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.

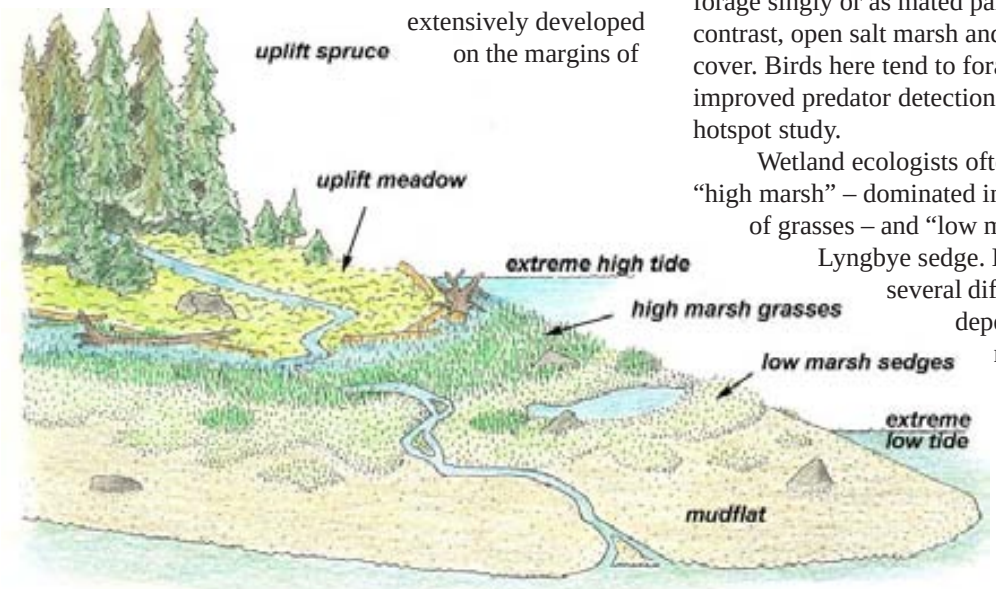


Fig 4.1 *Vegetational zones on tidal and supratidal surfaces at Mendenhall Refuge.*

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

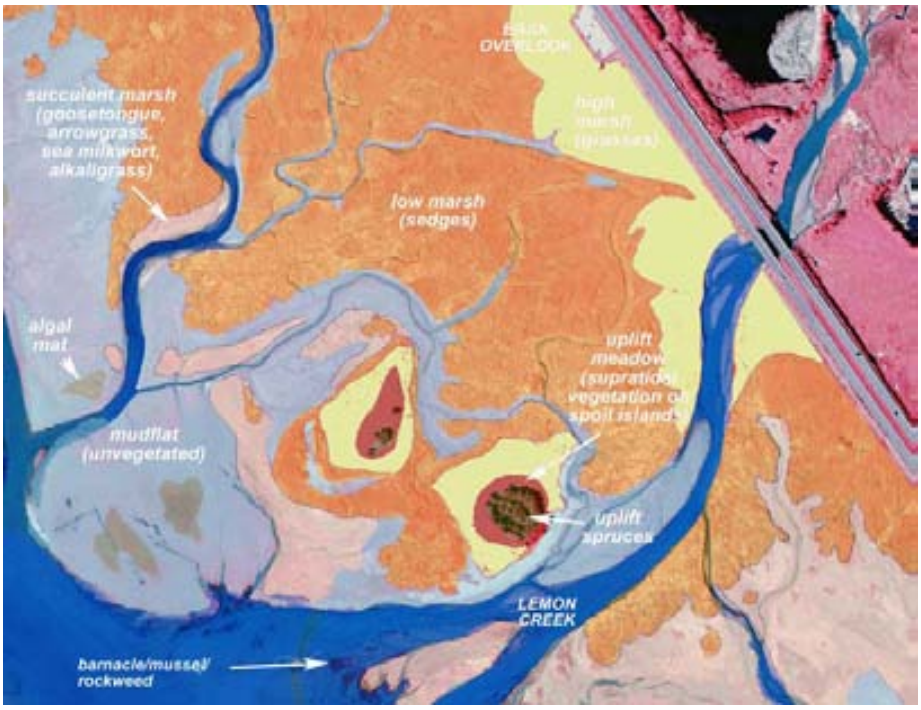
The extreme high tide line (EHWS), roughly 20 feet above sea level (MLLW) locally, defines the lowest extent of uplift meadow and the uppermost extent of salt marsh, a wave-sheltered intertidal community, usually estuarine, covered with vascular plants.

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.



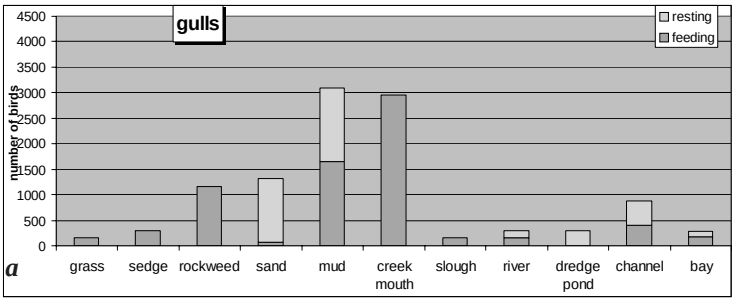
Map 4.1 *Vegetational zones at Lemon Creek estuary. From Mendenhall Refuge mapping in progress for the Southeast Alaska Land Trust. Compare Fig 4.11.*

