Abstract
In 2009, a survey of resident anglers in the seven-county Lake Ontario Region of New York State was completed. Data from this survey was used to examine the spatial relationships between an angler's location of residence and different fishing characteristics, as well as constraints and facilitators to fishing. Of the 7,000 questionnaires distributed, 723 were returned by anglers; 681 anglers completed the full survey. A GIS-based analysis (using property centroids) was used to examine spatial relationships. Significant spatial relationships between access and level of fishing participation were found. Anglers residing between 5 to 10 miles from the coastline had the highest average participation; similar results were identified for perceptions concerning access. Promotional efforts focused on attracting residents living further than 10 miles from the coast may be needed to increase involvement by resident anglers.

1.0 Introduction
Coastal businesses in the Lake Ontario region (i.e., Jefferson, Oswego, Cayuga, Wayne, Monroe, Orleans, and Niagara counties) are greatly dependent on anglers for business income. This study is focused on Lake Ontario resident anglers -- a large and fairly stable angler group whose travel within the Lake Ontario Region is less affected by high fuel costs and the state of the economy than non-resident anglers. Data collected from a previous Sea Grant study on these resident anglers (Kuehn et al., 2013) was used to conduct a spatial analysis of resident angler fishing characteristics and demographics according to location of residence using GIS software. The purpose of this study is to understand the spatial relationships between where responding anglers reside along the Lake Ontario coast, and their perceptions of constraints and facilitators specific to fishing efforts.

2.0 Literature Review
Two types of factors are considered in this study: constraints and facilitators. Constraints are defined as factors that limit or prevent participation in leisure activities (Crawford & Godbey, 1987; Henderson, Stalnaker, & Taylor, 1988). In contrast to constraints are “facilitators” -- factors that enable or promote participation in leisure activities (Raymore, 2002). Elements such as time available for fishing and costs related to fishing can be viewed as both facilitators and constraints, depending on an individual's circumstances. For example, someone who has a great deal of free time may be able to fish more frequently than someone with little free time. For the angler with more free time, time availability would be viewed as a facilitator; time availability might be viewed as a constraint for the person with little free time. This study examines the relationship between location of residence and fishing constraints and facilitators for NY’s Lake Ontario Region resident anglers.

3.0 Methods
A sample of 7,000 property owners (1,000 from each Lake Ontario County) was compiled from online, residential property records. Data for fishing characteristics, demographics, and importance of facilitators/constraints to fishing involvement was collected via a mail and internet survey during the fall of 2009 using a modified Tailored Design Method (Dillman, 2007). Survey questions included: fishing characteristics (i.e., number of trips per year, fish species preference, types of equipment used, location for fishing); demographics (i.e., age, income level, education level, location of residence); and constraints and facilitators. A qualifying question of “Have you or another member of your household participated in fishing at least once between 2005 and 2009?” was used to identify households containing an angler. An adult angler within the household was then asked to complete the full questionnaire. Participation was identified by asking respondents to indicate the number of fishing trips (for both the Lake Ontario Region and for all fishing locations) taken each year from 2005 to 2009; the average annual number of trips over this five-year period was then calculated for each respondent.
Survey statements related to constraints and facilitators were based on previous sportfishing research studies (for further detail, see Kuehn et al., 2013). Respondents were asked if each of the statements limits or enables their participation in fishing. The five-point scale used was: -2 = greatly limits participation, -1 = limits participation, 0 = neither, 1 = enables participation, 2 = greatly enables participation. A confirmatory factor analysis was then used to confirm the variable composition of constraint/facilitator factors (see Kuehn, 2013 for further details).

Using the centroid data for respondents' properties, the survey data were aggregated and mapped at the county- and town-level for New York’s Lake Ontario counties and at varying distances (buffer zones) from Lake Ontario shoreline using ArcGIS software. The fishing characteristics, demographics, and constraints/facilitators studied were: average number of fishing trips per year at all fishing locations and at Lake Ontario fishing locations only (averaged by respondent for 2005 through 2009), fish species preferred, type of rod/reel used, fishing from boat or shore, age, household size, and constraints and facilitators (i.e., time, economic costs, access and equipment, past experience, social support, weather, perceptions of the environment, perceptions of fisheries management; and level of knowledge, interest, and commitment).

