Island Conservation Society data management: Standardise data collection and extend current database

Technical Report · May 2019

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University of Seychelles
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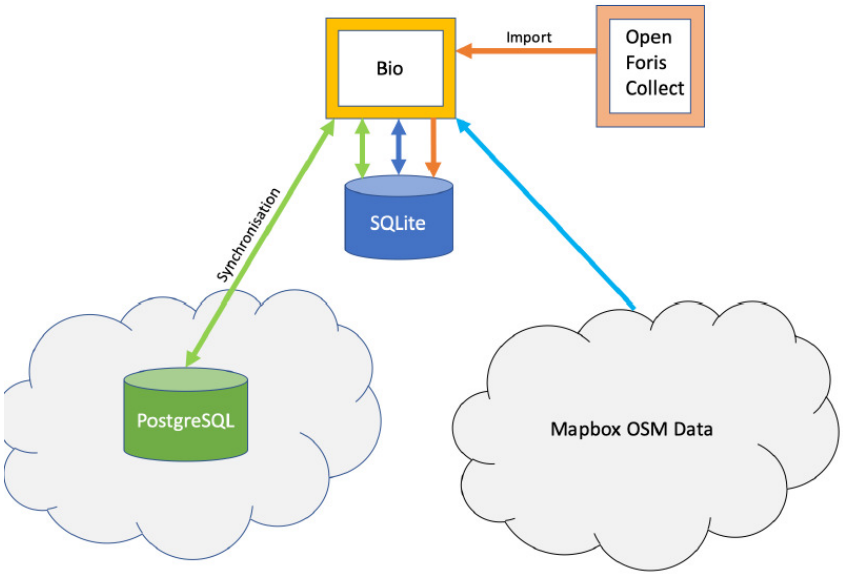
Island Conservation Society data management

Standardise data collection and extend current database



Bruno Senterre

Michael Wagner

Israel Alcindor

Eli Louise

Final report of consultancy

23rd May 2019

EXECUTIVE SUMMARY

A biodiversity database system has been developed as a cross-platform standalone application (Windows, Mac, Linux) which is designed to allow the integration of all data related to biodiversity and being collected by Island Conservation Society, and potentially other organizations in Seychelles. This application is named the "Bio Holistic Database". It includes a local SQLite database synchronizing with a server PostgreSQL database, an in-built map component, and data importation from Smartphone-based data collection surveys using Open Foris Collect Mobile (so far for Turtles, Tortoises, Coral reefs and Mangrove monitoring data, but the developed system can also cater for the development of future datasets as well).

The data contained in the Bio Holistic Database are referred to as the "Bio Data": 5363 Coral reef observations, 3937 Turtles and Tracks observations, 26050 KBA data (Key Biodiversity Areas data from the PCA-SEY National Herbarium database; CEPF project), 21629 other KBA data.

The database system has been demonstrated during a 4-days training. Several components remain unfinished and a work plan is given for the ongoing developments.

During the next 4 months, ICS teams should assimilate the materials shared during the training, and they should test extensively the phone-based data collection surveys. Requested modifications and corrections should be shared with the database development team (current authors) so that a final/validated version of those surveys can be produced to start data collection.

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ACKNOWLEDGEMENTS

We would like to express our gratitude to GOS-UNDP-GEF for funding the current study, and to the GOS-UNDP-GEF Programme Coordination Unit (PCU, Joanna Prosper) for their support in the implementation of the work. Island Conservation Society (ICS) has provided also an excellent support to this work, and we would like to thank in particular Pierre-André Adam (Head of Science and Projects, support for data access and for coral reef monitoring dataset), Jeanne Mortimer (turtles and tortoises datasets), and Sylvanna Antat (Mangrove monitoring dataset). A substantial part of the work done on the database development has been done under a CEPF-funded project (Critical Ecosystem Partnership Fund, focused on the 'KBA dataset'), led by Plant Conservation Action group (PCA) and the Seychelles National Herbarium (SEY) which offered an office space for the four authors of this report. We are very grateful to Charles Morel (Curator of the Herbarium) for this support. Finally, we would like to thank all participants to the training for their active and constructive participation and for their feedback.

Citation: Senterre, B., Wagner, M., Alcindor, I. & Louise, E. (2019) Island Conservation Society data management: Standardise data collection and extend current database. Consultancy Report, Island Conservation Society, Victoria, Seychelles, 18 pp.

I INTRODUCTION

Context

This consultancy is part of the GOS-UNDP-GEF Project "Expansion and Strengthening of the Protected Area Subsystem of the Outer Islands of Seychelles and its Integration into the Broader Land and Seascape" (Outer Islands or OI project).

Aim

The main aim consists in developing a spatially based decision support system to enable integrated natural resource management in the Outer Islands, and in particular to standardize data collection and to extend the current database for Island Conservation Society (ICS).

