EVIDENCE TO SUPPORT A BOUNDARY EXPANSION OF THE NISQUALLY DELTA IMPORTANT BIRD AREA TO INCLUDE THE SHORES AND BLUFFS OF ANDERSON ISLAND, WASHINGTON

By

Lindsay K. Raab

A Thesis:
Submitted in partial fulfillment
of the requirements for the degree
Master of Environmental Studies
The Evergreen State College
September 2010

This Thesis for the Master of Environmental Studies Degree

By

Lindsay K. Raab

has been approved for

The Evergreen State College

by

Alison Styring, Ph. D.
Member of the Faculty

Gerardo Chin-Leo, Ph. D
Member of the Faculty

Donald E. McIvor, M. S.
Science Coordinator, Audubon Washington

September, 2010

ABSTRACT

EVIDENCE TO SUPPORT A BOUNDARY EXPANSION OF THE NISQUALLY DELTA IMPORTANT BIRD AREA TO INCLUDE THE SHORES AND BLUFFS OF ANDERSON ISLAND, WASHINGTON

Located in the southern Puget Sound region, the Nisqually Delta Important Bird Area (IBA) encompasses 1,625 ha of land with habitats ranging from estuarine, freshwater, grassland and riparian zones. The area is an important stopover point on the Pacific Flyway migration route, and concentration of birds can reach over 9,000 during winter months. The current boundary of the Nisqually Delta IBA supports a high diversity of birds, particularly dabbling ducks. The purpose of this research was to determine if the boundary of the current IBA should be extended to include the shoreline and high bluffs of nearby Anderson Island.

In order to be designated as an IBA by the State IBA Technical Committee of Audubon Washington, an area must meet one or more of the following Criteria: 1) A site supports large concentrations of species of conservation concern, or supports several species of conservation concern in substantial numbers; 2) A site for species assemblages associated with a representative, rare or threatened natural habitat; 3) Long-term avian monitoring occurs in the area; 4) Species of conservation concern congregate in the area while breeding, or during migration or winter. Methods used to study this potential IBA boundary expansion consisted of a trial Christmas Bird Count on Anderson Island, Puget Sound Seabird Surveys from two sites on the island, and data collection and analysis from various sources such as Washington Department of Natural Resources and Washington Department of Fish and Wildlife.

This study supported an expansion of the current Nisqually Delta IBA with support for all four Crieria. The expansion request mirrored the proposed Nisqually Reach Aquatic Reserve boundary that includes the shores and bluffs of Anderson Island and other shorelines in the vicinity, as well the deep waters of the Reach. An extended IBA would provide overall ecological connectivity of relatively pristine and representative habitats including high bluffs, tidal flats, salt marshes and deep waters. It would encompass riparian, estuarine and nearshore habitats, all vital to growing and migrating juvenile salmonids such as Federally listed Chinook salmon (*Oncorhynchus tshawytscha*). Due to ample food supply and diverse, relatively undisturbed aquatic habitats, an extended IBA would support a higher diversity of bird species, particularly diving ducks, alcids, grebes and loons. The area within the proposed extended boundary appears to be particularly important to several species of conservation concern. The significant amount of high bluffs provides prime nesting habitat for Pigeon Guillemots (*Cepphus columba*). Surf Scoters (*Melanitta perspicillata*) are common to the area, perhaps due to the abundant food sources such as Pacific herring (*Clupea pallasi)*. Marbled Murrelets (*Brachyramphus marmoratus*) have been documented in parts of the area, theoretically using the Nisqually River as a corridor between potential nesting grounds at Mount Rainer National Park and foraging waters of southern Puget Sound. In conclusion, an expanded IBA, albeit non-regulatory, would officially recognize and further protect important aquatic bird habitats within the Nisqually Reach region.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would especially like to thank my advisor, Alison Styring, whose love for birds intrigued me in the first place. I am so glad that Alison sought me out when she first learned about this project one year ago, as it is now very special to me. She has assisted me with seabird identification, helped me though methodology of ornithological field work, and supported me throughout the research and writing process for this thesis. I am also very grateful for the guidance of my other thesis readers Gerardo Chin-Leo and Don McIvor. During the revision process, Gerardo asked me lots of questions that helped me think differently about some of my content. He also provided excellent advice on the organization of this paper. Don was a steadfast supporter throughout this entire year-long project. From day one, he was teaching me about Important Bird Areas and was always available and willing to answer my questions. His revisions in the end encompassed big picture questions as well as small details. I deeply appreciate all his time and support. I would also like to thank Jerry Johannes, naturalist and resident of Anderson Island. It was Jerry who originally came up with the hypothesis for an extended Nisqually Delta Important Bird Area and he was continuously full of information that greatly supported this project.

I am also full of gratitude for the consistent field assistance from my research partners Govinda Rosling and Maureen Thompson. I simply could not have done the Puget Sound Seabird Surveys without them. I'd also like to thank Tahoma Audubon members Diane Yorgason-Quinn and Faye McAdams Hands, Evergreen students Samantha Sadosky and Jeff Anderson (and his wife Laura), and Anderson Island residents Ann Dasch, Carol Paschal and Jane Groppenberger for the company and assistance during various field work days throughout this project.

I would also like to thank the following people for the consistent support throughout my research: Krystal Kyer, Tahoma Audubon; Adam Sedgely, Seattle Audubon; Kelley Turner, US Geological Survey; Jean Takekawa, Nisqually National Wildlife Refuge, Phil Kelley, Black Hills Audubon, Joe Evenson, Washington Department of Fish and Wildlife (WDFW), Kyle Murphy, Washington Department of Natural Resources (DNR); Betty Bookheim, Washington DNR; Michael Grilliot, former intern at Washington DNR; Daniel Hull, Nisqually Reach Nature Center; Art Wang, Tahoma Audubon; Scott Pearson, WDFW; John Pierce, WDFW; Sarah Garmire, Anderson Island; Mason Reid, Mount Rainer National Park, and John Richardson, Joint Base Lewis-McChord.

And finally, I'd like to express my deepest gratitude toward my family and friends for their much needed and constant support from the beginning to the end of this study. Mom, Dad, Erin, Marie, Rachel, Christina, Cathy, Kathleen- thank you for your patience, encouragement and love that saw me through the completion of this thesis.

INTRODUCTION

Like many conservation programs, the Important Bird Area (IBA) program focuses specifically on recognizing and conserving prime bird habitat. Birdlife International initiated the IBA program in Europe in 1985, and Audubon Society in the US adopted it in 1995 (Wells et al., 2005). The IBA program's main purpose is to identify, conserve and monitor critical bird habitat. It is a place-based conservation initiative that aims to recognize the top 10% of prime bird habitat. It takes a proactive approach by supporting not only rare and endangered species and habitat, but non-endangered species and habitat as well (D. McIvor, Audubon Washington, Science Coordinator, personal communication, September 24, 2009). Once these priority bird habitats have been identified, the IBA program helps ensure proper management and monitoring of bird habitat and populations (Wells et al., 2005). Land designated as an IBA provides refuge for birds during vital life processes such as breeding, migrating and wintering (Cullinan, 2001). In order to be designated as an IBA, an area must meet one or more of the following four criteria listed in *Important Bird Areas in Washington: Criteria for Site Selection* (Audubon Washington, 2008):

1. "Sites supporting significant populations of species of conservation concern in Washington . . . includes sites that have the largest concentrations of these species or those with several of these species present in substantial numbers" (relative to overall numbers in Washington and species range; p. 2). In order to define significant populations, different thresholds are listed for each species of conservation concern.

2. "Sites for species assemblages associated with a representative, rare or threatened natural community type in Washington" (p. 4). Sixteen community types are listed as representative, rare or threatened.

3. "Sites important for long-term avian research or monitoring" (p. 6). Long term is considered 10 years or more. This criterion is a contributor; it cannot be the sole criterion for justifying an IBA designation (D. McIvor, personal communication, September 24, 2009).

4. "Sites where birds regularly concentrate in significant numbers when breeding or during migration or winter" (p. 6). This criterion is broken down into several different scenarios with thresholds depending on the type of birds the area holds.

The purpose of this work was to determine if the boundary of the Nisqually Delta IBA should be extended to include the shores and bluffs of Anderson Island, Washington. The area in the extended boundary must meet one or more criteria of a state-level IBA in order to justify a

request to the Washington State IBA Technical Committee to expand the boundaries of the current Nisqually IBA (Fig. 1). Anyone can nominate an IBA to the Committee. The process involves data collection, research and a considerable amount of paperwork. If it is accepted at the state-level, it will be further assessed to determine if it should be considered an IBA at a continental or global level (D. McIvor, personal communication, September 24, 2009). See Appendix A for the letter that was sent by the author to the Committee on September 3, 2010.

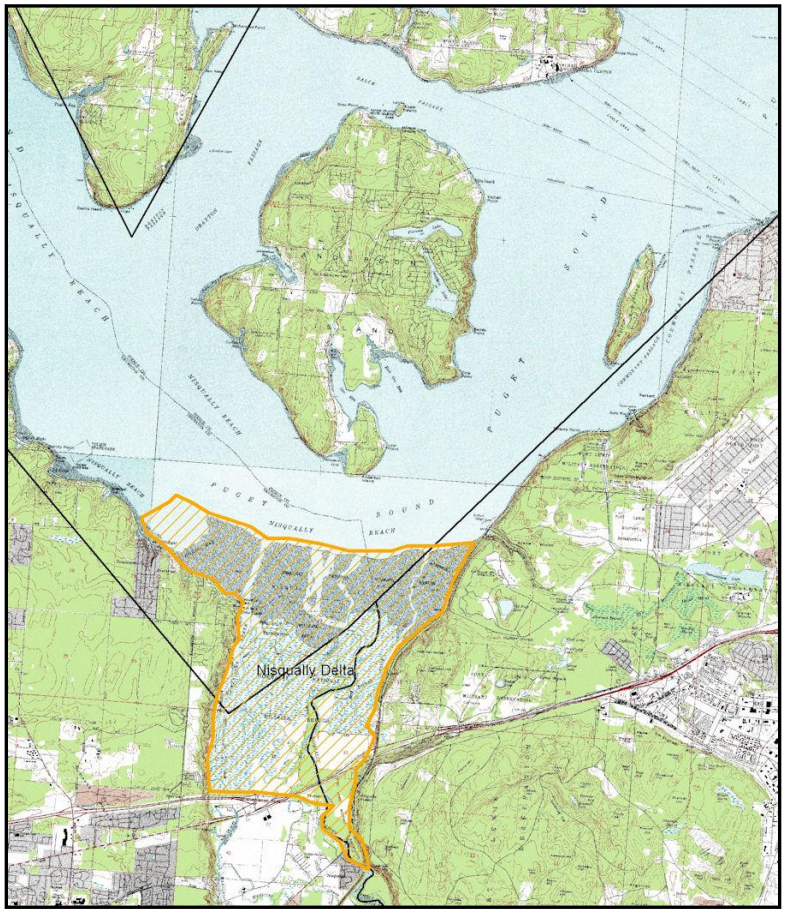


Fig. 1. The current boundary of the Nisqually Delta IBA, highlighted in orange (McIvor, 2009).

Important Bird Areas in Washington

In 1997, Audubon Washington partnered with Washington Department of Fish and Wildlife (WDFW) to initiate state-level IBAs in Washington (Cullinan, 2001). Currently, there are 74 IBAs in Washington located on both public and private lands (Fig. 2; Audubon Washington, 2010). Both aquatic and terrestrial IBAs are represented, and habitat types range from grassland or coniferous forest to brackish marsh or marine waters. Each IBA site will

ultimately have its own conservation management plan written specifically for its habitat and anthropogenic threats (Cullinan, 2001).

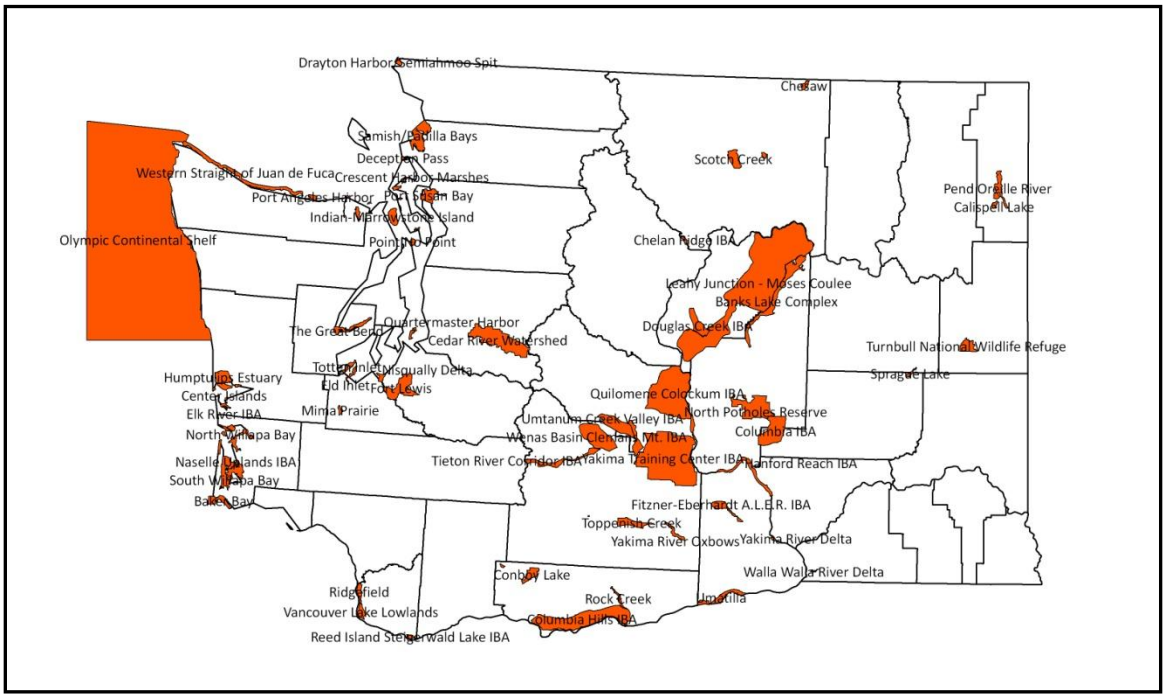


Fig. 2. Washington's 74 Important Bird Areas, highlighted in orange (McIvor, 2009).

Nisqually Delta Important Bird Area

The Nisqually Delta IBA is located in Thurston County and was designated as an IBA in 2001, nominated by Audubon Society Member Lisa Godina of Olympia, Washington (Godina, 2001; Cullinan, 2001). The 1,625 ha IBA includes estuarine, freshwater and saltwater marshes, non-native grassland, and riparian habitat types, and boasts over 9,000 waterfowl during fall migration (US Fish and Wildlife Service et al., 2010; Cullinan, 2001). The area is especially important for a variety of wintering waterfowl, seabirds, wading birds, and shorebirds. Wintering Dunlins (*Calidris alpina*) use the tideflats, and breeding Band-tailed Pigeons (*Patagioenas fasciata*) are attracted to the mineral springs in the area. Ninety percent of the site is managed for conservation and wildlife-related recreation, and is within the Nisqually National Wildlife Refuge (NWR), Nisqually State Wildlife Area and some tribal and private lands (Cullinan, 2001).

The Nisqually Delta IBA has gone through many changes within the last few years. Implementation of the Nisqually NWR Comprehensive Conservation Plan (CCP) began in 2009 and will continue over the next 15 years (see Appendix B for a map of the plan; US Fish and Wildlife Service, 2005). This restoration project will return the area to its historic, natural state of mainly estuary and floodplains, and is the largest tidal marsh restoration project in the Pacific

Northwest. The main goals of the CCP were to reconstruct the dike system to restore more than 70% of the diked area for estuarine habitat with tidal flow and salt water marshes, restore and enhance the remaining freshwater and riparian habitats, and expand the Refuge to over double its current size. In October 2009, the removal of the long-standing Brown Farm Dike inundated roughly 300 ha of the Refuge. Water level, salinity and temperature are carefully monitored (US Fish and Wildlife Service et al., 2010). The habitat changes are expected to positively impact many species, particularly juvenile salmonids, such as Federally listed Chinook salmon (*Oncorhynchus tshawytscha*) that spend about a month in the estuary growing and acclimating to salt water before migrating to open sea (Ellings & Hodgson, 2007). A post restoration fish study has been initiated, led by the Nisqually Indian Tribe (US Fish and Wildlife Service, 2005; J. Takekawa, Nisqually NWR Manager, personal communication, August 18, 2010).

Many different groups participate in avian monitoring in the Nisqually IBA. US Geological Service (USGS) staff have been performing annual and monthly surveys for the past year (K. Turner, USGS Restoration Biologist, personal communication, July 21, 2010). Students and other citizen scientists have surveyed Luhr Beach for the past three years (Hull, 2008). Migratory Bird Division of US Fish and Wildlife Service staff also performs an annual winter waterfowl survey in the Refuge each January. Nisqually NWR staff has been monitoring bird populations using aerial surveys since 1975. Some species, such as wigeons and grebes, have declined in recent years (US Fish and Wildlife Service, 2005; J. Takekawa, personal communication, July 30, 2010). A colony of nesting Great Blue Herons (*Ardea herodias*) was at a maximum of 101 nests in 1994, yet have dropped to as low as just three nests in 2001, likely due to eagle predation. Gulls have also declined slightly in recent years, perhaps due to a nearby landfill closure in 2000. Other species, such as geese, terns and cormorants appear to fluctuate from year to year (US Fish and Wildlife Service, 2005).

The 2009 dike removal is expected to positively impact many bird species, particularly waterfowl that tend to prefer estuarine areas, such as America Wigeon (*Anas americana*), Northern Pintail (*Anas acuta*), Green-winged Teal (*Anas crecca*) and Northern Shoveler (*Anas clypeata*). Although the comparison of bird density between pre and post-dike removal is hard to derive from Fig. 3 below, it is clear that the site hosts a large number and diversity of birds, particularly dabbling ducks. Phil Kelly, avid birder and field trip leader of Black Hills Audubon Society and Washington Ornithological Society, leads weekly bird walks at the Nisqually NWR. In his opinion, waterfowl numbers are up and raptor numbers are down since the dike removal.

However his observations are only from this past year, and long-term trends are unclear at this point (P. Kelly, personal communication, June 23, 2010).

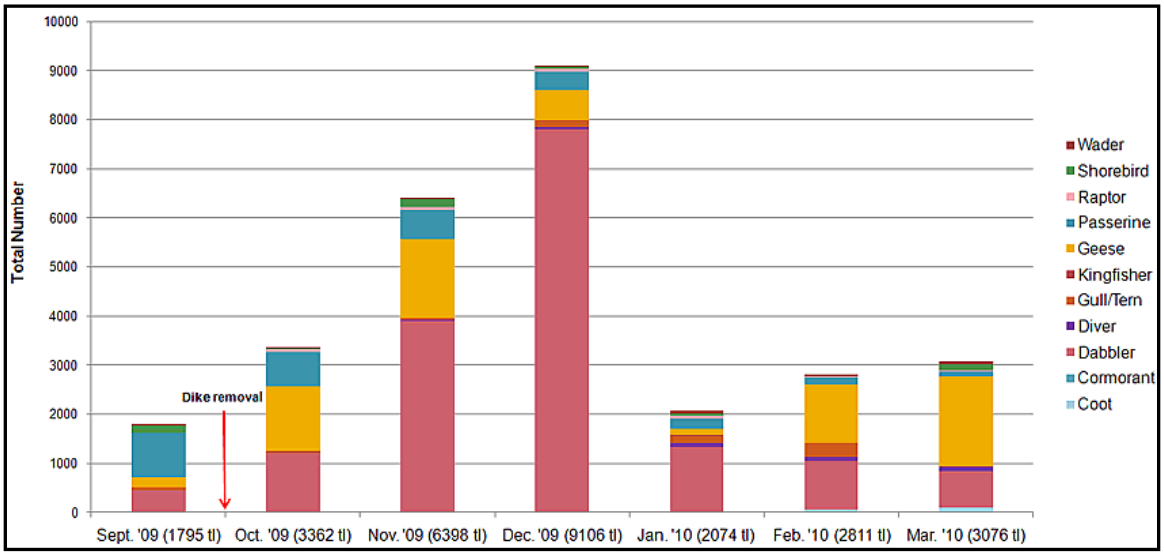


Fig. 3. Cumulative percent of foraging guilds detected during pre and post-Brown Farm dike removal bird surveys at the Nisqually National Wildlife Refuge (US Fish and Wildlife Service et al., 2010).

Proposed Nisqually Reach Aquatic Reserve

Part of the Nisqually Delta IBA lies within the boundary of a proposed aquatic reserve for the Nisqually Reach. The overall goal of the Aquatic Reserves Program is to identify, protect and enhance Washington State's aquatic resources. The Program was initiated by Washington Department of Natural Resources (DNR) in 2002 in order to designate state-owned aquatic ecosystems with native and unique habitats and species for increased site-based protection and conservation management (Bloch & Palazzi, 2005). Sites must meet specific ecological criteria, such as presence of priority species such as Killer whale (*Orcinus orca*), Olympia oyster (*Ostrea lurida*) and Marbled Murrelet (*Brachyramphus marmoratus*). The method for evaluating a site for aquatic reserve status is a multi-step, lengthy process that includes nomination of a site, DNR review, development of a management plan, State Environmental Policy Act review, and a final decision by the Commissioner of Public Lands. DNR has no regulatory control over the state's aquatic resources, and therefore partnerships are formed with local tribes, WDFW and other interested parties to enforce or encourage actions developed out of site-specific management plans. Examples of DNR-managed activities include consulting on low-impact community dock construction, insertion of mooring buoys, and monitoring and research of wildlife (Bloch & Palazzi, 2005).

Daniel Hull, Executive Director of the Nisqually Reach Nature Center (NRNC) submitted the aquatic reserve proposal application to Washington State DNR in 2008. Currently NRNC and other partners such as the Nisqually Indian Tribe and Nisqually NWR are drafting an aquatic reserve management plan that will help ensure protection of roughly 7,000 ha of state-owned aquatic lands (as reviewed by Hull, 2008). The draft management plan is scheduled to be finalized by the end of summer 2010, and will then go through the State Environmental Policy Act public review process. A decision on the aquatic reserve designation of the site will likely be made sometime in September or October, 2010 (K. Murphy, Washington DNR Aquatic Reserves Program Manager, personal communication, July 14, 2010). The proposal is justified by the relatively undeveloped and unarmored shorelines, abundant marine vegetation, variable sized sediment from silt to cobble, depth strata ranging from intertidal to over 600 feet, and the mix of freshwater, estuarine and marine habitats, allowing for high biodiversity of life (Appendices C-F; as reviewed by Hull, 2008). The proposed aquatic reserve boundary would ecologically connect the Nisqually estuary to the surrounding nearshore habitat, both vitally important for juvenile salmon species in the area (Ellings & Hodgson, 2007).

The Nisqually Reach Aquatic Reserve Program Technical Advisory Committee recommended that the aquatic reserve designation in the Nisqually Reach of Thurston and Pierce Counties (that partially overlaps the current Nisqually Delta IBA) should stretch from the shoreline of Tolmie State Park across Puget Sound to the south shoreline of McNeil Island to the eastern shoreline south of Steilacoom, bordered on the south by the Nisqually NWR, and on the west by the shoreline where the NRNC is located, north to the State Park. The aquatic reserve boundary would extend upstream in the Nisqually River and McAllister Creek and would also include the shorelines of Anderson, Eagle and Ketron Islands and the deep waters of Nisqually Reach (Van Cleve et al., 2009a; as reviewed by Hull, 2008). The legal description is pending survey completion by Washington DNR (K. Murphy, personal communication, July 27, 2010). Multiple entities own the land in the proposed boundary (Fig. 4) and land uses of the area include wildlife conservation, recreation, fishing, hunting, aquaculture, and residential (as reviewed by Hull, 2008; Godina, 2001).

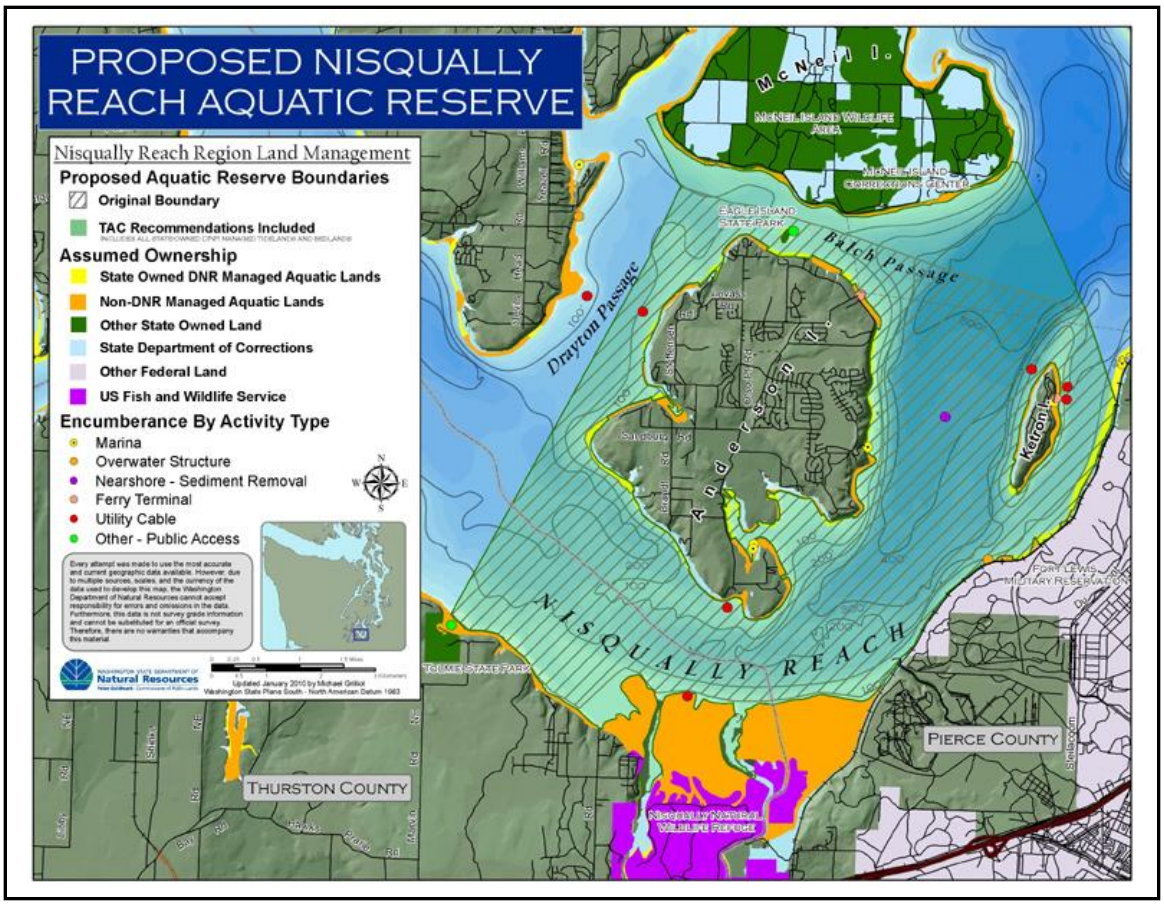


Fig. 4. Land use and management of the Nisqually Reach Region (Grilliot, 2010).

