North Pacific Pelagic Seabird Database (NPPSD): Compiling Datasets and Creating an Archive, Accessible Database, and Pelagic Seabird Atlas

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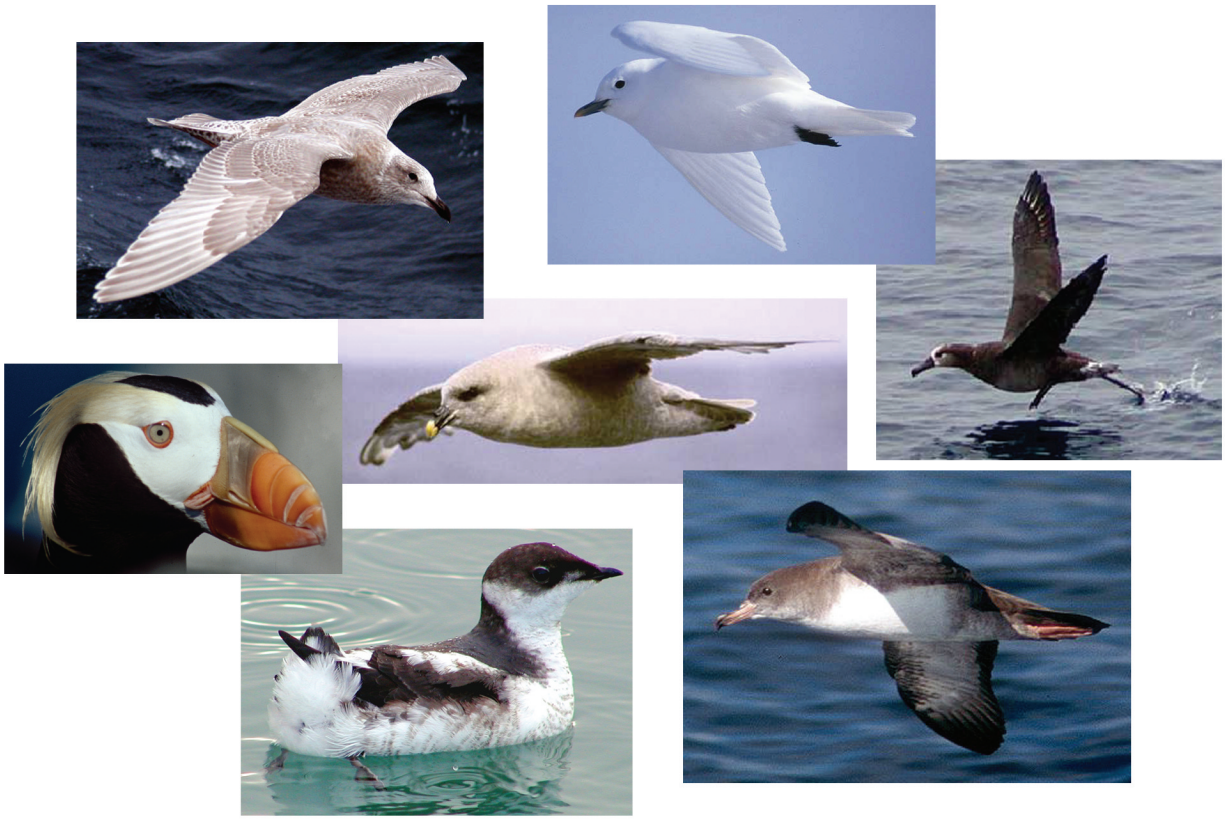

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ABSTRACT:

Data on the pelagic distribution and abundance of seabirds are critical for understanding the basic ecology of marine birds, monitoring population trends, assessing impacts of human activities, identifying critical marine habitats, and educating the public about seabird conservation. To address these needs, U.S. Geological Survey and U.S. Fish and Wildlife Service researchers undertook the task of consolidating and integrating data on the pelagic distribution of seabirds in Alaska and the North Pacific. Data was collected from numerous researchers and federal agencies. The data was imported into an Access® database and proofed. Numerous data quality issues were encountered and protocols to address them were developed. Survey areas were calculated from the data and animal densities were calculated for all species. The North Pacific Pelagic Seabird Database (NPPSD) project has collected data from researchers in the U.S. and Russia (1974-2003). The current version of the NPPSD (v. 1.0) includes 465 individual surveys between 1974 and 2002. These surveys comprised 65,644 transects and include counts of 6,995,932 seabirds and 29,739 marine mammals. The database is organized into four primary tables: seabird number, seabird density, marine mammal number, and marine mammal density. In the process of constructing the NPPSD, a number of additional databases were created including ones for metadata, species codes, and Short-tailed Albatross sightings. We created a users guide, that describes the NPPSD source data, the algorithms implemented within the database, and recommendations for using the data. Collaborations with the U.S. Fish and Wildlife Service, Minerals Management Service, University of California-Irvine, and the World Wildlife Fund have already yielded useful research and management products from the NPPSD.

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PURPOSE:

The need for comprehensive geographic data on the pelagic distribution of seabirds in Alaska and the Northern Pacific has long been recognized. During the Outer Continental Shelf Environmental Assessment Program (OCSEAP) of the 1970's, millions of dollars were spent to gather these data in advance of oil development on Alaska's continental shelves. This work culminated in an atlas on the "Pelagic Distribution and Abundance of Seabirds in the Gulf of Alaska and Eastern Bering Sea" (Gould et al. 1982) which documented the at-sea distribution and abundance of 16 common seabird species in Alaska. Since the collection of the OCSEAP data, numerous surveys have been conducted to determine the pelagic distribution of seabirds in the North Pacific (e.g., Hunt & Harrison 1990, Piatt et al. 1991, 1993, 1997; Schauer 1992, Elphick & Hunt 1993, Hunt et al. 1993, Gould & Piatt 1993, Klosiewski & Laing 1994, Agler et al. 1998, 1999). These data greatly expand the spatial and temporal scope of the data collected during the OCSEAP project; however, no attempt had been made to consolidate these data sets.

Pelagic seabird abundance data have been used to assess immediate (Piatt et al. 1990) and long-term (Klowsieski & Laing 1994) impacts of the *Exxon Valdez* oil spill on marine bird populations; model and predict the impact of oil pollution on seabird colony populations (Ford et al. 1987, 1991); assess long-term changes in marine ecosystems (Ainley et al. 1995; Veit et al. 1996; Agler et al. 1999); identify fine- and coarse-scaled features of marine ecosystems (Piatt et al. 1991, 1992; Elphick & Hunt 1993); estimate population sizes of rare or threatened species that are impossible to census using traditional methods (Piatt & Ford 1993; Agler et al. 1998; Kendall & Agler 1998); and examine seasonal movements and winter habitat use by seabirds (Piatt & Naslund 1995; Agler et al. 1998). These data could also be used to assess potential conflicts between commercial fisheries and marine birds (e.g., long-line fisheries and albatrosses), plan and manage marine reserves (e.g., Pribilof Islands, Glacier Bay National Park, Beringia International Park and Preserve), or as a tool for disseminating natural history information to the general public, educators, and the tourism industry.

Prior to our efforts, pelagic seabird data remained in hundreds of individual data files. While various investigators may have access to some of the data, the bulk of data were inaccessible to any one user group. Researchers interested in using multiple data sets have often been forced to use subsets of survey data and deal with the problems of integrating them for their specific area of interest. Combining all available data into a standardized database and then developing tools and products to map and interpret these data will provide scientists, resource managers, and the public with a powerful tool for seabird study and conservation. Thus, our long-term objectives are as follows:

1) Compile and document original raw databases

2) Merge all raw datasets into 4 dataset types with standardized formats. This archive would be updated annually, and would be the source for all data subsets used in subsequent analyses.

3) Develop database programs for accessing and querying the *Archive* for specific data subsets to be used for specific purposes (e.g., web-based mapping, atlas, etc.).

4) Create at least 3 distinct products from the *Archive:*
    a. A hard copy Pelagic Seabird Atlas for Alaska (full color maps, species accounts, review of survey methods, multi-author contributions)
    b. A CD for distribution containing the Archive, documentation of surveys, methods, software for data filtering, manipulation and export)
    c. Web-based pelagic data and map server (requiring filtered subset of Archive, web/HTML software, web user interface)

5) Establish a system for long-term maintenance of the Archive, and develop/acquire appropriate software tools for maintaining the database.

APPROACH:

The goal of the NPPSD was to compile a wide variety of seabird surveys into a single accessible database. The advantages of consolidating individual seabird surveys were recognized as early as the 1970s during the OCSEAP program. Adoption of a common data format and a central archive allowed the National Oceanographic and Atmospheric Administration (NOAA) managers of that project to compile the single largest set of seabird surveys up to that time. However, the OCSEAP program ended in 1982. In addition, the seabird survey data suffered from limited quality control and a lack of accessibility. Each survey was archived individually in a hierarchical data format with no query interface or means to integrate the individual surveys. While the OCSEAP data set represented a major step in making surveys comparable, the lack of accessibility has limited the utility of this dataset. Our plan was to use the OCSEAP data set as a starting point for developing the NPPSD. By starting with this large, similarly formatted set of data, we would develop the tools for integrating data into a new more accessible format. With these new tools we would begin the process of adding non-OCSEAP datasets.

The large number of surveys conducted since the conclusion of the OCSEAP program, include extensive new data sets from areas that were poorly sampled in OCSEAP studies including, Southeast Alaska, Prince William Sound, Cook Inlet, western Aleutians, western Bering Sea; Table 1). Unlike the OCSEAP data, recent (>1982) data were collected by numerous primary investigators and agencies, each of whom used different methods of data collection and archival.

Individual researchers select the most appropriate methods for a given project (e.g. a survey focused on albatross might choose a larger transect width than one focused on murrelets). However, almost all surveys collected data on multiple species. The advantages of bringing these surveys together in one database usually exceed the potential for increased variation from combining surveys that use different methods. Careful proofing of potential datasets and selection of a uniform metric can greatly minimize error.

Increasing the number of surveys in the database maximizes the spatial and temporal coverage of the survey data as well as increasing sample size.

Table 1. Summary of primary pelagic seabird datasets that were known to exist prior to beginning work on the NPPSD. Area surveyed (km^2) was estimated from the numbers of transects conducted times transect area (length times width). BS=Bearing Sea, ALEU=Aleutians, PWS=Prince William Sound, GOA=Gulf of Alaska, KOD= Kodiak, NCP=, CHUK=Chuckchi Sea.

Source	Type	Years	Square km	Area
OCSEAP	Ship/Aerial	1974-1982	63,100	ALL AREAS
Hunt et al.	Ship	1976-1998	+20,000	BS, ALEU
Irons et al.	Small boat	1984-1995	+ 2,520	PWS, GOA
Kodiak NWR	Ship	1984-1998	+ 8,100	KOD
Laing et al.	Small boat	1989-1991	1,700	PWS
Gould et al.	Ship	1989-1992	3,350	NCP, GOA
Day et al.	Ship	1980-1988	10,160	BS, NCP
Schauer et al.	Ship	1988-1991	1,630	BS, CHUK
Piatt et al.	Ship	1988-1999	9,800	ALL AREAS
Byrd & Piatt	Ship	1995-1999	+ 2,600	BS
Lindell	Ship	1993-1998	1,700	SE
TOTAL			+ 125,890	

The production of the NPPSD involved three major steps: (1) gathering, documenting, and archiving of datasets, (2) proofing and formatting of datasets in a relational database, and (3) processing data sets to integrate all surveys using a single metric. Although the final product is an Access Database, we archived datasets in their original formats and so that future analyses could access the data in their original format and sampling scale if necessary or archiving schemes (Fig. 1.).

There was considerable variability in the survey data. Even among the OCSEAP data sets we identified numerous disparities between surveys. Some differences were expected, e.g. "Aircraft" vs. "Boat" based surveys; however, the variability in the interpretation of NOAA proscribed formats (i.e. how the forms were filled out), and the lack of quality assurance - quality control (QAQC) was unexpected. The post OCSEAP investigations were even more variable; few used exactly the same protocols, and yielded different output formats. Data archive formats were also variable ranging from hardcopy to a variety of digital file types (e.g., ASCII, dBase, Access, Paradox, Excel). Our first step was to import each data set into a MS Access data table. The data was then proofed to the highest standards possible given the metadata available for each survey. The vast majority of the OCSEAP seabird surveys were conducted by U.S. Fish and Wildlife Service (USFWS). We obtained the original hardcopy data sheets from Dr. David Irons (USFWS). These data sheets were used to begin a metadata database (Fig. 2). This metadata database became a tool to assist in proofing data tables as well as a catalog of data that had been acquired. The amount of metadata available for each survey was highly variable. Most of the non-OCSEAP datasets were less well documented and we relied on the contributor to do basic proofing. We did identify values that were out of range for all datasets, and, where possible, corrections were made. Where a value was clearly out of the possible range (e.g., a vessel speed of 300), and it was not possible to identify correct values, the field was left blank.

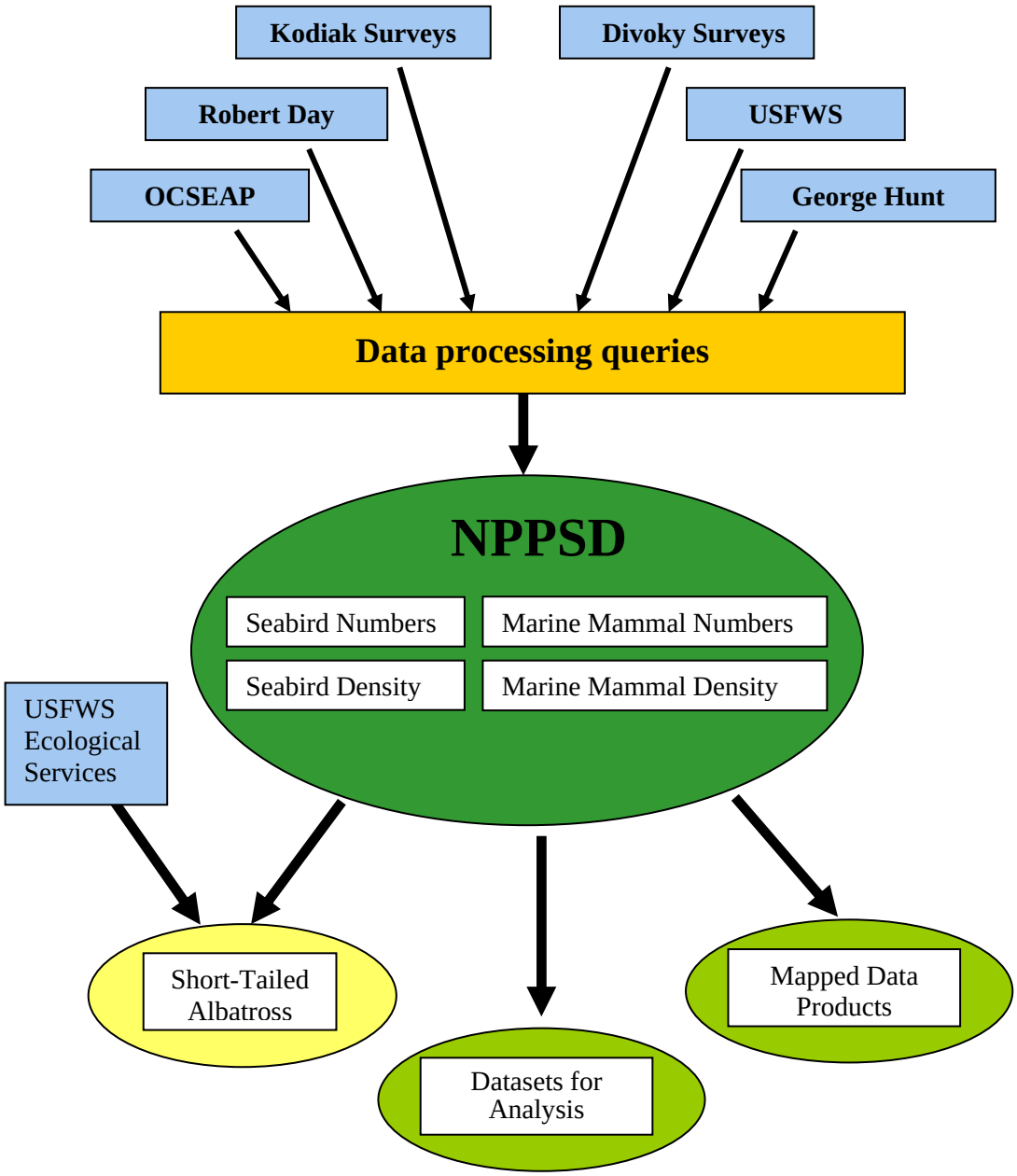

Figure 1. Conceptual model of the design of the NPPSD. Light blue boxes signify raw datasets, dark green ellipses signify data tables within the database, and olive green ellipses signify specific data products from the NPPSD. The yellow ellipse represents a new database that uses the NPPSD as one of its sources.

