



Local Seafood Availability in San Diego, California Seafood Markets

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Abstract

Like many developed coastal cities, San Diego, California has strong geographic and recreational ties to the adjacent ocean, but weak culinary ones. Less than 10% of the seafood consumed in the U.S., and San Diego in particular, is domestic. The popularity and abundance of farmers' markets and other local markets in San Diego indicates an interest among producers and the public alike in cultivating local, diverse food systems, but this trend has been slower to catch on for seafood. The goal of this project was, therefore, to define and begin to understand the influences on the patterns of locally sourced, domestic seafood availability in San Diego. This study focused on seafood availability in seafood markets including researching market websites and contacting seafood counter managers to determine the general frequency (consistent, occasional, none) at which the markets sold seafood produced by San Diego fishermen or aquafarmers. Seafood market locations were mapped, and demographic and spatial information was gathered for each market's zip code. The results of the study revealed that only 8% of San Diego's 86 seafood markets consistently carried San Diego-sourced seafood, and 14% of markets carried it on occasion. Increased density of these local seafood markets was correlated with proximity to the coast, with almost 80% of the markets located within 2 km of the coast. Neither per capita income nor racial diversity was correlated with local seafood market density, indicating that factors contributing to coastal isolation matter more than wealth or diversity in determining where local seafood is sold. The geographic disparity in local seafood availability may be due to a variety of factors, including a small fishing fleet, prevalence of imported seafood, limited waterfront and urban infrastructure needed to support a local seafood system, and a lack of public awareness about local fisheries. Information gleaned from this study can inform further investigation into the influences on local, equitable seafood systems, as well as help consumers, producers and marketers to make informed decisions about seafood purchases and marketing efforts.

Introduction

San Diego, California, USA is a coastal city of about 1.3 million people with a vital fishing heritage and history. Once dubbed the "Tuna Capital of the World, employing more than 40,000 people directly or indirectly in the [tuna fishing] industry" (Ellis, 2008, p. 217), the County is now home to just 130 local commercial fishermen (Leschin-Hoar, 2014; Gilmore, 2011). The once thriving

fishing industry has dwindled in part due to decreased awareness of the fishing community, its long heritage, and its products (Golden, 2012; Talley & Batnitzky, 2014). There is a push to revitalize commercial fisheries industry in San Diego in order to help reduce seafood trade deficits, bolster economies and job growth, and ensure availability of fresh, responsibly-sourced seafood for all

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San Diego residents (Paxton, 1994; Weber & Matthews, 2008; Pitcher, Kalikoski, Pramod, & Short, 2009; Schwartz, 2009; Helvey & Wick, 2013; Loring, Gerlach, & Harrison, 2013).

The city's proximity to the Pacific Ocean should make locally caught seafood easily accessible, but less than 10% of the seafood consumed by San Diegans (and Americans at large) is domestic, and diets are species poor, with most of what is eaten coming from just three species: tuna, salmon, and shrimp (National Fisheries Institute, 2014; National Marine Fisheries Service, 2012; Talley & Batnitzky, 2014). The popularity and abundance of farmers' markets and other local-food markets in San Diego (San Diego County Farm Bureau, 2016) indicate a widespread interest among producers and the public alike in cultivating local, diverse food systems. However, this trend has been slower to catch on for seafood (O'hara, 2011).