4.0 Results
4.1 Response Rate
Of the 7,000 questionnaires mailed to Lake Ontario households, 1,303 were completed and returned by 723 anglers (681 of whom completed the full survey) and 504 non-anglers; 76 respondents did not wish to participate. Following the removal of undeliverable addresses and non-Lake-Ontario property owners, the qualified sample totaled 5,580 households; the response rate was 23%. A short, one-page survey was used to check for non-response bias. No significant difference was found between the proportion of angler households responding to the full survey (55%) and the proportion responding to the short survey (55%).

4.2 Average Number of Fishing Trips
The number of annual fishing trips to all fishing locations (averaged for 2005 through 2009 for each county) ranged from 9 to 19 trips, with Oswego County residents having a slightly higher average (19 trips). Figure 1 illustrates the higher levels of participation (both on Lake Ontario and at all fishing locations) found in townships in the Oswego/Cayuga County area.

![Figure 1. Number of Fishing Trips per Year Aggregated at the Township Level](image)

The relationship between proximity of angler residence to shoreline and number of trips per year (to all fishing locations) was also mapped. Although no important differences were observed between respondents living from 0 to 5 miles away from the lake, and those living between 10.1 and 15 miles from the lake (respondents averaged approximately 13 annual visits to any fishing location), a difference was observed for respondents residing between 5.1 and 10 miles from the lake. Specifically, these respondents had a higher average number of annual visits to any fishing location (16 trips) in 2009 (Fig 2).

When the average number of annual visits to Lake Ontario was analyzed, similar distributions were found. Anglers living 0 to 2.5 miles from shoreline visited Lake Ontario approximately 9.5 times annually; anglers living 2.51 to 5 miles from shoreline visited Lake Ontario approximately 9 times annually; anglers living 5.1 to 10 miles from shoreline visited Lake Ontario approximately 12 times annually; and anglers living 10.1 to 15 miles from shoreline visited Lake Ontario approximately 9 times annually.
4.3 Fish Species Preferred by Respondents

All counties were characterized by anglers with preferences for different fish species, although (in all counties) nearly one-third of respondents indicated that they had no species preference. In comparison to other counties studied, Oswego County had fewer respondents (29%) indicate “no preference” for species. Among all counties, anglers showed slight preference for catching smallmouth bass, largemouth bass, walleye, and panfish. Respondents in each county indicated a lower preference for catching chinook/coho salmon, and for catching rainbow trout/steelhead (Figure 3).

4.4 Type of Equipment Used

Most counties were characterized by respondents who primarily use multiple types of fishing equipment. Spin casting rods/reels (with button) and spinning rods/reels were the most preferred, followed by bait casting rods/reels. In Cayuga, Jefferson, and Niagara counties, one to three respondents indicated use of fly fishing equipment (in remaining counties, use of fly fishing gear was not indicated). In Cayuga, Jefferson, Oswego, and Wayne counties, approximately 1 to 3% of respondents indicated that they use ice fishing equipment; in the remaining counties, use of ice fishing gear was not indicated (Figure 4).
4.5 Fishing from Boat or Shore
All counties were characterized by anglers that use multiple means of access. Among those respondents who use only one means of access, fishing from shore and from a gas-powered motorboat occurred most frequently. Similar results were found for all the townships and municipalities studied. Regardless of the distance they reside from shore, respondents reported accessing Lake Ontario, and its embayments and tributaries primarily from the shoreline (approximately one-third of responses), by gas-powered motorboat (approximately one-third of responses), and by multiple means (approximately one-third of responses) (Figure 5).

