HOTSPOTS:

BIRD SURVEY OF MENDENHALL WETLANDS APRIL 2002 to MAY 2003

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Some of the data for this paper were gathered by the authors under a contract between Discovery Southeast and the U.S. Fish and Wildlife Service (FWS), and were provided to FWS in a report entitled "Bird use of the Mendenhall Wetlands April 2002 to May 2003." The authors have included data from that report in this paper, along with additional information they have collected. Any conclusions and recommendations presented herein are the authors' personal views, and have not been endorsed by Discovery Southeast.

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Contents

Introduction **2**

1 Methods **2**
Study site and field methods for hotspots 2
GIS mapping of data 3
Phenology 3
Connections 4

2 Overview of diversity and abundance on the wetlands **4**
3 Summary maps and charts **5**
4 Glacial rebound, vegetation and birds **10**
5 Hotspot descriptions **17**
Mendenhall River mouth (r05) 17
Fritz Cove (r06) 18
Western mudflat sand lance area (r08) 19
Lower Fish Creek estuary (f08) 20
Upper Fish Creek estuary (f01) 21
Salmon Creek estuary (s01) 22
Otter Pond (a01) 23
Sedge flats west of Otter Pond (a08) 24
ERA heliport (e02) 25
Western Channel (f09) 26
Upper Mendenhall River (r02, 13, 03, 07 and 04) 27
Wigeon Ponds (p02) 28
Phalarope Slough (a10) 29
Junk Car Slough (a02) 30
Miller-Honsinger Pond (a04) 31
Float Plane Basin Finger Ponds (a03) 32
Auke Lake (x01) 33
Twin Lakes (t02) 34

6 Comparisons with Cain et al. 1988 ..... **35**
7 Phenology and distribution **36**
8 Connections with the rest of the world **44**
9 Animal food resources on the wetlands **45**
Fish 45
Mammals 48
Invertebrates 48

10 Synthesis and recommendations **51**
Shorebirds 51
Past and pending habitat loss 53
Birds and airplane safety 53
Dogs and birds 56
Hunting 57
Infrequently surveyed areas of the wetlands 58
Further research needs 59

Acknowledgments **59**
Literature Cited **59**

Appendices **61**
Appendix A Common and scientific names 61
Appendix B Species distribution maps 62
Appendix C Phenology tables for all refuge species 65

HOTSPOTS: BIRD SURVEY OF MENDENHALL WETLANDS, APRIL 2002 to MAY 2003

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Introduction

For 14 months we conducted bird surveys on the Mendenhall Wetlands State Game Refuge. The principal goal of this survey was to document areas of the wetlands that hosted large concentrations of birds at various seasons; these areas were called 'hotspots' of bird activity. A secondary goal was a rough comparison of present bird abundances with those recorded by Cain et al. (1988), using different methods. A third goal, which emerged as we were conducting the bird surveys, was a synopsis of bird phenology on the wetlands, showing seasonal patterns of use.

1 Methods

Study site and field methods for hotspots.

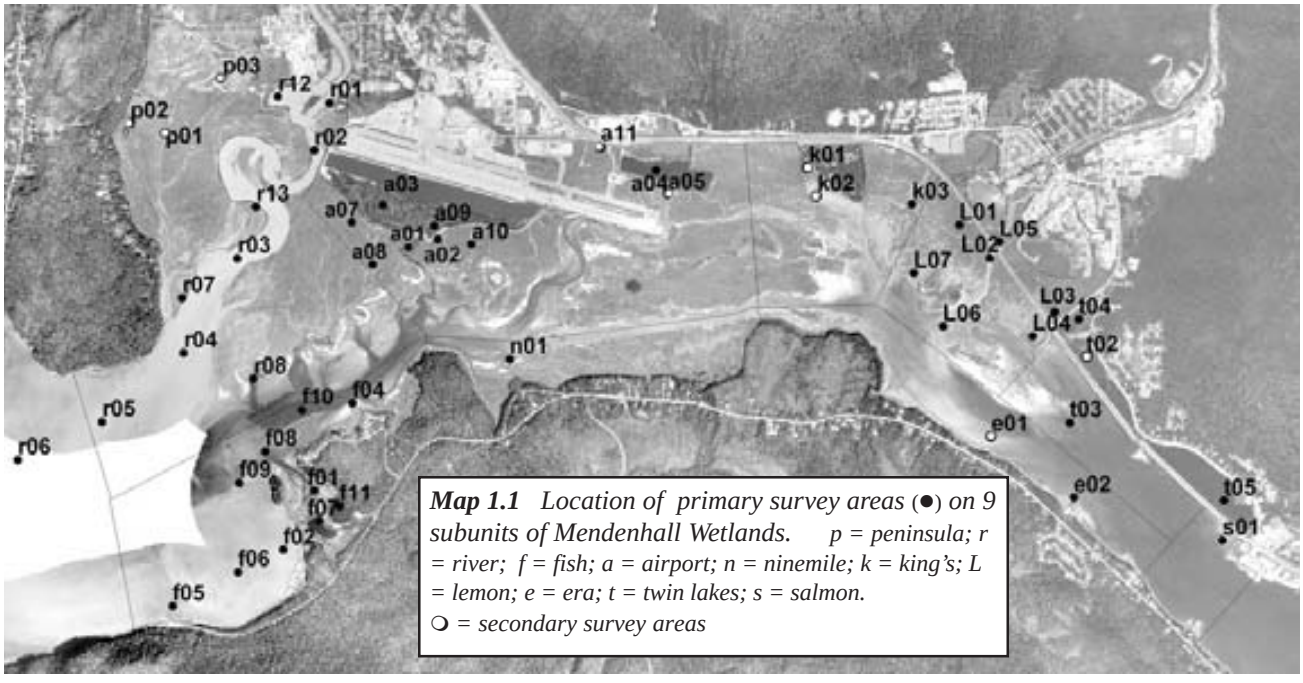
We surveyed most of the wetlands between the end of the Mendenhall Peninsula and Fritz Cove and the southeastern edge of the Salmon Creek delta (Map 1.1). Primary survey areas are those visited on all full surveys of the wetlands. Secondary survey areas were visited occasionally. One section of the wetlands north of Johnson Creek was not covered, because of poor access (Map 10.4). For place names used in the text, see orthophoto on back cover.

Eighteen full surveys were completed between April 2002 and May 2003 (Table 1.1), unequally distributed among seasons. Seasons were defined as in the American Birding Association's publication titled *North American Birds* and the existing Mendenhall Wetlands bird list (Armstrong and Gordon 2002):

Fall (August-November)
Winter (December-February)
Spring (March-May)
Summer (June–July).

Table 1.1. Dates of full surveys of the wetland. April and early May surveys were done in both 2002 and 2003.

Season	Dates	Number/season
Spring 2002	*April 2-5*	*5*
	April 11-14	
	April 27	
	May 3-5	
	May 14	
Summer 2002	*June 13*	*2*
	July 1-2	
Fall 2002	*August 12-15*	*5*
	September 3	
	September 22-25	
	October 24-25	
	November 29-30	
Winter 2003-03	*December 14*	*3*
	January 21	
	February 18	
Spring 2003	*March 20*	*3*
	April 23	
	May 5	



Map 1.1 *Location of primary survey areas (●) on 9 subunits of Mendenhall Wetlands. p = peninsula; r = river; f = fish; a = airport; n = ninemile; k = king's; L = lemon; e = era; t = twin lakes; s = salmon.*
❍ *= secondary survey areas*

Surveys were conducted by observers on foot, using binoculars and spotting scopes. We recorded all bird concentrations we saw, with notes on tide, weather, location, number of individuals, habitat and activity. Species present in smaller numbers were also recorded in order to build a record of species diversity for each survey area. All full surveys included each of the 42 primary survey areas, timed to center around low tides in daylight hours. Hotspot analyses used only these full-survey records, and omitted observations of single or small bird groups. This basic data set comprised 794 records.

In addition to the 18 full surveys, 41 "ancillary surveys" were done on an opportunistic basis. These occurred irregularly and covered only subsections of the wetland. We also included in our database many reports from reliable observers of bird concentrations in certain areas. Contributions from ancillary surveys and additional reports were analysed separately from full surveys.

Some sites were visited only periodically, including Auke Lake (x01), Twin Lakes (t02), Sunny Point (k01, k02) Wigeon Ponds area (p01, p02), golf course (p03), Fivemile (e01), Temsco turnoff (a11), and the slough at the east end of the runway (a05). Merging the full and ancillary surveys, the data set comprised 1261 records.

Limitations of the survey data Our surveys were done at monthly or fortnightly intervals, and so they obviously missed short pulses of birds, particularly those on migration. We have little information on the distribution and abundance of birds at high tides or at night, and clearly those distributions could be different from those at diurnal low tides. The picture we present therefore is necessarily only part of the story of birds on the wetland.

GIS mapping of data

Bird observation data were first entered into Excel spreadsheets, then into ArcView, 3.3, where patterns could be analysed spatially. Map 1.1 is excerpted from the ArcView project. The base photo is a 1996 digital orthoquad georeferenced by the US Forest Service. Because our observations were all associated with survey areas shown on the map, we could isolate any combination of parameters spatially. For example, a query might isolate all observations for Canada Goose involving resting groups of more than 100 birds, then compare that to all feeding observations for groups of similar size. All dots (survey areas) satisfying the query change color.

To compare our observations to those of Cain et al. (1988) we also entered 422 of their largest counts (biggest bird concentrations - equivalent to our hotspot records) into ArcView. In that study, counts were listed for 32 separate units of the refuge, a slightly different approach than in our hotspot study, which was more focused on key concentration areas. Still, the two ArcView projects make it possible to detect changes or consistency in use by different species over time. In Map 1.2, an example query is shown for wigeon. All units with records of more than 30 birds are shown in yellow. In an equivalent query of our 2002-03 hotspots ArcView project, dots instead of entire units change color, but spatial patterns can still be compared.

To produce the "scaled-dot" maps of species distributions in section 7 and Appendix B, we used ArcMap 8.2, a more advanced version of ArcView. We also used ArcMap to georeference vertical air photos of the refuge taken on a flight with USFWS on Oct 8, 2002. The photos were then used to map vegetation zones.

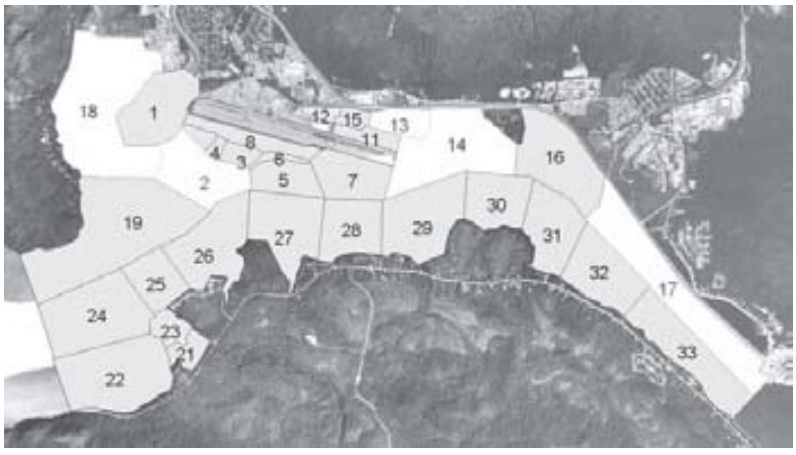
Phenology

We amalgamated all available records of birds on the wetlands. These were entered into Excel spreadsheets, to compile a summary of the seasonal patterns of avian abundance on the wetlands, by species.

The information presented in this section represents 10,881 bird observations on the Mendenhall Wetlands since 1986. For example, one observation could be 30 crows counted on a particular date. These observations were gathered from a variety of sources that included the following:

Paul Suchanek's observations from 1990 to 2002. Paul has recorded over 5,500 observations of birds on the Mendenhall Wetlands. His observations form a solid foundation for the phenology database.

Cain, S.L., J.I. Hodges, E. Robinson-Wilson. 1988. *Bird use of the Mendenhall Wetlands in Juneau, Alaska.* U.S. Fish and Wildlife Service. Juneau Office. They conducted bird surveys from February 19, 1986 to February 12, 1987. Units near the airport were visited twice weekly, and more distant units twice monthly. Their emphasis was on waterfowl and other highly visible species, but all birds seen were counted.



Map 1.2 *Exported from ArcView project created for Cain et al. (1988) records. Numbers identify the 32 subunits of the refuge used in that study (there was no unit 20). Units shown in white are those with records for more than 30 American Wigeon*

Bob Armstrong's and Richard Carstensen's point counts of birds on airport property from January through December, 2002. This work was done for SWCA, consultants hired to produce the Environmental Impact Statement for expansion of the Juneau Airport. Counts were conducted monthly throughout the year, with occasional additional surveys during the breeding season.

Data from the present hotspot study conducted from March, 2002, through May, 2003. Complete bird surveys of the Mendenhall Wetlands were conducted at least monthly.

Observations by local birders Richard Gordon, Steve Zimmerman, Gus van Vliet, and Laurie Craig.

Limitations of the phenology data Combining 18 years of data into one chart and assuming that chart represents the current pattern could, if the timing has changed significantly, lead to erroneous conclusions. The data by year may not be sufficient to determine whether or not a change has occurred. Such comparisons are beyond the scope of our work. However, we have included, with this report, the complete data set in Excel for anyone wishing to work with it.

Determining the highest count by week is possible for a given species. However, when species are combined - e.g., shorebirds - the highest count per week may be misleading. This limitation occurs because when you combine several years data different species may have higher counts in different years, which could have an effect of artificially inflating the numbers. However, we believe this method may accurately represent the potential occurrence of a group of birds by week and hence provides useful information.

Connections.

Information on where the birds seen on the wetlands have come from was derived from a number of sources (American Ornithologists' Union 1998, Carstensen 2000, Lincoln 1979, Pogson et al. 1999, Rothfels 1998, Terborgh 1989).

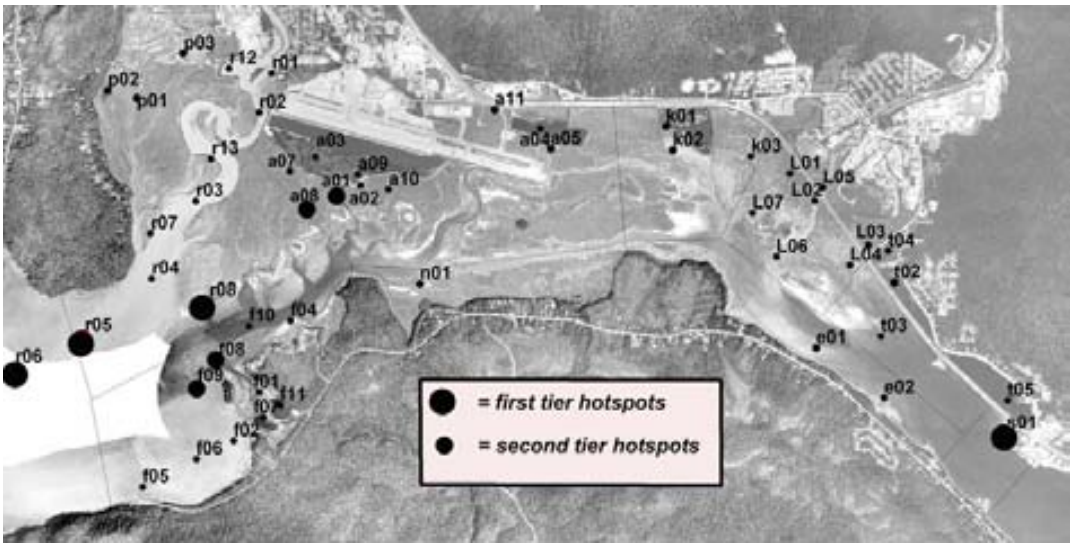
2 Overview of diversity and abundance on the wetlands

A total of 230 species of birds has been documented to occur on the Mendenhall Wetlands, as of January, 2002 (Armstrong and Gordon 2002). This represents 77% of the 300 bird species seen for the entire Juneau Area - from Taku Inlet to Berners Bay - (van Vliet et al. 2003) and 69% of the 335 bird species seen for all of Southeast Alaska - between Dixon Entrance and Yakutat (Armstrong and Gordon 2001).

The Mendenhall Wetlands are of special importance to waterfowl and shorebirds. At times one can see just about every species of waterfowl and shorebird that occurs in Southeast Alaska. To date, 34 species of waterfowl (40 for Southeast) and 40 species of shorebirds (44 for Southeast) have been seen on the Mendenhall Wetlands.

The numbers of birds occurring on the wetlands can be quite large. In every month except June, over 2,000 birds have been counted in the area at one time (Fig 7.1). During spring migration, in April and May, the total number of birds could reach a daily high of 16,000+ individuals (Fig 7.1). By species the greatest number (over 1,000 at one time) have been Canada Goose, Mallard, Surf Scoter, Ruddy Turnstone, Surfbird, Western Sandpiper, Bonaparte's Gull, Mew Gull, Glaucous-winged Gull, and Northwestern Crow. Substantial numbers (over 500 at one time) of other species have also been documented: Northern Shoveler, Greater Scaup, White-winged Scoter, Semipalmated Sandpiper, Least Sandpiper, Pectoral Sandpiper, Dunlin, Short-billed Dowitcher, and Common Redpoll.

These daily high counts only represent a small fraction of the total number of individuals that utilize the Mendenhall Wetlands in any given year. For migratory shorebirds this number could be quite high, especially considering that the daily turnover is rapid; shorebirds, for example, may spend only one to three days at resting and refueling sites on their way to their northern breeding grounds (Iverson et al. 1996).



Map 1.3 *Top annual hotspots overall (sums of seasonal means)*

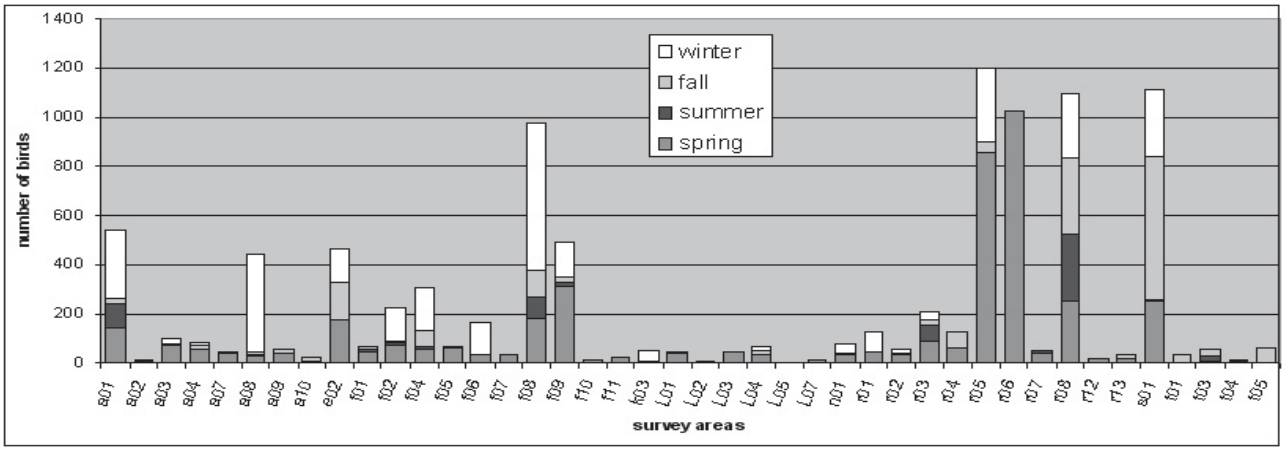


Fig 3.1 *Sum of seasonal mean number of birds for each survey point. Points with the tallest bars had the greatest abundance for the year, but the relative contribution of each season clearly differed among points.*

3 Summary maps and graphs

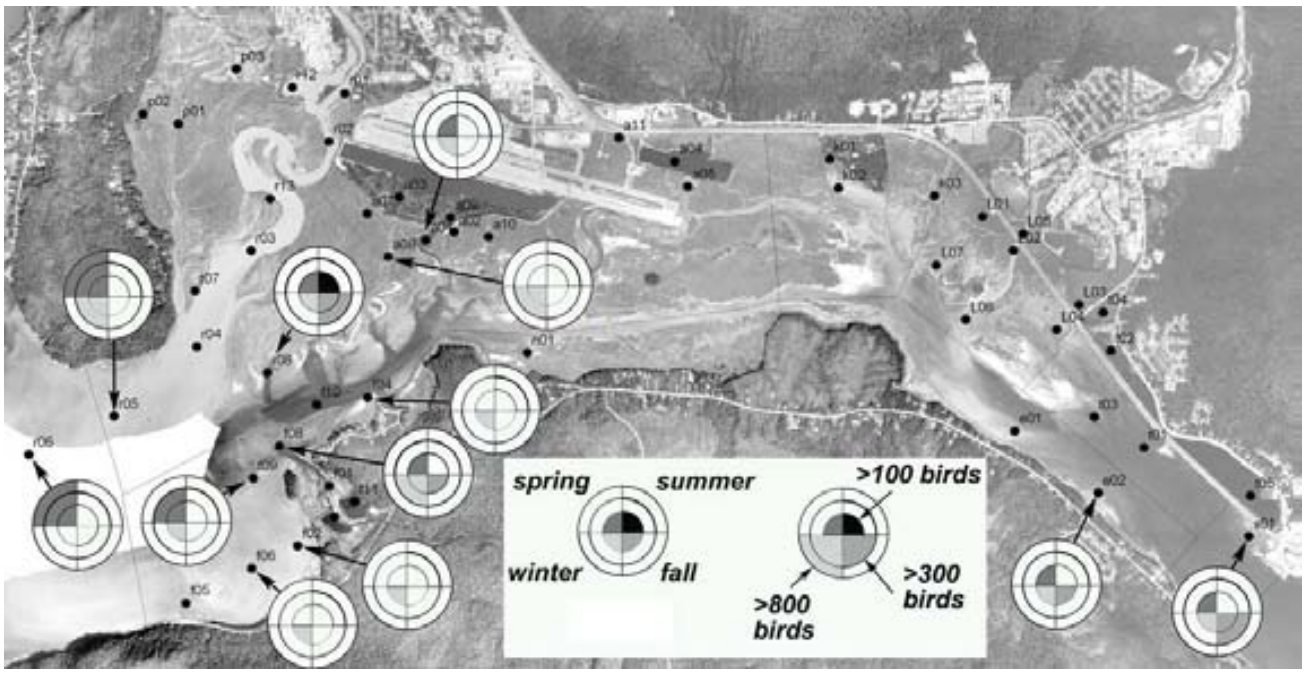
In this section we summarize our findings by hotspot and season, based upon analysis of full surveys that included all 42 primary survey areas (*n* = 794 records). We return to a more detailed analysis of spatial and temporal patterns of bird use in section 7 - *Phenology and distribution*. In that section we rely on all available bird records (*n* = 10,881) for the refuge, dating back to the USFWS study in 1986.

Several of our primary survey areas emerged as consistent 'hotspots.' Others were active only seasonally, and some we eventually designated as 'coldspots.' The top hotspots of bird activity over the entire year were Mendenhall River mouth (r05), Fritz Cove (r06), Western Mudflats between river mouth and channel (r08), and Salmon Creek estuary (s01). Total birds seen in these areas during full surveys over 14 months ranged from 4890 to 8186.

"Second tier" hotspots included Fish Creek estuary (f08), Western Channel (f09), Otter Pond (a01), sedge flats west of Otter Pond (a08), and ERA (e02). Counts at these survey areas ranged from 1487 to 3160 (Map 1.3).

There were strong seasonal differences, however, in the use of areas on the wetland. Heaviest use of the wetland occurred in spring and winter, and fewest birds were seen in summer (Map 3.1; Fig 3.1). The western mudflats (r08) received heavy use in all seasons, and Salmon Creek estuary (s01) was well used in three seasons (spring, fall, winter). Otter Pond (a01) and the sedge area west of Otter Pond (a08) were used most in winter.

Different categories ("groups") of birds used the wetlands in differing ways, concentrating in different



Map 3.1 *Top hotspots by season. All bird groups combined.*

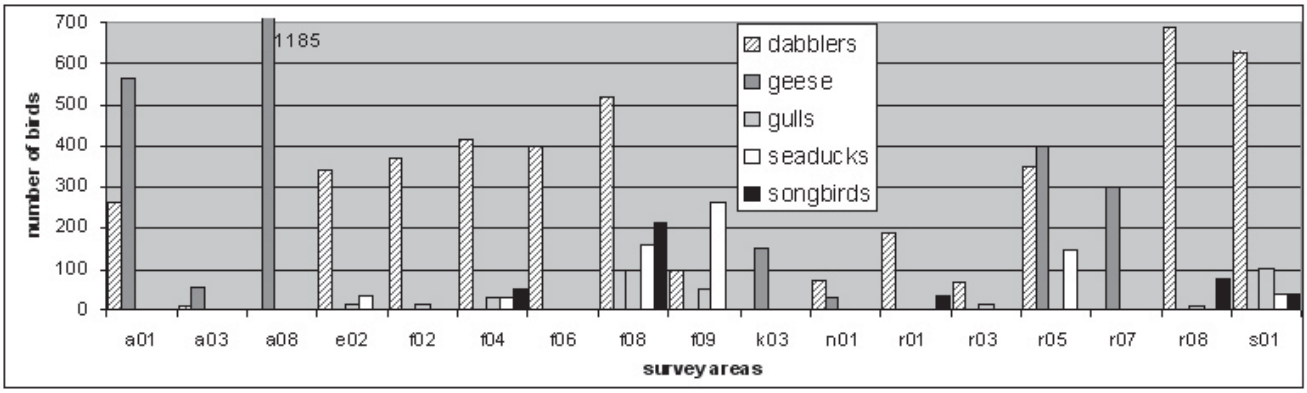
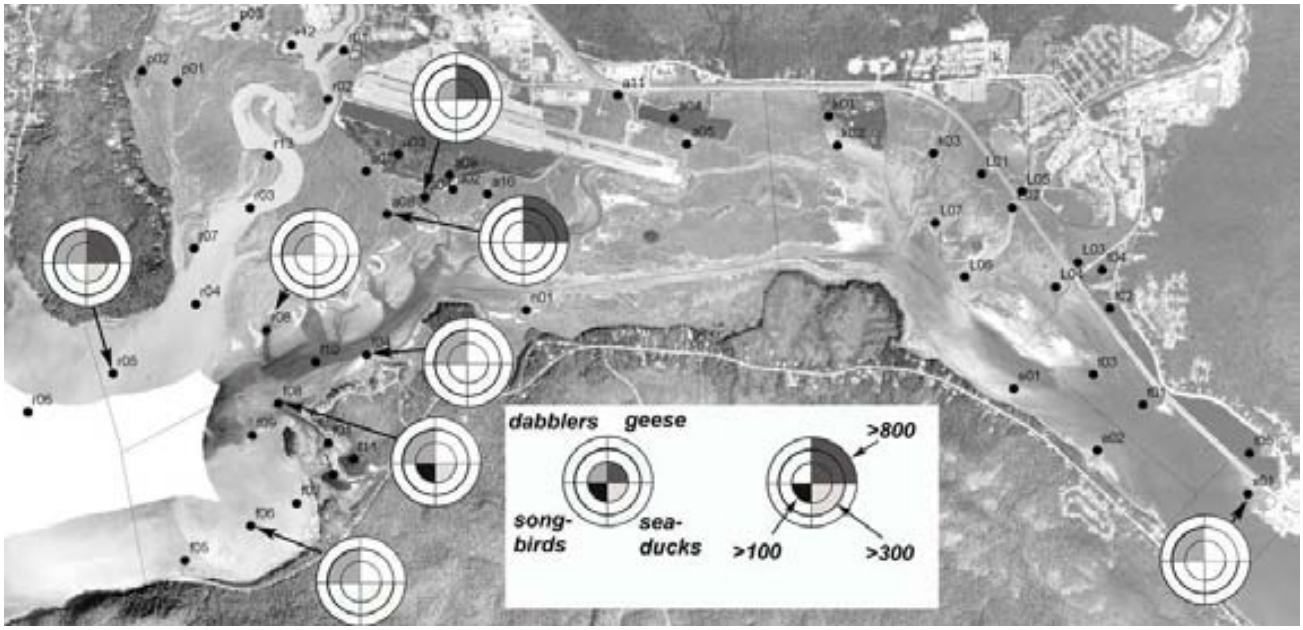


Fig 3.2 *Winter distribution of birds on the wetlands. These values are totals, not means, for use only* within season, *to visualize which groups contributed most to the seasonal pattern.*



Map 3.2 *Top winter hotspots by bird group*

places and different seasons. Rather than following a strictly taxonomic classification, our groupings were closer to the concept of "guild" or foraging strategy:

divers (loons, grebes, cormorant, alcids)
sea- or **diving ducks** (dive, rather than tip up)
dabblers (shallow water "puddle ducks")
geese (Canada, Snow, White-fronted)
swans (Trumpeter, Tundra)
shorebirds (plovers, sandpipers)
gulls (includes terns)
songbirds (for large groups on the wetlands this mostly means Northwestern Crows, but also swallows, longspur, etc.)

Some species were placed in their own "group" because of distinctive foraging behavior: **heron**, **crane**, **eagle**.

Winter (Map 3.2; Fig 3.2): Geese were the most numerous birds on the wetlands, concentrated in the sedge area west of Otter Pond (a08), followed by Otter Pond (a01) and Mendenhall River mouth (r05). Dabbling ducks were more widespread, concentrated along western Gastineau Channel (r08, f04, f08, the river mouth, and at the mouths of many streams). Gulls were not numerous but were found mostly at Salmon Creek estuary (s01) and Fish Creek estuary (f08). "Seaducks" (including diving ducks) occurred chiefly at Fish Creek estuary, Western Channel (f09), and Mendenhall River mouth. "Songbirds" (mostly Northwestern Crows) concentrated at Fish Creek estuary. Eagles and shorebirds were seldom seen in large numbers.

On Map 3.2, only those survey areas where more than 400 birds were counted for the season are shown. Only those bird groups with more than 100 counted for the season are included.

