INTRODUCTION

Dan Rapp and Sarah Youngren were funded through the U.S. Fish and Wildlife Service (USFWS) Inventory and Monitoring Program to assist in the completion of the French Frigate Shoals Biological Monitoring Data Quality and Analysis Project providing data files as requested for PI's of the project. Work for this project was based at the Tern Island Field Station, French Frigate Shoals, Hawaiian Islands National Wildlife Refuge, and off island at offices at Hawaii Pacific University (HPU), Waimanalo, HI.

Additional data quality and analysis deliverables were added based on findings during this project (denoted by * after stated deliverable), original scope of work items were completed to the best of our abilities during the period of this project. The project provided such services as securing and compiling monitoring data; digitizing hard copy data; fact checking data used for analyses; assisting in analyses and report writing; and creating new standard operating procedures (SOPs) such that further data collection and management is more strictly regulated (this final product is still in the draft stage).

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PROJECT TIMELINE

1) Tern Island Field Station (full time): 1, April - 18, June
2) Tern Island Field Station (half time):18, June - 21, July
3) Midway Atoll (approx. half time): 21, July - 9, August
4) HPU Offices (half time): 9, August - 9, October
5) Project End / Deliverables Submitted

PROJECT SCOPE OF WORK AND DELIVERABLES

PHASE 1: DATA MANAGEMENT AT TERN ISLAND FIELD STATION (1-APRIL– 21-JULY-2012)

1. **Organize data archive at the Tern Island Field Station and create a spreadsheet inventory of the field stations hard copy data.**

    a. All hard copy data found at the Tern Island Field Station has been organized into three sets of filing cabinets in the field stations living quarters. Field notebooks and banding data were compiled in drawers in the 'biology area' of the building. Additional hard copy data is compiled in filing cabinets found in the 'radio room' and 'archive room'. All filing cabinets used for compiling hard copy data at the field station were given an identification letter / number. Yearly journals from 1981-2009 were found to be in a very poor condition, this data was bagged and placed in rubbermade totes to be returned to USFWS Honolulu offices for digitization.

        i. **Suggestions for improvement:** An SOP needs to exist for how and where hard copy files get archived at the field station including the importance of writing the date and species on all files as well as delineating whether the data was entered and/or proofed, and whether the file is an original files or a copy. Additionally, archived data storage at the field station needs to be converted to more secure and transportable containers due to the harshness of the environment on such media (such as filing boxes with gaskets, these can be purchased for ~$12 each and roughly 12-15 would be needed).

    b. **Deliverables**

        i. Organize, compile, and inventory field station hardcopy files.
        ii. Create hardcopy inventory database.
        iii. Address methods for hardcopy data archival in SOP supplement.*

2. **Scan existing banding schedules, annual journals, annual reports, and other data that are not already scanned into pdf files, including roughly 2000 pages.**

    a. All updated copies of banding schedules at the field station were scanned creating a pdf file for every band schedule; pdf files were combined based on band prefixes. All prefix groupings were proofed for scanning errors band schedules with scanning errors were rescanned and added to the end of the prefix grouping. Some band schedules had inherent copying errors (i.e. files from Honolulu had portions of pages cut off) any data lost from these inherent errors can only be found from the original document which is not archived at the Tern Island Field Station.

        i. **Suggestions for improvement:** Methods for organizing banding schedule pdf files needs to be specified, we recommend filing by band prefix / suffix. Additionally, an SOP needs to exist for filing hard copy band schedules at the field station and in Honolulu offices.

It is recommended that the field station start using newer band schedule formats, like those used at Midway Atoll; this new format will simplify data collection and reduce errors. A more detailed SOP needs to exist for how to use banding schedules, including how schedules are updated when birds die. It is recommended that a central database exist for the refuge which compiles all banding data for all islands thereby making the data more accessible. Improved storage and methods for using hard copy banding schedules need to exist at the field station.

b. Portions of annual journals were scanned (mostly phenology data). The field stations annual journals are very large, handwritten, and in very poor condition, because of this all journals were prepared for transport back to Honolulu offices for digitization and filing at a later date.