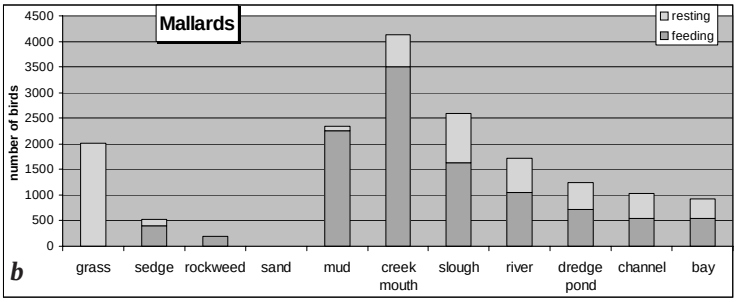
Lyngbye sedge, in spite of the relatively low percentage of land surface it covers in Southeast Alaska, may be the most important plant in our region for grazing birds and mammals. In wilder estuaries where mammals have easier access to the tidal marsh, sedges attract grazing black and brown bears, deer 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).

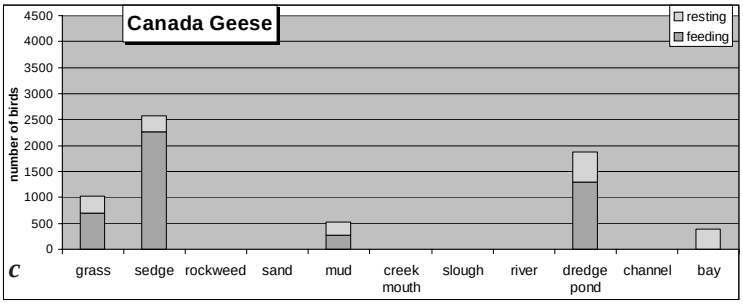
Other values of Lyngbye sedge are less widely recognized but equally important. This species produces copious seed (which seems rather odd considering how rarely seeds actually germinate in the salt marsh; the plant spreads largely by vegetative propagation). Sedge seeds form a large part of the fall 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).

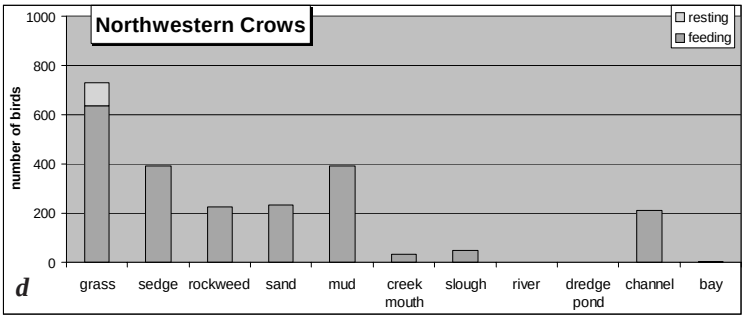
Fig 4.3 *Lyngbye sedges grazed by geese, ~15-foot tide level. Stems are triangular in section (grasses are round).*

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









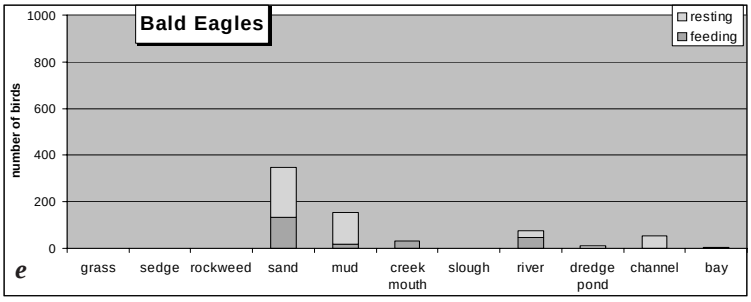


Fig 4.5 *Bonaparte's Gulls foraging in algal mat community, about 8-foot tide level*

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.

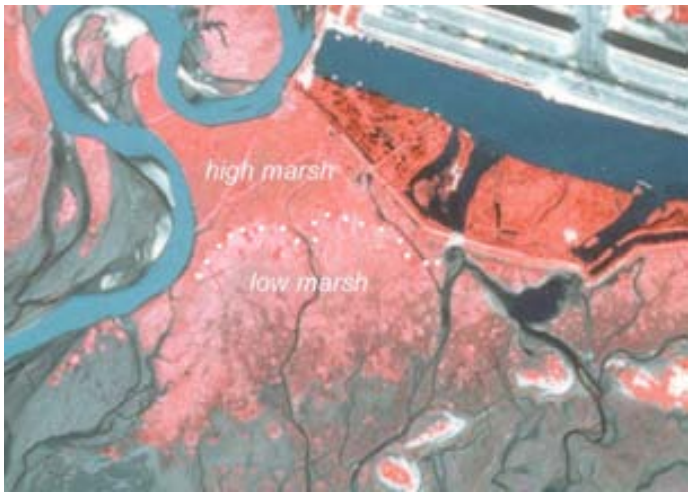
Foraging by snow geese has been studied at Hudson's Bay, one of few places in the world aside from northern Southeast Alaska where isostatic uplift is occuring fast enough to strongly influence vegetational development. Geese there appear to delay (but not arrest) the succession from low marsh to high 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.*