Spring (Map 3.3, Fig 3.3a & b): The most numerous groups were "seaducks', followed by dabblers and gulls. "Seaducks" were concentrated in Fritz Cove (r06) and secondarily at Western Channel (f09). Dabblers were seen especially at Mendenhall River mouth (r05), Salmon Creek estuary (s01), Fish Creek estuary (f08), and Otter Pond (a01) and secondarily at Mendenhall River near the trailhead at the end of Radcliffe Road (r01), Fish Creek (f01), Lemon Creek estuary (L06), Western mudflats (r08). Geese

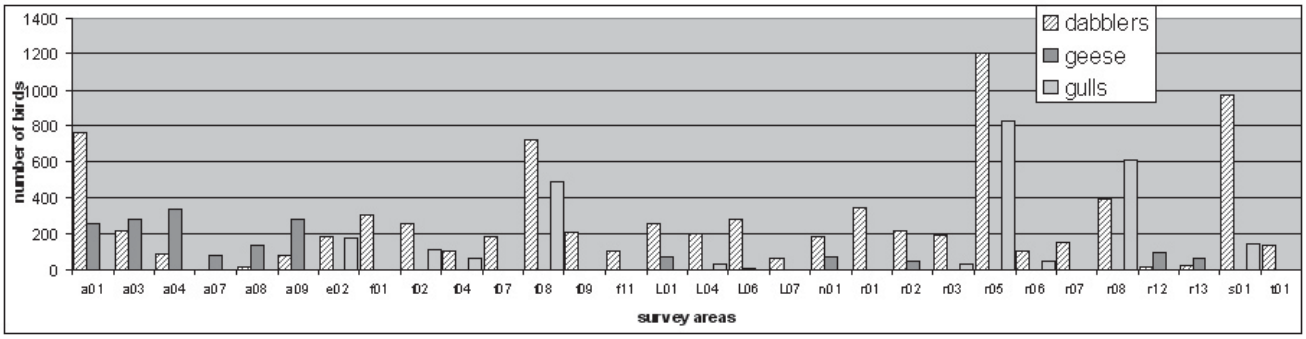


Fig 3.3a *Spring distribution of dabblers, geese and gulls on the wetlands. See explanation, Fig 3.2*

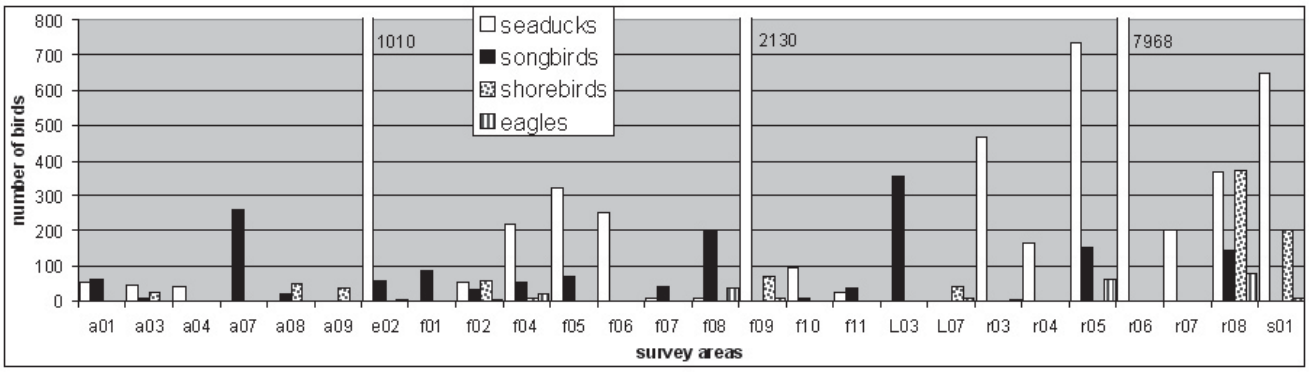
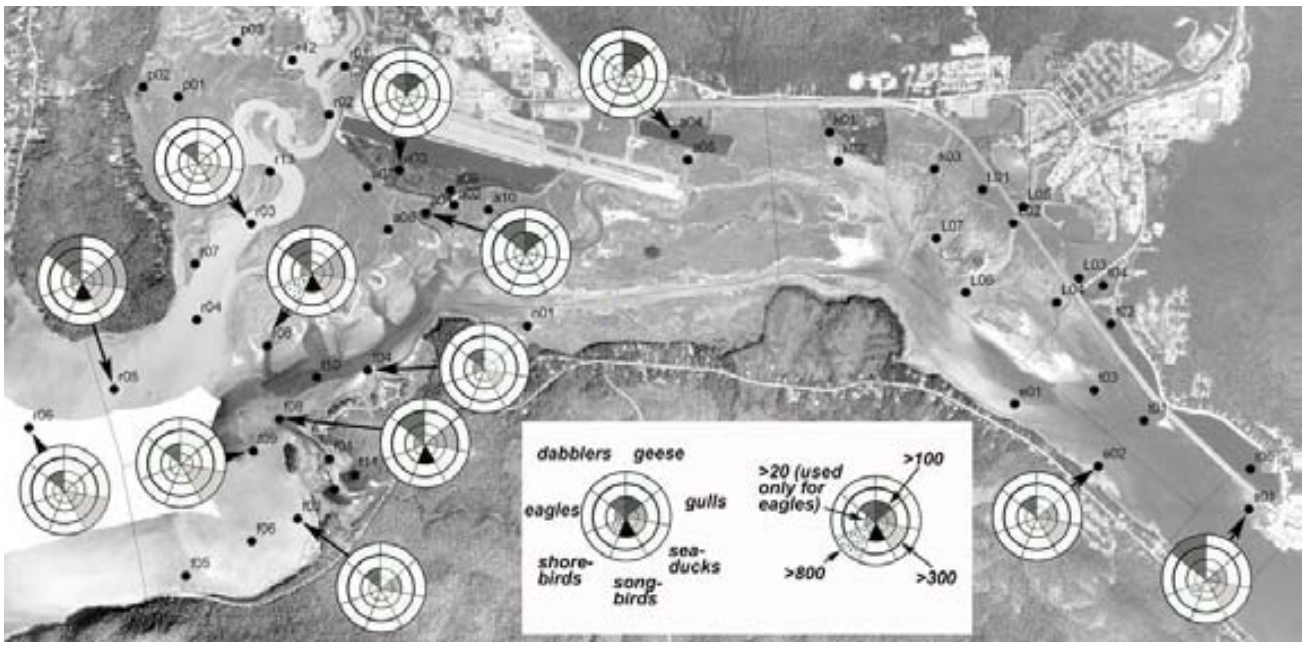


Fig 3.3b *Spring distribution of seaducks, songbirds, shorebirds and eagles on the wetlands. See explanation, Fig 3.2*

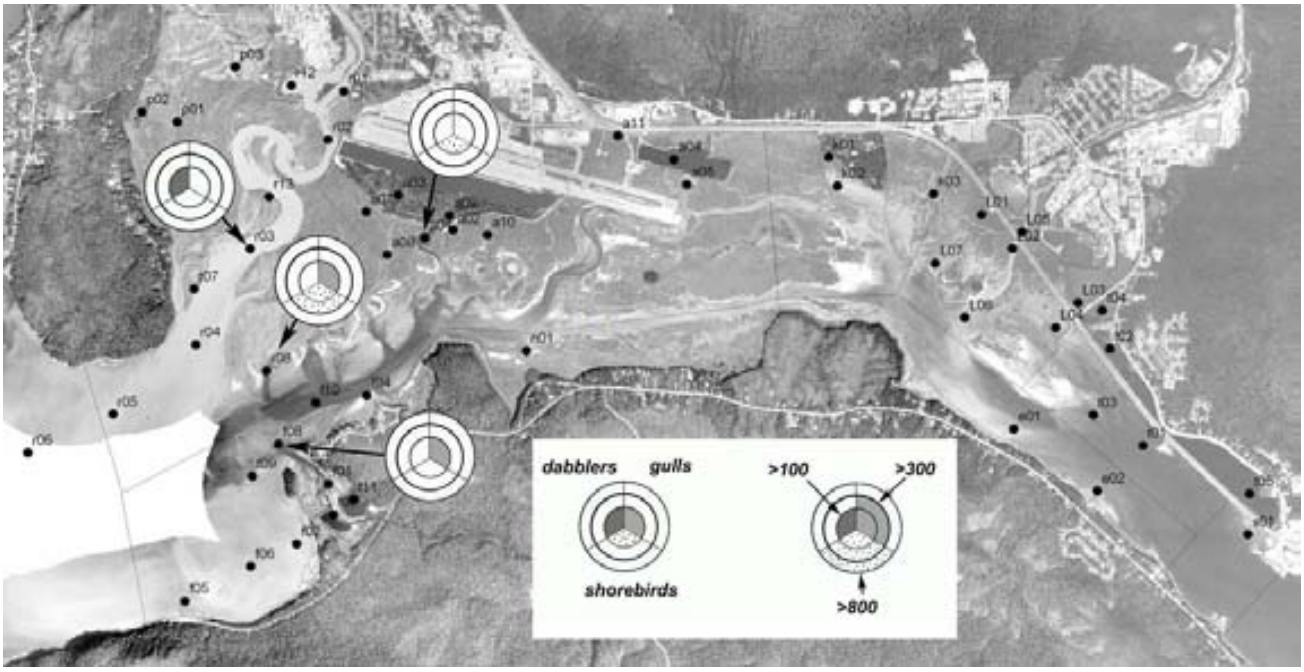


Map 3.3 *Top spring hotspots by bird group*

were found especially at Otter Pond (a01), Miller-Honsinger pond (a04), and the finger ponds near the Dike Trail (a03 and a04). Relatively heavy use by eagles was observed at Gastineau Channel near Bayview subdivision (f04, *n* = 23 observations), Fish Creek estuary; (f08, *n* = 36 obs.), Mendenhall River mouth; (r05, *n* = 62 obs.), and Western Mudflats; (r08, *n* = 79 obs.).

As on Map 3.2, only those survey areas where more than 400 birds were counted for the season are shown. Only those bird groups with more than 100 counted for the season are included. (An exception is made in the case of eagles, for which groups larger than 20 are shown - in order to indicate major feeding areas.)

Summer (Map 3.4; Fig 3.4): Summer is a slow time for birding on the wetlands. Nesting songbirds were of course numerous throughout the refuge perimeter in supratidal habitats. But these species were dispersed and did not show up in our hotspot counts. Gulls and shorebirds were the most numerous groups of flocking birds on the



Map 3.4 *Top summer hotspots by bird group*

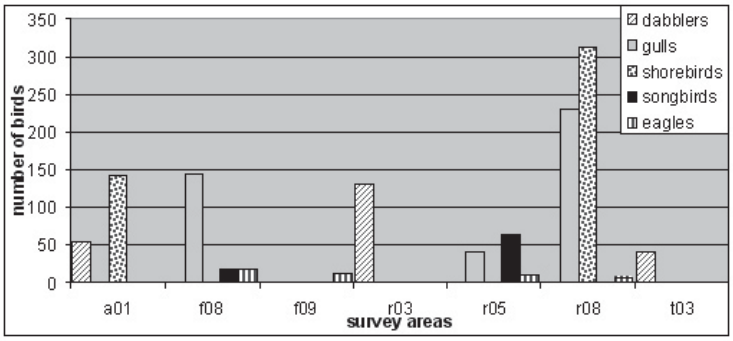


Fig 3.4 *Summer distribution of birds on the wetlands. See explanation, Fig 3.2*

wetlands, concentrated at Western Mudflats (r08) with a secondary concentration of shorebirds at Otter Pond (a01). Dabblers were seen mostly near the collapsed barge on the river edge (r03). Eagles were regularly seen at Fish Creek estuary (f08, *n* = 19 obs.). Other groups were scarce.

The summer season is defined as June and July. Generally this serves to isolate the breeding season from spring and fall migration seasons. In the case of shorebirds, however, an early southbound movement begins in July. If summer were redefined to exclude this migratory occurance, the paucity of bird records would be even more striking.

Unlike the other seasonal hotspot maps (3.2, 3.3 and 3.5), Map 3.4 includes 3 survey areas where less than 400 birds were counted for the season. Using the 400-bird minimum as a "hotspot criterion" would have excluded all observation areas except r08. Minimums for bird groups, however, are the same as for the other seasonal maps; only those bird groups with more than 100 counted for the season are included.

Fall (Map 3.5; Fig 3.5): Gulls were the most numerous birds on the wetland, concentrated at Salmon Creek estuary (s01) and at ERA (e02), with secondary concentrations elsewhere. Dabblers were concentrated at Western Mudflats (r08), with secondary concentrations at several sites. Shorebirds were seen mostly at Salmon Creek estuary, followed by Phalarope Slough (a10). "Seaducks" occurred mostly at Fish Creek estuary (f08), "songbirds" (mostly Northwestern Crows) at Western Mudflats, Mendenhall River oxbow (r13), and the sedge area west of Otter Pond (a08). Relatively heavy use by eagles occurred at Western Mudflats (*n* = 23 obs.) and Western Channel (f09, *n* = 14 obs.).

As on Map 3.2 and 3.3, only those survey areas where more than 400 birds were counted for the season are shown. Only those bird groups with more than 100 counted for the season are included. (Except for eagles, where groups larger than 20 are shown.)

Coldspots 'Coldspots' also occurred on our surveys. In general, the area with the lowest recorded mean levels of avian activity occurred in the narrow part of Gastineau Channel, from about n01 to Hendrickson Point, in all seasons. Other 'coldspots' included the Fish Creek ponds (f07, f11), three areas of the Mendenhall River (r07, r12, r13), JunkCar Slough (a02), and Phalarope Slough (a10). However, the fact that the seasonal means were low should not obscure the additional fact that some of these spots could occasionally host bird concentrations (see occasional hotspots pgs 27-32). Examples include: 1000 Rock Sandpipers at Vanderbilt estuary (L04) on May 2003; 120 Lesser Yellowlegs at Phalarope Slough (a10) on July 2, 2002. Furthermore, human and dog activity very likely influence spatial patterns of bird use, especially near the Dike Trail, and probably account for infrequently observed

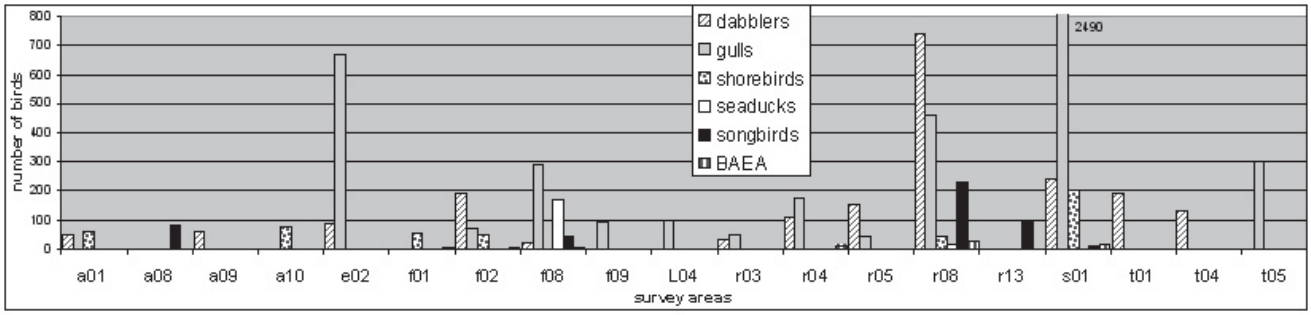
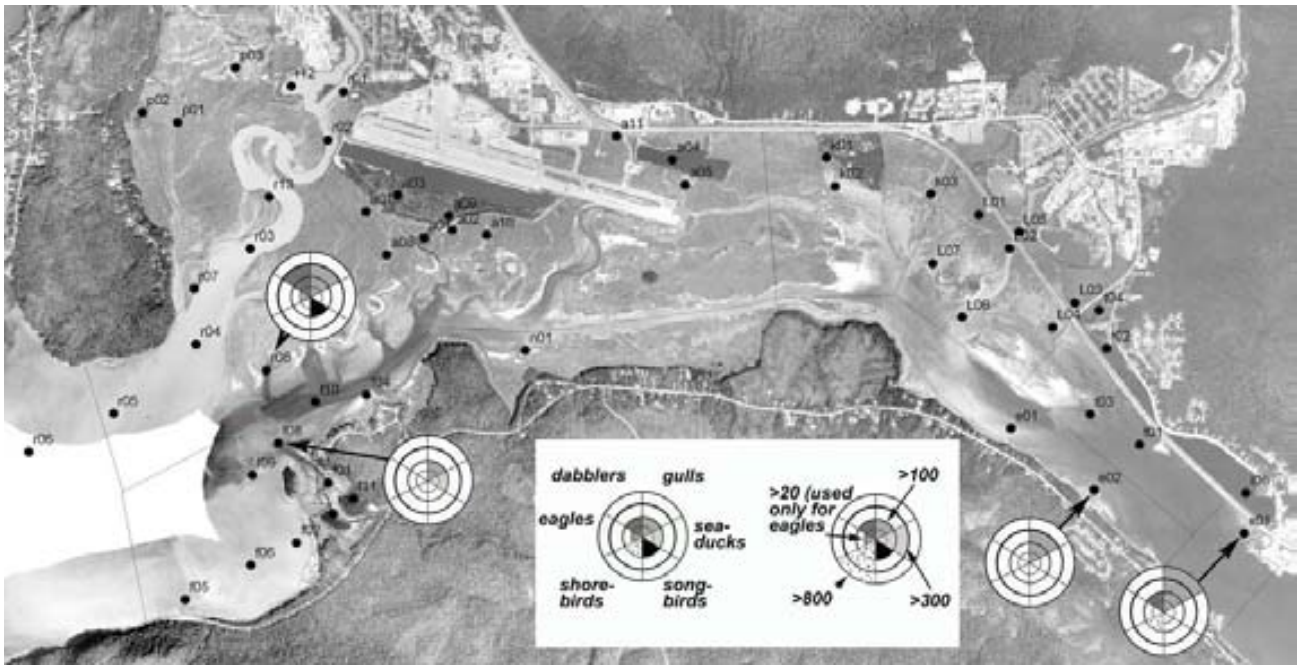


Fig 3.5 *Fall distribution of birds on the wetlands. See explanation, Fig 3.2*



Map 3.5 *Top fall hotspots by bird group*

concentrations there.

Ancillary surveys. These observations made in addition to the 18 full surveys provided additional information on high counts of some species. Important examples included:

Western Sandpiper - 2000 at r08, late April 2002
Rock Sandpiper - 1000 at L04, early May 2003
Mallard - 560 on Auke Lake, Oct 23 2002; 540 at f01, Apr 9, 2002;
Dunlin - 500 at r08, Apr 30, 2002
Bald Eagle - 20 at R03, Apr 20, 2002; 100 at f08, Apr 21 2002; Sept 7, 2002; 21 at r05, Apr 17, 2003; 44 at r03, Apr 26 2003; 20 at r08, Aug 22, 2002.

However, most of the counts from the ancillary surveys did not exceed those of the full surveys.

Ancillary surveys also documented some additional species that may be of special interest. Included in this list are:

Sandhill Cranes - 200 on Sept 19, 2002
Lesser Snow Geese - 35-47 on May 2-7, 2002,
Black Turnstones - 90 on May 2, 2002
Black-bellied Plovers - 50 on Apr 30, 2002
Bank Swallows - 150 on July 28, 2002
Lesser Yellowlegs - 50 on July 25, 2002

Two things can be especially noted about the sites that were visited only periodically: heavy use of Auke Lake by Canada Geese and Mallards in fall and early winter, and considerable use of Wigeon Ponds by Mallards and Canada Geese in spring and early summer.

4 Glacial rebound, vegetation and birds

The Mendenhall Refuge area is rising from the sea at about 0.6 inches per year (Hicks and Shofnos 1965). Because salt marsh plants are finely-tuned to specific durations of tidal submergence and exposure, vegetational zones have migrated dramatically on the wetlands in response to changing sea level. In addition to glacial rebound, human construction on the wetlands – especially the runway and the line of spoil islands paralleling Gastineau Channel – have created impediments to tidal flow, exacerbating the loss of vegetational types important to some birds, and increasing the acreage of habitats preferred by others (Bishop et al 1987).

Conifer forest surrounds the Mendenhall Refuge. In some areas, old-growth forest on steep bedrock surfaces ends abruptly at the high tide mark. More often, these mature hemlock-dominated forests are separated from open meadow and marsh by younger stands of Sitka spruce growing on land that has risen above the tides during the past century (Fig 4.1). These spruces may either occur as a tight belt of even-aged forest, or as a dispersed parkland of successively smaller saplings colonizing outward into the wetlands.

The closed spruce stands have very little foraging value for birds or other wildlife, but are the preferred nesting habitat for Northwestern Crow. Scattered spruces ("wolf" or "open-grown" trees) serve as scanning perches for Bald Eagle, American Kestrel and Merlin, and often hide nests of Song and Lincoln Sparrow. Because most of these species occur as dispersed singles or pairs, bird use of the conifer fringe was not well documented by our hotspot study or by the 1986 USFWS study.

Below the spruce groves are supratidal meadows, also on former tideland. We refer to this habitat as "uplift meadow." This meadow has been extensively developed on the margins of the refuge. In fact, the little that occurs within refuge boundaries is mostly former salt marsh that has succeeded to meadow since refuge establishment.

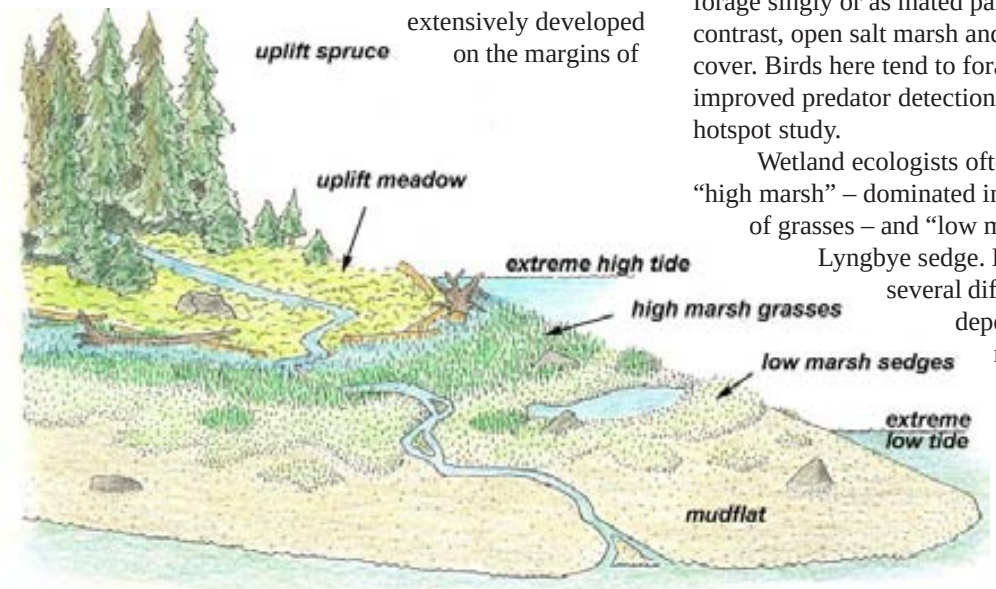


Fig 4.1 *Vegetational zones on tidal and supratidal surfaces at Mendenhall Refuge.*

Fig 4.2 *"Succulent marsh" - mostly sea milkwort and arrowgrass - growing at about the 13-foot tide level below the sedge-dominated low marsh*

Plant diversity in uplift meadows is high, and species composition varies from place to place depending on substrate and seed source for initial colonists. Many of these meadow species are palatable for mammalian grazers like deer, bear and porcupine, but much less so for grazing birds like geese that are intolerant of tannins and other compounds in supratidal plants (Buchsbaum 1987). Birds such as Savannah Sparrows nest here in great but dispersed numbers. Because out hotspot surveys focused on bird *concentrations*, we gathered few records for bird use of the uplift meadows

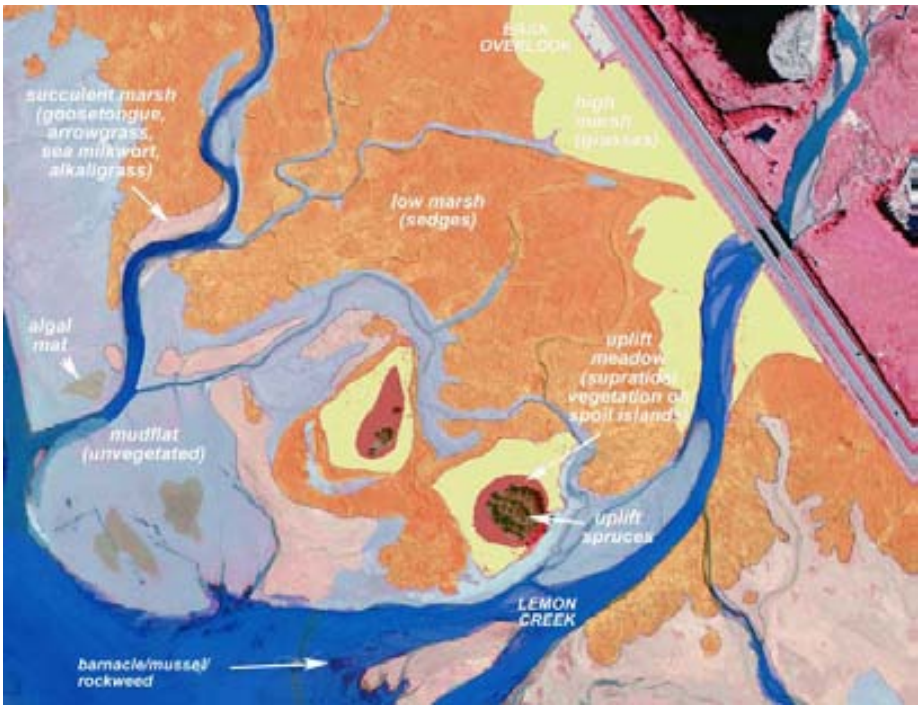
The extreme high tide line (EHWS), roughly 20 feet above sea level (MLLW) locally, defines the lowest extent of uplift meadow and the uppermost extent of salt marsh, a wave-sheltered intertidal community, usually estuarine, covered with vascular plants.

At this boundary, bird use changes dramatically. In supratidal habitats, more complex cover allows birds to forage singly or as mated pairs or small family groups. In contrast, open salt marsh and mudflat has little hiding cover. Birds here tend to forage in larger groups, partly for improved predator detection. This is where we focused our hotspot study.

Wetland ecologists often divide the salt marsh into "high marsh" – dominated in our area by several species of grasses – and "low marsh" – dominated locally by Lyngbye sedge. Below the sedge zone there are several different community types depending on substrate (finer muds or coarser sands and gravels) and exposure to tidal currents. In some cases sedges transition abruptly to mud flats. Elsewhere, a shorter "lawn" of alkali grass, goosetongue, sea milkwort, and arrow-grass can be found. We refer to

this rather spotty and less predictably distributed community as the "succulent marsh." For most salt-marsh foraging birds the low marsh and succulent marsh are far more important than high marsh.

The high marsh extends from extreme high water down to 16 or 17 feet above sea level. The 3 species of grasses most common in this zone are rye grass, hair grass, and foxtail barley. High marsh grasses are used by migrating flocks of seed eaters like pipits and longspurs. Crows often forage there, and grassy swards serve as resting habitat for birds like geese and mallards that require large open spaces where approaching predators can be detected (Fig 4.6 b,c & d). The grasses also support voles that attract hunters like Northern Harrier, American Kestrel and Short-eared Owl. Several times per month, high tides reach up into these grasses, forcing brief evacuation by voles, and destroying eggs of ground-nesting birds that have placed their nests a little too far below the uplift meadow. In early spring, freshly sprouting grasses attract migrant grazers like Snow and White-fronted Geese. But in general, grasses are more fibrous and less palatable than sedges that dominate the low marsh.



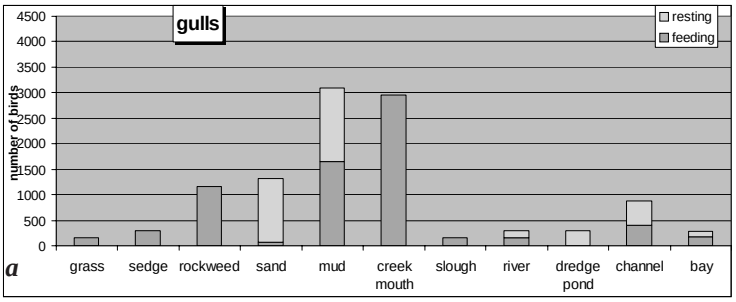
Map 4.1 *Vegetational zones at Lemon Creek estuary. From Mendenhall Refuge mapping in progress for the Southeast Alaska Land Trust. Compare Fig 4.11.*

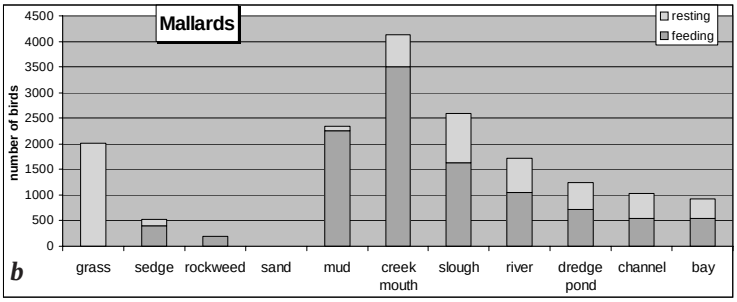
Lyngbye sedge, in spite of the relatively low percentage of land surface it covers in Southeast Alaska, may be the most important plant in our region for grazing birds and mammals. In wilder estuaries where mammals have easier access to the tidal marsh, sedges attract grazing black and brown bears, deer and even moose. While these mammals prefer their sedges in close proximity to forest or brush cover, the opposite is the case for geese, who have therefore inherited most of the great sedge fields of the heavily humanized Mendenhall Refuge (Fig 4.6c).

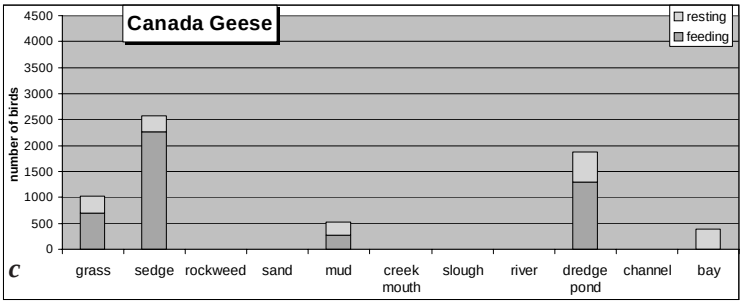
Other values of Lyngbye sedge are less widely recognized but equally important. This species produces copious seed (which seems rather odd considering how rarely seeds actually germinate in the salt marsh; the plant spreads largely by vegetative propagation). Sedge seeds form a large part of the fall diet of resident Vancouver Canada Geese (Jim King, pers. comm.). This shift from spring focus on sprouts to autumn seed consumption is driven by nutritional requirements as well as food availability. Protein and nitrogen requirements of Canada Geese are highest in spring, while the need for carbohydrates increases in fall (Buchsbaum 1987). Sedge seed also feeds mallards, teal and pintails; crop examinations on the Stikine River showed it was by far the most important food for these birds in autumn migration (Hughes and Young 1979).

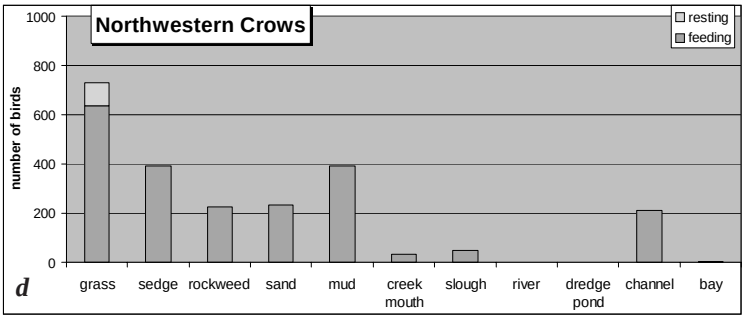
Fig 4.3 *Lyngbye sedges grazed by geese, ~15-foot tide level. Stems are triangular in section (grasses are round).*

Fig 4.4 *Barnacle/mussel/rockweed community at mouth of Mendenhall River, about 3-foot tide level.*









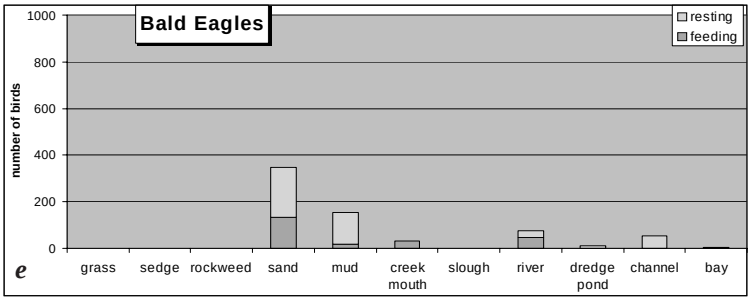


Fig 4.5 *Bonaparte's Gulls foraging in algal mat community, about 8-foot tide level*

A less direct benefit to birds of the Lyngbye sedge community comes by way of marine food chains. Marine algae trapped in the stems and leaves of sedges form the food base for invertebrates that feed rearing fish in the salt marsh (Levings and Pomeroy, 1979). These species include coho salmon that often spend their first summer in estuaries before retreating back up into headwater streams to overwinter. Other fish that prey on sedge-community invertebrates include juvenile herring, stickleback, staghorn sculpin and starry flounder (section 9, p 46). All of these species are potential prey for fish-eating birds from terns to mergansers.