This assignment is for a first phase, establishing the database required to deal with the following groups/datasets: turtles, terrestrial fauna (tortoises), mangroves, corals and reef fish. It may be followed up (funding dependent) with a second phase dealing with remaining protocols: Seagrass, Seabirds, Insects, Subsistence Fishing and Fish Spawning Aggregations, Coastal erosion, Water quality, Citizen Science (recreational diving and sports fishing), etc.

Terms of References

The contract was originally planned from October 2017 to August 2018, for a total of 140 consultancy days shared between the two lead consultants (Bruno Senterre and Michael Wagner). As the implementation of the standalone database application took more time than anticipated, the consultancy was extended to April 2019. In February, the Outer Islands Project further supported the development of the database by identifying and contracting two additional computer programmers to assist with the work and develop their skills: Israel Alcindor and Eli Louise are young Seychellois with A-Level from School of Advanced Level Studies; they were contracted from February to August 2019.

The planned deliverables are:

- **A data management system** for the 4 selected datasets of ICS, integrating and reviewing the individual data collection protocols developed by ICS, including discussions with domain experts responsible for each of these datasets.

- Implement **a training** for ICS database manager and ICS field teams to diffuse the results and demonstrate the new data collection and management system.

- Produce **a final report** of consultancy including a training guide.

Synergies with other projects

This GOS-UNDP-GEF funded project (focused on Outer Islands) overlaps largely with a CEPF-funded project (Critical Ecosystem Partnership Fund) led by Plant Conservation Action group (PCA) and the Seychelles National Herbarium (SEY) in collaboration with ICS and others to develop a similar biodiversity data management system with a more general scope, focused on the concept of Key Biodiversity Areas (KBAs). The CEPF project allowed giving to the designed database a much more integrative capacity. It also allowed some additional database development such as Smartphone-based data collection tools.

II RESULTS: WORK DONE AND DELIVERED PRODUCTS

II.1 Database design

Most of the database design (90%) was already developed during a preliminary phase of this database development (Senterre and Kaiser-Bunbury 2014; Senterre and Wagner 2016). Since then, ICS has produced reviewed and updated data collection protocols for several datasets. Therefore, our first task has been to review those new protocols and discuss them with their respective authors (consultants), in order to make sure we understood them properly and also to discuss adjustments needed for the purpose of integration in a single database system.

The domain experts met to discuss and review the four selected datasets are:

- Turtles monitoring (incl. tracks, nests, mating, juveniles): Jeanne Mortimer
- Aldabran Giant Tortoises monitoring: Jeanne Mortimer
- Coral reef monitoring: Pierre-André Adam
- Mangrove monitoring: Sylvana Antat

In short, the main improvement coming from those new discussions and reviews has been a stronger conception of the 'Methodologic index' (or module) of the database, where any method is defined by just three core attributes (populational scale, targeted pop. metrics, and time series) and custom code lists defined on nine method parameters (e.g. list of taxa considered, sexes considered, life stages/cohorts considered, etc.) (Figure 1 & Figure 2). In the previous version of this database design (2016), the code lists specific to a given method were not stored in the database as an explicit component actually describing the method, and therefore automatically adjustable for species observations made following a given method.

Apart from this conceptual improvement, the main result from the Domain expert consultations was the fine tuning of the fields, the code list elements and their dependencies for an optimal data entry flow.

