Caribbean Waterbird Census Manual

Promoting Conservation of Waterbirds and Wetlands Through Monitoring

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With funding and support from:
Western Hemisphere Migratory Species Initiative / Organisation of American States
US Fish and Wildlife Service, Division of International Conservation
US Fish and Wildlife Service, Neotropical Migratory Bird Conservation Act Fund
US Forest Service, Department of Agriculture, International Programs
Environment Canada, Canadian Wildlife Service
United Nations Environment Program, Specially Protected Areas and Wildlife-Regional Activity Center
Royal Society for the Protection of Birds
Cornell Laboratory of Ornithology
Optics for the Tropics

Version 2.0
DATE: 1 April 2019

Published by the BirdsCaribbean, 841 Worcester St. #130, Natick, MA 01760, USA. www.BirdsCaribbean.org email: Lisa.Sorenson@BirdsCaribbean.org, asutton@cwjamaica.com

Recommended citation: Sorenson, L. G., A. Haynes-Sutton, F. Rivera-Milan, and J. Gerbracht. 2019. Caribbean Waterbird Census Manual: Promoting Conservation of Waterbirds and Wetlands through Monitoring. BirdsCaribbean, Natick, MA. Xx pp.

"Like the resource it seeks to protect, wildlife conservation must be dynamic, changing as conditions change, seeking always to become more effective."

- Rachel Carson

Acknowledgements

This manual is the result of extraordinary support and commitment from many people and organizations. We gratefully acknowledge our funders and supporters – the Western Hemisphere Migratory Species Initiative, Organization of American States, US Fish and Wildlife Service, Environment Canada, US Forest Service, United Nations Environment Program, Specially Protected Areas and Wildlife-Regional Activity Center, Royal Society for the Protection on Birds, Cornell Laboratory of Ornithology, Optics for the Tropics, Negril Area Environmental Protection Trust, Bahamas National Trust, Ramsar Convention, Wetlands International, Waterbirds Conservation Council for the Americas, National Environment and Planning Agency, Caribbean Coastal Area Management Trust, Jack Sprat Restaurant, Irie Safari Boat Tours and WildlifeCounts.com.

We are grateful to many persons who contributed their time, resources and enthusiasm to make this project a success including John Alexander, Daniel Blanco, Franci Cuthbert, Lynn Gape, Maxine Hamilton, D. Brandon Hay, Floyd Hayes, Richard Huber, Ken Kriese, Jim Kushlan, Steve Latta, Arne Lesterhuis, Carol Lively, Taej Mundkur, Ingrid Parchment, Alessandra Vanzella-Khouri, David Wege, Geoff Welch, Jennifer Wheeler, Chris Wood, and many others. We also thank Caribbean Waterbird Census (CWC) workshop participants for asking tough questions and steadfastly supporting our efforts.

Abbreviations used in the text

CWC	Caribbean Waterbird Census
ISS	International Shorebird Survey
IUCN	International Union for Conservation of Nature
IBA	Important Bird Area
GPS	Global Positioning System
IWC	International Waterbird Census
NGO	Non-governmental Organization
NWC	Neotropical Waterbird Census
OAS	Organization of American States
SPAW-RAC	Specially Protected Areas and Wildlife-Regional Activity Center
UNEP	United Nations Environment Program
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
WHMSI	Western Hemisphere Migratory Species Initiative
WI	Wetlands International

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Introduction

In 2004, the Caribbean Waterbird Plan[1] identified major gaps in information about the status and distribution of wetland species, the lack of management or conservation programs for threatened species and wetlands of international importance, the general need to increase capacity to implement monitoring and conservation programs, and the urgent need to promote environmental awareness of the importance of wetlands in countries of the region, especially in light of the increasing vulnerability of coastal mangrove and wetland habitats from climate change impacts (e.g., sea level rise, increased storms and droughts) and the destruction of these critical habitats for development.

The Caribbean is also under-represented in regional initiatives including the Ramsar Convention, Specially Protected Areas and Wildlife (SPAW) Protocol of the Cartagena Convention, Western Hemisphere Shorebird Reserve (WHSRN) and the Western Hemisphere Migratory Species Initiative (WHMSI). These issues have been further highlighted in the completion of national waterbird reports[2] and analysis of Important Bird Areas (IBAs) in the Caribbean[3]. BirdsCaribbean's current project, *Promoting Wetland Bird Conservation Through the Caribbean Waterbird Census (CWC)* (funded by the Neotropical Migratory Bird Conservation Act and USFS), aims to address some of these gaps and needs through capacity building training workshops and development of the Caribbean Waterbird Census (CWC) manual and protocols.

The purpose of this manual is to provide specific instructions to people in Caribbean countries who expect to be involved in the implementation of the CWC. It provides:

- An outline of the CWC and how BirdsCaribbean expects it to develop
- Guidelines for designing and implementing the CWC in a country or at a site or group of sites
- CWC standard protocols for monitoring waterbirds and wetlands

The CWC offers a hierarchical and flexible approach to monitoring (employing levels of monitoring) that enables the user to choose the protocol and extent of participation in the program that is best suited to their objectives, available resources and capacity. The basic CWC protocols (Level 2 – area search and point count) include measures of detection probability, which are essential for accounting for bias in monitoring. Through this program, the Caribbean region will join Wetland International's global program of wetland bird monitoring, with data from the Caribbean filling a major gap in the coverage of the International/Neotropical Waterbird Census. It can be used to promote site conservation, assess impacts of climate change and other threats on waterbirds and wetlands, and design programs to protect, manage and restore wetlands.

This first version (1.0) of the CWC Manual is intended as a pilot version to be field tested in 2011. Based on feedback and further review, revisions and updates will be made to future editions of the manual. Note that this manual is not intended to be a comprehensive guide to designing and implementing monitoring programs. Many topics have been covered in other manuals, such as "Expedition Field Techniques – Bird Surveys" (Bibby . *et al.* 1998) and "The Northeast Bird Monitoring Handbook" (Lambert *et al.* 2009).

We hope that many people will participate in the CWC, from interested volunteers and birders to natural resource professionals working in government and non-government agencies and organizations. All of the data collected will be of immense value in helping to raise awareness about the importance of wetlands, better understand the distribution and abundance of waterbirds in the Caribbean in relation to habitat conditions and threats, and improve the effectiveness of management and conservation actions. We look forward to working with you on this exciting program.

[1] BirdsCaribbean. 2004. Draft Caribbean Waterbirds Plan 2003-8. BirdsCaribbean report, available on www.BirdsCaribbean.org.
[2] http://www.birdlife.org/action/science/species/waterbirds/downloads.html
[3] BirdLife International. 2008. Important Bird Areas in the Caribbean: Key sites for conservation. Cambridge, UK: BirdLife International. (BirdLife Conservation Series No. 15).

Background

What are waterbirds?

Families of birds that occur in the West Indies and are ecologically dependent on wetlands include Podicipedidae (Grebes), Pelecanidae (Pelicans), Phalacrocoracidae (Cormorants), Anhingidae (Darters), Ardeidae (Herons), Threskiornithidae (Ibises and Spoonbills), Phoenicopteridae (Flamingos), Anatidae (Ducks, Geese and Swans), Gruidae (Cranes), Aramidae (Limpkin), Rallidae (Rails, Gallinules and Coots), Jacanidae (Jacanas), Haematopodidae (Oystercatchers), Pandionidae (Ospreys), Recurvirostridae (Stilts and Avocets), Burhinidae (Thick-knees), Charadriidae (Plovers), Scolopacidae (Sandpipers, Snipes and Phalaropes), Laridae (Gulls), Sternidae (Terns) and Rynchopidae (Skimmers).

Figure 1: Great Blue Heron

Why is it important to monitor waterbirds in the Caribbean?

Birds are generally recognized to be indicators of the productivity and quality of wetlands. This is why the Ramsar Convention on Wetlands and BirdLife International both recognize that sites that regularly host 1% or more of a waterbird population qualify as a Wetland of International Importance and Important Bird Areas (IBAs). Information about the estimated global populations of waterbirds throughout the world has been developed by Wetlands International in their publication "Waterbird Population Estimates: Fourth Edition" available from www.global.wetlands.org.

Wetlands in the Caribbean and their bird populations are very little known. The BirdsCaribbean has been working for many years to promote conservation of wetlands and waterbirds, through several of its working groups including West Indian Whistling-Duck and Wetlands, Waterbirds, and Seabirds Working Groups. It has also produced a draft Caribbean Waterbirds Plan and assisted BirdLife International and Waterbird Conservation for the Americas in their production of national waterbird reports[4]. Increasing the awareness of wetlands and their conservation is an important objective of the BirdsCaribbean (see Appendix 1).

Threatened and endangered waterbird species in the insular Caribbean

Caribbean wetlands provide essential stop-over and wintering habitat for more than 126 aquatic and terrestrial neotropical migrant species. Twenty-six (17%) of these are included in the USFWS list of Birds of Conservation Concern[5] including wetland species such as Brown Pelican, Reddish Egret, Solitary Sandpiper, Lesser Yellowlegs, Whimbrel, Red Knot, American Oystercatcher, Short-billed Dowitcher and Least Tern, and terrestrial species such as the White-crowned Pigeon, Yellow-billed Cuckoo, Prairie Warbler and Prothonotary Warbler. They also provide breeding habitat for many resident species including several globally threatened birds such as the West Indian Whistling-Duck which has been the flagship species for BirdsCaribbean's wetland conservation efforts[6]

At least eight species of waterbirds that occur in the insular Caribbean are listed on the IUCN Redlist. This includes four Caribbean endemic species (West Indian Whistling-Duck *Dendrocygna arborea,* Zapata Rail *Cyanolimnas cerverai,* Caribbean Coot *Fulica caribea*, White-crowned Pigeon *Patagioenas leucocephala)*, one resident (Black Rail *Laterallus jamaicensis*) and three migrants (Piping Plover *Charadrius melodus*, Eurasian Curlew *Numenius arquarta* and Buff-breasted Sandpiper *Tyngites subruficollis*).

[4] Conservation Asessment of Waterbirds in the Ameritas, country reports available for download at: http://www.birdlife.org/action/science/species/waterbirds/downloads.html

[5] Birds of Conservation Concern 2008, USFWS, Division of Migratory Bird Management is available for download at: http://www.fws.gov/migratorybirds/

[6] Eco-Index Project Profile - West Indian Whistling-Duck and Wetlands Conservation Project: http://www.eco-index.org/search/results.cfm?projectID=979

The International Waterbird Census

The first International Waterbird Census (IWC) was established in Europe and parts of Asia. The program was very successful and today the IWC is"*by far the longest running and most globally extensive biodiversity monitoring program in the world.*" Delaney 2005. "*The census takes place every year in over 100 countries with the involvement of around 15,000 counters, most of whom are volunteers. More than half the effort is concentrated in Europe, but involvement in other parts of the world has increased markedly since 1990. Between 30 million and 40 million waterbirds are counted each year around the world, and details of the counts and the sites where they take place are held on the newly upgraded, state-of-the-art IWC database.*"Delaney 2005. Currently, the IWC is coordinated by Wetlands International from its headquarters in Wageningen, The Netherlands. Until 2009 there were four regional programs (Africa, Asia including Oceania, and the Neotropics including South America and Trinidad and Tobago (Figure 1). There were two major gaps – North America and the Caribbean.

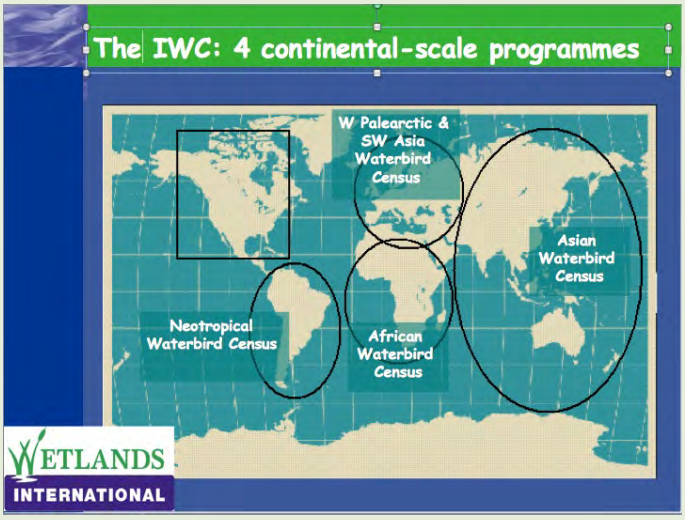


Figure 2: Distribution of International Waterbird Census area

The IWC has proved to be a very important tool for wetlands conservation worldwide. Since 1967, 1,369 Wetlands of International Importance have been designated in 138 countries under the Ramsar Convention using the results of the IWC. It has also contributed to the conservation of sites, e.g., through designation of Important Bird Areas by BirdLife International and to the identification of threatened species in IUCN's Red Data Book and though various Waterbird Species Action Plans. Involvement in the IWC has also helped to raise awareness of the importance of wetlands and their birds at many sites across the world.

Ramsar Convention

The Ramsar Convention employs the results of the IWC to designate Wetlands of International Importance. The Ramsar Convention establishes several criteria for the designation of sites including the 1% criterion, which states that any site which regularly holds 1% or more of a population of waterbirds qualifies as a Wetland of International Importance. Another criterion states that a wetland is Internationally Important if it regularly holds 20,000 or more waterbirds. These criteria depend on the results of regular, high quality counting. Based largely on the results of the IWC, publishes Waterbird Population Estimates at regular intervals. The latest version and other key publications on the world's waterbirds are available for download on the Wetlands International website[7].

Figure 3: Parottee Pond- a good place to practice

[7] http://www.wetlands.org/WatchRead/Keypublications/tabid/1860/Default.aspx

The Neotropical Waterbird Census (NWC)

The Neotropical Waterbird Census (NWC) began in Argentina, Chile, and Uruguay in 1991, followed by Colombia and Peru in 1992, and Bolivia and Ecuador in 1995. Since 2006, Venezuela, Suriname, Guyana, French Guyana and Trinidad & Tobago have also joined. Surveys are carried out in February and July. On average 500 sites are monitored and 450 volunteers participate. It is coordinated through WI's South American office in Quito, Ecuador.

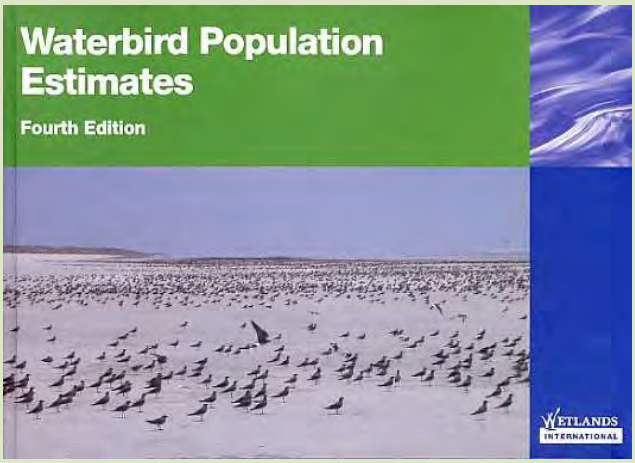


Figure 4: Waterbird Population Estimates

Origins of the Caribbean Waterbird Census

In February 2009, the BirdsCaribbean's Monitoring Working Group held a workshop entitled "Bird Monitoring in the Caribbean – Why, What, Where, When and How" in Nassau, Bahamas. The workshop was funded by the Western Hemisphere Migratory Species Initiative/Organization of American States, USFWS, USFS, RSPB and many others. It involved twenty-six participants from eighteen West Indian islands and two Caribbean rim countries and eight international presenters, including a representative from WI. As a result of discussions held at this workshop BirdsCaribbean decided to establish the Caribbean Waterbird Census (CWC) to complement the NWC. In consultation with monitoring experts and our local partners, we have designed our methods to suit the needs and goals of local partners. We employ a hierarchical approach that enables partners to choose the method that is best suited to their questions, resources and capacity. The results of the CWC can be nested into the NWC but its approach goes beyond that of the NWC.

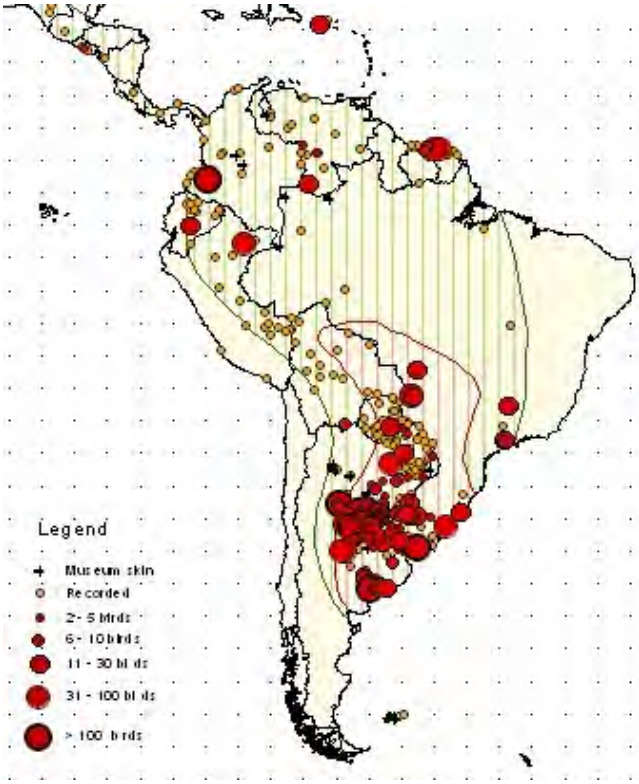


Figure 5: Location of survey points for the Neotropical Waterbird Census

A second workshop, focused specifically on the CWC, also funded by the WHMSI/OAS was held in Negril, Jamaica in February 2010. This workshop provided an opportunity to further develop the CWC by training potential national and site coordinators and discussing with them how the program will develop throughout the region. At the Waterbird Council for the Americas meeting in Panama (January 2010) a decision was taken to support the CWC and to help BirdsCaribbean to develop it as a model for Central and South America. Later in 2010, BirdsCaribbean received grants from the Neotropical Migratory Bird Act Program (USFWS), USFS and SPAW-RAC to provide small grants for persons on Caribbean islands to implement the CWC in pilot programs.

The Caribbean Waterbird Census (CWC)

What is the CWC?

The CWC is a region-wide waterbird and wetland monitoring program of the BirdsCaribbean. It is an informal regional partnership, based on a shared goal and a common objective to promote the conservation and management of resident and migratory waterbirds and their wetland habitats through monitoring.

Goal of the CWC

The overall goal of the CWC is to increase support for waterbird and wetland conservation in the insular Caribbean by promoting monitoring as means to improve science-based conservation planning and adaptive management of birds.

Objectives of the CWC

- The objectives of the CWC are to:
- Promote inventories, surveys and censuses of waterbirds and their habitats in all Caribbean countries
- Encourage broad-based participation in waterbird counts including NGOs, governmental agencies, institutions, communities and volunteers
- Ensure that as many internationally and nationally important sites as possible are conserved and monitored
- Increase awareness of conservation issues related to wetlands and waterbirds and what can be done to address these issues

Structure of the CWC

At the beginning the CWC will function as an informal partnership of Caribbean organizations that plan to monitor waterbirds at least once per year using methods based on an agreed standard methodology. It is envisaged that eventually there will be a regional coordinator and that each territory will implement its own national CWC program, with a national coordinator coordinating the national efforts and site coordinators implementing the surveys on the ground. BirdsCaribbean is seeking funding to support this proposal and has already obtained funding to support pilot projects in selected islands including Anguilla, Antigua, Bahamas, British Virgin Islands, Cuba, Dominica, Dominican Republic, Jamaica, St Lucia, St. Vincent and the Grenadines, and Turks and Caicos Islands.

Participation in CWC

The CWC is designed so that at the basic level it can be implemented by volunteers who can contribute to monitoring, and thus become more aware of the importance of wetlands and more committed to conservation. This basic level can be expanded to provide increasingly rigorous assessments of populations at sites and regionally. The BirdsCaribbean envisages its partners across the region working together to implement surveys across the Caribbean, using shared methods and coordinated dates. In this way, sites will eventually collaborate to build a picture of the status, distribution, and abundance of waterbirds and their conservation needs across the region.

If local agencies/NGOs are not currently doing any waterbird monitoring, we hope that this program will help them to get started. If some kind of monitoring is already underway, we invite you to join the CWC. We hope that this manual will help you to improve or expand your monitoring (e.g., by adding a measure of detection probability or monitoring multiple sites). It may be possible to make small changes in/adapt your protocol so that it is compatible with CWC methodology. Use of rigorous but flexible CWC standard protocols that account for bias and can be analyzed statistically will provide the best results for local monitoring efforts. It will also allow scaling up analysis and modeling of the data to facilitate national and regional assessments of waterbird numbers and trends.

Figure 6: Spring Pond in Jamaica

Support and funding for CWC

The CWC will be supported by an informal coalition of government agencies, protected areas, NGOs and private individuals who want to work together to monitor waterbirds, or simply to use the methods being developed by BirdsCaribbean. BirdsCaribbean's partners in designing, funding and implementing the CWC include US Fish and Wildlife Service, US Forest Service, SPAW-RAC, Cornell Laboratory of Ornithology, Royal Society for the Preservation of Birds, Wetlands International, BirdLife International, The Nature Conservancy (TNC), the Waterbird Council of the Americas, the Bahamas National Trust, Caribbean Coastal Areas Management Foundation, and many other local organizations and government agencies.

CWC Protocols

The CWC will consist of a set of standard protocols that can be used to answer questions related to conservation of waterbirds and their habitats. It will include a choice of recommended protocols for:

- Monitoring waterbirds. These will be offered with four levels of complexity, from very basic to advanced.
- Monitoring wetland habitats. The protocols and data sheets will include monitoring of factors that can influence abundance of birds at a site (also called site-specific covariates, e.g., water level, salinity, vegetation cover, threats, etc.).

The CWC protocols fit into a comprehensive framework for designing and implementing a bird monitoring program in the Caribbean developed by BirdsCaribbean as part of the Caribbean Birdwatch program (Figure 5). The Caribbean Birdwatch Manual, which will include practical advice on all aspects of monitoring and detailed protocols for all major groups of birds

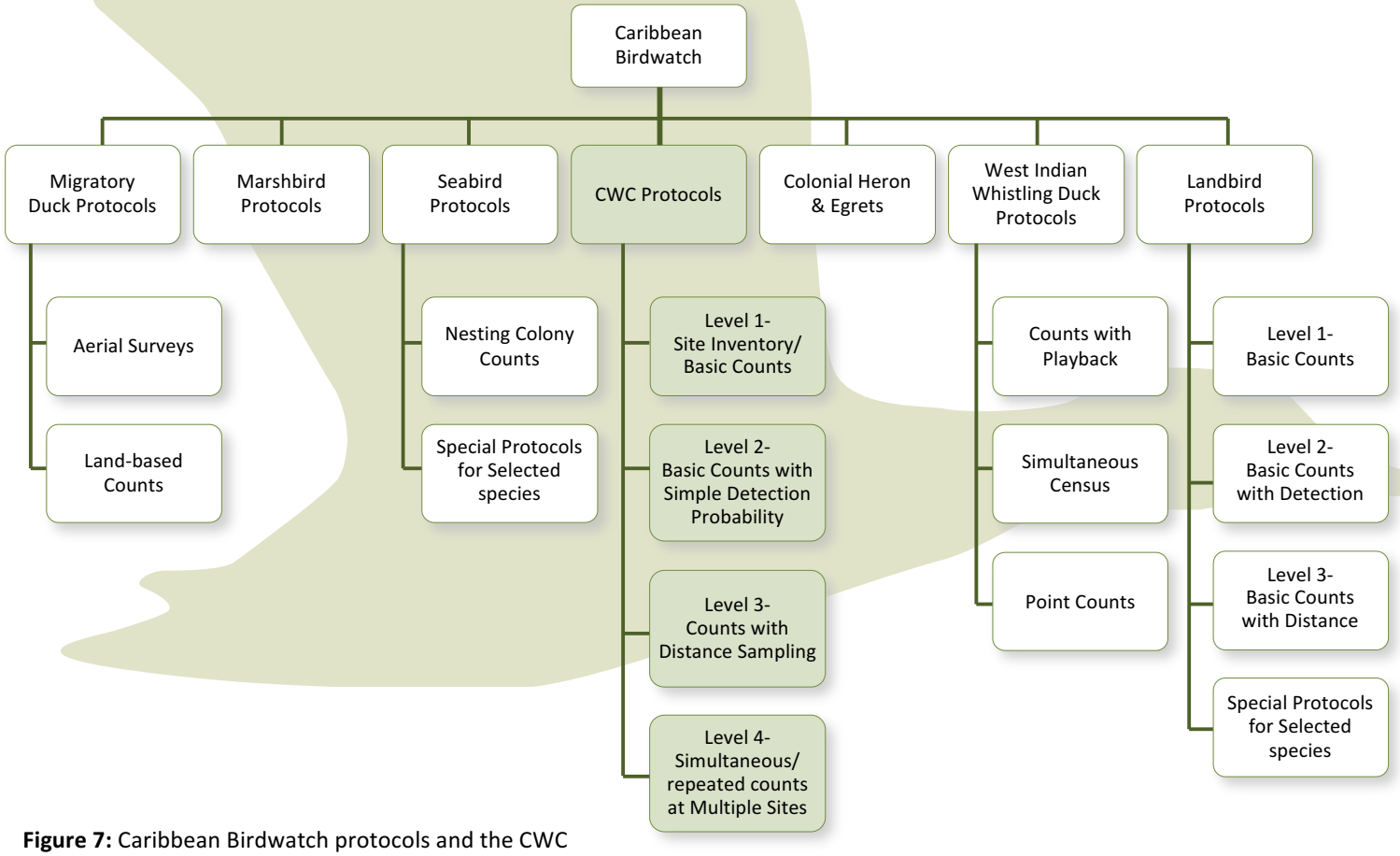


Figure 7: Caribbean Birdwatch protocols and the CWC

CWC timing and number of counts annually

Participants may conduct counts at any time of the year. The number and timing of surveys conducted in a year depends on local monitoring objectives, available resources, and the timing of migration and breeding on each island. Generally, for all-bird surveys BirdsCaribbean recommends 4 counts covering the main seasons. Participants in the CWC will be expected to implement at least one count annually in January. Recommended dates for CWC counts include:

- Winter (over-wintering and residents) – December-February**.** If possible include the **last three weeks of January** (one regional count conducted annually by as many participating sites as possible)[8]. **This is the main CWC count and it is hoped that as many sites as possible will support it.**
- **Spring -** migration and peak breeding for some Caribbean species (March-May)
- **Summer** - breeding and post-breeding for residents and summer migrants (June-August)
- **Fall migration** (September-November),
- **Other times of year.** Depending on the question(s) being addressed and the resources available, the CWC methodology can be used for counts at any other times of year (e.g., conducting monthly or weekly counts).

Species covered by the CWC

The CWC focuses on the commoner waterbird species – those that are active during the day, in open water or on the shore in wetlands and nearshore habitats. Monitors will also be encouraged to collect data on any landbirds that they detect during the counts. Separate protocols to be provided in BirdsCaribbean's Caribbean Birdwatch manual (which is still in draft form) will include cryptic, secretive, nocturnal and colonially nesting waterbirds. These protocols should be used to supplement the CWC where necessary.