Below the vascular plant communites of the salt marsh are broad expanses of mud, sand and gravel – visually barren-looking but in fact extremely food rich for specialized bird groups like shorebirds. This community was the subject of a related study and is treated at length in a separate report to USFWS (Willson and Baldwin, 2003).

Scattered among the open sand and mudflats are three more distinctive community types important to birds. The first could be refered to as the "succulent marsh" (Fig 4.2) because of the abundance of succulent vascular plants like goosetongue and arrowgrass. Generally these short-statured species are found on coarser substrates than the pure mudflats that favor Lyngbye sedge. We found abundant evidence of grazing by geese in this community. Arrow-grass (*Triglochin maritima* - not a true grass) is low in fiber and high in nitrogen, most important to geese in spring and early summer (Buchsbaum 1987). A related species, *T. palustris*, is a preferred forage species for geese on the Yukon-Kuskokwim Delta (Mulder 1996).

The other two community types that occur in small patches amongst the barren sand and mudflats are of marine origin. All of the communites described so far are dominated by essentially terrestrial plants – "halophytes" – that have evolved varying degrees of salt tolerance. In contrast, the lower limits of the salt

Fig 4.6 *Total number of birds counted during full plus ancillary surveys, by habitat and activity:* ***a)*** *Gulls (Glaucous-winged, Mew, Herring and Bonaparte's; n = 163 records),* ***b)*** *Mallards (n = 213 records),* ***c)*** *Canada Geese (n = 51 records),* ***d)*** *Northwestern Crows (n = 69 records),* ***e)*** *Bald Eagles (n = 75 records).*

Fig 4.7 *Thick ditchgrass bed in the finger ponds north of the airport dike trail.*

Fig 4.8 *November 1, 2002. Sedges have wilted along the slough terraces while grasses remain green and erect.*

marsh support communities dominated by essentially marine organisms - both plants and animals - that have evolved tolerance of varying degrees of exposure to air.

The most diverse community type is found in patches of barnacles, mussels and rockweed (Figs 4.4, 5.8). This complex community can occur at a range of tidal elevations from about zero to 12 feet above sea level. The dominant three species cannot attach to pure mud, and require at least a partial mix of coarse gravel or cobbles. As a result, the barnacle/mussel/rockweed community is patchy and by no means a consistent belt throughout the lower reaches of the refuge. This community is one of the primary reasons for the great bird concentrations at our "hottest" hotspot – the mouth of Mendenhall River. Larger birds like scoters and gulls (Fig 4.6a) may forage on the mussels and barnacles themselves, while smaller species like turnstones hunt the more mobile invertebrates that shelter in the crevices between barnacles and hide under fronds of rockweed.

Because no available air photography had been taken at a low enough tide to map the barnacle/mussel/rockweed community, Jack Hodges agreed to fly us over the refuge. From the USFWS Beaver (which has a camera port) we photographed much of the refuge during a zero-foot tide on Oct 8, 2002. The resulting photos were very helpful in delineating not only these lower rockweed/invertebrate communities (Map 4.4), but had the unanticipated bonus of clearly showing the contact between grassy high marsh and sedgy low marsh for many portions of the refuge (Fig 4.9)

A second "marine" community consists of bright green carpet-forming algae that in some places cover hundreds of square meters of sandy surface near the boundary of vascular low marsh and mudflat (Fig, 4.5, 5.1). The dominant genus in this felted mat is usually *Vaucheria sp*., in the group of yellow-green algae; other microscopic forms including diatoms, blue-green algae and green algae are included in the community. Because these plants lack roots or even the holdfasts of seaweeds like rockweed, this mat community is the most ephemeral of the types we considered important to birds. But comparing 2001 air photos to our observations in 2002 and 2003, it

Fig 4.9 *Slough nexus at east end of runway. Taken from USFWS Beaver on Oct 8, 2002 flight with Jack Hodges. In the fall, Lyngbye sedge turns pinkish brown and lies down while grasses remain green (compare Fig 4.8). From this photo series we were able to clearly delineate high marsh and low marsh on many portions of the refuge.*

appears that the algal mats form in roughly the same positions from year to year. Bonaparte's Gulls and Surfbirds frequented the mats, flipping aside the algae in search of invertebrate prey.

In addition to the mat-forming algae, a bright green tubular-shaped genus called *Enteromorpha* is common especially on the deltas of small streams in the intertidal. This seaweed has high concentrations of mineral nutrients unavailable in other marsh plants and was therefore important to Canada Geese in studies at Cape Cod (Buchsbaum 1987).

Ditch-grass (Fig 4.7) is a salt-tolerant vascular aquatic plant that grows in dredge ponds near the airport. We have also seen it in small amounts in natural brackish ponds just north of the refuge near the former Kmart pad, and in shallow salty lagoons near Echo Cove. But on the Mendenhall Refuge, ditch-grass is essentially restricted to ponds of human origin. This has created serious safety concerns, because for waterfowl ditch-grass is "one of the most valuable species of submerged aquatics in the whole country" (Martin, Zim and Nelson, 1951). Geese of all species, swans and many dabbling ducks consume the entire plant, from narrow leaves to seeds to rootstock. Ditch-grass also supports crustaceans and dense schools of sticklebacks that attract predatory birds like mergansers and herons. All of these birds are potential threats to airplane safety.

Ironically, humans have thus constructed some of the most bird-friendly habitats on the entire refuge in immediate proximity to the airport runway and floatplane landing pond. Most attractive to waterfowl are the east and west "finger ponds," (Fig 5.36) dredged arms that extend southward from the floatplane pond, easily visible from the airport Dike Trail. As soon as ice begins to melt off in the spring, geese and ducks pile in to the first openings to begin foraging on ditch-grass (Figs 4.6b&c, 7.3) . It seems clear that 1) ditch-grass is of major importance to waterfowl on the Mendenhall Refuge; and 2) the current location of ditch-grass ponds is inappropriate.

Influence of grazers on vegetation Changes due to isostatic uplift and human alterations on the Mendenhall Wetlands have affected grazing birds in the past and will continue to do so in the future. Less clear, but highly probable, is a reciprocal effect; grazers like geese, through selective clipping, grubbing, trampling and fertilization by droppings, affect salt marsh zonation and succession (Hik et al. 1992). Exclusion or concentration of grazers - the former at hazed safety areas or dog-frequented sites, and the latter at mitigation ponds or non-hunted sanctuaries - will bring about changes in plant communities.

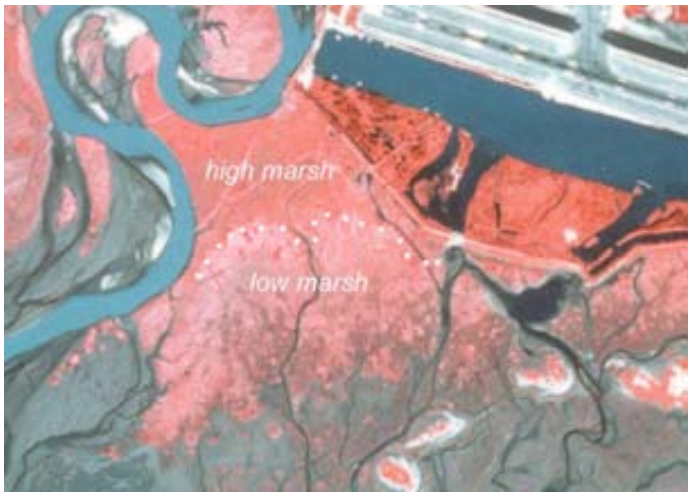
Foraging by snow geese has been studied at Hudson's Bay, one of few places in the world aside from northern Southeast Alaska where isostatic uplift is occuring fast enough to strongly influence vegetational development. Geese there appear to delay (but not arrest) the succession from low marsh to high marsh communities that takes place on rising surfaces. Where geese are excluded, grasses invade more rapidly. If grazers later return to these grassy swards, the community does not revert to the former sedge type (Hik et al. 1992).

The Hudson's Bay salt marsh has similarities and differences to the Mendenhall Wetlands. While overlap in plant community composition is high, grazing impacts in that more boreal marsh are primarily from summer-breeding Lesser Snow Geese. On the Mendenhall, grazing and rhizome-grubbing by related Canada Geese occurs in all seasons *but* early summer. Still, even a cursory examination of the low- and succulent marsh communities suggests that resident Vancouver Canada Geese are a "keystone species" in local salt marshes. In some areas nearly every blade of sedge, goosetongue and arrow-grass gets clipped. Droppings are sometimes found at densities of nearly one per square meter. And in the winter, the ground surface at the seaward margins of the vascular salt marsh is dotted with feeding craters, where geese have excavated rhizomes.

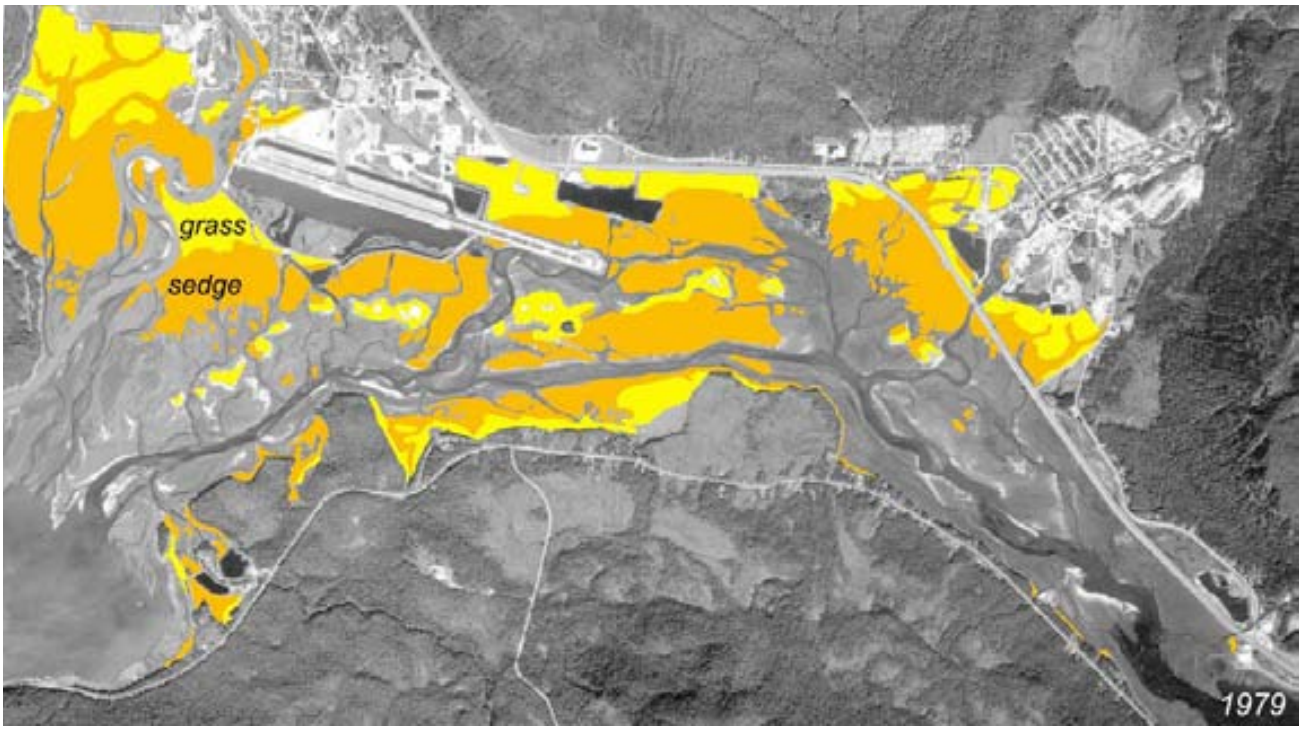
Planning for the future of Mendenhall Refuge requires a better understanding of the influences of geese on salt marsh communities.

Past, present and future We georeferenced 26 detailed images from the Oct 8, 2002 flight with USFWS and positioned them over digital orthoquads of the full refuge. We were then able to trace the contact between high marsh and low marsh over enough of the wetlands to gain a good picture of the current extent of these two key salt marsh communities. The Oct 8 imagery was particularly valuable because even the excellent 2001 SWCA low-elevation color infrared (CIR) photography does not show a color signature for high versus low marsh. Combining this information with ground-truthing conducted for SWCA consultants in fall 2002, we produced Map 4.4. In places such as the golf course and lower Lemon Creek wetlands, our mapping extends beyond the refuge boundaries, because salt marsh here, although isolated by development, is still important to wetland birds and fishes.

Interestingly, earlier CIRs taken in July 1979 by



Map 4.2 *1979 color infrareds show the grass-sedge break.*



Map 4.3 *Salt marsh vegetation based on 1979 NASA color infrared (CIR) imagery (here converted to B&W). A quarter century ago, sedge-dominated low marsh covered extensive areas west of the river and northeast of the runway near Miller-Honsinger Pond.*

Map 4.4 *Salt marsh re-mapped based on several sources: 1996 B&W digital orthophotos, 2001 low elevation CIRs commissioned by SWCA and CBJ, and 26 images from the Oct 10, 2002 flight with USFWS. Compared to Map 4.2 (1979), this map shows major expansion of high marsh grasses into former low marsh sedges. Largest beds of the barnacle/mussel/rockweed community are shown.*

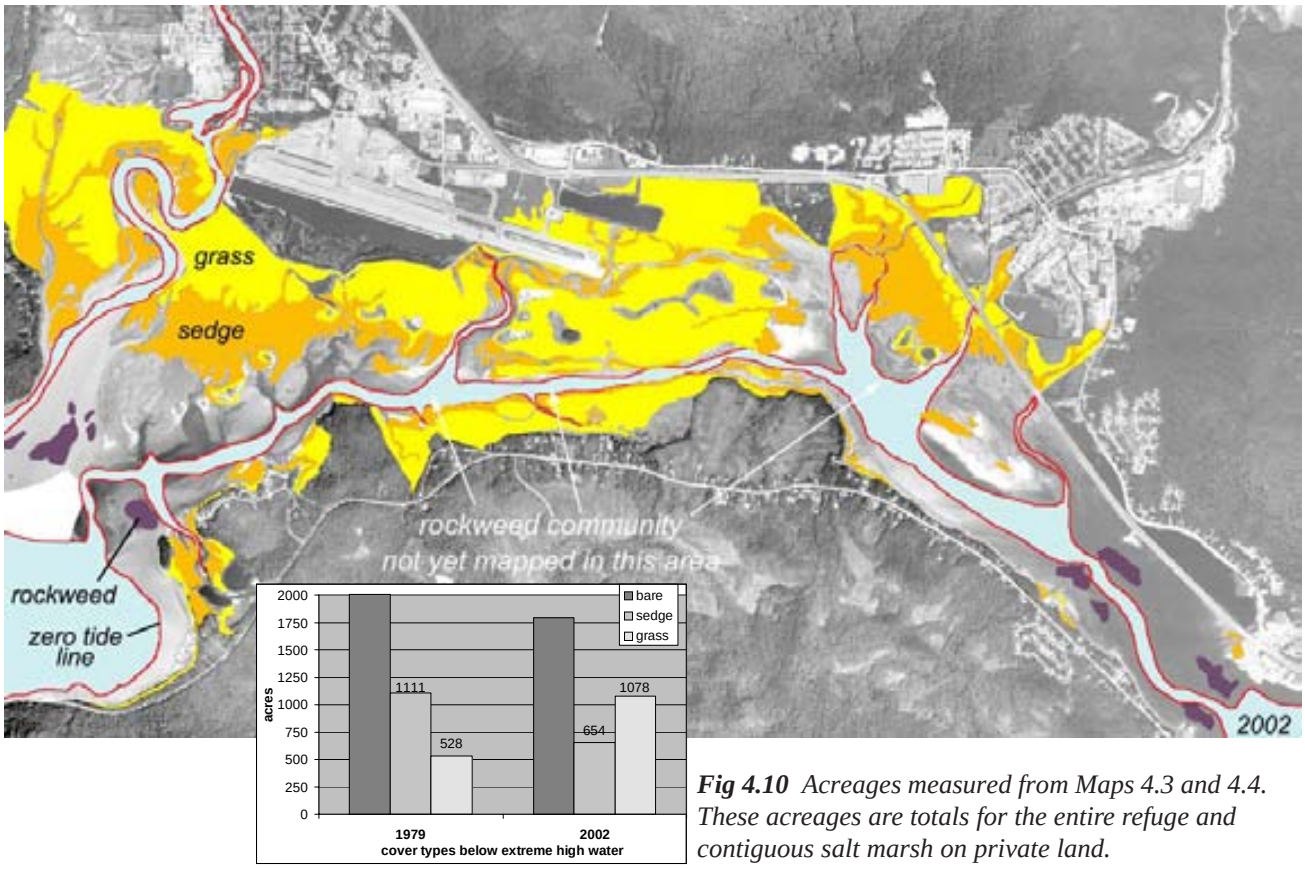


Fig 4.10 *Acreages measured from Maps 4.3 and 4.4. These acreages are totals for the entire refuge and contiguous salt marsh on private land.*

Fig 4.11 *View north over Lemon (right) and Switzer Creek estuaries, Apr 29, 2002. Spoil islands from channel dredging in foreground. Yellow line shows extent of a recent 16.5-foot high tide. In this area, grass high marsh is confined to a narrow band along Egan Drive, and most of the flats are still sedge low marsh (compare Map 4.1). This area will become increasingly important to waterfowl as low marsh elsewhere is lost to glacial rebound. It may also be deemed far enough from the runway to qualify for mitigation measures that could enhance habitat for wetland birds. (See mitigation measures, section 10)*

NASA distinguish high and low marsh much more clearly than do subsequent CIR photos (Map 4.2). Map 4.3 was based on this imagery. Comparison of maps 4.3 and 4.4 shows dramatic changes in extent of these marsh communities, supporting claims by longtime wetland residents like Jim and Mary Lou King that major loss of Lyngbye sedge has taken place over the last several decades. In a mere quarter century we have lost about half of our low marsh community (Fig. 4.10)

Maps 4.3 and 4.4 are fairly coarse-scale and should be considered an interim product. On much of the wetlands, shifting of the grass-sedge boundary takes place at much finer scales. For example in many locations where sedges used to occur as community dominants on multi-acre patches, they are now restricted to narrow inner terraces beside sloughs, inset a meter or two below the regional surface (Figs 4.8 and 4.9). These remnant linear strips of Lyngbye sedge need to be mapped and understood, because with continuing uplift, in another quarter century they could be all that remains to us.

The proportional changes in extent of high and low marsh are quite different when compared across 6 different subunits of the refuge. In some areas, low marsh may soon be "pinched off" by advancing grasses. Elsewhere, in places such as the mouths of Lemon and Switzer Creeks, there appears to be extensive mudflat that may allow sedge colonization, counterbalancing the loss of sedges to grasses at higher elevation. If sedge change continues to be disproportional on different refuge subunits, that will cause grazing birds to shift locations over time. Airport managers concerned with bird strike hazards and biologists regulating waterfowl hunting both need to understand these salt marsh successional trajectories.

The "succulent marsh" (Fig 4.2, Map 4.1), positioned between bare mudflat and low marsh sedges, is also extremely important to birds, but has not yet been mapped. Because the distribution of this community is patchier than that of low or high marsh, and strongly dependent on substrate coarseness and tidal flow dynamics, changes in location and extent will be harder to predict.

5 Hotspot descriptions

In this section we describe three types of hotspots:

Top hotspots are those areas that produced the greatest amount of bird activity over the entire year.

Occasional hotspots are areas that may be important in only one season and/or for only one purpose - for example a resting area for Mallards.

Nearby hotspots are areas outside, but near to the Mendenhall Wetlands and Refuge, in which there is an obvious connection and value to birds using the wetlands i.e. Auke Lake.

Mendenhall River mouth (r05) – top hotspot

• **The mouth of the Mendenhall River is probably the most important feeding habitat for ducks and shorebirds on the wetlands.** At times Western Sandpipers have been seen here in the thousands. Surfbirds, Ruddy Turnstones, Semipalmated Sandpipers and Dunlins often occur in the hundreds. We have counted up to 800 Northern Shovelers (May 14, 2002), 350 Mallards (Feb 18, 2003), and 300 American Wigeon (May 10, 2003) feeding in the sloughs and amongst the fucus beds of this area.

Fig 5.1 *View north over river mouth to Mendenhall Penninsula at a zero-foot tide, Oct 8, 2002*

• It also appears to be an important feeding area for Bald Eagles (often we counted 10 to 20 per survey), a loafing area for Canada Geese (up to 400 counted), and a feeding area for seaducks including scaups, scoters, and goldeneyes. About 200 Sandhill Cranes were sighted in the area on Sept 18, 2002.

• The river mouth is the premier spot to look for the less common shorebirds such as American Golden-Plover, Pacific Golden-Plover, Whimbrel, Hudsonian Godwit, Bar-tailed Godwit, Marbled Godwit, Red Knot, and Baird's Sandpiper.

Fig 5.2 *Surfbirds and Ruddy Turnstones at river mouth.*

Fig 5.3 *The mouth of the Mendenhall River offers a variety of habitat for birds including sand, mud, barnacle/ mussel/rockweed beds, algal mat communities, and a mix of freshwater and saltwater.*

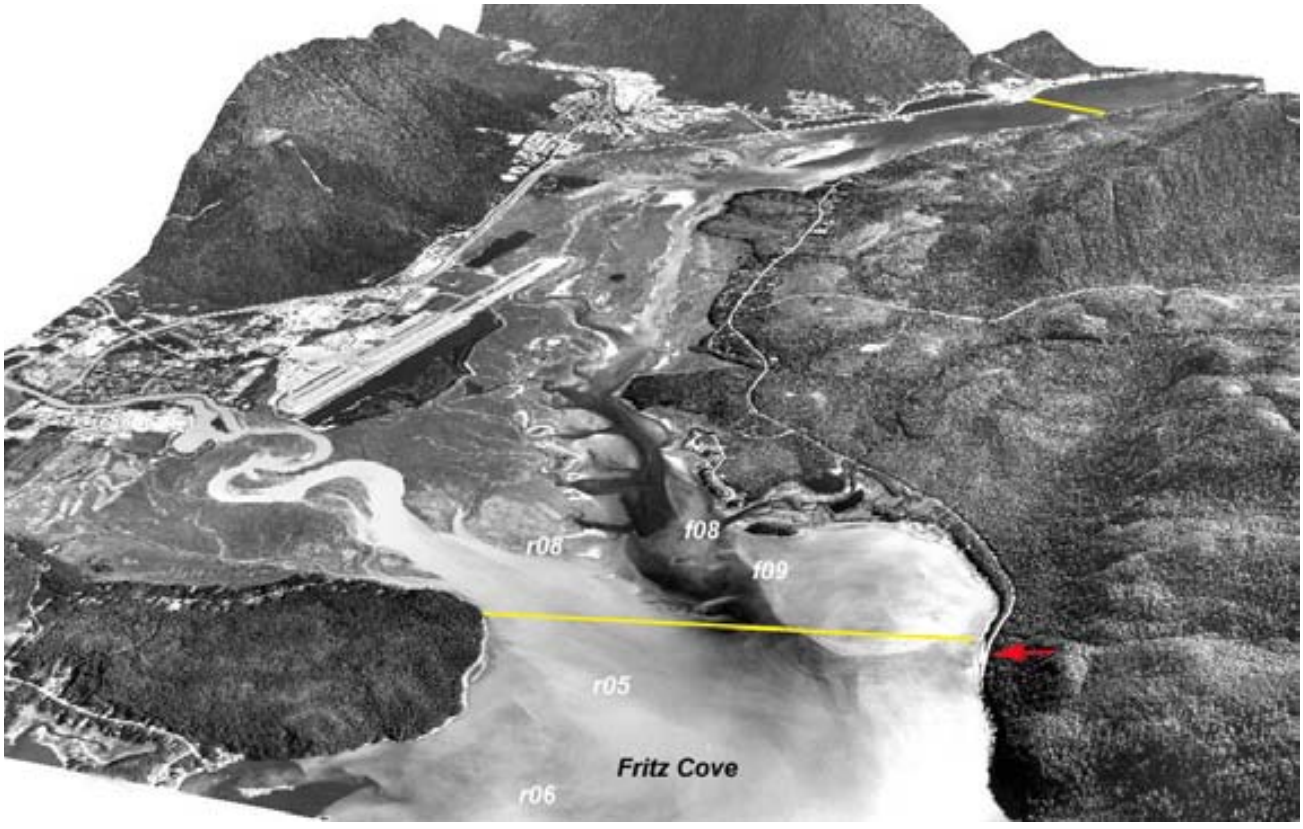
Fritz Cove (r06) - top hotspot

• **Fritz Cove is an important feeding and probable staging area for a variety of sea ducks and other water birds.** We observed 3,000-4000 Surf Scoters in early May, 2002 and up to 600 White-winged Scoters on May 14, 2002. Other birds that we have seen in significant numbers (20-100) include Bufflehead, Barrow's Goldeneye, Common Goldeneye, Long-tailed Duck and scaup. Marbled Murrelets, Horned Grebes, Red-necked Grebes, and Red-breasted Mergansers also gather and feed within Fritz Cove.

• On occasion we observed the bird concentrations being disturbed by jet skiers and guided kayak parties – especially during April and May.

Fig 5.4 *In late April and early May (Appendix C) one can see thousands of Surf Scoters in Fritz Cove.*

Fig 5.5 *View northeast over Fritz cove to Juneau Airport and Mendenhall Refuge. 3D image generated in ArcScene from 1996 digital orthoquads. Lines show refuge boundary. Arrow shows North Douglas boat launch. On low tides, mudflats are exposed out to r05*



Western Mudflat sand lance area (r08) - top hotspot

Fig 5.6 *On May 29, 2002 we counted 250 Bonaparte's Gulls feeding in area r08. View north to Mendenhall Penninsula.*

Fig5.7 *About 80 Bald Eagles feeding on Pacific sand lance at r08. View south to North Douglas boat launch.*

• **The Western Mudflat is one of the top hotspots of bird activity for the entire wetlands.** Several species of birds feed within this area including hundreds of Western Sandpipers, Dunlins, Ruddy Turnstones, American Wigeon, Mallards, scaup, Lapland Longspurs and American Pipits.

• We have recorded high numbers (hundreds, sometimes thousands) of birds using this area in every season of the year.

• This is also a burrowing area for Pacific sand lance, which attracts Bald Eagles, gulls, crows, and ravens that congregate here to feed on these fish.

Lower Fish Creek estuary (f08) - top hotspot

Fig 5.8 *Aaron Baldwin (left) and Mary Willson conduct a timed sample for invertebrate species and abundance in barnacle/mussel/rockweed beds at the mouth of Fish Creek.*

• **The mouth of Fish Creek, at low tide, is an important feeding area for American Wigeon, Green-winged Teal, and Mallard.** We have observed Mallards feeding in this area in the hundreds and close to a hundred wigeon and teal during winter and spring.

• Fish Creek may be an important feeding area for swallows. Up to 150 Barn Swallows and 100 Violet-green Swallows were reported hawking for insects here in July 2002. This is one of the best places in Juneau to observe Vaux's Swifts.

• The estuary is often used by gulls for resting – 350 Mew Gulls and 120 Glaucous-winged Gulls observed on Mar 20, 2003 and 80 Bonaparte's Gulls seen on May 5, 2002.

• The area is popular for feeding Northwestern Crows – 200 observed on Jan 21, 2003.

Fig 5.9 *Lower Fish Creek, Oct 8, 2002. Dark patches at bottom are the rockweed beds in Fig 5.8 above. Forested "island" at right is bedrock-cored, connected by a raised storm berm to the mainland (compare Fig 5.11).*

Upper Fish Creek estuary (f01) – top hotspot

Fig 5.10 *Fish Creek upper intertidal area at high tide on April 9, 2002 when we counted 540 resting Mallards.*

Fig 5.11 *Upper Fish Creek. Zero-foot tide on Oct 8, 2002. Gulls, corvids and eagles feed on salmon in the upper estuary.*

• **Upper Fish Creek estuary is a resting area for Mallards and other ducks at high tide.** Ducks commonly feed in the lower estuary (f08) during low tides and rest in the upper area (f01) at high tides. We have also observed American Wigeon, Gadwall, and Northern Pintail using this area in smaller numbers (10-30).

• Dowitchers, Dunlin and Lesser Yellowlegs often feed in this area in groups of 10-50 individuals.

• The ducks that rest in this area are occasionally disrupted by uncontrolled dogs. On one occasion we observed one dog completely chase out hundreds of Mallards that were resting in the area. Trail and access improvement in this area - under discussion by CBJ Parks and Recreation - could be further disruptive to resting waterfowl. At present the area has a rather muddy access trail that probably limits human use.

• Because of pre-existing human disturbances (dredge ponds at right) and distance from the airport, Fish Creek has been proposed as a potential enhancement (mitigation) site for waterbirds.

Salmon Creek estuary (s01) – top hotspot

Fig 5.12 *Mouth of Salmon Creek at high tide, April 29, 2002. Lower Twin Lake at top left.*

• **The Salmon Creek estuary is an important feeding and resting area for ducks, shorebirds and gulls.** We recorded about 300 Mallards feeding in the area in May, January and February. We counted up to 600 scoters (Surf and White-winged on May 5, 2003) and 90 American Wigeon on Apr 5, 2002. Dunlin feed in the area in winter and spring in numbers up to 200 (Apr 2, 2002). We often see impressive numbers of gulls, especially in fall when the salmon are in – 1,000 Mew Gulls, 700 Glaucous-winged Gulls, 500 Bonaparte's Gulls, and 100 Herring Gulls all on Aug 12, 2002.

• Bald Eagles frequent the area in small numbers – we have observed up to 16 (Sept 25, 2002) – usually feeding on salmon carcasses.

Fig 5.13 *Bonaparte's Gulls wheel over Salmon Creek, dipping for salmon eggs. Glaucous-winged gulls stand in the shallows*

Fig 5.14 *Dunlin and Mew Gulls often feed among the rockweed for invertebrates.*

Otter Pond (a01) top hotspot

• **Otter Pond is an important feeding and resting area for waterfowl.** We have observed up to 530 geese resting on the pond and up to 120 feeding among the nearby sedges. Mallards also use the area for both feeding and resting, sometimes in the hundreds (up to 360 counted).

Fig 5.15 *Dike Trail, Oct 8, 2002. a01 = Otter Pond.*

• A variety of both dabbling and diving duck species can also be seen feeding and resting on Otter Pond. We have seen Green-winged Teal, American Wigeon, Northern Shoveler, Northern Pintail, Blue-winged Teal, Bufflehead, Common Goldeneye, Canvasback, Scaup and Red-breasted Mergansers usually in small numbers, but occasionally in groups of 10-30 per species.

• Otter Pond is frequently used as a feeding area for shorebirds, particularly Greater and Lesser Yellowlegs and dowitchers. We have often counted 10-40 individuals and up to 142 (Lesser Yellowlegs) using the pond. This is a good area to observe Greater Yellowlegs catching and eating staghorn sculpins.

• On occasion we recorded high numbers of other birds using this area. We saw about 50 Horned Larks on April 27, 2002 and 235 Northwestern Crows on November 22, 2002.

• Otter Pond is one of the best birdwatching areas on the Dike Trail. There is always something to see. An observation bench with cover (Gazebo) is positioned at the NE end of the pond.

• Dogs often disturb birds at the pond. A trail parallels Otter Pond closer and below the Dike Trail where people often walk their dogs.

