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An impediment to consumer choice: Overfished species are sold as Pacific red snapper

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ABSTRACT

Concern over the collapse of many wild-caught fisheries has led to a recent focus on seafood-certification and consumer-driven support of sustainable seafood. However, such conservation strategies depend critically on the accurate labeling of seafood species in marketplaces. Pacific rockfish, a group of >60 species in the genus *Sebastes*, are often marketed as Pacific red snapper, but little is known about the number and identity of rockfish species sold under this name. We used a molecular approach to identify species sold as Pacific red snapper by grocery chains, local fish markets, and sushi restaurants in California and Washington. Using genetic data from two mitochondrial markers (cytochrome-*b* and control region), we identified seven species of rockfish (*Sebastes* spp.), tilapia (*Oreochromis* spp.), and one true red snapper (*Lutjanus campechanus*) in our samples. Among samples identified as rockfish, 56% were identified as species listed as overfished by the National Marine Fisheries Service within the past three years. By effectively permitting all species of rockfish to be sold under a common vernacular name, state and federal agencies compromise the ability of consumers to make informed choices when buying seafood.

1. Introduction

The world's oceans continue to face extreme fishing pressures despite an increasingly widespread understanding of the state of decline of fisheries worldwide (Pew Oceans Commission, 2003; US Commission on Ocean Policy, 2004). There is growing recognition that incorporating consumer behavior into conservation strategies will be necessary for reversing this trend, and seafood-certification and consumer-education programs are acknowledged as important tools for improving the sustainability of fisheries (Brownstein et al., 2003; Kaiser and Edwards-Jones, 2006). Recent surveys indicate that many consumers are willing to change their purchasing behavior to help conserve marine resources: In a 2003 survey, 72% of respondents in the United States said they would be more likely to buy seafood that had an "environmentally responsible" label (Seafood Choices Alliance, 2003). In a 2005 survey, 83% of respondents in the United Kingdom felt that overfishing was an important factor that would influence seafood purchases (Seafood Choices Alliance, 2007). In addition, focusing on market forces has proven to be an effective conservation strategy in addressing past fisheries-related conservation problems, including the promotion of dolphin-safe tuna (Kaiser and Edwards-Jones, 2006) and the boycott of swordfish (Brownstein et al., 2003). The increasing recognition of the importance of consumer behavior in marine conserva-

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tion has led to the creation of a number of consumer-education programs around the world (e.g., Australian Marine Conservation Society, Canadian-based Living Oceans Society, Southern African Sustainable Seafood Initiative, UK-based Marine Conservation Society, US-based Seafood Watch and SeaWeb's globally directed Seafood Choices Alliance) and seafood sustainability certification programs (e.g., UK-based Marine Stewardship Council).

A common requirement for the success of all consumer-based choice programs, as well as for fisheries monitoring in general, is accurate naming and labeling of seafood at the point of sale. Without accurate labels, active consumer choices are prevented and fisheries statistics are skewed. In particular, major recognized impediments to seafood-certification programs include mislabeling, misnaming, and the use of vernacular or generic labels for fisheries that contain both sustainable and non-sustainable fished species (Jacquet and Pauly, 2007).

Misnaming or mislabeling of seafood can occur in several forms. Most commonly, a less expensive or low-quality species is named or labeled as a more expensive, higher-quality, or more palatable-sounding species. Examples include Alaskan pollock sold as cod (US Food and Drug Administration [FDA], 2006), spiny dogfish sold as "cape shark" or "rock salmon" (Brownstein et al., 2003), and a variety of snappers (*Lutjanus* spp.) sold as red snapper (Marko et al., 2004). In addition, the Patagonian toothfish (*Dissostichus eleginoides*) is commonly sold as "Chilean sea bass", and many species from diverse fish families (e.g., groupers in the family Serranidae) are commonly sold as cod (family Gadidae). Such substitutions are in many cases illegal if seafood has been transported across state or international boundaries in the United States [Section 403(b) of the federal food, drug and cosmetic act], but within-state regulations on naming vary by locale. Ambiguities can also result when mixed-species fisheries are sold under one vernacular name (e.g. "whitefish" which can include halibut, Alaskan pollock, sole, cod, and black cod). Hold et al. (2001) found that commercial products labeled as salmon could be one of many different species of salmon, including multiple species that are endangered (World Conservation Union, 2006). However, they also found that salmon products labeled with a specific species of salmon (e.g. "chum salmon") were correctly labeled 97% of the time. Even where legal, the practice of misnaming seafood or marketing multiple species under one vernacular name can have important ramifications for market-driven conservation strategies, and such practices can hinder seafood-certification programs and potentially prevent consumers from making informed choices about sustainable purchasing.

