Pacific Islands Fisheries Science Center

Community Participation in Hawai'i Commercial Fisheries

JUSTIN HOSPITAL AND KIRSTEN LEONG

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Justin Hospital[1], Kirsten Leong[1]

[1]Pacific Islands Fisheries Science Center
   National Marine Fisheries Service
   1845 Wasp Boulevard
   Honolulu, HI 96818

U.S. Department of Commerce
Wynn Coggins, Acting Secretary

National Oceanic and Atmospheric Administration
Benjamin Friedman, Acting NOAA Administrator

National Marine Fisheries Service
Paul Doremus, Ph.D., Acting Assistant Administrator for Fisheries

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Cover photos clockwise from top left: Deep 7 bottomfish, NOAA photo by Kurt Kawamoto; pulling skipjack tuna (aku) from cooler, NOAA photo by Justin Hospital; two men on pelagic handline boat in Hilo harbor, NOAA photo by Justin Hospital; fish (opelu) in ice, NOAA photo by Justin Hospital; aerial view of Pier 38, JIMAR photo by Brian Gionfriddo; small boat in Honaunau Bay, NOAA photo by Justin Hospital; reeling in yellowfin tuna (ahi), NOAA photo by Kurt Kawamoto.

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Executive Summary

One of the responsibilities of NOAA Fisheries is to consider potential effects of fisheries management on fishing communities, "…to provide for the sustained participation of such communities and…to the extent practicable, minimize adverse economic impacts on such communities" (Magnuson Stevens Act (MSA), National Standard 8 (NS8), 16 U.S.C. § 1851(a)(8)). In 2017, NOAA Fisheries released a report on Community Participation in Catch Share Programs (Colburn et al. 2017) that identified community-level catch share performance metrics to understand changes in social vulnerability and community participation in fisheries involved in each of the U.S. catch share programs.

This report applies methodologies in Colburn et al. (2017) to assess community participation for select Hawai'i commercial fisheries from 2000 to 2018. Fishing communities are defined at the Census County Division (CCD) geographic scale resulting in 41 assessed in this report. Fisheries chosen for analysis include the pelagic longline, small boat Highly Migratory Species (HMS), main Hawaiian Islands (MHI) Deep 7 bottomfish, uku, and nearshore and reef fisheries, which collectively account for nearly all commercial fishing landings in the State of Hawai'i. For each fishery, we present a fishery performance overview, trends in community performance, and community social vulnerability indicators. Community performance is assessed through a Fishing Engagement Index (FEI) and metrics detailing community importance to regional fisheries (Regional Quotient) and fishery importance to local communities (Local Quotient) relative to a fishery-specific 3-year baseline period. Community social vulnerability indicators are calculated for environmental justice, economic, and gentrification pressure vulnerability.

The FEI measures community-level fishery participation based on pounds landed, revenue, active commercial fishers, and seafood dealers within a community. FEI scores were generated and compared for each community, where scores of 1.0 or greater are defined as highly engaged. The communities of Honolulu (O'ahu), North Kona (Hawai'i), and 'Ewa (O'ahu) were consistently highly engaged across nearly all fishery-specific fishing engagement indices. The O'ahu communities are the two most populous CCD communities in the State of Hawai'i so these results may not be surprising based on the composition of the FEI. North Kona, while a small community in terms of population, is the heart of the State's vibrant charter sport fishery and home to a major fishing port providing access to the favorable waters off West Hawai'i Island. Pelagic fisheries are the state's largest and most valuable fisheries and their FEI scores have held relatively stable over our period of analysis. The MHI Deep 7 bottomfish fishery has experienced significant management changes during our study period, and the composition of highly engaged communities has changed in important ways. We found more communities were highly engaged in 2018 relative to the baseline period (2004–2006). The uku fishery has seen individual years of high engagement from many Maui and Kaua'i communities, indicating the fishery likely plays an important role even if these communities do not consistently achieve the highly engaged FEI threshold. The nearshore and reef fish fishery had five communities highly engaged in all years, with Honolulu (O'ahu) and North Kona (Hawai'i) experiencing significant declines in engagement since the baseline (2000–2002) period, while the community of Wai'anae (O'ahu) underwent significantly increased engagement since the baseline.