Fig 5.16 *A Greater Yellowlegs catches a juvenile staghorn sculpin at Otter Pond. Yellowlegs are the only Alaskan shorebird known to prey heavily on fish.*

Fig 5.17 *On January 28, 2003 we estimated 530 Canada Geese landed on Otter Pond to rest and feed.*

Sedge flats west of Otter Pond (a08) - top hotspot

Fig 5.18 *View north to dike trail from a08*

Fig 5.19 *Resident geese feeding at a08, Jan 30, 2003*

• **These sedge flats are a very important feeding area for Canada Geese especially in winter and spring.** On several occasions we have counted over 100 Canada Geese (up to 685) feeding here during this time. The area also occasionally attracts Northwestern Crows (up to 60) and Western Sandpipers (up to 50 counted) feeding within the intertwining muddy areas.

• Dogs often chase feeding and resting geese in this area.

• Grazing concentrations will be displaced southward over the coming decades as the land rises and grasses replace the favored Lyngbye sedges. Compare Maps 4.3 and 4.4.

Fig 5.20 *View south to a08 flats, Apr 29, 2002. Line shows recent 16.5-foot tide.*

ERA heliport (e02) —top hotspot

Fig 5.21 *The area around Era Heliport includes a mudflat and salmon stream (Neilson Creek).*

Fig 5.22 *ERA heliport at zero-foot tide, Oct 8, 2002. Delta of Neilson Creek pushes into Gastineau Channel here, constricting it to a very narrow width at low tide. Dark patches on mudflats are barnacle/mussel/rockweed beds that help to account for scoter concentrations here*

• **Neilson Creek mouth is an important feeding area for waterfowl and gulls.** We counted up to 1,000 Surf Scoters (May 14, 2002), 200 Mallards (Jan 21, 2003), 500 Mew Gulls (Aug 12, 2002), 130 Bonaparte's Gulls (May 14, 2002) and 100 Glaucous-winged Gulls (Aug 12, 2002) feeding in the channel or on the flats in front of ERA heliport.

• The ERA site is also used for feeding by a variety of other ducks, but in smaller numbers (10-20 per observation) – American Wigeon, Bufflehead, Common Goldeneye, Green-winged Teal, and Northern Shoveler.

Western Channel (f09) - top hotspot

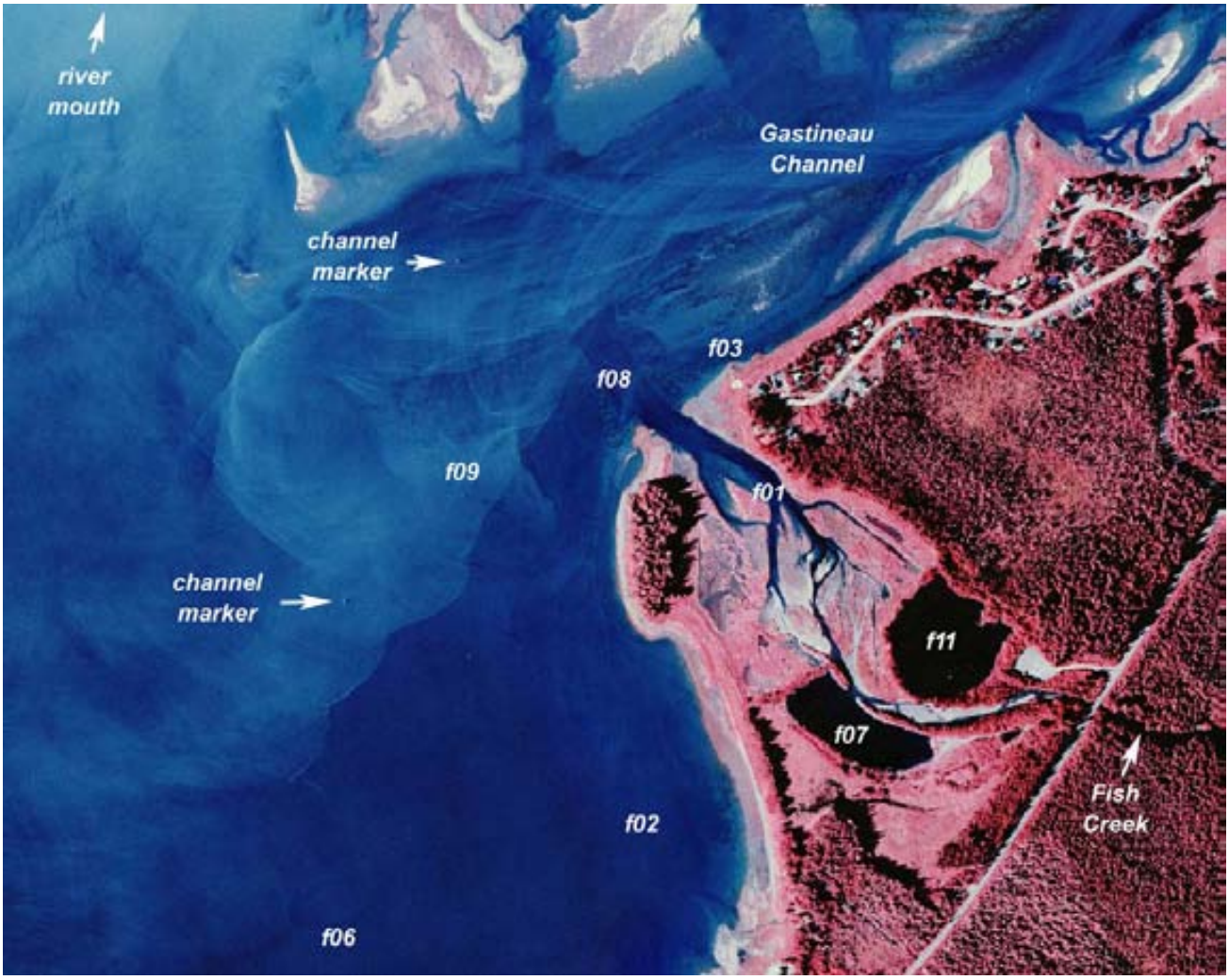


Fig 5.23 *Western Channel, f09. From 2001 low elevation color infrared imagery commissioned by SWCA consultants and CBJ. At this fairly high tide the mudflats and barnacle/mussel/rockweed beds at f09 are covered. Near f03 these beds are more shallowly covered, and can be detected as patches of darker blue. At a low tide it is possible to walk out nearly to the channel markers. Westernmost spoil islands (from dredging of Gastineau Channel in the early 1960s) show at top.*

• **Western Channel is an important feeding and resting area for a variety of waterfowl especially in late winter and spring**. We have counted up to 1,700 Surf Scoters (May 3, 2002), 160 scaup, 150 Mallards, 90 Red-breasted Mergansers, 80 American Wigeon, and 70 Green-winged Teal within this area. Also, we have observed up to 350 Bonaparte's Gulls and numerous Mew and Glaucous-winged Gulls using this area.

Upper Mendenhall River (r02, 13, 03, 07 and 04) – occasional hotspots

• **Middle reaches of the river are important for seaducks and dabblers, especially in spring.** Most of our records here are for resting and preening rather than feeding. The northern banks opposite the barge at r03 are a favored duck assembling area - elsewhere the river cutbanks rise more steeply from the water, restricting views of approaching predators. Dabblers use this area throughout the summer as well.

• The confluence of Casa del Sol Creek and Mendenhall River at r07 is a spring resting area for Mallard, teal, Gadwall, Common and Barrow's Goldeneye, and a feeding area for Canada Geese.

• Large numbers of birds were rarely seen at r02 and r13.

Fig 5.24 *Middle reaches of Mendenhall River estuary, 2001, SWCA color infrared photo. Note the very narrow "stem" of the oxbow loop.*

Fig 5.25 *Collapsed barge at r03, May 5, 2003. According to Joe Smith, this barge once held his dredging equipment for operations in the floatplane basin. The towboat had difficulties exiting the river and cut him loose.*

Fig 5.26 *View southwest from Dike Trail. Uplift meadow in foreground grades to high marsh grasses on left. In middle distance is large, eroding oxbow that will soon be breached. At that time the loop at r13 may turn into a tidal lagoon. This could provide exceptional bird habitat, unfortunately at rather close proximity to the runway.*

Wigeon Ponds (p02) – occasional hotspot

Fig 5.27 *Wigeon Ponds on May 14, 2002 when we counted 140 Mallards (at last pond).*

• **Wigeon Ponds appear to be an important resting area for Mallards**, especially in April and May when we have counted up to 500 (April 23, 2003).

• Wigeon Ponds are also an important feeding area for Canada Geese. We have counted over 100 geese here in June, feeding on Lyngbye sedges.

• The area offers nesting habitat for waterfowl. The only duck nest we found during our surveys of the wetlands was at Wigeon Ponds on May 20, 2003 (Fig 5.28).

Fig 5.28 *Mallard nest at wigeon ponds*

• Wigeon Ponds support the only known breeding population of western toads - a severely declining species - for the entire Juneau mainland from Thane to Amalga. We have found toadlets and tadpoles in two slightly brackish ponds within the Wigeon Ponds area (Carstensen, Willson and Armstrong 2003).

• The area is somewhat protected from human disturbance by a steep access trail and deep muddy areas that make walking difficult. During our surveys we have observed deer and bear in the area. However, we have also observed, and others have reported, three large unattended dogs chasing birds in the area.

Fig 5.29 *View south along Mendenhall Peninsula and Casa del Sol Creek. Wigeon Ponds cluster at edge of forest on right. These ponds are uniformly about one foot deep, on firmly compacted silt, with marestail and water milfoil.*

Phalarope Slough (a10) – occasional hotspot

Fig 5.30 *Phalarope Slough on July 2, 2003 showing concentration of feeding Lesser Yellowlegs. For location of Phalarope Slough, see oblique air photo, Fig 5.32*

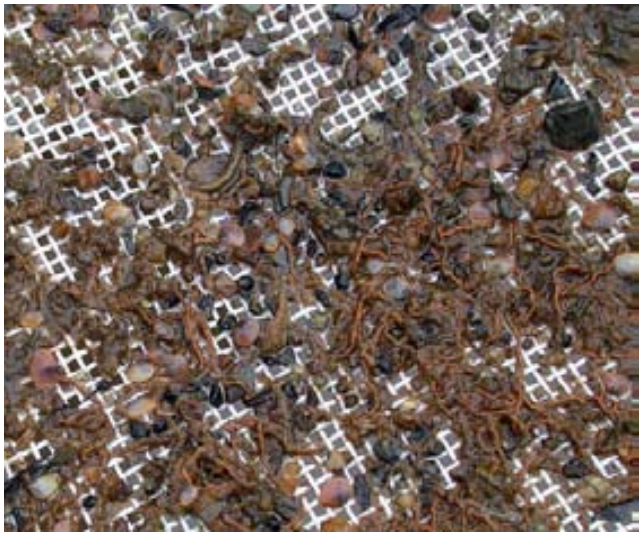


Fig 3.31 *Juvenile macoma clams sieved from the mud in Phalarope Slough. These are an important food for probers like dowitchers.* Corophium *amphipods – key foods for migratory shorebirds – are also abundant in Phalarope and Junk Car Sloughs. See appendices in Willson and Baldwin (2003) for more on birds and invertebrates.*

• **Phalarope Slough appears to be an important feeding area for Lesser Yellowlegs and dowitchers.** We have counted up to 120 Lesser Yellowlegs (July 2, 2003) and up to 40 dowitchers (Sept. 20, 2002) feeding here. The area is loaded with amphipods and baby macoma clams, which may be the main attractants for these shorebirds. Other species often seen feeding here include Greater Yellowlegs, Green-winged Teal and Northern Shovelers.

• Phalarope Slough is adjacent to the Dike Trail and a popular spot to watch birds. It received its name from the occasional Wilson's Phalarope seen here.

• Because of its nearness to the Dike Trail the birds are often disturbed by dogs chasing them.

Junk Car Slough (a02) – occasional hotspot

Fig 5.32 *View south over floatplane woodland, April 29, 2002. Junk Car Slough (a02) in mid distance; Phalarope Slough (a10) on left; East Finger Pond (a09) in foreground; Otter Pond (a01) on right.*

• **Junk Car Slough, just to the left (west) of the Gazebo usually has a small assemblage of feeding birds.** We have counted up to 33 Long-billed Dowitchers, 25 Lesser Yellowlegs, 40 Mallards, 47 Lesser Snow Geese, and 10 Golden-crowned Sparrows feeding in or immediately adjacent to this slough.

• This slough received its name from the number of junk cars that used to line its landward bank. Like other sloughs along the Dike Trail it is a popular spot to watch birds. As in other areas adjacent to the Dike Trail, dogs often disturb the feeding birds.

Fig 5.33 *Junk Car slough showing a concentration of feeding dowitchers.*

Miller-Honsinger Pond (a04) – occasional hotspot

Fig 5.34 *A pair of Tundra Swans with their cygnets on Miller-Honsinger pond*

• **Miller-Honsinger Pond appears to be an important resting and feeding area for small groups of waterfowl**. On occasion we have counted up to 225 Greater-white Fronted Geese (May 5, 2002), 72 Canada Geese and 60 Mallard (Apr. 11, 2002). We have also occasionally seen pairs of both Trumpeter and Tundra Swans and small numbers (10-20) of American Wigeon, Bufflehead and Greater Scaup.

• The area adjacent to this pond is popular among local birders, especially as a place to look for raptors. We have observed American Kestrel, Merlin, Gyrfalcon, Northern Harrier and Rough-legged Hawk hunting in this area. The brush and small trees adjacent to this pond are also a good place to observe songbirds.

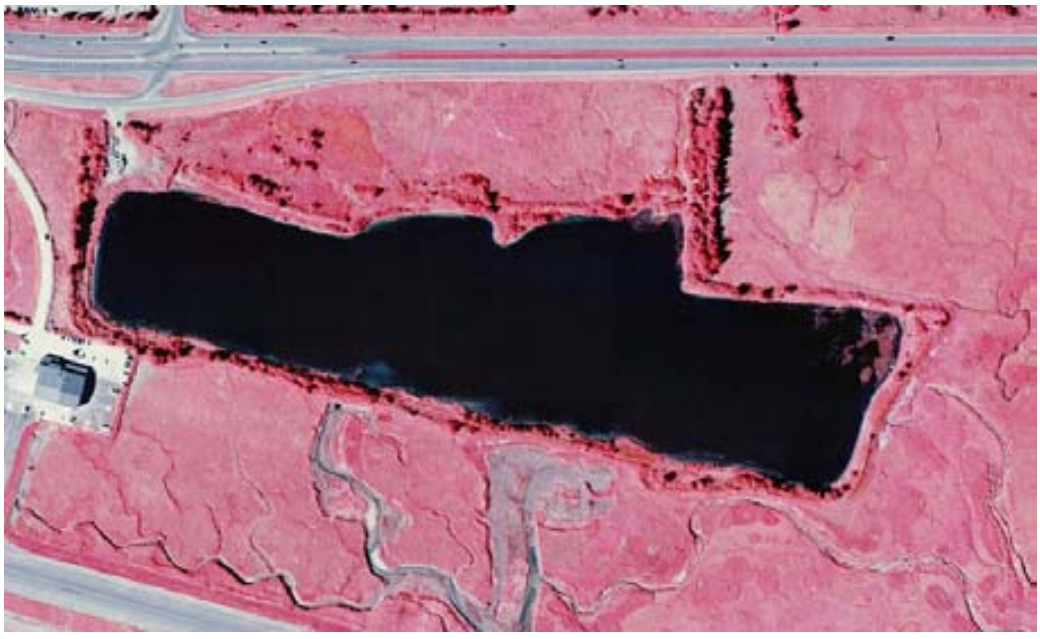


Fig 5.35 *Miller-Honsinger Pond, 2001 SWCA color infrared photo. Temsco helipad on left. West end of this pond is extremely noisy. Waterfowl congregate especially at the shallows in the northeast corner. This pond is brackish and has ditch-grass along the margins, but probably less than in the floatplane basin finger ponds, judging from the relative amount of use by waterfowl. Purchase of this pond has been suggested as a possible mitigation measure.*

Floatplane Basin Finger Ponds (a03 and a09) – occasional hotspots

Fig 5.36 *Canada Geese and other waterfowl concentrate in West Finger Pond (a03) to feed on ditch-grass just as soon as the ice is out in spring.*

Fig 5.36 *Ditch-grass*

• **East and West Finger Ponds are important feeding sites for Canada Geese and other waterfowl during April and May, when we have observed up to 230 geese and 160 Mallards.**

• The main attractant for these birds is ditch-grass (*Ruppia maritima*).

• The ponds are also used for feeding in the spring by a variety of other birds including American Wigeon, Bufflehead, Green-winged Teal, Greater Scaup, Northern Shoveler, Ring-necked Duck, Tundra and Trumpeter Swans and Greater White-fronted Geese.

• Greater and Lesser Yellowlegs and dowitchers usually feed here in small numbers during spring. We counted 150 Western Sandpipers on May 2, 2002.

• The woodlands surrounding the Finger Ponds provide nesting habitat for a variety of songbirds. During point counts (for another project) we determined that 13 bird species nested in the area and estimated they consisted of 350 individuals (female and male). The most common species of nesting songbirds were Ruby-crowned Kinglets, American Robins, Hermit Thrushes, Wilson's Warblers, Yellow Warblers, and Yellow-rumped Warblers.

Fig 5.37 *Goose feeding on ditch-grass*

Auke Lake (x01) – nearby hotspot

Fig 5.38 *On November 30, 2002 we counted 600 Canada Geese and 500 Mallards on Auke Lake. This is close to the total number of Vancouver Canada Geese that we have estimated for the entire Mendenhall Wetlands (500-700) and nearly equal to the total number of Mallards that we have counted for the entire wetlands (540).*

• **Auke Lake appears to be a very important resting area and "refuge" for Canada Geese and Mallards that typically forage for food on the Mendenhall Wetlands.** For both species we counted numbers in the hundreds on the monthly surveys in October, November and December until freeze-up. We found no use of Auke Lake by geese or mallards in August and an adjacent resident (Gretchen Bishop) kept records of the birds using Auke Lake and did not note any significant numbers until October.

• In late fall, during waterfowl hunting season, Canada Geese and Mallards typically leave the wetlands near sunrise, fly to Auke Lake, and then return to the wetlands after sunset. The geese apparently forage on Lyngbye sedges and other salt marsh plants throughout the night.

• If disturbed on Auke Lake they will fly to the Mendenhall Wetlands at other times. We once observed large numbers of geese flying to the wetlands from Auke Lake during hunting season around noon. We checked Auke Lake and found it being used by jet skiers.

• Other waterfowl occasionally use Auke Lake but in smaller numbers. We have counted up to 75 American Wigeon and 30 Barrow's Goldeneyes during the fall surveys. Other species are probably underestimated because of the difficulty seeing them amongst the large numbers of geese and Mallards and the long distance impairing identification.

Fig 5.39 *The twice daily flight of geese to and from Auke Lake often takes them directly through the western airplane approach path to the runway. This photo was taken on November 20, 2001 when they had been disturbed on Auke Lake. Notice the elevation above the approach lights at lower left.*

Twin Lakes (t02) and Vanderbilt marsh (t04) – nearby hotspots

Fig 5.40 *Vanderbilt marsh as viewed from the Pioneers Home, Oct 12, 2003.*

• **Twin Lakes is an important feeding area and "refuge" for Mallards and scaup during fall hunting season.** Throughout this area, resting birds are less than one quarter mile from roads, thus off-limits to hunting. We have counted around 100 Mallards on surveys during October – December in the marsh adjacent to the Pioneers Home. Counting Mallards from the road certainly results in underestimates. On Nov 1, 2002, we traversed Vanderbilt marsh while vegetation mapping and successively flushed 150 Mallards in groups of 20 to 40. We had only seen a fraction of these from the road beforehand. Up to 100 scaup have also been observed diving and feeding in the more open waters of Twin Lakes in October and November.

• Great Blue Herons frequently hunt for fish in this marsh and a pair of Red-winged Blackbirds nested there in 2003.

• Twin Lakes is a good area to look for the less common waterbirds. We have seen American Coot, Hooded Mergansers, Ring-necked Ducks, Canvas-backs and a Ruddy Duck on Twin Lakes. It is the best place in Juneau to find American Coot and Hooded Mergansers. Several of each species have been present here in recent years.

Fig 5.41 *View north over Egan Drive. Vanderbilt marsh, t04, was the original estuary of Vanderbilt Creek. During Egan construction, the creek was moved to the dredged channel in distance.*

6 Comparisons with Cain et al. 1988

We compared the results from our study (2002-2003) with the U.S. Fish and Wildlife study done in 1986 (Cain et al. 1988), using the maximum bird counts by month for both studies for selected bird species and groups (Figs 6.1 and 6.2). Because of differences in methodology of the two studies, we felt that the maximum numbers were most likely to reflect the relative abundance of the selected species and groups during the two time periods. We also used ArcView to compare spatial distribution of birds in the two studies.

These comparisons provide some insight as to the current status of birds now using the wetlands compared to what existed about 16 years ago. The two studies were roughly comparable, since they both surveyed the entire wetlands in a systematic manner. However, comparisons of this sort can be difficult because the observers were not the same and the techniques, timing and frequency of surveys differed between the two studies. One would expect maximum counts to be somewhat higher for the 1986 survey because the refuge was surveyed many more times per month than in 2002-03. For each species or species group we present our opinion as to its current status.

Canada Geese We think that the numbers of Canada Geese currently using the Mendenhall Wetlands are somewhat less than observed 16 years ago, because in every month except August and October we counted fewer geese than were counted in 1986. However, we believe that the decline is not as great as the data might indicate. The 1,753 geese observed by the USFWS in February may be due to counting the same birds more than once. If the geese are disturbed they typically fly from one part of the wetlands to another. Hence, during a survey that takes several hours, it is quite possible to double-count the same individuals. During our surveys, we kept track of flock movements as much as possible. It seems unlikely that the local population of winter-resident Vancouver Canadas would suddenly increase in numbers during one mid-winter month in 1986.

Of all Canada Goose observations in 1986 involving more than 25 birds (n = 61), only 2 records were south of Gastineau Channel. We noticed the same pattern in 2002-03; for observations of >25 birds (n = 42), only two were south of the channel. Evidently there is little to attract geese to the Douglas side for either foraging or resting.

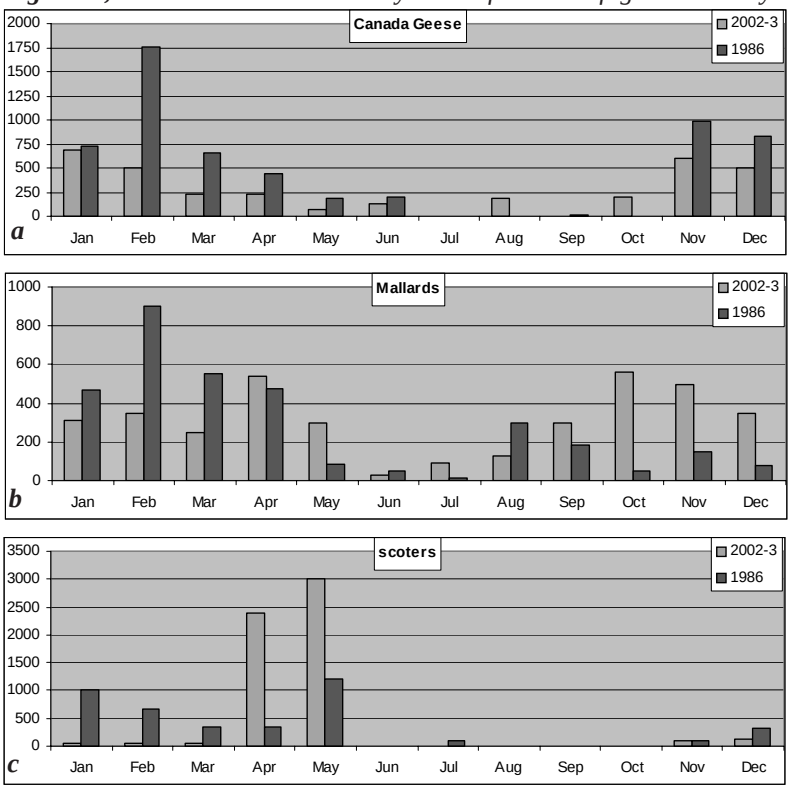
Mallards The number of Mallards currently using the wetlands is probably similar to the number in 1986. However, seasonal use now appears to be much greater in fall and less in winter. This shift in monthly use may be related to a shift in numbers and location of duck hunters.

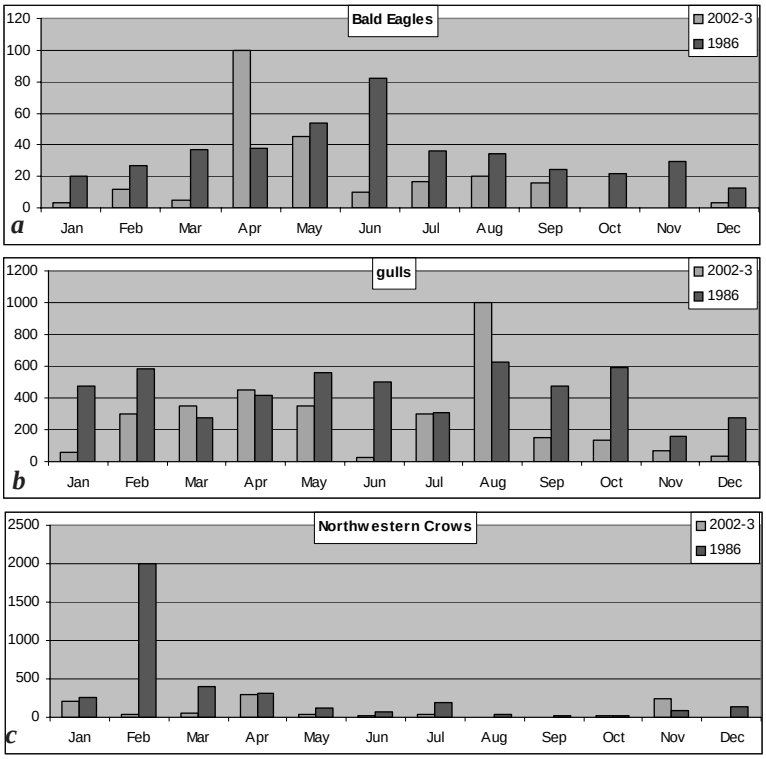
It appears that mallards are gathering in larger groups. In the 1986 study, USFWS observers saw Mallards in groups of 100 or more only 10 times. In 2002-03, we had 71 records of groups of 100 or more (39 records during full surveys), in spite of conducting far fewer surveys than the FWS team. Locations of Mallard observations were very similar in the two studies.

Scoters The number of Surf and White-winged Scoters using the waters near the wetlands is similar to that observed in 1986, but there appears to be a dramatic shift in timing. We saw few scoters during the winter months from December into March, yet the USFWS counted considerable numbers (high counts of 300 to 1,000 birds each month) during that period. This raises a number of questions. Have the numbers of scoters wintering in Alaska declined? Is the difference simply due to a shift in local wintering habitat? Are the scoters we observed migrants from outside Alaska? How does this relate to the overall decline of the Alaska breeding population of scoters (Conant and Groves 2001)?

Comparing spatial distribution in ArcView for the two studies reveals several differences. In 2002-03, we recorded no scoters of either species in Gastineau Channel near BayView subdivision (f04 in our study; unit 26 in the USFWS study). The 1986 survey counted 300 to 650 Surf

Figs 6.1a, b & c *Maximum counts by month for two Refuge bird surveys*





Figs 6.2a, b & c *Maximum counts by month for 2 Refuge bird surveys*

Scoters in this area in 4 months from November to May. Perhaps this merely reflects the fact that our counts were mostly taken around low tides, when the channel narrows and would not be suitable for large scoter flocks. In contrast, USFWS surveyed at randomly chosen times, covering a wider range of tidal heights.

Bald Eagles The numbers of Bald Eagles currently using the wetlands appear to be much less (about 50%) than what was observed 16 years ago. Since Bald Eagles are easily counted, we doubt that these differences are due to counting methods or observers. The one month - April - when our high count vastly exceeded that of 1986 reflects a sand lance feeding aggregation. Clearly those 100 eagles came from a huge surrounding area and say little about the year-round "carrying capacity" of the Mendenhall Wetlands.

Congregations of 10 or more eagles occurred in similar places during the two studies - primarily the river mouth and western Gastineau Channel.

Gulls The overall decline of gulls was the opposite of what we had expected. With DIPAC hatchery coming into production and the obvious influx of salmon from the hatchery into wetland streams, plus the large number of gulls that we observed feeding on the effluent from the hatchery, we anticipated an increase in today's gull population over 1986 levels. It is possible that the large number of gulls observed in 1986 was related in part to the attractant of the nearby Juneau landfill. We remember counting thousands of gulls at the landfill in the early 80's during the Audubon Christmas bird counts. The open landfill was closed when the garbage incinerator began operating.

Checking spatial distribution in the 1986 study for flocks of 100 or more, only Glaucous-wings were frequently recorded in units 16 and 17 near the landfill. In general, gulls of all kinds in both study years congregated at the mouths of Mendenhall River and the many streams entering the refuge.

Comparing highest monthly counts separately by species for the 3 common local gulls, the 1986 records were consistently higher than or equal to ours except for Mew Gulls in March and April, and for all 3 species in the month of August. Our high August counts reflect a massive influx of gulls to salmon streams - primarily the DIPAC bonanza. In 1986 only Glaucous-wings showed a minor peak in August; otherwise, whatever supported the high gull numbers in 1986 was available year-round.

Northwestern Crows The number of crows using the wetlands now appears to be considerably less than in 1986 (6.2c). We can think of two possible reasons. 1) The Juneau landfill attracted large numbers of crows back in the 1980s and may have supported higher populations than the natural food resources can now. 2) We also believe the number of crows using the wetlands for nesting has declined in more recent years. We no longer see the nesting colonies within the floatplane basin area that we used to see a number of years ago. Northwestern Crows nest in young spruces with very dense branches. Most spruces in the floatplane basin are now older and sparser-limbed than optimum for nesting crows.

Crows in groups of 100 or more (post breeding congregations?) were rare in both study years (n = 7 for 1986; n = 5 for 2002-2003). In both studies these large groups occurred between January and April at the mouth of the Mendenhall, Fish Creek, and near the Dike Trail.

The extremely high February count of 2000 crows in the 1986 survey may have been an amalgamated "superflock." We have observed such winter gatherings at Lena Beach, north of the refuge, but in 2002-03, our highest Mendenhall Wetlands counts were in the low hundreds.

7 Phenology and distribution

In this section we present information for several groups of birds and for the most abundant species, relying on our full phenology database that includes highest daily counts from numerous sources between 1986 and May, 2003. Graphs merge these results into highest daily count per week, except for three cases (Mallard, Bald Eagle and gulls) where counts are compiled by month. For species

and group distribution maps we employ data only from full surveys in 2002-03. Scaled dots generated in ArcMap show relative importance of hotspots for each species or group (Maps 7.1 through 7.7).

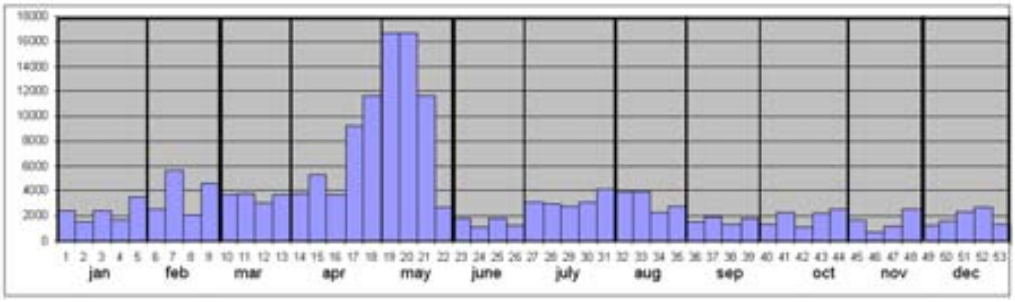


Fig 7.1 *Highest number of all species seen by week, 1986 through May 2003*

Peak bird numbers on the wetlands occur during spring migration, especially the 5 weeks between mid-April and late May, when the total number of birds could reach a weekly high of 16,000+ individuals (Fig 7.1). Fall migration is spread over a longer period, especially the 9 weeks in July and August, when up to 4,000 individuals per day may be seen. Even in winter, from 2,000 to 5,000 individual birds have been counted on the wetlands.

