National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Coastal Breeding Bird Monitoring Protocol for Boston Harbor Islands National Recreation Area

2015 Revision

Natural Resource Report NPS/NETN/NRR—2015/954

ON THE COVER
Double-crested Cormorants nesting on Middle Brewster Island
Photo: Carol Lynn Trocki

Coastal Breeding Bird Monitoring Protocol for Boston Harbor Islands National Recreation Area

2015 Revision

Natural Resource Report NPS/NETN/NRR—2015/954

Carol L. Trocki

55 East Main Road
Little Compton, RI 02837

Brian R. Mitchell[1] , Peter W. C. Paton[2]

[1] Northeast Temperate Network
54 Elm Street
Woodstock, VT 05091

[2] University of Rhode Island
Dept. of Natural Resources Science
Coastal Institute in Kingston, #105
1 Greenhouse Road
Kingston, RI 02881

April 2015

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received formal, high-level peer review based on the importance of its content, or its potentially controversial or precedent-setting nature. Peer review was conducted by highly qualified individuals with subject area technical expertise and was overseen by a peer review manager.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Northeast Temperate Network, (http://science.nature.nps.gov/im/units/netn/monitor/programs/coastalbirdss/coastabirds.cfm) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/). To receive this report in a format optimized for screen readers, please email irma@nps.gov**.**

Please cite this publication as:

Trocki, C. L., B. R. Mitchell, and P. W. C. Paton. 2015. Coastal breeding bird monitoring protocol for Boston Harbor Islands National Recreation Area: 2015 revision. Natural Resource Report NPS/NETN/NRR—2015/954. National Park Service, Fort Collins, Colorado.

NPS 035/128463, April 2015

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Update methods to reflect refinements during the 2007 field season, specifically adding methods for including a measure of detection probability to survey methods.	Protocol development
1.02	11/2008	Carol Lynn Trocki	Update to reflect editorial comments and analysis recommendations of NETN Monitoring Coordinator. Minor refinements to methods based on 2008 field season experience.	Internal review
1.03	1/2009	Carol Lynn Trocki	Update to reflect minor editorial changes recommended by NETN Monitoring Coordinator.	Internal review
1.04	4/2009	Carol Lynn Trocki	Update to reflect comments received during peer review; see Appendix C	External review
1.05	11/2009	Carol Lynn Trocki	Update to reflect comments received during peer review; see Appendix C	External review
1.06	4/2011	Carol Lynn Trocki and Brian Mitchell	Refine methods used for spotted sandpiper surveys and photo documentation of gull & cormorant surveys; add section on volunteer communication; minor editorial changes for improved clarity; add and update data management SOPs. Analysis report postponed to 2013 (approved by NETN and Regional I&M Program Managers)	Operational review
1.07	5/2012	Carol Lynn Trocki	Add text explaining how unforeseeable circumstances affecting survey schedule will be handled; update text to reflect photo documentation and scoring methods, update photo scoring datasheet in Appendix B; add SOPs for Photo Documentation, Photo Scoring, and Protocol Deviation	Operational review
1.08	3/2013	Brian Mitchell	Add gull & cormorant photo documentation and scoring SOPs, safety SOP, deviations SOP and Trimble Juno SOP. Remove GPS SOP since Trimble Juno devices record locations. Update hyperlinks in narrative and appendices.	Operational review
1.09	3/2014	Carol Lynn Trocki	Revise GPS track procedures; add four letter codes for island groups; update Photo Documentation SOP; update budget.	Operational review
1.10	3/2015	Carol Lynn Trocki	Revise GPS track procedures and add to Data Collection SOP accordingly; update references to Synthesis Report to specify target for 2014 data.	Operational review

Contents

Page

Figures vii

Tables vii

Appendices ix

Standard Operating Procedures (SOPs) xi

Acknowledgments xiii

Background and Introduction 1

- Monitoring Rationale: Waterbirds as a Vital Sign 3
- History of Waterbirds in BOHA 4
- Measurable Objectives 6
- Populations Being Monitored 6

Sampling Design 9

- Rationale for Sampling Design Selection 9
- Site Selection 9
- Sampling Frequency, Replication and Timing 9
- Recommended Number and Location of Sites 10
- Minimum Detectable Level of Change 10

Field Methods 11

- Sampling Protocol and Field Methods 11
- Summary of Survey Techniques 11
  - Common Eider 12
  - Cormorants and Gulls 12
  - Wading Birds 12
  - Large Shorebirds 13
  - Small Shorebirds 13
  - Tern Colonies 13

Contents (continued)

Page

Volunteer Recruitment, Training, and Communication 13

Accounting for Observer Error / Bias 14

Data Management, Analysis, and Reporting 17

Data Management 17

Raw Data Collection 17

Data Entry / Error Checking 17

Data Availability 17

Data Analysis 18

Reporting 18

Annual Reports 18

Analysis and Synthesis Reports 18

Program and Protocol Reviews 19

Personnel and Training 21

Roles and Responsibilities 21

Qualifications 21

Training 22

Safety Considerations 22

Operations 23

Research Permits 23

Scheduling Site Visits 23

Equipment 23

Budget 23

Literature Cited 25

Figures

Page

Figure 1. Map of Boston Harbor Islands National Recreation Area. 2

Tables

Page

Table 1. Members of the Boston Harbor Islands Partnership. 3

Table 2. Summary of survey techniques and survey metrics for each group of waterbird species nesting on islands in BOHA. 8

Table 3. Proposed schedule for 3-year survey rotation, based on annual effort and park priorities. 9

Table 4. Boston Harbor Islands (BOHA) coastal breeding bird stakeholder groups 14

Appendices

Page

Appendix A: Boston Harbor Islands Coastal Breeding Bird Protocol – Available Volunteer Materials 29

Appendix B: Field Data Sheets 31

Appendix C: Boston Harbor Islands Coastal Breeding Bird Protocol Review – Responses to Peer and Park Review Comments. 43

Appendix S1.A. Responding to an Incident 57

Appendix S1.B. Islands Owners and their Contacts 59

Appendix S1.C. Basic Park Radio Operation 61

Appendix S1.D. Job Safety Analysis 63

Appendix S1.E. Green-Amber-Red Risk Assessment 70

Appendix S1.F. Acknowledgement of Safety Training 74

Standard Operating Procedures (SOPs)

Page

SOP 1 – Safety 45

SOP 2 – Field Season Preparation 76

SOP 3 – Volunteer Recruitment & Training 82

SOP 4 – Data Collection 84

SOP 5 – Survey Techniques – Common Eider 114

SOP 6 – Survey Techniques – Cormorants & Gulls 118

SOP 7 – Photo Documentation of Cormorants & Gulls 120

SOP 8 – Survey Techniques – Wading Birds 126

SOP 9 – Survey Techniques – Large Shorebirds 130

SOP 10 – Survey Techniques – Small Shorebirds 132

SOP 11 – Survey Techniques – Tern Colonies 134

SOP 12 – Scoring Photos of Cormorant & Gull Nesting Colonies 136

SOP 13 – Data Management & Quality Assurance/Quality Control 138

SOP 14 – Data Analysis 144

SOP 15 – Reporting 146

SOP 16 – Protocol Changes and Deviations 148

Acknowledgments

Thanks to the incredible volunteers - Bob Stymeist, Bob Kelley, Polly Stevens, Carl Johnson, Susannah Corona, Wayne Petersen, Heather Warchalowski, Pat Dolan, Tim Factor, Sally Ferbert, Arthur Pearson, Rob Sheridan, Andrew Bernick, Amanda Ciardi, Peter Gawne, Katie Banks, Colin Millar, Jack Renfrew, Andrew Leahy, and Allie Oakley - who have participated during the first three years of this effort! They have been instrumental in gathering data about waterbirds in BOHA, developing these methods, and making the work so much fun!

Thank you also to park staff for their support and help with data collection: Valerie Wilcox, Marc Albert, and Sheila Colwell. And thanks to Mary Raczko for her tremendous efforts recruiting and coordinating volunteers.

We greatly appreciate Russ Bowles and his capable and professional staff at University of Massachusetts, Boston Marine Operations for providing transportation on the water. This project was supported and funded by the Northeast Temperate Network Inventory & Monitoring Program. Thanks to Adam Kozlowski for his helpful input and assistance with database development.

Background and Introduction

In 1992, the National Park Service (NPS) developed a national policy "to better understand [the] dynamic nature and condition of natural resources, to detect or predict changes that may require intervention, and to serve as reference points for more altered parts of the environment. By integrating this information into NPS planning, management, and decision-making, scientific knowledge of natural resources will improve NPS stewardship of our heritage lands" (NPS 1992). The result was that NPS developed an Inventory & Monitoring Program which identified all parks in the NPS system with significant natural resources and in 1998 created 32 "networks," or groupings, of parks linked by geography and shared natural resource characteristics. The goals of the networks are to work to develop common monitoring methodologies for data comparability, to reduce the level of effort required, and to share resources. Boston Harbor Islands National Recreation Area (BOHA) is one of thirteen park units included in the Northeast Temperate Network (NETN), which is one of four networks in the NPS Northeast Region.

BOHA includes 34 islands and peninsulas situated within the Greater Boston shoreline (Figure 1). It was established by Congress as a unit of the National Park System in 1996 (Public Law 104-333). The park has a threefold purpose of (1) preserving and protecting a drumlin island system within Boston Harbor, along with its associated natural, cultural, and historic resources, (2) telling the islands' individual stories and enhancing public understanding and appreciation of the island system as a whole, and (3) providing public access, where appropriate, to the islands and surrounding waters for education, enjoyment, and scientific and scholarly research for this and future generations (BOHA General Management Plan 2002). In support of the park's mission, volunteers will be used to implement the coastal breeding bird protocol. This will enhance community involvement with park islands, provide an opportunity for various stakeholders to participate in long-term monitoring within the park, and be a cost-effective means to implement this program.

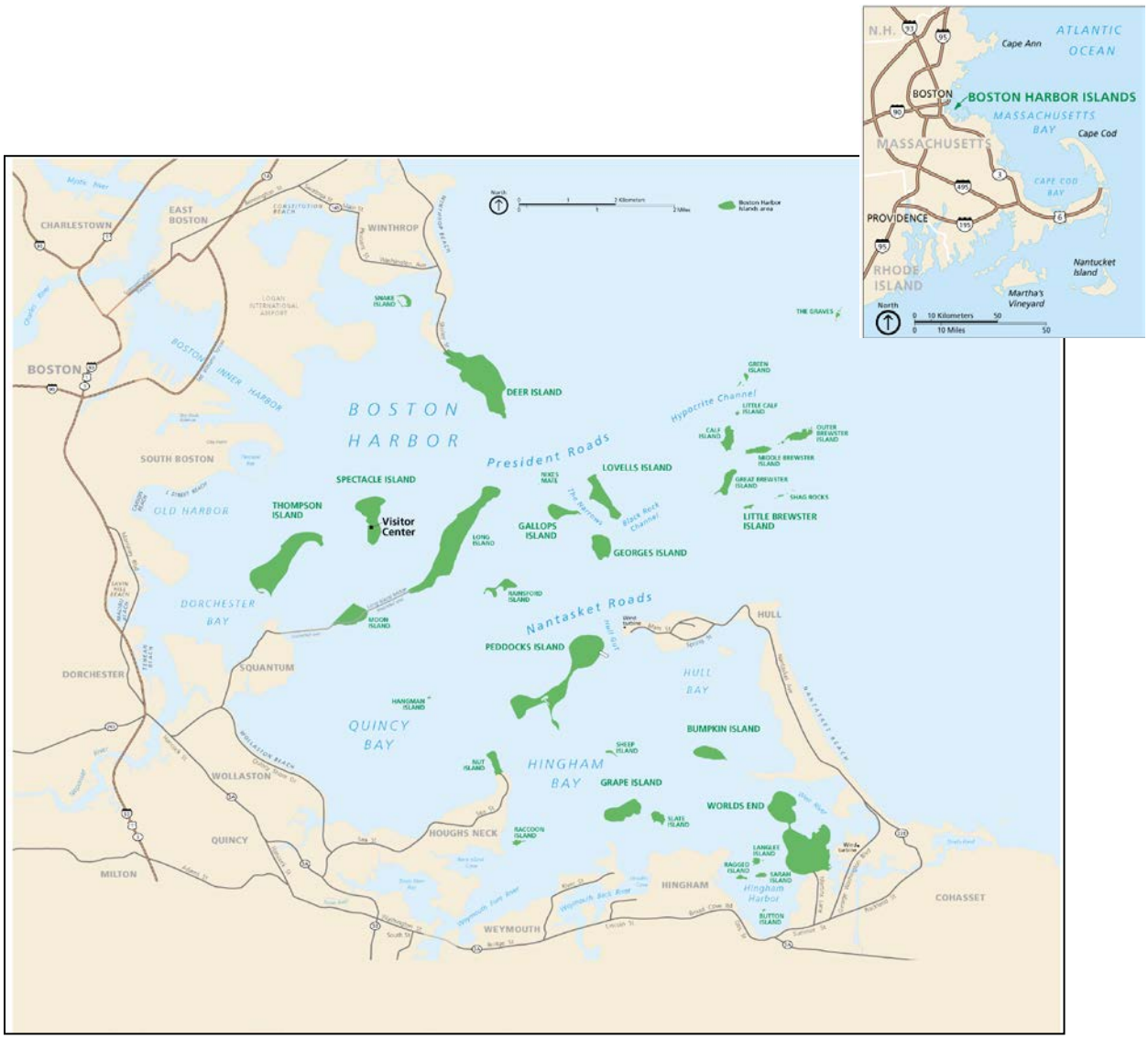


Figure 1. Map of Boston Harbor Islands National Recreation Area.

The Boston Harbor Islands are part of the only drumlin field in the United States that intersects a coastline. Located at 42° N latitude in the Northeastern Coastal Zone level III ecoregion (United States Environmental Protection Agency 2002), the islands have a humid maritime climate characterized by a moderate annual range of temperatures and definite summer and winter seasons. The park encompasses a total of 600 terrestrial ha, with islands and peninsulas ranging in size from 0.1 to 104.5 terrestrial ha (Roman et al. 2005). In addition, the park includes approximately 55 km of shoreline and 641 ha of intertidal habitat (Roman et al. 2005). BOHA is a unique unit of the national park system in that it is managed by a 13-member partnership which includes the National Park Service and other public and private stakeholders (Table 1). The NPS owns no land in the park.

Table 1. Members of the Boston Harbor Islands Partnership.

National Park Service
US Coast Guard
Massachusetts Department of Conservation and Recreation (2 seats)
Massachusetts Water Resources Authority
Massachusetts Port Authority
City of Boston, Environment Department
Boston Redevelopment Authority
Thompson Island Outward Bound Education Center
The Trustees of Reservations
Boston Harbor Island Alliance
Boston Harbor Islands Advisory Council (2 seats)

The islands vary in their geologic and ecologic composition, in addition to their degree of influence from human use over time. Available habitats include open water, rocky shores, tidal flats, beaches, dunes, cliffs, ledges, maritime shrub and deciduous forest communities, salt marshes, freshwater marshes, and a few examples of human-maintained fields and grasslands.

The flora and fauna of the islands reflect their long history of human use and alteration; forty-four percent of the plant species documented in the park are classified as exotic (Elliman 2005).

Monitoring Rationale: Waterbirds as a Vital Sign

Vital signs, as defined by NPS, are a subset of physical, chemical, and biological elements and processes that represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values. Birds are an important component of park ecosystems and sensitive to changes within them. They operate close to the limit of their ecological tolerance, and their high body temperature, rapid metabolism, and high ecological position in most food webs makes birds are an important indicator of ecosystem change at the local and regional scale (Fancy and Sauer 2000). A shift in environmental conditions or a change in the abundance of lower trophic level food sources, may produce a change in condition, reproductive rate, or abundance. By comparison, fish and invertebrate species, although they do have their particular sensitivities (e.g., low oxygen for fish and certain pollutants for insects), are in general able to tolerate much broader swings in environmental conditions, while trees are long-lived enough that it may take longer to detect population changes. Moreover, among the public, birds are a high profile taxa and many parks provide information on the status and trends of the park's avian community through their interpretive materials and programs.

In developing comprehensive long-term monitoring plans, birds are among the best taxonomic groups to monitor because:

- they are easily and inexpensively detected and identified
- a single survey method is effective for many species

- accounting and managing for many species with different ecological requirements promotes conservation strategies at the landscape scale
- many reference datasets and standard methods are available
- response variability is fairly well understood

Breeding birds were identified as a high-priority vital sign for NETN parks during the network's vital signs selection process and are one component of an integrated monitoring program being developed for BOHA (Mitchell et al. 2006). While forest breeding birds are the community of interest at most NETN parks, at BOHA coastal breeding birds (waterbirds) are the more important avian community. Other monitoring at BOHA includes rocky intertidal and salt marsh communities, as well as phenology and invasive plant species surveillance. Additional details on NETN's monitoring strategy can be found in Mitchell et al. (2006).

In 2002, BOHA was designated as a Massachusetts Important Bird Area (IBA). IBA sites provide essential habitat to one or more species of breeding, wintering, or migrating birds and generally support high-priority species, large concentrations of birds, exceptional bird habitat, and/or have substantial research or educational value. The Boston Harbor Islands provide habitat for a significant number of colonial-nesting waterbirds, including Least Terns (*Sterna antillarum*) and Common Terns (*Sterna hirundo*), which are both listed as species of special concern in the State of Massachusetts (Massachusetts Natural Heritage and Endangered Species Program 2007). BOHA also provides habitat for breeding wading birds including Snowy Egrets (*Egretta thula*) and Black-crowned Night-Herons (*Nycticorax nycticorax*) which are, respectively, species of high and moderate continental conservation concern (Kushlan et al. 2002). American Oystercatchers (*Haematopus palliates*) have expanded their range northward into Massachusetts and now have a substantial breeding population in the Boston Harbor Islands (Paton et al. 2005). The North American population of American Oystercatchers is listed as a high priority shorebird species with high conservation concern in the U.S. Shorebird conservation Plan (2004). In addition, eider, cormorants, several other wading and shorebird species, and gulls regularly nest on the islands.

History of Waterbirds in BOHA

Although much is known about the spatial distribution and abundance of breeding birds in Massachusetts (Veit and Petersen 1993), less has been published on the avifauna of the Boston Harbor Islands. One current comprehensive, long-term survey of birds in Boston Harbor is conducted by the Take A Second Look (TASL) program (see http://032acf2.netsolhost.com/tasl.htm), which has monitored waterbirds during winter months since 1980.

Although not part of a consistent monitoring program, periodic records of breeding waterbirds on the islands do exist. During 1984-85, the US Fish and Wildlife Service conducted a survey of all coastal waterbird colonies from Maine to Virginia (Andrews 1990), but this regional effort has not been repeated. The State of Massachusetts and Mass Audubon also conduct regular monitoring of coastal waterbirds in the state, but coverage and survey frequency varies and the Boston Harbor Islands have not been regularly included (Natural Heritage and Endangered Species Program, Scott Melvin,

Senior Zoologist, pers. comm., 2007 and Mass Audubon, Rebecca Harris, Director, pers. comm., 2007). Although BOHA wading bird colonies were recently resurveyed in 2006 (Manomet Center for Conservation Sciences, Katherine Parsons, Wildlife & Energy Senior Scientist, pers. comm., 2007).

From 1972 to 1982, Hatch (1984) documented an increase in the number of Double-crested Cormorants (*Phalacrocorax auritus*) nesting on the outer islands. In 1994, Blodget and Livingston (1996) estimated the numbers of nesting pairs of coastal waterbirds (waterfowl, cormorants, wading birds, shorebirds, gulls and terns) throughout the state of Massachusetts, and included BOHA in their survey. The 1994 inventory also documented the presence of 13 Common Eiders (*Somateria mollissima*) nesting in BOHA and speculated that this population may have descended from 175 chicks translocated from Casco Bay, ME to Penikese Island in Gosnold, MA in the early 1970s (Blodget and Livingston 1996). The Boston Harbor Islands are located at the southernmost extent of this species' range.

In 1993 and 1994, Parsons et al. (2001) included wading bird colonies on Sarah Island and Middle Brewster Island in a study conducted on wading bird productivity in the northeastern US. At that time, 725 wading bird nests were documented on Sarah Island, but researchers found that egg viability was low, presumably due to the influence of embryotoxic contaminants (Parsons et al. 2001). Nove (2001) summarized some breeding records of waterbirds in BOHA, but this report focused on islands that were publicly accessible through the island ferry system, and thus did not provide complete information for the park.

In 2001-2003, Paton et al. (2005) conducted an avian inventory of BOHA, which in part established the need for a long-term coastal breeding bird protocol in the park. When compared with previous studies, the Paton et al. (2005) waterbird inventory suggested that:

- Common Eiders have a small, but established colony of approximately 70 nests on islands in the Outer Harbor, primarily Calf Island.
- Double-crested Cormorants have redistributed themselves among the islands of the Outer Harbor, but have maintained fairly stable numbers since the 1980s (Andrews 1990, Hatch 1984).
- Wading birds have experienced a significant decline on Sarah Island where the population declined from 725 nests in 1994 (Parsons et al. 2001) to 112 nests in 2003. The number of nesting wading birds on Middle Brewster Island has varied from 124 nests in 1984-5 (Andrews 1990), to 207 nests in 1994 (Blodget and Livingston 1996), to only 14 pairs present in 2003. Wading birds are no longer present on Spectacle, Peddocks, or Gallops (Nove 2001).
- American Oystercatchers have increased from only several pairs in the early 1990s (Veit and Petersen 1993, Nove 2001) to approximately 16 pairs on 14 islands in 2003.

- Herring Gulls (*Larus argentatus*) have declined in BOHA (Andrews 1990), as they have regionally (Rome and Ellis 2004), which may be due in part to the restoration of Spectacle Island, a former land fill and gull nesting site.

- Great Black-backed Gulls (*Larus marinus*) have maintained a stable population in BOHA (Andrews 1990), though regional data suggests they may be increasing (Rome and Ellis 2004).

- Least Terns have a small but relatively stable population (<100 pairs), usually on Rainsford or Lovell's Islands (Hatch 2001, Nove 2001).

- Common Terns have declined from a peak of 100 pairs in 1993 (Hatch 2001) to approximately a dozen pairs on Snake Island in 2003.

Additional waterbird surveys conducted in BOHA in 2005 and 2006 used similar techniques and provided generally similar results (Trocki et al. 2007). However, because waterbird populations can fluctuate widely, it is necessary to establish a consistent and comprehensive long-term monitoring protocol in order to accurately measure population trends over time. In 2007, and again in 2008, waterbird surveys were conducted in BOHA as part of the development of this long-term monitoring protocol for coastal breeding birds in the park (Trocki and Paton 2007, Trocki 2008).

Measurable Objectives

The following objectives provide the basis for this coastal breeding bird monitoring protocol for Boston Harbor Islands National Recreation Area:

1) Determine annual changes and long-term trends in abundance of high priority coastal breeding bird species (Least Terns, Common Terns, and American Oystercatchers)
2) Conduct an annual surveillance program within the park to identify future use by threatened or endangered coastal breeding bird species, such as Piping Plover (*Charadrius melodus*) or Roseate Tern (*Sterna dougallii*).
3) Determine long-term trends in species composition and abundance of priority coastal breeding bird species (eider, cormorants, wading birds, shorebirds, and gulls)

In addition to these measurable objectives, we also seek to improve our understanding of breeding waterbird – habitat relationships in BOHA and the effects of habitat changes and management actions (such as invasive plant control or predator control) on waterbird species composition and abundance. Waterbird monitoring data can be correlated with ancillary data on park management actions, rocky intertidal communities, water quality, climate, and other available data to assist park managers in their efforts to protect and, in some cases, encourage the recovery of coastal breeding birds in the park.

Populations Being Monitored

This monitoring protocol focuses on populations of coastal bird species that breed on islands in BOHA. Many of these species nest colonially, some in mixed-species colonies. Required breeding

habitat varies by species, but includes beaches, rocky shores, cliffs, open ground, shrub and tree communities. The focal species for this protocol have been arranged into groups that correspond to their predominant nesting habits:

Common Eider – Vegetated Ground Habitats

- Common Eider (Somateria mollissima)

Cormorants & Gulls – Rocky Shore / Cliff Habitats

- Double-crested Cormorant (*Phalacrocorax auritus*)*
- Herring Gull (*Larus argentatus*)
- Great Black-backed Gull (*Larus marinus*)

Wading Birds – Shrub / Woodland Habitats

- Great Egret (*Ardea alba*)
- Snowy Egret (*Egretta thula*)
- Black-crowned Night-Heron (*Nycticorax nycticorax*)
- Glossy Ibis (*Plegadis falcinellus*)

Large Shorebirds – Beach / Shore Habitats

- American Oystercatcher (*Haematopus palliates*)
- Willet (*Catoptrophorus semipalmatus*)

Small Shorebirds – Nearshore Vegetated Ground Habitats

- Spotted Sandpiper (*Actitis macularia*)

Terns – Beach / Shore Habitats

- Least Tern (Sterna antillarum)
- Common Tern (Sterna hirundo)
- Surveillance for possible future populations of Piping Plover (Charadrius melodus) and Roseate Tern (Sterna dougallii)

*Double-crested Cormorants also nest in trees on Sarah Island.

A summary of the survey techniques and survey metrics for each group of species using shared habitat is provided in Table 2 below. Because islands in BOHA are limited in number and size, a complete census of all nesting activity occurring in the park is reasonable on a 3-year survey rotation. Additional information on survey techniques and implementation can be found in the corresponding SOPs.

Table 2. Summary of survey techniques and survey metrics for each group of waterbird species nesting on islands in BOHA.

Species Groups	Nesting Habitat	Survey Techniques & Metrics
Common Eider	Vegetated Ground	Complete ground-based nest counts, followed by boat-based crèche counts several weeks after hatching (count females and chicks on the water)
Cormorants & Gulls	Rocky Shore / Cliffs	Boat-based nest estimate; some ground-based nest counts in accessible locations
Wading Birds	Shrubs & Woodlands	Complete ground-based nest counts; estimates of nesting pairs based on counts of adults flushing from the colony may be necessary is inaccessible locations
Large Shorebirds	Beach / Shore Habitats	Boat-based counts of nesting pairs; ground based counts of nesting pairs or actual nests where possible
Small Shorebirds	Nearshore Vegetated Ground Habitats	Estimates of nesting pairs based on counts of flushing adults presumed to be incubating; ground-based nest counts wherever possible
Terns	Beach / Shore Habitats	Complete ground-based nest counts; estimates of nesting pairs based on counts of adults flushing from the colony may be necessary is inaccessible locations

Sampling Design

Rationale for Sampling Design Selection

Focal species for this protocol are all highly visible and most nest in colonies, making them relatively easy to locate. Given the limited number and size of islands in BOHA (28 islands, 21 of which are < 10 ha), completing a census of the entire park area for nesting waterbirds within a 3-year rotation is a reasonable goal. For this protocol, the sampling unit is the area comprising the colony or individual nest site, with the primary objective being to estimate the total number of nests and/or nesting pairs for each species.

Site Selection

Coastal waterbirds nest in a variety of habitats, and the specific requirements of each individual species are well understood and fairly predictable (see species descriptions included in volunteer training materials and in SOPs). Colonial-nesting waterbirds also exhibit a high degree of site fidelity, so colony locations are likely to remain similar from year-to-year. However, to accurately understand long-term trends, it is critical to have periodic and comprehensive surveys of all islands in the park to avoid a sampling bias for known locations. A regular surveillance program will ensure that all nesting species are detected and that shifts in colony locations are not incorrectly recorded as losses. A comprehensive approach to sampling will also allow for the detection of new colony sites or nesting by new species (such as Piping Plover or Roseate Tern).

Sampling Frequency, Replication and Timing

Surveys will be conducted annually for high priority species (oystercatchers and terns). A complete survey rotation including all focal species will be conducted over a 3-year period (Table 3). Surveillance surveys for new species and new colony sites will be ongoing in conjunction with all coastal breeding bird monitoring efforts. Sampling will be conducted from mid-May through mid-July each year. It is critical that surveys take place during the same stage of the nesting cycle for all species or groups each year. It is recognized however, that even during the peak nesting season counts will likely underestimate the true nesting effort of the population, given the likelihood that some nests will be missed. Surveys will coincide as closely as possible with peak incubation for each species to accurately assess peak nesting effort and minimize disturbance.

Table 3. Proposed schedule for 3-year survey rotation, based on annual effort and park priorities.

	Year 1			**Year 2**			**Year 3**		
Survey Tasks[1]	**May 15-31**	**June 1-15**	**June 15 – July 15**	**May 15-31**	**June 1-15**	**June 15 – July 15**	**May 15-31**	**June 1-15**	**June 15 – July 15**
Common Eiders	x		x			x			x
Cormorants & Gulls	x								
Wading Birds				x	x				
Large Shorebirds	x	x	x	x	x	x	x	x	x
Small Shorebirds / surveillance							x	x	x
Terns		x	x		x	x		x	x

[1] See corresponding SOPs for detailed information on methods and target dates

The effect of observer disturbance on the breeding success of colonial waterbirds remains a controversial topic (see Carney and Sydeman 1999, Nisbet 2000). If surveys are conducted too early in the season, disturbance may cause nesting individuals to relocate or abandon their efforts. Carefully designed survey protocols and thorough volunteer training will reduce the potential negative effects of disturbance.

In addition, several of the survey protocols include an element of replication. Repeated surveys of American oystercatchers, terns, and common eider chicks may occur several times during a single breeding season. In an effort to quantify variability, boat-based gull and cormorant surveys may include simultaneous surveys by multiple observers in addition to multiple surveys during a single breeding season. Data generated during replicated surveys must be treated appropriately, so as not to introduce bias into survey results.

In years where inclement weather or other unforeseeable circumstances prevent the completion of planned surveys, missed surveys will become a priority for the following year, with efforts made to accommodate both make-up work and work planned for that survey year. For example, 2011 was scheduled as Year 1 in the survey rotation, but a large storm stalled offshore in mid-May and prevented access to the Outer Harbor Islands for Common Eider ground-based nest surveys as planned. Therefore, surveying nesting eider will become the top priority in 2012, while still seeking to carry out wading bird surveys in early June as planned for a Year 2 survey rotation. Note that Year 3 has built in flexibility to accommodate 'make-up' work that may be needed. In some cases, this may mean that some species are surveyed two years apart, rather than three.

Recommended Number and Location of Sites

A census is an appropriate and efficient technique for surveying waterbirds in BOHA. Islands in the park are limited in number and size (28 islands, 21 of which are < 10 ha). Many of the focal species are conspicuous, nest colonially, and return to known locations repeatedly. In addition, most species use relatively restricted habitats, making it possible to thoroughly survey all potential nest sites (whether previously used or unused) on a 3-year rotation.

Minimum Detectable Level of Change

This coastal breeding bird protocol is conducted as a census, so a power analysis (which assumes a sampled population rather than a census) is not strictly appropriate. Nevertheless, there will be some minimum level of change that can be statistically detected as data are collected over the long term. In this case, major factors that will affect the ability to detect change are annual variation and observer error in census counts. The methods used in this protocol have not been used long enough at BOHA or similar areas to allow us to estimate the minimum level of detectable change, but we should be able to examine this after approximately six years of data collection for those species for which annual data has been collected. In developing this protocol, our intent has been to design methods that produce a reliable index of population size with repeatable counts that have less than 10% variability due to observer error when conducted simultaneously or consecutively. Over time, these methods will produce a dataset that can be used to better determine population trends.

Field Methods

Sampling Protocol and Field Methods

The coastal breeding bird monitoring protocol recommended here is derived from several standardized sources, with appropriate modifications to suit a volunteer effort at BOHA. To address the monitoring needs identified within the North American Waterbird Conservation Plan (Kushlan et al. 2002), the USGS Waterbird Monitoring Partnership has produced a Draft Manual of Recommended Breeding Season Population Census Techniques for Seabirds and Colonial Waterbirds (http://www.pwrc.usgs.gov/cwb/manual/; Steinkamp et al. 2003). In addition, Erwin et al (2003) recently completed a long-term waterbird monitoring protocol for Cape Cod National Seashore that includes information relevant to BOHA. However, both documents target larger colonies, where sampling is necessary based on time, effort, and disturbance constraints. The detailed methods employed at BOHA are appropriate for the small colonies found there, and for implementation by volunteers.

