

Hawaii Biannual Waterbird Survey 2017 Protocol Update



Prepared for:
U.S. Fish and Wildlife Service, Inventory and Monitoring Program
and
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INTRODUCTION

Background

This protocol update for the Hawaii Biannual Waterbird Survey includes components required by the U.S. Fish and Wildlife Service (USFWS) for inventory and monitoring on National Wildlife Refuges and serves as an enhanced survey protocol (USFWS 2013). This update revises and expands on previous survey materials developed by USFWS and the State of Hawaii Division of Forestry and Wildlife (DOFAW) during 2005. It is intended to improve data collection and management by: 1) revising and clarifying survey instructions and datasheets; 2) using consistent names for survey sites; 3) updating survey site locations and route maps; and 4) outlining workflow steps for annual data management.

The history of the Hawaii Biannual Waterbird Survey is briefly summarized to provide a foundation of how and why the survey was established. While survey instructions have been periodically updated, the survey technique (area search and count) has remained consistent since the survey was established. However, the need for and uses of data from the Hawaii Biannual Waterbird Survey have expanded since the establishment and original goals of the survey.

History

Surveys of waterfowl and other waterbirds in the State of Hawaii date back to the 1940s when Christmas Bird Counts were initiated on Oahu and subsequently expanded to other islands. Following World War II, DOFAW (then Division of Fish and Game) conducted annual ground and aerial waterfowl surveys to assess distribution and wintering waterfowl populations (USFWS 1985). This wintering waterfowl study, which was expanded to include endemic waterbirds during 1955, became the foundation for the current survey (USFWS 1985).

The survey increased to two times per year (summer and winter) during 1970 following the listing of four species of endemic waterbirds as federally endangered during 1967-1970 under the Endangered Species Acts of 1966 and 1969. An assessment of wetland habitats was also completed during this time. Beginning in 1975, data were collected in a more consistent manner to allow year-to-date comparisons (USFWS 1985); however, see Camp et al. (2014) for limitations associated with area search and count techniques for analyzing population trends. During the mid-1980s, surveys were synchronized and further standardized to achieve the following goals:

1. Simultaneously survey (census) suitable habitat on the main Hawaiian Islands.
2. Track minimum population estimates of endemic and migratory waterbirds.

Specific sampling methods and objectives from 1975 to the mid-1980s have not been located. Aerial surveys of remote locations are no longer conducted as part of the survey due to funding limitations and/or denied access. The Hawaii Biannual Waterbird Survey includes many lowland wetlands, reservoirs, and other aquatic habitats on the main Hawaiian Islands. However, a complete census of all suitable habitat is not currently feasible.

DOFAW, with the assistance of Hawaii Biodiversity and Mapping Program (HBMP), developed a MS Access database and digitized survey locations as polygons in ArcGIS, where efforts were initiated to standardize survey site names. During 2005, the survey instructions and datasheet were updated and a photo identification guide for endemic and migratory waterbirds was developed by USFWS. Due to funding staff shortages, standardization of survey site names was not completed and data entry stopped during 2007. During 2015, USFWS provided funding for data entry, resolution of survey site names, and updating the polygon shapefile and route maps for 2007-2015 survey locations. In collaboration with DOFAW and contractors familiar with survey methods, USFWS updated the MS Access database originally developed by HBMP to facilitate data entry and resolution of survey site names. The Hawaii Biannual Waterbird Survey methods were evaluated by U.S. Geological Survey (USGS) during 2011-2013 (Camp et al. 2014; R. Camp, USGS, unpublished data).

Target Species

Target species include endemic waterbirds, koloa-mallard hybrids, feral/domestic mallards, and migratory shorebirds and waterfowl on the main Hawaiian Islands (Table 1). Other species are recorded as incidental observations; however, this survey is not designed to provide a population or distribution estimate for these species because the entire range of habitats used is not surveyed (e.g., upland habitats used by Hawaiian geese and cattle egrets, ditches used by black-crowned night herons, etc.).

Table 1. Target species of waterbirds for the Hawaii Biannual Waterbird Survey.

