Appendix 5.3 Wetland Habitats

Featured Species-associated Wetland Habitats: Freshwater Grass Wetland, Freshwater Sedge Wetland, Bog, and Salt Marsh (Estuarine)

Wetlands are "edge" communities that contain poor soil drainage and represent a transitional zone between aquatic and terrestrial habitats. Alaska's wetlands occupy 43.3% of the state's 403,247,700 acres. This contrasts with the contiguous United States, where only 5.2% of the 1.9 billion acre land surface is composed of wetlands (Society of Wetland Scientists 1998). Wetland habitats in Alaska are numerous and complex; this conservation strategy highlights and provides simplified descriptions of a few of the wetland types found in Alaska. Alaska's CWCS strategy focuses on 4 main types of wetlands: bog, grass wetland, sedge wetland, and salt marsh. Wetland habitats can be isolated, ephemeral, or located in riparian areas hydrologically connected to surface waters of rivers, streams, and lakes. Small wetlands, even those without visible surface connections, are joined to stream systems by ground water, subsurface flows of water, and periodic surface flows, such as spring runoff. Significant wetlands also occur along the coastline and adjacent to river deltas, and within forests throughout the state.

Wetlands are abundant in the valleys and basins associated with Alaska river systems, including the Yukon, Kuskokwim, Porcupine, Tanana, and Koyukuk Rivers. The major river deltas also possess large wetland areas. One of the world's largest coastal deltas, the Yukon-Kuskokwim delta, supports several wetland types. Other predominant wetland deltas of Alaska include the Colville River delta on the Beaufort Sea Coast, the Copper River Delta in southcentral Alaska, and the Stikine River Delta in Southeast Alaska (Hall et al. 1994).

Bog habitats represent many thousands of years of wetland succession. In contrast to young freshwater wetland with only shallow organic material overlying mineral substrate, a bog consists of several feet of peat deposits. Bogs are characterized by spongy peat deposits, acidic waters, and an overlying vegetative layer of thick sphagnum moss. Peat forms when decomposing remains of mosses and sedges are left undisturbed and gradually accumulate as deep peat deposits. Bog habitat classifications include shrub-bog and forested-bog types, depending on successional stage of the landscape. Further classifications of Alaska's bog habitat have been developed based on water supply, distribution, and physiognomy (Batten and Murray 1982). Most of Alaska's wetlands are bogs, covering approximately 110 million acres.

Bogs receive most of their water from rainfall rather than from runoff, streams or ground water infiltration. As a result of this, and combined with acidic conditions, bogs are low in nutrients necessary for plant growth. Flora and fauna that live in bogs demonstrate many special adaptations to cope with the low nutrient levels, water-

logged conditions, and acidic waters. Evergreens and shrubs are the most abundant woody plants found in bog habitats.

Matanuska-Susitna Valley bog pond M. LaCroix, DNR

Because bogs require a persistently wet and cool climate in order to allow the growth of peat-forming sphagnum mosses, they are predominantly found in the Northern Hemisphere. Bogs have recently been recognized for their role in regulating the global climate by storing large amounts of carbon in peat deposits. Bog habitats are particularly susceptible to destruction as they take hundreds of thousands of years to develop, yet they can be destroyed in a matter of days.

Bog habitats often support wetland tree species dominated by dwarf black spruce (*Picea mariana*) (less than 10 ft tall at maturity). Black spruce communities are common near tree line in the Interior, Southcentral, and western Alaska on cold, wet sites just barely capable of supporting trees. Dwarf tamarack (*Larex laricina*) and birch (*Betula papyrifera*) may also occur. Dwarf tree cover is 25–60 percent in these areas.

In Southeast Alaska, common bog tree species include lodgepole pine (*Pinus contorta*), Alaska-cedar (*Chamaecyparis nootkatensis*), and mountain hemlock (*Tsuga mertensiana*). Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) are the dominant bog tree species along the Gulf of Alaska coast.