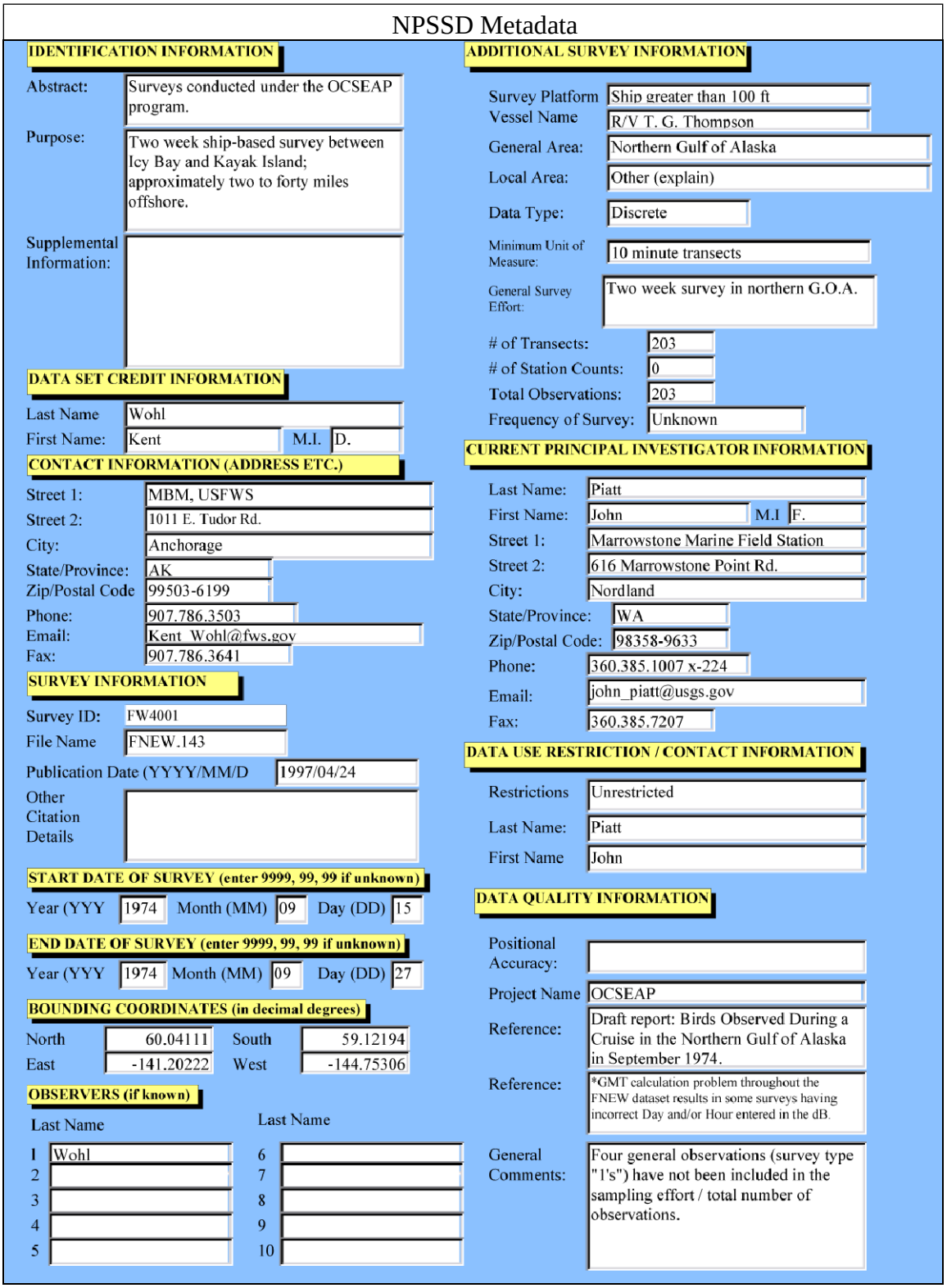

Figure 2. Screen shot of the “NPPSD Metadata Entry Form”.

The survey types gathered from all sources included aerial surveys, ship-based surveys using "OCSEAP Format" (OF), ship-based surveys using continuous data recording, and small-boat surveys. Aerial surveys generally comprised narrow strip transects, high speeds, continuous recording of animals along a transect, and less rigorous identifications of species (more lumping of species into genera or family groups). Most historical ship-based surveys were conducted using OCSEAP protocols where birds were counted within a 200-300m-wide strip and summed into transects (typically 10 minutes in duration). On most of these surveys flying birds were counted at regular intervals, not continuously, so as to minimize overestimation of seabirds due to the higher encounter rate of flying birds (Gould and Forsell 1989). Other historical survey methods involve counting all flying birds continuously. Both methodologies are still in use and some survey data came to us without information on which was used. Sample areas were calculated in one of three ways: (1) if we had transect width, vessel speed, and elapsed time we used that to calculate area, (2) if instead we had transect width and distance traveled (estimated by observers) we used that, and (3) if neither of the previous data sources were available and we had a beginning and an end location (lat-long), we used a formula to calculate distance. While it might seem preferable to use beginning and end locations to calculate areas, early surveys did not have access to precise location information and over short distances this lack of precision makes area calculations uncertain. Fortunately, there were relatively few transects in which areas were calculated in this manner.

In the 1990's, many investigators began to collect ship-based data using computer loggers, and bird observations were recorded continuously with GPS positions for each record (in contrast to the OF method of summing records into 10-min bins). In general, methods were otherwise similar to those used in OF surveys. Small-boat transects were often quite different from ship-based surveys. In many small-boat surveys, transect widths are typically smaller (e.g., 100-200 m), transects may follow coastlines from headland to headland (i.e., not fixed-length), all flying birds are counted, and census data are binned over the entire transect (e.g., Agler et al. 1998, 1999). Some investigators began continuous computer-logging (CCL) of individual birds on small-boat transects in the late 1990's. On these surveys, data were collected continuously along a transect with location data for

every sighting. The resolution of these CCL data is beyond the needs of the NPPSD. We decided to use the transect as designated by the researcher as the unit of measure for CCLs. On average CCL transects were slightly longer than the average standard transect (10 minute count) used in the OCSEAP program, but were roughly comparable. In general, all surveys involved the enumeration of marine birds and mammals observed on strip transects of some known or quantifiable distance. As long as there was sufficient data to determine the distance of a transect and a transect width, a density was calculated for all species. If area/density could not be calculated, the station/transect was dropped from the NPPSD.

We developed protocols for processing data into consistent formats. In short, following importation into an Access database and data proofing, each dataset was run through a series of database operations (queries). Queries were constructed to take existing data structures and yield a standardized format. This included the adoption of our "Comprehensive Species List" (Appendix 1). This list, based on the current taxonomy, was necessary to address issues of taxonomy changes and ad-hock species codes. Adoption of a standard format allowed us to develop a portable set of queries to: (1) link location and species count tables, (2) calculate survey areas, (3) calculate species densities, and (4) merge data sets into one of four unified data tables; one each for "Seabird Density", "Seabird Numbers", "Marine Mammal Density", and, "Marine Mammal Numbers". Conceptual diagrams of the data processing illustrate the 2 major processing operations. The first processing operation identified locations and calculated sample areas (Fig. 3). The second processing operation involved merging bird and marine mammal observations with the sample area calculations and calculation densities (Fig. 4). More comprehensive explanations of the data processing steps can be found in the "NPPSD Users Guide" (Appendix 2).

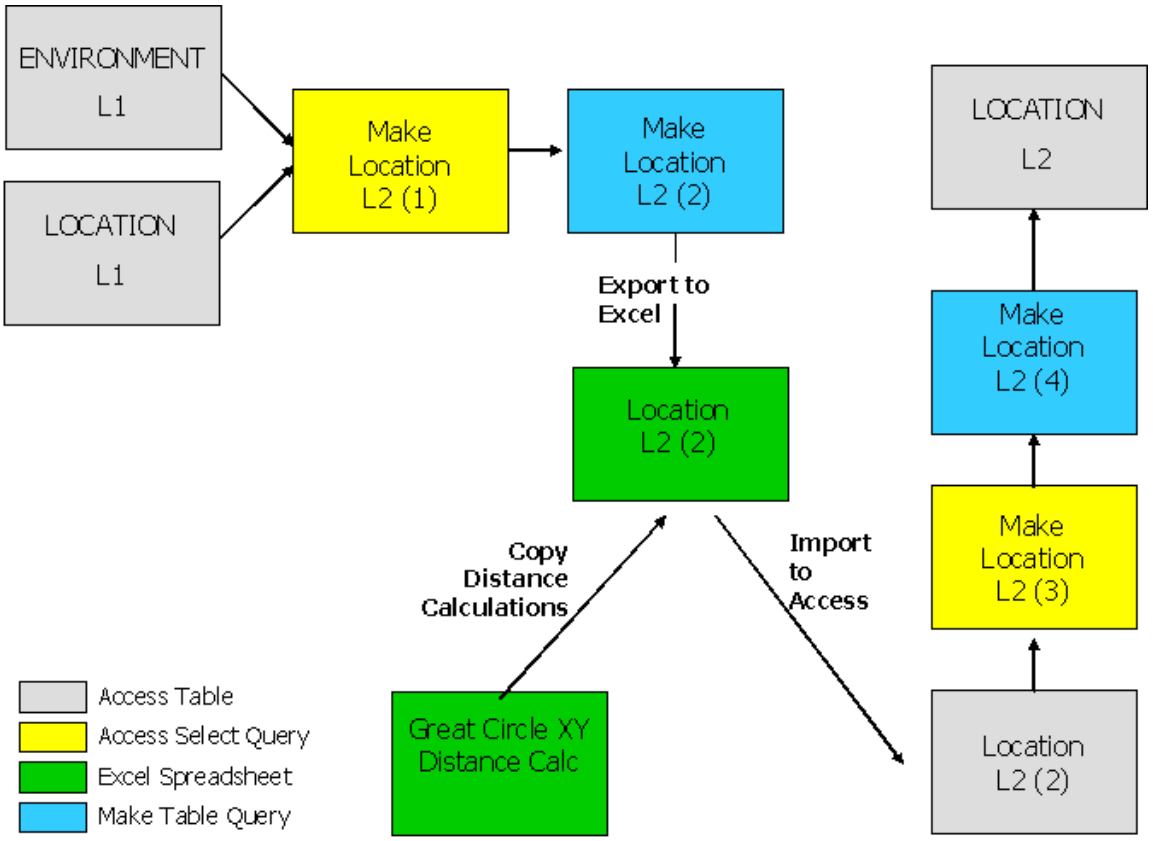

Figure 3. Conceptual diagram of the processing steps used to yield location and calculate sample area from data files coming into the NPPSD.

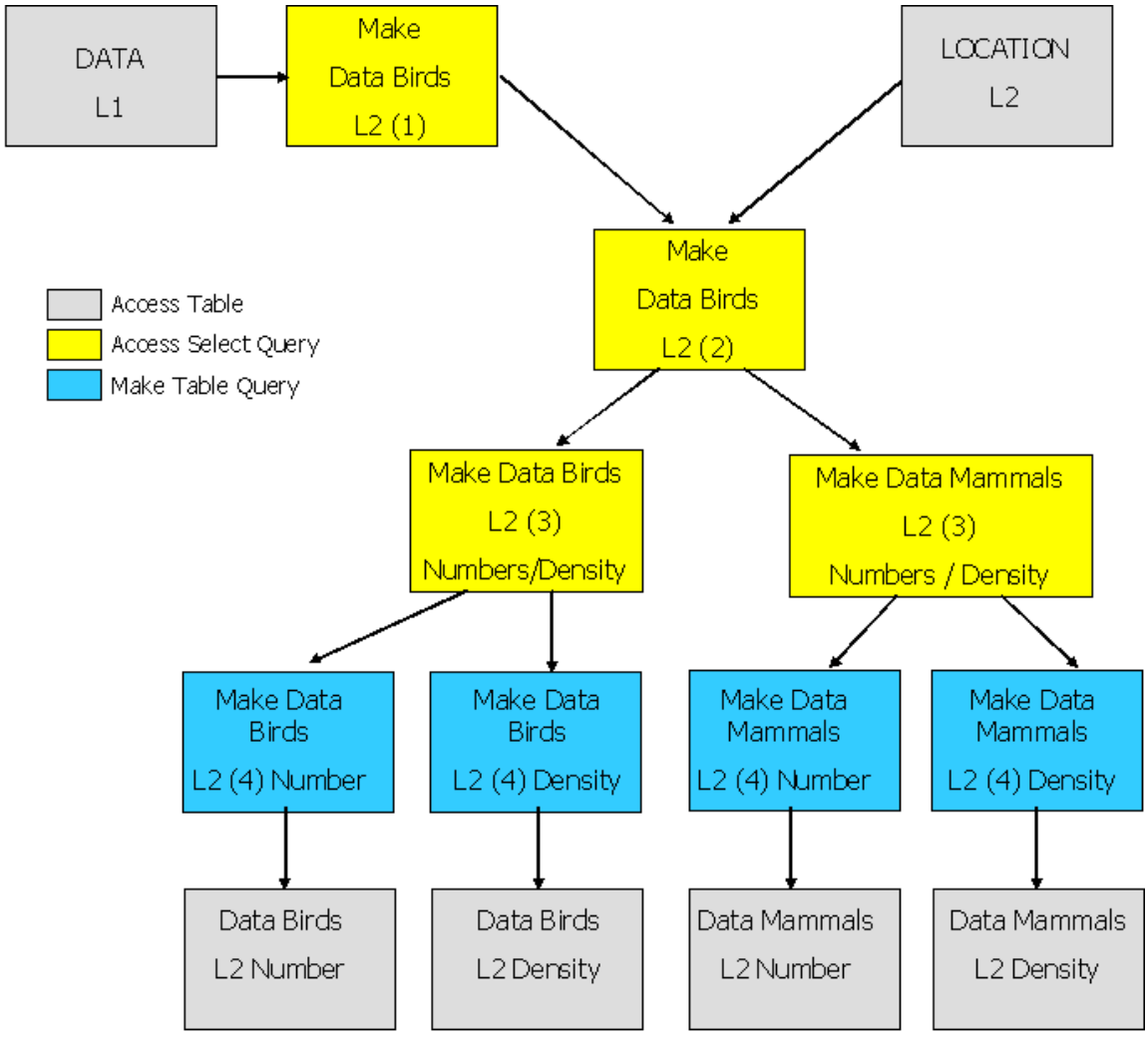

Figure 4. Conceptual diagram of the processing steps used to yield the four tables composing the NPPSD. Resulting data tables include fields for Location, Sample Area, Platform Type, Survey Type, and Number or Density.