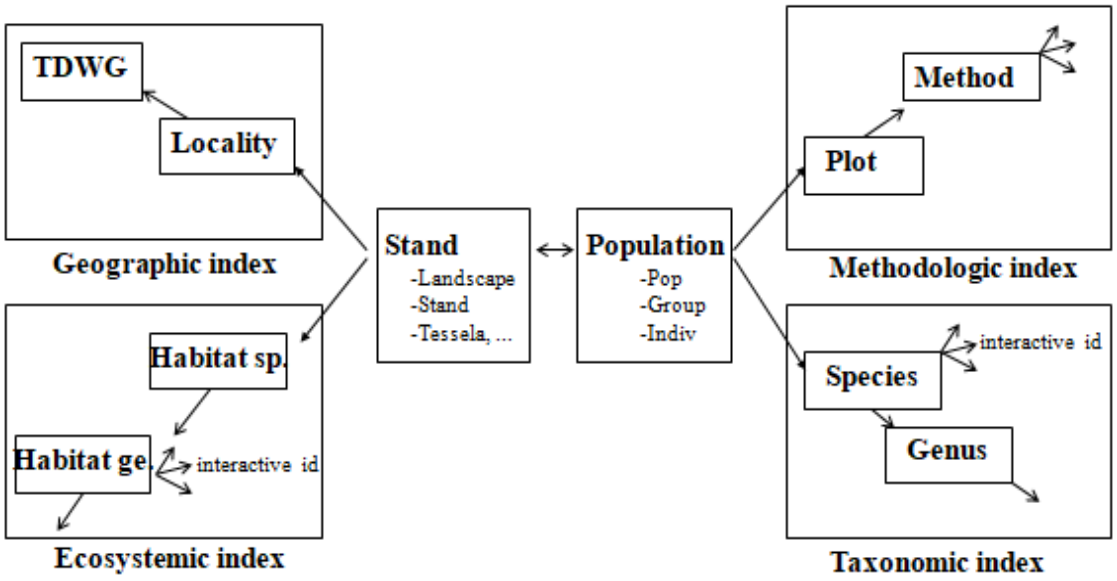

Figure 1. Overall architecture of the database.

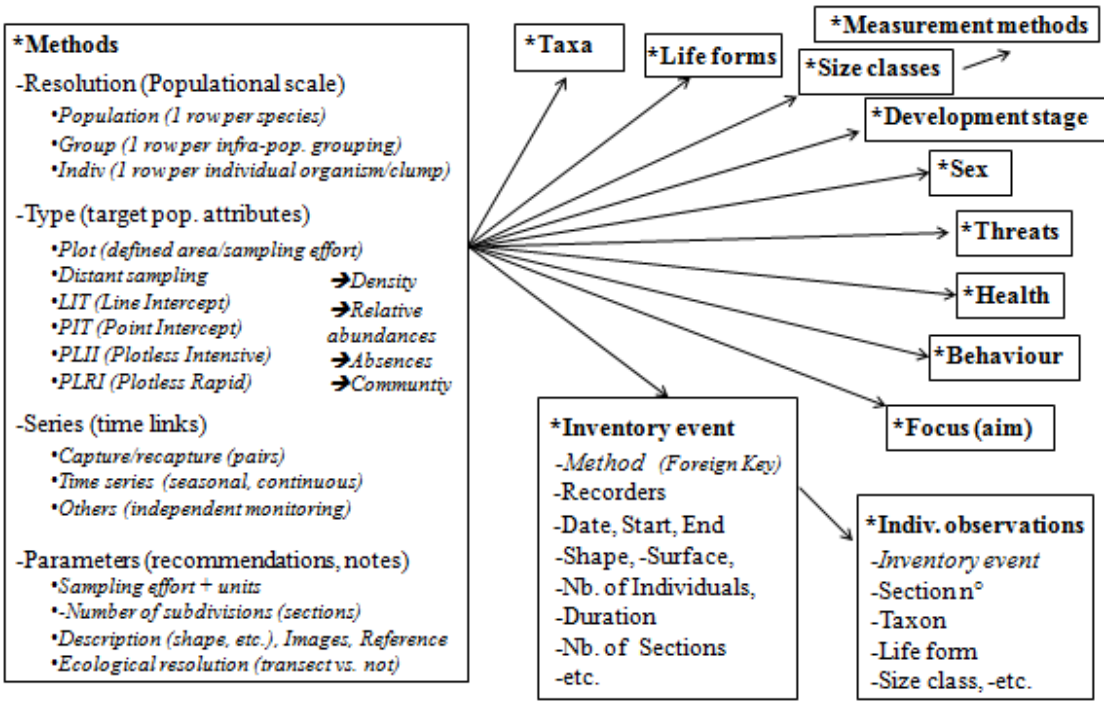

Figure 2. Overview of the universal method description scheme for species inventories.

II.2 Building indexes and cleaning code list elements

Again, most of the work had been done already during a preliminary phase (2016). The main improvement that we focused on was the general taxonomic index and the formatting of subsets of it for method-specific code lists.

As for all main indexes of the core database architecture, the taxonomic data needs to be flexible and to adjust to various levels of resolution. This is particularly true for the Coral reef monitoring dataset, and not so much for Mangroves, Turtles and Tortoises. But it will be also important for many other datasets where species identifications will not be necessarily straight forward. Therefore, we needed to root the taxonomic index more strongly, on an internationally accepted standard spanning the whole tree of life (Ruggiero et al. 2015).

For all elements provided in the original ICS code lists for coral reef monitoring, we therefore had to identify if the term was representing a taxonomic entity (species, genus, family, etc.), a life form (e.g. branching, plankton, etc.) or a combination of both (e.g. *Acropora* branching).

For all taxonomic terms, we checked spelling and we placed the taxon within Ruggiero's tree of life systematic.

Vernacular and local names used for taxonomic entities were then linked to their corresponding taxa in the tree of life (e.g. 'Lobsters' to 'Palinuridae' family, spiny lobsters).

