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NOTE

Evidence of Widespread Natural Reproduction by Lake Trout *Salvelinus namaycush* in the Michigan Waters of Lake Huron

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ABSTRACT. *Localized natural reproduction of lake trout* Salvelinus namaycush *in Lake Huron has occurred since the 1980s near Thunder Bay, Michigan. During 2004–2006, USGS spring and fall bottom trawl surveys captured 63 wild juvenile lake trout at depths ranging from 37–73 m at four of five ports in the Michigan waters of the main basin of Lake Huron, more than five times the total number captured in the previous 30-year history of the surveys. Relatively high catches of wild juvenile lake trout in bottom trawls during 2004–2006 suggest that natural reproduction by lake trout has increased and occurred throughout the Michigan waters of the main basin. Increased catches of wild juvenile lake trout in the USGS fall bottom trawl survey were coincident with a drastic decline in alewife abundance, but data were insufficient to determine what mechanism may be responsible for increased natural reproduction by lake trout. We recommend further monitoring of juvenile lake trout abundance and research into early life history of lake trout in Lake Huron.*

INDEX WORDS: *Lake trout, spawning, natural reproduction, Lake Huron, Great Lakes, fish management.*

INTRODUCTION

Lake trout *Salvelinus namaycush* populations in Lake Huron collapsed in the 1940s, primarily due to overfishing and sea lamprey predation, and efforts to restore these populations have been undertaken since the 1970s (Eshenroder *et al.* 1995, Krueger and Ebener 2004). Despite widespread stocking and seal lamprey control, however, there has been little evidence of natural recruitment of lake trout in the main basin (Eshenroder *et al.* 1995), although some recruitment has occurred in areas of Georgian Bay and the lake trout population in Parry Sound (Ontario) has been considered restored since 1997 (Reid *et al.* 2001). The restoration of lake trout populations in the Great Lakes remains an important priority in Great Lakes fisheries management (Eshenroder *et al.* 1999, Krueger and Ebener 2004).

Naturally produced juvenile lake trout have been captured in Lake Huron since the early 1980s near Thunder Bay, Michigan (Nester and Poe 1984, Johnson and Van Amberg 1995) and since 1994 on offshore reefs (DeSorcie and Bowen 2003). Although naturally produced eggs or fry have been noted in all of the Great Lakes since the 1980s (Jude *et al.* 1981, Marsden *et al.* 1988, Hansen *et al.* 1995, Fitzsimons and Williston 2000, Jonas *et al.* 2005), little evidence of sustained recruitment to older age classes exists outside of Lake Superior.

A number of potential impediments may prevent the reestablishment of widespread natural reproduc-

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tion of lake trout in the Great Lakes, including low spawning habitat availability and quality (Krueger *et al*. 1995b), predation of eggs and juveniles (Krueger *et al.* 1995a, Savino *et al.* 1999, Jonas *et al.* 2005), contaminants (Zint *et al.* 1995), and thiamine deficiency of spawning adults (McDonald *et al.* 1998). Here we present the first evidence, based on data collected by the U. S. Geological Survey (USGS) and the Michigan Department of Natural Resources (MDNR), that natural reproduction of lake trout has occurred throughout the Michigan waters of Lake Huron.

METHODS

USGS Bottom Trawling

The USGS Great Lakes Science Center has monitored fish abundance annually from 1973–2005 using 12 m (1973–1991) and 21 m (1992–2006) headrope bottom trawls at a set of fixed transects at up to eleven depth strata (9, 18, 27, 36, 46, 55, 64, 73, 82, 92, and 110 m) at five ports (Detour, Hammond Bay, Thunder Bay, Au Sable Point, and Harbor Beach) in the Michigan waters of Lake Huron (Fig. 1). Trawls were fished from the R/V *Kaho* during 1973–1977, and from the R/V *Grayling* during 1978–2005, with the exception of 1990, when some transects were fished from the R/V *Cisco*. Fall trawl surveys on Lake Huron were completed annually between 3 October and 15 November, except in 1992 and 1993, when surveys were completed in September; the fall survey was not conducted in 2000 due to mechanical problems. Spring trawl surveys were conducted between 20 April and 25 May in 1973–1985, 1987, 1998–2002, and 2004–2006.

On-contour trawl tows were conducted for 10 minutes during daylight hours at each transect each year. Tow duration was occasionally less than 10 minutes; catch was corrected to be equivalent to 10 minute tows in these cases. Although the surveys were primarily designed to provide annual estimates of prey fish abundance, all lake trout captured were routinely measured (total length to the nearest mm), weighed (nearest gram), and inspected for fin clips. The catch of unclipped juvenile lake trout less than or equal to 120 mm in length was expressed as the mean catch per tow for all tows conducted each year. Although two different trawls were used for the survey, catch rates of juvenile lake trout were too low to develop a correction for catches in the different nets, and catches were not corrected.

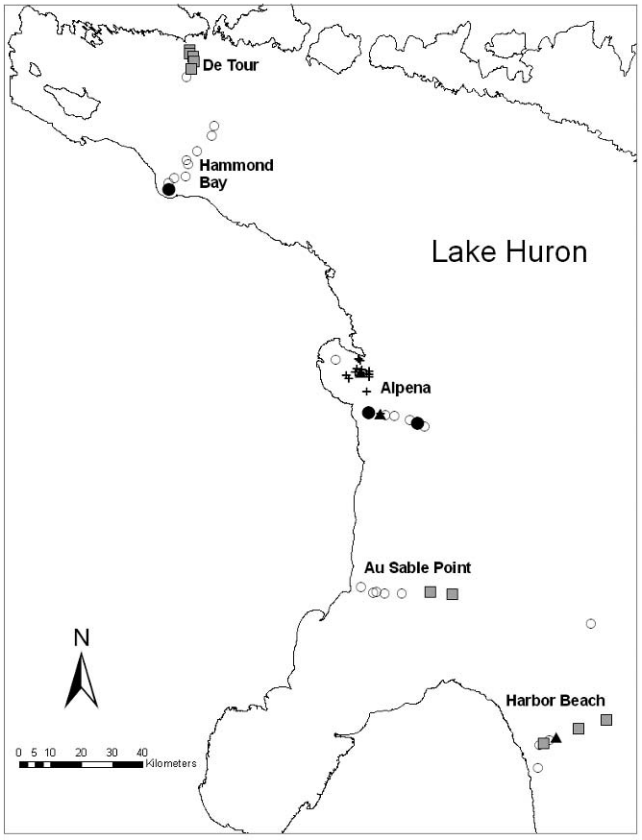

FIG. 1. Locations of sampling sites for USGS spring and fall bottom trawl surveys and MDNR summer trawl surveys in Lake Huron. Symbols show locations where wild juvenile lake trout were caught in USGS trawls prior to 2004 (solid circles), during 2004–2006 (shaded squares), and during both periods (solid triangles). Hollow circles indicate USGS trawl locations where wild juvenile lake trout have never been captured. Crosses indicate the locations of MDNR trawls in Thunder Bay.

We used 120 mm as a length cut-off to ensure that lake trout were wild, as the majority of hatchery-reared lake trout are stocked at sizes larger than 120 mm. For simplicity, we refer to naturally-produced juvenile lake trout as "wild," although they may be the progeny of hatchery-reared adults. All lake trout that are stocked in the Michigan waters of Lake Huron have a fin clipped (the specific fin varies from year to year) to allow identification of stocked fish (Ebener 1998). The clipping efficiency in lake trout hatcheries has averaged approximately 94 percent (Bronte *et al.* 2007), which means that