Work was conducted at the USGS Alaska Science Center, Anchorage, AK, 99503. Project management was subdivided between the Principal Investigator for the project, John F. Piatt and the project manager Gary Drew (USGS). John was responsible for the original proposal, project design, and project direction. Gary was tasked with the development of the database and its associated metadata catalog as well as the day to day management of the project and its personnel. Additionally, Gary was responsible for developing GIS products from the datasets. In addition to direct management, a "Working Group" was formed at the beginning of the project to develop plans, review progress, and provide feedback on the general direction of the project. The members of the "Working Group" were, John Piatt (USGS), john_piatt@usgs.gov - Project Leader, Gary Drew (USGS) gary_drew@usgs.gov, David Irons (USFWS) David_Irons@fws.gov, Jay Johnson (USFWS) jay_a_johnson@fws.gov, Kathy Kuletz (USFWS) Kathy_Kuletz@fws.gov, Shawn Stephensen (USFWS) Shawn_Stephensen@fws.gov, Shiway Wang (USGS) shiway_wang@usgs.gov, Michelle St. Peters (USGS) mstpeters@usgs.gov , and Jennifer Wetzel (USGS) jwetzel@usgs.gov.

FINDINGS:

The NPPSD version 1.0 was constructed from 456 individual surveys. These surveys contained 65,644 transects and include counts totaling 6,995,932 seabirds and 29,739 marine mammals. The database is organized into 4 primary tables; seabird number, seabird density, marine mammal number, and marine mammal density. Due to problems with some data, e.g. missing latitude information, not all transects could be utilized. Transects that were questionable were dropped from the final data tables. In some cases complete surveys were unusable due to missing information. The "Number" tables required dropping fewer samples because fewer criteria were required for these tables, In addition, "off-transect" observations were left in the number tables as were land-based and stationary observations. The "Number" tables are not intended to be used for calculations; they are intended to give information about the spatial distribution and range of species.

Table 2. Summary of transect number by data tables within the NPPSD database.

Data Table	Number of Surveys	Number of Transects
Seabird Density	377	57,660
Seabird Number	406	61,195
Marine Mammal Density	377	57,660
Marine Mammal Number	406	61,195

Table 3. Data acquired and archived in their original format but not yet added to the NPPSD.

Data Set	Number of Surveys	Number of Transects
Shuntov (Russia)	8	2900
Piatt (USGS)	15	1356
Irons (USFWS)	19	5088
Byrd/Piatt (USFWS/USGS)	9	225
Day	8	653

As mentioned in the prior section, during the creation of the NPPSD we encountered a fundamental problem with respect to the variation in use of species codes. This was primarily due to taxonomic changes and unique user-defined species codes. We found researchers often used several different codes for the same taxa. These problems made the development of a comprehensive code list for use in most Pacific at-sea surveys essential (Appendix 1). The current "American Ornithological Union Bird Species List" was not sufficient to cover all pacific marine species of seabirds and marine mammals. The four letter codes used in most at-sea surveys have not closely followed any one standard; different researchers use different codes for the same species and the same codes for different species. In addition, the taxonomic status of some species has changed. Out of necessity we have had to deal with this problem and bring all old data sets up to current

standards. For our list, we compiled a species code list that is current with the U.S. Department of Agriculture's "Integrated Taxonomic Information System" (ITIS) standards, and cross-linked it with historical four-letter and 12-digit codes used by investigators in the past. We are recommending that researchers conducting pelagic predator surveys in the North Pacific use the list we have made available on our NPPSD web site or on the distribution CD. A great deal of time was spent matching the codes used by various researchers to the new code list. We strongly recommend that researchers adopt the new taxonomic code list as it will facilitate the future integration of new datasets into the NPPSD.

Products

While the NPPSD was under development we received numerous requests for data and collaboration. Where possible, we responded with data, GIS products, collaborative presentations, and co-authorships. As the following list indicates, we have provided a wealth of information on seabird distribution to both governmental and non-governmental organizations over the last two years and made numerous efforts to inform others in the scientific community about our work.

- We provided the U.S. Fish and Wildlife Service and National Marine Fisheries Service with information about the pelagic distribution of Black-Footed and Laysan Albatrosses (Fig. 5) to assist in the development of long-line fishing regulations in Alaska (Livingston 2002).
- We provided distribution and density data for Kittlitz's Murrelet to the USFWS for use in development of the status review of the species as a prelude to listing under the Endangered Species Act..
- Distribution maps for Kittlitz's Murrelets were provided to USFWS and USGS biologists to aid in developing inventory plans throughout its range in Alaska.
- We provided the Minerals Management Service with a broad-scale map of seabird distribution in Alaska (Fig. 6), to assist in the assessment of environmental risk for offshore drilling lease areas (Minerals Management Service, 2003) .

- We prepared a database on endangered Short-tailed Albatross (STAL) for the USFWS Endangered Species Office, Anchorage, as part of a collaborative USGS/USFWS project. This dataset includes Short-tailed Albatross sightings from various sources by researchers and managers over a long period of time (Fig. 7). We selected all of the STAL sightings from the NPPSD and integrated them with a database compiled by the USFWS. We verified records, double-checked computer records against all available hard copy reports, corrected numerous errors in the data (those which were apparent and fixable), eliminated duplicate records that had crept into the USFWS database over time, and added additional records gleaned from new sources. Two manuscripts describing the distribution of STAL in relation to the environment and other albatrosses are in preparation by USGS and FWS.
- We reported on our project at the Pacific Seabird Group's Annual meeting in Santa Barbara, CA. January 2003. This poster can be found on the NPPSD web site under "Products".
- We reported on our project at the "Marine Science in the Northeast Pacific: Science For Resource Dependent Communities" symposium in Anchorage, AK January 2003. This poster can be found on the NPPSD web site under "Products".
- We worked with George Hunt and Jaime Jahncke (UC Irvine) on a presentation at PICES. This presentation "Prey Consumption and Energy Transfer by Seabirds in the Gulf of Alaska" was given at the 12th annual PICES meeting in Seoul, Korea.
- We coauthored the paper "Prey Consumption and Energy Transfer by Seabirds in the Gulf of Alaska" Deep Sea Research II (*in press*) with George Hunt and Jaime Jahncke of UC Irvine (Hunt et al. 2005, Fig. 8).
- We provided data on pink-footed shearwater to the "North American Conservation Action Plan" being prepared by the Commission for Environmental Cooperation (U.S., Canada, and Mexico). This species was selected because of its range and vulnerable status. Our data represented the only historical pelagic data for this species (Anonymous 2004).

- We collaborated with Bruce Robson who is working for the World Wildlife Fund on the planned Pribilof Islands Habitat Conservation Area. We used data from the NPPSD to develop detailed GIS maps of seabird surveys in the proposed Conservation Area (Fig. 9).
- We presented a paper "Predictable hotspots and foraging habitat of the endangered Short-tailed Albatross in Alaska" at the Alaska Bird Conference in Anchorage, AK March 2004.
- We presented a poster "Progress of the NPPSD: Current Utility and Future Goals", at the Alaska Bird Conference in Anchorage, AK March 2004.
- We provided a "Preliminary assessment of marine bird abundance and species composition in the vicinity of the Selendang Ayu oil spill, based on historical data from the North Pacific Pelagic Seabird Database" (Fig. 10).
- We presented "Surveying the Past: North Pacific Seabird Database" the Keynote presentation for the seabird session at the Marine Science in Alaska 2005 Symposium, January, 2005, Anchorage, AK

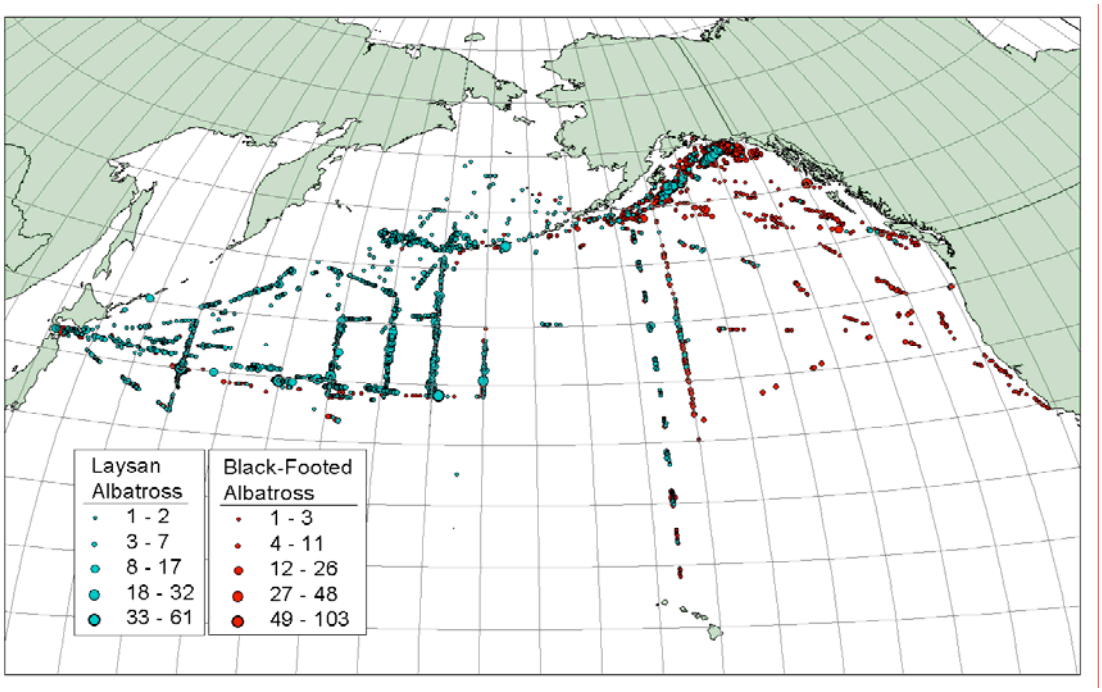

Figure 5. Distribution of Laysan and Black-Footed Albatross in the North Pacific. Data was extracted from an early version of the USGS North Pacific Pelagic Seabird Database. Data was provided to USFWS/NOAA.

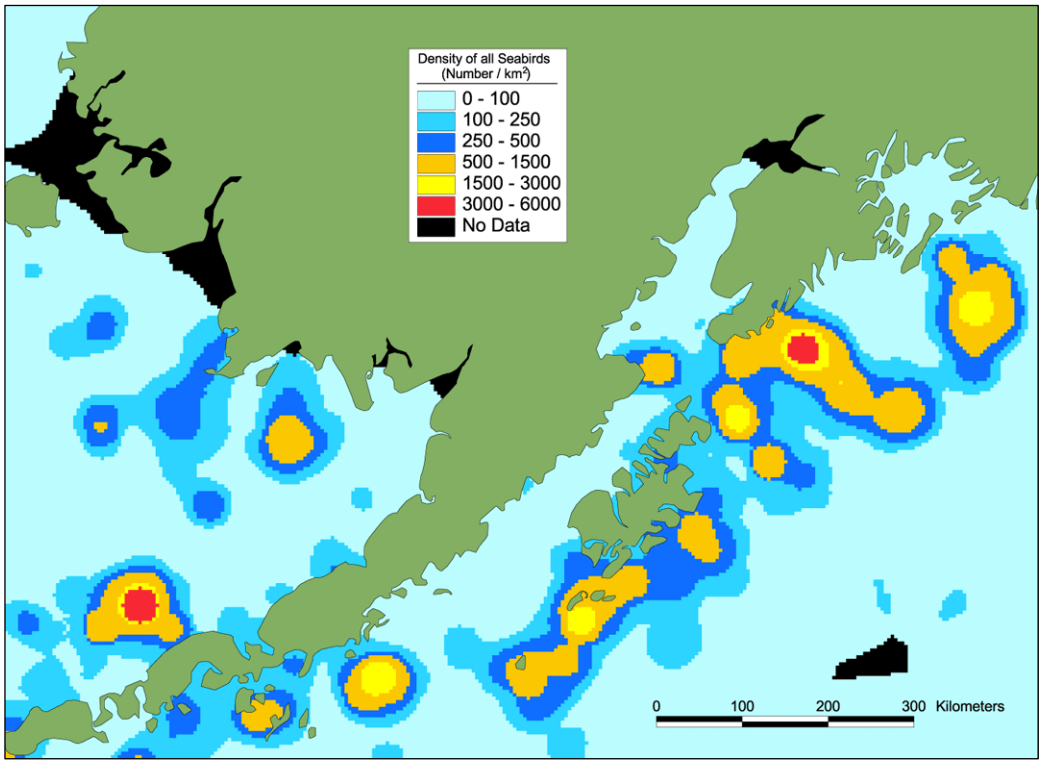

Figure 6. Seabird density map based on surveys conducted between 1974-1982. Data provided to Minerals Management Service**.**

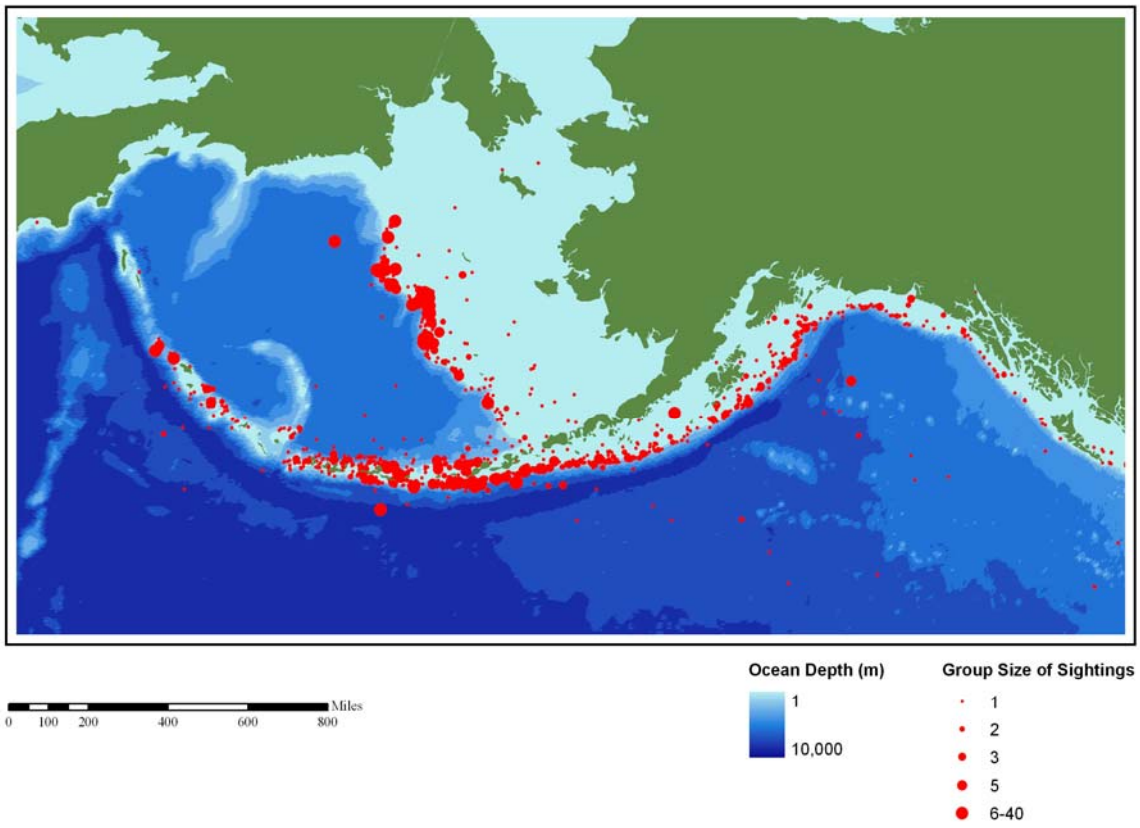

Figure 7. Sightings of Short-tailed Albatross (STAL) in the Northern Pacific 1903-2003. Red dots represent STAL sightings, with the size of the group indicated by the size of the dot. Data provided at the request of the USFWS, Ecological Services Division.