Then, once all taxonomic names were regrouped in the standard tree of life, we created method-specific code lists (basically similar to the original ICS code lists) with labels designed in a way to facilitate the data capture, e.g. "Lobsters (Palinuridae)", "Acanthuridae (Surgeons) (Acanthuriformes) (acant)". Users will then be able to enter any part of the label (e.g. 'surgeons') and the system can short list all elements containing that string of characters.

Those code lists are provided within the Open Foris Collect Mobile applications attached to this report. They will need never ending fine-tuning and additions.

II.3 Database application

Although a lot had been done in the preliminary phase of this work (2016), a lot more has been done under the current project. The database application (implementation of the design) has been completely redeveloped. It is not anymore developed as a plugin for QGIS, which made installation more complicated and offered less options in terms of offline data entry and data sharing management.

For those reasons, and also because the application development is done under several projects and personal investment, we decided to develop it as a standalone application. We name it the "Bio: Holistic Biodiversity Database on species and ecosystems" (in short "Bio: Holistic database").

Although most of the underlying work on computer programming has been done, the final development of data entry interface is not finished yet. The computer programming team (Michael Wagner, Israel Alcindor and Eli Louise), together with the designer (Bruno Senterre) have committed to finalize those from now to September, when the ICS database manager will be starting her employment with ICS.

To mitigate the delay in the database application development, we decided to develop Smartphone-based data collection tools. Those tools have been finalized and need testing by ICS field team to fine tune them. They can already be used for capturing new data and centralizing those until the Bio Holistic Database application is finalized. Then there will be an option to import directly data collected with Smartphones into the database system.

II.4 Data migration

Pre-existing ICS data are available for Turtles and Coral reef monitoring datasets, not yet for Mangroves and Tortoises (which are new datasets). For Coral reef monitoring, we received data only for two islands (Poivre and Silhouette) over one monitoring event (for the year 2017). For Turtles monitoring, we received data only for Silhouette Island, in the form of an Excel export from the original FileMakerPro format.

Those data have been migrated to the Bio Holistic Database, redistributing the information among the various tables of the new design. Those migrated data represent (in terms of individual/species observations):

- 5363 Coral reef observations
- 3937 Turtles and Tracks observations
- 26050 KBA data (from the PCA-SEY National Herbarium database; CEPF project)
- 21629 KBA data from Bruno Senterre's personal database on biodiversity explorations led by himself in several tropical countries of all continents

Those migrated data are useful to test the database interface. The data coming from outside Seychelles will be useful to give to the Seychelles KBA dataset an international value, through the capacity to integrate data from any continent and from various data collection protocols.

For Coral reef monitoring and Turtles, there is a much larger amount of backlog data to be migrated, but those are still in the process of being cleaned by ICS, prior to be available for migration. A lot of 'cleaning' cannot be fully automated.

II.5 Training and delivered products

Timeline

A training was done from 23rd to 26th of April 2019 and involved 14 participants from 6 organizations (ICS, TRASS, MCSS, SNPA, MEECC, GIF: Annex 2). Six different teams were represented within ICS: head office, Aride, Silhouette, Alphonse, Desroches and Farquhar.

Training manual

The material presented and the exercises, as well as the database application (preliminary, not yet functional state) and the finalized draft Smartphone data collection applications were shared on usb drive during the training and are also part of the delivered products attached to the present report (zipped folder named "Bio Holistic Database 2019", see Annex 1). All those products can be used by participants wishing to repeat the training, or shared with others needing to use some of the training elements (e.g. R statistics, database conception, Smartphone data collection, Open Street Map data contribution, etc.).

Name	Date modified	Type	Size
Bio Holistic Database application	30/04/2019 14:31	File folder	
Bio Open Foris Collect applications and datasets	30/04/2019 14:40	File folder	
Exercise-Database Conception-Smartphone data collection	30/04/2019 14:08	File folder	
Exercise-Open Street Map	29/04/2019 14:49	File folder	
Exercise-R	30/04/2019 14:31	File folder	
Participants feedback	30/04/2019 14:51	File folder	
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Alcindor 2019-Smartphone and Android devices comparative r...	25/04/2019 08:43	OpenDocument P...	965 KB
Louise 2019-Introduction to R and the world of data analysis a...	29/04/2019 11:23	OpenDocument P...	1,816 KB
Senterre 2019-ICS Biodiversity Data Management.pptx	25/04/2019 06:20	Microsoft Office P...	8,552 KB
Wagner 2019-Bio-An Information System for Biodiversity Cons...	29/04/2019 11:19	Adobe Acrobat D...	1,493 KB

III DISCUSSION: HOW TO USE THE DELIVERED PRODUCTS

Right now, ICS has the possibility to start using the developed material. We recommend considering the following steps. This temporary integration system has been implemented for KBA dataset and is operational.

