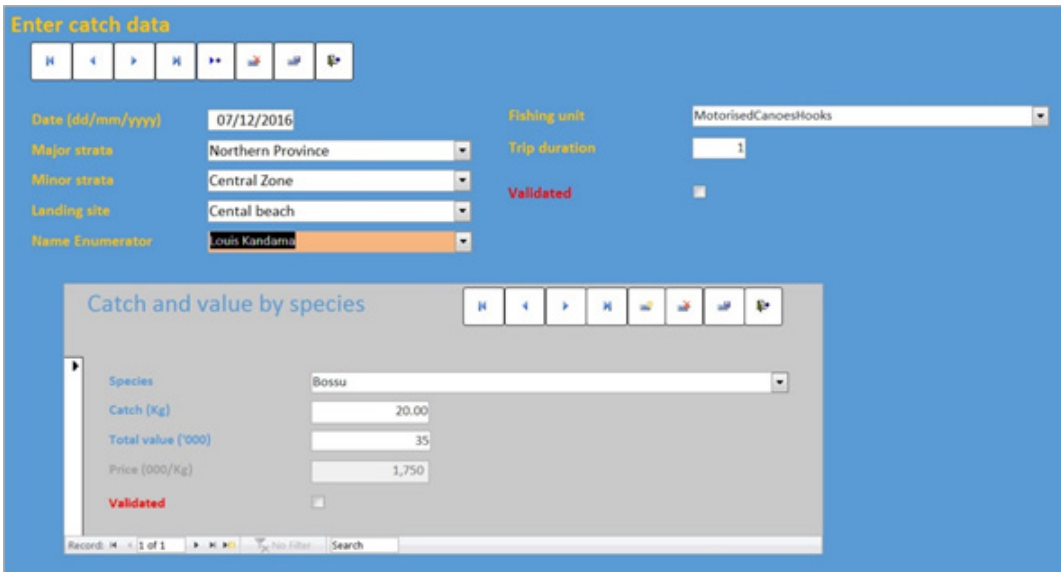
In the last step provide the catch and the value of the selected species and click **"Add record"** to continue with the second species for the selected fishing unit. You see that the **price per kg** is calculated automatically.

[8] In this case you enter the value of the total catch of each individual species, and the price per kg is automatically calculated.



Catch data entry for BAC

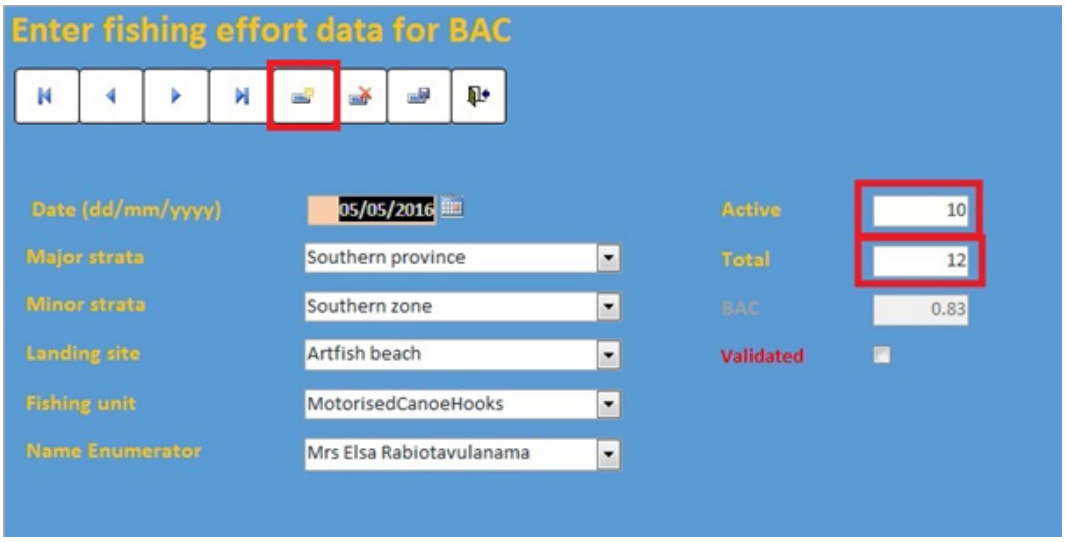
In the catch data entry form for the BAC system, the data entry for fishing effort has been removed, for the rest the data entry is similar to the form used for PAB.



Fishing effort data for BAC

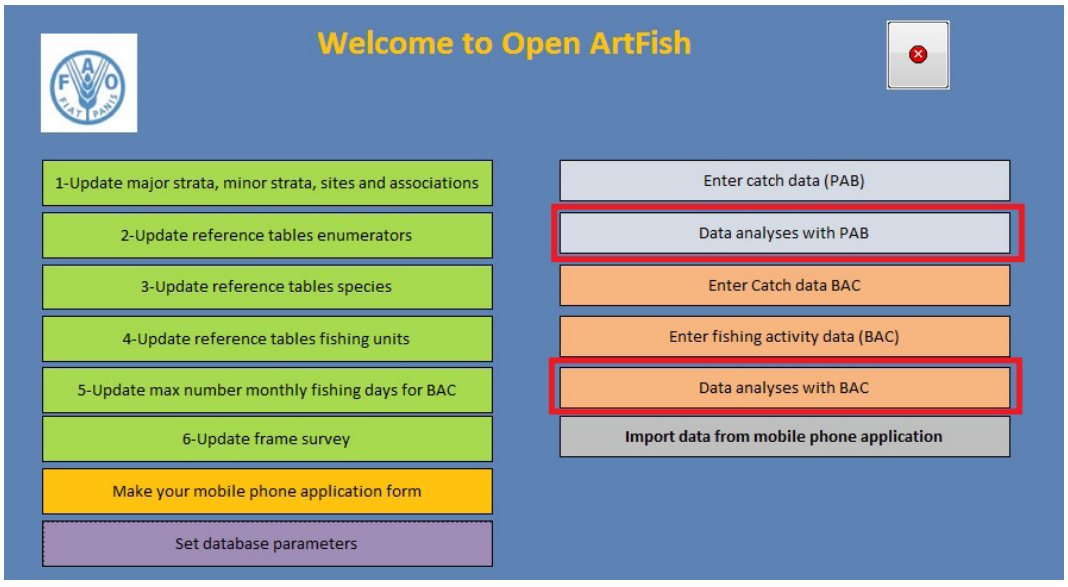
For the BAC system, fishing effort is collected through a separate data collection system (see pages 9–10) and collected data is entered in a separate form. Click in the main screen on **"Enter fishing activity data (BAC)"**.

With the popup menus enter: Date, Major strata, Minor strata, Landing site, Fishing unit and the name of the enumerator. Then enter the value of the number of active fishing units and the number of total fishing units at the selected landing site. Click "Add record" to continue with the next sample. The BAC is automatically calculated.

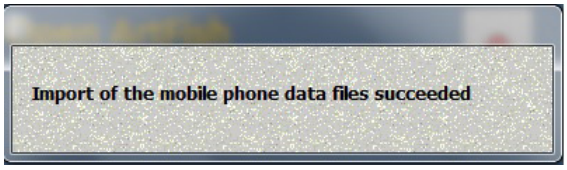


Import your data from a the mobile phone application

If you have set up mobile phone application for fisheries data collection (see page 33), then the data downloaded from the server in the cloud can be incorporated automatically by click on **"Import data from mobile phone application"** in the opening screen.



After a while the message **"Import of the mobile phone data files succeeded"**



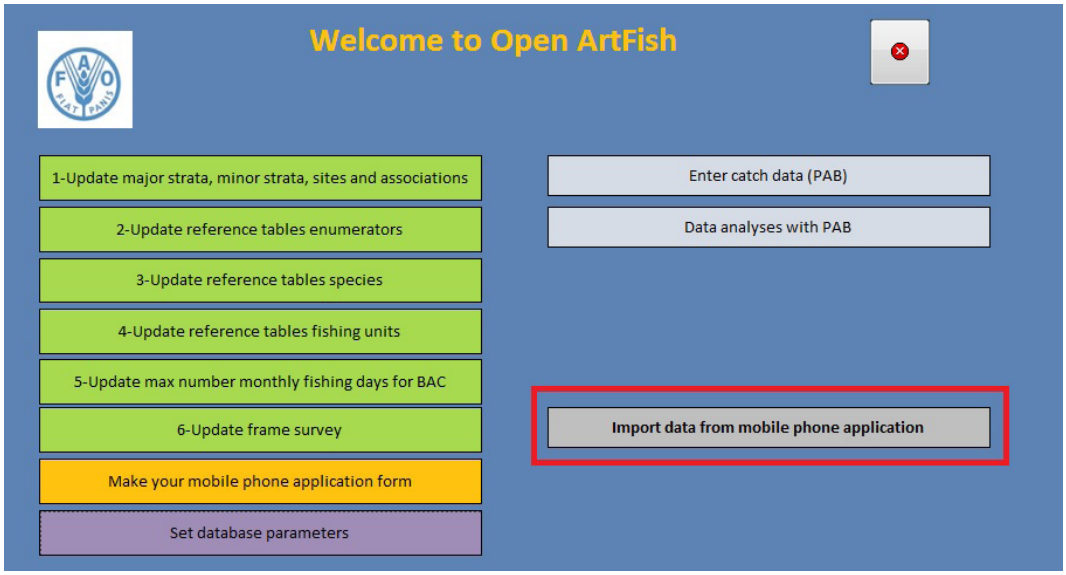
Please note you can **only** import the files if you have provided the default location of the mobile phone CSV files in the parameter settings!

Data analyses

Once your data is entered you can analyse the data and compile reports through the analyses and reporting module of OPEN ARTFISH.

Depending on your system you can:

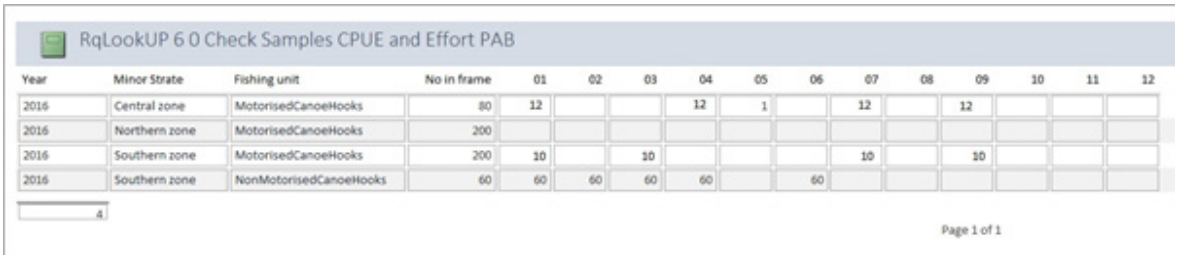
- Data analyses with PAB;
- Data analyses with BAC.



By clicking on **"Data analyses with PAB"** the screen below will open.

First you have to check if the numbers of monthly samples collected are sufficient. Click on **"Check number of samples".**

In the example presented below it is clear that the numbers of monthly samples are largely insufficient (50-75 samples per month is the rule of the thump).

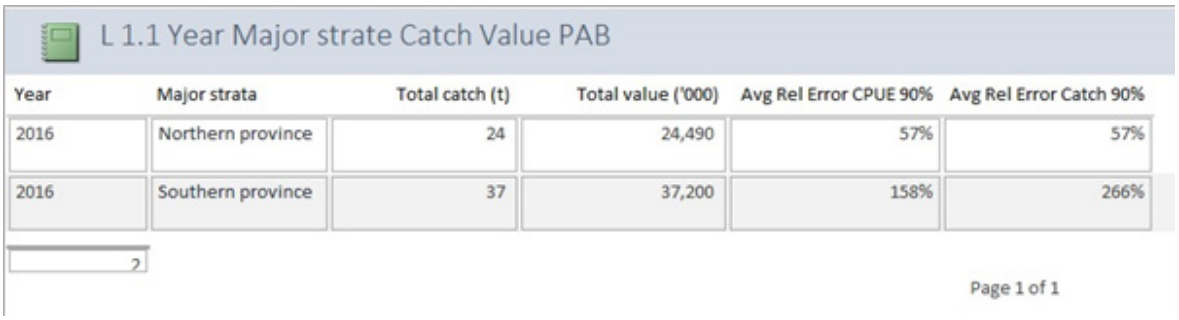


In the data analyses screen there are 7 popup menus, in the popups you can select:

- A distinct value for a year, month or distinct name for a strata, landing site, fishing unit or fish species;
- A * (star) which results in selecting all.

By clicking on the buttons the respective report will open and you can export the report to a Ms Excel file by clicking on the Ms Excel icon

An example of a generated report is presented below. Where needed, in the reports the relative error for CPUE and total catch are calculated (see page 9).



L 1.1 Year Major strate Catch Value PAB

Year	Major strata	Total catch (t)	Total value ('000)	Avg Rel Error CPUE 90%	Avg Rel Error Catch 90%
2016	Northern province	24	24,490	57%	57%
2016	Southern province	37	37,200	158%	266%

Page 1 of 1

By combining the different selections in the popup menus, almost any report can be generated.

The data analyses screen for a system set up with BAC is similar, only here we check the number of monthly samples for CPUE and for BAC.

THE FAO ODK MOBILE PHONE APPLICATION FOR SMALL-SCALE FISHERIES DATA COLLECTION

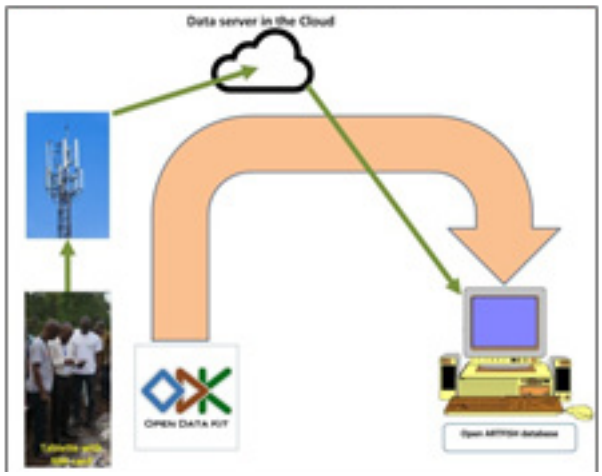
Introduction

The widespread use of mobile technologies and handheld devices (e.g smartphones, tablets,...) coupled with the rapid development in mobile networks (e.g 3G, 4G...) has greatly impacted many fields. They offer the ability of data exchange and better connectivity between workers without being tied to one location.

Fisheries data collection can benefit from the trend of the growing adoption of these technologies around the world. Due to its large numbers and large dispersion, small-scale fisheries catches can only be monitored through sample based data collection, carried out by enumerators at the landing sites. Till recently paper forms were filled at the landing sites and send to the department for processing. This traditional way is expensive and time consuming.

This process has been improved through the development of a mobile phone application for small-scale fisheries data collection, supported by the project TCP/SFC/3501 FAO COREP, "*Improvement of fisheries data collection in Central Africa*".

The mobile phone application was developed with the free software of OPEN DATA KIT (ODK);



1. Tailor made forms for mobile phones are designed in ODK and stored on a country specific server in the cloud;
2. The forms are downloaded on the mobile phone or tablet;
3. Data is collected at the landing sites and stored on the mobile phone memory;
4. At the end of the sampling day, a connection is made with the internet through the mobile phone network and newly collected data are send to the country specific server in the cloud;
5. Once a week, the fisheries statistics office connects with the server in the cloud and downloads the collected data of all landing sites into a database.

The new system is user's friendly, very easy to apply and leads to prompt information exchange on the small-scale fisheries. The operational costs of the system are low and are only related to the payment of the enumerators and the SIM card and the mobile data plan subscription.

FAO is not distributing a standard mobile phone application. In the following chapters it is explained how you can set up your own mobile phone application and how to link the mobile phone application to OPEN ARTFISH.

Have a look at the application

ODK collect

The application can be built and made operational with the free software provided by Open Data Kit (https://opendatakit.org). Open Data Kit (ODK) is an open-source suite of tools that helps organizations author, field, and manage mobile data collection solutions. The ODK goals are to make open-source and standards-based tools which are easy to try, easy to use, easy to modify and easy to scale.

It is indeed quite simple to set up a tailor made mobile phone data collection system with ODK. But it must be realized that the application is only a tool, it replaces the paper forms, but it does not change the sampling scheme and statistical requirements for data collection.

The development of the system goes through the following steps:

1. preparation;
2. set up a local server in the cloud;
3. design the application form in Excel;
4. convert the application form to XLM;
5. upload the form to the local server;
6. install the application on your mobile phone or tablet;
7. use the application to store collected data;
8. send the collected data to the server in the cloud;
9. download collected data from the local server to your computer;
10. upload the collected data into OPEN ARTFISH.

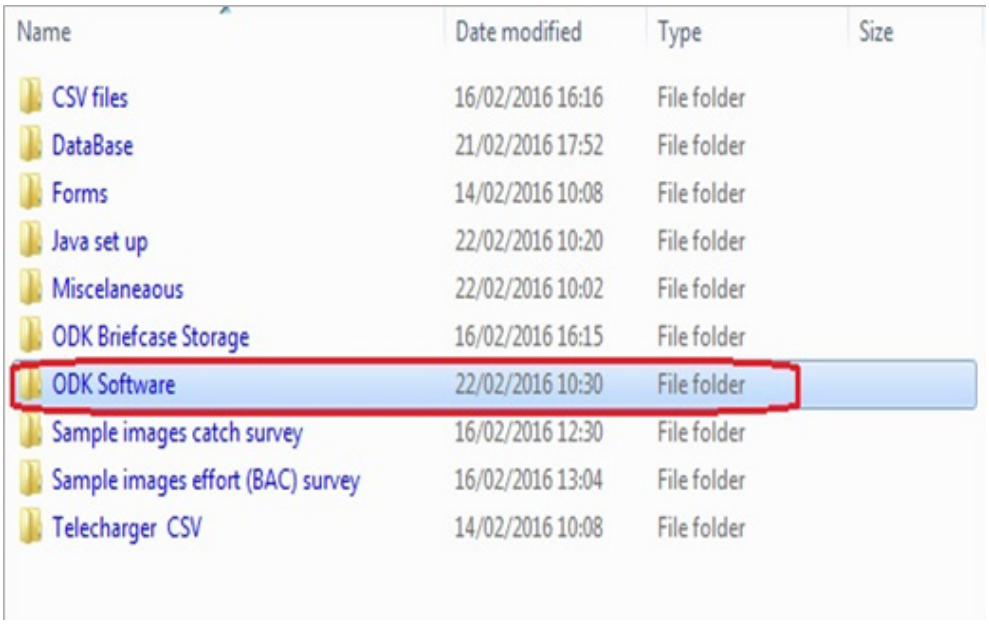
The ODK web site provides excellent guidance and explication on step 1-9 and the step are only summarised in the next chapters[9].

Preparation

First you have to prepare the computer(s) you will use to set up the system;

1. Install Java 7 or higher for windows. Go to java website and download Java (https://java.com/en/download/).Just follow the instructions.
2. Check if you have set up the OPEN ARTFISH sub directory correctly and that you have made the folder **"ODK Software".**

[9] Guidance can also be found in netfish.org



How to set up a local server in the cloud

A server in the cloud will be needed to store the digital forms and data collected in the field.

The simplest system is a server in the cloud. The server runs in the Google cloud, and is under normal use complete free of charge. It is possible to set up the whole system on a local server and ODK provides the info on how to set up such a local server (https://opendatakit.org/use/aggregate/).

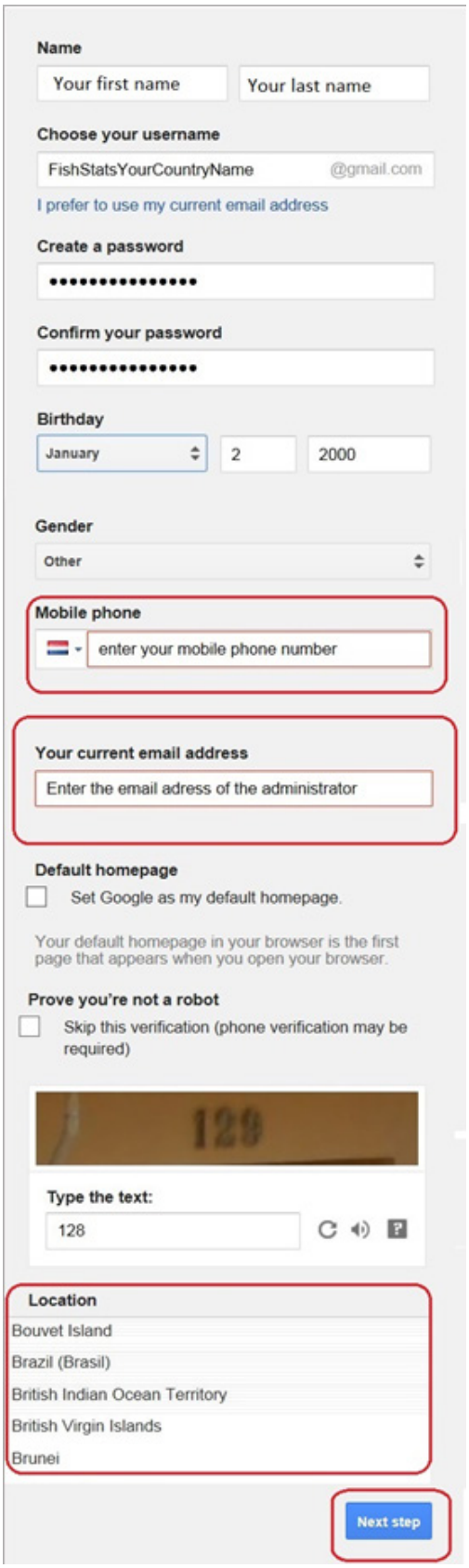
A country specific fisheries statistics server in the cloud can be created through:

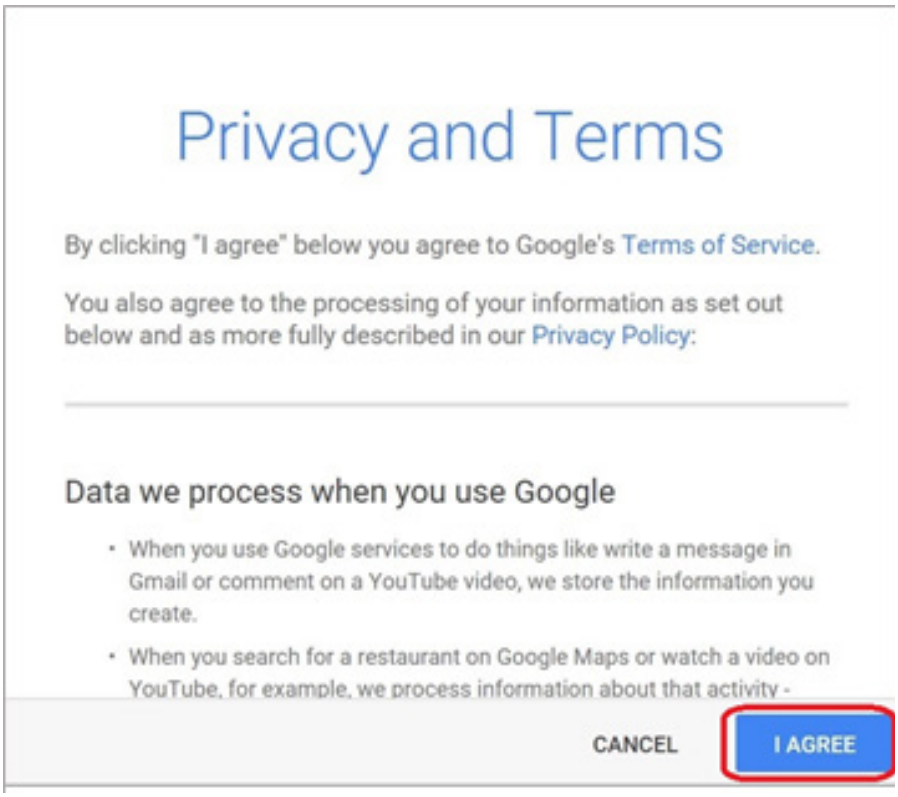
1. set up google account;
2. set up an application engine;
3. install ODK on the google cloud server.

Set up google account

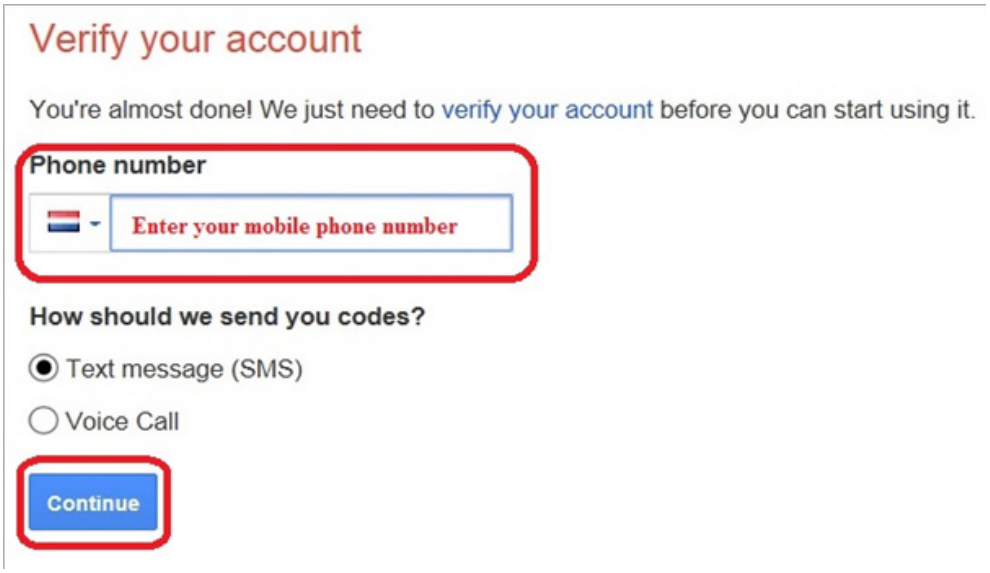
Go to https://accounts.google.com/signup and create a google account for your fisheries statistics;

Do not forget to provide mobile phone number and email address of the administrator of the system.

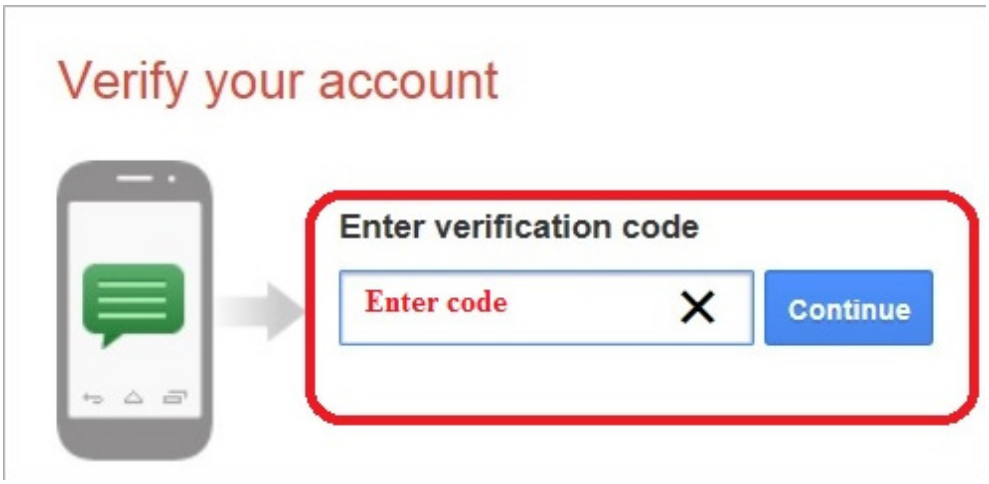




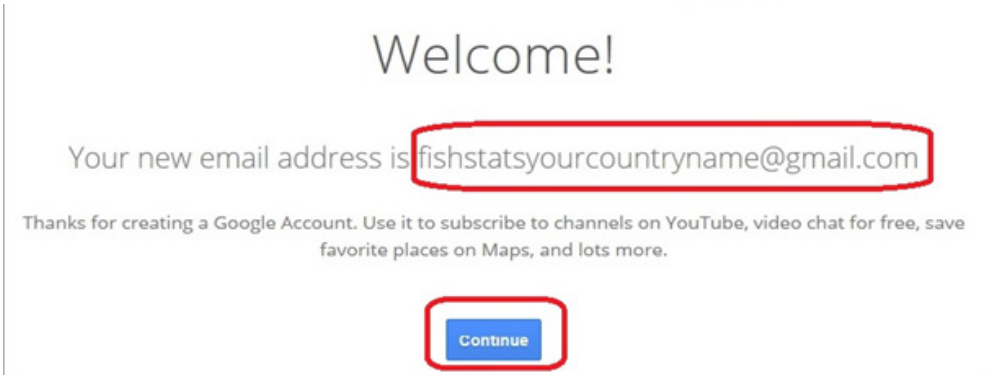
Agree on the terms of reference.



You will receive a code on your mobile phone.



Enter the code you received on your mobile phone.

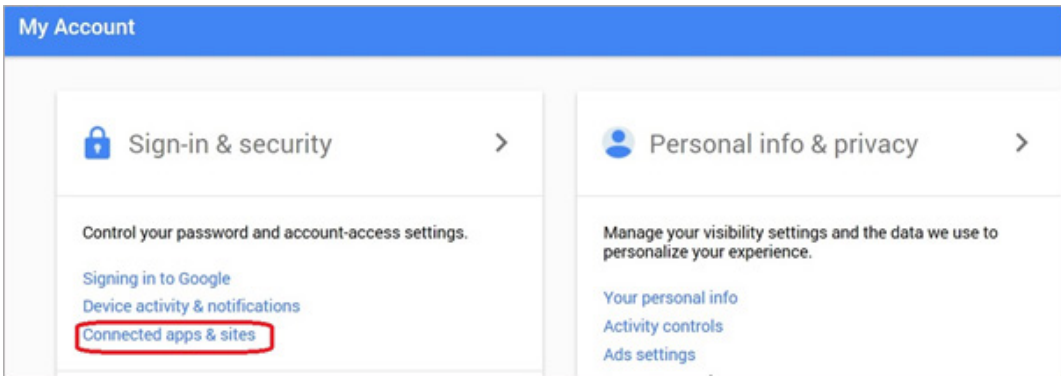


The Google account for fisheries statistics is created:'fishstatsyourcountryname@gmail.com'

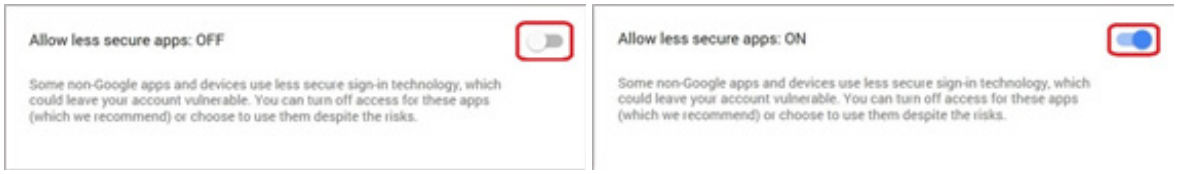
Set up an application engine

As a second step you have to create a Google app engine which is linked to your google account. **Google App Engine** is a platform as a service (PaaS) cloud computing platform for developing and hosting web applications in Google-managed data centers. (https://en.wikipedia.org/wiki/Google_App_Engine).

AppEngine is considered a "less secure application" usage by Gmail. You need to enable reduced security levels during the running of the upload script, before you go to the next steps.