Figure 9: Short-billed Dowitcher

Figure 8: Spotting birds at a distance

[8] CWC survey dates in 2011 are January 14th to February 3rd inclusive.

Area covered by the CWC

The CWC will be implemented throughout the insular Caribbean plus Bermuda including Trinidad and Tobago (although it is already part of the NWC).

Figure 10: Area covered by CWC

How is the CWC expected to develop?

The CWC has a proposed hierarchical structure, linking the regional program to BirdsCaribbean with three levels of coordinators. BirdsCaribbean has found some funding for basic monitoring expenses and training workshops to establish monitoring programs in a few pilot sites in 2010-11, but longer-term funding is still being sought. It is hoped that many countries will be able to find creative ways to support their CWC programs, by institutionalizing monitoring in their organization or agency (if it is not already in their work plan), by finding new sources of funding, or by involving volunteers.

Caribbean Regional Coordinator: The BirdsCaribbean is planning to identify funding to support a Regional Coordinator for the CWC. This person will be responsible for promoting and coordinating the regional CWC effort, supporting national coordinators and reporting to WI on progress. Ideally this should be a person with good leadership, fundraising, and coordination skills, and knowledge of waterbirds, survey techniques, and data management.

National Coordinators: National Coordinators will be responsible for selecting and supporting sites and site coordinators and will provide training for site coordinators and survey teams. They will also be responsible for collating data and preparing national reports once this framework has been established. Ideally the National Coordinator should be a person of national standing, an employee of the government or an NGO, with knowledge of waterbirds, survey techniques and data management. In addition, National Coordinators should have good networking skills and the ability to motivate volunteers to participate in the survey and complete the reports.

Site Coordinators: Site Coordinators will be responsible for carrying out surveys at selected sites. They may work independently or with a team of paid staff or volunteers, depending on the size of the site and the resources available. Site coordinators will be people who have commitments to the sites they are surveying. They may be government employees, protected area staff or volunteers who are committed to the conservation of particular sites.

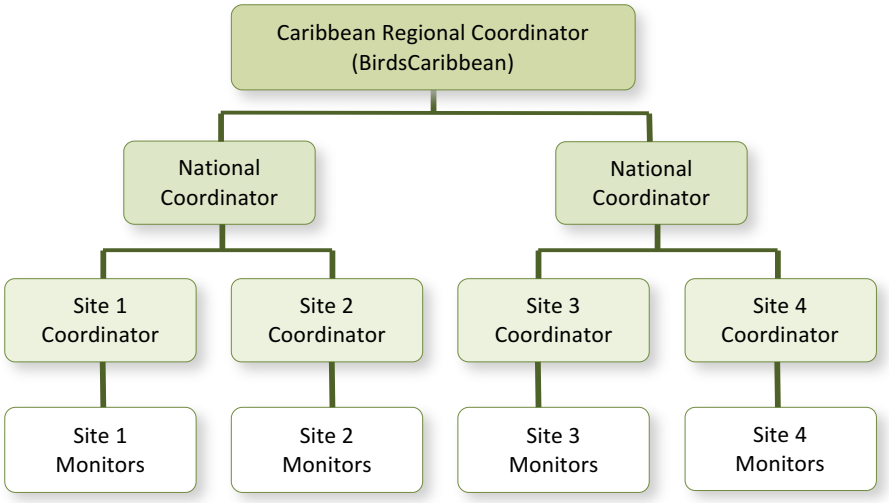


Figure 11: Proposed structure of CWC

Training for the CWC

National coordinators will be responsible for training site coordinators. The first cadre of trainers was trained at the BirdsCaribbean/OAS/WHMSI workshop held in Negril, Jamaica February 2010. Training materials include Powerpoint presentations available for download on the CWC ConserveOnline Workspace (http://conserveonline.org/workspaces/cwc):

- What is monitoring? Why monitor birds?
- Establishing the Caribbean Waterbird Census
- Levels of monitoring and CWC protocols: Species inventories, area searches and point counts
- General considerations in designing your monitoring program
- Applying the CWC methodology
- Describing your site, habitat surveys and IBA monitoring
- Examining the data: Simple approaches to data analysis
- What can you learn from monitoring data? Sample analyses from ongoing waterbird monitoring in St. Croix
- How to prepare reports and communicate your results to decision makers
- eBird Caribbean: Levels A-C Monitoring, What these data show and how it can be used for conservation planning and management

Other useful resources and references such as bird monitoring manuals and key papers on monitoring theory, strategy and studies are available on the Caribbean Birdwatch ConserveOnline workspace at: http://conserveonline.org/workspaces/caribbeanbirdwatch.

A basic introduction to monitoring will be provided in the BirdsCaribbean manual "*Caribbean Birdwatch – How to Design and Implement Bird Monitoring in the Caribbean*" which is expected to be completed in 2011. It will include basic information about designing a monitoring program, training, selecting equipment, assessing habitats and analyzing data, as well as a broad range of protocols.

Why get involved in the CWC?

There are many reasons why government agencies, NGOs, educators and other persons should choose to get involved in the CWC. These include:

- To determine what species of waterbirds occur at one or more important sites in your country and how their numbers are changing over time
- To assess the national and international importance of a wetland or group of wetlands (e.g., to determine whether a site meets requirements for Ramsar designation).
- To assess the effectiveness of management of a specific wetland by assessing the response of species using the wetland (e.g., increased diversity or numbers of birds) to the management action
- To participate in regional assessments of the status and distribution of a species or group of species, and to measure regional changes in their numbers and distribution (e.g., as a result of changes in the environment from natural and human-induced causes)
- As a tool to monitor changes in bird populations and their associated habitats over time from climate change
- To increase awareness and willingness amongst decision makers, natural resource and wildlife managers, community leaders, educators, the general public, especially youth, to take action to conserve wetlands of importance to migratory and resident birds
- To learn more about wetlands and wetland birds

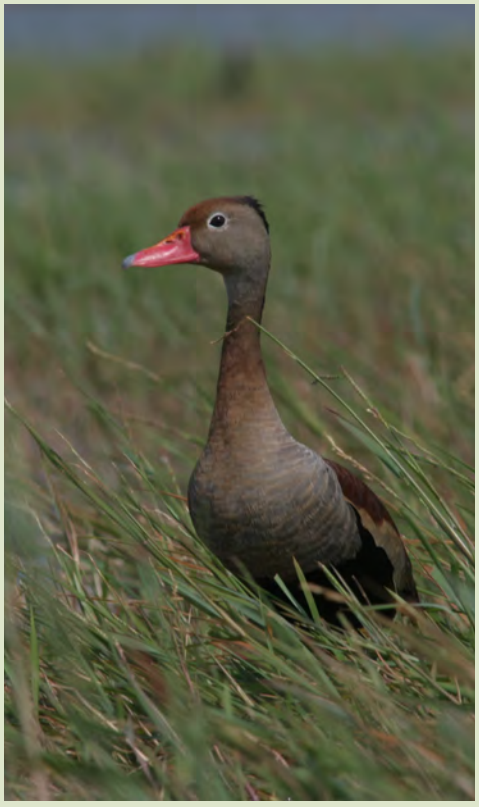


Figure 12: Black-bellied Whistling-Duck

Figure 13: The Observation Deck at Negril Royal Palm Reserve, Jamaica

Establishing a CWC Program

BirdsCaribbean would eventually like to see a national CWC network established in each country in the region. Some countries may be able to do this immediately. Others may only be able to establish site surveys at first.

Setting up the monitoring network

The role of the **national coordinator** will vary from country to country but may include:

1. Establishing the national network (including publicity and networking to promote the CWC)
2. Identifying sites and volunteers who would like to participate in the CWC or identifying priority sites to receive financial assistance
3. Helping each site to define objectives and define its survey methodology
4. Assisting with training survey site coordinators and survey teams in survey methods and simple approaches to data analysis
5. Once the regional program is established the national monitors will also be responsible for getting site coordinators to submit their results and collating these results into a national report.

ELEVEN QUESTIONS TO ASK IN DESIGNING ANY STUDY

- What is the question?
- Who will use the results?
- Who are the appropriate contacts?
- Where are the boundaries of the study?
- How is the effort going to be distributed?
- What methods will be used in the field?
- Is the method good enough for the purpose?
- Is the study realistic?
- What preparations are needed?
- How will the data be analysed?
- How will the results be disseminated? (From Bibby et al.) 1998)

The role of the **site coordinators** includes getting surveys implemented at the site level including:

1. Defining objectives and making sure they are realistic
2. Selecting an appropriate methodology (unless this has already been determined at the national level)
3. Identifying volunteers to assist and training them as necessary
4. Carrying out the surveys
5. Collating, entering and analyzing data
6. Preparing site reports
7. Disseminating information to stakeholders and partners so that it can be used for conservation

In addition national and site coordinators may need to get involved with fund raising, either on their own initiative or in cooperation with BirdsCaribbean to ensure the sustainability of the program.

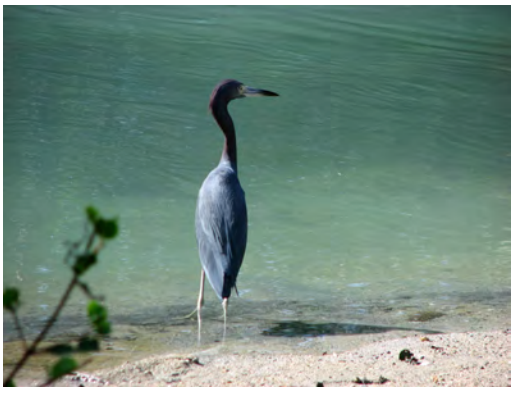


Figure 14: Tricolored Heron (left)

Figure 15: Little Blue Heron (far left)

Designing your monitoring program

There are many good sources of information on designing monitoring programs. One of the best is *The Northeast Bird Monitoring Handbook* by Lambert et al (2009). Another excellent resource is the BirdLife International *Expedition Field Techniques Bird Surveys* (by Bibby et al. 1998).

The main things to consider in designing any monitoring program are:

- Establishing your goals and objectives. Why are you setting up the program?
- Defining your site. Where are you going to survey? How will you select survey area and survey points?
- Defining your audience. Who will use the information and how will they use it?
- Deciding your methods.
    - If you have not surveyed the area before it may be necessary to do a one-year preliminary pilot study or reconnaissance surveys to plan your surveys, train your observers and refine your methods.
    - What level of monitoring is appropriate? What protocol will you use?
    - Who are the appropriate contacts in the area?
    - How will you reduce and account for sources of bias in your monitoring?
- Preparing for the surveys. What preparations will be needed? Include the equipment you will need, transportation, human resources, training, funding, etc.
- Using the data. How will it be entered, stored, analyzed and presented? How will it be used to answer your questions, for adaptive management in conservation programs, and to plan and improve monitoring in future?

Figure 16: Bahamas National Trust Park Warden, Apollo Butler He uses a rangefinder to measure the distance to the birds he is counting. Photo by Geoff Welch

Figure 17: Reddish Egret

Establishing goals and objectives – What is the question?

Establishing clearly defined goals and objectives is essential to the design of an effective monitoring program. The **goal** is the general statement of what the program is designed to achieve in relation to a specific problem. **The objectives** identify the specific measurable actions that will be carried out to implement the program and evaluate its success. Goals and objectives are essential parts of every program, whether at the site or national levels. They answer the question "Why monitor?" and lead to the answers to "What? Where? When? and How?"

For the CWC the basic questions are:

- What species of waterbirds are present at the site(s)?
- How are their numbers changing over time?
- What environmental factors (natural or human-induced) are linked to these changes?

These questions can lead to more detailed objectives, such as:

- Determining which species of resident or migrant waterbirds are present and their distribution and relative abundance throughout the year
- Measuring population sizes and trends—changes in numbers and density over time in waterbird populations in response to changes in the environment (e.g., management, variation in site conditions, site-based threats, external threats such as climate change, or other factors)
- Assessing the status of a threatened species (this may require special protocols)
- Justifying conservation action (e.g. declaration of the site as a Ramsar site or as a protected area)
- Assessing the need for specific management or conservation measures to improve the site for waterbirds
- Assessing the effectiveness of management or conservation measures in improving the site for waterbirds
- Engaging the local community in citizen science and wetland conservation
- Assessing the potential for nature-based tourism

Some species of waterbird have very specific habitat requirements or unusual behaviours. These cannot be adequately surveyed using a general methodology. Examples are colonial species such as seabirds and herons and egrets, or species that are always rare and hard to detect (such as marsh birds like crakes and rails), species that generally occur on large expanses of open water (such as ducks) and nocturnal ducks (such as the West Indian Whistling-Duck). Surveys of these species require special protocols.

At a glance - Ten Steps to Successful Caribbean Waterbird Conservation through Improved Monitoring

Step 1: Establish a clear purpose
- Define the problem
- Identify and consult stakeholders
- Set a conservation goal
- Develop monitoring objectives that are linked to the conservation goal

Step 2: Determine whether an existing program of protocol meets your need
- Consult with BirdsCaribbean on Caribbean Birdwatch and CWC protocols
- Build on monitoring programs that have worked elsewhere

Step 3: Assemble a team of collaborators with complementary interests and skills
- Form or participate in a monitoring partnership
- Engage people with the necessary expertise (e.g. bird identification, use of protocols, survey design, data analysis, data presentation)
- Define roles and responsibilities of team members.

Step 4: Summarize the relationship of target populations to other ecosystem elements, processes and *stressors*
- Summarize life history information for the species or species group of interest
- Build a conceptual model
- Identify important responses to monitor
- Revisit conservation and monitoring objectives

Step 5: Develop a statistically robust approach to sampling and data analysis
- Identify appropriate analytical procedures
- Delineate the sample frame
- Determine method for selecting sample sites

Step 6: Design and pilot standard field protocols that minimize error and bias
- Screen and train observers
- Simplify survey methods
- Stratify to minimize site effects
- Use standard methods to control survey effects
- Account for variation in detection rates (if called for by monitoring objectives)
- Obtain peer review of protocols
- Test protocols and solicit feedback from observers
- Use pilot data to establish quantifiable objectives and determine sample size

Step 7: Identify or develop a data management system
- Develop project metadata
- Design and manage the database
- Archive and exchange your data with BirdsCaribbean and eBird Caribbean
- Provide access to data according to legal requirements and project agreements

Step 8: Implement the monitoring program
- Prepare for the field season
- Perform the survey
- Enter and check the data for errors
- Explore and analyse the data

Step 9: Present results in a format that supports sound management and conservation decisions
- Interpret results and prepare reports with audience in mind
- Provide tools that inform management/conservation decisions
- Step 10: Evaluate and adjust management and monitoring to make better bird conservation decisions.
- Evaluate the conceptual model
- Adapt management if necessary
- Adjust monitoring, if necessary
- Assess the cost effectiveness of the chosen management and monitoring strategies

AMERICAN BIRD CONSERVANCY

Abstracted and adapted from:
The Northeast Bird Monitoring Handbook (Lambert *et al.* 2009)

Selecting sites – where will your surveys be carried out?

Defining the study area and selecting where exactly you will work is one of the most important and challenging aspects of the design of your monitoring program. It is closely linked to the objectives of the survey. The overall area from which you will select your study sites is called the **sampling frame**. If the objective of the survey is to identify the most important sites for waterbirds on an entire island, the sampling frame must include a full range of sites representing all the waterbird habitats in the island. If the objective is to survey waterbirds in a particular wetland or protected area, the sampling frame should include representative sites from across the entire wetland or protected area.

In many cases the selected site or sites will be already have been recognized as important internationally or locally:

- Actual or proposed Ramsar site[9]
- Important Bird Area (IBA)
- Western Hemisphere Shorebird Reserve Network (WHSRN) site[10]
- National Park or Marine Protected Area
- Wetlands in protected areas
- Wetlands in need of protection

Within a site the specific location you choose for your surveys will be determined by:

- Accessibility
- Presence of large numbers of species or species of concern or special interest or concentrations of large numbers of birds
- Availability of volunteers
- Use of the site, e.g., for tourism and education

If the proposed study site is small and/or open, it may be possible to do a complete count (census) of all the birds in the study area. If the study site is large and partly or wholly inaccessible and/or involves multiple wetlands in an area or island, conducting a complete census will be impossible. If the objective is to draw conclusions about what is happening in the whole area, it will be necessary to select survey points by sampling the area, using a statistically acceptable process (such as random or stratified random methods). For example, if one wishes to make an inference about the size of the WIWD population on an island, it would be wrong to select sites on the basis of previous knowledge of habitat use and abundance by this species. Unless you conduct a complete count (census) of all the wetlands, it will be necessary to have a representative sample of the distribution and abundance over space, meaning a sample of areas of low, medium and high density, using stratification or some other technique for sample allocation.

If access to the wetland is difficult or impossible (as is often the case in Caribbean wetlands because of dense mangroves or mud) and an index to waterbird abundance is acceptable, then a practical approach may be to use existing roads or dikes along wetlands as a transect route and locate count stations at vantage points around the wetland, being aware that your count will be biased. If the objective is to assess a management intervention designed to improve waterbird habitats (for example to assess the impacts of protected areas), then it will also be necessary to include control sites for comparison.

Where possible, sampling sites (point count stations and search areas) should be located randomly throughout the study area, independent (i.e. the chance of observing the same individual birds at two sites should be minimal), and there should be enough replicate counts to meet any statistical assumptions and achieve a desirable level of statistical power. In reality, site selection will depend in large part on access and logistics, however, one should systematically explore the options and decide on a monitoring scheme according to sampling capacity, but following as much as possible the principles of sampling design. More details on defining your sampling frame and selecting your sites and survey points for monitoring can be found in the section on Protocols for the Caribbean Waterbird Census and other monitoring manuals (e.g., Bibby et al. 1998).

Figure 18: Black-necked Stilts

[9] The Ramsar Convention is a global treaty under which national governments agree to designate wetlands of global importance. One of the criteria is that the wetland should support at least 1% of a regional population of a waterbird species.

[10] There are 2 WHSRN sites of Regional Importance in the Caribbean: Cabo Rojo Salt Flats in Puerto Rico (505ha, 1,249 acres) and Cargill Salt Ponds in Bonaire (2700ha).

Determining your audience - Who will use your results and how will they be applied?

It is very important to consider how your data will be used and by whom. The data should meet their requirements, but not greatly exceed them, otherwise effort may be wasted. The type and level of information needed will vary with how the information will be used. For example a site manager in a protected area may require very detailed information on the distribution and numbers of a target species, whereas a national environment plan may only need general information about which sites are most important for wetland birds.

Assessing your site – what to do if you are not familiar with a proposed study site

If you have never visited the area before it will be necessary to conduct a preliminary site assessment (also called a reconnaissance survey). The approach is simple.

- Do a literature search to determine whether there are any existing data from the site (published or unpublished)
- Get a map and image(s) of the location (e.g., from Google Earth, local Lands and Survey Department)
- Plan your visit to coincide with the maximum likelihood of seeing the maximum numbers and variety of birds (i.e. early in the day, at low tide, during peak breeding season, etc.)

Before visiting a site for the first time, acquire a good map or aerial photograph of the site and review this to determine accessibility of the site, general habitat and access routes. If the site has been surveyed previously, helpful information on site accessibility and habitat can often be gleaned from publications or even unpublished notes. Additionally previous surveys can also give you an idea of the species composition of the site (at least at the time of these surveys). Timing of this initial visit can be tailored towards species of interest if the presences of these species are known or suspected from previous surveys. Always determine land ownership and acquire written permission to enter and survey any private land.

Once you have determined how you can access the site, do your reconnaissance survey. This will help you to get the information you will need to design your monitoring program.

Determine an initial species list for the site (see Level 1 Monitoring: Site Inventory and Basic Counts). The goal with this initial survey is to determine what species are at the site, and ways of maximizing detection of species should be a driving factor in how you go about generating this initial list, keeping in mind that certain disturbances can negatively impact the birds at the site. Maximizing species detection is best accomplished by initially surveying the wetland from a place where birds would be minimally disturbed by your presence and from which you can see/hear a large proportion of the site. Playback for certain species can be helpful in determining the presence of cryptic/hard to see species such as rails. Early morning when birds are activie is generally the best time, but if it is a wetland subject to tidal fluctuations, high tide or a falling tide might be a better time for this initial visit.

It is important to make a description of the site on the first occasion that you visit. This will serve as a baseline and you will be able to assess any changes in the future. It is also important if your survey is going to be part of a coordinated national or international monitoring program, so that your site can be compared with others. Use the CWC Site Description Form to describe the area. Also make detailed notes of what you see, including vegetation types, water level, land uses and threats. Take many photographs, including panoramic shots and videos if your camera has this capacity.

On your photograph or map:

- Identify and map major habitat types and locate point source threats
- Identify potential survey locations (search areas or point count stations where you will conduct the count)
- Identify the boundary of the area you plan to count.

It is important to define the site clearly and where possible to survey the whole wetland. It is not always easy to decide where the boundaries of the site lie, e.g. is it a pond or the whole group of ponds in an area? How much of the vegetation surrounding the pond will you include in the count? There is no simple recipe for this, and the most

important thing is to make a decision, draw it on a map for future reference, and stick to it. The basic unit is the "count unit" which is "the geographical area that can be covered by one or two counters on a single visit" (Delaney 2005). Once drawn on a Google Earth image the area can be measured using a planimeter, which is available at http://www.acme.com/planimeter/ .[11] Data should be collected and stored by the count unit and can be aggregated later. On a given day you will probably visit several survey points. It is important to define the route between survey points and record this on a map on the first visit, then use the same route every time.

If you are using more than one point, determine the area you are going to survey from each point with reference to obvious landmarks and draw it on your map/image. If you have a GPS unit, take a GPS reading at each point and at the boundaries of the study site and search area. Otherwise make a note on your image and use Google Earth to get the coordinates later.

These are the Valley Church Ponds in Antigua. It appears from the photograph that it should be possible to census North Pond from one point on the road just south of the pond and all of the birds on Cocos Pond could be counted from 2 census points. If you were doing a reconnaissance survey of the area, your task would be to check this out and draw on the map exactly what areas (water and amount of shoreline and shoreline vegetation) will be included in the count (based on reference landmarks and measurements), keeping in mind that water levels will vary over time.

Figure 19: Valley Church Ponds, IBA in Antigua.

[11] See also: http://ebird.org/content/ebird/news/an-easy-way-to-calculate-distances-and-areas)

Designing your survey

It is very common to be overly ambitious in designing a study. It may actually be more useful to set and achieve a modest objective than to half accomplish something grander and end up with an unfinished job of limited value to anyone (Bibby et al. 1998). In designing your survey and sustaining it over the long-term, be sure to consider the amount of time and funding it will take to arrange permissions, carry out site reconnaissance and pilot surveys, plan your monitoring program and decide on protocols, assemble equipment and supplies, recruit and train volunteers, travel to the site and conduct the surveys, enter and analyze data, prepare reports and communicate the results to decision-makers, managers, the local community, etc. as needed. Think also about how you can make your surveys and participation in the CWC sustainable in the long-term by integrating surveys into existing national and site programs, by seeking ways to make the CWC maximally cost effective, by seeking sponsorship to continue the program, and by training participants to prepare funding proposals for future work.

Sampling and reducing bias

"The basic idea which underpins sampling is that because we cannot count a whole population or bird community, we take samples and extrapolate our results to provide estimates of the true population sizes or species diversities. In the same way, we might sample a variety of habitats to try to build up a true picture of what a species' habitat requirements really are. The problem with any sort of sampling is that there are many ways in which the sampling regime could be biased. For example, many birds are more active and vocal early in the morning, so if two forest areas are censused, one between 0600 and 0800h and the other between 1300 and 1500h, the results cannot be compared; the first area may seem to have more birds but is this because of a real difference in the bird populations, or just because the birds were easier to see and hear? The sampling regime was obviously biased, and there are many other ways in which bias can affect the outcome of any bird counting exercise. Another example of bias is comparing results from a noisy environment (e.g. riparian forest) with a 'quiet' habitat. Understanding the causes of bias and dealing with it in the appropriate way is the most important part of study design" (Bibby *et al*. 1998).

Unappreciated bias is one of the biggest problems undermining the value and credibility of survey and monitoring work. Some recommended ways to reduce bias include:

- ensuring that key parts of a site or key habitats are sampled,
- standardizing surveys according to observers, time of day, weather conditions, state of the tide (in the northern Caribbean), area covered, and the amount of time spent counting
- using the same methodologies are used at different areas or at different times, ensuring that there are no major differences in the abilities of observers working on the same project. Bibby *et al.* (1998) and Latham (2009) contain more detailed discussions of bias and how to reduce it.

Detection probability/detectablity

Another problem is that it is seldom possible to be sure that the observer carrying out the survey has seen (or detected) all the birds present during the count. Some species are easier to observe generally and some habitats conceal some birds more than others. Data based on an incomplete count cannot be used to estimate density or population numbers or to compare sites. Thus more sophisticated survey protocols try to measure the likelihood that all birds have been seen, which is called detection probability or detectability. This can be used to adjust the counts to produce an estimate of the actual numbers that were seen in a given area. There are several ways to do this, including comparing the numbers seen by two independent observers at the same time (double observer), repeating the counts over a period of a few days (repeated counts), dividing the count into time intervals and seeing how many new individuals are seen in the count periods (removal counts), and measuring the distance to each individual or flock when it is first seen (distance sampling). All these techniques have their challenges but they can greatly increase the usefulness of the data that are collected. This is described in more detail in the section on protocols.

Choosing protocols

Your choice of protocols depends on your objectives, the nature of the site(s), and the available resources. The CWC offers a range of protocols from Levels 1-4, which are designed to meet a broad range of circumstances (Table 1). All levels are acceptable but BirdsCaribbean recommends that you should select a method from Level 2 or 3 for CWC monitoring. The methods for each level of monitoring are described in great detail in the section on Protocols in this manual; they are summarized briefly below.

Figure 20: Flamingos in Flight

Table 1: Summary of Caribbean Waterbird Census (CWC) Levels of monitoring, including possible objectives, protocols and measures of detectability for each level and protocol.

CWC LEVEL OF MONITORING	POSSIBLE OBJECTIVES	PROTOCOLS	DETECTABILITY MEASURES[12]
Level 1 – Site Inventory/ Basic Counts	- Site Inventory, species checklists - Assess species diversity and numbers at a site (presence/absence) - Conduct a rapid assessment of species presence and raw numbers to identify possible important areas for monitoring, study and protection - Plan Level 2 or 3 monitoring, become aware of counting biases at site - Test count methods, train observers, refine skills, become familiar with the site - Contribute to our knowledge of waterbird populations by participating in the CWC at a basic level	Point Count, Traveling Count, Area Search	None, estimates of species diversity and numbers may be biased
Level 2 – Counts with simple detection probability	- Assess species diversity and numbers at a site (presence/absence) - Assess species-habitat relationships - Estimate density and abundance at site when detection probability is perfect or can be estimated from count data collected in the searched areas - Measure changes in relative abundance from year to year to monitor trends	Traveling Count or Area Search	- Repeated counts OR Double observer
	- Assess species diversity and numbers at a site (presence/absence) - Assess species-habitat relationships - Estimate detection probability, relative density and abundance - Measure changes in estimated parameters from year to year to monitor trends	Point Counts	- Removal counts - 6 minute counts divided into 2 3-minute intervals - Repeated counts - Double observer
Level 3 – Counts with distance sampling	As above, plus estimate absolute density (number/unit area), occupancy (use of point area), and population size (number in the wetlands sampled), assuming adequate survey design	Point Counts	As above plus distance estimation
Level 4 – Simultaneous/ Repeated Counts at Multiple Sites	- National abundance estimates of one or more target species - Size of waterbird populations in the entire country	Point Counts	- Removal counts - Repeated counts - Distance estimation

[12] Methods of measuring detection probability may be combined (i.e., more than one used) for maximum flexibility and power in data analysis and modeling. If done properly, point counts with distance estimation provide the most accurate and comprehensive data on bird populations and any changes.