Local food systems depend upon the traceability of products, including information on the source of a product, the pathways that product took to reach consumers, and where consumers can purchase responsibly-sourced and healthful food. While this information is often available for land based foods (e.g., Golan, et al., 2004; Levinson, 2009), it is largely lacking for seafood (Jacquet & Pauly, 2008). Long international supply chains, illegal, unreported and unregulated (IUU) fishing, mislabeling (or lack of labeling) of seafood products, and questionable third party certification schemes are all factors that complicate the traceability of seafood supply chains (FAO, 2012; Helyar et al., 2014; Jacquet & Pauly, 2008; Jacquet et al., 2010). This study's focus on determining the availability of locally caught seafood in San Diego speaks to this lack of transparency in the seafood supply chain, and contributes to local knowledge of the routes seafood may take in San Diego. This knowledge is crucial for both consumers and producers to make informed choices about food selection and marketing, such as identifying areas or communities where fresh seafood is in demand but not available (Johnson, 2007; Pieniak, Vanhonacker, & Verbeke, 2013). This information is also needed to develop and begin to test hypotheses about the barriers and trade-offs to secure, local food networks (Opara, 2003; Abatekassa & Peterson, 2011).

The goal of this study was, therefore, to provide a snapshot of locally sourced, domestic seafood availability in San Diego, and better understand some of the social influences on observed patterns of local seafood distribution. This goal was met by i) defining distributions of seafood markets, ii) determining the general sources of seafood sold at these markets, and iii) testing relation-

ships between the abundance of local seafood markets, and distance from the coast, per capita income, and racial diversity.

Methodology

Study area

This study was conducted from January 2015 through June 2015, and focused on the City of San Diego, as defined by the nine City Council districts (excluding Imperial Beach; **Figure 1**). Within this boundary, there are a total of 30 zip codes. If a zip code only partially fell within a City Council district, then the whole zip code was included in the area of study.

Seafood markets

A market or restaurant was defined as a "seafood market" if it had the word "seafood" in its name, or if it housed a dedicated, staffed fresh seafood counter that sold "fresh," uncooked seafood to the public. The markets were divided into seven categories: Fishermen's Market (a market owned and operated by commercial fishermen), Restaurant-Market (a retail market within a restaurant), Ethnic Market (a specialty market that primarily sold ethnic foods), Individual Market (a single store), Small Chain (≤ 5 markets owned by the same party), Large Chain (≥ 6 markets owned by the same party), and Wholesale/Distributor (an establishment that sold seafood primarily to markets, who then sold it to consumers). Maps were then created using ArcGIS[®] 10.3. The name, address, phone number, website address, and type of market were imported into ArcMap[™], market addresses were geocoded using ArcGIS[®] toolbox, and markets were mapped on ArcGIS[®] basemaps; software and basemaps are the intellectual property of Esri and are used herein under license.

Availability of local seafood

Each seafood market's website was researched and the seafood counter manager was contacted directly, by phone or in person, to determine the general frequency at which the market sold seafood produced by San Diego fishermen and aquafarmers (referred to as "San Diego seafood"). All of the distributors that were mentioned by market managers were also contacted in order to determine how often the distributors carried San Diego seafood; this information was used to assign a local seafood availability category to the seafood market. The following categories were assigned to each of the markets, according to the answers received:

- *Consistent* – the market contact confirmed that one or more San Diego-sourced products were available in the market throughout an average year.