i. Suggestions for improvements: The field stations annual journals should be digitized at the end of each year; this will secure the data and make it more accessible. Additional summary information on reproductive plot size and number of plots per species, and vegetation surveys would be useful to include in annual journals. Also, it should be emphasized that the data contained in journals should be accurate and as complete as possible for each entry. It is recommended that journal data also be entered in the prospective databases for each species, the updated seabird demographic plot database we created is a model of this.

c. Annual reports that weren't already digitized were scanned. Some digital files existed as older file formats (i.e. wordpad), these were converted to newer formats including the pdf file format.

i. Suggestions for improvements: Make sure a final pdf copy is saved each year along with the final data used for analysis.

d. Deliverables

i. Digitized and organized field station banding schedules.
ii. Digitized annual reports.
iii. Partial digitization of annual journals, additional hard copy files being transported back to Honolulu offices for securing.
iv. Address methods for scanning and filing scans in SOP supplement.*

3. Enter and proof missing 2010 albatross sweep data from Tern Island Field Station.

a. Missing sweep data was located, entered, proofed, and summarized. A report was written summarizing the albatross sweep from the 2010 field season.
b. Suggestions for Improvement: This is a very large data set that involves a great deal of time and disturbance to collect. We have noticed that while the methods for data collection are strong, the methods for data entry, proofing, and final copy storage could use improvement.

c. Deliverables

i. Compiled and organized raw albatross sweep data from 2010.
ii. Summary report written for 2010 albatross sweep.

4. Assist spring /summer USFWS crew with biological monitoring and data management and collection as needed.

a. Monitored Laysan Albatross, Black-footed Albatross, and Tristram's storm-petrel reproductive plots. Trained USFWS crew on proper bird banding techniques including banding data management; assisted with banding operations within French Frigate Shoals.

b. Deliverables

i. Monitored Laysan Albatross, Black-footed Albatross, and Tristram's storm-petrels reproductive plots, data completed.*
ii. Address methods for band management in SOP supplement.*
iii. Band application and banding data methods power point presentation.*
iv. Finalize demographic monitoring database. *
v. Address methods for demographic monitoring database in SOP supplement.*
vi. Address methods for data management and accountability in SOP supplement.*

5. Update banding, weather, outer island, marine debris, vagrant, vegetation, entrapment, and phenology spreadsheets with current data from April 1, 2012 through June 30, 2012. Compile weather data logger files into one folder. Compile, organize, and submit April 1, 2012 through June 30, 2012 banding data to refuge manager.

a. Data entry completed for all topics, banding data from April 1, 2012 through June 30, 2012 submitted to refuge manager and banding data manager. Updated copy left on Tern for continued data entry for this year.

b. Deliverables

i. Up to date banding, weather, outer island, marine debris, vagrant, entrapment, and phenology databases for the given period.
ii. Compiled files from the field stations weather loggers.
iii. Compiled and organized banding data for the given period.
iv. Address methods for data management in SOP supplement. *

6. **Run and update virus and malware protection software on Tern Island Field Station computers. Backup refuge folder (data archive) files twice a month on the field stations available hard drives during project period.**

    a. Virus and malware software updated and run on refuge computers during project period. Refuge folder (data archive) files backed up during project period.

        i. **Suggestions for improvement:** Methods for accurately managing and backing up the digital archive at the field station needs to be written. A common problem encountered was having file paths that were too long and as a result these files would not successfully backup. The use of a software program called Teracopy (freeware, that allows for stopping and restarting copying, as well as provides a way to check for copying errors, and files that did not copy) would be a good addition to this backup protocol. Virus and malware protection software at the field station needs to be updated and run regularly; a virus could be detrimental to the field station digital resources! Additionally, we recommend following protocols from the Midway Atoll refuge where a locked 'common drive' and an available for editing 'volunteer drive' exists for data storage.

    b. **Deliverables**

        i. Virus and malware software updated and run on refuge computers during project period.
        ii. Refuge folder (data archive) files backed up during project period.
        iii. Address methods for long term dataset management in SOP supplement.*