Status of Puget Sound Ecosystem

The Nisqually Reach is a small fraction of "Puget Sound country" which in its entirety spans 10,000 square miles, and hosts a high diversity of life (Fig. 5; Kruckeberg, 1991; pg. xvii). The actual waters of the Puget Sound range about 2,000 square miles (Nysewander et al., 1993) and are bordered by the Cascade Mountains to the east, Olympic Mountains to the west; Frasier River delta to the north, and low hills to the south. The 2,000-mile-long shoreline, surrounded by forest and dominated by steep cliffs, is home to many plants, animals and humans alike (Kruckeberg, 1991).

The human population of Puget Sound has grown over time, and is projected to continue to grow. In 1960, the population of the 12 counties that make up the Puget Sound region was about 1.8 million people. By 2008, that number had increased to 4.4 million. Population of the Puget Sound region is projected to reach 5.1 million by 2020 (Office of Financial Management, State of Washington, 2009). Largely due to anthropogenic influences, the Puget Sound ecosystem is currently in a state of disarray. According to a 2008 Water Quality Assessment, only 30% of

Washington's water bodies are up to standards (Susewind, 2008) and over 500 streams, lakes and rivers across the Puget Sound region are impaired. Hundreds of species are of conservation concern, mainly due to the millions of pounds of toxic contaminants entering the Sound each year (Department of Ecology, State of Washington, 2010; Washington Department of Fish and Wildlife, 2010). In response to major threats to the ecosystem, several initiatives such as the Puget Sound Partnership, Coalition to Protect Puget Sound Habitat, and People for Puget Sound have formed with a goal to clean up and restore the habitats within Puget Sound by 2020. With the elimination of pollutants entering the Sound, halt of destruction of natural habitats, and increased stewardship and monitoring to promote ecological sustainability, this goal is attainable (People for Puget Sound, 2010).

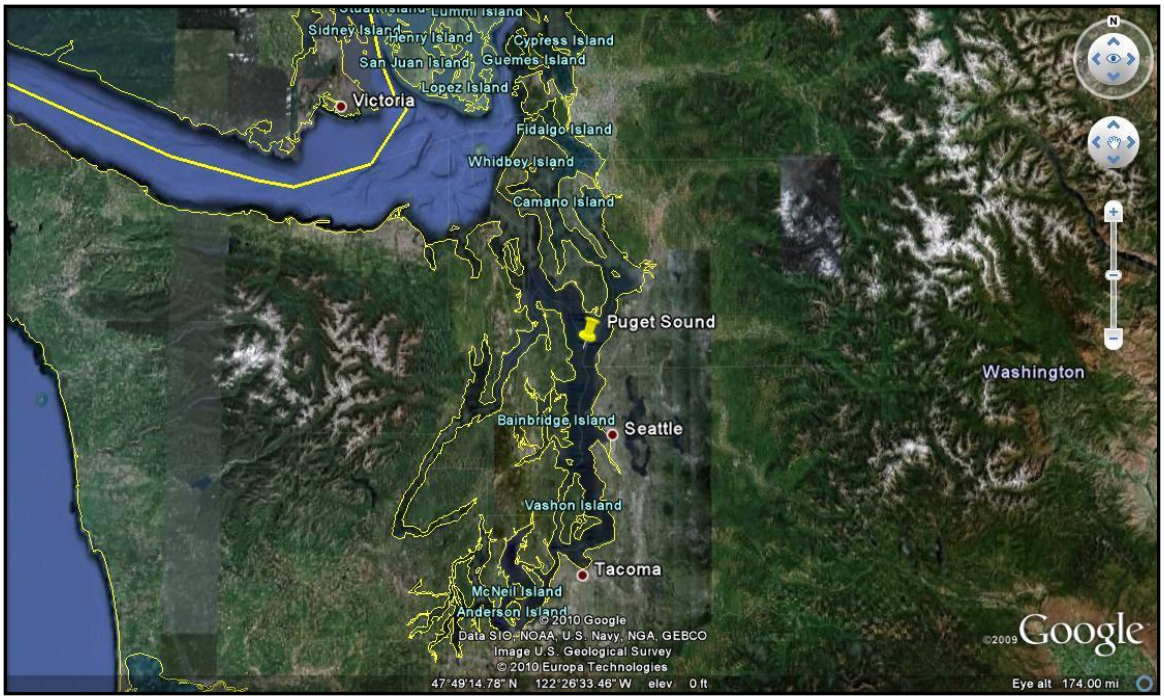


Fig. 5. Puget Sound, Washington State (Google, 2010).

Evidence for Birds at Risk in Puget Sound

Overall marine bird populations have declined in the Puget Sound region in the past 25 years (Nysewander et al., 2005a). Protection of critical bird habitat is necessary to sustain certain Puget Sound bird populations, such as Pigeon Guillemot (*Cepphus columba)*, Marbled Murrelet (*Brachyramphus marmoratus*) and Surf Scoter (*Melanitta perspicillata*). Puget Sound is one of the most important wintering areas for migratory birds in the Pacific Northwest (Wahl et al., 1981) and aids as an important resting point on the Pacific Flyway migration route (US Fish and

Wildlife Service, 2005). Waterfowl, shorebirds, wading birds, raptors and pelagic seabirds are particularly vulnerable due to major threats posed on wetlands (Hancock, 1984).

Wetlands are particularly prone to threats such as development, fragmentation, dredging and overexploitation (Groom et al., 2006; Hancock, 1984). Urban sprawl threatens Puget Sound wetland habitats as the population continues to rise. Benthic ecosystems are likely physically disturbed when activities such as dredging occur. Further, ecosystems under or near dredged material disposal sites may experience many deleterious effects such as habitat burial or toxic contamination (as reviewed by Hull, 2008). Aquaculture may impact fish and invertebrate species numbers, habitats, and ecosystem processes through physical disturbance and overexploitation. Therefore, marine birds are threatened by restricted food supply and potential change in migratory patterns (as reviewed by Hull, 2008). Habitat loss, fragmentation and destruction are primary reasons for population declines in waterbirds (Parnell et al., 1988). Other anthropogenic effects such as human disturbance, pollutants in water, accidental by-catch, plastic ingestion, and oil spills also largely threaten waterbird populations (Good et al., 2009; Petry & Fonseca, 2002; and as reviewed by Carney & Sydeman, 1999).

Anderson Island

Anderson Island is a small island of less than 2,400 ha with a relatively undeveloped shoreline ranging about 14 miles (Fig. 6; Van Cleve et al., 2009b; Heckman, 1967). It is only accessible by ferry or boat, and is the southernmost island in the Puget Sound, located in Pierce County. In 1841, Commander Charles Wilkes of the US Expedition named Anderson Island in honor of Alexander Caulfield Anderson, the chief trader of Hudson's Bay Company (Heckman, 1967). The first settlers, of Scandinavian descent, came to the island around 1870. One hundred years later, there were only about 100 year-round residents on the island (Heckman, 1967). In 1990, there were 548 residents. In the year 2000, that number had jumped to 2416 people living on the island, with about 750 houses (Office of Social and Economic Data Analysis, Univ. of Missouri Outreach & Extension, 2000). Many of the residents only stay on the island during the summers, and therefore anthropogenic effects are relatively low during winter months. Regardless of the recent increase in population on Anderson Island, the shoreline remains relatively undeveloped, with the exception of Oro Bay. The west side shoreline is particularly pristine, with several pocket estuaries and undeveloped bluffs (Van Cleve et al., 2009b). Lake Florence and Lake Josephine, two inner island lakes on the east side, provide habitat for a wide

range of species such as Red-winged Blackbird (*Agelaius phoeniceus*), Osprey (*Pandion haliaetus*) and American Coot (*Fulica americana*).

Development is limited on Anderson Island for several reasons. Restricted access to the island has limited the degradation of habitats on and near the island. The large amount of high bluffs, particularly on the east side, limits the number of houses that have and can be built. Land preservation on the island via the Parks Department, Cascade Land Conservancy, and zoning regulations further protect the island from development. The intact, relatively undisturbed marine vegetation of the nearshore habitat surrounding the island will become even more important for juvenile salmonids as their numbers increase due to the Nisqually River watershed and delta restoration (J. Johnannes, Anderson Island resident and Naturalist, personal communication, August 16, 2010; Ellings & Hodgson, 2007).

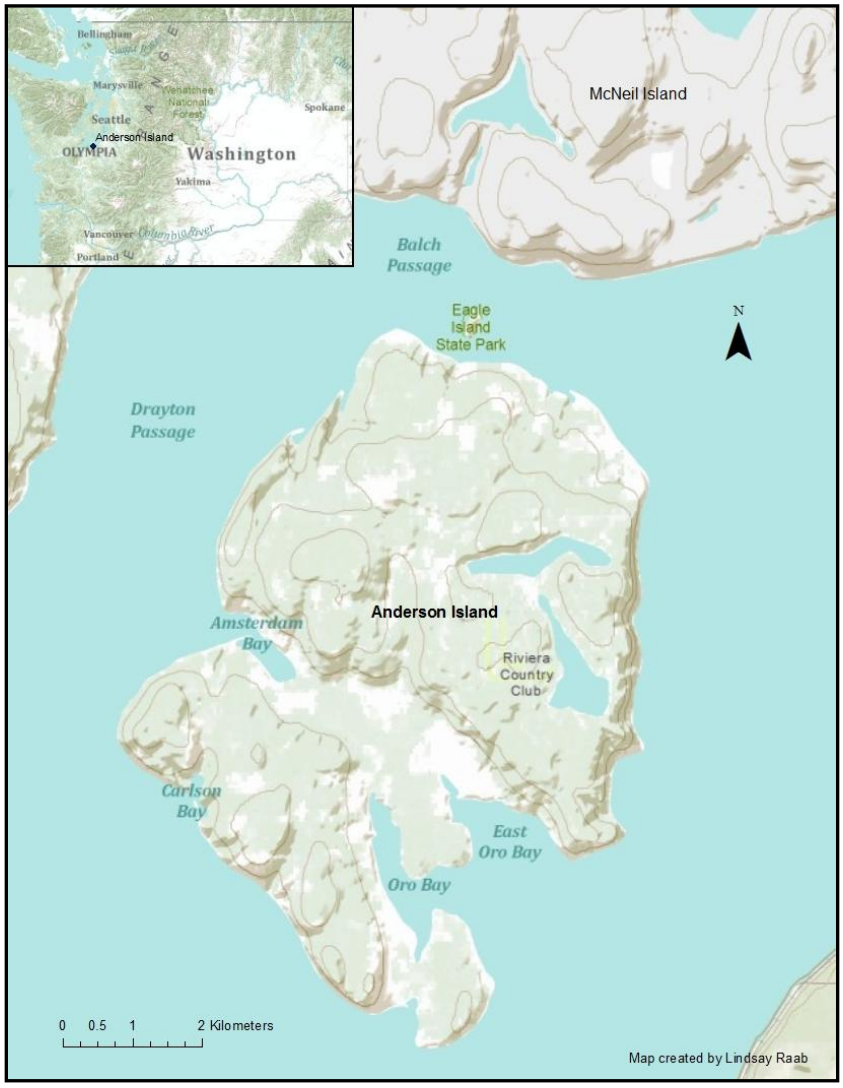


Fig. 6. Anderson Island in South Puget Sound, Washington.

METHODS

In order to investigate marine bird density, seasonal assemblages, and avian monitoring in the area (Criteria 1, 3 and 4) the author's methods were ten Puget Sound Seabird Surveys from two sites on Anderson Island, a trial Christmas Bird Count, and analysis of other data from various sources. The author generated maps of priority birds and fish species within the Nisqually Reach area using Geographical Information System (GIS) software. The author also analyzed the Nisqually Reach Aquatic Reserve proposal (Hull, 2008) and associated maps (Grilliot, 2010) to assess the types and quality of habitats, as well as the status of species and ecological processes within the area (Criteria 1, 2 and 4). Futher investigation on bird species concentrations, assemblages, diversity, and on-going avian monitoring projects in the proposed extended Important Bird Area (IBA) was needed to make a definitive assessment. This work addresses the need for further investigation.

Puget Sound Seabird Survey Project

In 2007, Seattle Audubon began an organized effort called the Puget Sound Seabird Survey (PSSS) project to monitor nearshore seabirds in central and southern Puget Sound. The aim of the PSSS project is to develop baseline data on counts and density of wintering nearshore marine birds in the Puget Sound. During the 2009-2010 PSSS season, citizen scientist volunteers performed bird surveys once a month from October to April at 68 waterfront locations across the Sound (Fig. 7).

Fig. 7. Puget Sound Seabird Survey Sites with selected labels (Seattle Audubon Society, 2010).

At each survey location, the volunteers established a site to take their observations. This spot should be held consistent throughout the survey season, and ideally from year to year. It should be a prime lookout point on or near the shoreline where surveyors can easily envision a half circle when looking out at the water. During the survey, volunteers record the species of each marine bird observed rafting on the water during a 15-30 minute period, along with its compass bearing, distance measurement and gender if possible. Other recorded observations include presence of oil on male Buffleheads (*Bucephala albeola*), number of walkers, dogs and boats in the area during the survey, presence of raptors overhead, and weather and tide conditions (Seattle Audubon Society, 2009).

The PSSS citizen science project was in its third year when two new sites on Anderson Island were established directly due to this work. The first was located on the ferry dock, 47 degrees 17'81" N, and 122 degrees 67.83" W. The other was at Andy's Marine Park, 47 degrees 14'65" N, 122 degrees 73'34" W. Because this work is considered a case study, the Anderson Island PSSS sites were not chosen at random. The PSSS work on Anderson Island began in January 2010 and ended in May 2010. The January survey was a trial run, and was done on the second Saturday of the month instead of the first. The May survey was done on the first Saturday

of the month, however the official PSSS season was over. The recommended tide time window was used in both cases. Exact protocol was followed for the February, March and April surveys (Seattle Audubon Society, 2009).

The study area of 2,262 ha of marine waters surrounding the island (Fig. 8) was derived by multiplying the top bound of the 95% confidence interval of the average visible distance from the shoreline from each of the ten surveys (1,004 m) by the shoreline distance (22,531 m). Using a weighted average of bird species data from each site, extrapolated results can be used as rough estimates of certain bird species within the study area (see Results section). Using Seattle Audubon's Bird Web as a guide, species specific survey data were not used in the weighted average to calculate the estimates if a bird species was listed as uncommon or rare for that month in the Puget Trough region (Seattle Audubon Society, 2008). Rough estimates of species documented during the PSSS were compared to thresholds for each species of conservation concern that are set forth as guidelines as to whether an area meets Criterion 1for a state-level IBA (Audubon Washington, 2008).

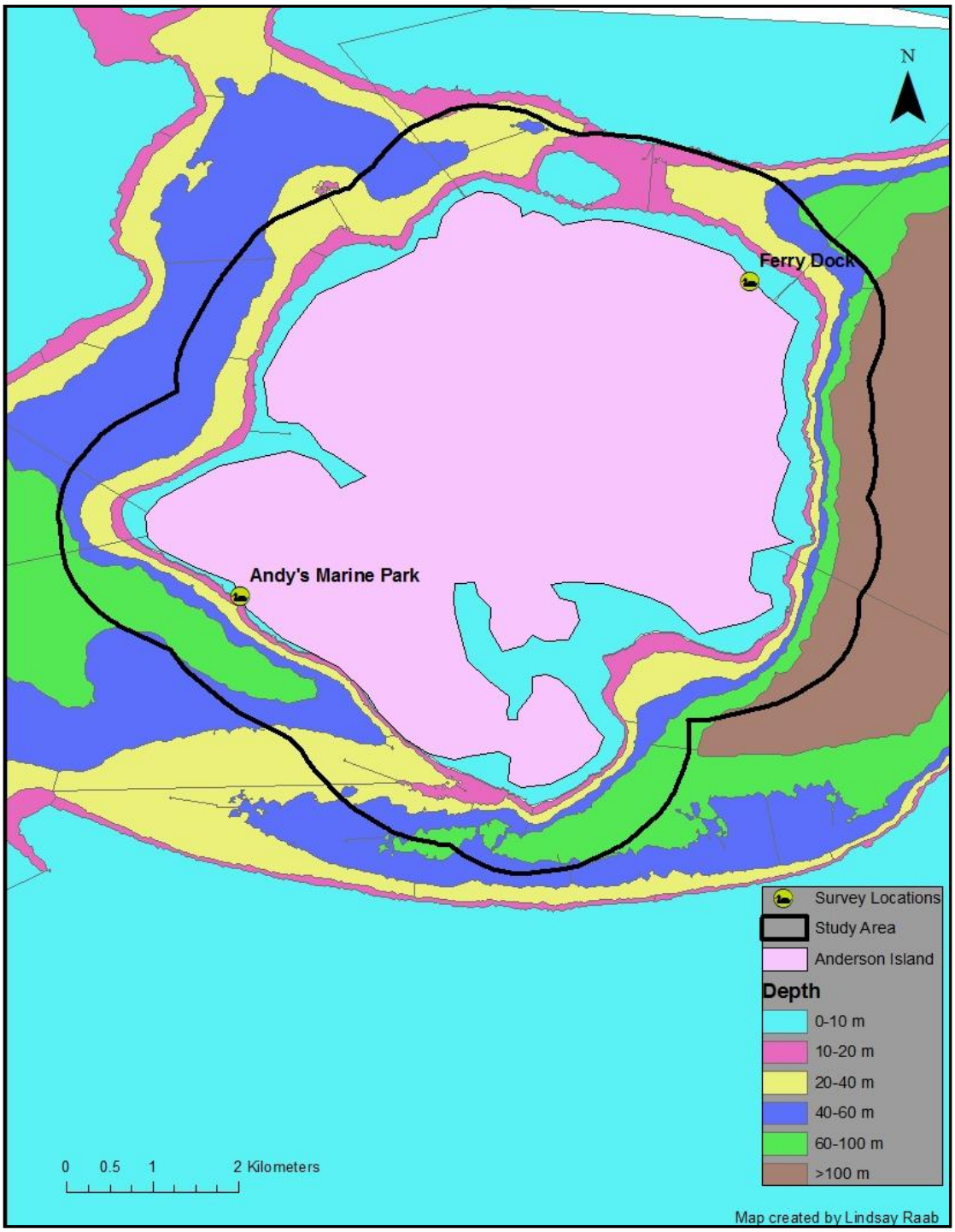


Fig. 8. Anderson Island Puget Sound Seabird Survey locations (bathymetry data from Marine Bird and Mammal Component of the Puget Sound Assessment and Monitoring Program, Washington Department of Fish and Wildlife).

Andy's Marine Park survey site

Researchers entered the site using a back entrance to get to the Andy's Marine Park survey site. From visible endpoint to endpoint, the shoreline measured 610.5 m, or 0.379 mi. This distance was calculated using a standard pace. The shoreline distance was multiplied by the 1,004 m (top bound of the 95% confidence interval of the average visible distance) to equal 61.3 ha total area for this site. The survey location is on the beach of the park, with towering bluffs standing about 30-50 ft high, stretching in both directions (Fig. 9). Many holes within bluffs were apparent, and bird fecal matter was observed near two of the holes during the May survey. The holes may have been nesting sites for Pigeon Guillemots (*Cepphus columba*) or Belted Kingfishers (*Megaceryle alcyon)*.

Fig. 9. View from Puget Sound Seabird Survey site at Andy's Marine Park on Anderson Island. Photo by Govinda Rosling.

The park also hosts a small lagoon, which lies behind where the researchers stood during the surveys. The lagoon is about 2-4 ha in size. The beach between the bluffs is made up of rocks and cobble with several large pieces of driftwood spread about. There is only one house visible from where the researchers stood, sitting above the bluff to the right of the site (if looking out toward the Sound). The site is heavily wooded behind the shoreline. Tree density is about one every 5-10 meters, and the mature trees in the area are roughly 70-160 years old (tree aging methods used from Van Pelt, 2007). The understory is comprised of plants ranging from Stinging

nettle (*Urtica dioica*), Evergreen and Red huckleberry (*Vaccinium ovatum* and *V. parvifolium*), Skunk cabbage (*Lysichiton americanum*), Salal (*Gaultheria shallon*), Indian-plum (*Oemleria cerasiformis*), Sword fern (*Polystichum munitum*), Braken fern (*Pteridium aquilinum*), Giant horsetail (*Equisetum telmatiea*), Scouring-rush (*Equisetum hyemale*) and Salmonberry (*Rubus spectabilis*). The canopy, quite typical of western Washington, is comprised of Western redcedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), Madrone (*Arbutus menziesii*), and Red alder (*Alnus rubra*).

Ferry dock survey site

The ferry dock is one of the most developed parts of the shoreline of Anderson Island. The area is made up of a concrete dock with a building and deck. There is a staircase on the side leading down to the rocky beach. The survey area was 1151.7 m or 0.716 mi from endpoint to endpoint, almost twice the size of Andy's Marine Park survey site (also measured using a standard pace). The shoreline distance was multiplied by 1,004 m (top bound of the 95% confidence interval of the average visible distance) to equal 115.63 ha total area for this site. The shoreline is thinly lined with trees and shrubs (Fig. 10) including Scotch Broom (*Cytisus scoparius*), Thimbleberry (*Rubus parviflorus*), Trailing blackberry (*Rubus ursinus*), English holly (*Ilex aquifolium*) in addition to many of the same species present at Andy's Marine Park. Several downed logs and large rocks lay near the retaining wall, and pieces of driftwood are scattered across the beach. Eight large pillars stand in the water, available for docking the ferry boat. During the surveys, several of the pillars served as common roosting places for all three species of cormorants, Great Blue Herons (*Ardea herodias*) and several species of gulls (Fig. 11). Barn Swallows (*Hirundo rustica*) and Rock Pigeons (*Columba livia*) were also common near the dock area.

Fig. 10. Shoreline to the north of the ferry dock survey location. Photo by Lindsay Raab.

Fig. 11. Pelagic, Double-crested and Brandt's Cormorants roost with a gull. Photo by Lindsay Raab.

Christmas Bird Count

In an effort led by the National Audubon Society, each year for the past 110 years during the time period of two weeks before and two weeks after Christmas, citizen scientists have taken part in Christmas Bird Counts (CBC) across the Americas. Put simply, groups of bird enthusiasts go out on a day during the time frame and count the number of bird species and individuals observed. Each group focuses on a specific geographical area within a 15 mile diameter circle. The "Count Compiler" is usually an expert birder and leads the group. That person is also in charge of entering the data online. The CBC effort is the longest-running wildlife survey project in history and there are now over 2,000 CBCs that occur annually. The main objective of CBC is to monitor and assess the status of bird populations over time (National Audubon Society, 2010).

On December 20, 2009, a group of nine citizen scientists performed an unofficial CBC on Anderson Island from 7:30 am – 2:30 pm. The weather was mostly cloudy in the morning, with light rain from about 8:00 – 8:30 am. There was light to moderate fog all morning. The sun came out from about 12:00-1:30 pm, and it became fairly windy around 1:30 pm. The temperature ranged from 45-55˚ F throughout the time period. The route was as follows: Ferry dock (7:30-8:30 am), Interlachen Park (8:30-9:00 am), Marina (9:00-9:45 am), Ann Dasch's house (9:45-10:30 am), Andy's Wildlife Park salt marsh (10:30-11:15 am), old store with dock on Eckenstein-Johnson Rd. (11:15-11:45 am), Jerry Johnannes' house (11:45 am-1:15 pm, includes a break for lunch), Andy's Marine Park beach and trail (1:15-1:45 pm), Johnson Historical Farm ponds and garden (1:45-2:30 pm). A total of 55, possibly 56, species were seen that day (see Results section for species list and counts). The goal of the trial CBC was to determine if several species of conservation concern assembled in substantial numbers in the area, possibly for breeding, migrating or wintering (Criteria 1 and 4).

Other Data

Data such as maps, tables and graphs were created or compiled from a variety of sources including Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) Program, WDFW Puget Sound Assessment and Monitoring Program (PSAMP), Washington State Department of Natural Resources (DNR) Aquatic Reserves Program and various chapters of the Audubon Society. WDFW PHS Program has been collecting data on important animal species and wildlife habitat for over 30 years. Data is maintained using GIS software. These data only represent what has been reported and documented by WDFW in a computer database and certain habitat and species may occur in areas not currently known to

WDFW. Maps of WDFW PHS data on priority bird and fish species were created by the author and are located in the Discussion section and were used to assess IBA Criteria 1, 2 and 4.

WDFW PSAMP is aimed at documenting and reviewing marine bird densities across the Puget Sound (Evenson et al., 2009). Aerial surveys using a transect method began in 1992. Summer surveys ended in the southern Puget Sound after the summer of 1996 (Nysewander et al., 2005a). Winter surveys began in 1993 in the southern Puget Sound region and are conducted during the months of December and January. The winter survey effort is still going on each year, with the exception of a reduced effort in 2007 due to budget cuts (J. Evenson, WDFW PSAMP Biologist, personal comminication, July 14, 2010). The author created five maps in this paper using the PSAMP Marine Density Atlas tools online (Evenson et al., 2009) and were assessed for IBA Criteria 1 and 4.

The application for the proposed Nisqually Reach Aquatic Reserve (Hull, 2008), species lists (Appendices C-F) and several maps, created by Washington DNR Aquatic Reserves Program Associate staff (Grilliot, 2010), were assessed for Criteria 1, 2 and 4. The bird data from Tahoma Audubon Society field trips on Anderson Island and nearby locations were reviewed for Criterion 1 (Appendix G). Several other data sources such as Nisqually National Wildlife Refuge, Northwest Forest Plan Interagency Regional Monitoring Program, Seattle Audubon, Birds of North America Online and several reports and journal articles were also reviewed to analyze the IBA criteria.

RESULTS

Puget Sound Seabird Surveys on Anderson Island

A total of 28 bird species were observed during the Puget Sound Seabird Surveys (PSSS) on Anderson Island. Due to the PSSS protocol, only the seabirds rafting on the water were officially counted, however all birds during the surveys at the two Anderson Island sites were noted, regardless of the bird's behavior (see Appendix H for raw data). The following bird count statistics are estimates derived from extrapolated PSSS results of the rafting birds, and can be used to get a general idea of the number of birds potentially using the study area surrounding the island (Table 1). These extrapolated results should be considered with minor reservations because topography and bathymetry surrounding Anderson Island are inconsistent. However, the locations of the PSSS sites capture a range of depths and due to plentiful prime bird habitat surrounding the island, it is likely that these estimates represent close to actual numbers for these species.

