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Methodological and Ideological Options

When Cleaning Too Much Pollution Can Be a Bad Thing: A Field Experiment of Consumer Demand for Oysters

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ABSTRACT

Oysters are a special kind of green product. They filter phytoplankton from water and thereby reduce nutrients, the primary driver of eutrophication of water that can consequently harm human health. Yet, where they can provide the most ecosystem benefit is in highly eutrophic waters and being raised in these 'polluted' waters may be an unattractive attribute for consumers. In this research, we use revealed-preference dichotomous-choice field experiments to test if and under what pollution mitigation circumstances oyster consumers will pay price premiums for oysters. The results from 290 adult participants in the Mid-Atlantic of the US suggest that providing information about eutrophication and oysters' ability to filter nutrients increases participants' WTP price premiums for oysters from low-nutrient waters and decreases their WTP price premiums for oysters from eutrophic waters with more nutrients. These results illustrate an important tension in how best to market green products like oysters, as the situations where they provide the most ecosystem benefits (in eutrophic waters) are also situations, which appear to raise the highest level of concerns among consumers. These results have implications on whether oysters should be actively marketed as a green product.

1. Introduction

Oysters are a unique kind of green product. They filter phytoplankton from water, which serves as a food source (helping oysters grow and reach marketable size), at which point oysters are harvested, thereby effectively removing nutrients from waters that are potentially suffering from eutrophication. Unlike other green products, such as shade-grown coffee, where the provision of the ecosystem services does not invoke any food safety concerns among consumers, oysters' provision of ecosystem services (filtering pollution out of water) may be viewed by consumers as a food safety risk. Therefore, there exists an inherent tension between potential safety concerns and the positive externalities provided by oysters, which are greatest the more eutrophic the body of water. In other words, when oysters are identified as being raised in waters that suffer from eutrophication they may induce disgust or concerns about contamination for consumers. This may create potential challenges for marketing oysters as a pollution reduction practice that not only provides these ecosystem services but is a desirable and profitable food source.

To our knowledge, consumers' willingness-to-pay (WTP) for water quality ecosystem services provided by oysters has not been studied. Based on earlier findings related to green markets, one might assume that oysters, being a green product, would fetch a price premium in the market. The literature on contamination and disgust, however, suggests that consumers might actually pay less for oysters that were produced in water polluted by nutrients. We designed a revealed-preference dichotomous-choice field experiment to examine consumers' WTP a premium for oysters that provide water quality ecosystem services using three information treatments. The results from 290 adult consumers suggest that participants will pay higher prices for oysters when provided with information about the oysters' ability to filter water and the nutrient level of the water from which the oysters were harvested. Furthermore, participants were more likely to buy oysters produced in eutrophic water in our baseline treatment in which no information was provided. However, the more information participants received about the oysters' ability to filter water and eutrophication problems, the less likely they were to purchase oysters from areas that had moderate to high nutrient waters.

According to the U.S. Environmental Protection Agency (EPA), "Nutrient pollution … is one of America's most widespread, costly and challenging environmental problems" (EPA, 2012). Howarth et al. (2002) found that 60% of coastal rivers and bays in the United States had been moderately to severely degraded by eutrophication, a process in which an excess of organic nutrients builds up in a water body. Mid-

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Atlantic estuaries in the US have been the most severely impaired by eutrophication (Bricker et al., 2007; Driscoll et al., 2003), which has caused overgrowths of algae that reduce the amount of oxygen in the water. The lack of oxygen in turn damages the plants and animals that inhabit the water. Consequently, eutrophication threatens the health of many estuarine systems and coastal zones, which are among the most productive ecosystems in the world (Agardy, 1997).

Eutrophication is associated with substantial economic impacts (Smith and Schindler, 2009; Anderson et al., 2000; Palm-Forster et al., 2016). A study by Dodds et al. (2009) estimated that the United States suffered annual losses of approximately $2.2 billion related to decreases in recreational use, declining real estate values, the cost of recovery efforts for endangered species, and loss of drinking water supplies. Similarly, Smith and Schindler (2009) estimated the cost of eutrophication pertaining to fisheries, drinking water, and human and livestock health in the billions of U.S. dollars per year.

Eutrophication and resulting algal overgrowths also affect human health. Dolah et al. (2001) point to the economic impacts from healthcare-related costs linked to blooms of toxic algae and the need to understand current and future impediments to provide improved risk assessments (see also Hoagland et al., 2002 and Granéli and Turner, 2006). These problems, however, are not confined to the United States; similar impacts have been reported in Europe and China (Camargo and Alonso, 2006; Giles, 2005; Kronvang et al., 2008; Leone et al., 2009; Woodward et al., 2012; Le et al., 2010).

One way to manage nutrient pollution is by employing water quality ecosystem services provided by shellfish aquaculture. Oysters, for example, are suspension feeders that consume phytoplankton and thereby reduce the amount of organic matter in the water, reducing eutrophication (Kirby and Miller, 2005). Oyster aquaculture is a versatile industry that provides a renewable and consumable private good along with ecosystem services, which are public goods, from estuaries and other water bodies. Rose et al. (2015) showed that oyster aquaculture can outperform other commonly applied best management practices for removing nitrogen on a per-acre basis and thus can provide a cost-effective management tool. The U.S. National Oceanic and Atmospheric Administration (NOAA) supports using shellfish aquaculture to remove nutrients and eliminate eutrophication (National Center for Coastal Ocean Science (NCCOS), 2015).