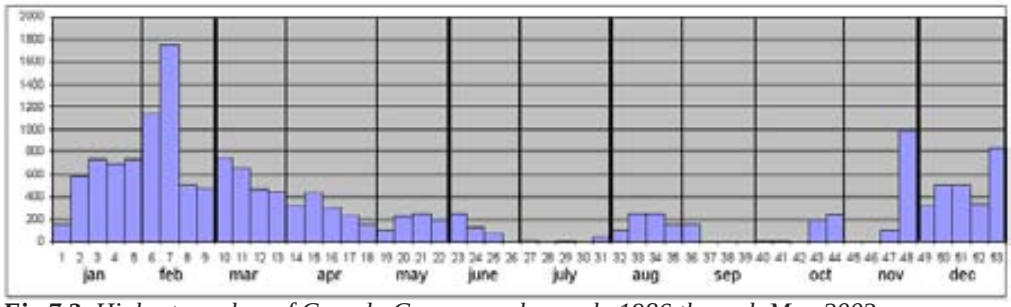


Fig 7.2 *Highest number of Canada Geese seen by week, 1986 through May 2003*

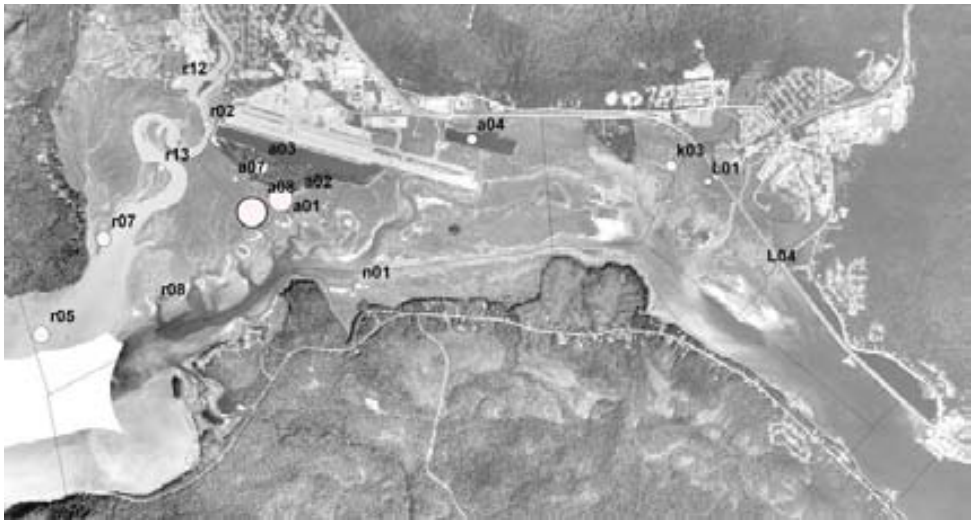
Canada Geese

Canada Geese are essentially year-round residents on the Mendenhall Wetlands, favoring low marsh and "succulent marsh" zones (section 4) and ponds near the dike. The resident subspecies is the Vancouver Canada Goose (*Branta canadensis fulva*), which lives and nests from northern Southeast Alaska southward to northern Vancouver Island, British Columbia. Within this area it is considered to be essentially a nonmigratory subspecies (O'Clair et al. 1997). Adults leave the Mendenhall wetlands in early April for nesting and adolescents leave in late June to remote areas for molting (Fig 7.2). In August they all begin returning to the wetlands where they remain until being chased out by hunters or extreme freeze-up. The phenology of these events have been described by local waterfowl biologist Jim King and related by O'Clair et al. 1997.

We estimate that the total number of Vancouver Canada Geese using the wetlands is between 500 and 700 individuals. This is based on counts covering the entire wetlands when we were fairly sure the geese had not been

Fig 7.3 *Canada Geese feeding on ditch-grass in the west finger pond as ice melts away, Apr 11, 2002*

Map 7.1 *Ranking of hotspots for Canada Geese. Largest dot - a08 - had the highest number of geese (1306) counted throughout the study period during full surveys (37 records for the species). Remaining dots are scaled proportionately.*



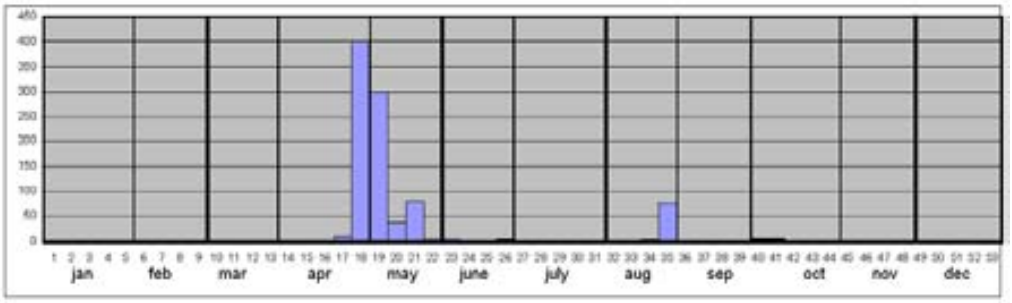


Fig 7.4 *Highest number of Greater White-fronted Geese by week, 1986 through May 2003.*

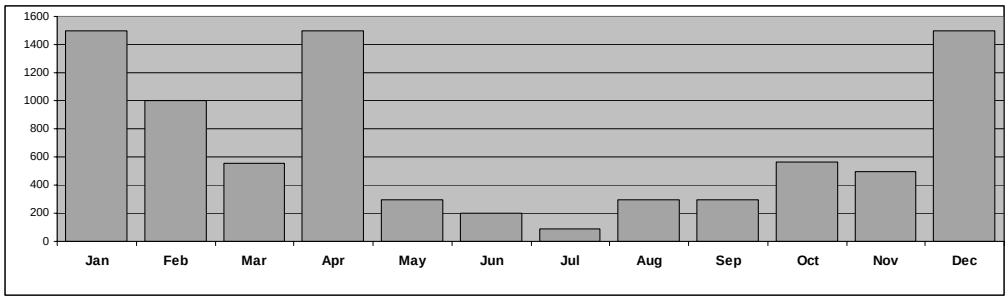
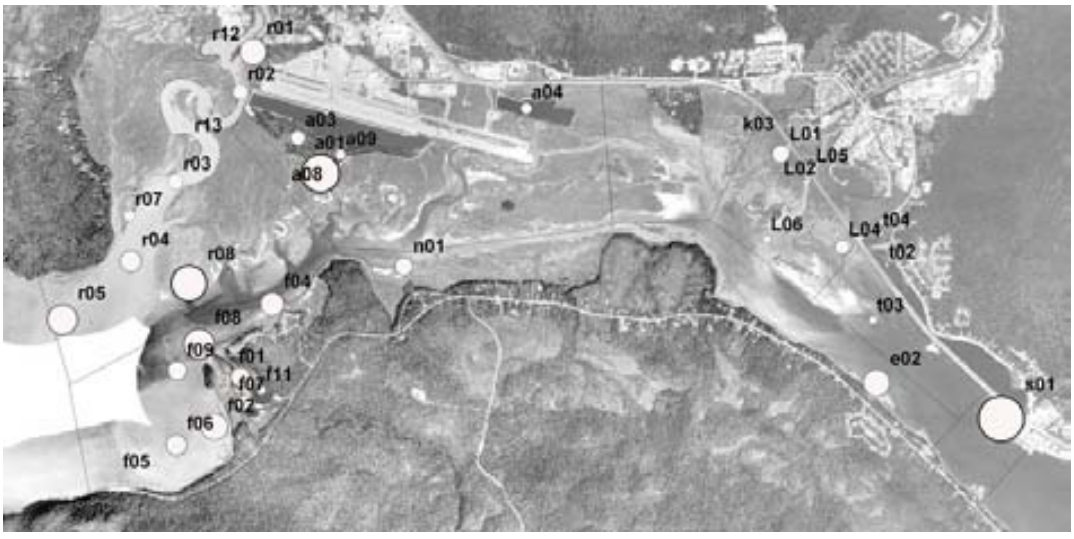


Fig 7.5 *Highest number of Mallards seen by month, 1986 through May 2003.*

Fig 7.6 *Greater White-fronted Geese*

Map 7.2 *Ranking of hotspots for Mallard. Largest dot - s01 - had the highest number of mallards (1660) counted throughout the study period during full surveys (151 records for the species). Remaining dots are scaled proportionately.*



disturbed. The high counts (over 1,000 individuals) recorded the first two weeks of February may have included some double counts from earlier studies when the birds flew from one area of the wetlands into another.

More than any other species, Canada Geese are disproportionately concentrated near the airport for both feeding and resting (Map 7.1) This is a safety concern.

Other geese

Other subspecies of Canada Goose use the wetlands during migration. Although difficult to identify, we have observed the Dusky Canada Goose (*B. c. occidentalis*), Cackling Canada Goose (*B. c. minima*), Aleutian Canada Goose (*B. c. leucoparia*), and Lesser Canada Goose (*B. c. parvipes*) especially during spring migration. These passing Lesser Canadas account for a small portion of some of the spring counts in figure 7.2.

Greater White-fronted Geese have occurred on the wetlands in the hundreds during late April and early May (Fig 7.4), especially in recent years. Snow Geese also occur in small numbers during this period.

Mallards

Mallards occur in greatest numbers on the wetlands from December through April, when up to 1,500 individuals have been seen in one day (Fig 7.5). (Hunting season use may be equally high but undocumented if it occurs at night as with geese.) In most other months the numbers range from 200 to 500 individuals. The Mendenhall Wetlands are an important wintering area for these birds and an important stopover for migrant Mallards, judging from the peak

numbers documented in April. While the greatest numbers were seen at Salmon Creek (s01) and the Western Mudflats (r08), Mallards were more equitably distributed throughout the refuge than other species we studied (Map 7.2) The Mendenhall Wetlands provide summer food and limited nesting habitat for Mallards. Every year at least one brood has been observed within the float plane basin.

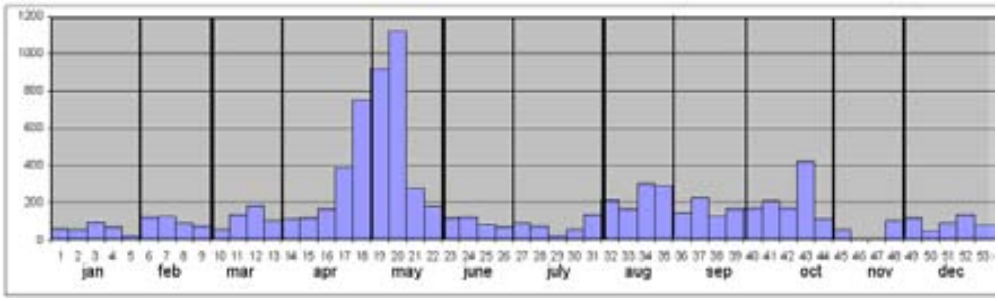


Fig 7.7 *Highest number of dabbling ducks (excluding Mallards) seen by week, 1986 through May 2003.*

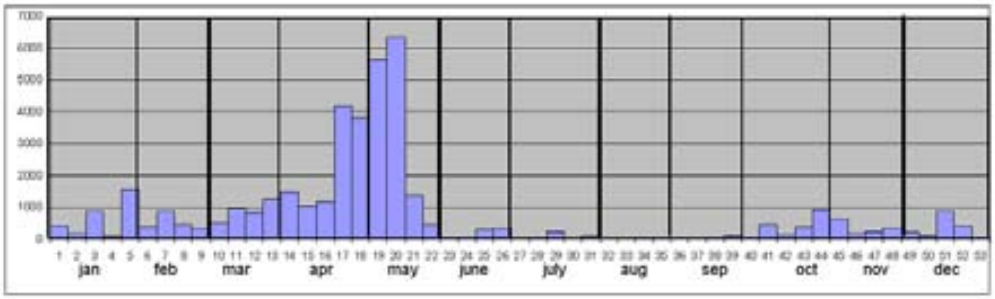


Fig 7.8 *Highest number of diving ducks (or "sea ducks") seen by week, 1986 through May 2003.*

Other dabbling ducks

Green-winged Teal, Northern Pintail, Northern Shoveler, and American Wigeon have been recorded in the hundreds, especially during April and May and again in August and September (Fig 7.7.) Gadwall and American Wigeon overwinter regularly on the wetlands in small numbers (10 to 100). Peak migratory passage on the refuge is from the last week in April through mid May. Fall passage is more protracted, lasting from August through October.

Species-by-species phenologies for dabbling ducks are found in Appendix C.

Fig 7.9 *Mallard with young in floatplane finger pond*

Diving ducks

The adjacent saltwater area of Fritz Cove, Gastineau Channel, and ponds within the Mendenhall Wetlands provide habitat for several species of diving- or sea ducks (Map 7.3). The most numerous of these is the Surf Scoter, which occurs in the thousands in April and May (Fig 7.8). Other species that typically number in the hundreds include Greater Scaup, White-winged Scoter, Common Goldeneye, Barrow's Goldeneye and Bufflehead. Diving ducks almost completely abandon the refuge from June through September, with the majority

Map 7.3 *Ranking of hotspots for diving ducks. Largest dot - r06 - had the highest number of sea ducks (6968) counted throughout the study period during full surveys (125 records for the group). Remaining dots are scaled proportionately.*

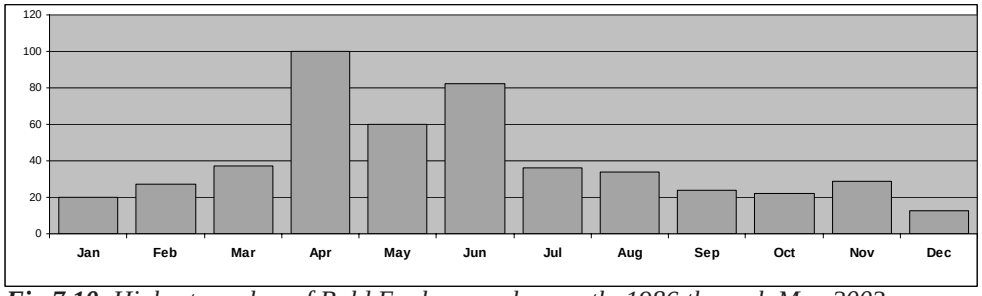


Fig 7.10 *Highest number of Bald Eagles seen by month, 1986 through May 2003.*

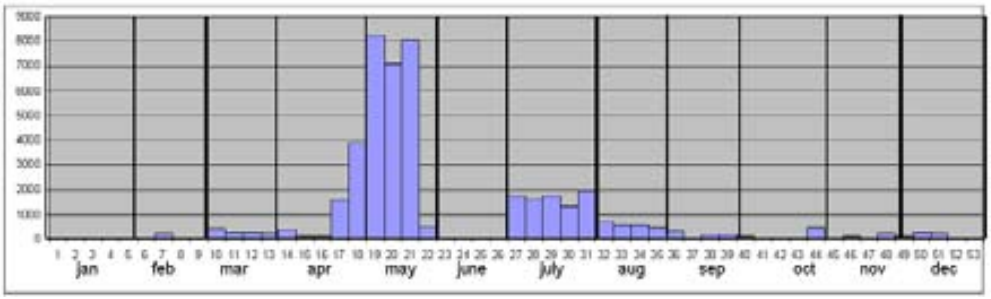


Fig 7.11 *Highest number of shorebirds seen by week, 1986 through May 2003.*

travelling far inland to nesting grounds. Returning in October, most of these species occur regularly throughout the winter, although overwintering Surf Scoters have been fewer in recent years.

Species-by-species phenologies for diving ducks are found in Appendix C. Distribution maps for several of the more common species are found in Appendix B.

Bald Eagle

In 1986, about 20 bald eagle nests bordered the Mendenhall Wetlands and about 35% of these were active in any given year (Cain et al.1988). The wetlands have been essential to the nesting success of these birds. Bald Eagles can be found on the wetlands essentially any day of the year, although the spatial distribution differed among seasons (Fig 7.10, Map 7.4). Usually 10 or so eagles can be seen during a wetland survey. Assemblies of 100 or more eagles may gather to feed on Pacific sand lance and eulachon – usually during April and May. These large congregations usually occur at considerable distances from the airport and its approach paths. Probably that is simply because fish are more available downriver, but there may also be a secondary exclusion effect. The nesting pair at Float Plane Basin, "Nellie and

Map 7.4 *Ranking of hotspots for Bald Eagle. Largest dot - r08 - had the highest number of eagles (117) counted throughout the study period during full surveys (56 records for the species). Remaining dots are scaled proportionately.*

Juan," are highly territorial, and have been seen to repeatedly drive off other eagles.

In spite of the late-summer abundance of salmon on the wetlands, our eagle counts in August and September are relatively low. Eagles are probably widely dispersed on salmon streams throughout Southeast Alaska at this time, and foraging on higher reaches of streams than the portions we observed in our wetland surveys. Compare Fig 7.10 to the monthly high counts for gulls (Fig 7.14) that respond more dramatically to salmon-related resources, especially near DIPAC.

Shorebirds

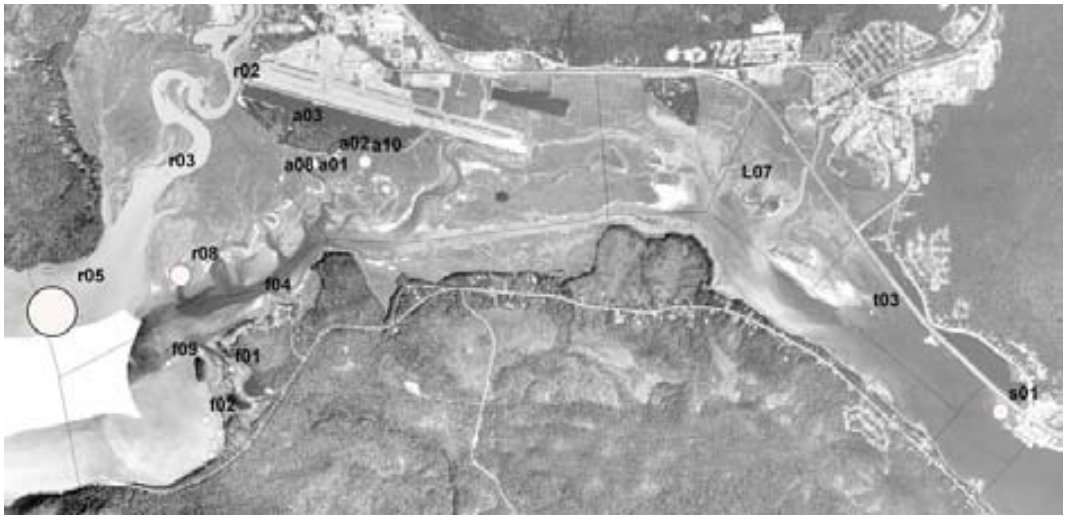
Migratory shorebirds on their way north typically occur in peak numbers from mid-April through the third week in May (Fig 7.11). The southward fall migration covers a greater number of weeks, with substantial numbers moving through in July and August. The fall migration of most shorebird species is over by early October.

Western Sandpipers are the most numerous shorebirds. Up to 5,000 individuals have been counted in a single day – on May 12, 1990 and again on May 17, 1992 (data from Paul Suchanek). Over 1,000 Ruddy Turnstones and Surfbirds have also been counted during one day. The wetlands are also important for Black-bellied Plovers, Greater Yellowlegs, Lesser Yellowlegs, Black Turnstones, Semipalmated Sandpipers, Least Sandpipers, Pectoral Sandpipers, Rock Sandpipers, Dunlins, Short-billed Dowitchers, and Long-billed Dowitchers. Counts for these species have typically been in the hundreds per day. Among migrant shorebirds, Greater Yellowlegs are often the earliest to arrive in spring, beginning around the first of April. The latest of the fall-migrant shorebirds is the Pectoral Sandpiper, sometimes still moving through in early November. Species-by-species phenologies for shorebirds are found in Appendix C.

According to Richard Gordon who has kept bird records since the 1960s, spring shorebird migration on the wetlands typically consists of 3 strong pulses occuring between April 26th and May 23rd. After each pulse, shorebird numbers drop precipitously. Fig 7.11 closely matches Gordon's estimate for overall migratory period, but of course averages out the pulses over the 17-year period of data collection. To effectively document such a dynamic passage, one would have to census the river mouth nearly every day for a month.

Some shorebirds winter on the Mendenhall Wetlands (Killdeer, Rock Sandpiper, Dunlin and Common Snipe). Dunlin often number over 100 individuals. A few species of shorebirds nest in the Juneau area and no doubt utilize the wetlands for feeding and rearing of their young. The local nesters include Killdeer, Greater Yellowlegs, Spotted

Fig 7.13 *Western sandpipers at mouth of Mendenhall River, May 5, 2003*



Map 7.5 *Ranking of hotspots for shorebirds. Largest dot - r05 - had the highest number of shorebirds (3850) counted throughout the study period during full surveys (59 records for the group). Remaining dots are scaled proportionately.*

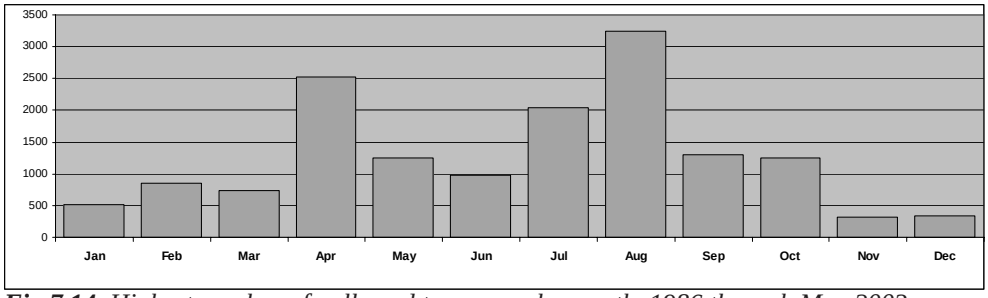


Fig 7.14 *Highest number of gulls and terns seen by month, 1986 through May 2003.*

Sandpiper, Least Sandpiper, and Common Snipe. Over the years we have found nests of Killdeer, Spotted Sandpiper and Least Sandpiper on the wetlands and have also observed nesting Greater Yellowlegs and Common Snipe in nearby bogs. Nesting Least Sandpipers have not been observed in recent years.

Gulls

Gulls are present on the Mendenhall Wetlands year-round. The two common overwintering species, Mew Gull and Glaucous-winged Gull, typically occur in the hundreds and on occasion over a thousand individuals (Fig 7.14). Both species concentrated at Salmon Creek estuary (s01) in fall, but the distribution of Glaucous-winged Gulls in spring differed from fall. Bonaparte's Gulls regularly occur in the hundreds, occasionally over 1,000, from mid-April to early October.

Glaucous-winged and Herring Gulls have a nesting colony on the rock face near the Mendenhall Glacier and probably use the Mendenhall Wetlands for foraging. Arctic Terns also use the Mendenhall Wetlands for feeding from late April to late August. The former spoil-island nesting colony in the central wetlands has been recently abandoned and we observed no nesting there in 2002 or 2003. Terns presently nest near the Mendenhall Glacier Visitor Center, and these birds probably use the wetlands for foraging.

Considering the abundant natural food resources at the confluence of the Mendenhall River, Fish Creek, and western Gastineau Channel, it is impressive that DIPAC hatchery concentrates even higher numbers of gulls (Map 7.6)

Species-by-species phenologies for gulls are found in Appendix C. Distribution maps for the 3 most common species - Mew, Bonaparte's and Glaucous-winged - are found in Appendix B.

Fig 7.15 *From left to right: Mew Gull, Bonaparte's Gull, and immature Glaucous-winged Gull in the bed of Salmon Creek, Aug 26, 2002. We observed specialized foraging behavior at that time. Glaucous-wings primarily ate from the long-dead salmon carcasses. Mews tended to forage for invertebrates, especially in the rockweed patches. And many Bonapartes wheeled over the creek, collecting washed-down salmon eggs. (Willson, unpublished data.)*

Northwestern Crows

Crows are common year-round

Map 7.6 *Ranking of hotspots for gulls and terns. Largest dot - s01- had the highest number of gulls (2735) counted throughout the study period during full surveys (136 records for the group). Remaining dots are scaled proportionately.*

residents on the Mendenhall Wetlands (Fig 7.16). In winter and early spring, the number of crows using the wetlands has been in the hundreds. We suspect these are aggregations of several flocks that gather together after the breeding season. We observed nesting crows in smaller groups during our 2002-2003 study on some of the spruce-covered islands on the wetlands.

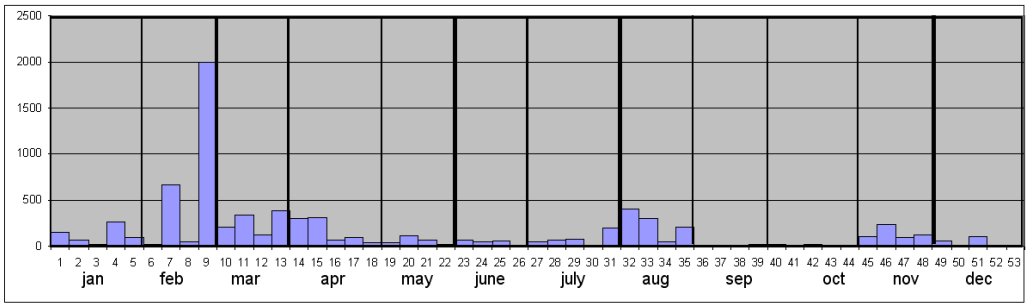


Fig 7.16 *Highest number of Northwestern Crows seen by week, 1986 through May 2003.*

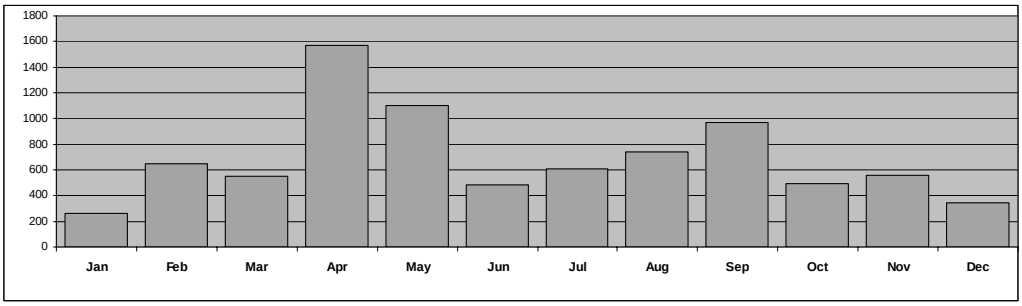


Fig 7.17 *Highest number of songbirds other than corvids (crow, raven, magpie) seen by month, 1986 through May 2003.*

Map 7.7 is based on a fairly low number of crow records gathered during full surveys (n = 49) and may not fully reflect the importance of different hotspots to crows. The largest dot at Vanderbilt Creek, for example, is based on a single record, and we never saw crows there again in large numbers.

Two other corvids - Common Raven and Black-billed Magpie - were occasionally recorded in small groups on the wetlands but our data were insufficient to plot phenologies or to create distribution maps.

Fig 7.18 *Crows digging for sand lance near Fish Creek.*

Other songbirds

A number of species of songbirds other than corvids utilize the Mendenhall Wetlands in large flocks for feeding. Tree Swallows, Violet-green Swallows, and Bank Swallows sometimes occur in the hundreds, hawking for insects from late April through July (Appendix C). A colony of Bank Swallows has existed along Mendenhall River in Brotherhood Park for a number of years. The wetlands appear to be an important feeding area for flocks of American Robin, American Pipit, Savannah Sparrow and Lapland Longspur during spring and fall migration, when these birds may occur in the hundreds. Flocks of Pine Siskins and Common Redpolls, numbering in hundreds of individuals, have also

Map 7.7 *Ranking of hotspots for Northwestern Crow. Largest dot - L03 - had the highest number of crows (314) counted throughout the study period during full surveys (49 records for the species). Remaining dots are scaled proportionately.*

been seen using the wetlands, often in late fall and early spring.

The floatplane basin woodland north of the Dike Trail is a magnet for migrating songbirds. Most of these woodland species tend not to occur in the large flocks that we targeted in our hotspots survey. Nevertheless, there is a strong migratory movement through this little woodland that is well known to Juneau birders, who consider the Dike Trail one of the best places to see northbound warblers, thrushes and sparrows throughout April and May.

There are two explanations for this phenomenon. The first is related to the character of the habitat and the second to its location. The floatplane woodland has a rich mix of coniferous and deciduous trees and shrubs. Deciduous habitat is much less common in Southeast Alaska than is coniferous forest. While deciduous belts are common along Juneau's coastlines, development has removed most of those patches large enough to attract large numbers of stopover migrants. The floatplane woodland is outstanding in this regard.

The second reason that songbirds are drawn to the floatplane woodland is its "island" character. Birders refer to the phenomenon as the Central Park effect, named for the concentration of migrating songbirds in New York City's only large undeveloped space. Migrants through Southeast Alaska follow straits and channels like Gastineau, especially in spring when uplands are still snowy. Songbirds of deciduous affiliation, passing northwestward over the Mendenhall Wetlands, naturally gravitate to the floatplane basin's wooded "island" surrounded by coverless salt marsh on one side and intensive development on the other.

Other than corvids, the only true year-round resident songbird on the Mendenhall Wetlands is the Song Sparrow. A number of them nest on the fringes and stay throughout the year.

8 Connections with the rest of the world

Of the 230 species of birds that have been seen on the Mendenhall Wetlands, only 16% are considered to be resident in Southeast Alaska. All of the rest are migratory, coming from various parts of the world. Figure 8.1 shows where we think the majority of birds are coming from.

Neotropical migrants Some 60 species, about one-fourth of the bird species recorded for the wetlands, are neotropical migrants; that is, they breed nearby or migrate through the wetlands, then head for Mexico, Central America, or South America to spend the winter. Greater Yellowlegs may fly more than 9,000 miles from Tierra del Fuego at the southern tip of South America. Other neotropical migrants include Cinnamon Teal, American Golden Plover, Hudsonian Godwit, Rufous Hummingbird, Olive-sided Flycatcher, and Yellow Warbler, to name a few.

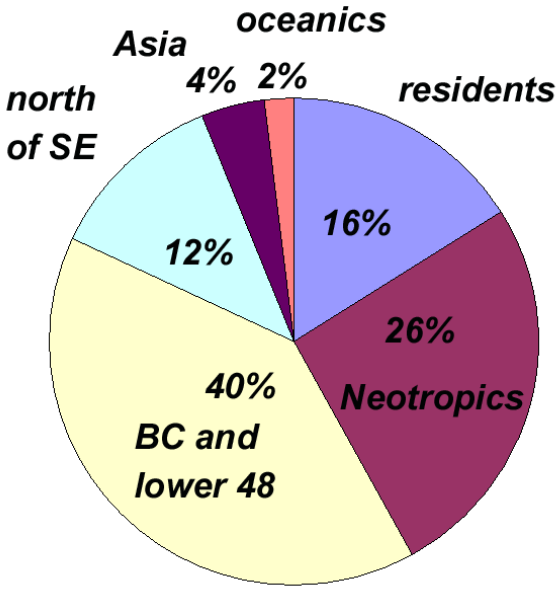


Fig 8.1 *Percentage of "our" bird species shared with other parts of the world*

The fact that 84% of the species seen on Mendenhall Wetlands have come from elsewhere highlights our shared responsibility for bird conservation efforts throughout the world.