Set up the Team Network with Open Foris Collect

-Designate clearly and list the individual teams, e.g. ICS-Silhouette, ICS-Farquhar, etc.

-Designate the Conservation Officer responsible for each of the the island teams.

-Designate clearly one Focal Person for each dataset, to be responsible for compiling feedback and requests from all teams contributing to that dataset (copying also the ICS Database Manager and 'dataset authorities' in email exchanges, see below). This includes notes on system improvements in the phone apps (add a field, add/change dependencies,

default values, etc.), additions of elements in code lists (e.g. person names, Island names, study sites, etc.), and compilation of data files exported from the phones of all teams.

-Designate for each dataset some 'authorities' to be copied to all emails exchanged with the Focal Person of a given dataset.

-Eventually set this up using the Dropbox solutions explained during the training (Figure 3)

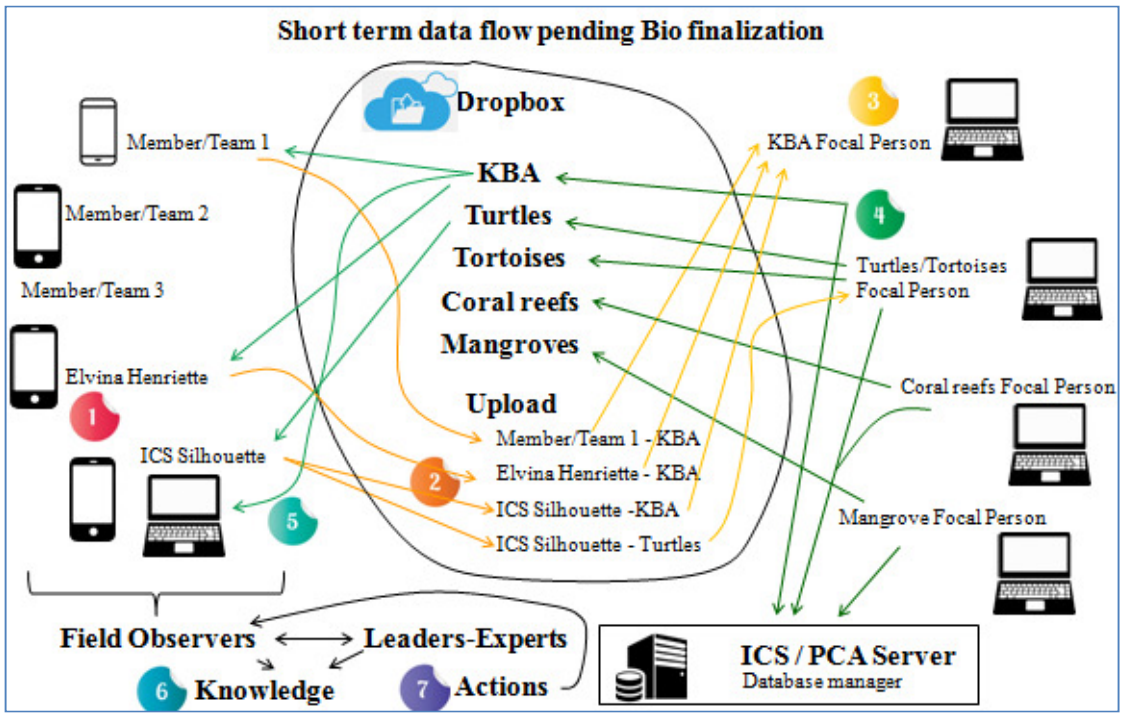

Figure 3. Flow chart of data and information exchanges within the Team Network (ICS and beyond).

Self-training, secondary training and collaborative work preparation

Once the Team Network is defined, we can start communicating formally. The first step is then to make sure that the data collection applications are well understood in their current state. From the training, all teams know how to install the surveys for the various datasets on their Android device. Before going out to try to collect data, users should first go through the surveys a few times, reading carefully all tips and notes provided on each of the screen of the surveys (so that they get to know the content).

Once the field team is familiar with the survey, it can be used during normal field monitoring activities. Phone-based data collection should be done in addition to usual paper data collection for at least a few months (duplicate data recording), until all teams have provided feedback and the survey design can be considered final.

As you test the data collection in various situations, take detailed notes on the errors and improvements needed in relation to specific screens of the surveys. Don't hesitate to ask for help or to discuss questions with colleagues, including the authors of this report.

Set up routine data collection, compilation and backups

Once the phone-based data collection surveys are considered final, then a well-defined routine must be followed as suggested in Figure 3, in order to compile/centralize data collected from all field teams.

Step-by-step procedures might need to be described to ensure that several backups are managed and that the main copy on the server is secured. The ICS database manager might need to do site visits to field teams to make sure that the procedure is fully assimilated. The routine could be:

-Team A exports from Android device data collected for Dataset X

-Team A leader upload the exported '.collect-data' file to the Dropbox folder shared with the Focal Person of that dataset and with the ICS Database Manager.