Scientific Name	Hawaiian Name ^a	Common Name
Endemic waterbirds (federally endangered)		
<i>Fulica alai</i>	‘Alea ke‘o ke‘o	Hawaiian coot
<i>Gallinula galeata sandvicensis</i>	‘Alae ‘ula	Hawaiian gallinule (previously moorhen)
<i>Himantopus mexicanus knudseni</i>	Ae‘o	Hawaiian stilt
<i>Anas wyvilliana</i>	Koloa maoli	Hawaiian duck
Migratory shorebirds^b		
<i>Pluvialis fulva</i>	Kolea	Pacific golden plover
<i>Arenaria interpres</i>	‘Akekeke	Ruddy turnstone
<i>Tringa incana</i>	‘Ulili	Wandering tattler
<i>Calidris alba</i>	Hunakai	Sanderling
<i>Numenius tahitiensis</i>	Kioea	Bristle-thighed curlew
Migratory waterfowl^b		
<i>Anas acuta</i>	Koloa mapu	Northern pintail
<i>Anas clypeata</i>	Koloa mōhā	Northern shoveler
<i>Anas platyrhynchos</i>		Mallard (migratory)
<i>Aythya affinis</i>		Lesser Scaup
Other		
<i>Anas wyvilliana</i> x <i>A. platyrhynchos</i>		Koloa-mallard hybrid
<i>Anas platyrhynchos</i>		Feral/domestic mallards

^a Hawaiian diacritical marks are used for accuracy of Hawaiian bird names; however, these diacritical marks are not included in bird names or Hawaiian place names in the database or the polygon shapefile.

^b Includes the most commonly observed species and/or species of conservation interest, but is not be a complete list of all species surveyed.

Objectives

Survey Objectives

Because of limitations associated with area search and count methods that do not account for detectability, survey objectives that indicate the magnitude of change desired for population indices, acceptable error, and/or power to detect changes of a specified magnitude for target species have not been established. Area search and count techniques provide “*only an index of species’ presence and relative abundance and [are] not robust compared to other census techniques widely used*” (Camp et al. 2014:1). Camp et a. (2014:1) further explain that:

“...population counts from area searches and direct counts do not account for imperfect detection of presence, with simple counts widely known to underestimate relative abundances by some unknown amount (Anderson 2001, USFWS 2011). Importantly, while changes in the occurrence and numbers of birds counted across years are assumed to be a close surrogate for true abundance, detection probabilities can change between years and sites making such trend analysis questionable (Anderson 2001; see also DesRochers et al. 2008).”

The Hawaii Biannual Waterbird Survey is intended to assess the distribution and minimum population of endemic and migratory waterbirds and using lowland wetlands during the wet season (January) and dry season (August). The survey data can also be used to describe waterbird communities (e.g., species diversity) and document general, broad-scale site conditions (e.g., water levels, vegetation cover). Overall survey goals include the following:

1. Determine the distribution and minimum population of endangered endemic waterbirds during the wet season and dry season at multiple geographic scales.
2. Determine the minimum wintering population, distribution, and species composition of migratory waterfowl and shorebirds.
3. Determine the distribution and minimum abundance of koloa-mallard hybrids.
4. Determine the distribution of feral/domestic mallards and identify expansion of range where they may pose an increased risk to koloa maoli.

Data collected incidental to survey objectives may contribute to the following:

- Re-sight efforts for banded birds.
- Assessments of conservation actions.
- Breeding locations for endemic waterbirds.
- Observations of uncommon or vagrant waterbird species.
- Documenting new species not previously observed in Hawaii.

Although survey data have also been used as an index to abundance and to estimate population trends over time, the search area and count technique is not the best approach to meet those objectives (see Camp et al. 2014). Information needed calculate detection probabilities and convert indices to direct population measurement of occupancy and abundance (Thompson et al. 1998, Anderson 2001) are not currently collected during the Hawaii Biannual Waterbird Survey (Camp et al. 2014).

Recovery Objectives

Recovery objectives are outlined in the Second Revision of the Recovery Plan for Hawaiian Waterbirds (USFWS 2011).

Site-specific Objectives

Detailed site-specific management objectives are developed by specific National Wildlife Refuges, state conservation areas, and other locations where habitat is managed for endangered waterbirds.

SAMPLING DESIGN

Sample Design

Counts of waterbirds are conducted at established locations, including a diversity of wetland, aquatic, and flooded habitats. See the Hawaii Biannual Waterbird Survey Instructions SOP for information on how to add and remove a location as a sampling unit. Surveys are designed to be a census of all individuals, but detectability varies by habitat and species, so survey data are considered minimum counts (Elzinga et al 2001).