Other dominant shrubs commonly present in Alaska's bog environs include sweet gale (*Myrica gale*), Alaska bog willow (*Salix fuscescens*), barclay willow (*S. barclayi*), leatherleaf (*Chamaedaphne calyculata*), resin birch (*Betula glandulosa*), and thinleaf alder (*Alnus tenuifolia*). Ericaceous shrubs that form loose mats may include *Kalmia polifolia* in Southeast Alaska and crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*) and mountain cranberry (*V. vitis-idea*), which are common in Interior, Southcentral and southwestern Alaska. Bog rosemary (*Andromea polifolia*) and bog cranberry (*Vaccinium oxycoccos*) may also be commonly present. Frequently occurring graminoid species include loose flower alpine sedge (*C. rariflora*) (Tande and Lipkin 2003), livid sedge (*Carex livida),* water sedge

(*C. aquatilis*), many-flower sedge (*C. pluriflora*), mud sedge (*C. limosa*), Sitka sedge (*C. sitchensis*), boreal bog sedge (*C. magellanica*), gray sedge (*C. canescens)*, Lyngbye's sedge (*C. lyngbyaei*), and tufted bulrush (*Trichoporum caespitosum*). Other commonly occurring species include marsh five finger (*Potentilla palustris*), buckbean (*Menyanthes trifoliata*), and mare's tail (*Equisetum* spp.). In addition, species such as russet cottongrass (*Eriophorum russeolum*), cordroot sedge (*C. chordorrhiza*), and pond lily (*Nuphar polysepalum*) may also be present. Plant cover is generally complete, or nearly so, in bog habitats (Viereck 1972, 1992). Mosses (*Sphagnum* spp.) may account for 50–100% of the ground cover. Lichens may be present or absent.

Bog-associated Species

Olive-sided Flycatcher, *Contopus cooperi*
Rusty Blackbird, *Euphagus carolinus*
Solitary Sandpiper, *Tringa solitaria; T. s. cinnamomea* race breeds in Alaska
Lesser Yellowlegs, *Tringa flavipes*
Dragonflies and damselflies (Odonata)
Dragonflies, Suborder Anisoptera
Damselflies, Suborder Zygoptera
Wood Frog, *Rana sylvatica*

Grass wetlands are dominated (50% or greater) by water-tolerant grass species. The grasses may occur in clumps or tussocks and may be intermixed with pure stands of sedges, subjected to fluctuating water regimes. The wetter sites generally are hummocky. Woody plants and lichens are absent. Aquatic mosses may occur seasonally. The soil substrate associated with grass wetlands is generally organic or mineral rich. In addition to providing important wildlife habitat, they perform as ground water recharge areas, storing storm and floodwaters that help maintain minimum base flows critical for downstream aquatic resources.

Dry Creek grass wetlands, Matanuska-Susitna region
B. McCracken, ADF&G

Alaska's grass wetlands plant communities are classified as mesic graminoid herbaceous by Viereck et al. (1992). Examples include bluejoint-small bedstraw

(*Calamagrostis canadensis-Galium trifidum)* and Pacific reed grass-red fescue (*Calamagrostic nutkaensis-Festuca rubra)* dominated communities.

Grass Wetland-associated Species

Northern Harrier, *Circus cyaneus*
Short-eared Owl, *Asio flammeus*
Dragonflies and damselflies (Odonata)
Dragonflies, Suborder Anisoptera
Damselflies, Suborder Zygoptera
Water fleas - *Daphnia* spp. (Copepoda)
Western Toad, *Bufo boreas*
Columbia Spotted Frog, *Rana pretosia*
Wood Frog, *Rana sylvatica*

Southeast Alaska Endemic Species

Sitka tundra vole, *M. oeconomus sitkensis*
Long-tailed vole, *Microtus longicaudus/coronarius* complex
Admiralty Island meadow vole, *M. pennsylvanicus admiraltiae*
Admiralty Island beaver, *Castor canadensis phaeus*
Revillagigedo Island meadow jumping mouse, *Zapus hudsonicus*
Montane shrew, *Sorex monticolus complex*

Sedge wetland habitats are dominated (50% or greater) by tall sedges (*Carex* spp.), cottongrasses (*Eriophorum* spp.), rushes (*Juncus* spp.), or bulrushes (*Scirpus* spp.) and are typically inundated with water. Trees, shrubs, and lichens are absent, but aquatic mosses may be present (Viereck et al. 1992). Sedges make up the largest genus of plants in Alaska and consist of erect, rooted, water-loving vegetation. The USDA-NRCS (Tande and Lipkin 2003) National Plants Database identifies 155 species, subspecies and varieties of sedges in Alaska, of which 113 can be found in wetlands.