-The Focal Person imports into Open Foris Collect the collect-data file, then cuts it from that folder and paste it in a Backup folder on his/her computer.

-A backup of all data from all Focal Persons is made on the ICS server (at least every Friday).

-Whenever a new version of a survey is released, the Focal Person communicates with all corresponding teams to make sure that all data has been migrated before upgrading to the new version.

IV CONCLUSION: FUTURE/ONGOING DEVELOPMENTS

So far, the components of the Bio Holistic Database developed include most of the SQLite database (local database), the map component (using Mapbox OSM Data) and the phone-based data collection surveys (with Open Foris Collect) (Figure 4).

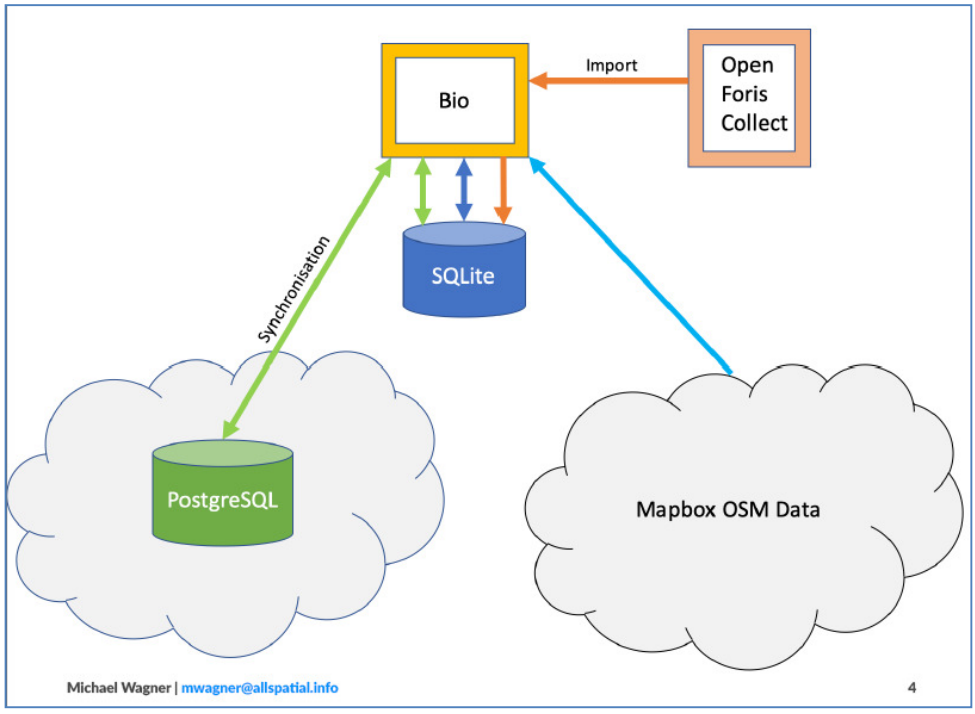

Figure 4. Main components of the Bio Holistic Database application.

The ongoing development planned to make the Bio Holistic Database functional are:

- May-Sep: Continued support to ICS for the improvements and corrections requested to finalize/validate the developed phone-based data collection surveys
- May-June: Finalize customised dialog windows for coral reef data
- June: Add customised dialog windows for turtle, tortoise and mangrove data
- May-June: Direct import of Open Foris data into Bio
- July: Add map interaction
- July-Sep: Synchronisation between local database (SQLite) and server (PostgreSQL)

Other tasks that are needed in the short to medium term include:

- Formalizing MoUs between collaborating organization (e.g. ICS-PCA-SEY)
- Migrate all historical data from the ICS backlog for Turtles and Coral reef monitoring
- Develop data analysis functionalities (using R)
- Develop an exhaustive taxonomic index of the biota of Seychelles and their meta-data
- Plan joint publications, joint projects, joint field work

The longer term vision suggested for the Bio Holistic Database is the one of a National Biodiversity Network, because the designed database aims at integrating all data on biodiversity, from ecosystems to plants, birds, insects, rainfall, etc. The overall aim is therefore to better understand our environment in order to use it in a more sustainable way, and for that it is essential to integrate as much as possible the many different methods that different people and teams have when looking at different aspects of the same environment. In addition, all these different approaches face mostly the same technical challenges to maintain taxonomic, geographic, methodologic description of their data.