Levels of monitoring and the CWC

The CWC is based on two methods; point counts and area searches. The point count method involves the observer standing in a fixed location (count station), counting all the birds seen or heard for a standard period of time (e.g., 6 minutes). The area search method is a method similar to birding – an observer moves through the habitat in a predefined area for a standard amount of time, and counts all the birds seen and heard. If you are not familiar with the site it may be necessary to do a preliminary reconnaissance survey followed by Level 1 Basic Counts in order to obtain a Site Inventory and plan more detailed Level 2 or 3 survey. CWC recommends that if possible monitoring of sites should be carried out using at least Level 2 methods, which include measures of detection probability. Each monitoring method is described in the section on Protocols, including information on possible objectives, advantages and disadvantages, assumptions, timing of counts, checklist of equipment, and detailed instructions on preparing for and conducting the count, filling out the count form, and measuring site and habitat variables (covariates).

LEVEL 1- Site Inventory/Basic counts

At it's simplest, avian monitoring consists of an inventory, that is, the determination of presence or absence of various species (Latta et al. 2005). Level 1 monitoring is primarily used to generate a site inventory, or list of species that occur at the site. It consists of visiting the site as often as possible to gather information on the number of species that occur through the year. The basic count methods in Level 1 monitoring (Traveling Count, Area Search or Point Count) may also be used by observers who wish to participate in the CWC, but do not wish to use the more complicated and demanding techniques recommended in Levels 2 and 3 or who lack the experience or resources to do so. Level 1 monitoring can be used to gain familiarity with the site, train observers, refine skills, and plan more detailed surveys (what Level 2 or 3 methods will be used, distribution of points, size of area, etc.). Whether the goal is to maximize the number of species seen or conduct consistent counts, all birds seen and heard should be counted and recorded, the size of the area should be measured and the amount of time spent counting should be recorded. With this information Level 1 count data can be entered into eBird Caribbean (see Appendix 2) and the counts will be maximally useful to analysis.

LEVEL 2 – Counts with Simple Detection Probability

TRAVELING COUNTS AND AREA SEARCHES

OPTION 2a Traveling Count or Area Search – Repeated Counts

The basic team consists of an experienced observer and a recorder. The person with greater skill in bird identification should be the observer. For area searches, the team has a copy of a map of the area with the predefined boundaries of the survey area clearly shown with reference to landmarks. They walk, wade or paddle through the wetland on a predetermined route for a standard period of time (usually 20 minutes, but can be shorter or longer depending on the size of the site and number of birds), taking care to avoid double counting by keeping track of movements of individual birds and flocks. For traveling counts, the team walks, drives or paddles the pre-determined trail or path (e.g., on a beach, or through a wetland), counting all birds seen or heard. Counts should be conducted in the early morning or late afternoon at the same time of day each time for non-tidal sites, and at the same state of the tide for tidal sites. The Area Search is repeated 2 or 3 times within a short period of time (e.g., 7 to 10 days) and the results compared to get an estimate of detection probability.

2b Traveling Count or Area Search with Double Observer

The methods are the same as in 2a above, however, in the double observer method of estimating detection probability, 2 such teams count the same wetland at the same time independently. Alternatively, 2 skilled observers with a tape recorder can conduct the count together. The teams/observers should stay together during the count but do their best not to influence each other's counts. Detection probability is simple to calculate in a spreadsheet with this method (ratio of 2 observers).

POINT COUNTS

2a Point Counts with Removal Counts

Counts of birds are made by a stationary observer and recorder from count stations located (ideally randomly) at vantage points along a transect route. Unless count areas are distinct, count stations should generally be >400m apart to secure independence. The size of the point count area depends on the size and shape of the wetland but the maximum count distance is 400m. All birds seen and heard are counted during a 6 minute count that is partitioned into

two 3-minute intervals. Birds are counted only once, in the first time interval in which they were detected; after this they are consider to be "removed" from the count. This is the simplest form of point count. The repeated counts and double observer approaches (2b, 2c below) can be added to increase the accuracy of the estimates.

2b: Point Counts with Repeated Counts

Using the repeated count method of estimating detection, the point count sites are surveyed 2 -3 times in within a short period of time (e.g., 7 - 10 days) during the CWC recommended seasons.

2c. Point Counts with Double Observer

If 2 observers with similarly good powers of observation and identification are available at the same time, detection probability can be estimated if they carry out the count simultaneously at the same site independently. However it is very difficult to ensure complete independence.

Level 3: Point counts with Distance Sampling

For Level 3 Point Counts are conducted as above, but in addition to other observations the distance from the observer to each individual bird or flock of birds is measured with a rangefinder. Distances are used to calculate absolute bird densities, from which you can calculate population sizes for particular areas. Distance data can also be used to calculate detection probabilities for each species in each habitat, thus comparisons can be made between species and between the same species in different habitats. Distance sampling requires slightly greater skill in data collection and this is why it is assigned to Level 3.

Level 4: Simultaneous/ Repeated Counts at Multiple Sites (Form 4)

This involved having teams of observers surveying multiple sites at the same time or repeating counts within a short period of time at multiple sites in order to obtain national estimates of population size.

Describing the habitat, threats and covariates

The current condition of the habitat (including factors such water level, salinity, vegetative cover, food abundance, weather, and human activities and threats, e.g. hunting, pollution, dredging, invasive species, etc.) likely influences the number and diversity of waterbirds at the site and our ability to count them. In addition, understanding the relationship between waterbirds and habitat and what constitutes good habitat is one of the basic objectives of monitoring. Thus, it is very important to record information on site-specific variables (known as covariates) before starting your monitoring program and at the time of each survey. The CWC provides a Site Description Form that records many important details about the site and serves as a baseline for monitoring. Key covariates are also assessed on the CWC count forms. Generally, when bird populations decline this is the result of direct or indirect threats to the birds or the ecosystems that support them. It is therefore important to monitor conditions and record data on threats at the survey sites so that conservation actions can be directed at reducing or mitigating threats. For more details on habitat monitoring see the CWC Protocols for Habitat Monitoring section of the manual. The BirdLife International monitoring manual (*Monitoring Important Bird Areas: A Global Framework, Version 1.2*[13]) provides a detailed approach to threats monitoring at IBAs.

Preparing for the CWC - determining the resources that will be needed

Investing time in carefully planning your project pays dividends in the long run. Procuring equipment and funding, and ensuring that you have all of the relevant background and reference information – on species, habitats, methodology, logistics, etc – is essential for fieldwork, but it is also important to consider whether you need to run training courses for fieldworkers in advance so that everyone fully understands what is required. Observers may need training in bird identification by sight and sound, and pilot counts should be conducted to practice counting birds, filling in the count forms, and learning the protocol. For projects working in remote or little known areas or involving large numbers of observers, planning may take a year or more and for complex projects it may be necessary to have one or more seasons of field trials of methodologies, including data recording forms, to ensure that everything works as planned (Caribbean BirdWatch 2009). It is recommended that you plan on one pilot season to learn the protocols, fine-tune your methods, and make sure that field persons are well trained.

[13] Available for download at the Caribbean Birdwatch ConserveOnline workspace: http://conserveonline.org/workspaces/caribbeanbirdwatch

Assembling a team of collaborators, procuring equipment and other resources, and training observers

When developing any type of plan, it is important that it is based on up-to-date information, follows accepted best practice, and builds on previous or complements ongoing work. Therefore during the planning stage of a monitoring program it is important to identify whom you should consult in order to help ensure your work is useful, progresses smoothly and that the results are relevant and useful. Such consultation can help with program design, logistics, and obtaining permissions and funding. Consultation and involvement of decision makers from the outset of planning can be extremely useful as they will be aware of your work and what you are hoping to achieve and therefore, hopefully, be more willing to take the appropriate action. Local contacts are likely to be able to assist with detailed knowledge of the study area, anecdotal information on past management of an area or changes in bird numbers. In many cases, ensuring that local communities are aware of your work can be valuable both for assistance with fieldwork and implementation of future conservation action. Also involving community members in a project helps make them feel valued, gives them a sense of 'ownership' of the area or species you are working on and provides an opportunity for increasing local skills and knowledge. Training of collaborators is an important role for national and site coordinators.

As well as your team, you will need to assess what other resources you will need to implement your program on the basis of past experience or from the reconnaissance visits. Resources that will be needed will include:

- Personnel
  - Trained observers
  - People who can assist with data entry, analysis, presentation, interpretation and statistics
- Transportation
  - Vehicles and boats and the funds to operate them
- Field equipment (e.g. binoculars, spotting scopes, tripods, rangefinders, GPS units etc.)
- Field clothes (suitable footwear, hats, pants etc.)
- Field guides
- Field supplies (e.g. field forms, pencils, mosquito repellent, first aid kits, etc.)
- Permits and permission letters (e.g. research permits, permission to work on private lands).

Training observers is a very important part of preparations. It is very important to ensure that observers are fully competent in field identification and understand the protocols. A training session at the beginning of the field season that includes practice counts is highly recommended. A variety of training resources including powerpoint presentations are available for download at: https://www.dropbox.com/sh/9h1ebbrrcnisoht/AAD3UaCzfgZoryCzerSmSyy8a?dl=0.

Using the data

Entering the data

Count data should be entered on the computer using eBird Caribbean (see Appendix 1) and/or standard CWC spreadsheets (available for download at: https://www.dropbox.com/sh/9h1ebbrrcnisoht/AAD3UaCzfgZoryCzerSmSyy8a?dl=0. Data entry should be done as soon as possible after the field trip, preferably the same evening.

Analysing the data

For site purposes a species list should be compiled, including the species present and their numbers by season, which can be compared annually with previous years. Also look for changes on maps and photographs and take action if any major changes due to human interference are noted. eBird Caribbean can be used to view maps and graphs of frequency and abundance of

birds species. Exploratory data analyses can also be conducted in Excel. Once you have several years' data you should use simple statistics to analyze population size, trends and changes. Most simple analyses can be performed on Excel and there are many statistical packages available to do basic statistics.

Some basic questions include:

- What species are present?
- What is the species richness and numbers of each species at the site and how does it compare with other sites?
- Are there any threatened, endangered or rare species or other species of special conservation interest? Any species of special interest to birders or ecotourists?
- What are the most common species and how large are their populations?
- Are there any changes occurring in species composition or numbers?
- If yes, how can this be related to changes in habitats, conservation management or threats (e.g. climate change)?

Storing the data

Make sure that electronic data are backed-up in at least two places (e.g. on an external hard drive and an online storage site (like google drive or OneDrive). Also make sure that original field notes are safely stored.

Presenting the results

Using and reporting the results is even more important than collecting it – a fact that is often forgotten. Unless the results of your study are made available, especially to those who control or influence the conservation and management of the species, habitats or sites that you are working on, then they are almost worthless. Make sure that your efforts contribute to conservation by writing them up and sharing them in appropriate ways. Formats for national and site reports are being developed and will be circulated.
It is important to think about the format of how your results are presented – publication in a scientific journal will be very different from a popular magazine or newspaper and many decision makers will not have the time or inclination to read a long, detailed technical report, so consider producing a short, easily readable summary.

How you disseminate the results will determine whether your results are applied effectively to conservation or not. The first step is to define your message, then your audience. Based on this you can determine what materials are best suited to communicate to your audiences. Some options include:

- **For supporters, volunteers and tourists** – provide a checklist of your site on the web and in newsletters, email alerts of rarities, or a blog of your activities, e,g, on eBird Caribbean
- **For Protected Area managers:** Provide a summary of major findings, focusing on management implications and need for action
- **For politicians** – Prepare a one page summary interpreting results (include simple graphs and photos) with reference to their concerns (wetland health, wetland functions and values, nature tourism/education value of the site, threatened and rare species using the site, conservation problems/successes)
- **For the scientific community** – peer reviewed scientific paper (e.g., *Journal of Caribbean Ornithology*), Avian Knowledge Network, local bird bulletins

Caribbean Waterbird Census – Level 1 Protocols for Counting Waterbirds

The CWC offers 4 levels of monitoring. These are:
Level 1 Site inventory/Basic counts
Level 2 Counts with simple detection probability
Level 3 Counts with distance sampling
Level 4 Simultaneous/ repeated counts at multiple sites

If you are not familiar with your site and/or you do not yet know what species are using the site, we recommend you start your monitoring program by conducting a Site Inventory. Basically, you visit the site as often as possible or at regular intervals over a year, and carefully identify and record all the birds that you see and hear. The objective is to develop a species list for each season/month of the year (winter, spring, summer, fall) so that you identify which species are breeding residents, which are fall and/or spring migrants and which are winter residents and their relative abundances (e.g., common, uncommon, rare, vagrant). When conducting a Site Inventory, it is not necessary to strictly follow the area search or point count protocol in that you can move around and are free to record and count birds for as long as you wish. However, DO record all species seen and heard, count the number of each species, note the size of the area that you counted, and the amount of time you spent counting. With this information you can enter the data into eBird Caribbean and make your counts maximally useful to analysis.

A Site Inventory/Level 1 count is an invaluable way to familiarize yourself with the site and plan your Level 2 or 3 monitoring program. It will:

- Help you figure out which count methodology is most appropriate for your site (area search or point count, also how you will measure detectability)
- Give you and your assistants time to improve your bird identification and counting skills
- Make you aware of the biases and other issues you need to deal with in counting the site (e.g., time of day, vegetative cover, tides and water levels, possible disturbance, etc.)
- Give you an opportunity to test your count methods, refine your skills, and train observers and recorders
- Decide on what habitat covariates (e.g., water level, salinity, state of vegetation, threats, etc.) you will measure and obtain practice taking these measurements

If you standardize the amount of time you spend counting and the area that you cover, and repeat your counts at least once annually, Level 1 methods can also be used for basic monitoring of waterbirds at a site. The data collected can contribute to our knowledge of species diversity and use of a site over time. In addition, if detection rates are known to be constant across space and time and/or if detection is 100% (e.g., in the case of a small open wetland), Level 1 counts may provide a simple means of estimating abundance and change over time (i.e., provide an index using raw counts) at the site, which may be adequate for certain monitoring objectives. Level 1 monitoring may also be appropriate for citizen scientists and birders who wish to contribute to our knowledge of waterbird populations and participate in the CWC (see Appendix 1: eBird Caribbean and Basic Counts (Level 1 Monitoring) for the CWC), but do not have time or resources to participate in Level 2 or 3 monitoring. Please note, however, the following important points:

1) The sensitivity of simple counts to errors and biases limits the usefulness of Level 1 count data for more rigorous statistical analyses and assessments. If your objective is to measure trends in population size over time, you need a well-designed sampling plan and a survey method that accounts for these errors and biases. Level 2 and 3 monitoring, which include measures of detection probability, account for these errors and biases and greatly increase the value of the data to science.

2) Many aspects of the Level 1 Point Count or Area Search methods are utilized in Level 2 monitoring so once a surveyor is familiar with the Level 1 protocols, moving to a protocol which includes detectability is very straightforward and is often as simple as repeating the Level 1 counts across multiple days.

Basic Counts - CWC Level 1 Monitoring

Objectives

Possible objectives of Level 1 Area Search and Point Count methods are:

- Conduct a rapid assessment of species presence and raw numbers to identify possible important areas for monitoring, study and protection.
- Test count methods, refine skills, and train observers and recorders, in preparation for use of standard protocols using more elaborated counting methods (Level 2 or 3).
- Compile a seasonally based list of species for the site, i.e., a Site Inventory and species checklist.
- Determine potential importance of a site based on the presence of threatened or endangered species, species diversity or high counts of a species of concern.
- Locate breeding colonies or nesting species.
- Assess species diversity and richness and community composition and how they change throughout the year (note that measures will likely be biased because detection probability is rarely perfect).
- Estimate an index of density and abundance (number of birds in a small area) if detection rates are known to be constant and/or when all individuals can be detected.
- Contribute to our knowledge of waterbird populations by participating in the CWC at a basic level.

Description of Method – Area Search and Point Count

The Area Search mimics the process that a birder would use while searching for birds in a given area and is easy to learn and popular with volunteers. A birder's goal is to maximize the number of species they see and the goal of a Site Inventory is much the same. When conducting an area search, the observer should move around the site or search area trying to identify and count ALL the birds in the area. Area Searches are often a good choice for wetlands that have good access such as boardwalks, dikes or which can be accessed by wading or canoe.

Area Searches will often provide a more comprehensive Site Inventory than a Point Count but there are often cases where Point Counts should be used. For example, if a wetland is not easily accessible or if birds will go into hiding because the observer is moving during an Area Search, then a Point Count should be conducted. Point Counts are also very easy to learn but unlike the Area Search, the observer stays at one place throughout the count period. Count stations, fixed locations to count birds, are established at vantage points around the edge of the wetland, and birds are counted for a specific period of time. Whether a Site Inventory is conducted with a Point Count, Area Search or even a combination of the two, the observer gathers and records the same information which includes what species are present and the numbers of individuals of each species. In addition, behaviors of interest or reproductive evidence should also be recorded.

Figure 21: Willet
Figure 22: Ruddy Duck

Many wetland birds are most active in the early morning or late afternoon, so Site Inventories should be conducted to match these active times. It's best to conduct an inventory in the first couple of hours after dawn and last 2 hours before dusk. For

coastal or tidal wetlands the best times to conduct an inventory will be more related to the tide than to sunrise and sunset. High tides will often concentrate shorebirds in narrower strips of land, which makes for easier counting and falling tides can also be a time of higher bird activity.

If you can repeat these counts, annually, seasonally or more frequently (if resources permit), this will provide not only seasonal species lists, but also show trends and changes across the seasons. To allow for comparison across the seasons or years, it is important that the counts are conducted exactly the same way each time you do the count: use the same protocol, start at the same time based on sunrise or tides, count for the same duration, and cover the same area or survey from the same count station. If the first count was an Area Search that started 1 hour after sunrise and covered 2.2 hectares, all subsequent counts should be conducted the same way.

Checklist of Equipment Needed for Level 1 Counts – Site Inventory/Basic Counts

Binoculars for all observers	
Spotting scope and tripod	
GPS	
Clipboard and pencils (sharpener, rubber)	
Aerial or survey map/Google Earth image or sketch map of area showing the wetland.	
Field forms – CWC Area Search Form for Basic Counts and Notes	
Country or site checklist of birds (if available)	
Field notebook (preferably waterproof)	
Coloured flagging tape (optional)	
Field guide (e.g., Birds of the West Indies)	
Waders or appropriate footwear	
Drab, non-colorful clothing (avoid wearing white), hat, sunscreen and bug spray	
Stopwatch or digital watch with countdown feature	
Digital camera with 7x or greater telephoto lens (optional but recommended)	

Selecting the Site

Ideally, the sites for both Area Searches and Point Counts should allow relatively easy detection and identification of birds (by sight or calls), and allow the observer unobstructed views of the wetland. In a wetland site, it is acceptable to make use of a boardwalk, trail or dike (or wade/walk through water), or if the water body is large enough and you have a canoe or kayak either an area search or series of point counts can be conducted throughout the wetland. The area covered by an Area Search is generally determined by what can be thoroughly covered in 10-30 minutes. Generally, this is up to 3 hectares but can be a larger area in open wetlands. Where a wetland is large enough and accessible it may be preferable to do several area searches. Search areas should be well defined on the ground and on a map and not overlap.

Observers

At least one observer should be able to identify by sight and sound all the species likely to be encountered at the site. Conducting Level 1 counts is also a very good way to train new observers in bird identification, counting methods, and to

familiarize surveyors with the site. Observers should stay together, act as one observer, and record all observations on the same sheet. Beginning birders and new volunteers should be encouraged to come along and get involved[14].

Conducting the Area Search

Prior to starting your count, make sure you have your binoculars on and your field form ready to record data on your clipboard. Approach the search area quietly in order to cause as little disturbance to the birds as possible and begin your count as soon as you arrive in the area. If you have a GPS, set it to begin recording your route. Record on your field form the start time of your count and your starting position on the map of the wetland. Identify and count every species you detect during the Area Search and make note of any behavior or breeding evidence you observe. If you flush birds as you arrive at the search area, do your best to record the species and number of individuals, as these should be included in your count. If you encounter a bird that is difficult to identify, make notes on its characteristics, behavior and vocalizations, or better yet, if you have a camera, take a picture and note it on your field form as "Unidentified." If you are limiting your count time to a specific duration for basic monitoring, then do not spend more than a minute or two trying to identify the bird. If it is still in the area after you have completed your survey, you can spend the time necessary to identify the bird and update your form.

One of the challenges that you often encounter with wetland monitoring is counting large flocks. Instead of counting every single bird in a flock, one good approach is to identify the species composition of the flock, estimate the proportion of each species and finally estimate the entire flock size (e.g, counting by 10s or 20s)[15]. You can then easily calculate good estimates of numbers for each species. Note: If doing the count from a boardwalk, road or dike that is not a loop, count the birds from a start point to an end point one way only to avoid counting birds twice. However, if you do come across a new species on the way back, record the species and number of individuals in your count, noting that it was seen on the way back.

If you are using Level 1 Area Search to monitor a site throughout the year and/or over a period of years, we recommend that you structure your count by following the same protocol each time you do the count, and cover the same area and count for the same duration. Twenty minutes is typical but counts can be shorter or longer depending on the size of the area and number of birds at the site.

Conducting the Point Count

Prior to starting your count, make sure you have your binoculars on and your field form ready to record data on your clipboard. Approach the point (count station) from which you will be counting quietly in order to cause as little disturbance to the birds as possible and begin your count as soon as you arrive. Record on your field form the start time of your count. Identify and count EVERY species you detect during the Point Count and make note of any behavior or breeding evidence you observe. If you flush birds as you arrive, do your best to record the species and number of individuals, as these should be included in your count. If you encounter a bird that is difficult to identify, make notes on its characteristics, behavior and vocalizations, or better yet, if you have a camera, take a picture and note it on your field form as "Unidentified." If you are limiting your count time to a specific duration for basic monitoring, then do not spend more than a minute or two trying to identify the bird. If the bird is still in the area after you have completed your count, you can spend the time necessary to identify the bird and update your form.

One of the challenges that you often encounter with wetland monitoring is counting large flocks. Instead of counting every single bird in a flock, one good approach is to identify the species composition of the flock, estimate the proportion of each species and finally estimate the entire flock size (e.g., counting by 10s or 20s). You can then easily calculate good estimates of numbers for each species. How much time should you spend on a point count? When you have counts of all the species you can detect from the count station, spend another 5 minutes searching for birds because some secretive species will begin to re-emerge. Once you complete the Point Count, record the duration in minutes of the survey on the field form and note your exact location, if you have a GPS, record the location as a point.

[14] Powerpoint presentations are available on the CWC ConserveOnline workspace (http://conserveonline.org/workspaces/cwc) to help with training in bird identification and counting techniques.
[15] A Wildlife Count CD is available to provide training with counting large flocks of birds.

If you are using Level 1 point count methods to monitor a site throughout the year and/or over a period of years, we recommend that you structure your count by following the same protocol each time you do the count, include the same area in your point count and count for the same amount of time. Six minutes is standard for Level 2 and 3 monitoring. If more time is needed, then use 9 minutes or 12 minutes.

Timing of Count/Number of Counts per Year

To participate in the Caribbean Waterbird Census, carry out at least one count during the regional CWC Winter Count in January (dates to be to be set annually by BirdsCaribbean)[16], plus if possible at least once per season in:

- Spring (migration and peak resident breeding) – March – May
- Summer (breeding and post-breeding for residents and summer migrants) – June-August
- Fall (migration) – September-November

Recording Data

Use the CWC Area Search or Point Count Form for Site Inventory/Basic Counts and notes on completing it below.

Analysing and Storing Data

Count data should be entered on eBird Caribbean (http://ebird.org/content/caribbean) as soon as possible after the count is completed. Choose the "Caribbean Waterbird Census (CWC) Area Search" option OR Caribbean Waterbird Census (CWC) Point Count" option on the "Submit Observations" page. The data can also be entered on a computer in standard CWC spreadsheets (available for download at: https://www.dropbox.com/sh/9h1ebbrrcnisoht/AAD3UaCzfgZoryCzerSmSyy8a?dl=0, and sent to the CWC Coordinator.

Once these data are entered into eBird Caribbean, you can easily generate a list of the species by season and examine the data by making histogram charts (e.g., in Excel) of the frequency of the more common species (e.g., mean number of birds, maximum number of birds). This will provide information on seasonal changes in species presence/absence as well as changes in abundance. Combined with historic information and records of birdwatchers and others familiar with the site, one can create a checklist for the site, with estimates of abundance categories (e.g., common, uncommon, rare, vagrant) for each season. This information can begin to tell you the conservation importance of a site based on the presence of threatened or endangered species, the diversity of bird species at the site, or the presence of a significant portion of a population.

Summary of Important Points

When conducting Level 1 monitoring, record the species and number of individuals and make sure to count every species you detect. Remember, the goal of a Site Inventory is to generate a complete list of species for the site. Recording all species also ensures that the data you collect are much more valuable, both currently and far into the future. If your records indicate that you saw 5 West Indian Whistling-Ducks and 4 Ruddy Ducks, but you did not reply "yes" to the question "Are you reporting all species?" in eBird Caribbean then we do not know if the wetland also had Blue-winged Teal or some other species. Even if a species is not of conservation interest today, it may be of interest 20 years from now, and if you collect data on ALL species today, those data will be much more useful in the future (see Appendix 2).

Conducting Level 1 Point Counts, Traveling Counts or Area Searches or annually or seasonally will provide a richer dataset for understanding how a wetland is utilized by differing species throughout the year and over time. Remember that it is important to follow the **same** protocol each time you conduct a repeat survey of an area.
- Count birds at the same time of day.

[16] CWC survey dates in 2011 are January 14th to February 3rd inclusive.

- Count birds at the same time(s) of year.
- Avoid counting in poor weather (heavy rain, high wind).
- Cover the same search area or point and spend the same amount of time identifying species and counting individuals per species.

Note that if you need to make any revisions to your protocol (e.g., change the starting location of the count, make a change to the survey schedule, size of area, etc.), be sure to keep a record of the change.