Spring Creek sedge wetland M. LaCroix, DNR

Sedge wetlands occur in very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, and sloughs and in depressions of upland areas throughout western, Interior, Southcentral, and Southeast Alaska and the Aleutian Islands

(Viereck et al. 1992), generally in organic-rich muck substrate. Common plant communities occurring in these areas include a list mainly from the species *Carex, Eriophorum,* or *Juncus.*

Other plant communities of sedge wetlands commonly found in Southcentral, Interior and Southeast Alaska include spike rush-mare's tail (*Eleocharis palustris-Hippuris vulgaris*), spike rush-spike watermilfoil (*Eleocharis palustris-Myriophyllum spicatum*), and spike rush-swamp horsetail-marsh horsetail (*Eleocharis palustris-Equisetum fluviatile-E. palustre*).

In the southern areas of the state sedge mats in water-filled lakes, ponds, and depressions are common and may consist of communities such as Russet cottongrass-white cottongrass (*Eriophorum russeolum-E. scheuchzeri*), cottongrass-buckbean (*Eriophorum* spp.- *Menyanthes trifoliata*), Russet cottongrass-Kellogg's sedge-bluejoint reedgrass (*Eriophorum russeolum-Carex kelloggii-Calamagrostis canadensis*), Russet cottongrass-mud sedge-bluejoint reedgrass (*Eriophorum russeolum-Carex limosa-Calamagrostis canadensis),* mud sedge-creeping sedge (*Carex limosa-C. chordorrhiza*), mud sedge-hair-like sedge (*Carex limosa-C. capillaries*), many-flowered sedge-Russett cottongrass (*Carex pluriflora-Eriophorum russeolum*), Kellogg's sedge-silvery sedge (*Carex kelloggii-C. canescens*), and livid sedge-buckbean (*Carex livida-Meyanthes trifoliata*).

Sedge Wetland-associated Species

Red-necked Grebe, *Podiceps grisegena*
Horned Grebe, *Podiceps auritus*
Dragonflies and damselflies, Odonata
Dragonflies, Suborder Anisoptera
Damselflies, Suborder Zygoptera
Western Toad, *Bufo boreas*
Water fleas - *Daphnia* spp. (Copepoda)
Alaska blackfish, *Dallia pectoralis*
Threespine stickleback, *Gasterostius aculeatus*
Ninespine stickleback, *Pungitius pungitius*

Salt marshes are intertidal wetlands vegetated with sedges (*Carex* spp.), goose-tongue (*Plantago* spp.) and other salt-tolerant plants. The salt marsh ecosystem falls between the mean high watermark and the lower intertidal zone. Alaska has 345,000 acres of salt marsh wetlands (Doyle 1998) and has 33,000 miles of coastline. Yet salt marsh habitat in Alaska represents only two-tenths of one percent of the state's total wetlands, and only 4% of the total vegetated tidal marshes in the United States.

Salt marshes are typically located at river mouths; behind barrier islands, coves, and spits; and on tide flats where low energy wave action and fine sediment deposits provide elevated land for marsh vegetation to establish. They are located at mid to upper intertidal elevations and characterized by salt-tolerant plant communities such as certain types of sedges and grasses. Species composition and distribution patterns of salt marsh vegetation communities can vary distinctly based on differences in elevation, drainage, and soil type. Some of the nation's most extensive complexes of

salt marsh habitat occur along the Alaska coast of the Beaufort Sea, Chukchi Sea, Bering Sea and the Gulf of Alaska (Society of Wetland Scientists 1998).

Common Alaska salt marsh species include hairgrass (*Deschampsia* spp.), and usually Bering hairgrass (*D. beringensis*). Hair grass communities are often found in the coastal areas of southern Alaska, typically in well-drained areas with mesic to dry soil characteristics. Salt-tolerant species of creeping alkali grass (*Puccinellia* spp.) and other halophytic forbs found along coastal marshes statewide include beach sandwort (*Honckenya peploides*), sea arrowgrass (*Triglochin maritimum*), sea plantain or goose-tongue (*Plantago maritima*), saltbush (*Atriplex* spp.), sand spurry (*Spergularia canadensis)* and scurvey grass (*Cochlearia officinalis*). These species are often codominant in their representation (Tande and Lipkin 2003; Viereck et al. 1992; Adam 1990).

