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User's Guide to the North Pacific Pelagic Seabird Database 2.0

Open-File Report 2015–1123

U.S. Department of the Interior
U.S. Geological Survey

Cover: A large flock of short-tailed shearwaters is joined by a humpback whale at feeding grounds in the eastern Aleutian Islands, Alaska. Typical of large vessels used to collect data on seabirds and marine mammals in the North Pacific, the NOAA ship *Oscar Dyson* is passing in the background. Photograph by Phil Clapham, National Oceanic and Atmospheric Administration (NOAA), September 7, 2005.

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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Area	
square kilometer (km^2)	247.1	acre
square kilometer (km^2)	0.3861	square mile (mi^2)
	Vessel speed	
kilometer per hour (km/h)	0.6214	mile per hour (mi/h)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=(1.8×°C)+32

Datum

Horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS84) datum.

Abbreviations and Acronyms

FGDC	Federal Geographic Data Committee
GIS	geographic information system
GPS	Global Positioning System
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NPPSD	North Pacific Pelagic Seabird Database
OCSEAP	Outer Continental Shelf Environmental Assessment Program
PICES	North Pacific Marine Science Organization
USGS	U.S. Geological Survey

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Abstract

The North Pacific Pelagic Seabird Database (NPPSD) was created in 2005 to consolidate data on the oceanic distribution of marine bird species in the North Pacific. Most of these data were collected on surveys by counting species within defined areas and at known locations (that is, on strip transects). The NPPSD also contains observations of other bird species and marine mammals. The original NPPSD combined data from 465 surveys conducted between 1973 and 2002, primarily in waters adjacent to Alaska. These surveys included 61,195 sample transects with location, environment, and metadata information, and the data were organized in a flat-file format. In developing NPPSD 2.0, our goals were to add new datasets, to make significant improvements to database functionality and to provide the database online. NPPSD 2.0 includes data from a broader geographic range within the North Pacific, including new observations made offshore of the Russian Federation, Japan, Korea, British Columbia (Canada), Oregon, and California. These data were imported into a relational database, proofed, and structured in a common format. NPPSD 2.0 contains 351,674 samples (transects) collected between 1973 and 2012, representing a total sampled area of 270,259 square kilometers, and extends the time series of samples in some areas—notably the Bering Sea—to four decades. It contains observations of 16,988,138 birds and 235,545 marine mammals and is available on the NPPSD Web site. Supplementary materials include an updated set of standardized taxonomic codes, reference maps that show the spatial and temporal distribution of the survey efforts and a downloadable query tool.

Introduction

The North Pacific is a vast region with complex topography and numerous oceanographic eco-regions that support a large number of highly productive marine communities, including globally significant fisheries and populations of seabirds and marine mammals. Seabirds are ubiquitous members of these communities and as higher trophic level consumers, they integrate processes that reflect primary and secondary production in marine ecosystems (Diamond and Devlin, 2003). Additionally, seabirds are relatively easy to observe and monitor, and all these qualities make seabirds useful indicators of marine ecosystem status (Veit and others, 1996; Piatt and others, 2007; Bond and others, 2011).

Data on the pelagic distribution and abundance of seabirds are critical for understanding the basic ecology of marine birds, monitoring population trends, assessing the effects of human activities, identifying critical marine habitats, and educating the public about seabird conservation. Specifically, at-sea surveys in the North Pacific have been used to:

- Assess the impacts of oil spills on marine bird populations (Ford and others, 1987; Piatt and others, 1990; Burger, 1992; Klosiewski and Laing, 1994);
- Assess long-term changes in marine ecosystems in response to climate or geological changes (Ainley and others, 1995; Veit and others, 1996; Agler and others, 1999; Drew and others, 2010; Renner and others, 2013);
- Identify scaled features of marine ecosystems (Piatt and others, 1991; Elphick and Hunt, 1993; Piatt and Springer, 2004, 2007);
- Measure association of seabirds with biophysical features and identify structure in marine communities (Gould and Piatt, 1993; Springer and others, 1999; Piatt and others, 2006; Drew and others, 2012; Renner and others, 2012);
- Estimate population sizes of rare or threatened species that are impossible to census using traditional methods (Piatt and Ford, 1993; Agler and others, 1998; Piatt and others, 2007, 2011);
- Examine seasonal movements and winter habitat use by seabirds (Piatt and Naslund, 1995; Agler and others, 1998, Renner and others, 2008);
- Assess conflicts between commercial fisheries and marine birds (Karpouzi and others, 2007; Renner and others, 2013); and
- Plan marine reserves and bird protected areas (Hyrenbach and others, 2006; Smith and others, 2014).

Most of these projects have focused on addressing fine- to meso-scale ecological questions, and few have been conducted over a sufficiently large spatial area or long enough timeframe to draw conclusions about broad-scale processes—for example, decadal-scale changes in large marine ecosystems (Renner and others, 2013). This limitation largely has been a logistical one. With few exceptions, the cost (in terms of money and the time required to conduct at-sea surveys) has restricted the scope of marine bird studies to relatively small (<10,000 km^2) marine areas, and has limited the ability to investigate processes that operate at large spatial scales.

The solution to high logistical costs is to combine the various directed and opportunistic surveys for marine birds at sea conducted during recent decades by different organizations and researchers. The need for a comprehensive geographic database on the pelagic distribution of seabirds in the North Pacific has long been recognized. During the Outer Continental Shelf Environmental Assessment Program (OCSEAP), administered by the National Oceanographic and Atmospheric Administration (NOAA), millions of dollars were provided from 1973 through 1982 to conduct at-sea surveys of biological resources in advance of oil development on the Alaska Outer Continental shelf. This work culminated in an atlas on the "Pelagic Distribution and Abundance of Seabirds in the Gulf of Alaska and Eastern Bering Sea" (Gould and others, 1982), which documented the at-sea distribution and abundance of 16 common seabird species in Alaska. The end of OCSEAP funding signaled the end of at-sea survey data consolidation in the North Pacific until the U.S. Geological Survey initiated efforts to compile the pelagic seabird data again during the 1990s (Piatt, 1992; Piatt and Ford, 2001).

With support from the North Pacific Research Board in 2002, we constructed the NPPSD 1.0, assembling datasets collected since 1982 and then integrating the datasets with the OCSEAP data. NPPSD 1.0 included data from 465 individual surveys conducted between 1974 and 2002 consisting of 61,195 transects (samples) with counts of 6,995,932 birds and 29,739 marine mammals. Most at-sea seabird surveys usually have included collection of data on marine mammals because they are often observed foraging in the same areas as marine birds (Croll and others, 1998). A large number of marine mammals were observed outside the boundaries of strip transects for birds, so the data cannot be used to calculate densities, but all observations were included in the database because of their use in determining general distributions or ranges. NPPSD 1.0 has been used frequently for analyses of seabird and marine mammal distribution in the North Pacific (for example, Piatt and Springer, 2004, 2007; Hunt and others, 2005; Drew and Piatt, 2008; Piatt and others, 2006, 2007; Melvin and others, 2006; Renner and others, 2008).

In developing NPPSD 2.0, we expanded the geographic scope of the database to include the important marine areas adjacent to the large marine ecosystems of Alaska (Gulf of Alaska, eastern Bering Sea, and Chukchi and Beaufort Seas) and that share common avifauna, including areas such as the California Current (from Canada to southern California), the western Bering Sea, and the Sea of Okhotsk. We also included more associated environmental data. The overarching goal of the NPPSD project continues to be the compilation of North Pacific seabird surveys to provide a tool for addressing broad-scale ecological questions. The proliferation of large spatial-scale environmental datasets derived from satellite imagery (for example, sea-surface temperature, chlorophyll-a) now provides an opportunity to measure habitat associations over expanded spatial and temporal scales. Additionally, making the NPPSD 2.0 accessible from the USGS Alaska Science Center Website (alaska.usgs.gov) expands public access to results of federally funded research.

The specific objectives for the NPPSD 2.0 were to:

- Compile, document, and archive new incoming datasets.
- Develop and maintain a current taxonomic code list.
- Standardize formats and reorganize individual raw datasets into two tables: locations and observations.
- Merge all individual datasets into the NPPSD 2.0 database using the two-table structure.
- Release database on USGS Alaska Science Center Website.
- Create and collaborate on products developed from the data.
- Promote the development of a “community of practice” for users of the NPPSD 2.0 to facilitate broad-scale spatial and long-term temporal analyses.

In this report, we provide details regarding how we designed the database, the database sources, spatial and temporal coverage, structure, and data use. In addition to the database itself, two additional tools have been developed—(1) an updated taxonomic code list, and (2) a data extraction interface. Both of these tools can be accessed through the USGS Alaska Science Center Website.

Database Overview

Data Sources and Geographic Coverage

The NPPSD 2.0 contains marine bird survey data that span the North Pacific, bounded by the United States and Canada on the east, and the Russian Federation, Japan and Korea on the west (fig. 1). Sampling longitudes range from 129° E to 117° W. Sampling latitudes range from 88.5° N to the equator, but samples south of latitude 30° N are very limited. The largest survey efforts occurred on the continental shelves of Alaska, British Columbia and California. The NPPSD 1.0 included all OCSEAP at-sea seabird surveys as well as additional survey data from Southeast Alaska, Prince William Sound, Cook Inlet, Aleutian Islands, and eastern Bering Sea (Drew and Piatt 2005). New datasets were acquired for the coasts and shelves of California, Oregon, Washington, British Columbia, western Bering Sea, and the Sea of Okhotsk (fig. 2). NPPSD 2.0 extends not just the spatial coverage, but also the temporal range of observations to 1973–2012. In some areas, these new data provided the first repeated sampling in 30 years. The effects of the additional data went beyond extending the temporal range. For example, the first version of the database had no data from the Sea of Okhotsk, but in the NPPSD 2.0, data were added from that region for a period spanning 22 years (1984–2005).

The new survey datasets were collected by numerous Federal, State, and foreign agencies working on various projects. The list of contributors is provided in appendix A. The diversity of contributors introduced various raw dataset formats, and datasets often lacked metadata documentation. We archived all incoming datasets and associated metadata, if provided. Most of the surveys included in the NPPSD 2.0 collected data on multiple species; however, there are a small number of taxa specific surveys where only one or two species were recorded. Users should note this distinction when selecting data. The geographic distribution of sampling effort is detailed in table 1. These areas are based on a modified version of the North Pacific Marine Science Organization (PICES) subregion map (appendix B).

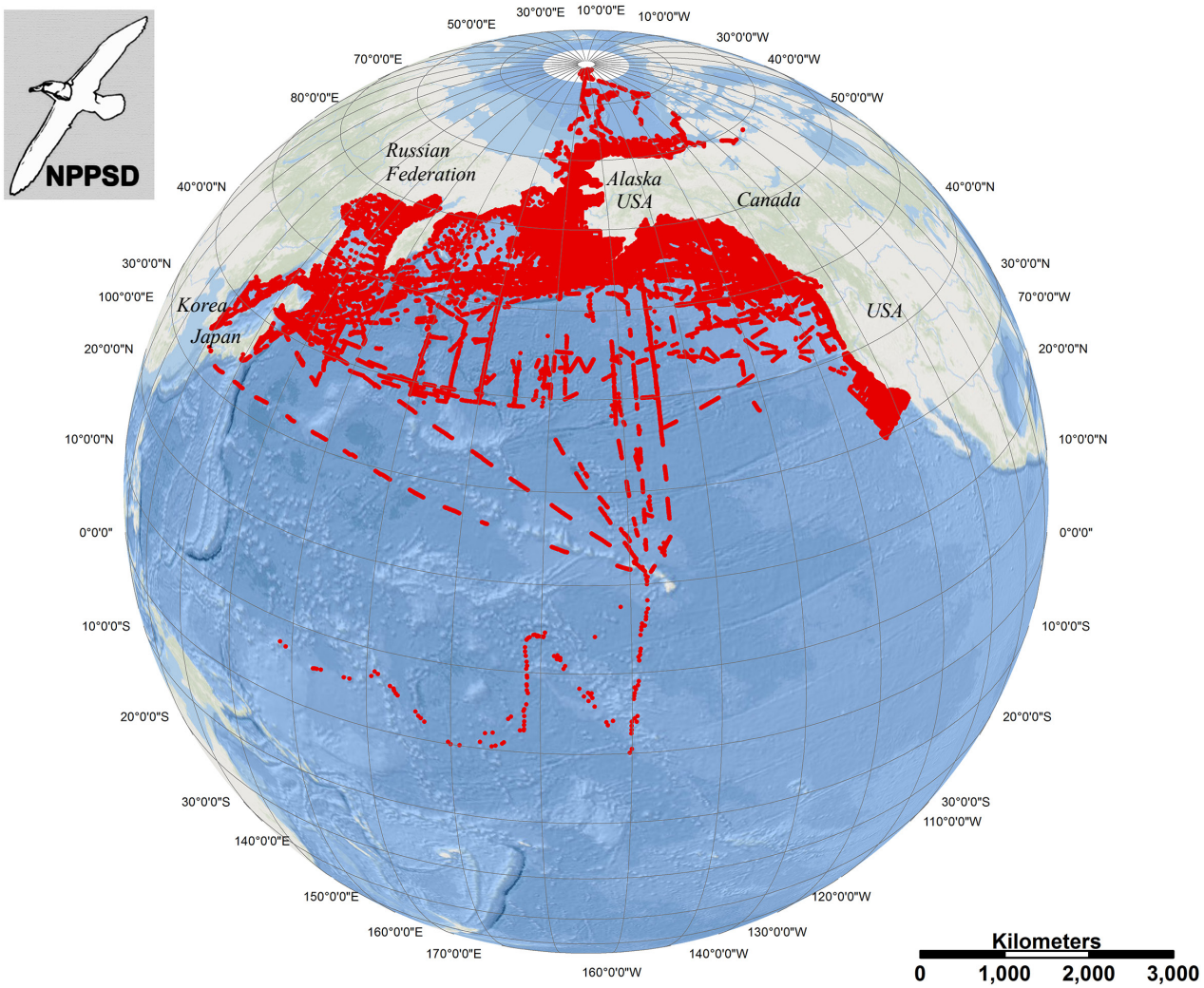

Figure 1. Global map showing scale of the North Pacific Pelagic Seabird Database (NPPSD). Red dots are individual transects (samples; total of 351,674).

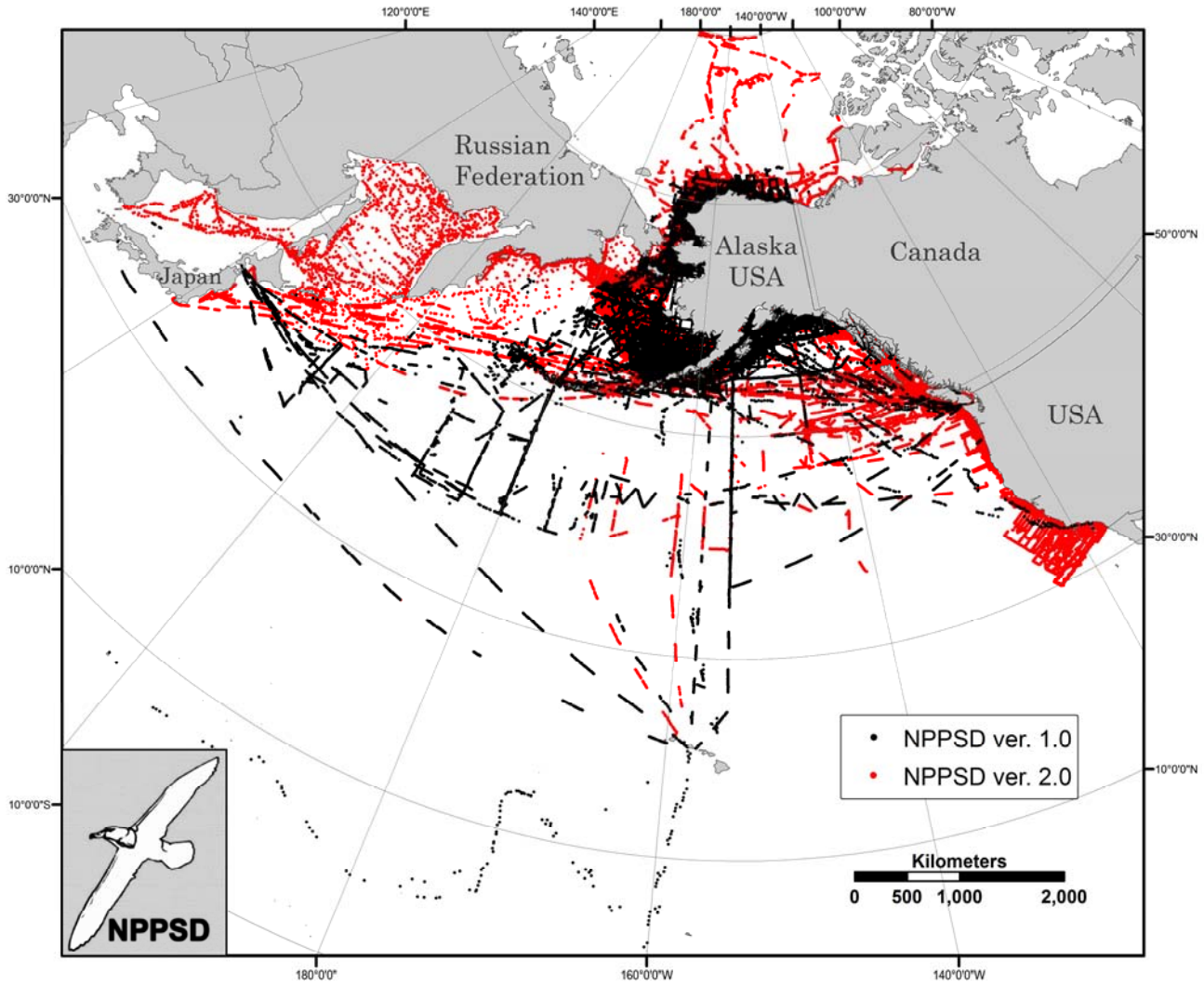

Figure 2. Geographic coverage of the North Pacific Pelagic Seabird Database (NPPSD). Sample points include the NPPSD version 1.0 and new samples added in the NPPSD version 2.0. Note that some new samples may be obscured by the samples from NPPSD 1.0 in some areas.

Table 1. Spatial distribution of pelagic seabird survey data (effort and observations) in the North Pacific Pelagic Seabird Database 2.0.

General area	Surveyed area (square kilometers)	Sample transects
Arctic Ocean	9,861	8,572
Aleutian Islands	9,882	13,521
Beaufort Sea	11,570	7,180
Bering Sea	74,661	87,452
California Current	31,349	66,717
Chukchi Sea	15,468	14,879
Eastern North Pacific	51,438	57,880
Western North Pacific	47,164	81,459
Coastal Gulf of Alaska	12,104	12,481
Sea of Japan	1,743	405
Sea of Okhotsk	5,019	1,128
Total	270,259	351,674

Database Structure

The most notable change in NPPSD 2.0 was the change from flat-file to relational-database format. The NPPSD 1.0 used a flat-file format that was simple and made it easy for users without database experience to select data. The volume of new data—a nearly five-fold increase in samples—made the previous flat-file format inefficient. The NPPSD 2.0 also was designed to minimize the redundancy found in version 1.0 of the database. This approach reduced storage requirements while giving the end-user more control over sample selection based on fields (for example, observer platform). The database was constructed with two tables: "tbl_LOCATION," hereafter referred to as the "location table," and "tbl_DATA_OBS," hereafter referred to as the "observation table." The location table provides a unique identifier, the spatial location and information on survey methods and conditions. The observation table contains information on the species, behavior, and number of marine birds and marine mammals. The two tables are linked by the Master Key field in both tables. Once in the new table structure, another round of proofing was conducted on both tables enabling us to identify and address numerous errors that had been missed in the initial examination as well as those that may have been a product of the conversion and reformatting process.