CWC Traveling Count/ Area Search Form for Site Inventory/Basic Counts

Date _____ Site Name:_____ Site Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Start Time: _____ End Time: _____ Duration: _____ Distance Traveled (m) _____ Area (Hectares): _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ Total # of spp:_____

Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes

ADDITIONAL NOTES

Sky codes: **0** = clear or a few clouds, **1** = partly cloudy/variable, **2** = cloudy/overcast, **3** = fog, **4** = drizzle, **5** = rain (do not survey)
Wind codes: **0** = calm; **1** = light air; **2** = leaves start to rustle; **3** = small branches start to sway; **4** = moderate breeze; **>4** Do not survey
Wind direction: N, S, E, W **Noise factor:** 1 = No noise, 2 = Moderate, 3 = Too much noise, do not survey
Number in group #: indicate sex if known, **M** = Male, **F** = Female, and if the bird is an immature, **J** = Juvenile
Detection Type (DT) **A** = **Au**ral, **V** = **V**isual, **F** = **F**ly over
Breeding Status (**BS**) (if any) **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood, **D** = **D**istraction display, **L** = **L**ocal young (limited flight or being fed by parents), **C** = **C**opulation or **C**ourtship observed, T = **T**erritorial behavior (chasing)
Human disturbance near count site at time of survey: Fishers, Hunters, Tourists, other _____
Water level - % of wetland covered with water: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100%
Vegetation - % of wetland covered with plants: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100% **Species** _____
Photograph taken of the site: Yes/No Unusual species: Yes/No _____

Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes

ADDITIONAL NOTES

NOTES ON COMPLETING THE CWC TRAVELING COUNT/ AREA SEARCH FOR SITE INVENTORY/BASIC COUNTS FORM[17]

Page _____ of _____: The page number of current page and the total pages for the survey route.

Date: Write the date of the survey as Day-Month-Year, using two numbers for month and day and four numbers for year.

Area Name: The name of the survey route or site (e.g., Great Pond).

Area Code/#: The code or number of the area being surveyed (e.g., GP1, GP2, or GP3).

GPS Loc: Coordinates for starting point of search area in UTM or decimal degrees (degrees, minutes and seconds) OR note your location so that you can find the coordinates from Google Earth later

Observer, Recorder, Trainees: The full name of the primary observer, the person recording the data, and secondary observers or trainees (if present).

Start time: The time (using a 24-hour clock) that you started your 20-minute search.

End time: The time (using a 24-hour clock) that you ended your 20-minute search.

Duration: Duration of survey in minutes, 20. The duration will depend on the distance that you travel or size of area that you search but aim for a duration of 15-20 minutes. Once this is set for your count, aim to complete the count in a similar amount of time each time you do the count. In the prescribed time, identify the birds that you can, but don't spend too much time on individual identifications. Identification to groups, such as small peeps, dowitchers, etc. is better than not counting everything. You can always spend some time post-count period with more refined identifications.

Distance Traveled: The distance that you walk, drive, or paddle during the count. We recommend that you keep this to less than 1 km. If the area that you need to cover is longer than this, break the count up into 1 km sections or less. If the habitat changes substantially, make this a separate count. If using the eBird Mobile app in the field (recommended), be sure to have the "Record track" feature turned on as this will record the distance that you travel during your count. This is found on the "Set Date & Time" of ""Start New Checklist" screen.

Area: Size of the area that you counted in hectares. This can be measured with an online planimeter (take 3 or more measurements and calculate the average size): http://www.acme.com/planimeter/

Temp: The temperature at the beginning of the survey recorded in degrees Celsius.

Sky code: The cloud cover and amount of precipitation at the beginning of the survey.

0 = clear or a few clouds **1** = partly cloudy/variable **2** = cloudy/overcast **3** = fog **4** = drizzle **5** = rain (do not survey)

Wind code: The wind at the beginning of the survey using the Beaufort Wind Scale class.

0 = calm, 0-1 mph, smoke rises vertically and the sea is mirror smooth

1 = light air, smoke moves slightly with breeze and shows direction of wind

2 = you can feel wind on your face and hear the leaves start to rustle

3 = gentle breeze, small branches start to sway, wind extends a light flag.

4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway

>4 = Do not survey, too much wind.

Wind direction: North, South, East or West

Noise: The noise experienced at the beginning of the count; 1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away (do not complete the count if there is too much noise). If the cause of the noise is expected to be a continuous problem over time, you may need to move your area search away from the source of the noise.

Total # of spp: The total number of species seen during the count.

[17] The CWC Traveling Count/ Area Search Count Form and Notes ca[illegible]d to suit your particular needs and situation (e.g., what variables are recorded, etc.), however, we recommend that you follow the ba[illegible]t of Area Search methods described in this protocol in order to maximize the scientific value of the data and capacity to compare moni[illegible]g sites and locations across the Caribbean.

COUNTING AND RECORDING BIRDS

Species Code or Name: A short clear abbreviation for the bird species common name should be recorded. If you are not using a standard abbreviation such as AOU species alpha codes—four-letter codes formed by using the first letter or two letters of each part of the bird's name (e.g., West Indian Whistling-Duck = WIWD, American Coot = AMCO, Yellow-crowned Night-Heron = YCNH)[18]—be sure to put a key to your abbreviations on the form. Use code *and* abbreviated name if you are not absolutely certain of the species code[19]. **If you make up codes be sure to record on your data sheet what they are to avoid confusion later.**

DT (Detection Type): The first behavioral cue that alerted the observer to the presence of the species; A = Aural, V = Visual, F = Fly over.

BS - Breeding Status: Any breeding evidence observed during the count should be recorded.

N = Current year's **N**est found in the study area with eggs or young, in the process of being built, or already depredated or abandoned.

M = Adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area.

F = adult seen carrying **F**ood or **F**ecal sac to or from a likely nest site in the study area.

D = Distraction **D**isplay or injury feigning by an adult bird.

L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area.

C = **C**opulation or **C**ourtship observed of a species within its breeding range

T = **T**erritorial behavior observed (calls, chasing).

TOT – Total number of individuals counted for each species

Identification or Behavior Notes: Details of any behavioral observations of the species or identification notes for "Unidentified" individuals. If you need help with species identification, share the photo with expert birders in the CWC network.

Human disturbance near count site at time of survey: Note any human activity that might affect bird abundance, e.g., Fishers, Hunters, Tourists, other – circle one or please describe

Water Level: The amount of water present may serve as an index of habitat availability/quality. Give an estimate or circle a category corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.

Vegetation - % of wetland area covered with plants: Can give an estimate or circle a category. **Dominant species:** If you know the name of the species write it here.

Photograph taken of the site: Note if a photo was taken and where/why.

Photographs of unusual species: Try to get a photo of any unidentified or unusual species for the site, note if a photo was taken so that you can remember to examine it later. If you need help with species identification, share the photo with expert birders in the CWC network.

Additional Notes: Make notes regarding unidentified birds, birds observed between points, threats to birds or habitats, changes you have observed in the wetland or other useful information. Be sure to write a note explaining any unexpected or rare species detected. When applicable, notes should be labeled with a number so that the note can be entered in the database with the appropriate record.

[18] **To download standard four letter species codes, visit: http://www.birdpop.org/alphacodes.htm**

[19] **AOU species codes should be learned and checked as they can be confusing, for example, White-crown Pigeon is WCPI, while White-cheeked Pintail is WHIP.**

CWC Traveling Count/ Area Search Site Inventory/Basic Counts Form – filled in with sample data and notes

Date _____ Area Name:_____ Area Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Survey Start Time: _____ Survey End Time: _____ Duration: _____ Distance Traveled (m)_____ Total # of spp: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ pH _____

Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes
BNST – Blk-necked Stilt	20	V		20	
SNEG – Snowy Egret	5, 7, 1, 2	V		15	
BWTE – BW Teal	12M, 8F, 14M, 7F, 2M	V		43	
WHIP – White-cheeked Pint.	3M, 1F	V	C	4	
Unident. Sandpipers	12	V		12	small, brown above and white belly, small thin black bill, yellowish-green legs
WIPL – Wilson's Plover	3, 6, 2	V	N	11	
WILL - Willet	4, 3	V		7	
COMO – Common Moorhen	15, 13, 7	V		35	
OSPR - Osprey	1	V		1	Seen catching and carrying a large turtle
SORA - Sora	1	A		1	
MAGR – Magn. Frigatebird					soaring over survey area.
GRYE – Gr. Yellowlegs	5, 13	V		18	
YCNH – Yellow-cr. Night Heron	1	V		1	

ADDITIONAL NOTES

- Upon arrival, flushed ~20 Black-necked Stilts near start of survey route; they did not return.
- 1 Wilson's Plover nest found with 4 eggs, one of the parents did a distraction display (feigned broken wing).
- Took photo of unidentified sandpipers.
- Took photos of Willets and Greater Yellowlegs to verify ID.

CWC Point Count Form for Site Inventory/Basic Counts

Date _____ Site Name:_____ Point Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Start Time: _____ End Time: _____ Duration: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ Total # of spp: _____

Pt. #	Time	Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes

ADDITIONAL NOTES

Sky codes: **0** = clear or a few clouds, **1** = partly cloudy/variable, **2** = cloudy/overcast, **3** = fog, **4** = drizzle, **5** = rain (do not survey)
Wind codes: **0** = calm; **1** = light air; **2** = leaves start to rustle; **3** = small branches start to sway; **4** = moderate breeze; **>4** Do not survey
Wind direction: N, S, E, W **Noise factor:** 1 = No noise, 2 = Moderate, 3 = Too much noise, do not survey
Number in group #: indicate sex if known, **M** = Male, **F** = Female, and if the bird is an immature, **J** = Juvenile
Detection Type (DT) **A** = **Au**ral, **V** = **V**isual, **F** = **F**ly over
Breeding Status (**BS**) (if any) **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood, **D** = **D**istraction display, **L** = **L**ocal young (limited flight or being fed by parents), **C** = **C**opulation or **C**ourtship observed, T = **T**erritorial behavior (chasing)
Human disturbance near count site at time of survey: Fishers, Hunters, Tourists, other _____
Water level - % of wetland covered with water: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100%
Vegetation - % of wetland covered with plants: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100% **Species** _____
Photograph taken of the site: Yes/No Unusual species: Yes/No _____

Pt. #	Time	Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes

ADDITIONAL NOTES

CWC Point Count Site Inventory Form – filled in with sample data and notes, 6 minute counts

Pt. #	Time	Species Code or Name	# in group	DT	BS	TOT	Identification or Behavioral notes
1	0630	BWTE-Blue-winged Teal	23M, 19F, 4M, 2F, 24M,10F	V		72	
		BWTE – Blue-Winged Teal	1F	A		1	
		GRYE – Greater Yellowlegs	5, 3, 9	V		17	
		SNEG – Snowy Egret	2	V		2	
		COMO – Common Moorhen	2A, 2J	V	L	4	
		OSPR – Osprey	1	V		1	
		SORA – Sora	1	A		1	
		MAGR – Magn. Frigatebird	5M, 3F, 4J	F		12	soaring over point area
	0636						
2	0647	BNST – Blk-necked Stilt	20	V		20	
		WHIP – White-cheeked Pint.	3M, 1F	A	C	4	
		YEWA – Yellow Warbler	1M	V		1	
		WIPL – Wilson's Plover	3	V	N	3	
		Unident. Sandpipers	14	V		14	small, brown above and white belly, small thin black bill, yellowish-green legs
		GBHE – Great Blue Heron	3	V	N	3	
	0653						

ADDITIONAL NOTES

Pt. #1

- Took photos of Greater Yellowlegs to verify ID.
- All frigatebirds were soaring over point area.

Pt. #2

- Upon arrival, flushed ~20 Black-necked Stilts near start of survey route; they did not return.
- Male WHIPs were courting female.
- 1 Wilson's Plover nest found with 4 eggs, one of the parents did a distraction display (feigned broken wing).
- Took photo of unident sandpipers ((small, brown above and white belly, small thin black bill, yellowish-green legs).

Page _____ of _____: The page number of current page and the total pages for the survey route.
Date: Write the date of the survey as Day-Month-Year, using two numbers for month and day and four numbers for year.
Site Name: The name of the survey route or site (e.g., Great Pond).
Point Code/#: The code or number of the point being surveyed (e.g., GP1, GP2, or GP3).
GPS Loc: Coordinates for Point Count in UTM or decimal degrees (degrees, minutes and seconds) OR note your location so that you can find the coordinates from Google Earth later
Observer, Recorder, Trainees: The full name of the primary observer, the person recording the data, and secondary observers or trainees (if present).
Start time: The time (using a 24-hour clock) that you started your point count survey route.
End time: The time (using a 24-hour clock) that you ended your point count survey route.
Duration: Duration of time to complete the survey route in minutes.

Temp: The temperature at the beginning of the survey recorded in degrees Celsius.
Sky code: The cloud cover and amount of precipitation at the beginning of the survey.
0 = clear or a few clouds **1** = partly cloudy/variable **2** = cloudy/overcast **3** = fog **4** = drizzle **5** = rain (do not survey)
Wind code: The wind at the beginning of the survey using the Beaufort Wind Scale class.
0 = calm, 0-1 mph, smoke rises vertically and the sea is mirror smooth
1 = light air, smoke moves slightly with breeze and shows direction of wind
2 = you can feel wind on your face and hear the leaves start to rustle
3 = gentle breeze, small branches start to sway, wind extends a light flag.
4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway
>4 = Do not survey, too much wind.
Wind direction: North, South, East or West
Noise: The noise experienced at the beginning of the count; 1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away (do not complete the count if there is too much noise). If the cause of the noise is expected to be a continuous problem over time, you may need to move your area search away from the source of the noise.
Total # of spp: The total number of species seen during the count.

COUNTING AND RECORDING BIRDS

Species Code or Name: A short clear abbreviation for the bird species common name should be recorded. If you are not using a standard abbreviation such as AOU species alpha codes—four-letter codes formed by using the first letter or two letters of each part of the bird's name (e.g., West Indian Whistling-Duck = WIWD, American Coot = AMCO, Yellow-crowned Night-Heron = YCNH)[20]—be sure to put a key to your abbreviations on the form. Use code *and* abbreviated name if you are not absolutely certain of the species code[21]. If you make up codes be sure to record on your data sheet what they are to avoid confusion later.
Number in group: Individuals are written down in the order they are observed. The number of individuals is recorded when more than one of a species is detected in a group, cluster or flock at the same moment in the same part of the wetland. As you arrive at the count station be ready to record any birds that are flushed.
DT (Detection Type): The first behavioral cue that alerted the observer to the presence of the species; A = Aural, V = Visual, F = Fly over. **N.b.** If you have a lot of birds to record, do not waste time recording age and sex of flyovers.
BS - Breeding Status: Any breeding evidence observed during the count should be recorded.

[20] To download standard four letter species codes, visit: http://www.birdpop.org/alphacodes.htm
[21] AOU species codes should be learned and checked as they can be confusing, for example, White-crown Pigeon is WCPI, while White-cheeked Pintail is WHIP.

N = Current year's **N**est found in the study area with eggs or young, in the process of being built, or already depredated or abandoned.

M = Adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area.

F = adult seen carrying **F**ood or **F**ecal sac to or from a likely nest site in the study area.

D = Distraction **D**isplay or injury feigning by an adult bird.

L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area.

C = **C**opulation or **C**ourtship observed of a species within its breeding range

T = **T**erritorial behavior observed (song, chasing).

TOT – Total number of individuals counted for each species

Identification or Behavior Notes: Details of any behavioral observations of the species or identification notes for "Unidentified" individuals. If you need help with species identification, share the photo with expert birders in the CWC network.

Human disturbance near count site at time of survey: Note any human activity that might affect bird abundance, e.g., Fishers, Hunters, Tourists, other – circle one or please describe

Water Level: The amount of water present may serve as an index of habitat availability/quality. Give an estimate or circle a category corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.

Vegetation - % of wetland area covered with plants: Can give an estimate or circle a category. **Dominant species:** If you know the name of the species write it here.

Additional Notes: Make notes regarding unidentified birds, birds observed between points, threats to birds or habitats, changes you have observed in the wetland or other useful information. Be sure to write a note explaining any unexpected or rare species detected. When applicable, notes should be labeled with a number so that the note can be entered in the database with the appropriate record.

Caribbean Waterbird Census – Level 2 Protocols for Counting Waterbirds

The CWC offers 4 levels of monitoring. These are:

- Level 1 Site inventory/Basic counts
- **Level 2 Counts with simple detection probability**
- Level 3 Counts with distance sampling
- Level 4 Simultaneous/repeated counts at multiple sites

The following protocols apply to Level 2 monitoring, using either Traveling Count, Area Search or Point Count methodologies. Level 1 monitoring is the most basic approach, used to provide a site inventory, gain experience in counting birds, and plan more detailed surveys. Levels 2-4 may provide the type of information needed for adaptive management of a site. Importantly, these levels may incorporate measures of *detection probability* (or *detectability*) for count data, or attain constant or perfect detection under standard census conditions.

Detection is rarely perfect due to the fact that some birds are more difficult to see or hear than others and some habitats conceal birds better than others. Perfect or constant detection is assumed in most studies that use an index of abundance derived from count data. Detection may be affected, however, by the observer, species, habitat, weather, and many other site and survey specific covariates. In population studies that require estimates of density (number of birds/unit area), it is essential to attain perfect detection, or estimate detection probability from count data. This can be done in several ways, including:

- *Repeated counts*: counts are repeated within a short period of time (e.g., 3 times in a week or 10 day period).
- *Removal counts*: counts are divided into equal time periods (e.g., two 3-minute counts). Birds are only counted in the first time period in which they are detected aurally or visually (i.e., they are recorded at the time of first detection only and are thereafter considered to have been "removed" from the count).
- *Double observer methods*: for example, two observers make independent counts at the same place at the same time
- *Distance sampling:* horizontal distances are measured between the observer and a single bird or the geometric center of a cluster of birds (group or flock). Distance sampling can be implemented using fixed-radius and variable-radius point counts (variable circular plots). Rangefinders should be used to measure exact distances or group distances into categories (e.g., 0–30, 31–60, 61–120, 121–180, 181–240, and >240 m; or just 0–240 and >240 m for binomial distance sampling models). For the CWC, however, we recommend measuring exact distances.

Using these methods it is possible to compare the densities of different species or the densities of the same species over space, time, or both. Each of these methods has advantages and disadvantages. The observer needs to pay careful attention to survey design and count standardization to meet basic method assumptions. The count methods may be combined to add flexibility to data analysis.

In the Caribbean many wetlands are small and/or are not heavily vegetated and it may be possible to conduct a census (complete count) of all the birds on the wetland from one or a few points. If you are confident that you can see and count all the birds that are present on the wetland, measures of detectability are less important.

Figure 23: Black-bellied Whistling-Duck

Area Searches[22] - CWC Level 2 Monitoring

Objectives

The Area Search method allows one to:

- Identify which species are present and prepare checklists
- Assess habitat use and seasonality in the searched areas
- Assess species diversity and richness, community composition, and relative abundance of species, assuming that detection remains constant in the searched areas over time
- Estimate density and abundance (number of birds in a small area) when detection probability is perfect or can be estimated from count data collected in the searched areas
- Measure changes in the relative abundance of species from year to year to monitor population trends
- Collect data about habitat use, including information about nesting behaviour and seasonality.

Description of Method

This method, while quantitative, mimics the process that a birder would use while searching for birds in a given area. It is a timed count in which the observer is free to move around in a predetermined plot or "search area," in a specific habitat type. Observers spend a standard time period (usually 20 minutes) walking and searching for birds in the search area, stopping or moving to investigate sightings or calls when appropriate. The search area is typically visited 1-3 times a season with observers recording species presence, number of individuals per species, and reproductive status or behavior.

Advantages and Disadvantages of Area Search Method

- The method is easy to learn and popular with volunteers.
- This method may be particularly well suited to a wetland that has some kind of access through part of it, e.g., boardwalk or dike, or one that is accessible by wading or canoe.
- Species such as herons, egrets, and seabirds on their nesting colonies, marshbirds, and nocturnal species require special protocols (see Caribbean Birdwatch manual).
- Point counts will provide better data for analysis and management.

Assumptions of Area Search Method

- All birds are detected in the search area, regardless of species, habitat, season and other factors.
- Bird species are correctly identified and accurately counted.
- No individual bird is counted more than once in the search area.
- There are no significant differences in detectability between observers, habitats, vegetation, years and species or if there are differences these can be accounted for.

The duration of the count, time of day of the survey, observers (2-4) and area (defined by habitat type, see below) do not vary throughout the study.

[22] Adapted from *Landbird Monitoring Protocol for Klamath Network Parks Standard Operating Procedure (SOP) #7 Conducting Area Search Surveys*, *The Area Search Bird Census: A Habitat based Method* (2003) by G.R. Geupel, C.J. Ralph, and S. L. Jones, and *Handbook of Field Methods for Monitoring Landbirds* (1993) by C.J. Ralph et al.

Factors to be considered include the size, location and shape of the search areas, and the number of searches that can be conducted per day, week or season. These should be determined via a pilot study (reconnaissance survey or site inventory). The factors to be considered are summarized in Table 1 and described in detail below.

Table 2: Summary of factors to consider in designing an Area Search for the CWC

Factor	Recommendations	Notes
Site selection	Site should be large enough to allow for 1- 3 search areas (e.g., 3-ha plots)	Search areas may be adjacent or separated. If inference beyond the search area is desired, then you need to consider the issue of randomization and replication for adequate coverage and representation of areas beyond the sampled areas. Search areas may be any size or shape (e.g., round, oval, linear, or irregularly-shaped).
Search area location	Should be located in wetland along boardwalk, trail, or dike or reachable by canoe. Areas and search routes should be mapped, marked by GPS and well described so that they can be revisited for subsequent surveys.	Record boundaries of search area using natural features, roads, structures and GPS points, etc. The area of the search and time need to be defined (e.g., 5 ha in 20 min)
Habitat type	Any (e.g., marsh, salt pond, mudflat, mangrove lagoon, stretch of beach, etc.), but preferably uniform	Method is suitable for any habitat type with adequate access.
Duration of search	20 minutes is typical but smaller or larger areas may require more or less time (e.g., 10 minutes or 30 minutes)	Once set for your site this is standard and must not be modified.
Size of search area	Determined by size and shape of wetland. This method is best for areas where the viewing distances are relatively small (50-100 m) and a spotting scope is not necessary for identification	Depends on habitat type – must be capable of being thoroughly searched in 20 minutes (see below). This must be determined in pilot surveys and defined on a map with reference to landmarks, GPS points, etc. (see above).
Number of searches per year /time of year	MINIMUM 1 count/year: CWC Winter Count in January (dates to be set annually by BirdsCaribbean)[23] PLUS (if possible) at least once per season - Spring (migration): March-May - Summer: June-August - Fall (migration): September-November OR once per month.	Number of searches and dates depend on your monitoring objectives, site, and resources. Once set, searches should be done on approximately the same dates annually. All sites participating in the CWC should aim to include survey dates to be set in the last 3 weeks of January.
Number of searches per season/site	Searches should be carried out more than once for each site in each season, e.g., once per week over a 2 or 3-week period.	Counts should be conducted at approximately the same time of year. To monitor migrants, conduct searches on a regular basis (e.g., 1 to 3 times per week) throughout the season.
Time of day	Within 4 to 5 hours after dawn or between 1600 and dusk.	Once set for your site, this is standard and must not be modified. Searches should not be conducted in the heat of the day.
Number of searches/day	3 to 5 searches can be done/day depending on conditions	

[23] CWC survey dates in 2011 are January 14th to February 3rd inclusive.

Factor	Recommendations	Notes
Estimating detectability	Use repeated counts (e.g., 2 or 3 counts within a 1 week or 10 day time period) or double observer method.	Counts may be conducted on consecutive days or every other day, the closer together in time the better to meet the assumption of a closed population

Checklist of Equipment Needed for Area Searches

Binoculars for all observers	
Spotting scope and tripod	
GPS	
Clipboard and pencils (sharpener, rubber)	
Aerial or survey map/Google Earth image or sketch map of area showing outline of search area, survey route and landmarks/boundaries	
Field forms – CWC Area Search for Waterbirds Count Form and Notes	
Country or site checklist of birds (if available)	
Field notebook (preferably waterproof)	
Coloured flagging tape (optional)	
Field guide (e.g., Birds of the West Indies)	
Waders or appropriate footwear	
Drab, non-colorful clothing (avoid wearing white), hat, sunscreen and bug spray	
Stopwatch or digital watch with countdown feature	
Digital camera with 7x or greater telephoto lens (optional but recommended)	
Stick, 1-2 metres in length, marked off in centimeters (to measure water depth)	
Measuring tape – (optional)	
Secchi disc (optional)	
Portable water meter, salinometer, or small sample bottles to collect water samples (optional but recommended) – to measure salinity, pH, etc.	

Selecting the Site

Ideally, the site should allow relatively easy detection and identification of birds (by sight or calls), and allow the observer to move about freely (e.g., on a boardwalk or wading/walking through or around the wetland). The site should be sufficiently large to provide at least 1 search area (or plot), measuring about 3 ha in closed habitats (e.g. dense mangroves) but larger areas of 10 ha or more can used in more open habitats. The major criterion for size is that the entire search area can be completely covered within the amount of time allotted for the search, usually 20 minutes. The duration of the search can be shorter or longer depending on the size of the area and number of birds, but once set for the area, it should not be modified.

In a wetland site, it is acceptable to make use of a boardwalk, trail or dike (or wade/walk through water), counting birds in a predefined area corresponding to the area in which birds can be detected and identified accurately using binoculars (whose area you can measure from a Google Earth image or a map). Alternatively, if you have a canoe or kayak in a large enough water body you can select survey sites based on selected points throughout the wetland. Random selection is not needed unless you wish to make an inference beyond the searched area.

Where a wetland is accessible enough it may be possible to do several area searches in 1 site. Search areas should be well defined and not overlap. If possible, select search areas systematically so that all major habitat types are represented. You should keep in

mind, and record for future reference, where the boundaries are by using natural features, roads, GPS points, etc. More than 3 search areas can be established within a site. It is important that the same search area, within the same boundaries, be surveyed on each visit. Areas and search routes should be mapped on a topographic map, route tracked with a GPS and well described (on the Site Description Form; see CWC Protocols for Habitat Monitoring) so that others can locate them and repeat the search accurately.

It may be very difficult to make regular surveys of remote areas, however, information from such areas is still important. Therefore, even a single 20-minute count would be of value in a specified habitat in an inaccessible area. One count per season would provide information on gross seasonal changes in these habitats.

Timing of the Survey – Time of Day and Suitable Weather Conditions

The best time for surveys is between sunrise and five hours after dawn. Note that after about 11:00 a.m. bird activity declines quickly, increasing again in the afternoon between about 1600 and dusk. Birds tend not to be active in rain or strong winds so avoid carrying out surveys in adverse weather conditions.

Number of Searches/Day

In ideal conditions 3 to 5 searches can be conducted per day.

Number of Searches/Season – Repeated Counts

In order to determine habitat associations and/or to estimate detectability, area searches should be done more than once for each site in each season. If your objectives are to determine movements and use of an area by migrants, it would be very useful to conduct counts more frequently, for example several times per week during migration periods.

Measuring Detectability

- **Repeated counts:** to estimate detectability of birds at the site, repeat the survey 2 to 3 times or more within a short period of time (e.g., within 1 week if possible).
- The **double observer** method can be used to estimate detectability if you have 2 highly skilled observers or teams that can conduct the count at the same place at the same time. The observer/teams should stay together during the count but conduct the count independently.