Sign in to the Gmail account and click on ***'Connected apps & sites'.***

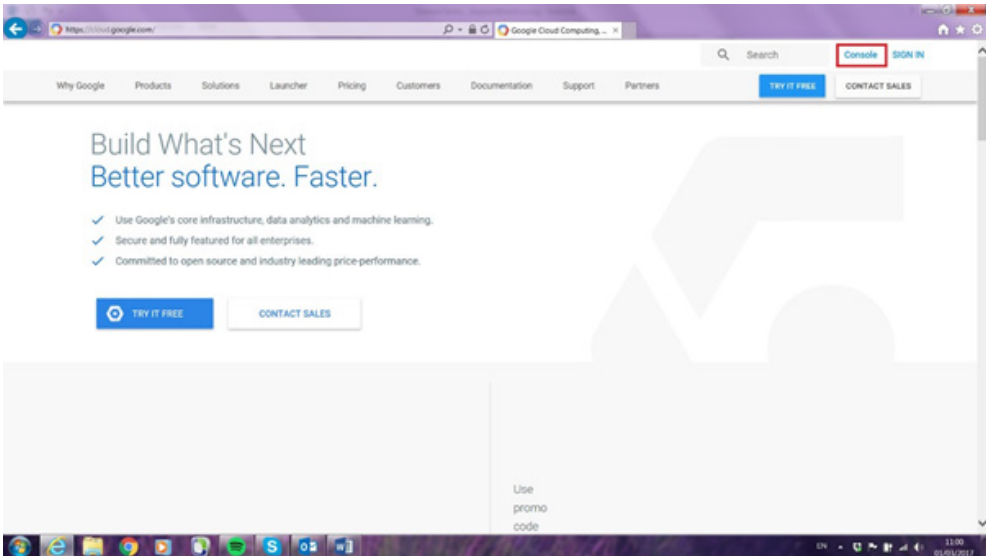


Switch on ***'Allow less secure app'.***

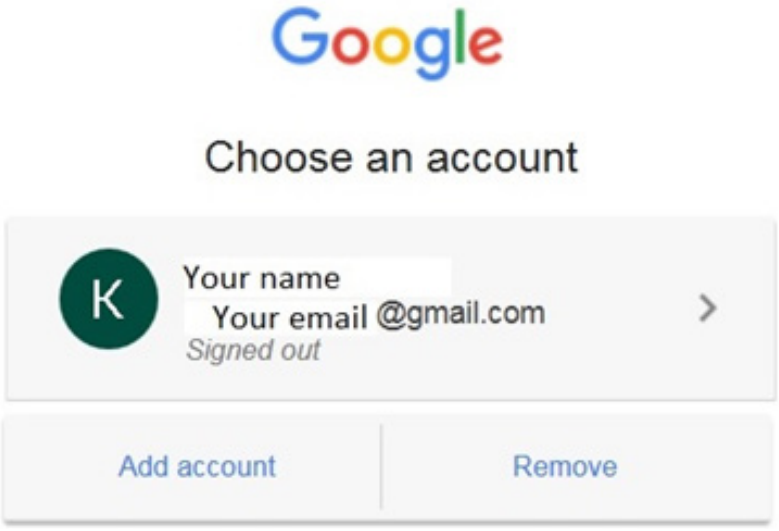
Without this you will **not** be able to create the application!

Now the application can be created. Before you create your application engine, please check the procedures at https://opendatakit.org/use/aggregate/, go to **Installing on App Engine (Cloud)**. This as the procedures changed two times in the last year.

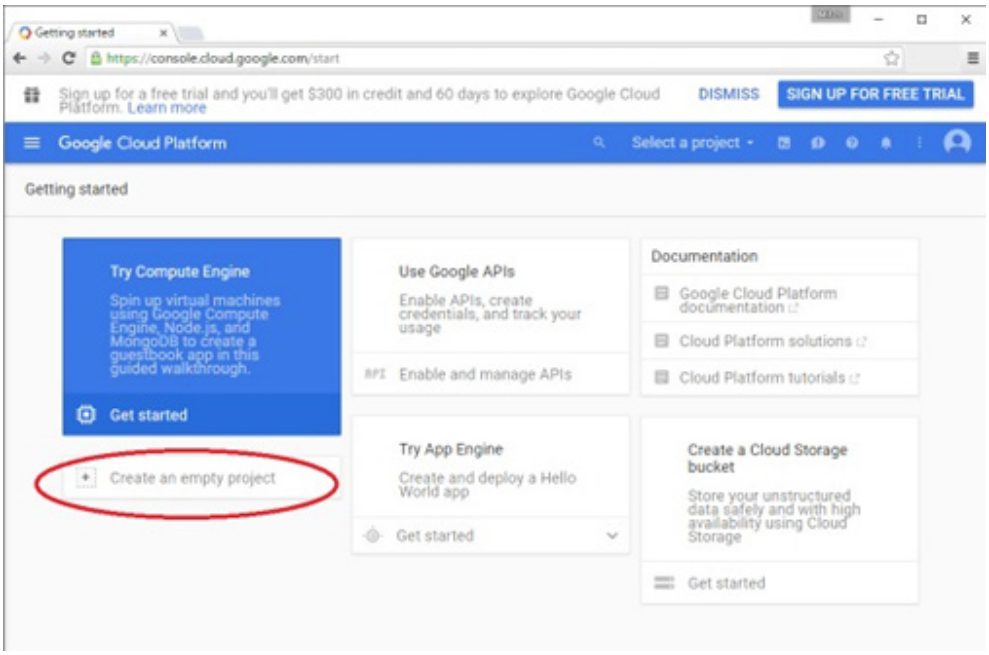
Go to https://cloud.google.com/ and click on "**console**".



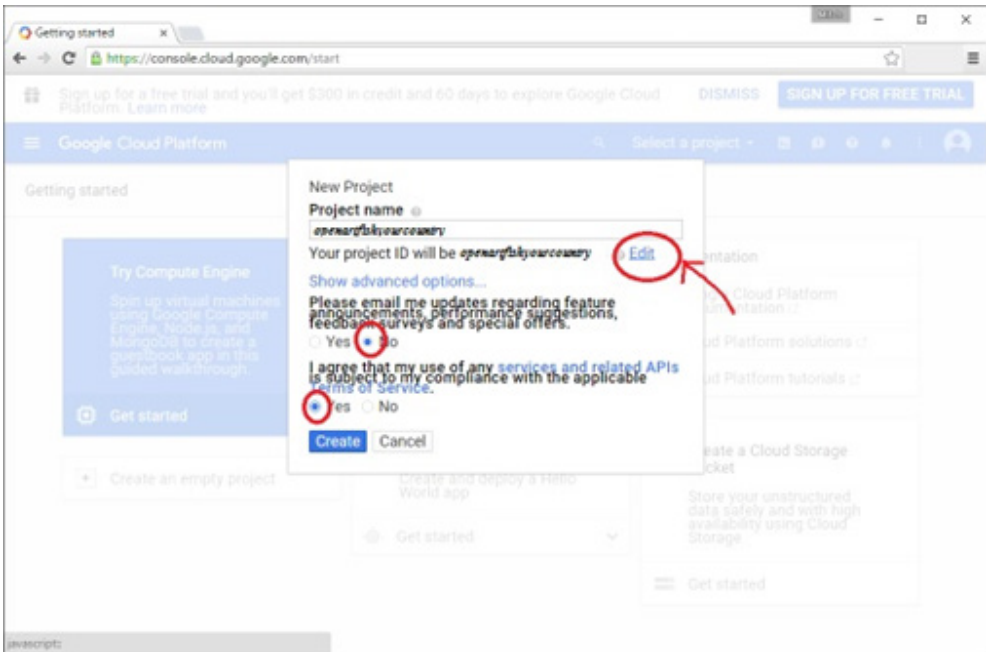
Sign in with your Gmail account you created.



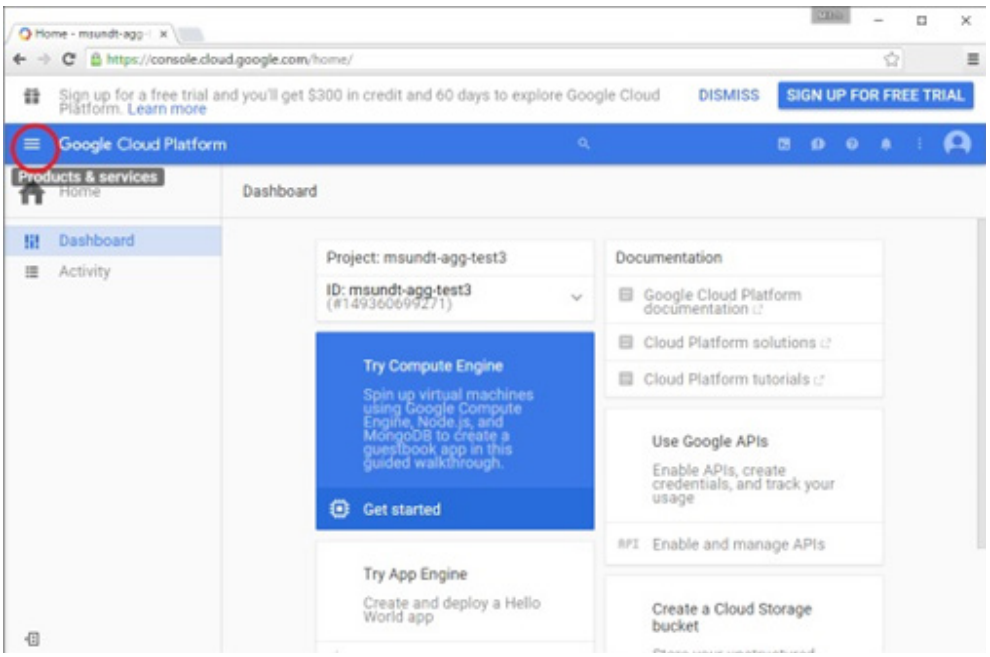
If you have never configured a Google Cloud Platform project, click on **"Create an Empty Project"**.



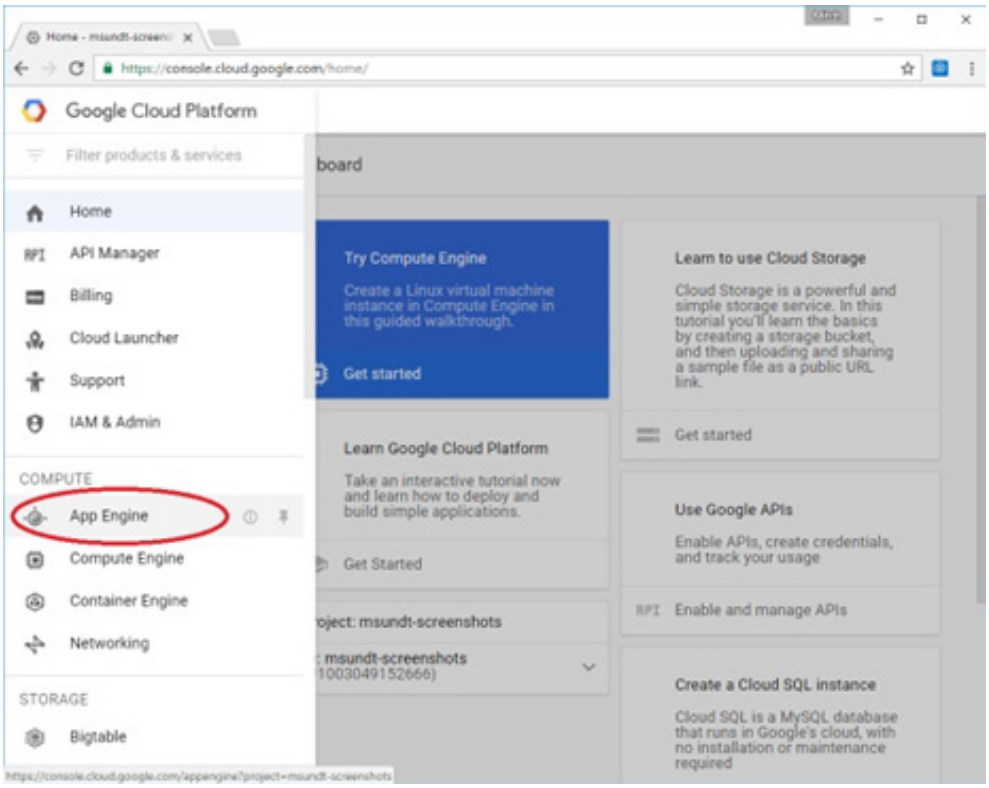
On the project-creation pop-up dialog, type in a project name that makes sense to you (*openartfishyourcountry*). Then choose "Edit" to edit the project id. The project id will be the first part of the URL to your ODK Aggregate server (i.e., your server will be referenced with a URL of the form https://project_id.appspot.com). You may want to use a project id that combines your organization name and the name of your data collection group or project. You may also need to accept Google's terms-and-conditions, as indicated in the screen-shot below:



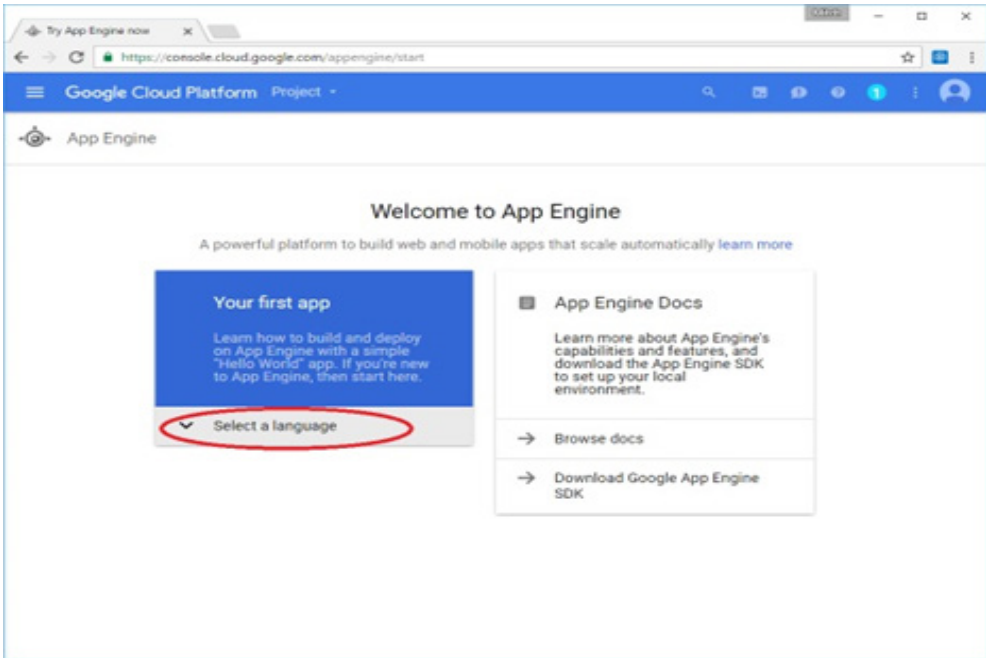
Now, click on the menu icon (three horizontal bars) to the left of "**Google Cloud Platform**" in the upper left side of the screen.



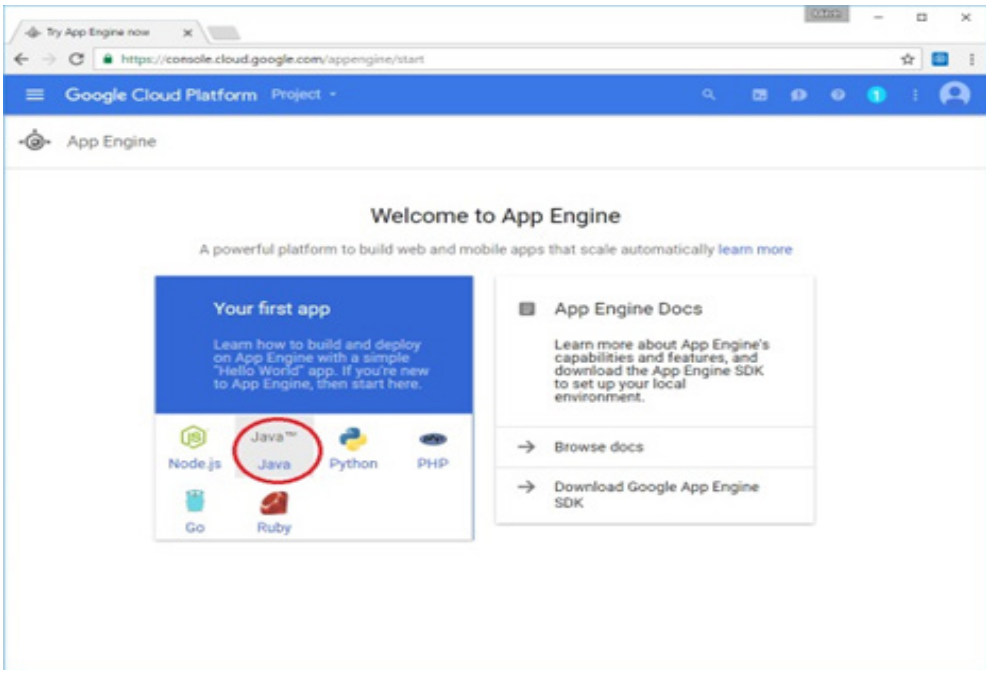
and select "App Engine":



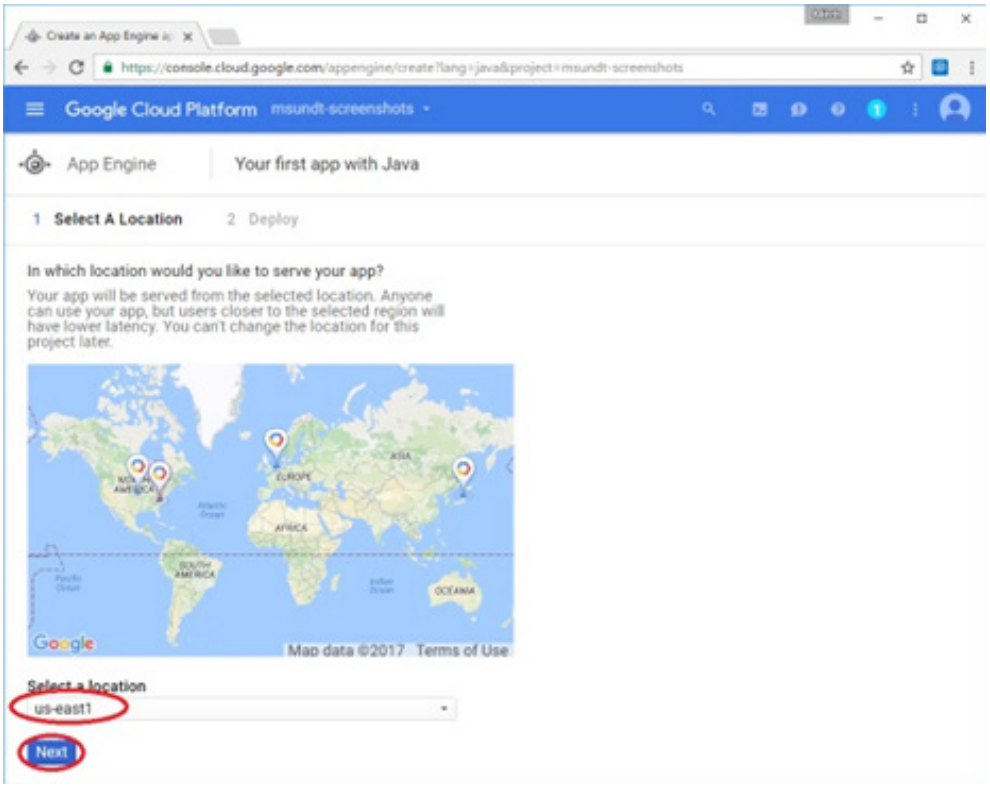
And click on the "Select a language" dropdown under the "Your first app" heading:



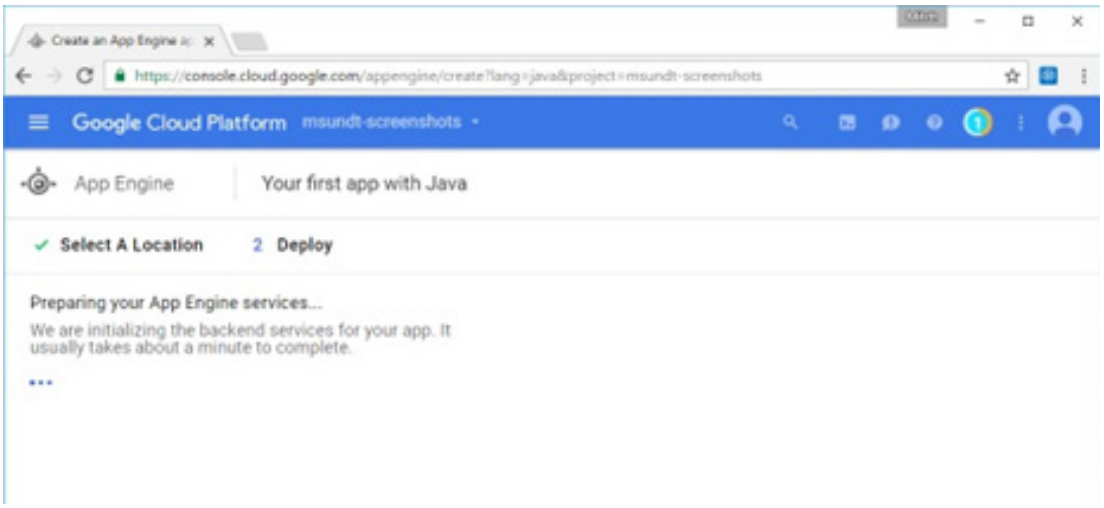
Choose "Java":



Select the datacenter location where this server will operate and click Next



Google will then begin configuring the server



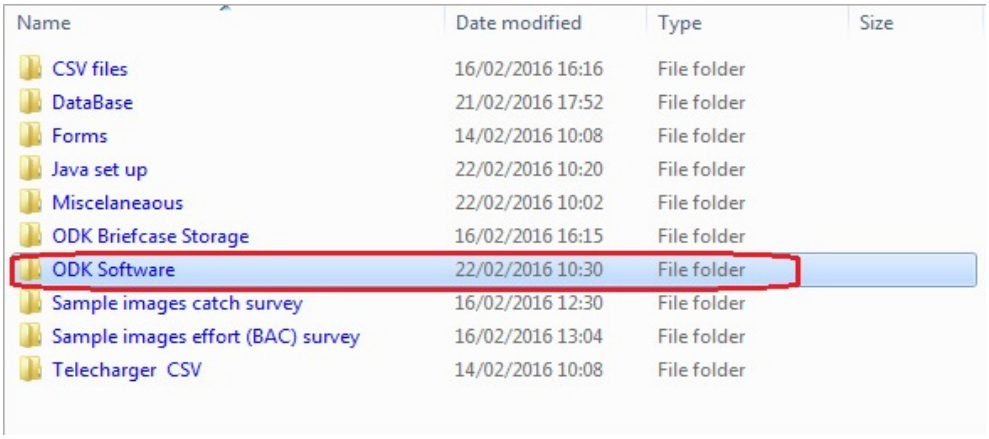
Congratulations, the application is created!

Write down the ID: '***openartfishyourcountry***' of your application. This is needed for installing ODK on your computer and on your application.

Install the ODK on the server

In the next steps the software ODK will be installed on the application you created on the local server.

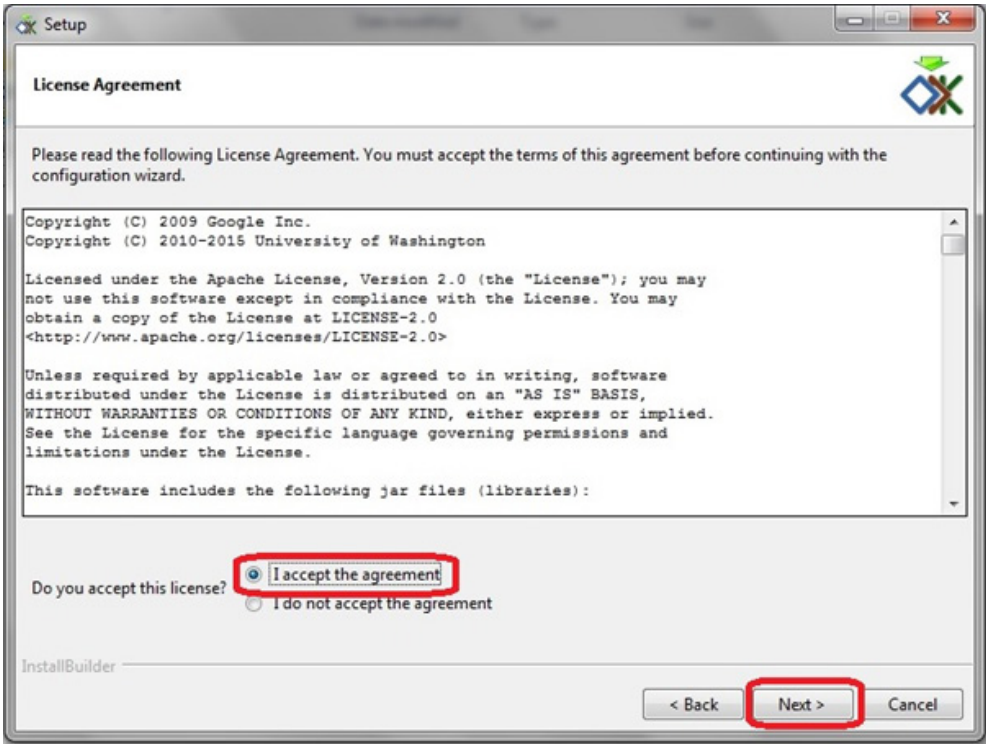
Download[10] ODK Aggregate V1.4.x from the ODK website (https://opendatakit.org/downloads/) and save it in the folder '**ODK software'.**



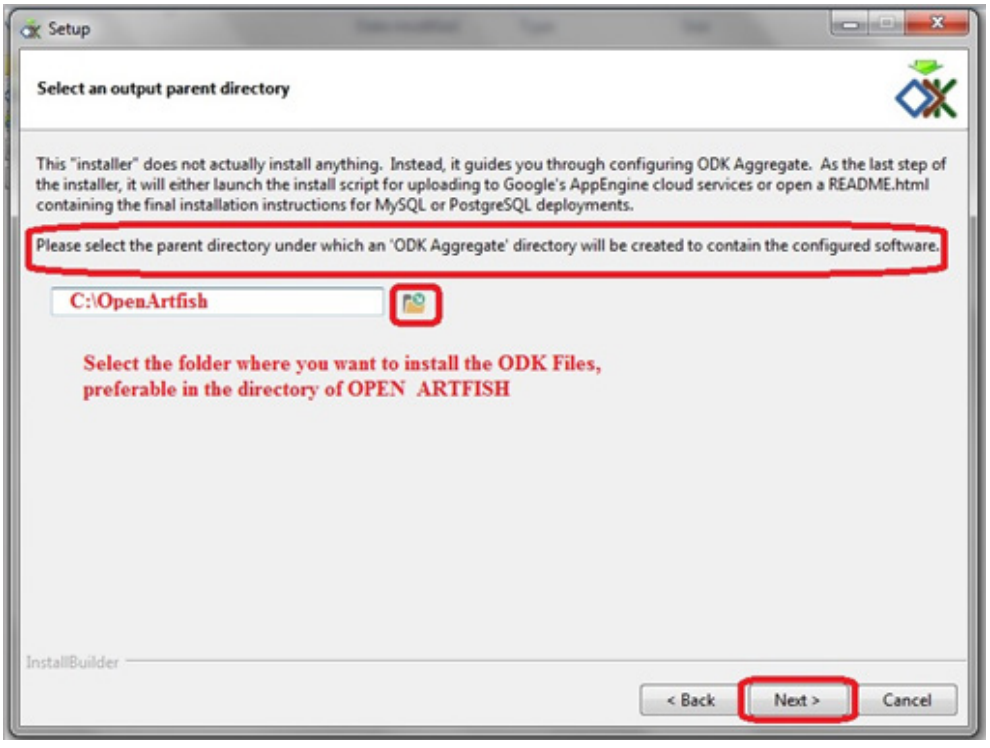
Double click it to start installing ODK (You need to have Java installed 7 or higher on your computer).

[10] This ensures that you always have the latest version of ODK aggregate.

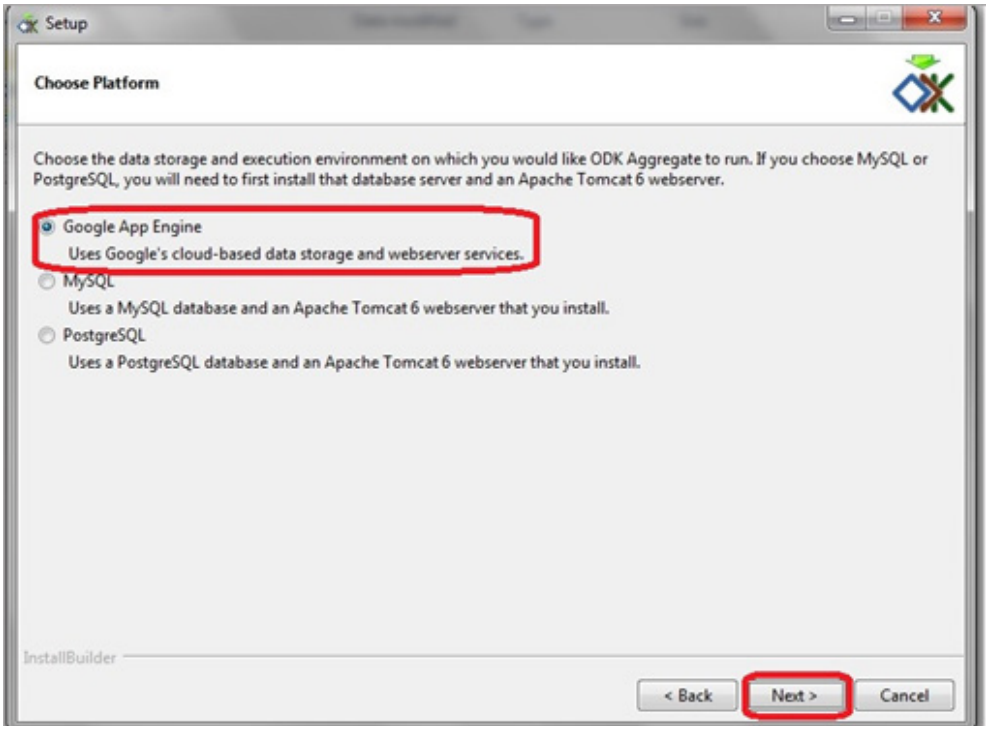
Accept the agreement and click **"Next".**



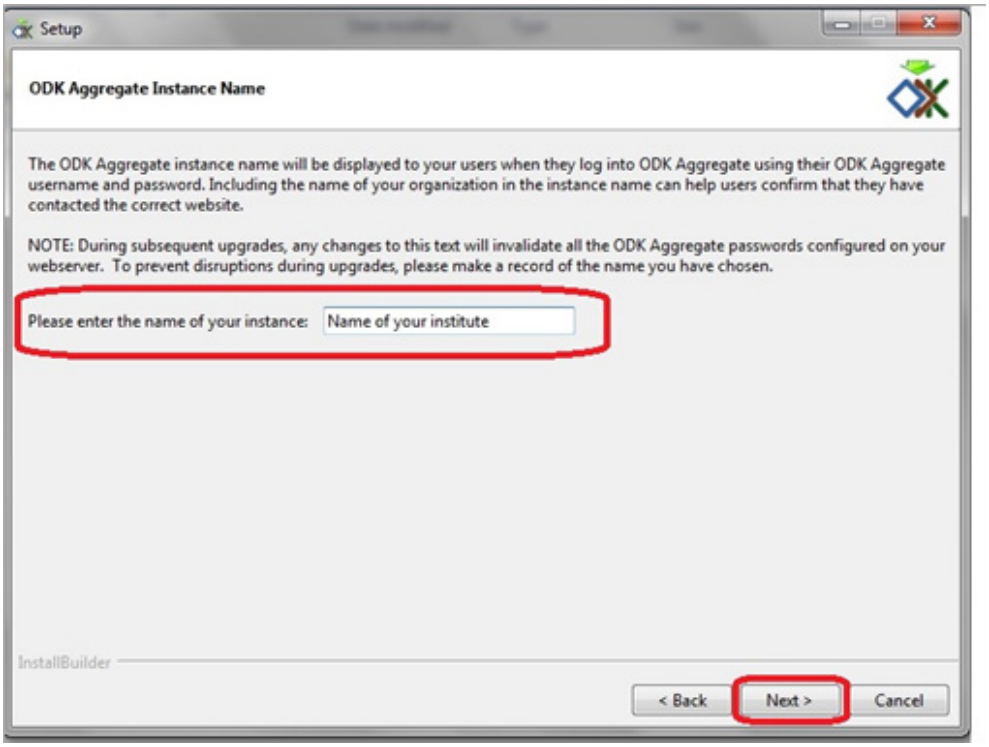
Select the folder were you want to install the ODK files and click: **"Next".**



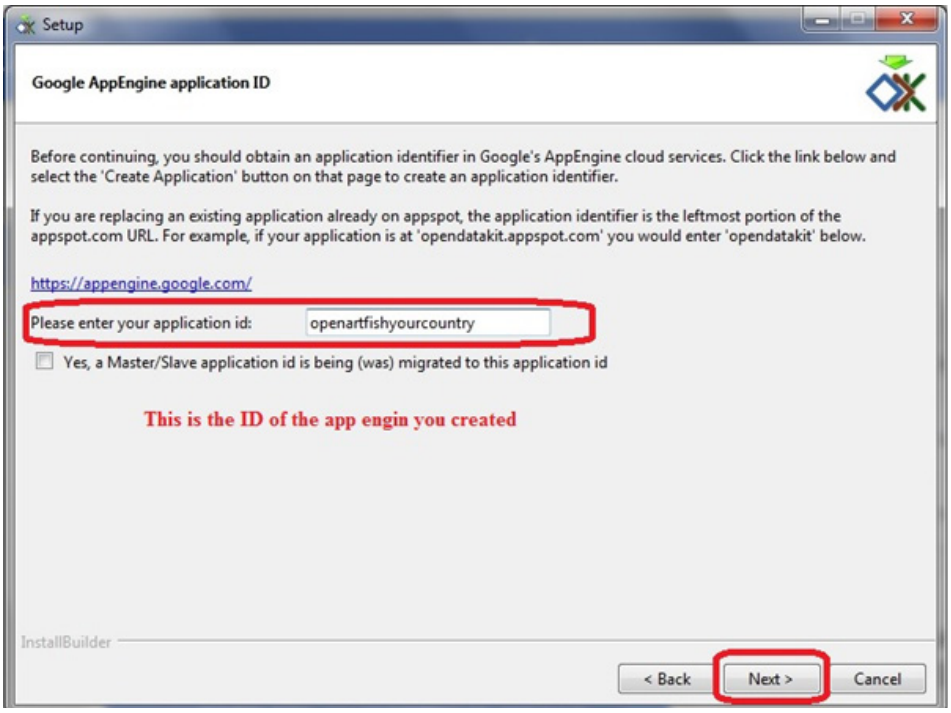
Select the first option. This will install the cloud based system and click "**Next".**



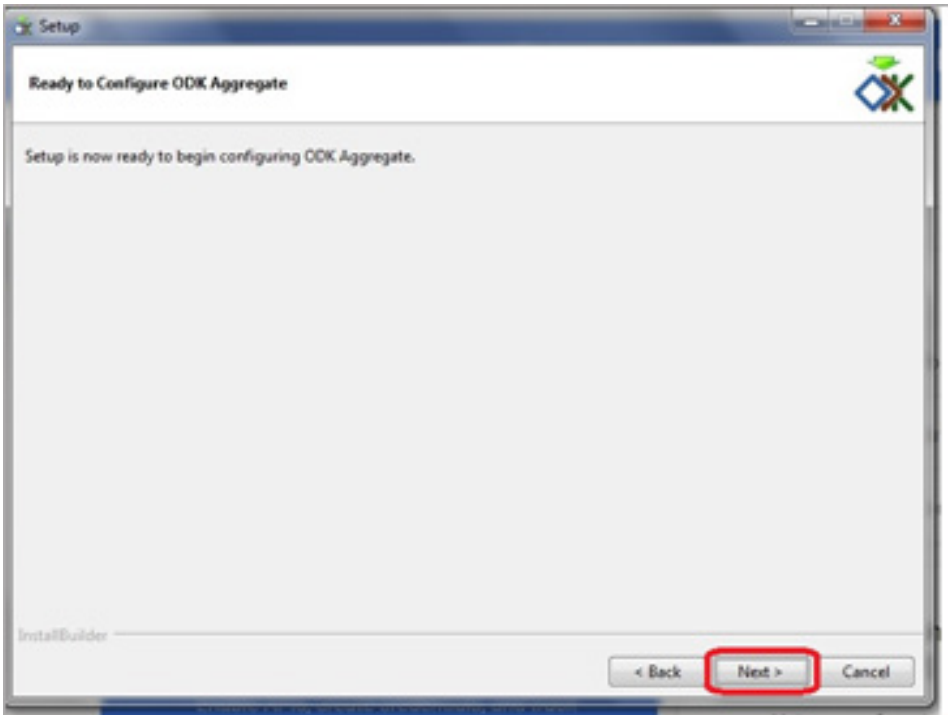
Enter the name of your institute, department or organisation and click **"Next".**



Provide the name of the administrator of the system (without spaces).
Write down this name! It is needed for the first time you login to the system.