Production of the NPPSD 2.0 involved three developmental steps—(1) data acquisition (that is, gathering, documenting and archiving of datasets); (2) formatting and proofing (that is, correcting and standardizing data in location and observation tables); and (3) consolidation (that is, merging all surveys in a single relational database) (fig. 3). Treatment of data evolved between versions 1.0 and 2.0, with the greatest accommodation needed for the basic differences in the way data were collected in early decades compared to later decades. For example, much of the NPPSD 1.0 data were in the form of discrete samples (for example, in 10-minute counts) and in the OCSEAP multiple three-table format; whereas much of the NPPSD 2.0 data were in the form of a single table of continuously recorded data, which had to be binned into discrete samples. Both data types yielded similar final tables, but the steps in developing those tables differed.

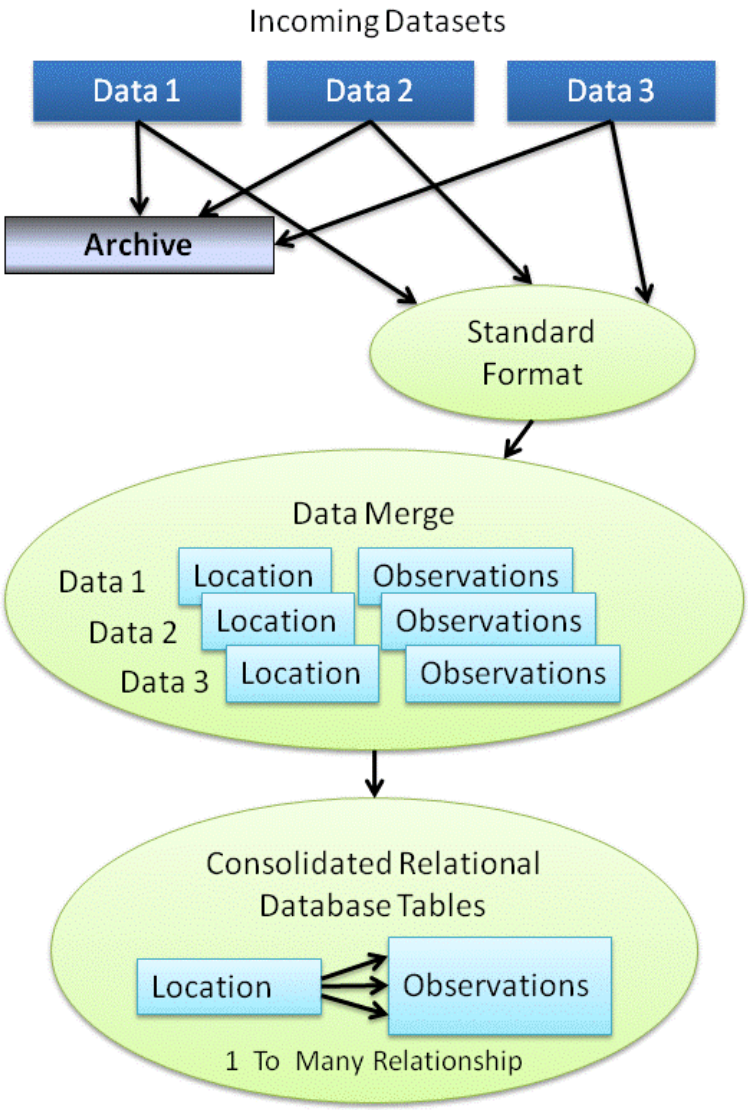

Figure 3. Conceptual model of North Pacific Pelagic Seabird Database processing and structure. Three rectangular boxes at the top of the model signify raw datasets, ellipses signify specific processes, and rectangular boxes inside ellipses signify data tables in the database.

Each dataset was imported into a relational database table for review. The data then were proofed using the highest standards possible given the metadata available for each survey. Simple queries were applied to identify values that were out of range. Corrections often could be made for obvious typographical errors. When no information was available for an out-of-range value, the contributor was queried (when possible). Where a value was outside the possible range (for example, a vessel speed of 300 km/h), and it was not possible to identify correct values through the contributor, the field was left blank. Datasets generally had little documentation, so contributors were contacted to address questionable or missing data values. Because data structure varied between surveys (for example, summarized by transect or continuous counts), contributed datasets were reorganized and queries were applied to standardize data into uniform fields, formats, and units. The results of these efforts were standardized tables that could be combined into a new relational database (fig. 3).

Taxonomic Codes

During creation of the NPPSD, numerous inconsistencies in use of species codes were identified. These inconsistencies could be traced back to two factors—(1) user-specific species codes, and (2) taxonomic changes. Different researchers often used different codes for the same taxa. This led to unnecessary confusion and increased the chances that errors would be introduced into the database. Additionally, the taxonomic status of some species has changed since the data were collected, leading to issues with legacy. For example, when taxonomy has split a species into two taxa, the "new" taxonomy will only be reflected for data collected after the change. It is essential that researchers understand that observations for one of these newly recognized species cannot be separated for previously collected data. These issues made the development of a current comprehensive code list for North Pacific at-sea surveys essential (appendix C).

We used the current American Ornithological Union bird species list (Pyle and DeSante, 2009) as a starting point for NPPSD 4-letter codes, and added unique codes for missing marine bird and marine mammal species. The NPPSD taxonomic code list 2.1 (appendixes C and D) includes the Integrated Taxonomic Information System (ITIS) (2013) Taxonomic Serial Number, scientific name, common name, NPPSD 4-letter code, and the National Oceanographic Data Center (NODC) (1996) Taxonomic Code Version 8. The NODC Taxonomic Code list is not current; it has not been updated since 1996, but it was taxonomically ordered. As such, the list remains a useful tool for sorting. In cases where species taxonomy has changed, additions were made to the NODC codes to reflect the new order. These added codes end in "99". This range of crosswalked standards maximized accuracy while ensuring compatibility with incoming data.

The NPPSD taxonomic code list for marine birds and mammals in the North Pacific is available on the NPPSD Web site. Because bird names will continue to change as new data strengthens our understanding of taxonomy, we view the code list as a dynamic document and expect both new additions and future revisions. All data in the NPPSD 2.0 have been reconciled with the current NPPSD taxonomic code list. We recommend that researchers adopt the NPPSD taxonomic code list, as it will facilitate the future integration of new datasets into the NPPSD. Updates to the code list will be posted on the NPPSD products page.

Location Table

In the location table, each record was unique, providing spatial and temporal information as well as details relevant to the sample transect (table 2). If a record failed to provide a latitude and longitude, the record was excluded. Latitude and longitude positions for each transect represent either the starting point (primarily before 1991) or transect centroid. Starting points were used when end of transect locations were not provided. These surveys were assumed to have been collected using the North American Datum of 1927 (NAD 27) and were converted to the World Geodetic System of 1984 (WGS 84). Data collected after 1990 were assumed to have been collected using a Global Positioning System (GPS) receiver set to the North American Datum of 1983 (NAD 83) or WGS 84 datums. The differences between NAD 83 and WGS 84 datums are well below the accuracy range of most GPS receivers (on the order of a few meters,) so they were treated as identical. For most datasets collected after 1990, contributors either provided the centroids or we were able to use a geographic information system (GIS) to extract the middle point of the transect from the provided track data. Some latitude-longitude locations were typographical errors (for example, over land), and were approximated using prior and following transect locations. If there were insufficient data to correct the point, then the record was excluded. The position type (start or centroid) is provided in the database. A sample area was calculated from the data that were provided. If a sample area could not be calculated for a record because of missing data (for example, transect length), this field was left blank. In these cases, the lack of sampled area also precludes the calculation of densities in the observation table (n=3260; <1 percent of transects). Environmental information (for example, sea-surface temperature) collected on surveys was included when provided; however, most transects lacked this information. If any data fields were missing, these fields were left blank, with the exception of the Contributor field, where blank fields were replaced with "Unknown."

Most fields in the location table are self-explanatory; however, there are several exceptions. Some fields were the result of calculations or classifications and required further description. Additionally, although numerous environmental fields are in the location table, such data were not available for most surveys. Surveys with environmental data tend to be those collected under the OCSEAP. Detailed explanations for a subset of the location table fields are as follows:

Master Key—The Master Key field provides the link between the location and observation tables. For the NPPSD 2.0, we used the Master Keys from the NPPSD 1.0, and those provided by contributors of new datasets. By using these "legacy" values, we retained the link to original datasets. The only requirement was that the Master Key be a unique identifier of each sample location. The location and observation tables were joined using the Master Key field with a one-to-many relationship. Thus, each record in the location table was unique but could be associated with multiple or no observation records in the observation table.

Survey ID—Additional survey identifier associated with incoming data. This field often is not unique and primarily is useful for linking back to raw datasets.

Station Number—Optional field included in some surveys that identifies a specific location. This field was provided in some surveys by researchers collecting repeated samples over time and is included for their benefit.

Modified Platform Type—We recognized five different platform types, adopted from OCSEAP-U.S. Fish and Wildlife (FWS) protocols (Gould and Forsell, 1989): (1) Aircraft, (2) Land, (3) Large Boat, (4) Small Boat, and (5) Station. Most samples were from Large Boats (> 20 m) and Small Boats (< 20 m). Land and station samples do not have a sample area and, therefore, do not have a density associated with a sample area. This field can be used to filter out samples that may be inappropriate for certain species or analyses. For example, aircraft-based surveys might be excluded for assessments of small species that are difficult to see or identify. Stations are a unique category indicating a fixed site; for example, an anchored ship or drilling platform. There are relatively few station data, all from OCSEAP years of study.

Modified Survey Type—Most of the data were classified as "Pelagic Survey." Some survey types were not specified, but they were assumed to be pelagic surveys when they included transect duration, width, and distance. During the OCSEAP data collection there also were station surveys, where species were counted in a fixed area (from a non-moving platform) over a fixed time period. These stations do not have a sample area, so they are automatically excluded from density calculations. The survey type "Off Transect Observation" is used only on a few samples from the OCSEAP data. No sample area is associated with these samples, and they are automatically excluded from density calculations. These observations will be included in exports of counts unless filtered out.

Survey Target—Identifies surveys as "All" (all species recorded) or taxa-specific. In the NPPSD 2.0, the only taxa-specific surveys in the NPPSD are for *Brachyramphus spp.* and Kittlitz's murrelets.

Fly-Bird Method—This field distinguishes between surveys that use the "snapshot" method (Tasker and others, 1984) of counting flying birds passing through the sample area from surveys that use alternate methods. In most surveys, flying birds were counted at regular intervals (snapshots), not continuously, to minimize overestimation of bird densities owing to the flux of rapidly moving birds across the transect (Tasker and others, 1984; Gould and Forsell, 1989). However, in some surveys, flying birds were counted continuously. Although it is accepted that counting all flying birds will lead to overestimates of density, the amount of bias will vary by species, behavior, and flight direction (Spear and others, 2004). Given the generally high variability of at-sea survey densities, and the high proportion of observed birds sighted while sitting on the water, this bias should not preclude comparisons of these data in most cases. The exception may be in the counts of birds rarely seen sitting on the water (for example, storm petrels). The methodology used for counting flying birds ("continuous" or "snapshot") was included in the NPPSD data table so users could decide how to treat and interpret the resulting counts. If the counting methodology was not specified, it was recorded as "Unknown." The user is cautioned that combining continuous and snapshot samples without further correction may not be appropriate for all analyses and results will vary by species. Users may use only birds not flying, both methods combined, or they may export flying birds separately for each methodology (continuous or snapshot) and apply their own correction factors. The user is responsible for handling such corrections.

Loc Method—This field provides details on the method used to determine the latitude-longitude location of the sample. Much of the OCSEAP data forming the core of the NPPSD 1.0 data contain only the latitude and longitude recorded at the beginning of the transect. For most of the post-OCSEAP data, the latitude and longitude locations are based on the centroid of the sample transect.

Lat—Latitude of the sample location in decimal degrees using the WGS 84 datum.

Lon—Longitude of the sample location in decimal degrees using the WGS 84 datum. These longitudes are based on a -180 to 180 degree coordinate system. The 180th meridian runs through the middle of the NPPSD study area; thus, the dataset includes both positive and negative longitudes.

Sample Area—A critical element of the location table was the calculation of the area sampled. This element was required to determine bird densities at sea (number of birds per km^2). Sample areas were calculated in one of four ways, in descending order of accuracy—(1) the contributors provided an accurate sample area based on their own calculations from GPS data; (2) we calculated area as a product of transect length (or bin length) measured from a GPS source times transect width; (3) we calculated area as a product of transect length (calculated from vessel speed and elapsed time) times transect width; and (4) if none of the previous data sources were available and we had a beginning and an end location (lat-lon), we calculated the minimum distance between start and stop, and multiplied it by transect width to calculate area. Records where no sample areas could be calculated cannot be used for density calculations.

Table 2. Fields and data descriptions of the location table ("tbl_Location") of the North Pacific Pelagic Seabird Database.

Field name	Description
Master Key	Up to 25-digit unique identifier linking locations to observations
Survey ID	Identifier for survey; for example, "Semidi Islands 2006"
Station Number	Number for each transect or station within a Survey ID
Modified Platform Type	Small Boat, Large Boat, Land, Station, or Aircraft
Modified Survey Type	Pelagic Survey, Station, or Unk (Unknown)
Survey Target	Either "All" or a specific species or taxa
Fly-Bird-Method	All or Snapshot
Loc Method	Start (start of transect), Centroid (midpoint of transect)
Lat	Lat - Decimal Degrees
Lon	Lon - Decimal Degrees
Year	Year YYYY
Month	Month 1–12
Day	Day of month 1–31
Julian Day	Julian Day 1–366
Hour	Local Time Hour 0–23
Minute	Minute 0-59
Elapsed Time	Minutes sampled
Transect Width	Strip (bin) width in meters
Speed	Average boat speed over bin in kilometers per hour
Source	Dataset provider
PI Credit	Contributing Scientist or Agency
Depth	Depth in meters
Surface Temperature	Temperature in °C
Surface Salinity	Surface salinity, to nearest tenth of a part per thousand (psu)
Barometric Pressure	Barometric pressure to nearest tenths of a millibar (haPa)
Barometric Trend	0-steady, + rising, or – falling
Wind Speed	In meters per second
Sea State	Beaufort Scale assumed
Weather	subjective not standardized
Sample Area	Area of bin in square kilometers

Observation Table

The observation table contains records with information regarding species, number observed, behavior, etc. (table 3). There may be multiple observations at a given location, so multiple records may share the same "Master Key." Although every effort was made to double-check data with the data contributor on species that were rare, difficult to identify, or seemingly beyond normal distribution range, we were often unable to verify unusual records. Nor did we presume to second-guess the species identifications made by individual observers. Therefore, observations of very rare, difficult to identify, or vagrant species should be used with caution. In addition to raw counts, density calculations (sample count/sample area) for each transect were stored in the observation table to increase the speed of queries; however, when binning data, density should be recalculated (total count in bin/total sampled area in bin). Common name and the NPPSD 4-letter code were included for each record.

As with the location table, most fields in the observation tables are self-explanatory. An exception is the treatment of "off-transect" observations. Although these observations could not be used to calculate densities, they were retained in the data tables to preserve rare sightings or to determine the spatial distribution (range) of species. Additional descriptions for several fields are as follows:

Master Key—This field links "Observations" to the location table using a many (observations)–to-one (location) relationship. Thus, in the observation tables, this field is not necessarily unique. Each Master Key may have many or no observations, so it may be repeated or absent in the Data table. If there are no observations, the cross-tabulation will return a zero for "SumOfNumber" and "Density."
Density—This field is calculated from taking the SumOfNumber value in this table and dividing it by the Sample Area from the associated location table record. If there are no observation records for a location record, a cross-tabulation with the location table will return a zero density for all species for that sample. Only "on transect" counts are included in the density calculation. See "Modified Behavior" below for how behaviors were treated as on or off transect.
NPPSD 4-Letter Code—Although somewhat redundant with common names, the 4-letter codes are used commonly by bird researchers for convenience, brevity, and compatibility (dbf format truncates field names to 10 characters, and that can result in duplicate field names). Note that both common name and 4-letter codes are filtered through the NPPSD taxonomic code list to standardize them among surveys.
Modified Behavior—A large number of behaviors were reported in raw datasets by various investigators. We selected a small number of broad categories and converted codes used by others to the closest equivalent. The categories are:

Feeding —exhibiting foraging behavior indicative of active feeding
Fish—on the water holding fish in bill
Flying —all flying birds not exhibiting active feeding behavior
Water—sitting on water
Unk—no behavior recorded, assumed to be on water in most cases
Boat—sitting on boat (these are treated as off-transect and not used for densities)
Dead— (these are treated as off-transect and not used for densities)
Land—on land (these are treated as off-transect and not used for densities)

OT-OBS—This field was added in this version of the NPPSD to ensure that rare "off-transect observations" (that is, out of the sampling area) were retained. In addition to rare sightings, Modified Behavior of "Boat", "Dead", and "Land" also were classified as OT-OBS.

Table 3. Fields and descriptions of the observation table ("tbl_Data_Obs") of the North Pacific Pelagic Seabird Database.

[Note The Master Key is not unique in this table. A given Master Key (sample location) may have multiple or no associated records in the observation table depending on the species observed.]

Field name	Description
Master Key	Up to 25-digit identifier used to link location table to observations
Common Name	Common name of species observed
Density	Number per square kilometer for a given species, behavior, OT-OBS combination.
SumOfNumber	Sum of a given species with similar behavior at this location
NPPSD 4-Letter Code	NPPSD version 2.1 4-letter code
Modified Behavior	General behavior (see detailed description in text).
Source	Person transferring data
PI Credit	Contributing Scientist or Agency
OT-OBS	Off Transect Observation – Yes or No
Comments	Explanatory text–254-character limit

Metadata for Contributed Surveys

The amount of content information, or metadata, available for each survey was highly variable. Surveys collected prior to the adoption of a Federal metadata standard (before 1995) lacked any formal metadata documentation. We were able to gain access to many of the hardcopy data forms prior to 1995, making the extraction of metadata possible. Because future researchers may not have access to these originals or the researchers that collected the data, a considerable effort was made to extract metadata for these surveys. These original data sheets also were invaluable for proofing early datasets and identifying errors.

When metadata were provided for a contributed dataset, they were archived with the raw incoming data. Contributors now are required to include basic Federal Geographic Data Committee (FGDC) compliant metadata with contributed datasets.

Metadata for the NPPSD 2.0

For general reference purposes, metadata for the entire NPPSD 2.0 dataset are provided with the NPPSD dataset (https://dx.doi.org/10.5066/F7WQ01T3).

