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Opportunities and barriers for fisheries diversification: Consumer choice in New England

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ABSTRACT

Diversification has been defined as one goal of sustainable fisheries. However, the role of consumer choice in successfully achieving this goal is unknown. We use a choice experiment survey to quantify consumer preferences for locally abundant and underutilized fish relative to more familiar and overfished species, as well as in the context of other common sustainability characteristics (locally sourced and eco-labeled fish). We find that while respondents valued local seafood and avoided seafood labeled as "unsustainable", even well-informed consumers placed a high value on familiar species. However, consumers that had previously purchased underutilized fish were willing to pay significantly more for these species. These results demonstrate that fisheries diversification faces challenges, but that consumer preferences may be malleable, suggesting a long-term potential to shift demand away from unsustainable stocks and meet larger conservation goals, provided consumer education occurs. Ultimately, these efforts have the potential to increase both the ecological and economic sustainability of marine fisheries.

1. Introduction

Fisheries diversification has been identified as one goal of sustainable fisheries and coastal sustainability initiatives, with both ecosystem and social benefits (Alden, 2011). Ecosystem benefits of spreading fishing effort more broadly across the ecosystem include reducing pressure on highly desirable, overfished species and reducing discards by creating markets for species that would otherwise be valueless. Social benefits include increased economic security to local fishers and a potential increase in community interest in sustainable fisheries that may come from educating consumers about a greater diversity of locally available sustainable seafood options (Kasperski and Holland, 2013; McClenachan et al., 2014).

Successful fisheries diversification relies on consumers choosing to purchase a greater variety of fish, particularly species that have high local abundances. Efforts to diversify seafood consumption in the U.S. include the Chefs Collaborative, a network of chefs who host "Trash Fish Dinners" or meals using locally abundant, but less familiar species (Leviton, 2013) and Community Supported Fisheries (CSFs), which use a direct marketing strategy to connect consumers to fishers, exposing shareholders to locally abundant seafood (Brinson et al., 2011; McClenachan et al., 2014). In New England, the non-profit Gulf of Maine Research Institute's *Out of the Blue* initiative promotes the consumption of Gulf of Maine fish whose populations are locally abundant, with the potential both to sustain greater fishing effort and to support larger local markets in the future (GMRI, 2013). While these local initiatives exist, it is unclear if consumers will choose to purchase so called "underutilized" fish, which may be unfamiliar or undesirable.

We addressed this question with a choice experiment (CE) survey designed to quantify consumer preferences for a range of fish species in New England. New England is an ideal place to examine fisheries sustainability and consumer choice because of a long history of overfishing (e.g., Rosenberg et al., 2005), and current initiatives to diversify fisheries (Alden, 2011; Pierce, 2013). Specifically, we measured consumers' marginal willingness to pay (WTP) for six species (Table 1): Atlantic cod (*Gadhus morhua*, Linnaeus), haddock (*Melanogrammus aeglefinus*, Linnaeus), Atlantic mackerel (*Scomber scombrus*, Linnaeus), Atlantic pollock (*Pollachius virens*, Linnaeus), silver hake (*Merluccius bilinearis*, Mitchill), and spiny dogfish (*Squalus acanthias*, Linnaeus). Two of these species (cod and haddock) have been historically popular, while the remaining four (mackerel, pollock, hake, and dogfish) have been promoted as "underutilized" due to low market demand and a small percentage of allowable catch being harvested (GMRI, 2013). The Gulf of Maine Research Institute (GMRI) highlighted these species as having a strong potential to diversify the New England seafood market

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because GMRI considers them to be sustainably fished based on strong management and high biomass relative to the defined management target (B/B_{MSY}; NOAA, 2013a) and marketable, based on higher prices in foreign markets (GMRI, 2013).

To provide context for our assessment of WTP across a range of fish species caught in New England, we also measured WTP for two other sustainability characteristics: the presence of an eco-label and the presence of a label indicating that the fish was caught locally. Finally, we evaluated conditions that might increase the likelihood that a consumer selects a locally abundant or underutilized fish species over better known or overfished species, including attributes of the seafood product (e.g., the inclusion of a recipe on the label) and characteristics of the consumers (e.g., income, previous exposure to one of the underutlized fish species). Our goal was to gain insight into the relative marketability of locally abundant fish in order to evaluate the ability of diversification of seafood markets to improve fisheries sustainability.

2. Methods

We use a choice experiment (CE) survey to quantify consumer preferences for a diverse range of fish species in New England. CE surveys are used to elicit public preferences for environmental goods and policies that are typically not related to existing markets (Boxall et al., 1996; Louviere et al., 2000). Respondents choose their preferred option from hypothetical but realistic choices that include the attributes important to the product. Typically, these attributes have multiple levels, designed to create realistic variation among options. The respondents' preferences for the product and for each attribute can be elicited from their choices using discrete choice statistical methods (Hanley et al. 2001; Alpizar et al., 2003; Carlsson et al., 2003; Dissanayake and Ando, 2014; Hensher and Greene, 2003; Hensher et al., 2005).