The survey methods recommended in this protocol focus on obtaining information on the relative abundance of coastal breeding species by estimating or directly counting all nests, incubating adults, or territorial nesting pairs (methods vary by species, see Table 2 and SOPs for details). These methods were selected based on their ability to:

- Accurately detect changes in species richness, relative abundance of nesting pairs, and nesting location for each focal species.
- Create minimal disturbance to nesting colonies and/or nesting pairs.
- Be implemented by trained volunteers working with a lead scientist and park staff.
- Be carried out with an annual budget of approximately $15,000.

Summary of Survey Techniques

Surveys will not be conducted when winds are greater than 25 km/h, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain. Surveys will generally be conducted between 0730h and 1230h each day and restricted to a temperature range of 10 to 35° C. Ground-based nest surveys will only be conducted when winds are below 20 km/hour, temperatures are 16 to 27° C, and there is no precipitation. A coordinated field schedule that specifies dates, target species, and islands to be surveyed will be compiled in advance of each field season. A small boat is required for all surveys, and a landing craft is critical for accessing many islands. It is also important to note that some islands are only accessible at high tide; therefore the annual field schedule must be coordinated with local tides (see SOP 2 – Field Season Preparation). Detailed descriptions of survey techniques are described in the SOPs; brief descriptions are provided below. Whenever possible, efforts will be made to limit disturbance during the nesting season while meeting protocol objectives. In some cases, islands with dense waterbird breeding sites (such as Sarah) may only be surveyed intensively using ground-based methods once every 3 years for all species.

Common Eider

Common Eiders nesting on the Outer Islands will be surveyed with a complete, ground-based nest count on a 3-year rotation. Common Eiders nest semi-colonially in BOHA and have generally been found nesting under overhanging vegetation, primarily sumac. Surveys will focus on known nesting areas on Calf, Little Calf, Green, Middle Brewster, Outer Brewster, and Great Brewster Islands, but regular reconnaissance will be undertaken to record shifts in nesting locations. During surveys, four to five observers will spread out in a line (approximately 3-4 m apart) and proceed through vegetation to flush incubating females and locate nests. Ground-based nest counts will target peak incubation, which may vary based on spring weather conditions, but should generally be timed for 15 May to 1 June.

Approximately 2-3 weeks following peak incubation, chicks can be observed rafting in crèches offshore near nesting islands. Water-based counts of chicks from 15 June to 15 July will provide supplementary data on Common Eider reproductive success for the year. Boat-based crèche surveys will be conducted in years following ground-based nest counts, but could also be conducted annually in conjunction with tern and oystercatcher surveys for very little additional effort.

Cormorants and Gulls

Double-crested Cormorants, Herring Gulls, and Great Black-backed Gulls all nest together on the rocky fringes of islands in the Outer Harbor, as well as on Sarah and Sheep Islands. Gulls also nest currently on George's, Gallops, Hangman, and on the steep drumlin bluff faces of Greater Brewster and Rainsford Island. Visible active nests (as evidenced by the presence of an incubating adult or visible chicks) will be counted by surveyors circling the island by boat at approximately 5 km/h from a distance of approximately 10-45 m offshore (or as close as the boat captain feels safe boat operation is feasible). All islands will be surveyed on a 3-year rotation between 15 May and 1 June. Although these surveys will likely underestimate the actual number of nesting pairs (not every nest will be visible from the water), they will provide a consistent index of relative abundance and a reasonable compromise for these focal species given their stable populations and abundance in the park. Boat-based surveys reduce sampling effort, disturbance to nesting birds, and safety risks to volunteers. Landing boats and negotiating terrain on many of the Outer Islands is difficult and can be dangerous. In some locations (Sheep, Great Brewster) boat-based nest counts are not possible and periodic ground-based counts will be conducted. Beginning in 2009, researchers will explore the use of high-resolution digital photography to document colony sites and quantify nesting individuals; a detailed SOP for photo documentation has been developed and will be field tested in 2012.

Wading Birds

There are currently five mixed-species wading bird colonies in BOHA, located on Calf, Middle Brewster, Outer Brewster, Sheep, and Sarah Islands. Black-crowned Night-Herons are the most common and widely distributed nesting species, but Snowy Egrets, Glossy Ibis, and Great Egrets regularly nest in the park as well. All active nests of wading bird species will be counted through a complete ground-based survey of each colony on a 3-year rotation. Surveys will target peak incubation and take place between 15 May and 5 June. In areas that are inaccessible due to especially dense vegetation, the number of nesting pairs will be estimated based on a count of adults flushed from the colony site by the research team.

Large Shorebirds

American Oystercatchers and Willets will be surveyed annually with boat-based surveys designed to estimate the number of nesting pairs on each island. Pairs of American Oystercatchers now nest on many islands in the park, whereas Willets have only been detected nesting on Snake Island. Both species nest near shore and are highly visible and vocal. Because of this, surveyors will be able to slowly circle each island by boat and accurately detect nesting pairs without causing undo disturbance at nest sites. Surveys will be conducted between 15 May and 15 July each year. Additional information on nest locations from ground-based nest counts and ground-based observations of territorial pairs will be collected when possible.

Small Shorebirds

Spotted Sandpipers are presumed to be nesting on nine islands in the park. Piping Plovers have not been documented nesting in the park, but nest elsewhere in Massachusetts and may colonize available habitat in BOHA in the future (such as beaches on Lovell's or Spectacle Island). Piping Plovers are a federally threatened species on the Atlantic Coast; if they are discovered nesting in the park in the future, the Piping Plover Atlantic Coast Population Recovery Plan (U. S. Fish and Wildlife Service 1996) should be consulted for monitoring and management guidelines. Walking surveys of suitable habitat (i.e., gently sloped pebble beaches with adjacent grassy areas) on island shorelines will be undertaken to estimate the number of nesting pairs of Spotted Sandpipers on a 3-year rotation. Callback surveys will be used to elicit a response from Spotted Sandpipers in areas where nesting is suspected. These walking surveys can also be used to gather additional information on American Oystercatchers (see SOP 9 – Survey Techniques – Large Shorebirds). Surveys will be conducted between 15 May and 15 July.

Tern Colonies

Least and Common Terns will be surveyed annually through a complete, ground-based nest count. Target islands (where nesting has occurred in the past) include Rainsford and Lovell's for Least Terns and Snake Island for Common Terns, but regular surveillance will be undertaken to identify all active colony sites each year. Roseate Terns have not been documented breeding in BOHA, but do nest at other sites in Massachusetts, generally in conjunction with Common Terns. Peak incubation (2-3 eggs in most nests) generally occurs between 10 June and 25 June, though Least Terns are known to be especially asynchronous. Therefore, Least Tern colony counts will be repeated 2-3 times during the month of June and into early July. Common Terns are also currently known to nest on a raised platform off Spinnaker Island. The platform itself is inaccessible, but the area will be surveyed annually by boat, though it is outside park boundaries, and the number of nesting pairs will be estimated based on a count of adults flushed from the colony site by the research team.

Volunteer Recruitment, Training, and Communication

Volunteers interested in participating in the long-term monitoring of coastal breeding birds in BOHA will be recruited by park staff each year. Efforts will be made to involve all stakeholders (Table 4; see SOP 3 – Volunteer Recruitment & Training and Appendix A for additional information).

Table 4. Boston Harbor Islands (BOHA) coastal breeding bird stakeholder groups.

Organization
BOHA Staff
NPS Inventory and Monitoring Program Staff
Massachusetts Dept. of Conservation and Recreation
Thompson Island Outward Bound Education Center
New England Aquarium
Mass Audubon
Harvard Museum of Comparative Zoology
Massachusetts Fish and Wildlife
Manomet Center for Conservation Science
Take a Second Look
Conservation Commissions for Boston, Hingham, Hull, and Winthrop
The Trustees of Reservations
Local birding clubs
Cornell Lab of Ornithology, citizen science contact
All other Island Partnership Members / Island Alliance
Participating community volunteers

Volunteers will be required to attend a training session led by the lead scientist and park staff prior to the start of the field season. Although volunteers of all skill levels will be welcome to participate, training efforts will focus on developing and assessing volunteer capabilities to ensure accurate, efficient, and safe data collection in the field.

During the field season, the lead scientist will provide regular updates to all volunteers to enhance volunteer participation, since only a limited number of volunteers will be able to participate in the field on any given day. Avenues for volunteer communication include direct e-mail lists, the park website (http://www.nps.gov/boha/supportyourpark/bird-monitoring.htm), and the NETN 'Field Notes' blog (http://northeastparkscience.wordpress.com/).

Accounting for Observer Error / Bias

Whenever feasible, supplementary survey methods will be used to quantify detection probabilities and observer bias (see Mackenzie and Kendall 2002). Counts of actual nests or incubating adults will always underestimate the true nesting effort of a population, since some nests are likely to go undetected by even the most vigilant observer. Population estimates can be improved by incorporating a measure of error (i.e., accounting for a probability of detection that is less than one).

In its simplest form, this technique requires repeat visits to a colony site using a 'mark-and-recapture' method or a double observer method of nest censusing to evaluate the portion of nests that are missed during a given visit. This measure of error (detection probability) can then be applied to population estimates to produce more accurate results.

Suggestions for including measures of detection probability are offered for each survey technique, where applicable (see SOPs for details on Common Eider, Cormorants & Gulls, Wading Birds, and

American Oystercatchers). Although every effort has been made to develop techniques that minimize disturbance and maximize efficiency, measuring detection probability requires repeat visits to colony sites and the temporary marking of nests (for eiders and wading birds). To offset these additional costs, these methods may be applied to only a subset of the areas to be surveyed and then extrapolated to the entire population, provided fairly consistent error rates are obtained.

Data Management, Analysis, and Reporting

Data Management

In order for this monitoring program to meet I&M Program goals, data management procedures will adhere to the guidelines established in the NETN data management plan (http://science.nature.nps.gov/im/units/netn/reports/reportsPubs.cfm#MonitoringPlan). A detailed data management plan is needed to ensure data quality, interpretability, security, longevity, and availability. The data collected on coastal breeding birds at BOHA will be recorded on field data sheets or entered into a Juno handheld device in the field using CyberTracker software. Juno data will be output from CyberTracker and uploaded into a MS Access database created by the NETN Data Manager and designed to meet all I&M program standards. Information on data sheets will be manually entered into the database. A metadata record and data dictionary for this database will be created.

Raw Data Collection

The field data specified in the survey methods section will be collected for focal species on standard data sheets or gathered directly in the field using a Juno handheld device configured with a CyberTracker survey-specific database created by the NETN Data Manager (Appendix B). Volunteers involved in data collection will be trained in advance to accurately complete the required information. Field records will be reviewed for discrepancies at the end of each day. Field data sheets will be copied and stored at both park and network offices.

Data Entry / Error Checking

Data will be entered from field data sheets into the CyberTracker database as soon as possible after data collection, usually by someone directly involved in the data collection effort. After data entry is complete, the database entries will be reviewed for discrepancies and then forwarded to the NETN Data Manager. Dated copies of the CyberTracker data and MS Access database will reside in multiple locations for archival and security purposes.

If data are collected electronically in the field, they will be downloaded from the handheld device after each field day throughout the season and reviewed for discrepancies. Downloaded data will be conveyed to the NETN Data Manager weekly, and a merged master file of CyberTracker data will be sent to the NETN Data Manager monthly. The master file will be further reviewed and uploaded into the MS Access database. At the end of the field season, the NETN Data Manager will conduct an additional 10% check of any data transcribed from data sheets to verify transcription accuracy.

Data Availability

NETN is committed to making monitoring data as widely available as possible. Any individuals interested in accessing the data set should contact the NETN Data Manager (contact information is at http://science.nature.nps.gov/im/units/netn/about/aboutus_main.cfm). Data on sensitive species can only be released with the approval of the natural resources manager for Boston Harbor Islands.

Data Analysis

Analysis will be conducted by the lead scientist coordinating this program or by NETN staff. A summary of results will be compiled on an annual basis. As the data set for this program grows, a variety of statistical methods will become feasible for analyzing trends in coastal bird populations. A detailed discussion of the statistical methods that may be most appropriate for data analysis is being developed.

Periodically, the NETN will conduct an analysis of the correlations between waterbird monitoring data and ancillary data describing habitats, management activities, and conditions in the park. Park datasets and records that may be of interest include: invasive species management activities (timing, methods, and locations), prey availability, training and recreational activities (or any other indications of human disturbance), and weather data (precipitation, temperature, wind) particularly early in the nesting season (April – June).

Reporting

The two major reports developed for this program will be an Annual Report (e.g., Trocki and Paton 2007) and an Analysis and Synthesis Report completed every three years beginning in 2014. Templates and formatting instructions are available at the NPS Northeast Region website: http://www.nps.gov/nero/science/Guidelines/Guidelines.htm.

In addition, weekly updates during the field season are shared by the lead scientist online with participating community volunteers and other interested stakeholders. This effort adds value for the park community and helps island managers keep track of the timing of nesting activities.

Annual Reports

Annual Reports will provide a general overview of activities and a summary of results from each year's field season and will be due to the NETN office by December 15 of each year. The annual report and responsibilities include:

- Document monitoring activities
- Summarize findings
- Document changes in the monitoring protocol
- Public interest highlights

Annual Reports will be shared with all interested stakeholders (see Table 4). In addition, contributing information to regional working groups on an annual basis will provide an opportunity for the detection of regional changes and the implementation of more comprehensive management strategies.

Analysis and Synthesis Reports

Analysis and Synthesis Reports will be completed every three years (beginning in 2014) and will provide more detailed analyses of population trends. Results will be interpreted to provide specific information related to the measurable monitoring objectives. In general these reports will estimate

patterns and trends in abundance and community composition and evaluate the efficacy of the current monitoring protocol to achieve the stated objectives. In addition, Analysis and Synthesis Reports will recommend changes to monitoring and management practices within the park.

Initial analysis and synthesis reports may be an appendix or supplement to the annual report, since in the early years of monitoring the data set will not support complex analyses. Trends may initially be presented using graphs of numbers over time, and the report may also explore the effects of weather and other factors on bird counts and reproductive success. If data about important factors that are likely to cause significant variability in the bird counts are not being measured, the report will suggest metrics that should be collected. The Lead Scientist will take the lead on developing this report, with assistance from network staff and other scientists as needed.

Program and Protocol Reviews

The protocol will be internally reviewed after every field season. This review (by NETN staff and cooperators) will focus on discussing any difficulties with protocol implementation and developing and documenting improved methods for future years. External peer reviews will be conducted every 5 to 10 years in order to ensure that the protocol is meeting stated objectives. The reviews will be conducted by scientists who are not directly involved with the implementation of the protocol. The reviewers may be associated with the NPS, other government agencies (e.g. USGS) or educational and non-profit organizations.

The protocol reviews include the following:

- Formal reviews of operations and results
- Review of protocol design and products to determine if changes are needed
- Evaluation of methods and objectives.

Personnel and Training

Roles and Responsibilities

Initial protocol development was completed through a cooperative agreement with researchers Peter W. C. Paton and Carol Lynn Trocki at the University of Rhode Island. A full-scale pilot of the monitoring program was undertaken in May and June 2007 and 2008, and a draft monitoring protocol was submitted to NETN in early 2008.

Key roles for implementing the BOHA Coastal Breeding Bird Monitoring program are:

Lead Scientist: Plans and schedules all monitoring activities. Works with BOHA staff to plan volunteer training session. Trains and supervises volunteers. Participates in all data collection and provides weekly updates to volunteers and other interested stakeholders throughout the field season. Oversees data entry, manages and archives data, performs initial data QA/QC checks, and develops annual report and takes the lead on developing analysis and synthesis reports.

BOHA Volunteer Manager: Recruits and coordinates volunteers. Provides logistical support for volunteer training and schedules volunteers for monitoring trips. Communicates public interest highlights. Organizes BOHA staff participation.

BOHA Staff Participant: Ensures safety and provides logistical support during monitoring trips. Assists with data collection as needed.

NETN Program Manager (or other designated NETN staff member): Oversees the contract / cooperative agreement. Acts as key liaison between the Lead Scientist and BOHA park staff.

NETN Data Manager: Provides assistance in creating and maintaining MS Access and CyberTracker databases for the protocol. Responsible for certifying that QA/QC procedures have been followed.

Volunteers: Collect data during trips overseen by the cooperating / contracting researcher.

Qualifications

The Lead Scientist responsible for implementing the Coastal Breeding Bird Monitoring Protocol in BOHA should have demonstrated experience conducting research on coastal breeding birds and a working knowledge of the logistical challenges inherent in conducting both land and boat-based surveys on remote islands with limited access. Experience working with volunteers is essential.

Volunteers participating in the protocol must have an interest in learning about coastal breeding birds and be willing to engage in scientifically rigorous monitoring techniques. Previous experience with bird identification or waterbird monitoring is helpful, but not required. Field work is physically demanding with limited access to emergency services; volunteers must be in good health and able to negotiate uneven, ungroomed paths with heavy vegetation. A volunteer job description can be found in Appendix A.

Training

New volunteers will be required to attend a training session prior to the start of the field season. Recurring review of species identification and survey methods will also be provided throughout the field season. More detailed information about volunteer training can be found in the SOPs, and in Appendix A.

Safety Considerations

Field work is physically demanding and involves small boat travel and hiking over rough terrain. Some of the islands are remote and access to emergency services may be limited. SOP 3 – Volunteer Recruitment & Training, provides more detailed information on volunteer training and safety considerations.

Operations

Research Permits

All researchers are required to file for permits and have copies on hand when in the field. Details for the permit application process can be found at http://science.nature.nps.gov/research/ac/ResearchIndex. It is permissible to apply for a multi-year (e.g., 5 or 10 years) permit for an ongoing monitoring project. Regardless of the length of the permit period, researchers are required to file an Investigator's Annual Report (IAR) online every year. For the coastal breeding bird monitoring program, the IAR can be brief, and will probably cite the annual report submitted separately to the park and NETN, as well as any recent trend analyses.

Scheduling Site Visits

A field schedule will be created in advance of each field season, taking into account a variety of components (see SOP 2 – Field Season Preparation). This field schedule will be circulated among the lead scientist, park staff, NETN staff, and the contracting boat captain (currently UMASS Boston) before being made final. This schedule, though subject to change, will be shared with volunteers and island managers in advance of the field season.

Every effort will be made by researchers to obtain permission for access from individual island contacts in advance of each field season. This will ensure appropriate access to sampling sites and inform researchers of possible closures or other necessary safety information (see Appendix SOP 2 – Field Season Preparation).

Equipment

A list of the supplies required to carry out this protocol can be found in SOP 2 – Field Season Preparation.

Budget

The estimated annual budget covers costs for personnel, travel, boat transportation, equipment, and volunteer training.

The funds needed to implement this program are contributed by the Northeast Temperate Network of the NPS Inventory and Monitoring Program. The annual estimated cost for fieldwork, annual reporting, and protocol revision in 2014 is $20,000.00. The budget from 2014 is provided in Table 5.

Table 5. BOHA Coastal Breeding Bird Monitoring Protocol, 2014 budget for volunteer training, field work, data entry & analyses, annual reporting, and protocol revision (does not include the cost of park staff to recruit & coordinate volunteers and provide basic administrative support).

Category	Cost
Contracting Researcher Salary	**$14,678.00**
field season scheduling, planning and administration (60 hrs)	
volunteer training session, planning, and implementation (24hrs)	
field work (10 days x 9hrs = 90hrs)	
data entry & annual analyses (48hrs)	
dissemination of results, preparation and attendance at regional working groups, park and/or network meetings (4 days x 8hrs = 32hrs)	
draft annual report (48hrs)	
protocol update and revisions (48hrs)	
plan/develop and draft analysis & synthesis report (2014, 2017)	
Mileage & Travel	**$1,066.80**
BOHA round trip travel (11 trips x 150 miles x $0.56)	
BOHA parking (11 days x $6.00)	
waterbird meetings	
Field Transportation Expenses	**$3,250.00**
contract landing craft from UMASS Boston (10 field days x 5hrs = 50hrs)	
Supplies & Equipment	**$750.00**
miscellaneous field supplies (pens, paper, field and datasheet printing, calipers, sheet protectors, batteries, etc.)	
volunteer Guide printing and binding	
annual supply addition and replacement, 1 item per yr (gps unit, telescoping mirror, weather station)	
volunteer appreciation gifts	
Grand Total	**$19,744.80**

Literature Cited

Andrews, R. (Compiler). 1990. Coastal waterbird Colonies: Maine to Virginia 1984-85. US Fish and Wildlife Service, Newton Corner, MA.

Blodget, B. G., and J. E. Livingston. 1996. Coastal colony-nesting waterbirds: the Massachusetts status report 1994-1995. Massachusetts Wildlife 4:10-20.

Boston Harbor Islands National Park Area. 2002. General Management Plan and Environmental Impact Statement. National Park Service, Northeast Region, Boston, MA.

Carney, K. M. and W. J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

Elliman, T. 2005. Vascular flora and plant communities of the Boston Harbor Islands. Northeastern Naturalist 12 (Special Issue 3):49-74.

Erwin, R. M., C. J. Conway, S. W. Hadden, J. S. Hatfield, S. M. Melvin. 2003. Waterbird monitoring protocol for Cape Cod National Seashore and other coastal parks, refuges, and protected areas. Long-Term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore, Wellfleet, MA.

Fancy, S., and J. Sauer. 2000. Recommended Methods for Inventorying and Monitoring Landbirds in National Parks. http://science.nature.nps.gov/im/monitor/protocols/npsbird.doc. Accessed 25 January 2010.

Hatch, J. J. 1984. Rapid increase of Double-crested Cormorants nesting in southern New England. American Birds 1984:984-988.

Hatch, J. J. 2001. Tern nesting in Boston Harbor: the importance of artificial sites. Bird Observer 29: 187-193.

Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Kapp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, D.C.

MacKenzie, D. I., and W. L. Kendall. 2002. How should detection probability be incorporated into estimates of relative abundance? Ecology 83:2387–2393.

Massachusetts Natural Heritage and Endangered Species Program. 2007. Massachusetts list of endangered, threatened, and special concern species. Massachusetts Division of Fisheries and Wildlife, Westborough, MA. http://www.mass.gov/dfwele/dfw/nhesp/nhrare.htm. Accessed 25 January 2010.

Mitchell, B.R., W. G. Shriver, F. Dieffenbach, T. Moore, D. Faber-Langendoen, G. Tierney, P. Lombard, and J. Gibbs. September 2006. Northeast Temperate Network Vital Signs Monitoring Plan. Technical Report NPS/NER/NRTR--2006/059. National Park Service, Northeast Temperate Network, Woodstock, VT.

National Park Service. 1992. NPS 75: Natural Resource Inventory and Monitoring Guidelines. http://www.nature.nps.gov/nps75/nps75.pdf. Accessed 25 January 2010.

Nisbet, I. C. T. 2000. Disturbance, habituation, and management of waterbird colonies. Waterbirds 23:312-332.

Nove, J. 2001. Birding the Boston Harbor Islands. Bird Observer 29:173-186.

Parsons, K. C., S. R. Schmidt, and A. C. Matz. 2001. Regional patterns of wading bird productivity in Northeastern US estuaries. Waterbirds 24:323-330.

Paton, P. W. C, R. J. Harris, and C. L. Trocki. 2005. Distribution and abundance of breeding birds in Boston Harbor. Northeastern Naturalist 12:145-168.

Roman, C. T., B. Jacobson, and J. Wiggin. 2005. Introduction to special issue, Boston Harbor Islands National Park Area: Natural Resources Overview. Northeastern Naturalist 12(Special Issue 3): 3-12.

Rome, M. S. and J. C. Ellis. 2004. Foraging ecology and interactions between Herring Gulls and Great Black-backed Gulls in New England. Waterbirds 27:200-210.

Steinkamp, M., B. Peterjohn, V. Byrd, H. Carter, and R. Lowe. 2003. DRAFT Breeding season survey techniques for seabirds and colonial waterbirds throughout North America. USGS Waterbird Monitoring Partnership, Laurel, MD.

Trocki, C. L. and P. W. C. Paton. 2007. Boston Harbor Islands Coastal Breeding Bird Monitoring: 2007 Field Season Summary. Natural Resources Report NPS/NER/NRR—2007/16. National Park Service. Boston, MA.

Trocki, C. L.. 2008. Boston Harbor Islands Coastal Breeding Bird Monitoring: 2008 Field Season Summary. Natural Resources Report NPS/NETN/NRTR—2009/209. National Park Service, Fort Collins, CO.

Trocki, C. L., N. W. Talancy, and P. W. C. Paton. August 2007. An Inventory of Amphibians, Reptiles, Nonvolant Mammals, and Select Bird Species on Islands in Boston Harbor. Technical Report NPS/NER/NRTR-2007/094. National Park Service. Boston, MA.

United States Environmental Protection Agency. 2002. Level III Ecoregions. USEPA National Health and Environmental Effects Laboratory. http://www.epa.gov/wed/pages/ecoregions/level_iii.htm

U. S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*) Atlantic Coast Population, Revised Recovery Plan. USFWS Regional Office, Hadley, MA.

U.S. Shorebird Conservation Plan. 2004. High Priority Shorebirds ─ 2004. Unpublished Report, U. S. Fish and Wildlife Service, 4401 N. Fairfax Dr., MBSP 4107, Arlington, VA.

Veit, R. R., and W. R. Petersen. 1993. Birds of Massachusetts. Natural History of New England Series. Massachusetts Audubon Society.

Appendix A: Boston Harbor Islands Coastal Breeding Bird Protocol – Available Volunteer Materials

Version 1.01

The following sample materials from 2008 are available upon request or for downloading from NETN's website at:
http://science.nature.nps.gov/im/units/netn/monitor/programs/coastalBirds/coastalBirds.cfm in the Coastal Birds row.

1. Boston Harbor Islands Volunteer Guide
2. Volunteer Training Session Agenda
3. Volunteer Training Session PowerPoint Presentation
4. Volunteer Job Description
5. Volunteer Agreement
6. Hazard Fact Sheets
    - 6a - Poison Ivy
    - 6b - Lyme Disease
    - 6c - Exposure to Airborne Pathogens in Wading Bird Colonies
    - 6d - West Nile Virus
    - 6e – Histoplasmosis

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	4/2009	Carol Lynn Trocki	Updated to include volunteer agreement and hazard fact sheets.	Operational review

Appendix B: Field Data Sheets

Version 1.02

Sample data sheets from the 2012 field season are provided for reference.

BOHA Waterbird Monitoring Program
Trip Details Form

Place field map here.

1. Form Completed By:

2. Date:

3. Trip Type (Circle one): Ground-based Survey Boat-based Survey

4. Island(s) Surveyed:

5. Observers:

6. Number of Survey Teams:

7. Start Time: 8. End Time:

9. Trip Coverage (Circle one): Complete Partial
(If partial indicate on map and explain in Notes)

Environmental Conditions		
10. Temperature:		(Fahrenheit)
11. % Cloud Cover:		(0-100%)
12. Wind Speed:		(0-5; 5-10;10-15)
13. Wind Direction:		
14. Tide Level:	High Mid	Low

Were these data collected:		
15. Colony Pictures?	Yes	No
16. GPS Track?	Yes	No
17. GPS Unit ID (if boat-based):		

18.	**Target Species**	**Phenology** (incubating, hatching, chick rearing, fledging)
a		
b		
c		
d		
e		

19. Notes: (flush counts, ancillary species, habitat descriptions, survey effort, major changes in environ. conditions):

The purpose of the Trip Details form is to summarize the trip conditions under which individual boat- or ground-based surveys took place. This form should act as something of a coversheet for and be filed with any Boat-based, Ground-based, or Photo Scoring Forms that are filled out in association with this trip.

Field	Requirements
1.	**Form Completed By:** Full name of individual who completes the form and can be contacted for questions.
2.	**Date:** Date (day, month, year) that the trip took place.
3.	**Trip Type:** Was this trip conducted by boat or from land/ground? Circle only one. Changing the Trip Type requires a new Trip Details Form be filled out (i.e. it is a separate trip).
4.	**Islands Surveyed:** The name of the all the islands visited during this trip.
5.	**Observers:** The full name of all the observers that participated in this trip.
6.	**Number of Survey Teams:** Number of survey teams (observer/recorder pairs) collecting data on this trip.
7.	**Start Time:** The time that the trip started (24 hr format).
8.	**End Time:** The time that the trip ended (24 hr format).
9.	**Trip Coverage:** Taking all the teams' effort into account was the entire route/island surveyed?
10.	**Temperature:** Temperature in degrees Fahrenheit; recorded at trip start
11.	**% Cloud Cover:** Percentage of sky with clouds (0-100%); recorded at trip start
12.	**Wind Speed:** Wind speed as determined by the Beaufort Scale (see chart below); recorded at trip start
13.	**Wind Direction:** Dominant direction wind is blowing from at start of survey (N, NE, E, SE, S, SW, W, NW)
14.	**Tide Level:** Level of tide at start of survey (High, Mid, Low)
15.	**Colony Pictures?:** Were pictures taken during this trip to assess species abundance? Yes or No.
16.	**GPS track?:** Was a GPS track documenting the path of this trip taken? Yes or No.
17.	**GPS Unit ID:** Unique name/ID found on GPS unit used during this trip.
18.	**Target Species & Phenology:** What bird species were specifically surveyed for during this trip and what phenology stage were they observed to be in?
19.	**Notes:** Place for additional notes on the trip, including but not limited to: counts of flushed target species, names of non-target species observed, quanitification of survey effort, and major changes in the environmental conditions during the survey.

Modified Beaufort Wind Scale (used to determine wind speed; Field 12)

Wind Speed (knots)	Wind Effects
0 - 5	Ranges from calm air to light breeze; flat water to waveletts with glassy crests; not breaking
5 - 10	Gentle breeze; large wavelets; crest begin to break; scattered whitecaps
10 - 15	Moderate breeze; Small waves with breaking crests; fairly frequent white horses.

SpeciesCode	CommonName
AMOY	American Oystercatcher
BCNH	Black-crowned Night-Heron
COEI	Common Eider
COTE	Common Tern
DCCO	Double-crested Cormorant
GBBG	Great Black-backed Gull
GLIB	Glossy Ibis
GREG	Great Egret
HERG	Herring Gull
LETE	Least Tern
MALL	Mallard Duck
PIPL	Piping Plover
SNEG	Snowy Egret
SPSA	Spotted Sandpiper
UNKN	Unknown species
UNWB	Unknown Wading Bird
WILL	Willet

Appendix B: Field Data Sheets (continued).

BOHA Waterbird Monitoring Program
Ground-based Survey Form

1. Date:	**5. GPS Unit ID:**
2. Island:	**6. Start Time:**
3. Observer(s):	**7. End Time:**
4. Recorder:	**8. Survey Coverage?** Complete Partial

Non-Target Spp? 9	Species 10	Unit (Nest, Pair, Adult) 11	Count 12	# Eggs 13	# Chicks 14	X Coord. (UTMs) 15	Y Coord (UTMs) 16	Notes 17

18. I have checked to make sure this datasheet is complete and legible (Field 1 thru 19).

Signature: _____ Date: _____

19. Page ___ of ____

The purpose of the Ground-based Survey Form is to record data collected by individual survey teams when conducting a ground-based trip. Upon completion, the Ground-based Survey Forms should be gathered by the trip leader from all survey teams and attached to their corresponding Trip Details Form. For more information on the methods used to collect data during ground-based surveys, please see the project's Standard Operating Proceedures.

Field	Requirements
1.	**Date:** Date (day, month, year) that the survey took place.
2.	**Island:** The name of the island where the survey was conducted.
3.	**Observer(s):** The full name of all the observers that participated in this survey.
4.	**Recorder:** Full name of the person who filled out the datasheet for this survey (only one recorder please!).
5.	**GPS Unit ID:** Provide name/unique ID for specific GPS unit used during this ground survey.
6.	**Start Time:** The time that the trip started (24 hr format).
7.	**End Time:** The time that the trip ended (24 hr format).
8.	**Survey Coverage:** Extent to which the island's nesting resources were surveyed. Circle one. See this survey's GPS track for more detail regarding survey coverage.
9.	**Non-target spp?:** Check this box if this observation records information on a species other than one of those specifically targeted by this survey.
10.	**Species:** Four-letter code of the species this record is about. See table below for codes. When recording species not listed below, use the species' full name or define code used in notes.
11.	**Unit:** Defines what is being counted - Nest (N), Pair (P), or Adult (Ad).
12.	**Count:** Number of Units (Field 11) observed.
13.	**# Eggs:** Number of eggs observed when the Unit (Field 11) is Nest.
14.	**# Chicks:** Number of chicks observed when the Unit (Field 11) is Nest.
15.	**X Coord:** 6 digit UTM coordinate where the observation was made (NAD83, Zone 19).
16.	**Y Coord:** 7 digit UTM coordinate of where the observation was made (NAD83, Zone 19).
17.	**Notes:** Place for additional notes on the species or nest observed.
18.	**Certification:** Place for team member to sign the datasheet to indicate that it has been reviewed to insure data are complete and legible. If multiple pages are produced, each are reviewed and signed independently.
19.	**Page __ of __:** Page number relative to total number of pages filled out by this team to complete this survey.