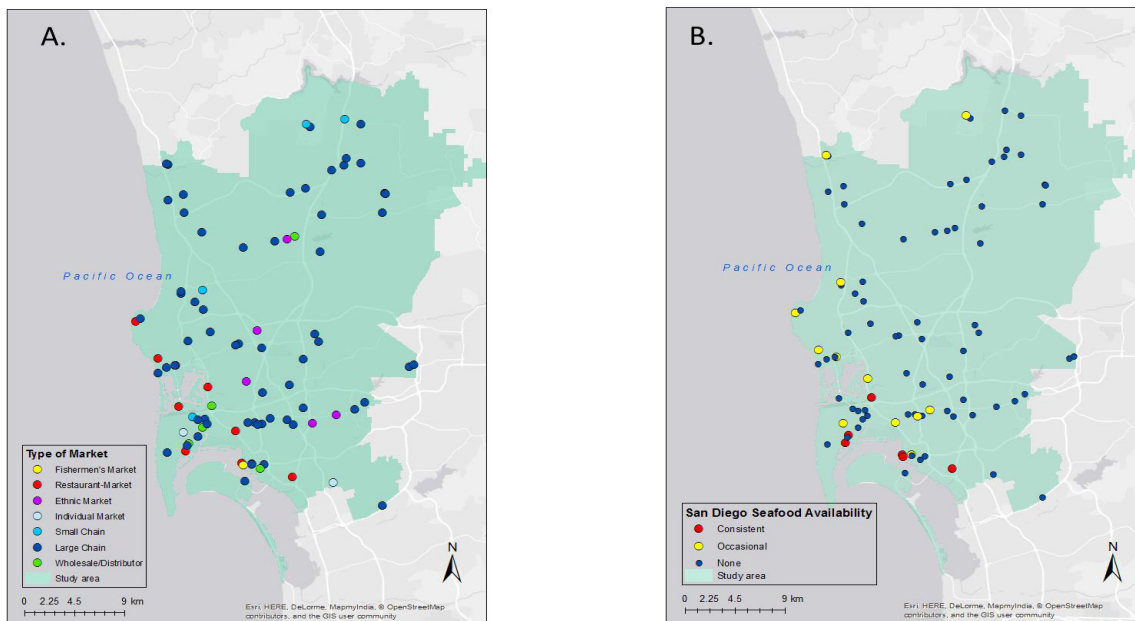


Figure 1: Maps of the City of San Diego, California showing distributions of the types of markets containing seafood counters (A), and the frequency at which the seafood markets carried San Diego-sourced seafood (B). Data are from January to June 2015.

- *Occasional* – the contact stated that one or more San Diego-sourced products were available occasionally during an average year, and/or said that products were potentially San Diego-sourced. (Products *potentially* came from a San Diego Market producer if products were sold to the market from a distributor who confirmed that it at least occasionally purchased that species from San Diego producers).
- *None* – the market contact confirmed that none of their available seafood came from San Diego producers.

Zip code characteristics

Demographic and descriptive data for each zip code were gathered from the website city-data.com (“City Data,” 2013) and the U.S. Census Bureau’s database “American FactFinder” (U.S. Census Bureau, 2014). These data included land area, population size, per capita income, and population by race for each zip code. Shannon-Wiener’s diversity index (normalized) was used to calculate the racial diversity of each zip code from the demographic data collected ($H' = -(\sum [p_i * \ln(p_i)]) / \ln(S)$ where p_i is the proportion of the population of a specific race within a zip code to the total population of that zip code, and S is the total number of categories used to group people by race within that zip code.) The normalized version of Shannon-Wiener’s diversity index gives a value between 0 and 1, where numbers closer to 1 represent more even,

diverse communities, and numbers closer to 0 represent communities more dominated by one group (Hurlbert, 1971; Gotelli, 2008; Ramezani, 2012). The density of markets (number of markets per area of each zip code) was calculated, as well as the distance from the nearest edge of each zip code to the coast, either to the Pacific Ocean, Mission Bay or San Diego Bay, whichever was closest.

Statistical analysis

Relationships between seafood market density and available geographic and demographic variables (distance from coast, income, H' for racial diversity) were explored using stepwise, multiple regressions (Zar, 2009). Regression criteria were $p \leq 0.10$ to enter the model and both $p > 0.05$ and $R^2 < 0.05$ to be removed. Relationships between distance from the coast and both income and racial diversity (H') were explored using simple, polynomial regressions (Zar, 2009). All regressions were run using JMP Pro®12 (2015). Descriptive statistics, H' and correlation graphs were created in Microsoft Excel® 14.5.