Sampling Units, Sample Frame and Target Universe

The target universe is the entire biological population of each target waterbird species and guild (see Table 1). The sample frame includes a diversity of aquatic habitats, including reservoirs, ponds, aquaculture fields, lowland wetlands, and other periodically flooded habitats (e.g., lawns, ball fields) used by endemic and migratory waterbirds that are accessible to observers. Sampling units include all locations designated as *semi-annual* in the Access database and shown on survey route maps (revision date December 2017). Attributes that are measured and recorded at each sampling unit are described in the Hawaii Biannual Waterbird Survey Instructions and Datasheet SOPs.

Sample Selection and Size

All sampling units designated as *semi-annual* in the sample frame are counted as part of the survey. *Discontinued* sampling units are not surveyed.

Survey Timing and Schedule:

Surveys are conducted the third Wednesday in January and August every year. If a survey cannot be completed on the regularly scheduled day, it should be completed the following day. Counts begin ½ hour before sunrise and should be completed before noon.

Sources of Error

Sources of error include sampling errors and non-sampling errors. Sampling error occur when the data collected do not reflect the true population and non-sampling errors result from human mistakes (Elzinga et al. 2001). Sampling errors include the following:

- Decreased sample size due to inaccessible survey locations.
- Varying detectability among species.
- Varying detectability among habitats.

Non-sampling errors include the following:

- Inconsistent field sampling effort among observers.
- Transcription and recording errors.
- Incorrect or inconsistent species identification.

FIELD METHODS AND SAMPLE PROCESSING

Pre-survey Logistics and Preparation

Prior to the survey, DOFAW Island Biologists send the following information to all primary observers (also referred to as lead counters) on each island:

- Maps with survey site locations;
- Survey instructions;
- Datasheet; and
- Leg band and neck collar information sheets.

Primary observers (lead counters) then coordinate logistics with their survey team (e.g., meeting location, start time) and review survey methods prior to the start of the survey.

Establishing Sampling Units

Sampling units are delineated in ArcMap in a polygon shapefile. Sampling units are permanent, but may be removed from the survey (*discontinued*) if conditions or access at a location change. New sampling units may also be added. See the Hawaii Biannual Waterbird Survey Instructions SOP for information on how to add and remove sampling units.

Data Collection Procedures

A count of all waterbirds observed and heard is conducted at each sampling unit (e.g., survey site location) for a minimum of 10 minutes or until all species are counted and recorded. See the Hawaii Waterbird Survey Instructions and Datasheet SOPs for more detailed information.

Processing of Collected Materials

No materials are collected as part of this survey protocol. If dead or injured birds are observed during the survey, follow reporting requirements pursuant to USFWS or DOFAW policy. Non-agency personnel should complete the Downed Wildlife Form and submit it to the DOFAW Island Biologist.

End-of-survey Procedures

Original datasheets are submitted to the designated DOFAW Island Biologist within one week of the survey. **Primary observers must scan or copy their datasheets and retain that copy.** DOFAW Island Biologists compile and review all datasheets to ensure that all locations were surveyed and that all required data fields are complete. DOFAW Island Biologists submit scanned electronic copies and a checklist of surveyed sites to the DOFAW Waterbird Coordinator by February 1st (winter survey) and September 1st (summer survey). In addition, **DOFAW Island Biologists must keep copies of all datasheets** at their respective office locations. See Data Management and Operational Requirements sections for additional information.

DATA MANAGEMENT AND ANALYSIS

Data Entry, Verification, and Editing

Scanned copies of the original datasheets are compiled for each island and survey period in Adobe Acrobat using a standardized file name convention. Data files for 2007-2015 were named with the following: YearSeason_Island_WaterbirdSurvey.pdf. This format should be continued for future surveys.

Data are entered by the DOFAW Waterbird Coordinator or a designated individual in the master Access database. To facilitate data entry, the document *Hints for Entering Survey Data into the Access Database* was prepared in collaboration with USFWS and DOFAW. In addition, a draft *Hawaii Waterbird Database User Manual* was developed by USFWS during 2015 that contains screen shots of data entry forms. Both documents are included as supplemental materials for the enhanced survey protocol.

At a minimum, data entry occurs annually. If staff time and resources permit, data entry occurs two times a year following each survey. Data entry includes attributes for the survey (e.g., time, weather, etc.), habitat conditions, species, and incidental comments, including leg bands and/or neck collars. See Hawaii Biannual Waterbird Survey Instructions and Datasheet SOPs for information on attributes collected during the survey.