Table 1. Puget Sound Seabird Survey summary statistics for the study area surrounding Anderson Island

Common Name	Density/10 ha	Standard Error/10 ha	Estimate for Study Area +/- Standard Error	Threshold needed for State-level IBA***
Pacific Loon	0.07	0.04	17 +/- 8	1200
Common Loon	0.07	0.03	17 +/- 7	60
Horned Grebe	0.11	0.04	24 +/- 11	1000
Red-necked Grebe	0.29	0.27	66 +/- 61	45*
Western Grebe	0.46	0.28	105 +/- 63	120*
Surf Scoter	0.42	0.10	96 +/- 22	600
Bufflehead	0.22	0.14	50 +/- 32	1400
Common Goldeneye	0.32	0.16	73 +/- 37	750
Barrow's Goldeneye	0.10	0.08	23 +/- 18	255
Red-breasted Merganser	2.04	1.97	462 +/- 445	250*
Mew Gull	0.04	0.03	10 +/- 6	300
Glaucous-winged Gull**	0.08	0.04	17 +/- 8	570
Unidentified Gull	0.14	0.06	31 +/- 14	N/A
Pigeon Guillemot	0.22	0.14	51 +/- 32	235

*Estimate for the study area + standard error meets the threshold for a state-level IBA
**Includes Glaucous-winged Gull x Western Gull hybrid data
*** Source: Audubon Washington, 2008

Anderson Island Christmas Bird Count

A total of 1,113 birds were observed throughout the trial Christmas Bird Count (CBC) on Anderson Island. Dunlin (*Calidris alpine*), Bufflehead (*Bucephala albeola*) and European Starlings (*Sturnus vulgaris*) were the most common. Fifty five species were observed during the Christmas Bird Count (possibly 56 species, depending on whether the seven unidentified goldeneyes were Common Goldeneye (*Bucephala clangula*) or Barrow's Goldeneye (*B. clangula*). None of the species counts came close to meeting the threshold needed for a state-level IBA (Audubon Washington, 2008), although these data are from just one day, with limited access to marine viewing sites. Perhaps with averages of daily counts over time, some of these species counts would meet state-level IBA thresholds.

Table 2. Species list from December 20, 2009 Christmas Bird Count on Anderson Island

Number	Common Name	Scientific Name	Count
1	Common Loon	*Gavia immer*	2
2	Horned Grebe	*Podiceps auritus*	55
3	Red-necked Grebe	*Podiceps grisegena*	2
4	*Western Grebe	*Aechmophorus occidentalis*	4
5	Double-crested Cormorant	*Phalacrocorax auritus*	9
6	Pelagic Cormorant	*Phalacrocorax pelagicus*	16
7	Great Blue Heron	*Ardea herodias*	4
8	Canada Goose	*Branta canadensis*	5
9	Eurasian Wigeon	*Anas penelope*	1
10	American Wigeon	*Anas americana*	85
11	Mallard	*Anas platyrhynchos*	20
12	Ring-necked Duck	*Aythya collaris*	11
13	Surf Scoter	*Melanitta perspicillata*	55
14	White-winged Scoter	*Melanitta fusca*	1
15	Bufflehead	*Bucephala albeola*	115
16	Common Goldeneye	*Bucephala clangula*	20
17	Unidentified Goldeneye (Barrow's or Common)	*Bucephala islandica* or *B. clangula*	7
18	Hooded Merganser	*Lophodytes cucullatus*	6
19	Common Merganser	*Mergus merganser*	6
20	Red-breasted Merganser	*Mergus serrator*	1
21	Bald Eagle	*Haliaeetus leucocephalus*	5
22	Red-tailed Hawk	*Buteo jamaicensis*	4
23	American Kestrel	*Falco sparverius*	1
24	Unidentified Raptor- Sharp-shinned Hawk or Merlin	*Accipiter striatus* or *Falco columbarius*	2
25	Spotted Sandpiper	*Actitis macularius*	1
26	Dunlin	*Calidris alpina*	300
27	Western Gull	*Larus occidentalis*	2
28	Glaucous-winged Gull	*Larus glaucescens*	15

29	Pigeon Guillemot	*Cepphus columba*	2
30	Rock Pigeon	*Columba livia*	4
31	Mourning Dove	*Zenaida macroura*	3
32	Anna's Hummingbird	*Calypte anna*	4
33	Belted Kingfisher	*Megaceryle alcyon*	4
34	Downy Woodpecker	*Picoides pubescens*	1
35	Northern Flicker	*Colaptes auratus*	5
36	Pileated Woodpecker	*Dryocopus pileatus*	1
37	Steller's Jay	*Cyanocitta stelleri*	5
38	Northwestern Crow	*Corvus caurinus*	20
39	Common Raven	*Corvus corax*	1
40	Black-capped Chickadee	*Parus atricapillus*	1
41	Chestnut-backed Chickadee	*Parus rufescens*	11
42	Red-breasted Nuthatch	*Sitta canadensis*	5
43	Bewick's Wren	*Thryomanes bewickii*	1
44	Winter Wren	*Troglodytes troglodytes*	6
45	Golden-crowned Kinglet	*Regulus satrapa*	30
46	Ruby-crowned Kinglet	*Regulus calendula*	4
47	American Robin	*Turdus migratorius*	16
48	Varied Thrush	*Zoothera naevia*	2
49	European Starling	*Sturnus vulgaris*	110
50	Spotted Towhee	*Pipilo maculatus*	9
51	Song Sparrow	*Melospiza melodia*	13
52	White-crowned Sparrow	*Zonotrichia leucophrys*	3
53	Dark-eyed Junco	*Junco hyemalis*	11
54	Red-winged Blackbird	*Agelaius phoeniceus*	6
55	House Finch	*Carpodacus mexicanus*	5
56	Unidentified Finch (American Goldfinch or Pine Siskin)	*Carduelis tristis* or *Carduelis pinus*	75

*Observed from the ferry, closer to Steilacoom than Anderson Island.

Other Data

Main sources for data used in this paper are Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Program, WDFW Puget Sound Assessment and Monitoring Program (PSAMP), Washington State Department of Natural Resources (DNR) Aquatic Reserves Program, Tahoma Audubon, and Nisqually National Wildlife Refuge (NWR). Maps, species lists and information from these sources and more are located throughout the Discussion section or in an Appendix. Table 3 summarizes selected resulting information used to assess Important Bird Area (IBA) criteria.

Table 3. Data collection for analysis of Important Bird Area Criteria

Source	Data	Criterion or Criteria assessed
WDFW PHS Program	Author created two maps from GIS data for priority bird and fish species in the Nisqually Reach region.	1, 3, 4
WDFW PSAMP	Author created five maps using PSAMP Marine Bird Atlas data and tools online.	1, 3, 4
Washington DNR Aquatic Reserves Program	Author compiled ecological maps, species lists, site observations, and aquatic reserve proposal information.	1, 2
Tahoma Audubon	Field trip data located in Appendix G.	1
Nisqually NWR	Author incorporated monthly and annual survey data into bird species list located in Appendix C.	1
Nisqually NWR Comprehensive Conservation Plan (CCP)	Author incorporated map of Nisqually NWR CCP plan in Appendix B, and bird species data into species list located in Appendix C.	1, 2, 4

DISCUSSION

After an extensive amount of data collection and research, the Nisqually Delta Important Bird Area (IBA) boundary extension request appears justifiable, and if approved, the extension should mirror the proposed boundary for the aquatic reserve in the Nisqually Reach region. An expanded IBA would connect the Nisqually River delta with the nearshore habitat of Anderson Island and other shorelines in the area. The two habitats are ecologically connected in terms of energy cycling and nutrient flow via fish. Hundreds of salmon exit the Nisqually estuary each year as fry seeking food and shelter in the marine vegetation, such as eelgrass (*Zostera marina*) and non-floating kelp (*Laminaria sp.*, *Egregia menziesii* and other species), in the nearshore habitat of Anderson Island (Ellings & Hodgson, 2007) providing ample food for waterbirds in the area. An expanded Nisqually IBA would encompass virtually every habitat represented in the Puget Sound including estuarine, freshwater, marsh, grassland, and riparian habitat types, the deep marine waters of the Nisqually Reach, as well as tidal lands, pocket estuaries, sandy shoreline and high bluffs of Anderson, Ketron, Eagle Islands and the south shoreline of McNeil Island (as reviewed by Hull, 2008). The Nisqually IBA currently supports many species of dabbling ducks and shorebirds (US Fish and Wildlife Service et al., 2010) while an extended IBA would encompass more habitat types and therefore a more diverse range of species of conservation concern, particularly diving ducks, grebes, loons, cormorants and alcids. The expanded IBA would represent a large, relatively undisturbed native habitat supporting high biodiversity of waterbird species (Appendix C; as reviewed by Hull, 2008).

Analysis of data from various sources such as Washington Department Fish and Wildlife (WDFW) and Washington State Department of Natural Resources (DNR) support that the proposed extended IBA may meet all four Criteria, particularly Criterion 2. For simplicity reasons, the four IBA criteria are listed again and an explanation follows to explain how the data may support each Criterion.

Criterion 1

Criterion 1 states: “sites supporting significant populations of species of conservation concern in Washington . . . includes sites that have the largest concentrations of these species or those with several of these species present in substantial numbers” (relative to overall numbers in

Washington and species range; Audubon Washington, 2008, pg. 2). Table 4 summarizes the highest counts of actual observations of certain species during this research.

Table 4. Observations of selected marine bird species in the proposed extended Important Bird Area

Common Name	Species Status*	Month	Year	Count	Source
Common Murre	Resident	June	2009	30	1
Pigeon Guillemot	Resident	May	2010	44	2
Red-breasted Merganser	Wintering Visitor	Jan.	2010	97	3
Surf Scoter	Wintering Visitor	Dec.	2009	55	5
Horned Grebe	Winter	Dec.	2009	55	5
Red-necked Grebe	Wintering Visitor	Mar.	2010	25	4
Western Grebe	Wintering Visitor	Mar.	2010	25	4
Brandt's Cormorant	Resident	Jan.	2010	7	4
Double-crested Cormorant	Resident	Feb.	2010	11	4
Pelagic Cormorant	Resident	Dec.	2009	16	5

Sources:
[1]Aquatic Reserves Technical Committee site visit, June 9, 2009
[2]Boat survey around Anderson Island, May 13, 2010
[3]Puget Sound Seabird Survey, Andy's Marine Park, Anderson Island, 2010
[4]Puget Sound Seabird Survey, Ferry Dock, Anderson Island, 2010
[5]Christmas Bird Count, Anderson Island, Dec. 20, 2009
*Information from Bird Web (Seattle Audubon Society, 2008)

When considering the study area surrounding the island derived from the Puget Sound Seabird Survey (PSSS) sites, the estimate plus a standard error for three species, Red-breasted Merganser (*Mergus serrator*), Red-necked Grebe (*Podiceps grisegena*) and Western Grebe (*Aechmophorus occidentalis*) all meet this Criterion (Table 1 in Results section). However, because these estimates were extrapolated PSSS data from the two Anderson Island sites, they assume bird density is uniform within the study area. These estimates are for the PSSS study area

surrounding Anderson Island, *not* the entire area included in the extended boundary request. If this data was extrapolated for the entire area within the requested boundary extension, bird density estimates would be much higher.

Eighty three marine bird species have been observed across the Sound during Puget Sound Assessment and Monitoring Program (PSAMP) surveys, including ducks, alcids, loons, grebes and more. Density of marine birds in the Nisqually Reach is substantially higher in the winter, with several cell densities greater than 1,000 birds per square km. Fig. 12 and 13 represent survey density data from both winter and summer surveys respectively.

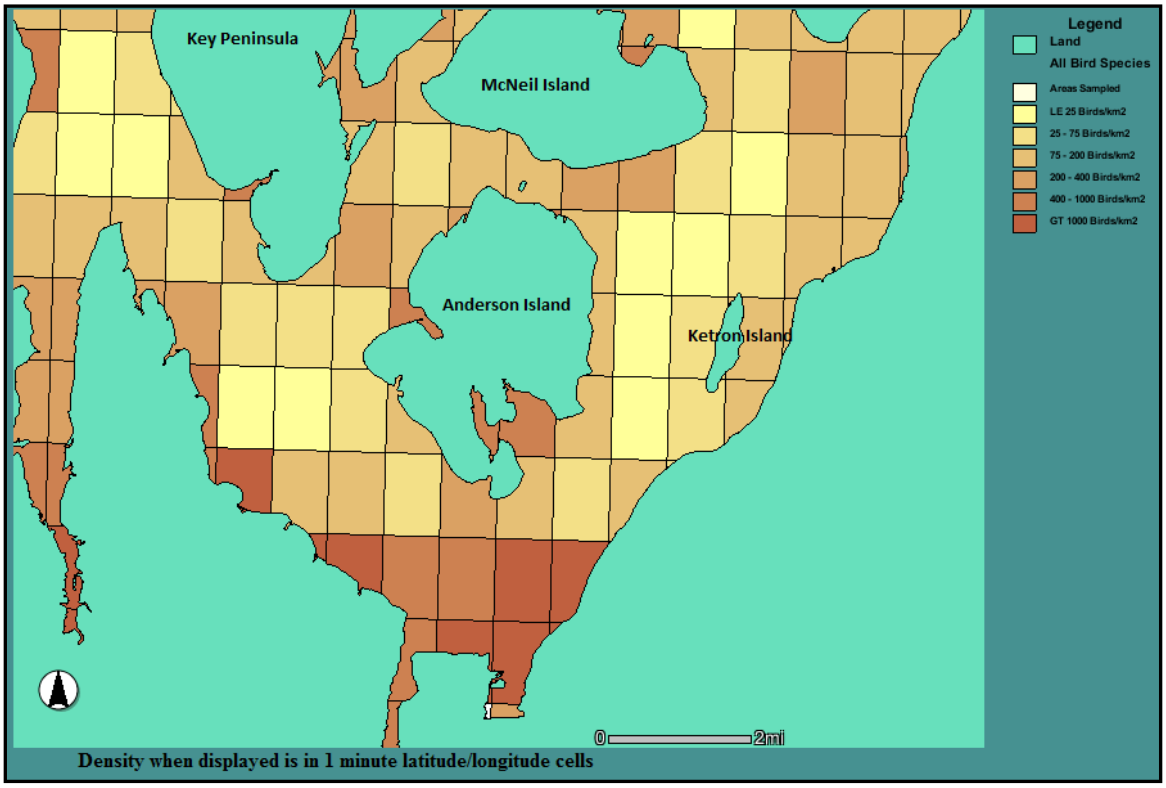


Fig. 12. Average mean density of all marine bird species from winters 1993 - 2006, 2008 - 2009. Species breakdown as follows: dabbling ducks and geese (33%); diving/sea ducks (31%); gulls (12%); shorebirds (13%); grebes and loons (4%); alcids (2%); and cormorants (2%) (Evenson et al., 2009).

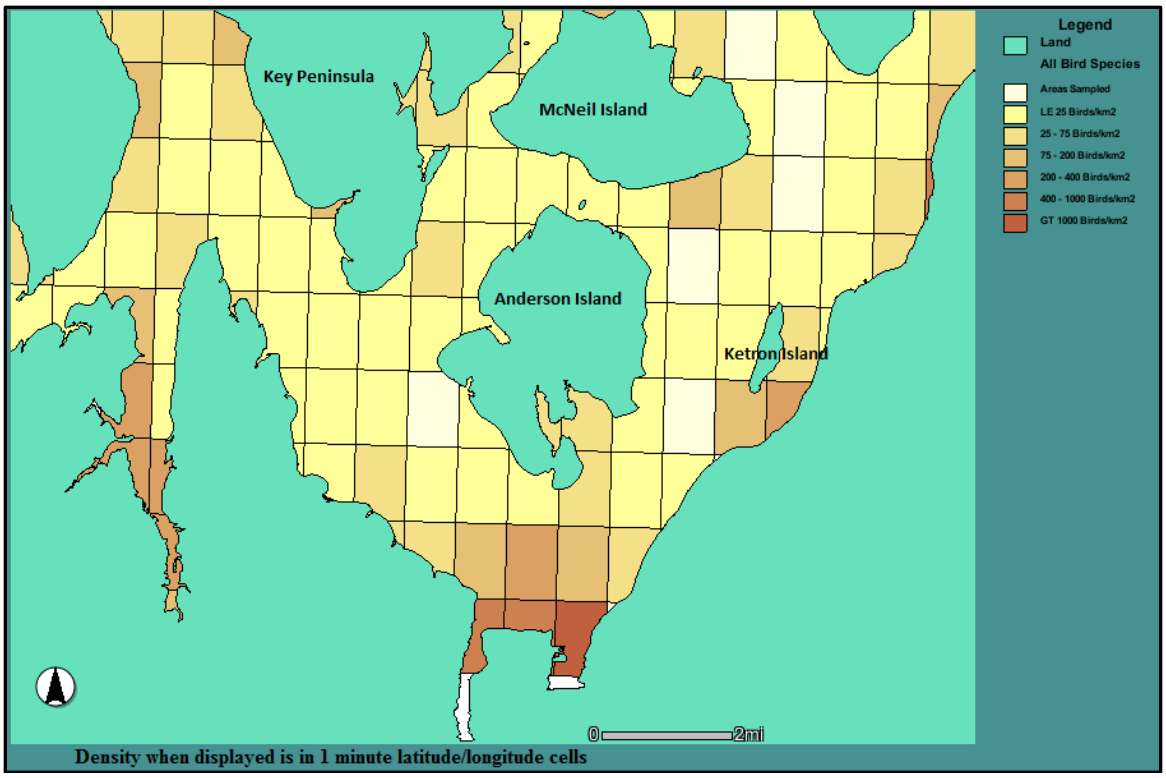


Fig. 13. Average mean density of all marine bird species from summers 1992 - 1996. Species breakdown as follows: gulls and terns (73%); alcids (10%), ducks and geese (8%), cormorants (4%), great blue herons (2%), and other species (2%) (Evenson et al., 2009).

When considering the diverse range of aquatic habitats within the entire proposed expanded IBA (including the current boundary) 134 bird species are represented (Appendix C) the majority of them are of conservation concern. Federal and State threatened Marbled Murrelets (*Brachyramphus marmoratus*) are particularly important inhabitants to at least a portion of the area within the proposed extended boundary. The Northwest Forest Plan Interagency Regional Monitoring Program (2008) estimates roughly 15-45 Marbled Murrelets forage in the waters surrounding Ketron Island. This estimate ties or surpasses the global-level IBA threshold of 15 (no state-level threshold is listed for this species). Marbled Murrelets are further discussed under Criterion 4 on pg. 42.

Data from Washington WFDW Priority Habitats and Species (PHS), Washington DNR (Fig. 14), US Geological Service (USGS) survey data (Fig. 15) and PSSS data from Anderson Island (Appendix H) support that Bald Eagles (*Haliaeetus leucocephalus*) are common to the area. In general, it is a sign of a healthy ecosystem when top predators, such as Bald Eagles, are in abundance. Although IBAs do not tend to support protecting territorial birds that tend to disperse at low densities, (Cullinan, 2001) it is important to note that top predators persist on

Anderson Island because of the abundant food sources and suitable habitat. Waterbirds such as juvenile cormorants, Pigeon Guillemots (*Cepphus columba*) and Great Blue Herons (*Ardea herodias*) are likely food sources for Bald Eagles on the island (Anthony et al., 1999; S. Garmire, Anderson Island Community Club President and island resident, personal communication, April 19, 2010).

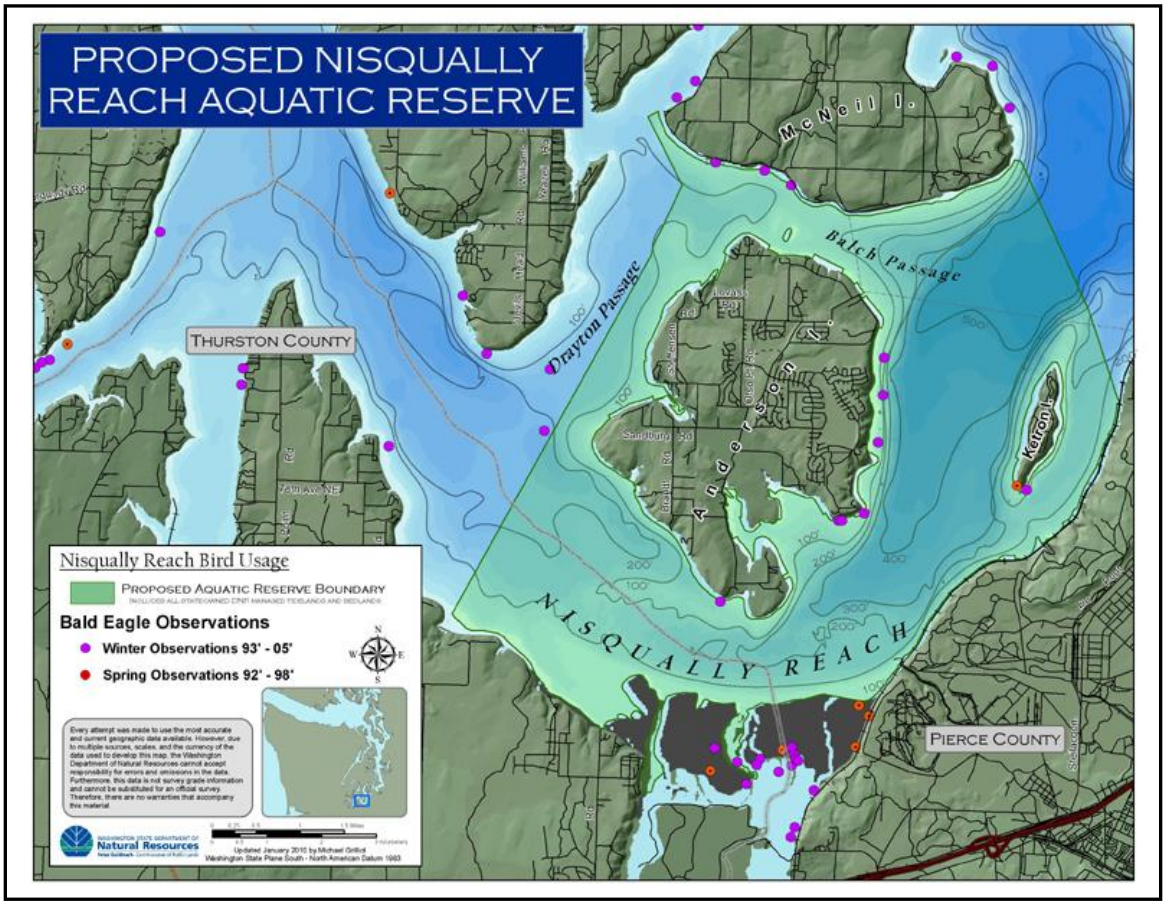


Fig. 14. Bald Eagle observations from winters 1993-2005 and springs 1992-1998 (Grilliot, 2010).

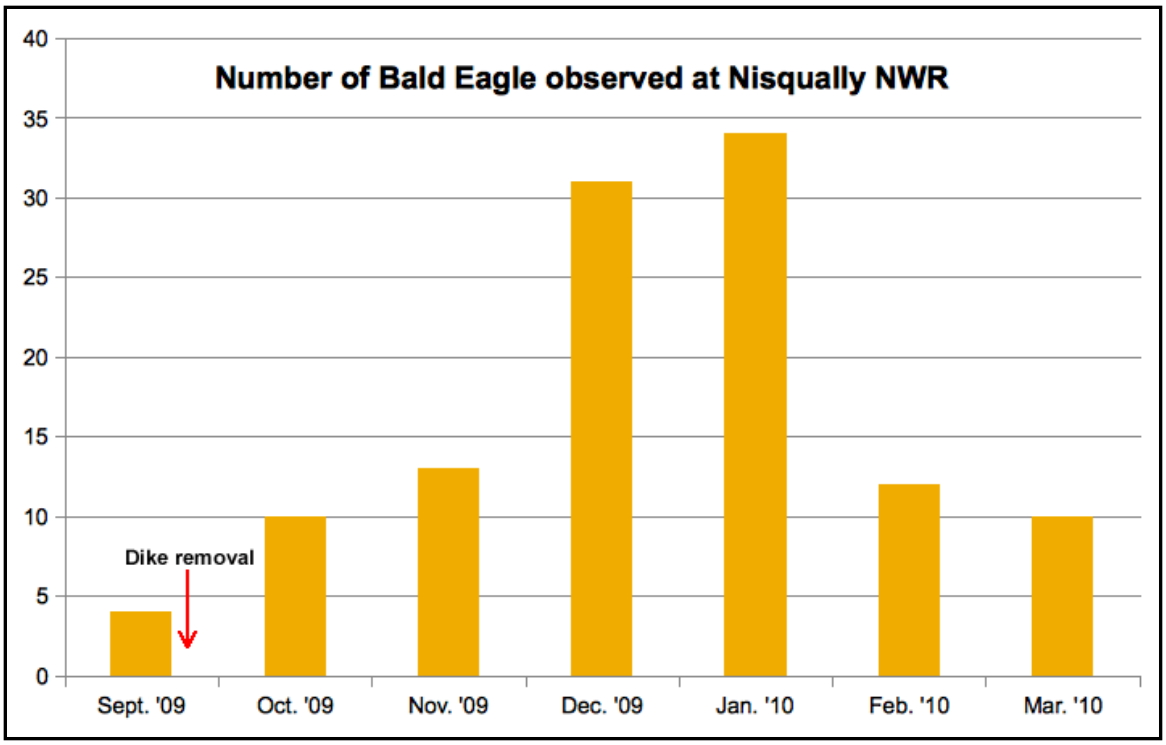


Fig. 15. Bald Eagle observations documented from monthly surveys at the Nisqually National Wildlife Refuge, Sept. 2009 - March 2010 (US Fish and Wildlife Service et al., 2010).

In sum, the area within the proposed extended IBA likely meets many of the state-level thresholds for many species such as Red-breasted Merganser, Red-necked Grebe, Western Grebe and Marbled Murrelet. The chance of meeting additional species thresholds increases if the current IBA is considered as well. Expanded avian monitoring efforts within the Nisqually Reach could further define counts for local marine bird populations.

Criterion 2

Criterion 2 states: "sites for species assemblages associated with a representative, rare or threatened natural community in Washington" (Audubon Washington, 2008, pg. 4). The extension boundary for the current Nisqually Delta IBA is best justified by this Criterion because of its extensive marine/estuarine foraging sites and rocky coastlines (high bluffs), both listed as rare or threatened habitats. These habitats within the area of the proposed extension are representative of relatively undisturbed native habitats with diverse ecosystems (Fig. 16-18). Pocket estuaries within the area likely house juvenile salmon and forage fish as they grow (Fig. 19; Ellings & Hodgson, 2007). The habitats within the area are prime seabird and marine mammal foraging grounds due to high diversity of invertebrates and fish (Appendices C-F).

Extensive mud flats provide habitat for mollusks such as geoducks (*Panopea generosa*; Fig. 20) and abundant non-floating kelp provides habitat for fish, as well as food for some waterbirds (Fig. 21). The site is remarkably less degraded than other parts of the Puget Sound (as reviewed by Hull, 2008) and the nearshore habitat is an extremely important area for juvenile salmonids, such as Federally listed Chinook salmon (*Oncorhynchus tshawytscha*) and Puget Sound steelhead (*Oncorhynchus mykiss*). The small fry find refuge in marine vegetation such as eelgrass and non-floating kelp when exiting the Nisqually River system (Ellings & Hogdson, 2007; Murphy et al., 2000). The marine vegetation also plays an important role as a Carbon sink in the face of global warming, and regulates temperature by providing shade for benthic species and substrate (Dring, 1992).