Database Contents

Biological Observations

The NPPSD 2.0 was the result of combining many individual survey programs for marine birds in the North Pacific. These surveys contained 351,674 sample transects covering an area of 270,259 km^2 and include the observations of 16,988,138 birds and 235,545 marine mammals. The 20 most abundant bird taxa are shown in table 4; a complete listing of all bird taxa counted and included in the NPPSD is shown in appendix C. Note that several of the taxa on the list are identified to a broader taxonomic class than species because of identification difficulties. The 20 most abundant marine mammals are shown in table 5. A complete summary listing of marine mammal observations in the NPPSD 2.0 is shown in appendix D.

Maps to identify species distributions can be created by selecting data from the database and binning it to the appropriate scale given the questions being addressed. Bins of NPPSD data can be created at any scale using a GIS, but at the scale of the North Pacific, 100 × 100 km "cells" are most appropriate. As an example, a summary of Tufted Puffin counts per bin divided by the total sampled area within each cell provides an index of density illustrating the distribution of this species across its entire range (fig. 4).

Sampling Effort

Survey efforts varied greatly over time and space, and were concentrated in a few productive continental shelf areas and thinly distributed over a much larger area of the northern seas. The spatial-temporal variability in sampling reveals which areas are most useful for assessing long-term changes in bird communities, and which areas need more attention in the future. A map that includes all surveys binned into 50 × 50 km cells reveals that effort was highly variable among areas, with the greatest sampling offshore of southern California, coastal British Columbia, southeastern and south-central coastal Alaska, and the eastern Bering Sea (fig. 5).

To examine the distribution of sampling efforts through time, the dataset was divided into four decadal periods: 1973–1982, 1983–1992, 1993–2002, and 2003–2012 (figs. 6*A*-6*D*). Each decadal period then was converted to a raster with a cell size of 50 × 50 km. The value (color) of the cell was equal to area sampled (in square kilometers) within each cell for these four time periods. Sampling intensity and extent varied widely across time periods (fig. 6). These map layers can be used as a guide for future research by identifying the sample availability for time periods of interest and (or) time spans. We overlaid the four periods and summed the number represented. When viewed this way, areas with extended temporal data are highlighted (fig. 7). The Bering Sea is the region with the most long-term data. Long-term data also are available for the Alaska Peninsula, southern British Columbia, and parts of the Aleutian Islands.

Temporal sampling efforts across years and seasons also were highly variable. At-sea sampling was relatively rare prior to the OCSEAP. The effect of that program can be seen in the rapid increase in sampling in 1975 (fig. 8). Since that time, sampling has varied in association with various programs and projects—for example, *Exxon Valdez* oil spill assessments after the 1989 spill and a large increase in sampling associated with the Bering Ecosystem Study and Bering Sea Integrated Ecosystem Research Program (2008–2014). Within-year sampling shows a seasonal bias, with the northern hemisphere summer breeding season (May–September) dominating the data records (fig. 9).

Table 4. A listing of the 20 most abundant bird taxa in the North Pacific Pelagic Seabird Database 2.0.

Common name	Scientific name	Number of birds
Unidentified Shearwater	*Procellariidae spp.*	3,337,645
Short-tailed Shearwater	*Puffinus tenuirostris*	2,093,018
Sooty Shearwater	*Puffinus griseus*	1,295,024
Unidentified Murre	*Uria spp.*	1,138,267
Northern Fulmar	*Fulmarus glacialis*	967,698
Least Auklet	*Aethia pusilla*	867,946
Long-tailed Duck	*Clangula hyemalis*	763,392
Crested Auklet	*Aethia cristatella*	550,097
Black-legged Kittiwake	*Rissa tridactyla*	565,974
Spectacled Eider	*Somateria fischeri*	523,456
Common Murre	*Uria aalge*	509,546
Tufted Puffin	*Fratercula cirrhata*	337,745
Glaucous-winged Gull	*Larus glaucescens*	324,568
Fork-tailed Storm-petrel	*Oceanodroma furcata*	315,615
Thick-billed Murre	*Uria lomvia*	148,581
Red Phalarope	*Phalaropus fulicaria*	134,727
Marbled Murrelet	*Brachyramphus marmoratus*	122,575
Unidentified Alcid	*Alcidae spp.*	110,653
Unidentified Phalarope	*Phalaropus spp.*	107,746
Unidentified Eider	*Somateria* or *Polysticta spp.*	104,871
Total		14,319,144

Table 5. A listing of the 20 most abundant marine mammal species in the North Pacific Pelagic Seabird Database 2.0

Common name	Scientific name	Number of marine mammals
Common Dolphin	*Delphinus delphis*	64,017
Sea Otter	*Enhydra lutris*	29,885
Steller Sea Lion	*Eumetopias jubatus*	27,808
Dall's Porpoise	*Phocoenoides dalli*	20,086
Pacific Walrus	*Odobenus rosmarus divergens*	16,859
Unidentified Dolphin	*Unidentified Delphinidae*	13,495
Harbor Seal	*Phoca vitulina*	12,599
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	9,832
California Sea Lion	*Zalophus californianus*	5,963
Northern Fur Seal	*Callorhinus ursinus*	5,774
Risso's Dolphin	*Grampus griseus*	3,607
Unidentified Seal	*Phocidae (Family)*	2,924
Humpback Whale	*Megaptera novaeangliae*	2,921
Northern Right Whale Dolphin	*Lissodelphis borealis*	2,853
Harbor Porpoise	*Phocoena phocoena*	2,302
Gray Whale	*Eschrichtius robustus*	1,752
Killer Whale	*Orcinus orca*	1,663
Unidentified Whale	*Cetacea (Order)*	1,658
Spotted Seal	*Phoca largha*	1,624
Fin Whale	*Balaenoptera physalus*	1,277
Total		228,899

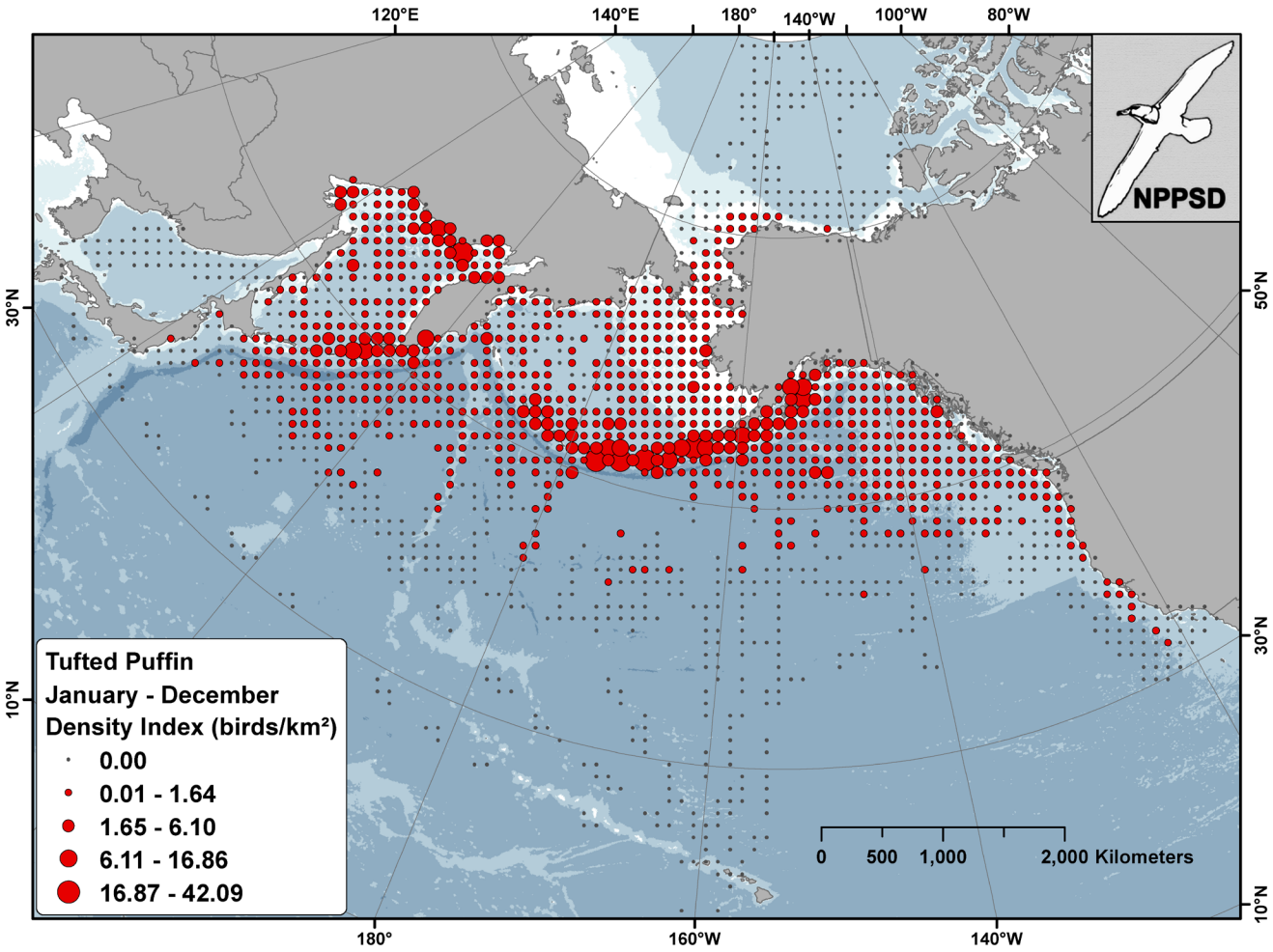

Figure 4. Density of Tufted Puffin across the North Pacific, 1973–2012. Data from the North Pacific Pelagic Seabird Database (NPPSD) were binned into 100× 100 kilometer cells; total numbers were divided by total sampled area. Gray dots represent sampled cells with zero counts.

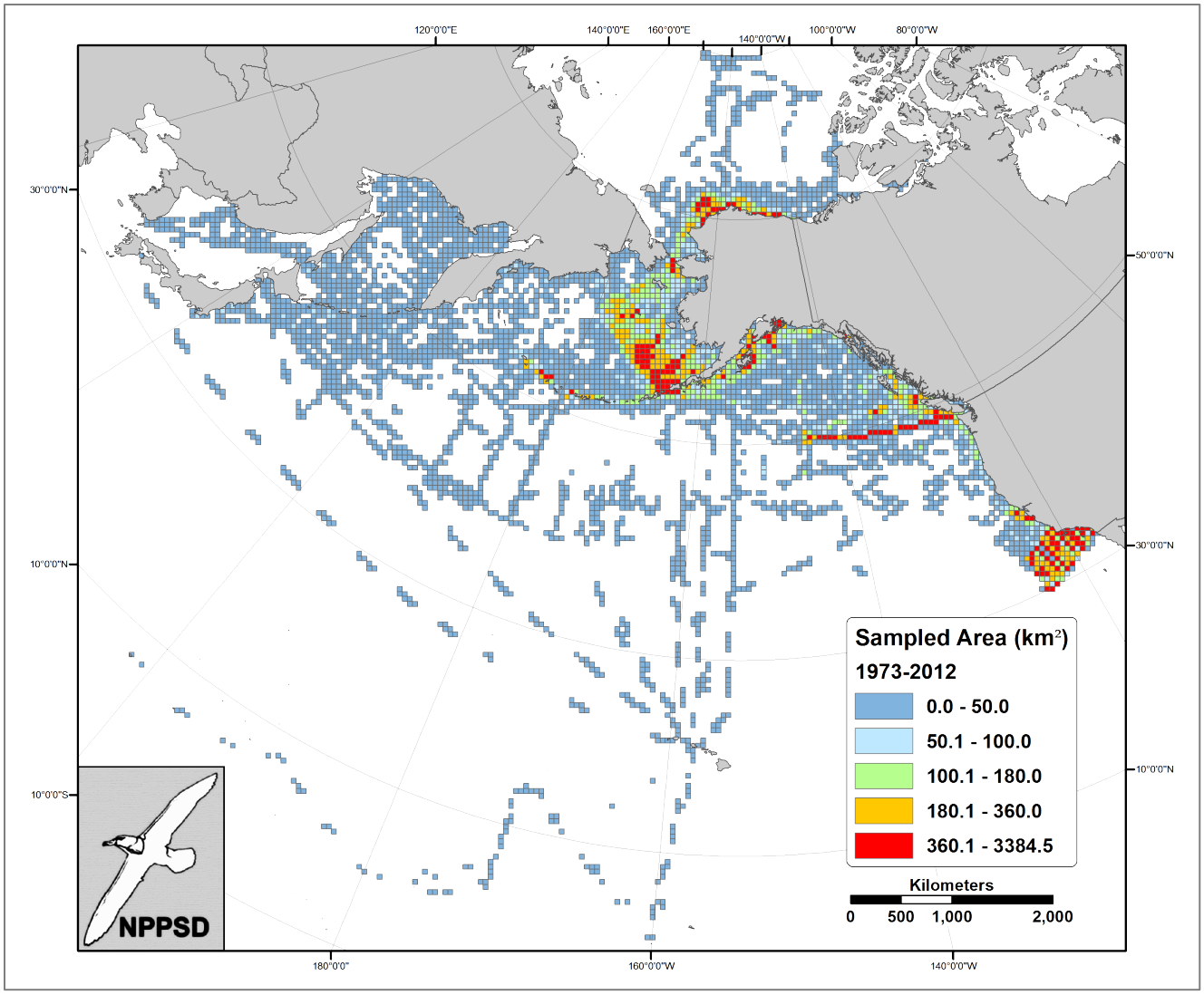

Figure 5. Distribution of samples (number of km^2 surveyed) in the North Pacific Pelagic Seabird Database (NPPSD) version 2.0, 1973–2012. The area sampled within 50 × 50 kilometer cells was summed for all years.

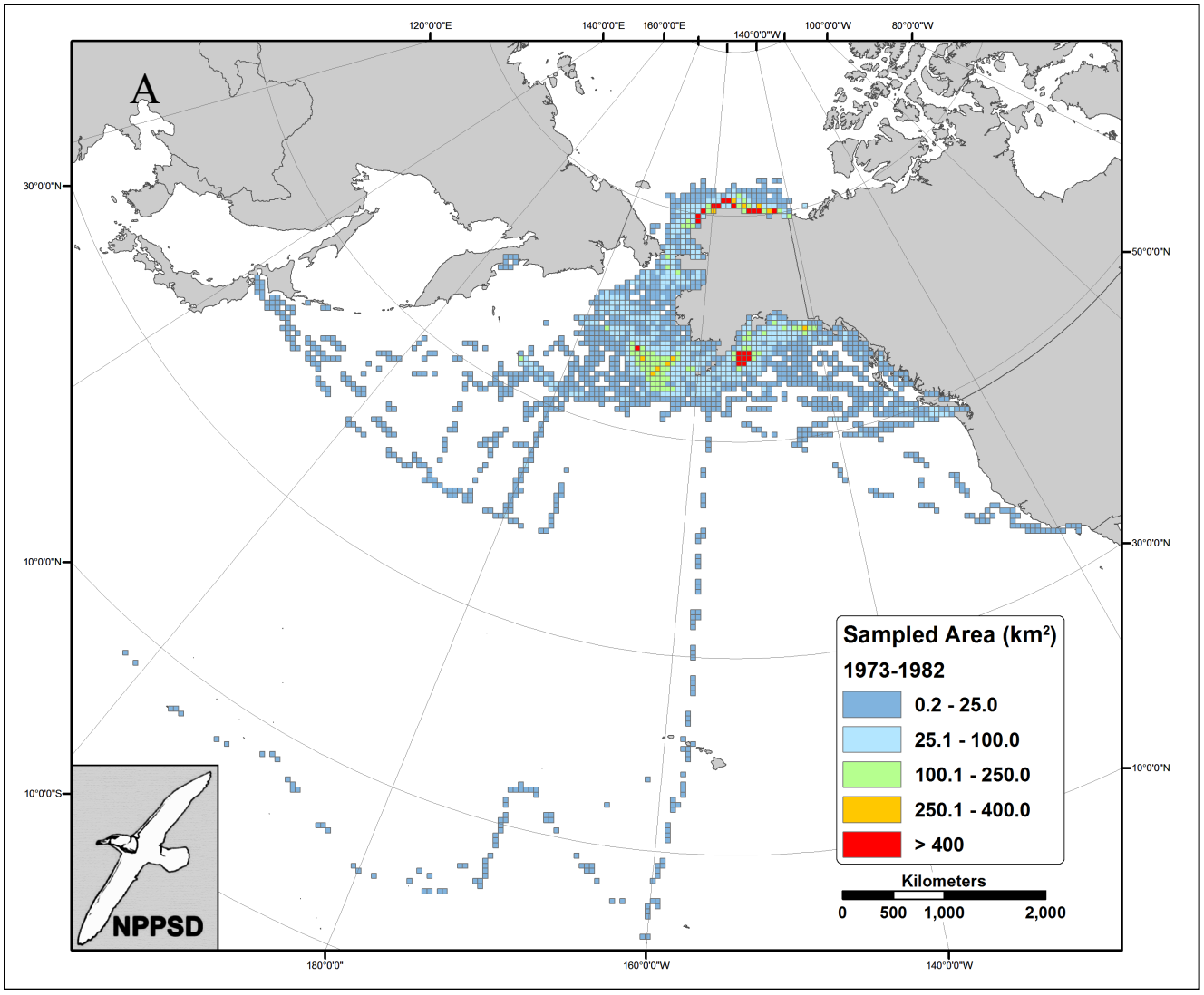

Figure 6. Sum of area sampled (number of km^2 surveyed) during four time periods (*A*) 1973–1982, (*B*) 1983–1992, (*C*) 1993–2002, and (*D*) 2003–2012. Cells are 50 × 50 km.