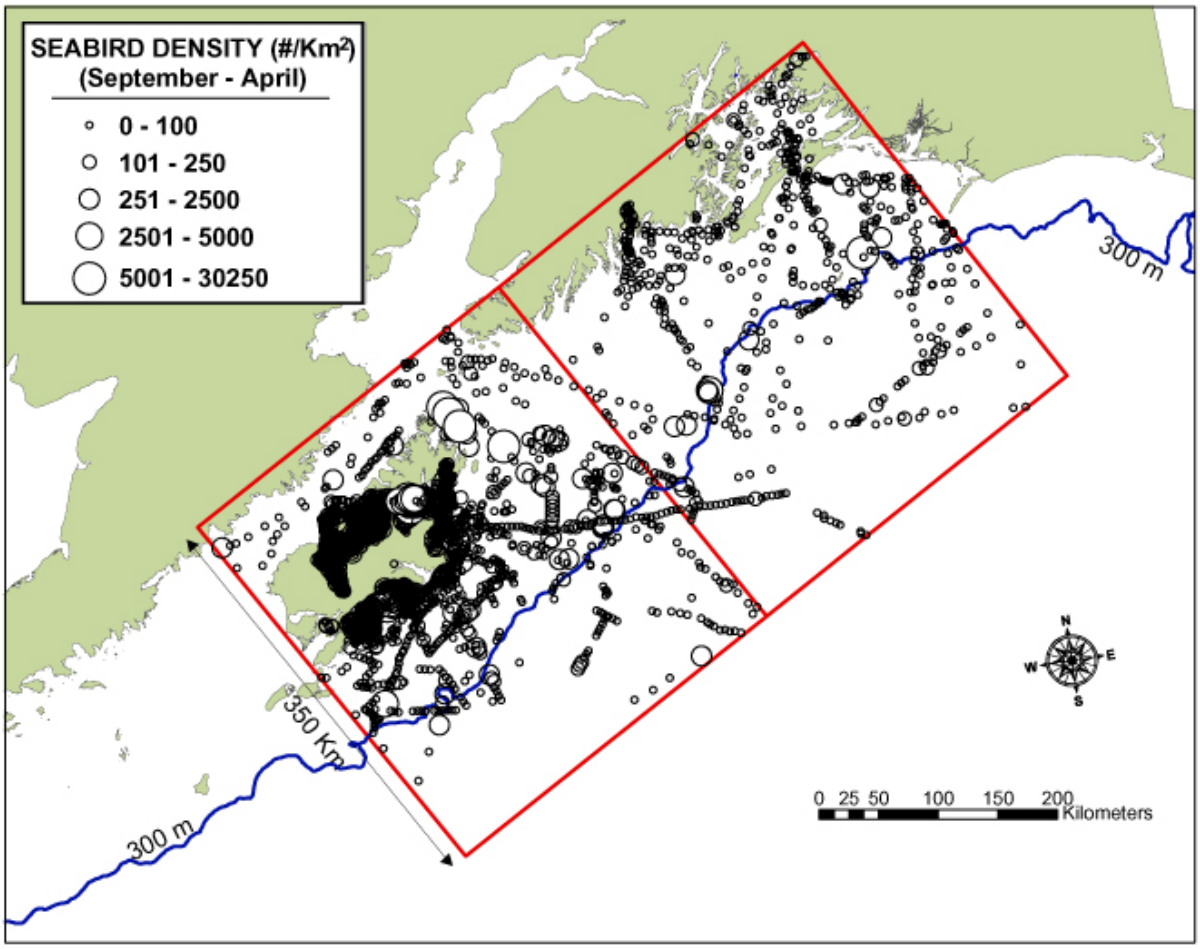

Figure 8. Area of the northern Gulf of Alaska examined in order to estimate "Prey Consumption and Energy Transfer by Seabirds in the Gulf of Alaska" (Hunt et al., in press). The red boxes represent the areas where seabird densities were calculated. Dot sizes reflect the summed densities of all seabirds on survey transects. The 300 m depth contour approximates the shelf break.

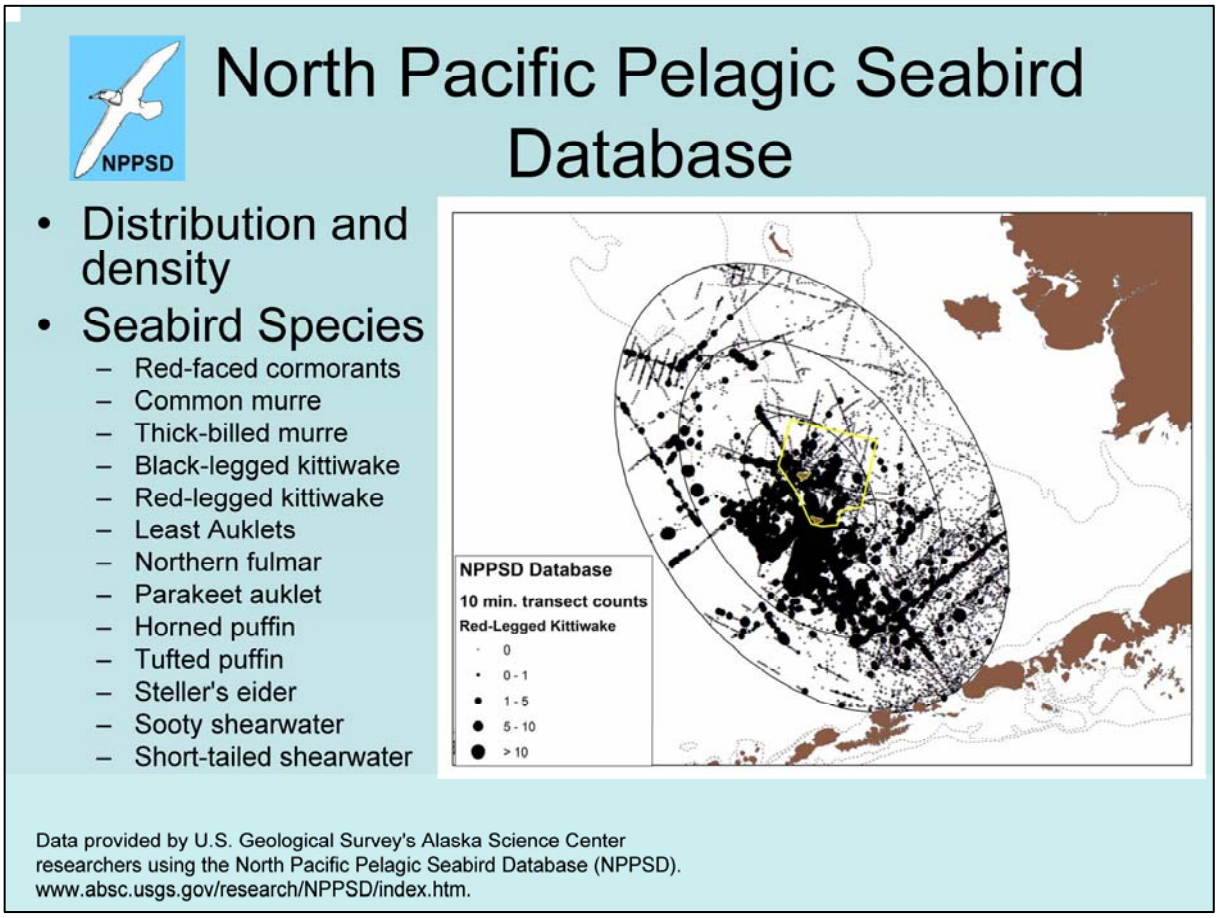

Figure 9. Maps of seabird distribution in and around the Pribilof Islands using data from the NPPSD. This image is from a presentation by Bruce Robson (World Wildlife Fund) on the planned Pribilof Islands Habitat Conservation Area.

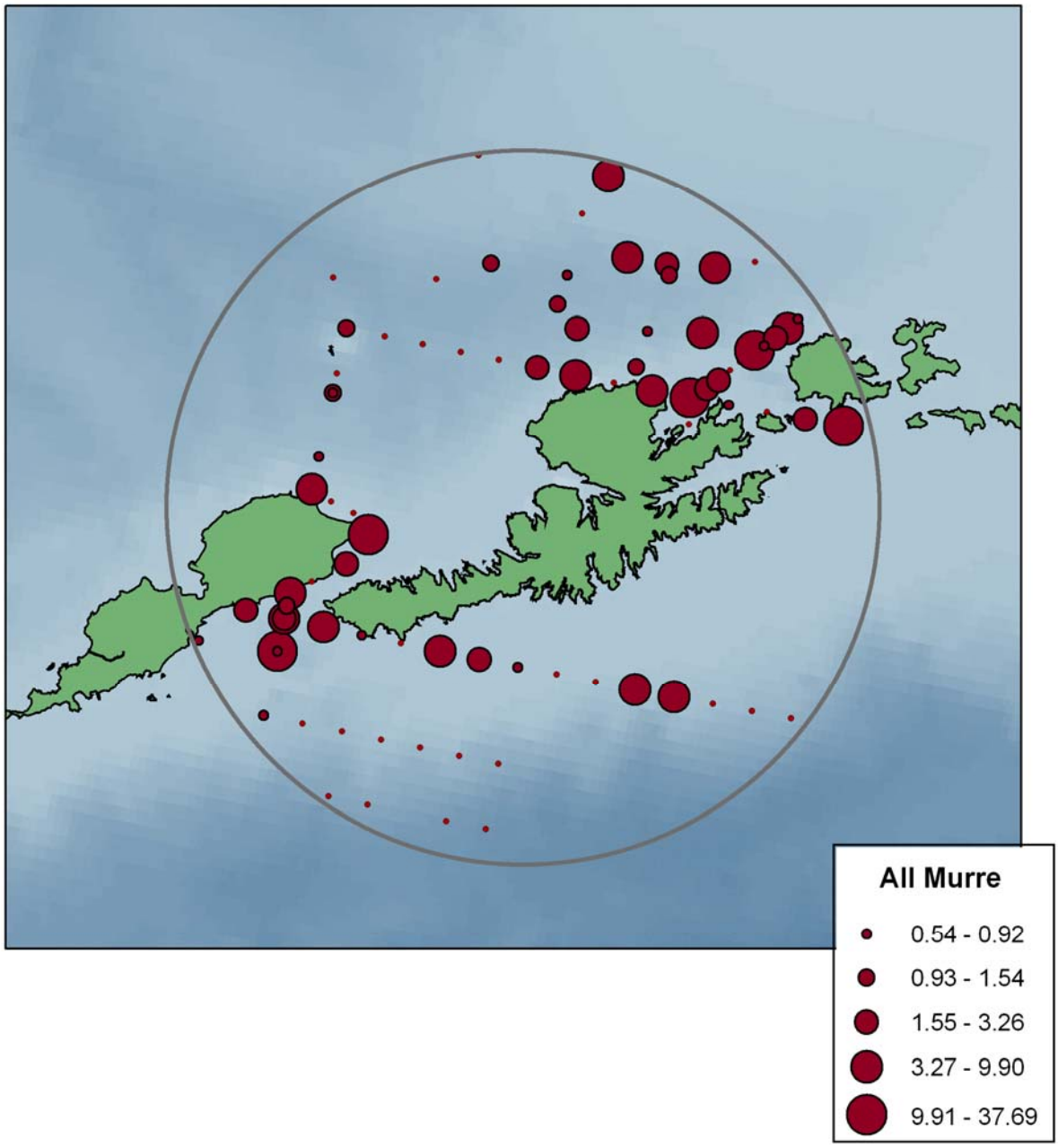

Figure 10. Seabird distribution in a 350 km by 660 km box bisected by the shelf break (300 m) in the northern Gulf of Alaska. Data provided to the USFWS in response to a request for data to assist in damage assessments for the M/V Selendang Ayu oil spill in December of 2004.

Problems

Several problems were encountered during the project that delayed or impeded progress. First and foremost, the USGS implemented a new policy on business practices and overhead shortly after our proposal was accepted and funded by NPMRI. The USGS retroactively applied a 45% overhead rate to the 131K received from NPMRI instead of the 15% we had proposed. Obviously, this had a major impact on our ability to meet our stated goals. In particular, this prevented us from hiring a database programmer early in the process. With regard to the data, we had not anticipated the lack of QAQC in the early data sets. Given the reasonably strict guidelines and uniform protocols we had assumed these data sets would be reasonably free from errors. In discussions with NOAA personnel at the National Oceanographic Data Center it became clear that NOAA only archived the data and left all QAQC to individual contributors. This resulted in some serious problems that only became clear well into the process. In addition to simple transcription errors we found surveys that did not include all transects surveyed, out of range values, and nonstandard codes. When NOAA received data they assigned a new unique name to the dataset, so when a data set was resubmitted there was no easy way to catch the redundancy. Finally, the U.S. Fish and Wildlife Service was a collaborator on this project and had agreed to provide the ArcIMS server and a GS-12 programmer to develop the GIS interface for the data. Recent court orders have limited the ability of Department of the Interior agencies to serve out data and the USFWS ARC/IMS server still remains uncertified and unable to act as our server. USFWS also suffered some funding cuts that prevented them from providing as much support as they had agreed to when the project was initiated. Despite these unanticipated hurdles, we were successful in our primary goal of putting seabird survey data together in a uniform accessible format.

Future Work

Additional work can be put in four categories:

1. Issues related to the database, e.g., adding more data to the existing NPPSD
2. Construction of a more user-friendly interface with which to share data

3. Publication of a hard copy Pelagic Seabird Atlas for Alaska (full color maps, species accounts, review of survey methods, multi-author contributions)
4. The long term maintenance of the system.

As indicated previously, we have acquired a substantial amount of data that has not yet been added to the NPPSD. Some of these data sets have been proofed and are near ready to be added, some have only recently been acquired. We are aware of several sources that have yet to provide their data to the NPPSD. There will also need to be an ongoing process of updating the database with new data sets as they are collected.

We would like to add both text-based and GIS-based search interfaces to the NPPSD. Currently, the data had been summarized into flat-files. While this is not the most efficient storage strategy, it is simple and requires users to have little database expertise in order to access the data. A "query form" interface was planned, however, this will require some restructuring of the data and programming of the form. This interface would be an integral part of the database. Additionally, we believe that a web base ArcIMS (GIS) interface will provide users with the best available tool for selecting and visualizing data in a spatial context.

In our original proposal we indicated that the publication of the hardcopy atlas would depend upon additional funding and identifying an interested publisher. Until we locate adequate funding, this part of the project will have to remain in the planning stage.