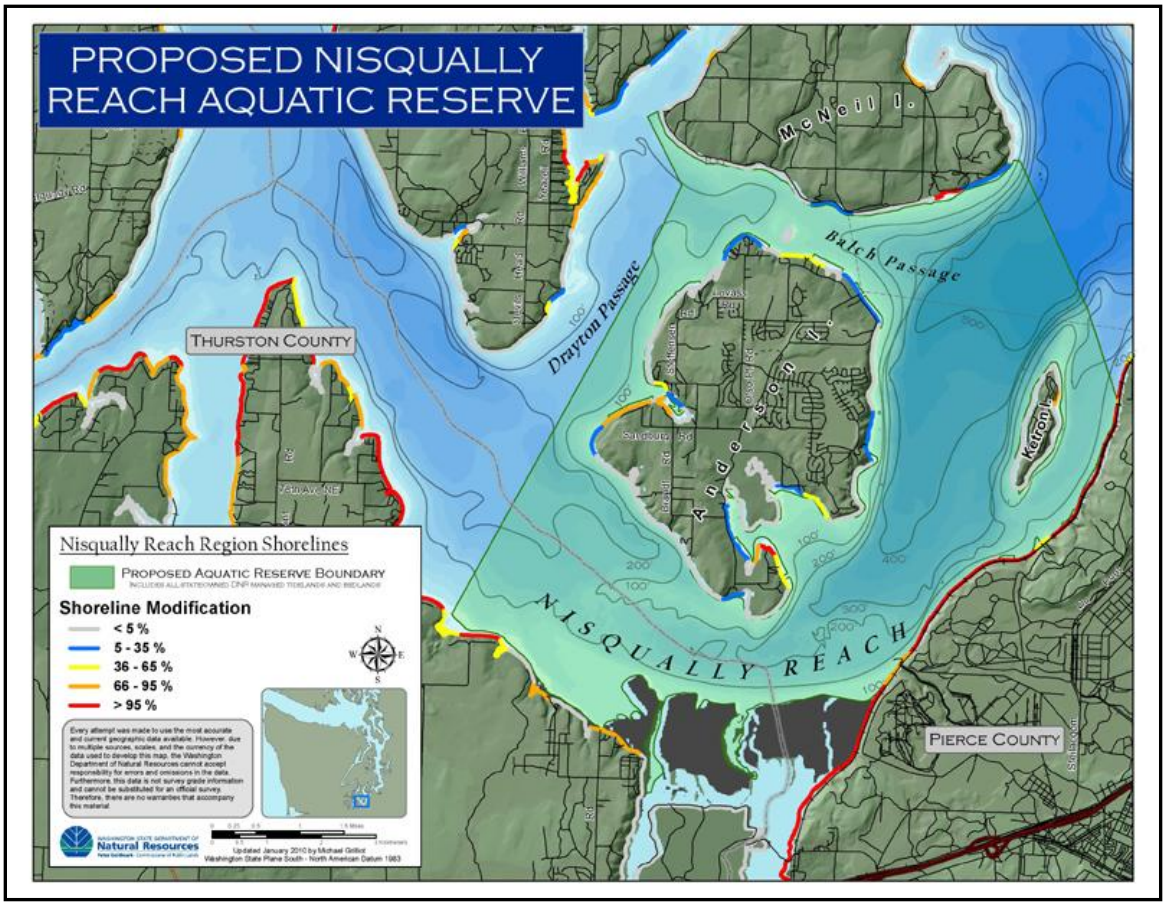


Fig. 16. Relatively low percentage of shoreline modification in the Nisqually Reach, with the exception of the western shoreline of Pierce County (Grilliot, 2010).

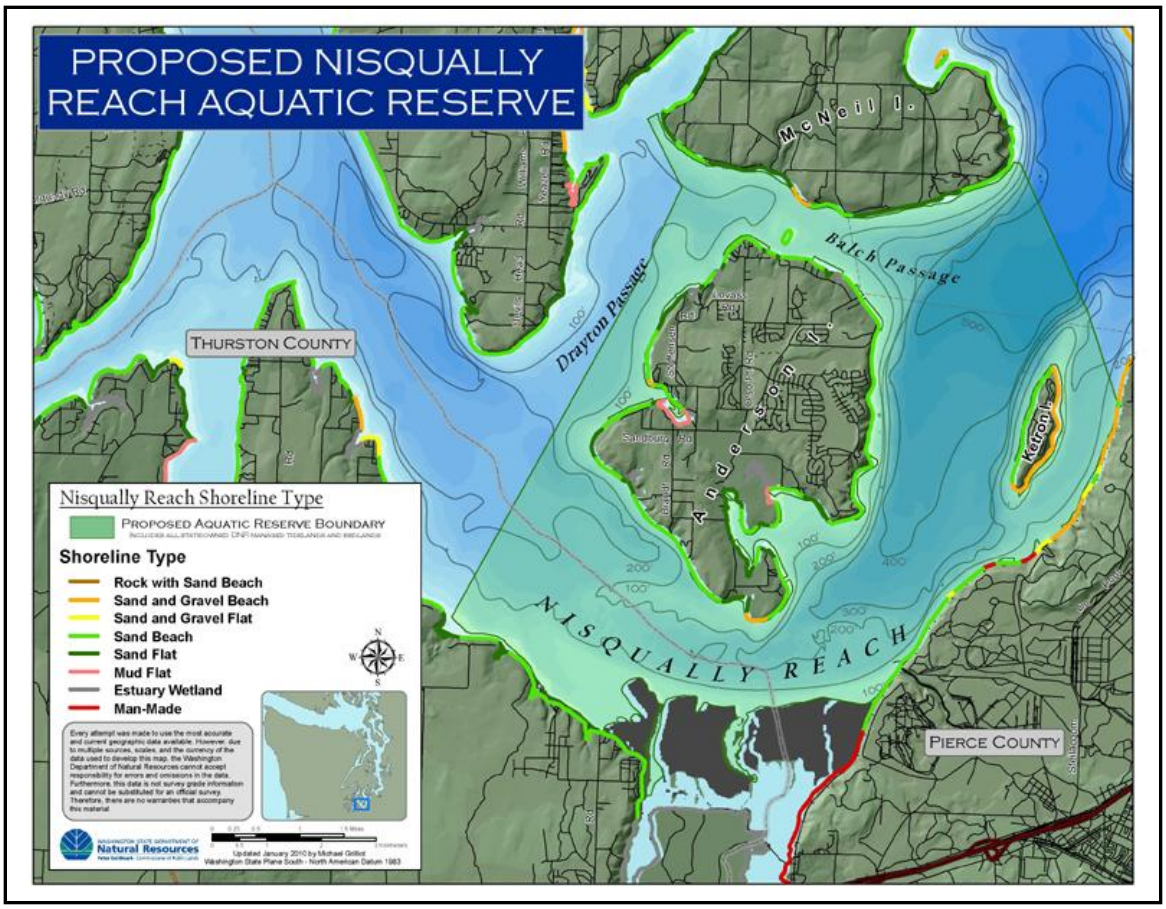


Fig. 17. The majority of shorelines in the Nisqually Reach are sand beaches and flats (Grilliot, 2010).

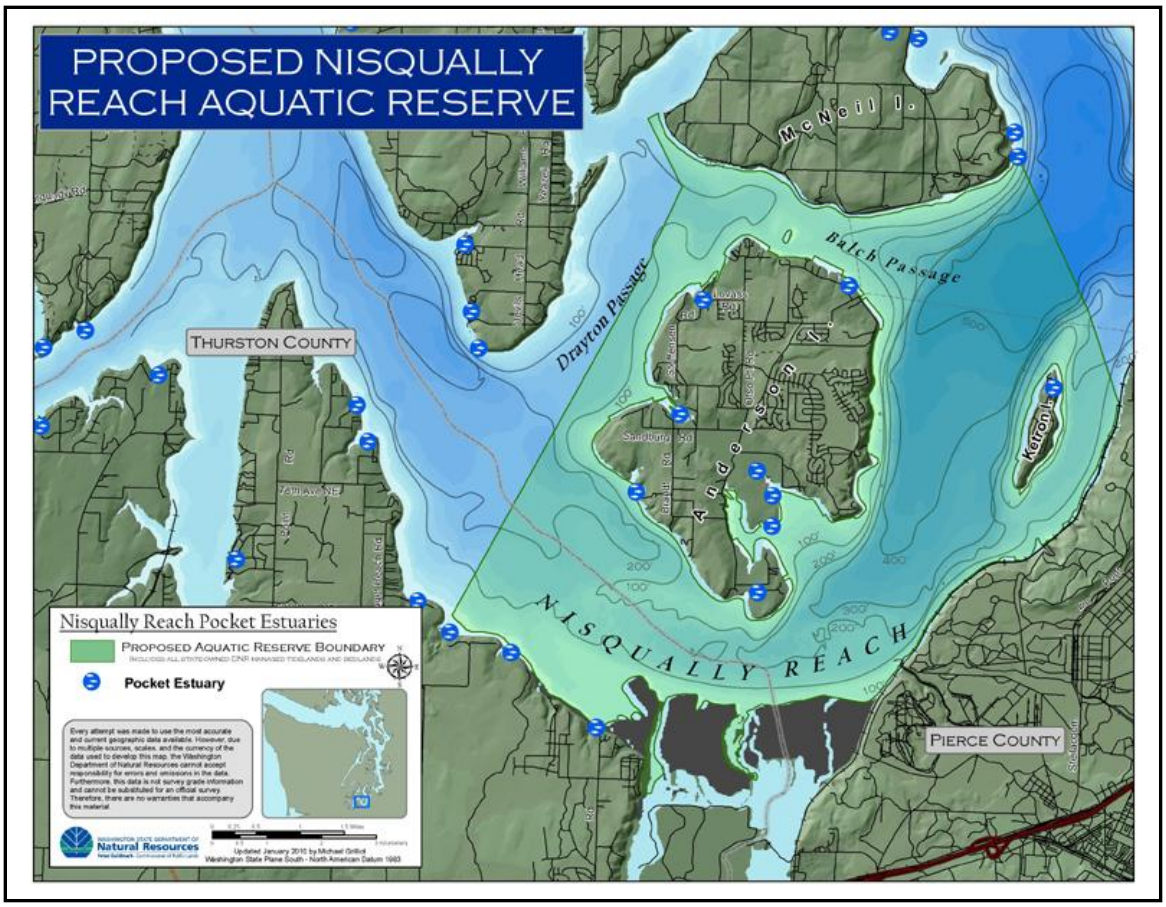


Fig. 18. Many pocket estuaries exist along shorelines in the Nisqually Reach (Grilliot, 2010).

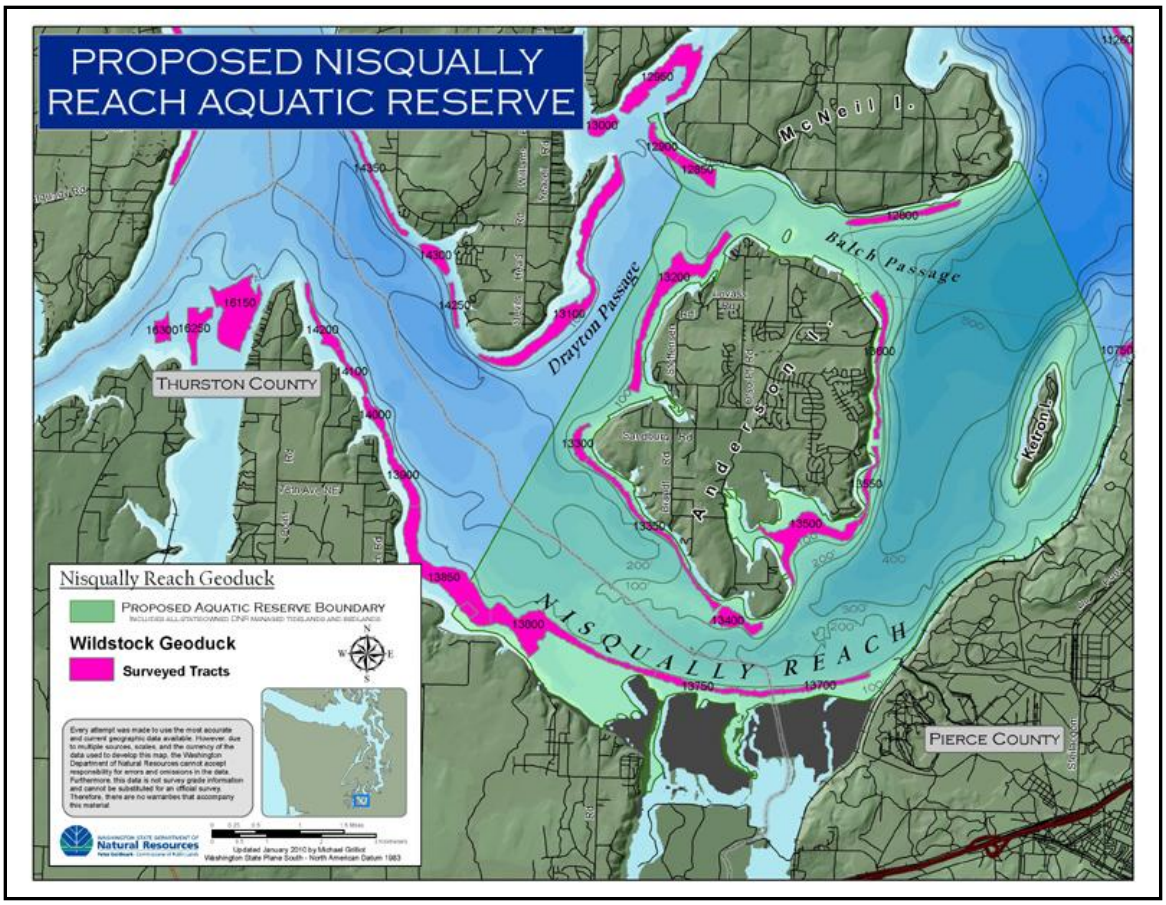


Fig. 19. Presence of geoduck population in the Nisqually Reach (Grilliot, 2010).

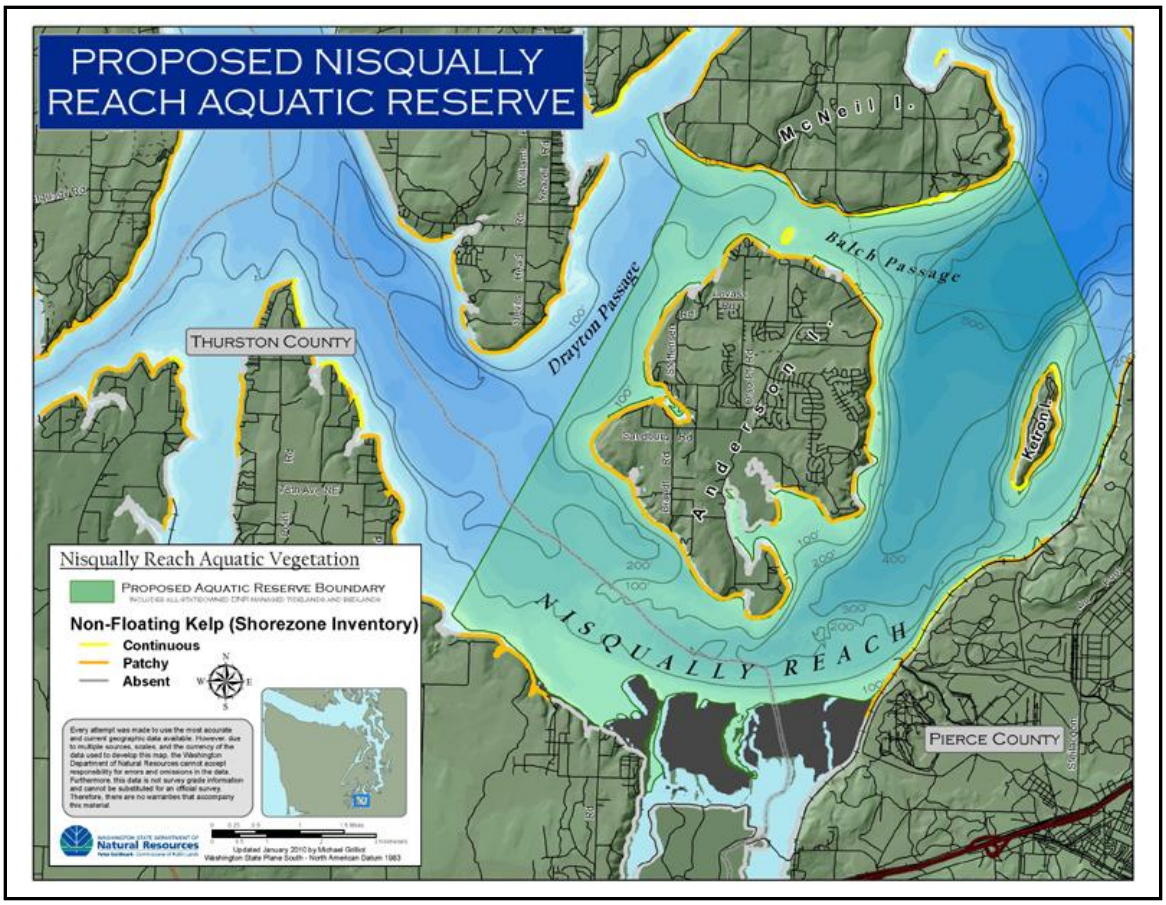


Fig. 20. Abundance of non-floating kelp in the Nisqually Reach (Grilliot, 2010).

WDFW PHS data portrays an abundance of forage fish such as surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes hexapterus)* in the Nisqually Reach (Fig 21). During a bird survey conducted on a boat of Anderson Island shoreline and nearshore habitat on May 13, 2010, fisherman Shawn White was impressed with the high abundance of "bait fish" that showed on his underwater monitor. During the one hour survey, 46 Pacific harbor seals (*Phoca vitulina*), 44 Pigeon Guillemots, five unidentified cormorants, five loons and many other seabirds were foraging in the area's prime aquatic habitat. The area is also important for several anadromous fish species (Appendix E) which utilize freshwater rivers and streams for spawning, estuary and sheltered marine habitat for growing and acclimating, and open ocean for the majority of their adult life (Ellings & Hodgson, 2007; Washington Department of Fish and Wildlife, 2000a).

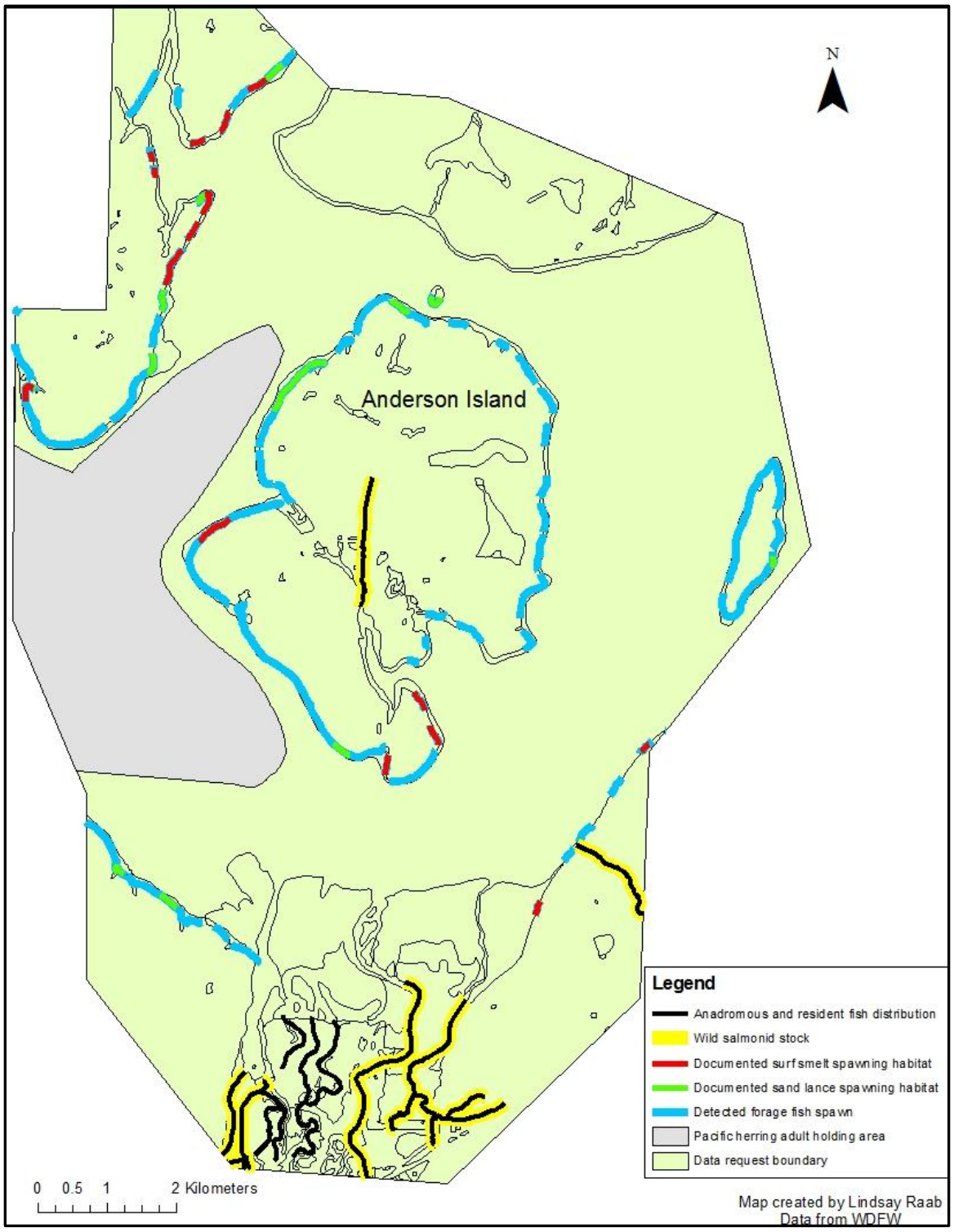


Fig. 21. Washington Department of Fish and Wildlife Priority Habitats and Species Program fish data for the Nisqually Reach region "Forage fish" represent Pacific sand lance and surf smelt. (Washington Department of Fish and Wildlife Priority Habitats and Species).

Criterion 3

Criterion 3 states: "sites important for long-term avian research or monitoring" (Audubon Washington, 2008, pg. 6). Although many bird enthusists live on the island, there has been no official, consistent long-term avian monitoring of the shoreline habitat on Anderson Island. Although, it is likely that the PSSS sites that were established during the 2009-2010 season will continue to be surveyed next season as well. However, WDFW PHS Program has been documenting reports of sitings of priority bird species in the state, including shorelines within proposed area, for over the past 30 years. WDFW PSAMP has been annually surveying the entire Sound, including the nearshore and deep water habitats within proposed area, for over fifteen years. If the Nisqually Reach is designated as an aquatic reserve, a request to increase avian monitoring in the area can be recommended as a priority action to Washington DNR Aquatic Reserves Program staff.

Criterion 4

Criterion 4 states: "sites where birds regularly concentrate in significant numbers when breeding or during migration or winter" (Audubon Washington, 2008, pg. 6). The site likely matches sub-category 4iv: "the site is known or thought to hold, on a regular basis, at least 50 seabirds, in either marine or terrestrial (nesting) areas . . . [s]eabirds include albatrosses, fulmars, shearwaters, storm-petrels, jaegers, and alcids" (Audubon Washington, 2008, pg. 6). Nesting and foraging habitats are available in the area for several alcid species. During the Aquatic Reserves Technical Advisory Committee assessment survey in June 2009, roughly 30 Common Murres (*Uria aalge*) were observed in the Nisqually Reach. Pigeon Guillemots also congregate on and near the island (Fig. 22), likely using the high bluffs for nesting sites. Further, Marbled Murrelets have also been documented in the area (Northwest Forest Plan Interagency Regional Monitoring Program, 2008).

Fig. 23 portrays PHS data on priority bird species locations on and near Anderson Island and the Nisqually Delta. Breeding seabird locations in the map represent alcid breeding colony locations from a 1989 US Fish and Wildlife Service (USFWS) survey (Speich & Wahl, 1989). Considering the island has not changed much over the past 50 years (S. Garmire, personal communication, April 19, 2010) the data portrays the long-term importance of the area in terms of alcid breeding habitat. The following discussion focuses on three species of marine birds (two alcids and one diving sea duck), and how the Nisqually Reach habitat characteristics fulfill one or more of the species' life stage requirements.

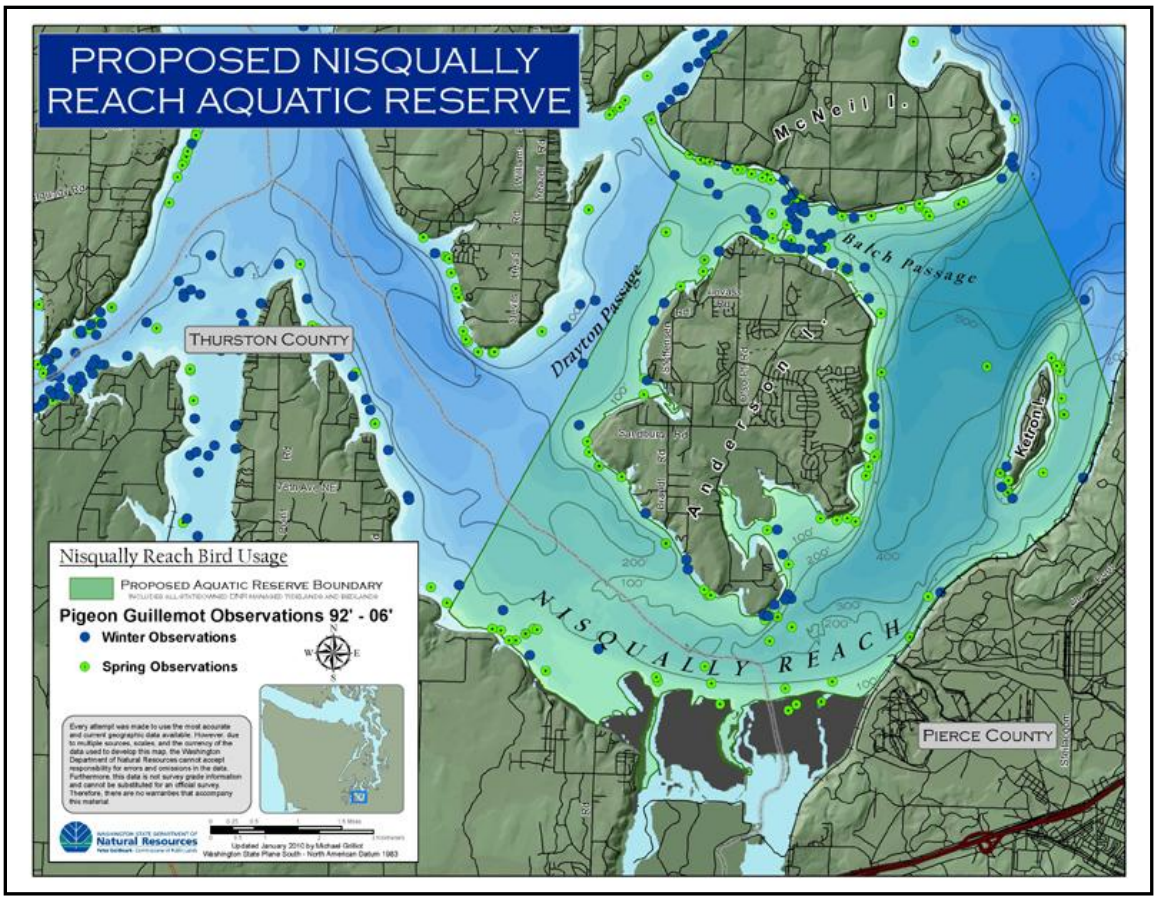


Fig. 22. Pigeon Guillemot winter and summer observations in the Nisqually Reach from 1992 – 2006 (Grilliot, 2010).