4.6 Age
For all areas studied, average age of respondents (calculated by county) ranged from 54 to 58 years. Calculated by township or municipality, the average respondents’ age ranged from 47 to 65 years, with no significant spatial trends evident (i.e., relationships between respondents’ age and proximity of residence to shoreline were not present).

4.7 Household size
For each county, the average household size of all respondents (i.e., respondents who were anglers as well as those who did not fish) ranged from 2.5 to 2.7 individuals. For townships and municipalities, the average household size ranged from 1.6 to 3.8 people, with the majority of respondents indicating a household size of 2.0 to 2.9 individuals. Trends among different distances of respondents’ residences from the shore (0-2.5 miles, 2.51-5 miles, 5.1-10 miles, and 10.1-15 miles) were not present.

4.8 Facilitators and Constraints
Facilitators were identified as those factors having a mean value of 0.21 or greater for the average respondent. Past experience (i.e., fishing experience as a child or teenager), good weather, social support, access and equipment (i.e., a respondent’s ability to travel to fishing locations and to own/borrow fishing equipment such as rods and reels), level of knowledge about fishing, level of interest in fishing, level of commitment to fishing, and health were identified as facilitators for the average respondent (Figure
6). Based on county-level analysis, factors that most facilitate respondents’ fishing participation included past experience, good weather, and social support.

The only facilitator identified as having a significant relationship with the respondents’ location of residence was access and equipment (Figure 7). Averaged by distance from shoreline, respondents indicated that access and equipment facilitated fishing participation slightly or moderately. Among respondents living 0 to 2.5 miles from the Lake Ontario shoreline, respondents indicated that this factor facilitated participation moderately (average 0.54); among those living 2.51 to 5 miles, and 5.1 to 10 miles from the shoreline, this factor facilitated participation moderately (average of 0.58); and among those living 10.1 to 15 miles from the shoreline, this factor slightly facilitated participation (average of 0.48).

Constraints were identified as factors with a mean value of less than -0.2. Poor weather constrained participation most, while lack of time, respondents’ perceptions of the environment, and economic costs moderately constrained participation (Fig. 8). None of the constraints were found to have a significant spatial relationship with respondents’ location of residence.
5.0 Discussion
Spatial analysis of the variables studied show few relationships between the variables and the distance of responding residents from the Lake Ontario shoreline. One relationship identified was for number of fishing trips taken in 2009. Specifically, respondents living between 5.1 and 10 miles from the shoreline had the highest levels of participation of all respondents both to Lake Ontario fishing sites, and to all fishing locations. This result seems counter-intuitive, since we would expect those closest to the shoreline to have the highest levels of participation. This higher participation rate by those living slightly inland may be due to the limited contact these inland residents have with the lake on a daily basis; it seems possible that respondents residing near the coastline may take the lake for granted somewhat, reducing their level of participation.

A similar result was identified for “access and equipment;” respondents living from 2.6 to 10 miles from shore perceived this factor to be a stronger facilitator than did those living within 2.5 miles of the shoreline. Respondents living further inland may be more dependent on coastal access for their fishing experiences than those living closer to the coast who may be able to access the lake from their own yards or nearby public facilities.

6.0 Conclusion
Overall, little spatial variation was noted for responding resident anglers in New York's Lake Ontario counties. Differences in participation and perceptions of access were, however, noted between those living directly on the coast and those living further inland. Residents living close to the coastline may not be as dependent on public access as those living further inland, and thus may not perceive access to be as important as those living further inland. Furthermore, participation was noticeably higher in the Oswego-Cayuga County area, an area known internationally for its salmon fishery on the Salmon and Oswego Rivers; it is likely that anglers residing in this area receive a high level of fishing-related promotions, encouraging their participation.

Results indicate that promotional efforts may be needed to attract residents living further than 10 miles from the coast. These residents will likely need detailed information concerning access locations and fishing-related events along the coast. Residents living within 10 miles of the shoreline appear to be more aware of the fishing opportunities available on the coast; however, continued promotions to these residents about fishing events and opportunities is needed to maintain their high level of participation.

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8.0 References