Number of Searches/Year

Area searches can be conducted at any time of the year. The number and timing of searches you conduct in a year depends on your monitoring objectives, available resources, and the timing of migration and breeding on your island. Generally, for all-bird surveys BirdsCaribbean recommends 4 counts covering the main seasons:

- Winter (over-wintering and residents) – December-February; **the core period for the CWC is January and BirdsCaribbean will set dates annually on which all participating** sites should try to count. These dates will include the last 3 weeks in January.
- Spring (migration and peak resident breeding) – March-May
- Summer (breeding and post-breeding for residents and summer migrants) – June-August
- Fall (migration) - September-November

Observers

At least 1 observer should be able to identify by sight and sound all the species likely to be encountered at the site. Pilot surveys should be conducted to become familiar with the species that are present and also to provide training to new persons, either as recorders or counters. Up to 4 observers per search is acceptable but 2 are preferable to minimize disturbance, standardize

search effort, and maintain high detection probability within and between visits. Two observers are also preferred for safety. Observers should stay together, act as 1 observer, and record all observations on the same sheet. Beginning birders and new volunteers should be encouraged to come along and get involved, but it is very important that the number and skills of the observers are standardized over the period of the monitoring project; changes in search effort (number and quality of observers, area covered, and time spent searching) will adversely affect the validity of any comparisons of species presence and abundance over time.

Preparing for the Area Search

Select area

- Pilot searches should be carried out to identify the general study area, mark the starting points of area searches, and the boundaries of the "on site" area which may be any shape or size (e.g., round, oval, linear, irregular), and for experienced observers to start to train less experienced ones to identify birds. The site should be mapped and thoroughly described on a site description form.

Select route

In most wetlands access will be limited and searches will be located along trails, roads, dikes and boardwalks. Where there are no trails, it may be possible to use a boat route (using a route that allows the observer to see all the birds with a minimum of disturbance.) The use of a boat (even a canoe and kayak) causes more disturbance than observing birds from the land, therefore it should be used only if necessary.

Train observers in bird identification and count methodology

- All observers should undergo training in bird identification by sight and sound and counting birds. Powerpoint presentations are available on the CWC ConserveOnline workspace (http://conserveonline.org/workspaces/cwc) to help with training[24] and practice counts should be conducted to familiarize observers with the protocol. Screen observers to ensure their skills are adequate, and if not, allow more time for practice in the field during a pilot period of monitoring.
- Select the person with the best identification skills to conduct the survey (primary observer); the other person(s) (recorder and trainees) should record data and help the primary observer keep track of which birds have been counted and any new birds that have come into view during the count. Any trainees present can practice spotting, identifying and counting birds. The observer and recorder should make sure that they review the notes on completing the CWC Area Search Data Form and practice counts should be conducted so that each person is well familiar with the protocol and use of the count form. The minimum number of observers is 1 (although this is not recommended for safety reasons), maximum 4, optimum 2 (primary observer and recorder). If there is 1 observer, use of a tape recorder to record count data is recommended. For the double observer method of estimating detection probability 2 such teams will be needed (or 2 skilled observers using tape recorders), working simultaneously. The assumption of this method is that the observers do not share information or influence each other's count, so do your best to work independently.

Assemble equipment and field forms

- Use the checklist above to assemble equipment and field forms. This should be done the day before the survey.

Conducting the Area Search

Starting the count

[24] The Wildlife Count CD is also available to practice estimating numbers of birds.

- Prior to approaching the survey area, have your binoculars on and your field form ready to record data on your clipboard. Approach the start of the search area quietly in order to cause as little disturbance to the birds as possible. Begin your count as soon as you are at the start of the route. If you flush birds as you arrive, do your best to record the species and number of individuals as these should be included in your count.

Route

- Walk (or canoe) on a predetermined 20-minute route in an approximate circle, oval or line using the field form to record all birds. If doing the count from a boardwalk, road or dike that is not a loop, count the birds from a start point to an end point one way only. If you detect a new species on your way back, however, this should be recorded in your count. Notes on completing the field form are provided below.
- Walk or paddle for exactly 20 minutes, stopping or moving to investigate sightings or calls as appropriate. Move systematically so that the entire area is covered in the time allotted.

Timing the count

- Use the countdown alarm feature on a digital watch to time the count. The 20-minute time constraint is an extremely important component of the technique and should be measured accurately.

Identifying birds

- Do not spend more than a minute identifying a difficult bird. Time can be spent identifying unknown birds after the standard time period allocated to the specific search area.

On area/Off area

- Concentrate on finding as many birds as possible within the search area ("on area") as the intent is to keep detection as high and as constant as possible in any given search area to justify comparisons of presence (detected species) and abundance (number per detected species).
- Record birds outside the search area ("off area") separately on your data sheet.

Flocks

- If you encounter a large mixed species flock, do not spend too much time figuring out the exact species composition. Spend 1-3 minutes making an estimate of the number of birds making up the flock and the proportion of each species. Pay special attention to identify the random straggler. If the flock is still present at the end of the 20-minute area search, you may then go back and figure out its exact composition.

Nest searches

- Do not conduct nest searches during the survey although you may record nesting activity. This can be done after the search (as with species identification).

Recording

- Record numbers of all birds of each species seen, heard, or both seen and heard in the search area during this time on the Area Search Count Form. If there is an unknown bird that cannot be identified, record it on your form as unknown.

Calls

- For birds heard calling, you will have to estimate whether they are inside your area or not.

Unknown calls or birds

- If you detect a bird but cannot immediately identify it, do not spend more than a minute of your 20-minute search tracking it. Record it as unknown, to closest taxonomic affiliation that you can determine (for example, "Unidentified Sandpiper" or "Unidentified Tern"), and continue your search. You can go back after your area search is complete to track it down to identify it. If possible, take a photograph and show it to experts in the CWC network for help with identification.

- Describe and/or draw the unknown bird as fully as possible in the "Additional Notes" section of the form (note the color of the crown, back, tail, throat, legs, etc., whether it had any markings on the face (e.g., eye ring), wing-bars, shape of the bill, size of the bird (in comparison to a bird that you know, e.g., bigger than a Greater Yellowlegs), behavior of the bird (e.g., feeding method, tail wagging), where in the habitat the bird was located (e.g., on the water, in the vegetation), and so forth. The data recorder should write down the description given by the primary observer. After the survey is completed, you can study your field guides and often determine, with a fair degree of confidence, the identity of the bird. If any of your bird identifications during the counts were uncertain, be sure to try and confirm that you named the bird correctly by checking your field guides. Don't be shy about asking birding experts to verify your identification of the bird.

Vegetation assessment

- Record the habitat variables you have decided to measure on your Area Search Count Form.

Collecting Data on Habitat and Conditions

The first step is to complete a detailed description of the overall habitat (site) by filling out the Site Description Form (see section on Habitat Monitoring). This will usually be done in the site reconnaissance visits. The objective is to provide a detailed description of the site, including habitat type, present condition, uses and threats. Once this has been done it will not be necessary to repeat it because it will be updated with observations of selected variables and any visible changes on your CWC Area Search for Waterbirds Count Form.

Each time you conduct a survey, it will be important to gather data on the habitat and current conditions at the site that may influence the number of birds at the site. All of these variables can be entered into the analysis of your data as covariates, allowing you to test hypotheses about the effect(s) of different conditions on numbers of species present and their abundance. We have included on the CWC Area Search for Waterbirds Count Form a number of potentially important covariates, such as weather conditions, water depth, salinity, extent of vegetation, etc. (see below). You may revise this form to include others or delete any variables you think are not applicable to your site.

If you are monitoring an IBA, we recommend that you follow BirdLife International's guidelines for monitoring threats, condition, and conservation actions at IBAs, and carry out this monitoring once per year if possible.[25]
Instructions and data forms are available in the BirdLife manual.

Recording Data

Use the CWC Area Search Count Form and notes on completing it below.

Analysing and Storing Data

Data should be entered on a computer in the standard CWC spreadsheets (available for download at: http://conserveonline.org/workspaces/cwc) as soon as possible after collection and tabulated according to the needs of the monitoring program in a format suitable for statistical analysis. Area Search data should be entered/uploaded into eBird Caribbean (choose the "Caribbean Waterbird Census (CWC) Area Search" option on the "Submit Observations" page). The data should also be sent to the CWC Coordinator.

[25] Available for download at the Caribbean Birdwatch ConserveOnline workspace: http://conserveonline.org/workspaces/caribbeanbirdwatch

Results could lead to inferences about species composition, breeding condition and numbers at a site or a series of sites. These could be used to compare sites or changes over time. See also the advice provided on the CWC ConserveOnline site about how to present data to decision-makers.

Summary of Important Points

Remember that it is absolutely essential to follow the **same** protocol (standard method) each time you do an area search. The protocol provided here specifies the exact technique to use so that the survey can be repeated by the same observer each time they count or by another observer in the future. The protocol is designed to minimize bias and error in the data, thereby increasing confidence in your survey findings. By following the protocol precisely, then comparisons of your counts are valid, and changes in the number of birds can be attributed to changes in the population.

- Count birds at the same time of day.
- Count birds at the same time(s) of year.
- Avoid counting in poor weather (heavy rain, high wind).
- Cover the same search area and spend the same amount of time identifying species and counting individuals per species (e.g., 20 minutes)

If you need to make any revisions to your protocol (e.g., change the starting location of the count, make a change to the survey schedule, size of area, etc.), be sure to keep a record of the revision history and archive of the previous versions of the protocol. Give the date that the change in the protocol was made and provide an explanation for the change.

Figure 24: Black-necked Stilts

CWC Area Search Count Form

Date _____ Area Name:_____ Area Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Start Time: _____ End Time: _____ Duration: _____Total # of spp: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ pH: _____

Species Code or Name	ON AREA # in group	DT	BS	TOT	OFF AREA # in group	DT	BS	TOT

ADDITIONAL NOTES

Sky codes: **0** = clear or a few clouds, **1** = partly cloudy/variable, **2** = cloudy/overcast, **3** = fog, **4** = drizzle, **5** = rain (do not survey)
Wind codes: **0** = calm; **1** = light air; **2** = leaves start to rustle; **3** = small branches start to sway; **4** = moderate breeze; **>4** Do not survey
Wind direction: N, S, E, W **Noise factor:** 1 = No noise, 2 = Moderate, 3 = Too much noise, do not survey
Number in group #: indicate sex if known, **M** = Male, **F** = Female, and if the bird is an immature, **J** = Juvenile
Detection Type (DT) **A** = **Au**ral, **V** = **V**isual, **F** = **F**ly over
Breeding Status (**BS**) (if any) **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood, **D** = **D**istraction display, **L** = **L**ocal young (limited flight or being fed by parents), **C** = **C**opulation or **C**ourtship observed, T = **T**erritorial behavior (chasing)

Water depth at index point (cm): _____ Distance of sample point from water edge (m): _____ Width of beach (m):_____
Salinity (note units and depth): Bottom _____ Mid-column _____ Surface _____
Turbidity: _____ **Tide state (circle one):** High, Incoming, Low, Outgoing
Human disturbance near count site at time of survey: Fishers, Hunters, Tourists, other _____
Water level - % of wetland covered with water: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100%
Vegetation - % of wetland covered with plants: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100% **Species** _____
Vegetation status (e.g., dry, new growth, flowering, fruiting, burnt) _____
Food: Low Medium High **Describe indicators used**_____
Photograph taken of the site: Yes/No Unusual species: Yes/No _____

Species Code or Name	ON AREA # in group	DT	BS	TOT	OFF AREA # in group	DT	BS	TOT

ADDITIONAL NOTES

NOTES ON COMPLETING THE CWC AREA SEARCH COUNT FORM[26]

Page _____ of _____: The page number of current page and the total pages for the survey route.

Date: Write the date of the survey as Day-Month-Year, using two numbers for month and day and four numbers for year.

Area Name: The name of the survey route or site (e.g., Great Pond).

Area Code/#: The code or number of the area being surveyed (e.g., GP1, GP2, or GP3).

GPS Loc: Coordinates for starting point of search area in UTM or decimal degrees (degrees, minutes and seconds) OR note your location so that you can find the coordinates from Google Earth later

Observer, Recorder, Trainees: The full name of the primary observer, the person recording the data, and secondary observers or trainees (if present).

Start time: The time (using a 24-hour clock) that you started your 20-minute search.

End time: The time (using a 24-hour clock) that you ended your 20-minute search.

Duration: Duration of survey in minutes, 20[27].

Total # of spp: The total number of species seen during the count.

Temp: The temperature at the beginning of the survey recorded in degrees Celsius.

Sky code: The cloud cover and amount of precipitation at the beginning of the survey.

0 = clear or a few clouds **1** = partly cloudy/variable **2** = cloudy/overcast **3** = fog **4** = drizzle **5** = rain (do not survey)

Wind code: The wind at the beginning of the survey using the Beaufort Wind Scale class.

0 = calm, 0-1 mph, smoke rises vertically and the sea is mirror smooth
1 = light air, smoke moves slightly with breeze and shows direction of wind
2 = you can feel wind on your face and hear the leaves start to rustle
3 = gentle breeze, small branches start to sway, wind extends a light flag.
4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway
>4 = Do not survey, too much wind.

Wind direction: North, South, East or West

Noise: The noise experienced at the beginning of the count; 1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away (do not complete the count if there is too much noise). If the cause of the noise is expected to be a continuous problem over time, you may need to move your area search away from the source of the noise.

pH: optional, record with a portable meter

COUNTING AND RECORDING BIRDS

Species Code or Name: A short clear abbreviation for the bird species common name should be recorded. If you are not using a standard abbreviation such as AOU species alpha codes—four-letter codes formed by using the first letter or two letters of each part of the bird's name (e.g., West Indian Whistling-Duck = WIWD, American Coot = AMCO, Yellow-crowned Night-Heron = YCNH)[28]—be sure to put a key to your abbreviations on the form. Use code *and* abbreviated name if you are not absolutely certain of the species code[29]. **If you make up codes be sure to record on your data sheet what they are to avoid confusion later.**

On Area: The numbers of each bird species counted on or within the search area. Birds seen, heard or both should be counted. Individuals are written down in the order they are observed. The number of individuals is recorded when more than one of a species is detected at the same moment at the same location. If possible record the sex of the individuals (M = Male, F = Female) and if the individual is hatched within the last 12 months and is not in adult plumage (J = Juvenile). If numbers are very large, use estimation techniques (e.g., counting by 10s or 20s, see powerpoints on count training on CWC

[26] The CWC Area Search Count Form and Notes can be modified to suit your particular needs and situation (e.g., what variables are recorded, etc.), however, we recommend that you follow the basic Area Search methods described in this protocol in order to maximize the scientific value of the data and capacity to compare monitoring data among sites and locations across the Caribbean.

[27] Although 20 minutes is typical, the length of time for an Area Search can be shorter or longer (e.g, 10 or 30 minutes) depending on the size of the area and number of birds present, however, once set for a site, it should not be modified.

[28] To download standard four letter species codes, visit: http://www.birdpop.org/alphacodes.htm

[29] AOU species codes should be learned and checked as they can be confusing, for example, White-crown Pigeon is WCPI, while White-cheeked Pintail is WHIP.

ConserveOnline website: http://conserveonline.org/workspaces/cwc). Fill in the total number of birds in the right column of both the on and off area columns for each species. An example of a filled-in data sheet is provided below.

DT (Detection Type): The first behavioral cue that alerted the observer to the presence of the species; A = Aural, V = Visual, F = Fly over.

BS - Breeding Status: Any breeding evidence observed during the count should be recorded.

N = Current year's **N**est found in the study area with eggs or young, in the process of being built, or already depredated or abandoned.

M = Adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area.

F = adult seen carrying **F**ood or **F**ecal sac to or from a likely nest site in the study area.

D = Distraction **D**isplay or injury feigning by an adult bird.

L = a young bird incapable of sustained flight (a "**L**ocal") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area.

C = **C**opulation or **C**ourtship observed of a species within its breeding range

T = **T**erritorial behavior observed (calls, chasing).

TOT – Total number of individuals counted for each species

Off Area: The numbers of each bird species counted off or outside the search area. Birds heard, seen, or both should be tallied. Birds flying over the site (excluding those aerial foraging within the search area) should be counted here. Focus on counting birds "on area" before counting birds "off area."

Observations outside the count period: Also note on your form if any birds are seen after the end of the count but before you leave the area (note species and number of individuals). Make sure you indicate that these observations were outside the count period.

Additional Notes: Any notes regarding unidentified birds, unusual observations, or other useful information. Be sure and write a note describing any unexpected or rare species detected. When applicable, notes should be labeled with a number so that the note can be entered in the database with the appropriate record.

OTHER HABITAT VARIABLES (Covariates)

Water depth at index point: Measure water depth at a predetermined point (e.g., GPS location mapped and described)

Distance of sample point from water edge: measure or estimate the distance of the sample point from the water's edge

Width of beach: Measure or estimate the exposed unvegetated area between water and high water mark

Salinity (note units and depth of samples): Establish a GPS location and measure salinity at the bottom, middle, and top of the water column. Remember to note whether you are measuring in ppt or %. OR take samples and label them clearly.

Turbidity: optional, can measure with a secchi disk

Tide state: High, Incoming, Low, Outgoing

Human disturbance near count site at time of survey: Note any human activity that might affect bird abundance, e.g., Fishers, Hunters, Tourists, other - please describe

Water Level: The amount of water present may serve as an index of habitat availability/quality. Give an estimate or circle a category corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.

Vegetation - % of wetland area covered with plants: Can give an estimate or circle a category. **Dominant species:** If you know the name of the species write it here

Vegetation status: Describe the general condition of the vegetation, e.g., dry, new growth, flowering, fruiting, burnt, etc.

Food: Estimate if levels are low, medium, or high, and describe indicators used (e.g., water levels, observation of aquatic invertebrates, fish, crabs, frogs and/or seeds or algae in the water, flowering and fruiting trees and bushes around the area, birds actively feeding, etc.)

Photograph taken of the site: Note if a photo was taken and where/why.

Photographs of unusual species: Try to get a photo of any unidentified or unusual species for the site, note if a photo was taken so that you can remember to examine it later. If you need help with species identification, share the photo with expert birders in the CWC network.

CWC Area Search Count Form – filled in with sample data and notes

Date _____ Area Name:_____ Area Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Survey Start Time: _____ Survey End Time: _____ Duration: _____Total # of spp: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ pH _____

Species Code or Name	ON AREA # in group	DT	BS	TOT	OFF AREA # in group	DT	BS	TOT
BNST – Blk-necked Stilt	20	V		20				
SNEG – Snowy Egret	5, 7, 1, 2	V		15				
BWTE – BW Teal	12M, 8F, 14M, 7F, 2M	V		43				
WHIP – White-cheeked Pint.	3M, 1F	V	C	4				
Unident. Sandpipers	12	V		12				
WIPL – Wilson's Plover	3, 6, 2	V	N	11				
WILL - Willet	4, 3	V		7				
COMO – Common Moorhen	15, 13, 7	V		35	13	V		13
OSPR - Osprey	1	V		1	2	V	N	2
SORA - Sora	1	A		1				
MAGR – Magn. Frigatebird					5M, 3F, 4J	F		12
GRYE – Gr. Yellowlegs	5, 13	V		18				
YCNH – Yellow-cr. Night Heron	1	V		1				

ADDITIONAL NOTES

- Upon arrival, flushed ~20 Black-necked Stilts near start of survey route; they did not return.
- 1 Wilson's Plover nest found with 4 eggs, one of the parents did a distraction display (feigned broken wing).
- Male WHIPs were courting female.
- Took photo of unidentified sandpipers (small, brown above and white belly, small thin black bill, yellowish-green legs).
- Took photos of Willets and Greater Yellowlegs to verify ID.
- All frigatebirds were soaring over survey area.

Point Counts Protocol – CWC Level 2 and 3 Monitoring

Objectives

The possible objectives of surveys done with the point count methods include:

- Identify which species are present, develop local checklists, ranges and seasons of use
- Determine how birds are using the habitat (including habitat type and seasonality)
- Assess diversity including species richness and community composition
- Estimate detection probability, occupancy (use of point area), density (number/unit area), and abundance (number in a given area)
- Estimate an index of relative abundance[30]
- Measure changes in estimated parameters from year to year to monitor trends

Description of Method

A point count consists of standing in a fixed location (count station) and counting birds for a specific period of time. For landbirds, one counts the number of individual birds (of each species) seen or heard within the area covered by a circle of a certain radius (fixed-radius point count) or unlimited radius with distance sampling (variable-radius point count or variable circular plot (VCP)). For waterbirds, the method is modified so that typically only birds on the wetland part of the habitat are counted (e.g., if the count station is on the edge of the wetland as will frequently be the case).

Counting stations may be established at intervals along a survey route for the wetland(s) that will be monitored. For large wetlands, a survey route may also be established in the wetland with count stations reached by boat or canoe. The general method is to drive the route, stopping at each of the stations, and counting the birds for a standard period of time. Depending on the objectives of the monitoring program and available resources, the route is surveyed 1-3 times (or more) per season with observers recording species presence, reproductive status, and number of individuals. Detection probability (detectability) can be estimated using one or a combination of double observer, repeated counts, removal counts and distance sampling methods. Because distance sampling requires the use of a rangefinder and a little more skill on the part of the counter, we have made this method of CWC counting Level 3.

Advantages and Disadvantages of Point Count Protocols

- Standard point counts corrected for detection probability may provide precise and unbiased data about changes in occupancy, density, and abundance at multiple spatial and temporal scales; point counts with distance sampling is the best protocol to meet method assumptions and have maximum capability for data analysis for science and management purposes.
- Depending on the number of points and travel distances, the point count method may require larger commitments of staff time and resources.
- The point count method may not provide sufficiently detailed information for some needs (e.g. to assess changes in the populations of rare species as a result of management or climate change).
- Species such as herons, egrets, and seabirds on their nesting colonies, marsh birds, and nocturnal species require special protocols (see Caribbean Birdwatch manual).

[30] Relative abundance may or may not be related to true abundance, depending on whether the assumption that detection is perfect or a constant proportion over space, time, or both, is met.

Assumptions of Point Count Protocol

- Unless detection distances are measured, all birds at the defined area of the point are detected (i.e., detection is perfect).
- Bird species are identified correctly by sight or sound and accurately counted
- Bird distribution is unrelated to point distribution
- For birds in clusters (groups or flocks), cluster sizes are recorded without error
- No movement of birds into or out of the defined area of the count station (i.e., the population is closed) for all types of counts (removal counts, double observer, repeated counts and distance sampling)
- For repeated counts, birds do not move into or out of the site between visits (this assumption may be hard to meet unless counts are conducted within a short period of time, e.g., within 1-2 weeks).
- When using distance sampling, distances are measured without error or birds are allocated to the correct distance categories

Additional Assumptions of Point Count Protocol with Distance Sampling (Level 3)

- Birds at the center of the point (zero distance) are always detected
- Birds are detected at their initial locations (before repulsion or attraction due to observer presence at the point)
- Distances are measured without error, or, if using distance categories, birds are allocated to the correct category
- For birds in clusters (groups or flocks), cluster sizes are recorded without error
- If the objective is to make inferences beyond the survey area (e.g., a particular wetland), then the sample points are representative of the entire survey region (e.g., defined as all the coastal wetlands >1 hectare on an island)

Designing the Survey

Factors to be considered include the size, location and access of the sites to be monitored, and the sample size (number of points) needed to achieve a desirable level of statistical power. These should be determined via a pilot study. The factors to be considered are summarized in Table 1 and described in detail below.

Table 1: Summary of factors to consider in designing a point count survey for the CWC

Factor	Recommendations	Notes
Point count station	Should be located at vantage points along a survey route on a road, trail, dike, or boardwalk, or reachable by canoe or boat. Generally, points should be 400 m apart unless count areas are distinct. Points, survey areas and routes should be mapped, marked by GPS and well described so that they can be revisited for subsequent surveys.	Record boundaries of point count survey areas using natural features, roads, structures and GPS points, etc.
Habitat type	Any (e.g., marsh, salt pond, mudflat, mangrove lagoon, stretch of beach, etc.)	Method is suitable for any habitat type with adequate access.
Length of point count	6 to 12 minutes divided into 3 minute intervals	Six minutes is standard, if more time is needed, use 9 or 12 minutes. Once set for your count station this is standard and must not be modified.

Size of point count area	Determined by size and shape of wetland but maximum count distance of 400 m.	Do not count birds that are >400 m distance from the count station
Number of points	As many as possible given your site(s) and resources; 25 is recommended and 12 is the minimum, however for small wetlands only 1 or a few points may be possible.	Depends on your site, objectives, and resources; pilot data can be used to help decide on the number of points.
Number of point count surveys per year /time of year	MINIMUM 1 count/year: CWC Winter Count in January (dates to be set annually by BirdsCaribbean)[31] PLUS (if possible) at least once per season - Spring (migration): March-May - Summer: June-August - Fall (migration): September-November OR once per month.	Number of surveys and dates depend on your monitoring objectives, site, and resources. Once set, surveys should be done on approximately the same dates annually. All sites participating in the CWC should aim to include survey dates to be set in the last 3 weeks of January.
Number of point count surveys per season/site	Depends on your objectives. Repeated counts - surveys should be carried out 2 to 3 times within 7 to 10 days.	Counts should be conducted at approximately the same time of year. To monitor migrants, conduct searches on a regular basis (e.g., 1 to 3 times per week) throughout the season.
Time of day	Within 4 to 5 hours after dawn or between 1600 and dusk.	Once set for your site, this is standard and must not be modified. Surveys should not be conducted in the heat of the day.
Number of point counts/ day	Depends on the site and length of survey route	
Estimating detectability	Level 2 monitoring - use **removal counts** combined with **repeated counts** if possible, or **removal counts** with **double observer**. Level 3 – The above plus **distance sampling**.	Methods can be selected depending on the availability of resources. Combining methods will allow maximum flexibility and power in data analysis

Checklist of Equipment Needed for Point Counts

Binoculars for all observers	
Spotting scope and tripod	
Rangefinder	
GPS	
Clipboard and pencils (sharpener, rubber)	
Aerial or survey map/Google Earth image or sketch map of area showing outline of search area, survey route and landmarks/boundaries	
Field forms – CWC Point Count for Waterbirds Count Form and Notes	

[31] CWC survey dates in 2011 are January 14th to February 3rd, inclusive.

Country or site checklist of birds (if available)	
Field notebook (preferably waterproof)	
Coloured flagging tape (optional)	
Field guide to birds (e.g., Birds of the West Indies)	
Waders or appropriate footwear	
Drab, non-colorful clothing (avoid wearing white), hat, sunscreen and bug spray	
Stopwatch or digital watch with countdown feature set to 3 minutes	
Digital camera with 7x or greater telephoto lens (optional but recommended)	
Stick, 1-2 metres in length, marked off in centimeters (to measure water depth)	
Measuring tape (optional)	
Secchi disc (optional[32])	
Portable water meter, salinometer, or small sample bottles to collect water samples (optional but recommended) – to measure salinity, pH, etc.	

Selecting the Points

Based on your monitoring objectives and results of pilot surveys, you have already determined your sampling frame (e.g., all coastal wetlands, protected wetlands, mangrove sites, etc., see Step 4 in the CWC Manual) and specific wetlands that will be monitored. If you are interested in making a statistical inference beyond the surveyed area of the counting points, then you have to consider the issue of randomization and replication to have representative coverage of the survey region or sampling frame. In the Caribbean this may be difficult due to inaccessibility (e.g., dense mangroves), dry conditions in some years, and muddy, wet or deep water conditions in others. A practical approach is to travel by land using roads, dikes, boardwalks or trails, or by boat on open water, rivers, or canals. Locate count stations at vantage points along your survey route using a minimum distance of 400 m between points to secure count independence. In situations where the points cover discrete areas, for example, where you cannot see one point area from the next and birds are unlikely to move between areas, points may be less than 400 m apart.

