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Developing Agent-Based Models of Recreational Behaviours at a Landscape Scale: The Case of Recreational Fishing in Northern Ontario

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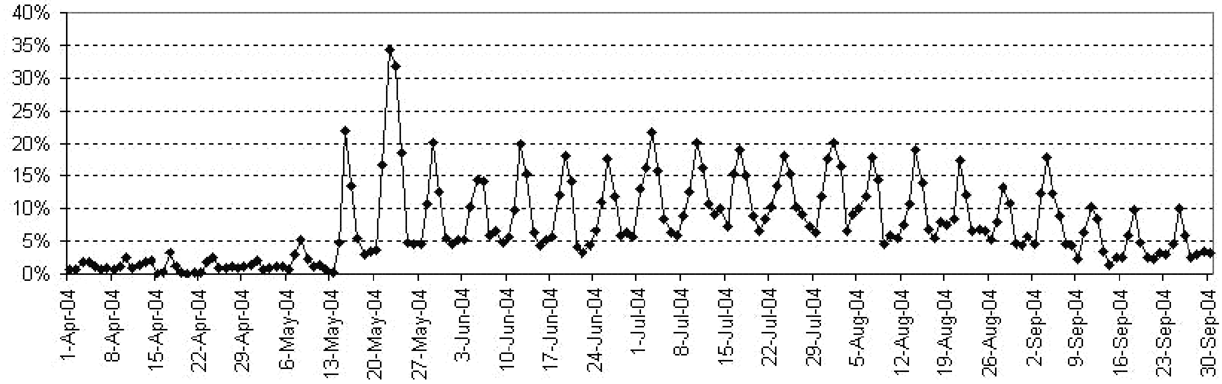
Agent-based models depicting recreational behaviours are becoming an important tool used by researchers and resource managers. These models provide opportunities for individuals to learn about complex relationships that agents have with environs and other agents. Past agent-based models have taught managers much about recreational use and impacts at specific sites or small areas (e.g. Itami and Gimblett 2001). Researchers, however, have spent less effort to operationalize these models at a landscape scale.

Adopting a landscape scale for an agent-based model of recreational behaviours is important for at least two reasons. First, resource managers are increasingly using a landscape scale when managing resources upon which recreationists depend. Consequently, managers increasingly require information about how management and other changes to recreational sites are likely to impact recreational behaviours at many recreational sites. For example, if fishing quality declines at one popular fishing site, managers will require information about expected changes in fishing use at that site along with these expected changes in use at all other fishing sites.

Second, behavioural processes such as recreational site choice typically operate at a landscape scale. When an inappropriate scale for a recreational behaviour is used, one likely predicts biased behavioural responses since the recreationists may substitute their current site for a competing site. We showcase an agent based model of recreational fishing behaviours developed for residents of northern Ontario, Canada. Our application focuses on over 400 fishing sites in an area with hundreds of square kilometres. While developing an agent-based model at this landscape scale is daunting, we illustrate some benefits of this approach during the presentation.

The behavioural rules for the angling agents come from an econometric model estimated (i.e. calibrated) from observed trip timing and site choices of anglers (see figures 1 and 2). The repeated nested logit model (Morey, Rowe & Watson 1993) represents an effective method to link the amount, timing, and locations of fishing trips taken by anglers. Since this model is consistent with random utility theory, one can use the model for economic welfare assessments besides as a guide for the behaviours of angling agents. Our application extends the normal estimation of the repeated nested logit model in three important ways. First, we formally account for different patterns of substitution among the fishing sites that are available to anglers. Second, we account for various trip contexts that include trip duration (day versus multiple day trips) and trip type (public versus private accommodation trips). Finally, the models account for many details around the timing of recreational fishing trip behaviours. Trip timing decisions are related to calendar events (e.g. day of week, holidays), weather (e.g. precipitation), culturally defined dates (e.g. children returning to school in September), and others.

Table 1: Temporal pattern of daily fishing participation rates (%) for northern Ontario anglers.



