Birds of Minnesota's Boundary Waters Canoe Area and Adjacent Upstream Regions, with Comments on Conservation Implications of New Copper Mining Under Consideration.

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The following account summarizes bird resources of the Boundary Waters Canoe Area (BWCA) and the adjacent mosaic of habitats located in the Superior National Forest (SNF) immediately outside of the BWCA, specifically those regions that are subject to potential on-site or downstream ecological effects of surface and underground mining for copper and other strategic metals. The author is a professional ornithologist and past-president of the American Ornithologists' Union. He also is a native of Minnesota and has extensive personal experience in the region under discussion.

Ornithological Summary

The habitats of the SNF and BWCA are designated as an official Important Bird Area (IBA) by the National Audubon Society, and are widely recognized as the premier wilderness area in the United States east of the Rocky Mountains. By certain measures, this is the most heavily visited wilderness areas in the U. S., and it is a very well known and popularly visited region among bird enthusiasts worldwide. The ecological setting is in the Laurentian Mixed Forest province, a unique transition zone between the great boreal forests, largely distributed in Canada, and the mixed deciduous forests of the eastern United States. This landscape is a mosaic consisting mainly of eight basic forest communities varying from upland pine and aspen-birch types to lowland conifer and open shrublands and bogs. The region is world famous for its water resources and wetland-associated habitats, including lakes, small ponds, cold water streams, warm water streams, bogs, and beaver meadows.

Because it is a mosaic of habitat types, this region hosts an extraordinarily diverse mixture of forest-inhabiting bird species, as well as dozens of species that depend on the world-famous lakes and wetland habitats characteristic of the southern boreal zone. Some 225 bird species regularly occur in the Superior National Forest (Green 2006), of which 163 species are documented as breeding species within the BWCA and surrounding areas. *This diversity constitutes 74% of Minnesota's list of regularly breeding bird species.* More than 60 additional species regularly depend on the BWCA region as stop-over sites for foraging and roosting during spring and/or autumn migration. Scientists and birders also have documented 51 species as "casual" (i.e., occasionally encountered, but not every year) and 36 as "accidental" (i.e., single occurrences only, since 1990).

Ornithological and Conservation Highlights

Watch List Species of Continental Concern

North America's two premier bird conservation consortia -- Partners in Flight (PIF) and the North American Bird Conservation Initiative (NABCI) -- have identified a total of 86 bird species that are of significant "continental concern" on their *Watch List for Continental United States and Canada* (Rosenberg et al. 2014). These are species of highest conservation priority, because of downward population trends, small population sizes, narrowly restricted habitat, or combinations thereof. Some of these species also are recognized as federally Threatened or Endangered in the U.S. and Canada, and all are showing significant population vulnerability. The Watch List fosters proactive conservation intended to help recover populations of the most at-risk species, and to keep the remaining species from reaching endangered status.

The BWCA region hosts 13 of these 86 highest-priority Watch List species. For all these species, every possible effort to conserve or restore their highest-quality habitats is essential for conservation of the species. Therefore, maintaining the pristine condition of all BWCA regional habitats represents a vital contribution to their long-term conservation. The 13 Watch List species found in the BWCA are:

Snowy Owl
Long-eared Owl
Eastern Whip-poor-will
Red-headed Woodpecker
Olive-sided Flycatcher
Wood Thrush
Golden-winged Warbler
Connecticut Warbler
Cape May Warbler
Canada Warbler
Harris's Sparrow
Rusty Blackbird
Evening Grosbeak

Species of Stewardship Priority for Minnesota

The dominance of coniferous forest, mixed conifer-aspen, black spruce, tamarack and white cedar swamps, and spruce bogs of the BWCA make this zone extraordinarily important within the context of birds and birding in Minnesota. The region supports from 25% to 100% of the Minnesota populations of a number of boreal-zone species, and for some of these the Minnesota populations constitute a significant proportion of their representation within the coterminous United States. Most such species are designated as "Stewardship Priorities for Minnesota" by PIF. In addition, the U. S. Forest Service designates certain species as "Regional Forester Sensitive Species (RFSS)." Species in these two prioritization categories, that are not already listed above and are noteworthy for being typical of BWCA habitats, are listed here:

American Black Duck
Spruce Grouse
Sharp-tailed Grouse

American Woodcock
Bald Eagle
Northern Goshawk
Great Gray Owl
Boreal Owl
Black-backed Woodpecker
American Three-toed Woodpecker
Yellow-bellied Flycatcher*
Philadelphia Vireo
Gray Jay
Boreal Chickadee
Winter Wren
Bohemian Waxwing
Palm Warbler
Bay-breasted Warbler
Black-throated Blue Warbler
Mourning Warbler
Pine Grosbeak
White-winged Crossbill

Wood Warbler Diversity

The BWCA is unusual among North American ecosystems in supporting an astonishing 24 species of wood warblers (family Parulidae) as breeders. This number represents two-thirds of all the warbler species that breed east of the Great Plains, and represents the highest diversity of breeding wood warblers anywhere in the world. Like the preceding category, this robust diversity of warbler species provides one of the signature features attracting birders from around the world to spend time in this region during spring and summer months.

Of particular importance on this list is one species, the Connecticut Warbler, which has a very limited breeding range and is regarded among the most iconic species of the greater BWCA region. This species is especially sensitive to water-quality issues in poorly drained areas, as it breeds mainly in nutrient poor black spruce and tamarack bogs, and wet second-growth and grassy margins along spruce forests or jack pine barrens, where the undergrowth and ground cover are composed of sphagnum mosses, alder, dogwood, Labrador tea, bog rosemary, bog laurel, and leatherleaf. This species is severely declining across its entire range, and in the Superior National Forest its population experienced a deeply alarming *7.4% annual decline* between 1995 and 2016 (Bednar et al. 2016).