Selecting the Number of Points

The number of points depends on the target species and the sample sizes needed to reach adequate precision of data to make inferences about significant differences in parameter(s) of interest (e.g., examining population size trends, comparing species richness or density among sites, before and after management treatments or natural events, etc.). This will be greater for rare species than common ones. The number of points per site will also depend on the size of the wetland and factors like accessibility and capacity (human and financial resources) to carry out the counts. Generally it is better to have a greater number of points per site than to count 1 point at a site a number of times.

For small and/or open wetlands, it may be possible to count the entire site at 1 or 2 count stations. For multiple sites, a minimum of 25 points is recommended to explore models with covariates affecting detection and/or abundance, and determine if parameters can be estimated with reasonable precision (say, CV <20%). Questions about survey design are best answered by conducting a pilot study to explore data collection and analysis, which will give specific recommendations about sample sizes, number of visits, and any modifications needed to make the survey cost-effective at multiple spatial and temporal scales. Consult with one of the CWC project leaders to get assistance and feedback on the design of your monitoring program.

[32] See: http://www.angfa.org.au/secchi.html, and also: "How to make a secchi disk" (PDF), available for download at http://conserveonline.org/workspaces/cwc

Length of the Point Count

CWC recommends a minimum count time of 6 minutes partitioned into two 3-minute intervals for most sites/habitats. If the site is large and/or typically has a large number and/or diversity of birds present, then a longer count period may be necessary. Long count periods may be problematic for meeting method assumptions about undetected movement inside and outside the point survey area. If more time is needed, then we recommend adding multiples of 3 to the minimum count time of 6 minutes, e.g., 9 or 12 minutes (maximum count time of 12 minutes), and partitioning the count into three or four 3-minute intervals. Once set for site, the count time should not be modified.

Timing of the Survey – Time of Day and Suitable Weather Conditions

Surveys start during the 15 minutes following local sunrise and should be completed within the following 4 to 5 hours. Rain or wind may change the audibility of bird sounds, while fog or rain may reduce visibility and bird activity. Surveys should not be conducted in adverse conditions. Time of day, fog, and rain may be important covariates affecting detection probability.

Estimating Detection

Given that the birds are present and available to be counted in the area covered by a point, detection is largely a function of distance from the observer to the single bird or cluster (group or flock) of birds. However, detection may also be affected by covariates related to the observers (number, experience, training), species (color, size, behavior), and environment (amount of vegetation, noise level, weather).

Any of the four ways of measuring detection probability can be used with point counts. For CWC Level 2 monitoring we recommend removal counts, repeated counts, or double observer approaches.

- **Removal counts:** Divide count into equal time periods. Record birds only in the first time period in which they are detected.
- **Repeated counts:** repeat the survey 2 to 3 times or more within a short period of time (e.g., 1 week or 10 days if possible).
- **Double observer:** 2 observers or teams make independent counts at the same place at the same time.
- **Distance sampling:** Measure the distance to each bird when it is first observed or geometric center of a cluster of birds using a rangefinder.

Distance sampling requires slightly greater skill in data collection, which is why we have assigned it to Level 3. If observers are well trained, it is possible to use an effective combination of count methods. For example, removal counts can be combined with repeated counts. With a rangefinder and careful measurement of detection distances, you can effectively combine distance and removal sampling in single visits, and distance and repeated sampling in repeated visits to counting points. Collecting flexible count data is advantageous as the data can be analyzed in different ways to account for survey and site-specific covariates (e.g., water depth, salinity, vegetation cover) that may affect detection and abundance per point and across points.

Number of Point Count Surveys/Year

Point counts can be conducted at any time of the year. The number and timing of surveys you conduct in a year depends on your monitoring objectives, available resources, and the timing of migration and breeding on your island. Generally, for all-bird surveys BirdsCaribbean recommends 4 counts covering the main seasons:

- Winter (over-wintering and residents) – December-February; **the core period for the CWC is January and BirdsCaribbean will set dates annually on which all participating sites should try to count. These dates will include the last 3 weeks in January.**
- Spring (migration and peak resident breeding) – March-May
- Summer (breeding and post-breeding for residents and summer migrants) – June-August
- Fall (migration) - September-November

Observers

At least 1 observer should be able to identify by sight and sound all the species likely to be encountered at the site. Pilot surveys should be conducted to become familiar with the species that are present and also to provide training to new persons, either as counters or recorders. Up to 4 observers per point count is acceptable but 2 are preferable to minimize disturbance, standardize count effort, and maintain high detection probability within and between visits. Two observers are also preferred for safety. Observers should stand together quietly at each count station, 1 person counting the birds and the other recording the data and helping to keep track of which birds have been counted (to avoid double counting) and any new birds that appear. New volunteers should be encouraged to come along and get involved, but it is very important that the number and skills of the observers are standardized over the period of the monitoring project; changes in the number and quality of observers will adversely affect the validity of any comparisons of species presence and abundance over time.

Preparing for the Point Count

Select point count stations

- Pilot surveys should be carried out to identify the general study area and establish the location of points using GPS and maps based on aerial photos or satellite images (e.g., Google Earth is a powerful tool for survey design and point mapping). Avoid placing count stations close to known nesting areas.

Define count area of each point

- For many wetlands points may be adjacent, therefore, it is important to define the boundaries of each point to avoid double counting. This is most often done by using landmarks (e.g. structures, vegetation, geological features). The maximum distance of birds included in your count should be 400 m, i.e., count all the birds that you can see to a maximum distance of 400 m.

Select observers- Train observers in bird identification and count methodology

- All observers should undergo training in bird identification by sight and sound and counting birds. Powerpoint presentations are available on the CWC ConserveOnline workspace (http://conserveonline.org/workspaces/cwc) to help with training[33] and practice counts should be conducted to familiarize observers with the protocol. Screen observers to ensure their skills are adequate, and if not, allow more time for practice in the field during a pilot period of monitoring.
- Select the person with the best identification skills to conduct the survey (primary observer); the other person(s) (recorder and trainees) should record data and help the primary observer keep track of which birds have been counted and any new birds that have come into view. Any trainees present (no more than 1 or 2) can practice spotting, identifying and counting birds. The observer and recorder should make sure that they review the notes on completing the CWC Point Count Data Form and practice counts should be conducted so that each person is well familiar with the protocol and use of the count form. Both observers work as a team to secure data quality and meet method assumptions (e.g., movement away in response to arrival at a counting point). If there is just 1 observer, a tape recorder should be used to record count data.

Assemble equipment and field forms

- Use the checklist above to assemble equipment and field forms. This should be done the day before the survey.

[33] The Wildlife Count CD is also available to practice estimating numbers of birds.

Conducting the Point Count[34]

Getting started

- Prior to approaching the survey point, have your binoculars on, scope and tripod ready to set up, and your field form ready to record data on your clipboard. Approach the point count station quietly in order to cause as little disturbance to the birds as possible, and get into position for the count. Counts should begin immediately when the observer reaches the station. If you flush birds as you arrive, do your best to measure their initial distances and count the numbers per species accurately.
- It is acceptable to make small movements on either side of your count station to see around obstructions, but do so quietly and in way that minimizes disturbance to the birds. After the count, you can move as needed to measure distances, identify species, and collect supplementary data at the point. Survey and site-specific data, such as weather, water depth, vegetation, and salinity should also be collected after the count.
- We do not recommend guessing distances. Use a rangefinder to measure distances to reference points, and whenever possible measure the horizontal distance to single birds or the perceived geometric center of clustered birds.

Doing the count

- Start stopwatch or timer that should previously have been set to 3 minutes for a 6-minute count.
- For each 3-minute interval record observations separately, making sure that each individual is only recorded in the first 3-minute time block when it was detected. Note: If there are a large number of birds in view on the pond and it takes you longer than 3 minutes to count and record them all (because there are so many), be sure to record these birds in the first time interval (e.g., 3 minutes) only, regardless of how long it takes you to count them. Both the observer and recorder should keep an eye out for any "new" birds that you detect at the site during the count (e.g., birds that were spotted hiding in the vegetation or birds, previously hidden, that swim or move into view) and record these in later time intervals as appropriate.
- Repeat 2 times for a 6-minute point count, 3 times for a 9-minute count and 4 times for a 12-minute count.
- Record each individual in the order it was observed (or heard). If more than one individual of a species is detected at the same moment at the same location record the number of individuals. In this case, fill in the appropriate record in the first available boxes, then on the same line record the number of individuals. If a bird flushes when the observer arrives at the point, the bird should be included according to its take-off place.

In/out of count area

- Count all the birds in the point count station area, which is determined, in part, by the size and shape of the wetland, vegetation present, etc. The maximum distance for counting birds is 400 m; do not include birds that are greater than 400 m distance from the count station.

Flocks

- If you encounter a large mixed species flock, do not spend too much time figuring out the exact species composition. Spend 1-2 minutes making an estimate of the number of birds making up the flock and the proportion of each species. Pay special attention to identify the random straggler. If the flock is still present at the end of the count, you can spend a few minutes to figure out its exact composition.

Nest searches

- Do not conduct nest searches during the survey although you may record nesting activity. This can be done after the search (as with species identification).

Level 2 Counts

- The basic Level 2 point count uses time removal as an index of detection within a count area per point (i.e., a bird is recorded only in the first time block in which it was detected).
- Where possible this should be augmented by using the repeated count method (i.e. the counts are repeated three times within a short time period (e.g., 1 week or 10 days) to increase the number of detections and meet method assumptions (e.g., population closure in the case of repeated-count sampling).

[34] Adapted from *Landbird Monitoring Protocol for Klamath Network Parks: Standard Operating Procedure (SOP) #5 Conducting Variable Circular Plot Point County Surveys*, Draft Version 1.0, and *Handbook of Field Methods for Monitoring Landbirds* (1993) by C.J. Ralph et al.

- If you have two observers who can identify birds well it may be possible to use the double observer approach. Their efficiency can be increased if they each use a small hand-held tape-recorder to record their observations.

Level 3 Counts – Measuring distances to Estimate Detection Probability

- When an individual bird is detected, its distance should be quickly measured with a rangefinder. A bird's distance from the station is determined by visualizing a plumb bob dropped from the bird's location; the distance from the observer to where the plumb bob would touch the ground is the distance recorded. The distance recorded for each individual is the distance to where the bird was first detected, regardless of its movements during the count period. Measure distances to the nearest meter; do not round distances to the nearest 5 or 10 m interval or estimate distances within bands.
- If exact distances cannot be measured because you cannot see the bird, then do your best to estimate the distance.

Unknown calls or birds

- If you detect a bird but cannot immediately identify it, do not spend time during your count trying to identify it. Record it as unknown, to the closest taxonomic affiliation that you can determine (for example, "Unidentified Sandpiper" or "Unidentified Tern"), and continue your count. After the count, you can spend a few minutes observing and trying to identify the bird. If possible, take a photograph and show it to experts in the CWC network for help with identification.
- Describe the unknown bird as fully as possible in the "Additional Notes" section of the form (note the color of the crown, back, tail, throat, legs, etc., whether it had any markings on the face (e.g., eye ring), wing-bars, shape of the bill, size of the bird (in comparison to a bird that you know, e.g., bigger than a Greater Yellowlegs), behavior of the bird (e.g., feeding method, tail wagging), where in the habitat the bird was located (e.g., on the water, in the vegetation), and so forth. The data recorder should write down the description given by the primary observer. After the survey is completed, you can study your field guides and often determine, with a fair degree of confidence, the identity of the bird. If any of your bird identifications during the counts were uncertain, be sure to try and confirm that you named the bird correctly by checking your field guides. Don't be shy about asking birding experts to verify your identification of the bird.
- Vegetation assessment
- Record the habitat variables you have decided to measure on your Area Search Count Form.

Collecting Data on Habitat and Conditions

The first step is to complete a detailed description of the habitat by filling out the Site Description Form (see section on CWC Protocols for Habitat Monitoring). This will usually be done in the site reconnaissance visits. The objective is to provide a detailed description of the site, including present condition, uses and threats. Once this has been done it will not be necessary to repeat it because it will be updated with observations of selected variables and any visible changes on your CWC Area Search for Waterbirds count form.

Each time you conduct a survey, it will be important to gather data on the habitat and current conditions at the site that may influence the number of birds at the site. All of these variables can be entered into the analysis of your data as covariates, allowing you to test hypotheses about the effect(s) of different conditions on numbers of species present and their abundance. We have included on the CWC Area Search for Waterbirds Count Form a number of potentially important covariates, such as weather conditions, water depth, salinity, extent of vegetation, etc. (see below). You may revise this form to include others or delete any variables you think are not applicable to your site.

If you are monitoring an IBA, we recommend that you follow BirdLife International's guidelines for monitoring threats, condition, and conservation actions at IBAs, and carry out this monitoring once per year if possible.[35]
Instructions and data forms are available in the BirdLife manual.

[35] Available for download at the Caribbean Birdwatch ConserveOnline workspace: http://conserveonline.org/workspaces/caribbeanbirdwatch

Recording Data

Use the CWC Point Count Form or CWC Point Count Form with Distance Sampling and notes on completing the forms below.

Analysing and Storing Data

Data should be entered on a computer in the standard CWC spreadsheets (available for download at: http://conserveonline.org/workspaces/cwc) as soon as possible after collection and tabulated according to the needs of the monitoring program in a format suitable for statistical analysis. Point count data should be entered/uploaded into eBird Caribbean (choose the "Caribbean Waterbird Census (CWC) Point Count" option on the "Submit Observations" page). The data should also be sent to the CWC Coordinator.

Reporting Results

Results could lead to inferences about species composition, breeding condition and numbers at a site or a series of sites. These could be used to compare sites or changes over time. See also the advice provided on the CWC ConserveOnline site about how to present data to decision-makers.

Summary of Important Points

Remember that it is absolutely essential to follow the **same** protocol (standard method) each time you do an area search. The protocol provided here specifies the exact technique to use so that the survey can be repeated by the same observer each time they count or by another observer in the future. The protocol is designed to minimize bias and error in the data, thereby increasing confidence in your survey findings. By following the protocol precisely, then comparisons of your counts are valid, and changes in the number of birds can be attributed to changes in the population.

- Count birds at the same time of day.
- Count birds at the same time(s) of year.
- Avoid counting in poor weather (heavy rain, high wind).
- Cover the same search area and spend the same amount of time identifying species and counting individuals per species (e.g., 20 minutes)

> If you need to make any revisions to your protocol (e.g., change the starting point of the count, make a change to the survey schedule, size of area, etc.), be sure to keep a record of the revision history and archive

Additional Notes: Any notes regarding unidentified birds, birds observed between points, other useful information should be recorded in your data sheets and/or field notebook. Be sure to write a note explaining any unexpected or rare species detected, make a sketch or take a photograph. Reasonable photographs can be taken with a small camera or digital camera and binoculars or telescope using a technique called digiscoping. Many websites describe this technique.

CWC Point Count Data Form

Date _____ Area Name:_____ Area Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Start Time: _____ End Time: _____ Duration: _____Total # of spp: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ pH _____

Pt. #	Time	Species Code or Name	# in group	DT	BS	Total

ADDITIONAL NOTES

Sky codes: **0** = clear or a few clouds, **1** = partly cloudy/variable, **2** = cloudy/overcast, **3** = fog, **4** = drizzle, **5** = rain (do not survey)
Wind codes: **0** = calm; **1** = light air; **2** = leaves start to rustle; **3** = small branches start to sway; **4** = moderate breeze; **>4** Do not survey
Wind direction: N, S, E, W **Noise factor:** 1 = No noise, 2 = Moderate, 3 = Too much noise, do not survey
Number in group #: indicate sex if known, **M** = Male, **F** = Female, and if the bird is an immature, **J** = Juvenile
Detection Type (DT) **A** = **Au**ral, **V** = **V**isual, **F** = **F**ly over
Breeding Status (**BS**) (if any) **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood, **D** = **D**istraction display, **L** = **L**ocal young (limited flight or being fed by parents), **C** = **C**opulation or **C**ourtship observed, T = **T**erritorial behavior (chasing)

Water depth at index point (cm): _____ Distance of sample point from water edge (m): _____ Width of beach (m):_____
Salinity (note units and depth): Bottom _____ Mid-column _____ Surface _____
Turbidity: _____ Tide state (circle one): High, Incoming, Low, Outgoing
Human disturbance near count site at time of survey: Fishers, Hunters, Tourists, other _____
Water level - % of wetland covered with water: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100%
Vegetation - % of wetland covered with plants: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100% **Species** _____
Vegetation status (e.g., burnt, dry, flowering, fruiting) _____
Food: Low Medium High **Describe indicators used**_____
Photograph taken of the site: Yes/No Unusual species: Yes/No _____

CWC Point Count Data Form

Pt. #	Time	Species Code or Name	# in group	DT	BS	Total

ADDITIONAL NOTES

CWC Point Count Form – filled in with sample data and notes

Pt. #	Time	Species Code or Name	# in group	DT	BS	Total
1	0630	BWTE – Blue-Winged Teal	23M, 19F, 4M, 2F, 14M, 10F	V		72
		BWTE – Blue-Winged Teal	1F	A		1
		GRYE – Greater Yellowlegs	5, 3, 9	V		17
		SNEG – Snowy Egret	2	V		2
	0633	COMO – Common Moorhen	2A, 2J	V	L	4
		OSPR – Osprey	1	V		1
		SORA – Sora	1	A		1
		MAGR – Magn. Frigatebird	5M, 3F, 4J	F		12
2	0647	BNST – Blk-necked Stilt	20	V		20
		WHIP – White-cheeked Pint.	3M, 1F	A	C	4
		YEWA – Yellow Warbler	1M	V		1
		WIPL – Wilson's Plover	3	V	N	3
		Unident. Sandpipers	14	V		14
	0650	GBHE – Great Blue Heron	3	V	N	3

ADDITIONAL NOTES

Pt. #1

- Took photos of Greater Yellowlegs to verify ID.
- All frigatebirds were soaring over point area.

Pt. #2

- Upon arrival, flushed ~20 Black-necked Stilts near start of survey route; they did not return.
- Male WHIPs were courting female.
- 1 Wilson's Plover nest found with 4 eggs, one of the parents did a distraction display (feigned broken wing).
- Took photo of unidentified sandpipers (small, brown above and white belly, small thin black bill, yellowish-green legs).

CWC Point Count with Distance Sampling Data Form

Date _____ Route Name:_____ Route Code/# _____ GPS Loc: _____

Observer _____ Recorder _____Trainees:_____

Start Time: _____ End Time: _____ Duration: _____Total # of spp: _____

Temp. ____°C Sky code: _____ Wind code: _____ Wind direction: _____ Noise: _____ pH _____

Pt. #	Time	Species Name	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	Total

ADDITIONAL NOTES

Sky codes: **0** = clear or a few clouds, **1** = partly cloudy/variable, **2** = cloudy/overcast, **3** = fog, **4** = drizzle, **5** = rain (do not survey)
Wind codes: **0** = calm; **1** = light air; **2** = leaves start to rustle; **3** = small branches start to sway; **4** = moderate breeze; **>4** Do not survey
Wind direction: N, S, E, W **Noise factor:** 1 = No noise, 2 = Moderate, 3 = Too much noise, do not survey
Number in group #: indicate sex if known, **M** = Male, **F** = Female, and if the bird is an immature, **J** = Juvenile
Detection Type (DT) **A** = **Au**ral, **V** = **V**isual, **F** = **F**ly over
Breeding Status (**BS**) (if any) **N** = active **N**est, **M** = carrying nesting **M**aterial, **F** = carrying **F**ood, **D** = **D**istraction display, **L** = **L**ocal young (limited flight or being fed by parents), **C** = **C**opulation or **C**ourtship observed, T = **T**erritorial behavior (chasing)

Water depth at index point (cm): _____ Distance of sample point from water edge (m): _____ Width of beach (m):_____
Salinity (note units and depth): Bottom _____ Mid-column _____ Surface _____
Turbidity: _____ **Tide state (circle one):** High, Incoming, Low, Outgoing
Human disturbance near count site at time of survey: Fishers, Hunters, Tourists, other _____
Water level - % of wetland covered with water: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100%
Vegetation - % of wetland covered with plants: _____ 0=None, 1-25%, 26-50%, 51-75%, 76-100% **Species** _____
Vegetation status (e.g., burnt, dry, flowering, fruiting) _____
Food: Low Medium High **Describe indicators used**_____
Photograph taken of the site: Yes/No Unusual species: Yes/No _____

CWC Point Count with Distance Sampling Data Form

Pt. #	Time	Species Name	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	Total

ADDITIONAL NOTES

CWC Point Count with distance sampling form – filled in with sample data and notes

Pt. #	Time	Species Name	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	# in group	Distance (m)	DT	BS	Total
1	0630	BWTE	23M, 19F	58	V		4M, 2F	14	V		14M, 10F	102	V		88
		BWTE	1F	~40	A										1
		GRYE	17	47	V										17
		SNEG	2	183	V										2
	0633	COMO	2A, 2J	5	V	L									4
		OSPR	1	113	V										1
		SORA	1	~30	A										1
		MAGR	5M, 3F, 4J	-	F										12
2	0640	GBHE	1	44	V										1

Page _____ of _____: The page number of current page and the total pages for the survey route.
Date: Write the date of the survey as Day-Month-Year, using two numbers for month and day and four numbers for year.
Area Name: The name of the survey route or site (e.g., Great Pond).
Area Code/#: The code or number of the area being surveyed (e.g., GP1, GP2, or GP3).
GPS Loc: Coordinates for starting point of search area in UTM or decimal degrees (degrees, minutes and seconds) OR note your location so that you can find the coordinates from Google Earth later
Observer, Recorder, Trainees: The full name of the primary observer, the person recording the data, and secondary observers or trainees (if present).
Start time: The time (using a 24-hour clock) that you started your point count survey route.
End time: The time (using a 24-hour clock) that you ended your point count survey route.
Duration: Duration of time to complete the survey route in minutes.
Total # of spp: The total number of species seen during the count.

Temp: The temperature at the beginning of the survey recorded in degrees Celsius.
Sky code: The cloud cover and amount of precipitation at the beginning of the survey.
0 = clear or a few clouds **1 =** partly cloudy/variable **2 =** cloudy/overcast **3 =** fog **4 =** drizzle **5 =** rain (do not survey)
Wind code: The wind at the beginning of the survey using the Beaufort Wind Scale class.
0 = calm, 0-1 mph, smoke rises vertically and the sea is mirror smooth
1 = light air, smoke moves slightly with breeze and shows direction of wind
2 = you can feel wind on your face and hear the leaves start to rustle
3 = gentle breeze, small branches start to sway, wind extends a light flag.
4 = moderate breeze, loose dust or sand on the ground will move and larger branches will sway
>4 = Do not survey, too much wind.
Wind direction: North, South, East or West
Noise: The noise experienced at the beginning of the count; 1 = none, 2 = moderate, 3 = too much noise, cannot hear birds >15 m away (do not complete the count if there is too much noise). If the cause of the noise is expected to be a continuous problem over time, you may need to move your area search away from the source of the noise.
pH: optional, record with a portable meter

COUNTING AND RECORDING BIRDS

Species Code or Name: A short clear abbreviation for the bird species common name should be recorded. If you are not using a standard abbreviation such as AOU species alpha codes—four-letter codes formed by using the first letter or two letters of each part of the bird's name (e.g., West Indian Whistling-Duck = WIWD, American Coot = AMCO, Yellow-crowned Night-Heron = YCNH)[36]—be sure to put a key to your abbreviations on the form. Use code *and* abbreviated name if you are not absolutely certain of the species code[37]. If you make up codes be sure to record on your data sheet what they are to avoid confusion later.
Number in group: Individuals are written down in the order they are observed. The number of individuals is recorded when more than one of a species is detected in a group, cluster or flock at the same moment in the same part of the wetland. As you arrive at the count station be ready to record any birds that are flushed, doing your best to measure the distance to their original location.

[36] To download standard four letter species codes, visit: http://www.birdpop.org/alphacodes.htm
[37] AOU species codes should be learned and checked as they can be confusing, for example, White-crown Pigeon is WCPI, while White-cheeked Pintail is WHIP.

Distance[38]**:** As soon as you see a bird, use the range finder to measure the horizontal distance from your observation point to the point where it was first seen. If the bird moves or is perched above the ground, visualize a plumb bob dropped from the bird's initial location and measure the horizontal distance to the point where the plumb bob would touch the ground. When birds are in a cluster, group or flock, count or estimate the number in the group and measure the distance to the geometric centre of the group.

DT (Detection Type): The first behavioral cue that alerted the observer to the presence of the species; A = Aural, V = Visual, F = Fly over. **N.b.** If you have a lot of birds to record, do not waste time recording age and sex of flyovers.

BS - Breeding Status: Any breeding evidence observed during the count should be recorded.

N = Current year's **N**est found in the study area with eggs or young, in the process of being built, or already depredated or abandoned.

M = Adult seen gathering or carrying nesting **M**aterial to a likely nest site in the study area.

F = adult seen carrying **F**ood or **F**ecal sac to or from a likely nest site in the study area.

D = Distraction **D**isplay or injury feigning by an adult bird.

L = a young bird incapable of sustained flight (a "Local") in the study area or very young (stub-tailed) fledglings being fed by parents in the study area.

C = Copulation or **C**ourtship observed of a species within its breeding range

T = Territorial behavior observed (song, chasing).

TOT – **Total** number of individuals counted for each species

Observations outside the count period: If a new species is seen after the end of the count but before you leave the point, you can make a note of it in the Notes section.

Additional Notes: Make notes regarding unidentified birds, birds observed between points, threats to birds or habitats, changes you have observed in the wetland or other useful information. Be sure to write a note explaining any unexpected or rare species detected. When applicable, notes should be labeled with a number so that the note can be entered in the database with the appropriate record.

OTHER HABITAT VARIABLES (Covariates)

Water depth at index point: Measure water depth at a predetermined point (e.g., GPS location mapped and described)

Distance of sample point from water edge: measure or estimate the distance of the sample point from the water's edge

Width of beach Measure or estimate the exposed unvegetated area between water and high water mark

Salinity (note units and depth of samples): Establish a GPS location and measure salinity at the bottom, middle, and top of the water column. Remember to note whether you are measuring in ppt or %. OR take samples and label them clearly.

Turbidity: optional, can measure with a secchi disk

Tide state: High, Incoming, Low, Outgoing

Human disturbance near count site at time of survey: Note any human activity that might affect bird abundance, e.g., Fishers, Hunters, Tourists, other - please describe

Water Level: The amount of water present may serve as an index of habitat availability/quality. Give an estimate or circle a category corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.

Vegetation - % of wetland area covered with plants: Can give an estimate or circle a category. Dominant species: If you know the name of the species write it here

Vegetation status: Describe the general condition of the vegetation, e.g., dry, burnt, new growth, flowering, fruiting, etc.