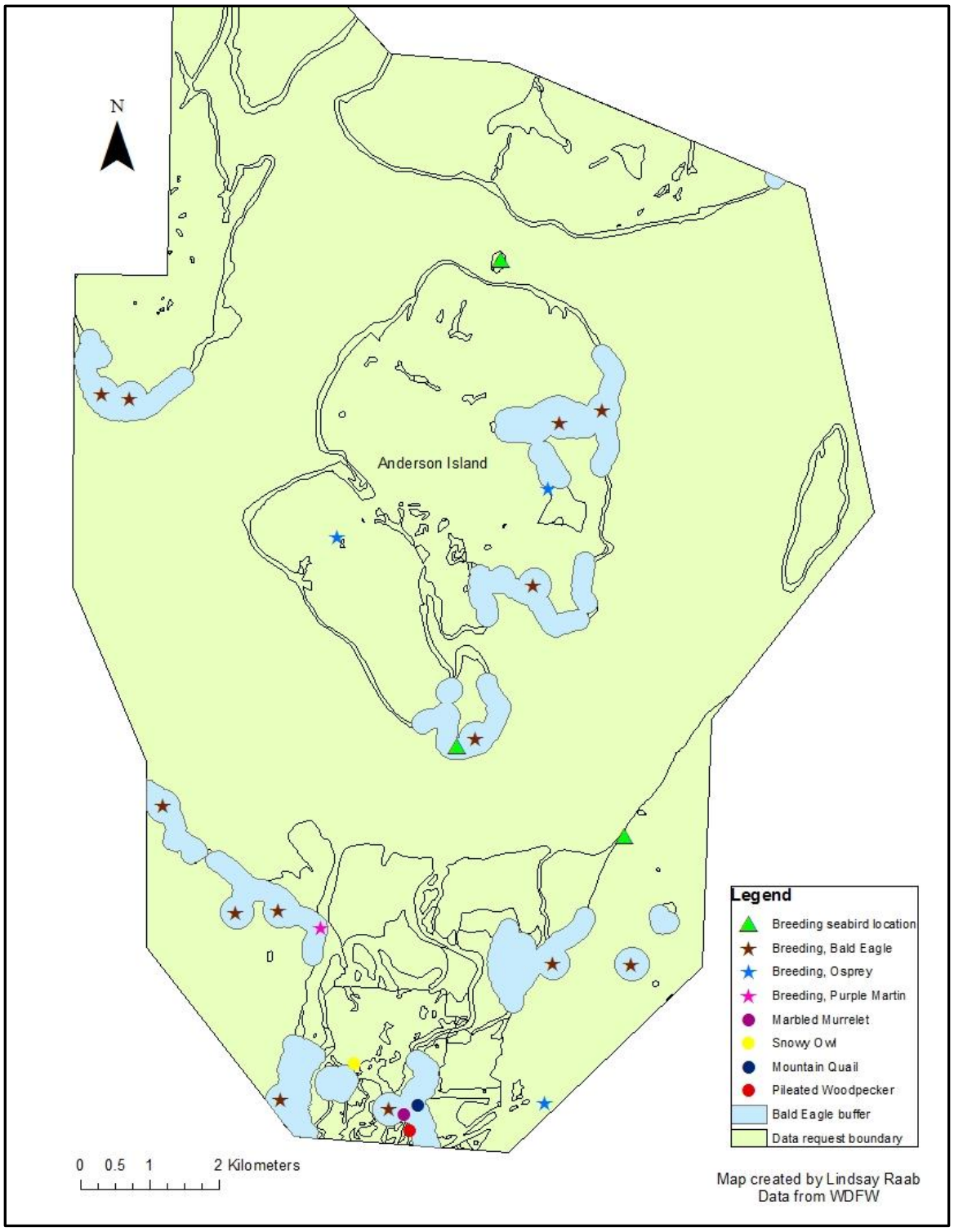


Fig. 23. Washington Department of Fish and Wildlife Priority Habitats and Species Program bird data for the Nisqually Reach region (Washington Department of Fish and Wildlife Priority Habitats and Species).

Pigeon Guillemot

Pigeon Guillemots (hereafter guillemots) are medium sized alcids, standing roughly 13 inches tall with a wingspan of about 23 inches. They are non-sexually dimorphic and have mostly white plumage during their non-breeding period, and all turn black with a white wing patch while breeding (Fig. 24; Sibley, 2003).

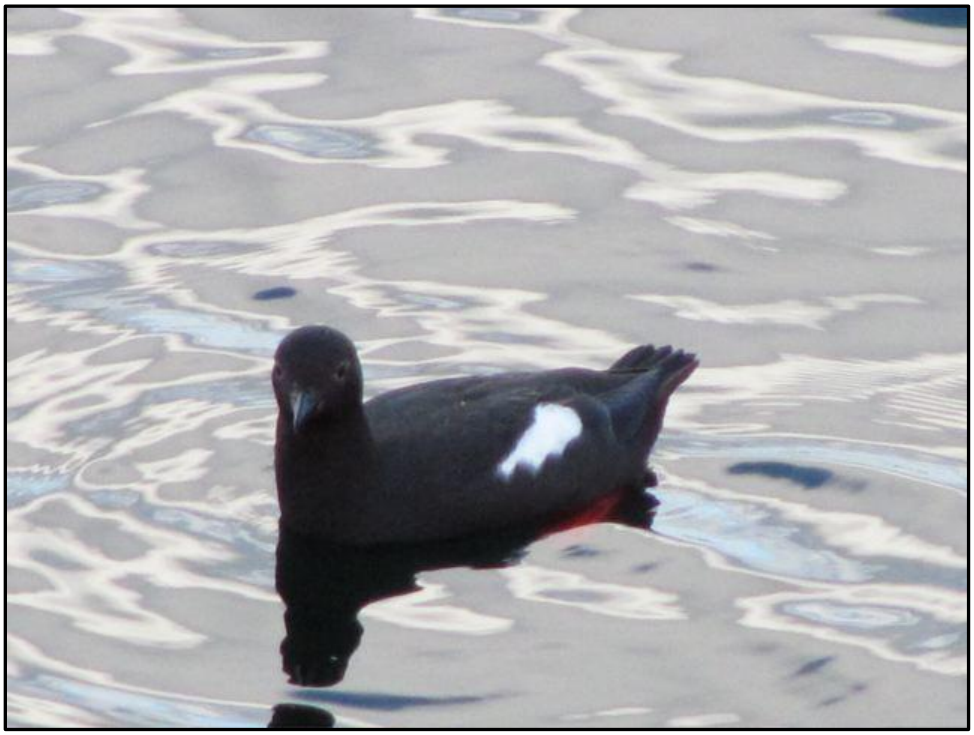


Fig. 24. Pigeon Guillemot in breeding plumage at the ferry dock Puget Sound Seabird Survey site. Photo by Govinda Rosling.

Washington guillemots tend to nest in crevices on the shoreline of marine waters, often using burrows in high bluffs as nesting sites (Morse et al., 2003). Clutch size can range from 1-2 eggs, with an average of about 1.5 eggs per nest. Guillemots usually lay their eggs during May through mid-July, and hatching occurs from the end of June to early August (Vermeer et al., 1993). They are one of the only alcids with a common brood size of two instead of one, and therefore reproductive success is relatively more of challenge for this species, especially with high levels of predation or limited food supply (Vermeer et al., 1993). Their tendency to nest near foraging sites may help enable guillemots to be able to raise two chicks (Speich & Wahl, 1989). They primarily forage on benthic fish in relatively shallow nearshore waters (Ewins, 1993; Speich & Wahl, 1989). Small fish such as blennies and sculpins make up the bulk of their diet (Emms & Verbeek, 1991) but they supplement their diet with mollusks and crustaceans as well (Seattle Audubon Society, 2008).

Guillemots are common throughout the year in the Puget Sound (Fig. 25; Seattle Audubon Society, 2008).

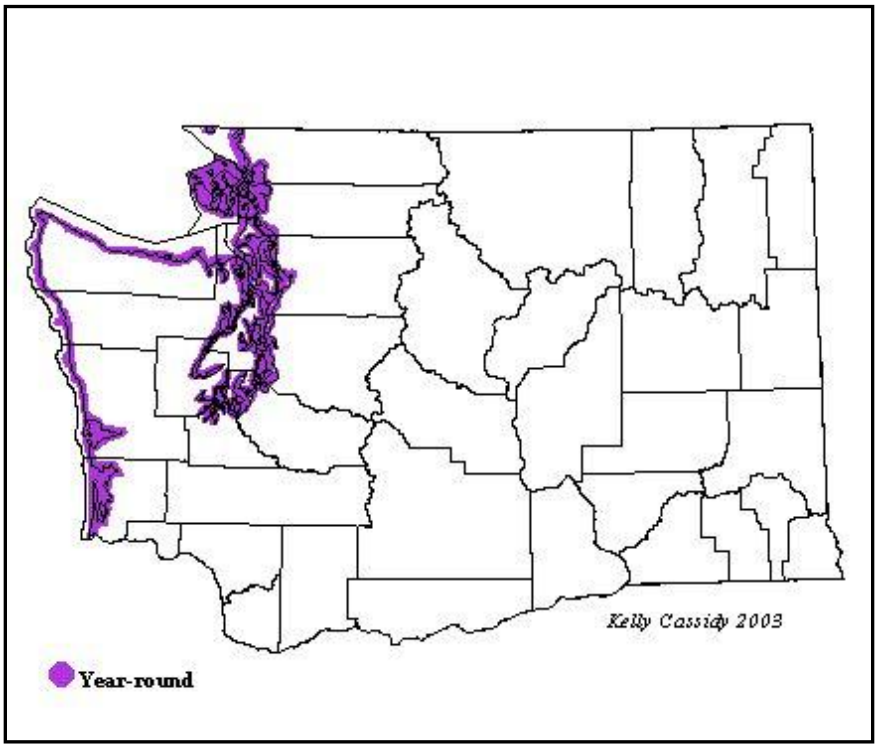


Fig. 25. Washington State Pigeon Guillemot range map © BirdWeb.org (Seattle Audubon Society, 2008).

Seattle Audubon (2008) states that guillemots are more common in the Puget Sound during winter months however PSAMP data reveals that they are more common during summer in the Nisqually Reach (Evenson et al., 2009) most likely due to high nest site availability and abundant food resources in the area. Overall mean density of guillemots during summer PSAMP surveys from 1992-1996 are shown in Fig. 26. There are muliple transects with density indices of 25-50 birds/square km in the area of the extended boundary request. The transect on the west side of Ketron Island displays a density of greater than 50 birds/square km (Evenson et al., 2009). Guillemots are not quite as prevalent in the area during winter months (Fig. 27) although the transect at the north end of Anderson Island has an average of greater than 10 birds/square km. This data indicates that some of the area within the proposed extended boundary offers abundant nesting sites and food sources during the breeding season. During the May PSSS, nine guillemots were observed at Andy's Marine Park, several of them vocalizing high-pitched whistles, possibly indicating a nesting site nearby (Morse et al., 2003; Sibley, 2003). During an unofficial May bird survey, 44 guillemots were observed throughout the waters within approximately 100 m

from Anderson Island shoreline. However, this survey was done from a small motorized fishing boat and therefore it is possible that some birds were counted more than once due to individual movements during the hour-long survey.

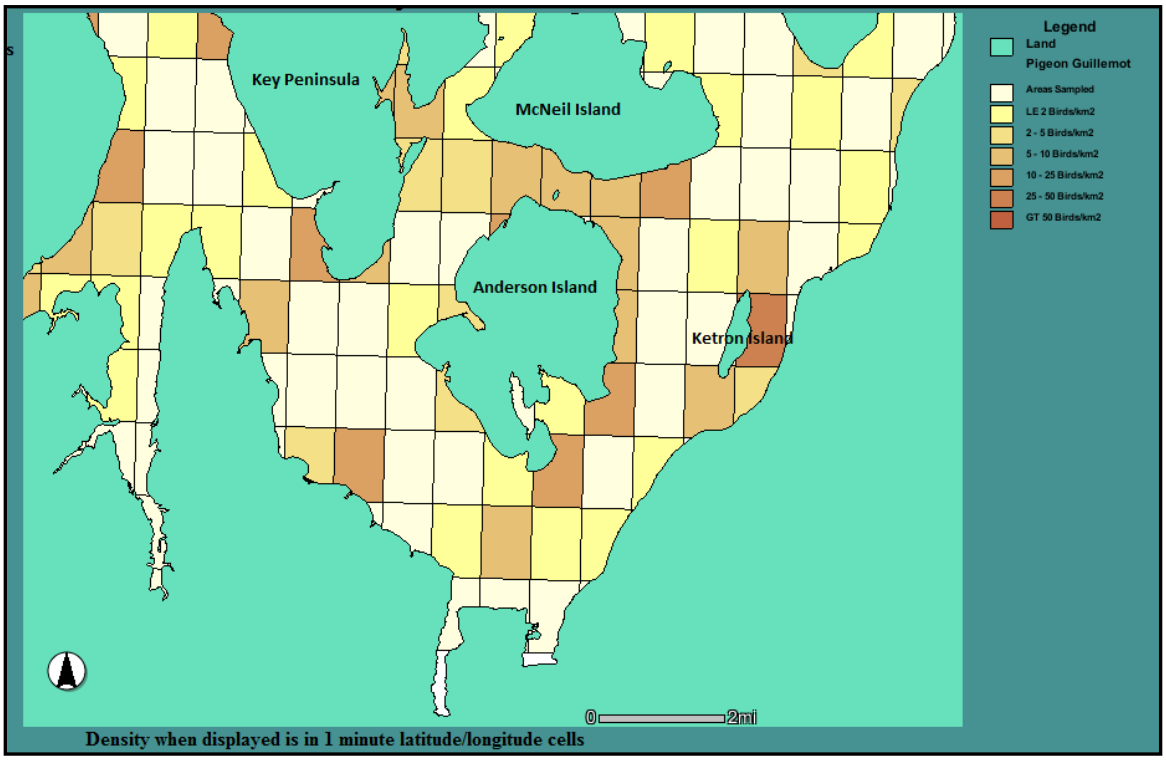


Fig. 26. Pigeon Guillemot average summer density in South Puget Sound, 1992 - 1996 (Evenson et al., 2009).

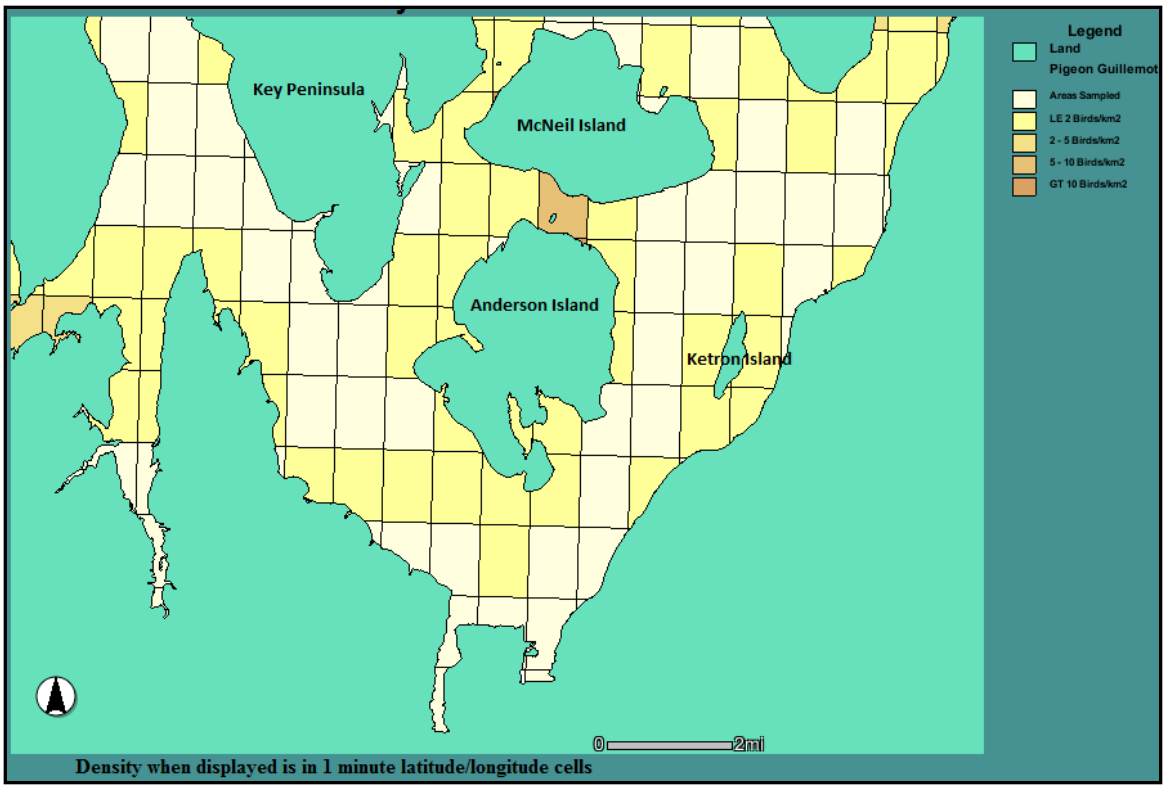


Fig. 27. Pigeon Guillemot average winter density in South Puget Sound, 1993 - 2006, 2008 - 2009 (Evenson et al., 2009).

Marbled Murrelet

The Marbled Murrelet (hereafter murrelet) is considered Federally and State Threatened by USFWS and falls under the 2010 International Union for Conservation of Nature Red List Endangered Category. It is a roundish alcid with black and white plumage during the non-breeding period (Fig. 28) and all dark brown plumage during the breeding period. Murrelets prefer mature, old-growth coniferous forest for nest sites (Rodway et al., 1993; Binford et al., 1975). They tend to nest on moss-covered large branches of Sitka spruce (*Picea sitchensis*), Western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*) at low elevation within forest with multi-layered canopies (Hamer & Nelson, 1995). During the incubation period, parent murrelets switch off sitting on the nest roughly every 24 hour hours, while the other mate of the breeding pair flies to nearby marine waters to forage for food (Bradley, 2002). They have been recorded to travel distances over 120 km from their nest to reach foraging waters (Whitworth et al., 2000). In the past century, murrelets have shifted to a lower-trophic level diet due to declines in fisheries, specifically affecting pre-breeding diets and leading to lower reproduction rates (Becker & Beissinger, 2006).

Murrelets were not observed during the PSSS, likely due to their low numbers, cryptic plumage (Binford et al., 1975) and low light movements (Rodway et al.,1993). However, one to three murrelets per square km have been documented foraging in a roughly 15 square km area of water within the proposed IBA boundary extension surrounding Ketron Island (Fig. 29; Northwest Forest Plan Interagency Regional Monitoring Program, 2008). Held largely by a sole landowner, Ketron Island is virtually undeveloped (as reviewed by Hull, 2008) and contains many coniferous trees that may provide nesting sites for murrelets. Recent radar detections of murrelets flying through the Nisqually corridor between Mount Rainer National Park and South Puget Sound indicate that the birds are more likely using the 8,000 ha of old growth forest on the west side of the mountain in the National Park as nest sites, although no nest surveys have been done in the Park (M. Reid, Mt. Rainer National Park Wildlife Ecologist, personal communication, August 2, 2010).

Fig. 28. Marbled Murrelets rafting at sea. Photo by Rick Bowers.

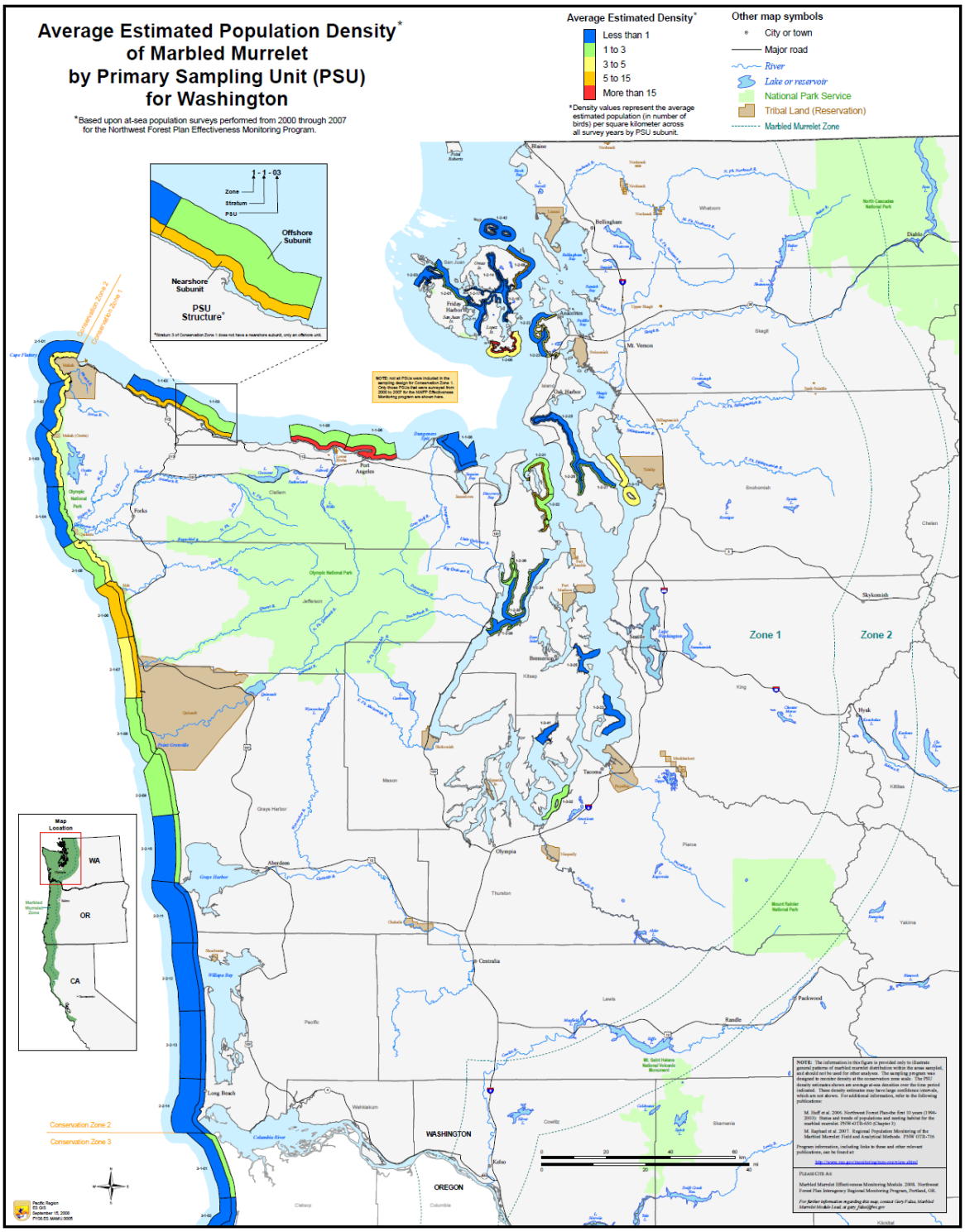


Fig. 29. Marbled Murrelet density in Washington State (Northwest Forest Plan Interagency Regional Monitoring Program, 2008).

Surf Scoter

The Surf Scoter (*Melanitta perspicillata* ; hereafter scoter) is an open-water, benthic-foraging sea duck and is the most common scoter in the Puget Sound region, especially from October to May (Seattle Audubon Society, 2008). Scoters are sexually dimorphic birds with distinctive triangular bills and wedge shaped heads. Males are mostly black with two white head-patches and a bright orange and white bill (Fig. 30). Females have a slightly less colorful bill and are mostly gray (Sibley, 2003). Populations of scoters in Puget Sound and across North America are in decline (Nysewander et al., 2005b). In response, WDFW hunting regulations have changed the bag limit from four to two scoters per day (Yuasa, 2010).

Fifty five scoters were observed during the Christmas Bird Count (CBC) on Anderson Island. Although scoters were not seen in large numbers during the Anderson Island PSSS, individuals of the species were consistently observed on the waters surrounding the island each month from January to May (Appendix H). In Puget Sound, scoters tend to forage in the nearshore shallow waters, especially those areas associated with eelgrass (as reviewed by Buchanan, 2006). They depend on marine waters during their non-breeding period, typically August to May (Fig. 31; Morse et al., 2003). While some non-breeders remain residents of Puget Sound year-round (Fig. 32), most scoters migrate north to inland lakes of Canada to breed, some leaving as early as March (Fig. 33). After breeding, scoters migrate to coastal Alaska, Washington, Oregon or back to Puget Sound to molt (Seattle Audubon Society, 2008; as reviewed by Buchanan, 2006). Their aquatic diet and flightless molting period makes scoters particularly vulnerable to toxic effects of pollutants (as reviewed by Savard et al., 1998). Scoters can be used as an indicator species because they are prone to bioaccumulation of organochlorines and heavy metal contaminents within marine and freshwater ecosystems (Eagles-Smith et al., 2009; Henny et al., 1991).

Fig. 30. Male Surf Scoter. Photo by Gerrit Vyn.

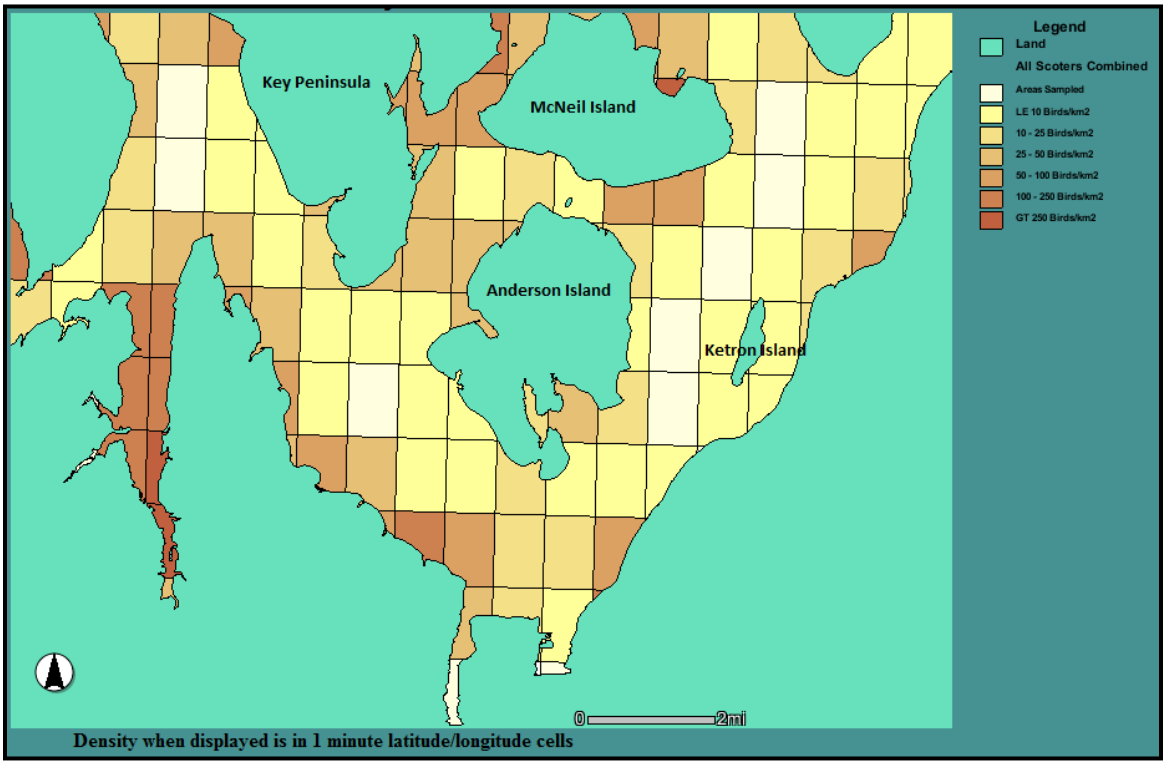


Fig. 31. Average winter density of Black Scoters, Surf Scoters and White-winged Scoters combined, 1993 - 2006, 2008 - 2009 (Evenson et al., 2009).

