Overview of Recent Research:
Effects of Global Warming on the Great Lakes

A FACTSHEET OF THE NATIONAL WILDLIFE FEDERATION'S GLOBAL WARMING CAMPAIGN

# Wildlife and Fisheries

## Declining Moose Populations in Minnesota

In a recent study of moose (*Alces alces andersoni*) at the southern edge of their range in northwest Minnesota, researchers found that over the past 40 years, declines in population growth are related to increases in mean summer temperature with winter and summer temperatures increasing by an average of 12 and 4°F (6.8 and 2.1°C), respectively over this period. Lack of food resources and increased exposure to deer parasites associated with warmer summer temperatures appear to be the primary cause of their decline. The authors suggest that the northwest Minnesota moose population likely would not persist over the next 50 years and that the southern distribution of moose may become restricted in areas where climate and habitat conditions are marginal, especially where deer are abundant and act as reservoir hosts for parasites.

*Murray, DL. et al, 2006. Pathogens, nutritional deficiency, and climate influences on a declining moose population. Wildlife Monographs 166:1-29.*

Photo: FWS, Ronald L. Bell

## Duck Populations and Prairie Potholes

Researchers projected future pond and duck numbers in the Prairie Potholes Region based on expected global warming-induced changes in air temperature and precipitation. Increased temperature scenarios resulted in increased drought conditions and declining numbers of both wetlands and ducks. Over the next 50 years, the breeding duck populations that use the Potholes region could fluctuate around means of 2.1 or 2.7 million ducks, about half of the current long-term mean of 5.0 million; while the number of ponds in May would drop from 1.3 million to 600-800,000.

*Sorenson, LG et al, 1998. Potential effects of global warming on waterfowl populations breeding in the Northern Great Plains. Climatic Change 40(2): 343-369.*

## Physical Changes to Lakes Will Impact Aquatic Organisms

In future scenarios for a doubled CO2 climate, researchers projected significant changes to characteristics of the Great Lakes. Physical changes, such as decreases in water level (0.65-8.2 ft or 0.2-2.5 m) and ice cover, and increases in water temperature 2-12°F (or 1-7°C) at surface, up to 14°F or 8°C at depth) will in turn affect phytoplankton, zooplankton and fishes. Some warm-water fish species could move north by 300-400 miles (500-600 km); invasions of warmer water fishes and disappearances of colder water fishes should increase. Climate change effects interact strongly with effects of other human-caused stresses such as eutrophication, acid precipitation, toxic chemicals and the spread of exotic organisms.

*Magnuson JJ et al, 1997. Potential effects of climate changes on aquatic systems: Laurentian Great Lakes and Precambrian Shield Region. Hydrological Processes 11(8): 825-71.*

## Disappearing Cold-Water Fish Species

Scientists projected changes to the distribution of fish species under a 2x$CO_2$ climate scenario at 209 locations in the contiguous United States. Cold-water fish habitat is projected to persist in deep lakes near the northern border of the United States, but is likely to be eliminated from most shallow lakes in the contiguous states, reducing the number of lakes that have suitable coldwater and cool-water fish habitat by up to 45% and 30%, respectively. On the other hand, warm-water fish habitat is likely to increase. Good-growth periods are projected to increase on average by 37 days for cool-water fishes and by 40 days for warm-water fishes.

*Stefan, H.G. et al. 2001. Simulated fish habitat changes in North American lakes in response to projected climate warming. Transactions of the American Fisheries Society, 130(3): 459-477.*

## Potential Changes to Fish Populations

Researchers used historical data to predict how growth of warm-water (e.g. smallmouth bass and yellow perch) and cold-water (e.g. lake trout) fish species may change under changing climatic conditions. In years with warmer air temperatures and early on-set of warm surface waters, smallmouth bass and yellow perch grew bigger and faster than normal. Lake trout growth was poorer likely due to early on-set of water stratification –trout fry had fewer days to feed on prey species in surface waters due to rapid warming.

*King, JR et al 1999. Empirical links between thermal habitat, fish growth, and climate change. Transactions of the American Fisheries Society 128(4): 656-665.*


## Yellow-Headed Blackbirds

Researchers found that during a dry period in the Prairie Pothole region in Iowa, yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), which solely breed in wetlands, nested later and laid fewer eggs, in part due to lack of food. Far fewer chicks hatched and fledged during these years primarily due to nest predation – more predators found and fed on more eggs and chicks during years with low water levels.

*Fletcher, RJ and Koford, RR, 2004. Consequences of rainfall variation for breeding wetland blackbirds. Canadian Journal of Zoology 82(8): 1316-1325.*

## Zebra Mussels Respond Favorably to Warmer Waters

Growth and survival of zebra mussels (*Dreissena polymorpha*) in southwestern Lake Erie and the Ohio River (KY) were studied in different water temperatures (within expected range of temperature increase for lakes of 3-7$^{o}$F or 2-4$^{o}$C). Experimental increases in temperature significantly enhanced growth rates in fall and early winter and increased mortality in the summer-fall season. Based on these experiments and related laboratory studies, the authors predicted northern populations of zebra mussels will probably benefit from predicted climatic change and may extend their range to higher latitudes and altitudes.

*Thorp, JH et al. 1998. Responses of Ohio River and Lake Erie dreissenid molluscs to changes in temperature and turbidity. Canadian Journal of Fisheries and Aquatic Sciences 55(1): 220-229.*

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