Data for survey site names not already found in the Access database as a survey site name or synonym should be entered as a subwetland under the “unknown wetland” for that island (e.g., wetland name = ‘Unknown : Kauai’) as follows:

- Choose the wetland ‘Unknown : [Island]’, then add a subwetland with the survey site name and synonym name exactly as written on the datasheet.
- Enter all survey and taxa attributes.
- Follow-up with the island biologist and/or primary observer to determine if the unknown site name is a new survey site or a synonym for an existing survey site.
- Once the name discrepancy is resolved use the *update query* to update the survey and taxa records to the appropriate wetland and subwetland.

Polygons for new survey sites should be located with at least one GPS point taken during a site visit and then digitized in ArcMap with recent imagery at scale range between 1:500 and 1:1,000. Survey site locations updated during 2017 were digitized on imagery taken from between 2009 and 2015. Image dates for each location varied based on image resolution, cloud cover, and shadows. When survey sites are discontinued, change the *SurveyFreq* in the Access database and ArcGIS polygon shapefile to *discontinued*.

QA/QC for data entry includes the following:

- Check that the number of surveys entered in Access equals the number of surveys on the datasheets for each survey period*island combination.
- Provide a list of biannual survey sites (designated as ‘semi-annual’ in the Access database) with missing data to the island biologists to see if these data can be located.
- Check that records in tbl_WetlandObs and tbl_WetlandObsTaxaCount have the same wetland and subwetland name. Once QA/QC of historical data (pre-2007) is completed, the database structure can be updated to prevent mismatches between the two access tables. After which, this QA/QC check will not be necessary.
- QA/QC MS Access records for each survey. Ideally this is completed by someone who did not enter the data. If this must be completed by the same person, complete this QA/QC at least 4 weeks after data are entered to look at it with fresh eyes.
- Check that names for new survey sites in the Access database and ArcGIS polygon shapefile are the same.

Metadata

Metadata will be developed by USFWS and/or DOFAW.

Data Security and Archiving

Original datasheets are filed at the DOFAW Island Offices. Scanned electronic copies of all datasheets are archived at the DOFAW Administrative Office in Honolulu, Hawaii. The master MS Access database and polygon shapefile are archived at the DOFAW Administrative Office. Editing of electronic data is restricted to the DOFAW Waterbird Coordinator, USFWS I&M Database Manager, and designated technician/contractor.

Data and survey route maps are not available to the public due to privacy concerns associated with accessing and surveying habitats on private lands. Data, including reports and export summaries, are available to researchers, biologists, land managers, and landowners upon request.

Analysis Methods & Software

Observations of target waterbird species are often summarized for each species and for species guilds by season and year to obtain a minimum population estimate for target species. Minimum population estimates have been used as indices of abundance to assess trends in species and species groups at various geographic and temporal scales. However, see Camp et al. (2014) for limitations associated with area search and count techniques for analyzing population trends.

DOFAW, USFWS, and other agencies/researchers have conducted a variety of data analyses, primarily using observations of endemic waterbirds from the Hawaii Biannual Waterbird Survey. Data analysis methods vary depending on research questions and management objectives. See published journal articles (e.g., Engilis and Pratt 1993, Reed et al. 2011, Underwood et al. 2013), agency documents (e.g., USFWS 2011) and unpublished reports (e.g., Uyehara et al. 2008) for detailed methods used to analyze data from the Hawaii Biannual Waterbird Survey.

Some commonly used summaries are available as reports and charts from the Access database. However, these reports need to be reviewed and updated as needed following modifications to the Access database structure during 2015.

REPORTING

DOFAW and USFWS complete reporting requirements pursuant to their respective agencies.

PERSONNEL REQUIREMENTS AND TRAINING

Roles and Responsibilities

The DOFAW Waterbird Coordinator oversees all project components including compiling and archiving electronic datasheets; entering data; and maintaining and updating MS Access, ArcGIS, and Adobe Acrobat files.

The DOFAW Island Biologists are responsible for distributing materials to all primary observers, collecting and compiling all datasheets following each survey, and sending scanned copies of all datasheets from their island(s) to the DOFAW Waterbird Coordinator.

The USFWS Inventory and Monitoring Data Manager works in collaboration with DOFAW to maintain and update the database structure in MS Access.

Primary observers are responsible for collecting data at their designated sampling units, sending their original datasheets to DOFAW Island Biologists, and keeping a copy of the datasheets for their records.