V BIBLIOGRAPHY

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Senterre B, Kaiser-Bunbury C (2014) Conception of an integrated database on the flora, fauna and vegetation of the Seychelles. Government of Seychelles, United Nations Development Programme, Victoria, Seychelles

Senterre B, Wagner M (2016) Standardization of data collection and creation of a biodiversity database: a PostgreSQL-PostGIS database for Island Conservation Society (Seychelles). Government of Seychelles, United Nations Development Programme, Victoria, Seychelles

VI ANNEXES

Annex 1. Complete list of sub-folders and files contained in the attached material of this report.

Annex 2. List of participants to the training done from 23-26 April 2019, and evaluation.

Annex 1. Complete list of sub-folders and files contained in the attached material of this report (2.74Gb, unzipped).

Directory of D:\Database\Bio\ZTraining ; delivered as a zipped file 'Bio Holistic Database 2019' to UNDP-PCU project manager, Joanna Prosper (j.prosper@pcusey.sc) and to ICS Head of Science & Projects, Pierre-André Adam (science@ics.sc).

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24/04/2019  15:00            37,694 turtle_track_en_20190424T132546.collect-mobile
24/04/2019  13:31             5,519 turtle_track_t_2019-04-24_13.30.collect-data
               4 File(s)         72,156 bytes
```

```
 Directory of D:\Database\Bio\ZTraining\Exercise-Database Conception-Smartphone data
collection

30/04/2019  14:08    <DIR>          .
30/04/2019  14:08    <DIR>          ..
19/09/2018  08:44           294,441 Exercise 1-Turtles and Tracks data sample-patrol log.pdf
17/09/2018  21:19           525,561 Exercise 1-Turtles and Tracks data sample-silhouette turtle
filemakerpro database.xlsx
17/09/2018  20:06           292,179 Exercise 1-Turtles and Tracks data sample-turtle
datasheet.pdf
19/09/2018  20:51            33,792 Exercise 2-Turtles nesting data form-turtle Nest Site
Description  Egg Clutch Survival 2014  (2016_06_27 12_13_14 UTC).xls
19/09/2018  20:51           388,811 Exercise 2-Turtles nesting data sample-Aride_17-
18_NSD11.jpeg
16/04/2019  16:27            13,961 Guidelines for the exercices relative to the ICS database
training.docx
               6 File(s)      1,548,745 bytes

 Directory of D:\Database\Bio\ZTraining\Exercise-Open Street Map

29/04/2019  14:49    <DIR>          .
29/04/2019  14:49    <DIR>          ..
29/04/2019  11:20        12,256,346 Introduction_to_OSM.pdf
23/04/2019  08:38        48,749,507 Introduction_to_OSM_Exercises.pdf
22/04/2019  20:58               107 mountain_peaks.csv
22/04/2019  21:23            19,853 OSM_Data_Model.docx
22/04/2019  21:24            63,550 OSM_Data_Model.pdf
29/04/2019  14:49    <DIR>          Software
               5 File(s)     61,089,363 bytes

 Directory of D:\Database\Bio\ZTraining\Exercise-Open Street Map\Software

29/04/2019  14:49    <DIR>          .
29/04/2019  14:49    <DIR>          ..
29/04/2019  14:50    <DIR>          Mac
29/04/2019  14:50    <DIR>          Windows
               0 File(s)              0 bytes

 Directory of D:\Database\Bio\ZTraining\Exercise-Open Street Map\Software\Mac

29/04/2019  14:50    <DIR>          .
29/04/2019  14:50    <DIR>          ..
22/04/2019  09:42        13,063,769 josm-macosx.zip
22/04/2019  09:37        83,214,616 jre-8u211-macosx-x64.dmg
               2 File(s)     96,278,385 bytes

 Directory of D:\Database\Bio\ZTraining\Exercise-Open Street Map\Software\Windows

29/04/2019  14:50    <DIR>          .
29/04/2019  14:50    <DIR>          ..
22/04/2019  21:13       166,190,448 jdk-12.0.1_windows-x64_bin.exe
```

```
22/04/2019  21:03        13,932,057 josm-setup.exe
24/04/2019  12:58        69,598,048 jre-8u212-windows-i586.exe
               3 File(s)    249,720,553 bytes

 Directory of D:\Database\Bio\ZTraining\Exercise-R

30/04/2019  14:31    <DIR>          .
30/04/2019  14:31    <DIR>          ..
29/04/2019  10:42             1,343 barchart.R
26/04/2019  08:27        82,818,984 R-3.5.3-win.exe
26/04/2019  08:27       133,103,936 RStudio-1.2.1335.exe
               3 File(s)    215,924,263 bytes

 Directory of D:\Database\Bio\ZTraining\Participants feedback

30/04/2019  16:29    <DIR>          .
30/04/2019  16:29    <DIR>          ..
30/04/2019  14:49           617,501 ICS 2019-Bio Training attendance list of participants.pdf
30/04/2019  13:50           454,556 Training_Evaluation_Form1.pdf
30/04/2019  14:47            16,876 Training_Evaluation_Form2.docx
30/04/2019  16:25            17,593 Training_Evaluation_Form3.docx
30/04/2019  13:41            16,686 Training_Evaluation_Form4.docx
               5 File(s)      1,123,212 bytes

