DATABASE SUPPORT FOR THE ALASKA COMPREHENSIVE CONSERVATION STRATEGY PLANNING EFFORT

By

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ABSTRACT

The Alaska Natural Heritage Program (AKNHP) entered into a partnership with the Alaska Department of Fish and Game's (ADF&G) Wildlife Diversity Program to summarize biological, ecological, and distribution information on a number of species featured in their Comprehensive Wildlife Conservation Strategy (CWCS) to aid with informed decision-making regarding the conservation status of these animals. The products resulting from this partnership, which occurred between 2004 and 2007, included summarizing ecological and biological data for 92 "featured species" to assess their conservation status rank. Additionally, range and element occurrence distribution maps were created for a subset of these species (56 of the 92), and the associated spatial information was entered into AKNHP's Biotics database.

The purpose of this project was to provide ongoing database support for the CWCS featured species dataset and to enhance its utility through the creation of integrated output products to ADF&G and its partner agencies via a web-based interface. During the course of this project AKNHP staff quality controlled element occurrence data previously entered into AKNHP's Biotics database during the 2004 and 2007 phase; updated or developed new occurrence records for 18 CWCS featured species; prepared for a national level data exchange with NatureServe; researched web-based tools and designed queries to facilitate data access for ADF&G biologists and partners; prepared web-based products including reports to serve tabular data; and contracted with Axiom, a web-design company, to implement a web based system that will provide users with query, visualization, and downloading capabilities for AKNHP ecological datasets, including featured species data sets.

ACKNOWLEDGEMENTS

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INTRODUCTION

The Alaska Department of Fish and Game's (ADF&G) statewide Comprehensive Wildlife Conservation Strategy (CWCS) was finalized in August 2005 and approved by the Director of the U.S. Fish and Wildlife Service in December, 2005, making Alaska eligible for future Congressional appropriations of State Wildlife Grants (SWG) funds. The overall goal of the CWCS is to conserve the diversity of Alaska's wildlife resources, focusing on those species with the greatest conservation need.

The CWCS highlights the conservation needs of a large number of species, species groups, and species assemblages. Within the CWCS, these species and groups are termed "featured species" and include fourteen taxonomic groups: amphibians and reptiles, marine fish, marine invertebrates, sea birds, marine mammals, terrestrial mammals, land birds, raptors, terrestrial invertebrates, water birds, shorebirds, freshwater fish, waterfowl, and freshwater invertebrates (ADF&G 2006).

The CWCS acknowledged that a serious impediment to the goal of better conserving broad arrays of species was the lack of information available on most Alaskan species and their habitats. Much of the research in the state has focused on game species that are important for commercial, recreational and subsistence users, while little attention has been focused on the state's other wildlife resources, including invertebrates, fish, amphibians, small mammals and birds. To that end, the Alaska Natural Heritage Program (AKNHP) entered into a partnership with the ADF&G's Wildlife Diversity Program between 2004 and 2007 to summarize biological, ecological, and distribution information on a number of "featured species" to aid with informed decision-making regarding the conservation status of these animals (Gotthardt et al. 2006 and 2007). The products resulting from this partnership included summarizing ecological and biological data for 92 "featured species" to assess their conservation status rank, and then for a subset of species (56 of the 92), we mapped their range and distribution and entered this spatial information into AKNHP's Biotics database.

The Biotics database is the newest generation of NatureServe's biodiversity data management software and is built on a sophisticated data model implemented in an Oracle database. The system incorporates custom applications for spatial data management, tabular data management,

data import/export and reconciliation, and reporting. The spatial component of the system is a custom geographic information system (GIS) application that supports basic digital mapping, spatial analyses, and data visualization. Element-referenced objects incorporated in the data model include information that relates to a species or community's identity, status, general distribution, and life history characteristics. Spatial entities in the data model include the location and bounds of a species population, sites of ecological, scientific or conservation interest, and areas under protective management.

Database management support is essential to the upkeep, updating, and refinement of existing featured species data as well as cataloging additional species data. Effective database management, establishing appropriate database access, and generating output for species data underpins the entire conservation planning process. The Biotics database serves a repository for synthesized species data from which reports and map layers can be produced that are crucial information needed by resource managers to better address conservation actions.

The purpose of this project was to provide ongoing database support for the CWCS featured species dataset and to enhance its utility through the creation of integrated output products to ADF&G and its partner agencies via a web-based interface.

The specific objectives were:

1. Refine and quality control all data assembled for 92 species of conservation concern (referred to throughout this report as “featured species”) for the CWSC process. Perform data requests of featured species data as needed to produce additional maps or reports for CWCS process.
2. Prepare web-based products as needed from these data and provide products as requested to ADF&G and partner agencies, i.e. Separate and map EO distributions by management units, watershed designations and ecosystem designations.
3. Integrate global information for 92 species and refine taxonomy according to national taxonomy standards. Integrate national data as part of annual data exchange with NatureServe.
4. Complete distribution mapping for 14 featured species already assembled by zoologist.
5. Research data access needs of ADF&G and partnership agencies for featured species data.
6. Conduct research, provide a design and cost assessment to ADF&G for building and implementing a web-based data delivery system for featured species data that incorporates query of species and geographical searches for species known distribution.

METHODS

Objective 1. Refine and quality control all data assembled for 92 species of conservation concern for the CWSC process. Perform data requests of featured species data as needed to produce additional maps or reports for the CWCS process.

The Biotics database allows for tracking of species information in both tabular and spatial formats. First, we conducted a quality control of all tabular information for 92 CWCS featured species entered into Biotics between 2004 and 2007 (see Appendix I for full species list). This

included textual descriptions of species biological and ecological characteristics that were used to generate Heritage conservation status ranks. This information was checked for content and completeness of literature citations. We also conducted a quality control of all spatial data, which had been developed for a subset (56) of the previously mentioned 92 featured species between 2006 and 2007 (Appendix I). For the spatial data, we compared the raw observation data used to develop **element occurrences** (see definition below) for individual species to mapped occurrences in the Biotics database. Corrections in regards to number of occurrences or spatial accuracy were adjusted when necessary. We also quality controlled all tabular information (attributes) associated with each occurrence record for completeness and made sure that all sources used to develop the spatial data component were referenced and linked.

An **element occurrence** (EO) is an area of land and/or water in which a species is, or was, present. An EO has practical conservation value for the element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population (e.g., long distance dispersers) or a group of nearby populations (*e.g*., metapopulation).

An EO record is a data management tool that has both spatial and tabular components including a mappable feature and its supporting database. EOs are typically represented by bounded, mapped areas of land and/or water. EO records are most commonly created for current or historically known occurrences of native species of conservation interest. They may also be created, in some cases, for extirpated occurrences.

Objective 2. Prepare web-based products as needed from these data and provide products as requested to ADF&G and partner agencies, i.e. separate and map EO distributions by management units, watershed designations and ecosystem designations.

We filtered all EO distributions currently housed in the Biotics database by management units, watershed designations and ecosystem designations. Spatial data filters included 1) native versus invasive species; 2) species or taxonomic group; 3) conservation status including NatureServe global and state ranks, U. S. Fish and Wildlife Service, ADF&G, Bureau of Land Management, and U. S. Forest Service; and 4) management units (i.e. landownership), BCR, EcoRegion (i.e. ecosystem designation), watershed, borough, township, and USGS quads.

Objective 3. Integrate global information for 92 featured species and refine taxonomy according to national taxonomy standards. Integrate national data as part of annual data exchange with NatureServe.

AKNHP participates in an annual data exchange of Biotics species data to NatureServe's centralized database. During this process, taxonomy was refined according to national taxonomy standards.

Objective 4: Complete distribution mapping for 14 featured species.

As a result of the Biotics data quality control review (Objective 1), spatial data were refined for eight featured species and used to update existing element occurrences and produce distribution maps. We also developed new element occurrence maps for an additional 10 featured species. Species to be mapped were originally selected cooperatively by ADF&G and AKNHP, and selection criteria was based on high state (S) ranks (e.g. S1 to S3) or species of conservation concern by federal or state agencies. Information on range and distribution for the 10 additional species was gathered during the 2006 to 2007 ADF&G/AKNHP Cooperative project (Gotthardt et al. 2007).

We used occurrence data to map the range and distribution of individual species. Here, range is defined as the total areal extent occupied by a given taxon and is usually estimated as the aggregation of all map units thought to be occupied by individuals of the target taxon in the study area (in this case, Alaska). We define distribution as the spatial arrangement of environments suitable for occupation by individuals of a given taxon and is usually estimated as a subset of all environments in the study area that regularly supports individuals. Distribution maps are finer in grain than range maps, with much inter-digitation of suitable and unsuitable environments that are potentially occupied by individuals.

To map the distribution of individual species we developed 1) an ArcGIS observations database and then 2) created "**source features**" and "**element occurrences**" for individual species based on observation data (this process is described in detail below). Range maps for individual species were developed by NatureServe and are available for download via the internet (http://www.natureserve.org/getData/animalData.jsp). We used observation data and the resultant element occurrences to modify the existing range maps developed by NatureServe, which were originally coarse in scale.

We used standards and protocols developed by NatureServe to create EOs for individual species. An EO often consists of multiple **source features** (this includes the area of an observation and then incorporates uncertainty associated with that location based on observation quality), generally delineates a species population, and represents the georeferenced biological feature that is of conservation or management interest. Distribution information used to derive EOs for individual species was obtained from published and unpublished literature, museum specimen data, unpublished data and field notes obtained directly from researchers. Occurrence data for each of the 18 species (eight refined and ten new species) is now current as of 2010.

The following is a summary of the specific steps used to develop the observations database and create EO distribution maps:

1. We compiled, synthesized, and georeferenced individual species location information from published and unpublished sources and used this data to develop geographic coverages depicting species observations in an ArcGIS project.
2. Observation data were filtered for duplicate records and erroneous or suspect location information. We also attempted to reconcile and then standardize the numerous coordinate systems used to record locations from such diverse data sets.

3. Using EO specifications developed by NatureServe for each taxon, we refined the observations data to reflect important life history stages and/or important species concentration sites (e.g., stopover areas, foraging concentrations, hibernacula).
4. Source features, EO records and associated attribute information were entered into the Heritage Program's Biotics database (see Table 1 for a full list of attribute fields included for each record).
5. We created a bibliography of references used to develop each data product (e.g., original observation points, EOs and ranges).
6. Maps depicting range, distribution, and when applicable, life history stage or species concentration sites (EOs), were developed for individual species.

Objective 5: Research data access needs of ADF&G and partnership agencies for Featured Species data.

AKNHP zoology staff met with the ADF&G Wildlife Diversity Program staff to discuss ADF&G data access needs and receive input as to how they would like to display and serve featured species data, both tabular and spatial, via a web-portal.

Objective 6. Conduct research, provide a design and cost assessment to ADF&G for building and implementing a web-based data delivery system for featured species data that incorporates query of species and geographical searches for species known distribution.

AKNHP staff met with two local website companies to explore a web-based interface for displaying Biotics spatial and tabular data and obtained cost estimates.

Table 1. Standardized list of attribute fields and definitions used to develop element occurrences.

FIELD NAME	DEFINITION
SCI_NAME	Scientific name
COM_NAME	Common name
G_RANK	Global Heritage Status Ranks (G1 - G5)
S_RANK	State Heritage Status Ranks (S1-S5)
EL_CODE	Heritage Program Element (Species) Code
DATA_SENS	Indicates if the data is sensitive to public use
SITE_NAME	Site name of the nearest named location
DIRECTIONS	Directions to site, more specific site names
LAT_DD	Latitude decimal degrees
LONG_DD	Longitude decimal degrees
DATUM	Datum of coordinates (NAD27 or NAD83)
COORD_SOUR	Source of coordinates
	LATLONG = latitude and longitude provided by source
	UTM = UTM coordinates provided by source
	MAP = coordinates obtained from map in source
	DESCRIPTION = mapped in ARCGIS or TOPOZONE using a description of location; directions used
	AK PLACES = coordinates assigned from AK place names dataset; site name used
ACCURACY_M	The accuracy of the coordinates in meters. If no accuracy is provided use 100, 2000, 10000 meters based on the description of the location.
PRECISION	The precision of the location and implied accuracy of the resultant mapped location.
	S = SECONDS = within 100 m
	M = MINUTES = within 2000 m
	G = GENERAL = within 10 km
	U = UNKNOWN = unknown
OBSERVER	Observer(s) name
REFERENCE	Short citation for data source
RSOURCE_CO	laska Natural Heritage Program database reference code for data source
DATE_	Observation or collection date (first date in range of dates)
YEAR_RANGE	Year or range of years particular record was observed or collected
OTHER_DATE	Other dates particular record was observed or collected
ABUND_COMM	Comments referring to abundance data
SURVEY_MET	Survey method used
EO_TYPE	Type of Observation
MIN_ELEVAT	Minimum elevation
ESA_STAT	Endangered Species Act Status
SPECIMEN	Indicates if a specimen was collected
COLL_COMM	Collector name, specimen ID# number if provided and other comments on the specimen collected
LIFE_STAGE	Life history stage - e.g. adult, subadult, egg mass
HAB_COMM	Habitat comments
GEN_COMM	General comments

RESULTS

Objective 1. Refine and quality control all data assembled for 92 species of conservation concern for the CWSC process. Perform data requests of featured species data as needed to produce additional maps or reports for the CWCS process.

We conducted a quality control of all textual information for 92 CWCS featured species, and conducted a quality control of all spatial data for 56 of the 92 featured species entered into Biotics between 2004 and 2007 (Appendix I). We compared the raw observation data for each individual species to mapped occurrences in the Biotics database.

Objective 2. Prepare web-based products as needed from these data and provide products as requested to ADF&G and partner agencies, i.e. separate and map EO distributions by management units, watershed designations and ecosystem designations.

To facilitate data access and prepare "web-ready" products for export from the Biotics database, we developed queries to filter spatial data by management units, watershed designations and ecosystem designations. Thus, once the web-interface is complete, the end-user should be able perform complex queries of spatial data from their desktop to produce lists of species of concern (i.e. federal or stated listed) by management or ecoregional designation (e.g., all state species of concern that have been mapped on State Refuges or State Critical Habitat Areas). As part of objective 6 (implement a web-based data delivery system for featured species), we are also planning a search interface that will enable filtering of data by geographic location. Users will be able to download raw data in tabular form (.csv and Microsoft Excel) in addition to spatial (GIS) formats (.shp and source raster format when applicable).

In addition to making spatial data accessible, we will also serve tabular data stored in Biotics via the web interface. Tabular data containing descriptive information about individual species ecology and biology are available for hundreds of species of potential concern in the Biotics database and are updated annually. Tabular information will be served in report format (as a .pdf). "**Conservation Status Reports**" will include information used to generate state and global conservation ranks, such as population size, range, population trend, threats, environmental specificity, stewardship, and monitoring and research needs. "**Species Summary Reports**" will display information on a species legal designation, migratory characteristics, habitats, diet, phenology, reproduction, economic status, and distribution in relation to specific political and physiographic boundaries. The end user will be able to query tabular data using the same query set developed for spatial data.

Objective 3. Integrate global information for 92 featured species and refine taxonomy according to national taxonomy standards. Integrate national data as part of annual data exchange with NatureServe.

We reviewed and updated the taxonomy of the 92 featured species using national taxonomy standards. AKNHP participates in an annual data exchange of Biotics species data to NatureServe's centralized database. The data exchange process benefits the entire network, providing current global data for all the "elements" that a program tracks, and facilitating the

sharing of data among NatureServe and the member programs. We were waiting to conduct the data exchange when all the products developed for this project were completed as of May 2010. The next scheduled data exchange with NatureServe is September 2010.

Objective 4: Complete distribution mapping for 14 featured species already assembled by zoologist.

Range and distribution maps were refined for 8 species with existing data and for 10 new featured species (Table 2). This included 15 birds (6 with existing data, 9 new), two mammals (1 with existing data, 1 new) and one reptile (all new).

A total of 1879 EOs were developed for this project, which were derived from 7564 source features (1854 EOs and 7520 source features for birds, 4 EOs and 23 source features for mammals, and 21 EOs derived from 21 source features for reptiles). Consistent data protocols set forth by NatureServe were used to develop all element occurrences. A complete list of attribute fields used to develop element occurrences is presented in Table 1. All spatial data were standardized using the NAD83 datum and then projected in Albers Conical Equal Area. Final maps depicting element occurrences, distribution and ranges of individual species are presented in Appendix II.