SpeciesCode	CommonName
AMOY	American Oystercatcher
BCNH	Black-crowned Night-Heron
COEI	Common Eider
COTE	Common Tern
DCCO	Double-crested Cormorant
GBBG	Great Black-backed Gull
GLIB	Glossy Ibis
GREG	Great Egret
HERG	Herring Gull
LETE	Least Tern
MALL	Mallard Duck
PIPL	Piping Plover
SNEG	Snowy Egret
SPSA	Spotted Sandpiper
UNKN	Unknown species
UNWB	Unknown Wading Bird
WILL	Willet

Appendix B: Field Data Sheets (continued).

BOHA Waterbird Monitoring Program
Incubation - Boat-based Survey Form

1. Date:
2. Start Time:
3. Observer(s):
4. Recorder:

Non-Target Spp? 5	Island 6	Segment 7	Species 8	Unit (N, P, A, IA) 9	Count 10	Notes 11

Scratch area

DCCO	HERG	GBBG

12. I have checked to make sure this datasheet is complete and legible (Fields 1 thru 13).

Signature: _____ Date: _____

13. Page ___ of ____

The purpose of this Boat-based Survey Form is to record data collected by individual survey teams when conducting a boat based trip coinciding with DCCO and Gull incubation. Upon completion, the Boat-based Survey Forms should be gathered by the trip leader from all survey teams and attached to their corresponding Trip Details Form. For more information on the methods used to collect data during boat-based surveys, please see the project's Standard Operating Procedures.

Field	Requirements
1.	**Date:** Date (day, month, year) that the survey took place.
2.	**Start Time:** The time that the trip started (24 hr format).
3.	**Observer(s):** The full name of all the observers that participated in this survey.
4.	**Recorder:** Full name of the person who filled out the datasheet for this survey (Only one recorder please!).
5.	**Non-target spp?:** Check this box if this observation records information on a species other than one of those specifically targeted by this survey.
6.	**Island:** The name of the island where the observation is made.
7.	**Segment:** Survey segment of the island that this observation was made.
8.	**Species:** Four-letter code of the species this record is about. See table below for codes. When recording species not listed below, use the species' full name or define code used in notes.
9.	**Unit:** Defines what is being counted - Nest (N), Pair (P), Adult (A), or Incubating Adult (IA).
10.	**Count:** Number of Units (Field 9) observed.
11.	**Notes:** Place for additional notes on the species or nest observed.
12.	**Certification:** Place for team member to sign the datasheet to indicate that it has been reviewed to insure that data are complete and legible. If multiple pages are produced, each are reviewed and signed independently.
13.	**Page __ of __:** Page number relative to total number of pages filled out by this team to complete this survey.

SpeciesCode	CommonName
AMOY	American Oystercatcher
BCNH	Black-crowned Night-Heron
COEI	Common Eider
COTE	Common Tern
DCCO	Double-crested Cormorant
GBBG	Great Black-backed Gull
GLIB	Glossy Ibis
GREG	Great Egret
HERG	Herring Gull
LETE	Least Tern
MALL	Mallard Duck
PIPL	Piping Plover
SNEG	Snowy Egret
SPSA	Spotted Sandpiper
UNKN	Unknown species
UNWB	Unknown Wading Bird
WILL	Willet

Appendix B: Field Data Sheets (continued).

BOHA Waterbird Monitoring Program
Creche - Boat-based Survey Form

1. Date:
2. Start Time:
3. Observer(s):
4. Recorder:

Non-Target Spp? 5	Island 6	Segment 7	Species 8	For use when species is Common Eider: # Adult Males 9	# Females 10	# Chicks 11	# Juv Males 12	Other / Notes 13

14. I have checked to make sure this datasheet is complete and legible (Fields 1 thru 15).

Signature: _____ Date: _____

15. Page ___ of ____

The purpose of this Boat-based Survey Form is to record data collected by individual survey teams when conducting a boat based trip coinciding with occurence of COEI creches. Upon completion, the Boat-based Survey Forms should be gathered by the trip leader from all survey teams and attached to their corresponding Trip Details Form. For more information on the methods used to collect data during boat-based surveys, please see the project's Standard Operating Proceedures.

Field	Requirements
1.	**Date:** Date (day, month, year) that the survey took place.
2.	**Start Time:** The time that the trip started (24 hr format).
3.	**Observer(s):** The full name of all the observers that participated in this survey.
4.	**Recorder:** Full name of the person who filled out the datasheet for this survey (only one recorder please!).
5.	**Non-target spp?:** Check this box if this observation records information on a species other than one of those specifically targeted by this survey.
6.	**Island:** The name of the island where the observation is made.
7.	**Segment:** Survey segment of the island that this observation was made.
8.	**Species:** Four-letter code of the species this record is about. See table below for codes. When recording species not listed below, use the species' full name or define code used in notes.
9.	**# Adult Males:** Number of common eider adult males observed
10.	**# Females:** Number of common eider females observed
11.	**# Chicks:** Number of common edier chicks observed.
12.	**# Juv Males:** Number of uvenile males observed.
13.	**Notes:** Place for additional notes on the species or nest observed.
14.	**Certification:** Place for team member to sign the datasheet to indicate that it has been reviewed to insure that data are complete and legible. If multiple pages are produced, each are reviewed and signed independently.
15.	**Page __ of __:** Page number relative to total number of pages filled out by this team to complete this survey.

SpeciesCode	CommonName
AMOY	American Oystercatcher
BCNH	Black-crowned Night-Heron
COEI	Common Eider
COTE	Common Tern
DCCO	Double-crested Cormorant
GBBG	Great Black-backed Gull
GLIB	Glossy Ibis
GREG	Great Egret
HERG	Herring Gull
LETE	Least Tern
MALL	Mallard Duck
PIPL	Piping Plover
SNEG	Snowy Egret
SPSA	Spotted Sandpiper
UNKN	Unknown species
UNWB	Unknown Wading Bird
WILL	Willet

Appendix B: Field Data Sheets (continued).

BOHA Waterbird Monitoring Program
Photo Scoring Form

1. Trip Date:
2. Photo Scorer:
3. Score Date:

Island 4	Segment 5	Species 6	Count Incubating Adults 7	Notes 8

9. I have checked to make sure this datasheet is complete and legible (Fields 1 thru 15).

Signature: _____ Date: _____

10. Page ___ of ____

This Photo Scoring Form is used to record the number of incubating adult birds counted from a mosaic of digital photos taken of coastal bird nesting colonies.

GENERAL INSTRUCTIONS

1) Locate the appropriate photo mosaic to be counted and review its associated Trip Details Form. Photos are named using the photo naming convention shown at the bottom of this form.
2) Before counting, each scorer should make a copy of the photo mosaic being scored. To name the new file simply add an underscore and the scorer's initials to the end of the existing photo file's name (ex. [Existing File Name]_CLT).
3) Each scorer should use their own Photo Scoring Form to record their counts.
4) Open the photo mosaic using the Paint or a similar program (Paint can be located here on any PC computer: Start --> All Programs --> Accessories).
5) As they are counted, birds should be marked with a bright color using the paint brush tool.
6) Final counts for each species observed should be recorded on the Photo Scoring Form.
7) The marked up photo should be saved and stored in the same folder as the original photo.

Field	Requirements
1.	**Trip Date:** Date (day, month, year) that the boat trip took place.
2.	**Photo Scorer:** Full name (first and last) of the person scoring the photo.
3.	**Score Date:** Date that the photo was scored.
4.	**Island:** The name of the island where the observation is made.
5.	**Segment:** Survey segment of the island that this observation was made.
6.	**Species:** Four-letter code of the species this record is about. See table below for codes. When recording species not listed below, use the species' full name or define code used in notes.
7.	**Count - Incubating Adults:** Number of incubating adults counted on this island segment by species.
8.	**Notes:** Place for additional notes on the species or nest observed.
9.	**Certification:** Place for team member to sign the datasheet to indicate that it has been reviewed to insure that data are complete and legible. If multiple pages are produced, each are reviewed and signed independently.
10.	**Page __ of __:** Page number relative to total number of pages filled out by this team to complete this survey.

Naming Photos

Before scoring:
BOHA_Boat_[Date]_[Island][SurveySegment][Number]
ex. BOHA_Boat_20090612_LittleCalfEast1

After scoring:
BOHA_Boat_[Date]_[Island][SurveySegment][Number]_[Scorer's Initials]
ex. BOHA_Boat_20090612_LittleCalfEast1_CLT

SpeciesCode	CommonName
AMOY	American Oystercatcher
BCNH	Black-crowned Night-Heron
COEI	Common Eider
COTE	Common Tern
DCCO	Double-crested Cormorant
GBBG	Great Black-backed Gull
GLIB	Glossy Ibis
GREG	Great Egret
HERG	Herring Gull
LETE	Least Tern
MALL	Mallard Duck
PIPL	Piping Plover
SNEG	Snowy Egret
SPSA	Spotted Sandpiper
UNKN	Unknown species
UNWB	Unknown Wading Bird
WILL	Willet

Appendix B: Field Data Sheets (continued).

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	4/2011	Carol Lynn Trocki	Updated to include 2010 datasheets.	Operational Review
1.02	5/2012	Carol Lynn Trocki	Updated with revised Photo Scoring Datasheets	New datasheet

Appendix C: Boston Harbor Islands Coastal Breeding Bird Protocol Review – Responses to Peer and Park Review Comments.

Version 1.00

Review comments are available upon request. We sincerely appreciate the comments and suggestions made by five peer reviewers and BOHA park staff.

Peer Reviewer #1: Sam Droege, USGS

Peer Reviewer #2: Wayne Petersen, Mass Audubon

Peer Reveiwer #3: Greg Shriver, University of Delaware

Park Staff Review: Marc Albert & Mary Raczko, BOHA

External Peer Review: Dr. Curtice Griffin, University of Massachusetts 4/09

External Peer Review: Kathy Parsons, Manomet Center for Conservation Sciences 4/09

SOP 1 – Safety

Northeast Temperate Network
Version 1.22

Definitions (alphabetical)
Boat Captain: Refers to the licensed pilot of the water craft used for implementing the Coastal Breeding Birds Monitoring protocol. The captain has primary responsibility for the safety of passengers while traveling and landing, and has the final say on safety procedures while passengers are on board the vessel.

Lead Scientist: Refers to the individual responsible for coordinating implementation of the coastal breeding bird protocol.

Monitoring Personnel: Refers to all personnel engaged in activities related to this protocol. This includes National Park Service (NPS) and other Boston Harbor Island Partnership agency employees, cooperators, contractors, and volunteers either actively participating in or observing monitoring activities.

Volunteers: Refers to any individual participating, but not being paid to participate, in water bird surveys. Volunteers are required to have a signed a Volunteer Agreement and Acknowledgement of Safety Training form before participating in any surveys.

Park Staff: Refers to an employee of one of the Boston Harbor Island Partnership agencies. The Park Staff member has primary emergency response authority during land-based portions of surveys and primary responsibility to document and communicate any safety concerns or incident response.

Overview
This Standard Operating Procedure (SOP) describes basic safety procedures that should be followed during coastal breeding bird sampling at Boston Harbor Islands National Recreation Area (BOHA). Personnel safety is the number one priority at all times. The coastal zone, because of frequent transitional travel between land and water, is an inherently dangerous place. Travel and work in boats and on shorelines requires careful, methodical movement. Awareness of weather, swell, and waves is crucial to safe coastal conduct. Monitoring personnel should be aware of the risks associated with implementing this protocol and what they can do to mitigate them.

The Northeast Temperate Network (NETN) considers the occupational health and safety of its employees, cooperators, contractors, and volunteers to be of utmost importance, and is committed to ensuring that all Monitoring Personnel receives adequate training on NPS safety procedures prior to field work. This SOP and supporting appendices were designed to provide a summary of safety issues that should be covered during the pre-season training, and to serve as a first reference in case of an incident. Topics covered in this document and its appendices include emergency procedures and contacts, incident reporting, field preparation, safe field procedures, boat safety, and workers compensation procedures. This SOP does not cover first aid.

Since this protocol utilizes both professional (paid) and volunteer personnel, each with their own level of responsibilities, this SOP has been structured to facilitate delivery of role appropriate safety information

to both audiences. Professional personnel (i.e. park staff and contractors) with full emergency response and pre-season responsibilities should read and understand the entire SOP and

all appendices. Volunteers, who are responsible for their own safe conduct but not for coordinating an emergency response, will need to read and understand just the appendices.

Appendix S1.A: Responding to an Incident

Specific steps to be taken during both incidents requiring an emergency response and incidents that do not.

Appendix S1.B: Islands Owners and their Contacts

Map of the islands of Boston Harbor and emergency contact information.

Appendix S1.C: Basic Radio Information

Simple instructions on how to use the radio carried by park rangers.

Appendix S1.D: Job Safety Analysis (JSA)

Documents specific hazards associated with this protocol and recommends approaches to mitigate these hazards.

Appendix S1.E: Green-Amber-Red Risk Assessment (GAR)

A general assessment of the risks associated with conducting the field-based activities of the NETN Coastal Breeding Bird Monitoring Protocol.

Appendix S1.F: Acknowledgement of Safety Training

A form required to be signed annually by all Volunteers of the program signifying that they have read all required safety documentation associated with the NETN Coastal Breeding Bird Monitoring Protocol.

Season Preparation

Safety Procedure Review

Each year prior to the start of the field season, the NETN Program Manager, Lead Scientist, and BOHA volunteer coordinator will work together to review safety procedures and update emergency contact tables. This Safety SOP will need to be reviewed and modified to incorporate any procedural changes in time for the spring training session. First aid kits should be checked and restocked with first aid supplies and should also include the most recent version of instructions on how to respond to an incident (Appendix S1.A), contact information for each island (Appendix S1.B), and basic information on operating a park radio (Appendix S1.C).

Pre-Season Training

All safety topics outlined in this SOP are to be thoroughly covered during a training session led by the Lead Scientist and BOHA volunteer coordinator held prior to the start of the field season. Training for the coastal breeding bird monitoring protocol is conducted annually during a single 4-6 hour session in mid-May. Safety responsibilities and requirements of Park Staff and Volunteers will be clearly differentiated during this training. It is the responsibility of the Lead Scientist and BOHA volunteer coordinator to insure that any Monitoring Personnel who begin their service without having attended the pre-season training are provided with this SOP and fulfill all the requirements included within.

Even though emergency response responsibilities differ depending on an individual's team role, all Monitoring Personnel are equally responsible for maintaining a safe work environment for themselves and their coworkers and insuring that safety remains at the forefront of daily activities throughout the field season. Everyone should clearly understand routine and emergency communication procedures and how to respond to medical emergencies as well as non-medical emergency incidents. Everyone should also carry the required supplies with them into the field in order to promote their own safety as well as allow them to respond effectively to an incident. More information on items recommended for personal safety is listed in the Personal Gear section of this SOP as well as in the protocol's Volunteer Handbook.

Job Safety

To a large extent, preventing accidents is a matter of recognizing and managing risks. To that end both a Job Safety Analysis (JSA; sometimes called a Job Hazard Analysis or JHA) and a Green-Amber-Red Risk Assessment (GAR) have been included as a part of this SOP (Appendices S1.D and S1.E). Both of these important tools outline the potential risks associated with participating in the Coastal Breeding Bird Monitoring Protocol and outline appropriate measures or behaviors to minimize them. This approach is consistent with NPS Directors Order 50, Reference Manual 50B for Occupational Health and Safety, and the 2011 NPS Operational Leadership Student Manual.

Both the JSA and GAR will be reviewed during pre-season training and are required annual reading for all Monitoring Personnel engaged in field activities related to this protocol.

Emergency Response

Regardless of efforts taken to reduce risk, accidents can and do happen. Prior to entering the field, all Monitoring Personnel should feel prepared to request help or initiate an emergency response if necessary. Specific steps, current contact information, and a map of island ownership are available at the end of this document (Appendices S1.A and S1.B).

Steps for responding to an incident will be taught during pre-season training, are required reading for all monitoring personnel engaged in field activities related to this protocol, and are available in the first aid kit accompanying each survey.

First Aid Kits and Training

A first aid kit should be with the crew at all times while in the field. An inventory of first aid kits should be performed prior to each field season to ensure that all medical supplies are in sufficient quantity and haven't expired. Medical supplies that are used should be promptly replaced. In addition to medical supplies, each first aid kit will have an inventory list of the supplies contained within it and a current copy of Appendices S1.A, S1.B, and S1.CB to reference in case of an incident.

It is strongly encouraged that at least one team member (in addition to the licensed Boat Captain) have current first aid and CPR certification.

Daily Communication and Planning

A park staff member with a cell phone and park radio will participate on each monitoring trip. Any Monitoring Personnel carrying additional communication devices (e.g. cell phones) should notify the rest of the crew during the dock-side pre-trip safety briefing. All Monitoring Personnel must be familiar with the operation and capabilities of the primary communication devices. Training for use of the park radio in the event the Park Staff is compromised will be covered during pre-season training. Basic radio information is also covered in Appendix S1.C. Unless they are water proof, communication items should be stored in a water resistant or water proof container (e.g. Ziploc bag).

Prior to the field season and as updates become available, the Lead Scientist and park volunteer coordinator must provide the island owners, NETN Program Manager, and the appropriate park staff with an outline for each trip (a.k.a. 'trip plan'). These trip data will be entered into the Boston Harbor Islands Programs and Events Database in order to make them available to all personnel (https://www.quickbase.com/db/main?a=SignIn). At a minimum, the trip plan must contain the:

- date and purpose of trip;
- names of all people on trip;
- destination and route, including map with the sampling location clearly marked;
- time of departure from dock and estimated time of return to or dock;
- radio frequency or cell phone number for contacting personnel on the boat; and
- type of watercraft, if applicable.

For this protocol, there will be no designated individual on land (Designated Office Staff or DOS) to coordinate trip completion check-ins. In the event of an emergency, the Boat Captain will use the emergency band on the marine radio to call for help. If the emergency occurs on land, the monitoring staff must contact the Boat Captain by cell phone to obtain emergency assistance, or a park radio can be used to obtain emergency services. In the event of a boat-based emergency where the Boat Captain is

compromised, another individual should attempt to radio for help on the marine radio, or use a cell phone or park radio to call for assistance.

Field Safety

Personal Gear

Each person is responsible for ensuring she/he is wearing field appropriate clothing and footwear, such as long pants, a hat, and boots. Dress in layers as the temperature and wind can change dramatically out on the harbor. For example, warm clothing may be needed during boat rides to the island sites, but once at the site, the weather may be very different. Most people are okay wearing the same shoes or boots for both boat and land surveys. Proper footwear will provide adequate ankle support and traction on both the wet metal deck of the boat as well as the variable natural surfaces encountered on the islands (slippery rocks, sand, uneven terrain). Depending on the weather, rain gear or warm clothing should be taken into the field and it is recommended that any extra clothing be kept in a water proof bag. Staff should take care to avoid overexposure to the sun by wearing sunscreen and/or protective clothing. In addition to providing protection from the elements long-sleeved shirts and pants are also effective at reducing the threats of biting insects and exposure to chemical or physical irritants (e.g. poison ivy, thorns).

Everyone should always carry ample water (2-3 liters) and food when working in the field. Dehydration is a serious condition that can lead to more serious conditions if untreated, and must be avoided. It is important to drink liquid frequently to maintain hydration on a warm day, even if you don't feel thirsty.

More information on 'what to wear' and 'what to bring' is available in the Boston Harbor Islands Volunteer Training Guide for Coastal Breeding Birds (Appendix A of the Coastal Breeding Birds Protocol; https://irma.nps.gov/App/Reference/Profile?code=2191670).

Pre-trip Safety Briefings

Each trip will begin with a safety briefing by the Lead Scientist and Boat Captain. The Boat Captain is responsible for reviewing her/his expectations for boat safety (see next section). The Lead Scientist will review the trip plan with Monitoring Personnel and highlight any potential hazards likely to be encountered that day (weather, poison ivy, etc.). Park Staff should also voice any trip specific safety concerns at this time. The BOHA volunteer coordinator is responsible for making sure all participants have a current, signed Acknowledgement of Safety Training form (Appendix S1.F) and Volunteer Agreement on file with the park prior to boarding the boat. Before leaving the launch, a quick survey should be undertaken to determine which participants are carrying cell phones.

Boat Safety

Boats are an integral part of coastal bird monitoring. Any boat used for this protocol meets or exceeds all requirements of the U.S. Coast Guard and will be piloted by a state–licensed captain. Follow all instructions from the captain to ensure your safety. Immediately upon boarding the boat and before it has left the dock, the captain will brief the Monitoring Personnel on boat safety. The briefing should include location of personal flotation devices (PFDs), man overboard (MOB) procedures, and location of fire extinguishers.

While on the boat, staff should remain vigilant to their surroundings and to potential hazards above, on, and below the water. Communicate your concerns to the captain immediately. Wet conditions, sudden changes in boat direction, strong winds, and rolling waves can all contribute to unstable footing in the

boat. Know your limitations and do not exceed them (e.g. motion sickness can be greatly enhanced by the use of binoculars). Tell the Lead Scientist that you would like to take a break or switch to recording data if you feel unwell or unstable.

Waves are a significant marine threat, even on relatively calm days. Large waves tend to arrive in sets, or groups, but rogue waves or wakes from large boats can make footing suddenly unstable in a boat. Be particularly vigilant of the surf conditions and tide level when boarding or disembarking the boat.

Weather

Weather conditions in the eastern U.S. can be hazardous and can change quickly. Monitoring Personnel are responsible for planning their day according to the local weather forecast and for being aware of their surroundings and changing conditions. It will be the decision of the Lead Scientist and/or the Boat Captain whether or not to cancel a trip or cut it short based on weather. The Lead Scientist bears the responsibility of contacting the DOS to communicate any weather related change in plans or cancellations.

Thunderstorms

Storms that produce strong winds and lightning are dangerous and should be avoided in the field. It is the Boat Captain's responsibility to monitor the weather and get the crew to a landing (temporary or the main dock) in the case of an impending thunderstorm. If caught in a lightning storm on land, personnel should seek shelter in a building or car as soon as possible. If no shelter is available, spread out and move to an open space. Squat low to the ground on the balls of your feet with your hands on your knees (do NOT lie flat on the ground). Avoid high elevations, conductive materials, and tall structures such as trees or telephone poles. If you are in the open and feel your hair stand on end (indicating lightning is about to strike), immediately make yourself the smallest target possible and minimize contact with the ground.

NOTICE! *A person struck by lightning and who is without a pulse can often be revived by prompt administration of CPR. If they have a pulse but are not breathing, then "rescue breathing" should be applied to the victim.*

Excessive Heat and Sun

Over exposure to heat and sun can cause dehydration, heat exhaustion, or heat stroke. All are serious conditions that can be life threatening, and should be avoided. When working in hot weather, be sure to drink plenty of water and eat foods that can replace electrolytes. Wear loose and light colored clothing, including a hat to block the sun's rays. It may help to shift the field schedule to avoid working outside during the hottest part of the day.

NOTICE! *Signs of heat stroke include hot, red or spotted (usually dry) skin, and the sufferer may be mentally confused, delirious, having convulsions, or unconscious. If heat stroke is suspected, seek immediate medical attention!*

Poor Air Quality

Summer ozone and particulate matter levels occasionally exceed federal health standards. Young children, seniors, and those suffering from asthma, chronic bronchitis, chronic obstructive pulmonary disease or heart problems are especially sensitive to poor air quality and should minimize outdoor

activity when poor air quality warnings are posted. The risks of occasional exposure to ozone and fine particulate matter are minimal for healthy individuals.

When poor air quality warnings occur, it is advisable to avoid overly strenuous activity during the hottest part of the day (pollution levels tend to be lowest early in the morning). To check local air quality forecasts, or learn more about health risks of air pollution, visit the AIRNow intergovernmental agency website: http://www.airnow.gov/.

Teamwork

Nobody may work by themselves when conducting coastal bird monitoring, no matter how experienced they are. When conducting land-based island surveys, all Monitoring Personnel must be in visual contact with at least one other person. If the field crew separates into multiple teams, the teams must periodically check in with each other regarding the status of sampling and where on the site they will be located. Emergency gear (e.g. first aid kit) must be placed in a central location above the tide line that is known to all members of the crew.

Individual crew members should engage in self-monitoring and share health concerns with Park Staff or the Lead Scientist as soon as they are discovered. If you do not feel quite right, you do NOT want to be on a remote island in case it gets worse. Many volunteers think that it will make them look bad, or affect their future service to call a trip short due to health concerns, but it is just the opposite. Volunteers that don't communicate their health concerns put their team in danger.

Slip, Trip, Fall Prevention

Uneven terrain, slippery surfaces, dense brush, and fatigue are all hazards that could result in a slip, trip, or fall. The boarding or disembarking from the boat (both at the dock and onto the islands) can be particularly hazardous. The following guidelines must be obeyed by Monitoring Personnel to avoid injury from slips, trips, or falls:

- Always wear appropriate footwear.
- Pay attention to where you are going, and remain alert of potential hazards.
- When boarding or disembarking from the boat always keep at least one hand free, and always test your footing before putting your full weight down. Walk at an appropriate pace and adjust pace for changes in terrain (e.g., slow down and take smaller steps on slippery surfaces).
- When hiking long distances, take breaks to avoid fatigue.
- When navigating to an off-trail location, choose the safest route (this may not be the shortest route).
- Avoid excessively steep terrain and sudden drop-offs.
- Always be careful when navigating over piles of scree, and alert others of loose footing or sliding debris.

Proper use of Backpacks

Monitoring Personnel may find it useful to carry a small backpack to keep their hands free when monitoring instruments (e.g. binoculars, Trimble Juno hand-held computer) are not in use. Backpacks are also useful for keeping safety items, sunscreen, water, snacks, and clothing layers nearby at all times. It is important for everyone to understand appropriate ways to pack and carry a backpack. Follow these guidelines:

- Use a sturdy field pack sized appropriately for the task with which you are going to use it.
- Pack heavy items in the center of the pack and close to your back.
- Make sure weight is evenly distributed from side to side.
- Once equipment is packed, tighten the compression straps to minimize movement inside the pack during travel.
- Always carry a pack with both shoulder straps and with the hip belt and chest straps secured.
- Keep your pack organized, and only carry the necessary equipment, food, and water to reduce weight.

Carrying Other Gear

Some of the more frequently used gear will have to be hand carried (e.g. Juno Trimble, binoculars, camera). When carrying something, keep one hand free - both for balance and so that the item can be shifted between hands. Remember to slow down and pay attention to your footing.

Airborne Pathogens in Coastal Bird Colonies

Island sites supporting high-density nesting of colonial nesting birds may present some risk for Monitoring Personnel who enter these areas. When disturbed (e.g. wind or trampling), pathogens that may be present in bird droppings or the excreta rich soil can become airborne as fine aerosols and infectious to humans via inhalation. The bacterium *Chlamydia psittaci* may be found in bird droppings and can cause severe pneumonia in humans. The highly publicized H5N1 virus that causes avian flu can also be excreted into feces, although this virus has yet to be found on the North American continent. The excreta rich soil may also harbor fungi that could be a concern for inhalation, such as *Histoplasma* and *Cryptococcus*. While the risk of exposure to such disease agents is likely low, Monitoring Personnel should be aware of this potential and take measures to minimize risk, particularly in high-density nesting areas where disturbance could increase aerosolizing contaminated material. For the most recent information available on the risks of the pathogens mentioned here please visit the Centers for Disease Control and Prevention website at http://www.cdc.gov/

Certain protective measures will reduce the risk of exposure to airborne infectious diseases. Avoid areas where feces accumulation is high. Survey colonies from a distance whenever possible, thus reducing disturbance to eggs and nestlings as well as human exposure to pathogens. If it is necessary to enter the colony, disturbance to the environment should be minimized to prevent aerosolizing any disease agent present. Lastly, field workers may choose to wear personal protective clothing and respirators. Handling of feathers, eggs, and other contaminated material should be avoided.

Mosquitoes and West Nile Virus (WNV)

West Nile virus is North America's most recent experience with a mosquito–borne disease. First detected in the northeastern U.S. in 1999, WNV has been detected in the mosquitoes of the Boston area annually ever since. Birds are the natural reservoir host and serve in the amplification of the virus via a mosquito-bird-mosquito epizootic transmission cycle, while humans (and other mammals) are incidental, dead-end hosts. The main route of human infection is through the bite of an infected mosquito. Although many people are bitten by mosquitoes that carry West Nile virus, most do not know they've been exposed and few develop severe disease or even notice any symptoms at all. For the most up-to-date information on symptoms, testing, and treatment of West Nile virus please visit the Centers for Disease Control and Prevention website at http://www.cdc.gov/ncidod/dvbid/westnile/

Engaging in the following personal protective measures can greatly reduce your exposure to mosquito-borne diseases, like WNV:

- When possible avoid outdoor activity during dawn and dusk when most mosquitoes are most active.
- Wear long-sleeved shirts and long pants whenever outdoors.
- Spray clothes with insect repellent. Repellents with 10% to 35% DEET (N, N-diethyl-meta-toluamide) will provide adequate protection under most conditions.

Deer ticks and Lyme Disease

Several species of ticks are commonly encountered in eastern U.S. parks while working in the field. This includes the deer tick (*Ixodes scapularis*), which is a known vector of Lyme disease and Ehrlichiosis. Although ticks have not been observed on most of the islands visited for this protocol, it is possible that ticks could be present, especially on inner islands such as Sarah, Peddocks, and Thompson. To reduce their exposure to tick bites, Monitoring Personnel should consider the following precautions:

- Clothes treated with permethrin have been found to be fairly effective tick repellant. Carefully follow the application instructions on the spray bottles to ensure your safety. The repellent will remain active for several weeks and through several washings.
- Tuck pants in socks and tuck in shirts. Wearing long sleeves and gaiters has been found to help.
- Check clothes and skin for ticks at the end of every field day. Ticks typically need to be embedded for at least 24 hours for disease transmission to occur; therefore, the earlier ticks are found and removed, the lower your chances are of acquiring a tick-borne illness.
- If you find a tick that is already embedded, use fine-tipped tweezers to firmly grasp the tick close to your skin. Slowly and steadily pull the tick's body away from your skin. Be careful not to crush the tick's body to minimize the chances of it regurgitating fluids into the wound. Clean the bite area once the tick is removed with soap and water.
- Keep an eye out for any early symptoms of tick borne diseases. Symptoms may include a bull's eye rash around the tick bite (doesn't always occur), tingling or numbness in extremities, a spotted rash on extremities, bad headaches, high fever, joint aches, stiff neck, fatigue, or swollen

glands. If you develop a combination of these symptoms soon after a tick bite, seek medical attention.

- If you start to notice symptoms of Lyme disease, file a workers compensation claim as soon as possible.

Additional information on this topic can be found on the Centers for Disease Control and Prevention (CDC) website: http://www.cdc.gov/Lyme/

Poisonous Plants and Animals

Both for personal safety and protection of park resources, it is never advisable for Monitoring Personnel to eat wild plants while working in a National Park regardless of their confidence in plant identification. Keep a safe distance from wildlife. See the JSA (Appendix S1.D) for appropriate actions to mitigate the plant and animal risks listed here.

Poison Ivy

Poison ivy (*Toxicodendron* spp.) is present at BOHA and can be very abundant in localized areas. Monitoring Personnel must learn how to recognize this plant. When working in areas with poison ivy, it is advisable to take precautions to avoid skin contact with any part of the poison ivy plant.

