

## 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*).

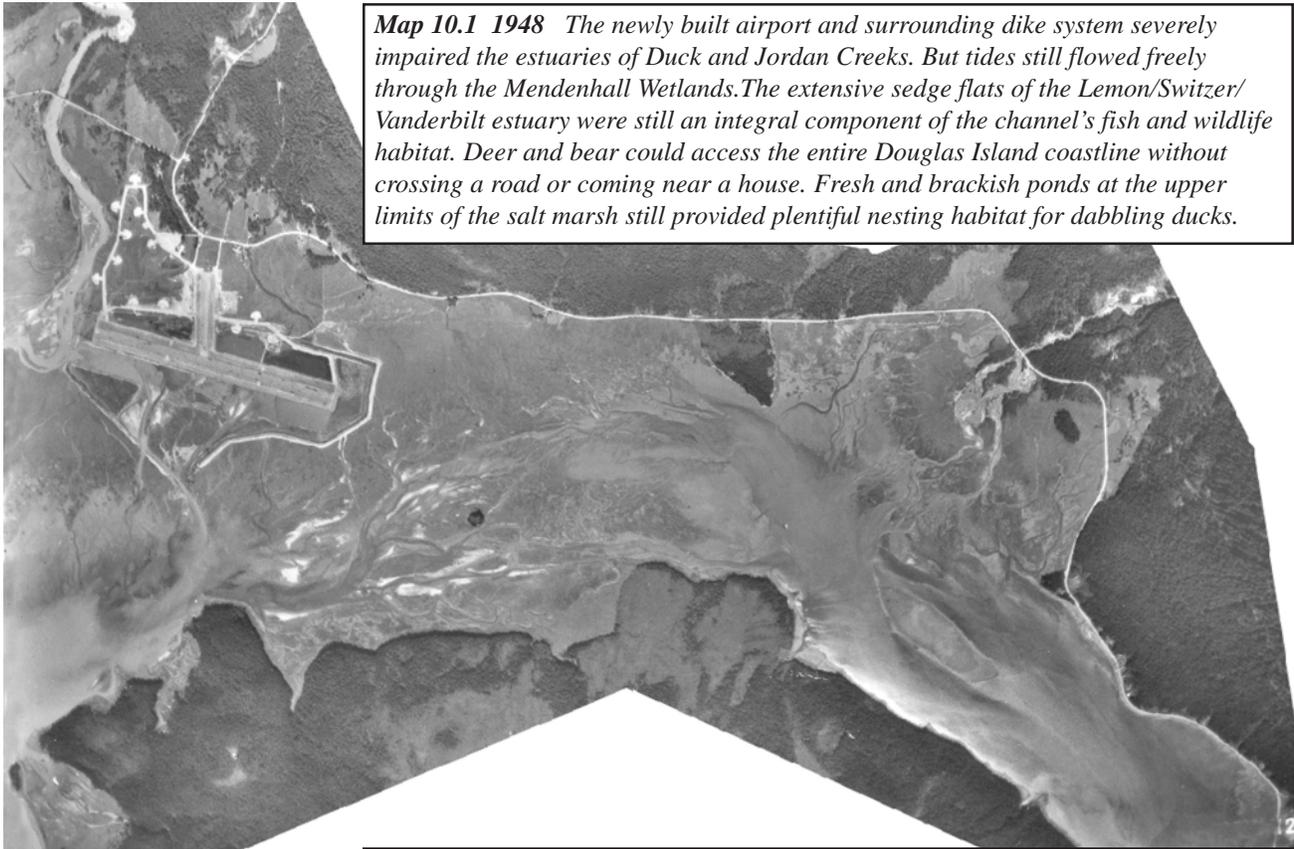
To help identify, monitor and prevent further degradation of shorebird stopover areas, a program coordinated by the Manomet Bird Observatory titled “Western Hemisphere Shorebird Reserve Network” has been established. Collaborators include over 140 public and private organizations in 7 countries. One result is the U.S. Shorebird Conservation Plan; Alaska's plan was written in March 2000. Cooperators for this plan have