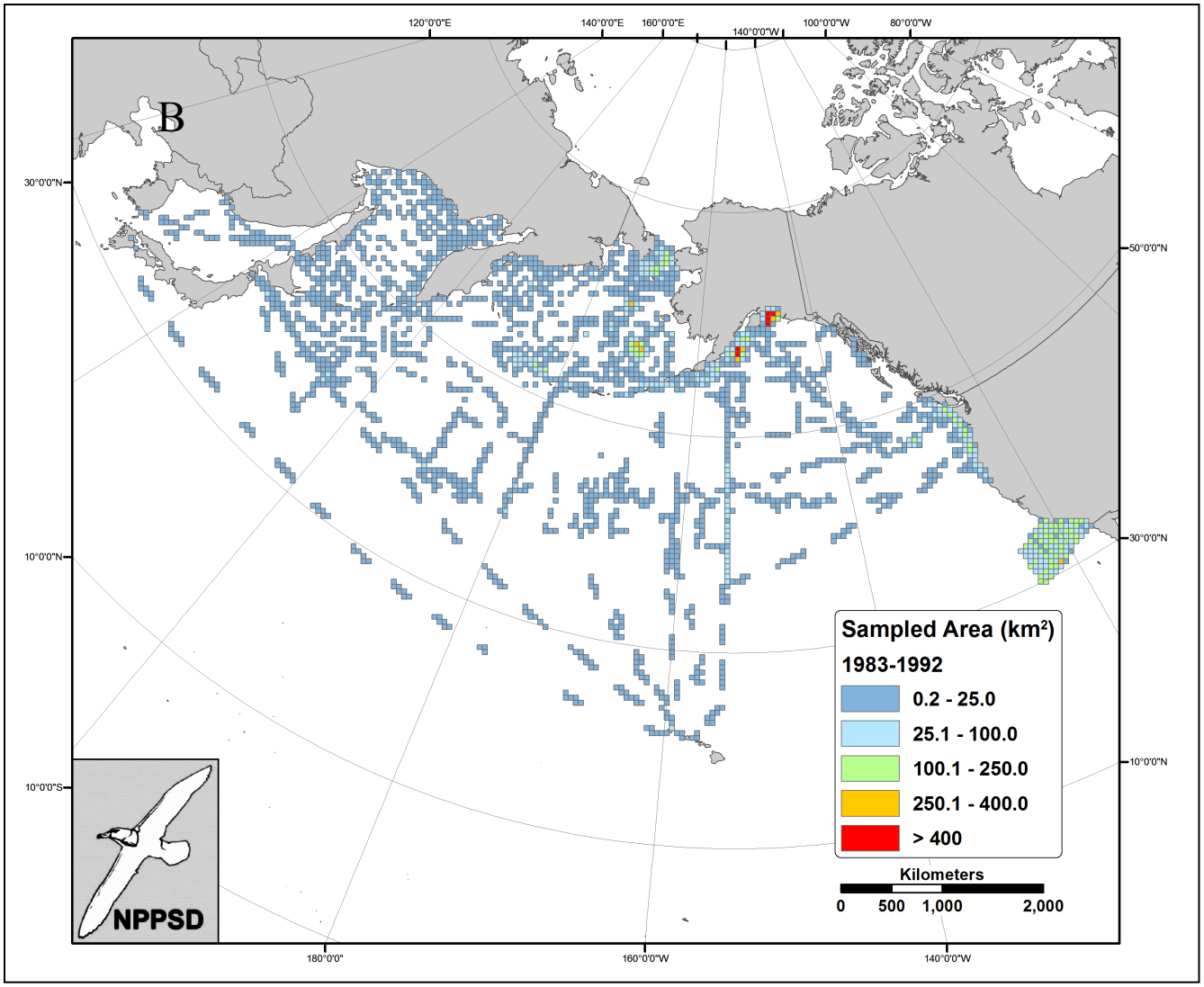

Figure 6. Continued.

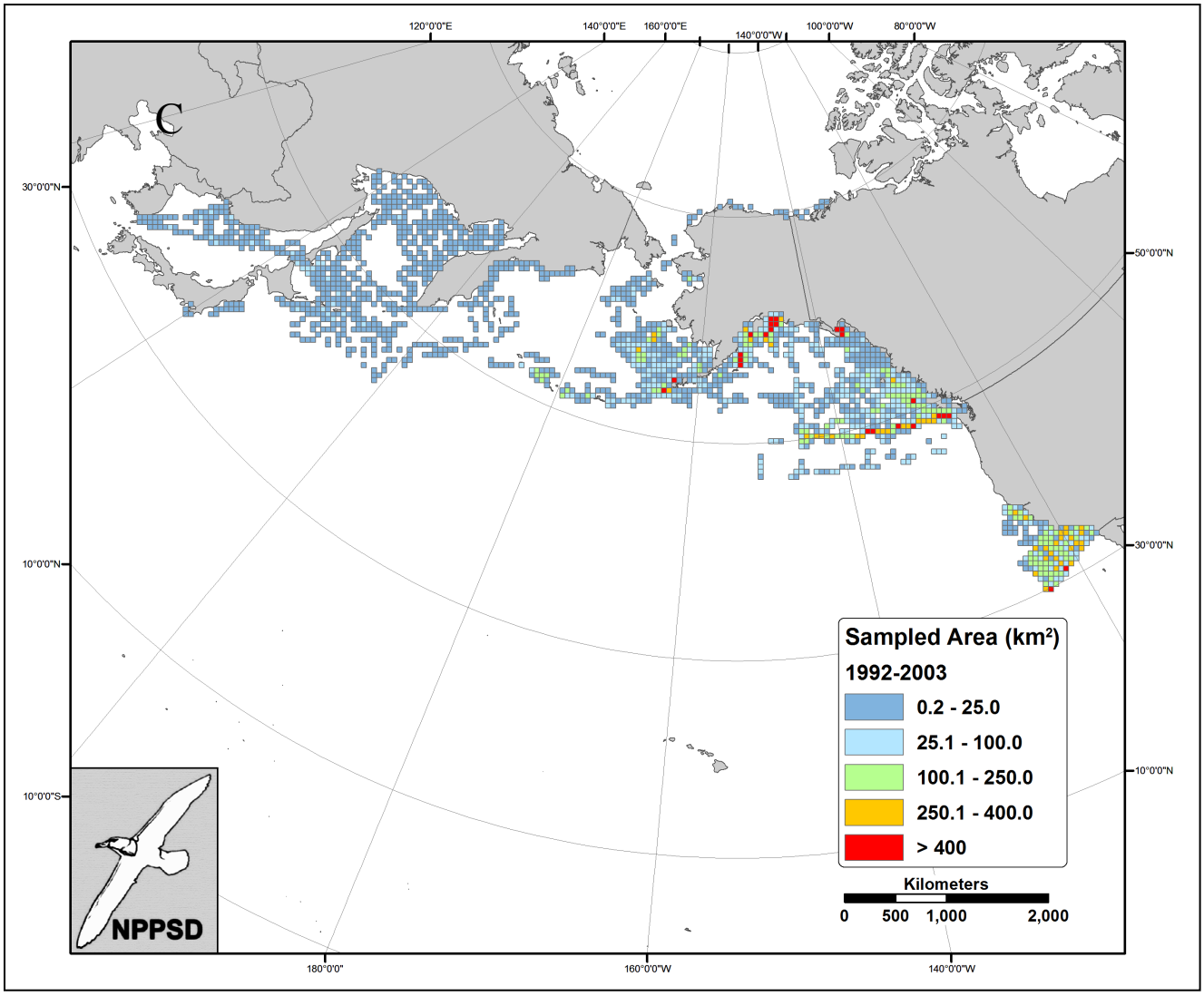

Figure 6. Continued.

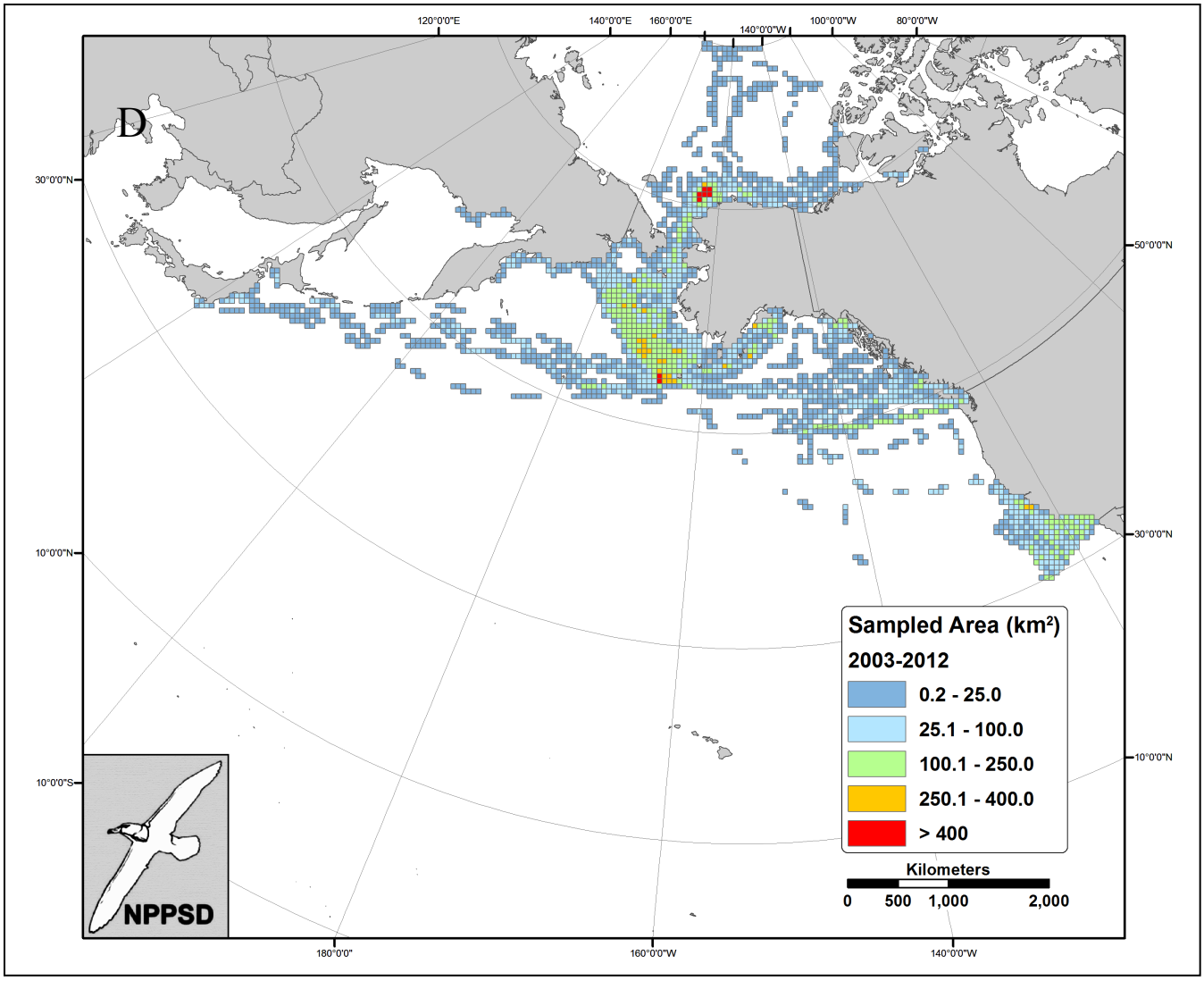

Figure 6. Continued.

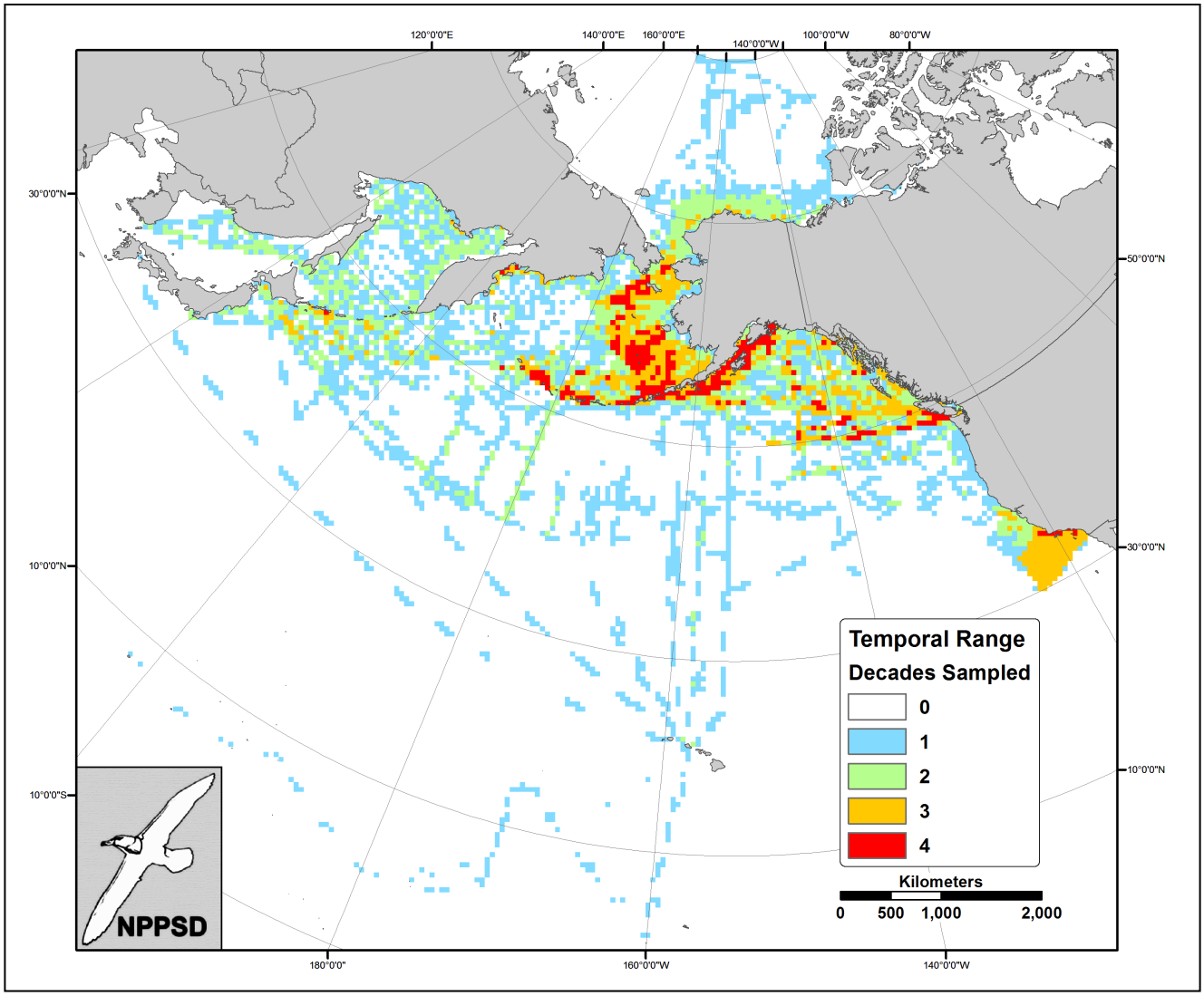

Figure 7. North Pacific Pelagic Seabird Database (NPPSD) version 2.0 sample representation across four decades—1973–1982, 1983–1992, 1993–2002, and 2003–2012. Cells are 50 × 50 km. Warmer colors indicate a longer sampling history.

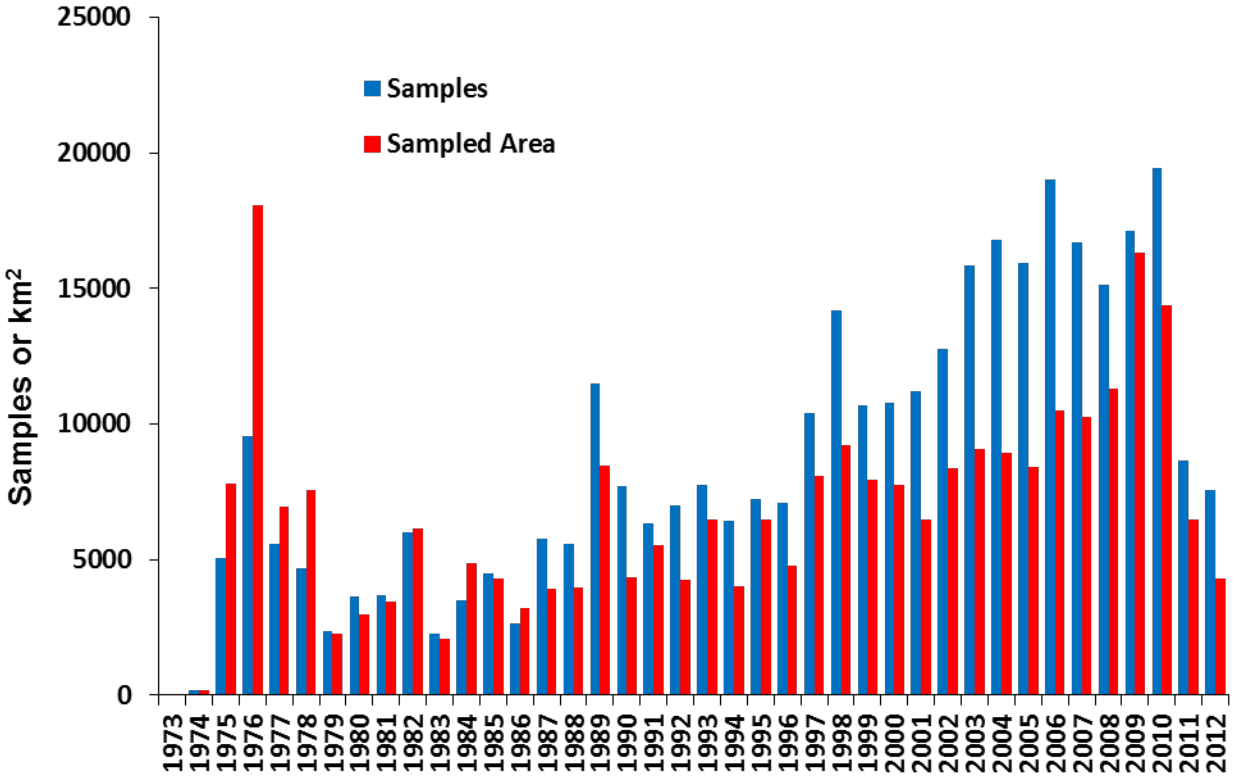

Figure 8. Numbers of monthly samples and sampled area for the North Pacific Pelagic Seabird Database (NPPSD), 1973–2012.

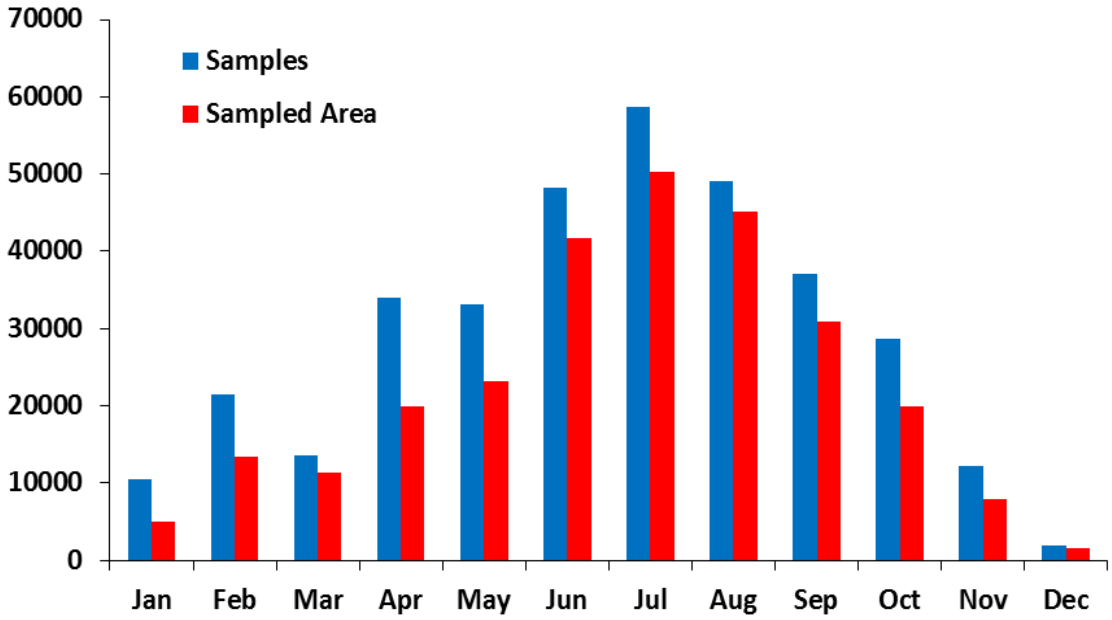

Figure 9. Graph showing numbers of monthly samples and sampled area for the North Pacific Pelagic Seabird Database (NPPSD), 1973–2012.