Qualifications

All primary observers (lead counters) need to be familiar with the sample units along their survey route(s), data collection procedures, and accurate identification of waterbirds. Agency staff or contractors entering data need to have attention to detail and a basic knowledge of Access and ArcGIS software.

Training

Volunteers and other observers learn the sampling units, survey route, and data collection procedures while assisting the primary observer with surveys. Trainings are periodically held in conjunction with the Hawaii Waterbird and Wetlands Workshop (HWWW) or by DOFAW

Island Biologists, as needed. The HWWW was originally initiated by the Hawaii Chapter of the Wildlife Society, then organized in partnership with Pacific Birds Habitat Joint Venture (PBHJV). PBHJV took over fiscal and organizational responsibility for the workshop during 2013. Training related to the Hawaii Biannual Waterbird Survey at the January 2016 workshop included the following:

- Overview of common errors observed on datasheets from 2007-2015.
- Review of survey methods and consistent use of site names.
- Review of end of survey procedures to ensure timely and complete records of all data.
- Panel discussion to solicit information to revise and improve waterbird survey datasheet and instructions.

The Hawaii Biannual Waterbird Survey Instructions, Datasheet, and Photographic Identification Guide are available on-line (<http://dlnr.hawaii.gov/dofaw>) and from the DOFAW Waterbird Coordinator and Island Biologists.

OPERATIONAL REQUIREMENTS

Budget

Equipment, vehicles, and fuel to conduct the surveys are provided by agency staff and volunteers. Annual data entry and updates to the database and GIS are necessary to reduce long-term costs and staff resources required to ensure data completeness and accuracy. Staff time required to complete pre- and post-survey tasks are listed below on an annual basis. If staff time is limited, the estimated annual cost to hire a technician or contractor to enter data and update sampling unit locations is estimated between \$2,000 and \$5,000 per year, depending on the quality of data collected and the number of spatial updates needed.

Staff Time

Surveys are conducted by personnel from state and federal agencies, non-governmental organizations, and volunteers. Time required for each person is estimated between 8 and 32 hours/year, depending on the number and size of sample units each person surveys. Time required for other survey activities is as follows:

- Pre- and post-survey logistics (DOFAW Island Biologists): 8-16 hours/year
- Pre- and post-survey logistics (DOFAW Waterbird Coordinator): 16-32 hours/year
- Data entry and QA/QC: 60 hours/year
- Database updates (USFWS I&M Database Manager): 24 hours/year
- Sampling unit updates: 16 hours/year
- Waterbird Survey Core-team Meeting: 4 hours/year

Establishment of the Waterbird Survey Core-team will increase continuity and ensure survey tasks are completed if the DOFAW Waterbird Coordinator position is vacant. The Waterbird Survey Core-team of 10-12 members (maximum) includes the DOFAW Waterbird Coordinator, DOFAW Island Biologists, and one representative each from USFWS Inventory and Monitoring Program, USFWS National Wildlife Refuges, USFWS Ecological Services, and Pacific Birds Habitat Joint Venture.

Schedule

The schedule for completing surveys and entering data is outlined in Table 2.

Table 2. Annual schedule for the Hawaii Biannual Waterbird Survey.

Date	Activity
January 1	DOFAW sends survey information to primary observers
January (third Wednesday)	Winter survey
January (fourth Wednesday)	Datasheets due to DOFAW Island Biologists
February 1	Datasheets due to DOFAW Waterbird Coordinator
August 1	DOFAW sends survey information to primary observers
August (third Wednesday)	Summer survey
August (fourth Wednesday)	Datasheets due to DOFAW Island Biologists
September 1	Datasheets due to DOFAW Waterbird Coordinator
September (third Wednesday)	Waterbird Survey Core Team Meeting
October-November	Data entry; database and GIS updates

Coordination

This survey is coordinated by DOFAW Waterbird Coordinator, located in the DOFAW Administrative Office, Honolulu, Hawaii.

List of Standard Operating Procedures and Supplemental Materials

- Hawaii Biannual Waterbird Survey Instructions
- Hawaii Biannual Waterbird Survey Datasheet
- Hawaii State Waterbird Count Photographic Identification Guide
- Neck Collar and Leg Band Information
- Downed Wildlife Form (for reporting observations of dead or injured birds to DOFAW)
- Maps of survey locations at National Wildlife Refuges
- Draft Hawaii Waterbird Database User Manual (note: this draft version is not ready for distribution)
- Hints for Entering Survey Data into Access Database

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