While the first phase of the NPPSD is complete, there remains the question of long-term maintenance. We expect that there will be new data to add every year. The Migratory Bird Branch of Region 7 USFWS had agreed to host the NPPSD on one of their servers and provide personnel to maintain it. Budget considerations have now limited the ability of USFWS to provide these services. We would recommend that some mechanism be found to maintain and operate the NPPSD.

EVALUATION:

In the proposal we listed 5 goals.

1. Compile and document original raw databases

This goal was accomplished in good measure. We were able to acquire many data sets known to us (Table 1). We also aquired data from the Russian Far East from Shuntov. Verbal commitments have been obtained for some of the remaining datasets known to exist. Our metadata database/catalog provides detailed information on each survey in the NPPSD as well as information on many of the datasets that are acquired but not yet added to the database.

2. Compile raw datasets into 4 (or less/more) major dataset types with standardized formats. This archive would be updated annually, and would be the source for all data subsets used in subsequent analyses.

The second goal was also accomplished to some degree. We used a Microsoft Access database to compile many of the incoming datasets into a single standardized format. Density was used as the integrating metric. The use of density allowed us to combine all datasets, regardless of platform. We also recognized the utility of having a database of simple numeric counts for spatial information, e.g., range. A large number of samples had to be dropped from the density tables when no sample area could be calculated. We wanted to preserve as much data as possible where simple presence/absence data is sufficient. In the process of developing the seabird tables it became obvious that we should develop similar tables for marine mammals as well.

3. Develop database programs for accessing and querying the *Archive* for specific data subsets to be used for specific purposes (e.g., web-based mapping, atlas, etc.).

Our third goal was partially accomplished. Because of funding cuts, we could not acquire the software and hardware needed to serve out the database, nor a programmer to develop

the software. As previously mentioned, the USFWS was a partner in this research and they were responsible for developing the interface to serve out the data over the internet. However, DOI legal restrictions on the serving of data and funding cuts precluded USFWS from completing these tasks. In response to this limitation, we made the final NPPSD data tables into flat files. This makes them easy to distribute and uncomplicated to use. Anyone familiar with tabular data would have no trouble navigating the tables. Additionally we are providing the data in Microsoft Access and ASCII comma delimited format. We developed some basic queries in Access that can be used to filter these tables; however, a basic knowledge of Microsoft Access is required.

4. Create at least 3 distinct products from the *Archive:*

a. A hard copy Pelagic Seabird Atlas for Alaska (full color maps, species accounts, review of survey methods, multi-author contributions)
b. A CD for distribution containing the Archive, documentation of surveys, methods, software for data filtering, manipulation and export
c. Web-based pelagic data and map server (requiring filtered subset of Archive, web/HTML software, web user interface)

5. Establish a system for long-term maintenance of the Archive, and develop/acquire appropriate software tools for maintaining the database.

In the proposal we stated that both the web site and the hard copy atlas were dependent upon obtaining additional funding. Although we did initially obtain funding from USFWS, as well as an in-kind commitment for developing a web based data query interface, the in kind contributions did not materialize due to funding and computer security restrictions. No funding was obtained for the hard copy atlas. As such, we feel that we achieved all of our goals within the limitations of our funding.

Modification of Goals

There were few modifications made to our goals and objectives, however, there was an important shift in emphasis. One shift in our goals was in favor of extensive QAQC as

opposed to getting the largest number of data surveys into the NPPSD. This modification began when we were entering metadata. We found numerous problems when trying to reconcile dates, times, and numbers of transects using the cruise reports that accompanied many of the original data entry sheets. This led us to look more closely at the original OCSEAP seabird survey data files which we discovered in a USFWS warehouse. We found large numbers of errors in the digitally transcribed data leading us to reassess our plans and require more QAQC before adding data to the NPPSD.

Our decision to spend more time proofing was also influenced by our awareness that we were in a unique position to examine the data from the OCSEAP surveys. We believe that this may be the last project that has access to the original transcribed data. Thus it was incumbent on us to "get it right", and we reviewed many thousands of original data sheets in our efforts to validate digital data sets.

Dissemination of Data

We initiated discussions with NOAA National Oceanographic Data Center NODC personnel with regard to updating the OCSEAP seabird survey data and archive it at NODC. We have suggested that we might pass back to them a proofed and verified data set; however, the format would not match that of the original dataset. An alternative solution would be to ask them to use their web site to identify the problems with the original data and redirect data queries to our web site.

We have been and will remain committed to data sharing. A CD is currently available and we plan to provide data in tabular format from our web site. The NPPSD continues to be used as a source for data calls and a larger problem has been a lack of time to fully participate in all of the proposed collaborations. Our listing of accomplishments indicates the potential of this database.

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Appendix 1. NPPSD recommended code list. The following list includes both marine birds and marine mammals observed in the Northern Pacific. The code list is broken into two portions one for seabirds, and one for marine mammals.

Seabirds

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9	No Birds	NONE	N/A	N/A
900204	Unidentified Sea Turtle	UNST	Cheloniidae	173828
91	Unidentified Bird	UNBI	Aves	174371
91070101	Unidentified Loon	UNLO	Gavia spp.	174468
9107010101	Common Loon	COLO	Gavia immer	174469
9107010102	Yellow-billed Loon	YBLO	Gavia adamsii	174470
9107010103	Arctic Loon	ARLO	Gavia arctica	174471
9107010104	Red-throated Loon	RTLO	Gavia stellata	174474
9107010105	Pacific Loon	PALO	Gavia pacifica	174475
91080101	Unidentified Grebe	UNGR	Podicipedidae spp.	174478
9108010101	Red-necked Grebe	RNGR	Podiceps grisegena	174479
9108010102	Horned Grebe	HOGR	Podiceps auritus	174482
9108010201	Western Grebe	WEGR	Aechmophorus occidentalis	174503
910901	Unidentified Albatross	UALB	Diomedea or Phoebastria or Thalassarche spp.	N/A
9109010101	Short-tailed Albatross	STAL	Diomedea albatrus	174515
9109010102	Black-footed Albatross	BFAL	Diomedea nigripes	174516
9109010103	Laysan Albatross	LAAL	Phoebastria immutabilis	554378
910902	Unidentified Procellariiformes	UNPR	Procellariiformes spp.	N/A
9109020101	Cape Petrel	CAPE	Daption capense	174534
9109020201	Northern Fulmar	NOFU	Fulmarus glacialis	174536
91090204	Unidentified Shearwater	UNSH	Procellariidae spp.	174532
91090204	Unidentified Dark Shearwater	UNDS	Procellariidae spp.	174532
910902040	Unidentified Light Shearwater	UNLS	Procellariidae spp.	174532
9109020401	Cory's Shearwater	COSH	Calonectris diomedea	203446
9109020402	Pink-footed Shearwater	PISH	Puffinus creatopus	174547
9109020403	Flesh-footed Shearwater	FSH	Puffinus carneipes	174548
9109020405	Wedge-tailed Shearwater	WTSH	Puffinus pacificus	174550
9109020406	Buller's Shearwater	BUSH	Puffinus bulleri	174552
9109020407	Sooty Shearwater	SOSH	Puffinus griseus	174553
9109020408	Short-tailed Shearwater	STSH	Puffinus tenuirostris	174554
9109020410	Newell's Shearwater	NESH	Puffinus auricularis	174558

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9109020412	Audubon's Shearwater	AUSH	Puffinus lheminieri	174561
9109020413	Streaked Shearwater	SKSH	Calonectris leucomelas	203449
9109020414	Christmas Shearwater	CHSH	Puffinus nativitatis	174565
91090205	Unidentified Petrel	UNPE	Pterodroma or Bulweria or Procellaria spp.	N/A
91090205	Unidentified Pterodroma	UNPT	Pterodroma spp.	174566
9109020503	Mottled Petrel	MOPE	Pterodroma inexpectata	174569
9109020504	Herald Petrel	HEPE	Pterodroma arminjoniana	174570
9109020505	Cook's Petrel	COPE	Pterodroma cookii	554395
9109020506	Kermadec Petrel	KEPE	Pterodroma neglecta	174573
9109020507	Juan Fernandez Petrel	JFPE	Pterodroma externa	174574
910902050702	White-necked Petrel	WNPE	Pterodroma cervicalis	554394
9109020508	Phoenix Petrel	PHPE	Pterodroma alba	174577
9109020509	Hawaiian Petrel	HAPE	Pterodroma sandwichensis	562561
9109020510	Bonin Petrel	BOPE	Pterodroma hypoleuca	174579
9109020511	Black-winged Petrel	BWPE	Pterodroma nigripennis	174580
9109020512	Solander's Petrel	SOPE	Pterodroma solandri	174581
9109020513	Stejneger's Petrel	STPE	Pterodroma longirostris	174582
9109020513	Pycroft's Petrel	PYPE	Pterodroma pycrofti	562560
9109020515	Barau's Petrel	BAPE	Pterodroma baraui	174584
9109020519	Gould's Petrel	GOPE	Pterodroma leucoptera	174588
9109020523	Murphy's Petrel	MUPE	Pterodroma ultima	174592
9109021201	Bulwer's Petrel	BUPE	Bulweria bulwerii	554144
910903	Unidentified Storm-petrel	UNSP	Oceanodroma or Hydrobates or Pelagodroma or Oceanites spp.	N/A
9109030101	White-faced Storm-petrel	WFSP	Pelagodroma marina	174621
9109030201	Fork-tailed Storm-petrel	FTSP	Oceanodroma furcata	174625
9109030202	Leach's Storm-petrel	LESP	Oceanodroma leucorhoa	174628
9109030203	Ashy Storm-petrel	ASSP	Oceanodroma homochroa	174634
9109030205	Band-rumped Storm-petrel	BRSP	Oceanodroma castro	174636
9109030207	Black Storm-petrel	BLSP	Oceanodroma melania	174640
9109030208	Sooty Storm-petrel	SOSP	Oceanodroma tristrami	174641
9109030209	Swinhoe's Storm-petrel	SWSP	Oceanodroma monorhis	174642
9109030301	Least Storm-petrel	LTSP	Oceanodroma microsoma	174646
9109030401	Wilson's Storm-Petrel	WISP	Oceanites oceanicus	174650
91100101	Unidentified Tropicbird	UNTR	Phaethon spp.	174672
9110010102	White-tailed Tropicbird	WTTR	Phaethon lepturus	174676
9110010103	Red-tailed Tropicbird	RTTR	Phaethon rubricauda	174679
9110020102	Brown Pelican	BRPE	Pelecanus occidentalis	174685
91100301	Unidentified Booby	UNBO	Sula spp.	174697

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9110030101	Masked Booby	MABO	Sula dactylatra	174699
9110030103	Brown Booby	BRBO	Sula leucogaster	174704
9110030104	Red-footed Booby	RFBO	Sula sula	174707
91100401	Unidentified Cormorant	UNCO	Phalacrocorax spp	174714
91100401	Pelagic/Red-faced Cormorant	PRCO	Phalacrocorax spp.	174714
9110040101	Great Cormorant	GRCO	Phalacrocorax carbo	174715
9110040102	Double-crested Cormorant	DCCO	Phalacrocorax auritus	174717
9110040104	Brandt's Cormorant	BRCO	Phalacrocorax penicillatus	174724
9110040105	Pelagic Cormorant	PECO	Phalacrocorax pelagicus	174725
9110040106	Red-faced Cormorant	RFCO	Phalacrocorax urile	174728
91100601	Unidentified Frigatebird	UNFB	Fregata spp.	174762
9110060102	Great Frigatebird	GRFB	Fregata minor	174766
9110060105	Lesser Frigatebird	LEFB	Fregata ariel	174769
9111010101	Great Blue Heron	GTBH	Ardea herodias	174773
91120101	Unidentified Swan	SWAN	Cygnus or Olor spp.	174984
9112010101	Mute Swan	MUSW	Cygnus Olor	174985
9112010202	Tundra Swan	TUSW	Cygnus columbianus	174987
9112010203	Trumpeter Swan	TRSW	Cygnus buccinator	174992
9112010301	Canada Goose	CAGO	Branta canadensis	174999
9112010303	Black Brant	BLBR	Branta nigricans	175013
9112010401	Emperor Goose	EMGO	Chen canagica	175042
9112010501	Greater White-fronted Goose	GWFG	Anser albifrons	175020
9112010601	Snow Goose	SNGO	Chen caerulescens	175038
91120109	Unidentified Teal	TEAL	Anas formosa or Anas crecca or Anas cyanoptera or Anas discors	N/A
9112010901	Mallard	MALL	Anas platyrhynchos	175063
9112010903	American Black Duck	AMBD	Anas rubripes	175068
9112010906	Gadwall	GADW	Anas strepera	175073
9112010907	Northern Pintail	NOPI	Anas acuta	175074
9112010910	Green-winged Teal	GWTE	Anas crecca	175081
9112010912	Blue-winged Teal	BWTE	Anas discors	175086
9112010916	American Wigeon	AMWI	Anas americana	175094
9112010917	Northern Shoveler	NOSH	Anas clypeata	175096
9112011001	Wood Duck	WODU	Aix sponsa	175122
91120111	Unidentified Duck	UNDU	Anatinae spp.	N/A
91120111	Unidentified Scaup	USCA	Aythya marila or Aythya affinis	N/A
9112011101	Redhead	REDH	Aythya americana	175125
9112011104	Ring-necked Duck	RNDU	Aythya collaris	175128
9112011105	Canvasback	CANV	Aythya valisineria	175129

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9112011106	Greater Scaup	GRSC	Aythya marila	175130
9112011107	Lesser Scaup	LESC	Aythya affinis	175134
91120112	Unidentified Goldeneye	UNGO	Bucephala spp.	175140
9112011201	Common Goldeneye	COGO	Bucephala clangula	175141
9112011202	Barrow's Goldeneye	BAGO	Bucephala islandica	175144
9112011203	Bufflehead	BUFF	Bucephala albeola	175145
9112011301	Long-tailed Duck	LTDU	Clangula hyemalis	175147
9112011401	Harlequin Duck	HADU	Histrionicus histrionicus	175149
9112011501	Labrador Duck	LADU	Camptorhynchus labradorius	175151
91120116	Unidentified Eider	UNEI	Somateria or Polysticta spp.	N/A
9112011601	Steller's Eider	STEI	Polysticta stelleri	175153
9112011601	Unidentified Eider	UNEI	Somateria or Polysticta spp.	N/A
91120117	Unidentified Eider	UNEI	Somateria or Polysticta spp.	N/A
9112011701	Common Eider	COEI	Somateria mollissima	175155
9112011702	King Eider	KIEI	Somateria spectabilis	175160
9112011703	Spectacled Eider	SPEI	Somateria fischeri	175161
91120118	Unidentified Scoter	UNSC	Melanitta spp.	175162
9112011802	White-winged Scoter	WWSC	Melanitta fusca	175163
9112011803	Surf Scoter	SUSC	Melanitta perspicillata	175170
9112011804	Black Scoter	BLSC	Melanitta nigra	175171
91120120	Unidentified Merganser	UNME	Mergus or Lophodytes spp.	N/A
9112012001	Hooded Merganser	HOME	Lophodytes cucullatus	175183
91120121	Unidentified Merganser	UNME	Mergus or Lophodytes spp.	N/A
9112012101	Common Merganser	COME	Mergus merganser	175185
9112012102	Red-breasted Merganser	RBME	Mergus serrator	175187
9113021002	Bald Eagle	BAEA	Haliaeetus leucocephalus	175420
9113030101	Osprey	OSPR	Pandion haliaetus	175590
9126	Unidentified Shorebird	UNSB	Charadriidae or Haematopodidae or Recurvirostridae or Scolopacidae spp.	N/A
9127030103	Black Oystercatcher	BLOY	Haematopus bachmani	176475
912704	Unidentified Plover	UNPL	Pluvialus or Charadrius spp.	N/A
91270402	Unidentified Plover	UNPL	Pluvialus or Charadrius spp.	N/A
9127040202	Semipalmated Plover	SEPL	Charadrius semipalmatus	176506
9127040204	Snowy Plover	SNPL	Charadrius alexandrinus	176510
9127041001	Tawny-throated Dotterel	TTDO	Oreopholus ruficollis	176559
91270411	Unidentified Plover	UNPL	Pluvialus or Charadrius spp.	N/A
912704110201	American Golden Plover	AGPL	Pluvialis dominica	176564
912704110202	Pacific Golden Plover	PGPL	Pluvialis fulva	554381