Bird Attacks

Coastal birds can become particularly aggressive to intruders when defending a territory or nest – even to the extent of striking or defecating on people. Went entering a colony, observers should remain aware of their surroundings, note the disposition of adults, and be mentally prepared to be harassed by protective adults from the air. Wearing a hat can greatly reduce the risk of a bird causing an injury to any observers.

Bees, Wasps, and Yellow Jackets

Bees, wasps, and yellow jackets could be encountered while traveling to monitoring sites, but are not a significant risk to most people. However, because of the remote nature of many of the survey sites, allergic reactions to stinging insects can pose a significant risk to people predisposed to them. Prior to participating in a survey it is recommended that anyone allergic to insect stings communicate the severity of their allergy to Park Staff.

Contact Information

See Appendix S1.A and S1.B for current emergency and non-emergency contact information.

Literature Cited

American Lyme Disease Foundation. 2000. Tick ID Card. Tim Peters and Company Inc., Peapack, New Jersey.

Cass, W. 2007. Shenandoah National Park Long Term Ecological Monitoring System. SOP #2, version 1.2. U.S. Department of Interior, National Park Service, Shenandoah National Park, Luray, Virginia.

National Park Service. 2003. Public Health Information Sheet: West Nile Virus – General Information. Public Health Program, Washington, D.C.

Sonoran Desert Network, National Park Service. 2008. SODN Field Safety Plan. Version 6.00. U.S. Department of Interior, National Park Service, Sonoran Desert Network Office, Tucson, Arizona.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	3/2012	A. Kozlowski	Based on Safety SOP v2.01 in the NETN Rocky Intertidal protocol	Original
1.10	3/2012	A. Kozlowski; M. Raczko; M. Albert	Refined response steps. Arranged document to have stand-alone appendices applicable to Volunteers.	Peer review
1.20	4/2012	A. Kozlowski; M. Raczko; M. Albert; C. Trocki; J. Karish	Added disease and pathogen risks to SOP body and JSA. Refined responsibilities of Boat Captain. Lengthened no response time before initiating a search. Reviewed GAR. Added basic radio info appendix.	Peer Review
1.21	5/2012	A. Kozlowski; M. Raczko; M. Albert;	Modified OWCP steps on where staff/volunteers can obtain CA-1.	Peer Review
1.22	3/2013	B. Mitchell	Remove requirement to have a DOS for check-ins. In the event of an emergency, monitoring staff must rely on the Boat Captain, cell phones, and park radios to obtain assistance. Update link to volunteer guide	Park staff felt the DOS requirement was not needed Web site update

Appendix S1.A. Responding to an Incident

Incident Requiring an Emergency Response

Immediate Response

1. **Call 9-1-1 and tell the operator:**
   a. "We need a marine response in Boston Harbor" and the island or nearest island to your location.
   b. Description of the vessel: "26 ft UMASS landing craft".
   c. Ask 9-1-1 who is responding (info later passed to DCR staff). If 9-1-1 operator doesn't know ask for a call-back.

   If cell phone reception is unavailable, use a handheld NPS radio or use the boat's marine radio to contact DCR State Base on Channel 10 (Appendix S1.C).

2. **Administer first aid** to the best of your knowledge, ability, and training. If appropriate, arrange for transporting the victim to the emergency room. Keep in mind that in many cases the Boat Captain is in the best position to help.

3. **Inform all team members** that an emergency is in progress and determine if emergency contacts of victim should be contacted.

4. For DCR owned islands: Call DCR by contacting the "State Base": (617) 727-1188. Let them know the nature of the incident and who is responding.

Secondary Response

5. As soon as it is practical to do so, inform the Designated Office Staff (DOS). Be sure to communicate to the DOS any information provided by 9-1-1 dispatcher or responding agency so this information can be relayed to island owners.

6. If it has not already been done, the DOS will contact 1) any emergency contacts for the victim; 2) the island owner; 3) the NETN Program Manager.

7. For NPS employees and volunteers involved in an injury producing incident, begin by filling out a CA-1 within 48 hours of the accident and turning it in to your functional supervisor. The form can be obtained from the DOS or downloaded from the Department of Labor (http://webapps.dol.gov/libraryforms/go-us-dol-form.asp?FormNumber=356). For contractors and cooperators, follow your organization's procedures for documenting accidents.

Incident Not Requiring an Emergency Response

1. Administer first aid and seek medical attention if needed.

2. Contact the DOS and, if applicable, your functional supervisor as soon as practical after any incident. The DOS will contact the NETN Program Manager as soon as it is practical to do so.

3. Follow instructions in Step 7 of Incident Requiring and Emergency Response section above.

NOTE: Never discard original paperwork related to workers compensation claims (including information from doctor's visits, and CA-1, CA-2, CA-16 or CA-17 forms).

Appendix S1.B. Islands Owners and their Contacts

Note: For all emergencies, first contact 9-1-1 and report location including that you need a "Marine response in Boston Harbor." See procedures for secondary response.

Table S1.B.1. Agency specific contacts for Boston Harbor Islands National Recreation Area

Organization	Contact	Phone	Radio Channel
National Park Service			
DOS (primary)	BOHA - Mary Raczko	(617) 223-8637	
DOS (secondary)	BOHA - Marc Albert	(978) 360-0421	
General Contact	Lead Scientist - Carol Trocki	(401)952-2937	
	NETN - Brian Mitchell	(802) 457-3368 x37	
U.S. Coast Guard (Little Brewster, The Graves)			
Report an Emergency	Marine Emergency	(617) 223-3201	
General Contact	Sally Snowman	(781) 925-0932	
DCR (Outer Islands except Little Brewster, Lovells, Peddocks, Grape, Bumpkin, Slate, Sheep)			
Report an Emergency	State Base	(617) 727-1188	10
General Contact	Susan Kane	(781) 740-1605 x206 (617) 438-4194	
Mass. Water Resources Authority (Deer)			
General Contact	Tom Lindberg	(617) 660-7974	
City of Boston (Long, Moon, Rainsford)			
General Contact	Bryan Glascock	(617) 635-3850	
Town of Hingham (Sarah)			
General Contact	Hingham Police	(781) 749-1212	
	Clifford Prentiss	(781) 741-1445	
Town of Winthrop (Snake)			
General Contact	Winthrop Police	(617) 846-1212	
	Norman Hyett	(617) 909-0912	
The Trustees of Reservations (Worlds End)			
General Contact	Hingham Police	(781) 749-1212	
	Ed Pitcavage	(978) 356-4351 x4011	
Thompson Island Outward Bound (Thompson)			
General Contact	Jim Scully and Arthur Pearson	(617) 326-3900 x121	

Appendix S1.B. Islands Owners and their Contacts (continued).

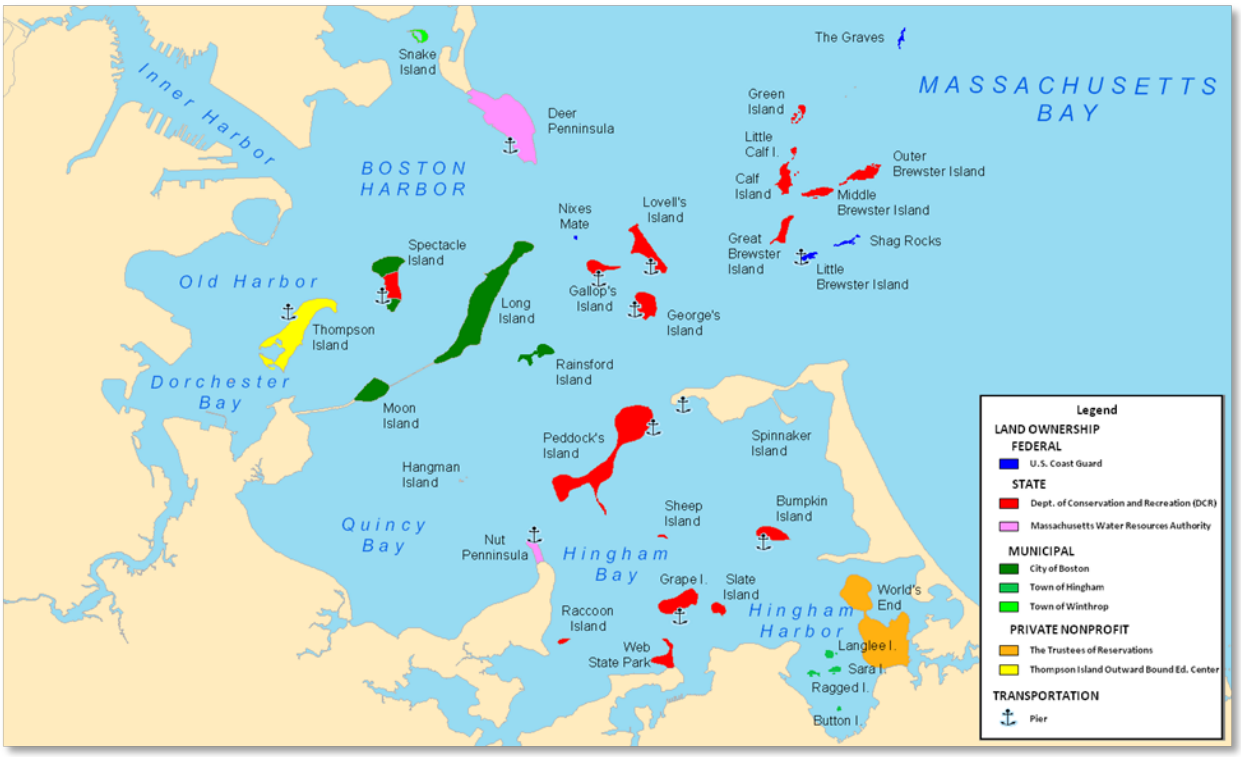


Figure S1.B.1: Map showing land ownership status of the island and associated lands in Boston Harbor.

Appendix S1.C. Basic Park Radio Operation

Basic Radio Information

1. The model is a Motorola MTS-2000

2. The Top Buttons
    a. Top left switch is power and Volume. Always turn volume up to loudest and adjust with each transmissions
    b. Top center switch is Channel.
        i. Emergency use Channel 10 DCR State Base (24 hrs).
        ii. Island rangers use Channel 14 and Channel 16.
    c. Toggle switch: Always set to "A"
    d. Menu Screen: should say "DCR 10" when on Channel 10.

3. The left side buttons
    a. Press the large button and hold as long as you are speaking to transmit
    b. Top blue button is for display light
    c. Middle button means nothing
    d. Last (third) small button is scan. If you are hearing many transmissions from other areas, chances are this has been pressed. Press to remove scan.

Standard Transmission Procedures

1. Speaker announces own call sign first, then states the call sign of the person needed. Call sign for the bird monitoring program is NPS Bird.

    a. example - " NPS Bird to State Base" or "NPS bird to Georges Island".

2. Call receiver states that they heard and understand the transmission. They could say "NPS Bird copies that", "That is received", "understood", or anything to that effect.

Emergency Procedure

1. Choose Channel 10 to contact DCR State Base.

2. Announce call "NPS Bird to State Base"

3. State Base will respond

4. Announce conditions of emergency and location / request assistance

    a. example – "Medical Emergency on Great Brewster Island, need assistance."

5. Respond to questions of State Base in a calm, succinct manner.

6. State Base will arrange for emergency response and provide instructions.

Appendix S1.D. Job Safety Analysis

JOB SAFETY ANALYSIS: Coastal Breeding Bird Field Work, including boat travel to and from island sites	**JOB TITLE:** Coastal Bird Monitoring Crew Members **DEPARTMENT:** Northeast Temperate Network **ANALYSIS BY:** Adam Kozlowski, NETN Data Manager	☒ **NEW** ☐ **REVISED** ☒ **REVIEWED** John Karish, NER I&M Program Manager
Required and/or Recommended Personal Protective Equipment: Required: Two modes of communication (i.e., radio and cell), life vests, first aid kit. Recommended as appropriate: rain gear, condition-appropriate footwear and clothing, hat, dry change of clothes, sufficient food and water.		

Tasks	Potential Hazards	Recommended Action or Procedure
Planning and Communication	Not being prepared and following plan/itinerary. Communication breakdowns.	• Plan ahead. Know where you and each crew member will be going, particular hazards associated with travel routes, and sites to be visited that day. Check expected weather, tide, and surf conditions for day and sites to be visited. • Conduct a pre-trip briefing when all team members participating that day are assembled. Solicit input from team members on any personal concerns or limitation they might have regarding the day's itinerary. • Understand itinerary of planned trip and follow carefully. Coordinate drop-off and pick-up times (or return times) and locations precisely. • Check in with Designated Office Staff (DOS) prior to field work with a trip plan, and after field work to confirm crew safety. If return will be delayed, contact DOS before agreed-upon check-in time to establish a new check-in time. Always carry two methods of communication with

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
		full charges.
Emergency Preparedness	Not knowing emergency procedures. Not having emergency supplies.	• Know who to contact and how to reach them (including how to operate communication equipment) in the event of a life-threatening or non-life-threatening emergency. • Bring a well-maintained first aid kit on each trip. • If teams split up in pairs, place safety equipment at a central location at the monitoring site that is known to all crew members and that is above the tide line.
Teamwork	Lack of awareness of other team members leading to delayed incident response	• Promote a cohesive team atmosphere that values input and/self critique. • Make sure that no crew member works alone and out of sight of other crew members; i.e., work in groups of two at a minimum. • If crew splits up into multiple pairs, the pairs should periodically check in with each other.
Boarding and disembarking the landing craft	Falling or tripping due to extremely slick, uneven, and unstable surfaces	• Obey all instructions from the Boat Captain and only board or disembark when he has directed it is safe to do so. • Always keep your center of gravity as low as possible and always keep at least one hand free and be prepared to lose your footing. • Offer and accept help from others when it is needed. Work as a team to safely transition from land to the boat or vice versa. • Pass gear between people on boat and land rather than carrying the gear onto the boat.

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
Riding in landing craft or other small boat	Boating accident; motion sickness; injuries from crossing waves/wakes; falling overboard into the ocean; exposure to wind, sun, and rain	• Obey all instructions from the Boat Captain. • Make sure you are familiar with man-overboard (MOB) procedures and location and use of safety equipment on boat (e.g. flotation devices, rescue pole). • Stay aware of the boat's surroundings to watch for hazards that may cause an unexpected change in the boat's direction (boat wakes, buoys, obstacles). Communicate concerns to the captain and other members of the team promptly. • Move carefully and deliberately, and ensure you have solid footing before using both hands for any task. • When the boat is in motion, stay flexible and try to move with the boat motion; avoid bracing yourself rigidly. • Bring a jacket, even on warm days, since it is cooler on the water. • Check the weather and be prepared with hat, sunscreen, and rain gear.
General foot travel	Falling or tripping due to wet areas, poor footing, uneven terrain, loose/rolling rocks.	• Use caution at all times. Walk carefully, watching footing. • Wear appropriate boots for conditions. Stay aware of your feet. Address blisters and hot spots promptly. • When walking on a steep slope, lean upslope. Ensure that stems and vines are alive and can support your weight before relying on them. • Use extreme caution traversing wet rocks, streams, steep slopes or blowdown areas. • Know your limitations and don't exceed them.

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
Walking through thick vegetation	Cut, scratched, or bruised by vegetation; eye or ear injuries	• Shield your eyes and face with your hands, glasses, or hat when moving through tall thick brush. Keep your head and eyes pointed somewhat downward so your head hits obstacles before your eyes. • Wear pants and long-sleeved shirts to protect bare skin. • Look before you grab vegetation to avoid grasping thorny stems. • Do not follow closely behind other people to avoid having branches snap back and hit you.
Hazard trees	Being struck by falling trees or branches	• Look up. Be alert for widow-makers, storm damaged trees with large broken limbs, and unstable standing dead trees. • Do not spend extended time in an area with hazard trees.
Carrying a pack and other equipment	Injuries from improper packing, adjustment, and lifting of backpacks. Injuries from improper carrying of gear	• Learn how to properly pack, adjust, lift, and carry a pack. • When hand-carrying gear, keep one hand free.
Working in heat, humidity, or cold	Heat exhaustion, sunburn, dehydration, hypothermia	• Evaluate the weather forecast each morning and plan field work accordingly. • Carry and drink plenty of water. • Take extra breaks during extreme weather events. Adjust the work routine to minimize exposure to extreme heat and humidity. • Take adequate garments for all possible weather conditions. Choose clothing that will keep you warm even if it gets wet.

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
Working outdoors during storms	Being struck by falling trees or branches; being struck by lightning	• Listen/listen to the weather forecast each morning. • Plan or adjust field work to avoid being out in thunderstorms. • Postpone work if safety will be compromised by storm conditions. If you see or hear a thunderstorm coming, retreat from high ground and exposed areas. Go inside a sturdy building or vehicle, if possible. • If you can't get inside and if you feel your hair stand on end, lightning is about to strike. • Make yourself the smallest target possible and minimize contact with the ground. • Crouch down on your pack on the balls of your feet and keep your feet close together. Place your hands on your knees and lower your head. • During a thunderstorm, members of the crew should stay separated by at least ten feet.
Working in and around coastal bird colonies	Attacks by adult birds; exposure to pathogens in guano	• Survey colonies from a distance whenever possible, thus reducing disturbance to eggs and nestlings as well as exposure of surveyors to potential pathogens and aggressive adult birds. • When entering a colony remain aware of your surroundings as well as the location and demeanor of adults to reduce surprises. • Wearing a hat can protect against being struck or defecated upon. • When traveling through a colony avoid areas where feces accumulation is high. • Make every attempt to minimize disturbance to guano deposits and the soil to reduce the aerosolizing any disease

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
		agent that may be present. • Do not handle eggs, feathers, or other potentially contaminated material. • Field workers may choose to wear personal protective clothing and respirators.
Poisonous plants, especially poison ivy	Contamination/toxicity from contact with poisonous plants	• Learn to identify poison ivy in its many growth forms. • Wear long sleeves and pants. • Be aware of poison ivy and avoid coming in direct contact with it. • Thoroughly wash hands, equipment, and clothes with Tecnu or similar specialized soap if you come into contact with poison ivy.
Bee, wasp, or yellow-jacket stings	Multiple stings from disturbing or stepping into nest areas	• Bees, wasps, or yellow-jackets may be encountered while traveling to monitoring sites. • Be alert to hives in brush, ground holes, or hollow logs. Watch for insects traveling in and out of one location. • If you or anyone you are working with is known to have allergic reactions to be stings, tell the rest of the crew and your functional supervisor. Make sure you carry emergency medication with you at all times and that your co-workers know where it is kept. • Wear long sleeve shirts and trousers, tuck in shirt. Bright colors and metal objects may attract bees or wasps. • If you are stung, a cold compress may bring relief. • If stinger is left behind, scrape it off of skin. Do not use tweezer as this squeezes the venom sack, worsening the injury.

Appendix S1.D. Job Safety Analysis (continued).

Tasks	Potential Hazards	Recommended Action or Procedure
		• If the victim develops hives, asthmatic breathing, tissue swelling or a drop in blood pressure, seek medical help immediately.
Bites from mosquitoes, black flies, and other insects	Itchy reactions to multiple bites Exposure to West Nile virus (WNV)	• Wear long sleeves and pants. • Avoid sitting on the ground or on logs, especially in dry sunny grassy areas. • Use insect repellants. Do not apply Permethrin, Permanone, or greater than 30% DEET directly to skin, only to clothing. • Carry after-bite medication to reduce skin irritation.
Ticks	Contracting diseases transmitted from ticks	• Use tick avoidance precautions, including pre-treating clothing with Permethrin, tucking pants into socks and shirt into pants when hiking to and from intertidal sites. • Wear clothes (including pants and long-sleeved shirts) that are light colored and check for ticks on clothing after traveling through vegetation. • Conduct a thorough tick check every evening after completing field work. • Know how to identify tick life forms, and the signs & symptoms of tick-borne diseases.

Appendix S1.E. Green-Amber-Red Risk Assessment

This appendix describes application of the GREEN-AMBER-RED (GAR) Risk Assessment Model, as outlined in the NPS Operational Leadership Student Manual (Version 2; July 2011), to the NETN Coastal Breeding Bird Monitoring Protocol. This GAR was written by the NETN Program Manager (Brian Mitchell) adopted for this protocol by the NETN Data Manager (Adam Kozlowski) on 9 March 2012 and approved by the NPS Northeast Region I&M Program Manager (John Karish) on 25 April 2012.

The GAR model allows for a general assessment of a task or operation and generates communication concerning the risks of an activity (in this case, conducting the field-based activities of the NETN Coastal Breeding Bird Monitoring Protocol). The most important part of the process is the team discussions leading to an understanding of the risks and how they will be managed.

The GAR is a seven step process. Each step is defined and explained in the context of the NETN Coastal Breeding Bird Monitoring Protocol below.

Step 1: Define the Mission or Task

The NETN Coastal Breeding Bird Monitoring protocol's field-based activities include: ground-based nest counts and boat-based counts of nesting pairs and individuals. A 26-foot landing craft is used to access the islands to conduct ground-based nest counts and to conduct the boat-based counts. Monitoring personnel work as part of a team when on the boat and may work in multiple pairs when conducting ground-based surveys. The activity is conducted on remote islands in the Boston Harbor National Recreation Area away from roads and trails. Island landings, where personnel and gear need to traverse the intertidal zone, have a number of innate safety hazards.

Step 2: Define the Threats

The threats/hazards for this activity along with mitigation measures are described in the associated Job Safety Analysis (Appendix S1.D). Of specific concern is that monitoring personnel will regularly be transitioning through uneven and extremely slippery surfaces immediately adjacent to the ocean and negotiating rugged, uneven landscapes in remote areas. A fatality through drowning or a severe slip and fall is possible and is the most significant risk encountered when conducting this activity.

Step 3: Assess Risk and Assign a Numerical Value

The numerical ranks (Table S1.E.1) were assigned by the NETN Data Manager, the NPS lead scientist for the NETN Coastal Breeding Bird Monitoring Protocol, and the BOHA Stewardship Program Director. It should be noted that at the time final numerical values were assigned (March 16, 2012) the protocol had been in development for several years and considerable time and effort had already gone into evaluating and mitigating risks.

The activity risk can be visualized using the colors of a traffic light. If the total risk value falls in the GREEN ZONE (1-35), risk is rated as low. If the total risk value falls in the AMBER ZONE (36-60),

Appendix S1.E. Green-Amber-Red Risk Assessment (continued).

risk is moderate and you should consider adopting procedures to minimize the risk. If the total value falls in the RED ZONE (61-80), you should implement measures to reduce the risk prior to starting the event.

The ability to assign numerical values or "color codes" to hazards using the GAR Model is not the most important part of risk assessment. What are critical to this step are the team discussions leading to an understanding of the risks and how they will be managed.

Table S1.E.1. NETN Coastal Breeding Bird Monitoring Protocol assigned risk codes of 0 (For No Risk) through 10 (For Maximum Risk) to each of the eight Green-Amber-Red Risk Assessment elements.

Element	Rating
Supervision	2
Planning	3
Communication	4
Contingency Resources	5
Team Selection	4
Team Fitness	5
Environment	6
Event/Evolution Complexity	5
Total Risk Score	34

Step 4: Identify Risk Control Options

Supervision

The NETN Coastal Breeding Bird Monitoring Protocol clearly identifies personnel, roles and responsibilities, and a chain of command. A functional supervisor (the contracted Lead Scientist) is always on the boat and on site with 2-4 volunteers. Nobody is allowed to work solo, everyone must remain in sight of at least one other team member at all times, and there are periodic check-ins between teams. A licensed captain always drives the boat and is responsible for boat safety. A member of BOHA park staff is responsible for carrying multiple communication devices (usually radio and cell phone), monitoring the volunteers for signs of distress, and responding to emergencies. The supervisor has many tasks to accomplish, so is not always focusing only on supervision. A score of 2 was assigned due to layered on-site supervision and the fact that the team is not large, and work is conducted in pairs with regular check-ins.

Planning

The NETN Coastal Breeding Bird Monitoring Protocol includes numerous SOPs that explain hiring, training, personal safety, emergency communication (equipment and contacts), and appropriate field activities. Crew members are required to review these materials during pre-season training and receive pre-trip safety briefings before outing. A Job Safety Analysis has been developed which all crew members must read and sign. Due to this advance planning, written documentation, and training procedures, a low score (3) was assigned.

Appendix S1.E. Green-Amber-Red Risk Assessment (continued).

Communication

Routine and emergency communication equipment and procedures are explained in the relevant SOPs. This includes coordination with park natural resource managers, rangers, and dispatch. Access to duplicate means of communication (radios and cell phones) is available on all trips and carried by a trained member of the BOHA park staff. Due to this advance planning, written documentation, and training procedures, a low score (4) was assigned.

Contingency Resources

Contingency resources include communication equipment and procedures that explicitly involve park rangers, park dispatch, and 9-1-1. Crew members always have at least two modes of communication (park radio and cell). The crew is instructed to place all safety gear (first aid kit, water) at a central location (the exception would be Park Staff radio). Notification of emergency services should happen within minutes of an incident, but emergency services may not be able to reach the crew quickly due to the remoteness of some sites. A score of 5 was assigned instead of a lower score because of the potential delay before emergency services could reach the crew.

Team Selection

The monitoring protocol clearly identifies the essential skills and abilities required to execute this protocol in a competent manner. Training occurs prior to when field work is conducted allowing time to assess individual and team weaknesses. A congenial team atmosphere values/encourages input from its members. The protocol benefits from many return Volunteers who ‘know the ropes’. A score of 4 was assigned (instead of a lower score) because at least some crew members may have limited experience, and may not have advance training in the particular safety issues that can arise. While some of these skills can be worked on during Monitoring Personnel training, there is no substitute for experience.

Team Fitness

Team selection seeks to ensure an overall high level of initial team fitness. Monitoring Personnel are only in the field for approximately six hours per day (not including drive times). Sampling always occurs during daylight hours. Work is a mixture of stationary and walking-based tasks and is not considered overly strenuous. A score of 5 was assigned because Volunteers are largely an older group, but skilled in the outdoors, often with many years experience. Monitoring Personnel must be diligent about adequate rest and nourishment to ensure that fatigue does not become a factor.

Environment

Environment was assigned a higher score (6) primarily because of the inherent dangers associated with traveling to and from islands in a small boat, loading and unloading the boat in the intertidal environment, the low temperature of the water, and the off-trail hiking conditions on the islands. Slips and falls combined with the remote nature of the sites are the primary safety concern. Poison ivy is abundant on several of the islands where volunteers will be working. Lack of shade on the open water increases the chance of personnel’s overexposure to the sun. Slow emergency response times typical to the islands also raise the concern of dealing with sudden, unpredictable changes in the health of Volunteers or staff. Helipads are available on several of the harbor’s islands and 9-1-1 responders and Park Staff are trained to navigate the complex emergency response jurisdictions. Careful attention is paid

Appendix S1.E. Green-Amber-Red Risk Assessment (continued).

to the weather and trips will be cancelled at the discretion of the Lead Scientist and/or Boat Captain. Despite training, working in pairs, and having multiple modes of emergency communication, the possibility exists for a serious accident to occur.

Incident Complexity

Incident complexity was assigned a score of 5 mostly because the monitoring tasks require staff to divide their attention among aggression by territorial birds, avoiding stepping on nests, keeping counts of individuals for multiple species, use of binoculars, and/or using a handheld computer while traveling in a moving boat or moving through dense foliage on uneven terrain. Changes to the weather and seas are of some concern, but working in teams where every member's input is valued helps mitigate that threat. Although individual Monitoring Personnel must use judgment and experience to respond appropriately, standardized operating procedures cover a high percentage of the activities and help staff manage the requirements made of them.

Step 5: Evaluate Risk vs. Gain

The score of this assessment (34) falls at the high end of the "green" zone, but still indicates a low risk activity. The NETN Program Manager has determined that the activity, if carried out in accordance with all SOPs, has an acceptable level of risk.

Step 6: Execute Decision

The decision made by the NETN Program Manager is to conduct the activity in accordance with NETN Coastal Breeding Bird Monitoring Protocol Standard Operating Procedures (SOPs).

Step 7: Supervise – Watch for Change

The NETN Program Manager continually solicits feedback from the Lead Scientist, NPS Staff, and Volunteers on safe execution of the protocol including risk control options not considered thus far.

Appendix S1.F. Acknowledgement of Safety Training

I hereby attest that I have read in its entirety and understand the information provided to me in the Northeast Temperate Network's Coastal Breeding Bird Monitoring Protocol Safety SOP Appendices, which includes the:

- Appendix S1.A: Responding to an Incident
- Appendix S1.B: Islands Owners and their Contacts
- Appendix S1.C: Basic Radio Information
- Appendix S1.D: Job Safety Analysis (JSA)
- Appendix S1.E: Green-Amber-Red Risk Assessment (GAR)

The information in these documents identify hazards of conducting field work required as a member of the NETN Coastal Breeding Bird monitoring team and document practices and behaviors to mitigate those hazards. I understand that part of my responsibilities as a member of the monitoring team is to practice these safety practices to the best of my ability.

_____ _____

Participant Signature Date

_____

Participant Name

SOP 2 – Field Season Preparation

Northeast Temperate Network
Version 1.06

Draft Field Schedule

Based on the previous year's accomplishments, draft a schedule for the coming year by 15 March. The schedule should include a matrix of dates, islands to be visited, and target species (Table S2.1). Dates must take into account the estimated peak of incubation (or other necessary phenology) for the target species. Some islands (Snake, Sheep, Rainsford, Middle Brewster, Outer Brewster) require high tide for landing; coordinate your draft schedule with the transportation provider to insure its feasibility.

It is advisable to include make-up / weather days during each week of the schedule. This allows the volunteer manager to plan accordingly for volunteers, and allows easy re-scheduling within a tight timeframe should an extra day be needed. Currently, the capacity of the survey boat is limited to six people, and monitoring tasks have been structured accordingly. No more than six people (including lead scientist and participating park staff) should be assigned for each field day.

Schedule Transportation, Volunteers, Access

Once the field schedule has been finalized, schedule marine transportation by 31 March. Currently, Marine Operations at UMASS Boston (http://www.umb.edu/umb/marineops/) is able to provide a landing craft and licensed captain for $65 per hour. Although a landing craft may not be necessary for all field work, the scheduled use of a landing craft maximizes the flexibility of field work on the islands.

Share the final field schedule with the BOHA volunteer manager, responsible for recruiting and coordinating volunteers, by 31 March. Circulate the final field schedule among island managers and partners by 7 April to ensure that access is permitted. Communicate with BOHA staff to obtain updated contact information for the appropriate list of partners in advance of each season. Obtain a valid research permit from the park (multi-year permits may be available).

Organizing Supplies

Supplies required for this protocol include:

- clipboards
- waterproof pens
- waterproof paper
- field data sheets
- park maps
- long-handled mirror for nest-checking
- first aid kit
- film (if using 35mm)
- calipers
- flagging
- batteries
- (digital) camera

- portable weather station
- GPS units (ideally 3-4)
- Juno handheld devices, fully charged (3)
- binoculars (most volunteers will come with their own, but extras are helpful)

Review available supplies and order any materials needed well in advance of the field season.

Table S2.1. BOHA Waterbird Monitoring, Draft 2008 Field Schedule.