Table 2. List of 18 CWCS featured species for which range and distribution maps were developed. Species common names denoted by an asterisk (*) indicate the eight species for which information was updated after quality control of the Biotics database. Species without an asterisk were newly created for this project. Also included in the table are the global (G Rank) and state (S Rank) conservation status ranks (refer to Appendix III for definitions), the EO type, the number of source features used to develop the EO, and the total number of element occurrences derived from the source features.

	Common Name	Scientific Name	G Rank	S Rank	EO Type	Source Features	Element Occurrences
BIRDS							
1	Steller's Eider	*Polysticta stelleri*	G3	S1B,S2S3N	Breeding	185	24
					Spring Staging	26	26
					Molting	6	6
2	King Eider*	*Somateria spectabilis*	G5	S3B,S3N	Breeding	3	3
					Staging	5	5
					Molting	3	3
					Nonbreeding	2	2
3	Yellow-billed Loon	*Gavia adamsii*	G4	S2S3B, S3N	Breeding	723	723
4	Red-faced Cormorant	*Phalacrocorax urile*	G5	S3	Breeding	294	294
5	Solitary Sandpiper	*Tringa solitaria*	G5	S4B	Breeding	837	80
6	Wandering Tattler	*Heteroscelus incanus*	G5	S4S5B	Breeding	230	54
7	Red-legged Kittiwake*	*Rissa brevirostris*	G2G3	S2S3B,S2N	Breeding	9	9
8	Aleutian Tern*	*Onychoprion aleuticus*	G4	S3B	Breeding	129	129
9	Marbled Murrelet*	*Brachyramphus marmoratus*	G3G4	S3	Breeding	34	34
10	Kittlitz's Murrelet*	*Brachyramphus brevirostris*	G2	S2B,S2N	Breeding	74	57
11	Snowy Owl	*Bubo scandiacus*	G5	S3S4	Breeding	1178	9

Table 2 (continued)

	Common Name	Scientific Name	G Rank	S Rank	EO Type	Source Features	Element Occurrences
BIRDS cont'd…							
12	Olive-sided Flycatcher*	*Contopus cooperi*	G4	S4S5B	Breeding	629	94
13	Gray-cheeked Thrush	*Catharus minimus*	G5	S4S5B	Breeding	1436	67
14	Smith's Longspur	*Calcarius pictus*	G5	S3S4B	Breeding	186	17
15	Rusty Blackbird	*Euphagus carolinus*	G4	S4B,S3N	Breeding	1463	150
MAMMALS							
16	Northern Sea Otter, SW Alaska population*	*Enydra lutris kenyoni*	G4T2T3	S3	Range	1	1
17	Northern Fur Seal	*Callorhinus ursinus*	G3	S2S3	Breeding	22	3
REPTILES							
18	Leatherback*	*Demochelys coriacea*	G2	S2	Observations	21	21

Objective 5: Research data access needs of ADF&G and partnership agencies for featured species data.

AKNHP zoology staff met with the ADF&G Wildlife Diversity Program staff to discuss ADF&G data access needs and how they would like to have spatial data for featured species displayed via a web-portal. At that time, Wildlife Diversity staff requested that queries for spatial data include a filter for featured species by ADF&G management regions (1 though 5) and also by Bird Conservation Units (BCRs).

Based on the needs of ADF&G Wildlife Diversity Program and their partners, AKNHP staff developed queries for displaying spatial and tabular data stored in AKNHP's conservation database (Biotics). Web-based products were also prepared by quality controlling and updating spatial relationships within Biotics. This included overlaying species data with geographic layers to display political and physiographic representations. Additional geographic layers, based on ADF&G needs (e.g., BCRs), were also loaded into Biotics for future query potential.

Objective 6. Conduct research, provide a design and cost assessment to ADF&G for building and implementing a web-based data delivery system for featured species data that incorporates query of species and geographical searches for species known distribution.

To implement a web-based interface for dissemination of Biotics data, we contracted with Axiom (http://www.axiomalaska.com), an Anchorage based web-design company, with an emphasis on serving ecological data. The cost estimate for this contract is $35,000 and is funded through AKNHP/UAA and the ADF&G Wildlife Diversity Program (project title "Development of a Cooperative Nongame Program between UAA and ADF&G"). The following plan details the redevelopment of AKNHP's website into a better organized and functional information gateway for dissemination of biological and ecological data holdings. Website redesign efforts will comply with University of Alaska Anchorage (UAA) technical specifications. Systems which will serve AKNHP and ADF&G Wildlife Diversity Program spatial data will be implemented through the installation of GeoServer, an open source mapping engine. Data interoperability will be ensured through adherence to Open Geospatial Standards (OGC) and the utilization of Web Maps Services (WMS), Web Feature Services (WFS) and Web Coverage Services (WCS). The resulting web-based system will provide users with a new web-site with embedded search, query and visualization systems for their ecological datasets.

The Biotics database (including rare plant and animal data) will be made available for users to query, visualize and download data via data grids and web-based maps. Currently, most data requests for Biotics data must be manually prepared. Data is currently stored in an Oracle database as points, which detail the exact location(s) of observed species during surveys.

Interoperability allows agencies to retain local control of data while also allowing outside computer systems to access data through standardized protocols (Figure 1). Data access based upon interoperability enables applications to draw upon and utilize information that can exist at multiple physical locations and are stored in a wide array of data formats. Interoperability data networks balance work load across multiple computing systems, leverage bandwidth, and provide a framework for cost sharing between organizations and open data access.

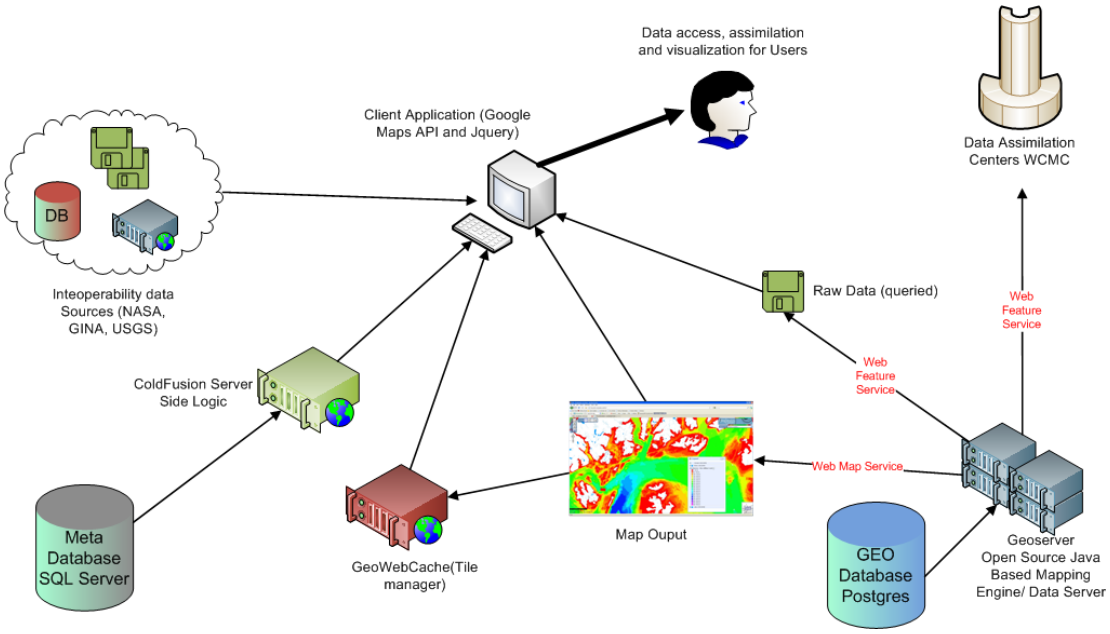

Figure 1. Data flow schematic portrays the flow of information and technological underpinnings of the proposed web-based system.

Through actions of developing this work plan, UAA Information Technology (IT) staff have authorized and created a virtual server instance within the UAA IT infrastructure to host web applications and data for this project. The project team has been given authorization credentials for the administration of these services remotely.

The specific tasks are:

1. Website redesign – work with AKNHP and ADF&G Wildlife Diversity Program staff to redesign the layout, navigation and overall concept of the AKNHP and ADF&G Wildlife Diversity Program website. This process will involve the development of new Cascading Style Sheets (CSS) in addition to HTML templates to ease site administration and facilitate future site expansion. This component involves the creation of website content that is not driven by database interactions.
2. Server deployment and configuration – deploy a data management framework for the storage and dissemination of AKNHP and ADF&G Wildlife Diversity Program datasets. This task will involve installing and configuring GeoServer geospatial data server, Postgres database, and ColdFusion webserver instance to a UAA server. UAA has already provided Axiom and AKNHP staff with a server instance to host the website and web applications.
3. Data transformation systems – design database views to extract a series of flattened tabular database outputs from the various data sources. These outputs would constitute the general data structure that users would download for various plant and animal species queries. Additionally, the database views will include spatial data information (points, lines and polygons) which will power the mapping components to this project.
4. Create data driven search and mapping applications – build data exploration and search interfaces to filter data by species, space, time and other parameters/metrics and provide

users with map based visualizations and raw data access though mapping systems. Tabular grids of query results will be coupled with map outputs to provide users with flexible interfaces to sorting and filtering data. Users will be able to download raw data in tabular form (.csv and Microsoft Excel) in addition to spatial formats (.shp and source raster format when applicable).

DISCUSSION

All conservation status information summarized for the 92 featured species and distribution information for 56 of these species has now been incorporated into the Heritage Program's Biotics database, making this information available to a wide audience at both state and global levels. Maps generated during this project represent current and historical knowledge, from a wide variety of sources, regarding the distribution and range of select featured species. These data sets offer the opportunity to geographically portray the overall native species diversity found within the state, as well as to consider regional, ecosystem, or biogeographical patterns exhibited by individual species or groups of organisms. We hope that this information will be used in land use planning decisions and to guide future research and inventory efforts by ADF&G staff and others.

Integration of featured species distribution information into a centralized repository (Biotics) provides an invaluable tool for generating and solving conservation questions at state, regional and local levels. State level data is transferred every two years to NatureServe's national database, providing for a broader perspective of species distribution and conservation status at both national and global scales. The overall goal of such efforts is to provide a scientific basis for effective conservation with an emphasis on biodiversity, while providing conservation groups, government agencies, corporations, academia, and the public with interpretable data to inform decisions about managing our natural resources.

Development and implementation of an organized and functional information gateway for dissemination of ADF&G and AKNHP biological data marks a significant milestone for the conservation of rare and endangered species. Visualization and download capabilities via a web-portal will greatly improve our data user's ability to access, query and extract data that has the potential to impact important decisions regarding Alaska's wildlife.

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Appendix I. List of 92 CWCS "featured species" previously entered into Biotics between 2004 and 2007 that were reviewed for completeness during this project. Species highlighted in bold indicate the 56 species for which element occurrence data were available and reviewed for spatial accuracy. Table includes species common name, scientific name, and G- and S-ranks current as of 2010.

	Common Name	**Scientific Name**	**G Rank**	**S Rank**
	BIRDS			
1	**Aleutian Tern**	***Onychoprion aleuticus***	**G4**	**S3B**
2	Arctic Tern	*Sterna paradisaea*	G5	S4S5B
3	**Beringian Marbled Godwit**	***Limosa fedoa beringiae***	**G5**	**S2B**
4	**Black Oystercatcher**	***Haematopus bachmani***	**G5**	**S2S3B, S2N**
5	Black-legged Kittiwake	*Rissa tridactyla*	G5	S5B, S5N
6	Blackpoll Warbler	*Dendroica striata*	G5	S4B
7	**Bristle-thighed Curlew**	***Numenius tahitiensis***	**G2**	**S2B**
8	Brown Creeper	*Certhia americana*	G5	S4
9	Cliff Swallow	*Petrochelidon pyrrhonota*	G5	S5B
10	Fork-tailed Storm-petrel	*Oceanodroma furcata*	G5	S5B, S4N
11	**Grey-cheeked Thrush**	***Catharus minimus***	**G5**	**S4S5B**
12	Hermit Thrush	*Catharus guttatus*	G5	S5B
13	**King Eider**	***Somateria spectabilis***	**G5**	**S3B, S3N**
14	**Kittlitz's Murrelet**	***Brachyramphus brevirostris***	**G2**	**S2B,S2N**
15	Leach's Storm-petrel	*Oceanodroma leucorhoa*	G5	S5B
16	Lesser Yellowlegs	*Tringa flavipes*	G5	S5B
17	**Marbled Murrelet**	***Brachyramphus marmoratus***	**G3G4**	**S2S3**
18	Northern Harrier	*Accipiter cyaneus*	G5	S4B
19	**Olive-sided Flycatcher**	***Contopus cooperi***	**G4**	**S4S5B**
20	**Pribilof Rock Sandpiper**	***Calcarius ptilocnemis ptilocnemis***	**G5T3**	**S3B, S2N**
21	**Queen Charlotte Goshawk**	***Accipiter gentilis laingi***	**G5T2**	**S2**
22	**Red-faced Cormorant**	***Phalacrocorax urile***	**G5**	**S3**
23	**Red-legged Kittiwake**	***Rissa brevirostris***	**G2G3**	**S2S3B,S2N**
24	Red-necked Grebe	*Podiceps grisegena*	G5	S4S5B, S4N
25	Red-throated Loon	*Gavia stellata*	G5	S4B, S4N
26	**Rusty Blackbird**	***Euphagus carolinus***	**G4**	**S4B, S3N**
27	Short-eared Owl	*Asio flammeus*	G5	S4B
28	**Smith's Longspur**	***Calcarius pictus***	**G5**	**S3S4B**
29	**Snowy Owl**	***Bubo scandiacus***	**G5**	**S3S4**
30	**Solitary Sandpiper**	***Tringa solitaria***	**G5**	**S4B**
31	Townsend's Warbler	*Dendroica townsendi*	G5	S4B
32	Violet-green Swallow	*Tachycineta thalassina*	G5	S5B
33	**Wandering Tattler**	***Heteroscelus incanus***	**G5**	**S4S5B**
34	White-crowned Sparrow	*Zonotrichia leucophrys*	G5	S5B

Appendix I (continued)

	Common Name	***Scientific Name***	**G Rank**	**S Rank**
35	Yellow-billed Loon	*Gavia adamsii*	G4	S2S3B, S3N
	TERRESTRIAL MAMMALS			
36	**Alaska marmot**	***Marmota broweri***	**G4**	**S4**
37	Big brown bat	*Eptesicus fuscus*	G5	SNA
38	**California myotis**	***Myotis californicus***	**G3G4**	**S2**
39	**Collared lemming**	***Dicrostonyx groenlandicus***	**G5**	**S4**
	St. Lawrence Island collared lemming	*D. g. exsul*	G5T3	S3
	Umnak Island collared lemming	*D. g. stevensoni*	G5T3	S3
	Unalaska Island collared lemming	*D. g. unalascensis*	G5T3	S3
40	Ermine	*Mustela erminea*	G5	S5
	Suemez Island ermine	*M. e. seclusa*	G5T3	S3
	Prince of Wales Island ermine	*M. e. celenda*	G5T3	S3
	Kodiak Island ermine	*M. e. kadiacensis*	G5T4	S4
	Baranof Island ermine	*M. e. initis*	G5T3	S3
	Admiralty Island ermine	*M. e. salva*	G5T2T3	S2S3
41	**Keen's myotis**	***Myotis keenii***	**G2G3**	**S1S2**
42	**Little brown bat**	***Myotis lucifugus***	**G5**	**S4**
43	**Long-legged bat**	***Myotis volans***	**G5**	**S2**
44	**Pribilof Island shrew**	***Sorex pribilofensis***	**G3**	**S3**
45	**Prince of Wales flying squirrel**	***Glaucomys sabrinus griseifrons***	**G5T2**	**S2**
46	**Silver-haired bat**	***Lasionycteris noctivagans***	**G5**	**S2**
47	**St. Lawrence Island shrew**	***Sorex jacksoni***	**G4**	**S4**
48	Alaskan hare	*Lepus othus*	G3G4	S3S4
49	**Wrangell Island red-backed vole**	***Myodes gapperi wrangeli***	**G5T3**	**S3**
	MARINE MAMMALS			
50	**Beluga - Cook Inlet pop. 4**	***Delphinapterus leucas Pop 4***	**G4T1**	**S1**
51	**Bowhead**	***Balaena mysticetus***	**G3**	**S3**
52	Harbor seal	*Phoca vitulina*	G5	S4S5
53	**Northern fur seal**	***Callorhinus ursinus***	**G3**	**S2S3**
54	**North Pacific Right Whale**	***Eubalaena glacialis***	**G1**	**S1**
55	**Northern sea otter**	***Enhydra lutris kenyoni***	**G4T3**	**S3**
56	**Pacific walrus**	***Odobenus rosmarus***	**G4**	**S3**
57	**Polar bear**	***Ursus maritimus***	**G3G4**	**S3**
58	**Sperm whale**	***Physeter macrocephalus***	**G3G4**	**S2**