Findings and Discussion

The seafood in San Diego’s seafood markets

A total of 86 seafood markets served the city of San Diego’s 1.3 million residents in the first half of 2015 (Figure 1 A). Only 8% of seafood markets consistently carried San Diego-sourced seafood, while 14% carried it on occasion (Figure 1B), or at least likely did. The source of seafood



Table 1: Results of regression analyses. Forward stepwise multiple regressions tested for relationships between density of (A) seafood markets and (B) local seafood markets, and the distance from the coast, annual income, and racial diversity. Only distance from the coast met the criteria to remain in the model. Simple polynomial regressions tested for relationships between (C) racial diversity, (D) income, and the distance from the coast. Data are from January to June 2015.

	R ²	p	F	df (n)
A. Density of seafood markets				
distance from coast	0.18	0.02	6.1	1,28 (30)
B. Density of local seafood markets				
distance from coast	0.12	0.01	7.6	1,28 (30)
C. Racial diversity (H')				
distance from coast	0.54	<0.01	15.5	2,27 (30)
D. Income (per cap annual)				
distance from coast	0.20	0.04	3.5	2,27 (30)

purchased by markets from a distributor was often uncertain. If the market manager mentioned buying from a distributor who in turn had claimed to buy from San Diego fishermen, then we assumed that San Diego seafood was, by chance, at least occasionally available. This uncertainty revealed the need for improved traceability of the seafood supply chain and product source, if we hope to make informed decisions about seafood choices and local seafood systems.

There was only one fishermen’s market, and one fisherman who consistently sold at several of the city’s farmer’s market; these were the only venues where consumers could buy San Diego’s catch directly from producers. Most (80%) of seafood restaurant-markets carried San Diego seafood at least occasionally, while nearly 50% each of seafood wholesalers, individually owned markets, and small chain grocery markets reported carrying San Diego seafood occasionally or more frequently. None of the five ethnic markets and only 7% of large chain stores carried San Diego-sourced seafood; these two market types comprised 72% of all seafood markets in San Diego.

Distributions of local seafood

Each zip code throughout the city had at least one sea-

food market of some type, indicating a citywide demand for fresh seafood, but this study revealed a geographic inequity in the supply of San Diego seafood. The density of all seafood markets (no. km²), as well as the density of markets selling local seafood (either consistently or occasionally), decreased with distance from the coast (**Figure 2A; Table 1**). In fact, 79% of markets selling San Diego seafood (and 100% of markets selling San Diego seafood consistently) were located within just 2 km of the coast. Neither per capita income nor racial diversity was correlated with the density of local seafood markets (comparison of **Figures 2A and 2B; Table 1**).

This link between local seafood access and distance does not mean that vulnerable communities are not among those lacking access to local seafood. Per capita income was lowest and racial diversity peaked in zip codes that were at intermediate distances (5-10 km) from the coast (**Figure 2B; Table 1**), revealing that this highly diverse, often underserved mid-city region of San Diego does not overlap with the distribution of local seafood availability (**Figure 2A**). Ethnic markets and large chain grocery stores, which generally did not offer locally caught species, were the main stores servicing this area. Similarly, large chain grocery stores with imported seafood were nearly the only sources of seafood available to low