Salt marsh, Knik Arm M. LaCroix, DNR

Lyngbye's sedge (*Carex lyngbyaei*) and many-flower sedge (*C. pluriflora*) represent the southern part of the state's coastal marsh habitat. Four-leaf marestail (*Hippuris tetraphylla*) and other salt-tolerant species such as fennel-leaf pondweed (*Potamogeton pectinatus*), ditch grass (*Ruppia spiralis*), or horned pondweed (*Zannichellia palustris*) may be present.

Coastal marshes in the northern part of the state support sedge species such as Ramensk's sedge (*Carex ramenskii*), Hoppner's sedge (*C. subspathacea*) and looseflower alpine sedge (*C. rariflora*).

Salt Marsh-associated Species

Zooplankton:
Copepods:
- *Neocalanus* spp.
- *Calanus* spp.
- *Acartia* spp.
- *Pseudocalanus* spp.
- *Oithona* spp.
- *Metridia* spp.
- *Podon* spp.
- *Evadne* spp.

Chaetognaths: *Sagitta elegans*
Euphausiids
Amphipods
Pteropods
Cladocerans
Cnidarian medusae
Ctenophores
Meroplankton (benthic invertebrate larvae)
Merlin, *Falco columbarius*
Short-eared Owl, *Asio flammeus*
Tule White-fronted Goose, *Anser albifrons gambeli*
Lesser Yellowlegs, *Tringa flavipes*
Solitary Sandpiper, *Tringa solitaria*
Threespine stickleback, *Gasterostius aculeatus*
Ninespine stickleback, *Pungitius pungitius*
Broad whitefish, *Coregonus nasus*
Bering cisco, *Coregonus laurettae*
Pacific sand lance, *Ammodytes hexapterus*
Capelin, *Mallotus villosus*

Ecological Role of Wetlands

Local landscape features, including the hydrology, water quality, vegetation communities, soil features, and invertebrate communities, determine the biogeography of Alaska's wetland-associated species. Species differ in their resource requirements for the completion of life stages as well as in their spatial and temporal patterns of wetland use. Many species use more than one type of wetland habitat due to resource limitations of one that are offered by another.

Wetlands are one of the most productive habitats and are important in preserving the state's biological diversity. Alaska's wetland habitats are heavily used as summer staging and breeding grounds for hundreds and thousands of migratory birds that use all 4 North American flyways to reach their wintering grounds. The expansive and varied wetland habitats of the Copper River Delta (CRD), for example, are of international importance as staging areas for millions of migrating shorebirds. Large wetland areas such as the CRD are extremely valuable because they provide large, whole, and intact complexes. The Lesser Yellowlegs Sandpiper and Solitary Sandpiper eat freshwater aquatic insects, such as diving beetles, dragonfly nymphs, and flies, as well as sand fleas and intertidal amphipods provided by salt marsh wetlands. Waterfowl and waterbirds are wetland-dependent, and many species of songbirds nest and/or feed in wetland habitats. Numerous birds and small mammal species survive on the variety of seeds provided by wetland plants. Raptors and owls often frequent wetlands to forage. For example, species such as the Great Gray Owl search for unsuspecting prey in the clearings of bog habitat. Threespine and ninespine stickleback provide an essential prey source for piscivorous birds such as grebes. Fish use wetland habitat for spawning, rearing, and refugia. In turn, brown bears forage for returning salmon in these same locations. Amphibians breed in wetlands, and many spend their entire lives in wetlands.

Copper River Delta wetland B. McCracken, ADF&G

Damselflies and dragonflies also use wetlands as their breeding and feeding grounds, as well as for cover. They are impressive predators on insects, such as aphids and mosquitoes. The olive-sided flycatcher feeds almost exclusively on flying insects, especially bees, wasps, winged ants, aphids and beetles. Voles are year round meadow residents that eat meadow grasses and seeds. They build distinctive runways crisscrossing through the area. They also dig underground tunnels, where they construct food and nesting chambers. During the winter in snow-covered areas, the voles make runways beneath the snow and feed on the snow-flattened grasses. Voles and other small rodents are the staple foods of weasels, martens, foxes, coyotes, all owls, most hawks, inland breeding gulls, jaegers, and occasionally Great Blue Herons, domestic cats, northern pike, and other voles (Osborn 1994). Blue Grouse forage in bogs for berries and insects. Wetland grasses and sedges provide habitat structure for production of invertebrates, crustaceans, and insect larvae that many species of animals depend on.