7. **Conduct field research for USFWS plastic ingestion project.**

    a. Data and samples were collected for this project at the Tern Island Field Station during the 2011 / 2012 field season. Samples are being housed at HPU facilities where they will be processed over the course of the next 2 – 3 years. Additional data analysis and report writing to be completed in 2 – 3 years.

    b. **Deliverables**

        i. Data and samples collected for study. *

PHASE 2: PROVIDE DATA QUALITY CONTROL FOR TERN ISLAND STATUS AND TRENDS REPORT (1-APRIL-2012 – 21-JULY-2012)

8. **Check data entries for minimum nesting pairs, number of egg nests, number of chicks observed for each year and species in the phenological summary database for the Tern Island Field Station; separate Tern Island and whole atoll (FFS) entries for seabird species from 1986 - 2011.**

    a. Data entries were checked per request from Dr. Paula Hartzell for the completion of the 1986 – 2011 status and trends report. All phenology pages from yearly journals were scanned and organized by species for future reference.

        i. **Suggestions for improvement:** An SOP needs to exist for the management of phenological data collected at the field station. We recommend all phenological data should be proofed and entered into a master database on a yearly basis.

    b. **Deliverables**

        i. Data entries checked for the French Frigate Shoals 1986 – 2011 status and trends report.
        ii. Digitized phenology pages from field station yearly journals.
        iii. Files from analysis included in archive dataset.

9. **Check data entries for mean incubation count (MIC), reproductive monitoring plot, outer island survey, and weather data hard and digital copy files; this includes approximately 150 entries.**

    a. MIC data was checked and corrected as per request from Dr. Paula Hartzell for the French Frigate Shoals 1986-2011 status and trends report.

        i. **Suggestions for improvement:** MIC data needs to be entered and proofed on a shorter term basis. Also, methods for MIC data collection need to be further specified within the field stations biological monitoring SOP so that data remains comparable between seasons.

    b. Data from reproductive plots was checked and corrected as per request from Dr. Paula Hartzell for the French Frigate Shoals 1986 - 2011 status and trends report.

        i. **Suggestions for improvement:** Reproductive plot data collection and management needs to be solidified, this includes the creation of digital databases. We recommend that the field station management and volunteer staff be made accountable for the data the collect so that is correctly entered and proofed before they leave the field station.

c. Outer island survey data was checked and corrected as per request from Dr. Paula Hartzell for the French Frigate Shoals 1986-2011 status and trends report.

i. **Suggestions for improvement:** All outer island data needs to be entered, proofed, filed on a more short term basis. Areas of data collection need to be improved, including checking for all species on each outer island visited for survey and filling in zeros for these species on survey forms.

d. Past weather data was not checked and corrected, however paper copies from 1979 - 1999 were located and scanned for future access.

i. **Suggestions for improvement:** As collected currently it is very difficult to retain the quality and accuracy of weather data at the field station. Sources of inaccuracy in the weather dataset include observer error and weather station maintenance. We recommend that an automated weather station be acquired and deployed at the field station, until that time we suggest that the weather data collection SOP be updated to provide more detail. Also, observers should be made to be more accountable for the weather data they collect this includes maintaining the weather station (e.g. keep the relative humidity thermometer wick wet) and maintaining time of day and location of data collection. Many errors occur when using the field stations anemometer: users need to stand in a universal location, orientate the device properly into the wind, and use a standard amount of time the device is allowed sample. We recommend installing a small windsock or even simpler device to obtain wind direction at the field station until an automated weather station can be installed. Additionally we suggest that the weather collection methods be attached to the inside of the weather station box to increase data accuracy and quality.

e. Deliverables

i. Data entries checked for the French Frigate Shoals 1986 – 2011 status and trends report.
ii. Files from analysis included in archive dataset.
iii. Updated Check data entries for mean incubation count (MIC), reproductive Updated MIC, reproductive monitoring plot, outer island survey, weather databases.
iv. Address methods for data management in SOP supplement. *

10. Compile list of years that reproductive plots have been employed at the Tern Island Field Station by species, this includes measures of plot size for each year.

c. Data regarding reproductive plot location and size were checked and corrected as per request from Dr. Paula Hartzell for the French Frigate Shoals 1986-2011 status and trends report.