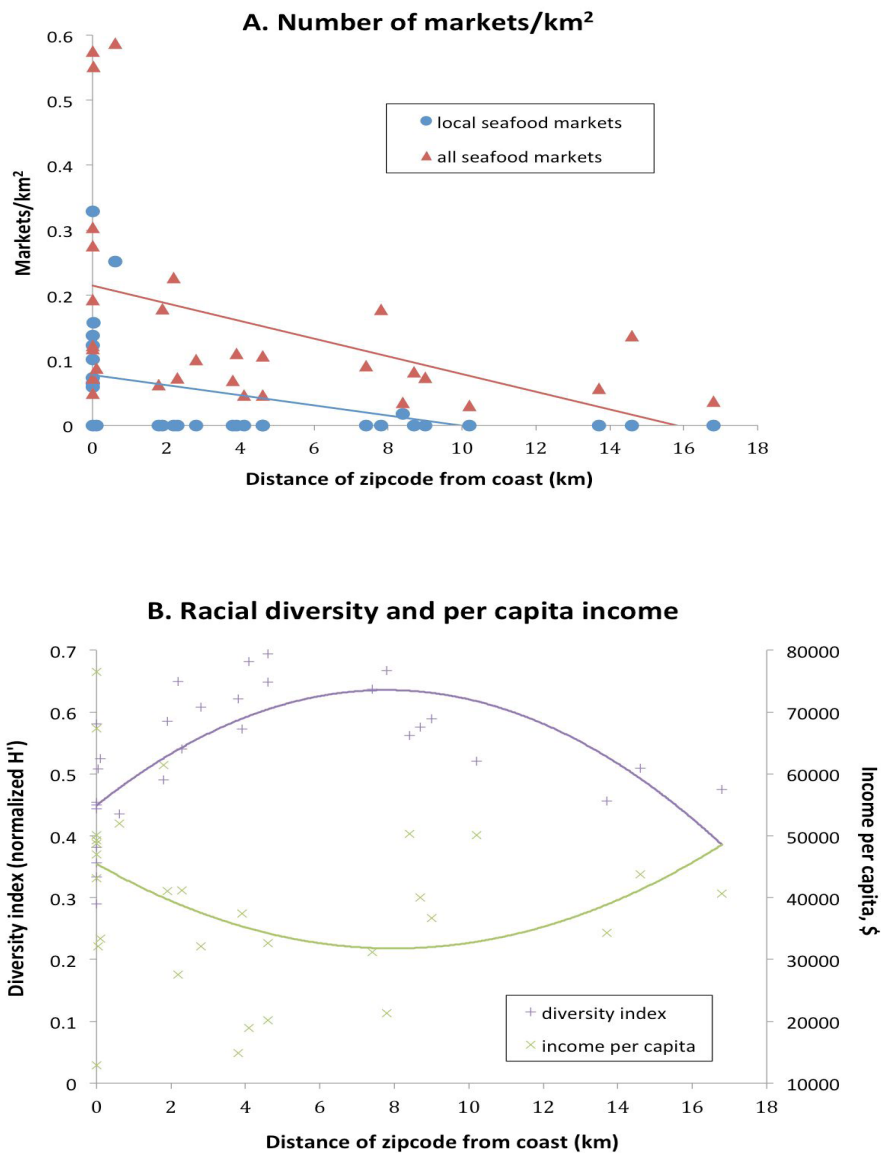


Figure 2 : Relationship between distance of a zip code's nearest edge to the coast of the Pacific Ocean, Mission Bay, or San Diego Bay (km) and both **(A)** the number of local and all seafood markets, and **(B)** racial diversity (H') and per capita income (\$).

diversity, middle class inland San Diego.

Potential limitations on local seafood access

A small fishing fleet, prevalence of imported seafood as compared with domestic seafood, limited waterfront and urban infrastructure needed to process and/or distribute local seafood, and lack of awareness of local fisheries are a few possible explanations for limited access to San Diego seafood based on the relatively few markets in San Diego that carry local seafood, and the strong association between these markets and proximity to the coast.

Small fleets. The relatively small number of 130 commercial fishermen in San Diego is itself a barrier to expanding access to locally sourced seafood. In 2014, the 1.3

million San Diego residents likely consumed 8.6 million kg of seafood, about eight times the amount of seafood landed in San Diego that year (based on an estimated 6.6 kg of fresh, commercial seafood consumed by the average American during 2014) (California Department of Fish and Wildlife, 2015; National Marine Fisheries Service, 2015). It is clear that the current, small fishing fleet could not supply enough local seafood to keep up with the demand of the entire city. Moreover, over half of California's commercial fishermen will retire within the next five years, with not enough qualified people to fill these jobs (Gilmore, 2011; Society for Human Resource Management, 2013; Leschin-Hoar, 2014). Efforts, such as formal apprenticeship programs and supporting regulatory strategies, are needed to overcome the barriers to entry for new fishermen, which include costly permits



and gear, limited numbers of fishery permits, and lack of formal training (Lerman, Eyster, & Chambers, 2009; Unified Port of San Diego et al., 2010; Gilmore, 2011; Shoffler, 2016).