Summary

This report provides documentation of the structure, scope, and limitations of the North Pacific Pelagic Seabird Database (NPPSD) 2.0. The NPPSD 2.0 is the largest database on marine birds and marine mammals at sea in the North Pacific, and is among the largest compilations of seabird distribution data in the world. This second version of the database represents a nearly five-fold increase in samples, while also substantially increasing the spatial and temporal range of the data. NPPSD 2.0 has expanded into previously underrepresented areas (for example, the Sea of Okhotsk and California), and has extended the time series of samples in some areas—notably the Bering Sea—to four decades. Spatial and temporal distributions, as shown in effort maps and temporal graphs, can assist researchers in determining the adequacy of the NPPSD to address specific questions. In conjunction with the current availability of broad-scale environmental datasets, the NPPSD 2.0 is a powerful tool to address broad-scale questions critical to the understanding of how climate change, regime shifts, and biogeography are associated with the distribution and habitat use of top marine predators. The database is available at https://dx.doi.org/10.5066/F7WQ01T3. To assist in the extraction of data from the NPPSD a query tool (appendix E) also is available on the NPPSD Web page on the USGS Alaska Science Center site (http://alaska.usgs.gov/).

Data from the NPPSD 2.0 already have been used in several publications since 2012. A complete list of products using the NPPSD (including version 1.0) is available on the NPPSD Web page on the USGS Alaska Science Center site. In addition to the database itself, the NPPSD taxonomic code list, available as a stand-alone product, provides a useful tool for standardizing data codes and crosswalking between various taxonomic conventions. Use of the NPPSD code list will assist in integrating new data quickly and accurately. This code list is a dynamic document that is periodically updated to represent current taxonomy. The most current version of this code list is available on the NPPSD Web page on the USGS Alaska Science Center site (http://alaska.usgs.gov/).

Acknowledgments

Development of NPPSD 2.0 was made possible by long-term support from the Wildlife Program of the U.S. Geological Survey Ecosystems Mission Area. The list of data collectors and contributors is long, and a full accounting is available from the metadata for the NPPSD. We thank all those observers for their long hours spent counting birds at sea, quite often during inhospitable conditions. A short list of major contributors to the NPPSD database (in addition to being major data collectors) includes: Vernon Byrd (U.S. Fish and Wildlife Service), Robert Day (ABR Inc.), Don Dragoo (U.S. Fish and Wildlife Service), R. Glenn Ford (Ecological Consulting, Inc., Portland, Oregon), George Hunt, Jr. (University of California-Irvine / University of Washington), David Irons (U.S. Fish and Wildlife Service), Kathy Kuletz (U.S. Fish and Wildlife Service), Kathleen Moore (Canadian Wildlife Service, Environment Canada), Ken Morgan (Canadian Wildlife Service, Environment Canada), Vjatcheslav Shuntov (Pacific Research Institute of Fisheries and Oceanography), Bill Sydeman (Farallon Institute), and Denny Zwiefelhofer (U.S. Fish and Wildlife Service). A complete list of contributors is available in appendix A. We are grateful to Anthony DeGange, Kathleen Moore, and Ken Morgan for reviewing this document and providing helpful comments to improve this manuscript. The North Pacific Research Board, U.S. Fish and Wildlife Service, and the U.S. Geological Survey, provided financial support to the NPPSD project.

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Appendix A. List of Contributors to the North Pacific Pelagic Seabird Database as Individuals, Program Managers, or Institutions

[Note for the few contributions for which credit for data was not clear we used observer's name, which may not reflect the actual principal investigator. Contributors of more than 1,000 transects are indicated by an asterisk*; of more than 5,000 transects are indicated by two asterisks**. Additionally, affiliations refer to time of data collection and may not reflect current status]

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Beverly Agler*	U.S. Fish and Wildlife Service, Region 7, Migratory Bird Management
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James Bartonek	U.S. Fish and Wildlife Service, Region 7
Judith Benson	Unknown
John Blackenship	Unknown
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Ken T. Briggs*	Ecological Consulting, Inc., Portland, Oregon
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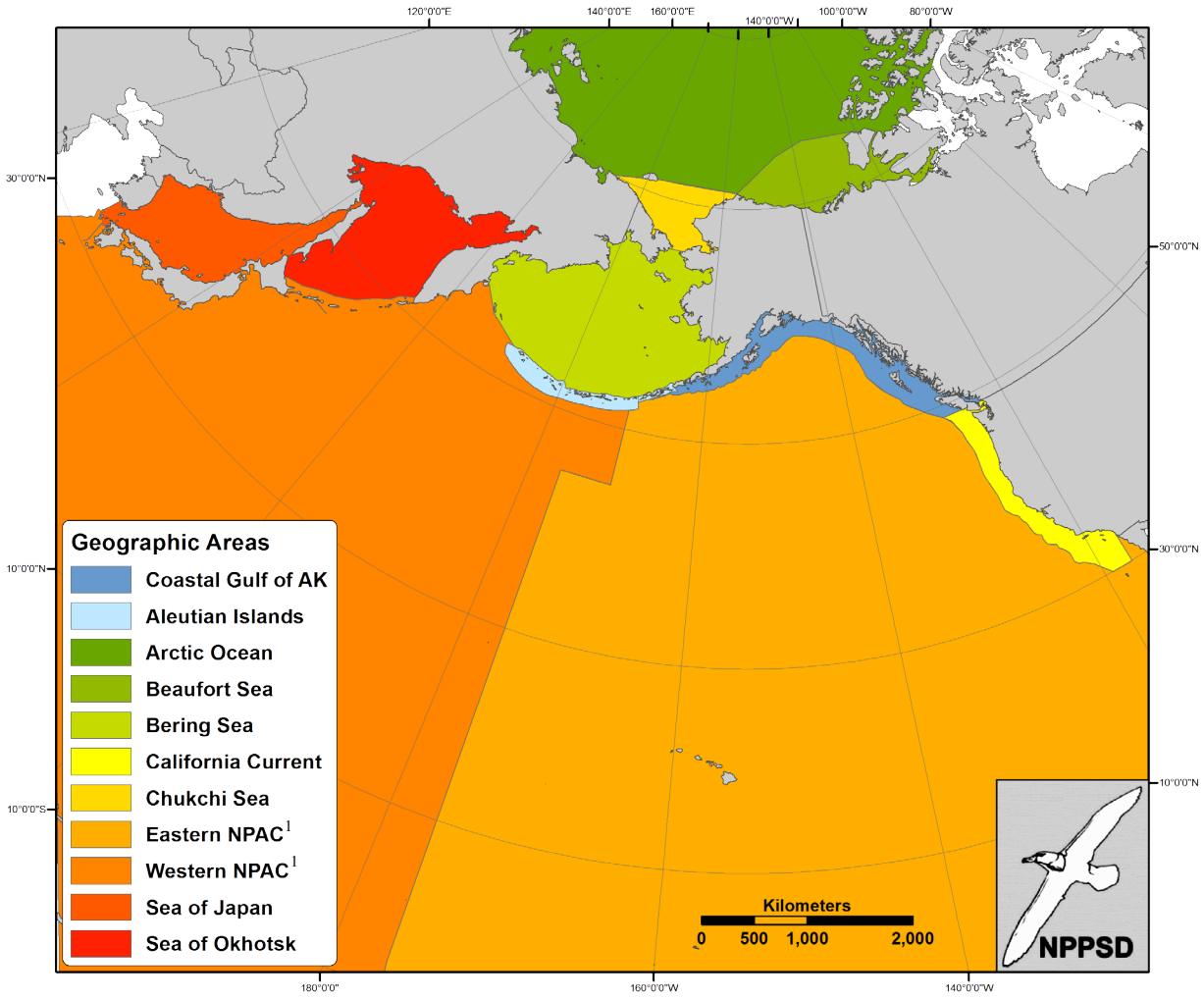
Appendix B. Map Showing Geographic Regions Used for Table 1

The map is based in the North Pacific Marine Science Organization (PICES) map of North Pacific subregions, but includes several modifications to include areas outside current PICES subregions (Arctic Ocean, Chukchi Sea, and Beaufort Sea).



[1] NPAC = North Pacific.

Appendix C. Bird Species from the North Pacific Pelagic Seabird Database (NPPSD) Taxonomic Code List 2.1

The following table includes the National Oceanographic Data Center (NODC) Taxonomic Code list useful for sorting, as well as the more current Integrated Taxonomic Information System (ITIS) Taxonomic Serial Number (TSN).

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
174371	Aves (Class)	Unidentified Bird	UNBI	91
174468	*Gavia spp.*	Unidentified Loon	UNLO	91070101
174469	*Gavia immer*	Common Loon	COLO	9107010101
174470	*Gavia adamsii*	Yellow-billed Loon	YBLO	9107010102
174471	*Gavia arctica*	Arctic Loon	ARLO	9107010103
174474	*Gavia stellata*	Red-throated Loon	RTLO	9107010104
174475	*Gavia pacifica*	Pacific Loon	PALO	9107010105
174478	*Podicipedidae spp.*	Unidentified Grebe	UNGR	91080101
174479	*Podiceps grisegena*	Red-necked Grebe	RNGR	9108010101
174482	*Podiceps auritus*	Horned Grebe	HOGR	9108010102
174485	*Podiceps nigricollis*	Eared Grebe	EAGR	9108010103
554027	*Aechmophorus clarkii*	Clark's Grebe	CLGR	91080102
174503	*Aechmophorus occidentalis*	Western Grebe	WEGR	9108010201
174513	Diomedeidae (Family)	Unidentified Albatross	UALB	910901
174515	*Diomedea albatrus*	Short-tailed Albatross	STAL	9109010101
174516	*Diomedea nigripes*	Black-footed Albatross	BFAL	9109010102
554378	*Phoebastria immutabilis*	Laysan Albatross	LAAL	9109010103
174512	Procellariiformes (Order)	Unidentified Procellariiformes	UNPR	910902
174536	*Fulmarus glacialis*	Northern Fulmar	NOFU	9109020201
174532	*Puffinus spp.*	Unidentified Shearwater	UNSH	91090204
174547	*Puffinus creatopus*	Pink-Footed Shearwater	PFSH	9109020402
174548	*Puffinus carneipes*	Flesh-footed Shearwater	FFSH	9109020403
174550	*Puffinus pacificus*	Wedge-tailed Shearwater	WTSH	9109020405
174552	*Puffinus bulleri*	Buller's Shearwater	BUSH	9109020406
174553	*Puffinus griseus*	Sooty Shearwater	SOSH	9109020407
174554	*Puffinus tenuirostris*	Short-tailed Shearwater	STSH	9109020408
174555	*Puffinus puffinus*	Manx Shearwater	MASH	9109020409
174557	*Puffinus opisthomelas*	Black-vented Shearwater	BVSH	910902040902
174558	*Puffinus auricularis*	Newell's Shearwater	NESH	9109020410
174561	*Puffinus lheminieri*	Audubon's Shearwater	AUSH	9109020412

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
174565	*Puffinus nativitatis*	Christmas Shearwater	CHSH	9109020414
N.A.	*Pterodroma or Bulweria or Procellaria spp.*	Unidentified Petrel	UNPE	9109020499_1
174566	*Pterodroma spp.*	Unidentified Pterodroma	UNPT	91090205
174569	*Pterodroma inexpectata*	Mottled Petrel	MOPE	9109020503
174570	*Pterodroma arminjoniana*	Herald Petrel	HEPE	9109020504
554395	*Pterodroma cookii*	Cook's Petrel	COPE	9109020505
174573	*Pterodroma neglecta*	Kermadec Petrel	KEPE	9109020506
174574	*Pterodroma externa*	Juan Fernandez Petrel	JFPE	9109020507
554394	*Pterodroma cervicalis*	White-necked Petrel	WNPE	9.10902050702
174577	*Pterodroma alba*	Phoenix Petrel	PHPE	9109020508
562561	*Pterodroma sandwichensis*	Hawaiian Petrel	HAPE	9109020509
174579	*Pterodroma hypoleuca*	Bonin Petrel	BOPE	9109020510
174580	*Pterodroma nigripennis*	Black-winged Petrel	BWPE	9109020511
174581	*Pterodroma solandri*	Solander's Petrel	SOPE	9109020512
562560	*Pterodroma pycrofti*	Pycroft's Petrel	PYPE	9109020513
174582	*Pterodroma longirostris*	Stejneger's Petrel	STPE	9109020513
174588	*Pterodroma leucoptera*	Gould's Petrel	GOPE	9109020519
174592	*Pterodroma ultima*	Murphy's Petrel	MUPE	9109020523
174611	*Procellaria parkinsoni*	Parkinson's Petrel	PAPE	9109021002
554144	*Bulweria bulwerii*	Bulwer's Petrel	BUPE	9109021201
203449	*Calonectris leucomelas*	Streaked Shearwater	STRS	9109021302
174619	Hydrobatidae (Family)	Unidentified Storm-petrel	UNSP	910903
174625	*Oceanodroma furcata*	Fork-tailed Storm-petrel	FTSP	9109030201
174628	*Oceanodroma leucorhoa*	Leach's Storm-petrel	LESP	9109030202
174634	*Oceanodroma homochroa*	Ashy Storm-petrel	ASSP	9109030203
174636	*Oceanodroma castro*	Band-rumped Storm-petrel	BRSP	9109030205
174638	*Oceanodroma tethys*	Wedge-rumped Storm-petrel	WRSP	9109030206
174640	*Oceanodroma melania*	Black Storm-petrel	BLSP	9109030207
174641	*Oceanodroma tristrami*	Tristram's Storm-petrel	TRSP	9109030208
174642	*Oceanodroma monorhis*	Swinhoe's Storm-petrel	SSTP	9109030209
174646	*Oceanodroma microsoma*	Least Storm-petrel	LTSP	9109030301

Appendix C. Continued.

ITIS TSN	Scientific Name	Common name	NPPSD 4-	NODC Taxonomic Code
174650	*Oceanites oceanicus*	Wilson's Storm-petrel	WISP	9109030401
174672	*Phaethon spp.*	Unidentified Tropicbird	UNTR	91100101
174673	*Phaethon aethereus*	Red-Billed Tropicbird	RBTR	9110010101
174676	*Phaethon lepturus*	White-tailed Tropicbird	WTTR	9110010102
174679	*Phaethon rubricauda*	Red-tailed Tropicbird	RTTR	9110010103
174684	*Pelecanus erythrorhynchos*	American White Pelican	AWPE	9110020101
174685	*Pelecanus occidentalis*	Brown Pelican	BRPE	9110020102
174697	*Sula spp.*	Unidentified Booby	UNBO	91100301
174699	*Sula dactylatra*	Masked Booby	MABO	9110030101
174704	*Sula leucogaster*	Brown Booby	BRBO	9110030103
174707	*Sula sula*	Red-Footed Booby	RFBO	9110030104
174712	*Morus bassanus*	Northern Gannet	NOGA	9110030107
174714	*Phalacrocorax spp*	Unidentified Cormorant	UNCO	91100401
174715	*Phalacrocorax carbo*	Great Cormorant	GRCO	9110040101
174717	*Phalacrocorax auritus*	Double-crested Cormorant	DCCO	9110040102
174724	*Phalacrocorax penicillatus*	Brandt's Cormorant	BRCO	9110040104
174725	*Phalacrocorax pelagicus*	Pelagic Cormorant	PECO	9110040105
174728	*Phalacrocorax urile*	Red-faced Cormorant	RFCO	9110040106
174762	*Fregata spp.*	Unidentified Frigatebird	UNFB	91100601
174766	*Fregata minor*	Great Frigatebird	GRFB	9110060102
174769	*Fregata ariel*	Lesser Frigatebird	LEFB	9110060105
174773	*Ardea herodias*	Great Blue Heron	GTBH	9111010101
174793	*Butorides virescens*	Green Heron	GRHE	9111010201
554135	*Ardea alba*	Great Egret	GREG	9111010601
174813	*Egretta thula*	Snowy Egret	SNEG	9111010701
174923	*Plegadis spp.*	Unidentified Ibis	UNIB	91110601
174983	Anatidae (Family)	Unidentified Duck, Goose, or Swan	UNWF	911201
174984	*Cygnus spp.*	Unidentified Swan	SWAN	91120101
174985	*Cygnus Olor*	Mute Swan	MUSW	9112010101
174987	*Cygnus columbianus*	Tundra Swan	TUSW	9112010202
174992	*Cygnus buccinator*	Trumpeter Swan	TRSW	9112010203
174999	*Branta canadensis*	Canada Goose	CAGO	9112010301

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
714068	*Branta hutchinsii*	Cackling Goose	CACG	911201030109
175011	*Branta bernicla*	Brant	BRAN	9112010302
175042	*Chen canagica*	Emperor Goose	EMGO	9112010401
175020	*Anser albifrons*	Greater White-fronted Goose	GWFG	9112010501
175038	*Chen caerulescens*	Snow Goose	SNGO	9112010601
175063	*Anas platyrhynchos*	Mallard	MALL	9112010901
175068	*Anas rubripes*	American Black Duck	AMBD	9112010903
175073	*Anas strepera*	Gadwall	GADW	9112010906
175074	*Anas acuta*	Northern Pintail	NOPI	9112010907
175081	*Anas crecca*	Green-winged Teal	GWTE	9112010910
175086	*Anas discors*	Blue-winged Teal	BWTE	9112010912
175093	*Anas querquedula*	Garganey	GARG	9112010915
175094	*Anas americana*	American Wigeon	AMWI	9112010916
175096	*Anas clypeata*	Northern Shoveler	NOSH	9112010917
175122	*Aix sponsa*	Wood Duck	WODU	9112011001
175124	*Aythya spp.*	Unidentified Scaup	USCA	91120111
714011	Anatinae (Subfamily)	Unidentified Duck	UNDU	91120111
175125	*Aythya americana*	Redhead	REDH	9112011101
175129	*Aythya valisineria*	Canvasback	CANV	9112011105
175130	*Aythya marila*	Greater Scaup	GRSC	9112011106
175134	*Aythya affinis*	Lesser Scaup	LESC	9112011107
175140	*Bucephala spp.*	Unidentified Goldeneye	UNGO	91120112
175141	*Bucephala clangula*	Common Goldeneye	COGO	9112011201
175144	*Bucephala islandica*	Barrow's Goldeneye	BAGO	9112011202
175145	*Bucephala albeola*	Bufflehead	BUFF	9112011203
175147	*Clangula hyemalis*	Long-tailed Duck	LTDU	9112011301
175149	*Histrionicus histrionicus*	Harlequin Duck	HADU	9112011401
N/A	*Somateria or Polysticta spp.*	Unidentified Eider	UNEI	91120116
175153	*Polysticta stelleri*	Steller's Eider	STEI	9112011601
175155	*Somateria mollissima*	Common Eider	COEI	9112011701
175160	*Somateria spectabilis*	King Eider	KIEI	9112011702
175161	*Somateria fischeri*	Spectacled Eider	SPEI	9112011703