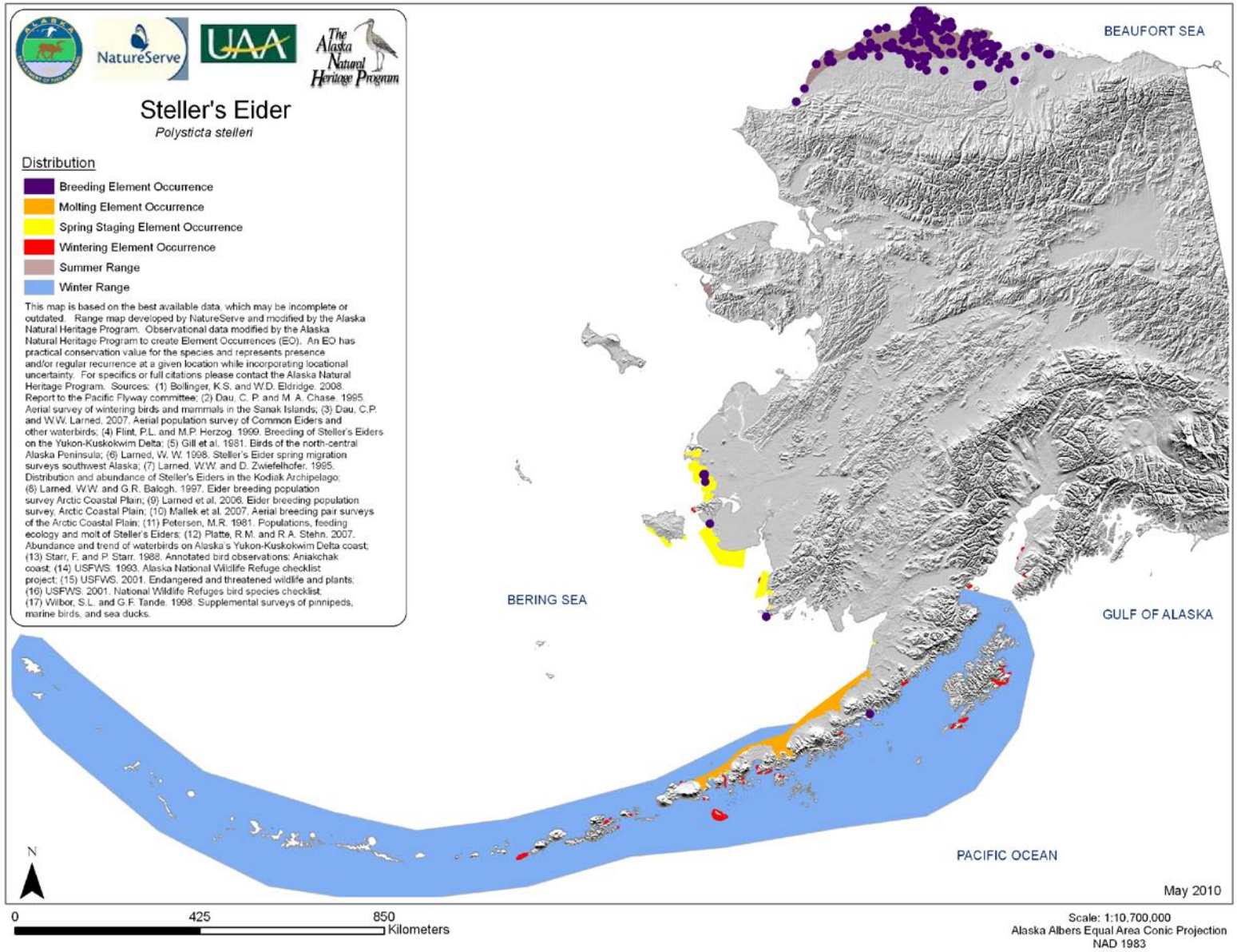
Appendix I (continued)

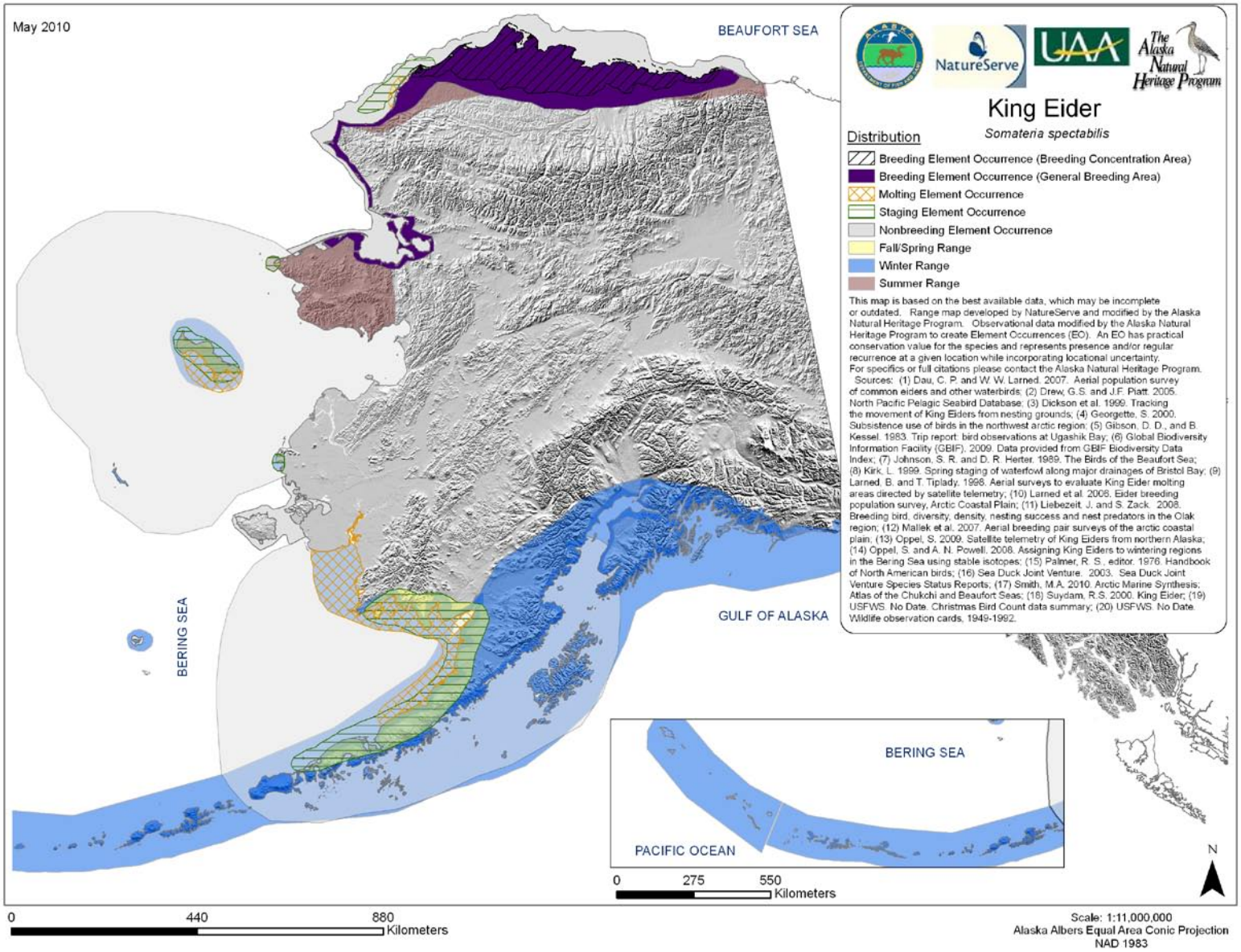
	Common Name	***Scientific Name***	**G Rank**	**S Rank**
	FISHES			
59	**Alaskan brook lamprey**	***Lampetra alaskensis***	**G3Q**	**S3Q**
60	Arctic cod	*Boreogadus saida*	G5	S4S5
61	**Arctic lamprey**	***Lampetra camtschatica***	**G4**	**S4**
62	Capelin	*Mallotus villosus*	G5	S5
63	Crescent gunnel	*Pholis laeta*	G5	S4S5
64	Prowfish	*Zaprora silenus*	G4G5	S3S5
65	**River lamprey**	***Lampetra ayresii***	**G4**	**S2**
66	Threespine stickleback	*Gasterosteus aculeatus*	G5	S5
67	**Trout perch**	***Percopsis omniscomaycus***	**G5**	**S3**
68	**Western brook lamprey**	***Lampetra richardsoni***	**G4G5**	**S1S2**
	AMPHIBIANS			
69	**Columbia spotted frog**	***Rana luteiventris***	G4	S2
70	**Long-toed salamander**	***Ambystoma macrodactylum***	G5	S3
71	**Northwestern salamander**	***Ambystoma gracile***	G5	S3
72	**Roughskin newt**	***Taricha granulosa***	G5	S4
73	**Western toad**	***Aaxyrus boreas***	G4	S3S4
74	**Wood frog**	***Lithobates sylvaticus***	G5	S5
	INVERTEBRATES			
75	**A cave amphipod**	***Stygobromus quatsinensis***	**G2G3**	**S2S3**
76	A chaetognath	*Sagitta elegans*	G5	S5
77	A lugworm	*Aren icoala pacifica*	G5	S4S5
78	**A mayfly**	***Rhithrogena ingalik***	**G1G3**	**S1S3**
79	Baltic macoma	*Macoma baltica*	G5	S5
80	Black Katy chiton	*Katharina tunicata*	G5	S5
81	Eelgrass shrimp	*Hippolyte clarki*	G5	S5
82	Eskimo arctic butterfly	*Oeneis alpina*	G3G4	S3
83	**Gordon's grasshopper**	***Melanoplus gordonae***	**G1G3**	**S1**
84	Gorgonian corals	*Gorgonacea*	not ranked	not ranked
85	Gumboot chiton	*Cryptochiton stelleri*	G5	S5
86	**Pinto abalone**	***Haliotis kamtschatkana***	**G3G4**	**S2S3**
87	**Ram's-horn valvata**	***Valvata mergella***	**G2**	**S1**
88	Sitka periwinkle	*Littorina sitkana*	GNR	S5
89	**Treeline emerald dragonfly**	***Somatochlora sahlbergi***	**G4**	**S3S4**
90	**Yukon floater mussel**	***Anodonta beringiana***	**G4**	**S3S4**
91	Zerene fritillary butterfly	*Speyeria zerene*	G5	S2

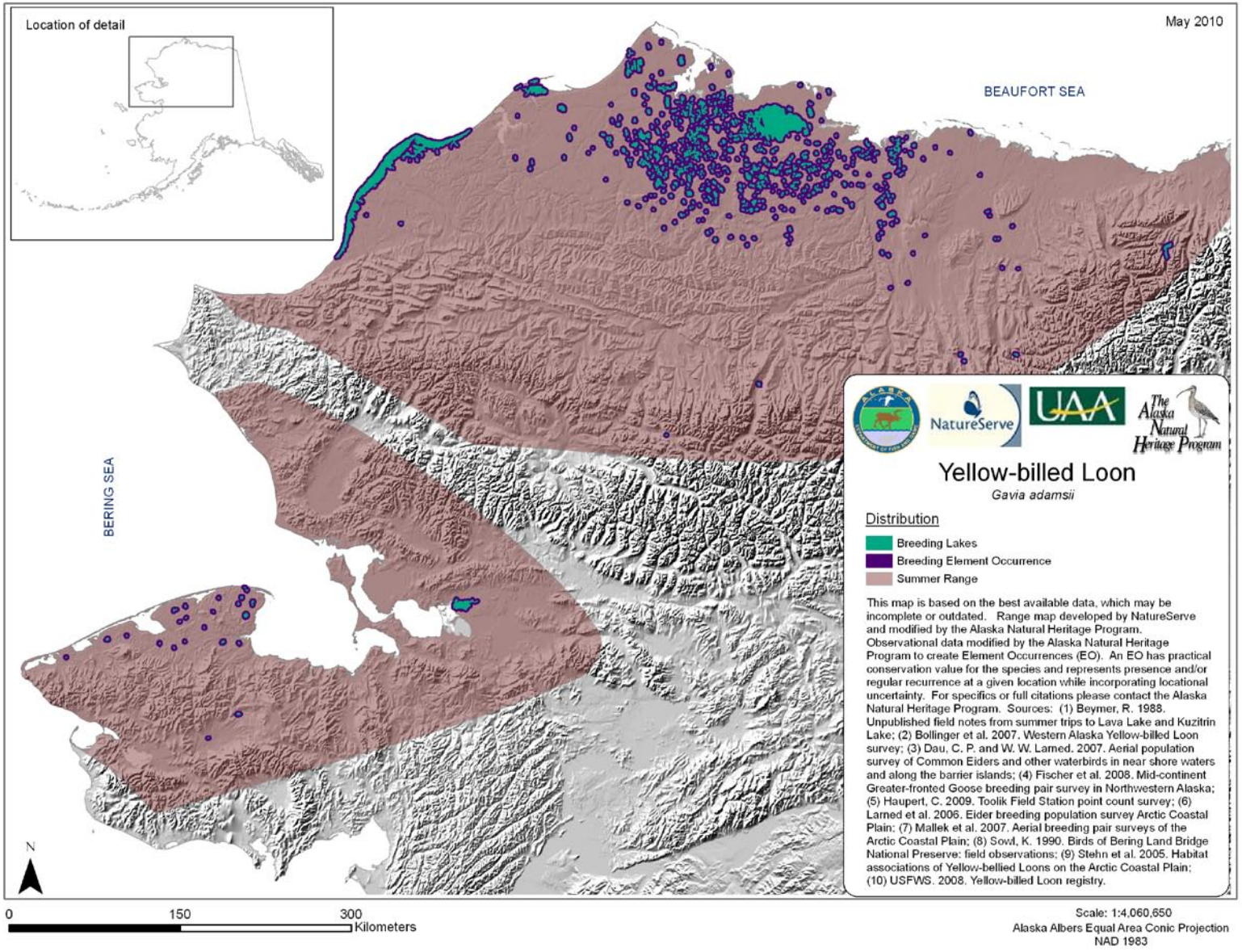
Appendix I (continued)