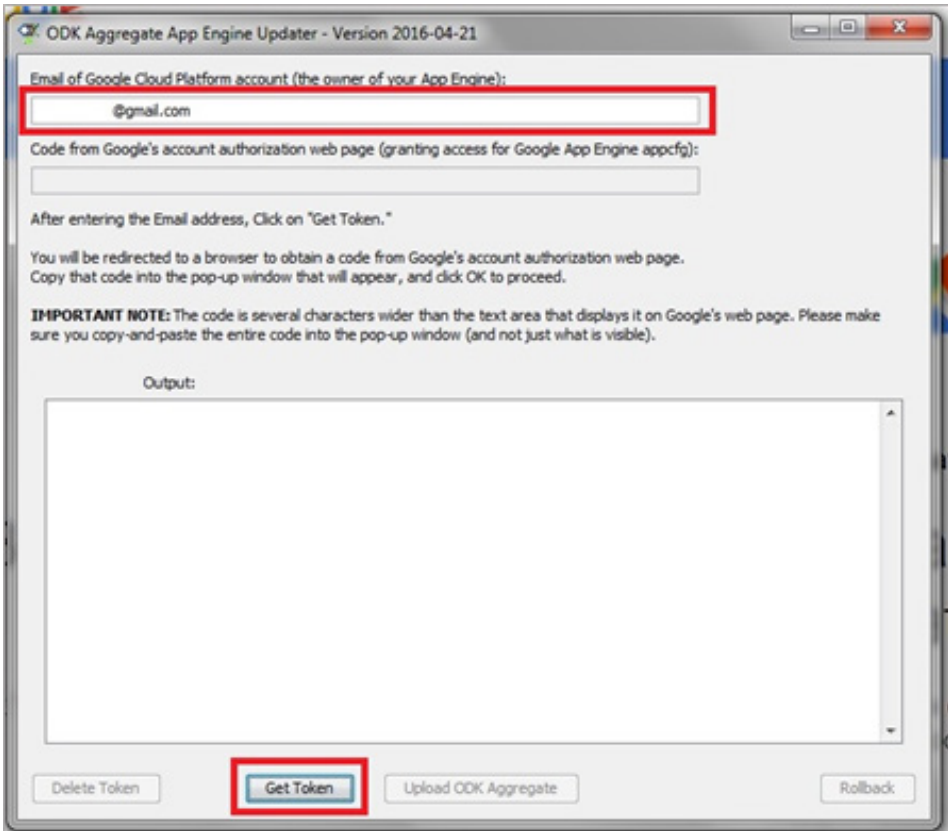
Click **"Next".**
Enter the ID of the application you created: ***'openartfishyourcountry'*** See page 27.



Click "**Next".**

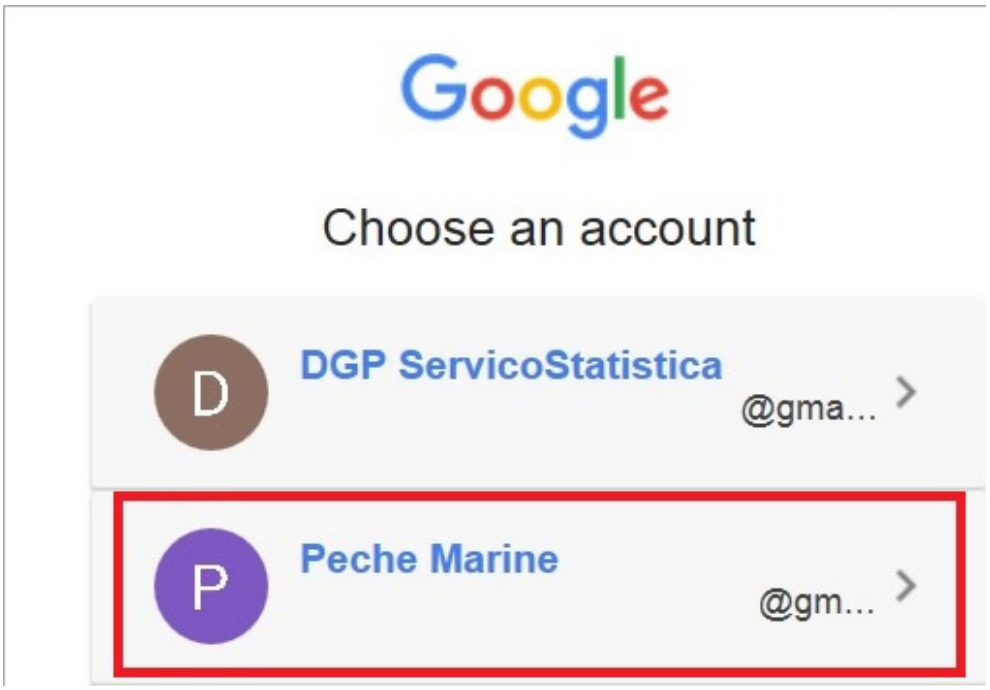
Click **"Finish"**. ODK will be installed on your computer, after some minutes the screen below will open.

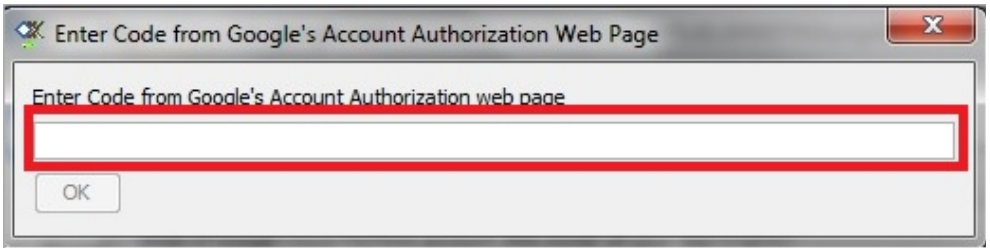
Enter the name of the Gmail account of the system, the password and click **"Get Token".**



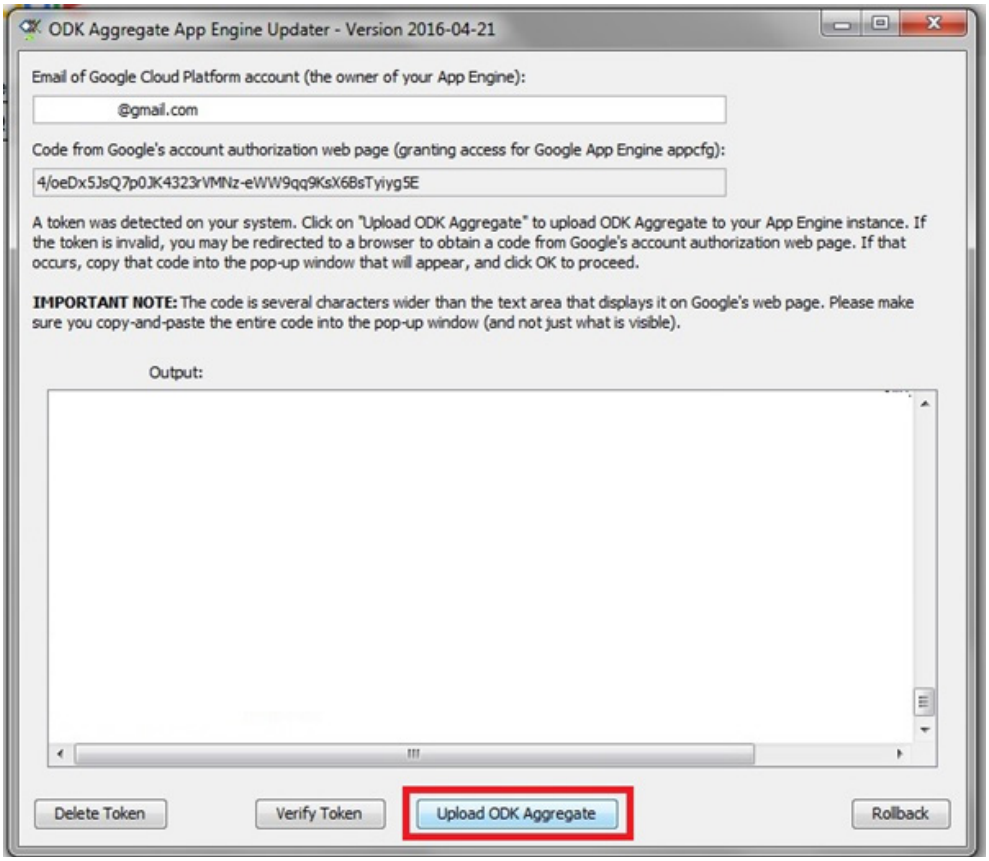
If you are running more then one Gmail accounts on your computure you have to select the account for which you created the application.

The screen below will open copy the code.





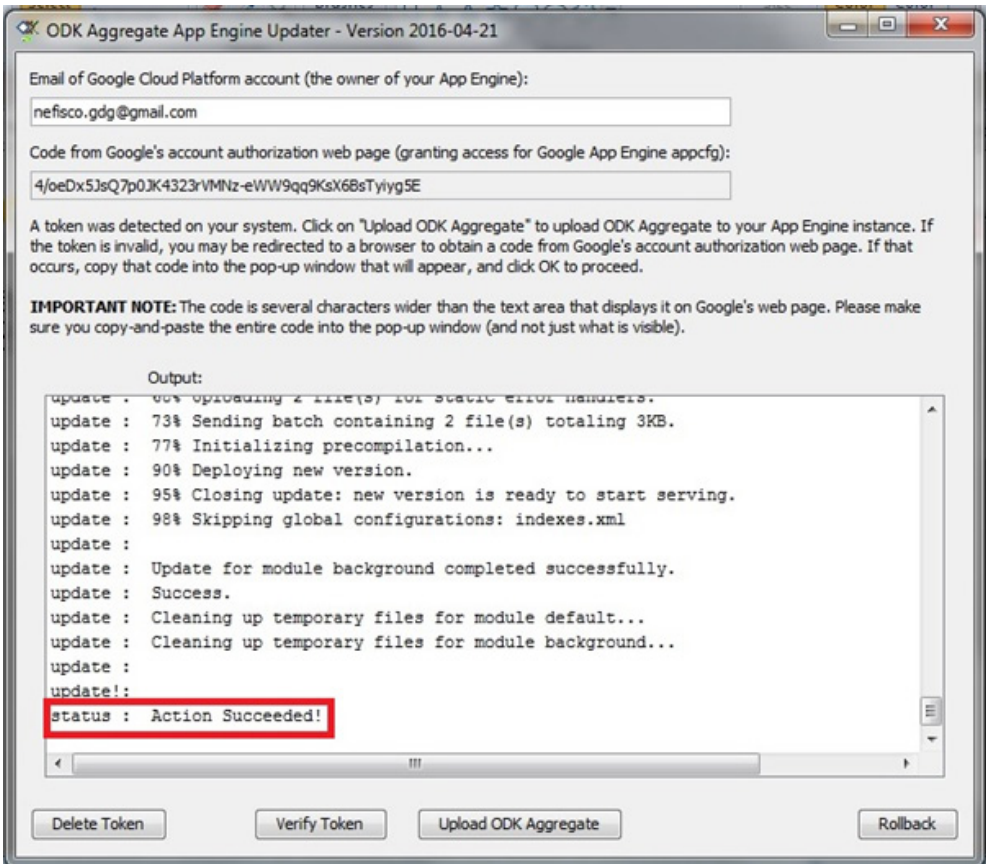
Paste the code in the application form and click ok



In the next screen click on **"Upload ODK aggregate"**

After a while you will see the message **"status: Action succeeded!"**

Congratulations, you created your statistics server in the cloud!

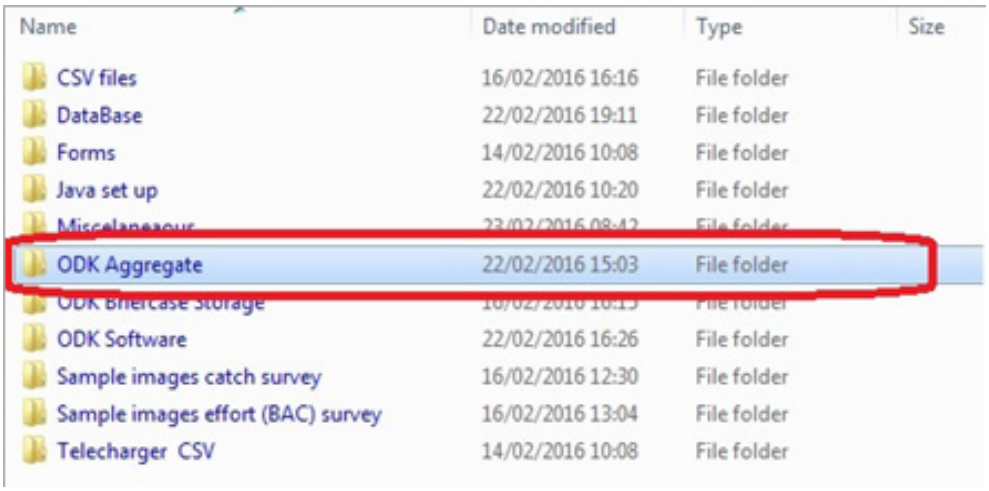


First time Log in on your server

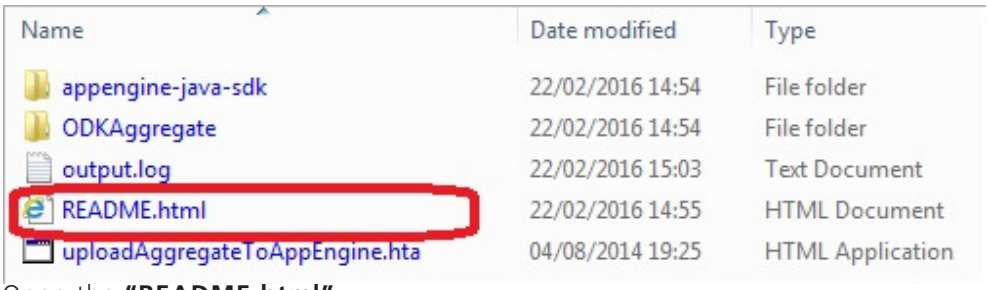
After the apllication has been created you can login for the first time. For this you need:

- The name of the administrator used to create the system (YourName see page 33).
- The first time login password for the administrator, which is **'aggregate'**

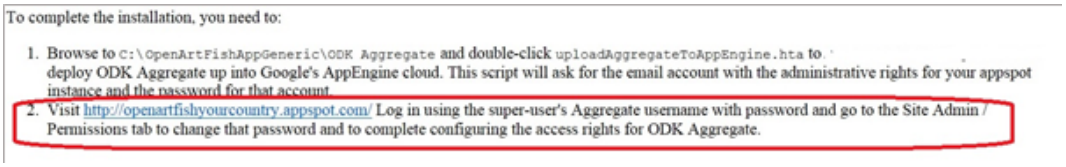
During the instalation a new folder **'ODK agregate'** has been created on your computer.



Open the folder **"ODK Aggregate".**

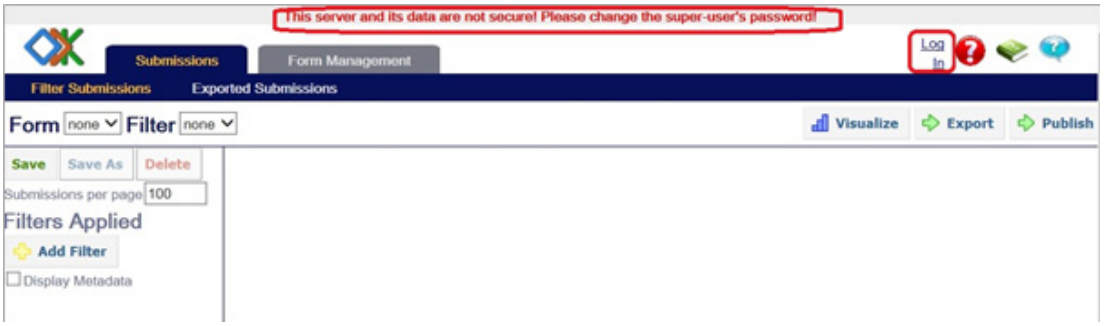


Open the **"README.html".**



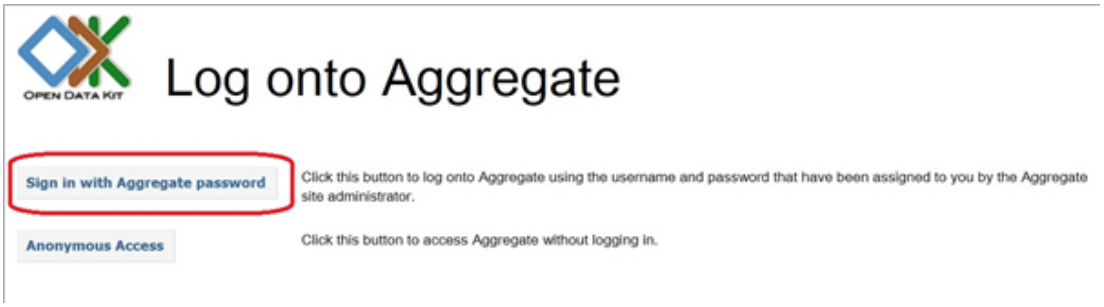
Here the web address of the created application is provided. https://openartfishyourcountry.appspot.com

Double click on **'the web addres'** for the first time log in.



Your application will open automatically. But please note the message **'This server and its data are not secure! Please change the super user's password!** The website is still public and anybody can login and look at the data.

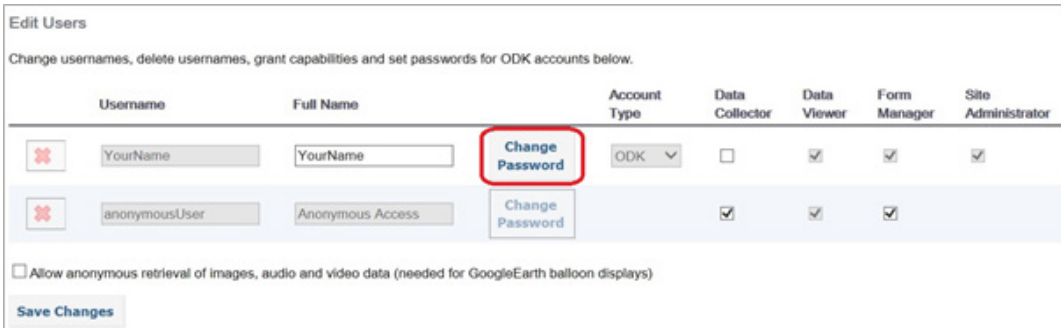
The super user is the name of the administrator, you entered during the installation of ODK (see page 33). To protect the website click on **'Login'.**



Click on **"Sign in with Aggregate password".**

Enter the name of the administrator you entered during the installation of ODK and the first time login password **"aggregate".**

Go to **"Site Admin"** to change the password of the administrator.

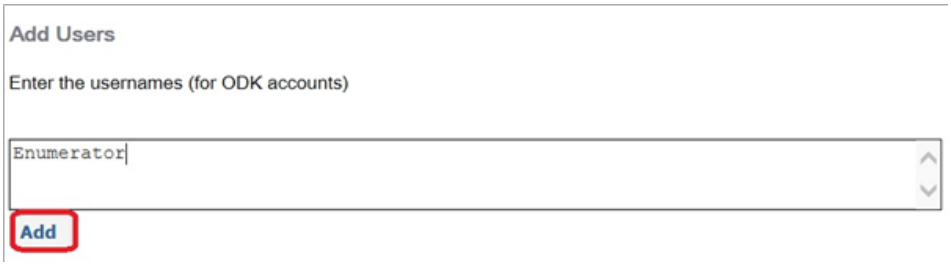


Change the password and click "**Save Changes".**

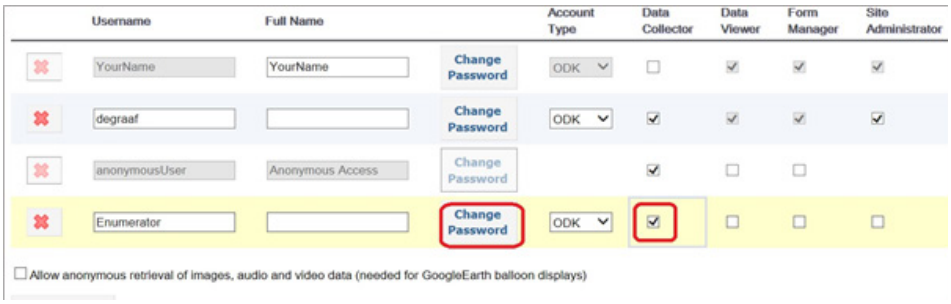
Do not forget to write down the password!

Add other users

Other users such as enumerators can be added similarly by the administrator.



Login on the sever



Go to **"Site Admin"**
Add the name and click **"Add"**

Toggle for the Enumerator **"Data Collector"** only. Change the password and save the changes.

How to design a mobile phone application ODK XLS form

Forms for a mobile phone application are first made in an ODK XLSform, which then is converted to an XLM form though the free software XLSForm.

Excellent guidelines on the creation of an ODK XLSform can be found on the ODK website (https://opendatakit.org/use/xlsform and http://xlsform.org/). A summary is provided in the Box below.

'XLSForm is a form standard created to help simplify the authoring of forms in Excel. Authoring is done in a human readable format using a familiar tool that almost everyone knows - Excel. XLSForms provide a practical standard for sharing and collaborating on authoring forms. They are simple to get started with but allow for the authoring of complex forms by someone familiar with the syntax described below.

The XLSForm is then converted to an XLMForm, a popular open form standard that allows you to author a form with complex functionality like skip logic in a consistent way across a number of web and mobile data collection platforms

Basic format

Each Excel workbook usually has two worksheets: survey and choices. A third optional worksheet called settings can add additional specifications to your form and is described below.

The survey worksheet

This worksheet gives your form its overall structure and contains most of the content of the form. It contains the full list of questions and information about how they should appear in the form. Each row usually represents one question; however, there are certain other features described below that you can add to the form to improve the user experience.

The choices worksheet

This worksheet is used to specify the answer choices for multiple choice questions. Each row represents an answer choice. Answer choices with the same **list name** are considered part of a related set of choices and will appear together for a question. This also allows a set of choices to be reused for multiple questions (for example, yes/no questions).

Both of these worksheets have a set of mandatory columns that must be present for the form to work. Additionally, each worksheet has a set of optional columns that allow further control over the behavior of each entry in the form, but are not essential to have. Every entry must have values for each of the mandatory columns, but the optional columns may be left blank.

The **survey** worksheet has 3 mandatory columns: **type**, **name**, and **label**.

- The **type** column specifies the type of entry you are adding.
- The **name** column specifies the unique variable name for that entry. No two entries can have the same name.
- The **label** column contains the actual text you see in the form..

The **choices** worksheet has 3 mandatory columns as well: **list name**, **name**, and **label**.

- The **list name** column lets you group together a set of related answer choices, i.e., answer choices that should appear together under a question.
- The **name** column specifies the unique variable name for that answer choice.
- The **label** column shows the answer choice exactly as you want it to appear on the form.

Source: ODK http://xlsform.org/

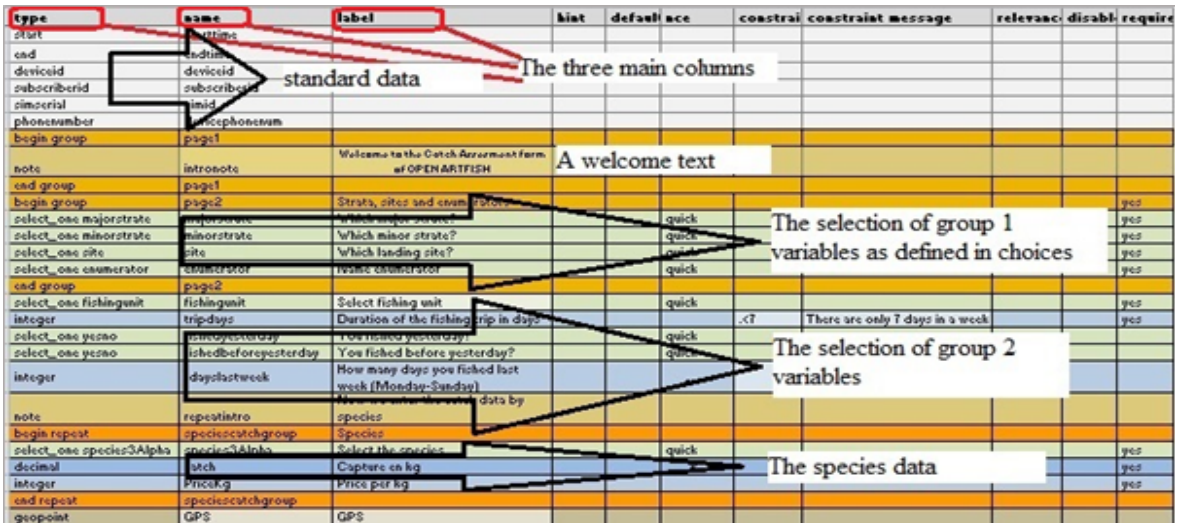
The OPEN ARTFISH ODK XLS form

The sample Excel form was downloaded from ODK (https://opendatakit.org/use/xlsform/) and was used to develop three OPEN ARFISH ODK XLS forms;

1. **CatchFormOpenArtfishPAB.xlsx**. Used for horizontal sampling, only one survey form is needed
2. **CatchFormOpenArtfishBAC.xlsx**. Used for vertical sampling, this form is used for catch data
3. **FishingEffortFormOpenArtfishBAC.xlsx**. Used for vertical sampling. This form is used for fishing effort data.

The survey sheet

The principle of the design and its functionality is explained with the first form CatchFormOpenArtfishPAB.xlsx.[11]

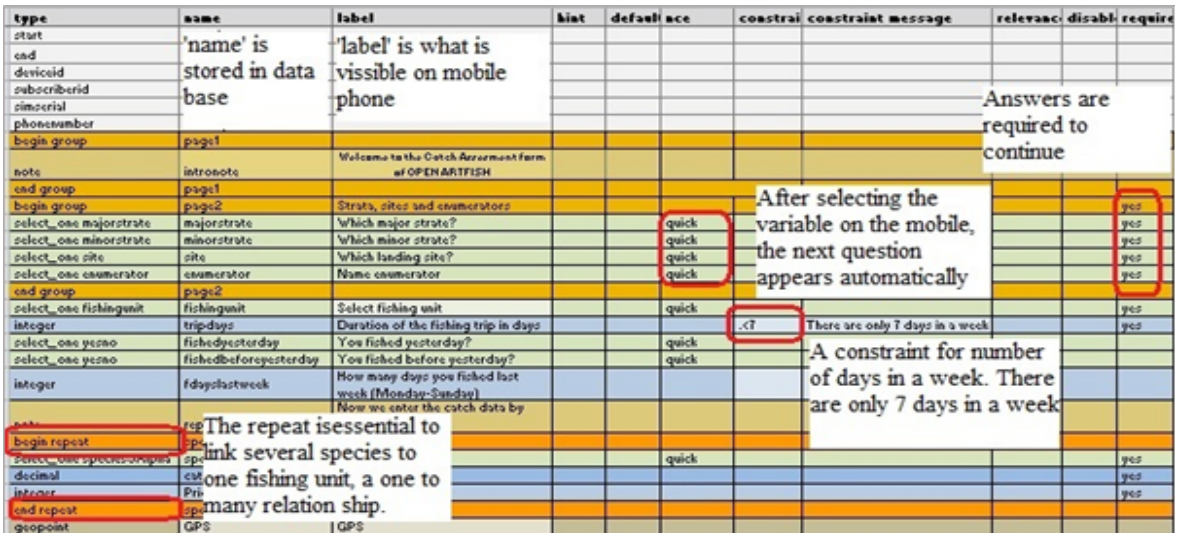


In the survey for the three main columns "type", "name" and "label"
Type: is the type of variable
Name: is the name of the variable as being stored in the database
Label: is the name of the variables as it will be displayed at the mobile phone

The first 5 rows are standard data not to be changed.
In the next rows the variables are grouped. This is not essential, but it facilitates data analyses in a later stage.
Group 1: sites, contains all the questions related to strata and sites
Group 2: fishingunits, contains all the question related to fishing units and fishing effort

As variable type you see;
Select_one xxx: this is a multiple choice, whereby the variable is provided in choices
Integer: variables with whole number only
Decimal: number written in decimal notation
Begin repeat: instruction to repeat the questions in the rows below
End repeat: instruction to stop the repeat
Note: a text displayed
Geopoint: takes the geographical reference at the moment the data are entered in the mobile phone

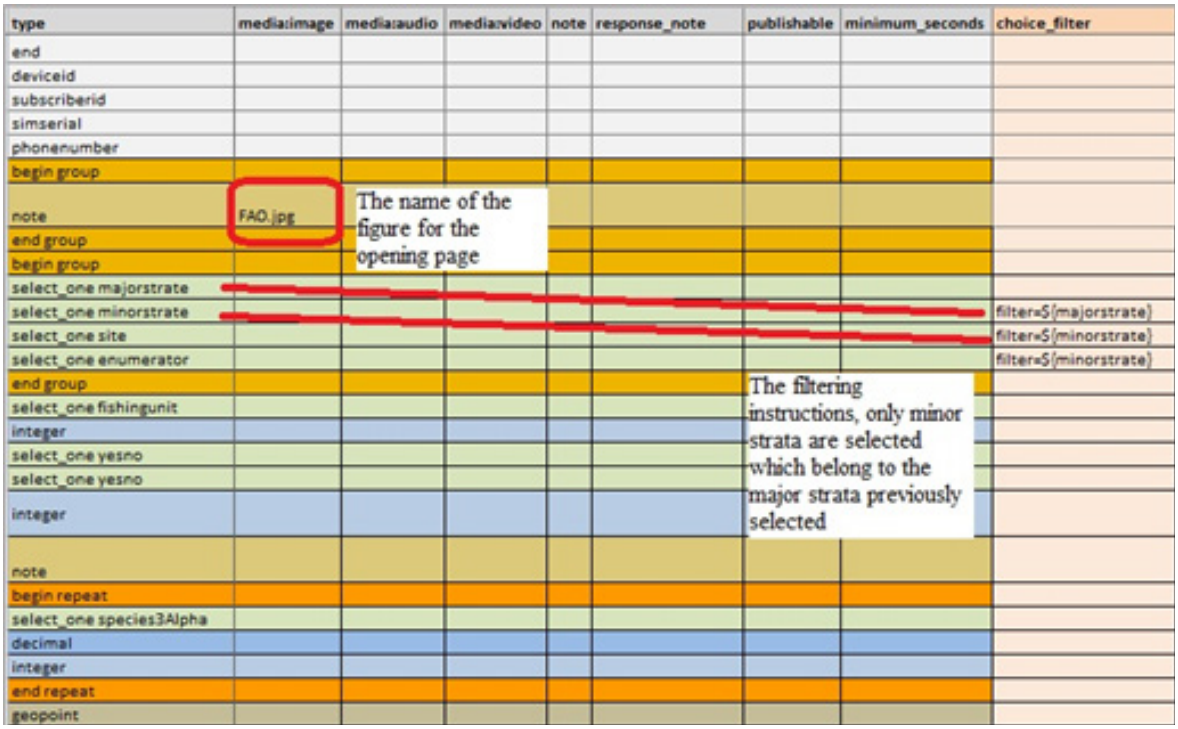
[11] Please note if you want to use the mobile phone application to be linked to OPEN ARTFISH, then you **cannot** change this form!