Marko et al. (2004) found that 77% of fish products labeled true red snapper (*L. campechanus*) on the East Coast of the United States were products of different species. That study used a genetic market analysis and found intentional mislabeling of a variety lower-quality fishes for substitution as the high-quality and overfished true red snapper. Our study focuses on a fish product named 'Pacific red snapper', which does not exist as a species. In such a case, consumer choice or fisheries documentation depends on a summary view of the species generally included under the Pacific red snapper label.

Under US Food and Drug Administration regulations, 13 species of Pacific rockfish can be sold through interstate commerce under the market name Pacific red snapper in California, Oregon, and Washington (Randolph and Snyder, 1993). Pacific rockfishes (*Sebastes* spp.) are an ecologically diverse genus of fishes that occupy a range of habitats from Mexico to Alaska (Love et al., 2002). Fifty-nine species of rockfish comprise important commercial and recreational fisheries on the West Coast of the United States, and today rockfishes are among the most valuable ground fish in the United States (Love et al., 2002). Several life history characteristics of rockfishes, such as slow growth and late age-at-maturity, result in high vulnerability of many rockfish to overfishing (Parker et al., 2000). Rigorous stock assessments have been carried out for only 15 of the 59 species of rockfishes, and of these, 7 species were estimated to be at 25% or less of their original biomass (Pacific Fishery Management Council [PFMC], 2006a). Because of concerns about stock depletion, numerous restrictions and regulations have been placed on rockfish fisheries in the United States and Canada, including annual harvest quotas, gear restrictions, and area and seasonal closures (PFMC, 2006a).

Using molecular methods, we conducted a survey of various retail outlets in Central and Southern California and Washington to determine the number of species being sold as Pacific red snapper. Specifically, we sought (1) to determine whether species not listed by the FDA are being marketed as Pacific red snapper and (2) to gain a broad understanding of the proportion of fishes being sold as Pacific red snapper that represent overfished species. We consider the results of this survey in light of available knowledge about the status of various rockfish stocks and discuss the impacts of misnaming and mislabeling on market-based conservation strategies.

2. Materials and methods

2.1. *Sample collection, DNA extraction and amplification of cytochrome-b*

We collected 77 whole fish or fillets either labeled as or verbally referred to by vendors as Pacific red snapper from 27 establishments in Central and Southern California and Washington. Samples were purchased in the cities of Monterey, Palo Alto, Menlo Park, Mountain View, Santa Barbara, Bakersfield, California and Seattle, Washington. Samples were purchased at a variety of seafood outlets, including 17 large grocery chains, 3 sushi restaurants, and 7 seafood markets. Sub-samples of each fish or fillet were placed in ethanol for preservation.

Genomic DNA was extracted from each sample using a NucleoSpin DNA extraction kit (BD Biosciences, San Jose, California). A segment of the mitochondrial gene for cytochrome-*b* was amplified by polymerase chain reaction using the following primers: GLUDG-L (TGA CTT GAA RAA CCA YCG TTG) and CB3-H (GGC AAA TAG GAA RTA TCA TTC) (Palumbi and Metz, 1991), and an AmpliTaq PCR Master Mix (Applied Biosystems). We chose to sequence cytochrome-*b* because, at the time of this study, Genbank contained sequences for nearly all the Eastern Pacific rockfishes at this lo-