The full wood warbler list for the region:

Ovenbird
Northern Waterthrush
Golden-winged Warbler
Black-and-white Warbler

Tennessee Warbler
Nashville Warbler
Connecticut Warbler
Mourning Warbler
Common Yellowthroat
American Redstart
Cape May Warbler
Northern Parula
Magnolia Warbler
Bay-breasted Warbler
Blackburnian Warbler
Yellow Warbler
Chestnut-sided Warbler
Black-throated Blue Warbler
Palm Warbler
Pine Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Canada Warbler
Wilson's Warbler

Birds of Lakes, Rivers, and Wetlands

The abundant freshwater resources throughout the BWCA region provide superb environmental conditions supporting 31 species of birds that depend on aquatic habitats for breeding. An additional 68 species pass through the region and use these habitats as migrants or winter visitors. Clearly, with nearly 100 bird species depending on its aquatic habitats, the still-pristine water quality across the BWCA region represents a crucial resource that merits utmost respect and careful protection. Any sort of degradation of these water resources – whether from acidification, heavy metal or other chemical pollution, nutrient loading, shoreline erosion, siltation, or other alterations and contaminations associated with mining activities – are likely to have drastic negative consequences on the populations, physiological conditions, and chemical accumulations of the fish, invertebrates, and plants that supply essential food for water birds. The 28 species of water birds that breed in the BWCA region are:

Canada Goose
Trumpeter Swan
Wood Duck
American Black Duck
Blue-winged Teal
Green-winged Teal
Ring-necked Duck
Common Goldeneye
Hooded Merganser
Common Merganser
Red-breasted Merganser

Common Loon
Pied-billed Grebe
Double-crested Cormorant
American Bittern
Great Blue Heron
Virginia Rail
Sora
Sandhill Crane
Killdeer
Spotted Sandpiper
Solitary Sandpiper
Wilson's Snipe
American Woodcock
Wilson's Phalarope
Ring-billed Gull
Herring Gull
Sedge Wren
Marsh Wren
Palm Warbler
Connecticut Warbler

Common Loon – Iconic State Bird and Bio-indicator of Freshwater Systems

No discussion of avian resources and conservation issues in the BWCA region would be complete without reference to the Common Loon, surely among the most iconic of State Birds across the United States and Canada. Because of its top trophic-level position, limited dispersal abilities, and relatively low reproductive output, this species has been long-recognized as a crucial biological indicator of water quality and aquatic ecosystem integrity across the boreal zone (Evers 2006). The species therefore bears special emphasis in relation to potential impacts on water quality from mining activities in the BWCA region. Indeed, recent population trends suggest the need for extreme caution: between 1995 and 2016, the Common Loon population of the Superior National Forest experienced an alarming 4.2% annual decline (Bednar et al. 2016). This trend suggests extreme sensitivity to changes in water quality and/or prey abundance, and research across the species' range bears this out.

As an apex predator on freshwater fish, Common Loons are highly susceptible to bioaccumulation of heavy metal toxins such as mercury and lead, the negative effects of which are documented by an enormous body of literature (reviewed by Evers et al. 2010). Of particular concern with respect to the possible effects of increases in methylmercury (MeHg) stemming from mining operations, numerous studies have shown that increased mercury concentrations in the tissues of loons produce strong negative effects on their physiology, feather symmetry, behavior during the breeding season, and reproductive success (e.g., Evers et al. 2008).

Negative effects of anthropogenic increases in lake acidity on prey densities and loon reproductive success are also well documented (e.g., McNicol et al 1995). Moreover, it bears

emphasis that acidification may itself increase the vulnerability of loons to mercury contamination, as acidification increases net MeHg production, making it more available for assimilation by aquatic organisms, leading to bioaccumulation up the food chain. Loon chick with even modestly elevated blood mercury levels had lower survival rates on lakes with pH <6.3 (Meyer et al. 1995). Decreased food intake by loon chicks on these lakes has been documented (Merrill et al. 2005), although it is unclear whether these were caused by mercury-induced behavioral or physiological impacts, or by ecological disruptions in the prey community, or both. Regardless, it is clear that even marginal levels of acidification and mercury methylization downstream from mining operations could substantially impair Common Loon populations, posing a major threat to the signature bird of the BWCA and the State of Minnesota. It is reasonable to conclude that similar impacts could affect the larger community of fish-eating bird species that today rely on the pristine aquatic communities of this region.

Conclusions

Bird species diversity in the BWCA and adjacent regions represent a signature resource for the State of Minnesota and the National Forest system, attracting visitors from around the world. The community includes dozens of species that are recognized by numerous sources as being of conservation concern. The currently unfragmented condition of this region's forest habitats -- and especially the pristine condition of its waters – represent a precious resource of utmost importance to bird populations on a global scale.

Little doubt exists that introduction of significant mining activities in the region will have adverse and potentially compounding impacts on the condition of the natural communities, aquatic resources, and bird communities that use them. Of particular concern is the potential for significant alteration of the otherwise nearly-pristine water resources in the region. Mining activities across northern North America are known to cause downstream effects such as acidification, mercury methylization and other forms of heavy metal contamination, nutrient loading, shoreline erosion, and siltation. These impacts cannot help but have drastic negative consequences on the populations, physiological conditions, and chemical bioaccumulations within the fish, invertebrates, and plants that supply essential food for essentially every species of bird that uses this region.

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