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9127041103	Black-bellied Plover	BBPL	Pluvialis squatarola	176567
912705	Unidentified Sandpiper	UNSA	Scolopacinae spp.	553481
91270501	Unidentified Turnstone	UNTU	Arenaria spp.	176569
9127050101	Ruddy Turnstone	RUTU	Arenaria interpres	176571
9127050102	Black Turnstone	BLTU	Arenaria melanocephala	176574
9127050401	Common Snipe	COSN	Capella gallinago	176586
9127050604	Whimbrel	WHIM	Numenius phaeopus	176599
9127050801	Spotted Sandpiper	SPSA	Actitis macularia	176612
91270509	Unidentified Yellowlegs	YELL	Tringa melanoleuca or Tringa flavipes	N/A
9127050901	Solitary Sandpiper	SOSA	Tringa solitaria	176615
9127050902	Wood Sandpiper	WOSP	Tringa glareola	176618
9127050903	Greater Yellowlegs	GRYE	Tringa melanoleuca	176619
9127050904	Lesser Yellowlegs	LEYE	Tringa flavipes	176620
9127051001	Wandering Tattler	WATA	Heteroscelus incanus	176635
91270512	Unidentified Stint	USTI	Calidris spp.	176641
9127051201	Red Knot	REKN	Calidris canutus	176642
9127051204	Rock Sandpiper	ROSA	Calidris ptilocnemis	176647
9127051205	Sharp-tailed Sandpiper	STSA	Calidris acuminata	176652
9127051206	Pectoral Sandpiper	PESA	Calidris melanotos	176653
9127051207	White-rumped Sandpiper	WRSA	Calidris fuscicollis	176654
9127051208	Baird's Sandpiper	BASP	Calidris bairdii	176655
9127051209	Least Sandpiper	LESA	Calidris minutilla	176656
9127051214	Dunlin	DUNL	Calidris alpina	176661
9127051216	Semipalmated Sandpiper	SESA	Calidris pusilla	176667
9127051217	Western Sandpiper	WESA	Calidris mauri	176668
9127051218	Sanderling	SAND	Calidris alba	176669
9127051301	Surfbird	SURF	Aphriza virgata	176673
91270514	Unidentified Dowitcher	DOWI	Limnodromus spp.	176674
9127051401	Short-billed Dowitcher	SBDO	Limnodromus griseus	176675
9127051402	Long-billed Dowitcher	LBDO	Limnodromus scolopaceus	176679
9127051501	Stilt Sandpiper	STIL	Calidris himantopus	554145
9127051601	Buff-breasted Sandpiper	BBSP	Tryngites subruficollis	176684
91270517	Unidentified Godwit	GODW	Limosa spp.	176685
9127051702	Bar-tailed Godwit	BTGP	Limosa lapponica	176687
91270701	Unidentified Phalarope	UNPH	Phalaropus spp.	176733
9127070101	Red Phalarope	REPH	Phalaropus fulicaria	554376
9127070301	Red-necked Phalarope	RNPH	Phalaropus lobatus	176735
91280101	Unidentified Jaeger	UNJA	Stercorarius pomarinus or Stercorarius parasiticus or	N/A

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
			Stercorarius longicaudus	
9128010101	Pomarine Jaeger	POJA	Stercorarius pomarinus	176792
9128010102	Parasitic Jaeger	PAJA	Stercorarius parasiticus	176793
9128010103	Long-tailed Jaeger	LTJA	Stercorarius longicaudus	176794
9128010201	Great Skua	GRSK	Catharacta skua	176796
9128010202	South Polar Skua	SPSK	Catharacta maccormicki	176801
91280201	Unidentified Gull	UNGU	Larinae spp.	553473
9128020101	Glaucous Gull	GLGU	Larus hyperboreus	176808
9128020102	Iceland Gull	ICGU	Larus glaucoides	176811
9128020103	Glaucous-winged Gull	GWGU	Larus glaucescens	176814
9128020104	Great Black-backed Gull	GBGU	Larus marinus	176815
9128020105	Slaty-backed Gull	SBGU	Larus schistisagus	176816
9128020106	Western Gull	WEGU	Larus occidentalis	176817
9128020108	Herring gull	HEGU	Larus argentatus	176824
912802010899	Glaucous-winged x Herring Gull Hybrid	GHGU	N/A	N/A
9128020109	Thayer's Gull	THGU	Larus thayeri	176828
9128020110	California Gull	CAGU	Larus californicus	176829
9128020112	Black-tailed Gull	BTGU	Larus crassirostris	176831
9128020113	Mew Gull	MEGU	Larus canus	176832
9128020114	Common Black-headed Gull	BHGU	Larus ridibundus	176835
9128020117	Bonaparte's Gull	BOGU	Larus philadelphia	176839
9128020201	Ivory Gull	IVGU	Pagophila eburnea	176851
91280203	Unidentified Kittiwake	UNKI	Rissa spp.	176806
9128020301	Black-legged Kittiwake	BLKI	Rissa tridactyla	176875
9128020302	Red-legged Kittiwake	RLKI	Rissa brevirostris	176845
9128020401	Ross' Gull	ROGU	Rhodostethia rosea	176864
9128020501	Sabine's Gull	SAGU	Xema sabini	176866
91280207	Unidentified Tern	UNTE	Sterninae spp.	553483
9128020701	Trudeau's Tern	TRTE	Sterna trudeaui	176886
9128020703	Common Tern	COTE	Sterna hirundo	176888
9128020704	Arctic Tern	ARTE	Sterna paradisaea	176890
9128020706	Aleutian Tern	ALTE	Sterna aleutica	176893
9128020707	Sooty Tern	SOTE	Sterna fuscata	176894
9128020710	Gray-backed Tern	GBTE	Sterna lunata	176912
9128020730	Caspian Tern	CATE	Sterna caspia	176924
91280208	Unidentified Tern	UNTE	Sterninae spp.	553483
91280211	Undentified Tern or Noddy	UNTN	Sterninae spp.	553483
91280211	Unidentified Noddy	UNNO	Anous or Procelsterna spp.	N/A

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9128021101	Brown Noddy	BRNO	Anous stolidus	176941
9128021102	Black Noddy	BLNO	Anous minutus	176944
9128021201	Swallow-tailed Gull	STGU	Creagrus Furcatus	176946
9128021501	Blue-gray Noddy	BGNO	Procelsterna cerulea	554390
9128021601	White Tern	WHTE	Gygis alba	176954
91280301	Unidentified Skimmer	SKIM	Rynchops spp.	176961
912901	Unidentified Alcid	UNAL	Alcidae spp./Laridae spp.	176967
912901	Unidentified Small Dark Alcid	USDA	Alcidae spp./Laridae spp.	176802
912901000	Unidentified Murrelet	UNML		
91290103	Unidentified Murre	UNMU	Uria spp.	176973
9129010301	Common Murre	COMU	Uria aalge	176974
9129010302	Thick-billed Murre	TBMU	Uria lomvia	176978
9129010401	Dovekie	DOVE	Alle alle	176982
91290105	Unidentified Guillemot	UNGI	Cepphus spp.	176984
9129010501	Black Guillemot	BLGU	Cepphus grylle	176985
9129010502	Pigeon Guillemot	PIGU	Cepphus columba	176991
91290106	Brachyramphus Murrelet	BRMU	Brachyramphus spp	176995
9129010601	Marbled Murrelet	MAMU	Brachyramphus marmoratus	176996
9129010602	Kittlitz's Murrelet	KIMU	Brachyramphus brevirostris	176998
9129010701	Xantus' Murrelet	XAMU	Synthliboramphus hypoleucus	177011
9129010801	Ancient Murrelet	ANMU	Synthliboramphus antiquus	177008
9129010802	Japanese Murrelet	JAMU	Synthliboramphus wumizusume	177009
91290109	Unidentified Auklet	UNAU	Aethia or Ptychoramphus spp.	N/A
9129010901	Cassin's Auklet	CAAU	Ptychoramphus aleuticus	177013
9129011001	Parakeet Auklet	PAAU	Aethia psittacula	554029
91290111	Unidentified Auklet	UNAU	Aethia or Ptychoramphus spp.	N/A
9129011101	Crested Auklet	CRAU	Aethia cristatella	177019
9129011102	Least Auklet	LEAU	Aethia pusilla	177020
9129011103	Whiskered Auklet	WHAU	Aethia pygmaea	177021
9129011201	Rhinoceros Auklet	RHAU	Cerorhinca monocerata	177023
91290113	Unidentified Puffin	UNPU	Fratercula spp.	177024
9129011302	Horned Puffin	HOPU	Fratercula corniculata	177029
9129011401	Tufted Puffin	TUPU	Fratercula cirrhata	177032

Marine Mammals

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9217	Unidentified Whale	UNWH	Cetacea spp.	180403
921802	Unidentified Dolphin	UNDO	Unidentified Delphinidae	180415
9218020401	Bottle-nosed Dolphin	BNDO	Tursiops truncatus	180426
9218020501	Spinner Dolphin	SPDO	Stenella longirostris	180429
9218020601	Common Dolphin	CODO	Delphinus delphis	180438
9218020803	Pacific White-sided Dolphin	PWSD	Lagenorhynchus obliquidens	180444
9218021001	Northern Right-whale Dolphin	NRWD	Lissodelphis borealis	180454
9218021101	Risso's Dolphin	RIDO	Grampus griseus	180457
9218021401	False Killer Whale	FKWH	Pseudorca crassidens	180463
92180215	Pilot Whale	PIWH	Globicephala	180464
9218021502	Short-finned Pilot Whale	SFWH	Globicephala macrorhynchus	180466
9218021601	Killer Whale	KIWH	Orcinus orca	180469
921802180	Unidentified Porpoise	UNPO	Phocoenidae spp.	552307
9218021801	Harbor Porpoise	HAPO	Phocoena phocoena	180473
9218022001	Dall's Porpoise	DAPO	Phocoenoides dalli	180480
9218030101	Beluga Whale	BEWH	Delphinapterus leucas	180483
9218040102	Sperm Whale	SPWH	Physeter catodon	180489
921805	Unidentified Beaked Whale	UBKW	Mesoplodon spp.	180506
9218050102	North Pacific Bottle-nosed Whale	BNWH	Berardius bairdii	180496
9218050102	Baird's Beaked Whale	BKWH	Berardius bairdii	180496
9218050201	Goose-beaked Whale	GBWH	Ziphius cavirostris	180498
9219	Unidentified Baleen Whale	UNBW	Mysticeti spp.	552298
9219010101	Gray Whale	GRWH	Eschrichtius robustus	180521
9219020101	Minke Whale	MIWH	Balaenoptera acutorostrata	180524
9219020103	Sei Whale	SEWH	Balaenoptera borealis	180526
9219020104	Fin Whale	FIWH	Balaenoptera physalus	180527
9219020201	Humpback Whale	HBWH	Megaptera novaeangliae	180530
9219030102	Bowhead Whale	BOWH	Balaena mysticetus	180533
9219030301	Right Whale	RIWH	Eubalaena glacialis	180537
9220020101	Sea Otter	SEOT	Enhydra lutris	180547
9220020201	River Otter	RIOT	Lontra canadensis	180549
92210	Unidentified Pinniped (Seal or Sea Lion)	UNPI	Caniformia spp.	552303
922101	Unidentified Seal	UNSE	Phocidae or Procyonidae or Otariidae spp.	N/A
9221010301	California Sea Lion	CASL	Zalophus californianus	180621
9221010501	Steller Sea Lion	STSL	Eumetopias jubatus	180625

Taxonomic Code	Common Name	NPPSD 4-Letter Code	Latin Name	ITIS Number
9221010601	Northern Fur Seal	NOFS	Callorhinus ursinus	180627
9221020101	Walrus	WALR	Odobenus rosmarus	180639
9221030101	Spotted Seal	SPSE	Phoca largha	180642
9221030102	Ringed Seal	RISE	Pusa hispida	622018
9221030106	Ribbon Seal	RBSE	Histriophoca fasciata	622021
9221030107	Harbor Seal	HASE	Phoca vitulina	180649
9221030301	Bearded Seal	BESE	Erignathus barbatus	180655

Appendix 2. NPPSD Users manual.

The North Pacific Pelagic Seabird Database Users Manual

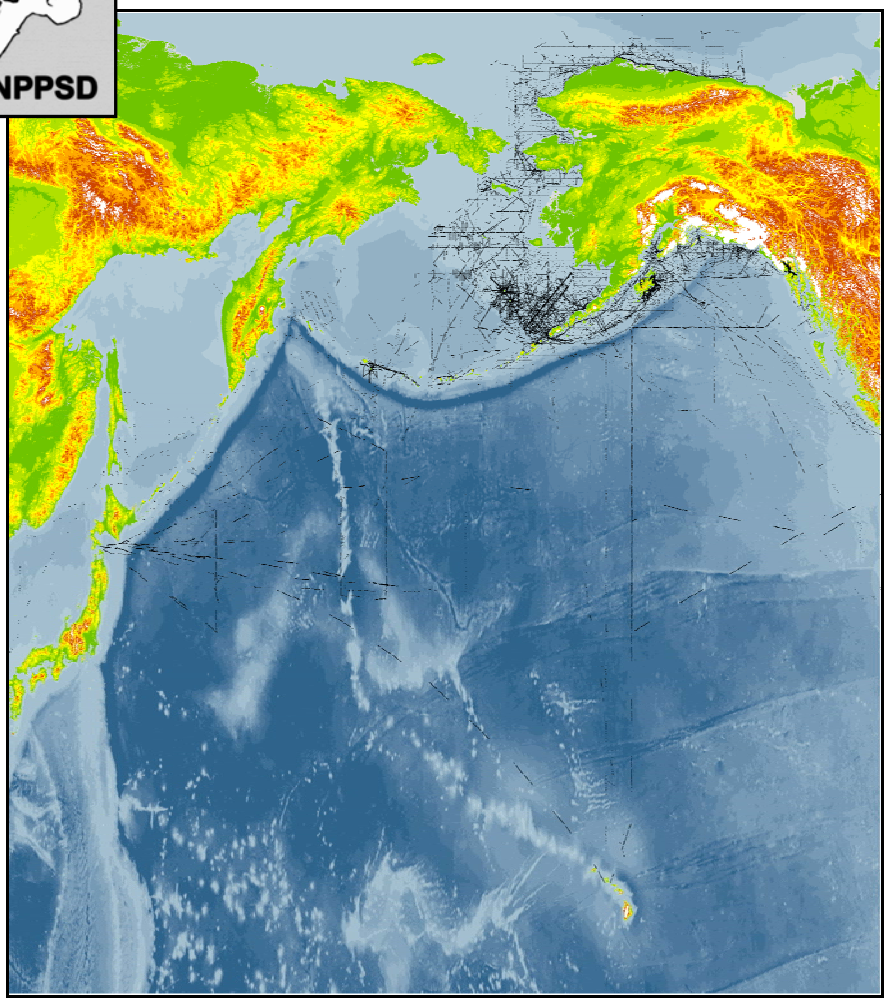

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Table of Contents

I. Why Did We Build The NPPSD?

Given the high cost of conducting surveys for seabirds, as well as the long lived nature and free ranging habits of many seabirds, it is not surprising that few researchers have been able to collect sufficient data to address large scale spatial and temporal questions. The North Pacific Pelagic Seabird Database (NPPSD) represents our efforts to merge the numerous at-sea surveys that have been conducted in the North Pacific (1972 to present). Until now, this vast data resource has remained scattered and difficult to access.

