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Designing long-term fish community assessments in connecting channels: Lessons from the Saint Marys River

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ABSTRACT

Long-term surveys are useful in understanding trends in connecting channel fish communities; a gill net assessment in the Saint Marys River performed periodically since 1975 is the most comprehensive connecting channels sampling program within the Laurentian Great Lakes. We assessed efficiency of that survey, with intent to inform development of assessments at other connecting channels. We evaluated trends in community composition, effort versus estimates of species richness, ability to detect abundance changes for four species, and effects of subsampling yellow perch catches on size and age-structure metrics. Efficiency analysis revealed low power to detect changes in species abundance, whereas reduced effort could be considered to index species richness. Subsampling simulations indicated that subsampling would have allowed reliable estimates of yellow perch (*Perca flavescens*) population structure, while greatly reducing the number of fish that were assigned ages. Analyses of statistical power and efficiency of current sampling protocols are useful for managers collecting and using these types of data as well as for the development of new monitoring programs. Our approach provides insight into whether survey goals and objectives were being attained and can help evaluate ability of surveys to answer novel questions that arise as management strategies are refined.

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Introduction

Long-term surveys are an essential component of fisheries management in the Laurentian Great Lakes that allow examination of temporal changes in fish communities and exploration of mechanisms underlying observed changes. The availability of multi-decade annual surveys has been an asset for documenting a variety of responses ranging from community change via biological invasion (e.g., Bunnell et al., 2006; Riley et al., 2008) to trends in physiological condition (e.g., Madenjian et al., 2000). Long-term data have also been used to develop predictive models of year class strength (e.g., Kocovsky et al., 2010), determine prey availability for stocked piscivores (e.g., Rand et al., 1993), and as inputs for setting harvest quotas (e.g., WTG, 2012). While long-term data have proven useful throughout the Great Lakes, nearly all standardized monitoring programs have focused on lacustrine components of the system with data from connecting channels being comparatively scarce.

The connecting channels of the Laurentian Great Lakes include the Saint Marys River (SMR), Saint Clair and Detroit River System (SCDRS), the Niagara River (NIA), and the Saint Lawrence River (SLR). These connecting channels are among the world's largest rivers, with all annual mean discharges exceeding 2100 m^3/s and represent either between-lake connections (SMR, SCDRS, NIA) or outflow to the Atlantic Ocean (SLR). Connecting channels are recruitment sources for multiple lake-dwelling species (e.g., Roseman et al., 2007) and are centers of biological diversity (Edwards et al., 1989; Pratt and O'Connor, 2011). Surprisingly, little long-term monitoring has occurred within connecting channels in comparison to the lakes-proper, despite their perceived importance to ecosystem function. To date, only the SMR has received spatially broad (river-wide) monitoring of adult fish populations with periodic gill net surveys that occurred about once every six years during 1975–2009 or periodic creel surveys (1999–2001, 2005–2009) (Greenwood et al., 2011; Schaeffer et al., 2011). The Great Lakes ecosystem depends partially on the health of connecting channels (Great

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Lakes Restoration Initiative, 2010), and thus, increased monitoring in connecting channels is desirable. The SMR time series provides an opportunity to assess the efficiency of the most comprehensive connecting channels sampling program within the basin for informing the design of long-term monitoring programs at other connecting channels.

The SMR typifies the challenges of conducting long-term assessments in connecting channels. The SMR flows for 112 km between Lakes Superior and Huron and is comprised of lotic, lentic, and wetland habitat complexes throughout the system (Ripley et al., 2011). Along the river's continuum, there are a series of natural lakes and embayments that provide distinct and unique habitats. Due to river length and habitat heterogeneity, the initial sampling during 1975 resulted in the establishment of 32 fixed-site gill net stations to provide broad spatial coverage and encompass available habitats (Gebhardt et al., 2002). Subsequent surveys followed the original design, but the survey was broadened to 45 sites in 1995 using a multi-agency approach (Fielder, 2002, Fig. 1). All surveys provided species composition, size structure, and relative abundance data. From 1995 forward, age structures were collected from several target species (i.e., angler-preferred), most notably walleye and yellow perch. In addition, angler creel surveys were conducted during most years after 1999 (Greenwood et al., 2011).

The SMR gill net survey was initiated to provide a broad community assessment for a region about which little was known (Schorfhaar, 1975). As the survey was repeated, it became to be considered a core component of a larger fish community assessment and a desirable source for stock assessment data (Gebhardt et al., 2002). The evolution and expansion of SMR monitoring ultimately resulted in insufficient resources (i.e., time and funding) to successfully complete both gill net and creel surveys within the same year. During 2006, the only year when both surveys were performed, Schaeffer et al. (2011) reported that there were substantial inconsistencies between the two surveys for northern pike (*Esox lucius*) and cisco (*Coregonus artedii*). Furthermore, gill net survey frequency gaps were large enough (i.e., up to 8 years) to allow individual year classes for some species to pass through the population without detection. While the SMR gill net survey has followed standard protocols and not experienced serious changes (e.g., shifts in gill net materials), it has been confronted with a new dilemma: can the historical survey effort meet current resource management's data needs, and could the design be modified to meet those needs with less effort? We examined survey data collected between 1975 and 2009 to answer these questions.

Methods

Gill net survey

We analyzed data from seven gill net surveys performed during August, 1975–2009. Surveys occurred about every six years and occurred in 1975 (32 net sets), 1979 (32 net sets), 1987 (27 net sets), 1995 (53 net sets), 2002 (44 net sets), 2006 (34 net sets), and 2009 (43 net sets). Gill net sites spanned the system from above Sault Ste. Marie to the head of the outflow into Lake Huron near Drummond Island (Fig. 1). The most recent collection (2009) followed methods established in earlier surveys to allow complete temporal comparability

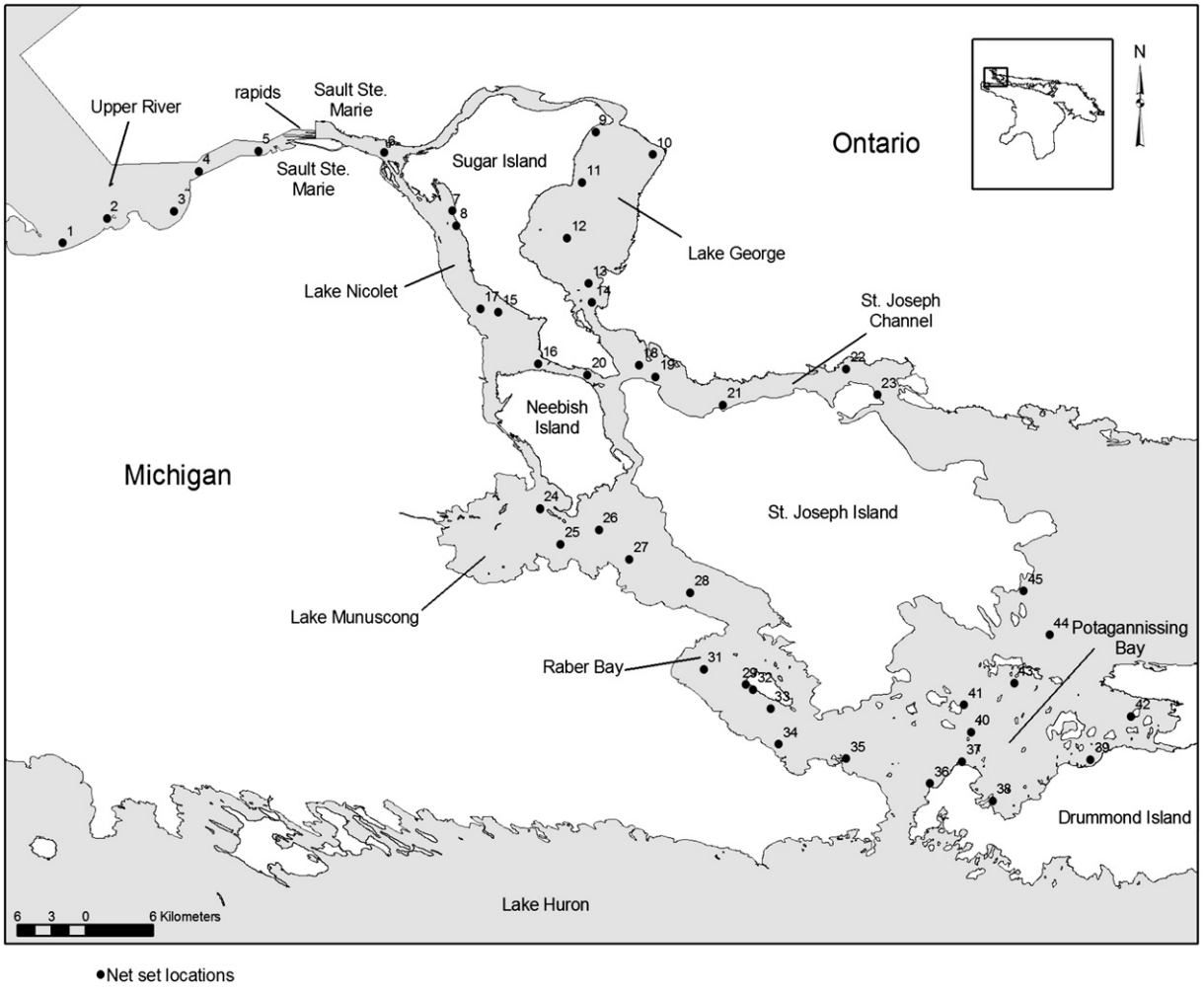

Fig. 1. Saint Marys River and location of gillnet sets made in August 2009. Surveys from previous years spanned either the same sites or sites within these locations.