In the fourth column "**appearance**" quick is entered for multiple choice questions. With this after selecting a variable on the mobile phone, the next question appears automatically.

In the fifth column "**constraints**", a constraint to a numeric value is provided. If the constraint is encounter, then the messages in column six "**constraint message**" will appear.

If in the 11th "**required**" yes is entered then this question has to be answered before continuing with the next question.



In column 16 "**media:image**" the name of the figure/image (including the extension) to be displayed on the mobile phone.

In the last column "**choice_filter**" the filtering option of the multiple choices can be provided. It links the multiple choice to a previous question asked. For example minor strata are linked to major strata and only the minor strata which are related to the previous selected major stratum will become visible on the mobile phone.

The choices sheet

The choices sheet provides the list of names for the variables which operate with multiple choices. It is essential the list_name is exactly the same as provided in the survey sheet after **Select_one xxx (i.e. the xxx).**

list_name	name	label	image	filter
yesno	1	yes		
yesno	0	no		
majorstrate	CodeMajS1	MajS1		
minorstrate	CodeMinS1	MajS1MinS1		CodeMajS1
site	CodeSite1	MajS1MinS1Site1		CodeMinS1
site	CodeSite2	MajS1MinS1Site2		CodeMinS1
site	CodeSite3	MajS1MinS1Site3		CodeMinS1
enumerator	CodeEnumerator1	AA		CodeMinS1
fishingunit	CanNonMotGN	Non motorised canoe with gillnet	CanNonMotGN.jpg	
fishingunit	CanMotRN	Motorised canoe with ring net	CanMotRN.jpg	
fishingunit	CanNonMotHL	Non motorised canoe with hooks	CanNonMotHL.jpg	
species3Alpha	MZZ	Mixed fish	MZZ.jpg	

In column 4, the filters applied are provided. In this case the minor strata are related to the major strata, the sites and the enumerators are related to the minor strata. But this only works if in the survey sheet the filters are set!

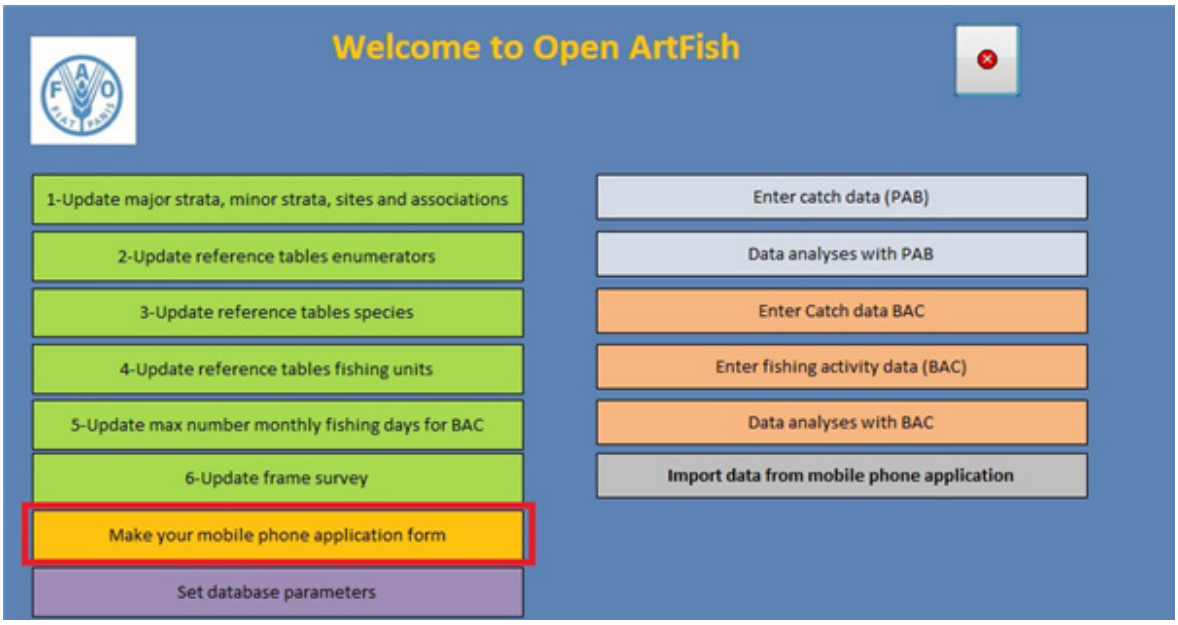
select_one majorstrate								
select_one minorstrate								filter=${majorstrate}
select_one site								filter=${minorstrate}
select_one enumerator								filter=${minorstrate}

Filling the choices sheet depends on your major strata, minor strata, etc., as selected in your sampling design and entered in OPEN ARTFISH.

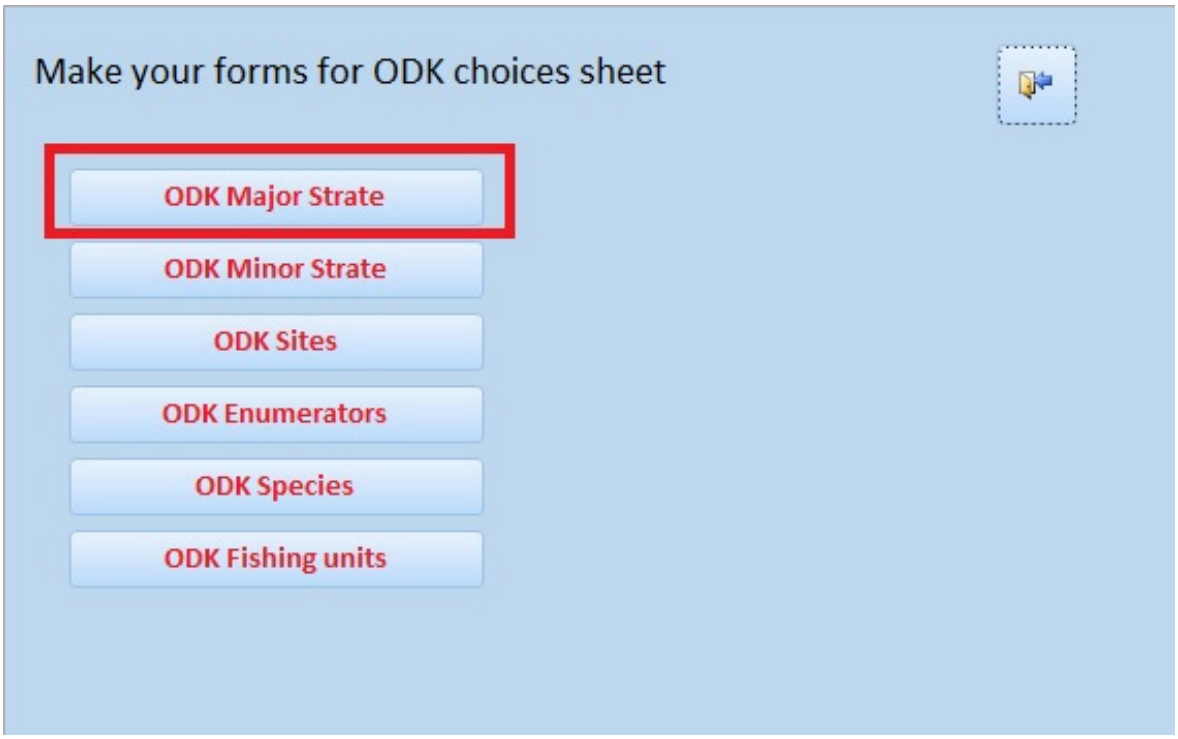
Creating the choices sheet with OPEN ARTFISH

OPEN ARTFISH can generate the needed information for the choices sheet automatically.

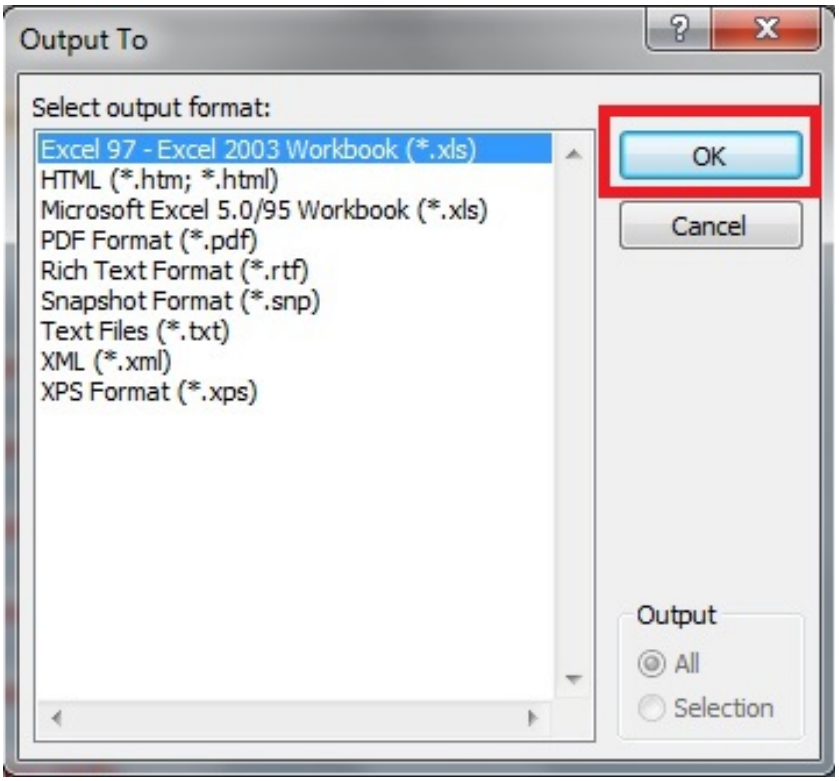
In the main screen of OPEN ARTFISH Click on **"Make your mobile phone application form"**



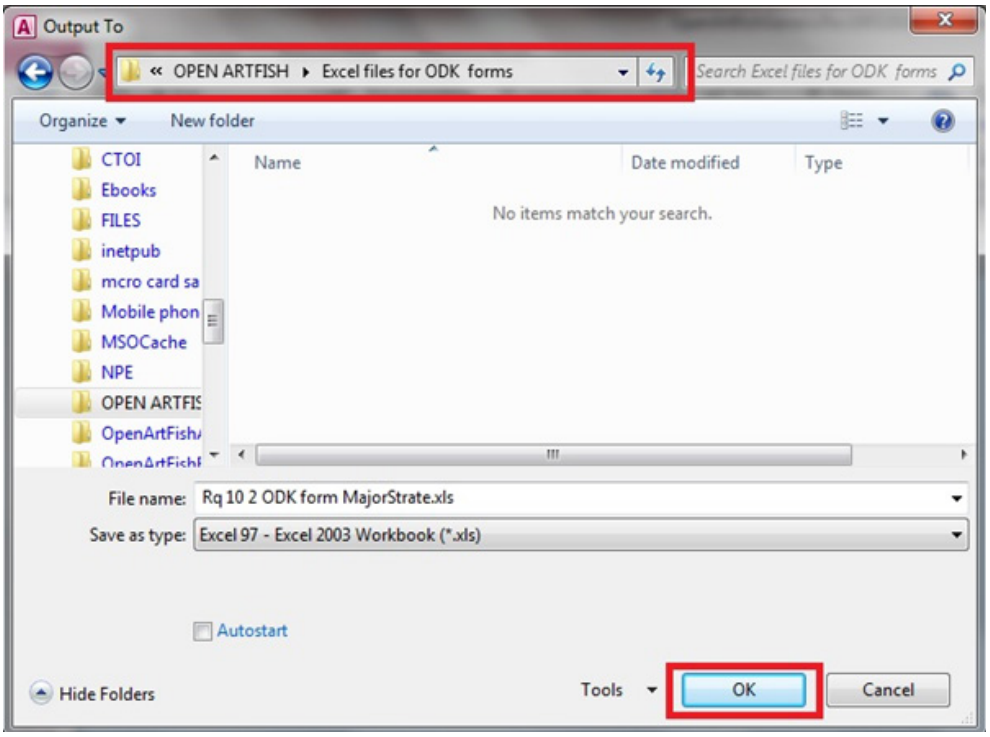
Then click on **"ODK Major Strate"**



The screen below will open.



Select **"Excel 97-Excel 2003 Workbook (*.xls)"** and click **"OK"**



Select the folder where you want to save the file (in this example C:\OPEN ARTFISH\Excel files for ODK forms) and click **"OK"**

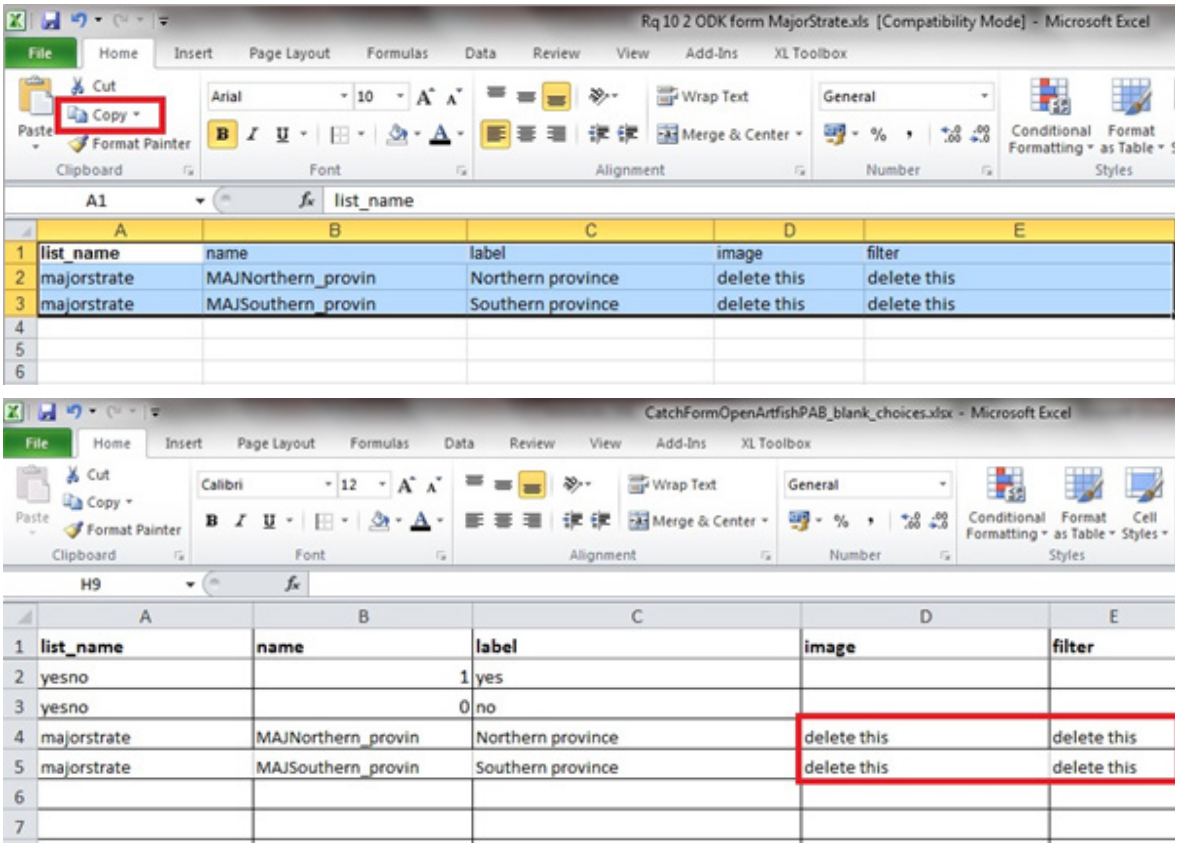
Repeat this for Minor strata, sites, enumerators, and species and fishing units.

Open the form **"CatchFormOpenArtfishPAB_blank_choices.xlsx"** (Download the empty form)

In the choices sheet only the two first rows are filled. The next rows are filled by copying and pasting the data from the excel files you just created.

	A	B	C	D	E
1	**list_name**	**name**	**label**	**image**	**filter**
2	yesno	1	yes		
3	yesno	0	no		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

Open **"Rq 10 2 ODK form MajorStrate.xls"** Select the range and copy



Past the selected range in the blank sheet and empty the cells where you see **"delete this".**

Repeat this for minor strata, sites, enumerators, fishing units and species.

The last thing you have to do is to provide the name of the images for the fishing units and species, for example **"MotorisedCanoeHooks.jpg"** or **"Nkako.jpg**", etc.

	A	B	C	D	E
1	**list_name**	**name**	**label**	**image**	**filter**
2	yesno	1	yes		
3	yesno	0	no		
4	majorstrate	MAJNorthern_provin	Northern province		
5	majorstrate	MAJSouthern_provin	Southern province		
6	minorstrate	MINCentral_zoneXXX	Central zone		MAJNorthern_provin
7	minorstrate	MINNorthern_zoneXX	Northern zone		MAJNorthern_provin
8	minorstrate	MINSouthern_zoneXX	Southern zone		MAJSouthern_provin
9	site	SITEAlpha_beachXXXX	Alpha beach		MINNorthern_zoneXX
10	site	SITEArtfish_beachXX	Artfish beach		MINSouthern_zoneXX
11	site	SITEBeta_beachXXXXX	Beta beach		MINNorthern_zoneXX
12	site	SITECentral_beachXX	Central beach		MINCentral_zoneXXX
13	enumerator	ENUMMr_AntonXXXXX	Mr Anton		MINNorthern_zoneXX
14	enumerator	ENUMMrs_Louise_Apha	Mrs Louise Aphada		MINNorthern_zoneXX
15	enumerator	ENUMMr_Malounga_Seb	Mr Malounga Sebastienne		MINNorthern_zoneXX
16	enumerator	ENUMMrs_Elsa_Rabiot	Mrs Elsa Rabiotavulanama		MINSouthern_zoneXX
17	enumerator	ENUMLouis_KandamaXX	Louis Kandama		MINCentral_zoneXXX
18	fishingunit	CanMotHL	MotorisedCanoeHooks	Add name picture fishing unit	
19	fishingunit	CanMotRN	MotorisedCanoeRingNet	Add name picture fishing unit	
20	fishingunit	CanNonMotGN	NonMotorisedCanoeGillnet	Add name picture fishing unit	
21	fishingunit	CanNonMotHL	NonMotorisedCanoeHooks	Add name picture fishing unit	
22	fishingunit	CanNonMotTR	NonMotrisedCanoeTraps	Add name picture fishing unit	
23	species3Alpha	AAA	Nkako	Add name of image for this species	
24	species3Alpha	ADI	Orfir	Add name of image for this species	
25	species3Alpha	AKA	Fado	Add name of image for this species	
26	species3Alpha	DIO	Alala	Add name of image for this species	

The settings sheet

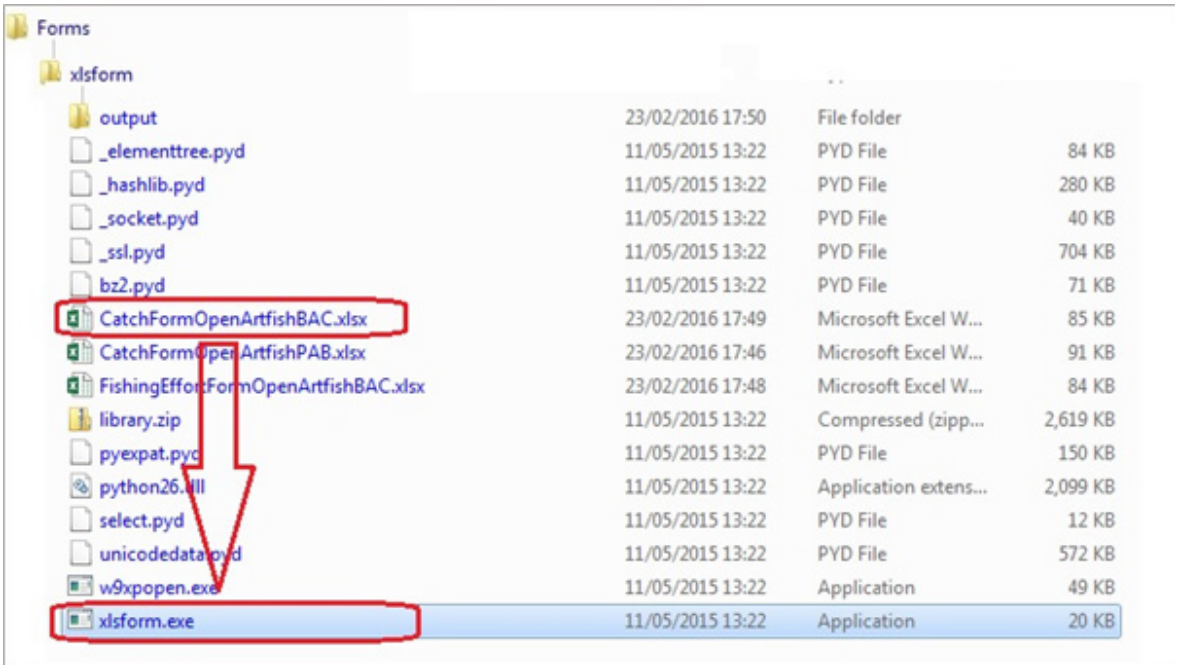
	A	B	C	D	E	F
1	**form_title**	**form_id**	**version**	**public_key**	**submission_url**	**default_language**
2	CatchFormOpenArtFishPAB	CatchFormOpenArtFishPAB	20161010			english
3						
4						

The setting sheet contains;
Form_title: The title of the form that is shown to users
Form_id: The name used to identify the form submission[12]
Version: the version of the form (in our case the date when the form is created) the format should be **"YYYYMMDD"!** This will result in a new version of a later date, which is lexically greater than the previous version.
Default _language: this sets which language should be used as the default.

The version of the form is of utmost important. If you make changes, add species fishing units etc. and you upload the form to the server, **you have to change the version**. Otherwise you risk losing data previously uploaded to the server.

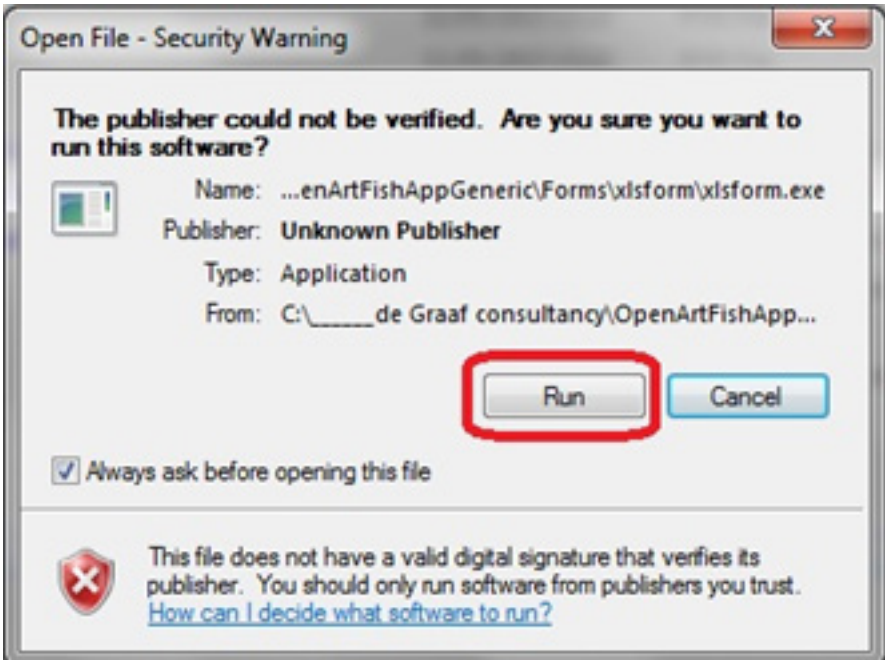
How to convert the XLS application form to XLM

Converting an XLS form to an XLM form is done with the software XLSform. This is already incorporated in the OPEN ARTFISH folders but can also be downloaded at https://opendatakit.org/downloads/download-info/xlsform-for-windows/.

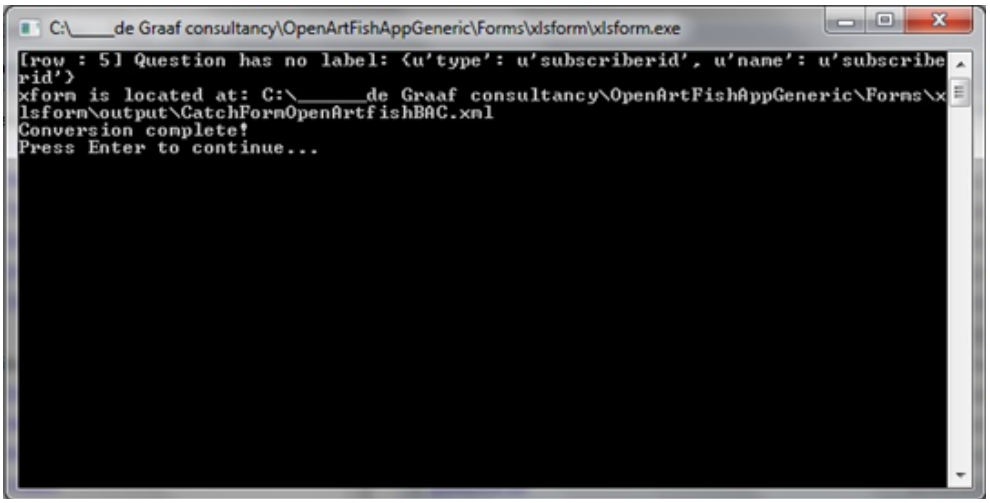


[12] Please note you cannot change the name if you are want to import the data into OPEN ARTFISH.

Simply drag XLSForms onto xlsform.exe.



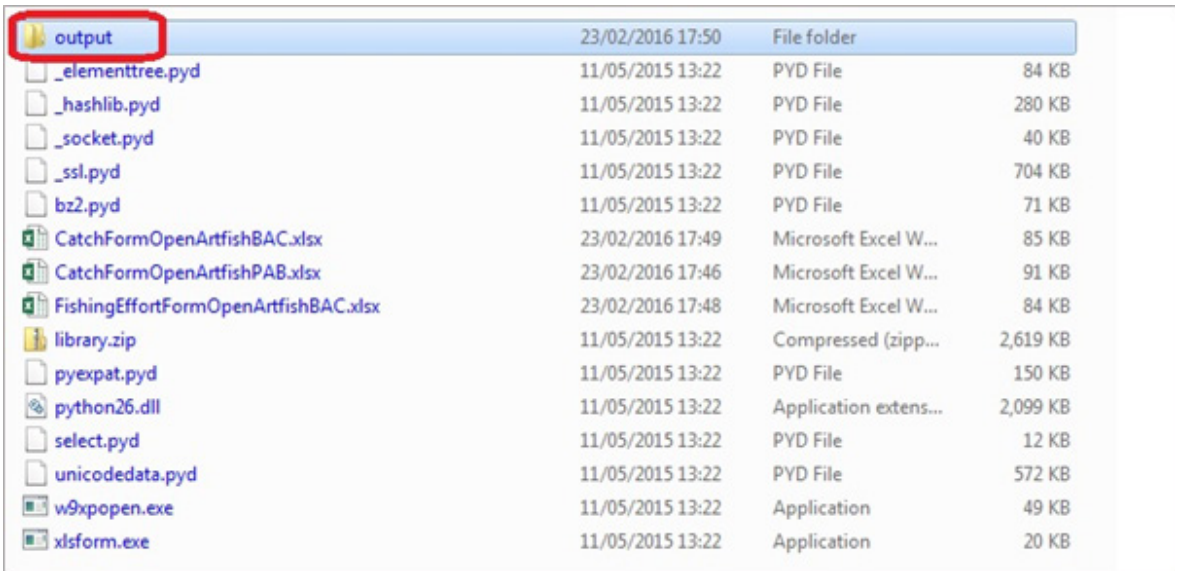
Click **"Run".**



Press **"Enter"** and the corresponding xlmform will appear in the output directory.

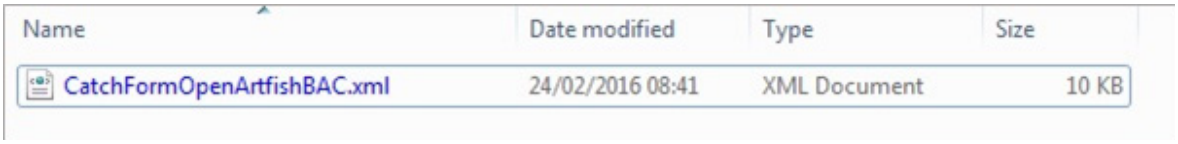
If there are design errors in the xlsform, they will be indicated in the above screen.

Open the output directory.



output	23/02/2016 17:50	File folder	
_elementtree.pyd	11/05/2015 13:22	PYD File	84 KB
_hashlib.pyd	11/05/2015 13:22	PYD File	280 KB
_socket.pyd	11/05/2015 13:22	PYD File	40 KB
_ssl.pyd	11/05/2015 13:22	PYD File	704 KB
bz2.pyd	11/05/2015 13:22	PYD File	71 KB
CatchFormOpenArtfishBAC.xlsx	23/02/2016 17:49	Microsoft Excel W...	85 KB
CatchFormOpenArtfishPAB.xlsx	23/02/2016 17:46	Microsoft Excel W...	91 KB
FishingEffortFormOpenArtfishBAC.xlsx	23/02/2016 17:48	Microsoft Excel W...	84 KB
library.zip	11/05/2015 13:22	Compressed (zipp...	2,619 KB
pyexpat.pyd	11/05/2015 13:22	PYD File	150 KB
python26.dll	11/05/2015 13:22	Application extens...	2,099 KB
select.pyd	11/05/2015 13:22	PYD File	12 KB
unicodedata.pyd	11/05/2015 13:22	PYD File	572 KB
w9xpopen.exe	11/05/2015 13:22	Application	49 KB
xlsform.exe	11/05/2015 13:22	Application	20 KB

The xlmform is created and can be uploaded to the server.