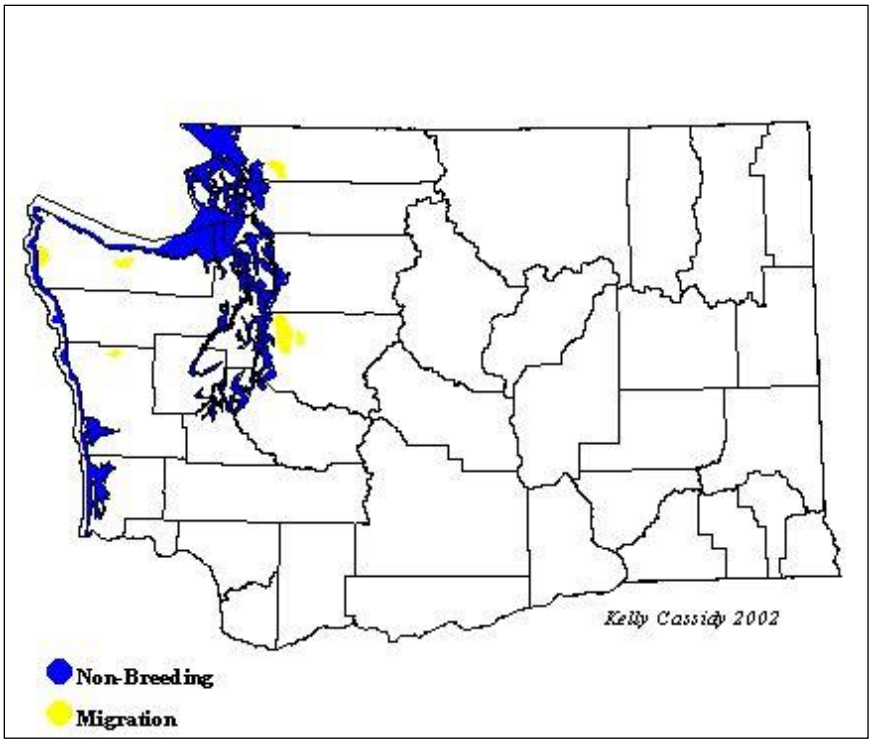


Fig. 32. Washington State Surf Scoter range map © BirdWeb.org (Seattle Audubon Society, 2008).

Fig. 33. Surf Scoter full range map. Breeding range of this species is still uncertain; dotted lines represent probable breeding range limits (Birds of North America Online).

The diet of scoters during their non-breeding period was initially thought to be primarily mollusks (Morse et al., 2003). Recent evidence suggests that scoters also depend heavily on soft-bodied prey, such as Pacific herring (*Clupea pallasi*) roe during spawning season (Anderson et al., 2008). In general, the spawning season for Washington herring begins in late January and ends in early April. Eggs are deposited on marine vegetation, such as eelgrass and kelp, commonly 0-10 ft in tidal elevation, and hatch about 14 days later (Stick & Lindquist, 2009; Washington Department of Fish and Wildlife, 1997). An overall habitat shift among Surf Scoters and White-winged Scoters has been observed in nearby Baynes Sound region, with 82% Surf Scoters moving within 2 km of active herring spawning sites (Lok et al., 2008). Herring spawning

sites may provide a prime site for aggregation and mating among certain sea duck species (Rodway et al., 2003). Foraging on accessible, energy-rich herring eggs may play a vital role in scoters' preparation for breeding, migration and reproduction (Alisaukas & Ankney, 1992). Squaxin Pass and Wollechet Bay are two documented herring spawning grounds in the vicinity of Anderson Island (Fig. 34; Stick & Lindquist, 2009). Due to threat of shoreline development, documented herring spawning grounds are protected by Washington Administrative Code Hydraulic Code Rules and managed by WDFW and local tribes (Washington Department of Fish and Wildlife, 1997). Further research is needed to investigate potential aggregations of scoters in these spawning areas.

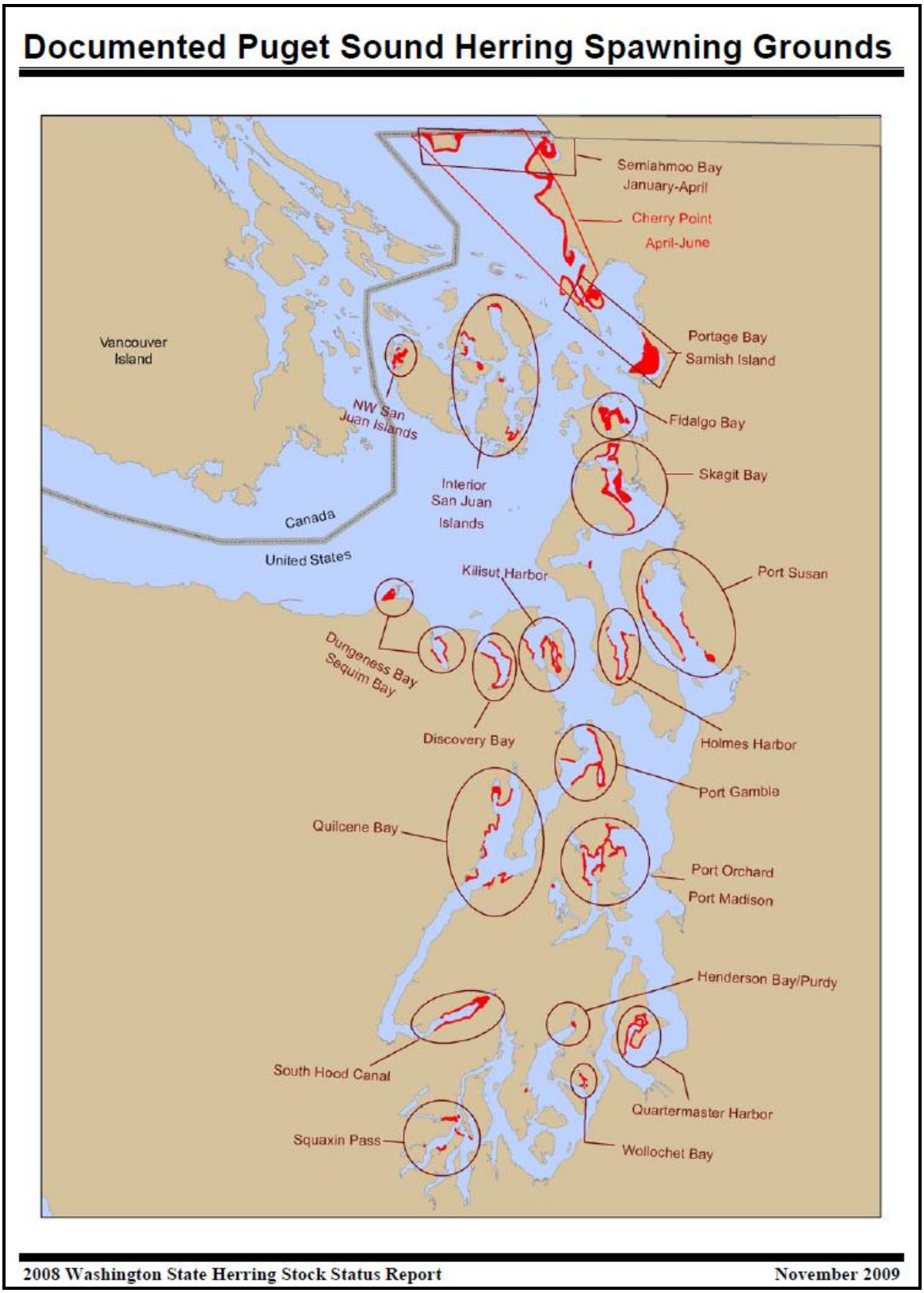


Fig. 34. Pacific herring spawning grounds in Puget Sound (Stick & Lindquist, 2009).

CONCLUSIONS AND RECOMMENDATIONS

Importance of Waterbirds

Acting as both predators and prey, waterbirds play an important balancing role in marine ecosystems. Waterbirds are often used as indicator species of overall health of an ecosystem (Paillisson et al., 2002). Their trophic level makes them prone to bioaccumulation of contaminants (Eagles-Smith et al., 2009). Colonial waterbirds are particularly sensitive to ecosystem changes and disturbance (as reviewed by Carney & Sydeman, 1999). High biodiversity is functionally important in processes of ecosystem services such as nutrient cycling and water purification. Overall biodiversity increases level of resilience of an ecosystem to catastrophic events such as oil spills or tropical storms (Chapin et al., 1997).

Marine birds also play an important role in Washington State's economy. Wildlife watching in general provides over 21,000 jobs in the state of Washington and about 1.7 billion dollars are spent each year on wildlife watching activities (Washington Department of Fish and Wildlife, 2000b). Avid bird watchers, often attracted to waterbirds, filter money through the economy via travel expenses and birding equipment. Hunting of marine birds, particularly ducks is a popular tradition and an important cultural and economical component as well. Aesthetics of birds are also appreciated by many hunters and non-hunters alike.

Recommendations

In addition to the Nisqually Delta Important Bird Area (IBA) extension request, several recommendations have been developed as a result of this study. First, there should be increased monitoring of other marine vegetation besides eelgrass and non-floating kelp in order to further understand marine vegetation composition and track changes overtime. Second, there should be increased avian monitoring in the Nisqually Reach via boat and land; the only current long-term monitoring in the area is via aerial surveys. Data from increased waterbird monitoring could assist in improved management strategies for the area. Third, there should be an inventory of Pacific herring (*Clupea pallasi*) roe in the nearshore habitat surrounding Anderson Island. This has never been done before, and it would be useful knowledge in terms of further understanding seabird-herring relationships. Finally, regarding the Puget Sound Seabird Survey protocol, it should be required (not optional) to record all waterbirds in the area during the survey, regardless of its behavior. For example, a cormorant viewed roosting on a man-made piling should be documented and counted in the official results.

Summary

The IBA extension request is justified by evidence for all four IBA Criteria. The current Nisqually Delta IBA and area within the proposed extension represents a large, relatively undisturbed, rare and natural habitat, vitally important for juvenile salmon, an ample food source for many waterbirds (as reviewed by Hull, 2008). High bluffs and abundant forage fish provide prime breeding habitat for Pigeon Guillemots (*Cepphus columba*); tidal flats rich with abundant mollusks and several nearby Pacific herring spawning sites provide prime winter and pre-migratory habitat for Surf Scoters (*Melanitta perspicillata*); and nearby coniferous old growth forest and abundant fish stocks within the Nisqually Reach provide prime nesting and foraging habitat for Marbled Murrelets (*Brachyramphus marmoratus*). The current Nisqually Delta IBA and the area within the proposed extension harbors a variety of aquatic habitats that have been documented to hold 134 bird species over time, many of conservation concern, including Bald Eagle (*Haliaeetus leucocephalus*), Red-breasted Merganser (*Mergus serrator*) and Western Grebe (*Aechmophorus occidentalis*). With bird and fish habitat quality and quantity declining at alarming rates, it is important to recognize and conserve the prime habitats that remain. Preservation and management of the Nisqually Reach is likely to benefit the South Puget Sound ecosystem as a whole (Sinclair et al., 1995). Expanding the Nisqually Delta IBA to include the Nisqually Reach has no foreseen drawbacks, and it will supplement the proposed aquatic reserve designation. An expanded IBA is likely to bring more attention to the area's overall importance to marine animal and plant populations in the Puget Sound.

REFERENCES

Alisaukas, R. T., & Ankney, C. D. (1992). The cost of egg laying and its relationship to nutrients in waterfowl. In B. D. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, & e. a. J. A. Kadlec, *Ecology and Management of Breeding Waterfowl* (pp. 30-61). Minneapolis, Minnesota: University of Minnesota Press.

Anderson, E. M., Lovvorn, J. R., & Wilson, M. T. (2008). Reevaluating marine diets of Surf and White-winged Scoters: Interspecific differences and the importance of soft-bodied prey. *The Condor* , 285-295.

Anthony, R. G., Miles, A. K., Estes, J. A., & Isaacs, F. B. (1999). Productivity, diets, and environmental contaminents in nesting Bald Eagles from the Aleutian Archipelago. *Environmental Toxicology and Chemistry , 18* (9), 2054-2062.

Audubon Washington. (2008). *Important Bird Areas in Washington.* Retrieved March 1, 2010, from Audubon Washington: Science: http://wa.audubon.org/science_IBAWashington_SelectionCriteria.html

Audubon Washington. (2010). *Science, Important Bird Areas*. Retrieved June 23, 2010, from Audubon Washington: http://wa.audubon.org/science_IBA.html

Becker, B. H., & Beissinger, S. R. (2006). Centennial decline in the trophic level of an endangered seabird after fisheries decline. *Conservation Biology , 20* (2), 470-479.

Binford, L. C., Elliott, B. G., & Singer, S. W. (1975). Discovery of a nest and the downy young of the Marbled Murrelet. *The Wilson Bulletin , 87* (3), 303-319.

Birds of North America Online. (n.d.). *Maintained by the Cornell Lab of Ornithology*. Retrieved August 3, 2010, from http://bna.birds.cornell.edu/bna

Bloch, P., & Palazzi, D. (2005). *Aquatic Reserve Program Implementation and Designation Guidance.* Retrieved August 16, 2010, from Washington Department of Natural Resources, Aquatic Reserves Program: http://www.dnr.wa.gov/Publications/aqr_rsve_guidance.pdf

Bradley, R. W. (2002). Breeding ecology of radio-marked Marbled Murrelets *Brachyramphus marmoratus* in Desolation Sound, British Columbia. *Masters Thesis, Simon Frasier University*, 1-86.

Buchanan, J. B. (2006). *Nearshore Birds in Puget Sound.* Olympia, Washington: Washington Department of Fish and Wildlife.

Carney, K. M., & Sydeman, W. J. (1999). A review of human disturbance on nesting colonial waterbirds. *Waterbirds , 22* (2), 68-79.

Chapin, F. S., Walker, B. H., Hobbs, J., Hooper, D. U., Lawton, J. H., Sala, O. E., Tilman, D. (1997). Biotic control over functioning of ecosystem services. *Science , 277* (2), 500-504.

Cullinan, T. (2001). *Important Bird Areas of Washington.* Olympia, Washington: Audubon Washington.

Department of Ecology, State of Washington. (2010). *Saving Puget Sound.* Retrieved 15 2010, July , from Department of Ecology, State of Washington: http://www.ecy.wa.gov/puget_sound/index.html

Dring, M. J. (1992). *The Biology of Marine Plants.* New York, New York: Cambridge University Press.

Eagles-Smith, C. A., Ackerman, J. T., DeLaCruz, S. E., & Takekawa, J. Y. (2009). Mercury bioaccumulation and risk to three waterbird foraging guilds is influenced by foraging ecology and breeding stage. *Environmental Pollution , 157*, 1993-2002.

Ellings, C. S., & Hodgson, S. (2007). *Niqually River estuary baseline fish ecology study: 2003-2006.* Olympia, Washington: Nisqually National Wildlife Refuge and Nisqually Indian Tribe.

Emms, S. K., & Verbeek, N. (1991). Brood size, food provisioning and chick growth in the Pigeon Guillemot *Cepphus Columba*. *The Condor, 93*, 943-951.

Evenson, J.R., D. Nysewander, B. Murphie, and T. Cyra (2009). *Marine bird densities from the inland marine waters of Washington as captured by PSAMP efforts 1992-2006, 2008-2009.* Marine Bird and Mammal Component of the Puget Sound Assessment and Monitoring Program, and Wildlife Resources Data Systems,Washington Department of Fish and Wildlife. http://wdfw.wa.gov/mapping/psamp/

Ewins, P. J. (1993). *Pigeon Guillemot (Cephus columba).* Retrieved July 13, 2010, from The Birds of North America Online: http://0-bna.birds.cornell.edu.cals.evergreen.edu/bna/species/049

Godina, L. M. (2001). Nisqually Delta . *Important Bird Areas in Washington, General Site Nomination and Data Collection Form* . Unpublished.

Good, T. P., June, J. A., Etnier, M. A., & Broadhurst, G. (2009). Ghosts of the salish sea: Threats to marine birds in Puget Sound and the Northwest straits from derelict fishing gear. *Marine Ornithology , 37*, 67-76.

Google. (2010). *Google Earth.* Retrieved July 29, 2010, from Image US Geological Service, Data SIO, NOAA, US Navy, NGA, GEBCO: http://nisquallydeltarestoration.org/

Grilliot, M. (2010). *Aquatic Reserves Status Proposed*. Retrieved July 14, 2010, from Nisqually Reach Nature Center: http://www.nisquallyestuary.org/aquatic.htm

Groom, M., Meffe, G. K., & Carroll, C. R. (2006). *Principles of Conservation Biology.* Sunderland, Massachusetts: Sinauer Associates, Inc.

Hamer, T. E., & Nelson, S. K. (1995). *Characteristics of Marbled Murrelet Nest Trees; USDA Forest Service Gen. Tech. Rep.* USDA Forest Service.

Hancock, J. (1984). *The Birds of the Wetlands.* New York: Library of Congress.

Heckman, H. (1967). *Island in the Sound.* Seattle: University of Washington Press.

Henny, C. J., Blus, L. J., Grove, R. A., & Thompson, S. P. (1991). Accumulation of trace elements and organochlorides by Surf Scoters wintering in the Pacific Northwest. *Northwestern Naturalist* , 43-60.

Hull, D. (2008). *Washington State Department of Natural Resources.* Retrieved June 26, 2010, from Nisqually Reach Aquatic Reserve Proposal: http://www.dnr.wa.gov/Publications/aqr_ac_nisquallyreach_proposal.pdf

Kruckeberg, A. R. (1991). *The Natural History of Puget Sound Country.* Seattle, Washington: University of Washington Press.

Lok, E. K., Kirk, M., Esler, D., & Boyd, W. S. (2008). Movements of Pre-migratory Surf and White Winged Scoters in response to Pacific herring spawn. *Waterbirds , 31* (3), 385-393.

Marine Bird and Mammal Component of the Puget Sound Assessment and Monitoring Program, and Wildlife Resources Data Systems, Washington Department of Fish and Wildlife (n.d.). Received June 3. Bathymetry for Puget Sound, *GIS layer* from Joe Evenson, Marine Biologist.

McIvor, D. (2009). Science Coordinator, Washington Audubon Society. Received Fall 2009.

Morse, B., Aversa, T., & Opperman, H. (2003). *Birds of the Puget Sound Region.* Olympia: R. W. Morse Company.

Murphy, M. L., Johnson, S. W., & Csepp, D. J. (2000). A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. *Alaska Fishery Research Bulletin , 7*, 11-21.

National Audubon Society. (2010). *The 110th Christmas Bird Count: Citizen Science in Action*. Retrieved from Audubon: http://www.audubon.org/bird/cbc/index.html

Northwest Forest Plan Interagency Regional Monitoring Program. (2008). *Marbled Murrelet Reports and Publications.* Northwest Forest Plan Interagency Regional Monitoring Program. Retrieved July 16, 2010, from: http://www.reo.gov/monitoring/reports/murrelet/WA_PSU_density_00_07_detailed.pdf

Nysewander, D. R., Evenson, J. R., Murphie, B. L., & Cyra, T. A. (2005a). *Report of marine bird and marine mammal component, Puget Sound Ambient Monitoring Program, for July 1992 to December 1999 period.* Olympia, Washington: Washington Department of Fish and Wildlife, Wildlife Management Program.

Nysewander, D. R., J.R. Evenson, B. M., Cyra, T., Kraege, D., Hall, B., & Lambourn., D. (2005b). *Scoter Satellite Telemetry Project in Puget Sound.* Retrieved July, 18, 2010 from Washington Department of Fish and Wildlife, Puget Sound Ambient Monitoring Program: http://wdfw.wa.gov/wlm/psamp/scoters/

Nysewander, D., Stein, J., & Jefferies, S. (1993). *Implementation Plan for Marine Bird, Waterfowl, and Marine Mammal Monitoring in the Puget Sound Ambient Monitoring Program.* Olympia, Washington: Washington Department of Wildlife, Wildlife Management Division.

Office of Financial Management, State of Washington. (2009). *Washington State Population Information for Growth Management*. Retrieved July 27, 2010, from Office of Financial Management, State of Washington: http://www.ofm.wa.gov/pop/gma/default.asp

Office of Social and Economic Data Analysis , Univ. of Missouri Outreach & Extension . (2000). *MCDC Demographic Profile 3, 2000 Census, Anderson Island, WA 98303.* Columbia: Missouri Census Data Center.

Paillisson, J. M., Reeber, S., & Marion, L. (2002). Bird assemblages as bio-indicators of water regime management and hunting disturbance in natural wet grasslands. *Biological Conservation , 106* (1), 115-127.

Parnell, J. F., Ainley, D. G., Blokpoel, H., Cain, B., Custer, T. W., Dusi, J. L., Kress, S., Kushlan, J. A., Southern, W. E., Stenzel, L. E., Thompson, B. C. (1988). Colonial waterbird management in North America. *Colonial Waterbirds , 11* (2), 129-169.

People for Puget Sound. (2010). *Save Our Sound*. Retrieved July 15, 2010, from People for Puget Sound: http://pugetsound.org/

Petry, M. V., & Fonseca, V. S. (2002). Effects of human activities in the marine environment on seabirds along the cost of Rio Grande do Sul, Brazil. *Ornitologia Neotropical , 13*, 137-142.

Rodway, M. S., Regehr, H. M., Ashley, J., Clarkson, P. V., Goudie, R. I., Hay, D. E., Smith, C. M., Wright, K. G. (2003). Aggregative response of Harlequin Ducks to herring spawning in the Strait of Georgia, British Columbia. *Canadian Journal of Zoology , 81* (3), 501-514.

Rodway, M. S., Regehr, H. M., & Savard, J.-P. L. (1993). Activity patterns of Marbled Murrelets in old-growth forest in the Queen Charlotte Islands, British Columbia. *The Condor , 95* (4), 831-848.

Savard, J.-P. L., Bordage, D., & Reed, A. (1998). *Surf Scoter, Melanitta perspicillata.* Retrieved July 14, 2010, from The Birds of North America Online (A. Poole, Ed.); Ithaca: Cornell Lab of Ornithology: http://0-bna.birds.cornell.edu.cals.evergreen.edu/bna/species/363/articles/introduction

Seattle Audubon Society. (2010). *Puget Sound Seabird Survey site locations.* Retrieved from Science Manager Adam Sedgley on April 20, 2010.

Seattle Audubon Society. (2009). *Puget Sound Seabird Survey Protocol.* Retrieved from http://www.seattleaudubon.org/sas/Portals/0/Science/Puget_Sound_Seabird_Survey/PSSS_Protocol_09-10.pdf

Seattle Audubon Society. (2008). *Bird Web*. Retrieved July 9, 2010, from http://www.seattleaudubon.org/birdweb/

Sibley, D. A. (2003). *The Sibley Field Guide to Birds of Western North America.* New York: Chanticleer Press.

Sinclair, A. R., Hik, D. S., Schmitz, O. J., Scudder, G. G., Turpin, D. H., & Larter, N. C. (1995). Biodiversity and the need for habitat renewal. *Ecological Application , 5* (3), 579-587.

Speich, S. M., & Wahl, T. R. (1989). *Catalog of Washington Seabird Colonies.* Washington, DC: Washington Department of Fish and Wildlife.

Stick, K. C., & Lindquist, A. (2009). *2008 Washington State Herring Stock Status Report.* Washington Department of Fish and Wildlife, Fish Program, Fish Management Division.

Susewind, K. (2008, June 20). *2008 Washington State Water Quality Assessment.* Retrieved July 15, 2010, from Department of Ecology, State of Washington: http://www.ecy.wa.gov/programs/wq/303d/2008/EPASubmittalLetter.pdf

US Fish and Wildlife Service. (2005). *Nisqually National Wildlife Refuge Final Comprehensive Conservation Plan.* Olympia, Washington: US Fish and Wildlife Service, Region 1.

US Fish and Wildlife Service; Nisqually Tribe; Ducks Unlimited; US Geological Service. (2010). Retrieved June 23, 2010, from Nisqually Delta Restoration: http://nisquallydeltarestoration.org/index.php

Van Cleve, B., Styring, A., Smith, J., Floberg, J., Bloch, P., Myers, D., Hull, D., Johnannes, J., Mumford, T. (2009a). *2009 Technical Advisory Committee Recommendations, Proposed Nisqually Reach Aquatic Reserve.* Retrieved July 14, 2010, from Washington State Department of Natural Resources: http://www.dnr.wa.gov/Publications/aqr_ac_nisquallyreach_2009tac_rcmd.pdf

Van Cleve, B., Strying, A., Smith, J., Floberg, J., Bloch, P., Murphy, K., Bookheim, B., Mumford, T., Hull, D., Myers, D. (2009b). 2009 Technical Advisory Committee Site Visit Notes, Nisqually Reach. *Washington State Department of Natural Resources.* Olympia, Washington.

Van Pelt, R. (2007). *Identifying Mature and Old Forests in Western Washington.* Olympia, Washington: Washington State Department of Natural Resources.

Vermeer, K., Morgan, K. H., & Smith, G. E. (1993). Nesting biology and predation of Pigeon Guillemots in the Queen Charlotte Island, British Columbia. *Colonial Waterbirds , 16* (2), 119-127.

Wahl, T. R., Speich, S. M., Manuwal, D. A., Hirsch, K. V., & Miller, C. (1981). *Marine bird populations of the Strait of Juan de Fuca, Strait of Georgia and adjacent waters in 1978 and 1979.* Seattle, Washington: Washington University, Seattle. College of Forest Resources.

Washington Department of Fish and Wildlife. (2010). *Wildlife Management, Endangered Species*. Retrieved July 15, 2010, from Washington Department of Fish and Wildlife: http://wdfw.wa.gov/wildlife/management/endangered.html

Washington Department of Fish and Wildlife, Priority Habitats and Species. (n.d.) *Digital Data for Anderson Island and Vicinity*. Olympia, Washington. Received from Data Release Manager Lori Guggenmos on April 13, 2010.

Washington Department of Fish and Wildlife. (2000a). *Chum Salmon*. Retrieved August 1, 2010, from Chum Salmon Life History: http://wdfw.wa.gov/fish/chum/chum-3.htm

Washington Department of Fish and Wildlife. (2000b). *Watchable Wildlife Industry*. Retrieved July 18, 2010, from Washington Department of Fish and Wildlife: http://wdfw.wa.gov/viewing/watchwld/watchwld.htm

Washington Department of Fish and Wildlife. (1997). *Herring*. Retrieved 12 2010, July , from Forage Fish Biology: http://wdfw.wa.gov/fish/forage/herring.htm

Wells, J. V., Niven, D. K., & Cecil, J. (2005). The Important Bird Areas program in the United States: Building a network of sites for conservation, state by state. *USDA Forest Service Gen Tech. Rep. PSW-GTR-191*, 1265-1269.

