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Water quality and recreational angling demand in Ireland

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ABSTRACT

Using on-site survey data from sea, coarse and game angling sites in Ireland this paper estimates count data models of recreational angling demand. The models are used to investigate the extent to which anglers are responsive to differences in water quality, with the water quality metric defined by the EU's Water Framework Directive. The analysis shows that angling demand is greater where water quality has a higher ecological status, particularly for anglers targeting game species. However, for coarse anglers we find the reverse, angling demand is greater in waters with lower ecological status. On average across the different target species surveyed anglers have a willingness to pay of € 371 for a day's fishing. The estimated additional benefit of fishing in waters with high versus low ecological status is € 122/day for game anglers but there is a decline in benefit of € 93/day for coarse anglers.

MANAGEMENT IMPLICATIONS

While one of the objectives of the Water Framework Directive (WFD) is to attain and retain good status in water bodies, the diversity in angler preferences means that not all anglers may be affected similarly by efforts that seek to improve water quality. Achieving good water status closely aligns with the interests of game anglers. However, we find that coarse angling demand is higher at sites with poor or bad ecological status. Therefore, what might be considered an improvement in water quality from a WFD perspective may be considered otherwise by coarse anglers, though, further research is required to rule out coincidental correlation between water quality and site specific characteristics important to coarse anglers.

1. Introduction

Marine and inland waterways provide many recreational opportunities including angling, boating, walking and wildlife viewing. In developed economies as many as half of the adult population participate in water-based recreational activities (Curtis, 2003; Environment Agency, 2009; Outdoor Foundation, 2013). And it is widely recognised that the enjoyment of water-based recreational activities is enhanced by higher water quality status, including in swimming (Arnold et al., 2013; Wade et al., 2010), boating, canoeing/kayaking, fishing and rowing (Dorevitch et al., 2011; Dorevitch, DeFlorio-Barker, Jones, & Liu, 2015), as well as tourism more generally (Aminu, Matori, Yusof, Malakahmad, & Zainol, 2014; Lee & Lee, 2015). However, not all recreational users recognise poor water quality or its associated risks (Burger, Staine, & Gochfeld, 1993; Westphal, Longoni, LeBlanc, & Wali, 2008).

Establishing the link between improved water quality status and enhanced recreational experiences is not trivial. In the first instance it is important to have a meaningful water quality indicator recognisable and understood by recreational users. Both objective and subjective measures of water quality have been successfully used to explain water-based recreational activity (Poor, Boyle, Taylor, & Bouchard, 2001). Objective measures have included levels of suspended solids (Egan, Herriges, Kling, & Downing, 2009), levels of harmful bacteria (Parsons, Helm, & Bondelid et al., 2003) and water clarity (Vesterinen, Pouta, Huhtala, & Neuvonen, 2010). Subjective measures have also included water clarity (Loomis & Santiago, 2013), as well as Likert scales (Hanley, Bell, & Alvarez-Farizo, 2003). Water clarity may be a useful indicator of water quality for activities such as swimming and boating but may be less useful for anglers who are more interested in fish stocks and catch rates. Fish catch rates are a commonly used quality indicator within angling recreational demand models (Chen, Lupi, & Hoehn, 1999). But catch rates are endogenous, depending on angler skill and fishing pressure. In addition, while water clarity may be a useful quality indicator for

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game species, such as trout and salmon that need high quality water habitat, coarse species can thrive in more eutrophic waters. A more complex indicator of water quality, such as ecological status, may be more useful in recreational angling demand models.

The European Union Water Framework Directive (WFD) requires that water bodies be of good ecological status, a description that covers indicators such as biological quality (i.e. fish, benthic invertebrates, aquatic flora), hydromorphological quality, physical-chemical quality, and chemical status. Vesterinen et al. (2010) suggest that ecological status, as defined within the WFD, may not be a quality indicator easily observable or understood by the public in a manner that would effect their recreation behaviour. Nonetheless, if recreational behaviour such as angling is affected by water quality, revealed behaviour of anglers will reflect the underlying ecological status of water bodies. For example, without knowledge of WFD status, anglers may visit water bodies with high ecological status more than water bodies with a poor or bad status. In the United States Egan et al. (2009) find that anglers are responsive to the full set of water quality measures used by biologists and furthermore, that changes in these quality measures translate into changes in the recreational usage patterns and well-being of anglers.