Salt marsh habitat provides marine, freshwater and terrestrial species a host of resources that may vary with tidal stage. For some species, access to the salt marsh is essential to a life function, while other species use salt marshes more opportunistically. Salt marsh wetlands provide spawning and nursery habitat for many marine invertebrates and fishes, including forage fish species, such as stickleback, and commercially sought species, such as Dungeness crab and Pacific herring. Salt marsh zooplankton, such as copepods, play an essential role in the food web conversion between phytoplankton and larger animals. Copepods feed on most phytoplankton species and occasionally on the juvenile stages of smaller copepods. Herring and smelt feed on copepods and amphipods provided by the salt marsh. Across the state, salt marshes provide resting habitat for geese, ducks, and shorebirds during migration. Raptors, such as Merlin, search for small mammals seeking refuge in the salt marsh.

Although the salt marsh environment is harsh with regular fluctuations in salinity and water inundation, it provides a constant source of differing foods due to differential decomposition rates of resident plant species. This is an important difference not afforded by habitats having more seasonal availability of resources. Plant and animal species' ecological interaction plays a vital role in the healthy function of all wetland

habitats. For example, wetland fauna facilitate decomposition of organic matter and enhance nutrient regeneration; they also serve as food for a variety of higher trophic levels.

Conservation Status

Alaska's wetland habitat is generally healthy. Localized development will likely continue to result in habitat alteration. Opportunities should be sought that alleviate negative impacts and maintain connectivity, as well as suitable areas of quality habitat important to the sustainability of species.

Threats to Alaska's wetlands include filling and dredging activities that fragment and block hydrologic processes and result in the elimination of and/or degradation of wetland habitat. These impacts are largely associated with transportation corridor construction, utility installation, natural resources extraction, and other development projects that result in wholesale wetland conversion.

Wetlands in Alaska are regulated through a permitting process administered under the Clean Water Act (CWA) by the EPA, through the COE. Pursuant to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act, the COE regulates the placement of fill and certain ground-disturbing activities within jurisdictional wetlands. Under Section 404 any unauthorized discharge of dredged or fill materials from a point source into navigable waters of the United States is prohibited. The specific intent of Congress in implementing Section 404 of the CWA is to address wetland alteration. EPA investigates potential illegal wetlands destruction and permit violations. In addition, Section 301 of the CWA prohibits any person from discharging pollutants from a point source without a permit. The issuance of individual and "nationwide" permits for these activities is subject to public review. If a project in wetlands requires an individual permit and is also located within the state's designated coastal zone, then that project is also subject to a state coastal review. The state's review of federal authorizations is coordinated by DNR's Office of Project Management and Permitting (OPMP). The COE cannot issue an individual permit until the state has itself issued a determination that the proposed project is consistent with the state's own coastal standards (found in 11 Alaska Administrative Code [AAC] 112) and any applicable local coastal district standards (adopted pursuant to 11 AAC 114).

The Alaska Coastal Management Program is predicated upon and made possible by the federal Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451-1465). The CZMA provides funding and regulatory structure for Alaska's program. The purpose of the state's program as articulated by its mission statement is to "provide stewardship for Alaska's rich and diverse coastal resources to ensure a healthy and vibrant Alaskan coast that efficiently sustains long-term economic and environmental productivity." Along the way, it provides the state and local coastal districts with the necessary tools to avoid, minimize, and mitigate for impacts to important and productive coastal resources, such as wetlands.

For federal regulatory and permitting purposes, the COE defines wetlands as “those areas that are inundated or saturated at a frequency and duration sufficient to support, and under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.”