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
175162	*Melanitta spp.*	Unidentified Scoter	UNSC	91120118
175163	*Melanitta fusca*	White-winged Scoter	WWSC	9112011802
175170	*Melanitta perspicillata*	Surf Scoter	SUSC	9112011803
175171	*Melanitta nigra*	Black Scoter	BLSC	9112011804
175175	*Oxyura jamaicensis*	Ruddy Duck	RUDU	9112011901
175183	*Lophodytes cucullatus*	Hooded Merganser	HOME	9112012001
175184	*Mergus spp.*	Unidentified Merganser	UNME	91120121
175185	*Mergus merganser*	Common Merganser	COME	9112012101
175187	*Mergus serrator*	Red-breasted Merganser	RBME	9112012102
175300	*Accipiter gentilis*	Northern Goshawk	NOGO	9113020501
175304	*Accipiter striatus*	Sharp-shinned Hawk	SSHA	9113020502
175350	*Buteo jamaicensis*	Red-tailed Hawk	RTHA	9113020601
175407	*Aquila chrysaetos*	Golden Eagle	GOEA	9113020901
175280	*Accipitridae spp.*	Unidentified Eagle	UNEA	91130210
175420	*Haliaeetus leucocephalus*	Bald Eagle	BAEA	9113021002
175423	*Haliaeetus pelagicus*	Steller's Sea Eagle	STSE	9113021003
175430	*Circus cyaneus*	Northern Harrier	NOHA	9113021101
175590	*Pandion haliaetus*	Osprey	OSPR	9113030101
175598	*Falco spp.*	Unidentified Falcon	UNFA	91130402
175599	*Falco rusticolus*	Gyrfalcon	GYRF	9113040201
175604	*Falco peregrinus*	Peregrine Falcon	PEFA	9113040203
175613	*Falco columbarius*	Merlin	MERL	9113040205
176177	*Grus canadensis*	Sandhill Crane	SACR	9120010102
176292	*Fulica americana*	American Coot	AMCO	9120040802
176446	Charadii (Suborder)	Unidentified Shorebird	UNSB	9127
176475	*Haematopus bachmani*	Black Oystercatcher	BLOY	9127030103
176479	*Pluvialus or Charadrius spp.*	Unidentified Plover	UNPL	912704
176506	*Charadrius semipalmatus*	Semipalmated Plover	SEPL	9127040202
176510	*Charadrius alexandrinus*	Snowy Plover	SNPL	9127040204
176514	*Charadrius mongolus*	Mongolian Plover	MOPL	9127040205
176564	*Pluvialis dominica*	American Golden Plover	AGPL	912704110201
554381	*Pluvialis fulva*	Pacific Golden Plover	PAGP	912704110202

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
176567	*Pluvialis squatarola*	Black-bellied Plover	BBPL	9127041103
553481	*Scolopacinae spp.*	Unidentified Sandpiper	UNSA	912705
176569	*Arenaria spp.*	Unidentified Turnstone	UNTU	91270501
176571	*Arenaria interpres*	Ruddy Turnstone	RUTU	9127050101
176574	*Arenaria melanocephala*	Black Turnstone	BLTU	9127050102
176586	*Capella gallinago*	Common Snipe	COSN	9127050401
726048	*Gallinago delicata*	Wilson's Snipe	WISN	912705040103
176593	*Numenius americanus*	Long-billed Curlew	LBCU	9127050601
176599	*Numenius phaeopus*	Whimbrel	WHIM	9127050604
176610	*Bartramia longicauda*	Upland Sandpiper	UPSA	9127050701
176612	*Actitis macularia*	Spotted Sandpiper	SPSA	9127050801
176614	*Tringa spp.*	Unidentified Yellowlegs	YELL	91270509
176615	*Tringa solitaria*	Solitary Sandpiper	SOSA	9127050901
176618	*Tringa glareola*	Wood Sandpiper	WOSP	9127050902
176619	*Tringa melanoleuca*	Greater Yellowlegs	GRYE	9127050903
176620	*Tringa flavipes*	Lesser Yellowlegs	LEYE	9127050904
176635	*Heteroscelus incanus*	Wandering Tattler	WATA	9127051001
176638	*Catoptrophorus semipalmatus*	Willet	WILL	9127051101
176641	*Calidris spp.*	Unidentified Stint	USTI	91270512
176642	*Calidris canutus*	Red Knot	REKN	9127051201
176647	*Calidris ptilocnemis*	Rock Sandpiper	ROSA	9127051204
176652	*Calidris acuminata*	Sharp-tailed Sandpiper	STSA	9127051205
176653	*Calidris melanotos*	Pectoral Sandpiper	PESA	9127051206
176654	*Calidris fuscicollis*	White-rumped Sandpiper	WRSA	9127051207
176655	*Calidris bairdii*	Baird's Sandpiper	BASP	9127051208
176656	*Calidris minutilla*	Least Sandpiper	LESA	9127051209
176661	*Calidris alpina*	Dunlin	DUNL	9127051214
176667	*Calidris pusilla*	Semipalmated Sandpiper	SESA	9127051216
176668	*Calidris mauri*	Western Sandpiper	WESA	9127051217
176669	*Calidris alba*	Sanderling	SAND	9127051218
176673	*Aphriza virgata*	Surfbird	SURF	9127051301
176674	*Limnodromus spp.*	Unidentified Dowitcher	DOWI	91270514

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
176675	*Limnodromus griseus*	Short-billed Dowitcher	SBDO	9127051401
176679	*Limnodromus scolopaceus*	Long-billed Dowitcher	LBDO	9127051402
554145	*Calidris himantopus*	Stilt Sandpiper	STIL	9127051501
176684	*Tryngites subruficollis*	Buff-breasted Sandpiper	BBSP	9127051601
176685	*Limosa spp.*	Unidentified Godwit	GODW	91270517
176686	*Limosa fedoa*	Marbled Godwit	MAGO	9127051701
176687	*Limosa lapponica*	Bar-tailed Godwit	BTGP	9127051702
176733	*Phalaropus spp.*	Unidentified Phalarope	UNPH	91270701
554376	*Phalaropus fulicaria*	Red Phalarope	REPH	9127070101
176735	*Phalaropus lobatus*	Red-necked Phalarope	RNPH	9127070301
176791	*Stercorariidae (Family)*	Unidentified Skua	UNSK	91280101
176792	*Stercorarius pomarinus*	Pomarine Jaeger	POJA	9128010101
176793	*Stercorarius parasiticus*	Parasitic Jaeger	PAJA	9128010102
176794	*Stercorarius longicaudus*	Long-tailed Jaeger	LTJA	9128010103
176801	*Catharacta maccormicki*	South Polar Skua	SPSK	9128010202
553473	*Larinae spp.*	Unidentified Gull	UNGU	91280201
176808	*Larus hyperboreus*	Glaucous Gull	GLGU	9128020101
176811	*Larus glaucoides*	Iceland Gull	ICGU	9128020102
176814	*Larus glaucescens*	Glaucous-winged Gull	GWGU	9128020103
N.A.	N.A.	Glaucous-winged x Herring Gull	GHGU	912802010399_1
176815	*Larus marinus*	Great Black-backed Gull	GBGU	9128020104
176816	*Larus schistisagus*	Slaty-backed Gull	SBGU	9128020105
176817	*Larus occidentalis*	Western Gull	WEGU	9128020106
N.A.	N.A.	Western x Glaucous-winged Gull	WGWG	912802010699_1
176824	*Larus argentatus*	Herring gull	HEGU	9128020108
176828	*Larus thayeri*	Thayer's Gull	THGU	9128020109
176829	*Larus californicus*	California Gull	CAGU	9128020110
176830	*Larus delawarensis*	Ring-billed Gull	RBGU	9128020111
176831	*Larus crassirostris*	Black-tailed Gull	BTGU	9128020112
176832	*Larus canus*	Mew Gull	MEGU	9128020113
176835	*Larus ridibundus*	Black-headed Gull	BHGU	9128020114
176837	*Larus atricilla Linnaeus*	Laughing Gull	LAGU	9128020115

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
176838	*Larus pipixcan*	Franklin's Gull	FRGU	9128020116
176839	*Larus philadelphia*	Bonaparte's Gull	BOGU	9128020117
176841	*Larus heermanni*	Heermann's Gull	HEEG	9128020119
176849	*Larus dominicanus*	Kelp Gull	KEGU	9128020128
176851	*Pagophila eburnea*	Ivory Gull	IVGU	9128020201
176806	*Rissa spp.*	Unidentified Kittiwake	UNKI	91280203
176875	*Rissa tridactyla*	Black-legged Kittiwake	BLKI	9128020301
176845	*Rissa brevirostris*	Red-legged Kittiwake	RLKI	9128020302
176864	*Rhodostethia rosea*	Ross's Gull	ROGU	9128020401
176866	*Xema sabini*	Sabine's Gull	SAGU	9128020501
553483	*Sterninae spp.*	Unidentified Tern	UNTE	91280207
176886	*Sterna trudeaui*	Trudeau's Tern	TRTE	9128020701
176887	*Sterna forsteri*	Forster's Tern	FOTE	9128020702
176888	*Sterna hirundo*	Common Tern	COTE	9128020703
176890	*Sterna paradisaea*	Arctic Tern	ARTE	9128020704
176893	*Sterna aleutica*	Aleutian Tern	ALTE	9128020706
176894	*Sterna fuscata*	Sooty Tern	SOTE	9128020707
176912	*Sterna lunata*	Gray-backed Tern	GBTE	9128020710
176922	*Sterna maxima*	Royal Tern	ROTE	9128020728
176923	*Sterna antillarum*	Least Tern	LETE	9128020729
176924	*Sterna caspia*	Caspian Tern	CATE	9128020730
176925	*Sterna elegans*	Elegant Tern	ELTE	9128020731
N/A	*Anous or Procelsterna spp.*	Unidentified Noddy	UNNO	91280211
176941	*Anous stolidus*	Brown Noddy	BRNO	9128021101
176944	*Anous minutus*	Black Noddy	BLNO	9128021102
554390	*Procelsterna cerulea*	Blue-gray Noddy	BGNO	9128021501
176954	*Gygis alba*	White Tern	WHTE	9128021601
176959	*Chlidonias niger*	Black Tern	BLTE	9128021802
176961	*Rynchops spp.*	Unidentified Skimmer	SKIM	91280301
176967	Alcidae (Family)	Unidentified Alcid	UNAL	912901
176973	*Uria spp.*	Unidentified Murre	UNMU	91290103
176974	*Uria aalge*	Common Murre	COMU	9129010301

Appendix C. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
176978	*Uria lomvia*	Thick-billed Murre	TBMU	9129010302
176982	*Alle alle*	Dovekie	DOVE	9129010401
176984	*Cepphus spp.*	Unidentified Guillemot	UNGI	91290105
176985	*Cepphus grylle*	Black Guillemot	BLGU	9129010501
176991	*Cepphus columba*	Pigeon Guillemot	PIGU	9129010502
176994	*Cepphus carbo*	Spectacled Guillemot	SPGU	9129010503
N.A.	*Brachyramphus or Synthliboramphus spp.*	Unidentified Murrelet	UNML	9129010599[1]
176995	*Brachyramphus spp.*	Brachyramphus Murrelet	BRMU	91290106
176996	*Brachyramphus marmoratus*	Marbled Murrelet	MAMU	9129010601
176998	*Brachyramphus brevirostris*	Kittlitz's Murrelet	KIMU	9129010602
554143	*Brachyramphus perdix*	Long-billed Murrelet	LBMU	9129010699[1]
177006	*Synthliboramphus spp.*	Synthliboramphus Murrelet	SYMU	91290108
177008	*Synthliboramphus antiquus*	Ancient Murrelet	ANMU	9129010801
177009	*Synthliboramphus wumizusume*	Japanese Murrelet	JAMU	9129010802
177010	*Synthliboramphus craveri*	Craveri's Murrelet	CRMU	9129010803
177011	*Synthliboramphus hypoleucus*	Xantus's Murrelet	XAMU	9129010804
N/A	*Aethia or Ptychoramphus spp.*	Unidentified Auklet	UNAU	9129010899[1]
177013	*Ptychoramphus aleuticus*	Cassin's Auklet	CAAU	9129010901
554029	*Aethia psittacula*	Parakeet Auklet	PAAU	9129011001
177019	*Aethia cristatella*	Crested Auklet	CRAU	9129011101
177020	*Aethia pusilla*	Least Auklet	LEAU	9129011102
177021	*Aethia pygmaea*	Whiskered Auklet	WHAU	9129011103
177023	*Cerorhinca monocerata*	Rhinoceros Auklet	RHAU	9129011201
177024	*Fratercula spp.*	Unidentified Puffin	UNPU	91290113
177029	*Fratercula corniculata*	Horned Puffin	HOPU	9129011302
177032	*Fratercula cirrhata*	Tufted Puffin	TUPU	9129011401
177935	*Asio flammeus*	Short-eared Owl	SEOW	9137020902
178106	*Megaceryle alcyon*	Belted Kingfisher	BEKI	9147010101
178536	*Cinclus mexicanus*	American Dipper	AMDI	9158110101
179665	Corvidae (Family)	Crow, Raven, Magpie	CORV	915845

1 NODC Taxonomic Codes for previously unrecognized taxa were generated to ensure correct phylogenetic order.

Appendix D. Marine Mammal Species from the North Pacific Pelagic Seabird Database (NPPSD) Taxonomic Code List 2.1

The following table includes the National Oceanographic Data Center (NODC) Taxonomic Code list useful for sorting, as well as the more current Integrated Taxonomic Information (ITIS) Taxonomic Serial Number (TSN).

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
179913	Mammalia (Class)	Unidentified Marine Mammal	UNMM	92
180403	Cetacea (Order)	Unidentified Whale	UNWH	9217
180415	*Unidentified Delphinidae*	Unidentified Dolphin	UNDO	921802
180426	*Tursiops truncatus*	Bottlenose Dolphin	BNDO	9218020401
180429	*Stenella longirostris*	Spinner Dolphin	SPDO	9218020501
180434	*Stenella coeruleoalba*	Striped Dolphin	STDO	9218020504
180438	*Delphinus delphis*	Common Dolphin	CODO	9218020601
555654	*Delphinus capensis*	Long-beaked Common Dolphin	LBCD	921802060199[1]
180444	*Lagenorhynchus obliquidens*	Pacific White-sided Dolphin	PWSD	9218020803
180454	*Lissodelphis borealis*	Northern Right Whale Dolphin	NRWD	9218021001
180457	*Grampus griseus*	Risso's Dolphin	RIDO	9218021101
180463	*Pseudorca crassidens*	False Killer Whale	FKWH	9218021401
180466	*Globicephala macrorhynchus*	Short-finned Pilot Whale	SFPW	9218021502
180469	*Orcinus orca*	Killer Whale	KIWH	9218021601
552307	*Phocoenidae spp.*	Unidentified Porpoise	UNPO	921802180
180473	*Phocoena phocoena*	Harbor Porpoise	HAPO	9218021801
180480	*Phocoenoides dalli*	Dall's Porpoise	DAPO	9218022001
180483	*Delphinapterus leucas*	Beluga Whale	BEWH	9218030101
180489	*Physeter macrocephalus*	Sperm Whale	SPWH	9218040102
180491	*Kogia breviceps*	Pygmy Sperm Whale	PSWH	9218040201
180506	*Mesoplodon spp.*	Unidentified Beaked Whale	UBKW	921805
180496	*Berardius bairdii*	Baird's Beaked Whale	BKWH	9218050102
180498	*Ziphius cavirostris*	Cuvier's Beaked Whale	GBWH	9218050201
552298	Mysticeti (Suborder)	Unidentified Baleen Whale	UNBW	9219
180521	*Eschrichtius robustus*	Gray Whale	GRWH	9219010101
180524	*Balaenoptera acutorostrata*	Minke Whale	MIWH	9219020101

Appendix D. Continued.

ITIS TSN	Scientific name	Common name	NPPSD 4-Letter Code	NODC Taxonomic Code
180526	*Balaenoptera borealis*	Sei Whale	SEWH	9219020103
180527	*Balaenoptera physalus*	Fin Whale	FIWH	9219020104
180528	*Balaenoptera musculus*	Blue Whale	BLWH	9219020105
180530	*Megaptera novaeangliae*	Humpback Whale	HBWH	9219020201
180533	*Balaena mysticetus*	Bowhead Whale	BOWH	9219030102
180537	*Eubalaena japonica*	Right Whale	RIWH	9219030301
180542	*Ursus maritimus*	Polar Bear	POBE	9220010101
180547	*Enhydra lutris*	Sea Otter	SEOT	9220020101
552326	Lutrinae (Subfamily)	Unidentified Otter	UNOT	9220020199[1]
180549	*Lontra canadensis*	River Otter	RIOT	9220020201
552303	*Caniformia (Suborder)*	Unidentified Pinniped	UNPI	9221
180621	*Zalophus californianus*	California Sea Lion	CASL	9221010301
180625	*Eumetopias jubatus*	Steller Sea Lion	STSL	9221010501
180627	*Callorhinus ursinus*	Northern Fur Seal	NOFS	9221010601
180636	*Arctocephalus townsendi*	Guadalupe Fur Seal	GUFS	9221010708
180639	*Odobenus rosmarus*	Walrus	WALR	9221020101
180640	Phocidae (Family)	Unidentified Seal	UNSE	922103
180642	*Phoca largha*	Spotted Seal	SPSE	9221030101
622018	*Pusa hispida*	Ringed Seal	RISE	9221030102
622021	*Histriophoca fasciata*	Ribbon Seal	RBSE	9221030106
180649	*Phoca vitulina*	Harbor Seal	HASE	9221030107
180655	*Erignathus barbatus*	Bearded Seal	BESE	9221030301
180672	*Mirounga angustirostris*	Northern Elephant Seal	NESE	9221031002

[1] NODC Taxonomic Codes for previously unrecognized taxa were generated to ensure correct phylogenetic order.

Appendix E. North Pacific Pelagic Seabird Database, Version 2 Query Tool

Purpose of Query Form

Although the data in the NPPSD v. 2.0 may be accessed directly by opening the NPPSD_Back.mdb file, we created a graphical filter and export tool hereafter referred to as the "Query Form", for the database in an effort to make the extraction of data as accurate and uniform as possible (fig. E1). This form provides an intuitive interface to assist users in selecting specific data from the larger NPPSD v. 2.0 dataset and exporting cross-tabulated summaries of these data. This tool is available with the NPPSD database on the NPPSD web site. We successfully tested the Query Form for accuracy on numerous filter combinations; however, we could not test all possible combinations. If users encounter any problems with the tool, please report using contact information available on the NPPSD web page at the USGS Alaska Science Center Website http://alaska.usgs.gov/.

Setup

The Query Form requires Microsoft Access 2003 or later. Note, for Access 2007 or later when the Query Form is first started, a yellow dialog box will appear beneath the "Ribbon" at the top of the page. You must click on "enable" to run the script that looks for the database. There is no installation; however the first time the Query Form is used, a dialog box indicate that it cannot locate the "back-end" (NPPSD database), and will ask for its location, select OK and a dialog box will appear. Either type or browse to the location of the NPPSD database file. Once the location is entered in the dialog box select refresh links. A new dialog box will appear to indicate if the linking was successful. Select OK and the Query Form should appear.