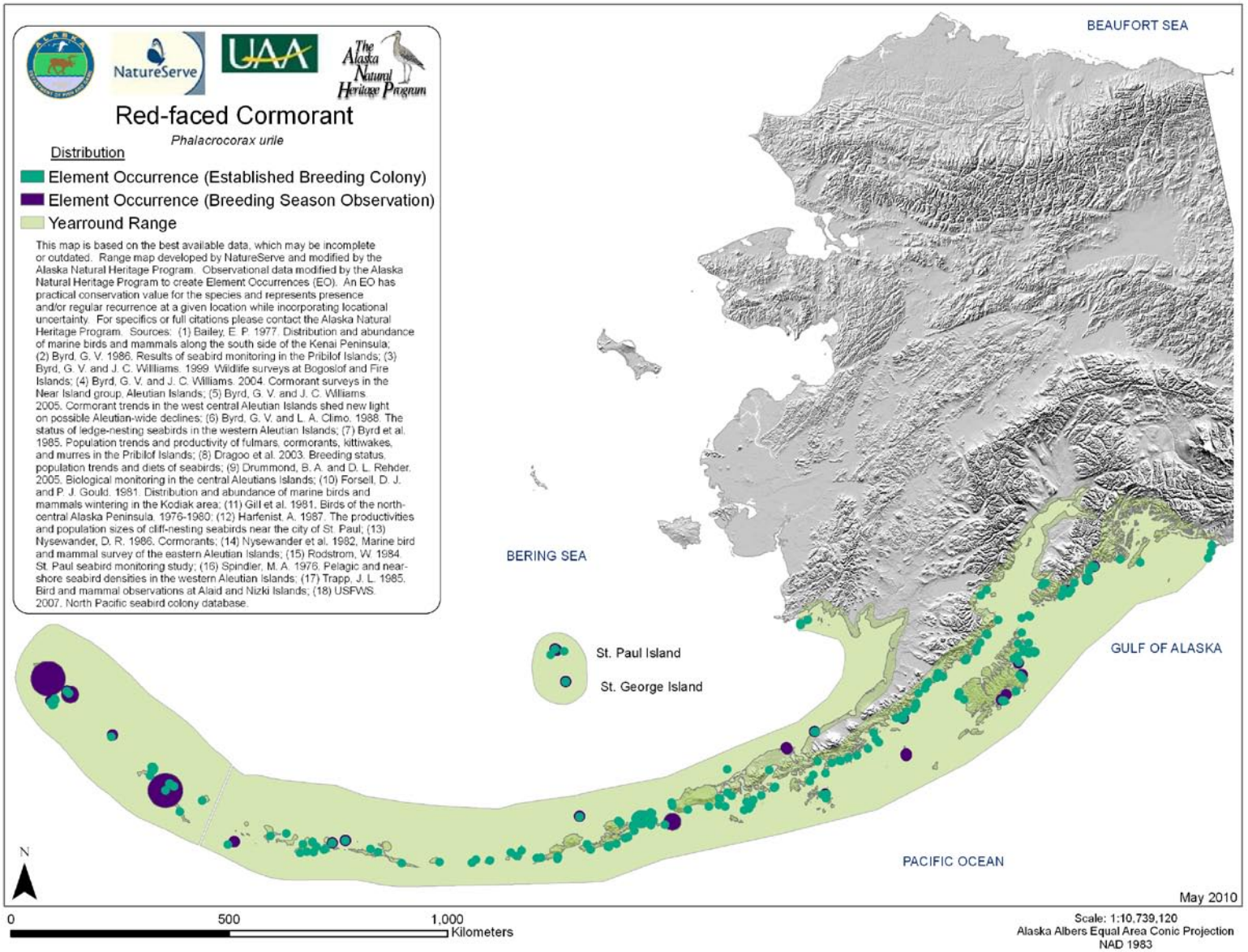
	Common Name	***Scientific Name***	**G Rank**	**S Rank**
	REPTILES			
92	**Leatherback**	***Dermochelys coriacea***	**G2**	**S2**

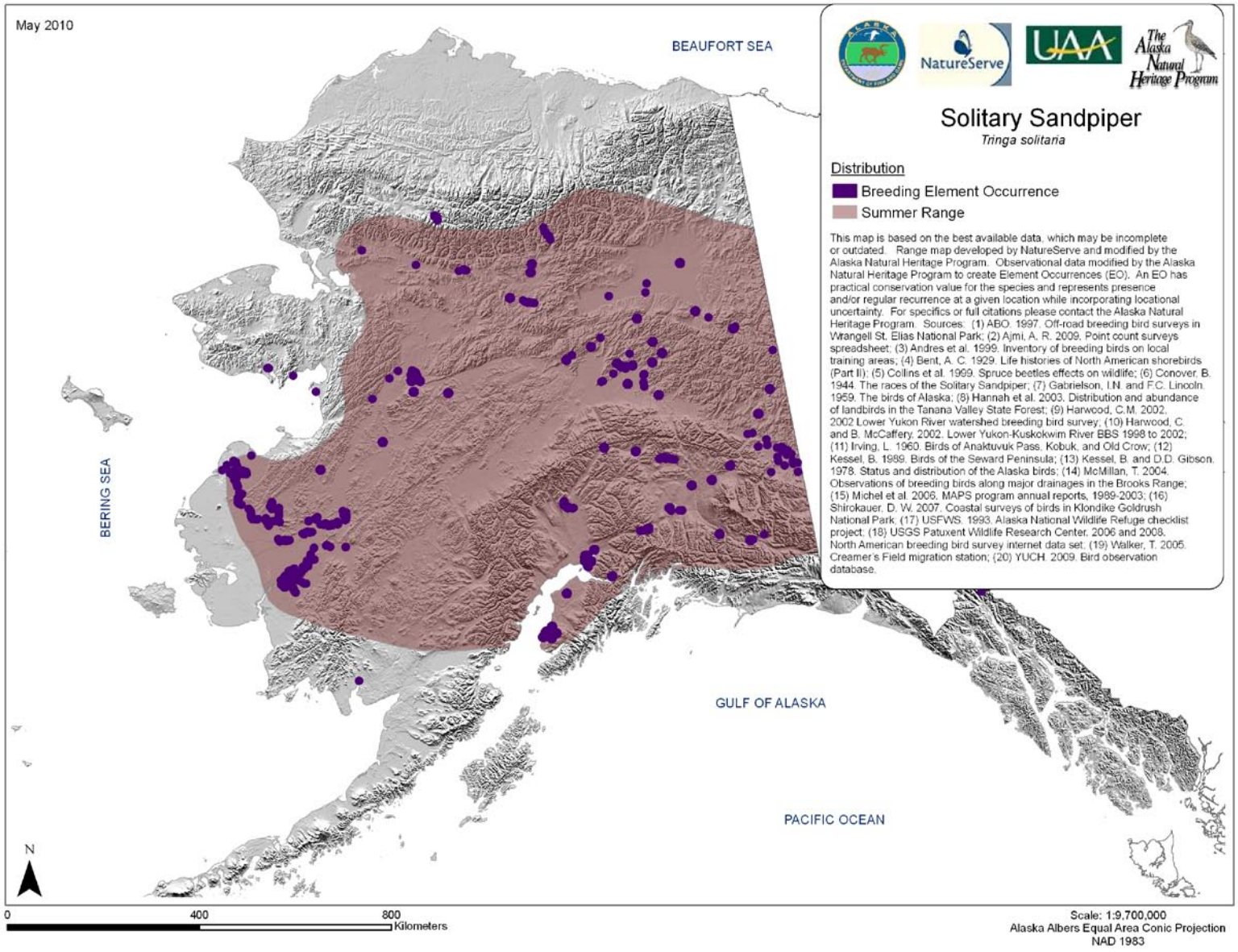
Appendix II. Range and distribution maps for 18 featured species.

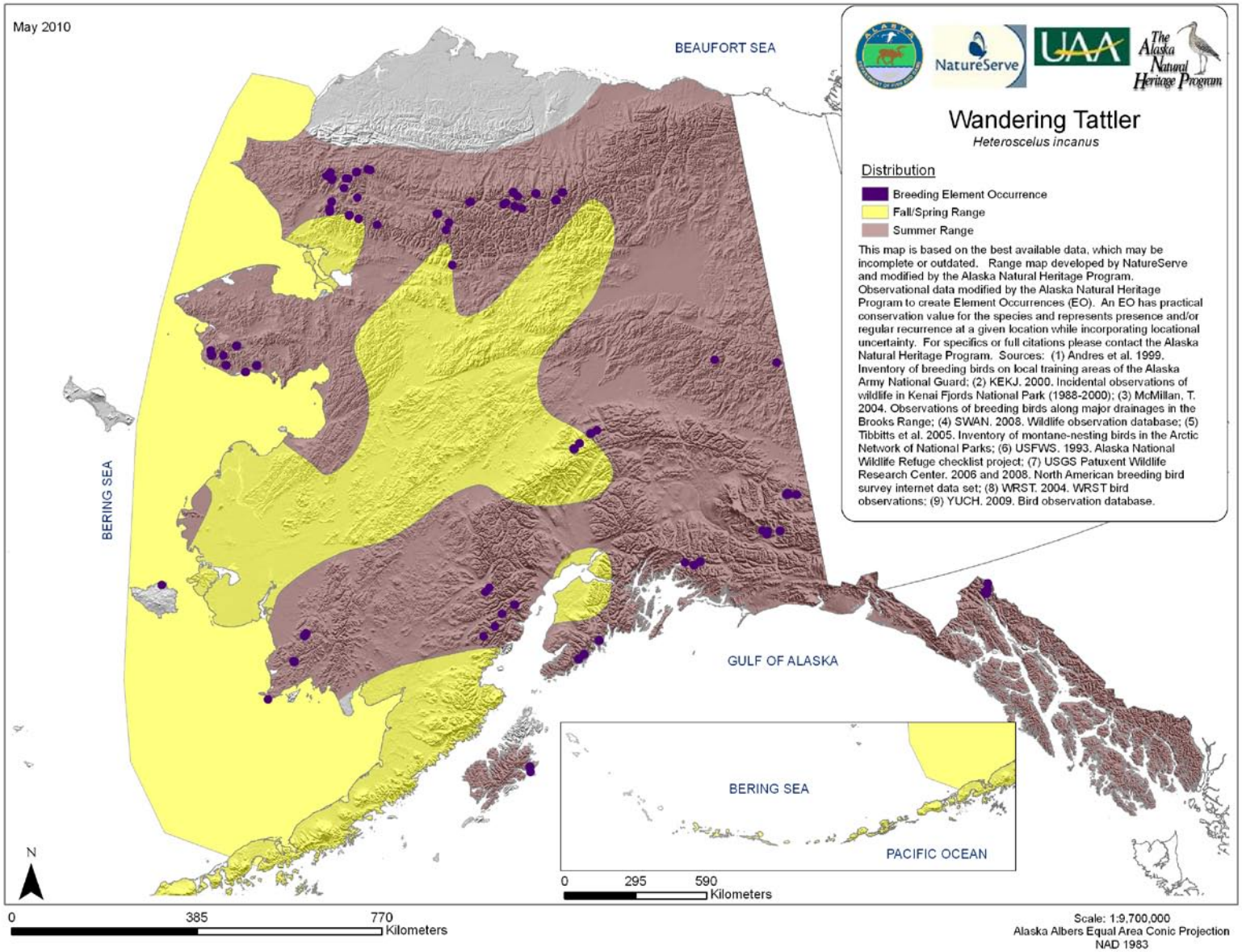



May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
King Eider
Somateria spectabilis
Distribution
Breeding Element Occurrence (Breeding Concentration Area)
Breeding Element Occurrence (General Breeding Area)
Molting Element Occurrence
Staging Element Occurrence
Nonbreeding Element Occurrence
Fall/Spring Range
Winter Range
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Dau, C. P. and W. W. Larned. 2007. Aerial population survey of common eiders and other waterbirds; (2) Drew, G.S. and J.F. Piatt. 2005. North Pacific Pelagic Seabird Database; (3) Dickson et al. 1999. Tracking the movement of King Eiders from nesting grounds; (4) Georgette, S. 2000. Subsistence use of birds in the northwest arctic region; (5) Gibson, D. D., and B. Kessel. 1983. Trip report: bird observations at Ugashik Bay; (6) Global Biodiversity Information Facility (GBIF). 2009. Data provided from GBIF Biodiversity Data Index; (7) Johnson, S. R. and D. R. Herter. 1989. The Birds of the Beaufort Sea; (8) Kirk, L. 1999. Spring staging of waterfowl along major drainages of Bristol Bay; (9) Larned, B. and T. Tiplady. 1998. Aerial surveys to evaluate King Eider molting areas directed by satellite telemetry; (10) Larned et al. 2008. Eider breeding population survey, Arctic Coastal Plain; (11) Liebezeit, J. and S. Zack. 2008. Breeding bird, diversity, density, nesting success and nest predators in the Olak region; (12) Mallek et al. 2007. Aerial breeding pair surveys of the arctic coastal plain; (13) Oppel, S. 2009. Satellite telemetry of King Eiders from northern Alaska; (14) Oppel, S. and A. N. Powell. 2008. Assigning King Eiders to wintering regions in the Bering Sea using stable isotopes; (15) Palmer, R. S., editor. 1976. Handbook of North American birds; (16) Sea Duck Joint Venture. 2003. Sea Duck Joint Venture Species Status Reports; (17) Smith, M.A. 2010. Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas; (18) Suydam, R.S. 2000. King Eider; (19) USFWS. No Date. Christmas Bird Count data summary; (20) USFWS. No Date. Wildlife observation cards, 1949-1992.
BERING SEA
PACIFIC OCEAN
0 275 550 Kilometers
N
0 440 880 Kilometers
Scale: 1:11,000,000
Alaska Albers Equal Area Conic Projection
NAD 1983


Location of detail
May 2010
BEAUFORT SEA
BERING SEA
N
NatureServe
UAA
The Alaska Natural Heritage Program
Yellow-billed Loon
Gavia adamsii
Distribution
Breeding Lakes
Breeding Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Beymer, R. 1988. Unpublished field notes from summer trips to Lava Lake and Kuzitrin Lake; (2) Bollinger et al. 2007. Western Alaska Yellow-billed Loon survey; (3) Dau, C. P. and W. W. Larned. 2007. Aerial population survey of Common Eiders and other waterbirds in near shore waters and along the barrier islands; (4) Fischer et al. 2008. Mid-continent Greater-fronted Goose breeding pair survey in Northwestern Alaska; (5) Haupert, C. 2009. Toolik Field Station point count survey; (6) Larned et al. 2006. Eider breeding population survey Arctic Coastal Plain; (7) Mallek et al. 2007. Aerial breeding pair surveys of the Arctic Coastal Plain; (8) Sowl, K. 1990. Birds of Bering Land Bridge National Preserve: field observations; (9) Stehn et al. 2005. Habitat associations of Yellow-bellied Loons on the Arctic Coastal Plain; (10) USFWS. 2008. Yellow-billed Loon registry.
0
150
300
Kilometers
Scale: 1:4,060,650
Alaska Albers Equal Area Conic Projection
NAD 1983


Red-faced Cormorant
Phalacrocorax urile
Distribution
Element Occurrence (Established Breeding Colony)
Element Occurrence (Breeding Season Observation)
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Bailey, E. P. 1977. Distribution and abundance of marine birds and mammals along the south side of the Kenai Peninsula; (2) Byrd, G. V. 1986. Results of seabird monitoring in the Pribilof Islands; (3) Byrd, G. V. and J. C. Williams. 1999. Wildlife surveys at Bogoslof and Fire Islands; (4) Byrd, G. V. and J. C. Williams. 2004. Cormorant surveys in the Near Island group, Aleutian Islands; (5) Byrd, G. V. and J. C. Williams. 2005. Cormorant trends in the west central Aleutian Islands shed new light on possible Aleutian-wide declines; (6) Byrd, G. V. and L. A. Climo. 1988. The status of ledge-nesting seabirds in the western Aleutian Islands; (7) Byrd et al. 1985. Population trends and productivity of fulmars, cormorants, kittiwakes, and murres in the Pribilof Islands; (8) Dragoo et al. 2003. Breeding status, population trends and diets of seabirds; (9) Drummond, B. A. and D. L. Rehder. 2005. Biological monitoring in the central Aleutians Islands; (10) Forsell, D. J. and P. J. Gould. 1981. Distribution and abundance of marine birds and mammals wintering in the Kodiak area; (11) Gill et al. 1981. Birds of the north-central Alaska Peninsula, 1976-1980; (12) Harfenist, A. 1987. The productivities and population sizes of cliff-nesting seabirds near the city of St. Paul; (13) Nysewander, D. R. 1986. Cormorants; (14) Nysewander et al. 1982. Marine bird and mammal survey of the eastern Aleutian Islands; (15) Rodstrom, W. 1984. St. Paul seabird monitoring study; (16) Spindler, M. A. 1976. Pelagic and near-shore seabird densities in the western Aleutian Islands; (17) Trapp, J. L. 1985. Bird and mammal observations at Alaid and Nizki Islands; (18) USFWS. 2007. North Pacific seabird colony database.
BEAUFORT SEA
BERING SEA
St. Paul Island
St. George Island
GULF OF ALASKA
PACIFIC OCEAN
N
0
500
1,000
Kilometers
May 2010
Scale: 1:10,739,120
Alaska Albers Equal Area Conic Projection
NAD 1983