Birds from British Columbia and the Lower 48 About 40% of the bird species seen on the Mendenhall Wetlands have wintered in British Columbia and/or within the Lower Forty-eight states. Swans and several species of dabbling ducks migrate only as far as farmers' fields, productive marshes, and national wildlife refuges to the south. Northern Pintails have strong ties to California, where it's estimated that about 85 percent of the pintails that breed in Alaska overwinter (Armstrong 1994). Other birds that may migrate only to B.C. or the Lower Forty-eight include many of the sparrows and blackbirds.

Birds from the north About 12% of the bird species we see on the wetlands breed in areas north of Southeast and migrate here to spend the winter. Examples of these include several of the diving ducks such as Buffleheads, Long-tailed Duck, Common and Barrow's Goldeneye and White-winged Scoters, and perhaps Snow Buntings and the occasional Snowy Owl or Gyrfalcon that visits the wetlands.

Oceanics A small number (2%) of the species seen on the wetlands come from or across the open ocean, often from islands and distant continents. The most notable of these would be the Arctic Tern, which may come from as far as Antarctica.

Asiatics Only 9 of the 230 species seen on Mendenhall Wetlands come from Asia, but these are the species that serious birdwatchers may find most exciting.

Fig 8.2 *Banded Snow Goose from Wrangel Island. Mendenhall Refuge, south of the golf course, May 5, 2003.*

Though many species of Asiatics occur regularly in western Alaska, most of the ones seen on the wetlands are vagrants. They have probably come quite by accident—perhaps because they were lost or blown off course by a storm. However, at least one, the Eurasian Wigeon, seems to occur every year on the wetlands in small numbers.

Residents About 37 species or 16% of the birds seen on the wetlands live nearby year-round. These include several Bald Eagles, Northwestern Crows, Common Ravens, Glaucous-winged Gulls, Marbled Murrelets, American Dippers, and Song Sparrows.

Further Evidence of Connections

The occurrence of birds banded elsewhere is further evidence of geographical connections between the wetland and the rest of the world:

• A male Snow Goose seen on Mendenhall Wetlands May 3, 2002 had been banded on 14 July 2001, and had hatched in the summer of 2000, on Wrangel Island, at 72°N in Russia's Chukchi Sea (Fig 8.2).

• A male Brant seen on the Mendenhall Wetlands May 14-21, 2003 had been banded on Banks Island (Canada) on August 1, 1992. It had previously been sighted during the 1997 spring migration in Nanvak Bay, Alaska, and during the winter in Baja California in 1998.

• Two White-winged Scoters were captured in the Juneau area and tagged with satellite transmitters in February 2001. One was captured at Middle Point and the other at Spuhn Island. They were then tracked inland to various locations in Yukon Territory Canada. One returned to Juneau on August 3 and the other October 2, 2001.

• A hatch-year female Western Sandpiper that was color-banded in La Paz, Southern Baja, Mexico, in September 2001 by a Mexican university biologist, Daniel Galindo Espinosa, was seen by Paul Suchanek on April 30, 2002 at Mendenhall Wetlands.

• A radio-tagged Short-billed Dowitcher, initially tagged at San Francisco Bay by USGS biologists (John Takekawa et al.), was relocated at Gray's Harbor in Washington State on May 9, 2001, and then relocated 8 days later at Mendenhall wetlands on May 17, 2001 by Gwen Baluss.

• A Red Crossbill, banded by Ralph W. Williams near the Mendenhall wetlands on May 13, 1991, was recovered in St. Albert, Alberta, Canada on May 9, 1992 (Canadian Atlas of Bird Banding, Volume I), approximately 825 miles away.

• An after-hatch-year male Golden-crowned Sparrow, banded by Ralph W. Williams near Mendenhall wetlands on April 18, 1990, was recovered in Victoria, B.C., on November 2, 1992. (Canadian Atlas of Bird Banding, Volume I).

9 Animal food resources on the wetlands

Plant foods for birds have been described in the preceding section called *Glacial rebound, vegetation and birds.* Here we describe fish and (briefly) invertebrate prey that attract birds to Mendenhall Wetlands.

Fish

A number of fish species spawn, feed and rear on and adjacent to the Mendenhall Wetlands. These fish attract and provide food for a variety of fish-eating birds including Bald Eagles, Belted Kingfishers, Arctic Terns, Bonaparte's Gulls, Mew Gulls, Herring Gulls, Glaucous-winged Gulls, Great Blue Herons, Red-breasted Mergansers, Common Mergansers, Northwestern Crows, and Common Ravens.

There are 15 fish-producing streams that empty out onto the wetlands. Considering their tributaries as well, there are 28 anadromous streams that fish access through the wetlands. Most of the fish (salmonids) using these streams also probably use the wetlands for feeding and

Fig 9.1 *Gulls feeding in the middle of Gastineau Channel on ground-up salmon from DIPAC hatchery.*

Fig 9.2 *Pink and chum salmon at the DIPAC hatchery are collected and ground-up for disposal into Gastineau Channel.*

Fig 9.3 *Eulachon schooling in shallows.*

short-term rearing. In addition the wetlands appear to be an important rearing and possible spawning area for a number of other anadromous and marine fish that are eaten by birds – eulachon, capelin, Pacific herring, Pacific sand lance, Pacific staghorn sculpin, starry flounder and other flounders, and threespine stickleback.

The Douglas Island Pink and Chum hatchery (DIPAC) is located adjacent to the Mendenhall Wetlands near Salmon Creek. This hatchery releases millions of salmon per year, many of which rear for a period within the wetlands, and many of the returning adults stray into adjacent streams.

Salmonids provide food for a variety of birds. Thirty-one bird species in southeastern Alaska feed on adult salmon and their eggs and young (Willson and Halupka 1995). In addition to the direct benefits salmon provide to these birds, nutrients from their carcasses help sustain productivity of stream and lake communities (Kline et al. 1990, Gende et al. 2002), which can further translate to plants and invertebrates used by birds.

Most or all of the salmonid species (coho, chum and pink salmon and cutthroat trout and Dolly Varden) use the floatplane lake and Duck, Jordan and Pederson Hill creeks on the wetlands near the Juneau airport (Bethers et al. 1995). All of these species use the freshwater and intertidal portions of these systems during certain life history stages. In the past, some of these systems have been stocked with hatchery fish – floatplane lake: 182,601 coho salmon in 1984; Jordan Creek: 3,000 brook trout in 1953 and 4,800 coho in 1970; Duck Creek: numerous stockings of coho, brook trout, and rainbow trout between 1919 and 1984 (Bethers et al.1995).

The Mendenhall River, the Lake, and their tributaries provide a considerable amount of spawning and rearing habitat for salmonids. All of the above species have been documented for this watershed (Bethers et al. 1995). In addition, various Mendenhall Ponds have been stocked in the past with brook trout, rainbow trout, cutthroat trout, king salmon, coho salmon, and Arctic grayling (Bethers et al. 1995). All of the sea-going species pass through the Mendenhall Wetlands during out- migration periods.

Mendenhall Lake is a major overwintering area for the Dolly Varden of the Juneau area (Schmidt et al. 1973). Large numbers of smolt, subadult and adult Dolly Varden leave the lake in spring, migrating down the Mendenhall River and out to sea. During this migration we have observed numerous Bonaparte's gulls feeding on the smolt and concentrations of subadult Dolly Varden near the northwestern end of the Juneau Airport runway.

Chum, coho, pink, and chinook salmon young and adults from DIPAC's Macaulay Salmon Hatchery no doubt use tidal sloughs and streams around the Mendenhall Wetlands for early marine rearing and spawning. Last year (2003), the hatchery released over 35 million salmon young into Gastineau Channel. Some of the returning adults will likely stray into and spawn in streams associated with the wetlands.

Eulachon (*Thaleichthyes pacificus*) often spawn in the lower reaches of Mendenhall River during spring. Eulachon are unusually high in lipid content and attract numerous predators at a time when the predator energy demands are high (Marston et al. 2002). At Berners Bay,

35 miles north of the Juneau Airport, average daily counts of 40,000 gulls and 600 Bald Eagles have been observed feeding on eulachon in the lower reaches of the rivers (Marston et al. 2002). In pre-settlement times, the Mendenhall estuary may have attracted similar bird concentrations. We have observed up to 125 bald eagles feeding on the spawning eulachon in the Mendenhall River.

Capelin (*Mallotus villosus*), like sand lance, eulachon and herring, are considered to be an important forage fish in Alaska, although the role that capelin play as food for birds of the Mendenhall Wetlands is not known. On occasion, both juveniles and adults have been observed trapped in tidal sloughs near the Juneau airport (Bishop et al. 1987).

Pacific herring (*Clupea pallasii*) are an important food for Bald Eagles in the Juneau area, as they were often found cached at their nests (Scott Gende, pers. comm.). Bald Eagles often concentrate to feed on spawning herring elsewhere in Southeast Alaska (Hodges et al. 1979), including Berners Bay (MFW pers. obs.). Both juvenile and adult herring have been observed trapped in small tidal ponds near the Juneau airport (Bishop et al. 1987).

Pacific sand lance (*Ammodytes hexapterus*) are small (6-8 inches as adults), thin, silver-sided forage fish. They typically form dense schools along tidal channels and also burrow in sand (Dick and Warner 1982, Yamazaki 1995). They are extremely important in the diet of Marbled Murrelets, kittiwakes, murres and puffins and constitute a major prey for at least some populations of 40 species of birds (Willson et al. 1999).

On the Mendenhall Wetlands, at least two areas of sand lance burrowing activity have been noted, one straight out from the mouth of Fish Creek near channel marker 19A and the other up the channel near marker 18. In the area near marker 19A we have observed numerous gulls, ravens, crows, and up to 85 bald eagles feeding on the sand lance during low tides (Fig 7.12) (Willson and Armstrong 1998). We have also observed Arctic Terns bringing sand lance to their young at the colony that once existed on the wetlands.

Pacific staghorn sculpin (*Leptocottus armatus***)** are abundant in shallow intertidal areas and are easy prey for Greater Yellowlegs, Great Blue Herons, Arctic Terns, Common Mergansers, and Belted Kingfishers (Bishop et al. 1987; our pers. obs.). Staghorn sculpins have been obtained in intertidal channels on the wetlands, sometimes up to 200 per seine haul, on all sampling dates from early April to mid-July (Bishop et al. 1987).

Starry flounder (*Platichthys stellatus*) was the most common flounder captured on the Mendenhall Wetlands during a study in 2002 by Lynn Mattes. They were also numerous within the intertidal channels near the airport in 1986 (Bishop et al. 1987). We have observed Great Blue Herons feeding on them and they were

Fig 9.4 *Buried Pacific sand lance.*

Fig 9.5 *Juvenile Pacific staghorn sculpin*

Fig 9.6 *Juvenile starry flounder*

Fig 9.7 *Three-spined sticklebacks stranded during "drought" on margins of finger ponds in floatplane basin.*

common prey items brought to eaglets in one Southeast study (Ofelt 1975).

Threespine stickleback (*Gasterosteus aculeatus*) provide a source of food for Arctic Terns, mergansers, diving ducks and Great Blue Herons (O'Clair et al. 1997). We have observed Great Blue Herons, Arctic Terns and Greater Yellowlegs feeding on stickleback at the wetlands. Two forms of threespine stickleback occur in southeastern Alaska – a marine form and a freshwater form. Both forms occur within the streams and sloughs on the wetlands adjacent to the Juneau Airport (Bishop et al. 1987). In Jordan Creek an estimated 10,000 stickleback were observed in decreasing numbers from the mouth to headwaters during a survey in 1970 (Reed and Armstrong 1971).

Great blue heron prey more successfully on sticklebacks than on juvenile salmonids (Butler, 1997). Altering a stream in ways that favor salmonids over sticklebacks (increased flow and shade, reduced backwatering) could reduce activity by herons.

Mammals

Few mammals other than long-tailed voles provide significant prey for birds on the refuge.

The long-tailed vole (*Microtus longicaudus*) is a common year-round resident on the Mendenhall Wetlands. They inhabit the sedge and grass areas and eat the tender stem bases, roots and seeds. They are excellent swimmers so the tidal sloughs do not necessarily restrict their movements. We have observed a number of raptors hunting for and feeding on voles within the wetlands.

At the higher tides of the year voles are often forced to swim during daylight hours. We have observed both Bald Eagles and Short-eared Owls taking advantage of their vulnerability during these times. At other times, long-tailed voles are the major food of Northern Harriers, American Kestrels and Short-eared Owls on the wetlands. Over the years we have examined hundreds of owl pellets collected from the wetlands and found the long-tailed vole to be the major, and sometimes only, prey consumed.

Invertebrates

Intertidal invertebrates are important foods for wetland birds. The Mendenhall Refuge's large expanse of visually barren sand and mudflat is in fact a treasure-field of buried (benthic) marine invertebrates like crustaceans, bivalves and worms. Invertebrates even provide the physical structure for some habitats in the case of the barnacle/mussel/rockweed community (Figs 4.4, 9.9)

Intertidal invertebrates of mudflats and the barnacle/mussel/rockweed communities were sampled on the wetland (Willson and Baldwin, 2003). Here we present only a few photographs of the most significant bird prey items. Among them are: amphipods, isopods, snails (*Littorina*), clams (*Macoma*), and polychaete worms.

Fig 9.8 Dead long-tailed vole in uplift meadow, Dike south of Miller/ Honsinger Pond, Apr 4, 2002. These voles are considered "irruptive:" every 5 to 10 years they reach very high densities on the upper perimeter of the Mendenhall Wetlands. In these years we see larger numbers of raptors.

Fig 9.9 *Barnacles and mussels are "keystone invertebrates." Mussels directly feed the huge staging rafts of scoters at the river mouth. And by turning mud and sandflats into more structurally complex habitat, barnacles and mussels provide home for more invertebrate bird food. Here Aaron Baldwin hunts for amphipods and isopods.*

Fig 9.10 *Amphipods are often found in great swarms by gulls and shorebirds turning over rockweed fronds.*

Fig 9.11 Eogammarus confervicolus *is a very common amphipod on the refuge*

Fig 9.12 Americorophium *amphipods live in tubes on the substrate. This is a female out of her tube. These amphipods are important shorebird food.*

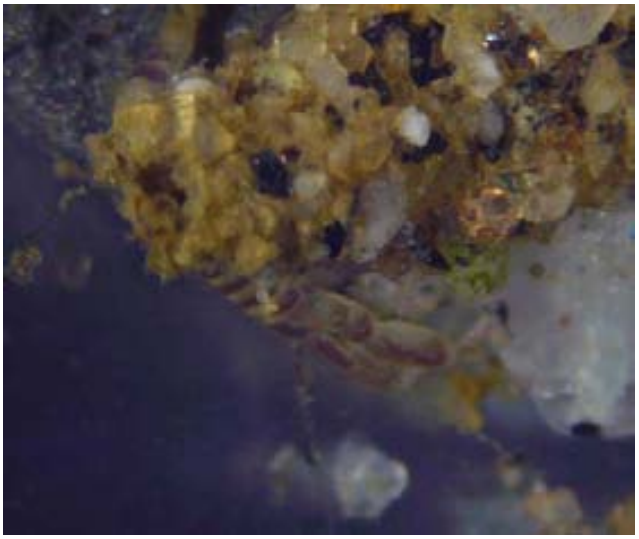


Fig 9.13 *Single tube of* Americorophium *magnified.*

Fig 9.14 Americorophium *colonies form fuzzy mats in low salinity sloughs such as Junk Car and Phalarope.*

Fig 9.15 *Baby* Macoma balthaca *clams sometimes occur in the 1000s per m^2, important for mud probing shorebirds. Adult macomas rarely exceed 1.5 cm and live in muddy sand close to the surface, where they are eaten by gulls and sea ducks. See also Fig 5.31*

Fig 9.16 Littorina sp. *– an important food of Harlequin Ducks and probably other diving ducks.A barnacle is riding on this one's shell.*

Fig 9.17 *Isopods like* Gnorimosphaeroma *sp. wedge in among the mussels. See Fig 9.9*

Fig 9.18 *Isopod,* Pentidotea *sp. lives among the rockweed fronds.*

Fig 9.19 *Lugworms,* Arenicola *sp. live in the sediments. They make distinctive coiled castings of digested dirt.*

Fig 9.20 Nephthys sp. *shorebirds pull these out of the sediments.*

10 Synthesis and recommendations

What's so special about the Mendenhall Wetlands that makes this spread of marsh and mudflat attractive to so many birds? One answer to this question has been developed in section 4 - *Glacial rebound, vegetation and birds*. Another comes to mind as we consider the needs of shorebirds. According to Scott Weidensaul who wrote *Living on the Wind*:

> "most of the world's surface is useless to a shorebird—too wet, too dry, too forested, too mountainous, too farmed, too urban, too this or that. Much of the wetland habitat on which many species depend has been lost. So the relatively few places that still suit the birds' needs are important beyond measure."

Shorebirds

The Mendenhall Wetlands are indeed important beyond measure because they are one of the few places in Southeast that provide ample food and habitat for big flocks of migrating shorebirds. Along their migratory routes shorebirds depend on a relatively few stopover sites - usually separated by considerable distances - for refueling and resting. During the stopover, best foraging conditions are often available only for a few hours around low tide.

Shorebird stopover sites continue to be degraded and destroyed. Research has indicated that many shorebird species are in serious decline throughout the Western Hemisphere. Of the 72 species and subspecies of shorebirds addressed in the U.S. and Canada National Shorebird Plans, almost half (49%) have experienced apparent population declines since 1970. For 17 of these taxa, all but one of which occurs on the Mendenhall Wetlands*, the declines are statistically significant (Andres and Gill 2000).

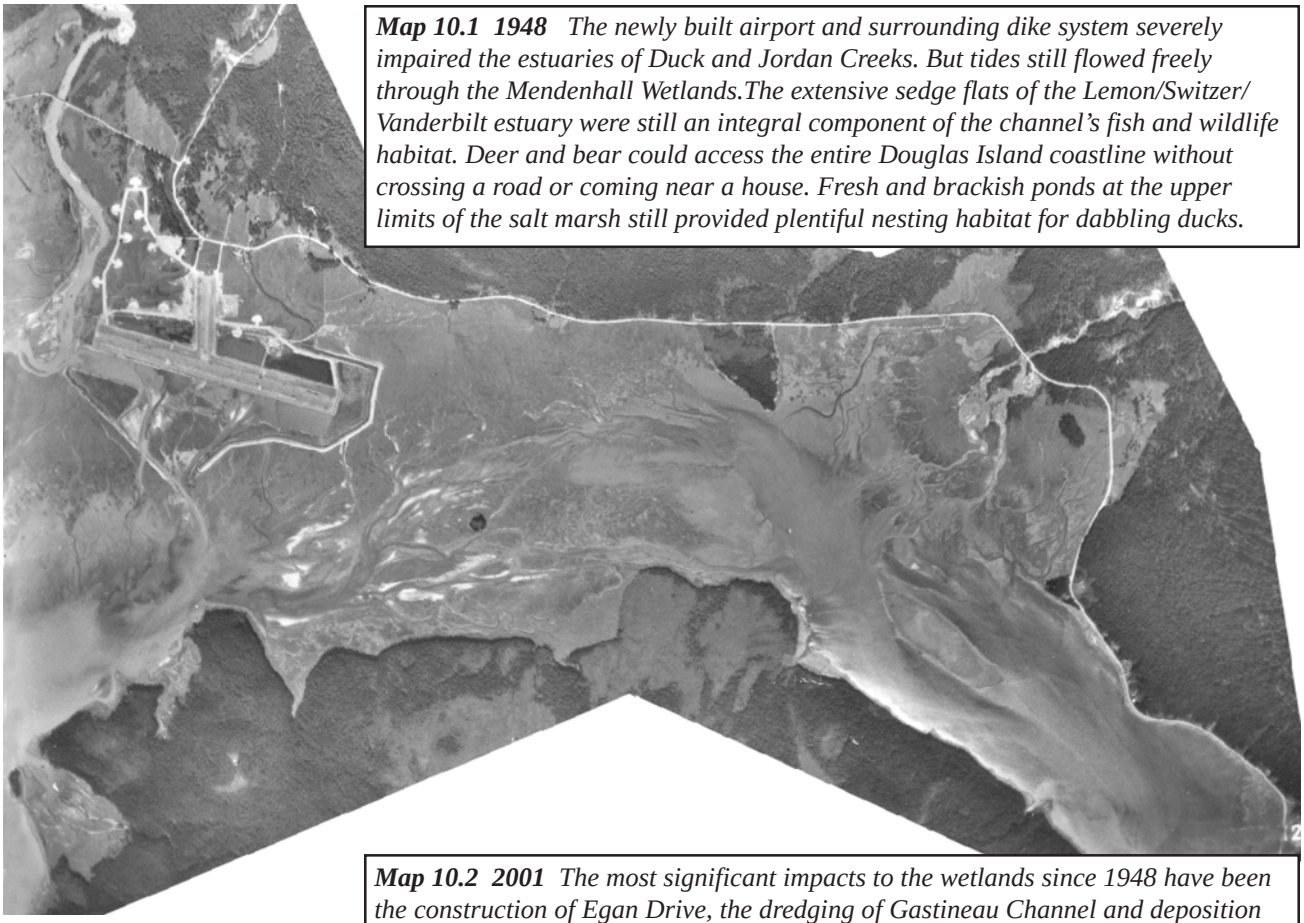
On the remaining beaches and salt marshes that offer quality foraging and resting habitat, human recreation increasingly impinges on shorebird activity. Recreational use of these habitats tends to peak at the same times that shorebirds are passing through. In a study comparing consequences of human disturbances to different waterbird groups, gulls were least likely to be permanently displaced, while herons and shorebirds flew away the greatest distances (Burger 1981). Disturbed shorebirds waste precious energy and foraging time flying to another beach or marsh, where prey may not be as abundant. (Burger 1986). For a small bird on a journey of thousands of miles between wintering and breeding ranges, efficiency of refueling and quality of resting time can mean the difference between life and death, or between success or failure at reproduction.

Studies of shorebird response to various kinds of human activities have found that the most serious disturbances were caused by dogs (Burger 1986, Lafferty 2001). We return to this concern below (*Dogs and birds*).

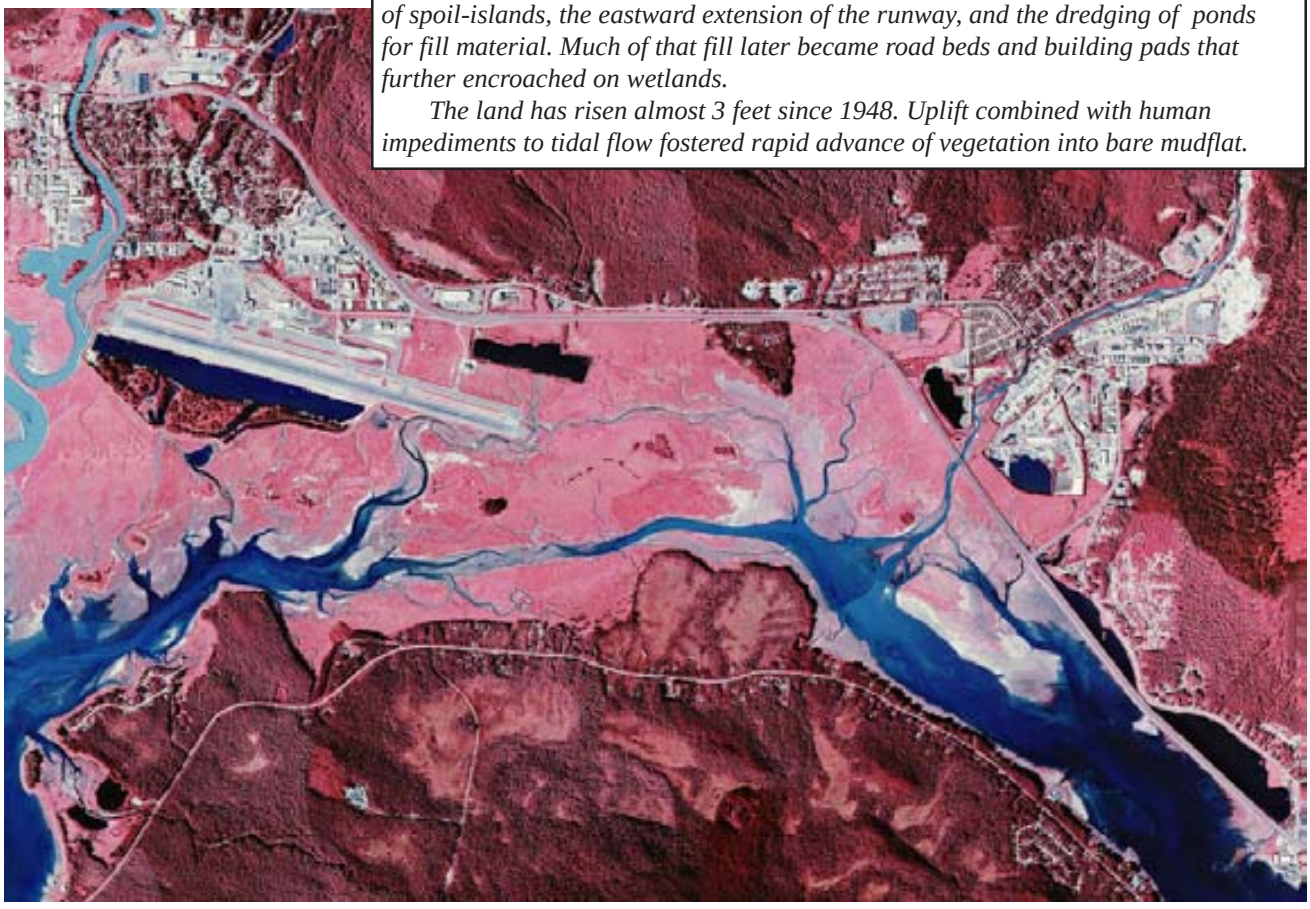
To help identify, monitor and prevent further degradation of shorebird stopover areas, a program coordinated by the Manomet Bird Observatory titled "Western Hemisphere Shorebird Reserve Network" has been established. Collaborators include over 140 public and private organizations in 7 countries. One result is the U.S. Shorebird Conservation Plan; Alaska's plan was written in March 2000. Cooperators for this plan have included the Alaska Department of Fish and Game, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service and U.S. Geological Survey – Biological Resources Division. This plan recognizes only 3 important shorebird sites in Southeast Alaska – Stikine River Delta, Yakutat Forelands and Mendenhall Wetlands. In fact the Mendenhall Wetlands are currently under consideration for inclusion within the Western Hemisphere Shorebird Reserve Network.

Fig 10.1 Surfbirds hunt through the barnacle/mussel/rockweed community at low tide on the Mendenhall River Mouth. Dunlin in right foreground.

*The shorebirds listed as declining are: Whimbrel, Marbled Godwit, Surfbird, Dunlin, Buff-breasted Sandpiper, Short-billed Dowitcher, Black-bellied Plover, American Golden-Plover, Killdeer, Ruddy Turnstone, Red Knot, Sanderling, Semipalmated Sandpiper, Least Sandpiper, Common Snipe, Red-necked Phalarope, and Red Phalarope.



Map 10.1 1948 *The newly built airport and surrounding dike system severely impaired the estuaries of Duck and Jordan Creeks. But tides still flowed freely through the Mendenhall Wetlands.The extensive sedge flats of the Lemon/Switzer/ Vanderbilt estuary were still an integral component of the channel's fish and wildlife habitat. Deer and bear could access the entire Douglas Island coastline without crossing a road or coming near a house. Fresh and brackish ponds at the upper limits of the salt marsh still provided plentiful nesting habitat for dabbling ducks.*



Map 10.2 2001 *The most significant impacts to the wetlands since 1948 have been the construction of Egan Drive, the dredging of Gastineau Channel and deposition of spoil-islands, the eastward extension of the runway, and the dredging of ponds for fill material. Much of that fill later became road beds and building pads that further encroached on wetlands.*

The land has risen almost 3 feet since 1948. Uplift combined with human impediments to tidal flow fostered rapid advance of vegetation into bare mudflat.

Our bird surveys in 2002-03 were mostly centered around periods of low tides. During high tides, shorebirds rest along quiet stretches of beach. Important shorebird resting areas were not documented by our study. More information on resting areas for all wetland bird groups needs to be acquired before proposed developments such as the second channel crossing can be weighed.

We recommend that all portions of the Mendenhall Wetlands important to foraging and resting shorebirds be protected from future developments, and - during key migration periods - from the most disruptive forms of recreational activities (*Dogs and birds*, below). These areas (Map 7.5) include the Mendenhall River mouth, the estuaries of Fish and Salmon Creeks, all sloughs and ponds near the Dike Trail, and the western end of Gastineau Channel up to channel marker 19. These estuaries are critical not only for shorebirds but for migratory and resident waterfowl.

Migratory shorebirds and waterfowl are the species most often discussed in association with Mendenhall Refuge. Certainly, however, the wetlands are equally important to gulls and terns, a number of migrating songbirds, and the raptors that travel with and prey upon them. Local resident species such as Mallards, Bald Eagles, Northwestern Crows and Common Ravens also depend heavily upon the Mendenhall Wetlands.

Past and pending habitat loss

We have already lost much of the Mendenhall Wetlands to development (Maps 10.1 and 10.2). Almost all of the upland marsh transition zone between the intertidal area and the forest is gone. This is the area that once supported nesting waterfowl and other birds. In its place sits the airport, much of the land along Industrial Boulevard, Fred Meyer, the Juneau Christian School, the now defunct K-Mart, Egan Expressway and a number of other encroachments. Much of this development required a portion of the wetlands to be filled, which directly destroyed feeding habitat for birds.

Considering what has already been lost one could argue for a "no-more-wetland-loss policy." However, in an area where flat building sites are at a premium, and with an expanding population, "no more loss" is probably unrealistic. Consultants have been hired to assess alternate sites for a second channel crossing to Douglas Island. Airport administrators plan to expand farther into the surrounding marshes. Fill proposals have been submitted for wetlands near former K-mart and Western Auto. Accretion filings could potentially expand private lands into the Refuge. With this reality in mind, determination of important areas for birds (hotspots) can help to identify areas where development should and should not be allowed.

Care should be taken, however, in using these hotspots to help direct developments. Some, because of post-glacial uplift, will change over time. Others may change because of increased sedimentation, global warming, changes in river channels, pollution, or other causes. So what is hot now may be cold sometime in the future and vice versa.

Another thing to consider is the interrelationships that occur between habitats within the Mendenhall Wetlands. Just because one habitat type or location is not used as much by birds does not necessarily mean it is less important. One area might serve as a nursery area for fish that later move elsewhere where birds prey upon them. One area could be useful in supplying nutrients to sites downslope where the sedges grow best and attract the most geese. Or the value of one area may simply be in filtering out pollutants before they reach an area important for birds. And of course birds are not the only criterion for habitat value. The high marsh and uplift meadows between Ninemile and Johnson Creeks on Douglas Island may have low use from bird groups like waterfowl and shorebirds relative to the rest of the refuge, but it is one of the best places for deer and bear to access coastal foraging sites that are elsewhere cut off by the expressway and other forms of high-speed, high-density human activities.

Overall, our most notable hotspots were at the Fritz Cove end of the refuge, including the river mouth, Western Channel, and Western Mudflats. Also very important were Salmon Creek estuary, Otter Pond, the sedges west of Otter Pond, and the Neilson Creek estuary near ERA (Map 1.3). But there are strong seasonal and species differences in use of the wetland. Future development proposals that impinge upon the wetland should take into account not only the overall pattern of bird concentrations but also the seasonal and species-specific patterns.

Regardless of uplift or successional change, one habitat that will always be important to birds is the area around and near the mouths of rivers and major streams.

We recommend that all stream and river estuaries on Mendenhall Wetlands be protected from further development, except in the case of airplane safety issues (e.g. Duck Creek), and in the case of experimental efforts to enhance wildlife habitat (e.g. Fish Creek, Duck Creek - see below).