The Regional Quotient reflects a community's engagement in a fishery, or a community's importance to the fishery. This report presents Regional Quotient values for active fishers,

pounds landed, and revenue. Monitoring the Regional Quotient can provide valuable information, outside of the FEI, for fishery managers to target outreach and education, particularly in communities that lack elements important to the FEI (e.g., number of dealers or fishers) for them to be considered highly engaged. We found high levels of stability in Regional Quotient values for the number of active fishers in Hawai'i communities, suggesting that fishing community composition was consistent, but fishery landings and revenues did not demonstrate similar levels of stability. Trends in community-level Regional Quotient values for pounds landed and revenue closely follow trends in community FEI scores. Communities that were highly engaged for all years, or a specified portion of years, comprised a significant share of landings and revenue for Hawai'i fisheries. Trends in the Regional Quotient provide additional insights into changing fishery dynamics across communities. The small boat HMS fishery, MHI Deep 7 bottomfish, and uku fisheries all saw notable increases in contributions from communities that had not been highly engaged since the baseline period.

The Local Quotient metric provides a glimpse into the importance of a fishery to an individual community by measuring the share of fishery activity relative to all fishing within a community. Local Quotient values shed light on the levels of fishery diversification in a community, with high values indicating high levels of reliance for a community in that fishery. The Local Quotient is a valuable measure of fishery reliance that can be coupled with the FEI to allow managers to consider additional perspectives when assessing potential impacts from management decisions. Assessing who is impacted and how may be different if one only considers participation (FEI) or reliance (Local Quotient). In 2018, the average Local Quotient score for HMS landings and revenues in Hawai'i communities was 73% and 68%, respectively, indicating a strong reliance on pelagic resources. For just over half (54%) of Hawai'i communities, the HMS fishery comprised at least 80% of community landings and revenues in 2018. Insular fisheries such as the MHI Deep 7 bottomfish, uku, and nearshore and reef fish fisheries account for the remaining fishery contributions to communities across the State of Hawai'i. Although, the majority of communities rely heavily on pelagic fisheries, it does not diminish the economic, cultural, and social value provided by insular fisheries.

Social vulnerability indicators highlight the diversity of Hawai'i communities from a socio-demographic perspective. Three sets of indices were developed to examine environmental justice, economic factors that can affect individual or community resilience and adaptability to change, and gentrification pressure indicators. Communities in Hawai'i that were more highly engaged across more years tended to have larger than average populations and lower vulnerability scores than those less consistently engaged over the time period examined. In general, neighbor island communities tended to have slightly higher social vulnerability indicator scores relative to O'ahu communities and were more prevalent in the insular fisheries. Many of these fishers may engage in a mix of commercial and non-commercial fishing. Fishing engagement indices based only on commercial fishing metrics may miss important non-commercial fishing contributions.

The findings in this report lay an important foundation for understanding community participation in Hawai'i commercial fisheries and produce opportunities for future work, such as developing comparable indices for non-commercial fisheries. The community performance indicators are flexible enough to be applied to individual species or species groups, which can also be used to inform future management alternatives.

Introduction

One of the responsibilities of NOAA Fisheries is to consider potential effects of fisheries management on fishing communities, "…to provide for the sustained participation of such communities and…to the extent practicable, minimize adverse economic impacts on such communities" (Magnuson Stevens Act (MSA), National Standard 8 (NS8), 16 U.S.C. § 1851(a)(8)). In 2013, social indicators were developed to assess the vulnerability and resilience of fishing communities in the U.S. Southeast and Northeast Regions (Jepson and Colburn 2013). Indices were developed for social vulnerability, gentrification, fishing engagement, and fishing reliance. Since then, these indicators have been calculated annually at the national level with input from all regions.[1]

In 2017, NOAA Fisheries used these indicators to assess Community Participation in Catch Share Programs (Colburn et al. 2017). The study developed community-level catch share performance metrics to understand changes in social vulnerability and community participation in fisheries involved in each of the U.S. catch share programs. Catch share programs utilize various strategies to allocate a portion, or share, of the total allowable fish catch, or quota, of a given fishery to individuals, groups, communities, or other entities. As there are no catch share managed fisheries in the Pacific Islands Region (PIR), no PIR fisheries were included in Colburn et al. (2017). However, NOAA has responsibilities to provide for the sustained participation of fishing communities, regardless of type of management controls. The Pacific Islands Region (PIR) completed a regional assessment of community social vulnerability indicators in 2018 (Kleiber et al. 2018). This report applies methodologies used in Colburn et al. (2017) to assess trends in community participation across select Hawai'i commercial fisheries from 2000–2018.

Overview of Hawai'i Commercial Fisheries

Commercial fishing activities in Hawai'i are generally separated into pelagic and insular ecosystems. Offshore fisheries target large pelagic species with distributions straddling domestic and international waters, and insular fisheries include nearshore species that occur in both state and federal waters and are managed jointly by the State of Hawai'i, Department of Land and Natural Resources, Division of Aquatic Resources, the National Marine Fisheries Service (NMFS), Pacific Islands Regional Office (PIRO), and the Western Pacific Fishery Management Council (WPFMC 2019 a, b). Detailed descriptions of PIR fisheries are available in the Pacific Islands Fishery Monographs series on Fishing Fleets and Fishery Profiles (Markrich and Hawkins 2016).

Pelagic fisheries include the Hawai'i longline fishery, main Hawaiian Islands (MHI) troll and handline, offshore handline, and the aku boat (pole and line) fisheries. The charter sport fishery is also included as much of the catch is retained and sold by the captains. Pelagic fisheries represent the state's largest and most commercially valuable fishery sector. In 2018, the pelagic fisheries collectively landed approximately 37.7 million pounds of fish with a total ex-vessel value of $114.8 million (WPFMC 2019b). A total of 3,308 fishermen were licensed that year, including 1,982 (60%) who indicated that their primary fishing method and gear were intended

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[1] https://www.st.nmfs.noaa.gov/data-and-tools/social-indicators/

to catch pelagic fish (WPFMC 2019b). Most commercial licenses with pelagic fishing as their primary method were issued to longline fishermen (45%) and trollers (42%) with the remainder issued to ika shibi and palu ahi (handline) (13%) (WPFMC 2019b). The Hawai'i longline fishery alone accounted for 83% of the total commercial pelagic catch and 87% of the ex-vessel revenue in 2018 (WPFMC 2019b). As a point of reference, the second largest pelagic fishery, MHI troll, represented only 7% of the catch and revenue. Thus, for the purposes of this report, non-longline small boat pelagic fisheries are analyzed together as the Highly Migratory Species (HMS) fishery. Tunas comprised 67% of the pelagic total catch in 2018, billfish 15%, and smaller amounts of various large pelagic species (WPFMC 2019b).

Many small boat fishers engage in both pelagic and insular fisheries. The ability to switch between gear types and fisheries is one of the defining characteristics of Hawai'i fisheries and allows fishers to adapt to weather and fishing conditions to optimize viability of their operations (WPFMC 2002). Insular fisheries in this report include the MHI Deep 7 bottomfish fishery, uku, and nearshore and reef species fisheries. Although the direct monetary value of these fisheries is only approximately 10% of the pelagic fishery, they are culturally and socially important (Glazier 2007; Calhoun et al. 2020). The MHI Deep 7 bottomfish fishery is the most well-known commercial insular fishery, targeting deep-slope snappers and a grouper that are prized for cultural significance and sold to local restaurants. The uku (*Aprion virescens*, family Lutjanidae) fishery is popular for both commercial and non-commercial fishers. Nearshore and reef fish fisheries include hundreds of coral reef ecosystem dependent species that are managed collectively under the Hawaii Archipelago Fishery Ecosystem Plan. Commercial fishing for nearshore and reef species can be shore-based or boat-based and includes a wide range of gear types including rod and reel, spear, nets, and traps. While most reef fish are caught for subsistence and recreation, they may be sold to offset costs of fishing or for additional income. Considering both commercial and non-commercial fishing, the majority of fishing activity (in terms of participation and effort) in the State of Hawai'i targets nearshore and reef fish species.