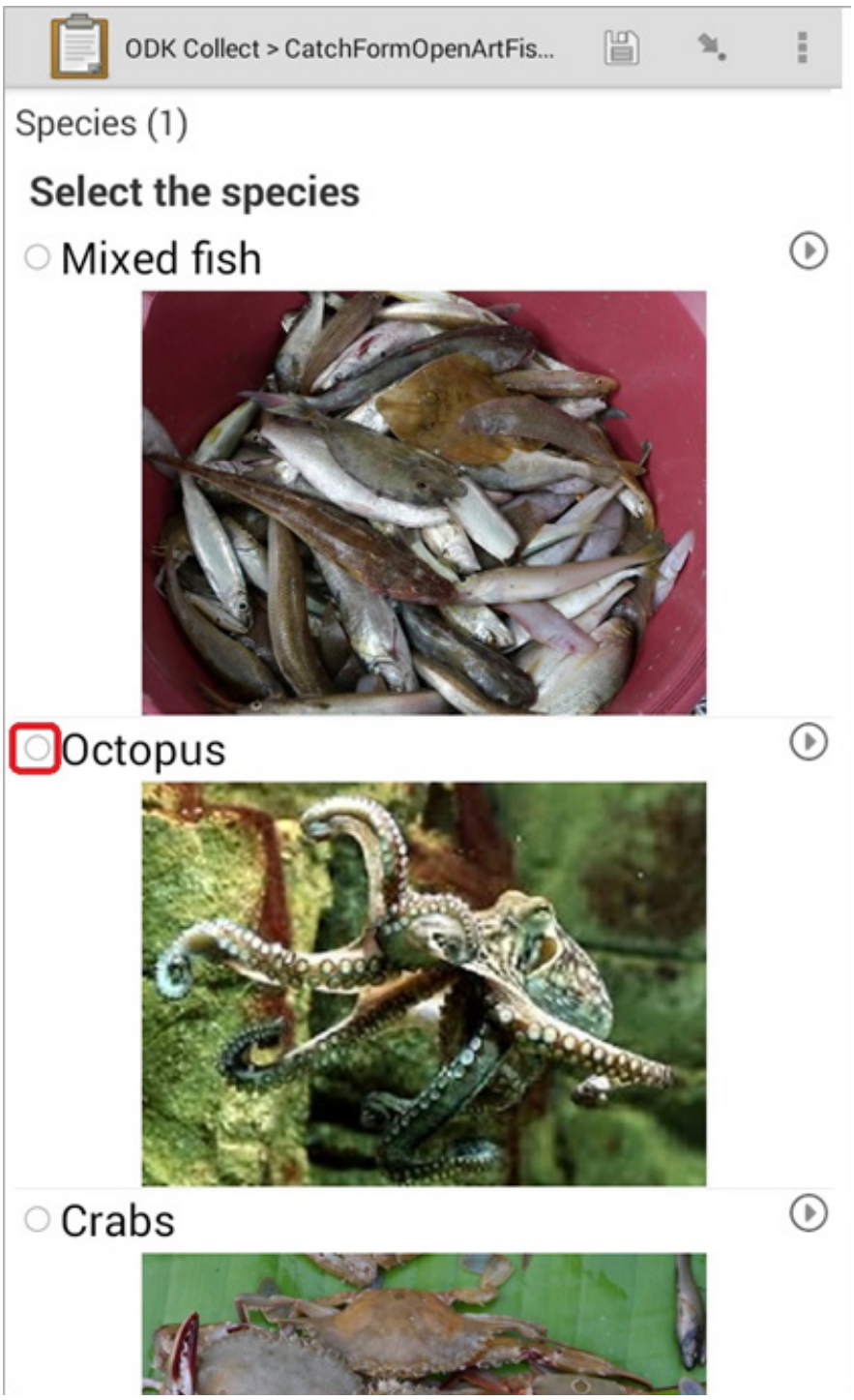


Name	Date modified	Type	Size
CatchFormOpenArtfishBAC.xml	24/02/2016 08:41	XML Document	10 KB

The images for your mobile phone application

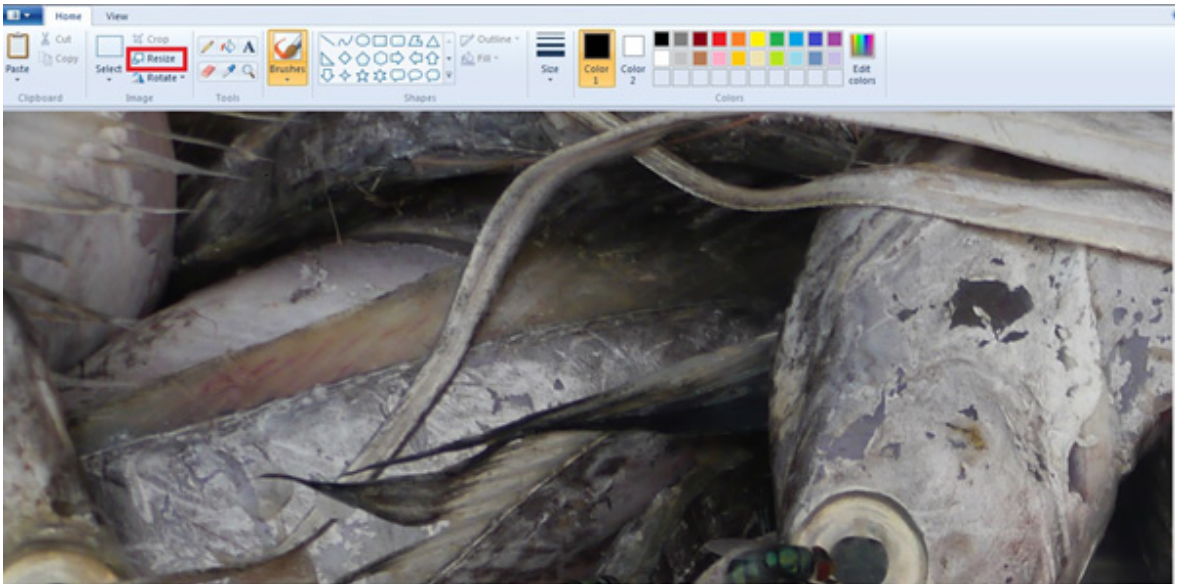
On the mobile phone the fishing units and species are displayed with an image and a name.

The best resolution for the mobile phone application seems to be 400 DPI horizontally for a table and 800 DPI for a mobile phone.



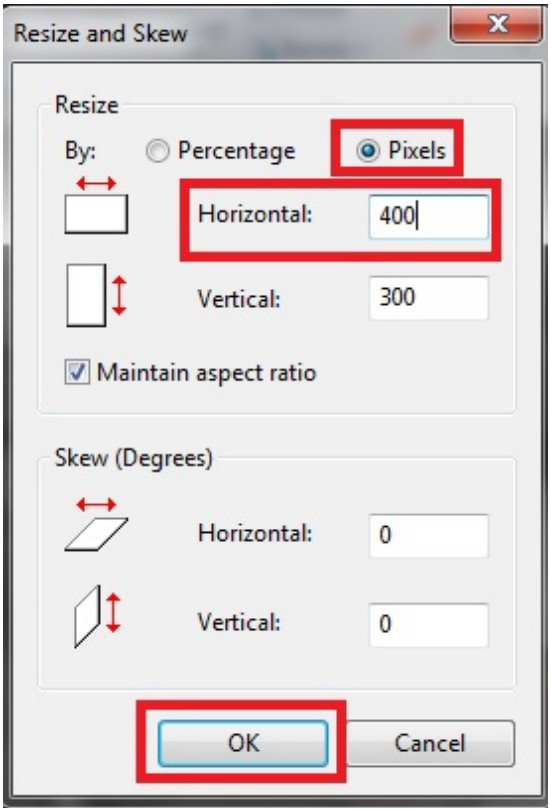
You can change the resolution for any image with the programme **"Paint"** which is installed on almost any computer.

Open an image in Paint



Click on **"Resize"**

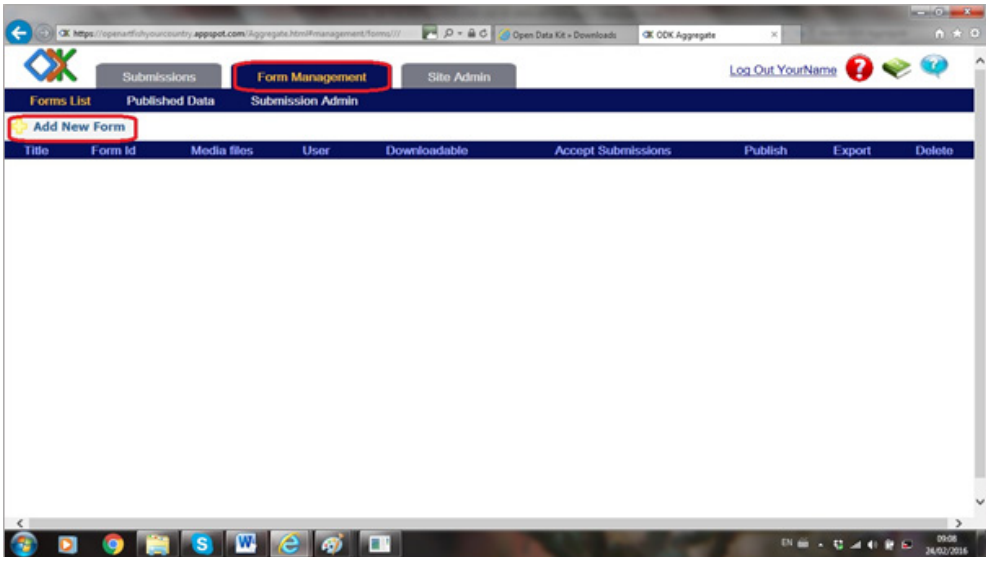
Select "Pixels" and enter 400 for the horizontal size (the vertical size will be adjusted automatically), clock "OK" and save the image.



How to upload the XLM form to the local server in the cloud

You can upload the created xlmform to the server;

Login with as administrator on the server.

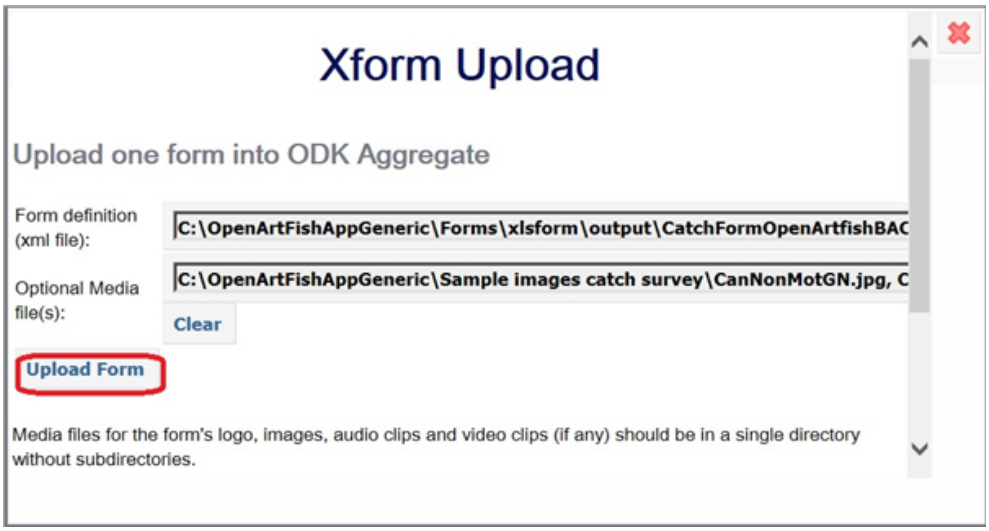


Select **"Form management"**

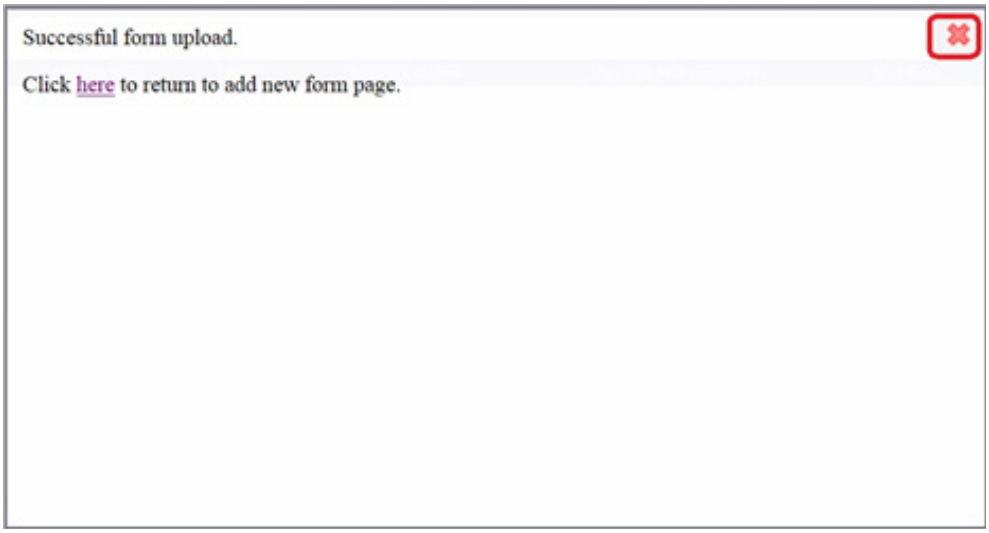
Select **"Add New Form"**

Browse to the folder where the xlmforms are stored and select the form to upload.

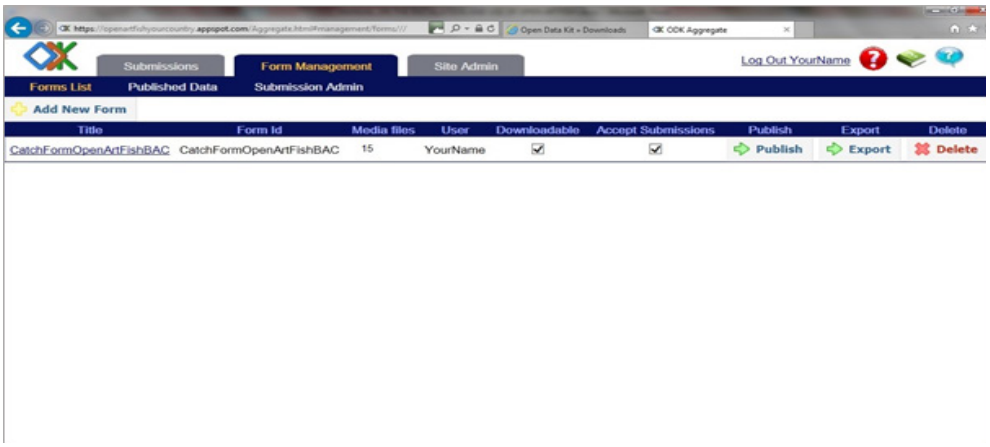
Browse to the folder where the accompanying media files (photos/images) for this form are stored and select all.



Click **"Upload Form"**



The file is uploaded. Close this message.



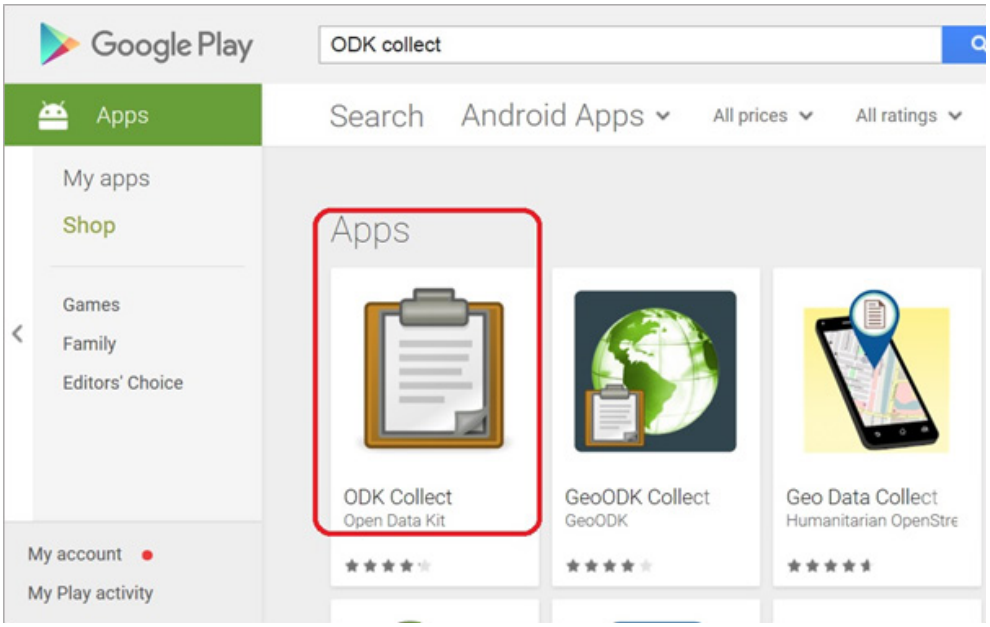
The selected form and 15 accompanying figures are successfully uploaded. The system is ready for use after this file is downloaded on a tablet or mobile phone.

How to install the application on your mobile form or tablet

The mobile phone application will only run on Android devices with an external SDCard.

Downloading from Google Play

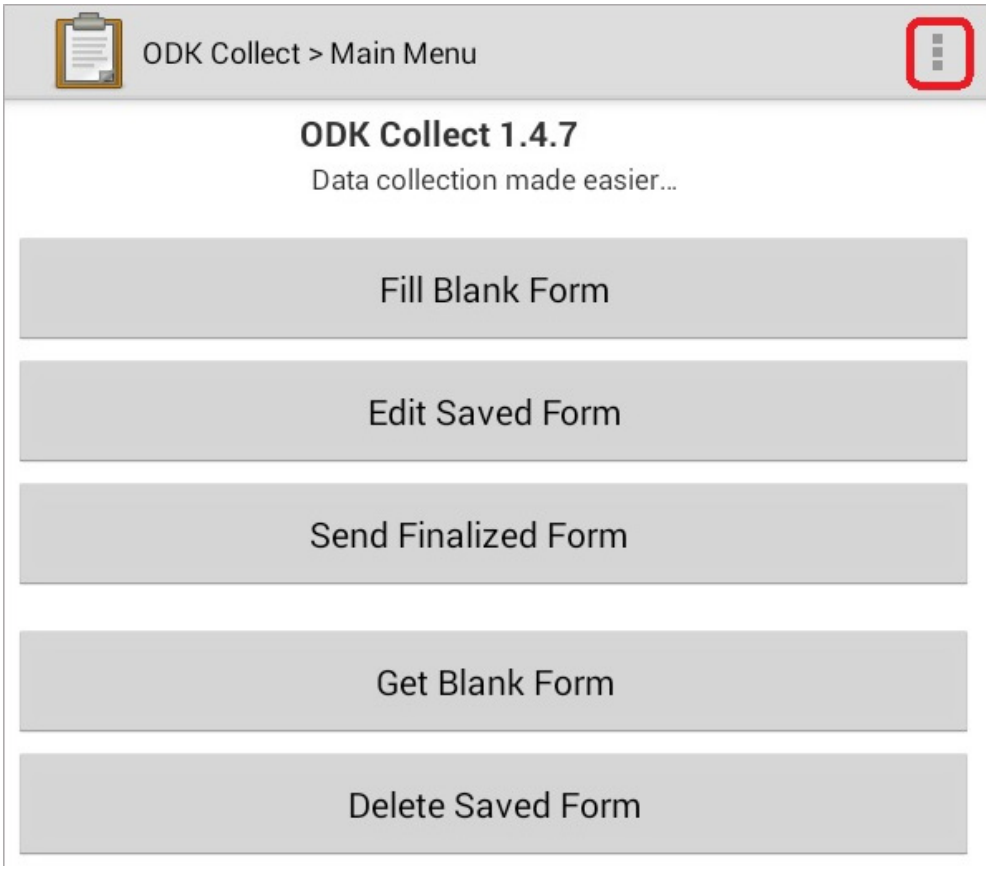
1. From your device's application drawer, choose the Play Store.
2. Search for "ODK" and choose "ODK Collect" from "Open Data Kit".



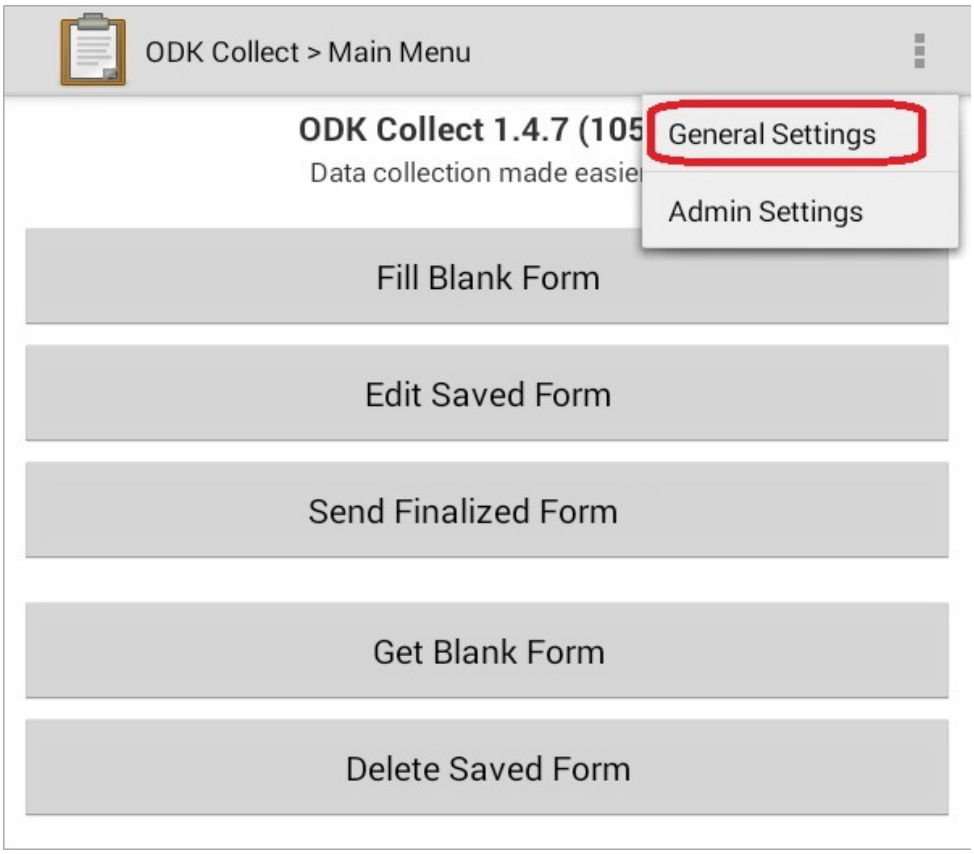
3. Select ODK collect and click the Install button. Click OK after viewing the security settings.
4. An ODK collect icon will appear on the mobile phone once installation is completed.

Configuring the application

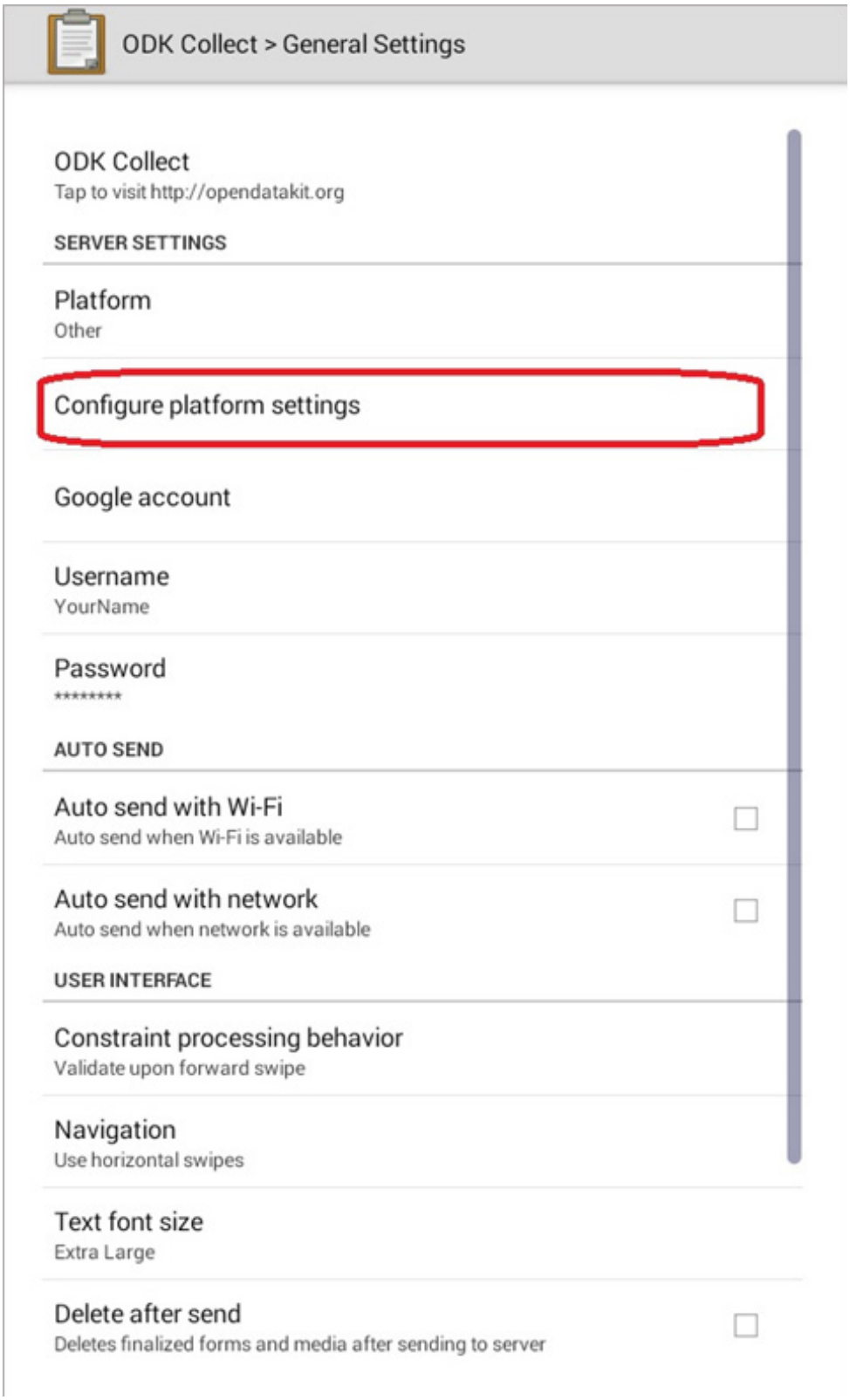
By clicking the icon, ODK Collect opens with the screen below.



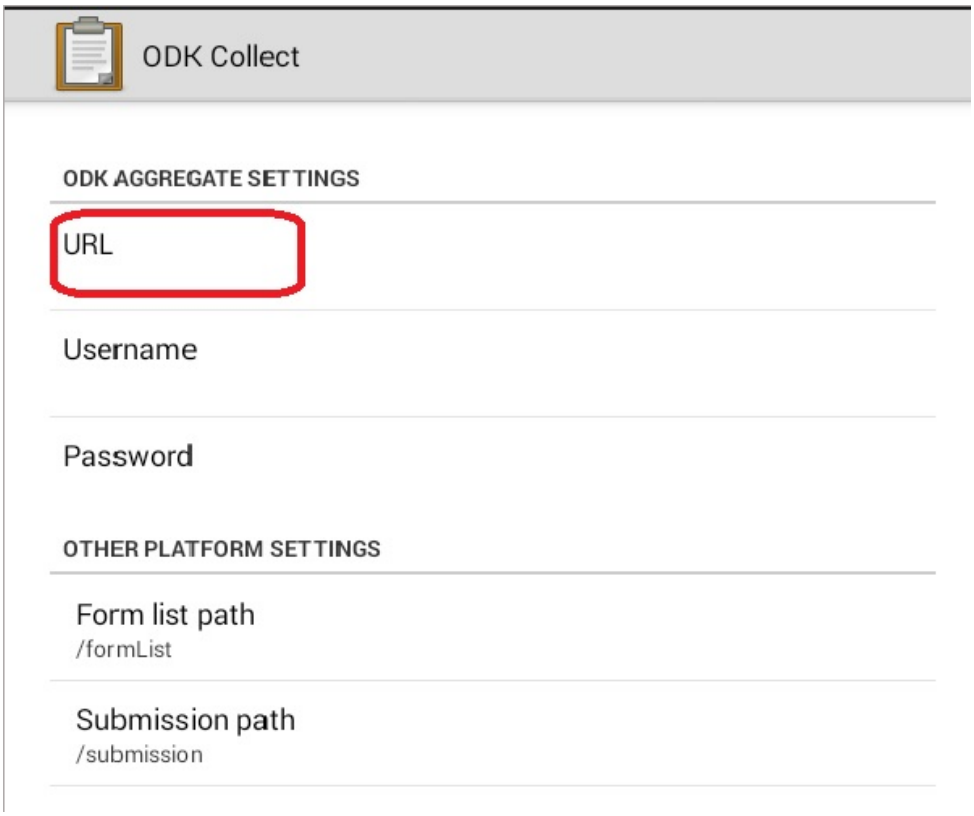
Click on the right top corner to open the **"General Settings"**