May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0
400
800
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Solitary Sandpiper
Tringa solitaria
Distribution
Breeding Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) ABO. 1997. Off-road breeding bird surveys in Wrangell St. Elias National Park; (2) Ajmi, A. R. 2009. Point count surveys spreadsheet; (3) Andres et al. 1999. Inventory of breeding birds on local training areas; (4) Bent, A. C. 1929. Life histories of North American shorebirds (Part II); (5) Collins et al. 1999. Spruce beetles effects on wildlife; (6) Conover. B. 1944. The races of the Solitary Sandpiper; (7) Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska; (8) Hannah et al. 2003. Distribution and abundance of landbirds in the Tanana Valley State Forest; (9) Harwood, C.M. 2002. 2002 Lower Yukon River watershed breeding bird survey; (10) Harwood, C. and B. McCaffery. 2002. Lower Yukon-Kuskokwim River BBS 1998 to 2002; (11) Irving, L. 1960. Birds of Anaktuvuk Pass, Kobuk, and Old Crow; (12) Kessel, B. 1989. Birds of the Seward Peninsula; (13) Kessel, B. and D.D. Gibson. 1978. Status and distribution of the Alaska birds; (14) McMillan, T. 2004. Observations of breeding birds along major drainages in the Brooks Range; (15) Michel et al. 2006. MAPS program annual reports, 1989-2003; (16) Shirokauer, D. W. 2007. Coastal surveys of birds in Klondike Goldrush National Park. (17) USFWS. 1993. Alaska National Wildlife Refuge checklist project; (18) USGS Patuxent Wildlife Research Center. 2006 and 2008. North American breeding bird survey internet data set; (19) Walker, T. 2005. Creamer's Field migration station; (20) YUCH. 2009. Bird observation database.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983


May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
NatureServe
UAA
The Alaska Natural Heritage Program
Wandering Tattler
Heteroscelus incanus
Distribution
Breeding Element Occurrence
Fall/Spring Range
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Andres et al. 1999. Inventory of breeding birds on local training areas of the Alaska Army National Guard; (2) KEKJ. 2000. Incidental observations of wildlife in Kenai Fjords National Park (1988-2000); (3) McMillan, T. 2004. Observations of breeding birds along major drainages in the Brooks Range; (4) SWAN. 2008. Wildlife observation database; (5) Tibbitts et al. 2005. Inventory of montane-nesting birds in the Arctic Network of National Parks; (6) USFWS. 1993. Alaska National Wildlife Refuge checklist project; (7) USGS Patuxent Wildlife Research Center. 2006 and 2008. North American breeding bird survey internet data set; (8) WRST. 2004. WRST bird observations; (9) YUCH. 2009. Bird observation database.
N
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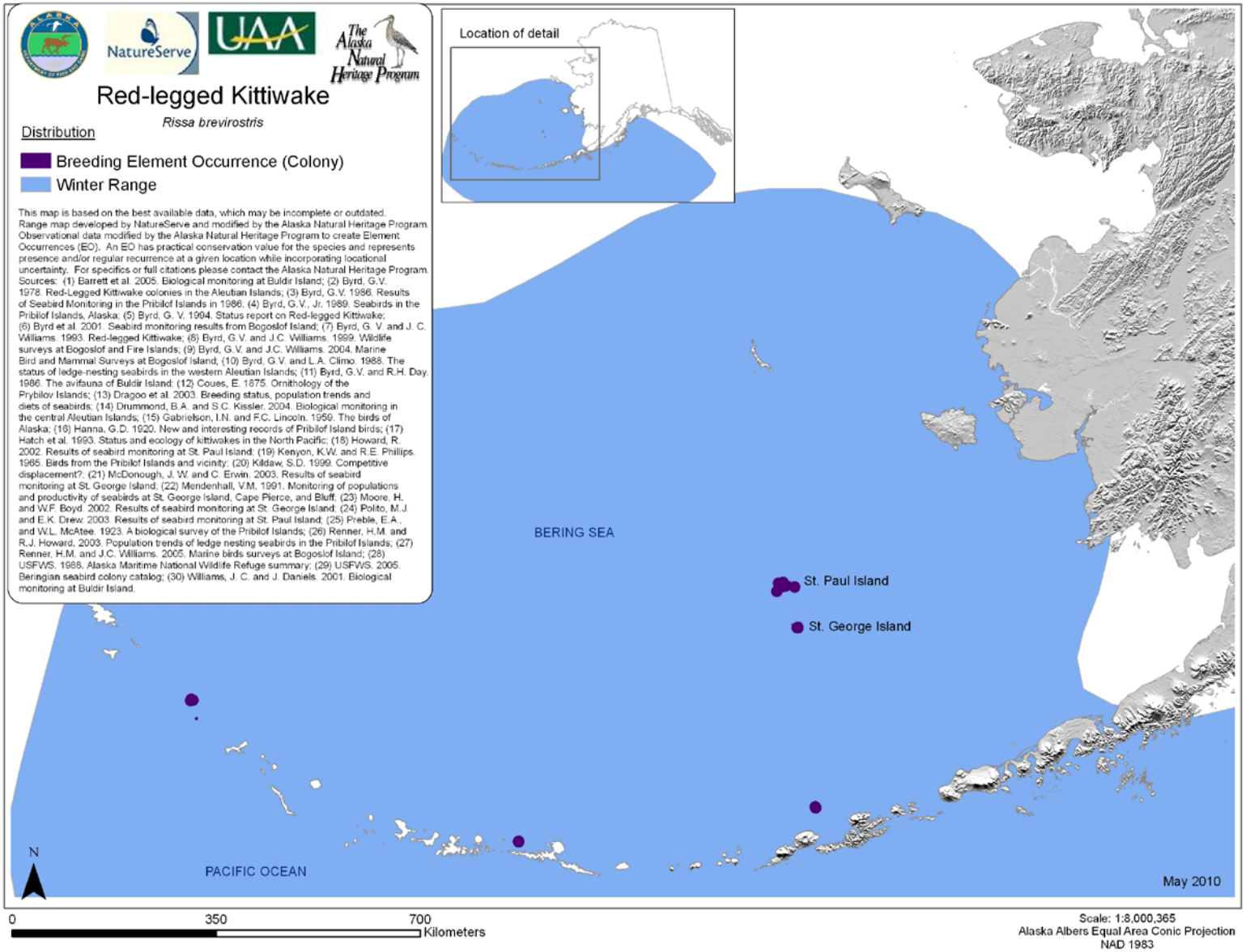
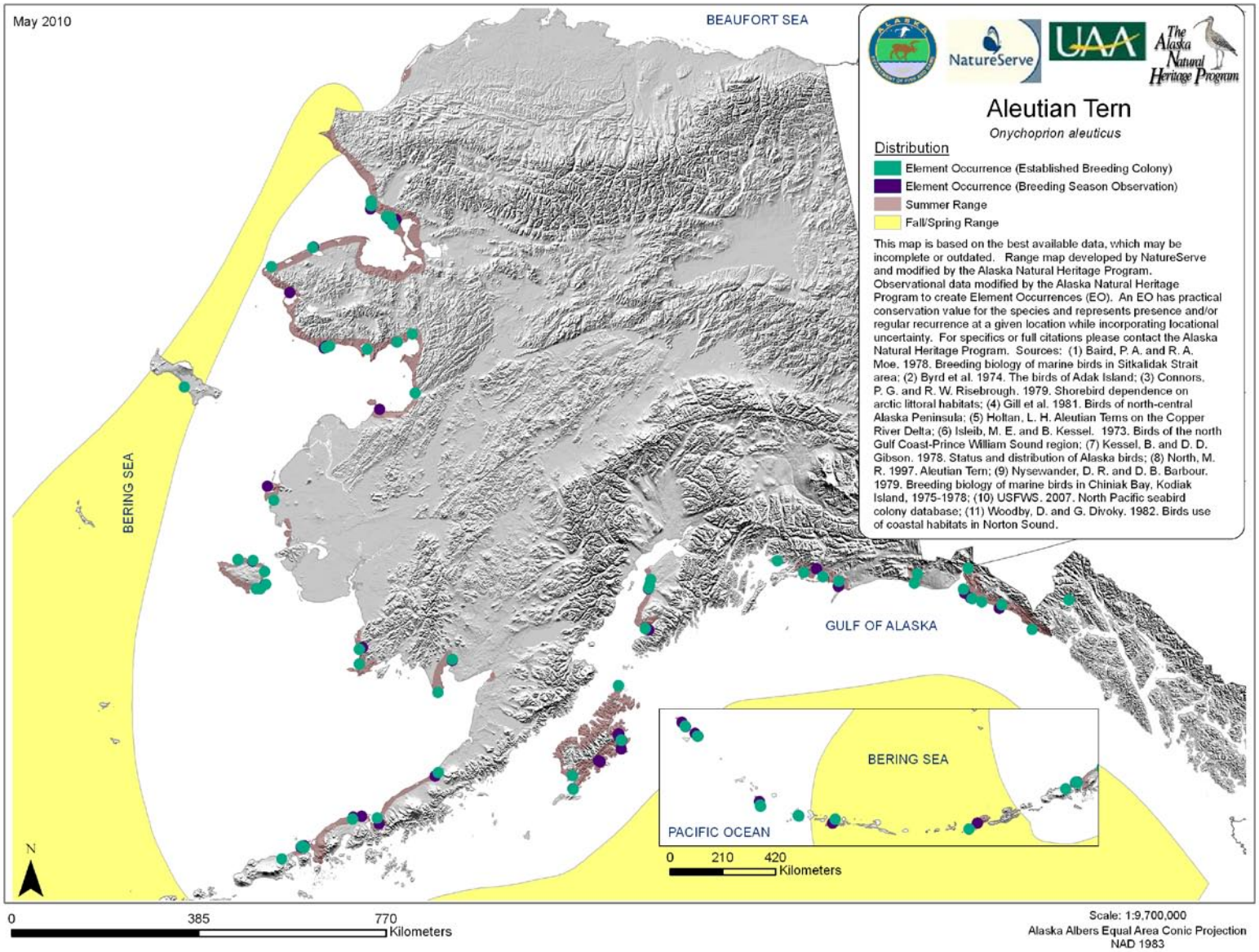
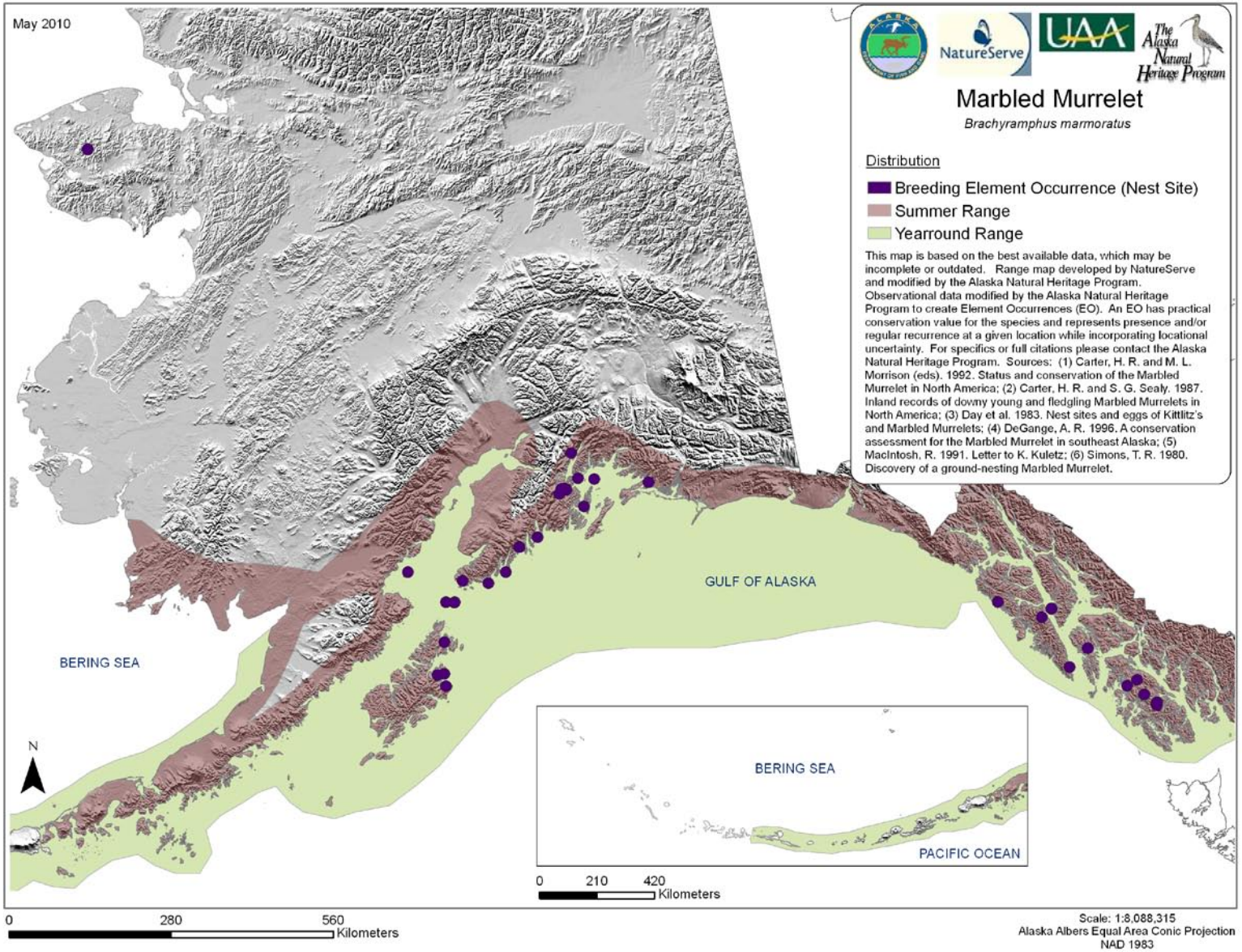
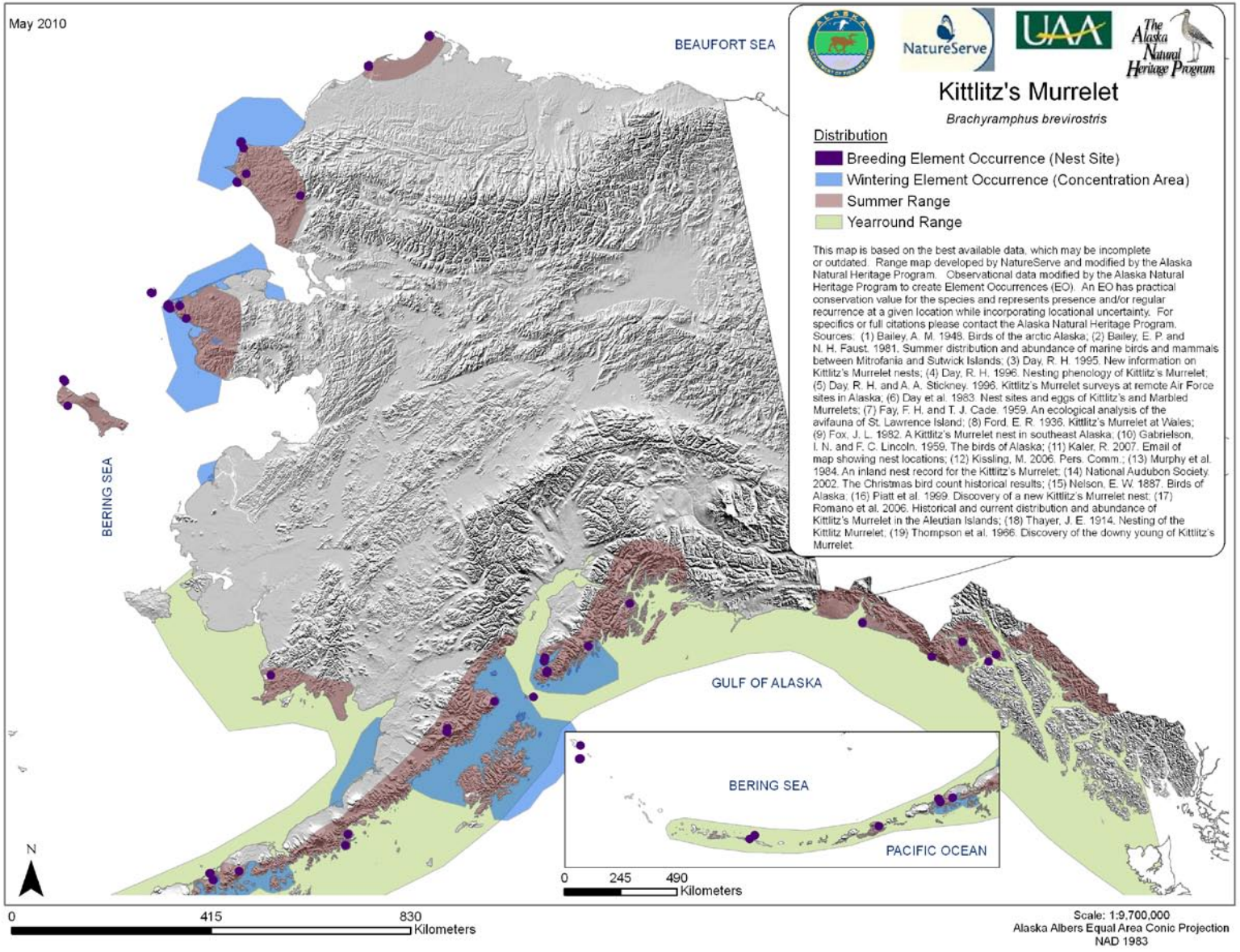
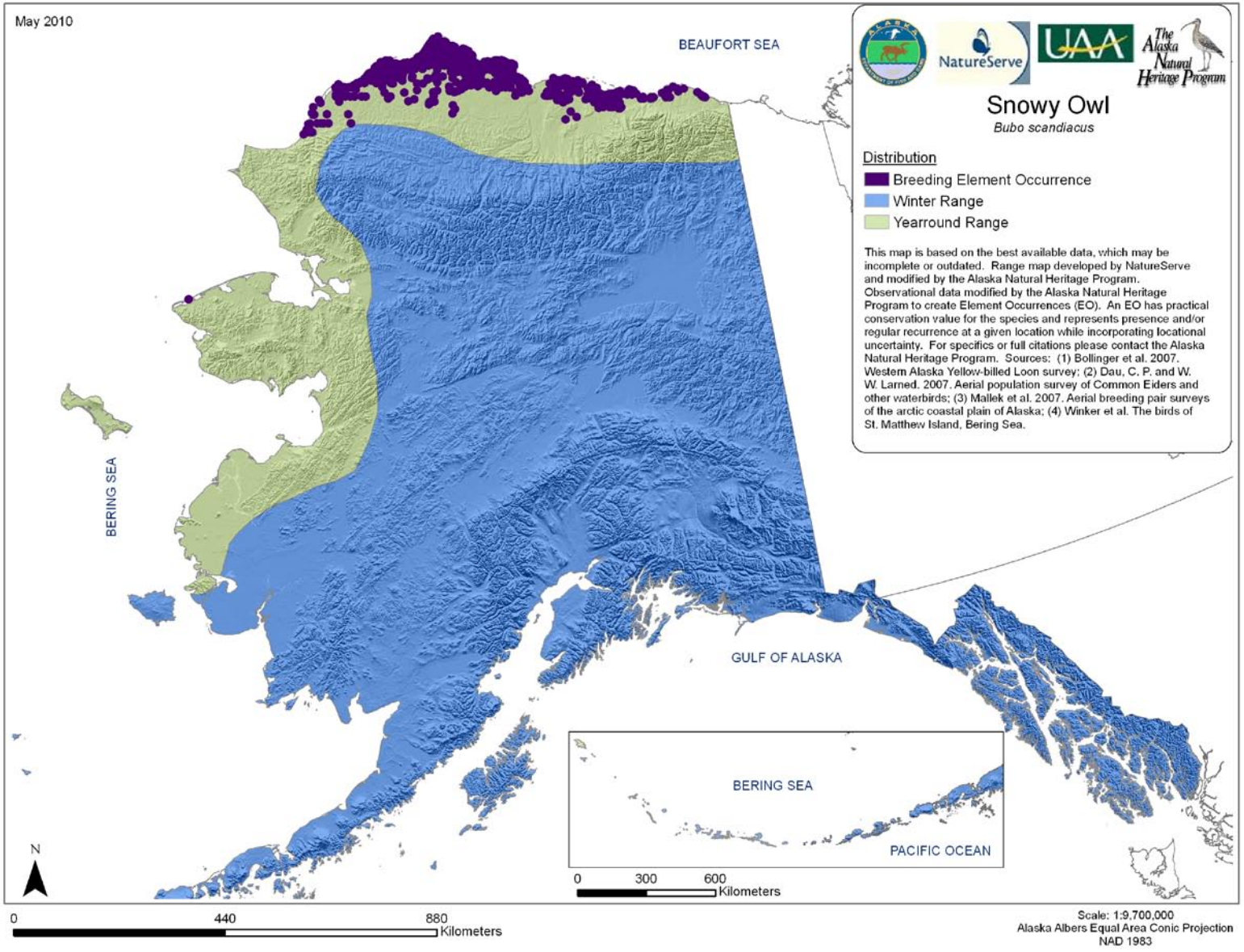
Alaska Albers Equal Area Conic Projection
NAD 1983