Unfortunately, in the Chesapeake and Delaware Bay, oyster numbers have declined by 90–99% from historic numbers due to disease and overfishing, and globally, 85% of all oyster reefs have collapsed (Beck et al., 2009). NOAA's Chesapeake Bay office estimates that oysters once were able to filter the entire Chesapeake Bay in one week, providing a substantial public service (National Oceanic and Atmospheric Administration, 2015). A major concern associated with private investment in oyster aquaculture in the Mid-Atlantic is that market prices for oysters are likely to understate their true societal value, because their provision of ecosystem services are not included in the price and thus may lead to underinvestment, which translate to under-provision of the ecosystem services.

One potential solution is the "green" market for local, environmentally friendly goods. Products demanded from green markets are impure public goods because they display characteristics of both public and private goods. They can be provided privately but increase social welfare in the process (Vandermerwe and Oliff, 1990; Ferraro et al., 2005). The expansion of green markets is largely due to consumers' willingness to pay (WTP) price premiums for goods that exhibit environmental benefits. Examples of green products are electricity generated by renewable energy, eco-tourism, pollination services provided by honey, organic produce, and shade-grown coffee (Wu et al., 2015; Messer et al., 2000). Laroche et al. (2001) reported on then increasingly environmentally conscious market place, and Coddington (1990) found that 67% of Americans reported being willing to pay 5–10% more for environmentally friendly goods. Markets for foods labeled as environmentally friendly has experienced strong growth both nationally and internationally with > 450 different types of eco-labels (Ecolabel Index, 2015; Messer et al., 2017; CAST, 2015). Certified organic food labels, among others, is an example for foods that are perceived as reducing the environmental footprint. Bernard and Mathios (2005), for example, used scanner data and found that individuals were willing to pay a $0.73 price premium for milk that was labeled as organic versus conventional milk. Kanter et al. (2009) showed that participants in an experiment were willing to pay a $0.29 price premium for milk that was labeled as organic compared to conventional milk. Dhar and Foltz (2005) and Liu et al. (2013) find that individuals place considerable value onto organic and rbST-free milk resulting in their WTP significant price premiums for these attributes. Moreover, Blend and van Ravenswaay (1999) showed that > 40% of individuals were willing to pay a price premium of $0.40 per pound of apples that had an eco-label attached to them. Similarly, labels pertaining to sustainable practices (such as organic) have been shown to generate price premiums (Loureiro et al., 2002).

On the other hand, consumers have concerns when oysters are identified as being raised in waters that suffered from eutrophication. Some of these responses may be reflected by disgust while other individual responses may be the result of actual fear of bodily harm. According to James et al. (2010) there are five major toxic syndromes in humans associated with harmful algal blooms (paralytic shellfish poisoning, diarrhoetic shellfish poisoning, neurotoxic shellfish poisoning, amnesic shellfish poisoning and azaspiracid poisoning). However, Smayda (1997) reports that only 60–80 of the 3400–4100 phytoplankton species, about 2%, are harmful. In the United States, State programs are responsible for managing estuary health and prohibit harvest of oysters during harmful algae blooms. Therefore, all marketable oysters are expected to be safe[1] for human consumption. However, people may still perceive oysters harvested from nutrient rich waters as potentially dangerous and react by shunning the consumption. Kecinski et al. (2016) showed that some consumers shun items despite the lack of an objective or scientific risk. Furthermore, Hansen et al. (2003) point out that decision makers assess food risks on the grounds of personal value systems. Slovic (1987) argues that individuals risk perception is driven by the potential for catastrophic risk and unknown risk, whereas Klein and Kunda (1994) report on individuals' preferences for controllable risks – oysters harvested from a water column may be perceived as "having little control" over the water quality and potential contaminants.

Few economic studies have examined the preferences for oysters. Bruner et al. (2014) used an experimental auction to measure consumers' WTP for traditional raw oysters versus postharvest-processed raw oysters. Though postharvest-processing reduces the health risks associated with eating raw oysters, the authors showed that consumers had greater WTP for traditional raw oysters than for processed ones. Dedah et al. (2011) looked at the impacts of oyster demand and labels warning of serious illness and death among people who suffered from liver disease, chronic illnesses, and weakened immune systems after consuming raw oysters. They found that such warning labels reduced demand for oysters from the Chesapeake and Gulf regions but increased demand for oysters from the Pacific region and imported oysters. Two studies, (a) Li et al. (2017) and (b) Kecinski et al. (2017) use experimental economics to study oyster demand. Specifically, (a) looked at demographic factors that make consumers more likely to select

[1] Note, there are risks associated with consuming raw seafood, including oysters. Therefore, when we say "safe", we are referring to risks that are considered normal for raw seafood consumption. Furthermore, harmful bacteria accumulations in estuaries such as *V. vulnificus* and *V. parahaemolyticus* are generally associated with warmer water temperature, hence the "old" rule of thumb to consume oysters during months that contain the letter "r" and avoid the warmer months (May–August). Our experiments were carried out during March and April. Additionally, the National Shellfish Sanitation Program requires that oysters harvested for raw consumption to meet specific time-to-temperature requirement during months when water temperature exceeds 26.6 °C (Froelich and Noble, 2016).