Birds and airplane safety

Juneau Airport has the greatest impact of any human structure or activity on fish and wildlife habitat of the Mendenhall Wetlands. Because of approach and take-off requirements for planes, the impact of aviation far exceeds the actual footprint of the airport on the wetlands. Habitats attractive to birds of concern (primarily waterfowl, gulls, corvids, eagle and heron) are inappropriate at close proximity to the runway and floatplane pond. In fact, the threat of bird strikes along the various runway approach paths could veto several prospects for enhancement projects at great (though as yet undetermined) distances from the runway.

Bird-strike issues weave a Gordian knot of conflicting needs that is beyond our ability to untie. Our hotspot surveys and other recent research projects on the wetlands do, however, offer perspectives that may be useful. We will comment here on 3 aspects of the problem: attractive habitats, stream channel design, and mitigation ponds. All relate to the question of bird hotspots and airplane safety.

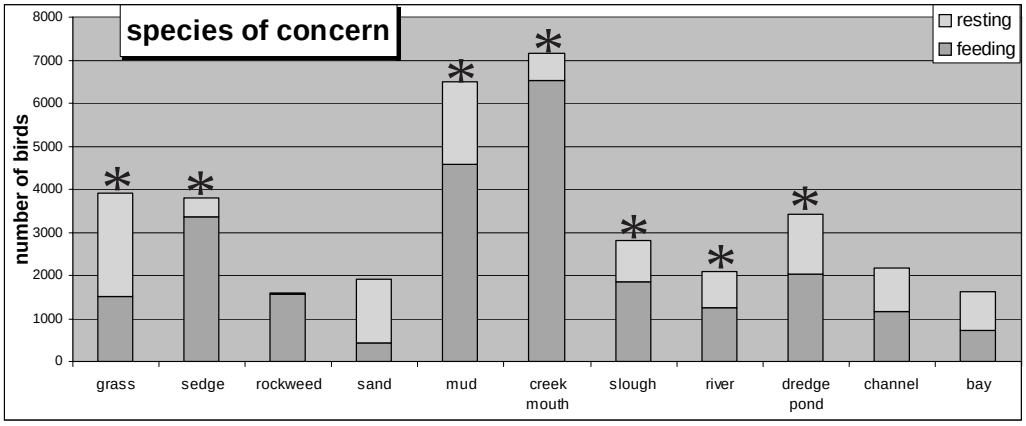


Fig 10.2 *Total number of birds of 7 species counted throughout Mendenhall Refuge during full and ancillary surveys by habitat type and activity (n = 571 records). Includes Mallards, Canada Geese, Bald Eagles, Northwestern Crow, and 4 gulls (Bonaparte's, Mew, Herring and Glaucous-winged). Asterisks show habitats in immediate proximity to Juneau Airport facilities.*

Attractive habitats

Juneau Airport is closely hemmed by highly attractive bird habitats: shallow ditch-grass ponds, tidal sloughs and mudflats, freshwater streams, sedge low marsh, and the Mendenhall River itself. Airport staff are kept busy hazing birds away from these habitats. Resident birds can sometimes be "educated" to stay clear, but in spring and fall they are replaced by a steady stream of "naive" migrants. One of the hottest adjacent habitats is the muddy slough system just south of the runway on the eastern end. During hunting season these sloughs rapidly fill with dabbling ducks between each tour by hazing staff (see *Hunting* below)

The bird groups of greatest concern to airplane safety at Juneau Airport are waterfowl, gulls, corvids, Bald Eagle, and Great Blue Heron. Among waterfowl, Mallard and Canada Goose rise to the top of the list because they are year-round residents, heavy-bodied, and outnumber other species of ducks and geese.

To evaluate attractiveness of habitats to the key birds of concern, we merged 571 records for Mallard, Canada Goose, Bald Eagle, Northwestern Crow and gulls of 4 species taken during full and ancillary surveys throughout the refuge. (Great Blue Heron is a major security risk at the airport but our hotspot study did not collect enough records of this mostly solitary bird for habitat-use analysis.) We also compared relative use of habitat types for feeding versus resting among these bird species. Foraging habitats are considered to be stronger attractants than habitats used for loafing or nesting, because plentiful food causes birds to endure more harassment (Federal Aviation Administration 2002). The most attractive habitats to the above-listed birds of concern are creek mouth, mud flat, dredge pond, and sedge low marsh. All are used primarily for feeding (Fig 10.2; the species are also treated separately in Fig 4.6).

We recommend an intensive habitat-based study of bird activities and movements near Juneau Airport. Such a study should result in a defensible ranking of nearby habitats posing greatest risks to airplane safety. Major habitat alterations such as tree removal should not proceed without this information. A ranking of bird habitat values will also help to determine the soundest mitigation options to counter losses due to Airport expansion.

Creek relocations on airport property Duck and Jordan Creeks flow through Airport property just before joining Mendenhall River. Both are deemed attractive to birds of concern, and there are proposals to relocate them farther from proximity to airport facilities. Whether or not these channels are actually moved, consideration should be given to what *kinds* of stream habitat attract birds that endanger planes.

Not all kinds of quality fish or wildlife habitat will attract birds of concern. We rarely see waterfowl, gulls,

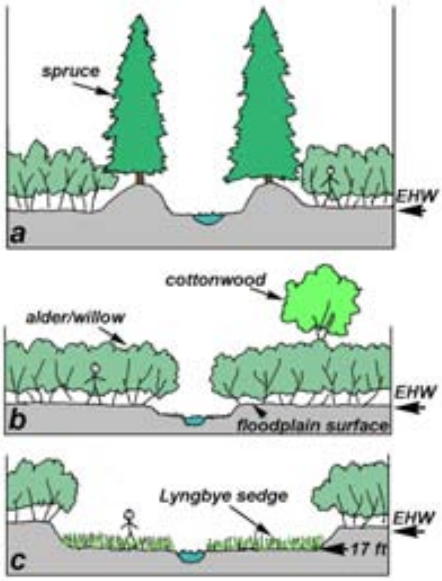


Fig 10.3 *Three cross-sectional stream profiles:* ***a)*** *Traditional diked and channelized type at Juneau Airport. Low values for rearing fish. Relatively low attractiveness to birds of concern.* ***b)*** *Stream is not confined by dikes, and occasionally floods, discouraging conifers. Foliage overhangs the stream, cooling and introducing nutrients. Good salmonid rearing. Low attractiveness to most birds of concern.* ***c)*** *Stream margins are intertidal and support sedges. High value to rearing fish, and major exporter of nutrients to downstream habitats. High attractiveness to birds of concern.*

eagles, or herons in closed deciduous brush along streams. Even corvids are less common here than along more open reaches. If allowed to meander naturally, such streams develop good habitat for rearing salmonids (Fig 10.3b). During spawning season, adult salmon and their carcasses are largely inaccessible to the above birds that shun tight spaces with limited views.

Designing for streams with the features shown in profile 10.3b may take some trial and error, but Juneau Airport is an ideal place to conduct the experiments. It is already closely monitored, and incentives for success are high. Deciduous brush grows quickly, and plantings can accelerate revegetation. A key design element is careful elevational grading, to prevent tidal sedge establishment (Fig 10.3c) in reaches close to the airport, yet still allow for overbank flooding, to promote deciduous cover (Fig 10.3b). Establishment of scattered conifers would not constitute failure from a habitat perpective, but they would need to be topped periodically to prevent view obstruction from the tower.

Map 10.3 *Distances in miles from the runway. It has not yet been decided at what distances F.A.A. will oppose habitat enhancement efforts that attract birds of concern near Juneau Airport. This map is only intended to promote discussion of feasible mitigation options. Arrows show locations of possible created or altered ponds.*

Where streams flow through Juneau Airport, the goal is to *avoid* hotspots, at least for certain bird groups. We recommend active management to increase cover of overhanging deciduous brush margins to discourage large birds dangerous to planes, yet allowing naturally meandering channels with improved habitat for *rearing* salmonids that may not be as attractive as sticklebacks to birds of concern such as heron (see sticklebacks, p. 48).

Mitigation ponds As part of their work on the Juneau Airport EIS, SWCA consultants are gathering ideas on potential mitigation measures to counterbalance prospective environmental losses as the airport expands, or alters nearby habitat in the interests of airplane safety.

One proposal is for pond construction or enhancement, a common practise on waterfowl refuges. As discussed in section 4, ditch-grass is limited in distribution on the wetlands, and is currently a major attractant bringing waterfowl to brackish ponds near the airport. East and West Finger Ponds between the Dike Trail and Floatplane Pond are especially problematic. They may eventually be filled or otherwise manipulated to reduce bird activity there.

Our goose foraging and resting records are both concentrated close to the airport (Fig 7.1). Creation of new ditch-grass ponds at safer distances from the runway is an appealing idea. But there are many unknowns that first have to be addressed:

What constitutes a “safe” distance (Map 10.3)?

What is the particular combination of salinity, depth, substrate texture and seawater exchange that makes for a successful ditch-grass pond?

Will waterfowl necessarily use ditch-grass ponds if they are created elsewhere?

One suggested site is the mouth of Fish Creek. Geese presently make relatively little use of the Douglas Island side of Gastineau Channel (Map 7.1). Creation of attractions on this side could help to draw birds away from the airport, and add to the overall wildlife values of the refuge.

An alternative to creation of new ponds would be in-filling of ponds that are presently too deep. At pond f11 (Map 1.1) we recorded relatively low use by geese and dabbling ducks. This pond is too deep for extensive growth of ditch-grass or freshwater aquatic vegetation. If shallowed to a suitable level, and manipulated to achieve the proper salinity, it might support ditch-grass. But some have asked whether waterfowl, particularly geese, would feel comfortable using a pond with such closely encroaching forest.

Considering all of the unknowns, it may be best to begin with a small experimental pond, in a more open location. Such habitat enhancement efforts could be effective in combination with dog-free, no-hunting sanctuaries within the refuge (see below).

Ditch-grass is of course not the only logical target for wildlife enhancement efforts. Another possibility is slough alteration to increase the cover of Lyngbye sedge.

We recommend a study of the environmental requirements of ditch-grass, and a survey of pond-creation projects on other waterfowl refuges, to instruct similar efforts on the Mendenhall. We also recommend several very small-scale experiments with deepening of

Fig 10.4 *Unleashed dogs in Otter Pond.*

Fig 10.5 *Recently placed sign at beginning of the dike trail explains problems with dog harassment of wildlife. Many dog walkers continue to allow their pets to roam off trail.*

high marsh (grassy) tidal sloughs in an effort to increase growth of Lyngbye sedge.

Dogs and birds

Loss of wetland habitat can be exacerbated when birds are prevented from using the habitat that remains. During our surveys we frequently noted birds - especially waterfowl and shorebirds - being displaced by uncontrolled dogs. This was very common along the Dike Trail in Otter Pond, East and West Finger Ponds, Junk Car Slough and in Phalarope Slough. All of these sites are important areas for feeding shorebirds and waterfowl, especially during higher tides when the river-mouth mudflats are covered by salt water. Harassment by dogs continues to occur despite messages on the airport sign at Radcliffe Road trailhead instructing people to keep pets on a leash, and the newer sign near r02 (Fig 10.3) explaining the stress that dogs impose on birds.

We have also observed loose dogs chasing birds throughout the refuge, sometimes at considerable distances from their owner. Dogs flush birds at the mouth of Fish Creek on Douglas Island. We have recently observed three large dogs ranging completely unattended, chasing birds on the west side of Mendenhall River.

We recognise that many people make an attempt to control and prevent their dogs from chasing birds. Many do not, however, and these dogs cause stress to birds using the Mendenhall Wetlands.

The dog/wildlife problem is not unique to Juneau. Lafferty (2001) studied interactions of people, dogs and birds on a California beach, concluding:

> "Dogs disturbed birds disproportionate to their numbers due to the tendency for some dogs to chase birds and the possibility that some birds, such as snowy plovers, are more sensitive to dogs than humans. . . Although the countywide leash law was posted at the main beach entrance, this law was not enforced, explaining the near absence of compliance by dog owners. . . The Southern Pacific Coast Regional Shorebird Plan . . proposes limiting human disturbance to shorebirds and, in particular, restricting dogs from beaches with important shorebird habitat and leashing dogs on all other beaches."

Burger (1986) studied effects of human activity on shorebirds in Delaware Bay. She reached similar conclusions about the categories of human recreation most disruptive to birds:

> "The results of this study . . . suggest that beaches with high shorebird populations should be protected from human activities - particularly during late May and June . . . Short of closing beaches, they should be off limits to dogs, unattended children, and joggers."

The above-cited studies were conducted in areas of high human densities. The pressure for recreational access to beaches in California and Delaware is correspondingly far more intense than on the Mendenhall, and stemming that pressure with regulations protecting birds will require both diplomacy and tenacity.

The City and Borough of Juneau's Parks and Recreation is currently holding meetings to discuss questions of dogs on trails. As with any controversial subject, it may take some time before there is widespread acceptance of the need for change.

On many bird refuges elsewhere, it is almost taken for granted that dogs are leashed or completely prohibited:

> "In campgrounds, developed recreation sites, and in state and national parks, pets must be kept on leash or be otherwise confined. No pets are allowed on trails in national parks. Pets are not allowed in National Wildlife Refuges except for hunting dogs where hunting and the use of dogs is permitted." *Public Lands Museum website: www.publiclands.org.*

To begin the slow process of putting the 'refuge' back into our Refuge, proponents of wildlife protection should: 1) plan an educational campaign to build support for dog regulations, and; 2) identify a few key areas where dog/wildlife conflicts are most disruptive, and press for restrictions *and enforcement*.

Education would be most effectively promoted by a coalition of many groups including agencies, the Kennel

Fig 10.6 *Duck-hunting blind at junction of floatplane pond with the east finger pond. The airport issues permits to hunters to use this area. The deterrent value of this practise is questionable because of the high daily turnover of southbound waterfowl. Birds that only spend a short time on the wetlands probably cannot be "educated" by hunters not to use the airport vicinity. Firing can also have the unintended consequence of scaring birds into the flight path. Finally, it appears contradictory to set out decoys to lure in waterfowl to teach them not to use the area.*

Club, Humane Society, and conservation organizations. Much progress has recently been made in this regard by the Dogs Task Force Committee. The wildlife subcommittee of that group is assembling basic information on sensitive areas including the Mendenhall Refuge. Another subcommittee is investigating options for "dog parks" – less sensitive places designated for off-leash activity where dog owners might be encouraged to exercise their pets.

As for item 2, there is no more appropropriate place to begin than on the Airport Dike Trail. Laws are already in place. Values to shorebirds and waterfowl have been well documented by this and other studies. The Dike Trail has a devoted "clientele," not only of dog-walkers but of birders and others who appreciate the chance to see wildlife at close range. Thousands of school children get their first good look at water birds through telescopes during SeaWeek activities on the Dike Trail. Dogs have seriously impacted the educational potential of this area.

We recommend enforcement of the Juneau Borough leash law along the Dike Trail and of State laws governing harassment of wildlife on and near the refuge. We also recommend an examination of dog policies on other wildlife refuges and parks, and research into how other communities have dealt with this potentially divisive issue.

Hunting

It has long been common knowledge that hunting displaces waterfowl using the Mendenhall Wetlands to Auke Lake. Birds rest on the lake during the day and return to the wetlands at night to feed (O'Clair et al. 1986, Cain et al. 1988). Our data support these early views (see section 5 Auke Lake x01). The birds resting on the lake are the resident population of Vancouver Canada Geese and probably the overwintering population of Mallards. It seems unlikely that migrant waterfowl would remain in the area long enough to learn this behavior – unless they simply followed the resident birds.

This at least twice-daily movement between the wetlands and Auke Lake appears to put these birds in direct line with aircraft approaching and taking off at the Juneau Airport from and to the northwest (Fig 5.39). In recent years our warmer winters have meant that Auke Lake is available as a refuge for a longer period, which may prolong this wildlife hazard. Last year Auke Lake was ice-free well into December. We observed jet skiers on the lake in November that caused the geese to fly back to the wetlands around noon. The reason for the jet skiers being on Auke Lake at this time was unknown to us.

We recommend that an assessment be conducted of the potential hazard that these waterfowl movements to and from Auke Lake may have for aircraft at the Juneau Airport.

Hunting also has the unintended consequence of causing some birds to concentrate in rarely-hunted sloughs paralleling the eastern end of the runway. Throughout the refuge, hunting keeps waterfowl in motion, and inevitably some of these birds land near or cross airport flight space.

In 1988, the US Fish and Wildlife Service (Cain et al. 1988) recommended closing a portion of the Mendenhall Wetlands to hunting. Listed as reasons for the closure were:

> "1) provide a fall refuge for all waterfowl, 2) provide more opportunities for non-consumptive use of the birds, 3) enhance hunting in adjacent areas by keeping birds nearby, and 4) help draw birds away from non-huntable areas adjacent to the airport, thus reducing the potential bird strike hazard."

We agree with these goals, as explained in the preceding section on *Birds and airplane safety*. Cain et al. concluded:

> "ADFG should initiate a plan to designate a portion of the refuge as a non-hunted sanctuary during the waterfowl hunting season. Any area designated should provide for the needs of concerned species and for continued non-consumptive use by humans."

Combining a no-hunting and dog-free zone at a suitable distance from the airport with habitat enhancement such as creation of a ditch-grass pond would have very high likelihood of producing a primary hotspot for geese and dabbling ducks. Observation/ photography blinds would make such a sanctuary popular recreationally as well.

We recommend that a survey of management strategies on other waterfowl refuges be done to determine the benefits of no-hunting zones to birds, hunters, and the non-hunting public.

Infrequently surveyed areas of the wetlands

The Mendenhall Wetlands cover a very large area. In the interests of efficiency we generally tried to scan from overlook positions quickly accessible from roads. Exceptions were at the mouths of Fish and Ninemile Creeks, each requiring a 15 minute walk, and the mouth of Mendenhall River, requiring about an hour each way if one stopped frequently to record birds.

There were several other areas that would have required similarly long hikes from roads that we chose not to survey. Larger birds like geese could be seen and counted by spotscope in these areas from great distances, but obviously many smaller birds would be missed, as well as those hidden from view in vegetation or down in the sloughs.

Map 10.4 outlines the areas within and adjacent to the refuge that we did not cover on a regular basis. The largest patch includes the extreme eastern end of the runway, the Johnson and Hendrickson Creek estuaries, and the central dredged portions of Gastineau Channel.

Initial walks through this area as well as scans from high bluffs on Sunny Point turned up few large groups of birds. The USFWS study in 1986 did include observation points that offered fairly good views of much of this area. Examining their data, it appears that large groups of birds were uncommon in these units. Nevertheless, it should not be assumed that because we have few records of birds in this part of the refuge, it has low wildlife value. If this area should come under scrutiny during evaluation of second channel crossing options, for example, additional bird studies will be needed.

Important wetland areas contiguous to the refuge that we rarely surveyed included the golf course west of Industrial Boulevard and marsh habitats along Switzer, Lemon and Vanderbilt Creeks. These include private lands that could be purchased and added to the refuge as mitigation. More should be known about their habitat values and enhancement potential.

Map 10.4 *Shaded patches show areas infrequently covered during the hotspot study.*

Recommended research

• Survey wetland bird populations refuge-wide at intervals of roughly every 5 years, and after any large-scale developments.
• Search the wetland fringes for crow nests, concentrating on young spruce stands in uplift meadows. There are indications that crows have declined since the 1986 survey.
• Document the effects on waterbirds of uncontrolled dogs, using the methods of Burger (1986) and Lafferty (2001).
• Document the response of waterfowl to hunting between Sept 30 and Dec 15. Other hunting-related studies could include crop sampling to determine bird diets, and a survey of hunter attitudes toward closed sanctuaries.
• Conduct bird surveys at night (especially foraging waterfowl) and at high tides (especially waterbird resting areas), to fill in gaps that were not addressed in the current study.
• Map areas of intensively clipped vegetation in the sedge low marsh and succulent marsh during late spring and mid fall as an additional measure of where foraging waterfowl are concentrating. In some ways such a survey could be more representative of overall use than actual bird counts, as clippings show cumulative presence better than do isolated observations. (Droppings also show bird presence but are left by resting as well as foraging waterfowl. Goose droppings are easily distinguished from those of Mallard and other ducks.)
• Document harassment of geese on Auke Lake, and if it is occuring, provide enforcement.
• Shorebirds should be re-surveyed at least every few years. Key period is April 26 to May 23. This could be done on a fairly informal basis if local birders were willing to share their counts with an agency or NGO compiler. Large pulses of spring shorebirds probably do not often slip through the refuge without being detected by one or more of Juneau's active birders.
• Conduct study of tidal current and sediment transport, particularly around spoil islands, as a measure of the ability of tidal scour to "grade" certain sloughs and sparsely vegetated surfaces, offsetting the effects of glacial rebound.
• Potential food resources for fish and wildlife on the wetlands are poorly understood. Studies should address these plant and invertebrate foods and their relationship to changing community structure and distribution.
• Identify all undeveloped or lightly developed private properties containing wetlands contiguous to the Refuge. Purchase of such properties should be among the highest ranking options for mitigation.

Acknowledgments

Pauline Strong created the phenology mega-table (Appendix C) and the graphs produced from those data. Gus van Vliet contributed information on banded birds seen on and near the Mendenhall Wetlands. Paul Suchanek let us use all of his records of bird sightings on the Mendenhall Wetlands, which had been already entered into Excel. Richard Gordon gave us copies of his many years of bird observations at the mouth of Mendenhall River. Steve Zimmerman reviewed the phenology table and helped fill in the blanks for the accidental and casual birds. Laurie Craig kindly called us whenever she sighted unusual concentrations of birds on the wetlands. We are grateful to volunteers who assisted with the surveys: Sari Saunders, Jenny Purcell, and Mike Tobin.

Others who gave us bird records; Mark Schwan, K. Koski, Nina Mollet, Gwen Bayliss, Ian MacIntosh, Jim King.

On April 29, 2002, Rusty Yerxa flew us over the refuge and surrounding areas. Many of the oblique air photos in this report were taken during that flight. Jack Hodges took us up in the USF&WS Beaver during a zero-foot tide to get vertical photographs of the mudflats and other key wetland habitats. Michelle Kissling, USFWS, had the original concept for this study. She lent us GPS units and laser rangefinder for our initial mapping of hotspots. Bob Christensen of SEAWEAD gave us training and frequent consultation on ArcView 3.2 and ArcMap 8.2, both of which proved instrumental in data analysis.

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Appendix A

Common and scientific names

common names for plants used in text follow Pojar and MacKinnon. 1994

Vascular plants

alkali grass	*Puccinellia nutkaensis*
arrow-grass	*Triglochin maritima*
ditch-grass	*Ruppia maritima*
foxtail barley	*Hordeum jubatum*
goosetongue	*Plantago maritima*
hair grass	*Deschampsia caespitosa*
Lyngbye sedge	*Carex lyngbyei*
rye grass	*Elymus arenarius*
sea milkwort	*Glaux maritima*
Sitka spruce	*Picea sitchensis*

Algae

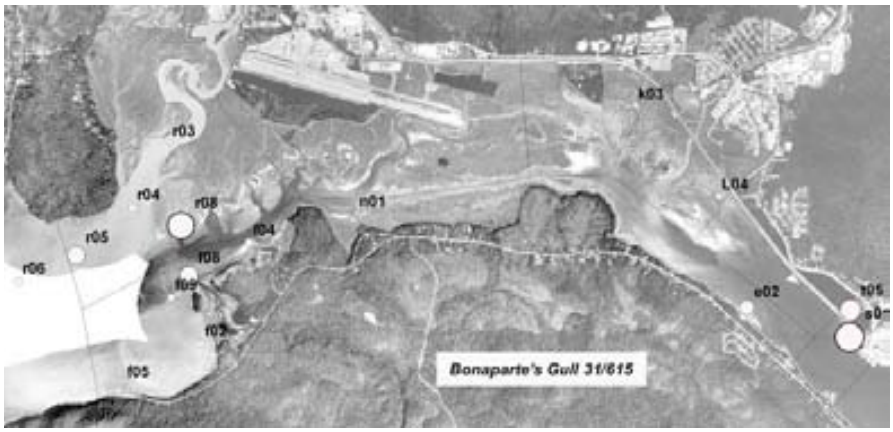
rockweed	*Fucus distichus*
"tube algae	*Enteromorpha sp*
"mat algae"	*Vaucheria sp*

Appendix B

Species distribution maps

Section 7 contains distribution maps for groups of birds such as gulls and diving ducks. The maps below show distributions for several individual species within these groups. Among dabbling ducks, only Mallard (Map 7.2) and American Wigeon (below) provided enough records for distribution mapping.

Largest dot on each of the following maps had the highest number of birds counted throughout the study period during full surveys. Remaining dots are scaled proportionately. A fraction beside the species name - e.g. 34/456 - means that a total of 34 records was collected for the species during the 18 full surveys, while the largest dot represents an accumulated count for that species of 456 for that particular survey area. (For resident species this may include individuals counted more than once on successive visits. These are therefore not abundances, but reflect the consistent use of certain areas by the indicated species.)

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f06
American Wigeon 34/456


a04
a03
a01
r03
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L04
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r04
r08
r05
r06
f08
f09
f07
Scaup sp. 25/668


r06
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f09
e02
f02
f06
f05
Surf Scoter 16/6030


r06
f08
f09
f05
White-winged scoter 7/640


r12
r01
r02
a04
a03
a01
r03
t04
r08
t04
r05
e01
r06
e02
s01
Bufflehead 23/50


r03
r07
r04
t10
t04
r05
r06
t11
s01
Barrow's Goldeneye 20/430


r03
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t02
Common Goldeneye 23/120

Appendix C Phenology of birds occurring on the Mendenhall Wetlands.

This phenology chart includes all bird species that have been documented for the Mendenhall Wetlands by Armstrong and Gordon (2002). When the week of occurrence for a particular species was unknown to us we used the symbols + (accidental or casual), R (rare) or U (uncommon) to correspond to season and abundance on the Mendenhall bird checklist.

We amalgamated all available records of birds on the wetlands. These were entered into Excel spreadsheets, to compile a summary of the seasonal patterns of avian abundance on the wetlands, by species.

The information presented in this section represents 10,881 bird observations on the Mendenhall Wetlands since 1986. For example, one observation could be 30 crows counted on a particular date. These observations were gathered from a variety of sources that included the following:

- Paul Suchanek's observations from 1990 to 2002. Paul has recorded over 5,500 observations of birds on the Mendenhall Wetlands. His observations form a solid foundation for the phenology database.

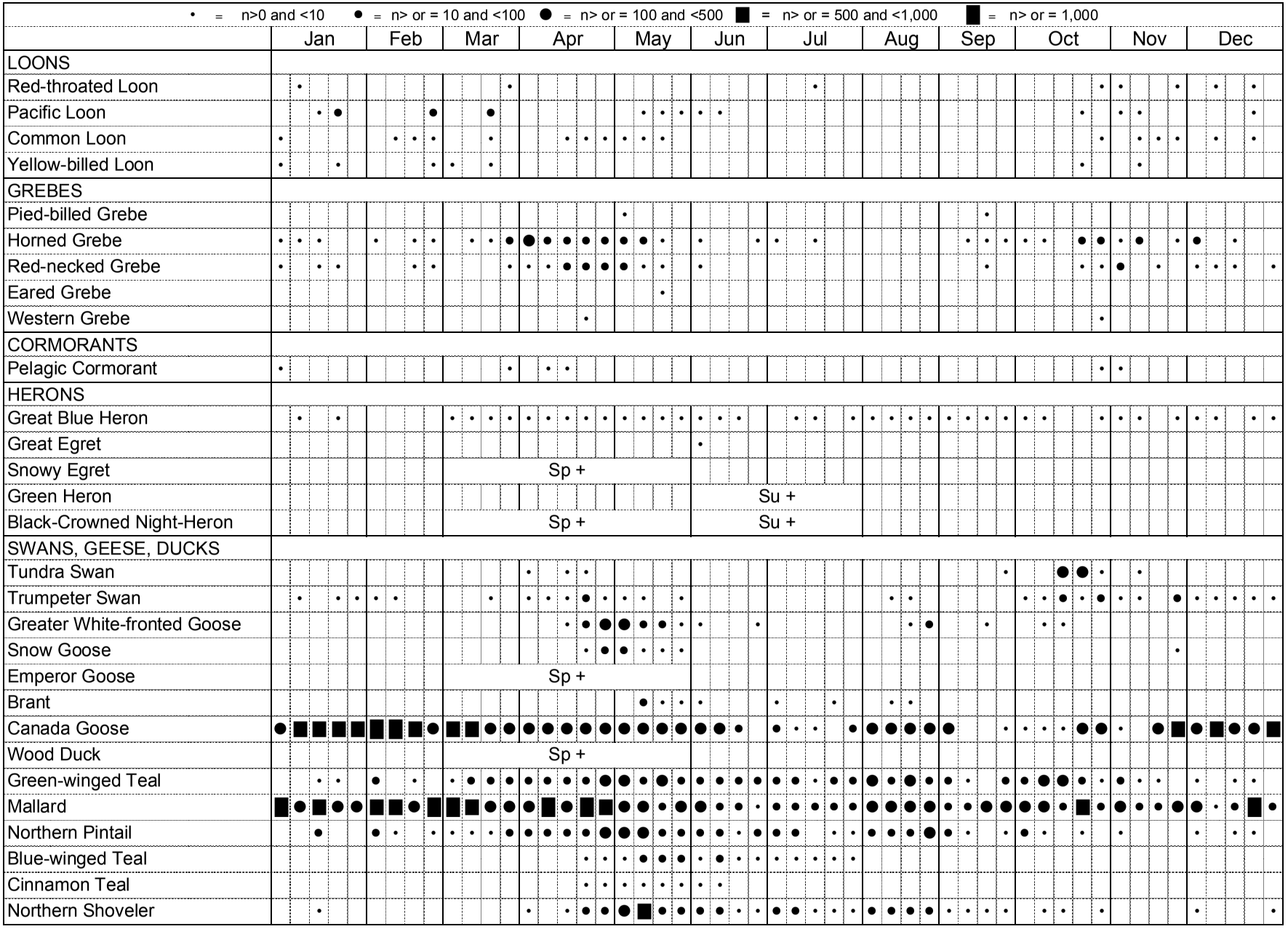
- Cain, S.L., J.I. Hodges, E. Robinson-Wilson. 1988. *Bird use of the Mendenhall Wetlands in Juneau, Alaska.* U.S. Fish and Wildlife Service. Juneau Office. They conducted bird surveys from February 19, 1986 to February 12, 1987. Units near the airport were visited twice weekly, and more distant units twice monthly. Their emphasis was on waterfowl and other highly visible species, but all birds seen were counted.

- Bob Armstrong and Richard Carstensen's point counts of birds on airport property from January through December 2002. This work was done for SWCA, consultants hired to produce the Environmental Impact Statement for expansion of the Juneau Airport. Counts were conducted monthly throughout the year, with occasional additional surveys during the breeding season.

- Data from the present hotspot study conducted from March 2002, through May 2003. Complete bird surveys of the Mendenhall Wetlands were conducted at least monthly.

- And finally we incorporated observations by local birders Richard Gordon, Steve Zimmerman, Gus van Vliet, and Laurie Craig.