II. Where Did The Data In The NPPSD Come From?

The NPPSD is a compilation of datasets from numerous sources. While most of the data is comprised of at-sea boat based surveys, there are also data from stations, land based observations, fixed-wing and helicopter aerial surveys.

OCSEAP

The Outer Continental Shelf Environmental Assessment Program (OCSEAP) was a project aimed at developing scientific information about the continental shelf region of Alaska during the 1970s, in advance of potential oil development. At-sea seabird surveys were one part of this program. The OCSEAP data set consists of 273 separate survey files. Data was collected primarily over the shelf region, but the majority of the North Pacific was represented. These files were archived by NOAA in hierarchical data format. These files were sub-divided into tables in a relational database (Location, Environment, Ice, Comments and Data).

U.S. Fish and Wildlife Service Archives

These files were recovered from several 9-track tapes labeled “FWS TAP Archival Data.” Out of the 243 surveys found on these tapes, 100 were identical to surveys already contained within the OCSEAP dataset. Like the OCSEAP dataset, this data was wide ranging. After thorough proofing and cleaning, 142 surveys remain in the

TAP dataset. We also found hard copies of datasheets for several surveys that could not be found in digital format. These surveys were entered into data tables.

Kodiak Small Boat Coastal Surveys

The Kodiak Winter Surveys are a compilation of small boat transects conducted around Kodiak from November 1979 to February 2003. Denny Zwiefelhofer (U.S. Fish and Wildlife Service) cleaned and proofed all data. We received 40 surveys from him in May 2004. All surveys were conducted using OCSEAP format and coding systems. Only minor changes and corrections were necessary to integrate this dataset.

Survey data acquired but not yet added to the NPPSD

Datasets acquired but not yet integrated into the NPPSD include surveys of the Russian Far-east conducted by (Shuntov), Cook Inlet Alaska (Piatt) and Glacier Bay, Alaska (Piatt), and Prince William Sound, Alaska (Irons). We anticipate that additional data sets will be added as time permits. Any additions to the database will be noted through an announcement on the NPPSD website and the version (currently 1.0) of the NPPSD.

III. What Is The Conceptual Design Of The NPPSD?

Conceptually, the NPPSD is quite simple. The raw data files are imported to Access data tables. These tables were then proofed and standardized through a series of queries. The final results of these queries were four tables that comprise the NPPSD (Fig. 1).

The database is organized into 4 primary tables; seabird number, seabird density, marine mammal number, and marine mammal density. Due to problems with some data, e.g., missing latitude information, not all transects could be utilized. Transects that were questionable were dropped from the final data tables. The “Number” tables required dropping fewer samples, “off transect” observations were left in the number tables as were land based and stationary observations where no “sampling area” could

be calculated. The "Number" tables are not intended to be used for calculations; they are intended to give information about the spatial distribution and range of species.

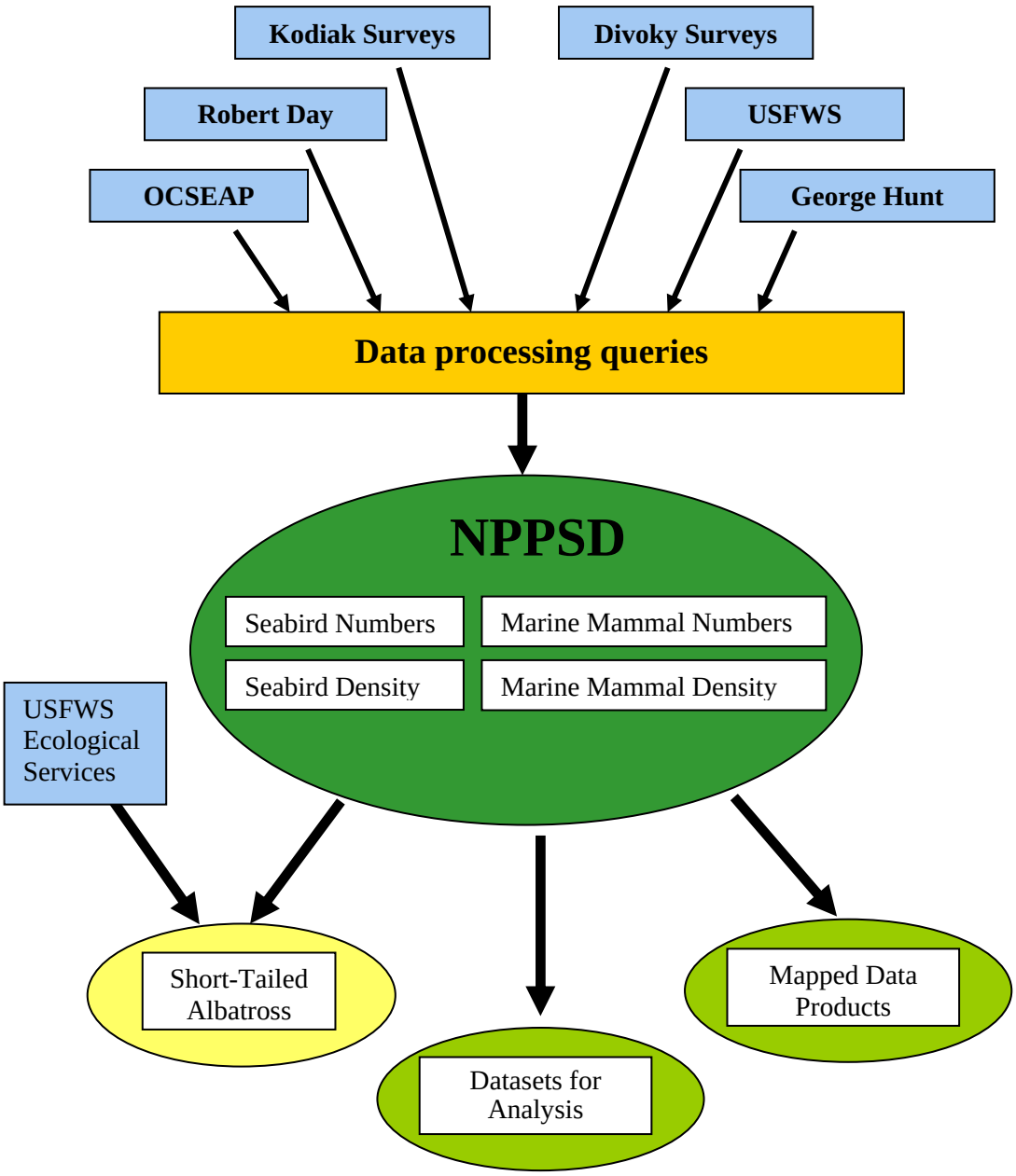

Figure 1. Conceptual model of the design of the NPPSD. Light blue boxes signify raw datasets, dark green ellipses signify data tables within the database, and olive green ellipses signify specific data products from the NPPSD. The yellow ellipse represents a new database that uses the NPPSD as one of its sources.

IV. How Are The Data Processed?

While the conceptual design itself is simple, the execution of this design is more complicated. After archiving a copy of the incoming data, data sets are read into Access data tables and a unique 20 digit identifier or "Master Key" (see below) is assigned to identify each sample site.

THE MASTER KEY

The Master Key is composed of eight pieces of information:

1. Survey ID – 6 digits
2. Station Number – 3 digits
3. Year – 2 digits
4. Julian Day – 3 digits
5. Hour – 2 digits
6. Minutes – 2 digits
7. Platform Type – 1 digit
8. Survey Type or Sampling Technique – 1 digit

In this way we were able to use the relational capabilities of the Access software to link individual locations with multiple sightings. Samples were interchangeably referred to as "transects," as they represent the sightings along a survey track. The data fields roughly follow the OCSEAP data collection format for pelagic surveys. To allow the datasets to be merged we standardize all of the shared fields.

Detailed Processing Steps for the Location Table

The following section details the queries used to process the proofed data sets into standardized tables.

Make Location L2(1)

-Converts Platform Type and Survey Type into standardized formats

- Calculates Distance using Speed x Elapsed Time

- Attaches relevant Environment table data to its appropriate Location record

Make Location L2(2) and L2(3)

-Calculates Sample Area using three different methods – If enough information was available to calculate area surveyed, using, in order of preference:

1. Distance calculated in L2(1) x Elapsed Time
2. Distance Recorded x Elapsed Time
3. Great Circle Formula value (uses start and end latitude and longitude to determine distance traveled) x Elapsed Time

Make Location L2(4)

- Removes records that have a Sample Area with a value of zero
- Makes final Location table (LOCATION L2)

LOCATION L2

This table contains location, time, and environmental information.

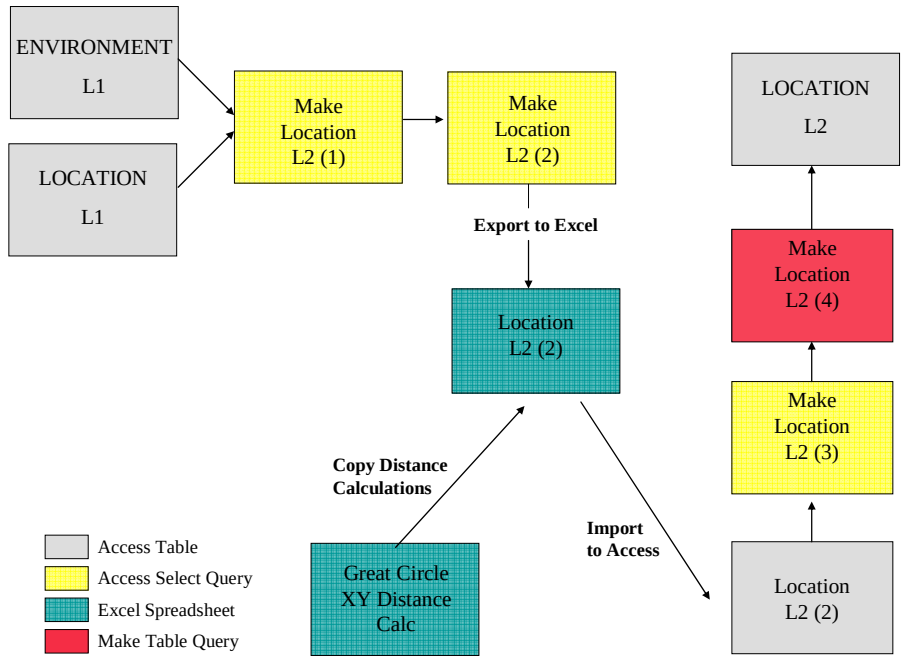

Figure 2. Flow chart showing how the Location table is processed and what software programs were used for each step.

Processing Steps for the Data table and Calculating Animal Density

Make Data Birds (or Mammals) L2(1)

- Creates a Modified Behavior Type - Some surveys use Gould's coding system for identifying animal behavior while others used the NODC codes. We replace each code with an appropriate description of the behavior. This eliminates the need to cross reference multiple code lists.
- Adds standardized taxonomic codes and common names (see section V for more detail on how taxonomic codes were standardized)
- Selects only records of calls made within the described area surveyed
- Selects only bird (or mammal) calls

Make Data Birds (or Mammals) L2(2)

- Calculates Bird Density using the Sum of the Number of each species seen during each station divided by the Sample Area. If the total number seen was zero, the density is zero. If the sample area is zero, the density field is left blank.

Make Data Birds (or Mammals) L2(3) Density Crosstab

- Calculates the total density for each species at each station for each Location record.
- Reformats how the data is seen. Each species now has its own field.

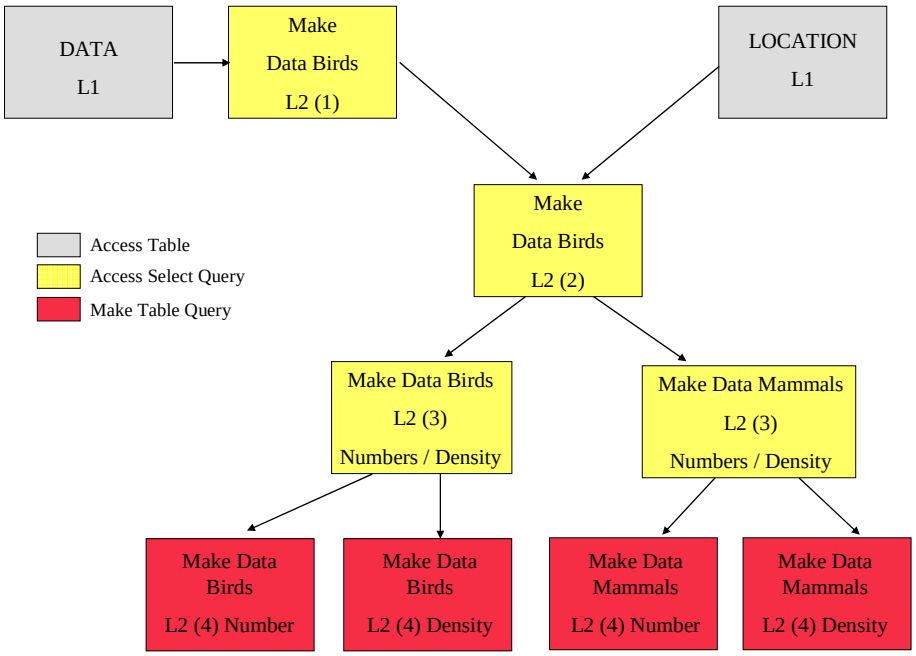

Figure 3. Flow chart showing how Data table is processed, what software programs are used during each step and the resulting output tables. Note that we used common name for species. This allowed us to avoid the confusion of using codes.

Make Data Birds (or Mammals) L2(3) Numbers Crosstab

- Same type of query as the Density Crosstab, only instead of total Density in each cell, the total number of individuals seen is calculated. In addition to the by species counts or densities the following data fields are included in each table:

Master Key

Modified Platform Type

Modified Survey Type

Sample Area

Start Latitude Decimal Degrees

Start Longitude Decimal Degrees

Year

Month

Day

Julian Date

V. Why Did You Create A New Taxonomic Code?

Although the creation of this new code was peripheral to the NPPSD, it was a natural outgrowth of the process of integrating the datasets. The species identification codes used by researchers varied considerably across the surveys. The OCSEAP surveys used the NOAA "Taxonomic Code"; a twelve digit number. However, we found several problems with it. First, it was out of date. Taxonomies have been updated for a number of species. Additionally, the long numeric codes were never suitable for data collection. This led to the use of four letter codes for collection of data with later transcription into the 10 digit codes. The four letter codes were less standard and there were numerous transcription errors. An example was the use of UNAL for unidentified alcid as well as unidentified albatross. Only a careful examination of the original data sheets allowed us to resolve the identity of the ambiguous codes in the early datasets. Similar issues accompanied all of the incoming datasets. With so many data sources and ways to code species seen, it was critical to standardize what taxonomic codes were used, and what will be used in the future. Initially, we had hoped to standardize on the U. S. Department of Agricultures Integrated Taxonomic Information System (ITIS) website (www.itis.usda.gov). The ITIS codes are supposed to be the authoritative reference for species worldwide. However, we found some difficulties integrating survey data with ITIS. For one, the six digit taxonomic serial numbers are not useful for field data collection. Another issue are animals such as the glaucous-winged x herring gull hybrid that do not exist in the ITIS system. Finally, there are no provisions in ITIS for groupings that are not strictly taxonomic, Such as the term unidentified small dark alcid USDA. Where possible, we followed the AOU four letter codes. In cases where the AOU list did not include the necessary code we used the most commonly used code from the survey data. When conflicts arose, we choose the most parsimonious code. A complete crosswalk table for incidental sightings, outdated 4-Letter Codes, and opportunistic calls (Passerines, land animals, etc.) was developed for internal use.