     Total Files Listed:
              65 File(s)  2,950,151,971 bytes
              56 Dir(s)  298,956,800,000 bytes free
```

Annex 2. List of participants to the training done from 23-26 April 2019, and evaluation.

REGISTRATION FORM

DATE: 23rd to 27 April TIME: All Days VENUE: PCU meeting Room

ACTIVITY: ICS Biodiversity Geo Database training

No	NAME	GENDER	ORGANISATION	PHONE	EMAIL ADDRESS	23rd April	24th April	25th April	26th April	27th April
1	Pierre Andre Adam	M	ICS Head Office	4375354	science@ics.sc					
2	Nasreen Khan	F	ICS Aride	2503049	~~aride@ics.sc~~ aridescience@ics.sc					
3	Melinda Curran	F	ICS Aride	2534212	~~aride@ics.sc~~ arideconservation					
4	Francois Baguette	M	ICS Silhouette	2714488	silhouette@ics.sc					
5	Gail Fordham	F	ICS Alphonse		alphonse@ics.sc					
6	Craig Nisbet	M	ICS Desroches		desroches@ics.sc				✓	
7	Matthew Morgan	M	ICS Farquhar		farquhar@ics.sc				X	
8	Aurelie Duhec	F	Consultant		aurelieduhec5@gmail.com				✓	
9	James Mougal	M	SNPA		j.mougal@gov.sc				✓	
10	Rabia Somers	F	MCSS		rabasomers@gmail.com					
11	Elyn Brutus	F	MEECC		e.albert@env.gov.sc					
12	Vicky Stravens	F	TRASS		vkib16@yahoo.com					
13	Mariliana Leotta	F	GIF		mleotta@gif.sc				✓	
14	Jeanne Mortimer	F	ICS consultant		jeanne.a.mortimer@gmail.com					
15	Israel Alcindor	M	Student Support		israelr.alcindor@gmail.com					
16	Eli Louise	M	Student Support		eli.louise7@gmail.com					
17	Michael Wagner	M	Consultant		mwagner@allspatial.info					
18	Bruno Senterre	M	Consultant		bsenterre@gmail.com					
19										
20										

Training Evaluation Form

Training date: April 23-26, 2019

Training purpose:
- Demonstrate/show the developed database and tasks done under this consultancy
- Explain (through presentations and exercises) the choices made (database specificities) and the reasons behind it in view of ICS data management needs
- Test data entry for the developed datasets (coral reef & turtles monitoring)
- Propose and discuss the next steps for ICS take over and for ongoing development

Training venue: PCU Meeting Room / UNDP, Victoria

Trainers: Bruno Senterre, Michael Wagner, Eli Louise, Israel Alcindor

Instructions: Please indicate your level of agreement with the statements listed below in #1-10.

We received feedback from 6 participants as follows (The numbers show many participants choose that particular answer):

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
1. The objectives of the training were clearly defined.	2	3	1		
2. Participation and interaction were encouraged.	3	3			
3. The topics covered were relevant to me.	1	3	2		
4. The content was organized and easy to follow.	1	3	2		
5. The materials distributed were helpful.	2	2	1		
6. This training experience will be useful in my work.	4	1	1		
7. The trainer was knowledgeable about the training topics.	4	2			
8. The trainer was well prepared.	3	3			
9. The training objectives were met.	1	4	1		
10. The time allotted for the training was sufficient.	2	3	1		

11. What did you like most about this training?

-Open Street Map session and conversion from flat to relational database were most useful and applicable.

-Diversity of content and mix of theory and practice

-Informal setting

-Clear and precise presentations

-Foris and OpenStreetMap

-Data collection using mobile apps

12. What aspects of the training could be improved?

-Training was too long for the content to share

-More time should have been spent on the Foris Surveys

-Further exploration of R

-Better timing of the various activities

-Confusion about how the tools shown can be incorporated into the participants' work programme

-More statistical analyses of R could've been done

13. How do you hope to change your practice as a result of this training?

-Hope to upgrade the current methods of data management within my organization with the ones tought

-Hope to contribute to OpenStreetMap regularly

14. What additional trainings would you like to have in the future?

-A training only on using the final bio database

-Any training on software for use in conservation

-A more specific R course tailored for visualization and description of ICS datasets

-Further training on R and GIS

15. Please share other comments or expand on previous responses here:

-Liked how biologists and computer programmers can interact and join interests. This opens up the biology and conservation world.

Thank you for your feedback!