Birds of the Mendenhall Wetlands, Highest Number Seen by Week, 1986 - 2002



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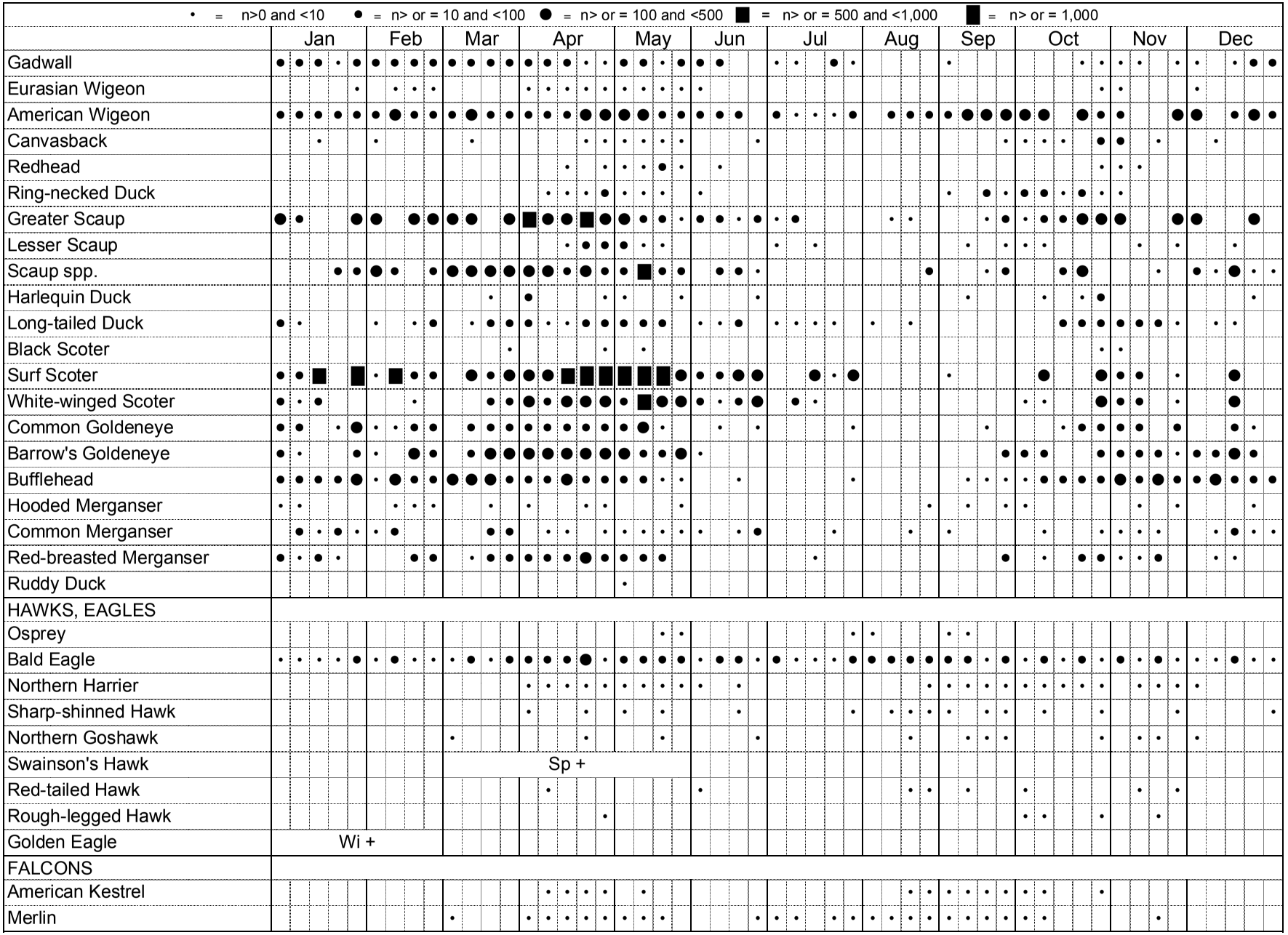

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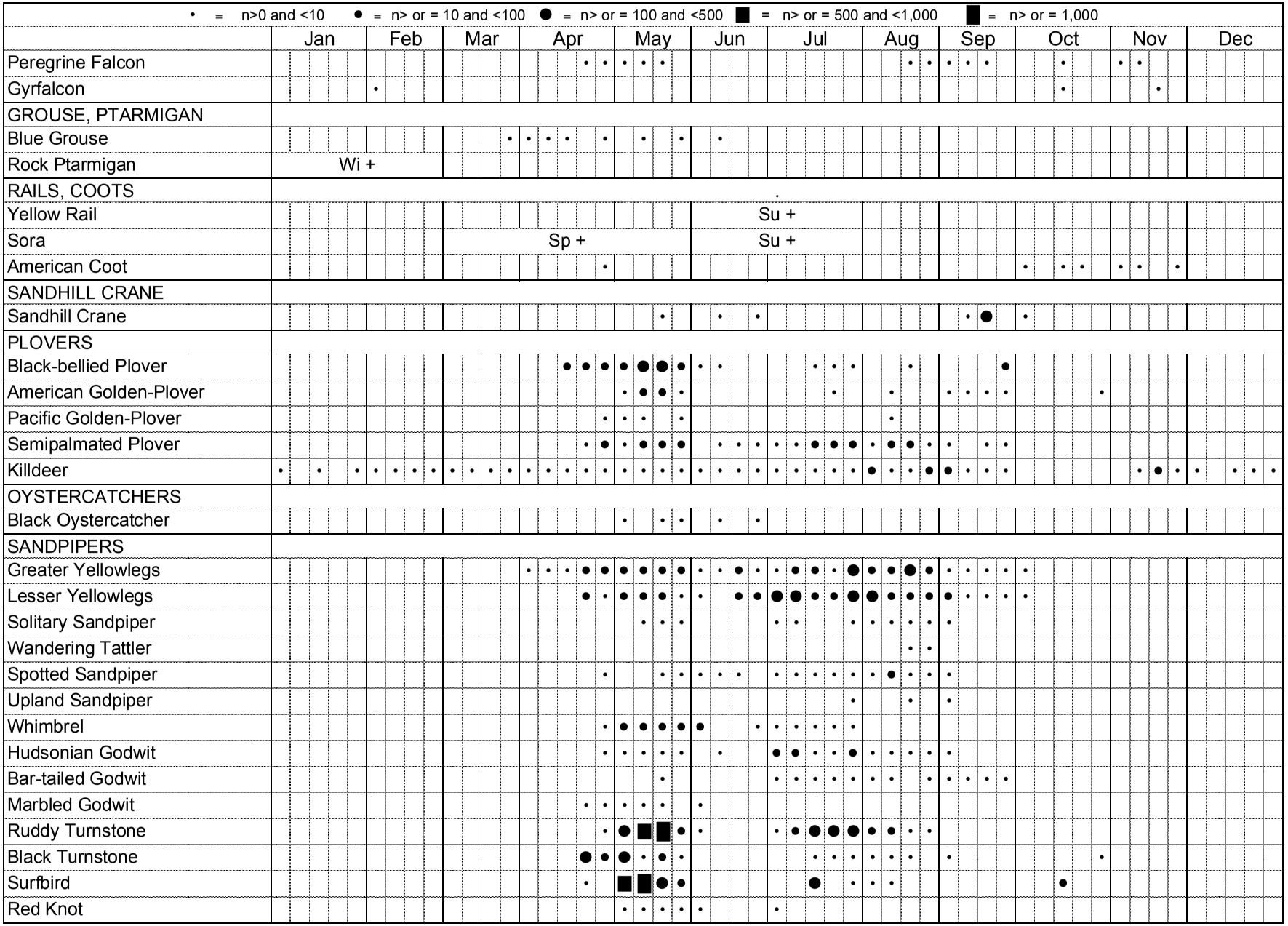

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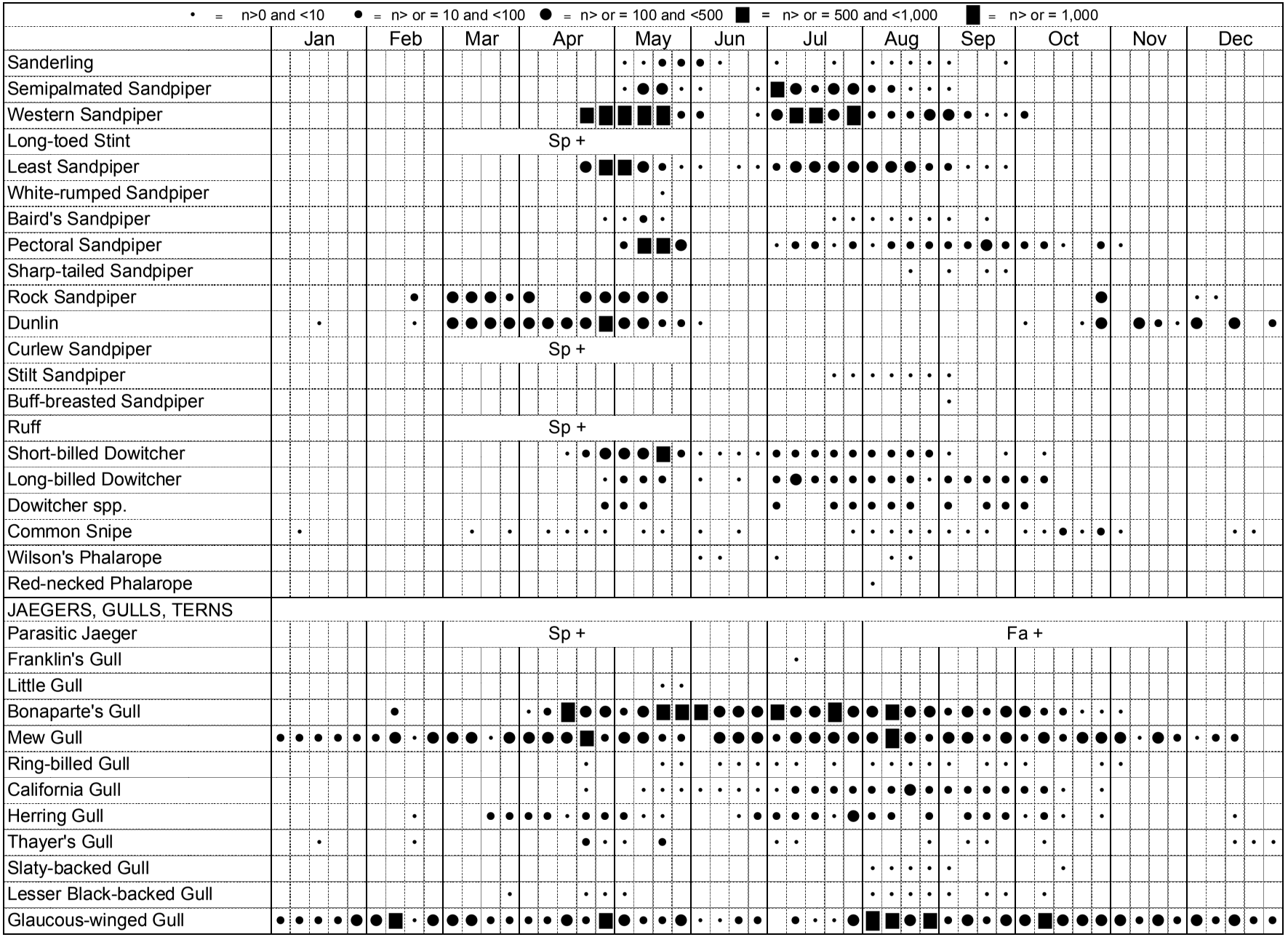

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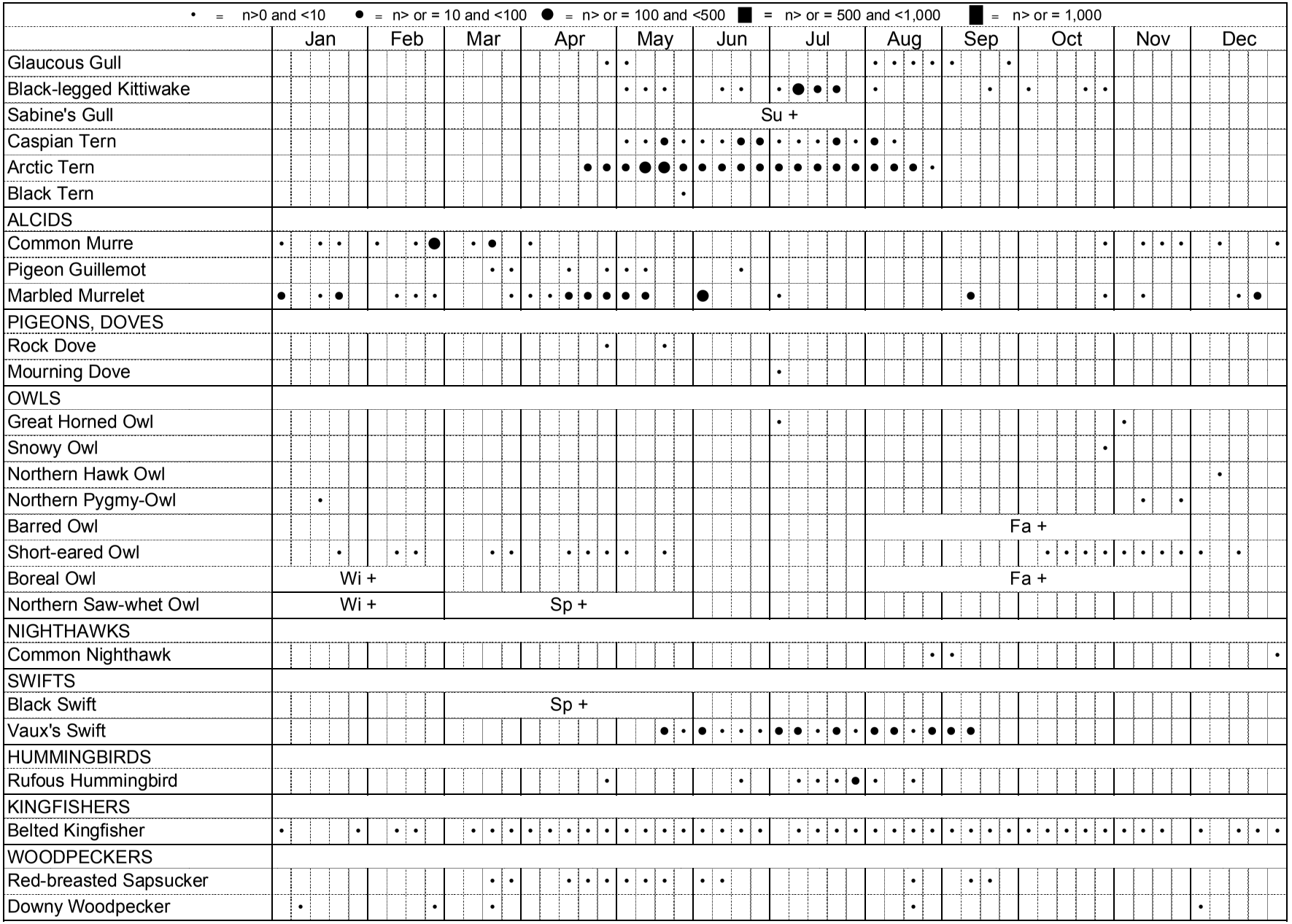

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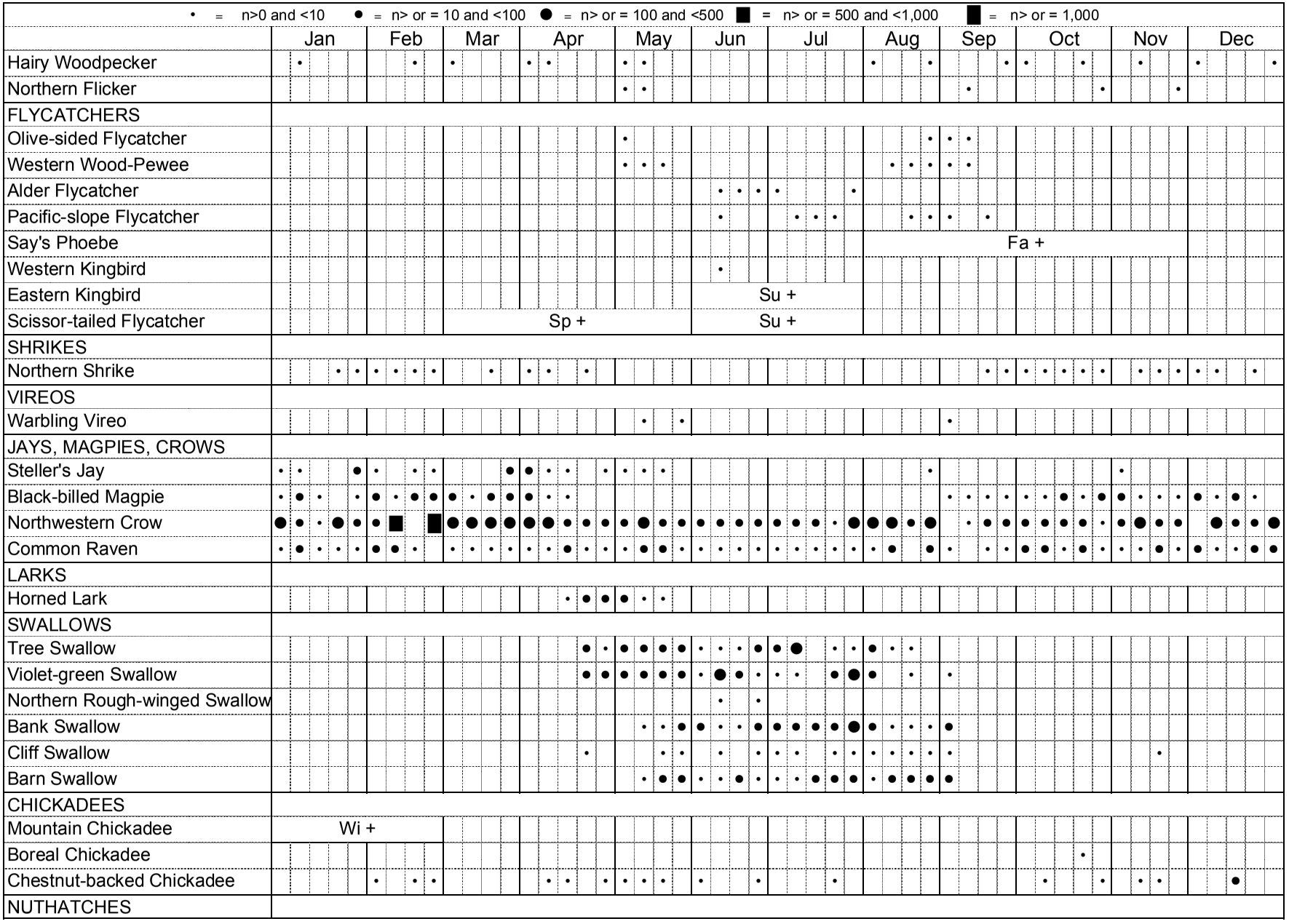

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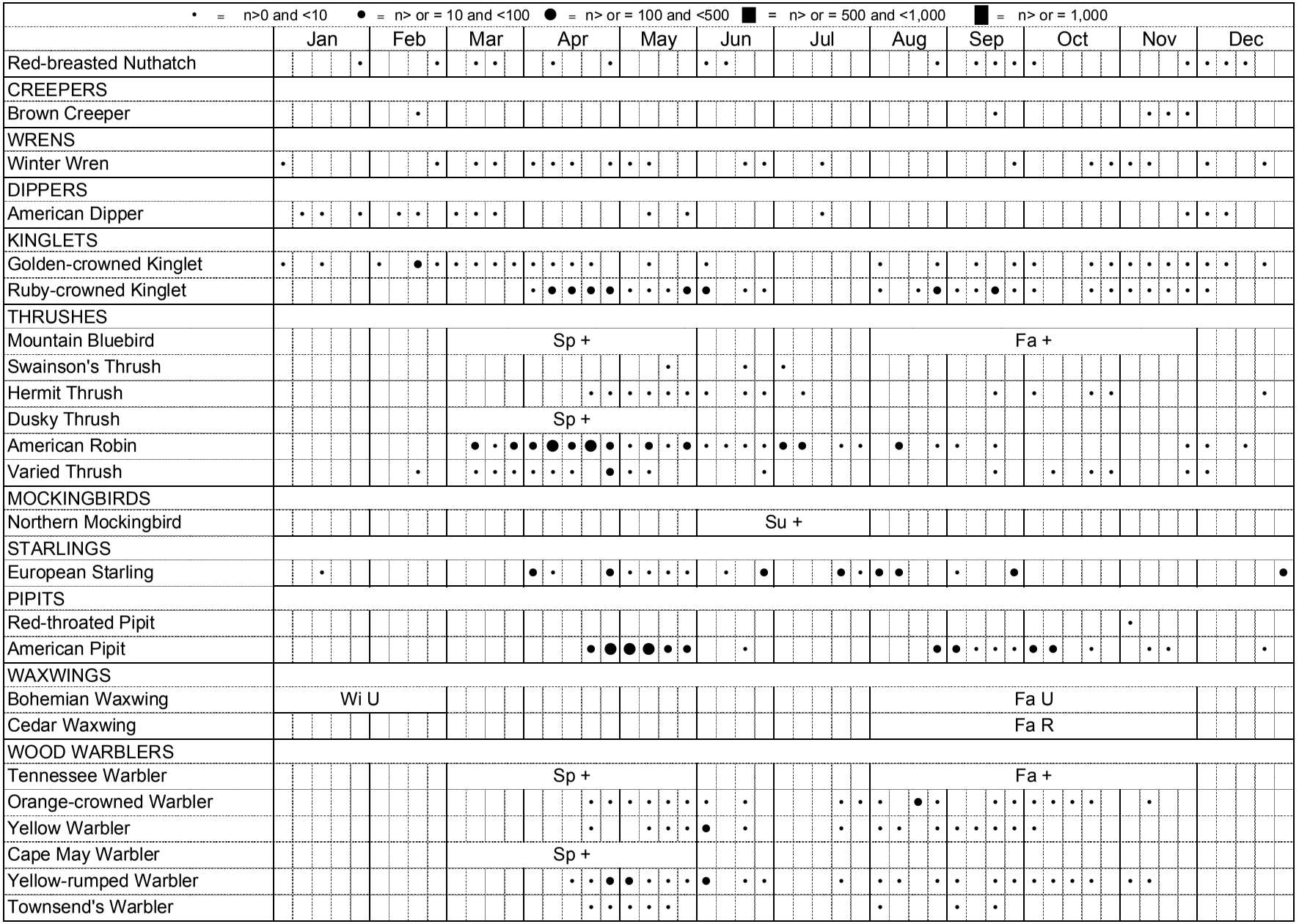
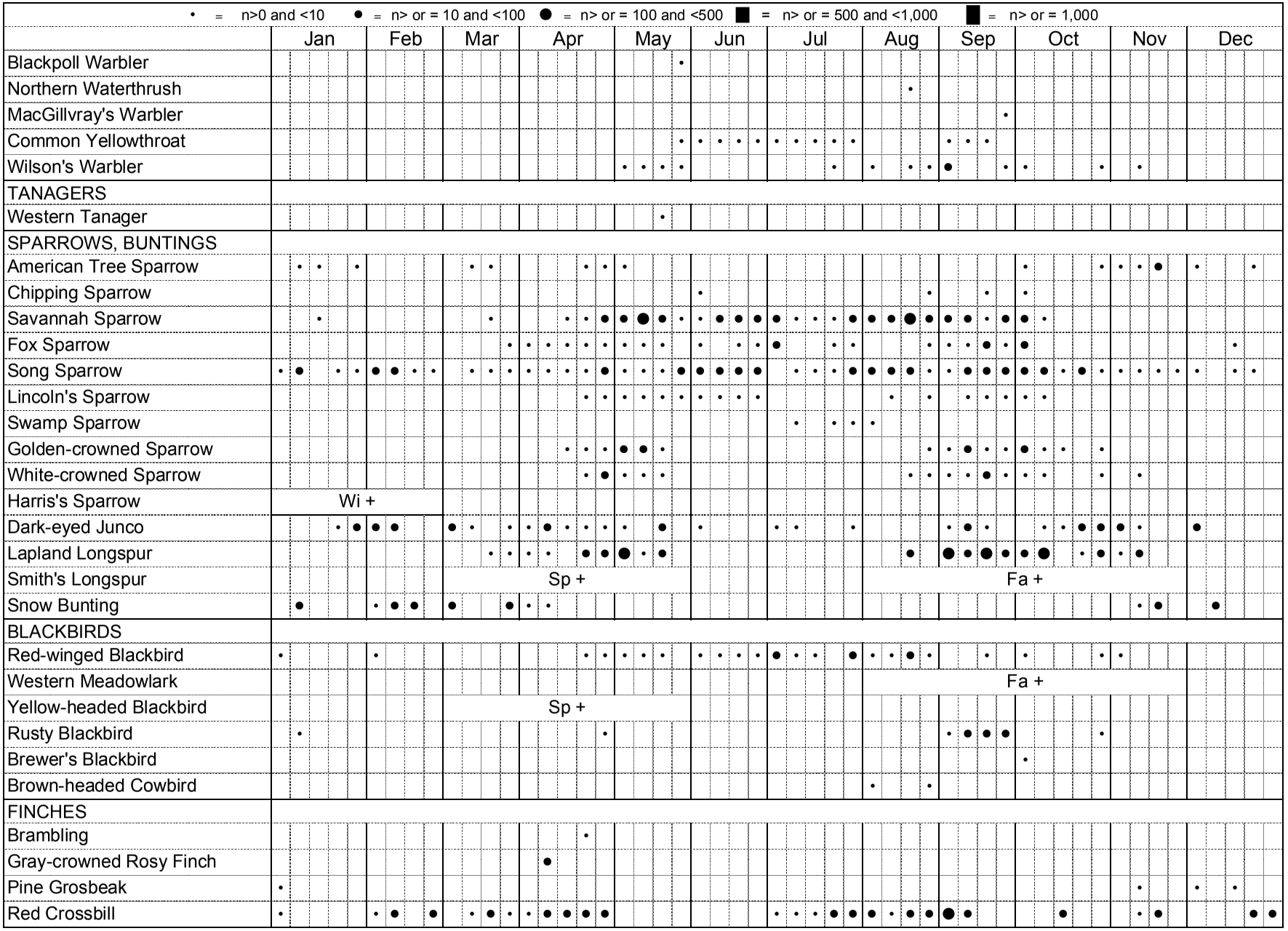
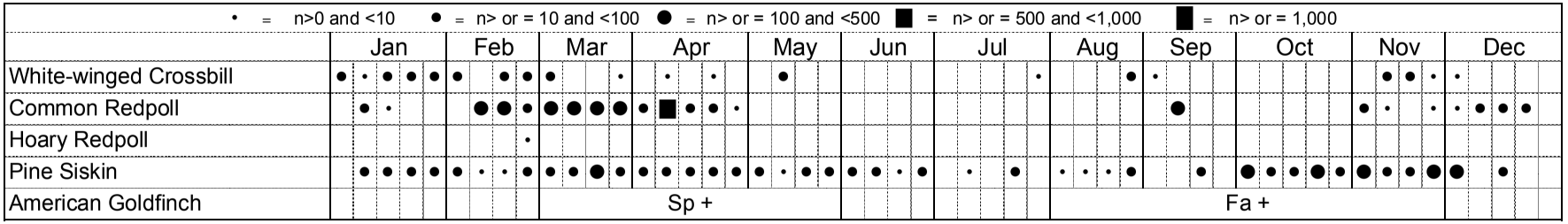
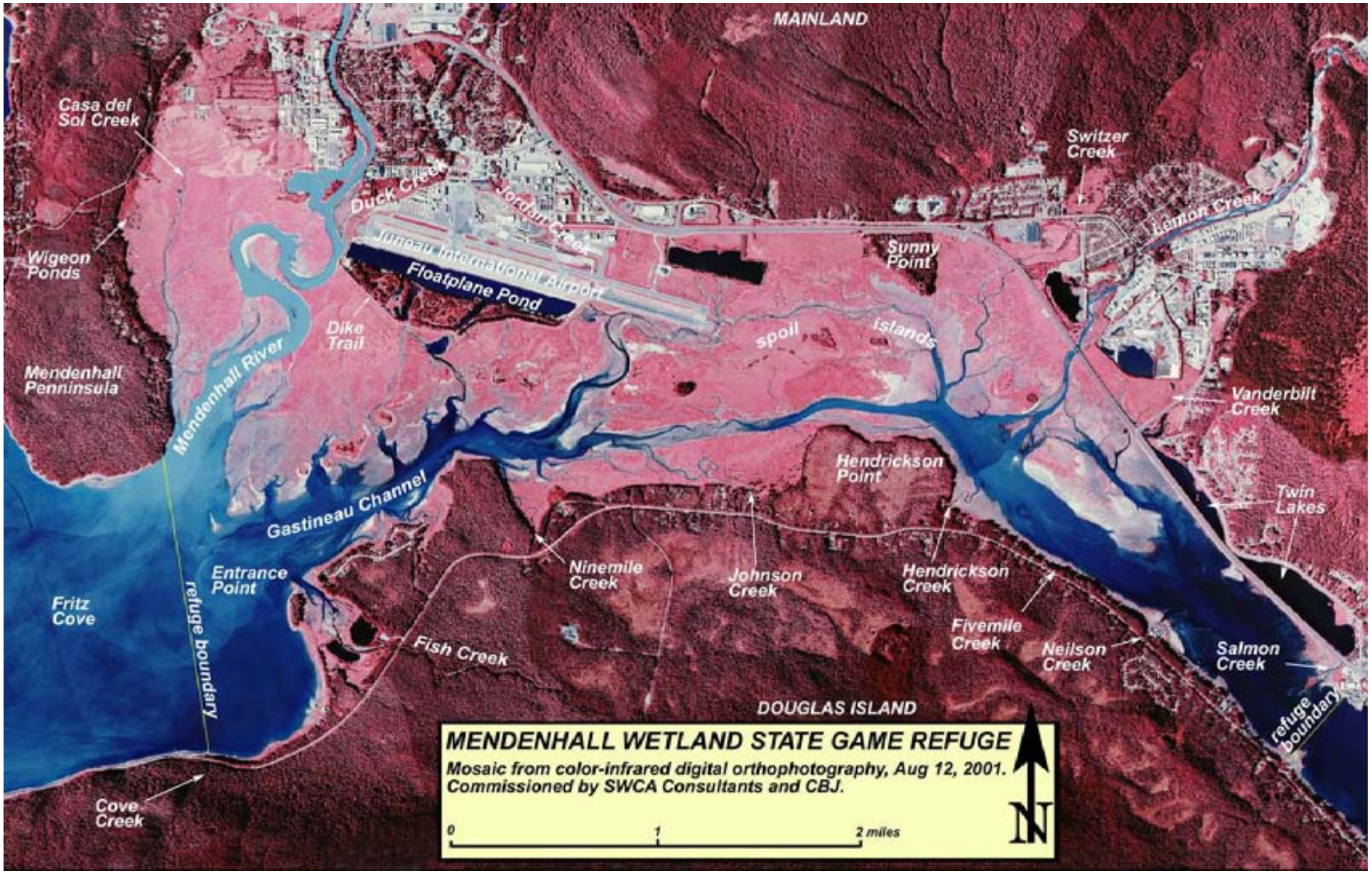


Birds of the Mendenhall Wetlands, Highest Number Seen by Week, 1986 - 2002



Birds of the Mendenhall Wetlands, Highest Number Seen by Week, 1986 - 2002




MAINLAND
Casa del Sol Creek
Wigeon Ponds
Duck Creek
Jordan Creek
Juneau International Airport
Floatplane Pond
Dike Trail
Mendenhall River
Mendenhall Penninsula
Switzer Creek
Lemon Creek
Sunny Point
spoil islands
Vanderbilt Creek
Hendrickson Point
Twin Lakes
Gastineau Channel
Entrance Point
refuge boundary
Fritz Cove
Ninemile Creek
Johnson Creek
Hendrickson Creek
Fivemile Creek
Neilson Creek
Salmon Creek
Fish Creek
DOUGLAS ISLAND
refuge boundary
Cove Creek
MENDENHALL WETLAND STATE GAME REFUGE
Mosaic from color-infrared digital orthophotography, Aug 12, 2001.
Commissioned by SWCA Consultants and CBJ.
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