Whitworth, D. L., Nelson, S. K., Newman, S. H., VanVliet, G. B., & Smith, W. P. (2000). Foraging distances of radio-marked Marbled Murrelets from inland areas in southeast Alaska. *The Condor , 102* (2), 452-456.

Yuasa, M. (2010). General duck hunting season begins on Oct. 16. *The Seattle Times*, Retrieved August 18, 2010 from: http://seattletimes.nwsource.com/html/othersports/2012625279_outn15.html

APPENDIX A

Letter to Audubon Washington

Washington State IBA Technical Committee
c/o Don McIvor
Audubon Washington
129 Old Twisp Hwy
Twisp, WA 98856-9773

September 3, 2010

To: Washington State IBA Technical Committee:

I am a graduate student at The Evergreen State College in the Master of Environmental Studies program. My thesis, titled *Evidence to Support a Boundary Expansion of the Nisqually Delta Important Bird Area to include the Shores and Bluffs of Anderson Island, Washington* is enclosed.

I am writing this letter to request an expansion of the current boundary of the Nisqually Important Bird Area (IBA). There are two options for an expanded IBA. The first (Option 1) is laid out in my enclosed thesis, and suggests a boundary expansion that would mirror the proposed aquatic reserve for the Nisqually Reach. The other option (Option 2) suggests a smaller expansion; to expand the current IBA boundary northward to include part of the Nisqually Reach, and the bluffs, shoreline and waters within one kilometer of Anderson Island. The two options are discussed further below.

Option 1

The proposed IBA boundary expansion extends the current IBA roughly 6000 ha and mirrors the proposed aquatic reserve boundary for the Nisqually Reach (which overlaps with the current IBA). The legal description for the proposed aquatic reserve is pending. Depending on that description, the proposed extended IBA may go beyond the aquatic reserve proposal to include the high tide shorelines and bluffs of Anderson Island, Ketron Island, Eagle Island, southern end of McNeil Island and segments of Thurston County and Pierce County. An extended IBA would provide overall ecological connectivity of relatively pristine and representative habitats including high bluffs, tidal flats, salt marshes and deep waters (support for Criterion 2; see Figure 1). Therefore, it would support a greater diversity of bird species, particularly alcids, grebes and cormorants (Table 1). The area is also vitally important for juvenile salmon that exit the Nisqually River system as young fry and seek food and refuge in the marine vegetation of the nearshore habitat of Anderson Island and nearby shorelines before migrating out to sea, providing an ample food supply for waterbirds in the area.

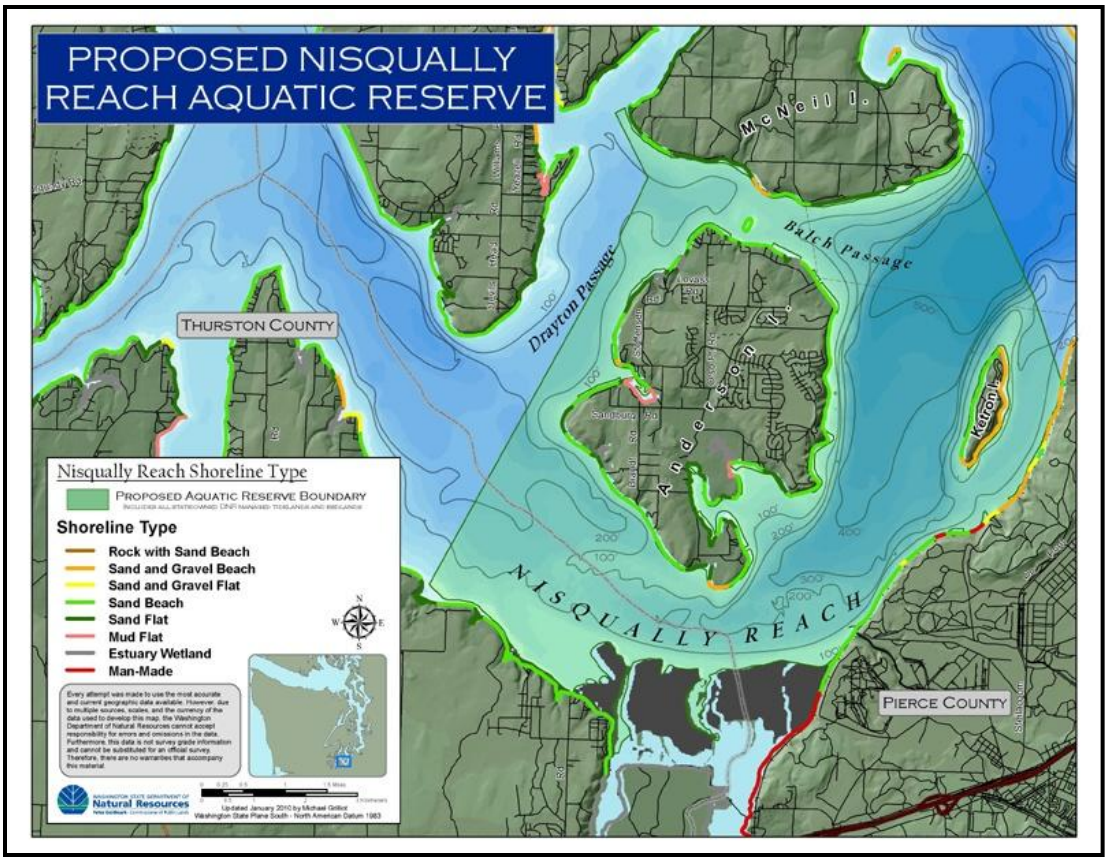


Figure 1. Shoreline habitat types within the Nisqually Reach region (Grilliot, 2010).

Table 1. Observations of marine birds in the proposed extended IBA

Species Name	Species Status	Month	Year	Count	Types of Birds	Data Quality	Principal Data Collector	Source	Criteria
Horned Grebe	W	Dec.	2009	55	A	Good	Raab	5	1
Red-necked Grebe	W	Mar.	2010	25	A	Good	Raab	4	1
Western Grebe	W	Mar.	2010	25	A	Good	Raab	4	1
Brandt's Cormorant	R	Jan.	2010	7	A	Good	Raab	4	1
Double-crested Cormorant	R	Feb.	2010	11	A	Good	Raab	4	1
Pelagic Cormorant	R	Dec.	2009	16	A	Good	Raab	5	1

Surf Scoter	W	Dec.	2009	55	A	Good	Raab	5	1
Red-breasted Merganser	W	Jan.	2010	97	U	Good	Raab	3	1
Common Murre	R	June	2009	30	A	Good	Styring	1	4iv
Pigeon Guillemot	R	May	2010	44	B	Good	Raab	2	4iv

Sources:
[1]Aquatic Reserves Technical Committee site visit, June 9, 2009
[2]Boat survey around Anderson Island, May 13, 2010
[3]Puget Sound Seabird Survey, Andy's Marine Park, Anderson Island, 2010
[4]Puget Sound Seabird Survey, Ferry Dock, Anderson Island, 2010
[5]Christmas Bird Count, Anderson Island, Dec. 20, 2009

The area within the proposed extended boundary appears to be particularly important due to the significant amount of high bluffs providing prime nesting habitat for Pigeon Guillemots (*Cepphus columba*). Surf Scoters (*Melanitta perspicillata*) are common to the area, perhaps due to the abundant food sources such as Pacific herring (*Clupea pallasi*) roe. Marbled Murrelets (*Brachyramphus marmoratus*) have been documented in parts of the area, theoretically using the Nisqually River as a corridor between potential nesting grounds at Mount Rainer National Park and foraging waters of the South Puget Sound (support for Criteria 1 and 4iv).

The majority of extended IBA is open marine waters of the state (roughly 85%). The remaining 15% of the area consists of pocket estuaries, shorelines, bluffs and aquatic tidelands owned by Washington Department of Natural Resources, Nisqually National Wildlife Refuge, Washington Department of Fish and Wildlife, Fort Lewis, Burlington Northern Railroad, National Oyster Company, Tolmie State Park and numerous private entities. A draft management plan for the proposed aquatic reserve is scheduled to be finalized by the end of late summer, and then will go through the State Environmental Policy Act public review process. A final decision on the aquatic reserve designation of the site will likely be made sometime in September or October, 2010. If the designation is approved, the aquatic reserve will be managed by Washington Department of Natural Resources (as reviewed by Hull, 2008).

Land uses of the area include wildlife conservation, recreation, fishing, hunting, aquaculture, and residential. Conservation lands in the vicinity include Tolmie State Park (42 ha), Fort Lewis (20,000 ha Douglas-fir forest, 8,200 ha prairies and open grassland, 1,500 ha oak woodland and oak-mixed woodland, 1,800 ha wetland) Mount Rainer National Park (95,000 ha), Nisqually National Wildlife Refuge (1,200 ha), Anderson Island Parks (130 ha), McNeil Island wildlife refuge (1,200 ha) and parts of Thurston and Pierce County shorelines. Threats are listed and ranked in Table 2.

Table 2. Threats to birds in the Nisqually Reach

Threat	Level	Notes
Storm water runoff	High	Impervious surfaces and high rainfall events cause a variety of contaminants to wash into Puget Sound.
Joint Base Lewis/McChord sewage treatment plant at Solo Point	High	Discharges a large amount of treated and/or raw sewage into the Sound.
Aquaculture	High	National Oyster Company (located in the current IBA boundary) and several private aquatic operations may cause damage to natural benthic communities.
Shoreline development	Medium	Development particularly threatens the shoreline and nearshore habitat of McNeil Island. It has remained largely undeveloped due to the State Corrections Center that was first built on the island in the late 1800s. However, the prison is in the process of closure, and therefore the natural and pristine state of the ecosystem is at risk.
Hunting	Low/Medium	Waterfowl hunting is allowed in certain areas within the Nisqually Delta and Reach. Regulations for decreased bag limits allow for relatively low risk to overall population numbers.
Dredged material disposal site	Low	Regulations ensure relatively low impact to overall ecosystem.

Option 2

This proposed extension would expand the current Nisqually Delta IBA directly northward to include the part of the Nisqually Reach between the current IBA and Anderson Island, as well as the bluffs, shoreline and nearshore habitat surrounding Anderson Island out to one km. This option would expand the current IBA roughly 1,500 ha. The extended area is about 80% open marine water (owned by DNR), and the remaining 20% is high bluffs and nearshore habitat including pocket estuaries, tidal flats and shoreline (mostly owned by private entities and the Anderson Island Parks Department). This expansion would also ensure ecological connection between the Nisqually Delta and the nearshore habitat of Anderson Island. However, the foraging area with documented sightings of Marbled Murrelets is not included in this option. Further, the

other shorelines in the area (that are not included in this option) are most likely important for juvenile salmon as well.

The nearby conservation lands are the same as the first option. Threats change slightly; the dredged material disposal site is not included in the proposed boundary for Option 2 (however it is still very nearby). The threat of shoreline development on Anderson Island is low due to zoning regulations and lack of developable land due to high bluffs and existing houses. Threats due to aquaculture, storm water runoff, sewage treatment plant discharge, and hunting remain the same level, regardless of the option.

There are pros and cons to both options described above. I personally recommend Option 1 because the entire Reach represents prime bird habitat, and it holds many species of conservation concern, several in significant numbers, including Marbled Murrelet. Option 1 would supplement the proposed aquatic reserve designation in the area to further protect and recognize prime aquatic habitats within southern Puget Sound.

Please let me know if you have any questions or concerns. Feel free to contact me at 612-309-9932 or raablk@gmail.com. I appreciate all of your time and efforts.

Thank you,

Lindsay Raab
Graduate Student
Master of Environmental Studies Program
The Evergreen State College

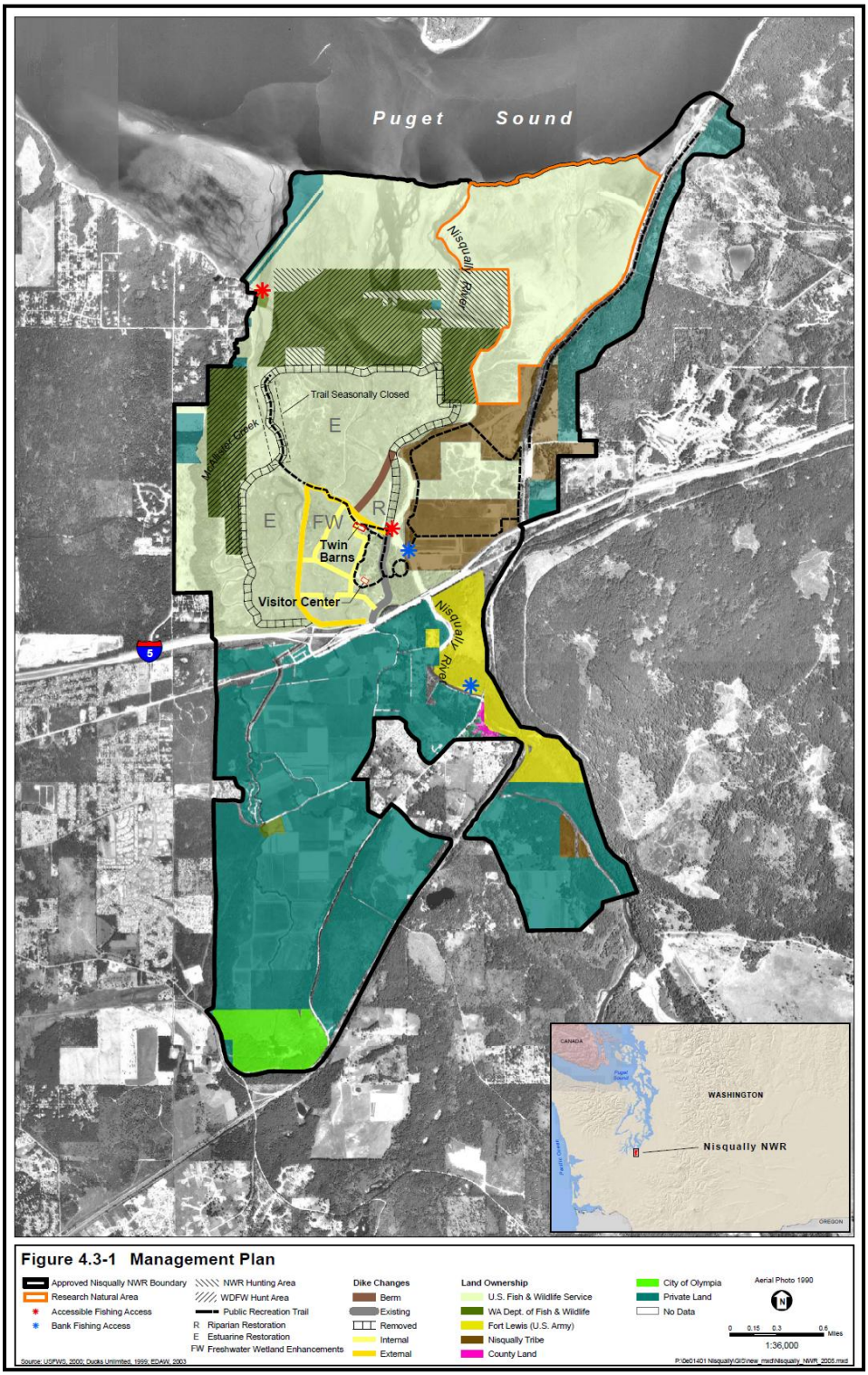
References:

Grilliot, M. (2010). *Aquatic Reserves Status Proposed*. Retrieved July 14, 2010, from Nisqually Reach Nature Center: http://www.nisquallyestuary.org/aquatic.htm

Hull, D. (2008). *Washinton State Department of Natural Resources.* Retrieved June 26, 2010, from Nisqually Reach Aquatic Reserve Proposal: http://www.dnr.wa.gov/Publications/aqr_ac_nisquallyreach_proposal.pdf

APPENDIX B

Map of Nisqually National Wildlife Refuge Comprehensive Conservation Plan (US Fish and Wildlife Service, 2005).



APPENDIX C

Bird Species List for Nisqually Reach Aquatic Habitats

The 134 species listed below have been observed in the Nisqually Reach region and can be associated with aquatic habitats including estuary, mudflats, salt and freshwater marshes, pond, riparian, rocky or sandy beach, nearshore, or open marine water (according to Bird Web, Seattle Audubon, 2008). Data compiled by author in cooperation with Washington State Department of Natural Resources Aquatic Reserves Program staff in 2010.

Common Name	Scientific Name	Notes
Red-throated Loon	*Gavia stellata*	1, 2, 4
Pacific Loon	*Gavia pacifica*	1, 2, 4, 5
Common Loon	*Gavia immer*	1, 2, 3, 4, 5, 6
Yellow-billed Loon**	*Gavia adamsii*	2, 4
Pied-billed Grebe*	*Podilymbus podiceps*	1, 2, 4, 7
Horned Grebe	*Podiceps auritus*	1, 2, 3, 4, 5, 6, 7
Red-necked Grebe	*Podiceps grisegena*	1, 2, 3, 4, 5
Eared Grebe	*Podiceps nigricollis*	2, 4
Western Grebe	*Aechmophorus occidentalis*	1, 2, 3, 4, 5
Laysan Albatross**	*Phoebastria immutabilis*	4
Short-tailed Shearwater**	*Puffinus tenuirostris*	4
Leach's Storm Petrel**	*Oceanodroma leucorhoa*	4
American White Pelican**	*Pelecanus erythrorhynchos*	1, 4
Brown Pelican**	*Pelecanus occidentalis*	4
Brant's Cormorant	*Phalacrocorax penicillatus*	2, 4, 5
Double-crested Cormorant	*Phalacrocorax auritus*	1, 2, 3, 4, 5, 6, 7
Pelagic Cormorant	*Phalacrocorax pelagicus*	1, 2, 3, 4, 5
American Bittern*	*Botaurus lentiginosus*	4, 7
Great Blue Heron*	*Ardea herodias*	1, 2, 3, 4, 5, 6, 7
Great Egret	*Ardea alba*	4
Green Heron*	*Butorides virescens*	4, 7
Turkey Vulture	*Cathartes aura*	4
Snow Goose	*Chen caerulescens*	4
Greater White-fronted Goose	*Anser albifrons*	4, 6, 7
Canada x Greater White-fronted Goose***	*Anser albifrons* x *Branta canadensis*	7
Canada Goose*	*Branta canadensis*	1, 2, 3, 4, 5, 6, 7
Cackling Goose	*Branta hutchinsii*	6, 7
Brant	*Branta bernicla*	1, 2, 4, 6
Trumpeter Swan	*Cygnus buccinator*	4
Tundra Swan	*Cygnus columbianus*	4

Wood Duck*	*Aix sponsa*	4
Gadwall*	*Anas strepera*	1, 4, 6, 7
Eurasian Wigeon	*Anas penelope*	2, 3, 4, 6, 7
American Wigeon	*Anas americana*	1, 2, 3, 4, 6, 7
Mallard*	*Anas platyrhynchos*	1, 2, 3, 4, 5, 6, 7
Blue-winged Teal*	*Anas discors*	4
Cinnamon Teal*	*Anas cyanoptera*	4
Northern Shoveler*	*Anas clypeata*	4, 6, 7
Northern Pintail*	*Anas acuta*	1, 2, 4, 6, 7
Green-winged Teal*	*Anas crecca*	1, 4, 6, 7
Canvasback	*Aythya valisineria*	2, 4
Ring-necked Duck*	*Aythya collaris*	1, 3, 4, 6, 7
Lesser Scaup	*Aythya affinis*	2, 4
Greater Scaup	*Aythya marila*	1, 2, 4
Harlequin Duck	*Histrionicus histrionicus*	2
Surf Scoter	*Melanitta perspicillata*	1, 2, 3, 4, 5, 6, 7
White-winged Scoter	*Melanitta fusca*	1, 2, 3, 4
Black Scoter	*Melanitta nigra*	2, 4
Long-tailed Duck	*Clangula hyemalis*	2, 4
Bufflehead	*Bucephala albeola*	1, 2, 3, 4, 5, 6, 7
Common Goldeneye	*Bucephala clangula*	1, 2, 3, 4, 5, 6, 7
Barrow's Goldeneye	*Bucephala islandica*	1, 2, 4, 5
Hooded Merganser*	*Lophodytes cucullatus*	1, 3, 4, 6, 7
Common Merganser	*Mergus merganser*	1, 3, 4, 6, 7
Red-breasted Merganser	*Mergus serrator*	1, 3, 4, 5, 6, 7
Ruddy Duck	*Oxyura jamaicensis*	4
Osprey	*Pandion haliaetus*	1, 4, 7
White-tailed Kite**	*Elanus leucurus*	4
Bald Eagle*	*Haliaeetus leucocephalus*	1, 3, 4, 5, 6, 7
Sharp-shinned Hawk	*Accipiter striatus*	4
Red-shouldered Hawk**	*Buteo lineatus*	4
Rough-legged Hawk	*Buteo lagopus*	4
Merlin**	*Falco columbarius*	4, 7
Gyrfalcon**	*Falco rusticolus*	4
Peregrine Falcon	*Falco peregrinus*	4, 5, 6, 7
Virginia Rail*	*Rallus limicola*	4
Sora**	*Porzana carolina*	4
American Coot*	*Fulica americana*	1, 4, 7
Sandhill Crane	*Grus canadensis*	4
Black-bellied Plover**	*Pluvialis squatarola*	4

American Golden Plover**	*Pluvialis dominica*	4
Semipalmated Plover	*Charadrius semipalmatus*	4
Killdeer*	*Charadrius vociferus*	1, 4, 6, 7
Black-necked Stilt**	*Himantopus mexicanus*	4
American Avocet**	*Recurvirostra americana*	4
Greater Yellowlegs	*Tringa melanoleuca*	1, 4
Lesser Yellowlegs	*Tringa flavipes*	4, 7
Willet**	*Tringa semipalmata*	4
Spotted Sandpiper*	*Actitis macularius*	3, 4
Whimbrel**	*Numenius phaeopus*	1, 4
Red Knot**	*Calidris canutus*	4
Sanderling**	*Calidris alba*	4
Western Sandpiper	*Calidris mauri*	1, 4, 6
Least Sandpiper	*Calidris minutilla*	1, 4, 7
Baird's Sandpiper**	*Calidris bairdii*	4
Pectoral Sandpiper	*Calidris melanotos*	4
Sharp-tailed Sandpiper**	*Calidris acuminata*	4
Dunlin	*Calidris alpina*	1, 3, 4, 7
Short-billed Dowitcher	*Limnodromus griseus*	4
Long-billed Dowitcher	*Limnodromus scolopaceus*	4, 7
Common Snipe***	*Gallinago gallinago*	4
Wilson's Snipe	*Gallinago delicata*	7
Wilson's Phalarope*&**	*Phalaropus tricolor*	4
Red-necked Phalarope	*Phalaropus lobatus*	4
Parasitic Jaeger	*Stercorarius parasiticus*	4
Franklin's Gull**	*Larus pipixcan*	4
Black-headed Gull**	*Larus ridibundus*	4
Bonaparte's Gull	*Larus philadelphia*	1, 4, 6
Heermann's Gull	*Larus heermanni*	4
Mew Gull	*Larus canus*	1, 4, 5, 6, 7
Ring-billed Gull	*Larus delawarensis*	1, 4, 6, 7
California Gull	*Larus californicus*	7
Herring Gull	*Larus argentatus*	1, 4, 7
Thayer's Gull	*Larus thayeri*	4
Slaty-backed Gull**	*Larus schistisagus*	4
Western Gull	*Larus occidentalis*	1, 3, 4, 6, 7
Glaucous-winged Gull	*Larus glaucescens*	1, 3, 4, 5, 6, 7
Glaucous-winged x Western Gull	*Larus sp.*	1, 4, 5, 6, 7
Glaucous Gull**	*Larus hyperboreus*	4
Caspian Tern	*Hydroprogne caspia*	1, 4, 7

Common Tern	*Sterna hirundo*	4
Common Murre	*Uria aalge*	1, 4
Pigeon Guillemot	*Cepphus columba*	1, 3, 4, 5
Marbled Murrelet	*Brachyramphus marmoratus*	1, 4
Ancient Murrelet**	*Synthliboramphus antiquus*	4
Rhinoceros Auklet	*Cerorhinca monocerata*	4
Band-tailed Pigeon*	*Patagioenas fasciata*	4
Barn Owl*&**	*Tyto alba*	4
Short-eared Owl*	*Asio flammeus*	4, 7
Vaux's Swift	*Chaetura vauxi*	4, 7
Belted Kingfisher	*Megaceryle alcyon*	1, 3, 4, 5, 6, 7
Willow Flycatcher*	*Empidonax traillii*	7
Northwest Crow	*Corvus caurinus*	1, 3, 4, 5, 6, 7
Tree Swallow*	*Tachycineta bicolor*	4, 7
Violet-green Swallow*	*Tachycineta thalassina*	1, 4, 7
Northern Rough-winged Swallow*	*Stelgidopteryx serripennis*	4
Bank Swallow**	*Riparia riparia*	4
Cliff Swallow*	*Petrochelidon pyrrhonota*	4
Barn Swallow*	*Hirundo rustica*	4
Marsh Wren*	*Cistothorus palustris*	4, 6, 7
Red-winged Blackbird*	*Agelaius phoeniceus*	4, 6, 7
Purple Martin	*Progne subis*	1
American Goldfinch	*Carduelis tristis*	7

*Evidence of species breeding on the Nisqually National Wildlife Refuge at least once since 1975
** Listed as rare, uncommon, or not listed for the Puget Trough region for all 12 months (Seattle Audubon, Bird Web)
*** Information on this species is not on Bird Web, Seattle Audubon website

Notes:

1- Data collected from Nisqually Reach Nature Center displays and education materials throughout years 2002-2010 by Washington Department of Natural Resources (DNR) Aquatic Reserves Program staff.

2- Black Hills Audubon Society Christmas Bird Count Data from roughly 1994-2009. Data received by DNR Aquatic Reserves Program staff from Black Hill's Audubon Member George Walter in 2010.

3- Tahoma Audubon Society's trial Christmas Bird Count on Anderson Island, 2009. Data collected by author.

4- Documented sighting of species in the Nisqually National Wildlife Refuge (NWR) at least once since 1975. Data from Nisqually NWR Comprehensive Conservation Plan, Appendix E, 2005.

5- Puget Sound Seabird Survey data, Anderson Island Andy's Marine Park and Ferry Dock sites, January-May, 2010. Data collected by author.

6- US Geological Survey (USGS) Delta Wide Survey at the Nisqually NWR, January, 2010. Data received by author from Restoration Biologist Kelly Turner on July 21, 2010.

7- USGS monthly surveys at the Nisqually NWR, September 2009 - March 2010. Surveyed area was restricted to footprint of the old dike. Data retrieved by author from the Nisqually Delta Restoration website at http://nisquallydeltarestoration.org/science_birds.php on June 23, 2010.

APPENDIX D

Marine Mammals and Bats in the Nisqually Reach

Marine mammal and bat species list for proposed Nisqually Reach Aquatic Reserve. Data compiled by Washington Department of Natural Resources (DNR) Aquatic Reserves Program staff in 2010.