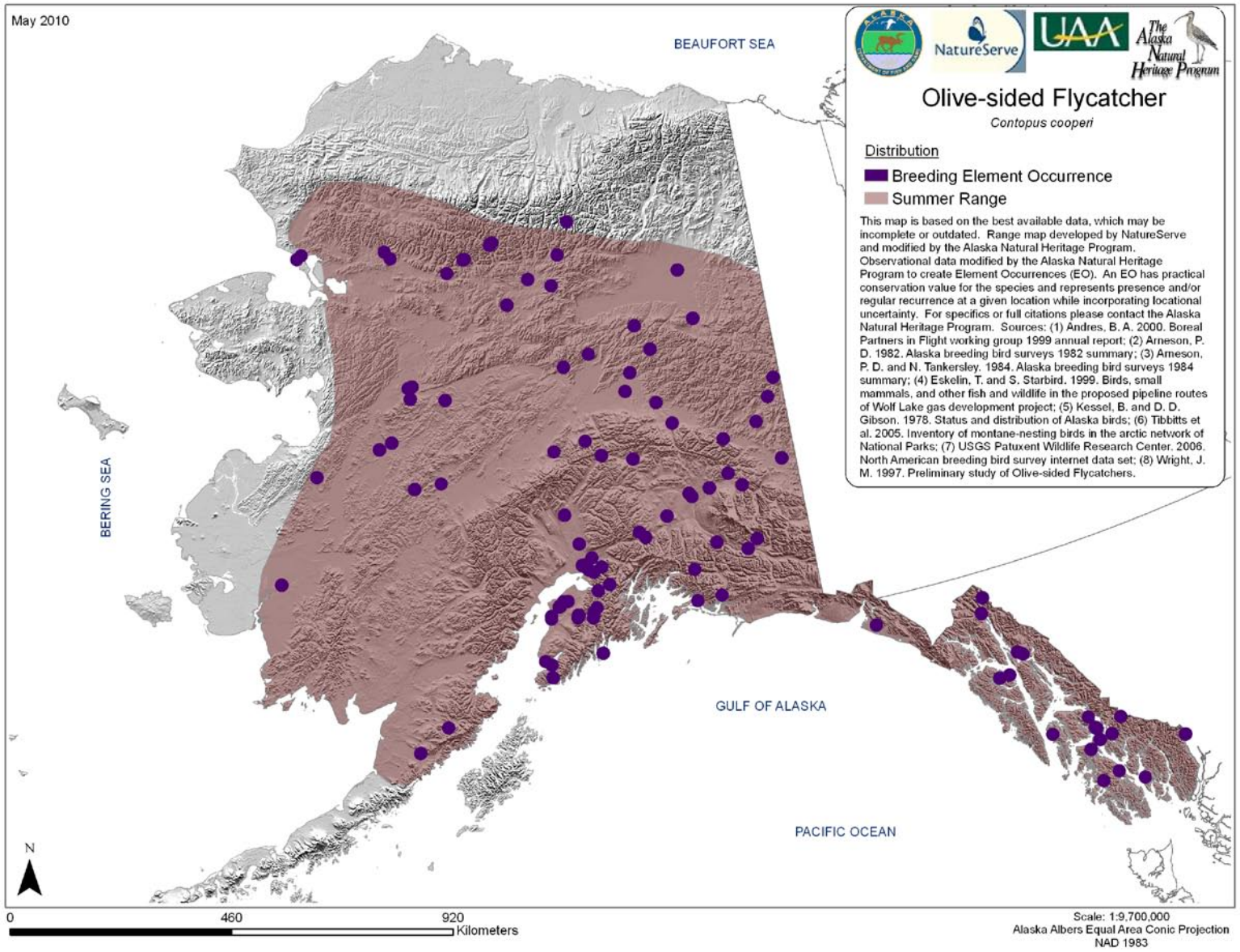

NatureServe
UAA
The Alaska Natural Heritage Program
Red-legged Kittiwake
Rissa brevirostris
Distribution
Breeding Element Occurrence (Colony)
Winter Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Barrett et al. 2005. Biological monitoring at Buldir Island; (2) Byrd, G.V. 1978. Red-Legged Kittiwake colonies in the Aleutian Islands; (3) Byrd, G.V. 1986. Results of Seabird Monitoring in the Pribilof Islands in 1986; (4) Byrd, G.V., Jr. 1989. Seabirds in the Pribilof Islands, Alaska; (5) Byrd, G. V. 1994. Status report on Red-legged Kittiwake; (6) Byrd et al. 2001. Seabird monitoring results from Bogoslof Island; (7) Byrd, G. V. and J. C. Williams. 1993. Red-legged Kittiwake; (8) Byrd, G.V. and J.C. Williams. 1999. Wildlife surveys at Bogoslof and Fire Islands; (9) Byrd, G.V. and J.C. Williams. 2004. Marine Bird and Mammal Surveys at Bogoslof Island; (10) Byrd, G.V. and L.A. Climo. 1988. The status of ledge-nesting seabirds in the western Aleutian Islands; (11) Byrd, G.V. and R.H. Day. 1986. The avifauna of Buldir Island: (12) Coues, E. 1875. Ornithology of the Prybilov Islands; (13) Dragoo et al. 2003. Breeding status, population trends and diets of seabirds: (14) Drummond, B.A. and S.C. Kissler. 2004. Biological monitoring in the central Aleutian Islands; (15) Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska; (16) Hanna, G.D. 1920. New and interesting records of Pribilof Island birds; (17) Hatch et al. 1993. Status and ecology of kittiwakes in the North Pacific; (18) Howard, R. 2002. Results of seabird monitoring at St. Paul Island; (19) Kenyon, K.W. and R.E. Phillips. 1965. Birds from the Pribilof Islands and vicinity: (20) Kildaw, S.D. 1999. Competitive displacement?: (21) McDonough, J.W. and C. Erwin. 2003. Results of seabird monitoring at St. George Island; (22) Mendenhall, V.M. 1991. Monitoring of populations and productivity of seabirds at St. George Island, Cape Pierce, and Bluff. (23) Moore, H. and W.F. Boyd. 2002. Results of seabird monitoring at St. George Island; (24) Polito, M.J. and E.K. Drew. 2003. Results of seabird monitoring at St. Paul Island; (25) Preble, E.A. and W.L. McAtee. 1923. A biological survey of the Pribilof Islands; (26) Renner, H.M. and R.J. Howard. 2003. Population trends of ledge nesting seabirds in the Pribilof Islands; (27) Renner, H.M. and J.C. Williams. 2005. Marine birds surveys at Bogoslof Island; (28) USFWS. 1988. Alaska Maritime National Wildlife Refuge summary; (29) USFWS. 2005. Beringian seabird colony catalog; (30) Williams, J. C. and J. Daniels. 2001. Biological monitoring at Buldir Island.
Location of detail
BERING SEA
PACIFIC OCEAN
St. Paul Island
St. George Island
N
0
350
700
Kilometers
May 2010
Scale: 1:8,000,365
Alaska Albers Equal Area Conic Projection
NAD 1983

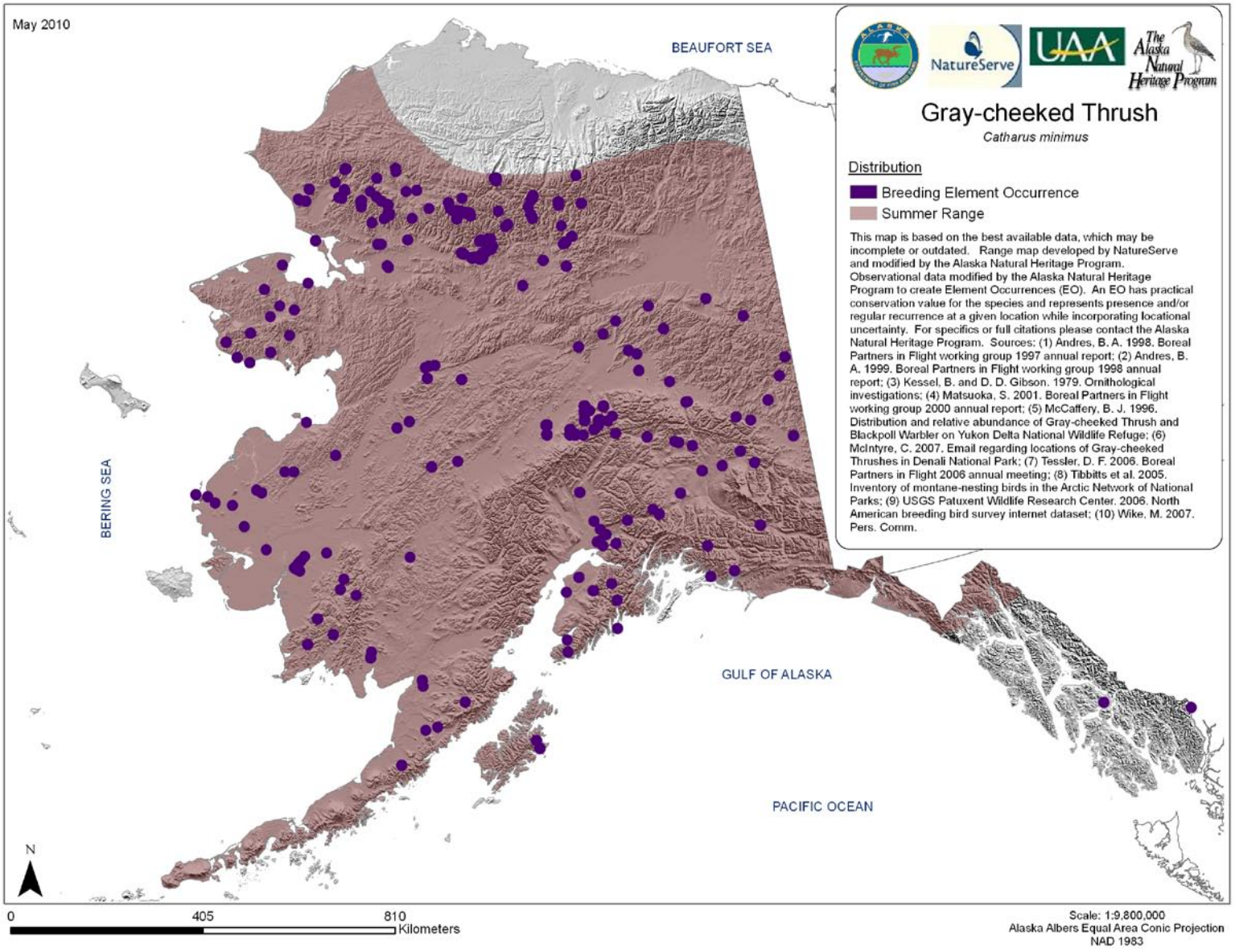

May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
BERING SEA
N
0 385 770
Kilometers
0 210 420
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Aleutian Tern
Onychoprion aleuticus
Distribution
Element Occurrence (Established Breeding Colony)
Element Occurrence (Breeding Season Observation)
Summer Range
Fall/Spring Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Baird, P. A. and R. A. Moe. 1978. Breeding biology of marine birds in Sitkalidak Strait area; (2) Byrd et al. 1974. The birds of Adak Island; (3) Connors, P. G. and R. W. Risebrough. 1979. Shorebird dependence on arctic littoral habitats; (4) Gill et al. 1981. Birds of north-central Alaska Peninsula; (5) Holtan, L. H. Aleutian Terns on the Copper River Delta; (6) Isleib, M. E. and B. Kessel. 1973. Birds of the north Gulf Coast-Prince William Sound region; (7) Kessel, B. and D. D. Gibson. 1978. Status and distribution of Alaska birds; (8) North, M. R. 1997. Aleutian Tern; (9) Nysewander, D. R. and D. B. Barbour. 1979. Breeding biology of marine birds in Chiniak Bay, Kodiak Island, 1975-1978; (10) USFWS. 2007. North Pacific seabird colony database; (11) Woodby, D. and G. Divoky. 1982. Birds use of coastal habitats in Norton Sound.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983