Order #	Taxonomic Code	Common Name	Latin Name	NPPSD 4-Letter Code	Old 4-Letter Code	ITIS Number
10000200	91	No Birds	N/A	NONE	NONE	N/A
10000300	91	Unidentified Bird	Aves	UNBI	UNBI	174371
10000400	91070101	Unidentified Loon	Gavia spp.	UNLO	UNLO	174468
10000700	9107010101	Common Loon	Gavia immer	COLO	COLO	174469
10000800	9107010102	Yellow-billed Loon	Gavia adamsii	YBLO	YBLO	174470
10000900	9107010103	Arctic Loon	Gavia arctica	ARLO	ARLO	174471
10001100	9107010104	Red-throated Loon	Gavia stellata	RTLO	RTLO	174474
10001200	9107010105	Pacific Loon	Gavia pacifica	PALO	PALO	174475
10001300	91080101	Unidentified Grebe	Podicipedidae spp.	UNGR	UNGR	174478
10001400	9108010101	Red-necked Grebe	Podiceps grisegena	RNGR	RNGR	174479
10001500	9108010102	Horned Grebe	Podiceps auritus	HOGR	HOGR	174482
10001600	9108010201	Western Grebe	Aechmophorus occidentalis	WEGR	WEGR	174503
10001601	910902	Unidentified Procellariiformes	Procellariiformes spp.	UNPR	UNPR	N/A
10001700	910901	Unidentified Albatross	Diomedea or Phoebastria or Thala	UALB	UALB	N/A
10001800	9109010101	Short-tailed Albatross	Diomedea albatrus	STAL	STAL	174515
10001900	9109010102	Black-footed Albatross	Diomedea nigripes	BFAL	BFAL	174516
10002000	9109010103	Laysan Albatross	Phoebastria immutabilis	LAAL	LAAL	554378
10002400	9109020201	Northern Fulmar	Fulmarus glacialis	NOFU	NOFU	174536
10002800	91090204	Unidentified Shearwater	Procellariidae spp.	UNSH	UNSH	174532

Figure 4. Screen shot of the Taxonomic Code List table for the NPPSD. For the most recent list, please see the NPPSD website: (http://www.absc.usgs.gov/research/NPPSD/index.htm)

The following notes explain further the source and meaning of each field in the taxonomic code table.

Common Name – Most frequently used common name for each species.

Latin Name – This is the Latin name or group of names that best suits the call made for each species or group of species. Using Unidentified Auklet as an example again, both Aethia and Ptychoramphus are listed under Latin name.

NPPSD 4-Letter Code – This code follows standard 4-Letter Code convention, except in cases where two 4-Letter Codes collide. In these cases, we chose a new 4-Letter Code that is unique.

ITIS Number – This number refers to the Taxonomic Serial Number assigned to each species on the website for the Integrated Taxonomic Information System developed by the USDA (www.itis.usda.gov). Each species is referenced to a webpage that is continually being updated. This way, even if a Latin Name becomes outdated, the ITIS website can direct the user to the most current taxonomic information.

VI. Where is the Data stored?

The processing queries produce 4 tables from each dataset:

1. DATA BIRDS L2 DENSITY
2. DATA BIRDS L2 NUMBER
3. DATA MAMMALS L2 DENSITY
4. DATA MAMMALS L2 NUMBER

These tables are all the products of the final crosstab queries described in **Make Data Birds (or Mammmals) L2(3) Density (or Numbers) Crosstab** found above. They are stored in a database called NPPSD Data Tables. They are exported to a database called NPPSD Summary, and merged with data from all sources.

VII. How Do I Access Data From The NPPSD?

The current version of the NPPSD can only be accessed through the distribution CD. The data exists in two versions, (1) an Access Database and (2) as four ASCII text files (one for each of the data tables). To select data using Access database software, the user opens the database on the CD, selects the Queries menu and the template that corresponds to the type of data desired; Seabird Density, Seabird Numbers, Marine Mammal Density or Marine Mammal Numbers (Fig. 5).

With the desired query highlighted, select the "Design" Icon at the top of the page. This should open up the query in "Design View" (Fig. 6). The query templates all include the same nine fields (Master Key, Platform Type, Survey Type, Sample Area, Year, Month, Day, Latitude, and Longitude). Users simply scroll through the list of species on the upper left hand side of the screen and double click on one or more species. Then execute the query and a table with the desired data will be displayed (Fig. 7). Results from queries can be exported to other formats.

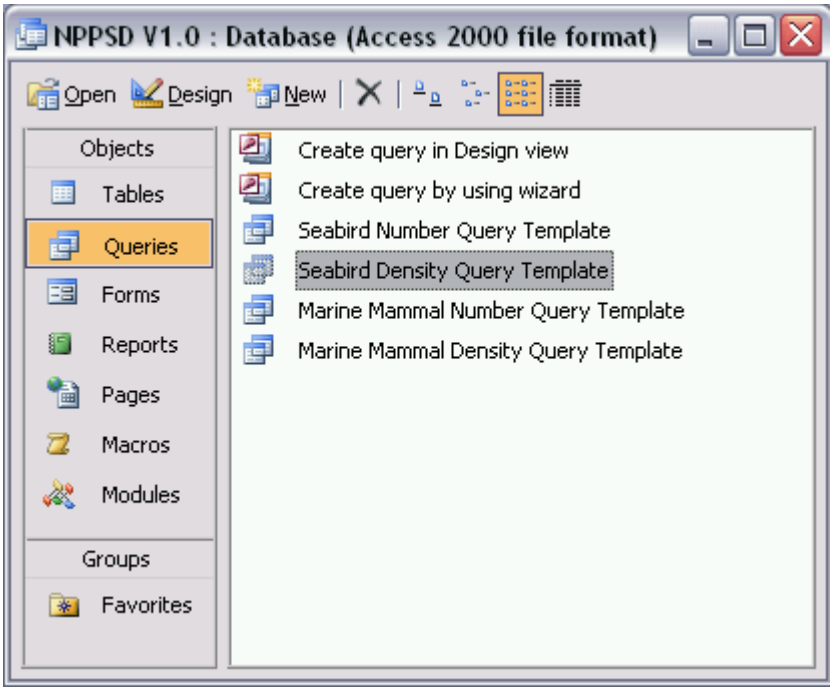

Figure 5. Screenshot of the Access database queries NPPSD Note templates need to be modified by users to select the species of interest.

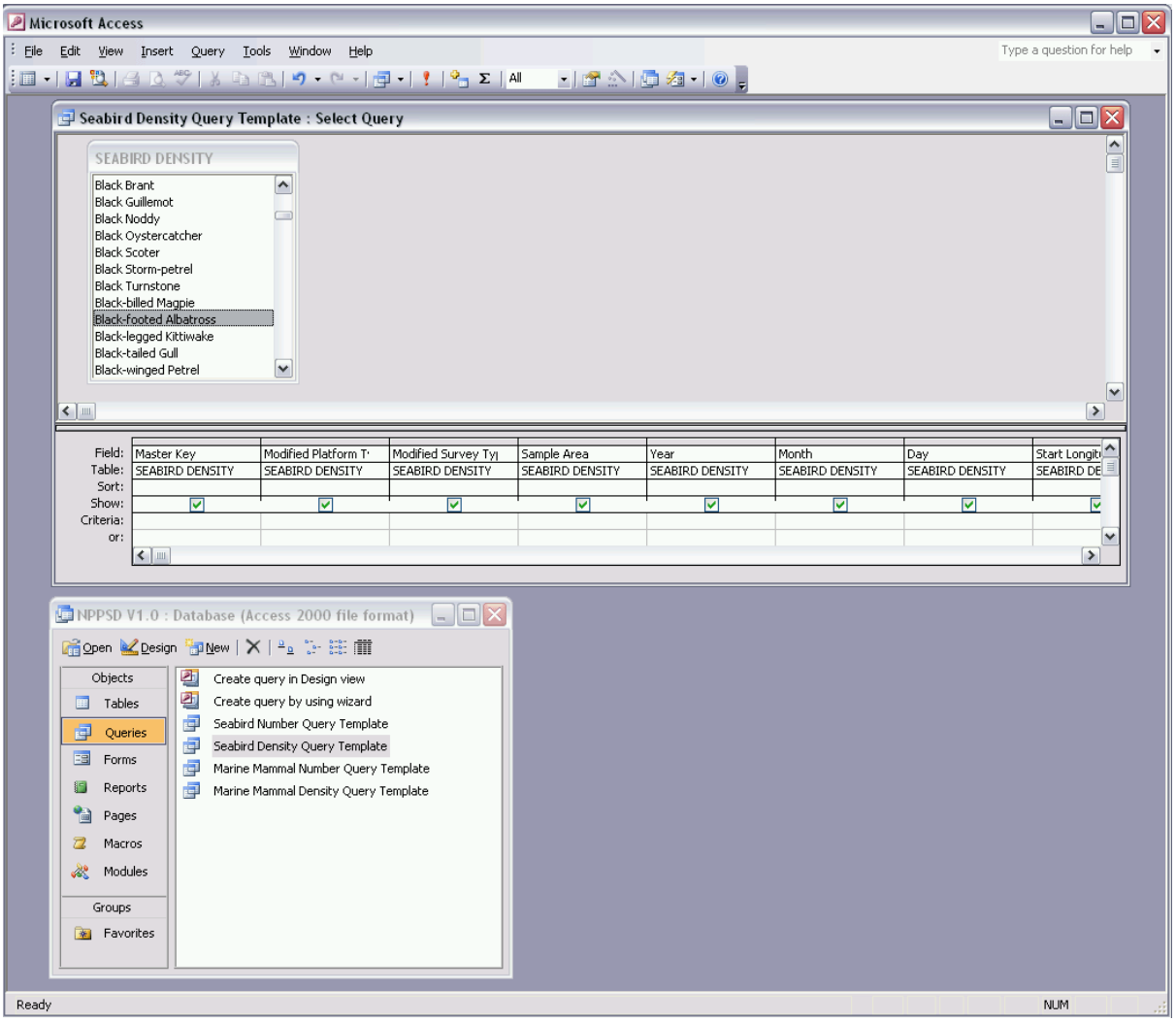

Figure 6. Screenshot of the Access database query “Seabird Density”.

For users unable to use the Access data tables we have included ASCII text files versions of all four tables on the CD in the directory named ASCII Data Files. These files are comma delimited with the following names:

Seabird_Number.csv

Seabird_Density.csv

Marine_Mammal_Number.csv

Marine_Mammal_Density.csv

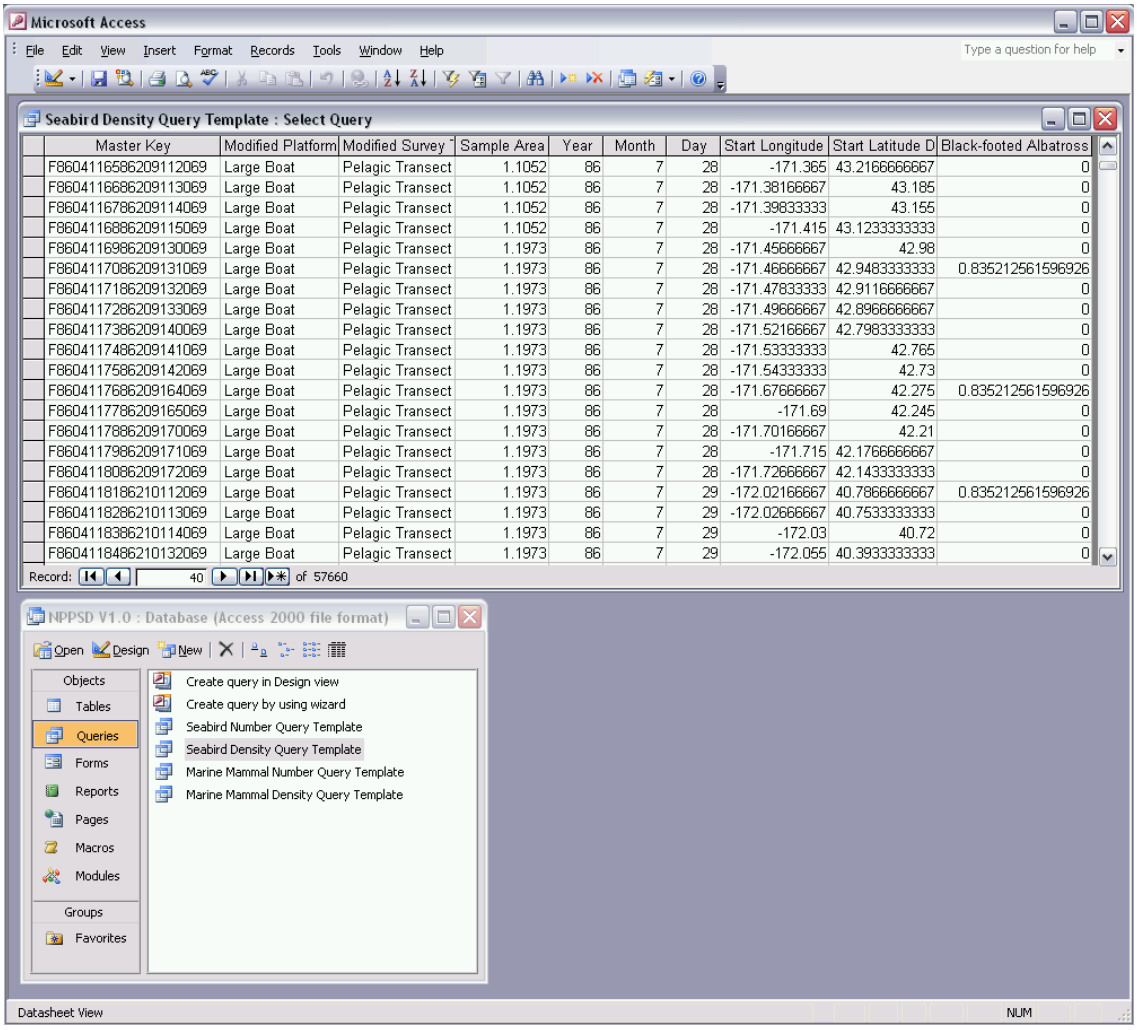

Figure 7. Screenshot of the Access database query "Seabird Density" following its execution.

VIII. When Will The NPPSD Be Updated?

We are planning to have periodic updates of the NPPSD. Due to budget and time limitations, there is no schedule for these updates; however, we suggest visiting our website to get the latest NPPSD news. Additionally, questions can be directed to gary_drew@usgs.gov.