An important conservation action for Alaska’s wetland habitat is to continue the effort of wetland mapping. Although wetlands are the predominant habitat in the state, wetland mapping and inventory status in Alaska is substantially behind efforts elsewhere in the nation. The USFWS National Wetlands Inventory (NWI) has finalized mapping for approximately 35% of Alaska’s wetlands (W. Pearson, USFWS National Wetlands Coordinator, Anchorage, personal communication) (See NWI Region 7 map on page 14 of this appendix). The USFWS is required by Section 401 of the Emergency Wetlands Resources Act of 1986 to report each decade to Congress on the status and trends of the nation’s wetlands. The USFWS published a report in 1994 entitled the *Status of Alaska’s Wetlands* (Hall et al. 1994). This report is currently due for an update. Currently there are no statewide efforts to inventory and monitor the health of the state’s wetland resources in terms of water quality. The USFWS defines wetlands as “lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that are adapted for life in water or in saturated soil.”

The NWI mapping has limitations in that some wetland habitats are excluded from the NWI report including seagrasses or submerged aquatic vegetation found in the intertidal and subtidal zones of estuaries and nearshore coastal waters (i.e., salt marsh). In addition, Alaska’s NWI is conducted at a 1:60,000 scale (G.F. Tande, personal communication); thus, many small yet important wetlands are undetected in the survey. These are important details to note as Alaska looks forward to the assessment of its own wetland resources.

The most recent wetlands status report, entitled *Status and Trends of Wetlands in the Conterminous United States*, covers the timeframe of 1986 to 1997 (Dahl 2000). A 2005 update to this report is scheduled for release by early 2006; however, neither Alaska nor Hawaii are included (G.F. Tande, personal communication). The information presented in this report provides a means to evaluate existing federal programs and policies, identify national or regional wetlands issues, and increase public awareness of and appreciation for wetlands. Alaska’s wetlands losses continue to be unmonitored, and the state’s baseline inventory has yet to be completed. Given the predominance of wetland habitats in Alaska and their value as essential habitat for many species, the completion of the state’s wetland mapping inventory should be considered one of the most important conservation measures for implementation. An Alaska NWI would be instrumental in analyzing government policy, establishing state policy and legislation for the protection of wetland resources, and setting internal guidelines.

In addition to completing the state's wetland mapping inventory, wetland conservation actions should be created for activities such as timber harvesting and road construction, transportation corridors, grazing, development and recreation, agriculture, and mining. To complement the conservation measures, a robust mitigation plan should be developed and implemented for all unavoidable impacts that occur to wetland habitats. The mitigation plan should address 5 basic type of compensatory mitigation, including restoration, creation, enhancement, exchange, and preservation. Land acquisition is a beneficial means to protect wetland areas; however, it does not account for potential net loss of wetland habitat. Landowner incentives to protect wetland habitats should be encouraged.

Best management practices and policies to avoid, minimize, and mitigate for unavoidable impacts to wetland habitats should be implemented at the State and local government planning levels. Alaska's Duck Stamp Program, for example, provides annual funding for wetland acquisition and enhancement projects through the sale of state duck stamps and prints to the public. This program established in state law (AS 16.05.130) directs that money accruing to the state from hunters' waterfowl conservation tag fees may not be diverted to a purpose other than 1) the conservation and enhancement of waterfowl; 2) the acquisition, by lease or otherwise, of wetlands that are important for waterfowl and public use of waterfowl in the state; 3) waterfowl related projects approved by the commissioner; 4) the administration of the waterfowl conservation program, and 5) emergencies in the state as determined by the governor (The Biodiversity Partnership 2003).

Because Alaska's land ownership remains mostly in large blocks of state and federal holdings (approximately 64% federal, 25% state, 0.7% private, and 10% Native corporation; U.S. Department of the Interior 2004), it is conducive to implementing large-scale conservation efforts that minimize wetland loss and avoid disruption of drainage patterns and habitat fragmentation. In addition, best management practices adapted at the local and regional level can be particularly effective in protecting habitats under immediate pressure from developmental impacts.

Government agencies with water rights jurisdiction should strive to set minimum flow rates and levels for streams and lakes that maintain ecologically viable aquatic systems, including wetlands.

Wetland conservation actions that develop a better understanding of wetland-associated functions and the importance of wetlands to fish and wildlife species should include the efforts to identify the state's wetland-dependent species, including the less mobile species, for example, amphibians versus waterfowl. In addition, Alaska's should identify specific wetland habitats required of the associated species and focus on protection and restoration of these wetland types in complexes that account for the spatial requirements of species. Lastly, wetland studies that identify the specific hydrologic and ecologic role(s) of individual wetlands should be conducted.

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