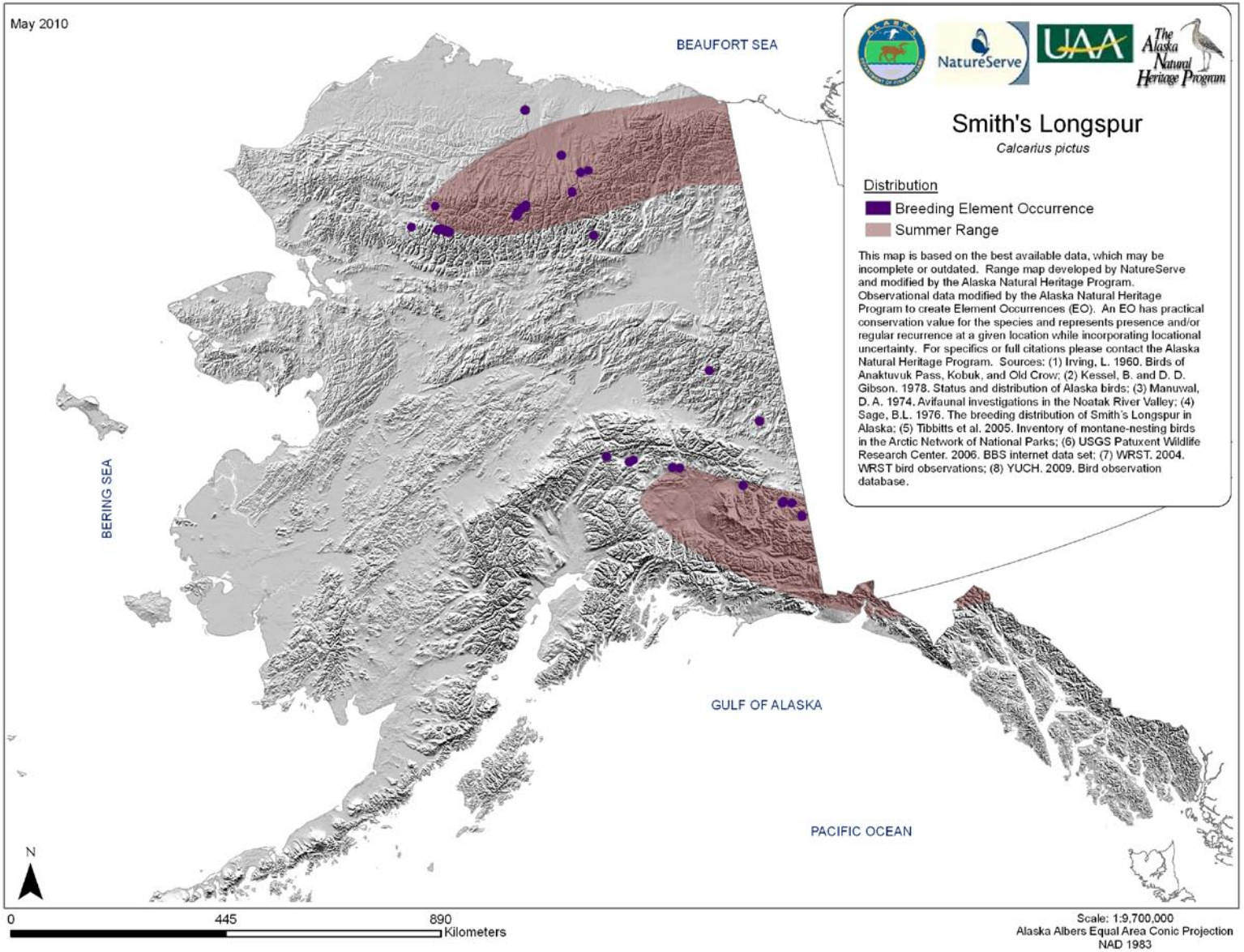

May 2010
NatureServe
UAA
The Alaska Natural Heritage Program
Marbled Murrelet
Brachyramphus marmoratus
Distribution
Breeding Element Occurrence (Nest Site)
Summer Range
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Carter, H. R. and M. L. Morrison (eds). 1992. Status and conservation of the Marbled Murrelet in North America; (2) Carter, H. R. and S. G. Sealy. 1987. Inland records of downy young and fledgling Marbled Murrelets in North America; (3) Day et al. 1983. Nest sites and eggs of Kittlitz's and Marbled Murrelets; (4) DeGange, A. R. 1996. A conservation assessment for the Marbled Murrelet in southeast Alaska; (5) MacIntosh, R. 1991. Letter to K. Kuletz; (6) Simons, T. R. 1980. Discovery of a ground-nesting Marbled Murrelet.
GULF OF ALASKA
BERING SEA
N
BERING SEA
PACIFIC OCEAN
0 210 420
Kilometers
0 280 560
Kilometers
Scale: 1:8,088,315
Alaska Albers Equal Area Conic Projection
NAD 1983

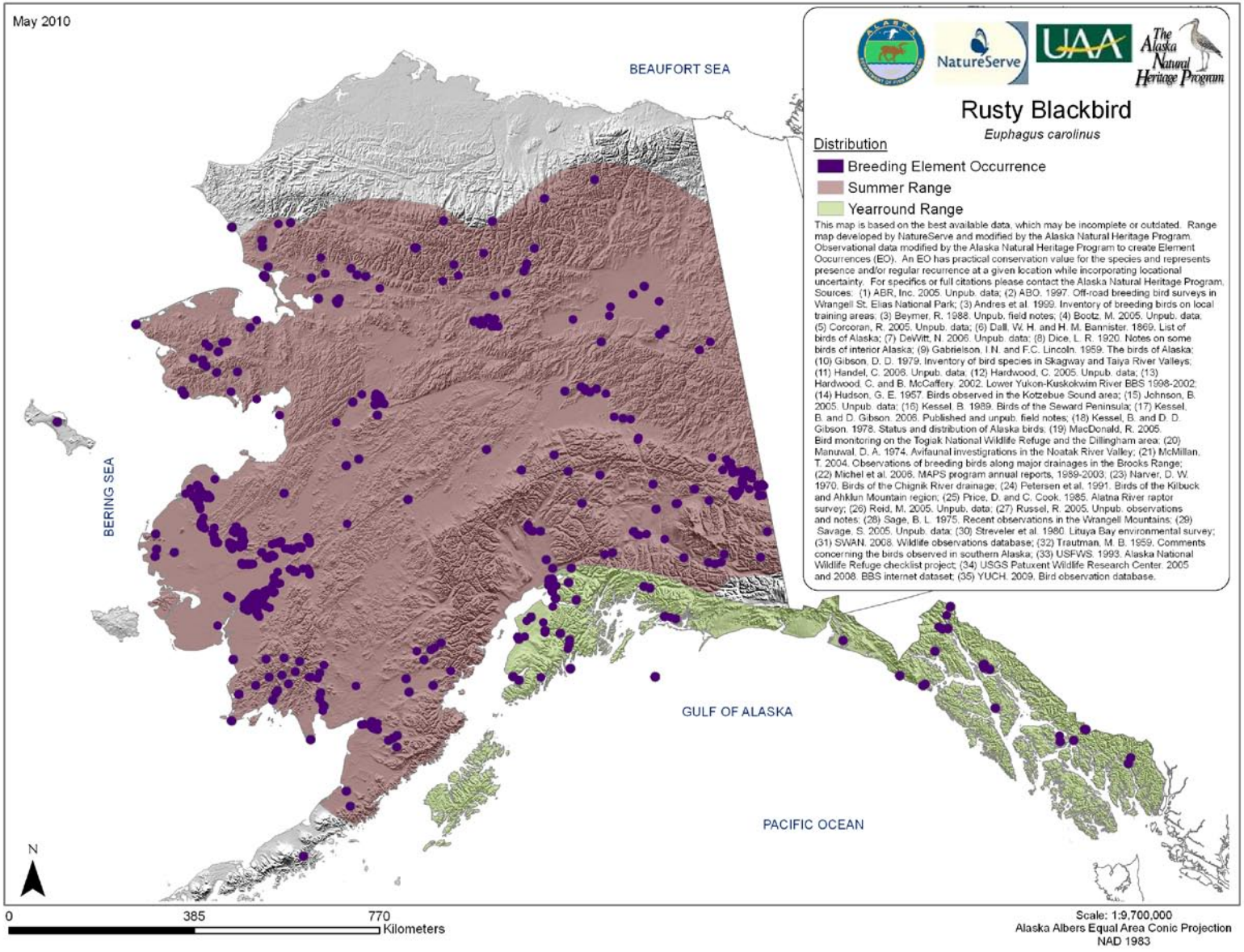

May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0 415 830 Kilometers
0 245 490 Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Kittlitz's Murrelet
Brachyramphus brevirostris
Distribution
Breeding Element Occurrence (Nest Site)
Wintering Element Occurrence (Concentration Area)
Summer Range
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program.
Sources: (1) Bailey, A. M. 1948. Birds of the arctic Alaska; (2) Bailey, E. P. and N. H. Faust. 1981. Summer distribution and abundance of marine birds and mammals between Mitrofania and Sutwick Islands; (3) Day, R. H. 1995. New information on Kittlitz's Murrelet nests; (4) Day, R. H. 1996. Nesting phenology of Kittlitz's Murrelet; (5) Day, R. H. and A. A. Stickney. 1996. Kittlitz's Murrelet surveys at remote Air Force sites in Alaska; (6) Day et al. 1983. Nest sites and eggs of Kittlitz's and Marbled Murrelets; (7) Fay, F. H. and T. J. Cade. 1959. An ecological analysis of the avifauna of St. Lawrence Island; (8) Ford, E. R. 1936. Kittlitz's Murrelet at Wales; (9) Fox, J. L. 1982. A Kittlitz's Murrelet nest in southeast Alaska; (10) Gabrielson, I. N. and F. C. Lincoln. 1959. The birds of Alaska; (11) Kaler, R. 2007. Email of map showing nest locations; (12) Kissling, M. 2006. Pers. Comm.; (13) Murphy et al. 1984. An inland nest record for the Kittlitz's Murrelet; (14) National Audubon Society. 2002. The Christmas bird count historical results; (15) Nelson, E. W. 1887. Birds of Alaska. (16) Piatt et al. 1999. Discovery of a new Kittlitz's Murrelet nest; (17) Romano et al. 2006. Historical and current distribution and abundance of Kittlitz's Murrelet in the Aleutian Islands; (18) Thayer, J. E. 1914. Nesting of the Kittlitz Murrelet; (19) Thompson et al. 1986. Discovery of the downy young of Kittlitz's Murrelet.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983

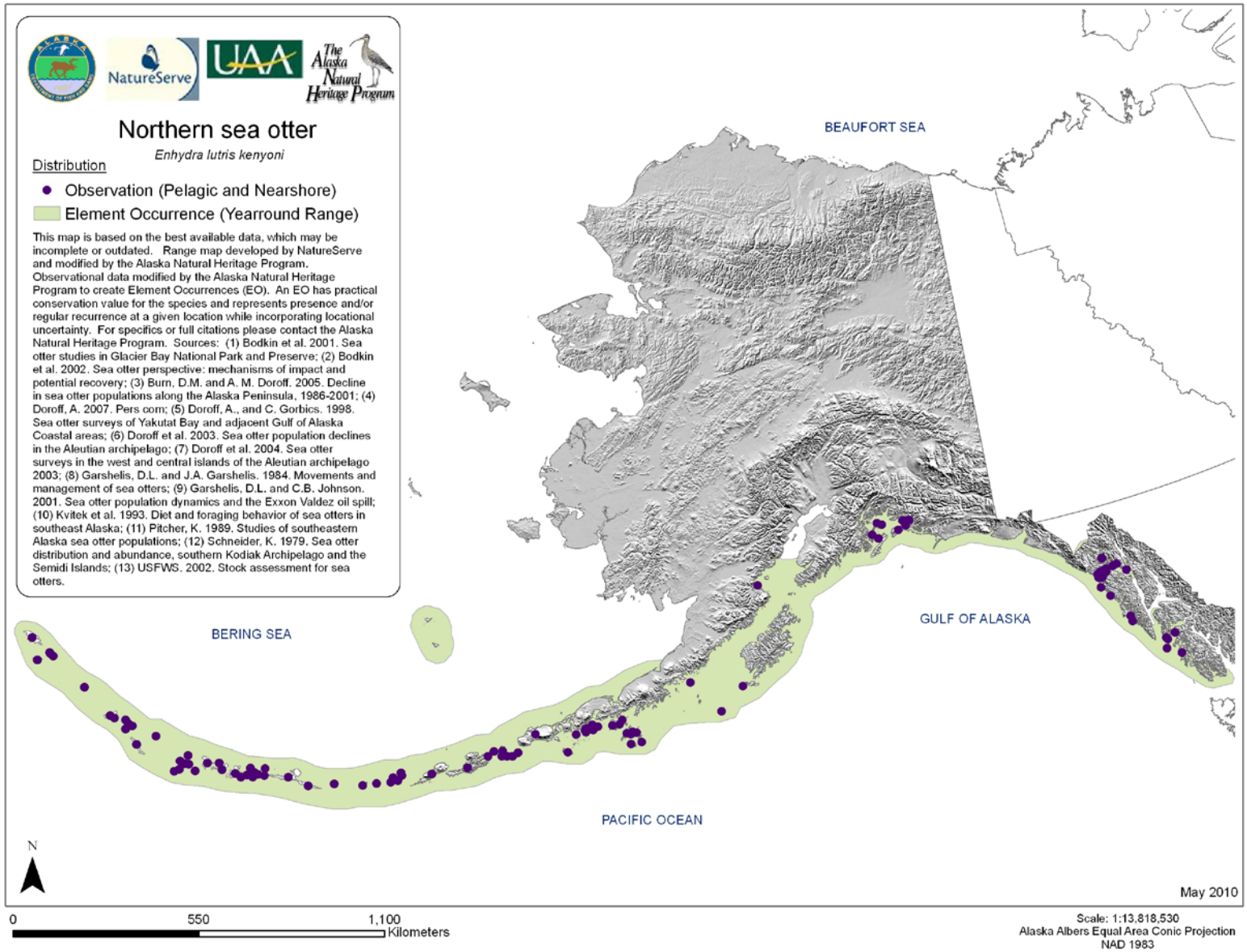

May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
NatureServe
UAA
The Alaska Natural Heritage Program
Snowy Owl
Bubo scandiacus
Distribution
Breeding Element Occurrence
Winter Range
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Bollinger et al. 2007. Western Alaska Yellow-billed Loon survey; (2) Dau, C. P. and W. W. Larned. 2007. Aerial population survey of Common Eiders and other waterbirds; (3) Mallek et al. 2007. Aerial breeding pair surveys of the arctic coastal plain of Alaska; (4) Winker et al. The birds of St. Matthew Island, Bering Sea.
N
0 440 880 Kilometers
0 300 600 Kilometers
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983