Query Form Menu

The Query Form menu has six panels: (1) Records, (2) Filter Records, (3) Sort Records, (4) Hide/Show Columns, (5) Other Options, and (6) Export (fig. E1). When the Query Form opens it loads a subset of the data to the Records panel. This subset of records provides users with series of populated fields from the linked location and observation tables to assist with the selection of filters. The text boxes and check boxes throughout the form will be blank. Unless an entry is made no filter or action, e.g. sorting, will occur. Descriptions of the individual query form panels are given below.

Records Panel

The Records panel will look familiar to most users. Fields are listed across the top of the panel. Each record is displayed as a row. Users can scroll through this panel as they would any database table or spreadsheet. As previously mentioned above, when first loaded, the Query Form selects a subset of the data, i.e. Aleutian Tern (ALTE) for the Species. This panel can be very helpful in understanding the dataset in general as well as specific selections.

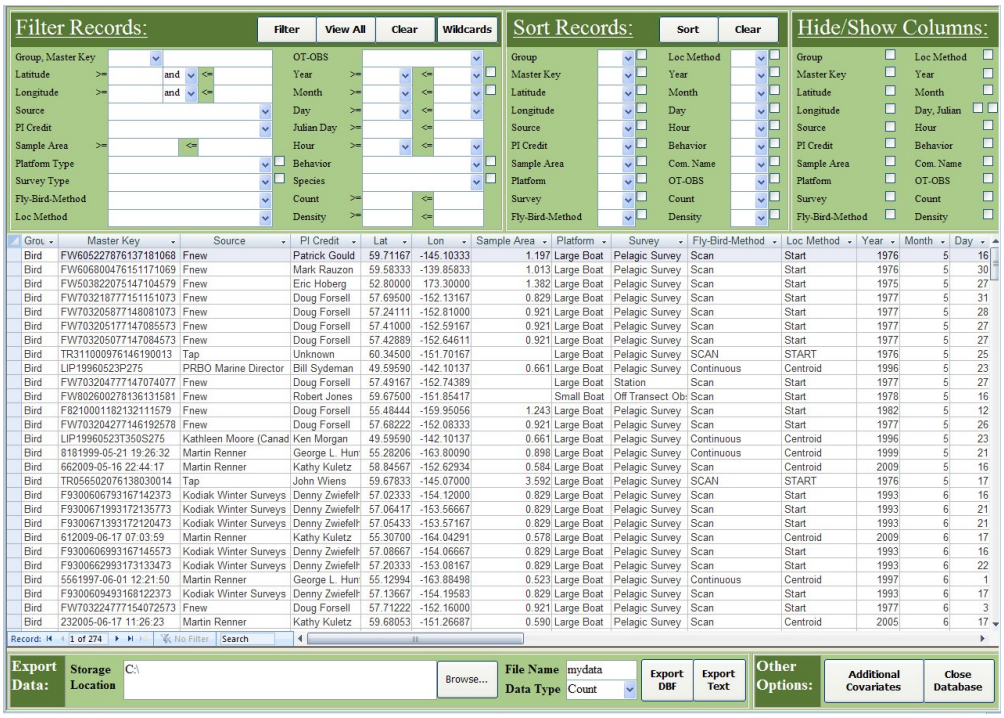


Figure E1. The NPPSD v2.0 "Front End" query form for selecting variable filters and export type and location for marine birds and mammals.

Filter Records Panel

The Filter Selection panel allows users to select the specific subsets for most fields. Boxes following field names are by default blank (fig. E1). Users may enter field values in these boxes or select values with pull-down menus. These menus are associated with lookup tables providing users with the available values in the database (fig. E2). Fields capable of multiple selections will have a check-box following the text box (fig. E3). To make multiple selections from a field, e.g., both "Flying" and "Water" in the Behavior field, check the box and a window will open allowing users to make multiple selections. Once checked, a pop-up window will be displayed. Users select the variables desired and then select the close button. The pop-up window for species includes information on the total count for each species. This may help end-users identify species that are so rare that the NPPSD may not provide the data necessary for numeric analysis (fig. E4). Once all filters are selected the filter button should be selected and the records meeting the selected criteria will be displayed in the Records panel. In addition to the filter button at the top of the Filter Records panel there are three additional buttons "View All", "Clear", and "Wildcards". The View All button removes current filters and displays all observations and associated location data. The Clear button must be used to remove current filters prior to making a new selection. The Wildcard button opens up a pop-up window listing wildcard characters and their use.

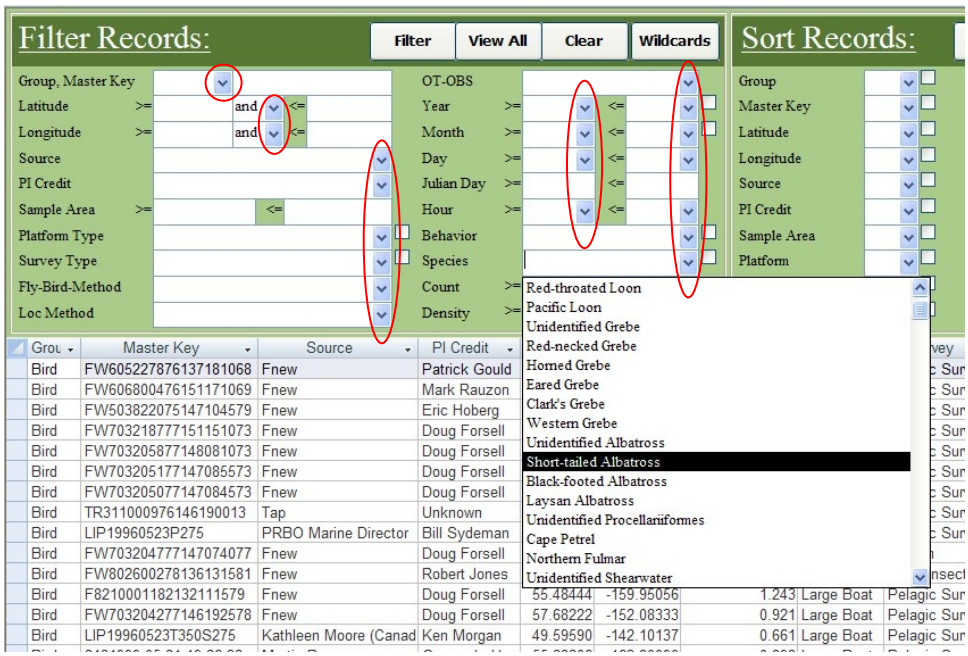


Figure E2. Filter selection panel of the NPPSD v2.0 "Front End." The red ovals indicate drop down controls. Clicking on any drop down control will open an associated lookup table. Once open, a single selection can be made by clicking on any item in the drop down menu.

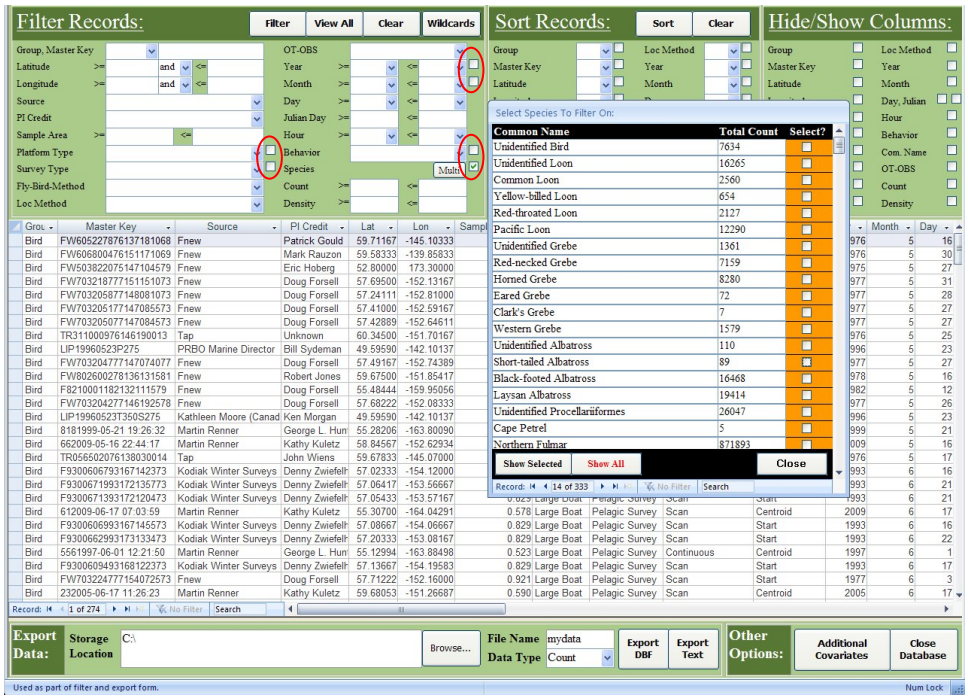


Figure E3. Some variables in the Filter selection panel of the NPPSD v2.0 have check-boxes next to them (red ovals). Selecting on one of the boxes will open a multiple selection window. This window allows users to select multiple items.

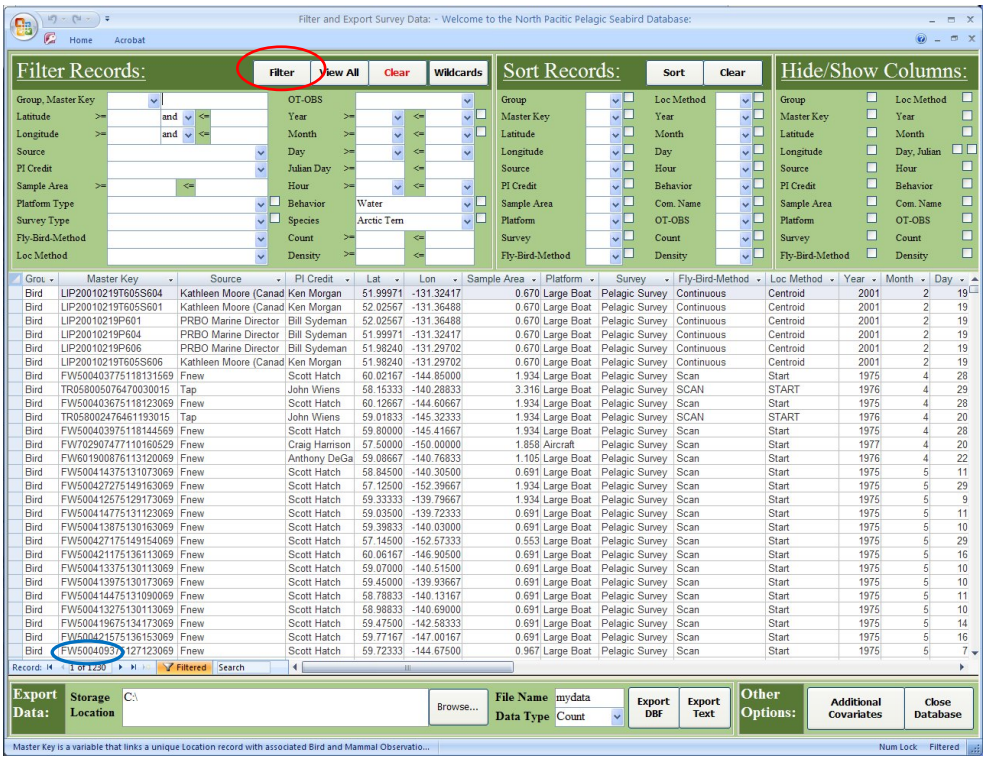


Figure E4. Once selections are made the Filter button (red oval) is clicked and the selected records will be displayed. The number of records matching the filtered fields is found in the bottom left of the record display window (blue oval).

Sort Records Panel

The Sort Records panel lists 20 of the fields from the location and observations tables. To sort on a field, users must select the check-box next to the field and then use the associated drop down menu to select the sort order (fig. E5). For a single field select one, for multiple fields assign the sort order accordingly. All sorts are from low to high.

Hide/Show Columns Panel

The Records Panel contains much more information than can be displayed in the available space. To assist users in displaying only the necessary fields we included the "Hide/Show Columns." This panel provides a set of check-boxes that will hide all checked fields (fig. E5). Clicking on a check-box selects a field and it will not be displayed in the Records Panel. Clicking on the box a second time will remove the check and the field will be displayed again. Changes are only made to the Records Panel display; hidden fields will not affect output.

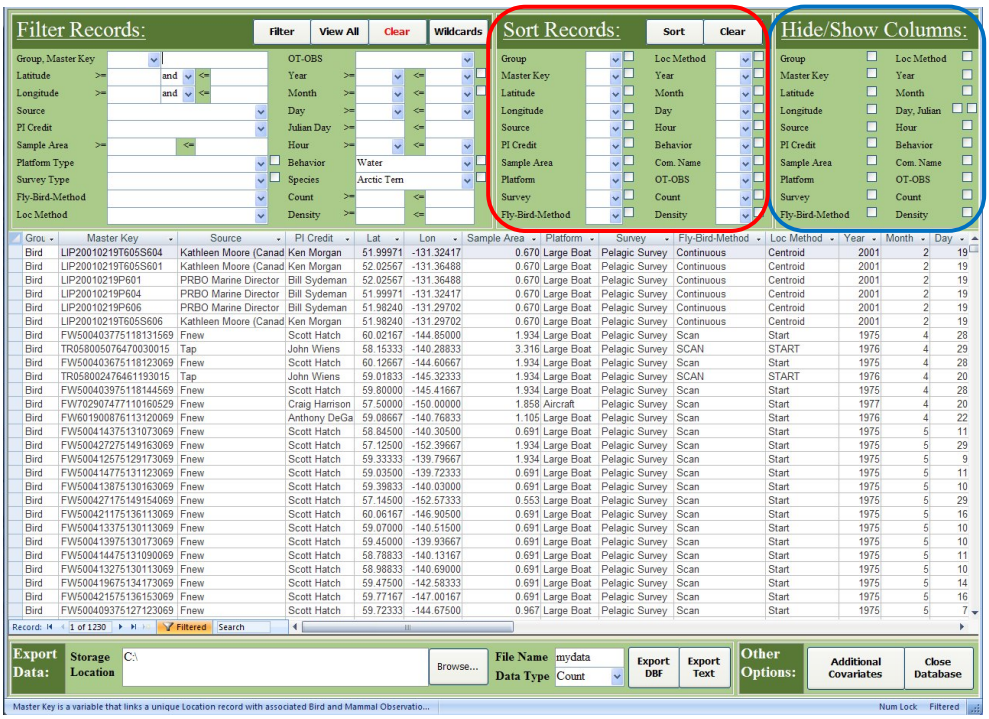


Figure E5. Location of the "Sort Records" pane (red square) and "Hide/Show Columns" pane (blue square) Hide/Show Columns Panel

Other Options Panel

The Other Options panel will open a pair of pop-up windows. The first informs users that selected fields will be added to the output. The second is a check-box with the available fields (fig. E6). For all but the "Behavior" field these variables are not typically included in cross-tabulated output because of the large number (> 50%) of missing values. The Behavior field is unique in that it affects the cross-tabulation by summarizing observations by behavior. If this field is not selected, behaviors selected using the Filter Records panels are summarized together; the behavior field is filtered but not included as a group.

Export Panel

The Export Panel provides users with a combination of text-boxes and buttons to select the location and type of table exported (fig. E7). The left portion of the panel is dedicated to a text-box/browse button used to determine the destination for the export, the C:\ drive is the default. Next to the storage location text-box there is a text box for the file name and beneath it the data type drop-down box. Users can select either "Count" or "Density". Note, if Density is selected only records that have an associated sample area will be output. In effect selecting density acts as a de facto filter. Once location, file name and data type are selected users should select either the "Export DBF" or "Export Text". Selecting the Export DBF button will run a cross-tabulation query using the entire user selected criteria and make a dBase (.dbf) file. Selecting the Export Text button will run a cross-tabulation query using all of the user selected criteria and make a comma delimited ASCII text (.csv) file.

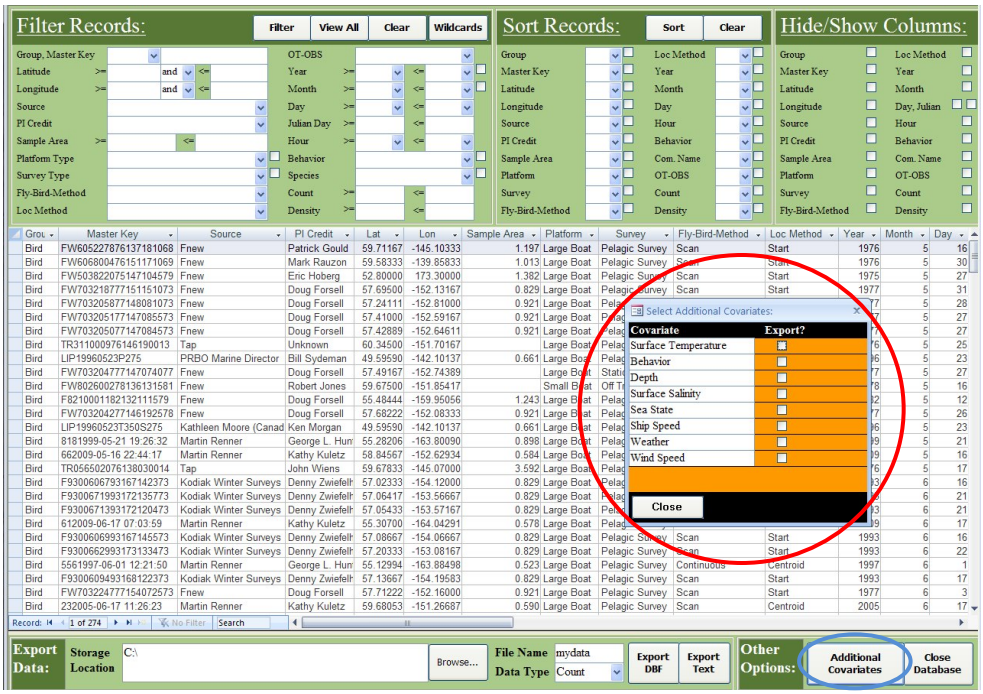


Figure E6. Selecting the "Additional Covariates" button (blue circle) will open a multiple selection window (red circle). Checking a box adds that variable to the cross-tabulation output.