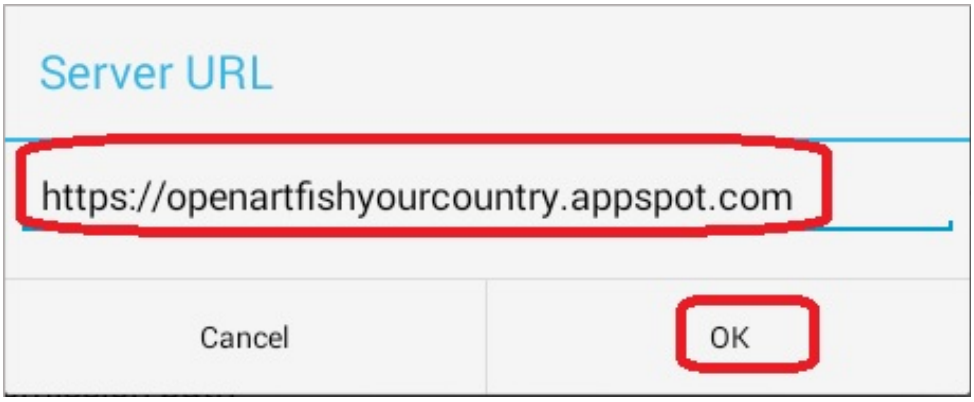
Select **"General Settings"**



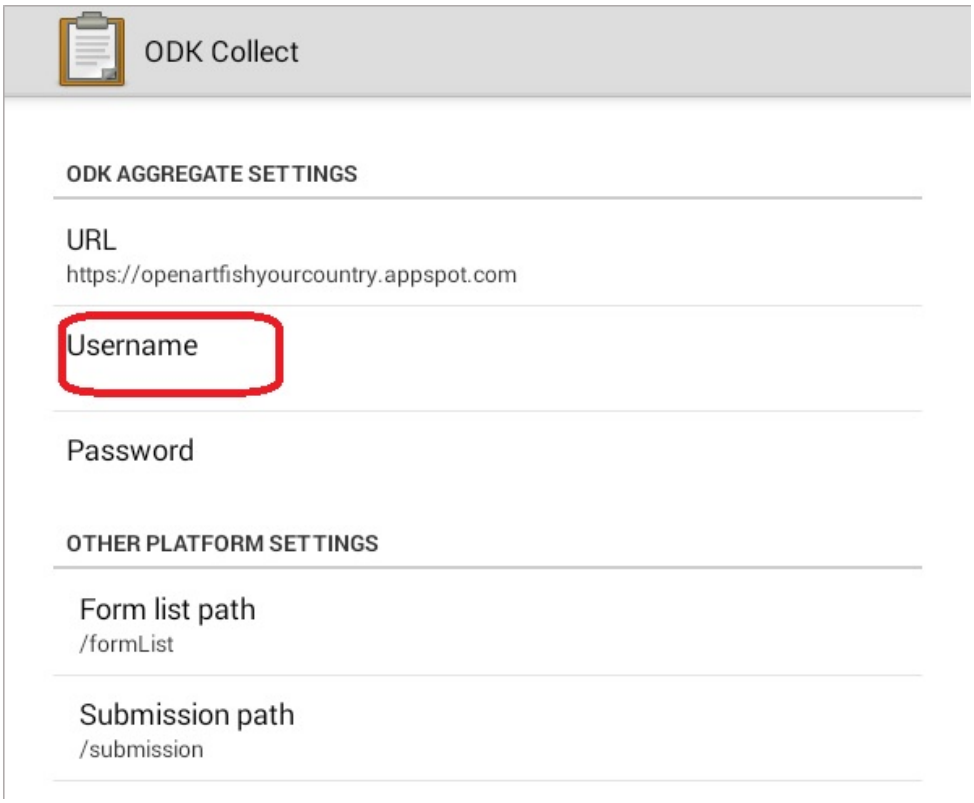
Select **"Configure platform setting"**



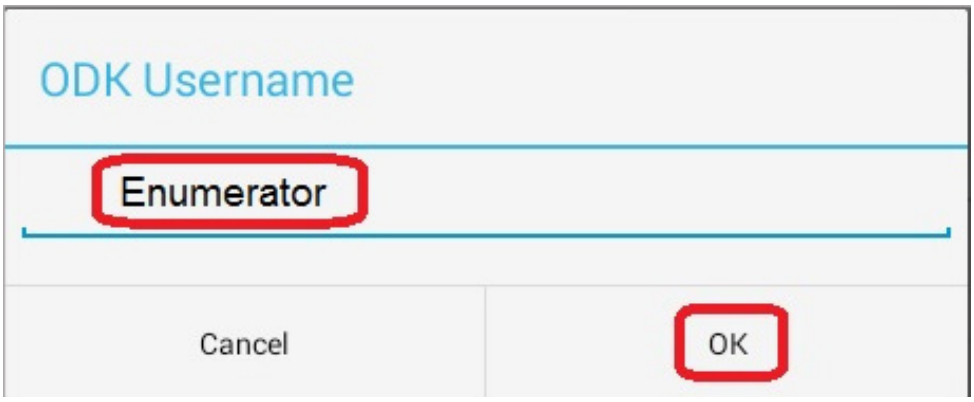
Select **"URL"**



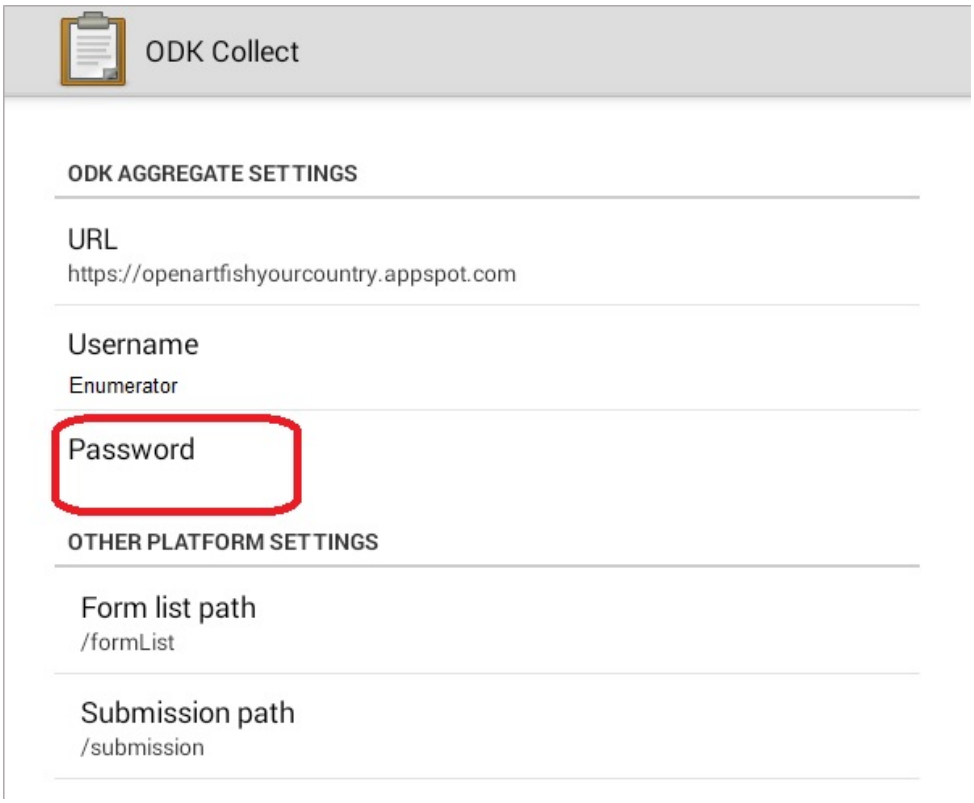
Enter the address of your server and click **"OK"**



Select **"Username"**



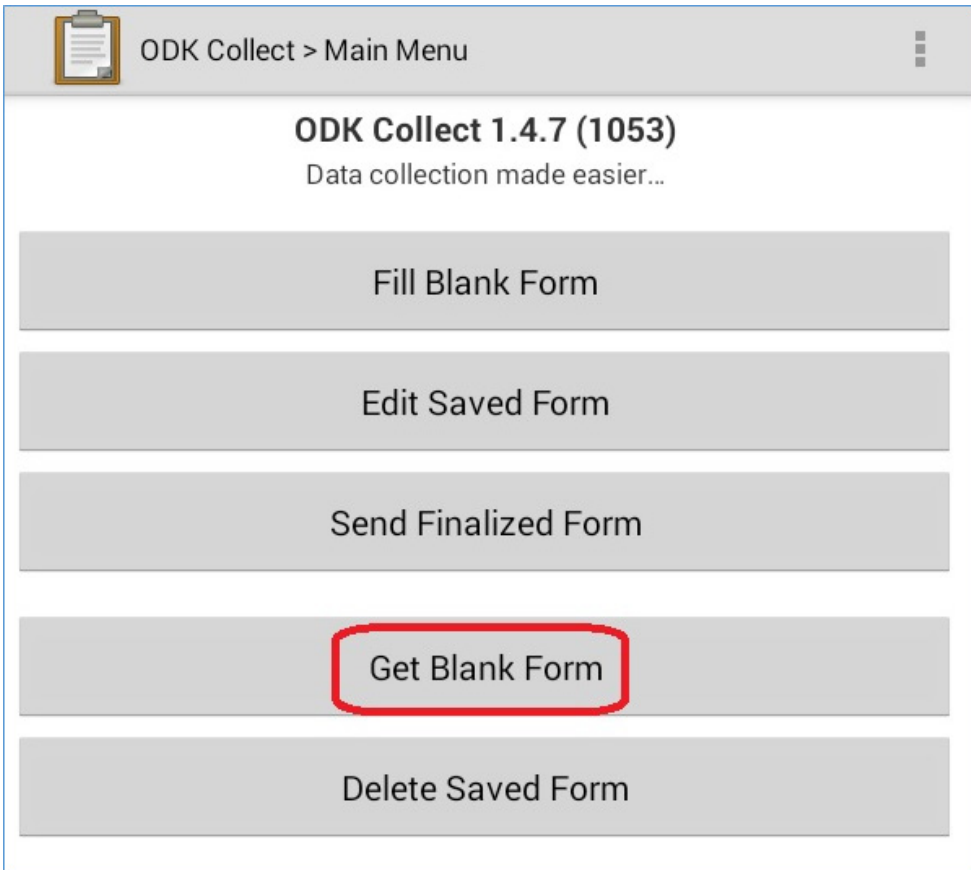
Enter the Username. In this case it is **"Enumerator"** with data collection rights only (See page 39).



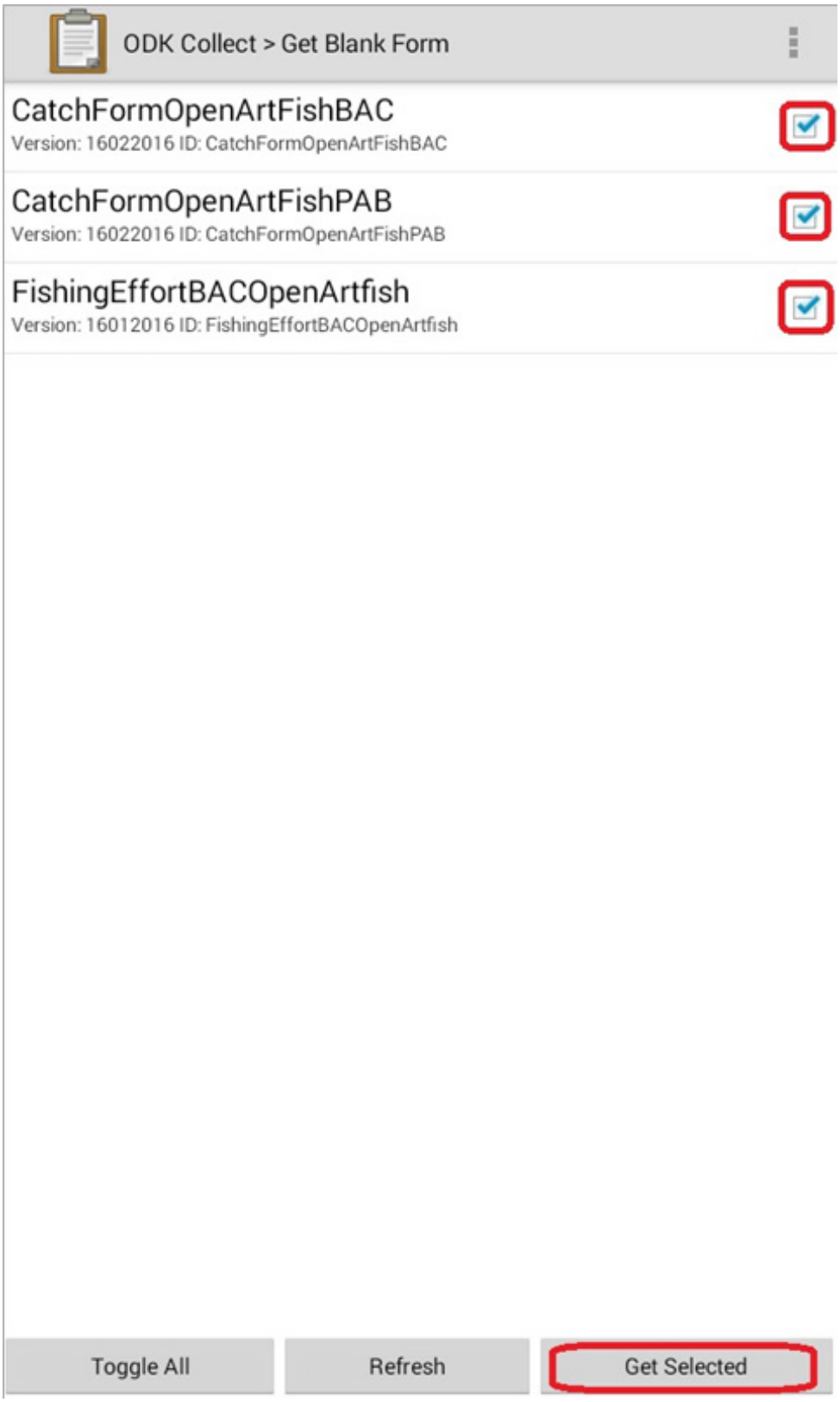
Select **"Password"** and enter the password for the enumerator.

Close the forms and go back to the main screen.

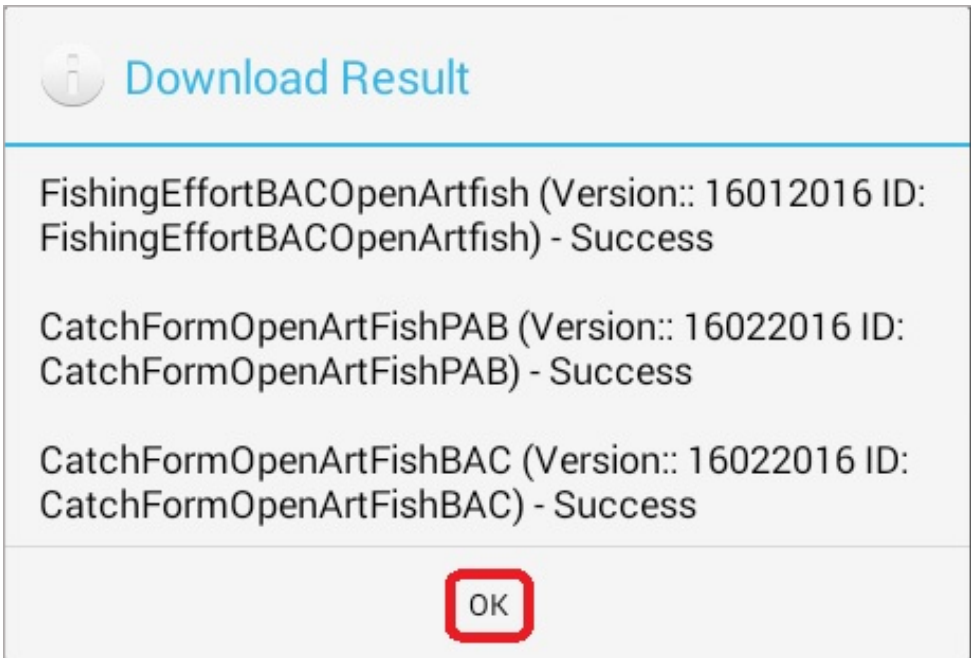
Download forms from the server in the cloud



Click **"Get Blank Form"**



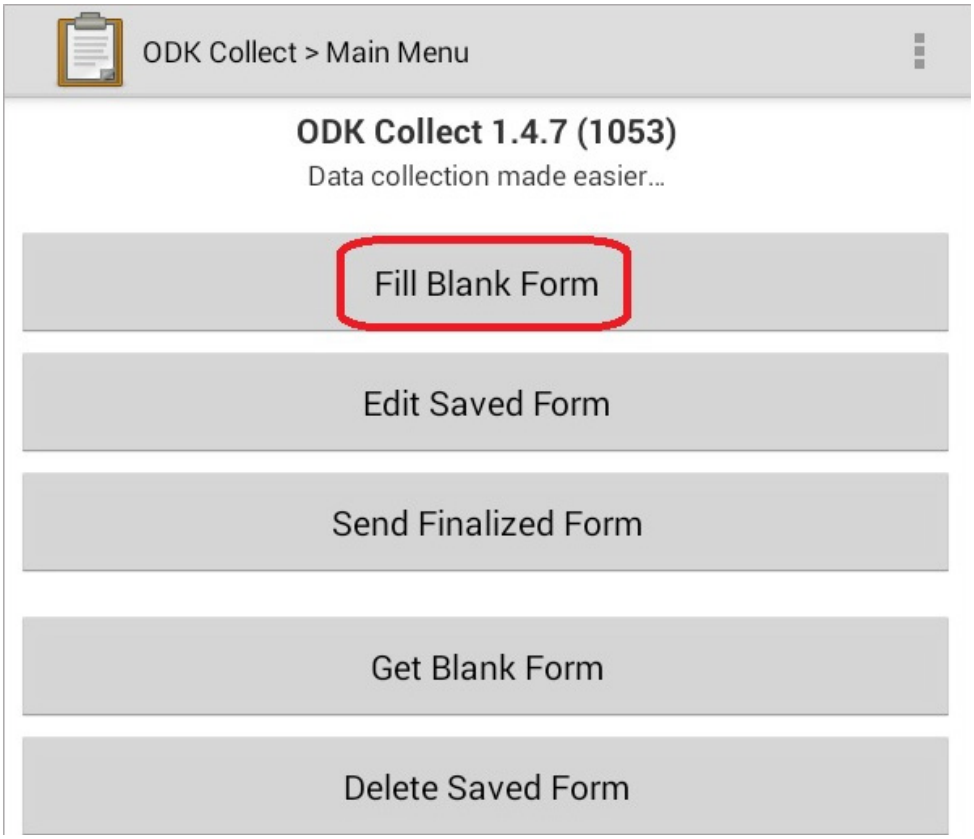
Toggle the forms to download and click **"Get Selected".**



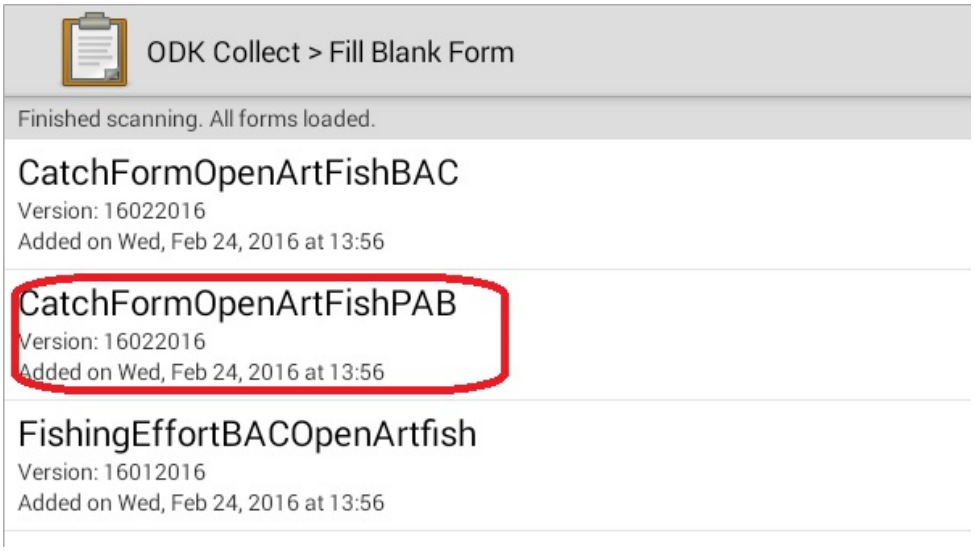
The forms are successfully downloaded, click **"OK".**

Using the application in the field

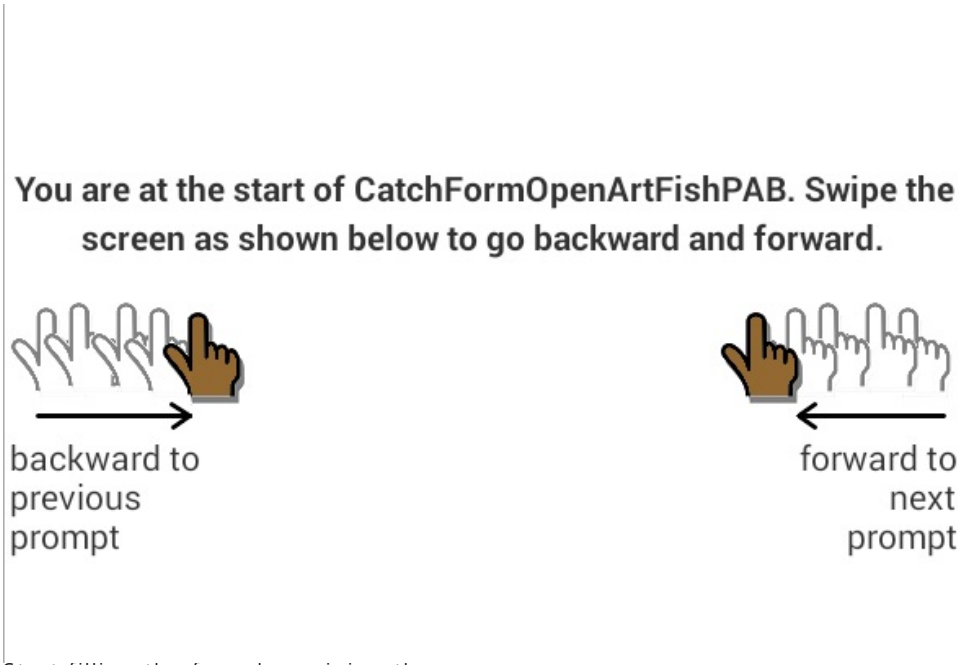
Have a look or read the text below



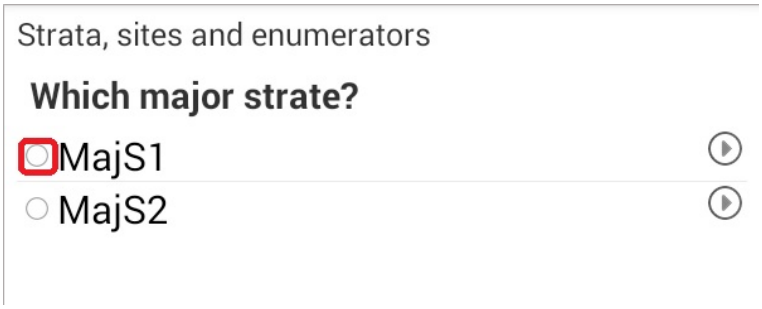
Click **"Fill Bank Form"**



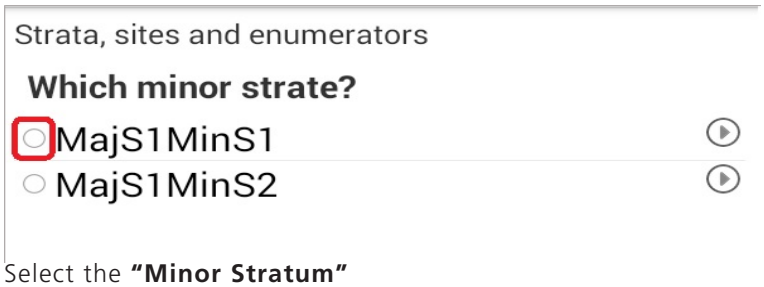
Select the form to fill.



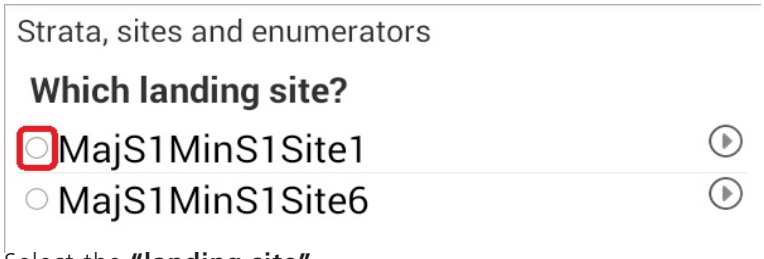
Start filling the form by swiping the screen.



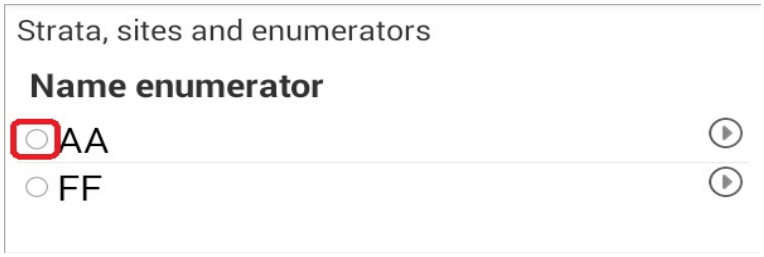
Select the **"Major Stratum"**



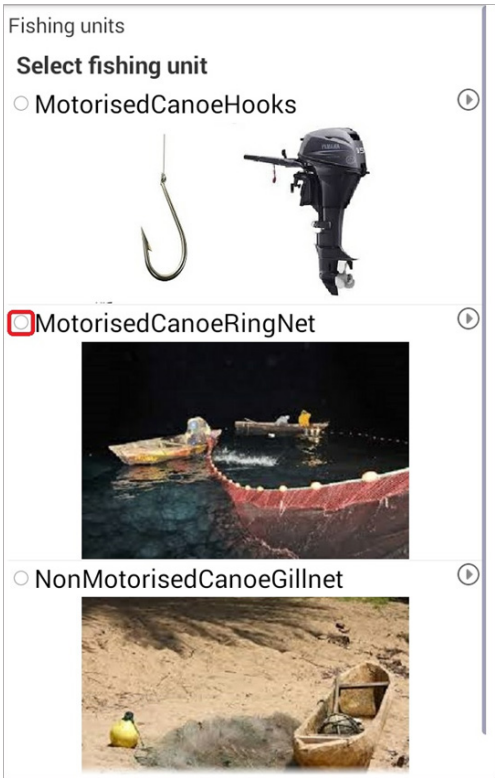
Select the **"Minor Stratum"**



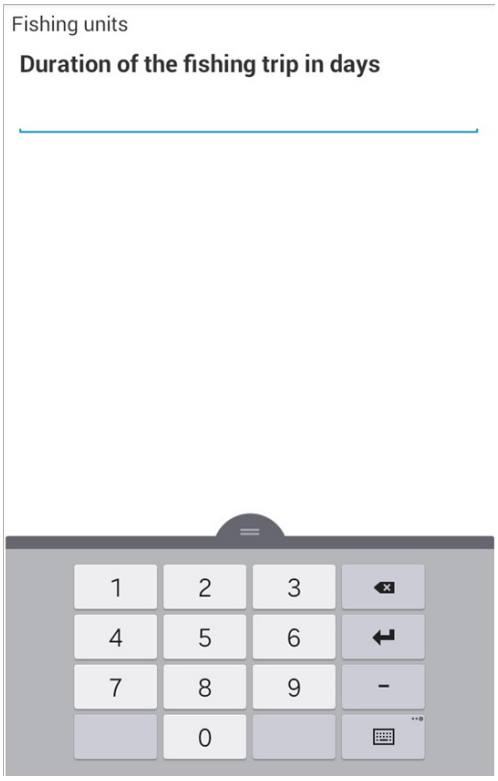
Select the **"landing site".**



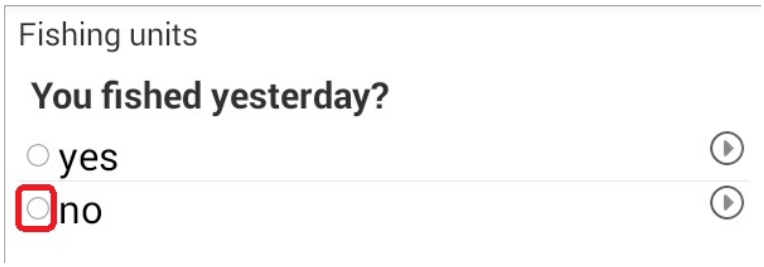
Select the **"Name of the enumerator"**



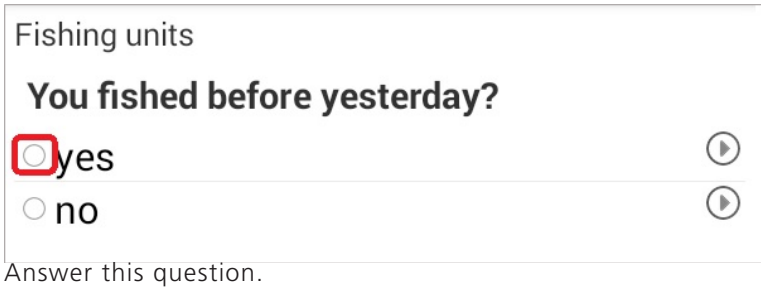
Select **"the fishing unit"**



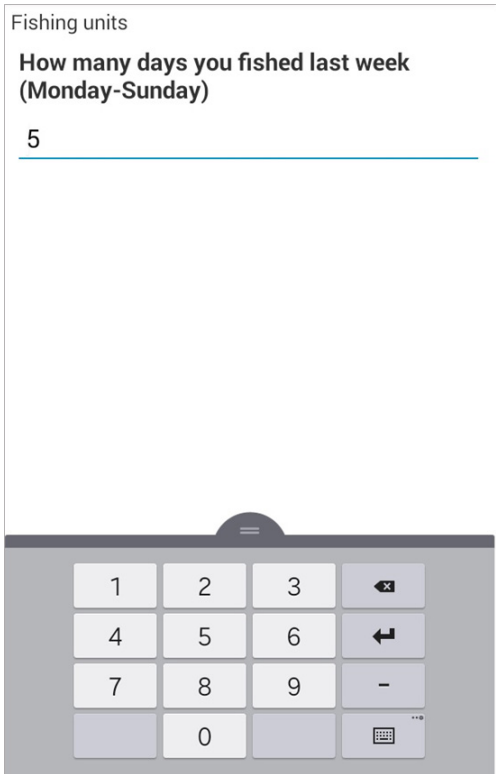
Enter the duration of the fishing trip in whole days.



Answer this question.

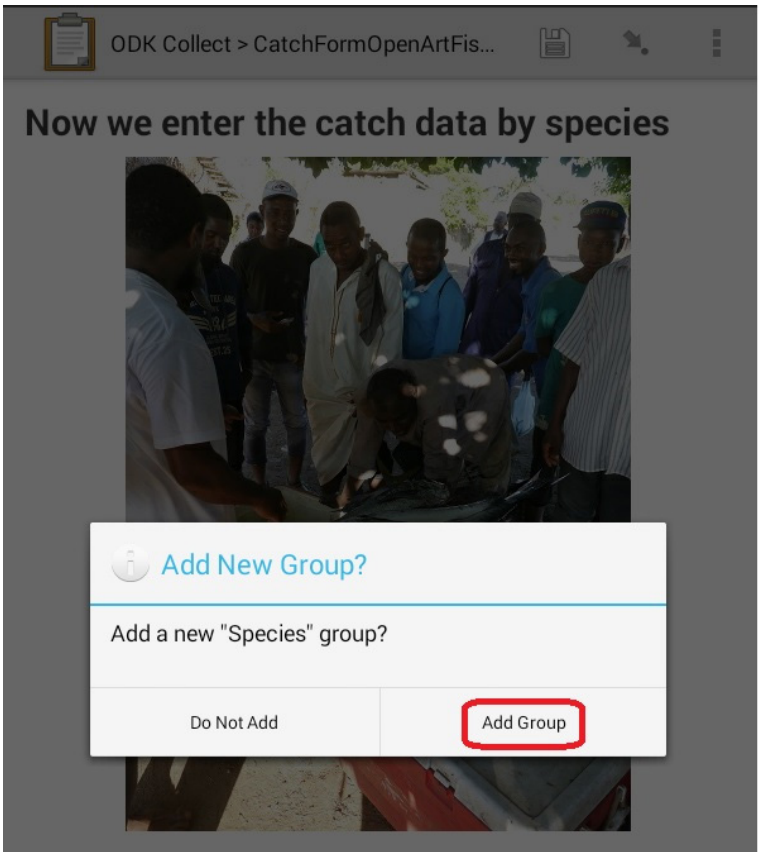


Answer this question.

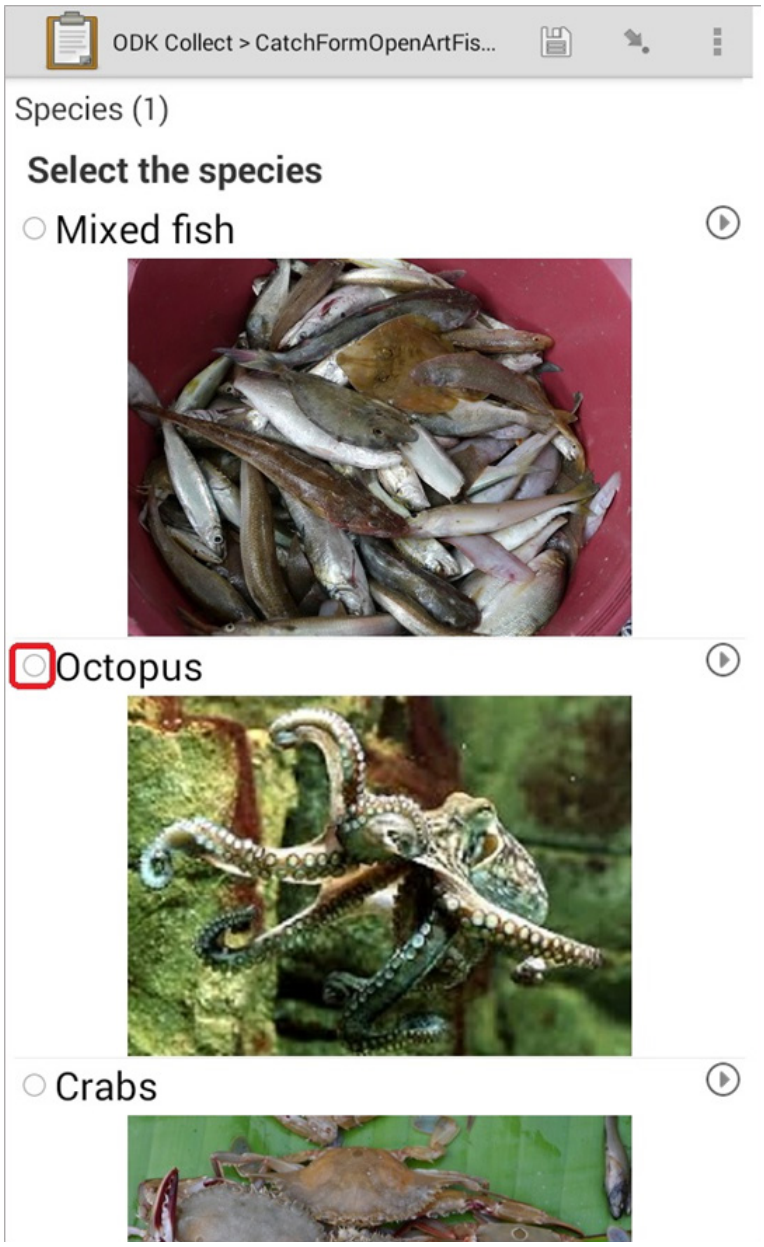


Answer this question.