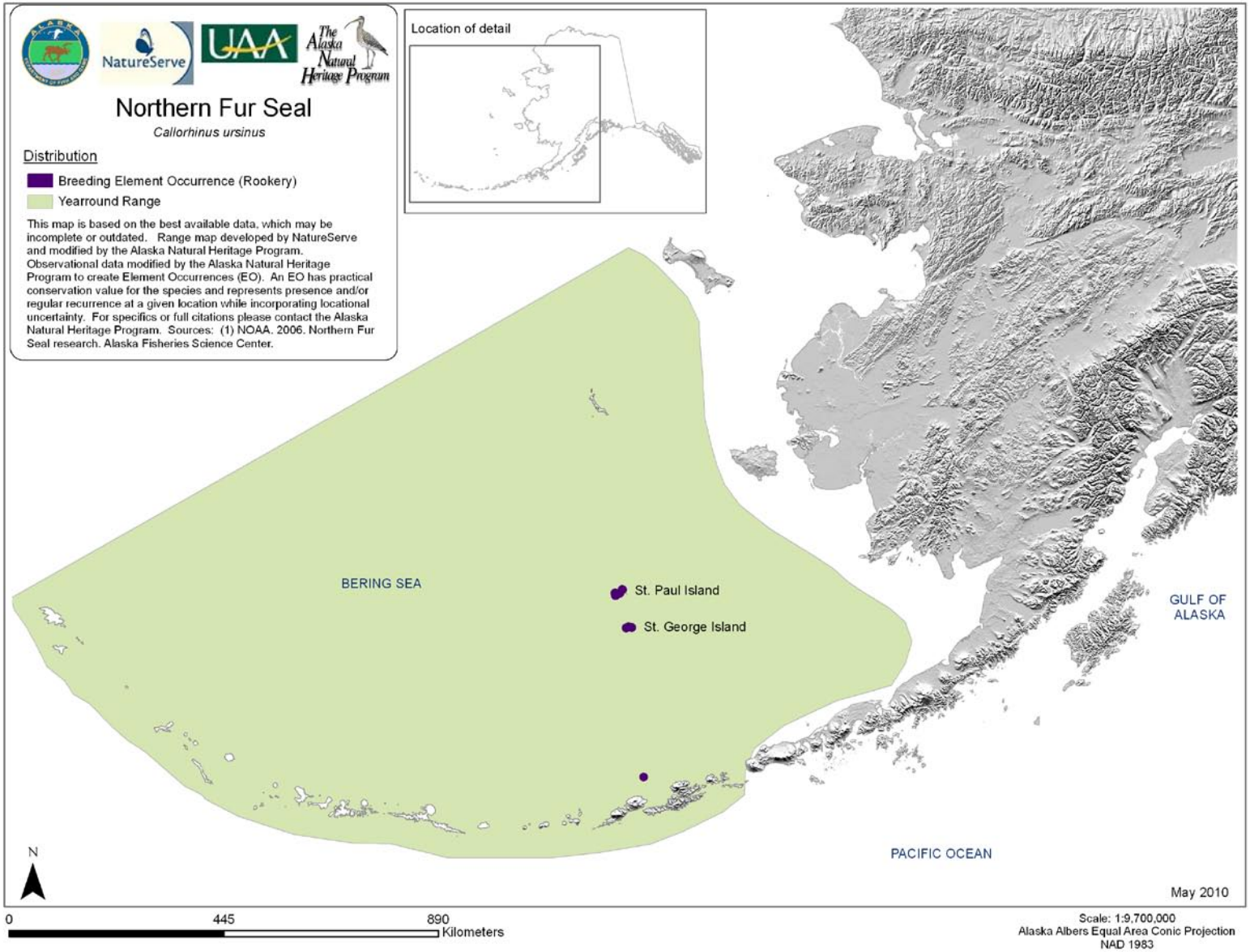

May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0
460
920
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Olive-sided Flycatcher
Contopus cooperi
Distribution
Breeding Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Andres, B. A. 2000. Boreal Partners in Flight working group 1999 annual report; (2) Arneson, P. D. 1982. Alaska breeding bird surveys 1982 summary; (3) Arneson, P. D. and N. Tankersley. 1984. Alaska breeding bird surveys 1984 summary; (4) Eskelin, T. and S. Starbird. 1999. Birds, small mammals, and other fish and wildlife in the proposed pipeline routes of Wolf Lake gas development project; (5) Kessel, B. and D. D. Gibson. 1978. Status and distribution of Alaska birds; (6) Tibbitts et al. 2005. Inventory of montane-nesting birds in the arctic network of National Parks; (7) USGS Patuxent Wildlife Research Center. 2006. North American breeding bird survey internet data set; (8) Wright, J. M. 1997. Preliminary study of Olive-sided Flycatchers.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983

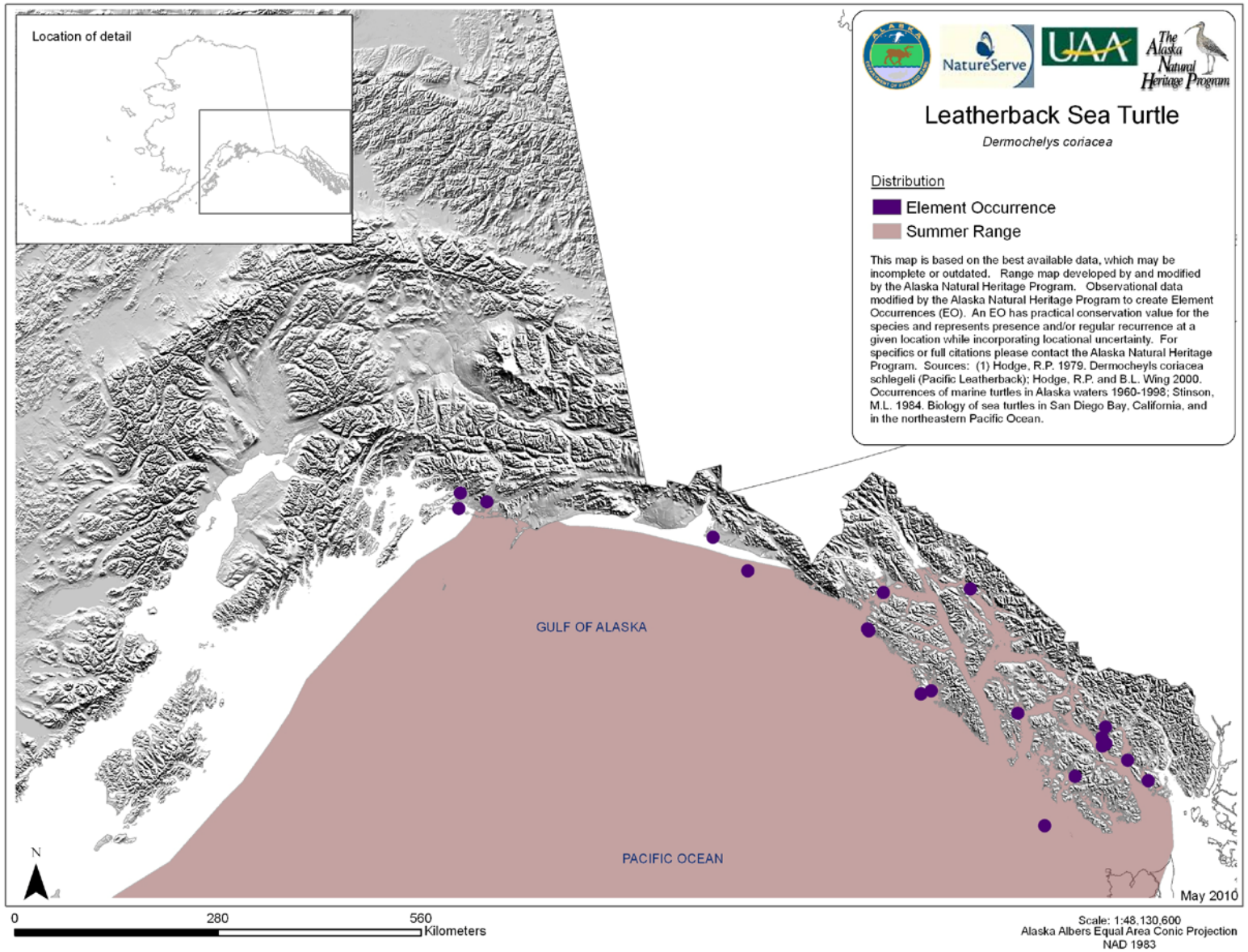

May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0
405
810
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Gray-cheeked Thrush
Catharus minimus
Distribution
Breeding Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Andres, B. A. 1998. Boreal Partners in Flight working group 1997 annual report; (2) Andres, B. A. 1999. Boreal Partners in Flight working group 1998 annual report; (3) Kessel, B. and D. D. Gibson. 1979. Ornithological investigations; (4) Matsuoka, S. 2001. Boreal Partners in Flight working group 2000 annual report; (5) McCaffery, B. J. 1996. Distribution and relative abundance of Gray-cheeked Thrush and Blackpoll Warbler on Yukon Delta National Wildlife Refuge; (6) McIntyre, C. 2007. Email regarding locations of Gray-cheeked Thrushes in Denali National Park; (7) Tessler, D. F. 2006. Boreal Partners in Flight 2006 annual meeting; (8) Tibbitts et al. 2005. Inventory of montane-nesting birds in the Arctic Network of National Parks; (9) USGS Patuxent Wildlife Research Center. 2006. North American breeding bird survey internet dataset; (10) Wike, M. 2007. Pers. Comm.
Scale: 1:9,800,000
Alaska Albers Equal Area Conic Projection
NAD 1983


May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0
445
890
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Smith's Longspur
Calcarius pictus
Distribution
Breeding Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Irving, L. 1960. Birds of Anaktuvuk Pass, Kobuk, and Old Crow; (2) Kessel, B. and D. D. Gibson. 1978. Status and distribution of Alaska birds; (3) Manuwal, D. A. 1974. Avifaunal investigations in the Noatak River Valley; (4) Sage, B.L. 1976. The breeding distribution of Smith's Longspur in Alaska; (5) Tibbitts et al. 2005. Inventory of montane-nesting birds in the Arctic Network of National Parks; (6) USGS Patuxent Wildlife Research Center. 2006. BBS internet data set; (7) WRST. 2004. WRST bird observations; (8) YUCH. 2009. Bird observation database.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983


May 2010
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
0
385
770
Kilometers
NatureServe
UAA
The Alaska Natural Heritage Program
Rusty Blackbird
Euphagus carolinus
Distribution
Breeding Element Occurrence
Summer Range
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program.
Sources: (1) ABR, Inc. 2005. Unpub. data; (2) ABO. 1997. Off-road breeding bird surveys in Wrangell St. Elias National Park; (3) Andres et al. 1999. Inventory of breeding birds on local training areas; (3) Beymer, R. 1988. Unpub. field notes; (4) Bootz, M. 2005. Unpub. data; (5) Corcoran, R. 2005. Unpub. data; (6) Dall, W. H. and H. M. Bannister. 1869. List of birds of Alaska; (7) DeWitt, N. 2006. Unpub. data; (8) Dice, L. R. 1920. Notes on some birds of interior Alaska; (9) Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska; (10) Gibson, D. D. 1979. Inventory of bird species in Skagway and Taiya River Valleys; (11) Handel, C. 2006. Unpub. data; (12) Hardwood, C. 2005. Unpub. data; (13) Hardwood, C. and B. McCaffery. 2002. Lower Yukon-Kuskokwim River BBS 1998-2002; (14) Hudson, G. E. 1957. Birds observed in the Kotzebue Sound area; (15) Johnson, B. 2005. Unpub. data; (16) Kessel, B. 1989. Birds of the Seward Peninsula; (17) Kessel, B. and D. Gibson. 2006. Published and unpub. field notes; (18) Kessel, B. and D. D. Gibson. 1978. Status and distribution of Alaska birds. (19) MacDonald, R. 2005. Bird monitoring on the Togiak National Wildlife Refuge and the Dillingham area; (20) Manuwal, D. A. 1974. Avifaunal investigations in the Noatak River Valley; (21) McMillan, T. 2004. Observations of breeding birds along major drainages in the Brooks Range; (22) Michel et al. 2006. MAPS program annual reports, 1989-2003; (23) Narver, D. W. 1970. Birds of the Chignik River drainage; (24) Petersen et al. 1991. Birds of the Kilbuck and Ahklun Mountain region; (25) Price, D. and C. Cook. 1985. Alatna River raptor survey; (26) Reid, M. 2005. Unpub. data; (27) Russel, R. 2005. Unpub. observations and notes; (28) Sage, B. L. 1975. Recent observations in the Wrangell Mountains; (29) Savage, S. 2005. Unpub. data; (30) Streveler et al. 1980. Lituya Bay environmental survey; (31) SWAN. 2006. Wildlife observations database; (32) Trautman, M. B. 1959. Comments concerning the birds observed in southern Alaska; (33) USFWS. 1993. Alaska National Wildlife Refuge checklist project; (34) USGS Patuxent Wildlife Research Center. 2005 and 2006. BBS internet dataset; (35) YUCH. 2009. Bird observation database.
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983


Northern sea otter
Enhydra lutris kenyoni
Distribution
Observation (Pelagic and Nearshore)
Element Occurrence (Yearround Range)
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Bodkin et al. 2001. Sea otter studies in Glacier Bay National Park and Preserve; (2) Bodkin et al. 2002. Sea otter perspective: mechanisms of impact and potential recovery; (3) Burn, D.M. and A. M. Doroff. 2005. Decline in sea otter populations along the Alaska Peninsula, 1986-2001; (4) Doroff, A. 2007. Pers com; (5) Doroff, A., and C. Gorbics. 1998. Sea otter surveys of Yakutat Bay and adjacent Gulf of Alaska Coastal areas; (6) Doroff et al. 2003. Sea otter population declines in the Aleutian archipelago; (7) Doroff et al. 2004. Sea otter surveys in the west and central islands of the Aleutian archipelago 2003; (8) Garshelis, D.L. and J.A. Garshelis. 1984. Movements and management of sea otters; (9) Garshelis, D.L. and C.B. Johnson. 2001. Sea otter population dynamics and the Exxon Valdez oil spill; (10) Kvitek et al. 1993. Diet and foraging behavior of sea otters in southeast Alaska; (11) Pitcher, K. 1989. Studies of southeastern Alaska sea otter populations; (12) Schneider, K. 1979. Sea otter distribution and abundance, southern Kodiak Archipelago and the Semidi Islands; (13) USFWS. 2002. Stock assessment for sea otters.
BEAUFORT SEA
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
N
May 2010
0
550
1,100
Kilometers
Scale: 1:13,818,530
Alaska Albers Equal Area Conic Projection
NAD 1983


NatureServe
UAA
The Alaska Natural Heritage Program
Northern Fur Seal
Callorhinus ursinus
Distribution
Breeding Element Occurrence (Rookery)
Yearround Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by NatureServe and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) NOAA. 2006. Northern Fur Seal research. Alaska Fisheries Science Center.
Location of detail
BERING SEA
St. Paul Island
St. George Island
GULF OF ALASKA
PACIFIC OCEAN
N
0
445
890
Kilometers
May 2010
Scale: 1:9,700,000
Alaska Albers Equal Area Conic Projection
NAD 1983


Location of detail
NatureServe
UAA
The Alaska Natural Heritage Program
Leatherback Sea Turtle
Dermochelys coriacea
Distribution
Element Occurrence
Summer Range
This map is based on the best available data, which may be incomplete or outdated. Range map developed by and modified by the Alaska Natural Heritage Program. Observational data modified by the Alaska Natural Heritage Program to create Element Occurrences (EO). An EO has practical conservation value for the species and represents presence and/or regular recurrence at a given location while incorporating locational uncertainty. For specifics or full citations please contact the Alaska Natural Heritage Program. Sources: (1) Hodge, R.P. 1979. Dermocheyls coriacea schlegeli (Pacific Leatherback); Hodge, R.P. and B.L. Wing 2000. Occurrences of marine turtles in Alaska waters 1960-1998; Stinson, M.L. 1984. Biology of sea turtles in San Diego Bay, California, and in the northeastern Pacific Ocean.
GULF OF ALASKA
PACIFIC OCEAN
N
May 2010
0
280
560
Kilometers
Scale: 1:48,130,600
Alaska Albers Equal Area Conic Projection
NAD 1983

Appendix III. NatureServe global (G ranks) and state (S ranks) conservation status rank definitions. Global ranks reflect an assessment of the condition of the species across its entire range. State ranks reflect an assessment of the condition of the species across its state range.

Rank	Definition
GX / SX	**Presumed Extinct** (species)— Not located despite intensive searches and virtually no likelihood of rediscovery.
GH / SH	**Possibly Extinct** (species)— Missing; known from only historical occurrences but still some hope of rediscovery.
G1 / S1	**Critically Imperiled**—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 / S2	**Imperiled**—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 / S3	**Vulnerable**—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4 / S4	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5 / S5	**Secure**—Common; widespread and abundant.

Variant Ranks

Rank	Definition
G#G#	**Range Rank**—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. A G2G3 rank would indicate that there is a roughly equal chance of G2 or G3 and other ranks are much less likely. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
GNR	**Unranked**—Global rank not yet assessed.
GNA	**Not Applicable**—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

Rank Qualifiers

Rank	Definition
?	**Inexact Numeric Rank**—Denotes some uncertainty about the numeric rank (e.g. G3? - Believed most likely a G3, but some chance of either G2 or G4).
Q	**Questionable taxonomy**—Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.
C	**Captive or Cultivated Only**—At present extant only in captivity or cultivation, or as a reintroduced population not yet established.