Date	Day	Target Area	Target Species	Islands - Boat Survey Only	Islands - Landing Needed	Notes
12-May	Mon	Outer Islands	DCCO & gulls, COEI, waders, AMOY	Little Brewster, Great Brewster, Little Calf, Green, Shag Rocks	Middle Brewster, Outer Brewster, Calf	Morning High Tide
13-May	Tues	Outer Islands	DCCO & gulls, COEI, waders, AMOY	Little Brewster, Great Brewster, Little Calf, Green, Shag Rocks	Middle Brewster, Outer Brewster, Calf	Morning High Tide
14-May	*Wed*	*Outer Islands*				*Weather Make-up; Extra Field Day*
19-May	Mon	Hingham Harbor	DCCO & gulls, AMOY	Ragged, Langlee, Button, Grape, Slate, Bumpkin	Sarah, Sheep	
23-May	Fri	Hingham Harbor	DCCO & gulls, AMOY	Ragged, Langlee, Button, Grape, Slate, Bumpkin	Sarah, Sheep	
26-May	*Mon*	*Hingham Harbor*				*Weather Make-up; Extra Field Day*
29-May	Thurs	Inner Harbor, Hingham, Dorchester	AMOY, gulls	Hangman, Rainsford, Georges, Gallops, Lovells, Thompson, Spectacle		Early Morning High Tide
30-May	Fri	Outer Harbor, Hingham	as needed to complete DCCO & gulls	Peddocks; Inner Harbor as time permits	Outer Islands as Needed	Morning High Tide
2-Jun	*Mon*	*Inner Harbor, Hingham, Dorchester*				
4-Jun	Wed	Snake, Lovells, Rainsford	terns, AMOY	Inner Harbor as needed	Rainsford, Lovells, Snake	
5-Jun	*Thurs*	*Snake, Lovells, Rainsford*				*Weather Make-up; Extra Field Day*
12-Jun	*Thurs*	*Snake, Lovells, Rainsford*				*Weather Make-up; Extra Field Day*
13-Jun	Fri	Snake, Lovells, Rainsford	terns, AMOY, COEI chicks	Outer Islands, Inner Harbor as needed	Rainsford, Lovells, Snake	Morning High Tide
24-Jun	Tues	Outer Islands; Terns as needed	COEI chicks, terns	Outer Islands	Rainsford, Lovells, Snake	Morning High Tide

Table S2.1 (continued). BOHA Waterbird Monitoring, Draft 2008 Field Schedule.

Date	Day	Target Area	Target Species	Islands - Boat Survey Only	Islands - Landing Needed	Notes
1-Jul	Wed	Outer Islands; Terns as needed	COEI chicks, terns	Outer Islands	Rainsford, Lovells, Snake	
15-Jul	Tues	Outer Islands; Terns as needed	COEI chicks, terns	Outer Islands	Rainsford, Lovells, Snake	Morning High Tide

Volunteer Recruitment, Training Session

Communicate with the BOHA volunteer manager responsible for coordinating and recruiting volunteers. By 31 March, agree to a date and location for an early May volunteer training session. Update volunteer materials accordingly.

Prepare Field Data Sheets and Field Maps

Update field data sheets and field maps as needed. Print in advance. Use waterproof paper to improve ease of use in damp situations.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Update to clarify timing of steps. Provide UMASS website and update of field schedule.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes in response to comments during peer review; see Appendix C.	External review
1.05	4/2011	Carol Lynn Trocki	Add Juno handheld devices to supply list; update landing craft rates.	Operational review
1.06	3/2013	Brian Mitchell	Update landing craft rate.	Operational review

SOP 3 – Volunteer Recruitment & Training

Northeast Temperate Network
Version 1.03

Volunteer Recruitment

A BOHA staff member (currently Volunteer Manager, Mary Raczko) will assume the primary responsibility of volunteer recruitment and management. However, the lead scientist coordinating the project should work closely with the designated BOHA volunteer manager to develop and update volunteer recruitment materials in advance of each field season (by 1 March). See Appendix A for a sample volunteer job description.

Volunteer Training

The lead scientist and the designated BOHA volunteer manager will work together to agree on a draft field schedule (by 15 March) and volunteer training session date and location (by 31 March) each year. Volunteers should have some experience with general bird identification and monitoring techniques, and must be approved by the BOHA volunteer manager and lead scientist to participate. Ideally, a consistent core group of volunteers will return to work on this project each year. See Appendix A for sample volunteer training materials.

Managing Volunteers in the Field

The BOHA volunteer manager will work with the lead scientist to assign volunteers and park staff for field work according to the draft field schedule and with input from the lead scientist. The BOHA volunteer manager will be the primary point of contact for volunteers during the field season and will assist in informing participants of changes in the field schedule due to weather, etc.

The lead scientist will bear the primary responsibility for volunteer management while in the field. A BOHA staff person will participate in field work daily and will be available to assist and represent the park in an emergency situation.

Tasks will be assigned in the field based on individual volunteers' comfort level and skills. Clear and precise communication with volunteers and the BOHA volunteer manager will be necessary at all times to ensure a positive experience and quality data.

Volunteer Appreciation

Volunteers should receive a copy of the annual summary report each year. Distribution of this report and appropriate volunteer appreciation material (thank you cards, small gifts, etc.) should be coordinated with the BOHA volunteer manager.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.02	1/2009	Carol Lynn Trocki	Minor editorial changes and change to reflect Appendix A including all training materials.	Internal review
1.03	4/2009	Carol Lynn Trocki	Minor editorial changes based on input received during peer review process; see Appendix C.	External review

SOP 4 – Data Collection

Northeast Temperate Network
Version 1.03

Overview

The Northeast Temperate Network (NETN) Coastal Bird Monitoring Protocol uses Trimble Juno handheld computers to collect both spatial and tabular data in the field. Specifically, CyberTracker mobile database software (http://cybertracker.org/) is used to provide a custom front-end interface to facilitate data entry by field staff. In addition to regulating user input of tabular data, CyberTracker allows users to engage/disengage the field computer's GPS capacity to store locations on demand (points). Upon returning from the field and synching with a desktop computer, both tabular and spatial data can be reviewed and finalized. Since the strengths of CyberTracker lie in the deployment and reintegration of mobile databases and not long-term storage or data manipulation, NETN uses a Microsoft Access database front and backend to facilitate data processing, querying, and report writing. Spatial data exported from CyberTracker are converted into ArcGIS shapefiles for manipulation and storage (Figure S4.1). While CyberTracker is the best choice for collecting spatial data on demand, beginning in 2015, track data will be collected with a handheld GPS unit. Upon returning from the field, track data will be downloaded and converted into ArcGIS shapefiles for manipulation and storage.

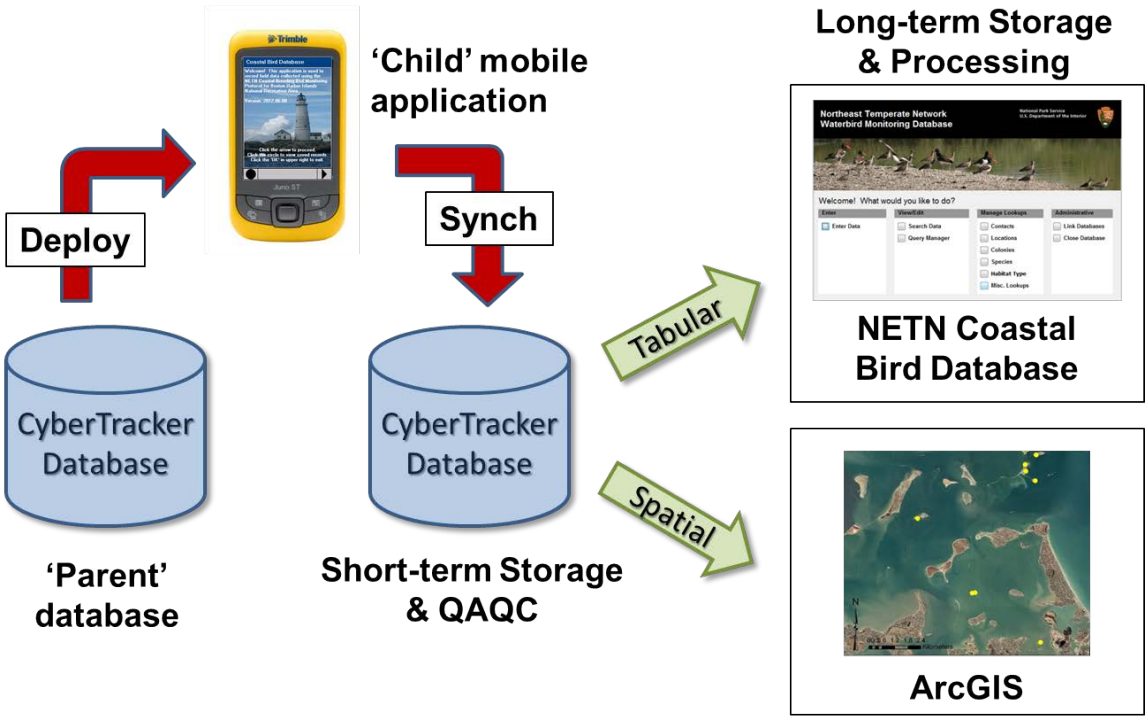


Figure S4.1. Overview of software and hardware components involved in collecting, managing, and storing data collected during implementation of NETN's Coastal Bird Monitoring Protocol.

Although data are collected in the field, most of the preparatory and data management steps are handled in the office on an office computer. Procedures in this document are presented in the order in which they would most naturally occur (Figure S4.2).

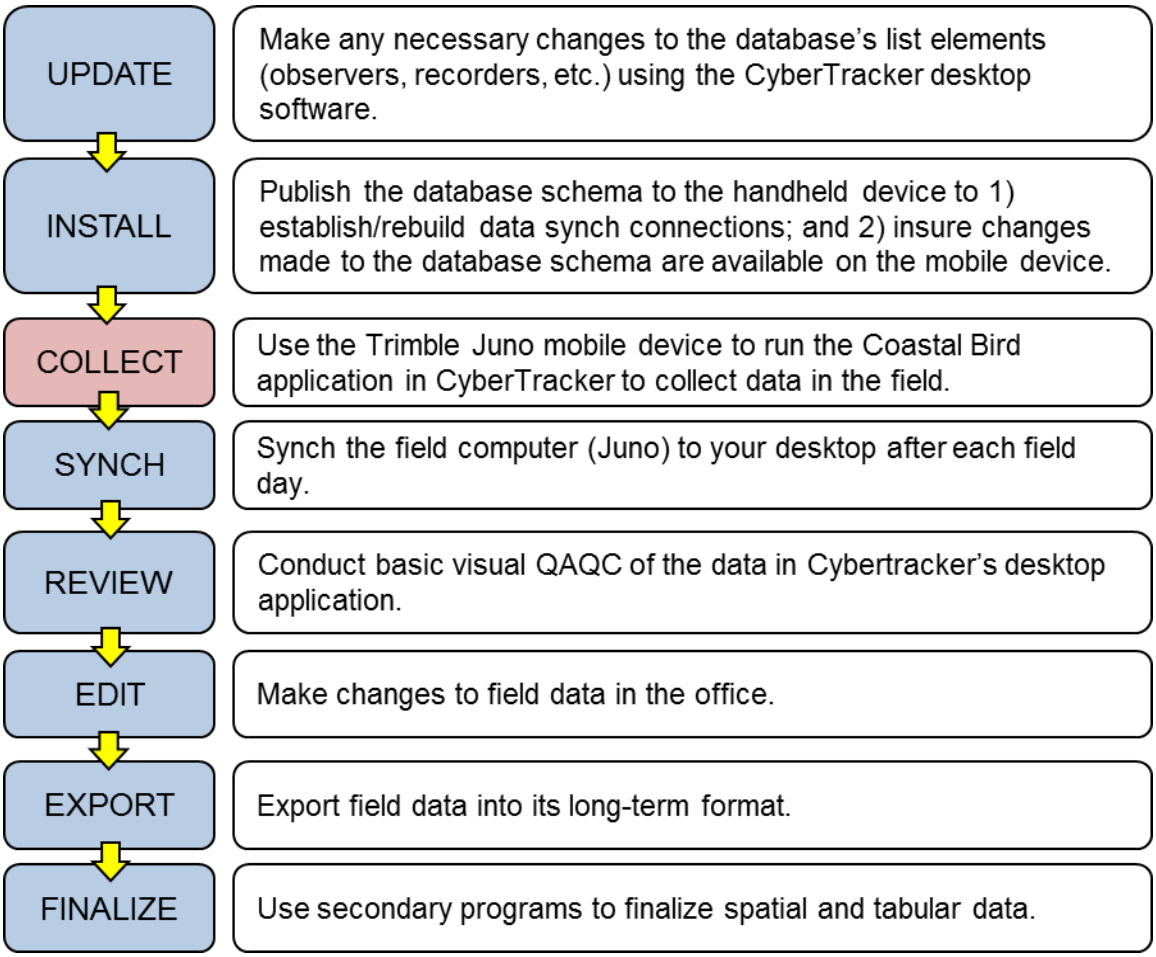


Figure S4.2. Basic workflow for managing the coastal bird Cybertracker database. Steps in 'blue' are accomplished in the office. Steps in 'red' are accomplished in the field.

Updating CyberTracker

How to change the observer / recorder radio list

The BOHA Coastal Bird CyberTracker database uses pick-lists (radio-lists) to record the initials of survey observers and recorders. Even though the observers and recorder lists contain the same initials, Cyber Tracker requires that the Elements that store the data in the backend be different. Therefore in addition to having a separate data field (a.k.a Element) for each volunteer, the database also requires that two Elements must exist for each volunteer – one to store data collected using the observer radio list and one to store data collected using the recorder radio list (e.g. CLT_obs and a CLT_rec). The use of aliases prevents the user from having to see the _obs or _rec suffixes in the actual pick-lists. Although the example given here is for observer and recorder lists, these steps may be used to replace/update any Element list in Cyber Tracker.

Changing the values in the radio lists requires that you remove any pre-existing Elements associated with the list and then add in the new list of elements being used to create the list. So let's get started…

Removing outdated data elements ***(Figure S4.3):***

1) Open the CyberTracker database you are interested in making changes to (e.g. BOHA_Coastal_Bird_20110512).
    a. Open the Cyber Tracker program
    b. File → Open database
2) Select 'Elements' from the drop-down list in the upper-left corner of the Cyber Tracker screen.
3) Select the application screen name from the directory that contains the elements you would like to modify.
4) Select the Elements you would like to remove (click on the grey box to the left of the row to select that row. Hold the Shift Key to select consecutive rows, hold the Control key to select multiple rows that are not necessarily consecutive).
5) Right click or use the button in the menu to 'Delete Element'.

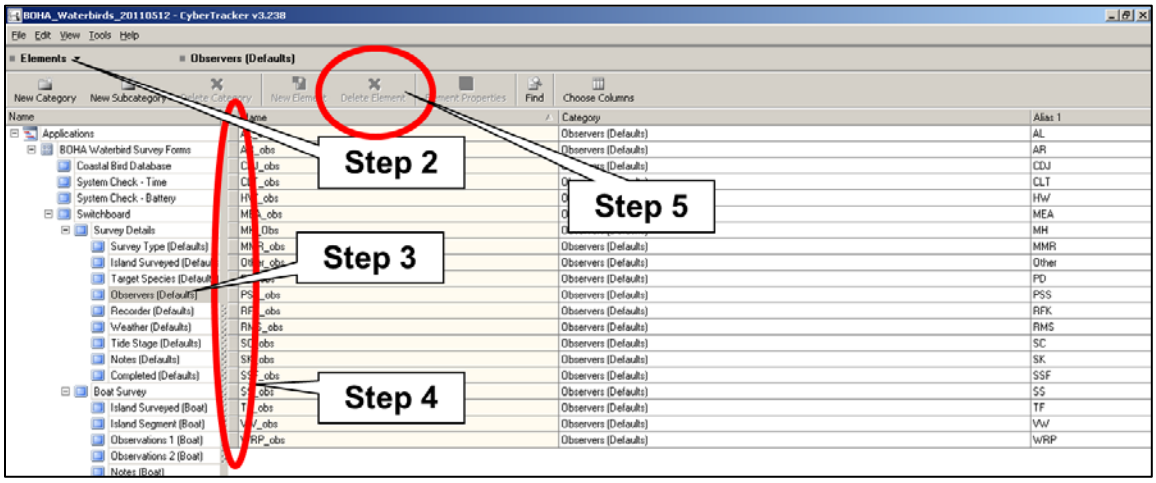


Figure S4.3. CyberTracker screenshot showing steps 2 through 5.

Adding new data elements ***(Figure S4.4)***

6) Select 'Applications' from the drop-down list in the upper-left corner of the Cyber Tracker screen.
7) Navigate to the screen you would like to make changes to (e.g. Observers).
8) Select 'Layout' from the tool bar.
9) Click on radio list on the screen image to bring up properties for that checklist.
10) In the Properties section select the 'Elements' row and then click the "..." button to open the Element List editor.

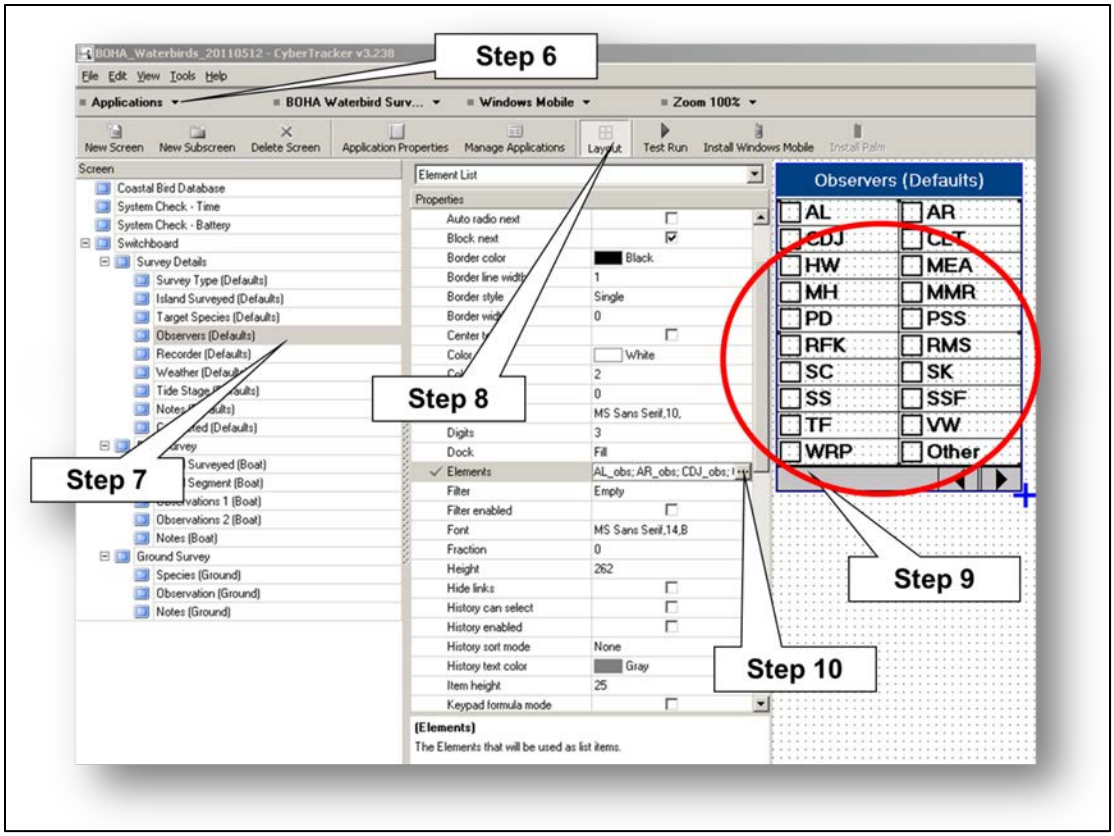


Figure S4.4. CyberTracker screenshot showing steps 5 through 8.

Although new values are often easier to edit one-by-one, for longer lists or lists that change annually (like the Observers and Recorder lists) it is easier to cut and paste the Elements as a group from Excel. NETN manages an Excel file for this purpose. CyberTracker_ElementsLists_[DATE].xlsx is used to store recurring pick-list Names (Column 1) and their Aliases (Column 2). Steps 11 – 15 provide instruction on how MS Excel lists can be used to quickly update CyberTracker Element lists.

11) Open the Microsoft Excel spreadsheet that contains the list of elements you would like to update.
12) Select and then copy this list (Ctrl+C).
13) Back in CyberTracker, click the 'Paste from Excel' button on the bottom of the 'Edit Element List' window.
14) Follow the prompts and verify that the Elements you wanted were added properly.
15) Exit the Element List editor by clicking OK and save the database.

Installing CyberTracker

Deploying the database as a mobile device application

When properly deployed, CyberTracker establishes a parent-child relationship between the 'parent' database stored on your office computer and the 'child' version of the database loaded to the mobile device. In essence, the role of the parent database is to share its schema or data structure with the child. The role of the child is to share data it has collected back to the parent for permanent storage. Before every deployment, this connection should be refreshed by reinstalling the application to the mobile

device to insure that both 1) changes to the parent schema are made available to the mobile device and, 2) data collected by the mobile device will be synched with the proper parent database.

1) Attach your mobile device to your computer using the USB cables provided.
2) Turn on your mobile device. Although they don't directly affect installation of a CyberTracker application, it is a good idea to proceed with any prompts to synch your Windows Mobile device (e.g. updates clock, etc.). Although it will vary from computer to computer, some type of notification will be provided when you are successfully connected.
3) Open the CyberTracker desktop application and then the database file you wish to act as the 'parent' file (i.e. provide the architecture for what a user of the mobile device will see – and – receive the data collected by the mobile device whenever it is docked/connected).
4) To install the CyberTracker application currently open, select 'Applications' from the drop-down list in the upper-left corner of the CyberTracker screen.
5) Click the 'Test Run' button to open the 'Test Run and Install' window.
6) Click the 'Install to Windows Mobile'
7) A registration password may be required. Please use "ct3rhino".
8) Follow the prompts on both the CyberTracker application and on your windows mobile device screen.
9) A successful install will result in the 'BOHA Coastal Bird Survey App' application being loaded to your mobile device. To open/view click on your mobile device:
    a. Click on the Microsoft 'flag' icon in the upper left corner of screen
    b. Select CyberTracker from the dropdown menu
    c. The application will open directly if it is the only one loaded on your mobile device. If there is more than one, you will need to select the one you wish to use from the list.

Collecting data using CyberTracker

Page overview

The Coastal Bird Database application is constructed from a sequence of data pages. Each page plays a role in either directing the flow of data or controlling the order or format in which information is collected. The pages can be roughly categorized into three types – informational, action required, and data entry. An overview of all the pages in the application is provided in Figure 5. Detailed explanations of each individual page can be found at the end of this section.

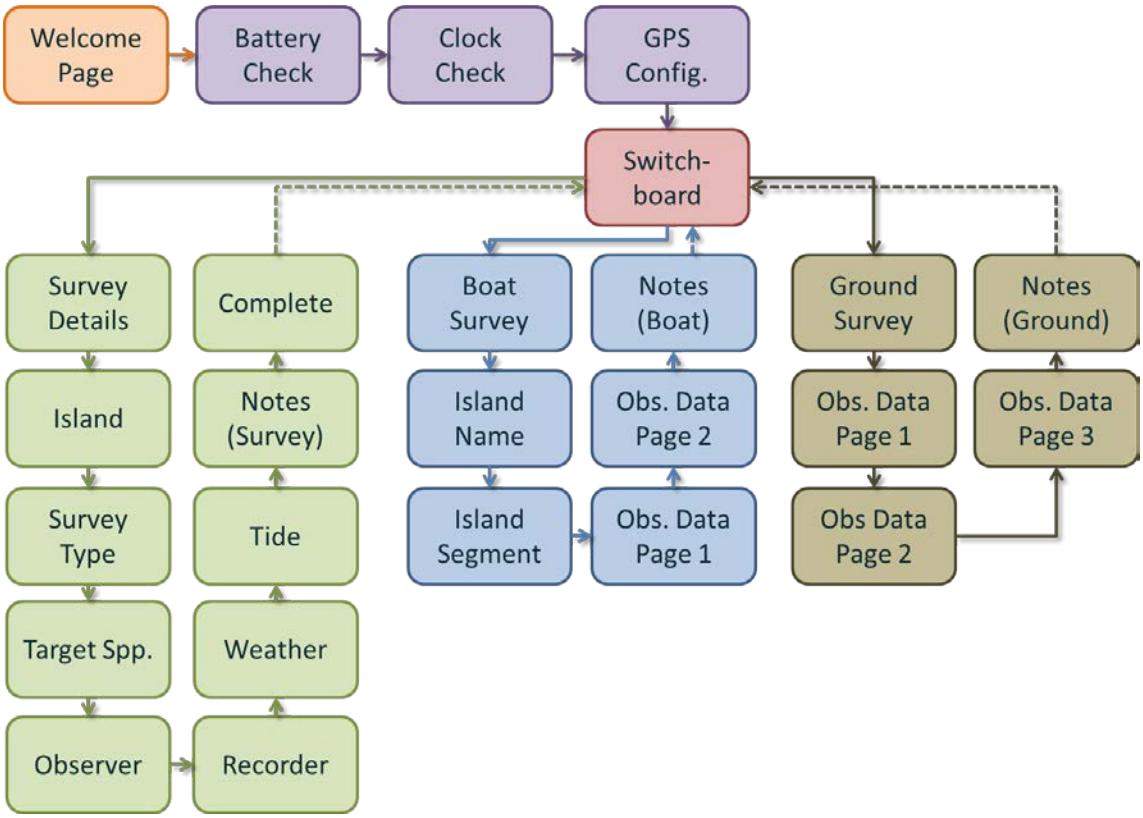
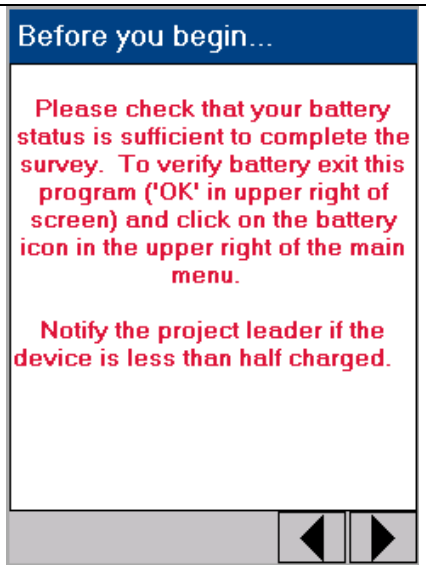
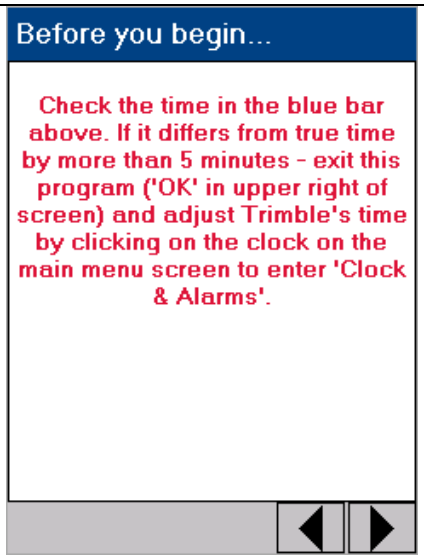
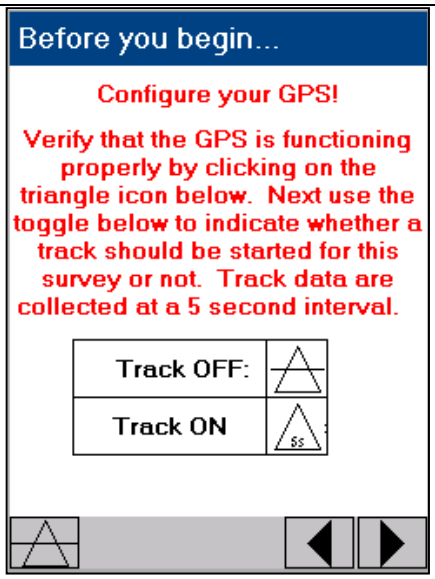


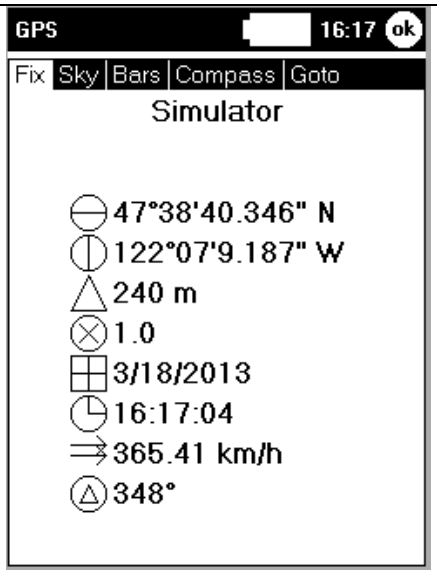
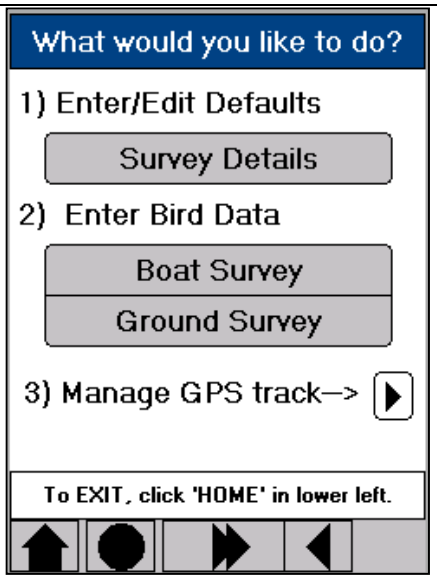
Figure S4.5: Overview of Coastal Bird database application pages and the relationships between them. Arrows indicate order pages can be accessed during typical use. Color scheme highlight page groups. Orange = splash page; Purple = action required; Red = switchboard page; Green = default data entry; Blue = boat survey data entry; Brown = ground survey data entry.

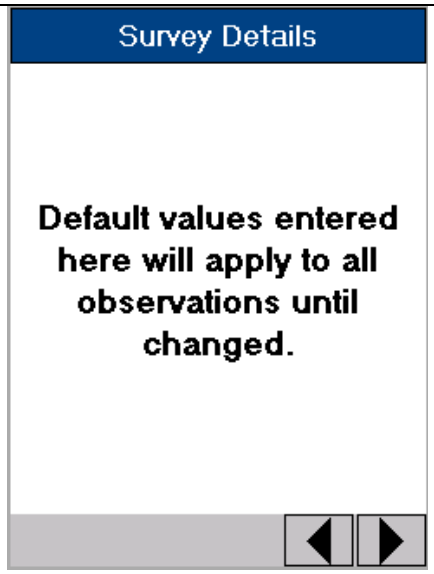
IMPORTANT: CyberTracker collects and stores data as a flat file, making it more similar in character to a spreadsheet than a relational database (see this video on understanding flat vs. relational databases: http://www.youtube.com/watch?v=qt1hN0Eiut4). Although storing data in a flat file makes the information very straightforward to interpret, it requires repeated entry of a large amount of information (for example weather, site name, and observer are required for each bird observed during a survey!). In addition to being tedious, repeated entry of redundant information can greatly increases the chance of data entry error. As a work around, the Coastal Bird database application requires users to enter default survey information prior to entering observation data. CyberTracker then appends anything recorded in the default fields to each observation. In this way, observers only need to enter the default information once and the information will be added to all applicable observations made under those default conditions. When default conditions change (e.g. weather changes or observers switch) the defaults should be edited accordingly, so as to update the data appended to any further observations made during new default conditions. See Figure S4.5 for an overview of the types of data considered to be default.

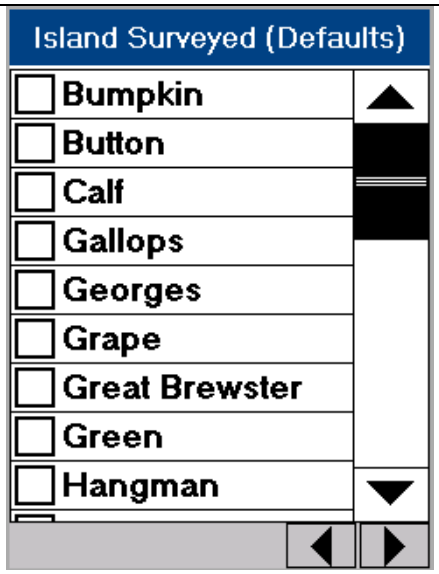
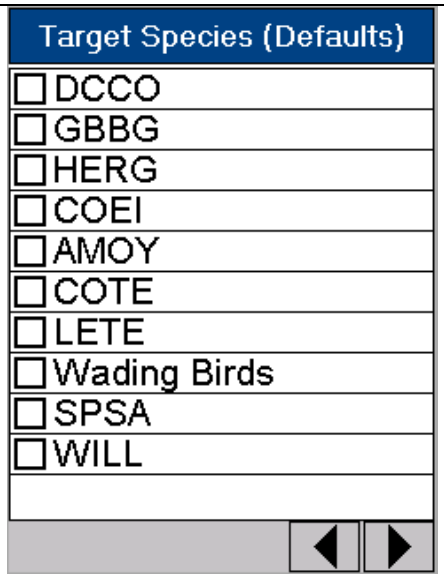
Page details

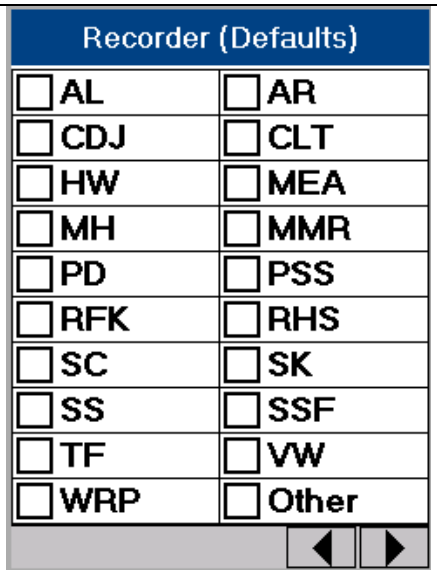
Welcome/Splash Page Designed to be the first page users of the mobile application see. Has a short purpose statement, version stamp, and basic navigation instructions. <u>Bottom menu</u>: Circle: Shows data records currently stored in application. Forward arrow: Moves to next Page.	
Battery Check Page First of three 'Before you begin…' pages. Provides instructions on how to check for battery status of Trimble Juno. <u>Bottom menu</u>: Forward arrow: Moves to next page. Back arrow: Go to previous page.	