While small boat and nearshore activities are widely dispersed within and among the islands, supporting industries associated with large-vessel fisheries such as the longline fishery are primarily concentrated in Honolulu. The Hawai'i fishing and seafood industry is an integrated food production and supply system that links fishers to our nation's only fresh tuna auction, the fish auction buyers (mainly wholesalers), and ultimately, retailers and restaurants in Hawai'i and across the United States. In 2018, Honolulu was the nation's #6 port in seafood value ($106 million, NMFS 2020). Commercial fisheries in Hawai'i operate year-round although revenues typically peak from March to June, with a second seasonal peak during the holiday months of December and January. During 2018, there were 121 active seafood dealers, over 2,500 licensed fishers with commercial sales, and a world-renowned charter/for-hire industry.

Fisheries chosen for analysis in this report include the Hawai'i Longline fishery, small boat Highly Migratory Species (HMS), main Hawaiian Islands Deep 7 bottomfish, uku, and nearshore and reef fisheries, which collectively account for nearly all commercial fishing landings in the State of Hawai'i. For each fishery, a set of community-level performance metrics (Table 1) is reported to examine changes over time, through 2018, relative to a 3-year baseline. The baseline period for most fisheries in this report is 2000–2002, except for the MHI Deep 7 bottomfish fishery with a baseline of 2004–2006 to highlight management changes in the fishery that began in 2007.

Community Performance Indicators

Following Colburn et al. (2017), we calculated two categories of indicators to monitor community dependence on fisheries. The first category measures commercial fishing engagement by community and includes a Fishing Engagement Index, Regional Quotient, and Local Quotient (see Table 1 for definitions and timeframe). The second category includes community-specific measures of environmental justice, economic, and gentrification pressure indicators based on those developed in Jepson and Colburn (2013). Together, these six metrics form the Community Performance Indicators (further defined in Table 1).

Table 1. Definitions of community performance indicators, following Colburn et al. (2017).

Performance Indicator	Definition	Timeframe
Fishing Engagement Index*	Index consisting of species pounds landed and revenue, number of licensed fishers with landings, number of dealers within a community	Baseline to 2018
Regional Quotient* (fishers, pounds, and revenue)	Community share of species divided by total for species in region	Baseline to 2018
Local Quotient* (pounds and revenue)	Community share of species divided by total for all species in community	Baseline to 2018
Community Social Vulnerability Indicators (CSVIs)	Environmental Justice Indicators: Poverty, Population Composition, Personal Disruption, Economic Indicators: Housing Characteristics, Labor Force Structure Gentrification Pressure Indicators: Housing Disruption, Retiree Migration, Urban Sprawl	2018 American Community Survey 5-year Estimate (2014–2018)

This report examines trends for select regional fisheries for these Community Performance Indicators over time, from a 3-year baseline period through 2018. While these trends may show increases, decreases, or little change for any given fishery, the framework does not allow us to attribute trends to any specific factors. Changes in trends can be attributed to many considerations which we cannot control such as macroeconomic conditions, changes in the natural environment, or fishery dynamics and regulations.

Methods

Each of the community performance indicators was created following the methodology established in Colburn et al. (2017). Indicators have been developed for communities at various scales across NOAA Fisheries regions (Census Designated Place (CDP), Minor Civil Division (MCD), or Census County Division (CCD)). In the Pacific Islands Region, MSA fishing communities have been designated at the island-level for Hawaiʻi and the archipelago level for the other inhabited areas (68 FR 46112). The MSA recognizes that Pacific Island areas "…contain unique historical, cultural, legal, political, and geographical circumstances which make fisheries resources important in sustaining their economic growth" (16 USC § 1801 (a)(10)). Supplemental amendments to the region's Fishery Management Plans formally recognized the vital role of fishing communities (both commercial and non-commercial) in supporting local food systems, nutrition, food security, and community social cohesion (WPFMC, 2002; 68 FR 46112). Further, they acknowledged the central role of fishery resources in the social, cultural, and economic fabric of Hawaiian society, designating all islands as fishing communities (WPFMC, 2002). However, at this scale it is difficult to capture differences among communities within islands. Kleiber et al. (2018) determined that the CCD scale is an appropriate scale to use in the PIR as it allows for finer-scale analysis of communities within islands as well as meaningful integration into biological vulnerability models. Thus, communities defined and reported in this report align with the CCD boundaries as determined by the U.S. Census, resulting in 41 communities assessed for the State of Hawaiʻi (see Appendix).