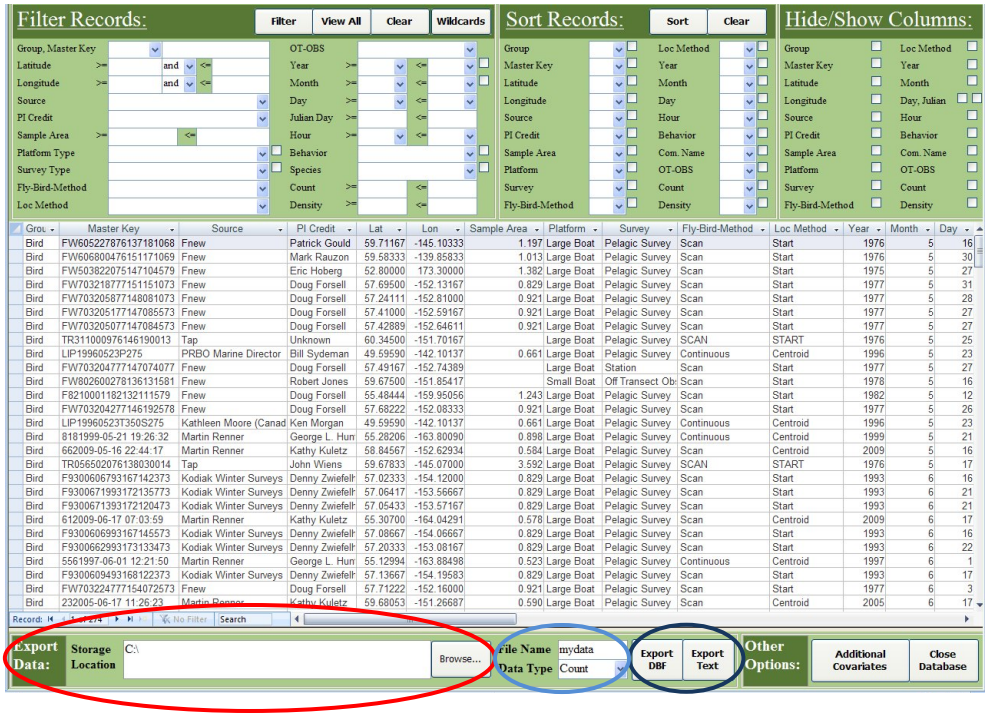
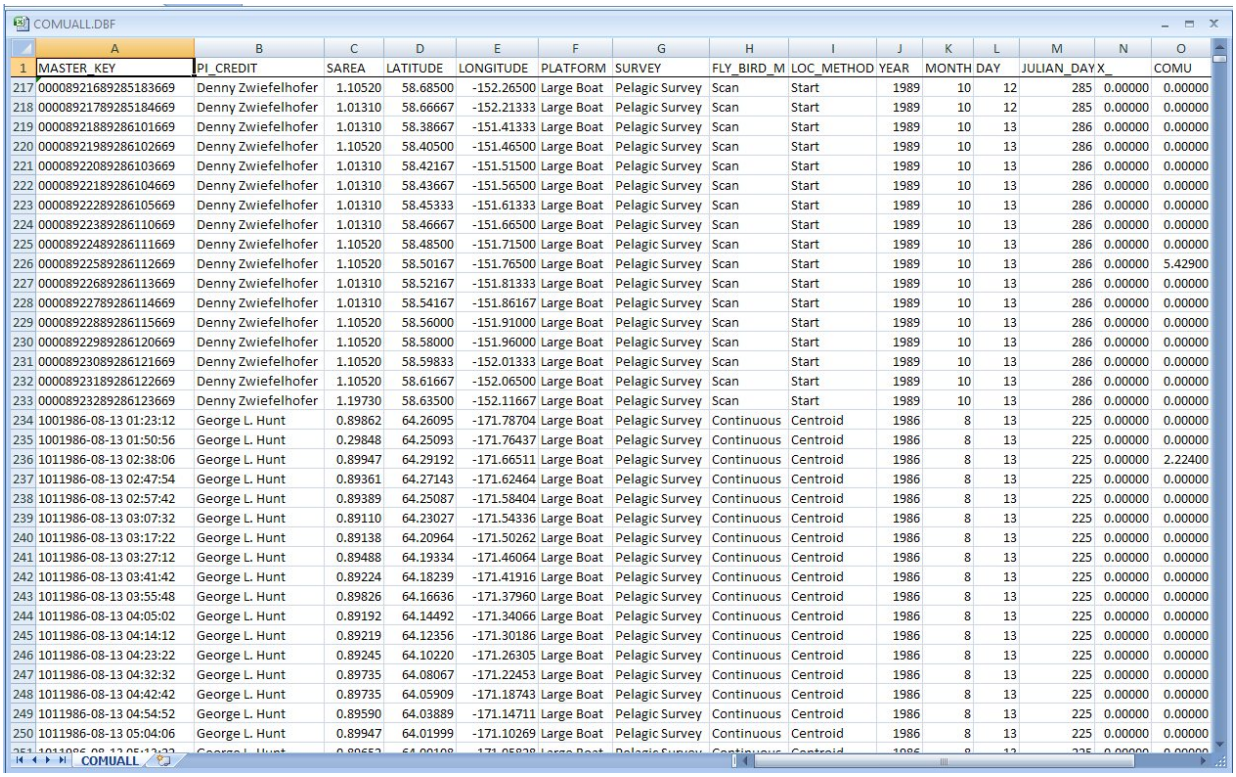


Figure E7. The export panel consists of a text boxes/browse button for the location for the exported file (red circle), a text box and pull-down menu for file name and data type (light-blue circle), and buttons for selecting a database (dbf) or comma delimited (csv) file (dark-blue circle).

Data Output

Output from the Data Query Form can be written to either dbf or csv formats. Regardless of format the outputted field names are consistent with the NPPSD database fields (fig. E8). One product of the cross-tabulation is a null field (assigned as "X_" in the dbf output or "<>" in the csv output) immediately prior to filter selected species. This field is a result of the cross-tabulation and can be deleted or ignored. Species are presented as one or more columns depending on the selection filter. In the csv output the species are identified with the "Common Name", in the dbf output they are identified with "4-letter NPPSD Code". The 4-letter codes are necessary in the dbf output due to field name length restrictions of this format. Note the csv output currently includes quotes around field names and values. This is a product of the export query and cannot currently be changed. Users can either strip the text delimiters or change data types in their software. Users of spreadsheet software should be aware of the limitations of specific programs. A cross-tabulation of the entire NPPSD v.2 has more rows and more columns than many spreadsheets can load, e.g. Excel 2003. Care should be taken to assure no data is truncated.



COMUALL.DBF

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	MASTER_KEY	PI_CREDIT	SAREA	LATITUDE	LONGITUDE	PLATFORM	SURVEY	FLY_BIRD_M	LOC_METHOD	YEAR	MONTH	DAY	JULIAN_DAY	X_	COMU
217	00008921689285183669	Denny Zwiefelhofer	1.10520	58.68500	-152.26500	Large Boat	Pelagic Survey	Scan	Start	1989	10	12	285	0.00000	0.00000
218	00008921789285184669	Denny Zwiefelhofer	1.01310	58.66667	-152.21333	Large Boat	Pelagic Survey	Scan	Start	1989	10	12	285	0.00000	0.00000
219	00008921889286101669	Denny Zwiefelhofer	1.01310	58.38667	-151.41333	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
220	00008921989286102669	Denny Zwiefelhofer	1.10520	58.40500	-151.46500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
221	00008922089286103669	Denny Zwiefelhofer	1.01310	58.42167	-151.51500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
222	00008922189286104669	Denny Zwiefelhofer	1.01310	58.43667	-151.56500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
223	00008922289286105669	Denny Zwiefelhofer	1.01310	58.45333	-151.61333	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
224	00008922389286110669	Denny Zwiefelhofer	1.01310	58.46667	-151.66500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
225	00008922489286111669	Denny Zwiefelhofer	1.10520	58.48500	-151.71500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
226	00008922589286112669	Denny Zwiefelhofer	1.10520	58.50167	-151.76500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	5.42900
227	00008922689286113669	Denny Zwiefelhofer	1.01310	58.52167	-151.81333	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
228	00008922789286114669	Denny Zwiefelhofer	1.01310	58.54167	-151.86167	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
229	00008922889286115669	Denny Zwiefelhofer	1.10520	58.56000	-151.91000	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
230	00008922989286120669	Denny Zwiefelhofer	1.10520	58.58000	-151.96000	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
231	00008923089286121669	Denny Zwiefelhofer	1.10520	58.59833	-152.01333	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
232	00008923189286122669	Denny Zwiefelhofer	1.10520	58.61667	-152.06500	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
233	00008923289286123669	Denny Zwiefelhofer	1.19730	58.63500	-152.11667	Large Boat	Pelagic Survey	Scan	Start	1989	10	13	286	0.00000	0.00000
234	1001986-08-13 01:23:12	George L. Hunt	0.89862	64.26095	-171.78704	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
235	1001986-08-13 01:50:56	George L. Hunt	0.29848	64.25093	-171.76437	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
236	1011986-08-13 02:38:06	George L. Hunt	0.89947	64.29192	-171.66511	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	2.22400
237	1011986-08-13 02:47:54	George L. Hunt	0.89361	64.27143	-171.62464	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
238	1011986-08-13 02:57:42	George L. Hunt	0.89389	64.25087	-171.58404	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
239	1011986-08-13 03:07:32	George L. Hunt	0.89110	64.23027	-171.54336	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
240	1011986-08-13 03:17:22	George L. Hunt	0.89138	64.20964	-171.50262	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
241	1011986-08-13 03:27:12	George L. Hunt	0.89488	64.19334	-171.46064	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
242	1011986-08-13 03:41:42	George L. Hunt	0.89224	64.18239	-171.41916	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
243	1011986-08-13 03:55:48	George L. Hunt	0.89826	64.16636	-171.37960	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
244	1011986-08-13 04:05:02	George L. Hunt	0.89192	64.14492	-171.34066	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
245	1011986-08-13 04:14:12	George L. Hunt	0.89219	64.12356	-171.30186	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
246	1011986-08-13 04:23:22	George L. Hunt	0.89245	64.10220	-171.26305	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
247	1011986-08-13 04:32:32	George L. Hunt	0.89735	64.08067	-171.22453	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
248	1011986-08-13 04:42:42	George L. Hunt	0.89735	64.05909	-171.18743	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
249	1011986-08-13 04:54:52	George L. Hunt	0.89590	64.03889	-171.14711	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000
250	1011986-08-13 05:04:06	George L. Hunt	0.89947	64.01999	-171.10269	Large Boat	Pelagic Survey	Continuous	Centroid	1986	8	13	225	0.00000	0.00000

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Figure E8. Cross-tabulation density output from the NPPSD v2.0 Query Form. Note that the field names are limited to meet the restrictions of the dbf format (10 characters).

The dbf format, in addition to compatible with various database and spreadsheet software can be read directly into ArcGIS (tested on versions $\geq$9.3). To add a dbf file to an ArcGIS project, select "Add Data" from the file menu or standard tool bar. Navigate to the location of the dbf file and select "Add". Once added the file will be displayed in the 'Table of Contents" on the left side of the display (fig. E9). Highlight the table and select "Display XY Data" (fig. E9). Users need to identify Longitude as the "X Field" and Latitude as the "Y Field" (fig. E10). Beneath the X-Y fields the coordinate description in a

new project should say “Unknown Coordinate System.” Regardless of what it says, select “Edit” and a new window will open. Navigate to “Geographic Coordinate Systems”, then World” and then select “WGS 1984”, then select “OK” and the window will close. ArcGIS will then warn you that the table does not have an ObjectID field so functionality may be limited, including selecting querying, or editing features. The table will need to be converted to a shape file or geodatabase file to implement the full functionality of ArcGIS. Right click on your new layer in the Table of Contents, click Data -> Export Data. Confirm that “this layer’s source data” is selected for the coordinate system and change the output feature class directory and file name as appropriate. You will be back in the coordinate system window, select “OK and it will close and the data in the dbf file should display. Note that users will need to change symbology from single symbol if the file contains multiple species or if the user wants to use graduated symbols based on the number or density.

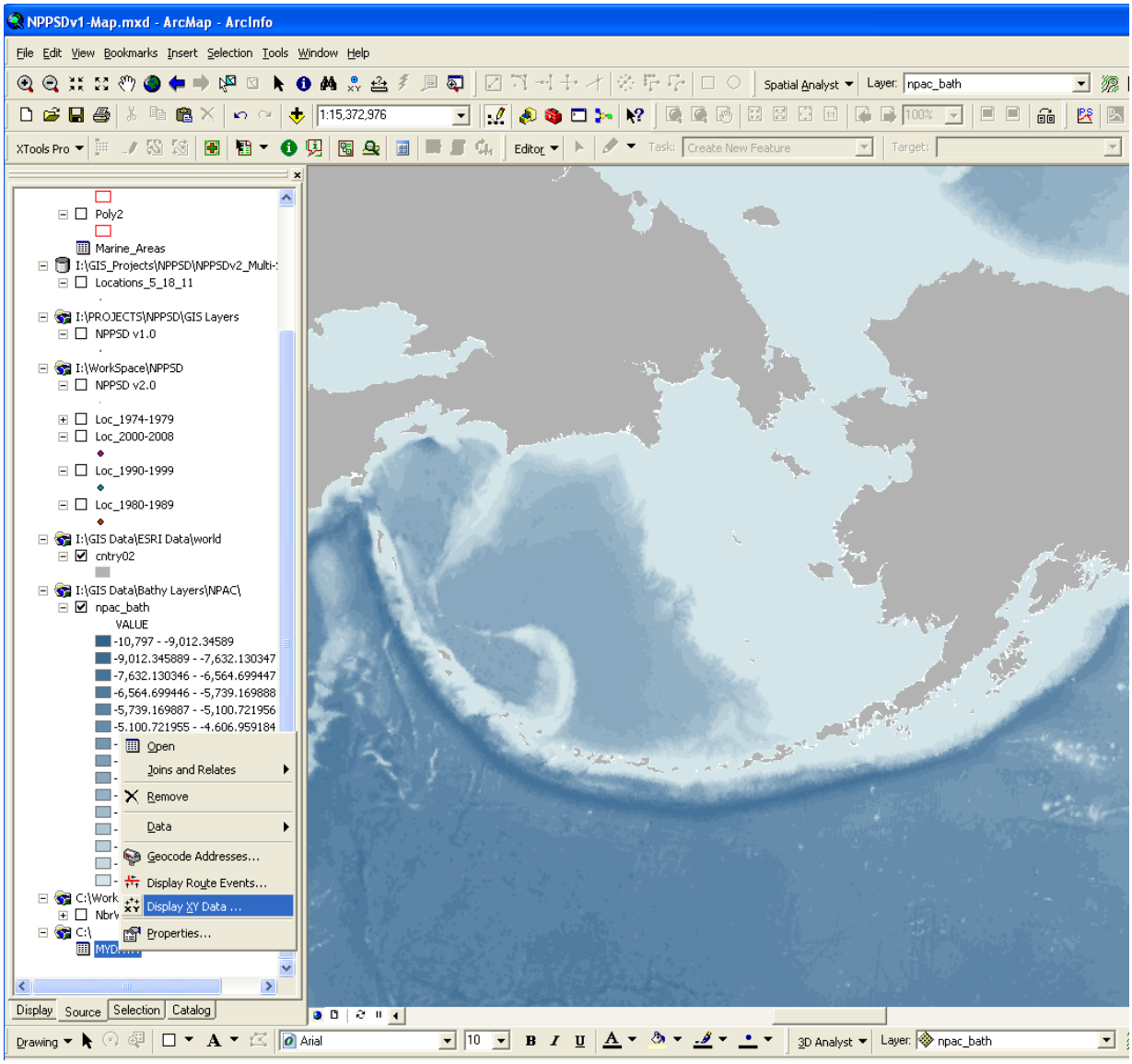

Figure E9. Cross-tabulation density output from the NPPSD v2.0 Query Form. Note that the field names are limited to meet the restrictions of the dbf format (10 characters).

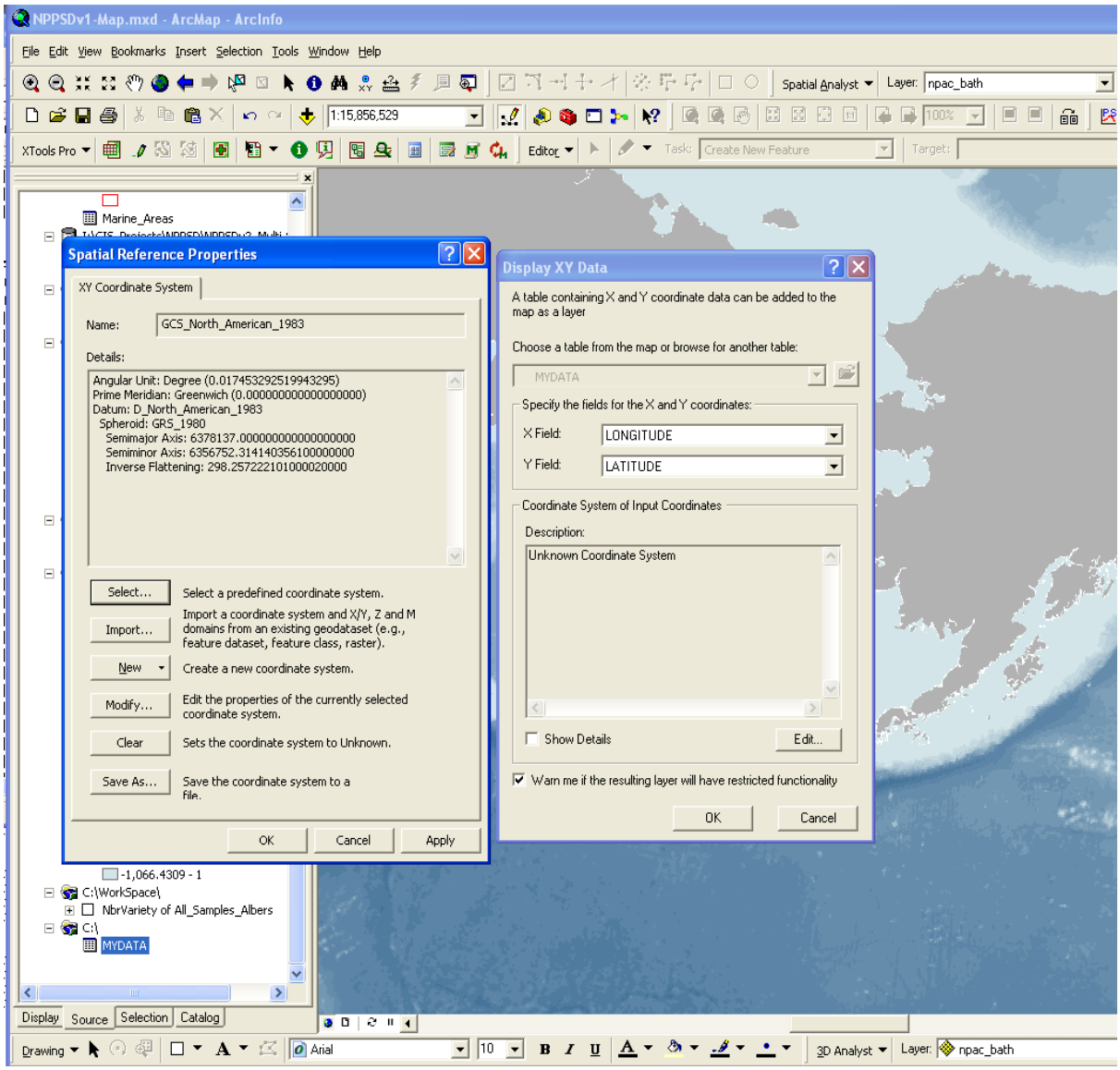

Figure E10. Cross-tabulation density output from the NPPSD v2.0 Query Form. Note that the field names are limited to meet the restrictions of the dbf format (10 characters).

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