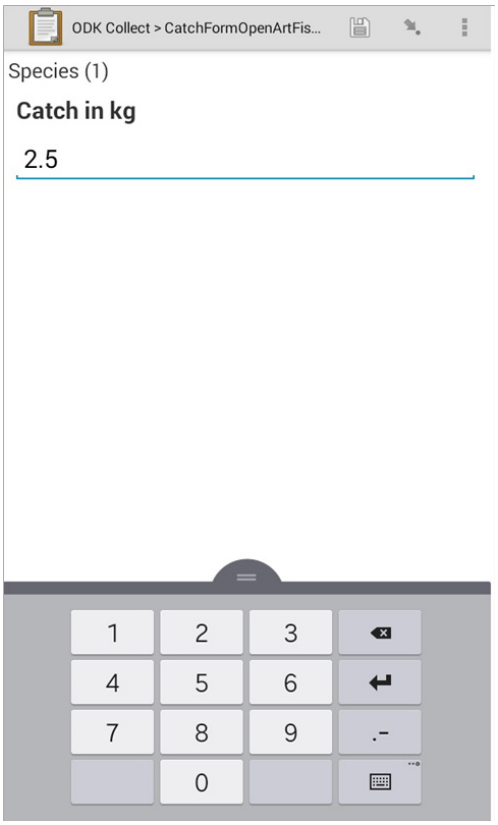
Swipe to next screen.



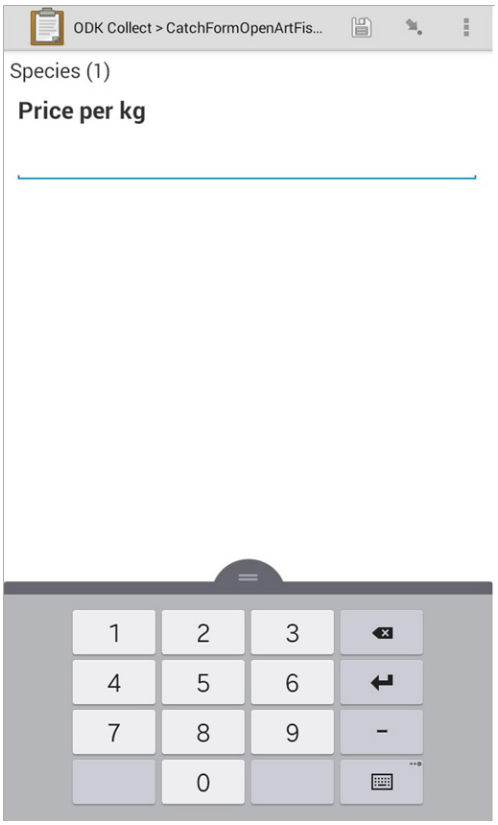
Add a group of fish species.



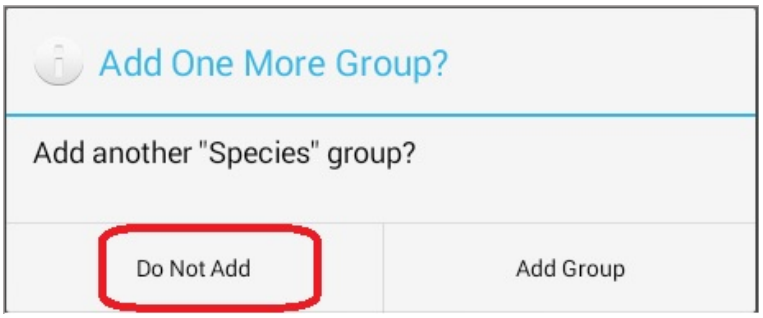
Select the species for which catch data being collected.



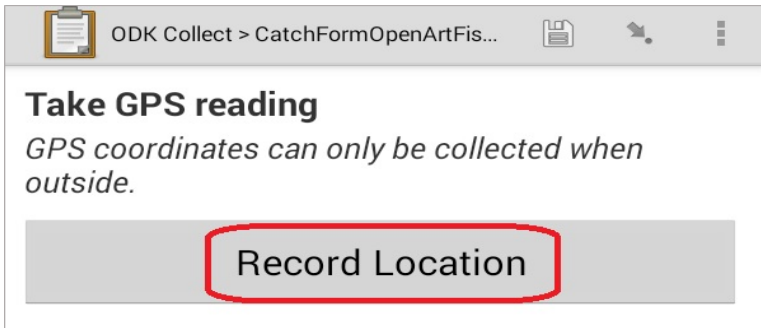
Enter the total weight (in kg) of the landings for the selected species.



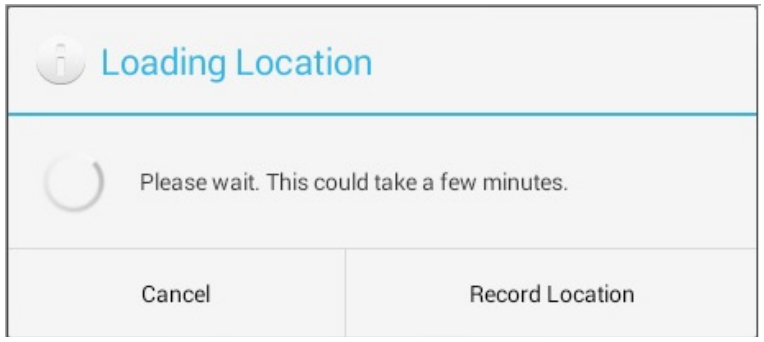
Enter the fish price per kg, the fisher get for the selected species.



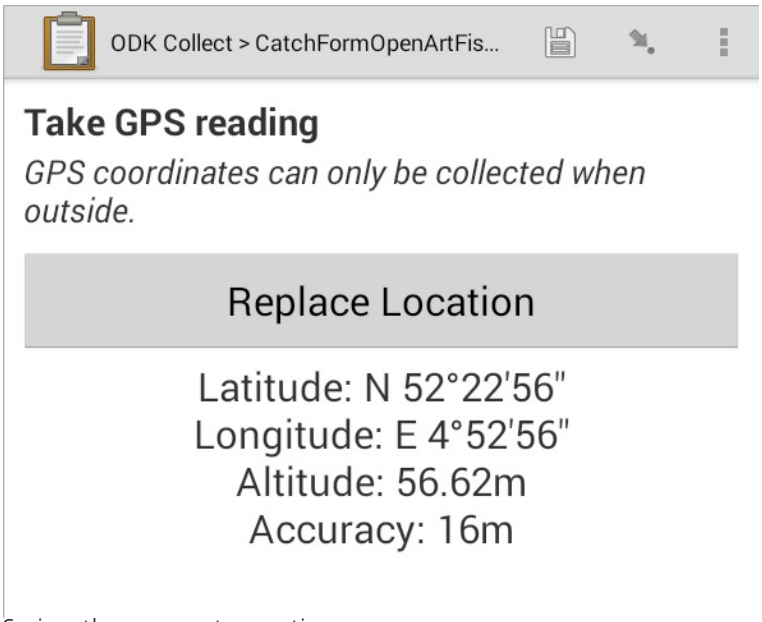
Select **"Do Not Add"** if there are no other species. Select **"Add Group**" if the landings of an additional species have to be entered.



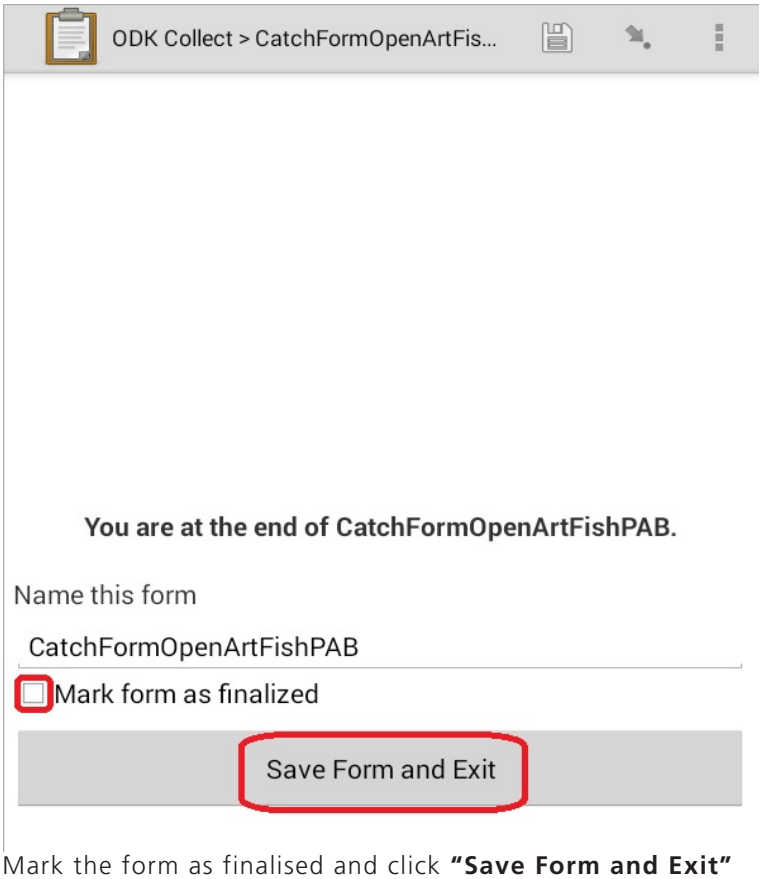
Click **"Record Location"** to take the GPS reading of the landing site**.**



Once the GPS reading is there (Accuracy becomes visible), click **"Record Location".**

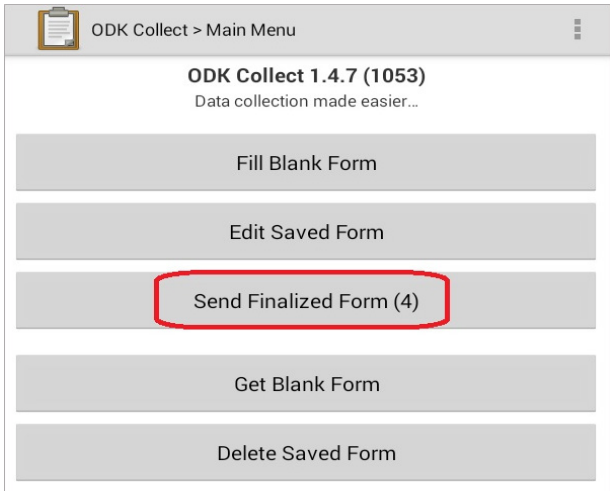


Swipe the screen to continue.

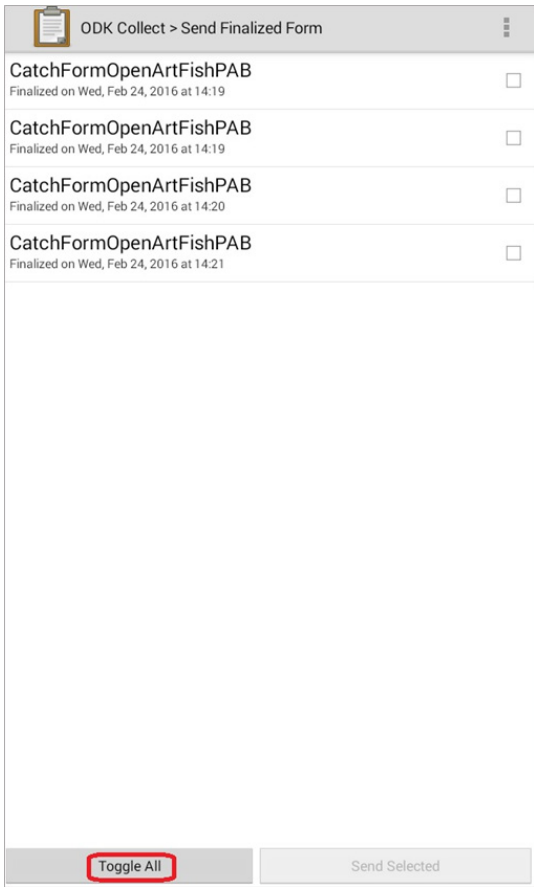


Mark the form as finalised and click **"Save Form and Exit"**

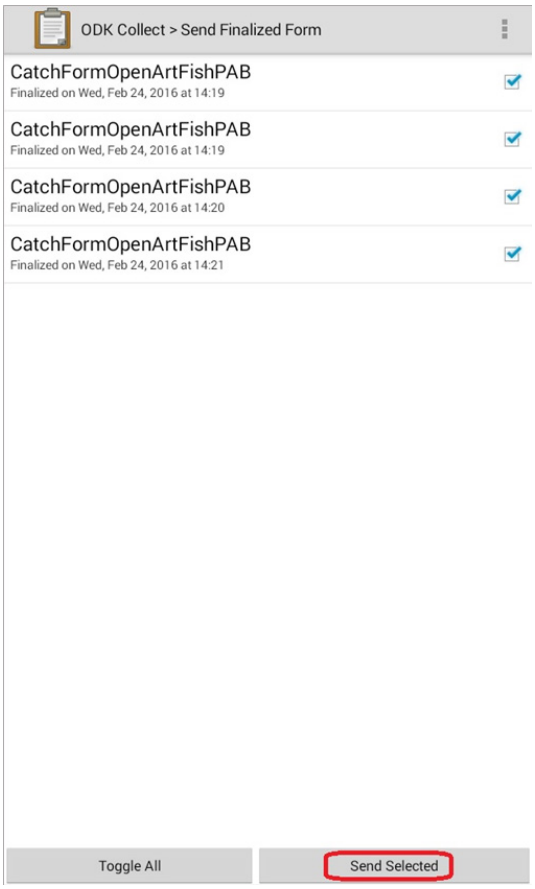
Sending the collected data to the server in the cloud



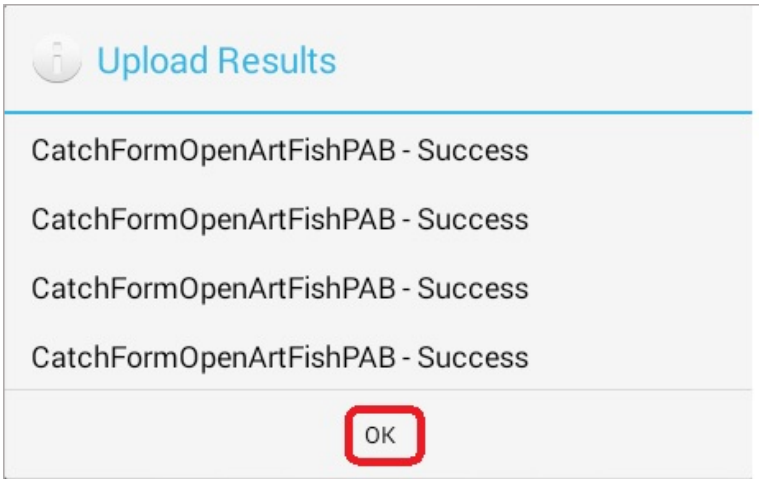
Click "**Send Finalised Form**", there are 4 forms saved and ready for sending.



Toggle the forms.



Click **"Send Selected"**

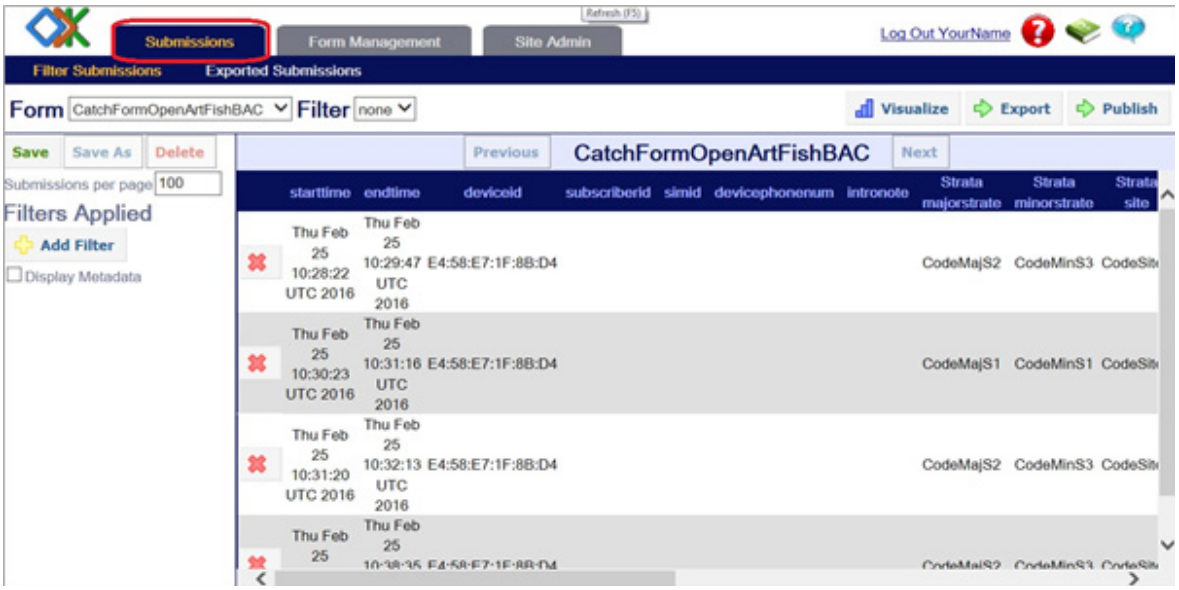


The selected forms are send successfully to the server in the cloud. Click **"OK"** to close the form.

How to download collected data from the server in the cloud

If you login to the server and open the **"Submissions",** you see that the forms are successfully uploaded to the server. On the submission page you see various options such as Visualise, Export and Publish. However, for OPEN ARTFISH you **never use these options!**

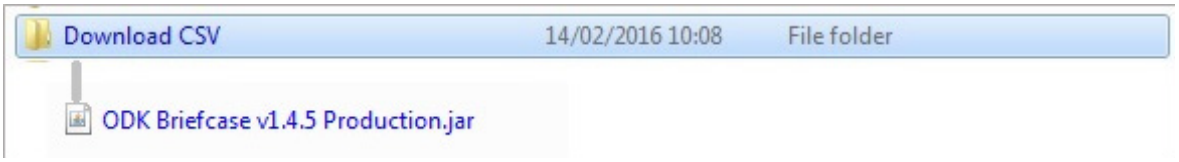
For OPEN ARTFISH the software **"ODK briefcase"** is used to download the form to your computer (https://opendatakit.org/use/briefcase/).



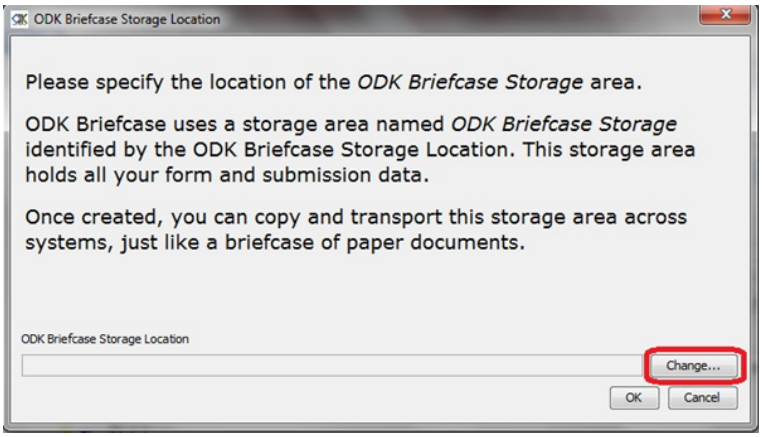
ODK Briefcase can:

1. pull blank forms and finalized forms (submissions) from ODK Collect or ODK Aggregate into a local ODK Briefcase Storage location.
2. export the finalized forms (submissions) to a CSV file for processing by other applications.

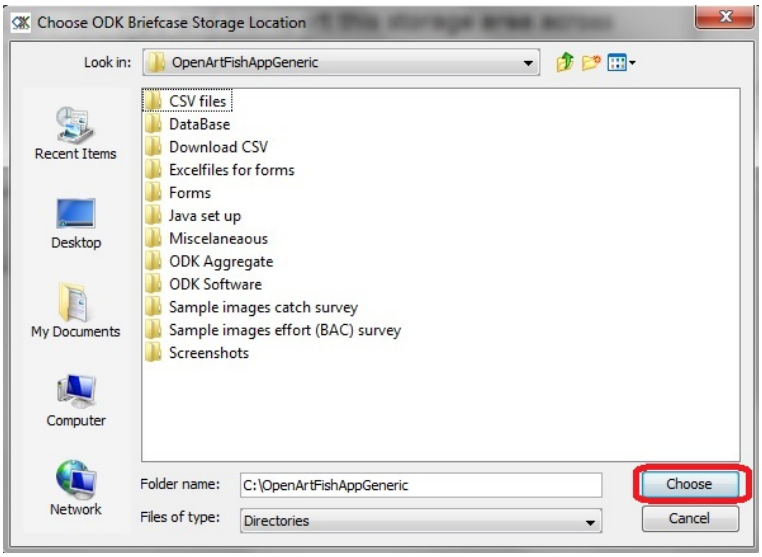
Check in your OPEN ARTFISH subfolder if "**ODK Briefcase vN.N.N. Production.jar" is** available. If not download it from https://opendatakit.org/downloads/download-category/briefcase/



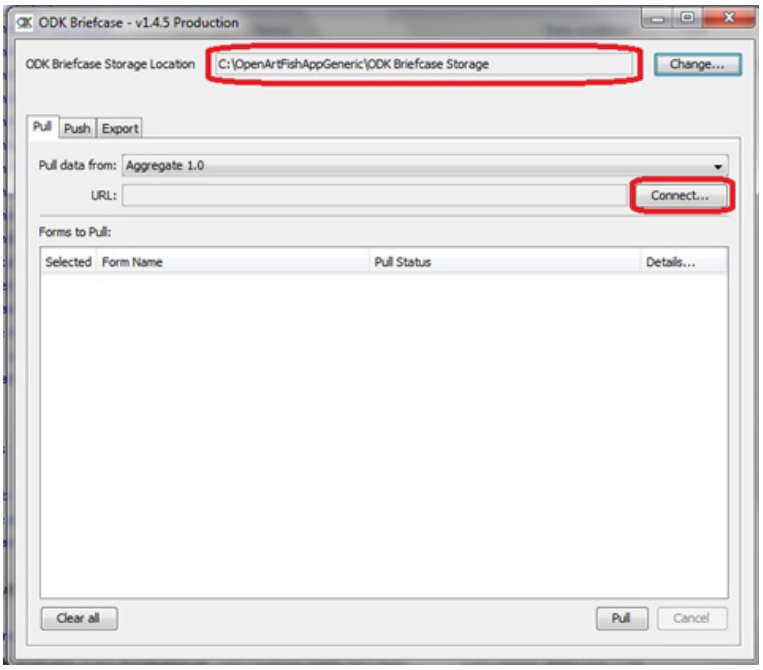
Click on **"ODK Briefcase Production.jar",** if Java 7 has been installed then the screen below will open.



Browse to your location (preferable in OPEN ARTFISH).

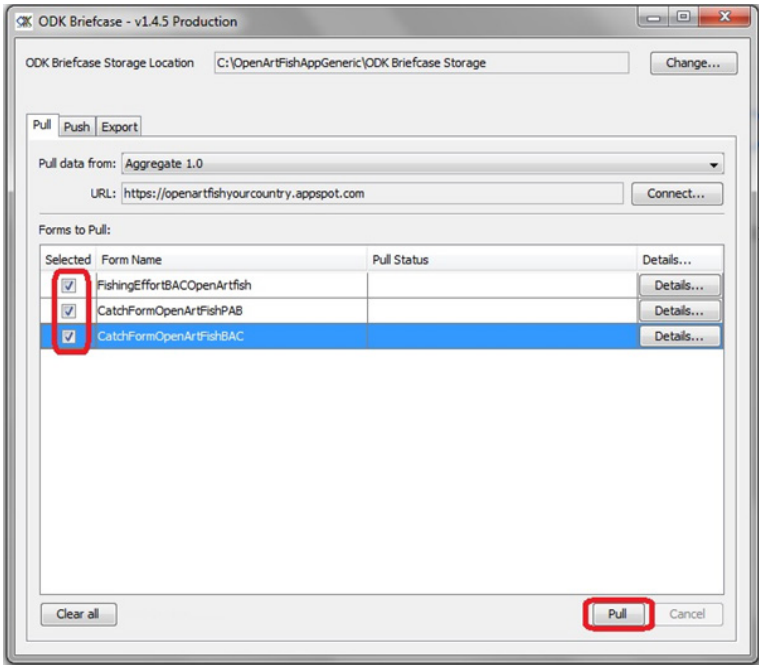


Click on **"Choose"**

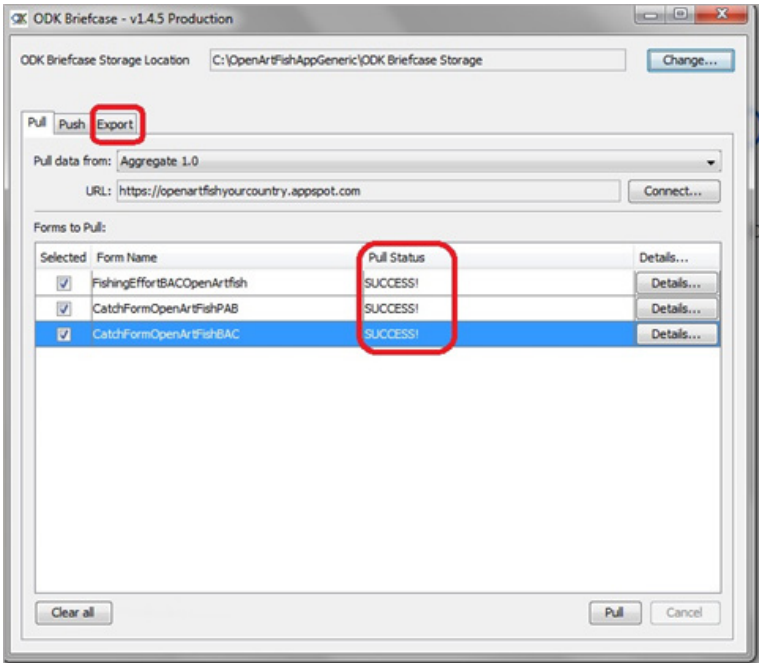


You see that the ODK Briefcase Storage Location is selected. Click **"Connect"** to connect with the server in the cloud.

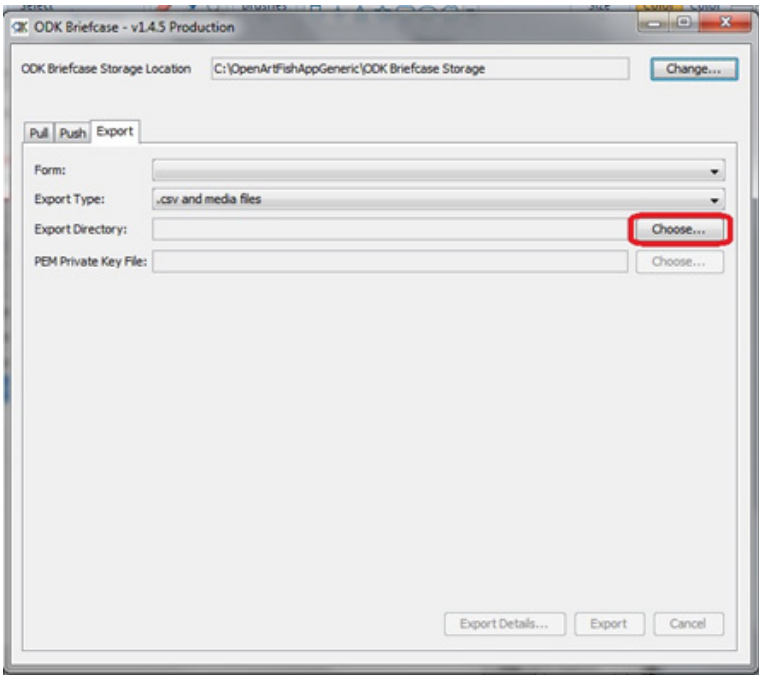
Enter the Web address of your server, the username of the Administrator and the password and click **"Connect"**



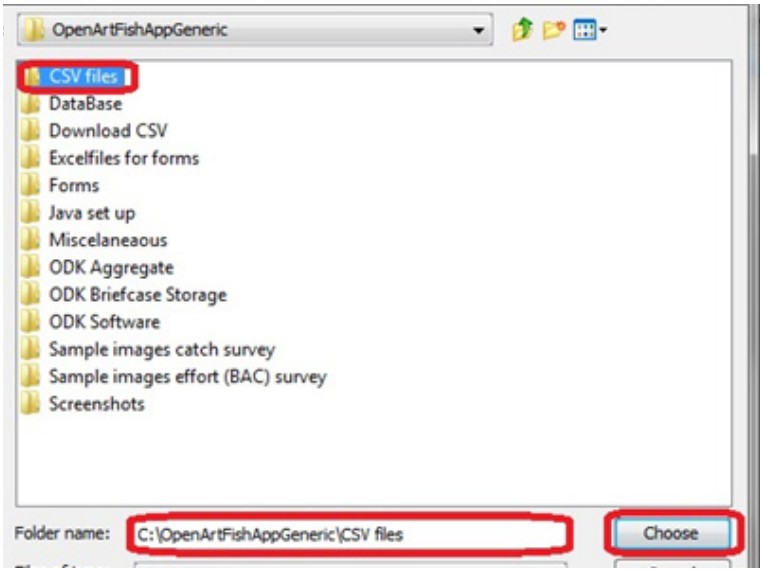
Toggle the forms and click **"Pull"**.



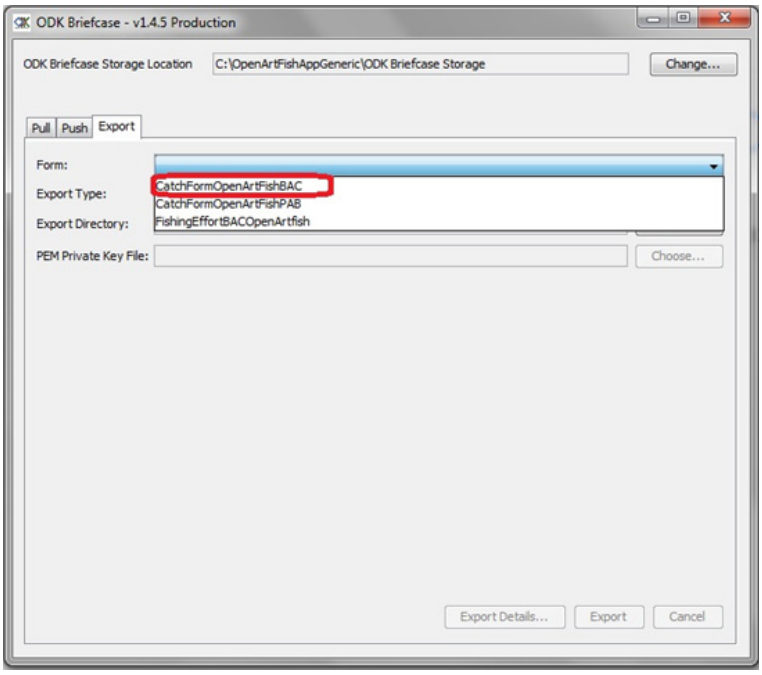
The importation was successful. Click **"Export"** to continue.



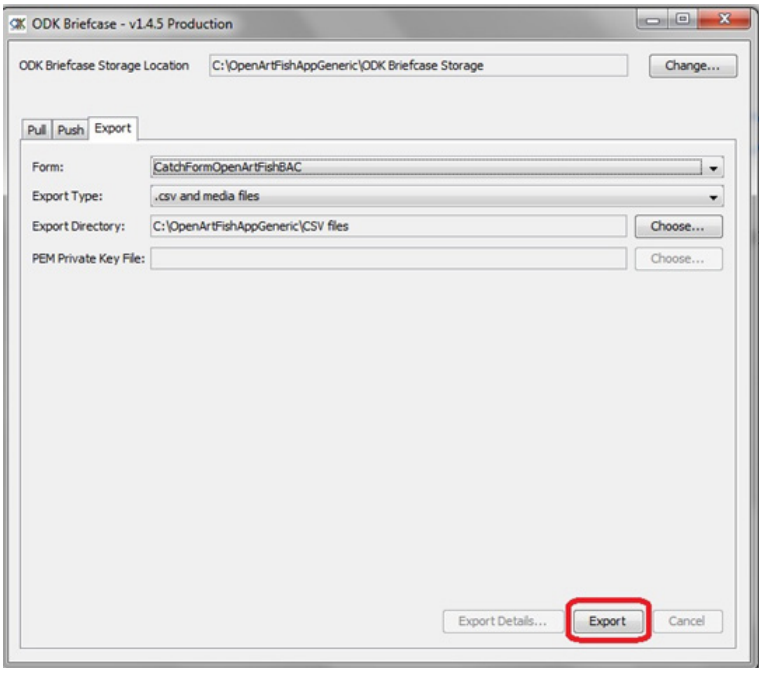
Click **"Choose"** and browse to the Export Directory where you want to store the files (the "CSV files folder in OPEN ARTFISH).