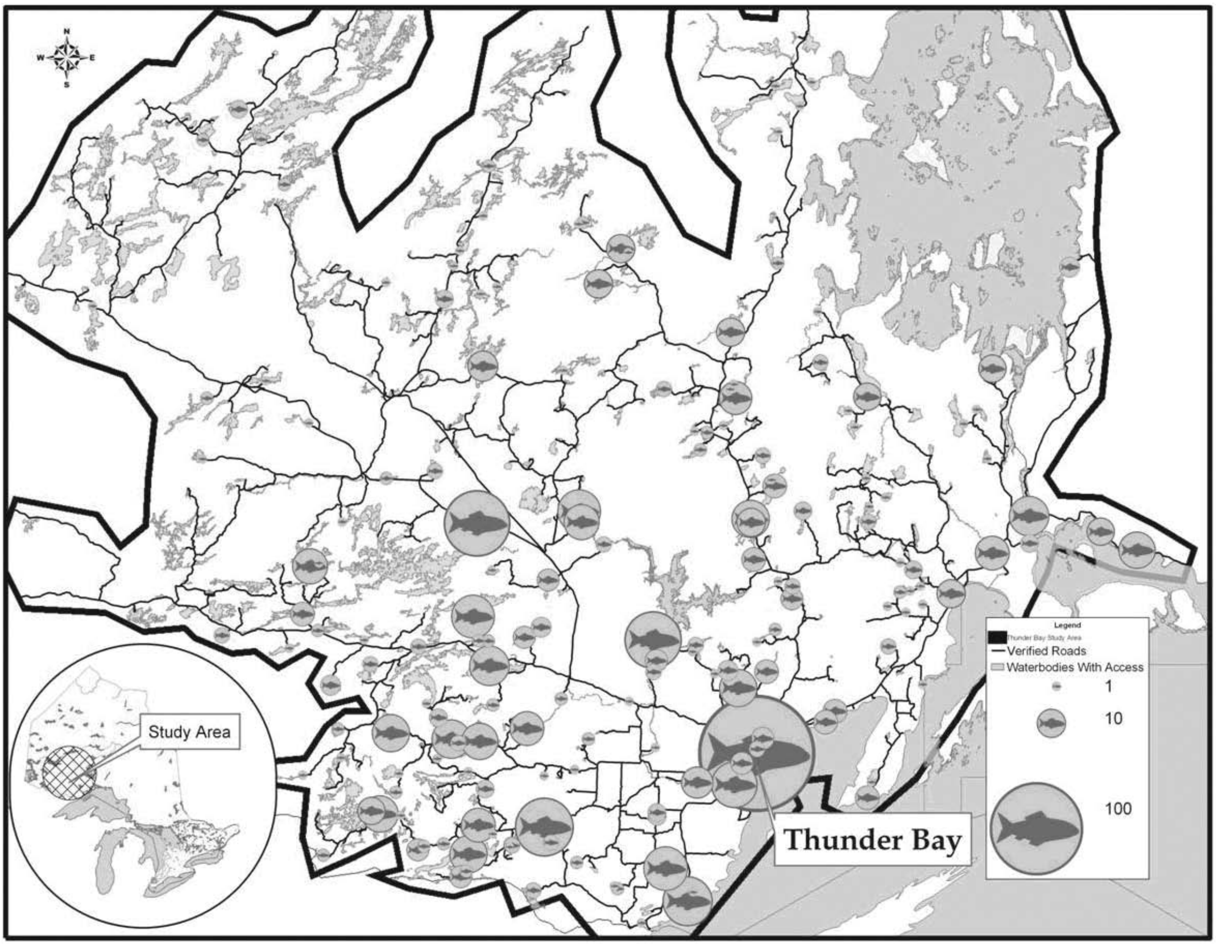


Figure 1: Spatial pattern of observed fishing site use for northern Ontario anglers.

Calibration of the agent-based model is on-going to ensure a good fit between monitored fishing site use and the use predicted by the model. Efforts are also underway to create a more dynamic agent-based model of recreational fishing. By programming fish as agents, we hope to provide a link to the impacts of angling behaviours on fisheries abundance. This model would allow us to predict longer-term effects of management decisions on recreational fishing.

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