i. **Suggestions for improvements:** Reproductive plot dimensions and locations need to be added to annual species journal pages, including maps of plot locations and nest attempt locations within these plots for the given year.

b. Deliverables

i. Years and dimensions of reproductive plots provided for 1986 – 2011 status and trends report.
ii. Files from analysis included in archive dataset.
iii. Address methods for yearly documentation in SOP supplement. *

11. Compile total number of eggs and chicks, by reproductive plot, by year, for each species monitored at the Tern Island Field Station using reproductive plot methods, from initiation through the 2011 reproductive year.

d. Data regarding reproductive plots were checked and corrected as per request from Dr. Paula Hartzell for the French Frigate Shoals 1986-2011 status and trends report.

e. Deliverables

i. Data entries checked for the French Frigate Shoals 1986 – 2011 status and trends report.
ii. Files from analysis included in archive dataset.
iii. Address methods for yearly documentation in SOP supplement. *

12. Complete missing data entries for 2011 species accounts, as well as 20 year biological status and trends information for each species, as supplied by USFWS, to the extent possible from existing files at the Tern Island Field Station.

f. Data entries for this dataset were checked per request from Dr. Paula Hartzell for the French Frigate Shoals 1986 – 2011 status and trends report.

i. **Suggestions for improvements:** Update SOP for what needs to be completed for yearly species accounts, additionally collect data throughout the year in a way that species accounts don't have to be compiled at the end of the year based solely on what the manager remembers and interprets to be correct/interprets from incomplete volunteer files and weekly reports (will be made easier with new reproductive plot spreadsheets that include plot phenology dates).

g. Deliverables

i. Data entries checked for the French Frigate Shoals 1986 – 2011 status and trends report.
ii. Files from analysis included in archive dataset.

13. Compile list of special projects, by species or topic, from French Frigate Shoals / Tern Island Field Station annual narratives, and from field station volunteer special projects, and add to species biological status and trends files.

h. Data entries for this dataset were checked per request from Dr. Paula Hartzell for the French Frigate Shoals 1986 – 2011 status and trends report. Files from the field stations 2010 – 2011 volunteer special projects were compiled and organized in one centralized location.

i. Suggestions for improvements: It is recommended an SOP be written to standardize the methods for special projects conducted by staff at the Tern Island Field Station. Additionally a database needs to be created documenting what projects have been completed and where if any data will be published.

i. Deliverables

i. Data entries checked for the French Frigate Shoals 1986 – 2011 status and trends report.
ii. Compiled and organized files from the field stations 2010 – 2011 volunteer special projects.
iii. Address methods for yearly documentation in SOP supplement. *

PHASE 3: REPORTING AND DATA ORGANIZATION DOCUMENTS FOR CORRECTIVE AND IMPROVED EFFICIENCY (21-JULY-2012 – 9-OCT-2012)

14. Make recommendations for additional, corrective, or improved efficiency; and recommendations for future work related to current project.

a. SOP's, forms, and databases were created to improve data quality, management, and analysis at the field station; these files are compiled and/or discussed in a biological monitoring SOP supplement report. Additional recommendations for improved data quality and management at the field station are made within this document and the biological monitoring SOP supplement report.

b. Deliverables

i. French Frigate Shoals biological monitoring SOP supplement report!*

ii. Recommendations were made for improved data collection and management at the field station through work with Tern Island Refuge Managers.

iii. Recommendations also made for future work related to the French Frigate Shoals Biological Monitoring Data Quality and Analysis Project.