Common Name	Scientific Name	Notes
Pacific Harbor Seal	*Phoca vitulina*	1, 3, 4
California Sea Lion	*Zalophus californianus*	1, 2, 3, 4
Northern Sea Lion	*Eumetopias jubatus*	1, 2, 3, 4
Killer Whale	*Orcinus orca*	1, 2, 3, 4
False Killer Whale	*Pseudorca crassidens*	1, 2
Gray Whale	*Eschrichtius robustus*	1, 2, 3, 4
Minke Whale	*Balaenoptera acutorostrata*	1, 2, 3, 4
Harbor Porpoise	*Phocoena phocoena*	1, 3, 4
Yuma Myotis	*Myotis yumanensis*	2, 5
Little Brown Myotis	*Myotis lucifugus*	2, 5
Long-eared Myotis	*Myotis evotis*	2, 5
Long-legged Myotis	*Myotis volans*	5
Keen's Myotis	*Myotis keenii*	5
California Myotis	*Myotis californicus*	5
Townsend's Big-eared Bat	*Corynorhinus townsendii*	2, 5
Big Brown Bat	*Eptesicus fuscus*	5
Hoary Bat	*Lasiurus cinereus*	2, 5
Silver-haired Bat	*Lasionycteris noctivagans*	2, 5

Notes:

1- Data collected from Nisqually Reach Nature Center displays and education materials throughout years 2002 - 2010.

2- Species documented at the Nisqually National Wildlife Refuge (NWR). Data retrieved from Nisqually NWR Comprehensive Conservation Plan, Appendix E 2005.

3- Data from John Calambokidis, Research Biologist, Cascadia Research, retrieved in 2010.

4- Data from Steve Jefferies, Biologist, Washington Department of Fish and Wildlife, Marine Mammal Program, retrieved in 2010.

5- Data from John Fleckenstein, Zoologist, DNR Natural Heritage Program, retrieved in 2010.

APPENDIX E

Fish in the Nisqually Reach

Fish species list for proposed Nisqually Reach Aquatic Reserve. Data compiled by Washington Department of Natural Resources Aquatic Reserves Program staff in 2010.

Common Name	Scientific Name	Notes
Pacific Lamprey	*Lampetra tridentata*	4
Spotted Ratfish	*Hydrolagus colliei*	1, 4
Spiny Dogfish	*Squalus acanthias*	1, 4
American Shad	*Alosa sapidissima*	1, 3, 4
Northern Anchovy	*Engraulis mordax*	1, 3
Pacific Herring	*Clupea harengus pallasi*	1, 2, 3, 4
Surf Smelt	*Hypomesus pretiosus*	2, 3, 4
Pink Salmon	*Oncorhynchus gorbuscha*	2, 3, 4
Chum Salmon	*Oncorhynchus keta*	2, 3, 4
Coho Salmon	*Oncorhynchus kisutch*	1, 2, 3, 4
Sockeye Salmon	*Oncorhynchus nerka*	3, 4
Chinook Salmon	*Oncorhynchus tshawytscha*	2, 3, 4
Steelhead	*Oncorhynchus mykiss*	2, 3, 4
Coastal Cutthroat	*Oncorhynchus clarki*	2, 3
Bull Trout	*Salvelinus confluentus*	2, 4
Pacific Cod	*Gadus macrocephalus*	1, 4
Lingcod	*Ophiodon elongatus*	1
Pacific Whiting (Hake)	*Merluccius productus*	1, 4
Pacific Tomcod	*Microgadus proximus*	1, 4
Walleye Pollock	*Theragra chalcogramma*	1, 4
Plainfin Midshipman	*Porichthys notatus*	1, 4
Northern Clingfish	*Gobiesox meandricus*	4
Tube-Snout	*Aulorhynchus flavidus*	4
Three Spine Stickleback	*Gasterosteus aculeatus*	2, 3, 4
Bay Pipefish	*Syngnathus leptorhynchus*	2, 3, 4
Brown Rockfish	*Sebastes auriculatus*	1, 4
Copper Rockfish	*Sebastes caurinus*	1, 4
Quillback Rockfish	*Sebastes maliger*	1, 4
Redstripe Rockfish	*Sebastes proriger*	1
Sharpchin Rockfish	*Sebastes zacentrus*	1
Puget Sound Rockfish	*Sebastes emphaeus*	1
Sablefish	*Anoplopoma fimbria*	1, 4

Kelp Greenling	*Hexagrammos decagrammus*	1, 4
Rock Greenling	*Hexagrammos lagocephalus*	4
White-spotted Greenling	*Hexagrammos stelleri*	1, 4
Painted Greenling	*Oxylebius pictus*	4
Cabezon	*Scorpaenichthys marmoratus*	1, 4
Red Irish Lord	*Hemilepidotus hemilepidotus*	1, 4
Padded Sculpin	*Artedius fenestralis*	1, 4
Smoothhead Sculpin	*Artedius lateralis*	4
Silverspotted Sculpin	*Blepsias cirrhosus*	4
Reticulate/Riffle Sculpin	*Cottus perplexus/gulosus*	4
Torrent Sculpin	*Cottus rhotheus*	4
Shorthead Sculpin	*Cottus confusus*	4
Coastrange Sculpin	*Cottus aleuticus*	4
Prickly Sculpin	*Cottus asper*	4
Buffalo Sculpin	*Enophrys bison*	1, 4
Pacific Staghorn Sculpin	*Leptocottus armatus*	1, 2, 4
Grunt Sculpin	*Rhamphocottus richardsoni*	1, 4
Sailfin Sculpin	*Nautichthys oculofasciatus*	1, 4
Tidepool Sculpin	*Oligocottus maculosus*	4
Tadpole Sculpin	*Psychrolutes paradoxus*	4
Soft Sculpin	*Psychrolutes sigalutes*	4
Manacled Sculpin	*Synchirus gilli*	4
Roughback Sculpin	*Chitonotus pugetensis*	1, 4
Sharpnose Sculpin	*Clinocottus acuticeps*	4
Calico Sculpin	*Clinocottus embryum*	4
Northern Sculpin	*Icelinus borealis*	1
Ribbed Sculpin	*Triglops pingeli*	1
Slim Sculpin	*Radulinus asprellus*	1
Spinyhead Sculpin	*Dasycottus setiger*	1
Great Sculpin	*Myoxocephalus polyacanthocephalus*	1, 4
Northern Spearnose Poacher	*Agonopsis vulsa*	1, 4
Pygmy Poacher	*Odontopyxis trispinosa*	4
Tubenose Poacher	*Pallasina barbata*	4
Sturgeon Poacher	*Agonus acipenserinus*	1, 4
Blacktip Poacher	*Xeneretmus latifrons*	1, 4
Ringtail Snailfish	*Liparis rutteri*	4
Marbled Snailfish	*Liparis dennyi*	1
Shiner Perch	*Cymatogaster aggregata*	1, 2, 3, 4

Striped Seaperch	*Embiotoca lateralis*	1, 4
Pile Perch	*Rhacochilus vacca*	1, 2, 3, 4
Slender Cockscomb	*Anoplarchus insignis*	4
High Cockscomb	*Anoplarchus purpurescens*	4
Pacific Snake Prickleback	*Lumpenus sagitta*	4
Penpoint Gunnel	*Apodichthys flavidus*	3, 4
Rockweed Gunnel	*Apodichthys fucorum*	4
Crescent Gunnel	*Pholis laeta*	3, 4
Saddleback Gunnel	*Pholis ornata*	2, 3, 4
Pacific Sand Lance	*Ammodytes hexapterus*	2, 3, 4
Arrow Goby	*Clevelandia ios*	3, 4
Bay Goby	*Lepidogobius lepidus*	4
Northern Ronquil	*Ronquilus jordani*	1
Pacific Sanddab	*Citharichthys sordidus*	1, 4
Speckled Sanddab	*Citharichthys stigmaeus*	1, 3, 4
Arrowtooth Flounder	*Atheresthes stomias*	1
Starry Flounder	*Platichthys stellatus*	1, 2, 3, 4
Rex Sole	*Glyptocephalus zachirus*	1, 4
Petrale Sole	*Eopsetta jordani*	1
Flathead Sole	*Hippoglossoides elassodon*	1, 4
Dover Sole	*Microstomus pacificus*	1, 4
Rock Sole	*Pleuronectes bilineata*	1, 3, 4
Butter Sole	*Isopsetta isolepis*	1, 4
English Sole	*Parophrys vetulus*	1, 3, 4
Southern Rock Sole	*Lepidopsetta bilineata*	1
Northern Rock Sole	*Lepidopsetta polyxystra*	1
Sand Sole	*Psettichthys melanostictus*	1, 4
Slender Sole	*Lyopsetta exilis*	1
Hybrid Sole	*Inopsetta ischyra*	1
White Sturgeon	*Acipenser transmontanus*	4
Bigfin Eelpout	*Aprodon cortezianus*	1
Blackbelly Eelpout	*Lycodes pacificus*	1
Shortfin Eelpout	*Lycodes brevipes*	1
Wattled Eelpout	*Lycodes palearis*	1
Snake Prickleback	*Lumpenus sagitta*	1, 3
Slipskin Snailfish	*Liparis fucensis*	1
Showy Snailfish	*Liparis pulchellus*	1
Ribbon Snailfish	*Liparis cyclopus*	1

Eulachon	*Thaleichthys pacificus*	1
Pacific Pompano	*Perrilus simillimus*	1
Longspine Combfish	*Zaniolepis latipinnis*	1
Gray Starsnout	*Asterotheca alascana*	1
Pacific Spiny Lumpsucker	*Eumicrotremus orbis*	1
Big Skate	*Raja binoculata*	1
Sandpaper Skate	*Raja kincaidi*	1
Longnose Skate	*Raja rhina*	1
Sixgill Shark	*Hexanchus griseus*	1

Notes:

1- Washington Department of Fish and Wildlife (WDFW) Trawl Data from stock assessment surveys 1987-2008. Data received from WDFW Marine Fish Biologist Bob Pacunski 2010.

2- Data retrieved by from Nisqually National Wildlife Refuge (NWR) website at http://www.fws.gov/Nisqually/wildlife/fish_sp.html in 2010.

3- Data from Nisqually River Estuary Baseline Fish Ecology Study: 2003-2006 by Christopher Ellings and Sayre Hodgson (October 2007).

4- Species documented at the Nisqually NWR. Data retrieved from Nisqually NWR Comprehensive Conservation Plan, Appendix E 2005.

APPENDIX F

Invertebrates in the Nisqually Reach

Invertebrate species list for proposed Nisqually Aquatic Reserve. Data compiled by Washington DNR Aquatic Reserves Program staff in 2010.

Common Name	Scientific Name	Notes
Sea Mouse Uniden.	*Aphroditidae sp.*	1
Scale Worm	*Halosydna brevisetosa*	1
Orange Sea Pen	*Ptilosarcus gurneyi*	1
Orange Sea Cucumber	*Cucumaria miniata*	1
White Sea Cucumber	*Eupentacta quinquesemita*	1
Red Sea Cucumber	*Parastichopus californicus*	1
Sweet Potato Sea Cucumber	*Molpadia intermedia*	1
Salt And Pepper Cucumber	*Cucumaria piperata*	1
Speckled Sea Lemon	*Anisodoris nobilis*	1
Rainbow Nudibranch	*Dendronotus irus*	1
Common or Spot Nudibranch	*Triopha catalinae*	1
California Arminid	*Armina californica*	1
Rosy Tritonia	*Tritonia diomedea*	1
Smooth Stem Sea Whip Uniden.	*Virgularia sp.*	1
Mottled Orange Anemone	*Stomphia coccinea*	1
Gigantic Anemone	*Metridium farcimen*	1
Metridium Uniden.	*Metridium sp.*	1
Sea Anemone Uniden.	*Order Actiniaria sp.*	1
Sand Rose Anemone	*Urticina columbiana*	1
Scarlet Anemone	*Urticina lofotensis*	1
Sea Urchin Uniden.	*Order Echinoidea sp.*	1
Sponge Uniden.	*Phylum Porifera sp.*	1
Glassy Sea Squirt	*Ascida paratropa*	1
Pink Short Spined Sea Star	*Pisaster brevispinus*	1
Rose Sea Star	*Crossaster papposus*	1
Sunflower Star	*Pycnopodia helianthoides*	1
Slime Star	*Pteraster tesselatus*	1
Leather Star	*Dermasterias imbricata*	1
Vermilion Star	*Mediaster aequalis*	1
False Ochre Star	*Evasterias troschelii*	1
Morning Sun Star	*Solaster dawsoni*	1
Stimpson's Sun Star	*Solaster stimpsoni*	1
Banana Starfish	*Luidia foliata*	1
Fried Egg Jellyfish	*Phacellophora camtschatica*	1

Barnacles	*Cirripedian nauplius larvae*	2
Squat Lobster	*Mundia quadrispina*	1
Brachyuran Crab zoea	*Order Decopoda*	2
Kelp Crab	*Pugettia producta*	1
Graceful Decorator Crab	*Oregonia gracilis*	1
Hairy Porcelain Crab	*Pachycheles pubescens*	1
Hermit Crabs Uniden.	*Paguridae sp.*	1
Graceful Crab	*Cancer gracilis*	1
Dungeness Crab	*Cancer magister*	1
Pygmy Rock Crab	*Cancer oregonensis*	1
Red Rock Crab	*Cancer productus*	1
Graceful Kelp Crab	*Pugettia gracilis*	1
Longhorned Decorator Crab	*Chorilia longipes*	1
Cladoceran	*Cladocera*	2
Amphipod	*Corophium salmonis*	2
Amphipod	*Corophium spinicorne*	2
Amphipod	*Corophium sp.*	2
Amphipod	*Anisogammarus pugettensis*	2
Amphipod	*Parathemisto pacifica*	2
Amphipod	*Eogammarus confervicolus*	2
Amphipod	*Eogammarus sp.*	2
Amphipod	*Hyperiidae*	2
Isopod	*Gnorimosphaeroma oregonese*	2
Isopod	*Isopoda Uniden.*	2
Copepods	*Copepoda nauplius larvae*	2
Cyclopoid Copepod	*Cyclopoid*	2
Calanoid Copepod	*Calanoid*	2
Harpacticoid Copepod	*Harpacticoid*	2
Ostracod	*Ostracod*	2
Krill	*Euphausia pacifica*	2
Shortscale Eualid	*Eualus suckleyi*	1
Hippolytidae	*Hippolytidae sp.*	1
Crangonid Shrimp Uniden.	*Crangonidae sp.*	1
Hooded Shrimp	*Cumacea sp.*	2
Horned Shrimp	*Paracrangon echinata*	1
Bay Ghost Shrimp	*Callianassa/Neotrypaea californiensis*	2
Blue Mud Shrimp	*Upogebia pugettensis*	1, 2
Dock Shrimp	*Pandalus danae*	1
Sidestriped Shrimp	*Pandalus dispar*	1
Opossum Shrimp	*Neomysis mercedis*	2

Alaskan Pink Shrimp	*Pandalus eous*	1
Shrimp	*Crangon sp.*	2
Spotted Prawn	*Pandalus platyceros*	1
Moon Snail	*Polinices lewisii*	1
Oregon Hairy Triton	*Fusitriton oregonensis*	1
False Geoduck	*Mya truncata*	1
Geoduck Clam	*Panope abrupta*	1
Pacific Gaper	*Tresus nuttallii*	1
Bent-Nose Macoma	*Macoma nasuta*	1
Green Sea Urchin	*Strongylocentrotus droebachiensi*	1
Big Red Squid	*Berryteuthis magister*	1
California Market Squid	*Loligo opalescens*	1
Squid Uniden.	*Theuthidida-Myopsida*	1
Giant Octopus	*Octopus dofleini*	1
Little Red Octopus	*Octopus rubescens*	1

Notes:

1- Washington Department of Fish and Wildlife (WDFW) Trawl Data from stock assessment surveys 1987-2008. Data received from WDFW Marine Fish Biologist Bob Pacunski 2010.

2- Data collected from Nisqually Reach Nature Center displays and education materials throughout years 2002 - 2010.

APPENDIX G

Tahoma Audubon Society Field Trip Data from Nisqually Reach Region

The following bird data was collected in 1998, 2001 and 2005 by members of the Tahoma Audubon Society on several different field trips to areas in close proximity to Anderson Island (Tahoma Audubon Society, Located on Mar. 23, 2010). Additional information documented that is not shown here includes types of pollution (if any), uses of the area, and further observations on mammals and plants. Tahoma Audubon Society is currently inputting all fieldtrip data into online databases. Only the most recent data from the area surrounding Anderson Island is shown here.

A. Field Trip to Anderson Island on April 25, 1998

- Time: 7:45 am – 12:45 pm
- Number of people: 16
- Leaders: John and Karen Parks
- Miles covered: About 6 mi.
- Weather: Most sunny, calm
- Description of area: Slightly used; Mixture of farm fields, woods and fresh water lakes and ponds
- Total number of species identified: 69 species

BIRD LIST:

Common Loon
Horned Grebe
Western Grebe
Double-crested Cormorant
Pelagic Cormorant
Great Blue Heron
Canada Goose
Wood Duck
Mallard
American Wigeon
Greater Scaup
Surf Scoter
Common Goldeneye
Bufflehead
Hooded Merganser
Common Merganser
Osprey
Bald Eagle
Sharp-shinned Hawk
Red-tailed Hawk
Killdeer
Greater Yellowlegs
Spotted Sandpiper
Bonaparte's Gull
Glaucous-winged Gull
Caspian Tern
Pigeon Guillemot
Marbled Murrelet
Rock Dove
Band-tailed Pigeon
Rufous Hummingbird
Belted Kingfisher
Downy Woodpecker
Northern Flicker
Pileated Woodpecker
Pacific Slope Flycatcher
Tree Swallow
Violet-green Swallow
N. Rough-winged Swallow
Barn Swallow
Steller's Jay
Northwestern Crow
Common Raven
Chestnut-backed Chickadee
Bewick's Wren
Red-breasted nuthatch
Winter Wren
Golden-crowned Kinglet
Ruby-crowned Kinglet
American Robin
European Starling
Orange-crowned Warbler
Yellow-rumped Warbler
Black-throated Gray Warbler
Wilson's Warbler
Spotted Towhee
Chipping Sparrow
Fox Sparrow
Song Sparrow
Golden-crowned Sparrow
White-crowned Sparrow
Dark-eyed (Oregon) Junco
Red-winged Blackbird
Brown-headed Cowbird
Purple Finch
House Finch
Pine Siskin

American Goldfinch House Sparrow

B. Field trip to McNeil Island on April 28, 2001

- Time: 9:30 am – 3:00 pm
- Number of people: about 20-30
- Checklist by: Roxy Giddings
- Miles covered: Undocumented
- Weather: Overcast, light rain, heavy rain, wind
- Description of area: Undocumented
- Total number of species identified: 38 species

BIRD LIST:

Common Loon
Eared Grebe
Brant
Canada Goose
Wood Duck
Mallard
Surf Scoter
White-winged Scoter
Bufflehead
Red-breasted Merganser
Bald Eagle
Killdeer
Glaucous-winged Gull
Rufous Hummingbird
Belted Kingfisher
Downy Woodpecker
Northern Flicker
Pileated Woodpecker
Pacific-slope Flycatcher
Tree Swallow
Violet-green Swallow
N. Rough-winged Swallow
Steller's Jay
American Crow
Chestnut-backed Chickadee
Winter Wren
Marsh Wren
American Robin
European Starling
Orange-crowned Warbler
Savannah Sparrow
Song Sparrow
Golden-crowned Sparrow
Dark-eyed Junco
Red-winged Blackbird

C. Field Trip to Key Peninsula on March 26, 2005

- Time: 8:00 am – 12:00 pm
- Number of people: 7
- Leader: Rolan Nelson
- Miles covered: About 25 mi.
- Weather: Steady rain, light wind
- Description of area: Slightly used
- Total number of species identified: 37 species

BIRD LIST:

Common Loon
Horned Grebe
Double-crested Cormorant
Great Blue Heron
Canada Goose
Mallard
American Wigeon
Greater Scaup
Harlequin Duck
Surf Scoter
White-winged Scoter
Common Goldeneye
Barrow's Goldeneye
Bufflehead
Hooded Merganser
Red-breasted Merganser
Common Merganser
Osprey

Bald Eagle
Merlin
Killdeer
Mew Gull
Glaucous-winged Gull
Rock Pigeon
Belted Kingfisher
Northern Flicker
Tree Swallow
Violet-green Swallow
Steller's Jay
American Crow
American Robin
European Starling
Orange-crowned Warbler
Song Sparrow
Dark-eyed Junco
Red-winged Blackbird
Pine Sisken

D. Field trip to Nisqually National Wildlife Refuge and Luhr Beach on September 15, 2005

- Time: 8:00 am – 3:30 pm
- Number of people: 6
- Leaders: Ruth and Patrick Sullivan
- Miles covered: About 63 mi.
- Weather: Rain and drizzle in the morning, partly cloudy in the afternoon
- Description of area: Slightly used
- Total number of species identified: 81 species

BIRD LIST:

Common Loon
Pied-billed Grebe
Horned Grebe
Red-necked Grebe
Eared Grebe
Western Grebe
Double-crested Cormorant
American Bittern
Great Blue Heron
Great White-fronted Goose
Canada Goose
Green-winged Teal
Mallard
Northern Pintail
Blue-winged Teal
Northern Shoveler
Gadwall
America Wigeon
Cackling Goose
Greater Scaup
Lesser Scaup
Surf Scoter
While-winged Scoter
Bufflehead
Hooded Merganser
Ruddy Duck
Bald Eagle
Northern Harrier
Red-tailed Hawk
Peregrine Falcon
Virginia Rail
American Coot
Black-bellied Plover
Great Yellowlegs
Western Sandpiper
Least Sandpiper
Sharp-tailed Sandpiper
Dunlin
Long-billed Dowitcher
Wilson's Snipe
Mew Gull
Ring-billed Gull
Black-capped Chickadee
Chestnut-backed Chickadee
Brown Creeper
Bewick's Wren
Winter Wren
Marsh Wren
Golden-crowned Kinglet
Ruby-crowned Kinglet
American Robin
Cedar Waxwing
European Starling
Yellow-rumped Warbler (Audubon's)
Yellow-rumped Warbler (Myrtle's)
Spotted Towhee
Savannah Sparrow
Fox Sparrow
Song Sparrow
Lincoln's Sparrow
Golden-crowned Sparrow
White-crowned Sparrow
Dark-eyed Junco
Red-winged Blackbird
Brewer's Blackbird
Purple Finch
House Finch
American Goldfinch

APPENDIX H

Puget Sound Seabird Survey Raw Data from Anderson Island Sites, 2010.

	Bald Eagle	Peregrine Falcon	Unidentified Raptor (large)	Bufflehead	Red-breasted Merganser	Unidentified Merganser species	Mallard	Surf Scoter	Common Goldeneye
Jan. 16 Andy's	1	0	1	0	97	0	0	3	8
Jan. 16 Dock	0	0	0	0	1	1	0	3	1
Feb. 6 Andy's	1	0	0	7	1	0	0	2	0
Feb. 6 Dock	0	0	0	0	0	0	0	7	2
Mar. 6 Andy's	1	1	0	6	0	0	0	0	2
Mar. 6 Dock	0	0	0	1	0	0	0	9	8
Apr. 3 Andy's	3	0	0	0	0	0	2	0	0
Apr. 3 Dock	0	0	0	0	3	0	0	8	0
May 1 Andy's	2	0	0	0	0*	0	0	4	0*
May 1 Dock	3	0	0	0	0*	0	0	0	0*
Total	11	1	1	14	102	1	2	36	21
Mean	1.10	0.10	0.10	1.40	10.20	0.10	0.20	3.60	2.10
Variance	1.43	0.10	0.10	7.38	931.07	0.10	0.40	11.38	10.32

	Barrow's Goldeneye	Unidentified Goldeneye species	Glaucous-winged Gull	Glaucous-winged Gull x Western Gull	Mew Gull	Unidentified Gull species	Pacific Loon	Common Loon	Western Grebe
Jan. 16 Andy's	4	0	0	0	0	2	1	0	0
Jan. 16 Dock	0	0	0	0	0	4	0	1	3
Feb. 6 Andy's	1	0	0	0	0	0	1	0	1
Feb. 6 Dock	0	2	1	0	0	2	1	0	13
Mar. 6 Andy's	0	0	0	0	1	0	2	0	0
Mar. 6 Dock	0	0	3	1	2	0	0	0	25
Apr. 3 Andy's	0	0	0	0	0	0	0	1	0
Apr. 3 Dock	0	0	2	0	0	0	0	1	0
May 1 Andy's	0*	0	0	0	0*	0	0	1	0*
May 1 Dock	0*	0	0	0	0*	4	0	3	0*
Total	5	2	6	1	3	12	5	7	42
Mean	0.50	0.20	0.60	0.10	0.30	1.20	0.50	0.70	4.20
Variance	1.61	0.40	1.16	0.10	0.46	2.84	0.50	0.90	69.73

	Red-necked Grebe	Horned Grebe	Unidentified Grebe species (small)	Brandt's Cormorant	Double-crested Cormorant	Pelagic Cormorant	Unidentified Cormorant species	Pigeon Guillemot	Belted Kingfisher
Jan. 16 Andy's	0	0	1	0	0	0	1	0	1
Jan. 16 Dock	0	2	0	7	7	7	1	0	0
Feb. 6 Andy's	0	0	1	0	0	0	0	1	1
Feb. 6 Dock	0	1	0	0	11	7	0	0	0
Mar. 6 Andy's	1	0	0	0	0	0	0	9	1
Mar. 6 Dock	25	3	0	1	6	12	0	4	0
Apr. 3 Andy's	0	0	0	0	0	0	0	0	1
Apr. 3 Dock	0	4	0	3	0	2	0	1	0
May 1 Andy's	0*	0*	0	0	0	0	0	0	0
May 1 Dock	0*	0*	0	0	0	0	0	2	0
Total	26	10	2	11	24	28	2	17	4
Mean	2.60	1.00	0.20	1.10	2.40	2.80	0.20	1.70	0.40
Variance	62.04	2.22	0.18	5.21	16.49	18.62	0.18	8.23	0.27

	Great Blue Heron	Rock Pigeon	Northwestern Crow	Northwestern Crow or Common Raven	Mourning Dove	Barn Swallow	Canada Goose	Unidentified flying birds
Jan. 16 Andy's	0	0	0	0	0	0	0	0
Jan. 16 Dock	0	0	0	0	0	0	0	0
Feb. 6 Andy's	0	0	0	0	0	0	0	0
Feb. 6 Dock	1	2	0	0	0	0	0	0
Mar. 6 Andy's	0	0	2	0	0	0	0	0
Mar. 6 Dock	0	2	1	0	0	0	0	0
Apr. 3 Andy's	0	0	0	4	0	0	0	0
Apr. 3 Dock	0	2	0	0	0	0	0	0
May 1 Andy's	1	0	2	0	2	0	0	20
May 1 Dock	0	0	0	1	0	25	0	0
Total	2	6	5	5	2	25	2	20
Mean	0.20	0.60	0.50	0.50	0.20	2.50	0.20	2.00
Variance	0.18	0.93	0.72	1.61	0.40	62.50	0.40	40.00

*These survey data were not used in the weighted average to calculate species estimates for within the study area (see Results section) if a bird species was listed as uncommon or rare for that month in Puget Sound on Bird Web (Seattle Audubon Society, 2008).