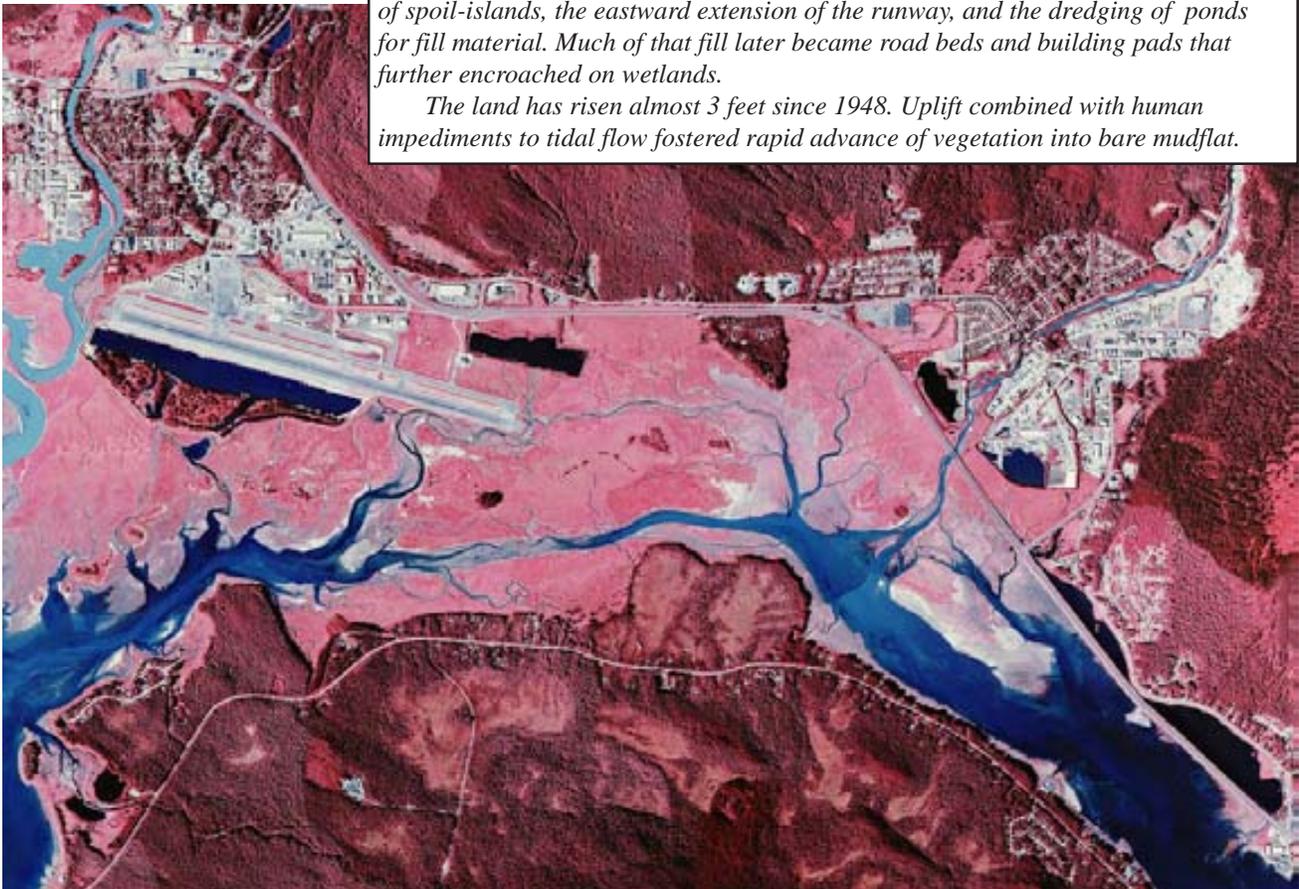
Fig 10.1 Surfbirds hunt through the barnacle/mussel/rockweed community at low tide on the Mendenhall River Mouth. Dunlin in right foreground.

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.

\*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.

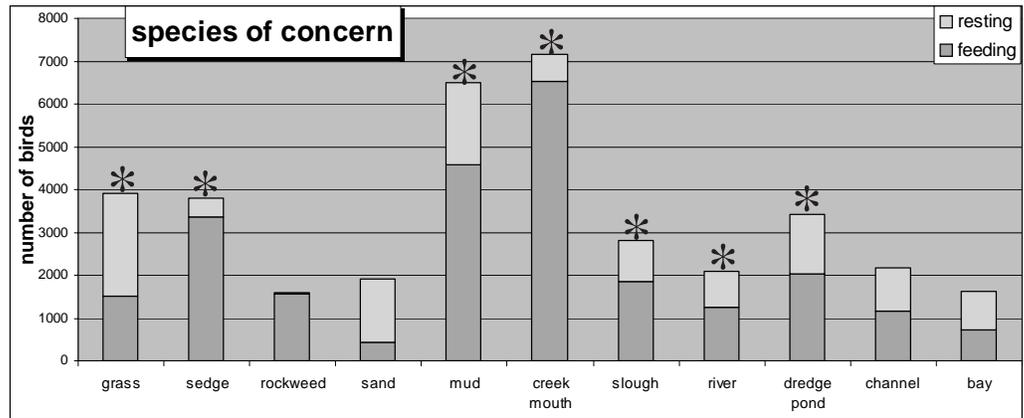
### Attractive habitats

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.**

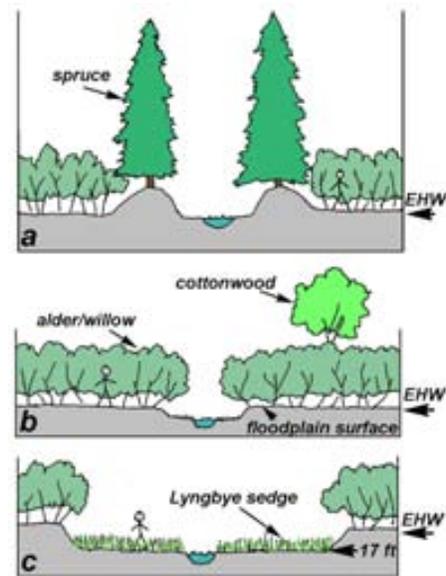


**Fig 10.2** Total number of birds of 7 species counted throughout Mendenhall Refuge during full and ancillary surveys by habitat type and activity (n = 571 records). Includes Mallards, Canada Geese, Bald Eagles, Northwestern Crow, and 4 gulls (Bonaparte’s, Mew, Herring and Glaucous-winged). Asterisks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

**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 perspective, but they would need to be topped periodically to prevent view obstruction from the tower.

**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?



**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.

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 infilling 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.

**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,



**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.

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 appropriate 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 “cliente,” 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-hunttable 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 spottoscope 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.