There are five status classes within the WFD's classification scheme for water quality: high, good, moderate, poor and bad. These are nominally easy to understand though the water assessment process for classification is multifaceted and complicated (Directive 2000/60/EC, 2000). The use of WFD ecological status classifications is relatively recent, being first used to assess Irish river water quality in 2010 (McGarrigle, Lucey, & Ó Cinnéide, 2010). At the time our angling dataset was collected the WFD classifications would not have been widely familiar to anglers or the general public. But if recreational usage patterns of Irish anglers are responsive to the WFD ecological status categories, similar to the Egan et al. (2009) study, the WFD classifications are an ideal metric for conveying water quality information to prospective anglers at specific fishing sites.

The primary research question in this paper is whether recreational anglers are responsive to water quality, as measured by the EU's WFD classification. Among the earliest studies to consider the benefits of improvements in water quality for recreational water users are Bockstael, Hanemann, and Kling (1987); and Bockstael, McConnell, and Strand (1989). These studies use a variety of water quality metrics but when considering recreational anglers the only quality metric available was catch rates. Catch rates may be thought of as a proxy for water quality conditions but there is no explicit linkage between catch and water quality. Subsequent studies by Kaoru (1995) and Tay, McCarthy, and Fletcher (1996) explicitly model angler demand (site choice and trip length) as a function of objective water quality measures (e.g fecal coliform bacteria, suspended solids, phosphorus discharge, biochemical oxygen demand). While their results vary by angling site and quality metric, they establish a clear positive relationship between higher levels of water quality and angler demand. Ahn, De Steiguer, Palmquist, and Holmes (2000) find a similar result for trout fisheries in the Appalachian mountains but use a water quality metric that is effectively an amalgamation of scientific assessments of whether streams can support wild or hatchery trout. Their water quality metric has a correspondence with the status classes within the WFD's classification scheme. Englin, Lambert, and Shaw (1997) follow a different approach, jointly estimating angler demand and catch functions. Their estimated demand model for a trout fishery exhibits a positive relationship between predicted total catch and the number of trips, whereas predicted catch increases with reduced turbidity and higher levels of dissolved oxygen. Massey, Newbold, and Gentner (2006) also use a two equation approach but within the context of a bioeconomic model. Their result is slightly different, finding that improved water quality (i.e. dissolved oxygen) increases fish abundance rather than catch rates but like Massey et al. find that anglers are more likely to visit sites with higher total catch. Revealed preference approaches have also been used to measure the impact of water pollution events on angler demand, such as an oil spill (Alvarez, Larkin, Whitehead, & Haab, 2014), while stated preference approaches have been used to measure the impact of water quality on angling behaviour (Eiswerth, Kashian, & Skidmore, 2008).

Finding whether recreational anglers are responsive to the WFD classification system is analogous to the study by Egan et al. (2009) in the United States. Water quality status may not be observable to an angler, as the WFD status is not normally posted at fishing sites. Separate from whether WFD status is observable to anglers, an important research issue is whether 'good quality' differs by use type. What swimmers and anglers might consider 'good quality' may differ due to the nature of their activity. In the same way different types of anglers might have diverse views on what is 'good quality' from the perspective of their activity. If so, 'good quality' from an angling perspective may not align with the definition of good water quality measured by WFD status. What we wish to establish is whether water quality, as defined by WFD status, is a fishery characteristic that can affect anglers' experience and choices. In Ahn et al. (2000) the water quality metric is somewhat analogous to the WFD classification, where they find that anglers' perspective of a 'good quality' Appalachian trout fishery aligns well with their water quality metric. It is an empirical question whether anglers in other fisheries will be responsive to the WFD classification.

The analysis in the paper provides greater insight into preferences for angling within Ireland but the research also has wider policy relevance. It indicates the usefulness of the WFD classification system to both anglers and fishery managers to signal better quality fisheries, *ceteris paribus*. However, given the diversity in angler preferences, especially coarse versus game fishers, not all anglers may be affected similarly by improvements in water quality.

2. Methodology

2.1. Data

Angler data were collected by on-site survey at sites around the Republic of Ireland. The survey was undertaken between March and November 2012 and included the prime angling season with respect to each angling category. In total 903 anglers were interviewed. The survey collected travel cost data for the intercepted trip, as well as information on the number of trips in the last 12 months. A full description of the survey design and implementation is available in Tourism Development International (2013).

Water quality data for the period 2007–2009 from water quality monitoring stations proximate to the angling survey sites were downloaded from http://gis.epa.ie/. Water quality monitoring and data are summarised in McGarrigle et al. (2010). We used the WFD ecological status as an indicator of quality and created a dummy quality variable distinguishing between 'High/Good/Moderate' or 'Poor/Bad' ecological status.

While the original angler dataset had 903 observations, for reasons outlined below observations were omitted in model estimation, including 139 observations where the interviewed angler paid the expenses of multiple anglers. A further 21 observations were omitted where trip length exceeded 14 days on the assumption that the primary purpose of these trips may not have