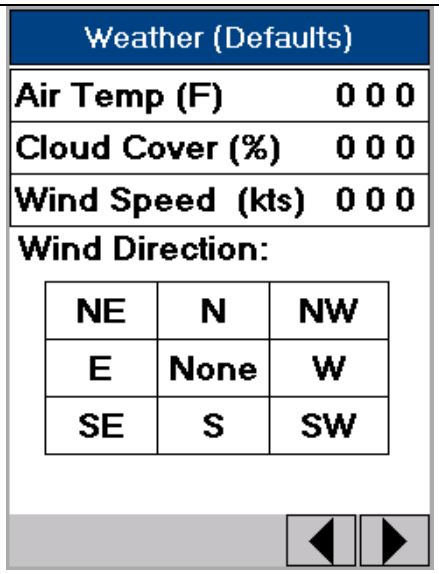
Clock Check Page 2nd of three 'Before you begin…' pages. Provides instructions on how to check and correct the Trimble Juno clock. <u>Bottom menu</u>: Forward arrow: Moves to next page. Back arrow: Go to previous page.	
Configure the GPS 3rd of three 'Before you begin…' pages. Page with prompts to check GPS configuration and choice to turn tracking feature on and off. Use the desktop application to change (shorten, lengthen) the interval at which track data are collected. <u>Bottom menu</u>: Transparent triangle: Opens GPS page to check status of onboard GPS. Forward arrow: Moves to next page. Back arrow: Go to previous page.	

GPS Status Page Graphical interface through which a user can check on the status of the built-in GPS receiver communicating with the mobile device. This screen page is also shown when waypoint data are collected (when a record is saved). Clicking the 'OK' button in the upper right returns you to the main application pages.	
Switchboard Gateway to 1) default (survey level), 2) survey (boat vs. ground) data entry forms, and 3) Configure GPS track page. <u>Bottom menu</u>: House: Return to Welcome page Circle: Shows data records currently stored in application. Double-forward arrow: Skip – in this case helps clear the switchboard of previous selections. Back arrow: Go to previous page.	

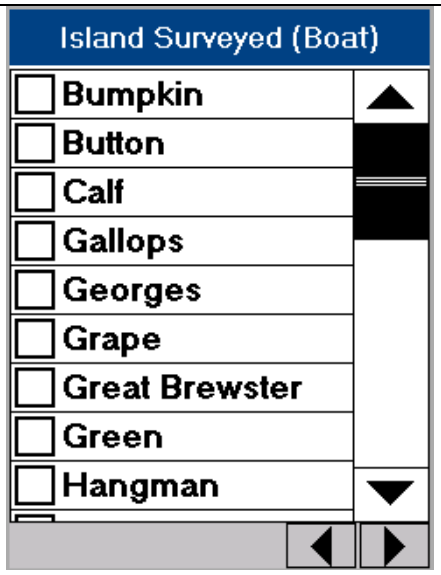
Survey Details (Defaults) Disclaimer that survey defaults values entered will apply to all observations until changed. REMEMBER: Survey defaults should be changed any time any of the conditions defined as a default changes (e.g. observer, weather, tide, etc.)	
Survey Type (Defaults) <u>Where?</u> Check to indicate location data will be entered. Use 'Field' for data collected out in the field. Use 'Office' for data that may have been entered into a notebook and entered after returning from the field. Use 'Test/Practice' when making a dummy record so that it is easy to find and delete if accidentally synched with the parent database. <u>How?</u> Check type of survey defaults apply to – Boat or Ground survey.	

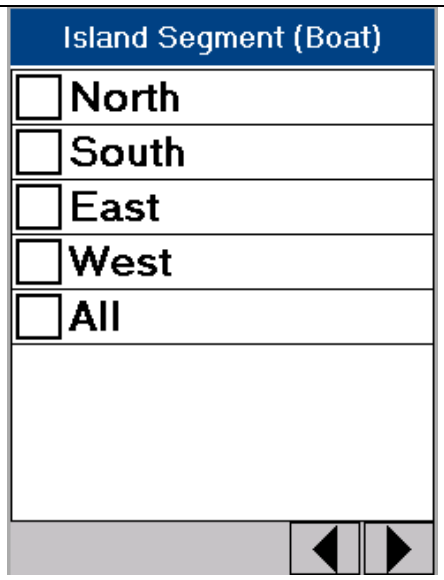
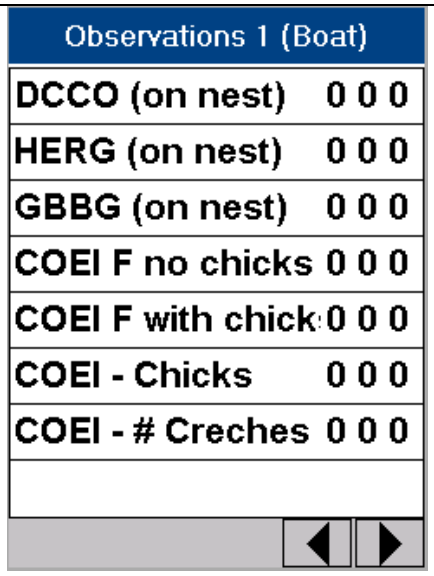
Island Surveyed (Defaults) Only appears when 'Ground Survey' is checked on previous page. Choose a single island from the list.	
Target Species (Defaults) Check all focal species that apply for this survey.	

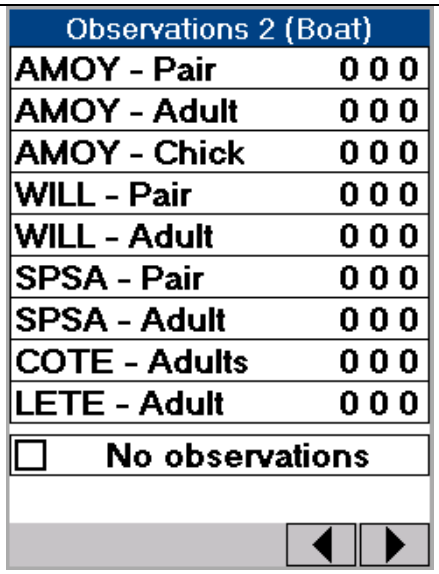
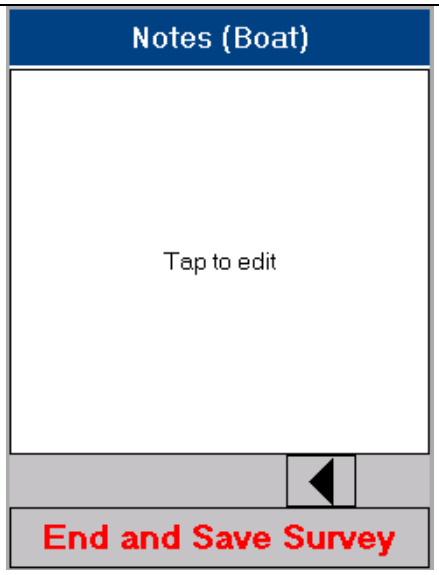
Observers (Defaults) Choose the initials of any/all person/s filling the role of observer during this survey.	
Recorder (Defaults) Choose the initials of the person acting as recorder during this survey.	

Weather (Defaults) Record air temperature, cloud cover, wind speed and wind direction at time data was being collected. For numeric values tapping in the upper half of the number adds 1, tapping in the lower half of the number subtract 1.	
Tide Stage (Defaults) Check the box that most closely corresponds with the tide stage present when collecting survey data.	

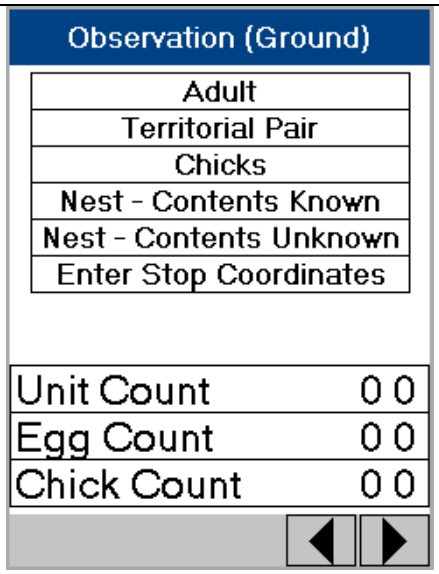
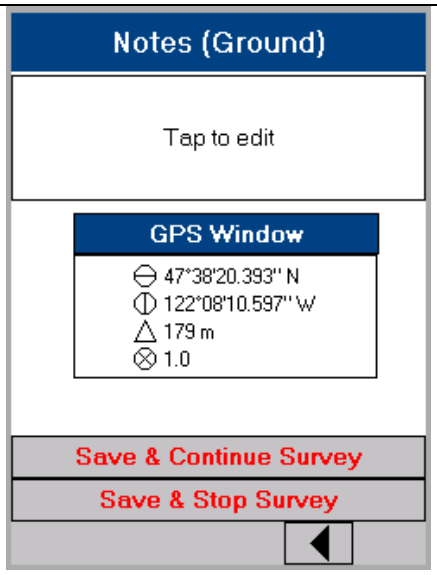
Survey Notes (Defaults) Place to add general notes relevant to all observations associated with these defaults.	
Completed (Defaults) Verification that all default fields have been completed. Clicking 'Enter Survey Data' takes you back to the Switchboard.	

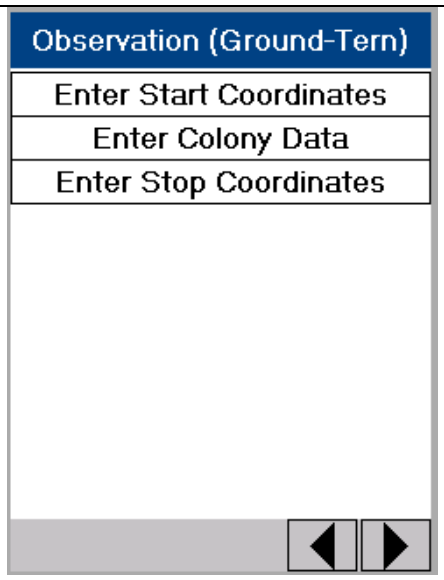
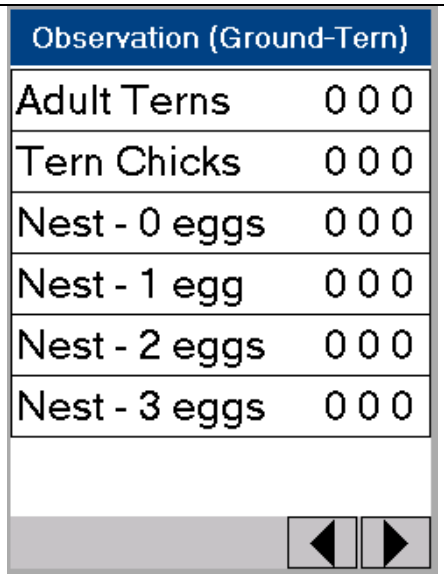
Boat Survey - Start (Boat) Notification that you are about to start entering data associated with a boat survey. <u>Bottom menu</u>: Double-forward arrow: Skips back to the Switchboard if user mistakenly got to this page.	
Island Surveyed (Boat) Check the name of the island that will be covered during this boat survey and too which the bird counts will apply.	

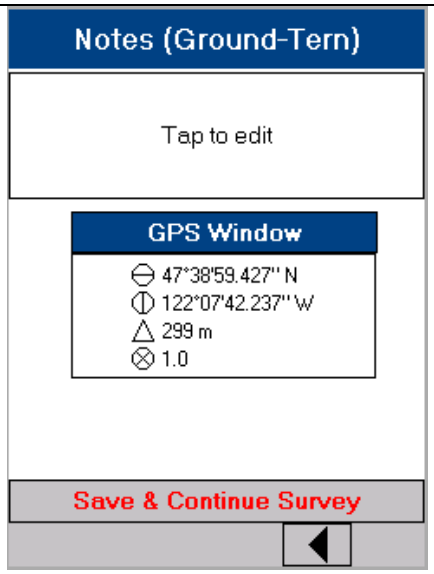
Island Segment (Boat) Check the island segment covered during this boat survey and to which the bird counts will apply. Note: Segment is required b/c the most efficient path for the boat is often not to circumnavigate each island in its entirety but to rather pass down the same side of numerous islands and get the far side of each on the return trip.	
Observations Page 1 (Boat) First half of species checklist to which survey counts can be tallied.	

Observations Page 2 (Boat) Second half of species checklist to which survey counts can be tallied. Note: If no birds are observed, recorder should check the 'No observations' box.	
Notes (Boat) Place to add notes specific to this boat survey. Clicking 'End and Save survey' button saves the current record, records a waypoint, and then returns the user to the Switch board page. Before starting another survey, the recorder should assess whether or not default conditions need to be updated.	

Ground Survey - Start (Ground) Notification that you are about to start entering data associated with a ground survey. <u>Bottom menu</u>: Double-forward arrow: skips back to the Switchboard if user mistakenly got to this page.	
Species (Ground) Select the species you would like to record an observation for. If COTE or LETE (Common or Least Tern) is selected you are taken to the colony survey pages. All other species selections will take you to the general ground observations page…	

Observation (Ground) While survey is being conducted select a single observation type from the top pick list. Use the 'Enter Stop Coordniates' for your last entry when you have decided to end the survey. Add the necessary count for the unit selected in the top of the form by toggling the numbers on the lower half of the form. Not all counts will be used (e.g. if you observe an adult with chick away from a nest, you would record a 'Unit Count' of '1' and a 'Chick Count' of '1' – but no value for 'Egg Count'.	
Notes (Ground) Place to add notes specific to this ground survey observation. <u>Save & Continue</u> – saves current record, records a GPS coordinate, and takes recorder back to Species (Ground) page. <u>Save & Stop</u> – saves current record, records a GPS coordinate, and takes recorder back to Switchboard to start a different survey.	

Colony Observation (Ground-tern) Enter Start Coords – Jumps user to Notes page. Record any start notes then click 'Save & Continue' to record start coordinates for this survey. When returned to the species page enter your species again to return to this page. Enter Colony Data – see next page detail. Enter Stop Coords – Jumps user to Notes page. Record any end notes then click 'Save & Stop' to record stop coordinates for this survey.	
Enter Colony Data (Ground-tern) Use number toggles to record each individual encounter with terns (eggs, adults, nests) over the course of the survey.	

Notes (Ground-tern) This page allows you to add notes specific to each tern observation. Clicking the 'Save & Continue' button records a coordinate for your observation and returns you to the Ground-Species page to continue your survey (loop through the ground/ground-tern pages until survey is complete). To end your survey, from the Observation page select 'Enter Stop Coordinates', enter any notes about the colony and then choose 'Save & Stop Survey' to collect a coordinate for where the survey was stopped.	

Synching field data in the office

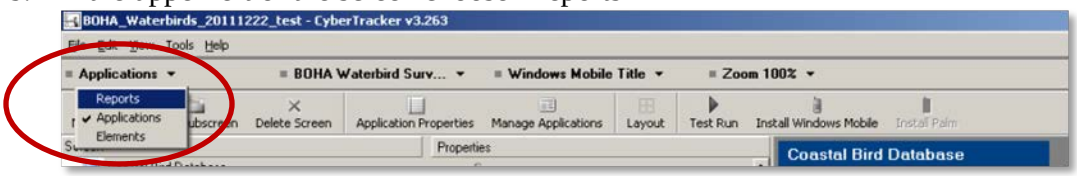
Data collected on the mobile database application should be synched with the parent database immediately after returning from the field. When set-up properly, the synch process is as easy as connecting your mobile device to the computer on which the parent database resides. Windows mobile software will make the connection and all the data will be moved from the mobile device to the parent database. See specific steps below.

Synching Steps

IMPORTANT: CyberTracker does not provide any prompts or ask the user's permission to synch data from the mobile device to the parent database. During the synch process all data are removed from the mobile device. For these reasons, it is imperative that a proper connection between the application and parent database is maintained so that the data are 'piped' to the right place. This 'synch' connection is established each time the database is installed to the mobile device (see "Installing CyberTracker," above). Once the application has been installed the parent (DB) and child (mobile application) connection has been made. This connection is built from a combination of external characteristics of the file (e.g. location, name) and internal characteristics of the database (e.g. fields/elements). Be aware that any changes made to the parent file (either external or internal) while the child application is deployed may affect your ability to synch the data.

1. Connect the mobile device (powered up) to the computer (powered up) that was used to deploy the database and upon which the parent database resides.
2. Data will be moved from the mobile device to the parent database when the connection between the two devices is established. This is usually an automatic process with only subtle indications that it is happening.
3. To check that the data was successfully synched:

a. On your office computer, open CyberTracker and the parent database.
b. In the upper left of the screen choose 'Reports'



c. Use either established queries or create a new one to view your records and verify that the range of dates includes the full extent of the data that you expected to be downloaded.
d. Also, a successful synch will remove all data from your mobile application. To verify this, open the mobile CyberTracker application and from the 'Welcome' page click the solid black circle in the lower left of the screen to view any data records currently stored in the application. There should be no current records.

Troubleshooting

Even with the best intentions, sometimes changes will occur to your parent database (e.g. moved or renamed the file) while the child application is deployed and collecting data. So what happens to synched data when the relationship between the parent database and child application is broken? CyberTacker will still attempt to synch the data and in doing so will remove it from your mobile device - but don't panic! Under circumstances where there is not an obvious parent database to append the data to, CyberTracker resorts to storing it a new/temporary database. One of the easiest ways to discover and manage where your data has gone is to use CyberTracker's Data Recovery Console.

1. In any CyberTracker view (Application, Report, etc.) choose 'Tools' from the Menu.
2. Click 'Data Recovery Console'
3. Colored indicators (red vs. green) alert you to possible issues with orphaned data, staging data, or outgoing data. The recovery console also offers a tool for recovering data from your mobile device's SD card.

Reviewing data in CyberTracker

At its simplest, CyberTracker data comes in two types: Points and Tracks. Both of these data types are stored in the .mdb (Microsoft Database) file that CyberTracker uses to store its data. Both types of data can be viewed in CyberTracker, but only point data can be edited or exported. Track or route data cannot be exported from CyberTracker but rather must be manipulated directly in the database (.mdb) file using other software (e.g. MS Access or ArcGIS). See the "Export" section of this SOP (below) for more information.

Tabular Data

Review of tabular data in CyberTracker is most easily accomplished using queries. Although they take a little trial and error to create, once setup and saved they are easy to maintain with just a little tweaking when changes are required.

Simple steps to review tabular data in CyberTracker (Figure S4.6):

1) Open CyberTracker
2) Navigate to the database you are interested in (File → Open Database)

3) Switch CyberTracker to 'Reports' view.
4) Any saved queries will be shown as tabs in the main body of the screen.
5) To create a new Query, click the 'New Query' button.
6) For both new and saved queries use 'View Properties' to add/modify which fields are included in the query.
7) Use the 'Advanced' button to apply filters to the results returned by your query.
8) Query results can be exported to Excel using the 'Export View' button.

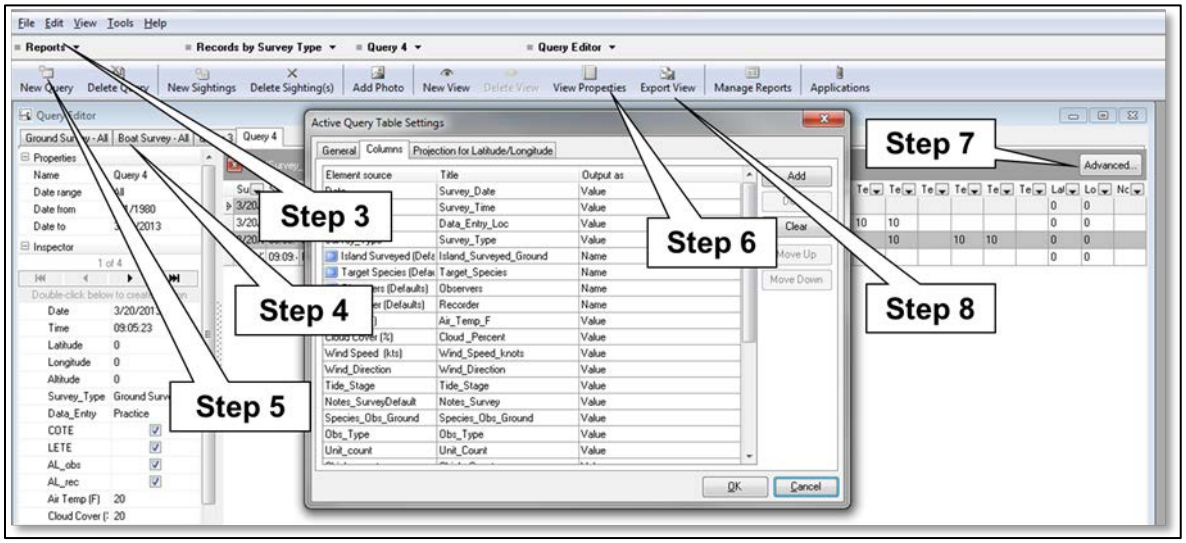


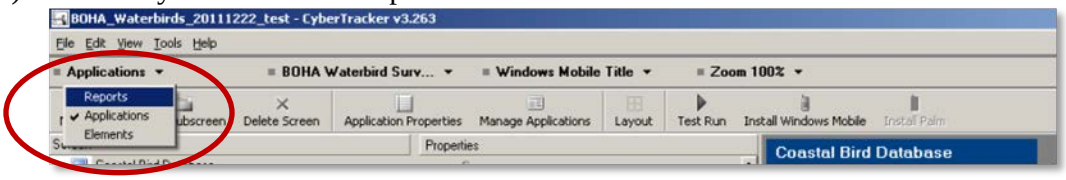
Figure S4.6. CyberTracker screenshot showing steps 3-8 for reviewing tabular data.

Spatial Data

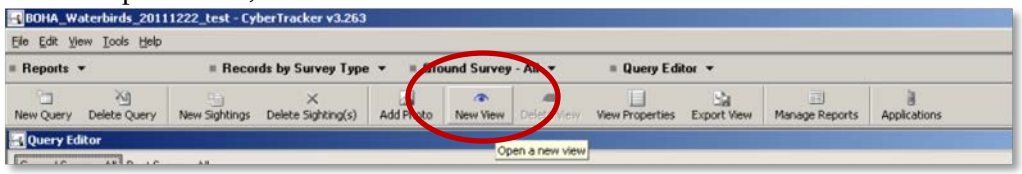
CyberTracker offers a basic mapping interface which allows for viewing spatial data in the program and displaying data over imagery base layers. Practical use is limited to quick accuracy assessments and limited error correction. In-depth spatial data manipulation mainly occurs after data has been exported from CyberTracker.

Simple steps to review your spatial data in CyberTracker:

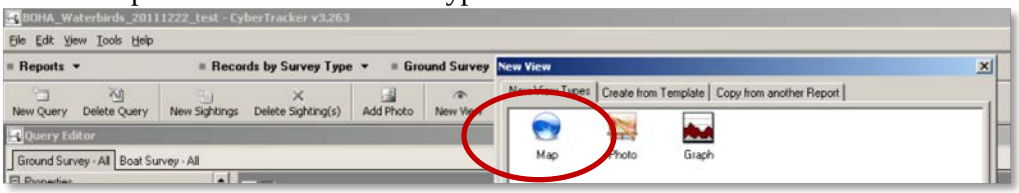
1) Open CyberTracker
2) Navigate to the database you are interested in (File → Open Database)
3) Switch CyberTracker to 'Reports' view.



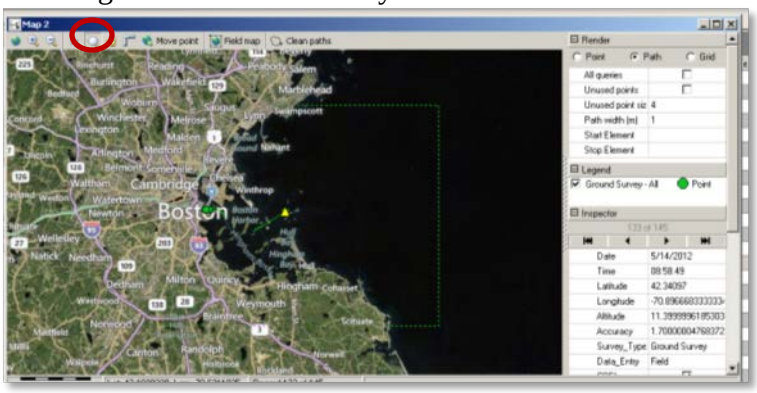
4) In the 'Report' view, add a 'New View'



5) Select ‘Map’ from the ‘New View Types’ tab of the ‘New View’ menu.



6) Once the map opens, select and use the magnify glass tool to draw increasingly detailed bounding boxes to zoom in on your data/area of interest.



Helpful browsing tips:

- To better distinguish between routes and points, select the ‘Path’ radio button in the map menu on the upper right.
- Use the ‘Arrow’ tool from the map menu to select any point and view the data in the ‘Inspector’ section of the map menu.

Edit

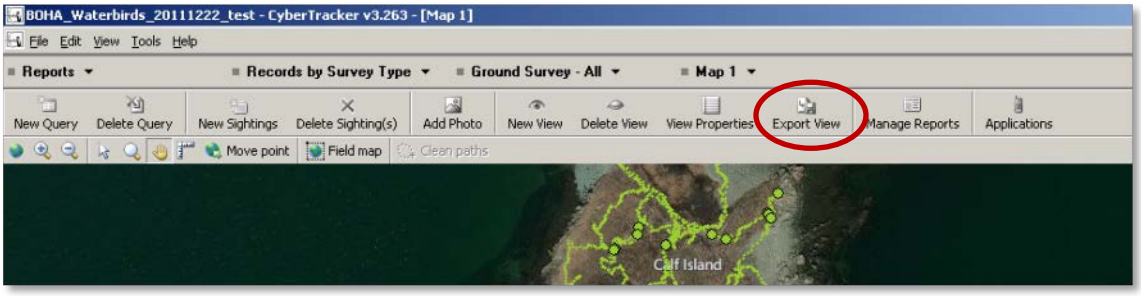
Editing tabular and spatial (point) data in CyberTracker is possible, but tedious and not recommended. Since the CyberTracker database is an intermediary step to the MS Access database, it is recommended that data editing occur either during the exported Excel spreadsheet phase or in Access after it has been imported.

There is no support in the CyberTracker user interface for exporting or editing routes/tracks. However, since the CyberTracker database is a Microsoft Access MDB file, you can open it and modify the "Waypoint2" table directly. See the “Export” section (below) for more details.

Export

Quick map image

CyberTracker allows for the export of a quick map image using the ‘Export View’ button in the ‘Report view’. Saving the map as a bitmap, JPEG, or Windows metadata file are the best options for insuring its compatibility in most software programs.



Tabular or point data

Export of tabular data is a simple process once a query has been generated to summarize your data (see the section "Reviewing data in CyberTracker – Tabular Data" [above] for guidance on building queries). Once you have a query working the way you want it to work, results can be exported to Excel using the 'Export View' button (Figure 6; Step 8).

Exporting data for import into the NETN Coastal Bird Database (Access) is handled using the two core queries saved in CyberTracker:

a) Ground Survey –All
b) Boat Survey – All

These queries should not be modified without making corresponding changes to the VBA import code in NETN's Coastal Bird Database (Figure S4.1).

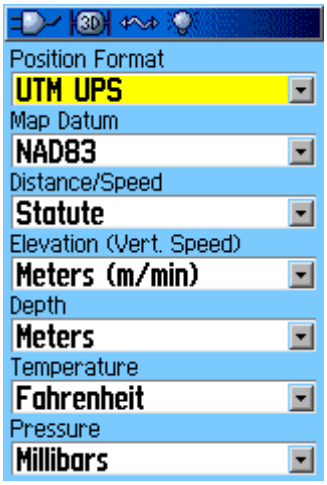
Collecting Track Data

Individual handheld Garmin GPS units are used to track survey effort during both boat-based and ground-based surveys. While conducting a boat-based survey, the lead scientist will use a handheld GPS to record a track of the boat's path during the survey. During ground-based surveys, each team of volunteers will use a handheld GPS to track their path as they search for nests, colonies, etc. These tracks are later downloaded to a computer using DNR Garmin, converted into ArcGIS shapefiles, and named with a standard convention linking each to corresponding survey data. In this way, these tracks provide a spatial representation of survey effort that can be used to assess coverage for a given date and location. Detailed steps for setting up and using the GPS unit are presented below.

Setting up the GPS Unit

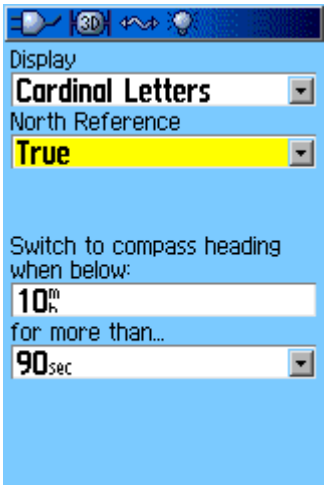
The instructions and illustrations below are specific to the Garmin 76CSX unit, though a variety of similar Garmin GPS units may actually be used. Menu options are accessed similarly on many Garmin handheld units, but the applicable owner's manual should be consulted.

1. Make sure the GPS is set to map datum UTM NAD83.
    a. Go to the Main Menu by pressing 'Menu' twice.
    b. Toggle to 'Setup' and press 'ENTR'.
    c. Toggle to 'Units' and press 'ENTR'.
    d. Set the 'Position Format' to '**UTM UPS'** and the 'Map Datum' to '**NAD83'**. To change these, highlight the field press 'ENTR'. Then toggle to the appropriate setting and press 'ENTR' again.
    e. To get back to the Setup menu press 'QUIT'.



2. Make sure the GPS is set to True North.
    a. Toggle to 'Heading' on the Setup menu and press 'ENTR'.
    b. Set the 'North Reference' to '**True'**.

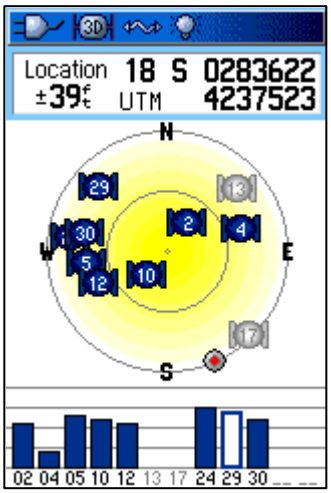
Note: These settings will be saved on the GPS and should not have to be re-entered each time the unit is turned on.



3. **<u>Be sure to carry at least one full replacement of batteries</u>** for the GPS receiver.

4. As soon as you turn the unit on, it starts to look for satellites. You can track the status of the satellites by pressing 'Page' until you reach the Satellite screen. The GPS is most accurate when it has at least four satellites and a 3D position. The location of satellites in the sky changes from day to day and thus sometimes satellite reception is more difficult to achieve.