Food: Estimate if levels are low, medium or high and describe indicators used (e.g., water levels, observation of aquatic invertebrates, fish, crabs, frogs and/or seeds or algae in the water, flowering and fruiting trees and bushes around the area, birds actively feeding, etc.)

[38] **This applies only if you are doing Level 3 counts with distance sampling.**

The CWC offers 4 levels of monitoring. These are:

- Level 1 Site inventory/Basic counts
- Level 2 Counts with simple detection probability
- Level 3 Counts with distance sampling
- **Level 4 Simultaneous/repeated surveys at multiple sites**

If you wish to conduct a national survey, i.e., gather data on the population size of a particular waterbird species (e.g., an endangered species like the West Indian Whistling-Duck, WIWD) or on the size of waterbird populations in the entire country, you can conduct a simultaneous survey or carry out Level 2 or 3 surveys at multiple sites to obtain national abundance estimates. Careful consideration will need to be given to the sampling frame definition, randomization, and replication because the objective will be to make extrapolations beyond the surveyed area (i.e., to wetlands not sampled). Methods for conducting a simultaneous survey of WIWDs are provided in a separate protocol. If you wish to plan a national survey of waterbirds we recommend that you consult with a statistician and/or one of the experts in the CWC monitoring network.

Caribbean Waterbird Census Protocols for Habitat Monitoring

The amount of data that you need to collect about habitats depends on your objectives and resources. Generally it is better to collect too much information than too little so long as data collection does not become onerous or detract from collecting data on birds. This is increasingly important because of the unpredictable impacts of climate change on wetlands. As with all types of data collection it is important to consider analysis and use in the design phase.

Why monitor habitats?

At the CWC site level, waterbird habitats are monitored in order to:

- Understand the relationship between waterbirds and their environment, for example, why are birds in some habitats and not others, what constitutes good quality habitat?
- Measure changes in the habitat that might be related to observed changes in populations, e.g., water levels
- Assess the effectiveness of a management action on habitat, bird diversity and abundance, e.g., restoring natural water flow, removal of invasive plants
- Measure changes in habitat quality and availability following a natural or human-caused event e.g., hurricane, building a road through a wetland that impedes water flow.
- Detect and act on threats in good time. Monitoring provides information for advocacy and for planning interventions.
- Assess the effectiveness of conservation efforts. Is investment in conservation actually bringing about an improvement in the habitat or greater availability of preferred habitats? Are 'sustainable use' approaches really proving sustainable?

How will habitats be monitored in the CWC?

BirdsCaribbean offers the **CWC Site Description Form,** which records many important details about the site and serves as a **baseline** for monitoring. Each level of monitoring also includes collection of **data on site-specific covariates**, variables that potentially influence the number of birds that are detected and counted, including habitat variables. These are included in the various CWC count forms. Additional data can be collected using the optional **fixed-point photography method**, which provides a visual record of changes in habitats. If you are monitoring an Important Bird Area (IBA), we recommend that you follow the monitoring guidelines in *Monitoring Important Bird Areas: A Global Framework, Version 1.2*[39] – this is an excellent system for monitoring threats to IBAs ('Pressure'), the condition of IBAs ('State'), and conservation actions taken at IBAs ('Response').

Habitat Covariates for Level 1-4 monitoring

The conditions of wetlands change over time in ways that greatly affect the numbers and distribution of birds; therefore it is important to collect data on habitat conditions at the time of the survey. Each monitoring protocol form includes space for collection of habitat data, as well as detailed instructions on how to collect the data.

A number of factors such as habitat type, vegetative cover, water depth, salinity, disturbance, and food abundance likely influence the diversity and number of waterbird species at a site and our ability to count them. Each time you conduct a count, we recommend that you measure these variables and/or collect simple index information (factor covariates) such as: habitat type (salt pond = 1, brackish marsh = 2, mangrove swamp = 3), habitat availability (0 = none, 1 = 0-25%, 2 = 25-50%, 3 = 50-75%, 4 = 75-100%), food abundance (0 = none, 1 = low, 2 = medium, 3 = high), disturbance type (hunting, garbage, fire, etc.), and

[39] Available for download at the Caribbean Birdwatch ConserveOnline workspace: http://conserveonline.org/workspaces/caribbeanbirdwatch

disturbance level (0 = none, 1 = low, 2 = medium, 3 = high). This information is very useful for multiple covariate analysis and to create an index of habitat availability/quality.

The definition of good or poor quality habitat is challenging because it will depend on the site (wetland type) and the species of waterbirds using the site. Species with different life histories use different kinds/parts of the habitat (deeper water vs. shallow water vs. mud flats), thus, good habitat for shorebirds will not necessarily be good habitat for ducks. Although it may be difficult we encourage you to come up with an index of habitat quality (this can be developed over a period of months). The index will likely be related to the extent of water available. For example, if the wetland is bone dry, then the habitat availability/quality is zero or close to zero. If this is useful, then your index could be based on the amount of water that is present, (0 = none, 1 = 1-25%, 2 = 25-50%, 3 = 50-75%, 4 = 75-100%), corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.

Habitat availability/quality may also be related to the amount and type of vegetation present. For example, a wetland that is completely choked or covered with dense bulrush or cattail (*Typha* spp) is probably poor quality habitat for most waterbirds. Measuring the type and extent of vegetative cover may provide a useful index to habitat availability/quality or it may contribute to the development of a composite index (i.e., several variables combined). A number of variables are included in the CWC count forms; you can revise these forms to include others or delete any variables you think are not applicable to your site.

CWC Site Description Form

The CWC Site Description Form is designed to provide a standard description of the site, in a format that will allow for comparison among sites, if necessary. It should be completed once, at the start of surveys, usually during the site reconnaissance visits. The form includes information on location, habitat type and condition, uses, and threats. It includes a site map, which may be drawn on a Google Earth image (see the section on Google Earth below), or on a topographic map, or provided as a hand-drawn sketch map. The site map should clearly indicate the survey locations (point count stations or area search locations).

Caribbean Waterbird Census (CWC)
Site Description Form

COUNTRY:	**DATE:**	DY:	MO:	YR:	**ALTITUDE (m):**
NAME OF SITE:			**SITE CODE:**		
PROVINCE/PARISH:					**AREA (ha):**
NEAREST LARGE TOWN:					
COORDINATES	deg.	min.	sec.		N/S
at centre of site	deg.	min.	sec.		E/W
NAME OF RECORDER:					
CONTACT INFORMATION	E-MAIL:		TELEPHONE:		

HABITAT TYPES	**EXTENT**	**NOTES (Include notes on habitats, special features and species)**
Saline		
Hyper-saline/ saline lagoon, or salt pond		
Mangrove swamp, pond, lagoon, island		
Sandy beach, berm, shoreline		
Coral reef		
Seagrass bed		
Salt flat, salina		
Intertidal mudflat, sandflat		
Sand bank		
Tidal creek		
Estuary, estuarine lagoon		
Sand cay		
Rocky strand		
Open sea, bay, strait		
Other		
Brackish		
Brackish lagoon, pond		
Brackish marsh		
Brackish lake		
Other		
Freshwater		
Herbaceous freshwater marsh		
Stock/farm pond		
River, stream, canal, ditch		
Seasonal pools on flooded grassland		
Rice field		
Lake, reservoir, tank		
Sewage pond		
Swamp forest (Royal Palm, *Pterocarpus)*		
Other		

PROVIDE A BRIEF DESCRIPTION OF YOUR SITE (include main habitats, physical features and dominant plant species (if known).					
MEASUREMENTS (Please fill in information from your index point or circle a category)					
GPS COORDINATES	deg.	min.	sec	N/S	
	deg.	min.	sec	E/W	
Water depth at index point (cm)		Distance of sample point from water edge (m)			
Width of beach (m)					
Salinity (note units)	Bottom	Mid-column	Surface		
Salinity (circle if no salinometer)	Fresh	Brackish	Saline		
Turbidity (Secchi disc depth)		pH			
Tidal range (cm)					
% of wetland covered with water:	None	1-25%	26-50%	51-75%	76-100%
% of wetland covered with plants:	None	1-25%	26-50%	51-75%	76-100%
Vegetation status:	Dry	New growth	Flowering	Fruiting	Burnt
Food: Low, medium, high (describe indicators used					
HYDROLOGY (circle those that apply to your site)					
Principal hydrology: tidal, fed by spring, stream, connection to sea, local rainwater, run-off from watershed, blue hole					
Water permanence: permanently wet, semi-permanently wet, seasonally flooded, ephemeral, tidal					
Water level management: controlled water level, inactive controlled water level, no water level control, unknown					
Notes:					
PROTECTION STATUS (circle those that apply to your site)					
Land Protection: protected site, partially protected site, no protection, unknown					
If protected, state the type of protection: marine protected area, national park, reserve, conservation area, fish sanctuary, other (state which)					
Land tenure: government owned, private owned, mix of government and private ownership					
Name of organization(s) or agency(ies) responsible for management and conservation:					
Organizations, agencies, or groups involved in conservation activities or projects (describe briefly):					

LAND USE AND HUMAN ACTIVITIES (circle all that apply)	
Aquaculture: fish, lobsters, shrimp, seamoss Other (list)	Outdoor recreation: picnicking, hiking, photography Other (list)
Agriculture: livestock, small farming, marijuana	Bird watching, wildlife watching
Fishing: subsistence, sport, commercial	Tourism: nature, culture, heritage
Shrimping: pots, trawls	Aquatic recreation: swimming, sun-bathing, snorkeling, diving, kayaking, sailing, canoeing, wind surfing, kite surfing, speed boats, paddle boats, boat tours
Crabbing: land crabs, swimming crabs	Dredging, sand mining
Salt production	Solid waste disposal, waste water treatment
Production of honey	
Hunting: (list species)	Research: (list main categories)
Harvest of craft materials, e.g., reed/thatch cutting for basket making	Other: (please list)
Cutting of mangroves or other wood for timber, charcoal production, fodder, production of tannin	

OTHER IMPORTANT FAUNA AND FLORA: (e.g., threatened or economically important species - please list)

THREATS - Rank all that apply 0 = None, 1 = Little, 2 = Moderate, 3 = Large-scale, 4 = Unknown
AGRICULTURE
Livestock gazing [ ], marijuana cultivation [ ], Small cultivation [ ], forestry [ ], fuelwood [ ], orchards [ ]
Aquaculture: fish [ ], shrimp [ ]. Mariculture [ ]
Other (state)
RESIDENTIAL & COMMERCIAL DEVELOPMENT
Housing [ ], commercial [ ], industrial [ ], hotels [ ], villas [ ], marina [ ], squatting [ ], golf course [ ] Other (state) [ ]
ENERGY PRODUCTION AND MINING
Mining: sand [ ], clay [ ], limestone quarrying [ ]
Power stations [ ], LNG plants [ ], other (state) [ ] Other: (state) [ ]
Utility and service lines [ ] cell towers [ ]
Other (state)
TRANSPORTATION & UTILITIES
Roads [ ], off-road traffic [ ]
Shipping channels [ ], heavy boat traffic [ ]
Other (state)
OVER-EXPLOITATION, PERSECUTION AND CONTROL OF SPECIES
Hunting: commercial [ ], subsistence [ ], sport [ ]
Fishing: commercial [ ], subsistence [ ], sport [ ]
By-catch [ ]
Cutting, harvesting or destruction of mangroves or other species (state which) [ ]; firewood collection [ ], charcoal production [ ], selective harvest [ ], extraction of sticks for fish pots [ ]; other (state) [ ]

Egg collection: subsistence [ ] state species , commercial [ ] state species
Harvest of protected/threatened species (state which) [ ]
Other (state) [ ]
HUMAN INTRUSION AND DISTURBANCE
Land tours [ ], boat tours [ ]
Other (state) [ ]
MODIFICATION OF NATURAL ECOSYSTEMS
Excessive fire [ ], fire control [ ]
Dredging [ ], draining [ ], filling in for development [ ] Describe briefly:
Shoreline encroachment: housing [ ], roads [ ], agriculture[ ], tourism [ ]
Natural hydrology changed by development: roads [ ], dykes [ ], dams [ ], filling for construction [ ] diversion of water for other uses [ ], interruption of natural circulation patterns and currents [ ]
Deforestation of watershed [ ]
Other (state) [ ]
INVASIVE SPECIES
Feral animals: cats [ ], dogs [ ], goats [ ], cattle [ ], pigs [ ]
Invasive mammals: rats [ ], raccoons [ ], mongoose [ ], monkeys [ ] other (state) [ ]
Invasive aquatic animals: Tilapia [ ], catfish [ ], carp [ ], shrimp [ ], lionfish [ ], other (state)
Overgrowth by invasive plants, e.g., water hyacinth [ ], *Typha* spp [ ], vines [ ], other (state) [ ]
Predation of adult birds [ ], young [ ], eggs [ ] By introduced rats [ ], feral cats [ ], dogs [ ], mongoose [ ] other (state) [ ]
POLLUTION
Domestic sewage [ ], solid waste [ ], industrial waste [ ], pesticides [ ], fertilizers [ ], oil [ ], agricultural wastes [ ], bathing [ ], washing [ ], siltation [ ], noise [ ], air-bourne pollutants [ ], thermal pollution [ ], light pollution [ ], eutrophication [ ] Other (state) [ ]
GEOLOGICAL EVENTS
Volcanic eruptions [ ], earthquakes [ ], mudslides) [ ], tsunamis [ ]
CLIMATE CHANGE AND SEVERE WEATHER
Hurricanes [ ], drought [ ], floods [ ], rising sea level [ ], high temperatures [ ], fire [ ], coral bleaching [ ], other (state) [ ]

PROVIDE A SKETCH MAP OF YOUR SITE SHOWING MAIN PHYSICAL AND NATURAL FEATURES (e.g. trails, nesting colonies) AND LOCATION OF AREA SEARCH ROUTE OR SURVEY POINTS, ON A TOPOGRAPHIC MAP OR GOOGLE EARTH IMAGE ON A SEPARATE SHEET or SKETCH IT BELOW

Notes on how to complete the Site Description Form

COORDINATES		The site coordinates should be from the approximate geographic centre of your study area. You can generate them from a Google Earth image of your area.
HABITAT TYPES	**EXTENT**	**NOTES**
HABITAT TYPES		This is a list of the most common habitat types in Caribbean wetlands. Please rank all those that occur in your study area under the "Extent" column. Add other types if these ones do not work well for your wetland.
EXTENT		Rank the habitats that are present in your wetland according to your best estimate of the % of the total area they cover according to the scale below.
	0	Not present
	1	Not very extensive, covers less than 25% of wetland
	2	Fairly extensive, covers 26-50% of wetland
	3	Very extensive covers >51% of wetland
NOTES		Make notes about any aspects of the habitat type that may influence bird distribution or numbers

PROVIDE A BRIEF DESCRIPTION OF YOUR SITE (include main habitats, physical features and dominant plant species (if known)
Provide a very brief description of the site.

MEASUREMENTS (Please fill in whatever information you can provide from your index point)	
INDEX POINT	The index point is a single point at which you will take measurements every time you survey the wetland. It should be convenient (possibly the first place you get to) and representative.
COORDINATES	Coordinates of index point.

Water depth at index point: Measure water depth at a predetermined point (e.g., GPS location mapped and described).
Distance of sample point from water edge: measure or estimate the distance of the sample point from the water's edge.
Width of beach: Measure or estimate the exposed unvegetated area between water and high water mark.
Salinity (note units and depth of samples): Measure salinity at the bottom, middle, and top of the water column. Remember to note whether you are measuring in ppt or %. OR take samples and label them clearly.
Turbidity: Optional, can be measured with a secchi disk (instructions for making a secchi disk available at www.conserveonlineworkspace/cwc).
Tidal range (cm): Include the difference between mean high and low water marks here if you know it or can estimate it.
pH: Optional, can be measured with a pH meter or pH paper.
Other habitat covariates: Water level, extent of vegetative cover, vegetation status, and estimates of food abundance may provide an index of habitat availability/quality. These can be assessed for your site from habitat at your index point (which may be one of your point count stations or area search locations), and also at each of your CWC survey sites (record data on CWC count forms), if desired. The data provided here will provide a baseline. First, decide on you potential habitat at the site. If you have reached your point by canoe or have walked (possibly on a dike) or waded out to your point and have wetland all around you, then your potential habitat is a full circle with a radius of 400m around you. If you are standing on the edge of the wetland, then the potential habitat is a ½ circle (with radius up to 400m). Be sure to record on a map what part of the wetland you are including in your measurements.

Water Level: % of wetland area covered with water: Can give an estimate or circle a category corresponding to the level or amount of water available in the wetland, with zero indicating no water (severe drought) and 4 indicating flooded/maximum water levels.
Vegetation: % of wetland area covered with plants: Can give an estimate or circle a category based on your best estimate.
Vegetation status: Describe the general condition of the vegetation, e.g., dry, new growth, flowering, fruiting, burnt, etc.
Food: Estimate if levels are low, medium, or high (circle one) and describe indicators used (e.g., water levels, observation of aquatic invertebrates, fish, crabs, frogs and/or seeds or algae in the water, flowering and fruiting trees and bushes around the area, birds actively feeding, etc.)
HYDROLOGY (circle those that apply to your site)
Use this section to describe aspects of the water regime in your study site that might affect ecosystem function, waterbirds and their habitats.
LAND USE AND HUMAN ACTIVITIES (circle all that apply)
Use this section to describe human activities at your study site.
OTHER IMPORTANT FAUNA AND FLORA: (e.g. threatened, endemic or economically important species - please list)
Use this section to describe other important biodiversity at the site (e.g. endemic or threatened plants or animals or ecosystems). Might include nesting sea turtles, crocodiles, Royal Palms, bats, iguanas, etc.)
THREATS – Rank all that apply, 0 = None, 1 = Little, 2 = Moderate, 3 = Large-scale, 4 = Unknown
Use this section to list and rank the threats to your wetland and its birds. Score each threat using the following scale (which combines scope (extent), severity (how bad the effects are), and duration (time period over which impacts occur) into one score: 0 = Threat not present 1 = Threat present but impact is small 2 = Threat present and impact is moderate (i.e., felt only in a limited area, not very severe) 3 = Threat and impact is severe (i.e., felt in more than half of the wetland or by more than half of the population of waterbirds or very severe in the area where it is having an impact) 4 = Unknown (i.e., there is no available information about this threat).
AGRICULTURE: Includes all types of agriculture that occur in your study area.
RESIDENTIAL AND COMMERCIAL DEVELOPMENT: Threats from human settlements that result in habitat destruction and degradation. Note that aspects that relate to pollution should be included in that section.
ENERGY PRODUCTION AND MINING: Threats from the production of minerals and energy.
TRANSPORTATION AND UTILITIES: Threats from long-narrow corridors of disturbance from roads, utility lines. Also cell towers.
OVER-EXPLOITATION, PERSECUTION AND CONTROL: Threats from consumption of wild biological resources, including deliberate and unintentional harvest, persecution and hunting, as well as control activities. Note that cutting and harvesting includes firewood collection.
HUMAN INTRUSIONS AND DISTURBANCE: Threats from human activities that alter, destroy or disturb habitats and species or ecological functions.
NATURAL SYSTEM MODIFICATIONS: Threats that alter the natural functions of wetlands and associated ecosystems, by interfering with their hydrology, filling, dredging or changing water levels.
INVASIVE SPECIES: Threats from introduced and native plants, animals or pathogens that harm biodiversity (by killing them or destroying habitats) following introduction, spread or excessive increase.
POLLUTION: Threats from point and non-point sources of materials that damage animals and plants and their habitats.
GEOLOGICAL EVENTS: Threats from natural catastrophes that can damage wetlands and their biota.
CLIMATE CHANGE AND SEVERE WEATHER: Threats from long and short-term events, and the increase of such events as a result of climate change.

PROVIDE A SKETCH MAP OF YOUR SITE SHOWING MAIN PHYSICAL AND NATURAL FEATURES (e.g., nesting colonies) AND LOCATION OF SURVEY POINTS, ON A TOPOGRAPHIC MAP OR GOOGLE EARTH IMAGE ON A SEPARATE SHEET
This map should indicate your study area, survey points and the area that is being surveyed from each point. If you wish, you may also show the above information on the map (e.g., major habitat types, locations for human activities, location of threats).
What to do with this form
Check and enter the data as soon as possible after collecting it. BirdsCaribbean will shortly be providing a Survey Monkey site, which will allow you to enter the data directly into BirdsCaribbean's database and thereby contribute to our plans to build an on-line directory of Caribbean wetlands of importance for birds. Data entered into this site will be returned to you as an Excel spreadsheet. CWC participants will be informed as soon as this facility has been set up. If you have questions about filling out the Site Description Form, contact Jessica Rozek Canizares (Jessica.Rozek@BirdsCaribbean.org) or Lisa Sorenson (Lisa.Sorenson@BirdsCaribbean.org)

Fixed-point photography

Photographs are a good way of documenting changes to a site though generally at the broad, rather than fine, scale and therefore are a very useful and simple tool for monitoring habitat changes. Many habitats change relatively slowly and a series of photographs may show changes imperceptible to protected area staff, especially when staff change. Photographs are also a dramatic way of illustrating changes and problems.

To be truly useful, care needs to be taken when setting up a fixed-point photograph program, with equal consideration given to establishing an accurate and secure storage and documentation system so that photographs can be linked to locations. A good archiving system requires time and money so if this is unlikely to be possible and sustainable, it is probably better not to start. With the increasing use of digital cameras, some of which either have in-built or at least are compatible with, Global Positioning System (GPS) technology, archiving and referencing images and supporting information is becoming much easier. The frequency at which photographs need to be repeated will depend on the objectives of your monitoring and the anticipated rate of change of the habitat that you are monitoring.

A recommended strategy for establishing a program is outlined below:

- walk the site and select potential fixed points which are either likely to be recognisable well into the future or record their positions using a GPS.
- use a fixed, rather than zoom, lens as this will ensure that the field of view is consistent between photographs.
- always use a tripod.
- either photograph a panoramic arc from left to right, with 10-30% overlap between images, or take photographs at fixed compass bearings.
- mark tripod locations and bearings of photographs on a map. It may also be useful to photograph tripod locations.
- record the date, time and focal length of the lens used, plus any other information that may be useful such as the name and contact details of the photographer, type and ISO rating of the film used etc.
- ensure that all details are carefully documented and that information and images are cross-referenced. Developing a standard recording sheet can help with this.
- if film is being used, consider having it processed to archival quality to ensure it does not deteriorate. Black and white prints last longer than colour but may show less detail.
- if film is used, ensure that storage facilities are suitable, for example dry, dark and at a relatively constant temperature.
- whether using film or digital images, consider making two copies of everything and storing them in separate locations for added, long term security

Using Google Earth

As mentioned above, increasing use is being made of satellite images and Geographical Information Systems (GIS) for preparing habitat maps for large areas but satellite images can be expensive, therefore in some situations the free images available from Google Earth – www.earth.google.com - may be an acceptable substitute.

Google Earth displays satellite images of the Earth's surface and allows users to view locations either looking perpendicularly down or at an oblique angle. The degree of resolution available is variable and largely based on points of interest and popularity of locations but most land areas, except for some islands, are covered at least 15 metres per pixel resolution. The highest resolution images are 15 cm resolution. Two dimensional (2D) images are available for most of the Earth but there is increasing 3D coverage.

Google Earth displays coordinates using latitude/longitude, based on the 1984 World Geodetic System datum (WGS84). The quality and date of the images used varies but most are relatively recent - the approximate date of images is displayed in the

bottom information bar in the latest (beta) version of the program (version 4.3). Also it should be noted that the date of the image might change with the level of zoom, as much of the close up imagery is based on aerial photographs.
Several additional data layers are available such as roads, centres of population, national boundaries, places of interest and major topographical features. There are several potentially useful tools built into the program including the facility to add location markers, draw polygons and lines, with the facility to measure the length of the latter, and add photographs. Additional features, such as the ability to measure areas of polygons and to import waypoints etc from selected GPS devices, are available in the commercial version of the program, Google Earth Plus. A full description of how to use the program and its features is available in a comprehensive online Help section.

The area of polygons can also be measured using an on-line tool, Google Planimeter -http://www.acme.com/planimeter/ - which provides a Google Earth-style interface, with maps and satellite images, on which you can define the boundary of your polygon by simply clicking on points around the perimeter of the area you wish to measure. The area is automatically calculated and displayed in m^2, hectares, km^2, acres and $mile^2$.

Currently, every image created from Google Earth using the satellite data provided is copyrighted under United States Copyright Law and may not be used except under the licenses provided by Google. Google allows non-commercial personal use of the images, for example on a personal website, as long as copyrights and credits are displayed. Therefore there may be limitations in its use for the production of reports and presentations. A similar, but copyright free, program that may be more suitable for some uses is NASA's World Wind – www.worldwind.arc.nasa.gov. World Wind only runs on the Windows operating system whereas Google Earth runs on Windows, Macintosh and Linux systems.

The main limitation of Google Earth from a habitat monitoring point of view is the potential variability in the date and quality of images, particularly in the case of large sites. However, for providing a 'snap shot' of sites for documenting broad changes, preparing basic habitat maps and for planning fieldwork, the program has a great deal to offer.
A selection of images highlighting the positive and negative features of Google Earth are shown below.

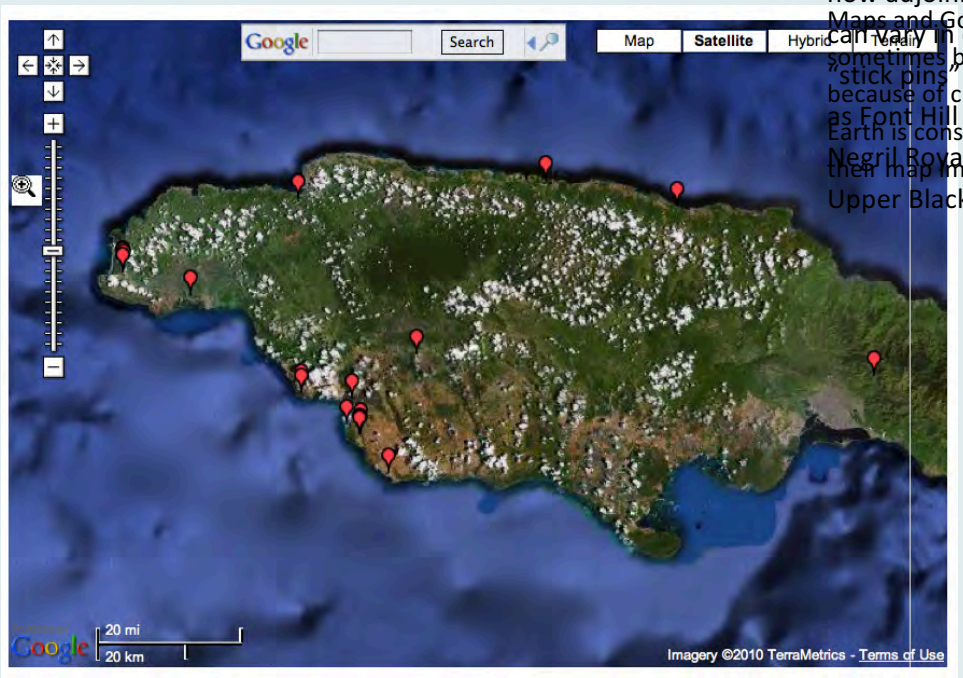


Figure 25: Basic image of western Jamaica from Google Maps in eBird Caribbean showing how adjoining satellite images can vary in quality. The red "stick pins" are locations such as Font Hill Nature Preserve, Negril Royal Palm Reserve and Upper Black River Morass.