Prevalence of imported seafood. About 90% of the seafood consumed in the United States is imported from overseas (National Oceanic and Atmospheric Administration, 2016). In 2014, \$20.2 billion worth of seafood (2.5 billion kg) was imported into the U.S. By comparison that same year, the U.S. exported \$5.3 billion, almost the same value of seafood as it landed (\$5.5 billion for 4.3 billion kg) (National Marine Fisheries Service, 2014). The broad availability of imported seafood is in part a function of the globalized food system, which puts local fishing fleets, like San Diego's, in competition with large, industrialized international fishing outfits (Greenberg, 2014; National Oceanic and Atmospheric Administration, 2015). This uneven competition, coupled with other factors that disproportionately impact smaller fleets, may have catastrophic effects on small fishing communities. For example, the post World War II decline in San Diego's flourishing tuna industry was a result of a steady increase in the import of foreign caught tuna, in combination with restrictions implemented at home to reduce interactions between marine mammals and purse seines (widely adopted in the late 1950s), and limits placed on the extent of fishing grounds for the San Diego fleet (Schoell, 1999; Sullaway, 2008; Showley, 2012). Additionally, because of their national scope, large chain grocery stores do not often purchase products from local producers, instead utilizing large-scale "distribution centers that collect and deliver food products to individual retail stores" (Abatekassa & Peterson, 2011, p. 51). Chain supermarkets have established, long-term relationships with distributors who collect goods from producers who can meet the supermarkets' insurance, price, and volume requirements (Abatekassa & Peterson, 2011). These entrenched food pathways limit expansion and support for local food systems, often resulting in few places for consumers to buy fish caught by local fishermen, as observed in San Diego.

The availability of local seafood in this globalized market-dominated system may also be low due to low local retention of catch. Over one third of U.S. commercial landings are exported abroad (National Marine Fisheries Service, 2014; Greenberg, 2014, introduction). The extent to which San Diego landings are kept within the area is somewhat unclear and varies with species. Some San Diego fishermen testified that only 20 to 25% of their catch stays in San Diego (Shoffler, 2016). Similarly, a recent study revealed that 95 to 99% of San Diego-caught California spiny lobster and 90% of market squid are

shipped abroad, primarily to the Chinese market (Shoffler, 2016; Masury and Tripp, 2016). Regardless of the exact percentage of San Diego catch that is retained in the area, it is clear that retention could be improved to better meet the demand of the city's residents. For example, supplies can be increased with a more efficient distribution throughout the greater San Diego region of locally caught species, in particular species that are inadvertently caught (e.g., "trash fish"; Oko, 2011) and those that were once desirable, but are now largely exported for uses other than direct consumption (e.g. market squid, sardine) (Ueber & MacCall, 2005). Efforts like direct marketing, where fishermen sell directly to consumers and the food service industry, can also help to increase local retention of local catch, while allowing fishermen to capture more of the value added to their product and collectively build resilience to socio-ecological vulnerabilities (Johnson, 2007; Stoll, Dubik, & Campbell, 2015). Direct markets allow for more local sales of a greater diversity of local seafood because people are more apt to try novel foods when presented with the choices and the ability to hear about sourcing and preparation from producers (Talley & Batnitzky, 2014)