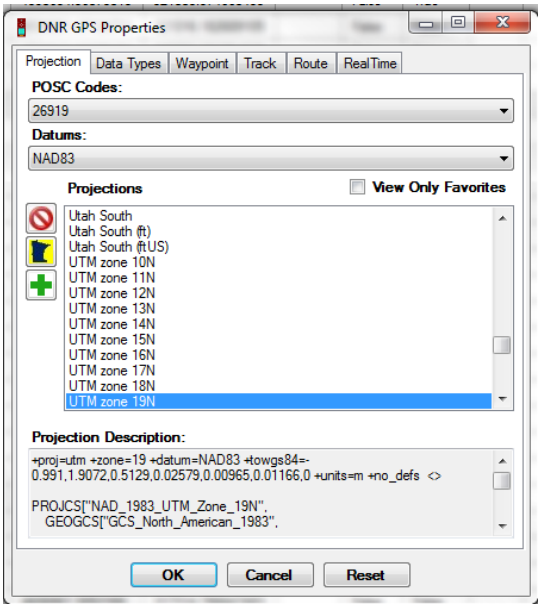
5. The current estimated accuracy of the receiver is also displayed on this page. The accuracy fluctuates as satellite signals are gained and lost. An accuracy of +/– 10 m (30 ft) or better is desirable to precisely document location.



While the GPS is running and has a satellite connection, it will be collecting a track record. A tracking GPS unit should accompany each survey team during boat-based and ground-based surveys.

Connecting the Garmin Handheld GPS Unit to a Computer

The instructions and figures below are specific to the Windows operating system and the DNR GPS software (version 6.1.0.6 or higher). DNR GPS freeware must be loaded onto your machine before you begin these steps. The latest version of DNR GPS can be obtained here: http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html



1. Connect the Garmin handheld GPS unit to a computer using a USB cable.
2. Turn the GPS unit on.
3. Open DNR GPS.
4. Confirm that DNR Garmin recognizes the unit.
5. Set the Projection in DNR GPS: select File > Set Projection.

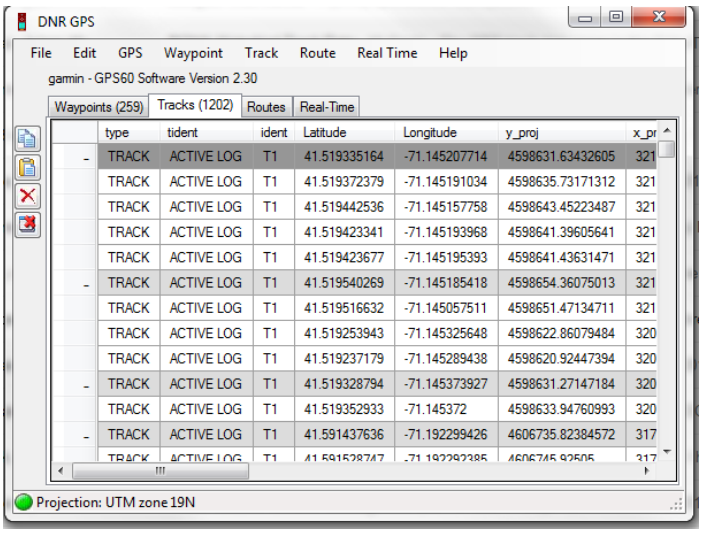
    a. On the Projection tab, under 'Datum', select 'NAD_1983'.
    b. Select 'UTM_Zone_19N' from the Projections drop-down menu.
    c. Select 'OK'.

The Projection will now appear at the bottom center of the main MN DNR—Garmin/ArcMap screen.

Downloading Waypoints and Tracks

Survey tracks should be downloaded onto a computer upon return to the office from the field.

1. Open the ArcGIS map document with the relevant files.
2. Connect the GPS unit to the computer with a USB cable and turn it on.
3. Open DNR GPS and verify that the GPS is acknowledged and that the projection is set to NAD 83, UTM Zone 19N. If you need help, see the section above on setting up DNR GPS.
4. To download tracks, select Track > Download. The saved track from the GPS will now appear in the table.



type	tident	ident	Latitude	Longitude	y_proj	x_pr
TRACK	ACTIVE LOG	T1	41.519335164	-71.145207714	4598631.63432605	321
TRACK	ACTIVE LOG	T1	41.519372379	-71.145191034	4598635.73171312	321
TRACK	ACTIVE LOG	T1	41.519442536	-71.145157758	4598643.45223487	321
TRACK	ACTIVE LOG	T1	41.519423341	-71.145193968	4598641.39605641	321
TRACK	ACTIVE LOG	T1	41.519423677	-71.145195393	4598641.43631471	321
TRACK	ACTIVE LOG	T1	41.519540269	-71.145185418	4598654.36075013	321
TRACK	ACTIVE LOG	T1	41.519516632	-71.145057511	4598651.47134711	321
TRACK	ACTIVE LOG	T1	41.519253943	-71.145325648	4598622.86079484	320
TRACK	ACTIVE LOG	T1	41.519237179	-71.145289438	4598620.92447394	320
TRACK	ACTIVE LOG	T1	41.519328794	-71.145373927	4598631.27147184	320
TRACK	ACTIVE LOG	T1	41.519352933	-71.145372	4598633.94760993	320
TRACK	ACTIVE LOG	T1	41.591437636	-71.192299426	4606735.82384572	317
TRACK	ACTIVE LOG	T1	41.591528747	-71.192292385	4606745.92505	317

1. Note that all tracks on the GPS are downloaded.
2. You can either save all the tracks or select specific tracks, representing a unique survey, to save. If you do not highlight any of the tracks, they will all be saved as a single file. To highlight a specific survey track, click on the row identifier. Hold down the 'Shift' key and select the last record in the series that represents the unique survey of interest. In the above image, clicking on '1' highlighted the row. These tracks should be saved as a shapefile.

    a. To save as a shapefile, select File > Save To > ArcMap > File and 'Save as type: ESRI Shapefile (3D)'.

    The naming convention should include the identifier of the GPS used (blue, yellow, or black) and the date the file was collected following the format "**blue_06232010.shp**".

    This file will automatically appear in the Table of Contents of the ArcGIS Map Document that you have open.

3. Close DNR GPS and verify the contents of the new shapefile in the map document to ensure that your data were properly transferred.
4. Export the shapefile data to the Coastal Birds geodatabase. The geodatabase is located on the NETN server at Z:\Projects\Monitoring\Coastal_Birds\5_Data\Data and is named Coastal_Birds_Spatial_Data.mdb.
    a. In ArcMap, in the Table of Contents, right-click on the shapefile and select Data > Export Data.
    b. Under 'Output feature class:' navigate to the geodatabase and click 'OK'.
    c. Select 'Yes' when asked if you want to '…add the exported data to the map as a layer'.

Deleting Tracks from the GPS Unit

The GPS receiver can hold multiple tracks, but it is advisable to delete the downloaded tracks from the GPS periodically to keep it from becoming full while in the field. To clear the track record on the GPS device:

1. Go to the Main Menu by pressing 'MENU' twice.
2. Toggle to 'Tracks' and press 'ENTER'.
3. Toggle to 'Clear' and press 'ENTER'.
4. 'Do you really want to clear the track log?' Toggle to 'Yes' and press 'ENTER'.
5. To get back to the Setup menu press 'QUIT'.

Finalize

Finalization of both tabular and spatial data will occur after data has been exported or extracted from CyberTracker.

Tabular data: The final repository for tabular coastal bird data is the network's Access database. Quality assessment and control of the data should occur at the same time data are imported. Since there are no paper data sheets to review (100% digital data collection), QAQC is limited to looking for omitted or out-of-range values. Queries used to create recurring annual data summaries are maintained and greatly speed up annual reporting.

Route/Track data: The final repository for route/track spatial data (point data are stored with the tabular observations) is an ArcGIS geodatabase. Edits/corrections are most easily made after the data have been exported from the GPS unit and converted to a geodatabase layer. In addition to cleaning up any errors, a metadata file should be authored for each individual layer created.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	3/2013	Adam Kozlowski and Carol Lynn Trocki	New SOP	Use of Juno handheld units and CyberTracker rather than Garmin GPS and paper data sheets.
1.01	5/2013	Brian Mitchell	Revised spatial data procedures to store data in a geodatabase.	Shapefiles cannot store time information.
1.02	3/2014	Carol Lynn Tocki	Revise procedure for exporting track data; add standard codes for island & route names	Error in instructions required a small change in the steps; clarification of data naming
1.03	3/2015	Carol Lynn Trocki	Revise track data collection to reflect the use of a handheld gps unit; simplify naming convention of track data to reflect date and gps unit	Operational review; CyberTracker generated track data was cumbersome to export to ArcGIS; naming convention including island name lacked flexibility for route changes

SOP 5 – Survey Techniques – Common Eider

Northeast Temperate Network
Version 1.07

Survey Parameters

These methods target incubating female Common Eider (*Somateria mollissima*). Complete ground-based nest censuses will be conducted every 3 years from 15 May to 1 June. Nest counts will be followed by boat-based surveys of chicks on the water from 15 June to 15 July. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation. Boat-based surveys will not be conducted when winds are greater than 25 km/h, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain.

Currently, Common Eider are known to nest throughout the Outer Islands, but are most concentrated on the northern side of Calf Island.

Survey Methods

Prior to and during land-based surveys, be aware of nesting locations of non-target species and avoid these locations whenever possible. This includes carefully surveying landing beaches for American Oystercatcher pairs prior to landing.

In BOHA, eider usually nest under overhanging vegetation (primarily sumac) on the Outer Islands. With four to five observers, spread 3-4.5 m (10-15 feet) apart should-to-shoulder, walk in a line and progress through suitable vegetation on each island, watching for flushing females. Be sure to record the start and end time for all survey efforts, as well as making note of the survey route followed (GPS unit set to track). Record environmental conditions (temperature, wind speed, wind direction, cloud cover) prior to beginning surveys.

When a female eider is flushed, search the immediate area to locate the nest. Record the nest's contents (number of eggs and/or chicks) and record the nest location using a GPS. If using a Juno handheld device, select appropriate survey type so GPS coordinates of each nest are recorded. Maintain constant vocal communication with other observers as you search to assure complete coverage of each island and reduce the chances of double-counting nests. To minimize disturbance and increase the likelihood of finding nests, time surveys appropriately for the peak incubation period.

Approximately two to three weeks following ground-based surveys, return to the Outer Harbor to record the numbers of chicks observed. Crèche surveys follow a similar route and method as boat-based gull and cormorant surveys. Circle the entire perimeter of each island in the Outer Harbor in a small boat traveling at approximately 5 km/h (3 mph) as close to shore as the boat Captain will allow (between 9-46 m [30-150 feet] offshore). Maintain a minimum distance of about 50 m from crèches to avoid disturbing

the birds. Record the number of female common eider and chicks on the water rafting in crèches. Beginning in 2009, NETN will explore whether it is feasible to use a high-resolution digital camera to photograph creche observations so that counts can be verified in the
office. Surveys should be repeated several times during the latter half of the breeding season, from 15 June to 15 July.

Quantifying Detection Probabilities

To quantify a measure of error in nest counting, a sub-sample of nests could be counted using a mark-and-recapture technique, which requires two visits to a nesting colony, ideally on successive days. On the first site visit, for each nest found, contents and GPS location should be recorded and a the nest should be marked with a uniquely numbered popsicle stick or other unobtrusive, biodegradable identifier placed on the ground next to the nest. On the second visit (ideally the next morning) a thorough nest search should be undertaken. All previously marked nests should be identified by popsicle stick number and contents recorded. All 'new' nests should have both contents and GPS location recorded. This information can then be used to calculate an estimate of the actual number of nests present based on the detection probability, or percentage of nests likely to be found during a single search effort.

Example from 2008 field season:

On May 14, 77 nests were located on the north end of Calf Island by a team of six trained observers. On May 15, 60 nests were located on the north end of Calf Island by a team of six trained observers, 43 of which had been marked on the previous visit. Given this information, the following ratio can be constructed:

nests marked on first visit / total number of nests = number of nests found marked on second visit / total number of nests found on second visit

77 / X = 43 / 60 where X = the total number of nests on the north end of Calf Island

X = 107 estimated number of nests

detection probability = 43 / 60 = 72%

Further research is needed to determine the effects of repeated disturbance on incubating females.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Update to include recording start and stop times and environmental conditions. Update section on detection probability to reflect unknown effects of repeated surveys on incubating females.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes. Add information about pending test of digital photographic methods and better describe mark-and-recapture techniques for determining detection probability.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on input from peer review; see Appendix C.	External review
1.05	11/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters.	Operational review
1.06	04/2011	Carol Lynn Trocki	Updated to reflect possible use of Juno handheld device for electronic data collection in the field.	Operational review
1.07	3/2013	Brian Mitchell	Avoid non-target species during land-based surveys, and maintain a minimum distance from crèches to avoid disturbance.	Operational review; concerns about nest disturbance.

SOP 6 – Survey Techniques – Cormorants & Gulls

Northeast Temperate Network
Version 1.07

Survey Parameters

These methods target incubating Double-crested Cormorants (*Phalacrocorax auritus*), Herring Gulls (*Larus argentatus*), and Great Black-backed Gulls (*Larus marinus*). These species will be surveyed using a boat-based census of all appropriate and visible nesting habitats every 3 years. Surveys will estimate the number of nesting pairs by recording the number of visible, actively nesting adults.

Although boat-based methods will likely underestimate the actual number of nesting adults, information gathered should provide a reliable index of relative abundance and spatial distribution. Surveys will be conducted from 10 May to 5 June. Surveys should be conducted once per week for three consecutive weeks during the peak of the breeding season to reduce interannual variation.

Surveys will not be conducted when winds are greater than 25 km/h, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain. Surveys will generally be conducted between 0730 and 1230 each day and restricted to a temperature range of 10 to 35° C. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation. Surveys will be discontinued if signs of unnecessary stress or predation are observed.

If a survey is discontinued due to birds appearing stressed or from high predation rates, the survey will not be repeated that week and the data will be marked as incomplete in the database, along with the approximate percentage of the island that was surveyed. The lead scientist will then review the field methods and environmental conditions on the survey date, and work with local experts to determine whether the field methods can be altered to reduce stress or predation.

Double-crested Cormorants, Herring Gulls, and Great Black-backed Gulls all nest together on the rocky fringes of islands in the Outer Harbor, as well as on Sarah and Sheep Islands. Gulls also nest currently on George's, Gallops, Hangman, and on the steep drumlin bluff faces of Greater Brewster and Rainsford Islands.

Survey Methods

Circle the entire perimeter of each island, where gulls or cormorants are present, in a small boat traveling at approximately 5 km/h(3 mph) as close to shore as the boat Captain will allow (between 9-46 m [30-150 feet] offshore). Maintain a minimum distance of about 50 m from Common Eider crèches to avoid disturbing the birds. Be sure to record the start and end times of each survey effort, as well as making note of the survey route (GPS unit set to track). Record environmental conditions (temperature, wind speed and direction, cloud cover) prior to beginning surveys.

Use at least two independent observers to record the number of active nests determined by the presence of an incubating adult, an adult standing on or in a recognizable stick nest, or the presence of visible chicks within a stick nest. Be careful not to overestimate the number of active nests by counting nearby adults that are not on a nest. If it is helpful, observers may work in teams with one observer and one recorder each.

Record the approximate location of each nesting colony on a field map, noting the date and species present. Note any available evidence indicating the breeding stage for each species (presence of eggs or chicks, adults engaged in nest building, feeding chicks, etc.).

In 2009, NETN began exploring the feasiblity of using a high-resolution digital camera to photograph the shoreline from the boat so that numbers of nesting individuals of each species could be counted in the office. It is also hoped that these photos can provide documentation of long-term changes in the spatial distribution of nest sites among islands. While preliminary investigations of photo documentation are promising, the methods require additional refinement. The use of consistent photo stations and differences in photo scoring among observers are two issues that will be explored in 2011. NETN will begin developing a detailed SOP for photo documentation in 2011.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Update to reflect clarification including timing and survey route in data collection.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes. Added information about pending test of digital photographic methods.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on input from peer review; see Appendix C.	External review
1.05	11/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters.	Operational review
1.06	4/2011	Carol Lynn Trocki	Updated to reflect additional information regarding photo documentation.	Operational review
1.07	3/2013	Brian Mitchell	Maintain a minimum distance from crèches to avoid disturbance.	Operational review; concerns about disturbance.

SOP 7 – Photo Documentation of Cormorants & Gulls

Northeast Temperate Network
Version 1.01

Overview

Boat-based surveys of gulls and cormorants are known to produce highly variable results, due to observer differences and the challenges of counting incubating birds from a moving boat. A high-resolution, image-stabilizing camera is used to photograph the shoreline of the nesting islands during boat-based surveys. Efforts are made to shoot overlapping photographs in a steady and consistent manner, so that photographs can then be mosaicked into composites of recognizable island locations (Figure S7.1). The ultimate goal in establishing photographic documentation methods is to allow the number of visible, nesting individuals of each species to be verified in the office following field surveys and to produce an archival record of colony locations and annual survey results.

These photographic methods are still in development. In addition to testing various camera settings, NETN is exploring whether camera surveys should be conducted concurrently with volunteer surveys (SOP 6 – Survey Techniques – Cormorants & Gulls).

Ideally, the two survey methods would be concurrent, but suitable weather conditions for photo surveys done concurrently with volunteer surveys are rare. It may be more feasible to have the lead scientist (or a park staff member) conduct the photo surveys on a good weather day, separate from planned trips with volunteer observers. We hope that photo surveys will prove to be a less variable and more sensitive index of change in cormorant and gull populations than the current volunteer-based surveys, but it will take several years of successful photo monitoring to determine whether this is the case. In the meantime, NETN will employ both survey methods.

Figure S7.1. A sample panoramic photo mosaic comprised of several photos of the east side of Green Island, taken on 18 May 2010, during a boat-based survey of the Outer Islands in Boston Harbor Islands National Recreation Area.

Camera Settings

There are a number of shooting strategies and camera settings that improve the photo stitching process and quality of the resulting panoramic photos. Currently, photos are taken with a Sony DSLR A350 camera with 14 megapixel sensor and internal image stabilization.

Recommended Camera Settings (from ArcSoft Panorama Maker 4 photo stitching software):

Set Exposure Manually. Meter the scene in Aperture-priority or Shutter-priority mode, read your meter in the brightest section to avoid overexposure, and manually lock the Aperture and Shutter Speed for each series of shots.

Auto Focus. NETN is currently investigating optimal focus settings; most recommendations are to use manual focus but auto focus is easier and gave better results in some field tests.

Focal Length. Use the same focal length for all photos in a panorama sequence. The optimal focal length (or focal length range) is being investigated by NETN.

Turn Auto White Balance Off. Manually set the most appropriate white balance and use the same setting for all shots in a series.

Use One Exposure Setting. Before you begin to shoot, use the camera's light meter to find an exposure that works best for the entire sequence.

Turn Off the Flash. Do not use a flash and turn off the camera's auto-flash feature.

Ensure Date and Time Settings are Accurate. This is especially important for matching photos to the GPS track reference, if needed.

The camera battery should be fully charged in advance of each field day.

Photo Collection

Photos are obtained during boat-based surveys of nesting cormorants and gulls in the Outer Harbor Islands. Ideally, photo coverage will include all surveyed nesting islands and be identical in scope to visual boat-based surveys. Photos are taken while circling each island by boat at approximately 5 km/hr from a distance of approximately 10-45 m offshore (or as close as the boat captain feels safe boat operation is feasible). Maintain a minimum distance of about 50 m from Common Eider crèches to avoid disturbing the birds. Visual surveys by volunteer observers may be taking place simultaneously.

Surveys will not be conducted when winds are greater than 25 km/hr, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain. Surveys will generally be conducted between 0730 and 1230 each day and restricted to a temperature range of 10 to 35° C. Ideal conditions for photo surveys are significantly more limited, with seas less than 0.6 m (2 ft), winds less than 15 km/hr, good visibility, and good lighting conditions.

Following the guidelines below should result in photos that are appropriate for photo-stitching into island segment panoramas, and of adequate quality and resolution to be useful in identifying individual birds to species and enumerating incubating individuals or nests.

Collect a Time-stamped GPS Survey Track. This track can be extremely useful for locational reference when processing and naming photos.

Establish a Series of Photos Based on Recognizable Landmarks. Following the survey track, begin and end a series of shots with a recognizable landmark, such as a rocky outcropping, rock feature, etc. A series will generally be several hundred meters in length. Whenever possible, use the same landmarks used in previous surveys.

Shoot Sequential Photos in Less than 40 Seconds Time. Adhering to this timeline improves the consistency of conditions, making the photo stitching process smoother. In addition, ArcSoft Panorama Maker software has the ability to automatically group photos by 'shot time' which can be a helpful feature during processing. Sequential photos should be taken in groups of no more than six at a time.

Keep Camera in the Same Plane Throughout a Series. Ideally, a tripod would be used. This is difficult on a moving boat, but all efforts should be made to keep the camera framed consistently for all shots in a sequence. The shoreline of the islands can be a helpful reference point; keep this baseline as consistently aligned in the frame as possible for each shot in a sequence.

Use 25% to 50% Overlap. Overlap each shot in a sequence by at least 25%. Always shoot sequentially in direction of boat travel; never back up or reshoot an area already covered, to avoid locational confusion while post-processing and labeling photos.

Insert Divider Shots Manually. To make photo processing easier, manually insert divider shots in between island segments by taking a blank photo of the water, lens cap, etc.

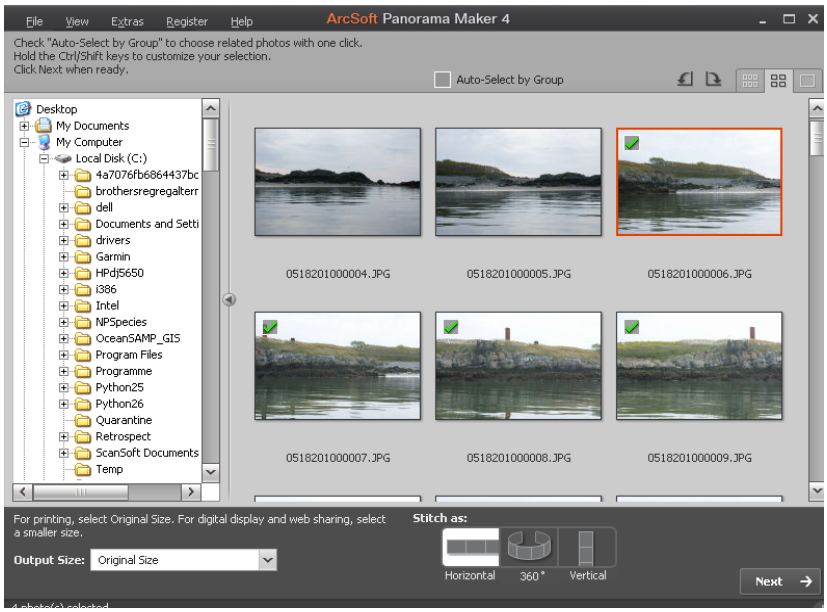
Photo Processing

Photos should be downloaded from the camera following each field day. Photos should be numbered sequentially and clearly labeled by survey date for processing. Photo stitching should be undertaken with ArcSoft Panorama Maker 4, or similar software.

1. Open ArcSoft Panorama Maker 4 software.

2. Navigate to date-specific boat survey photos.

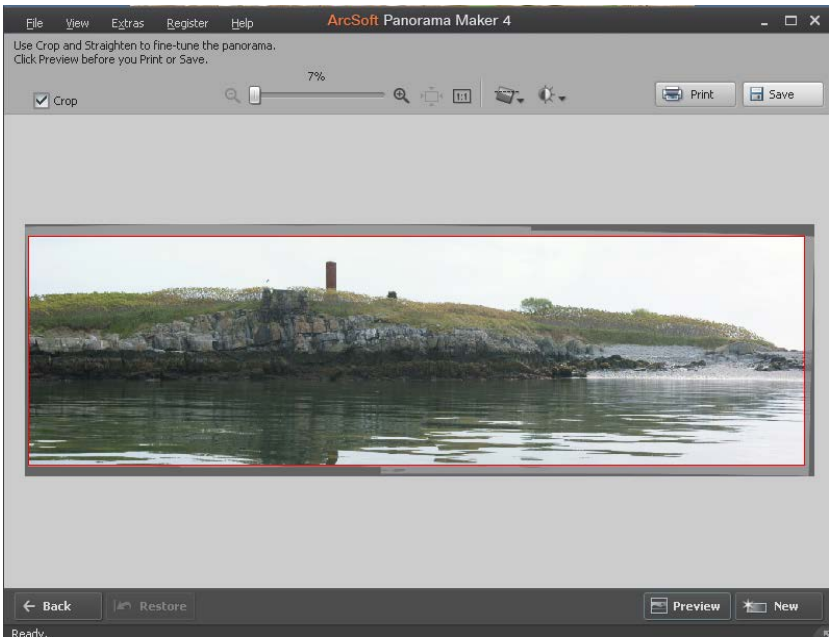
3. Select photos belonging to a series. If using 'Auto-Select by Group' function, make sure that no more than 6 photos are selected in each series.



4. Select ‘Next’ in the bottom right-hand corner of the screen.

5. Adjust photo selection to complete series as needed. Select ‘Stitch’ in the bottom right-hand corner of the screen.

6. Review resulting panorama.



If acceptable, select 'Save' in the upper right-hand corner of the screen. Save mosaicked photo according to the following naming convention:

BOHA_Boat_YYYYMMDD_ Island_SurveySegmentNumber.jpg

YYYY: Year

MM: Month

DD: Day

Island: See four letter island codes below.

Survey Segment: Generally referenced by cardinal direction (E, W, N, S)

Number: Sequential identification of panoramic photo series within a specific Island Segment

For Example, the photo above would be named: BOHA_Boat_20100518_CALF_E1.jpg

Island Name	4 Letter Code
Calf	CALF
The Graves	GRAV
Green	GREE
Little Brewster	LIBR
Little Calf	LICA
Middle Brewster	MIBR
Outer Brewster	OUBR
Shag Rocks	SHAG

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	2/2013	Carol Lynn Trocki	New SOP	New SOP
1.01	3/2013	Brian Mitchell	Maintain a minimum distance from crèches to avoid disturbance	Operational review; concerns about disturbance

SOP 8 – Survey Techniques – Wading Birds

Northeast Temperate Network
Version 1.07

Survey Parameters

These methods target nesting Great Egrets (*Ardea alba*), Snowy Egrets (*Egretta thula)*, Black-crowned Night-Herons (*Nycticorax nycticorax)*, and Glossy Ibis (*Plegadis falcinellus*). Complete ground-based nest censuses will be conducted every 3 years between 15 May and 5 June. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation. Surveys will be discontinued if signs of stress are observed, such as hypothermic or overheated young, branching older young, or harassment by potential predators.

If a survey is discontinued due to birds appearing stressed, the survey will not be repeated that year and the data will be marked as incomplete in the database, along with the approximate percentage of the colony that was surveyed. The lead scientist will then review the field methods and environmental conditions on the survey date, and work with local experts to determine whether the field methods can be altered to reduce colony stress.

Wading bird colonies will not be unnecessarily disturbed during other survey efforts. All waterbird breeding information for islands with wading bird colonies will be gathered during wading bird surveys, even though this may result in data being gathered off-cycle. For example, Sarah Island currently has the largest wading bird colony in Boston Harbor. Ground-based surveys on Sarah targeting wading birds will be conducted every third year. Information on other waterbird species potentially using the island (such as Spotted Sandpipers or American Oystercatchers) will be collected during wading bird visits, or estimated through boat-based surveys that do not disturb the wading bird colony.

Currently, wading birds are known to have nesting colonies on Calf, Middle Brewster, Outer Brewster, Sheep, and Sarah Island. Sarah is the largest and densest colony location.

Survey Methods

Prior to and during land-based surveys, be aware of nesting locations of non-target species and avoid these locations whenever possible. This includes carefully surveying landing beaches for American Oystercatcher pairs prior to landing.

Determine the location of active colonies by observing wading bird activity, such as adults landing in trees, carrying nesting material or carrying food. Record environmental conditions (temperature, wind speed and direction, cloud cover) prior to beginning surveys.

Record colony location using a GPS unit and field map notations. Also record the primary vegetation used for nesting. Carefully approach the colony site, noting the estimated number of adults present, by species, as they flush. Be sure to note the GPS location of the colony boundary as you enter. Add an

observer outside the colony to identify and count flushing adults if the colony is large or densely vegetated. Record your starting time.
With four observers working in teams of two, work through the colony systematically, recording nests and nest contents as you go. Identify active nests by species whenever possible based on nest/egg characteristics, nestlings, or by the attending adult. When it is not possible to identify the nest to a particular species, simply list as Unknown Wading Bird (UNWB). When feasible given time constraints, obtain GPS coordinates for each individual nest detected. If using a Juno handheld device, select appropriate survey type so GPS coordinates of each nest are recorded. Make sure to distinguish wading bird nests from those of other species (like cormorants or gulls), which may nest nearby, especially on Sarah and Sheep.

Upon exiting the colony, note your GPS location again. For irregularly shaped colonies, you will need to obtain additional GPS points along the edges sufficient to delineate the boundary of the colony. Record your ending time and any additional notes.

Quantifying Detection Probabilities
To quantify a measure of error in nest counting, a sub-sample of nests could be counted using a mark-and-recapture technique, but this would require at least two visits to a nesting colony, ideally on successive days. On the first site visit, for each nest found, record contents and GPS location and mark the nest tree with a unique number using water-based paint or some other unobtrusive, biodegradable identifier like biodegradable flagging. On the second visit (ideally the next morning) a thorough nest search should be undertaken again. All previously marked nests should be identified by number and contents recorded. All ‘new’ nests should have both contents and GPS location recorded. This information can then be used to calculate an estimate of the actual number of nests present based on the detection probability, or percentage of nests likely to be found during a single search effort.

Further research is needed to determine the effects of this repeated disturbance on incubating females and chick survival rates. Alternative approaches, such as using a double-observer method within a given colony visit could also be explored.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Update to include recording environmental conditions. Update section on detection probability to reflect unknown effects of repeated surveys on incubating females.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes. Add information better describing mark-and-recapture techniques for determining detection probability.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.05	12/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters and disturbance avoidance.	Operational review
1.06	4/2011	Carol Lynn Trocki	Update to reflect possible use of Juno handheld devices for electronic data collection in the field.	Operational review
1.07	3/2013	Brian Mitchell	Avoid non-target species during land-based surveys.	Operational review; concerns about nest disturbance.

SOP 9 – Survey Techniques – Large Shorebirds

Northeast Temperate Network
Version 1.07

Survey Parameters

These methods target nesting American Oystercatchers (*Haematopus palliatus*) and Willets (*Catoptrophorus semipalmatus*) with a boat-based survey of nesting pairs on islands in BOHA. All islands within BOHA will be surveyed annually. Currently, American oystercatchers nest on 9 islands in the park, while nesting Willets have only been observed on Snake Island.

Because these species are large, visible, and generally vocal, survey efforts may be spread over the nesting season (15 May to 15 July) with observations focusing on individuals or pairs that appear to be defending or incubating a nest or brooding chicks.

Surveys will not be conducted when winds are greater than 25 km/h, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain. Surveys will generally be conducted between 0730 and 1230 each day and restricted to a temperature range of 10 to 35° C. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation.

Survey Methods

Circle the entire perimeter of each island in a small boat traveling at approximately 5 km/h (3 mph) as close to shore as the boat Captain will allow (between 9-46 m [30-150 feet] offshore). Maintain a minimum distance of about 50 m from Common Eider crèches to avoid disturbing the birds.

While circling, scan the shoreline carefully for the presence of American Oystercatchers or Willets. Note evidence of breeding pairs, such as agitation and defensive maneuvers as you approach a particular location, the presence of an incubating adult, or the presence of unfledged chicks on the shore.

Record environmental conditions (temperature, wind speed and direction, cloud cover) prior to beginning surveys. Record the number of breeding pairs and any chicks observed on each island by species. Also be sure to record the approximate location and date of your observations on a field map as well as survey start and end times. While you may wish to include records of presumed non-breeding adults, be sure to list these as such.

Often, American Oystercatchers may be observed during surveys targeting other species (such as ground or boat-based eider or cormorant & gull surveys). Repeated boat-based surveys of known nest locations should be conducted throughout the breeding season to gather data on reproductive success whenever possible.