15. List options and costs for converting all electronic copies from past data collection efforts at the Tern Island Field Station to current long-term electronic storage format.

c. Outdated, and now obscure, file formats were identified within the field stations digital archive (i.e. refuge folder). Files in paradox 9 corel database exist, conversion software capable of reformatting the field stations old files to modern file formats exists; it is recommended this software be purchased. Additionally some files are still in word pad format, however can be opened with Microsoft word and thus were not all converted to word files. Options for converting these file formats to modern digital formats were explored.

i. Suggestions for improvement: As a general rule, using and creating obscure file formats should be avoided whenever possible, and as programs are phased out we need to ensure that archival copies that can be used with new programs remain. Additionally for data at the field station we recommend purchasing a solid state hard drive for the working data folder. Solid state hard drives are now available from most major electronic dealers. One of the advantages of using solid state hard drives over standard spinning disk hard drives is that solid state hard drives are much more stable (i.e. no moving parts). As the cost of the technology comes down it is recommended the field station move away from spinning disk hard drives and onto solid state hard drives. It is also recommended that the Tern Island Field Station purchase a flat bed scanner to compliment the stations paper feed scanner.

d. Deliverables

i. Options for converting outdated and obscure file formats at the field station to modern digital formats were explored and recommendations made.

16. Organize all electronic data from biological monitoring conducted by the USFWS at French Frigate Shoals, including data gathered from this project, into a single location in meaningful units and modern formats. Provide a copy of these files on an external hard drive to USFWS personal, including Inventory and Monitoring staff.

a. The field stations digital resources were reviewed, compiled, and reorganized using modern electronic file organization practices; a copy of this organization was sent back to the Tern Island Field Station, and a copy was backed up at the USFWS Honolulu offices. Many files remain in a file format (paradox 9 corel) which we did not have a file convertor or program file for. Files that were in word pad format were generally left in that format as they can be opened in Microsoft Word.

b. Suggestions for improvement: The digital archive of biological monitoring data collected at the Tern Island Field Station (i.e. refuge folder) contains many old file formats created by software programs no longer used it is suggested that these files be converted to usable modern file formats. Another source of data disorganization and loss within the field stations digital archive comes from having multiple copies of the same file saved to numerous locations. We suggest that the field station follow the supplemental SOP provided by this project for future archiving of digital biological monitoring data at the Tern Island Field Station. Furthermore, it's unknown what digital files from the Tern Island Field Station the USFWS Honolulu offices have and/or what work has been done to these files, a bridge need be established between the field station and the Honolulu offices digital archives.

c. Deliverables

i. A reorganized digital archive of the field stations biological monitoring data.
ii. Address methods for yearly documentation of digital archiving in SOP supplement. *

17. Organize all digital literature and establish a digital reference library.

a. Organized and compiled the refuges digital literature resources to allow for easy importation of these files into a reference management tool (i.e. the free software Mendeley).

i. **Suggestions for improvement:** we recommend that the field stations reference library, as created for this project, be maintained and updated with current literature on a regular basis.

b. Deliverables

i. Compiled and organized digital literature.
ii. Address methods for use in SOP supplement. *
iii. Create a Mendeley Library for the field station. *

18. Compile temperature and nest box data from artificial nest box experiments, acoustics, and trail camera studies conducted in 2010-2012 at the field station into one electronic folder.

e. Data from artificial nest box experiments has been compiled; this data is still being analyzed, results will likely be published. This study is to be repeated at the field station during the 2012 – 2013 field season.*

f. Acoustics data collection was completed for the 2011 - 2012 field season at the Tern Island Field Station, compilation of this data and analysis is in progress. Additional acoustics data to be collected at the field station during the 2012 – 2013 field season. *

g. Trail camera studies were conducted during the 2011 – 2012 field season at the field station providing a large quantity of video footage (> 100 GB), this footage is currently being reviewed, compiled, and analyzed. *

NEW DIRECTIONS: RECOMMENDATIONS FOR ADDITIONAL IMPROVEMENT

STANDARDIZATION

Additional SOP's, databases, formats and forms need to be established for the Tern Island Field Station to build on those provided by this project. The creation of these files will increase data quality at the field station and improve the efficiency at which it is collected, decreasing stress to wildlife and staff and providing additional time for other projects at the field station. We recommend that the SOP's, databases, formats and forms created for the operation of the Tern Island Field Station also be used for other islands within the Hawaiian Islands National Wildlife Refuge. There needs to be standard practices in monitoring and data collection and management across the Hawaiian Islands National Wildlife Refuge, it is our hope that the Tern Island Field Station can be the example by which other field stations within the refuge can follow. It would be best to have a refuge biologist / biometrician to help implement these refuge wide standards and provide additional direction.