Waterfront and urban infrastructure. Even with more fishermen and fish there remains, however, a noted lack of waterfront infrastructure used for docking, offloading, maintaining boats and gear, holding and refrigerating catch, and direct marketing of catch along the San Diego coast (Halmai, 2013). Recent efforts have restored some waterfront infrastructure in San Diego, including provision of dock space for the fishermen's market, as well as the replacement of one dock with a new crane and hoist, and the installation of an ice machine and a live holding tank (Unified Port of San Diego et al., 2010). These upgrades are, however, relatively few given the size and needs of the fleet, controlled by non-fishermen entities, and installed in a location where few commercial fishermen dock (Harvey, 2013). The increased establishment and upkeep of fishermen-owned and operated waterfront infrastructure will help overcome this infrastructural barrier to establishing local food systems, and forge pathways between San Diego fishermen, and the San Diego consumers, retailers, and distributors who have been largely choosing imported seafood (Gloucester Community Panel, 2003; Culver, Richards, & Pomeroy, 2007; U.S. Department of Agriculture, 2015).

Urban infrastructure that can support a local fishing industry and food system is also needed. The most common urban planning strategies implemented in the U.S. to promote local community-based food production and to improve equitable access to local food products involve preserving rural agricultural land, supporting ur-



ban farms and community gardens, and improving consumer access to farmers' markets (Hodgson, 2012; e.g., Marin County Community Development Agency, 2007). Less emphasized are strategies for supporting local and regional food distribution and processing networks (Hodgson, 2012). Because the production side of local marine seafood systems is restricted to the coast, it may be more important to promote local distributional and processing infrastructure to encourage retention and consumption of local seafood in San Diego, although this may reduce the added revenue fishermen reap from direct marketing their catch. Local distribution companies may help bridge the gap between fishermen and local markets, and establish those trusted relationships between producers, distributors, and retailers that are missing on a local scale (Abatekassa & Peterson, 2011).

Public awareness. Lastly, the significant difference between the seafood species that are regularly consumed by San Diegans, and the species that are caught by San Diego fishermen, likely contributes to the low consumption of local seafood (Talley and Batnitzky, 2014). San Diego fisheries include some mainstream species, including higher trophic level finfish like tuna and swordfish, but also many less well-known fisheries (invertebrates such as Kellet's whelk and wavy turban snail, and coastal groundfish and pelagics, such as rockfish, sablefish, and Pacific mackerel) (Talley & Batnitzky, 2014; Tuna Harbor Dockside Market, 2016; California Department of Fish & Wildlife, 2015). The very narrow San Diego seafood diet – compounded by prevalent, inexpensive imports of mainstream species – results in an egregious lack of awareness of the species landed locally (Talley & Batnitzky, 2014). This lack of awareness and dietary adventurousness is likely a deterrent to selling locally caught species throughout the city, and may partially explain why local seafood is not widely available. As mentioned above, direct marketing serves as a potential solution to this problem, as consumers may be more likely to try new foods when they have personal relationships with the producers, are presented with information about sourcing and preparation, and are offered the chance to taste new items (Zepeda & Deal, 2009; Talley & Batnitzky, 2014).

Conclusion

The information provided by this study provides a snapshot of the current conditions of the availability of local, San Diego-sourced seafood in San Diego markets. The large majority of markets carrying local seafood are located within 2 km of the coast, cutting off most of this coastal city from its own seafood. Solutions to improving local seafood availability include training a new genera-

tion of fishermen, and increasing the social capital and infrastructure needed to boost direct sales, local retention rates, and equitable distribution of locally caught seafood. Raising consumer awareness about local fisheries through direct marketing experiences and outreach efforts will contribute to a stronger demand for locally caught species and support of the local fishing industry.

The results of this study, as well as the limitations and potential solutions discussed above, reveal that there are many remaining research needs within San Diego's seafood system. Uncertain, but likely important, are the impacts of law, policy, local history, global and local economics, marketing, and zoning or land use configurations on the growth of the fishing industry, the supplies and public demand for local seafood, and on the distribution and equitable access to local seafood products. Further, socio-economic analyses are needed to understand the trade-offs, barriers and opportunities associated with strengthening the local seafood system.

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Conflict of Interests

The authors hereby declare that there are no conflicts of interest.

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