Figure 28: Close up view of Negril Royal Palm Reserve – from this it would be possible to prepare a basic habitat map, and the image could be archived and used to monitor changes in extent of open water, scrub, encroachment by buildings and roads etc.

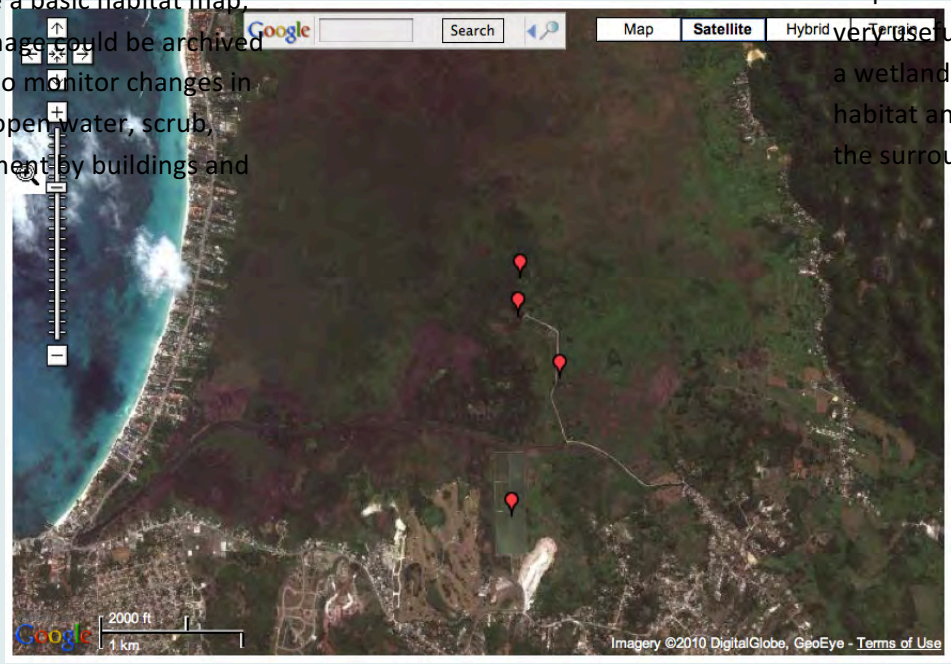
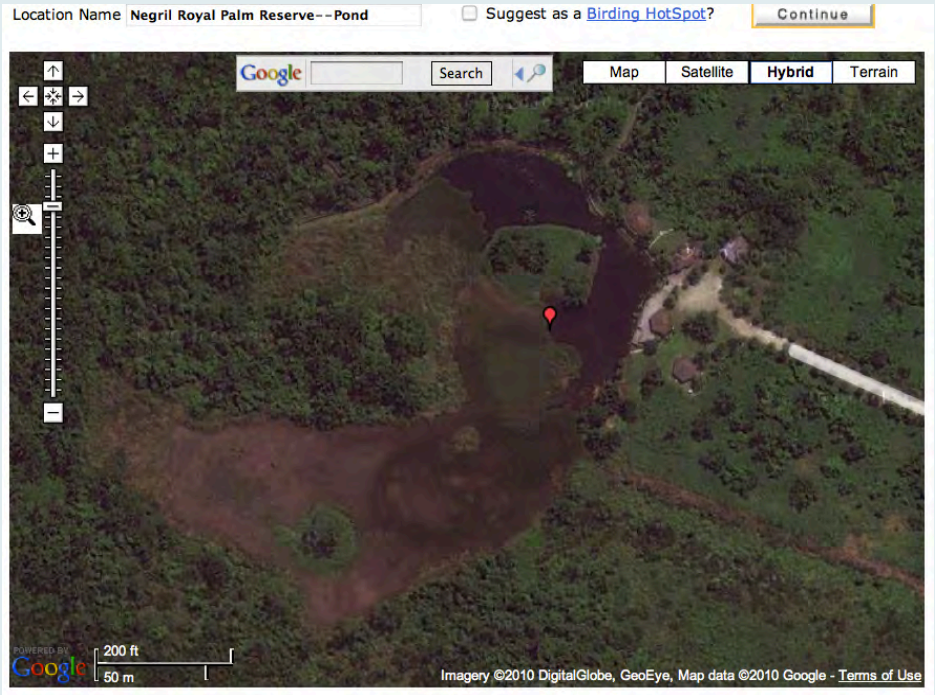


Figure 27: Map of Negril Royal Palm Reserve and the surrounding region. Maps at this resolution can be very useful in planning access to a wetland or determining habitat and even threats from the surrounding region.



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[1] http://www.birdlife.org/action/science/species/waterbirds/downloads.html

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[40] **Many useful resources, reports, manuals, papers, and Powerpoint presentations are available for download from BirdsCaribbean's ConserveOnline sites "Caribbean Birdwatch" or "Caribbean Waterbird Census."**

Glossary of Some Terms Related to Counting Birds

Abundance – The average density of selected species in places where they are present and sampled (or occupied patches).

Area search – A method of counting birds while walking through a predetermined area for a fixed period of time.

Census – A total count of the number of individuals of birds at a site by species. Note that the term is widely used in manuals and monitoring literature to refer to methods/ all types of incomplete counts (e.g., point counts) to estimate population size and trends. Many people use the word *census* interchangeably with count and survey. However, the word census is also used to mean a complete count, a total number without any error or uncertainty.

Covariate - A variable that is possibly predictive of the outcome under study. A covariate may be of direct interest or it may be a confounding or interacting variable.

Density – Number of birds per unit area.

Detection probability or detectability – A measure of the likelihood that an individual will be seen in a count.

Index, as in "index of abundance" – a measurement that is related to the actual total number, for example, the number of nests counted in a breeding colony (as an index to the number of breeding pairs)

Occupancy – A measure of number of patches in a habitat that are occupied by the species or group of species that are being studied.

Metadata – Information about data (e.g. bibliographies, keywords in a paper)

Point Count – A method of counting birds while standing at a predetermined geographic location or point for a set period of time.

Point count station – Fixed location from which to count birds using the point count method.

Population size – Number of birds in a survey region

Relative Abundance – A comparison of the number of individuals of species counted at a site on the same date or between the same species on different dates. This provides an index of numbers at the site but cannot be used to measure density or populations.

Sampling Bias – Factors that affect the accuracy of counts in a systematic way.

Sampling Frame – The geographic area or group of similar habitats within a geographic area from which sample points will be selected.

Site Inventory – A complete list of the species present at a site.

Species richness – The total number of species using the site.

Statistical power – The probability that a statistical test will reject a false null hypothesis (i.e., that it will not make a Type II error), the probability of finding a difference that does exist. Power analysis can be used to calculate the minimum sample size required to accept the outcome of a statistical test with a particular level of confidence.

Survey – A way to estimate numbers or relative abundances of species or groups of species at a site based on sampling.

Trend – Changes in numbers over time.

Appendices

Appendix 1 - About BirdsCaribbean

BirdsCaribbean (formerly the Society for the Conservation and Study of Caribbean Birds)) is a nonprofit 501 c (3) membership organization working to conserve the birds of the Caribbean and their habitats through capacity building, research, conservation action, education, outreach and communication. Founded in 1988, BirdsCaribbean is the largest single bird conservation organization in the Greater Caribbean region, including Bermuda, the Bahamas and all islands within the Caribbean basin.

The overarching goal of the BirdsCaribbean is to increase the capacity of Caribbean ornithologists, resource managers, conservation organizations, institutions, and local citizens to conserve the birds of the Caribbean and their habitats. We aim to achieve this by 1) developing regional conservation projects, activities, and materials that facilitate local research, management, conservation, education and outreach, and 2) Building networks and partnerships with local, national and international organizations and institutions that share our bird conservation goals.

Who we are

BirdsCaribbean is staffed with an Executive Director, Administrative Assistant and . and run by volunteers and is funded by projects. Its board is elected by the members and consists of the Executive, Editor-in-Chief of *The Journal of Caribbean Ornithology*, and Directors-at-Large. The board serves for a term of two years with an opportunity to renew for one term. The Board for 2019-2020 consists of:

Lisa Sorenson, Executive Director (USA)
Andrew Dobson, President (UK/ Bermuda)
Justin Proctor, Vice-President (USA)
Laura Bambini, Treasurer (UK/ Montserrat)
Hannah Madden, Secretary (St. Eustatius)
Adrianne Tossas, Director-at-Large (Puerto Rico)
Ancilleno Davis, Director-at-Large (Bahamas)
Lisa Austin, Director-at-Large (USA)
Jason Townsend, Editor-in-Chief of BirdsCaribbean's *Journal of Caribbean Ornithology* (USA)

What we do

BirdsCaribbean holds a week-long international conference every two years, has a number of active Working Groups and publishes *The Journal of Caribbean Ornithology*. With assistance from the US Fish and Wildlife Service, BirdsCaribbean also sponsors the publication of local bird field guides. BirdsCaribbean works to raise public awareness, knowledge and appreciation of the value of the region's many endemic bird species and their habitats through its flagship programs: the *Caribbean Endemic Bird Festival* (CEBF), *West Indian Whistling-Duck (WIWD) and Wetlands Conservation Project*, *BirdSleuth Caribbean*, *Caribbean Waterbird Censu*s and the *Caribbean Birding Trail*. BirdsCaribbean also raises awareness about migratory birds through celebration of *World Migratory Bird Day*.

BirdsCaribbean works through projects, which are developed through its working groups. Current working groups include Working Groups: West Indian Whistling-Duck and Wetlands, Threatened Birds, Seabirds, Waterbirds, Bird Monitoring, Caribbean Wildlife Art, Media, Invasive Species, White-crowned Pigeons, and Caribbean Parrots. The CWC is part of a program that was initiated by the Monitoring Working Group.

CWC materials

As well as this manual, BirdsCaribbean has developed various materials that would be useful in the development of CWC programs. These include waterproof plastic field identification cards in English, Spanish and French for waterbirds, including :

- Wetland Birds of the Caribbean
- Seabirds of the Caribbean

- Resident and Migratory Ducks of the West Indies

There are also identification cards for the common landbirds of Antigua and Barbuda, Bahamas, Bermuda, Grenada, Cayman Islands, Guadeloupe, Jamaica, Martinique, St. Vincent and the Grenadines, St. Lucia, and Puerto Rico, and others are in production.

We have also produced an identification booklet on "Mangroves of the Caribbean," "BirdSleuth Caribbean: Connecting Kids through Birds" curriculum, "Migratory Birds of the West Indies" Colouring Book, "Save Our Seabirds" poster, and "Wondrous West Indian Wetlands: Teachers' Resource Book." Most of these items are available for download from our website www.BirdsCaribbean.org or contact Lisa Sorenson (Lisa.Sorenson@BirdsCaribbean.org).

How you can help

Become a member today

Show your support for the organization by becoming a member. Categories of membership include ordinary member, Caribbean national/ student, institutional and corporate/ benefactor member. We also have a sponsorship program. You can join here: https://4agc.com/commerce_pages/9e901464-0c6c-484e-82f7-081944171ff9

Get involved

BirdsCaribbean has a small staff; much of our work is carried out by volunteers. There are many opportunities to use any or all of your skills. From monitoring your favourite birding locality to delivering educational programs, we can use your help or the support of your organization.

Provide funding

Funding to support our general activities and specific projects is always much appreciated and every dollar goes directly to putting conservation on the ground.

BirdsCaribbean is a registered 501 c (3) organization in the U.S.A thus US donations are tax-deductible. Check our website for more information about projects and programs that would benefit from your support.

Find out more

To find out more about the BirdsCaribbean including how to join, visit www.BirdsCaribbean.org.

Appendix 2. eBird Caribbean and Basic Counts (Level 1 Monitoring) for the CWC

For many sites in the Caribbean there is very little information about the presence of bird species, thus reporting even a single incidental sighting of a bird has value for science, education and conservation. However, observations are much more useful when certain conditions are met. One of the most important considerations is to record and report all the species you see or hear. Another is to repeatedly visit the same location at the same time of day and cover the same area. The CWC includes a variety of more structured and rigorous techniques to understand bird distribution, but it is amazing how much can be learned when large quantities of data are gathered with relatively simple protocols that focus on complete, effort-based checklists gathered repeatedly from the same locations[41].

eBird Caribbean is a web-based database in which surveyors submit, save and explore their bird observations. Created from a partnership of the Society for Conservation and Study of Caribbean Birds and the Cornell Lab of Ornithology, it is an invaluable tool for birders, scientists, natural resource managers, and conservationists. Entering your monitoring data into eBird Caribbean will allow you to keep track of local bird observations, view maps and graphs of frequency and abundance of bird species and at the same time contribute to expanding our knowledge of bird distribution and abundance throughout the Caribbean.

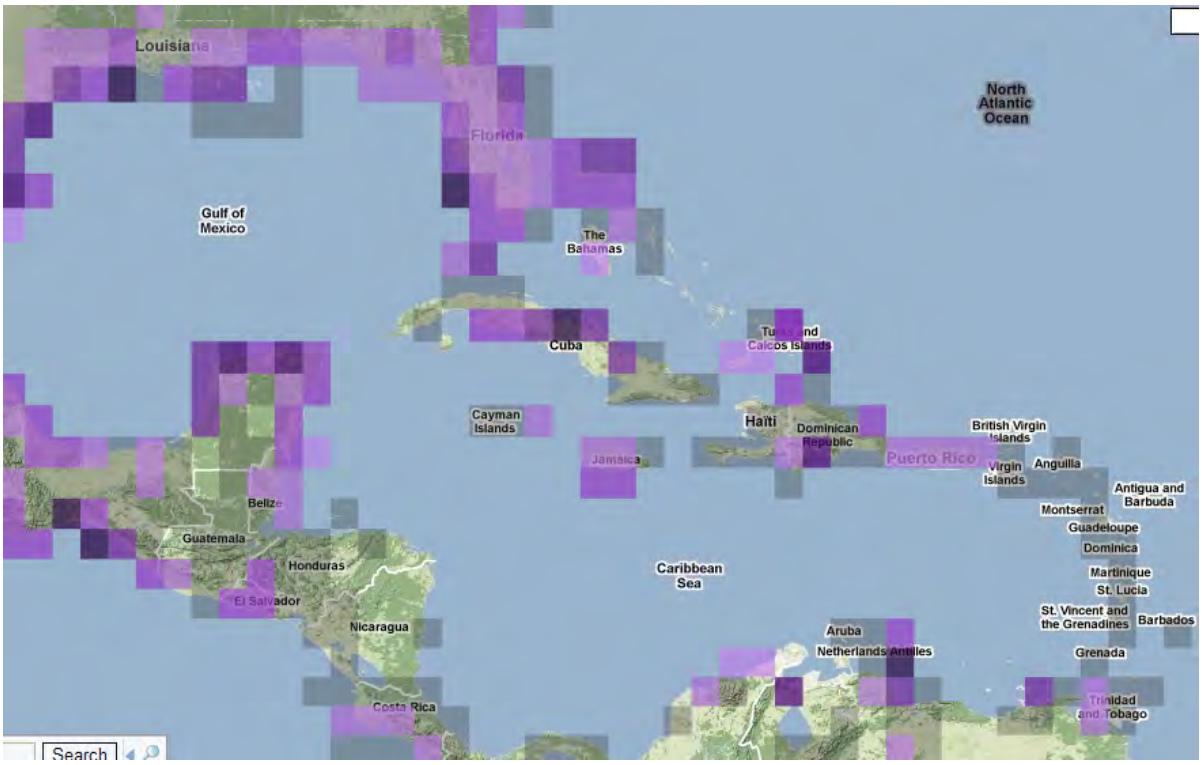
eBird Caribbean offers several CWC protocols which are used for Level 1 and 2 monitoring data.

Point Count: Observations made from a specific location (count station), counting a defined area. Recommended duration is 6-12 minutes though longer durations may be necessary for certain counts[42].

Area Search: Observations made while traveling and counting within a defined area. Examples include walking along existing boardwalk or shoreline and counting birds in the entire wetland. Recommended duration is 20 minutes though shorter or longer durations may be necessary for certain sites.

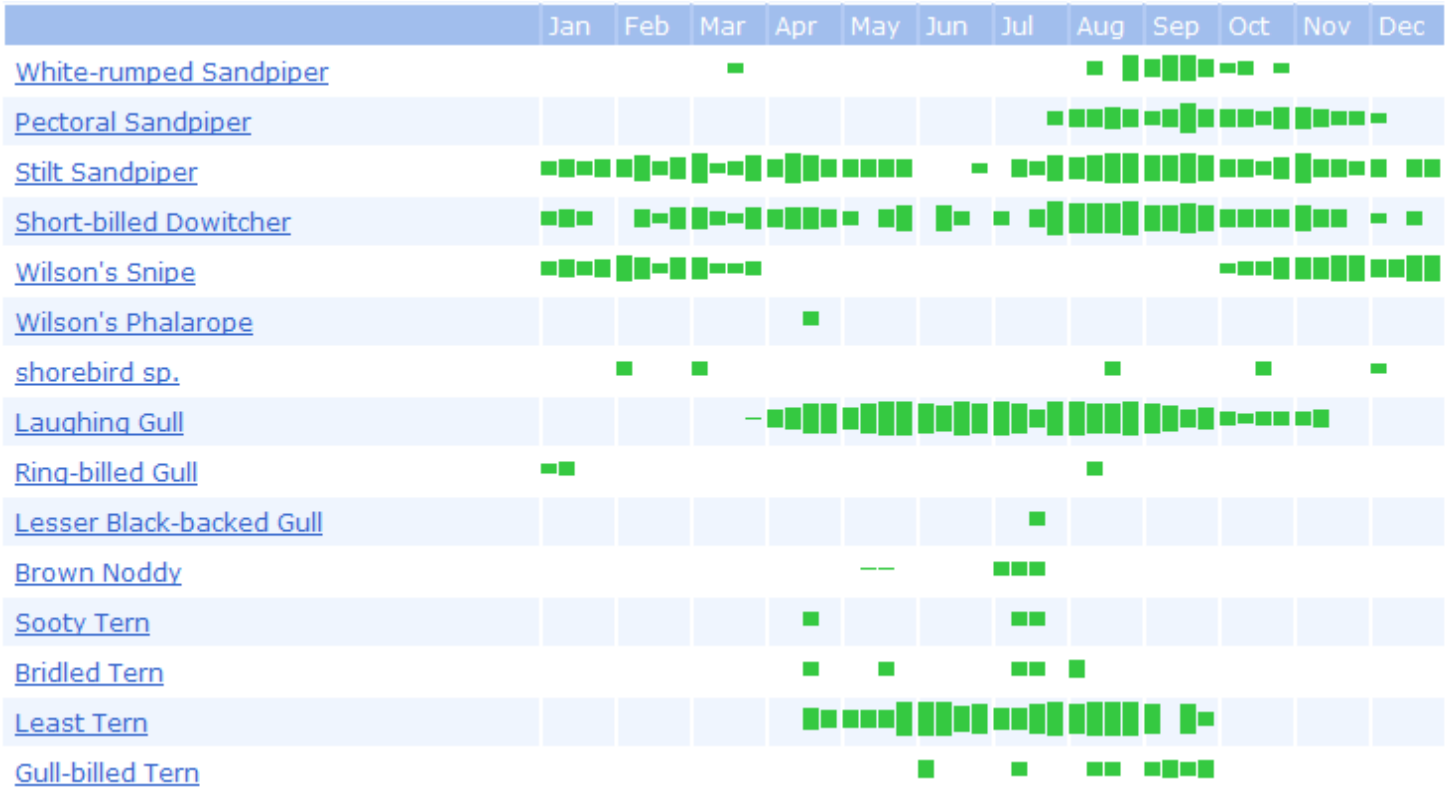
Using either of these methods, you should be able to develop a complete list (or checklist) of birds observed at your site on the date of your visit. A complete checklist includes all the birds that you were able to identify to the best of your ability. A complete checklist, entered into eBird is much more useful than a single record or an incomplete list. A "record" is just one observation of a bird (e.g., one Reddish Egret at Monumento Natural Bahía de las Calderas, Dominican Republic on 18 Sep 2010), while a "complete checklist" is all of the birds associated with that birding/sampling event (e.g., everything you saw/heard at Monumento Natural Bahía de las Calderas, Dominican Republic on 18 Sep from 7AM-9AM while covering a 3 hectare wetland). When you answer 'Yes' when eBird asks “Are you reporting all species?” the lack of detection for all other species can be inferred. This means that when all of the “complete” checklists are combined across the Caribbean, eBird can then compile and display distribution maps that show not only where the birds were (presence), but also where they were not recorded (absence). With enough data over sufficient time and sites, true absence can be inferred from regions where a species has never been recorded. This can also help to show where eBird currently lacks sufficient data to say whether or not the species is present (see below). This combined with a habitat map could suggest locations that need more surveys. You will also be able to compare presence and absence at your site over time.

[41] See also: Effort-based observations enable powerful data analysis, Sept. 24, 2010, http://ebird.org/content/ebird/news/effort_based_obs
[42] See CWC protocols for more information on recommended count duration.



The map above shows the overall distribution of Reddish Egret in the Caribbean region as tracked by eBird. The intensity of the colors on the map reflect where Reddish Egret is frequently reported or rarely reported. The darker purple around the Gulf Coast and in Greater Antilles indicate areas where Reddish Egret are frequently reported. The paler purple in Jamaica and Puerto Rico show where Reddish Egrets are present but much less frequently reported. Note the extensive areas of gray in the Lesser Antilles and across much of Central America. These gray areas represent 100km grid squares where eBird has at least 5 complete checklists, but no Reddish Egrets have been reported. The 'blank' areas, on the map show where eBird lacks data (e.g., across parts of Mexico, Central and South America). It is not known for sure whether Reddish Egret occur here or not from the data collected in eBird because there are not enough complete checklists from these regions.

eBird Caribbean has the ability to create frequency bar charts, which indicate the percentage of checklists where a species was seen during each week for a specific location or IBA or even an entire country. Wide bars indicate species that are commonly observed, narrow bars show species that are infrequently observed. For instance in the bar charts below for the US Virgin Islands, Brown Noddy is uncommonly observed in May, Short-billed Dowitcher is present year round, Laughing Gull is commonly seen May through September, and White-rumped Sandpiper is largely a fall migrant. While fairly simple, these charts show very well the details of the seasonal distribution of wetland birds. Additional charts and graphs display high counts and abundance of a species through the year. Such graphs can be very useful in understanding the dynamics of species composition at a site, group of sites, country or region.



It is also important to remember that with eBird your data do not exist in a vacuum. When you enter a checklist into eBird Caribbean and provide the date and exact location, we are able to link your observations with a variety of other datasets like habitat, population density and climate. In fact, each checklist is linked with *hundreds* of other variables that affect bird distribution and abundance. eBird can use these to develop models of bird distribution that predict where a species occurs. Their initial efforts have focused on the Lower 48 United States, but the long-term plan is to expand these analyses to the entire Western Hemisphere, including the Caribbean. Of course, this depends on the sufficiency of the data, among other factors.

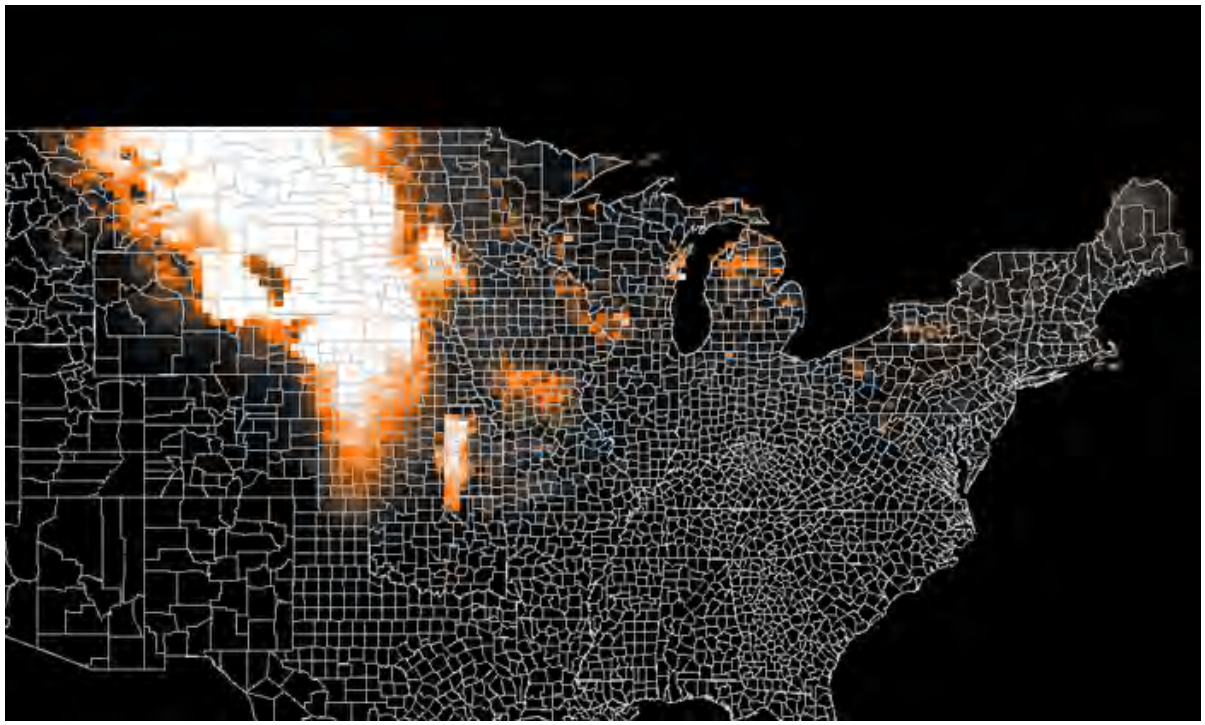


Figure 1. Spatio-temporal Exploratory Model (STEM) visualization of the June distribution of Upland Sandpiper across the Lower 48 United States based on eBird effort-based observations.

In the map above note the detail with which we are able to estimate the breeding distribution of the Upland Sandpiper. Comparison with existing range maps show a similar core range in the Dakotas, Nebraska, eastern Montana, etc., but the differences are also striking: on the STEM map the areas east of Iowa and Wisconsin are patchy and predicted at very low occurrence. Since Upland Sandpiper has largely disappeared from its eastern breeding range, it seems that the STEM map is extremely accurate. The greatest value of the STEM maps is that they show an indication of density, so we can see the areas of concentration in the northern Great Plains and how it compares to remnant breeding populations in the East. Given how accurate this Upland Sandpiper map seems to be, we are optimistic about the utility of these maps for revealing patterns that may not have been apparent previously. Current STEM modeling requires large numbers of Point Count and Area Search based observations as well as external datasets covering habitat, weather, climate, population and others. Today it probably cannot be applied to Caribbean birds, but as more and more data are gathered and entered into eBird Caribbean, analysis techniques such as STEM can be used and will greatly increase our knowledge of bird populations throughout the Caribbean. What is so exciting about STEM is how good these maps are and how they truly show what can be accomplished with simple observational data.

Society for the Conservation and Study of Caribbean Birds