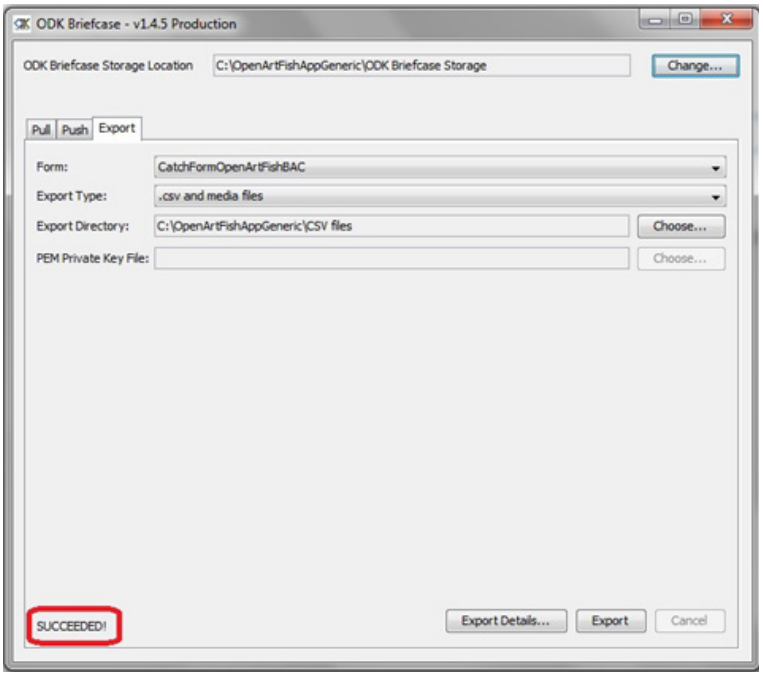
Select the directory and clock **"Choose".**



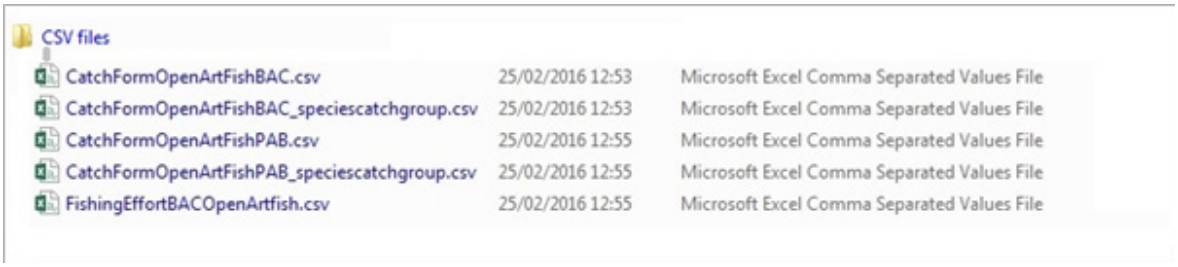
Select the file you want to export.



Click **"Export".**



Export Succeeded. Repeat procedures for all other data.



If you go to the CSV files folder you the CSV files you downloaded. Note: for the Catch forms you see two files the "CatchForm" and "CatchFormSpeciescatchgroup" the **"one to many relationship"**

How to import the data into OPEN ARTFISH

This is presented in the chapter "Import your data from a mobile phone application" (page 28).

TRICKS AND TIPS

In this chapter some tricks and tips are provided on sampling of small-scale fisheries

Sustainable routine data collection scheme for small-scale fisheries should be simple.

- Do not mix up scientific data collection with routine data collection;
- Focus on you major fishing units;
- Focus on your major fish species;
- Group your fishing units, to reduce you monthly samples;
- Do not make too many minor geographical strata, as for each minor strata and fishing unit you have to sample 50-75 fishing units per month. i.e if you have 6 minor strata with 5 fishing, then you have to sample 6*5*75=2250 fishing units per month. If an enumerator can take 7 samples on a day and he work 20 day a month then you need 2250/(7*20) = 16 enumerators. Do you have the funds to pay them?
- Do not complicate the work of the enumerator by sending him/her to all kind of landing sites, sample at large landing sides only.
- Do not forget zero catches

REFERENCES

FAO, *Guidelines for the routine collection of capture fishery data. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand, 18–30 May 1998*, FAO Fisheries Technical Paper. No. 382. Rome, FAO. 1999. 113p.

Stamatopoulos, C., *Sampled-based fishery surveys. A technical handbook*, FAO Fisheries Technical Paper. No. 425. Rome, FAO. 2002. 132p.

de Graaf, G.J., Nunoo, F., Ofori Danson, P., Wiafe, G., Lamptey, E. & Bannerman, P. 2014. *International training course in fisheries statistics and data collection*. FAO Fisheries and Aquaculture Circular No. 1091. Rome, FAO. 134 pp.

ANNEX 1 DESIGN STRUCTURE OF OPEN ARTFISH

The structure of OPEN ARTFISH

OPEN ARTFISH consists of "**Tables**", "**Forms**" and "**Reports**". These three main components are linked by aid of "**Relations**" and "**Queries**".
Tables: are the containers of the data.
Forms: is a window or screen used to enter data in the tables.
Report: is an output of the database.
Relationships: Through a relationship two tables containing data obtained from groups with similar characteristics are matched, e.g. frame survey data of 'non-motorised canoes with gillnets can be matched with CPUE data of 'non-motorised canoes with gillnets from the landing survey and with effort data of 'non-motorised canoes with gillnets from the effort survey.
Queries: Queries are the primary mechanism for retrieving information from a database and consist of questions presented to the database in a predefined format.

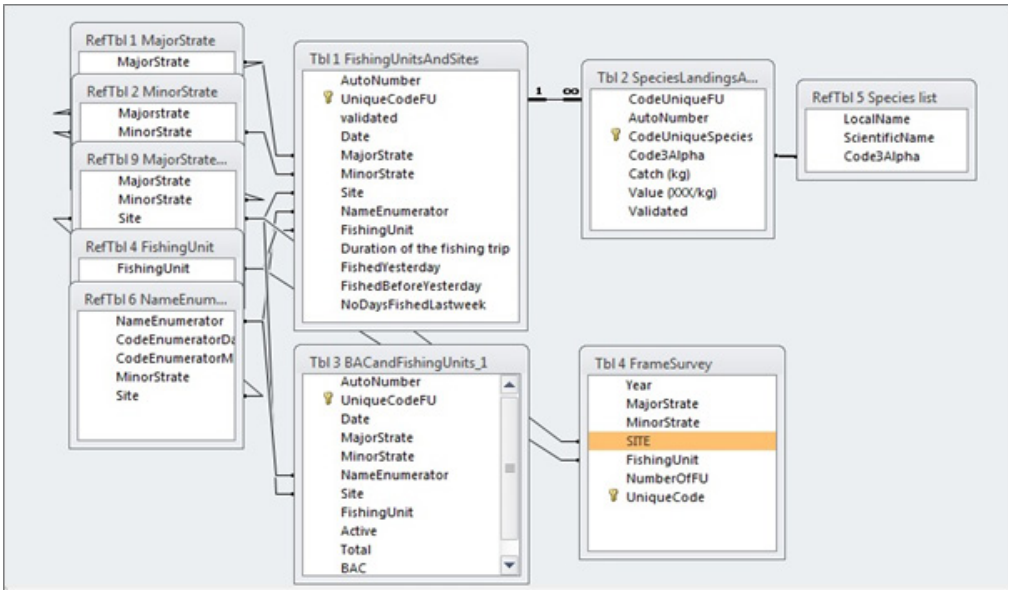
In Figure 5 the basic structure of tables and relationships of OPEN ARTISH is presented.

On the left hand side the definition or reference tables are presented. The reference tables contain the information for the; major strata; minor strata; landing sites; gears; and species.

On the right hand side the tables containing the data collected through; the frame survey; the landing survey; the effort survey; and the species survey are presented.

The lines indicate the relationships and the relationships allows us to make calculations using all inter connected tables through queries.

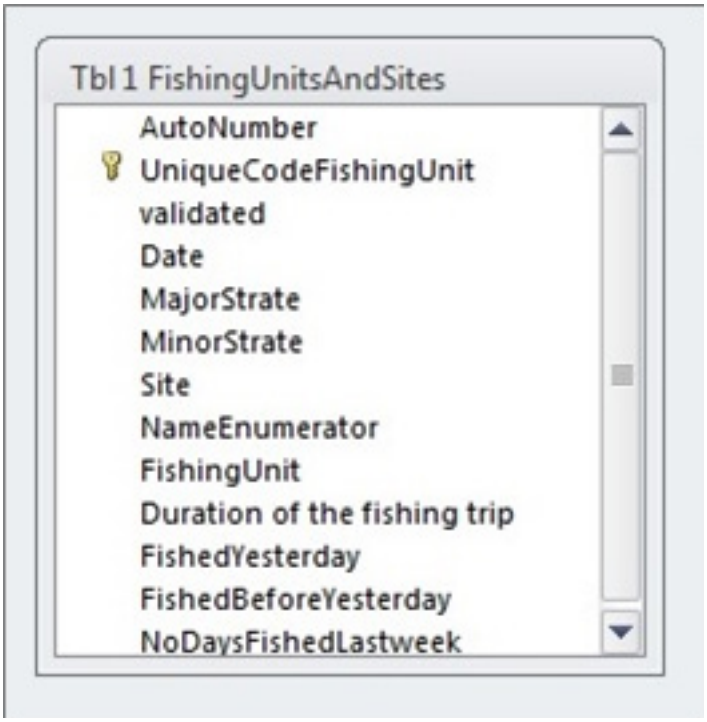
FIGURE 5
Relational structure of OPEN ARTFISH



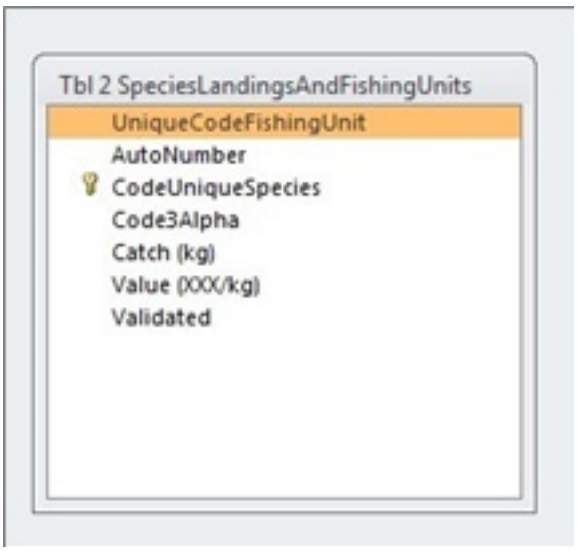
Tables of OPEN ARTFISH

Data collected during sampling and which are used to estimate total catch is stored in 4 Tables:

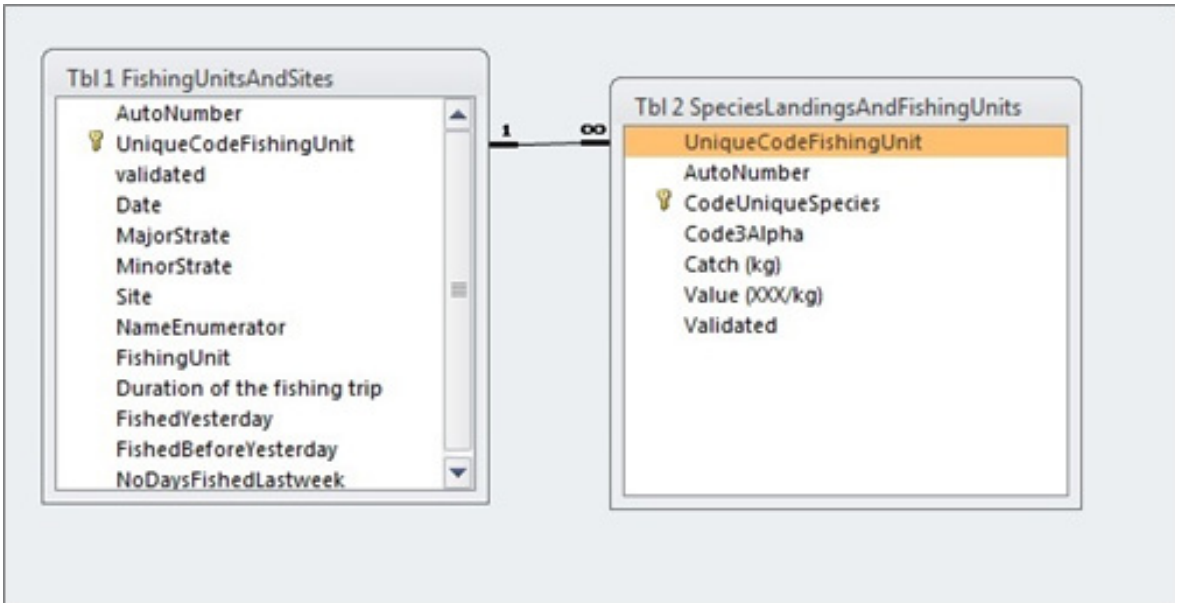
Tbl 1 FishingUnitsAndSites: In this table the landing site and the characteristics of each sampled fishing unit and the data to calculate PAB are stored. Each sampled fishing unit is given a unique code (primary key).



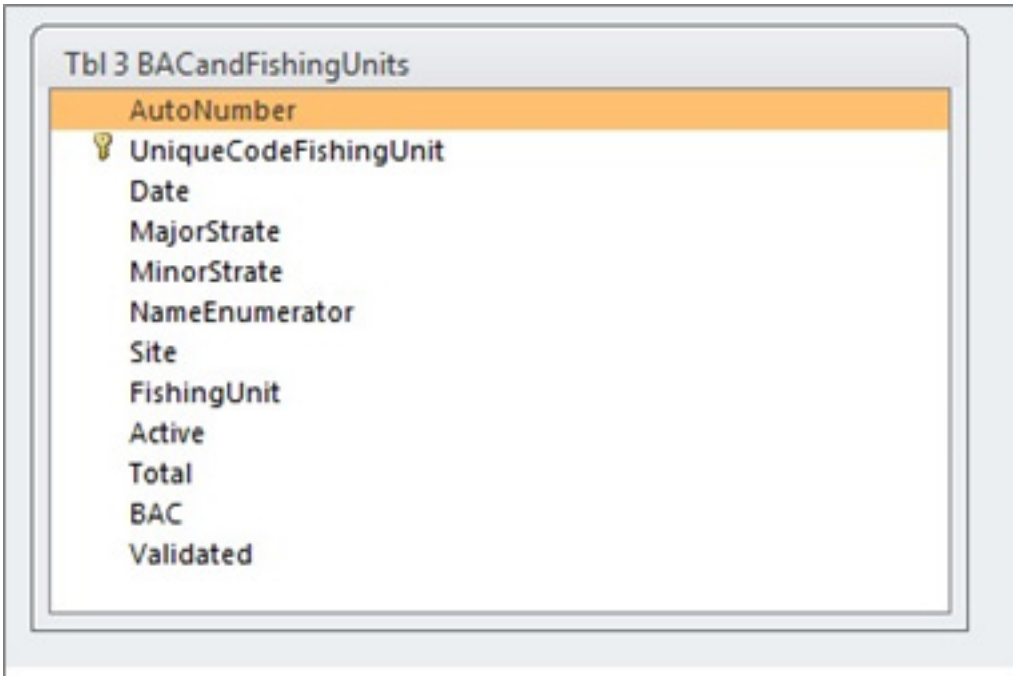
Tbl 2 SpeciesLandingsAndFishingUnits: In this table the quantity and price of the landed species are stored. Each landed species is given a unique code (primary key)



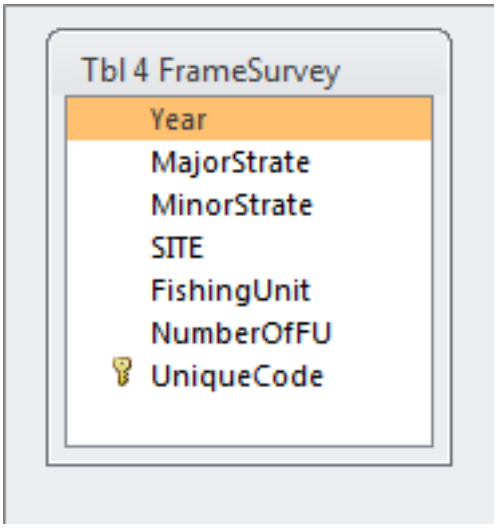
It should be noted that Table 1 and Table 2 are linked through the unique primary key (UniqueCodeFishingUnit) of the fishing unit sampled. This one-to-many relationship maintains the integrity between several landed species and the fishing unit sampled.



Tbl 3 BACandFishingUnits: This table stores the data of active and total number of fishing units at the selected landing site. This data is only used if number of fishing days are calculated with the Boat Activity Coefficient (BAC). Here also each type of fishing unit sampled is given a unique code (primary key)

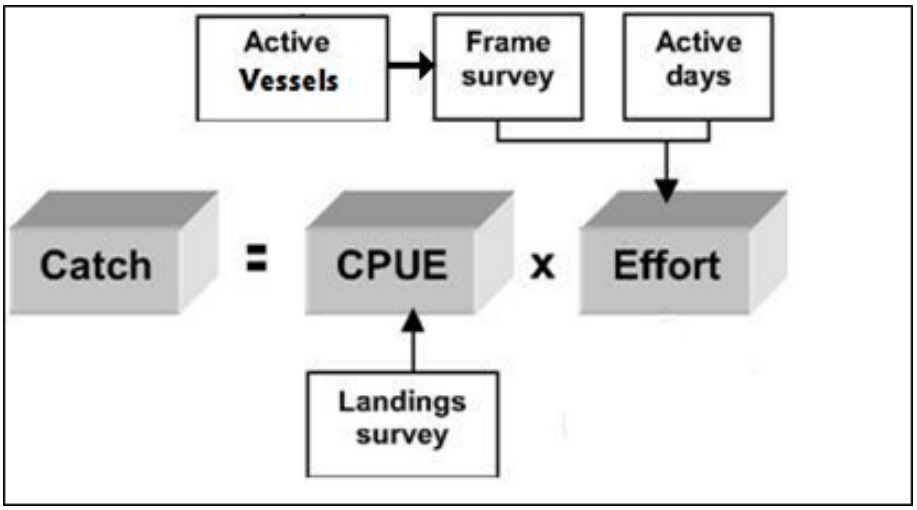


Tbl 4 FrameSurvey: This table stores the number of fishing units at each landing site as obtained from a frame survey or register.



Queries of OPEN ARTFISH

One of the major outputs of OPEN ARTFISH is the monthly total catch by the different fishing units, using the generic formula below.

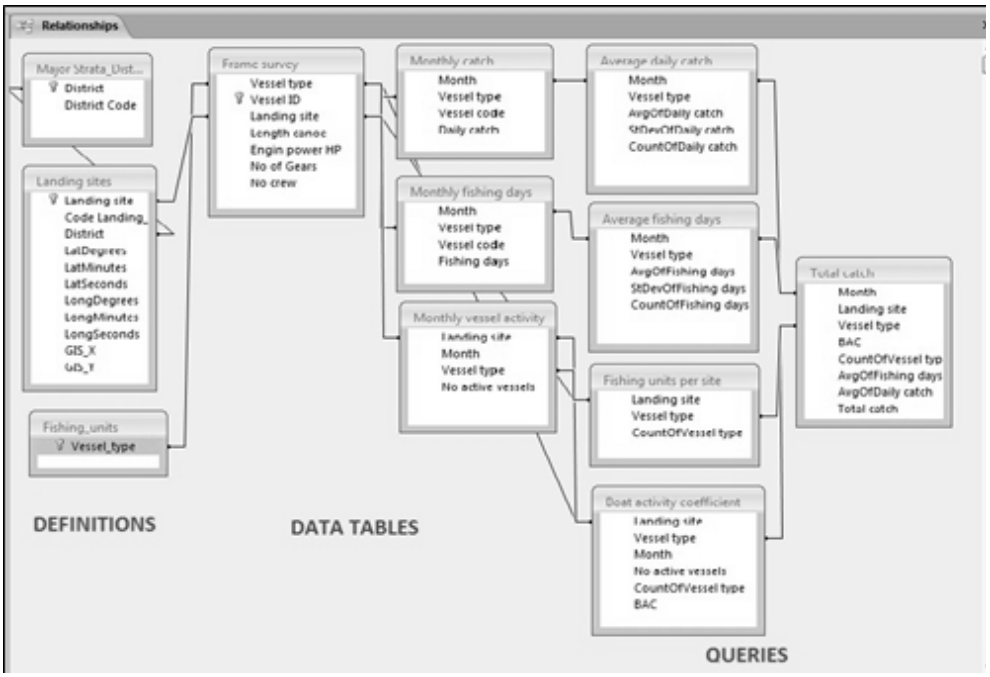


Through a number of sequential queries the total monthly catch by fishing unit is calculated for each minor strata.

$$Total\ catch_{type} = Total\ vessels_{type}\ fishing\ days_{type}\ CPUE_{type}$$

Relational structure of queries used to calculate total catch is presented in Figure 6.

FIGURE 6
Relational structure of queries used to calculate total catch



The different queries used to estimate total catch by fishing unit and species are summarised in the next paragraphs.

Rq 1 DailyCPUEbyFishUnit: By using ***Tbl 1 FishingUnitsAndSites***, this query calculates the sum of all landed species, or the total daily landings (CPUE) for each individual sampled fishing unit.
Rq 2 YearMonthMinorStrateFUAverageCPUE: By using ***Rq 1***, the average monthly CPUE, Standard deviation of CPUE, Number of samples taken, Square Root of the number of samples and the degrees of freedom by type of fishing unit and minor strata are calculated.

Rq 3 YearMonthMinorStrateFUAverageCPUERelError: By using ***Rq 2*** and ***RefTbl 14 tDistributionFractiles*** the confidence limit, relative error for CPUE is and the maximum CPUE is calculated with a 90% probability level.

Rq 4 1 NbrFishingUnitsMajorStrateMinorStrateSite: By using ***Tbl 4 FrameSurvey*** it calculates the number of fishing units by type of each landing site.

Rq 5 1 PAB sampled fishing units: By using ***Tbl 1 FishingUnitsAndSites*** the PAB for each sampled fishing unit is calculate

Rq 5 2 YearMonthMinorStrateFishingAVGPAB: By using ***Rq 5 1*** the average monthly PAB, Standard deviation of PAB, Number of samples taken, Square Root of the number of samples and the degrees of freedom by type of fishing unit and minor stratum are calculated.

Rq 5 3 YearMonthMinorStrateFishingUnitAvgBAC: By using ***Tbl 3 BACandFishingUnits***, the average monthly BAC, Standard deviation of BAC, Number of samples taken, Square Root of the number of samples and the degrees of freedom by type of fishing unit and minor stratum are calculated.

Rq 5 4 YearMonthMinorStrateFishingUnitAVGBACRelErrorBAC: By using ***Rq 5 3*** and ***RefTbl 14 tDistributionFractiles*** the relative error for BAC is calculated at a 90% probability level.

Rq 5 5 YearMonthMinorStrateFishingUnitNbrFishingDaysBAC: By using ***Rq 5 4*** and ***RefTbl 15 FishingUnitMaxNumberMonthlyFishingDays*** the average and maximum number of fishing days by minor stratum and fishing unit are calculated.

Rq 5 6 YearMonthMinorStrateFishinUnitAvgPABRelError: By using **Rq 5 2** and ***RefTbl 14 tDistributionFractiles*** the confidence limits for PAB, relative error for PAB and Maximum PAB are calculated at a 90% probability level, by minor stratum and fish unit.

Rq 5 7 YearMonthMinorStrateFishingUnitNbrFishingDaysPAB: By using **Rq 5 6** the average and maximum number of fishing days by minor stratum and fishing unit are calculated for horizontal sampling for effort (PAB).

Rq 6 1 YearMonthMajorMinorSiteFishingUnitCaptTotalesWithBAC: by using **Rq 3, Rq 4 1, Rq 5 5 and,** the monthly total catch by minor stratum and fishing unit is calculated for vertical sampling for effort.

Rq 6 2 YearMonthMajorMinorSiteFishingUnitCaptTotalesWithPAB: by using ***Rq 3, Rq 4 1, Rq 5 7*** and ***RefTbl 11 Month*****,** the monthly total catch by minor stratum and fishing unit is calculated.

Rq 7 1 YearMonthMinorStrateFishingUnitCatchBySpecies: by using ***Tbl 1***

FishingUnitsAndSites and ***Tbl 2 SpeciesLandingsAndFishingUnits*** the total sampled catch and average price by species, fishing unit and minor stratum are calculated.

Rq 7 2 YearMonthMinorStrateFishinUnitCatchAllSpecies; by using ***Tbl 1 FishingUnitsAndSites*** and ***Tbl 2 SpeciesLandingsAndFishingUnits*** the total sampled catch of all species combined by fishing unit and minor stratum are calculated.

Rq 7 3 YearMonthMinorStrateFishingUnitSpeciesComposition: by using ***Rq 7 1*** and ***Rq 7 2,*** the monthly species composition by fishing unit and minor stratum is calculated.

THEN THE FINAL QUERY FOR ESTIMATION WITH BAC:

Rq 8 1 YearMonthMajorMinorSiteFishingUnitSpeciesValueBAC: By using ***Rq 6 1*** and ***Rq 7 3***, The total landings, value and relative error for CPUE and Catch are calculated by month, site and fishing unit for vertical sampling of effort.

THEN THE FINAL QUERY FOR ESTIMATION WITH PAB:

Rq 8 2 YearMonthMajorMinorSiteFishingUnitSpeciesValuePAB: By using ***Rq 6 2*** and ***Rq 7 3***, The total landings, value and relative error for CPUE and Catch are calculated by month, site and fishing unit, for horizontal sampling of effort.

These two final queries are used to create the reports presented in the analyses form. These two queries can be used to create any other report required locally as it would not change the basic structure of OPEN ARTFISH.

Reports

In the form for data analyses for horizontal sampling (PAB) or vertical sampling (BAC) a number of standard reports are presented. By combining the input values for the reports almost any report can be made.

The analyses form and reports are based on LookUP queries taking data from the final two queries;

- Rq 8 1 YearMonthMajorMinorSiteFishingUnitSpeciesValueBAC
- Rq 8 2 YearMonthMajorMinorSiteFishingUnitSpeciesValuePAB

As mentioned before making new reports can be done without altering the basic structure of OPEN ARTFISH.

ANNEX 2 FRACTILES OF T-DISTRIBUTION

When the sample size is large, say 100 or above, the used t-distribution is very similar to the standard normal distribution, as with increasing sample sizes t_{n-1} approaches the value of 1.96 However, with smaller sample sizes, the t-distribution is leptokurtic, which means it has relatively more scores in its tails than does the normal distribution. As a result, you have to extend farther from the mean to contain a given proportion of the area.

Recall that with a normal distribution, 95% of the distribution is within 1.96 standard deviations of the mean. Using the t-distribution, if you have a sample size of only 5, 95% of the area is within 2.78 standard deviations of the mean (from t distribution fractile table). Therefore, the standard error of the mean (sem) would be multiplied by **2.78** rather than 1.96 in order to obtain the Confidence Limits. With increasing sample sizes t_{n-1} approaches the value of 1.96.

TABLE 1: T Distribution Fractile Table

Sample size	Degree of freedom	90PercentFractile	95PercentFractile	99PercentFractile
2	1	6.31	12.71	63.66
3	2	2.92	4.3	9.93
4	3	2.35	3.18	5.84
5	4	2.13	**2.78**	4.6
6	5	2.02	2.57	4.03
7	6	1.94	2.45	3.71
8	7	1.9	2.37	3.5
9	8	1.86	2.31	3.36
10	9	1.83	2.26	3.25
11	10	1.81	2.23	3.17
12	11	1.8	2.2	3.11
13	12	1.78	2.18	3.06
14	13	1.77	2.16	3.01
15	14	1.76	2.15	2.98
16	15	1.75	2.13	2.95
17	16	1.75	2.12	2.92
18	17	1.74	2.11	2.9
19	18	1.73	2.1	2.88
20	19	1.73	2.09	2.86
21	20	1.73	2.09	2.85
22	21	1.72	2.09	2.85
23	22	1.72	2.09	2.85
24	23	1.72	2.09	2.85
25	24	1.72	2.09	2.85
26	25	1.71	2.06	2.79
27	26	1.71	2.06	2.79
28	27	1.71	2.06	2.79
29	28	1.71	2.06	2.79
30	29	1.71	2.06	2.79
31	30	1.7	2.04	2.75
32	31	1.7	2.04	2.75
33	32	1.7	2.04	2.75
34	33	1.7	2.04	2.75
35	34	1.7	2.04	2.75
36	35	1.7	2.04	2.75
37	36	1.7	2.04	2.75
38	37	1.7	2.04	2.75
39	38	1.7	2.04	2.75

Sample size	Degree of freedom	90PercentFractile	95PercentFractile	99PercentFractile
40	39	1.7	2.04	2.75
41	40	1.68	2.02	2.7
42	41	1.68	2.02	2.7
43	42	1.68	2.02	2.7
44	43	1.68	2.02	2.7
45	44	1.68	2.02	2.7
46	45	1.68	2.02	2.7
47	46	1.68	2.02	2.7
48	47	1.68	2.02	2.7
49	48	1.68	2.02	2.7
50	49	1.68	2.02	2.7
51	50	1.67	2.01	2.68
52	51	1.67	2.01	2.68
53	52	1.67	2.01	2.68
54	53	1.67	2.01	2.68
55	54	1.67	2.01	2.68
56	55	1.67	2.01	2.68
57	56	1.67	2.01	2.68
58	57	1.67	2.01	2.68
59	58	1.67	2.01	2.68
60	59	1.67	2.01	2.68
61	60	1.67	2	2.66
62	61	1.67	2	2.66
63	62	1.67	2	2.66
64	63	1.67	2	2.66
65	64	1.67	2	2.66
66	65	1.67	2	2.66
67	66	1.67	2	2.66
68	67	1.67	2	2.66
69	68	1.67	2	2.66
70	69	1.67	2	2.66
71	70	1.67	2	2.66
72	71	1.67	2	2.66
73	72	1.67	2	2.66
74	73	1.67	2	2.66
75	74	1.67	2	2.66
76	75	1.67	2	2.66
77	76	1.67	2	2.66
78	77	1.67	2	2.66

Sample size	Degree of freedom	90PercentFractile	95PercentFractile	99PercentFractile
79	78	1.67	2	2.66
80	79	1.67	2	2.66
81	80	1.67	1.99	2.64
82	81	1.67	1.99	2.64
83	82	1.67	1.99	2.64
84	83	1.67	1.99	2.64
85	84	1.67	1.99	2.64
86	85	1.67	1.99	2.64
87	86	1.67	1.99	2.64
88	87	1.67	1.99	2.64
89	88	1.67	1.99	2.64
90	89	1.67	1.99	2.64
91	90	1.67	1.99	2.64
92	91	1.67	1.99	2.64
93	92	1.67	1.99	2.64
94	93	1.67	1.99	2.64
95	94	1.67	1.99	2.64
96	95	1.67	1.99	2.64
97	96	1.67	1.99	2.64
98	97	1.67	1.99	2.64
99	98	1.67	1.99	2.64
100	99	1.67	1.99	2.64

Knowledge of the status and trends of capture fisheries, including socio-economic aspects, is a key factor for sound policy development, better decision-making and responsible fisheries management. Capacity building in data collection and fisheries statistics has always been a high priority for FAO, regional fisheries bodies and national fisheries authorities. The most recent effort by FAO was the development of this toolkit for routine small-scale fisheries data collection. The toolkit comprises a generic database (OPEN ARTFISH) and a mobile phone application for routine small-scale fisheries data collection. The primary objective of the toolkit is to facilitate the implementation of cost effective and sustainable routine data collection, storage and analyses of data, using appropriate statistical procedures.

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