Our CE presented respondents with opportunities to express preferences for six fish marketed in New England's seafood system that represent a range of stock statuses (Table 1, NOAA, 2013a). At the time of the study (December 2013), three of these fish (spiny dogfish, pollock, and Atlantic mackerel) were locally abundant, with biomass assessed as higher than management targets in the two primary fishing areas, the Gulf of Maine and Georges Bank (B/B_{MSY} = 1.35–3.57). Two of the species (silver hake and haddock) were not overfished, but below management targets in at least one of the two major fishing grounds (B/B_{MSY} = 0.67–1.34). One species (Atlantic cod) was overfished in both George's Bank and the Gulf of Maine (B/B_{MSY} = 0.07–0.18). As well, these species represent a range of popularities, with cod and haddock historically popular and commonly found in supermarkets and the remaining four species identified as underutilized (GMRI, 2013). We excluded one species (Acadian redfish, *Sebastes fasciatus*, Linnaeus) identified by GMRI as underutilized because we deemed it to have a strong likelihood of overfishing based on a major fisheries collapse in the past and biological characteristics that suggest a strong potential for overfishing.

Table 2
Attributes and levels for the choice experiment survey.

Attribute	Attribute levels
Species	1. Pollock[a,c] 2. Atlantic mackerel[a,c] 3. Silver hake[c] 4. Spiny dogfish[a,c] 5. Haddock 6. Atlantic cod[b]
Origin label	1. Caught in the Gulf of Maine 2. Caught in US 3. Caught in Iceland
Eco-label	1. Best choice (pollock, Atlantic mackerel, spiny dogfish) 2. Good alternative (silver hake, haddock, Atlantic cod caught in Iceland) 3. Avoid (Atlantic cod caught in Gulf of Maine or US) 4. No label (all six species)
Price	1. High 2. Medium 3. Low
Preparation	1. Recipe included on label 2. Recipe not included on label

[a] Locally abundant species.
[b] Overfished species.
[c] Underutilized species.

In addition to species, we included the following four attributes: price, origin of catch, eco-label, and the presence of a recipe on the label. Each attribute included between two and six levels, which were all based on actual possibilities in the marketplace (Table 2). For example, each price label represented one of three possible price levels (low, medium, and high), which were constrained to a range of current retail prices for each species (Tables 1 and 2). Eco-labels were based on Monterey Bay Aquarium Seafood Watch ratings, so that the number of levels of this attribute varied among species based on actual ratings. The inclusion of a recipe allowed us to determine if additional information about preparing unfamiliar species increases their appeal.

Hypothetical but realistic seafood labels were created with one level of each attribute represented on each label (Fig. 1, Table 2). The CE design was generated using SAS (Kuhfeld, 2010) and resulted in 36 choice sets. A block design was created where the 36 choice sets were separated in blocks of six choice profiles, giving six unique surveys containing six questions each. For each choice profile the respondents were presented with choices between two seafood products and asked to indicate their preference. Respondents were also given a third option of choosing neither fish and the opportunity to describe why they made each choice. Survey versions

Table 1
The six species included in the analysis. 2013 stock status as measured by B/B_{MSY} for Gulf of Maine and Georges Bank stocks (NOAA, 2012, 2013a), 2012 landings for New England (NOAA, 2013b), and the low, mid, and high retail prices included in the choice experiment. B/B_{MSY} values >1 indicates a healthy stock. B/B_{MSY} values >0.5 indicates a stock is not overfished.

Species	Designation	Georges Banks B/B_{MSY}	Gulf of Maine B/B_{MSY}	Landings (m)	Retail prices
Atlantic cod (*Gadhus morhua*)	Overfished, historically popular	0.18	0.07	4754	$8.99, $11.99, $14.99
Haddock (*Melanogrammus aeglefinus*)	Historically popular	1.34	0.59	1970	$8.99, $11.99, $14.99
Silver hake (*Merluccius bilinearis*)	Underutilized	0.67	0.97	5760	$8.99, $11.99, $14.99
Spiny dogfish (*Squalus acanthias*)	Locally abundant, underutilized	1.35	1.35	7535	$3.99, $5.99, $8.99
Pollock (*Pollachius virens*)	Locally abundant, underutilized	2.15	2.15	6734	$5.99, $8.99, $11.99
Atlantic mackerel (*Scomber scombrus*)	Locally abundant, underutilized	–	3.57	4370	$3.99, $5.99, $8.99