Currently, there is a comprehensive banding program being implemented for American Oystercatchers along the Atlantic coast, including sites in Massachusetts, and banding of American Oystercatchers in BOHA may occur in 2009. During American Oystercatcher surveys, all sightings of banded birds will be reported. Information on band reading and the banding project can be found at: http://www.ncsu.edu/project/grsmgis/AMOY/Banding.htm
All volunteers will receive training to properly read and record American Oystercatcher bands.

While conducting shorebird surveys, be on the lookout for Piping Plovers, which are not currently known to nest in Boston Harbor, but may colonize the area in the future. Be sure to complete a data sheet for each island surveyed, even if no nesting birds are detected.

Quantifying Detection Probabilities

Although locating all individual nests is beyond the scope of this protocol, it is possible to estimate the detection probability of these techniques by conducting multiple surveys of nesting islands and counting the number and location of nesting pairs on repeated visits. Detection probability is likely very high (approximately 1.0) during ground-based surveys, but may be more variable during boat-based surveys. Efforts to quantify detection probabilities with periodic ground-based surveys will be incorporated into field work. The appearance of banded American Oystercatchers in BOHA will also aid in the quantification of detection probabilities.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Clarification of techniques – add start and end date, null data entry.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes. Clarification of need to determine detection probabilities for methods.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.05	11/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters.	Operational review
1.06	4/2011	Carol Lynn Trocki	Updated to reflect the use of repeated surveys throughout the breeding season for AMOY.	Operational review
1.07	3/2013	Brian Mitchell	Maintain a minimum distance from crèches to avoid disturbance.	Operational review; concerns about disturbance.

SOP 10 – Survey Techniques – Small Shorebirds

Northeast Temperate Network
Version 1.07

Survey Parameters
These methods target nesting Spotted Sandpipers (*Actitis macularis*), but can also be used to gather additional information on American Oystercatchers (*Haematopus palliatus*) and to detect possible future colonization by Piping Plovers (*Charadrius melodus*). These species will be surveyed by a walking census of all appropriate nesting habitats every 3 years. Surveys will estimate the number of nesting pairs by recording the number of adults exhibiting territorial behavior flushed from nesting areas. Direct nest counts will be included whenever possible. Callback surveys may be used to elicit a response from Spotted Sandpipers in areas where nesting is suspected.

Spotted sandpiper nests are notoriously difficult to locate. In addition, this species may have two to three broods per season, making their nesting efforts extremely asynchronous. Surveys will be conducted from 15 May to 15 June with a second round of late season surveys (after 1 July) included whenever possible. Surveys will not be conducted when winds are greater than 25 km/h, precipitation reduces visibility, or when boating conditions are deemed unsafe by the boat captain. Surveys will generally be conducted between 0730 and 1230 each day and restricted to a temperature range of 10 to 35° C. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation.

On islands where Spotted Sandpipers may nest within close proximity to other sensitive waterbirds (wading birds or eiders), efforts will be made to census Spotted Sandpiper breeding activity while conducting ground-based nest counts for these other species, even though this may result in data being gathered off-cycle. For example, Sarah Island currently has the largest wading bird colony in Boston Harbor. Ground-based surveys on Sarah targeting wading birds will be conducted every third year. Information on Spotted Sandpipers activity on Sarah will be collected during wading bird visits, or estimated through boat-based surveys.

Survey Methods

Prior to and during land-based surveys, be aware of nesting locations of non-target species and avoid these locations whenever possible. This includes carefully surveying landing beaches for American Oystercatcher pairs prior to landing.

Record environmental conditions (temperature, wind speed and direction, cloud cover) prior to beginning surveys. With 3-4 observers, spread out in a line no more than 9 m (30 feet) apart should-to-shoulder and progress through suitable vegetation on each island, watching for flushing male sandpipers. When an individual is flushed from appropriate nesting habitat and exhibits territorial behavior, record that

individual accordingly. If time allows, search the immediate area to try and locate the nest. If a nest is found, record its contents (number of eggs and/or chicks) and its GPS location. If using a Juno handheld device, select appropriate survey type so GPS coordinates of each nest are recorded. Be sure to record the start and stop time of all survey efforts as well as the track of your survey route on a field map and, preferably, also with a GPS.

Maintain constant vocal communication with other observers as you search to assure complete coverage of each island and reduce the chances of double-counting adults that are presumed to be nesting in a given area. To reduce disturbance and increase the likelihood of finding nests, time surveys appropriately for the peak incubation period, which is difficult for this species because they may double, or even triple, brood.

While conducting shorebird surveys, be on the lookout for Piping Plovers, which are not currently known to nest in Boston Harbor, but may colonize the area in the future.

Quantifying Detection Probabilities

Although locating all individual nests is beyond the scope of this protocol, it is possible to estimate detection probabilities for this species by conducting multiple surveys of known nesting islands and gathering information on the number and location of territorial adults detected. We suggest surveying Rainsford Island (the largest known Spotted Sandpiper nesting colony) three times within one week during the height of the breeding season to establish some measure of detection probability for this species.

Revision History Log

Versions #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Clarify survey techniques including adding start and stop times, survey location information, and improving description of detection probability estimate.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes only.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.05	12/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters and to clarify disturbance avoidance efforts.	Operational review
1.06	4/2011	Carol Lynn Trocki	Updated to reflect effort directed at territorial adults, rather than nest searching.	Operational review
1.07	3/2013	Brian Mitchell	Avoid non-target species during land-based surveys.	Operational review; concerns about nest disturbance.

SOP 11 – Survey Techniques – Tern Colonies

Northeast Temperate Network
Version 1.07

Survey Parameters

These methods target nesting tern species with a complete ground-based census of all nesting colonies within BOHA. Least Terns (*Sterna antillarum*) and Common Terns (*Sterna hirundo*) are currently known to nest in the park. In addition, there is the possibility that Roseate Terns (*Sterna dougallii*) may nest in BOHA in the future, most likely in a Common Tern colony. Each colony will be censused annually. Least Terns are known to be asynchronous in their nesting habits; therefore, Least Tern colonies and potential colony sites should be visited two to three times each season. Ground-based nest surveys will only be conducted when winds are below 20 km/h, temperatures are 16 to 27° C, and there is no precipitation.

Common Terns have recently nested on Snake Island, while Least Terns have oscillated between Rainsford and Lovells Islands. Spectacle and Peddocks Islands may also have appropriate habitat for nesting terns in the future. All islands should be surveyed for tern activity beginning in early June.

Survey efforts should target peak incubation, indicated by two or three eggs in most tern nests. Based on previous year's observations, peak incubation generally occurs between 10 June and 25 June for these species, but can vary based on both weather patterns and early-season colony disturbance.

Survey Methods

Prior to and during land-based surveys, be aware of nesting locations of non-target species and avoid these locations whenever possible. This includes carefully surveying landing beaches for American Oystercatcher pairs prior to landing.

Determine the location of active colonies by observing tern activity from a distance (note incubating adults or adults delivering food). Record colony location and site conditions. Record environmental conditions (temperature, wind speed and direction, cloud cover) prior to beginning surveys. Carefully approach the colony site, noting the estimated number of adults present as they flush. Be sure to note the GPS location of the colony boundary as you enter. Record your starting time.

Working in pairs (or groups for larger colonies), line up across the beach shoulder-to-shoulder, dividing the appropriate habitat from the wrack line to vegetation into swaths no more than 3 m (10 feet) wide. Designate a recorder. Working as a team, proceed slowly through the colony, calling out nest contents to a common recorder. Communicate with your partner(s) in identifying each sighted nest to avoid double-counting or under-counting nests.

CAUTION: Tern eggs and nests are extremely well-camouflaged and very easily stepped on. Carefully scan the ground below your foot with every single step, then scan the area around you for nests before stepping again.

Upon exiting the colony, note your GPS location again. For irregularly-shaped colonies, you will need to obtain additional GPS points along the edges, sufficient to accurately delineate the extent of the colony. Record your ending time and any additional notes.

Quantifying Detection Probabilities
Because so few terns nest in the park, and because these species are particularly sensitive to disturbance, double counts and nest marking are not recommended. However, a measure of observer error could be calculated on a demonstration colony using well camouflaged wooden eggs.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	5/2008	Carol Lynn Trocki	Minor clarification and grammatical changes.	Internal review
1.02	11/2008	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.03	1/2009	Carol Lynn Trocki	Minor editorial changes; note lack of tern nesting in BOHA in 2008 limited refinement of methods.	Internal review
1.04	4/2009	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.05	11/2009	Carol Lynn Trocki	Updated to reflect the addition of environmental parameters.	Operational review
1.06	4/2011	Carol Lynn Trocki	Deleted info about exploring detection probability in 2010; see 2010 annual report for findings.	Operational review
1.07	3/2013	Brian Mitchell	Avoid non-target species during land-based surveys.	Operational review; concerns about nest disturbance.

SOP 12 – Scoring Photos of Cormorant & Gull Nesting Colonies

Northeast Temperate Network
Version 1.00

Overview

This SOP describes the process undertaken when 'scoring' panoramic photos of nesting gulls and cormorants obtained during boat-based surveys (see SOP 7 – Photo Documentation of Cormorants & Gulls for additional information about photo collection and processing). The goal in establishing photographic documentation methods is to allow the number of visible, nesting individuals of each species to be counted in the office following field surveys, and to produce an archival record of colony locations and annual survey results. Ideally, multiple volunteers will be involved in counting photographed nests to allow for exploration of observer differences.

Photo Scoring

Photos will be scored by trained, volunteer waterbird monitors after boat-based surveys have been completed and processed survey photos are available. The 'Photo Scoring Form' (See Appendix B. Field Data Sheets, 'Photo Scoring Form') will be used to record the number of incubating adult birds or nests counted from mosaicked photographs.

1. Locate the appropriate photo mosaic to be counted (e.g., Figure S12.1) and review its associated Trip Details Form. Photos are named using the photo naming convention shown here:
2. BOHA_Boat_YYYYMMDD_ Island_SurveySegmentNumber.jpg
3. (For example: BOHA_Boat_20100518_CALF_E1.jpg)
4. Before counting, each scorer should make a copy of the photo mosaic being scored. To name the new file simply add an underscore and the scorer's initials to the end of the existing photo file's name, as shown here:
5. BOHA_Boat_YYYYMMDD_ Island_SurveySegmentNumber_Scorer'sIntials.jpg
6. (For example: BOHA_Boat_20100518_CALF_E1_clt.jpg)
7. Each scorer should use their own Photo Scoring Form to record their counts.
8. Open the photo mosaic using the software program Paint or a similar program (Paint can be located here on any PC computer: Start --> All Programs --> Accessories).
9. As they are counted, birds should be marked with a bright color using the paint brush tool, as shown in the marked photo below (Figure S12.2). Adding 'Start' and 'Stop' lines to photos may be helpful to avoid double-counting areas shown in multiple mosaics.

Figure S12.1. A sample panoramic photo mosaic comprised of several photos of the east side of Green Island, taken on 18 May 2010, during a boat-based survey of the Outer Islands in Boston Harbor Islands National Recreation Area (BOHA_Boat_20100518_GreenE1.jpg).

Figure S12.2. A close-up of the photograph above, showing incubating Double-crested Cormorants marked in green, incubating Great Black-backed Gulls marked in blue, and incubating Herring Gulls marked in red. This photo mosaic was taken from the east side of Green Island during a boat-based survey of the Outer Islands on 18 May 2010 (BOHA_Boat_20100518_GreenE1_clt.jpg).

10. Final counts for each species observed should be recorded on the Photo Scoring Form.

11. The marked up photo should be saved and stored in the same folder as the original photo.

Data Management

Copies of all scored and un-scored photos will be conveyed to the NETN Data Manager for archiving by the lead scientist at the end of the field season.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	2/2013	Carol Lynn Trocki	New SOP	New SOP

SOP 13 – Data Management & Quality Assurance/Quality Control

Northeast Temperate Network
Version 2.00

Acknowledgements

This SOP benefited greatly from the content and ideas expressed in these documents:

Heartland Network. 2004. Standard operating procedure #11: Data management. *In* Vegetation community monitoring protocol for the Heartland I&M Network and Prairie Cluster Prototype Monitoring Program. Version 1.0. National Park Service, Heartland Inventory and Monitoring Network and Prairie Cluster Prototype Monitoring Program, Republic, Missouri.

Thomas, S., and B. Moore. 2007. Standard operating procedure #6: Data management. *In* A protocol for monitoring Allegheny woodrats (*Neotoma magister*) at Mammoth Cave National Park. Version 2.1. National Park Service, Cumberland Piedmont Inventory and Monitoring Network, Mammoth Cave, Kentucky.

Southeast Coast Network. 2008. Quality assurance/quality control & field data collection standards. Version 1.0. National Park Service, Southeast Coast Inventory and Monitoring Network, Atlanta, Georgia.

Overview

Careful, accurate collection of data as directed in these SOPs is critical to the success of coastal breeding bird monitoring. This SOP describes quality assurance/quality control (QA/QC) procedures for accurate data collection, transcription and stewardship, and assessment of data quality. The Network will use a field computer database or standardized datasheet for data collection, as weather conditions and technology permit. An overview of the data management and quality control procedures detailed in this SOP are diagramed for quick reference in Figure S13.1.

Data Collection

Standard Methods

The lead scientist and bird monitoring volunteers shall use the following general methods to insure data quality in the field:

- Volunteers serving as observers should be well trained and confident in their ability to accurately obtain data records (see Volunteer Recruitment and Training SOP). Less skilled observers can participate by working in tandem with more experienced individuals.

- Volunteers serving as recorders will be trained in data entry requirements by the Lead Scientist at the beginning of the field season; requirements will be briefly reviewed at the beginning of each survey effort.
- When possible, multiple observers will be used during a single survey effort to improve accuracy and reduce bias. Photo documentation will also be implemented to reduce observer error during boat-based surveys for incubating gulls and cormorants (see forthcoming Photo Documentation SOP).

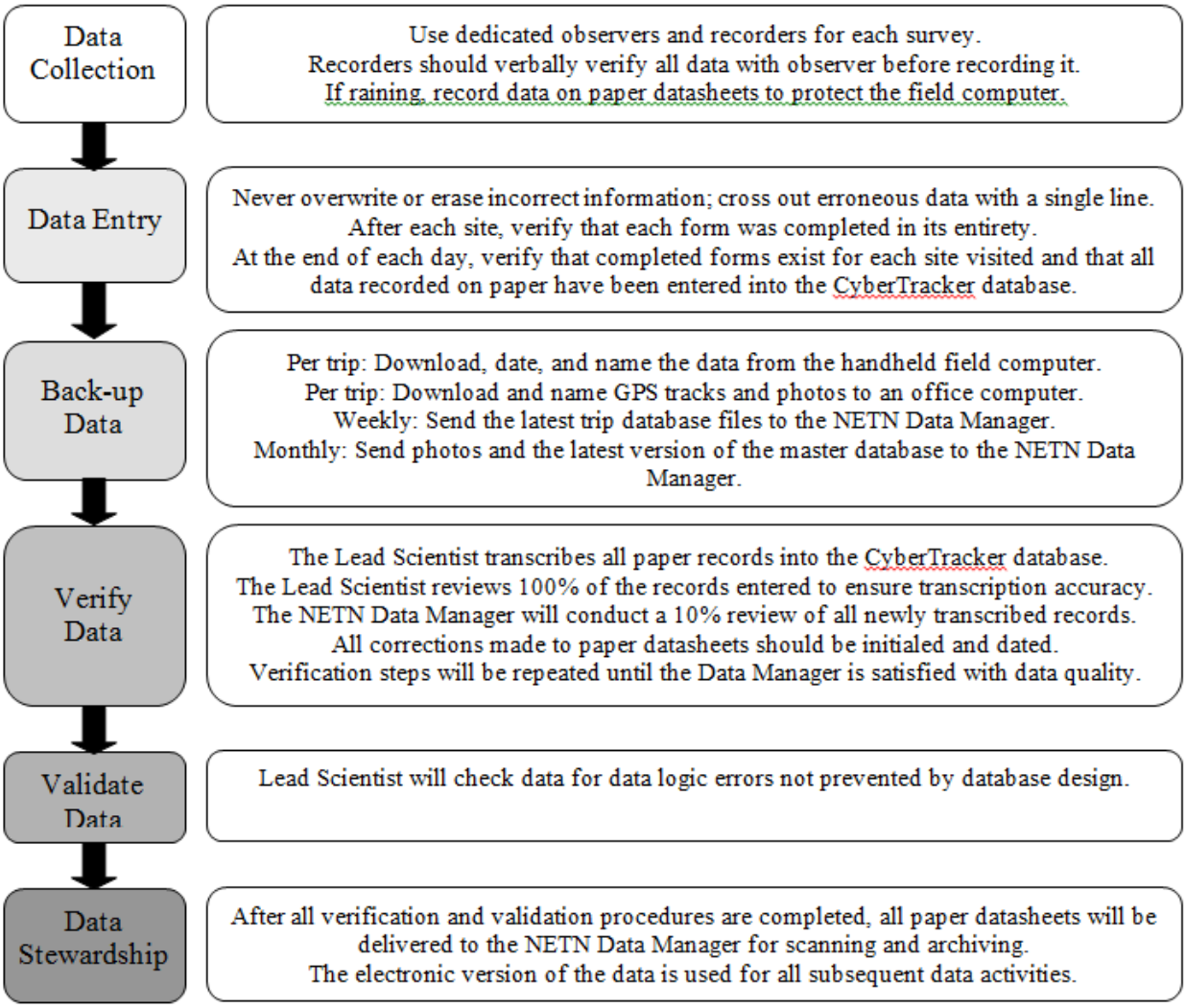


Figure S13.1. QA/QC steps quick-reference.

Handheld Field Computer

When survey conditions and technology permit, waterbird volunteers will record data directly into the CyberTracker database on a handheld computer. This will eliminate the time and potential error involved in data transcription from field notes.

The database will include clearly designated fields for each observation to be recorded, including notes, and all ancillary data on location, survey effort, and environmental conditions. The database, working in partnership with the global-positioning capabilities of the field computer, will also automate collection of spatial data (coordinates and tracks). The user interface of the database should be designed to match the datasheet as closely as possible to facilitate transcription of data when conditions dictate they be collected on paper datasheets.

Datasheets

Paper datasheets will always be available as a backup for electronic data collection in case of computer malfunction or other unforeseen circumstances. Datasheets will contain as much preprinted information as possible with designated labels for specific data elements, including general data such as date and observer/recorder names. Datasheets will clearly identify all required information, using examples where needed to ensure that the proper data are recorded. Paper datasheets will require the recorder to sign his/her name to verify that the datasheets have been filled out in their entirety. Paper will be acid-free; water resistant (Rite in the Rain) paper will not be used for this protocol since data will not be collected in inclement weather.

Data Entry / Transcription

Data Verification

Data quality and verification involve checking the accuracy of field data at each stage they are transcribed from their original source. To minimize the possibility of carrying entry errors forward into analysis, the data quality and verification process for this protocol involve multiple checks. After computerized data are verified to accurately reflect the original field data (i.e., the entered data match the collected data), the paper forms will be archived and remaining data manipulation shall be done in the database.

Field Data Collected Using Field Computer

During data entry into the CyberTracker database, the recorder entering the data will verbally double check all field values for accuracy and completeness with the observer(s) collecting/announcing the data. All discrepancies will be corrected prior to moving to the next data field.

Upon completing data collection for each survey, the recorder entering the data will check the entire form for completeness and if necessary verify values with the observer. After completing the last site of the day, the number of records present in the digital file shall be compared against the known number of sites for which data were recorded.

Field Data Collected Using Paper Datasheets

All information added to a datasheet must be printed using pen and clearly legible.

- ► While manually recording data, the recorder entering the data will verbally double check all field values for accuracy and completeness with the observer(s) collecting/announcing the data. All discrepancies will be corrected prior to moving to the next data field.

Information shall never be erased and incorrect or older information shall never be overwritten. Revisions shall be accomplished by crossing-out the erroneous data with a single line and then entering the correct value.
Upon completing data collection for each survey, original datasheets shall be reviewed and checked for legibility and completeness. The recorder responsible for completing this field verification should initial the datasheet in the appropriate location.

Paper Data Transcribed to Computer

Data on paper datasheets will be transcribed into the CyberTracker database by the Lead Scientist. Transcription will occur as soon as possible after the survey to maximize the Lead Scientist's ability to recognize and fix errors. During the process of transcribing data from paper datasheets into the CyberTracker database, the Lead Scientist will double check all entries and correct discrepancies prior to advancing to the next datasheet.

Following data entry into the CyberTracker database, the Lead Scientist shall review 100% of the records entered to ensure that values present on field forms were accurately and completely transcribed into digital form. Notes or changes made to the datasheets should be written on the sheets using a different colored pen/pencil. Anyone making modifications to the paper datasheet shall indicate their identity (initials) and the date the changes were made.

Ten percent of records are reviewed a second time by the NETN Data Manager. All comments and changes should be recorded on the datasheets. If a significant transcription error (e.g., incorrect values or missing records) is found during the 10% review, then the entire data set will be verified again (i.e., repeat the 100% and subsequent 10% checks until the data manager is satisfied with the data quality). In cases where the transcription errors detected follow a pattern, an effort will be made to discover the source of the re-occurring error and correct it through additional training or modifications to the protocol.

Data Verification and Validation

Although data may be correctly transcribed from the original field forms, their values may not always be accurate or logical. For example, an individual recorder may repeatedly use an inaccurate 4-letter code to identify a focal species (i.e. HEGU instead of HERG). As often as possible components of the data validation process have been built into the database (e.g., menu ordering, island lists, species pick-lists, etc.). Although many validation problems can be addressed by a well designed database, the Lead Scientist or NETN Data Manager must also review and validate the data after verification is complete. The Lead Scientists and NETN Data Manager are the authorities on the methodologies and species involved.

Data Stewardship

Good data stewardship practices play a critical role in long term data security and help prevent irretrievable loss of information.

- Immediately after returning from the field, any data collected on paper datasheets will be transcribed to the CyberTracker database. All post-field corrections and remarks made to

paper datasheets should be annotated with the date and initials of the person making the changes. Immediately after paper data transcription is complete, copies of the database should be backed-up to an external hard drive or desktop computer. Each day should have its own individual database file to act as an original record of that survey trip. The date (YYYYMMDD) will be added to the end of the database's file name to makes it easy to organize and sort the potentially large number of sequential files. The latest sequential database files should be copied by the Lead Scientist and sent to the NETN Data Manager on a weekly basis.

- Sequential CyberTracker files will be merged by the Lead Scientist to create a single master file in Microsoft Excel. Any additional data that could not be collected in CyberTracker (e.g., notes) will be added to the Excel file, which will serve as the master field database. The master field database should be copied by the Lead Scientist and sent to the NETN Data Manager monthly throughout the field season. The Lead Scientist and NETN Data Manager should then check the database periodically to catch and prevent recurring data entry errors.

- Field photos and GPS tracks shall be downloaded, named, and stored on a desktop computer immediately upon returning from each field trip (See SOP 7 – Photo Documentation of Cormorants & Gulls and

SOP 4 – Data Collection with the Trimble Juno). These datasets should be copied by the Lead Scientist and sent to the NETN Data Manager monthly (with the master CyberTracker file).

- Once the computerized data are verified as accurately reflecting the original field data and validation is complete, the paper field forms shall be delivered to the NETN Data Manager. The Data Manager will scan all original datasheets and store them as color, high-resolution images on the NETN server. The electronic version of the data will be used for all subsequent data activities. Original paper datasheets will be archived.

Care will be taken to store the electronic equipment in secure locations when not in use.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	11/08	Carol Lynn Trocki	Update to clarify methods based on comments provided by the NETN Network Coordinator.	Internal review
1.01	1/09	Carol Lynn Trocki	Added information about recording and managing GPS track data and update date of submission requirement based on current contract.	Internal review
1.02	4/09	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.03	6/11	Adam Kozlowski and Carol Lynn Trocki	Significant revision to match other NETN Data Management SOPs.	Operational review

SOP 14 – Data Analysis

Northeast Temperate Network
Version 1.03

Data Analysis

A summary of results will be compiled on an annual basis (see Trocki 2008 for an example from the 2008 field season). In this annual summary, methods should be reviewed and any changes from previous years noted and explained. The annual summary should provide a detailed description of survey effort, including dates, times, and the individual islands visited. Results should include the counted or estimated number of nests/pairs for each species and each island surveyed. Maps and descriptions of the spatial distribution of survey efforts and nesting colonies should be included. Estimates of detection probability should be discussed wherever available, but raw (naïve) estimates should also be given. The discussion section should include recommendations for improvement to the monitoring protocol, as well as suggestions for management.

Future Trend Analysis

As the data set for this program grows, a variety of statistical methods will become feasible for analyzing trends in coastal bird populations. A detailed discussion of the statistical methods that may be most appropriate for data analysis is being developed. This SOP will be updated to discuss trend analyses as it becomes possible to conduct them.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	11/2008	Carol Lynn Trocki	Updated to reflect change in appendices label.	Internal review
1.02	1/2009	Carol Lynn Trocki	Minor editorial changes only.	Internal review
1.03	4/2009	Carol Lynn Trocki	Minor editorial changes, clarification, and additional elaboration added based on comments received during peer review; see Appendix C for additional information.	External review

SOP 15 – Reporting

Northeast Temperate Network
Version 1.04

Annual Reports

Annual Reports will provide a general overview of activities and a summary of results from each year's field season and will be due to the NETN office by 15 December of each year (see Trocki 2008, SOP 14 – Data Analysis for detailed information). The annual report responsibilities include:

Document monitoring activities
Summarize findings
Document changes in the monitoring protocol
Public interest highlights

Annual reports will be shared with all stakeholders and project participants. In addition, contributing information to regional working groups on an annual basis will provide an opportunity for the detection of regional changes and the implementation of more comprehensive management strategies. Templates and formatting instructions are available at Northeast Region website: http://www.nps.gov/nero/science/Guidelines/Guidelines.htm.

Analysis and Synthesis Reports

Analysis and Synthesis Reports will be completed every three years and will provide more detailed analyses of population trends. Initial Analysis and Synthesis Reports may be an appendix or supplement to the annual report, since in the early years of monitoring the data set will not support complex analyses. Trends may initially be presented using graphs of numbers over time, and the report may also explore the effects of weather and other factors on bird counts and reproductive success. If data about important factors that are likely to cause significant variability in the bird counts are not being measured, the report will suggest metrics that should be collected. Detailed operating procedures for completing an Analysis and Synthesis Report will be developed with the first report in 2014.

Informal Field Season Reporting

Weekly updates during the field season will be shared by the lead scientist online with participating community volunteers and other interested stakeholders. This effort will add value for the park community and help island managers keep track of the timing of nesting activities.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.01	11/2008	Carol Lynn Trocki	Minor editorial changes and update submission date to reflect current contract.	Internal review
1.02	4/2009	Carol Lynn Trocki	Minor editorial changes based on comments received during peer review; see Appendix C.	External review
1.03	6/2011	Brian R. Mitchell	Updated info about analysis and synthesis reports, including changed date for first report (2010 to 2013)	Operational review
1.04	3/2015	Carol Lynn Trocki	Update to reflect the completion of the first Synthesis report in 2014	Operational review

SOP 16 – Protocol Changes and Deviations

Northeast Temperate Network
Version 1.02

Overview

This SOP documents deviations from established methods and major changes in the protocol. Deviations are situations where data were collected in a manner that is substantially different from the methods documented within the SOPs used during a particular field season. Major changes are fundamental shifts in the way data are collected that cannot easily be reconciled with earlier data. Major changes are not deviations, provided that the changes are documented in the SOPs. Deviations are labeled as such; otherwise the items below document changes.

Overall Protocol Changes

2007: Preliminary protocol development.

2008: Revised protocol narrative and draft SOPs submitted.

2009: Protocol underwent peer review.

2011: GPS and Data Management SOPs added.

2012: Photo Documentation, Photo Scoring, Trimble Juno, and Changes and Deviation SOPs added; GPS SOP dropped.

2013: Revised procedure for exporting track data from Juno; updated Photo Documentation SOP; updated budget to reflect current contract.

2014: Revised SOP 4 'Data Collection' to reflect use of a handheld GPS unit for collecting track data; updated Synthesis Report to reference first undertaking with data through 2014.

Field Survey Methodology Deviations and Changes

<u>Cormorants & Gulls</u>
2009: Began regularly including The Graves and Little Brewster Island in boat-based surveys. Began exploring the feasibility of using high-resolution digital photography to document gull and cormorant nesting during boat-based surveys; photo mosaicking and scoring techniques were explored.

2010: Continued efforts to refine photographic documentation methods for gull & cormorant boat-based surveys.

2011: Boat-based surveys and additional investigations of photo documentation techniques were scheduled, but a large storm stalled offshore prevented access to the Outer Islands during the incubation period in mid to late May.

<u>Common Eiders</u>
2007: Crèche counts included ducklings and adult females.

2008: Complete ground-based survey conducted. On Calf Island, a mark-and-recapture experiment was applied to nest searching efforts to quantify detection probability. Crèche counts improved to include a count of ducklings with attending females by individual crèche, to allow for calculations of average crèche size and size range, as well and the total number of females in the area.

2009: Began regularly including The Graves and Little Brewster Island in crèche counts.

2011: Complete ground-based counts were scheduled, but a large storm stalled offshore prevented access to the Outer Islands during the incubation period in mid to late May. (Deviation)

Wading Birds
2009: Complete ground-based survey conducted. During the preliminary survey individual nest trees were marked and an attempt was made to revisit the colony post-breeding to assess whether or not a post-season survey could adequately index nesting effort; heavy vegetation prevented this effort.

2012: Unable to survey wading birds on Sarah and Sheep Islands due to advanced nesting at time of scheduled survey; survey cancelled to avoid disturbing the colonies. Colonies on Calf, Outer Brewster, and Middle Brewster were surveyed. (Deviation)

Terns
2010: Conducted an experiment using a ‘dummy’ tern colony to assess detection probabilities for Least Tern nests.

Small Shorebirds
2010: Undertook ground-based nest searching and investigated the use of callback surveys to document Spotted Sandpiper nesting effort and/or locate nests with limited results. SOPs for Spotted Sandpipers were revised to reflect a focus on adults suspected of nesting given behavioral cues.

Volunteer Management
2009: Significant efforts were made to increase communication with volunteers and interested other during the field season with regular e-mail updates and postings to the NETN blog.

GPS Tracks
2008 to 2011: GPS tracks collected using Garmin GPS units. Raw data is missing from 2008 and 2009, complete for 2010, and partial for 2011. Shapefile tracks are available for all 4 years, but the tracks have no time information.

2012: GPS tracks collected using the Trimble Juno, at 5 second intervals. Shapefile tracks were made in 2012, but these files have no time information. Raw data files are missing, except for trips on 14 May, 29 June, 12 July, and 26 July.

2013: Updated Data Collection SOP to include procedure for converting track data from CyberTracker into an ArcGIS geodatabase; added 4-letter island and bay codes for track data naming convention.

2014: Updated Data Collection SOP to reflect a reversion to using a handheld GPS to collect track data, as CyberTracker proved extremely cumbersome; removed 4-letter island code from track naming convention since inconsistent for boat-based surveys.

Data Management

2007: Data were entered into a MS Excel spreadsheet and passed to the NETN Data Manager for uploading into an MS Access database.

2008: Data were entered into a MS Access database created by the NETN Data Manager.

2009: Data were entered into a revised MS Access database created by the NETN Data Manager.

2010: Preliminary efforts were undertaken to move to an electronic data collection process. Field data sheets were entered into a preliminary Cybertracker database at the end of the field season.

2011: A Cybertracker database was developed by the NETN Data Manager for the start of the season and field tested with regular updates and improvements made throughout the summer. Because of changes made to the program during the field season, the final version of the data was re-entered into a final Cybertracker database by the lead scientist at the end of the field season, from a combination of paper and electronic data collected in the field.

Revision History Log

Version #	Revision Date	Author	Changes Made	Reason for Change
1.00	2/2013	Carol Lynn Trocki	New SOP	New SOP
1.01	5/2013	Brian Mitchell	Add details about history of GPS track data	Document status of data archive
1.02	3/2015	Carol Lynn Trocki	Added 2013 and 2014 changes	Operational Review

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 035/128463, April 2015

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov