American Eel Sampling in Lake Champlain
2012 Progress Report

Introduction

American eel *Anguilla rostrata* support important commercial fisheries where populations remain at harvestable levels. However, downward trends in harvest data have raised concern for the population of eel in the United States and Canada. Organizations such as the Great Lakes Fishery Commission and the Atlantic States Marine Fisheries Commission have identified the eel as a high research priority and/or have prepared management plans for the species.

The Richelieu River connects northern Lake Champlain to the St. Lawrence River and supported a commercial eel fishery until it was closed in 1998 because harvest dramatically declined. The rebuilding of two dams on the river has been partly to blame for the decline (Verdon et al. 2003). The Dams at Saint-Ours, Québec and Chambly, Québec were refurbished in the mid-1960s. Evidence of these dams' impacts on eel recruitment to Lake Champlain can be seen in eel surveys in 1979 and 1985. Mark-recapture studies conducted in three Lake Champlain bays, Paradise Bay, Keelers Bay and Converse Bay indicated a decline in estimated population size (Labar and Facey 1983, Labar 1987) and an increase in average size of eel caught, reflecting an aging population that has not been sufficiently supplemented by recruits. Total catch in Paradise Bay declined from 85 eels captured in 1979 to 50 in 1985. Keeler Bay eel catch dropped from 146 eels captured to 81eels; and Converse Bay catch dropped from 138 to 78 eels.

In 1997 an eel ladder was constructed at the dam in Chambly and in 2001 a fish ladder and an eel ladder were built at St Ours. Faune Québec, in cooperation with a commercial fishermen union and Hydro- Québec, initiated a ten-year eel stocking program in 2005 in the Richelieu River to further enhance eel recruitment. From 2005 to 2008 an average of about 692,000 elvers (circa 50-60 mm TL) were transferred annually from the Atlantic Coast (Nova Scotia, Canada) to the Richelieu River (Table 1), where they were scatter stocked during the daytime in the first 15 km of the river, between Saint-Paul-de-l'Ile-aux-Noix and the Canada-US border.

In order to monitor the success of these stocking efforts and new passage facilities, Québec asked the United States Fish and Wildlife Service's Lake Champlain Fish and Wildlife Resources Office in Essex Junction, Vermont for assistance by repeating the Lake Champlain surveys. The Service conducted eel surveys in 2007, 2010 and 2012. This report presents the findings of the 2012 sampling efforts.

Study Area

Lake Champlain (1,140 km^2) borders New York and Vermont and extends into Québec (Figure 1). Keeler and Paradise Bays are situated on the eastern side of South Hero, Vermont in what is described as the Northeast Arm of the lake. Converse Bay is located further south on the lake in the town of Charlotte/Ferrisburg. All the bays varied in substrate from mud with vegetation to bear rock. In addition to the bays, the shoreline along Grand Isle, Vermont was also sampled.

Methods

Electro-fishing was conducted by boat with a pulsed direct current of ~2.5 amps. Sampling was conducted after dark when eels were presumed to be most active. Sampling transects were electronically recorded using a global positioning unit and followed the shoreline generally staying in less than 2 meters depth. An effort of one hour was selected as the sampling time which covered approximately 2 kilometers of shoreline. Collected eels were anesthetized, measured, weighed and checked for presence of a passive integrated transponder tag.

In addition, researches from Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences participated in the sampling. They were interested in comparing their work on Lake Ontario with Lake Champlain sampling. To make this possible our methods were therefore modified such that the hour-long transect was divided into 5 minute segments (~100 meters in length). After each segment, eels collected were processed.

Results/Discussion

Eel sampling occurred on the nights of July 10 (Converse Bay), July 11 (Grand Isle) and August 16 (Paradise and Keeler Bay) in 2012 (Figures 2, 3 and 4). Greater numbers of eels were collected or observed at each location relative to sampling in 2010 (Table 2). While only one eel was collected in Keeler Bay, 13 additional eels were observed. Similarly in Paradise Bay, 2 eel were collected but 4 eels were observed. The greatest increase in number of eels encountered was in Converse Bay where 57 and 98 eels were collected and observed, respectively. An increase in eels along Grand Isle shoreline was also reported.

Eels collected ranged in size from 232 millimeters (mm) to 638 mm. Mean length was 430 mm (SD = 87) and mean weight was 164 grams (SD = 108). In 2010, mean length was similar at 458 mm (SD = 83) and mean weight was 208 g (SD = 131). Many smaller eels were observed but not netted. Figure 5 compares length frequencies for the two sampling years.

It would appear that recruitment of eels to the main lake portion of Lake Champlain has been good. However, movement of eel into the Northeast Arm (Keeler and Paradise

Bay) has been less successful. The Northeast Arm is somewhat isolated from the main lake by highway and old railroad causeways. Access into the Northeast Arm is limited to small openings in these causeways that allow boat traffic to pass. It would be expected that recruitment into this portion of the lake would be less rapid than the main lake.

While the main lake sampling has shown some promising results, other sampling unrelated to these efforts has also shown an expansion of eel abundance. The Vermont Department of Fish and Wildlife surveys bass populations in lower Lake Champlain (Bridport, Vermont to West Haven, Vermont). In 2013, eels were too numerous to process as this hindered the bass sampling (Shawn Good, Vermont Department of Fish and Wildlife, personal communication).

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References

Labar, G. W. 1987. Changes in population structure of American eels, Anguilla rostrata, in Lake Champlain, Vermont, U.S.A., after initiation of a commercial fishery. Presented at the 1987 meeting of the European Inland Fisheries Advisory Council Working Party on Eel, Bristol, England, 12-16 April, 1987.

Labar, G. W., and D. E. Facey. 1983. Local movements and inshore population sizes of American eels in Lake Champlain, Vermont. Transactions of the American Fisheries Society 112:114-116.

Verdon, R., D. Desrochers, and P. Dumont. 2003. Recruitment of American eels in the Richelieu River and Lake Champlain: Provision of upstream passage as a regional-scale solution to a large-scale problem. American Fisheries Society Symposium 33: 125-138.

Table 1. Summary of American eel stocking in the upper Richelieu River.

Year	Number of glass eels
2005	600,000
2006	1,000,000
2007	425,500
2008	746,000
2009	0
2010	0

Table 2. Comparison of American eel sampling efforts in Lake Champlain.

Year	Number of eels collected (observed but not collected)			
	Keeler Bay	Paradise Bay	Converse Bay	Grand Isle shoreline
2007	0	0	0	1
2010	1	1(1)	25(17)	14 (3-5)
2012	1 (13)	2 (4)	57 (98)	21 (12)

Figure 1. Map of Lake Champlain showing sampling areas.

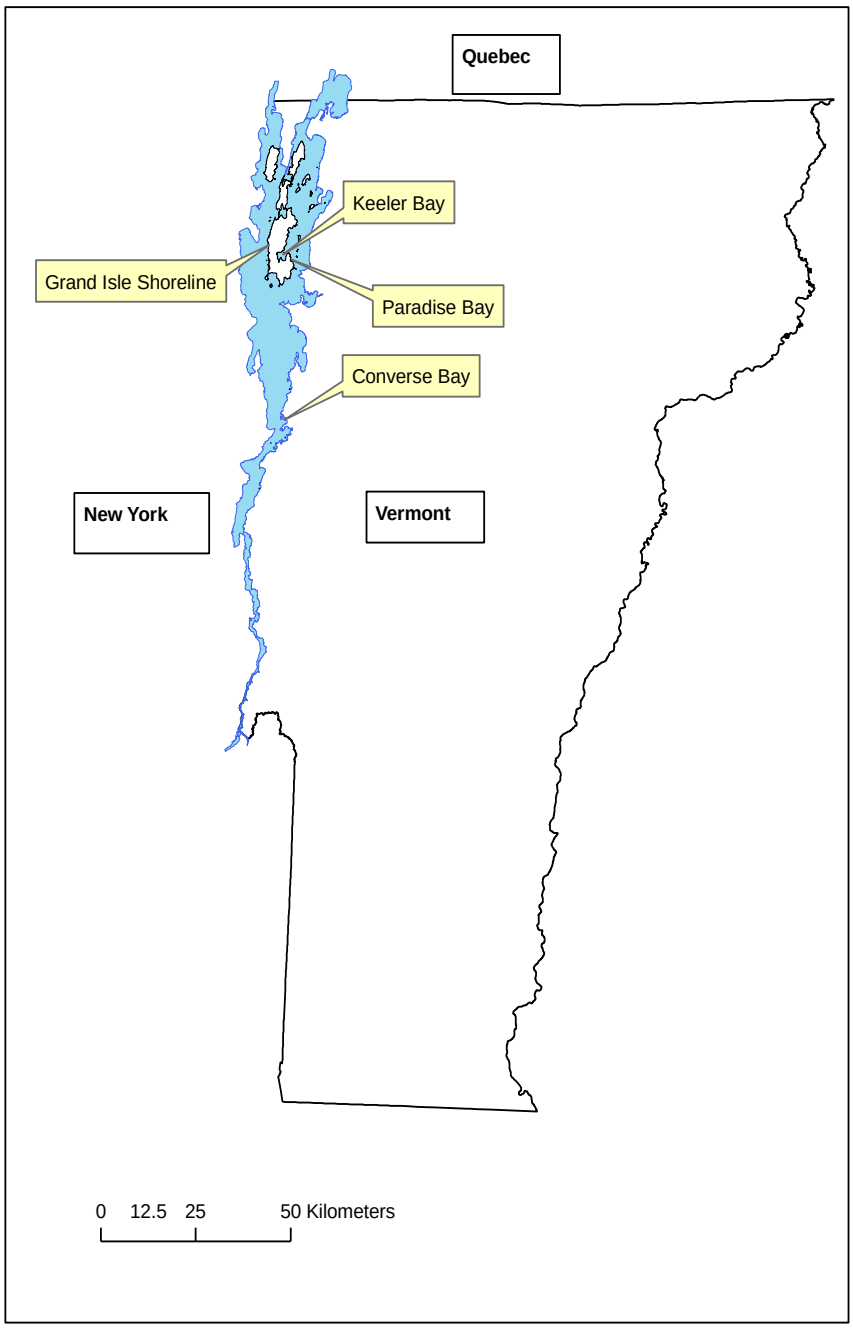

Figure 2. Map of Keeler and Paradise Bay showing electro-fishing transects.

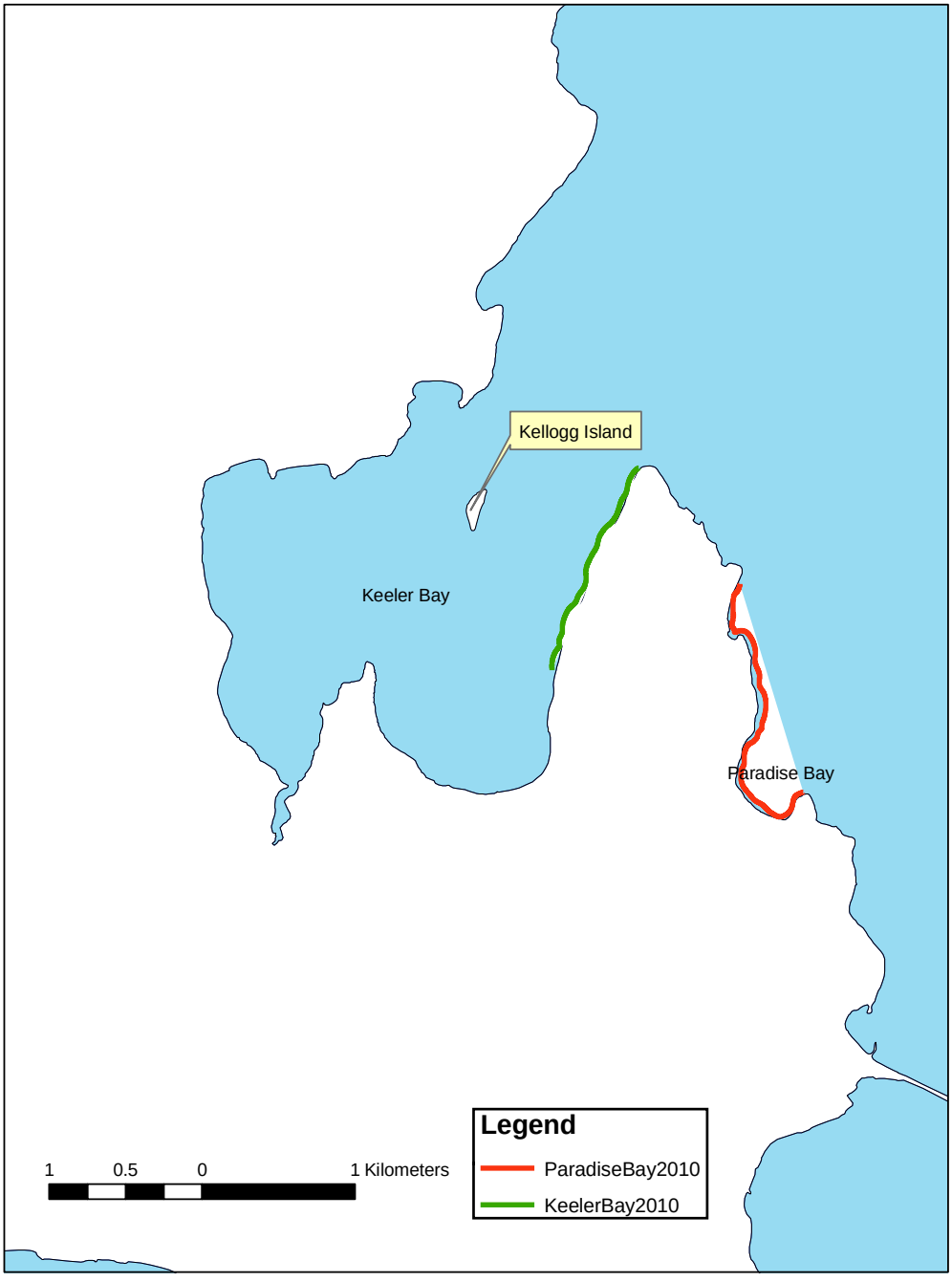

Figure 3. Map of Converse Bay showing electro-fishing transects.

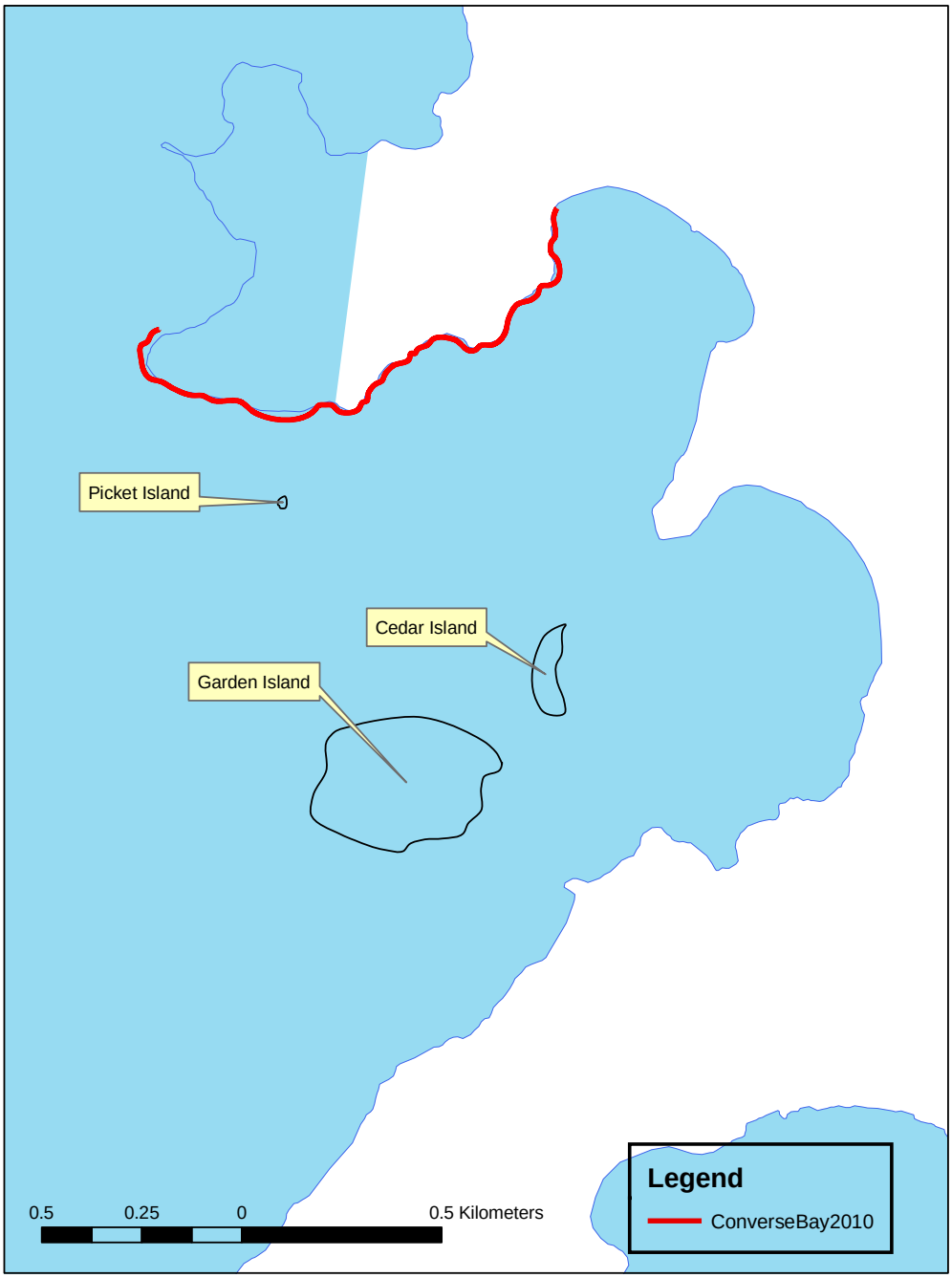

Figure 4. Map of Grand Isle shoreline showing electro-fishing transect.

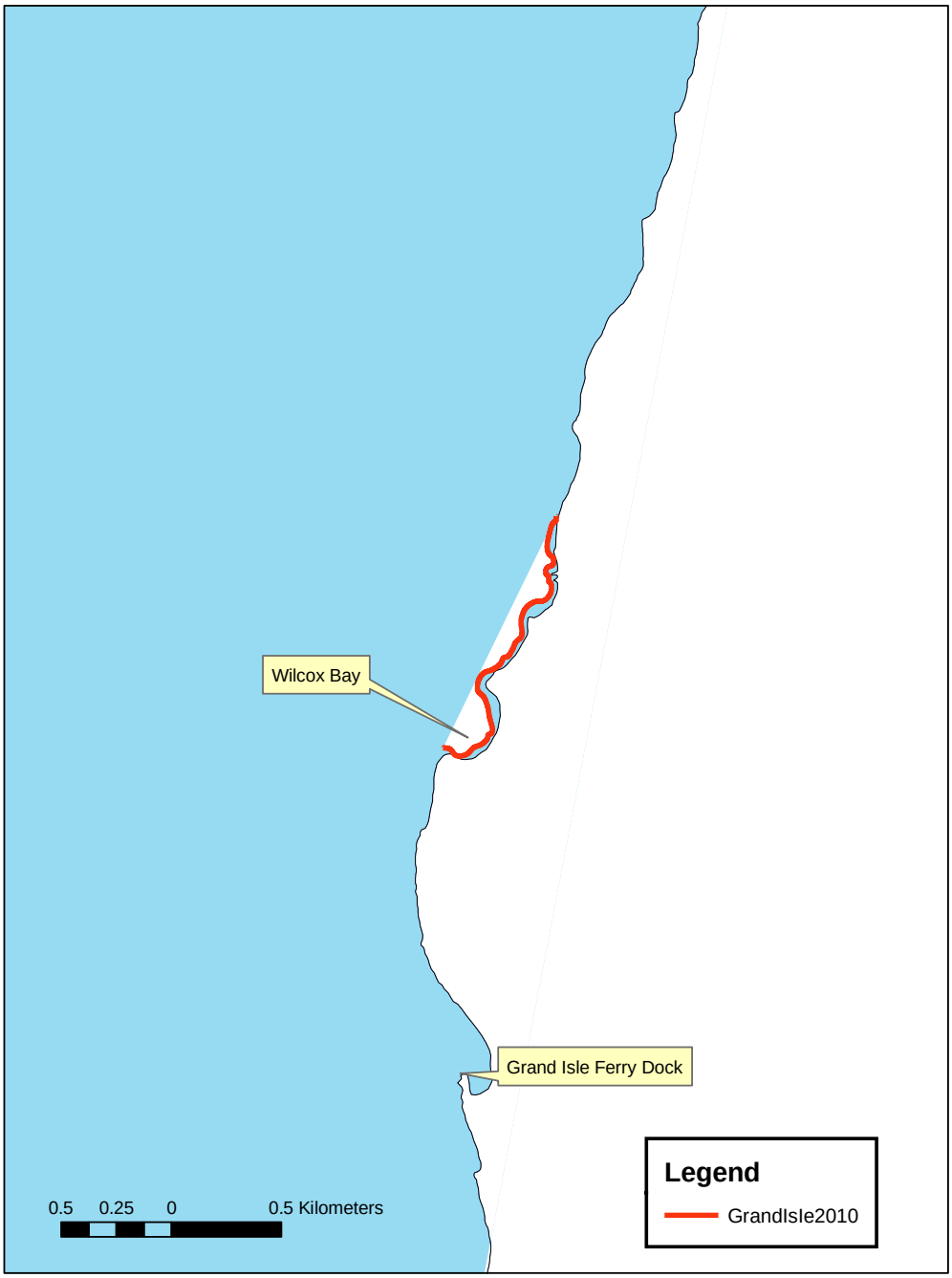

Figure 5. Comparison of Length frequency distributions of American eel sampled in Lake Champlain , 2010 and 2012.