In Hawaiʻi, it is common for fishery participants to shift among gear types and fisheries, including between commercial and non-commercial activities (WPFMC 2019 a, b). For example, many people with commercial fishing permits may only sell portions of their catch to cover expenses such as fuel, bait, and ice. For the purposes of this report, we utilized the legal definition of commercial fishing: fishing for sale, barter, or trade (16 USC § 1802 (4)). We report on the associated metrics collected in conjunction with commercial fishing permits, regardless of individual fisher motivation or identity.

Fishing Engagement Index

The Fishing Engagement Index (FEI) measures the participation of a given community in a fishery, relative to other coastal communities in the region. Data come from State of Hawaiʻi Division of Aquatic Resources fisher catch reports (PIFSC 2021a) and dealer reports (PIFSC 2021b), summarized by fisher and business zip code, then aggregated to CCD (Kleiber et al. 2018).

For each fishery, a principal component factor analysis (PCFA) was conducted on pounds landed and revenues, number of dealers/processors, and the number of commercial-licensed fishers reporting landings within a community to create a single standardized index score. A single factor solution for the PCFA was achieved, indicating that all variables included in that PCFA related to community fishing engagement. The scores of the PCFA were normalized to have a mean of zero, and the normalized scores were used as the index scores for each community.

Diagnostic tests were applied to ensure robust FEI estimates. The Kaiser-Meyer-Olkin (KMO) measure determines the sufficiency of sample size (Kaiser 1974). Bartlett's test of sphericity

(Bartlett 1937) is used to evaluate homoscedasticity in variances to ensure there is sufficient variation to support analyses of components. To test the internal consistency of the variables in each component, we used an Armor's theta reliability test (Armor 1973). Finally, the determinant is assessed to ensure that the matrix for analysis is not an identity matrix and does not demonstrate multicollinearity. See Jepson and Colburn (2013) for a full description of index construction and diagnostics.

Fishing Engagement Index (FEI) scores were generated and compared for each community. Highly engaged communities are defined as those with FEI scores of 1.0 or greater, as this represents one standard deviation above the mean. This FEI engagement threshold is represented by a dashed line in all FEI indicator trend figures. This report focuses on communities that were highly engaged for a least one year from the baseline through 2018.

The chosen baseline period was determined by relevant changes in data reporting requirements or management regime for each fishery. The baseline period for most fisheries in this report is the 3-year period of 2000–2002. This time frame reflects a transition period in state fishery data reporting requirements. A 3-year average was believed to appropriately represent fishery conditions during this transition and provide an accurate basis to compare future conditions under new reporting requirements. However, for this report, the MHI Deep 7 bottomfish fishery baseline is specified as 2004–2006 as this fishery changed to a Total Allowable Catch (TAC) quota-based management regime in 2007. A 3-year pre-TAC average baseline was chosen to examine community-level impacts of the shift to quota management.

Regional Quotient

To assess a community's contribution to regional participation, landings, or revenue for a particular fishery, we calculated the Regional Quotient. The Regional Quotient for participation is the share of licensed commercial fishers in a community reporting landings for that fishery divided by the total regional fishers in the fishery. The Regional Quotient for landings is the share of community landings for that fishery divided by the total regional landings of the fishery. For revenue, it is the share of the community revenue from the fishery divided by the total regional revenue of the fishery.

Due to significant differences in scale and the fact that longline fishers (in general) do not participate in other regional fisheries, the Regional Quotient presented for non-longline fisheries in this report excludes longline fishers, landings, and revenues, and thus represents fisheries relative to all other non-longline fisheries.

Local Quotient

To assess the importance of a particular fishery relative to all fisheries engaged in by a community, we calculated the Local Quotient. The Local Quotient for landings is the percentage of community landings for that fishery divided by the total community landings for all fisheries. For revenue, it is the percentage of the community revenue of the fishery divided by the total revenue for all fisheries in the community. This provides a measure of how reliant a community is on particular fisheries' resources and can provide insights into the degree of commercial fishery diversification within a community.

Similar to the Regional Quotient, due to significant differences in scale and the fact that longline fishers (in general) do not participate in other regional fisheries, the Local Quotient presented for non-longline fisheries in this report excludes longline fishers, landings, and revenues. Thus, it represents fishery reliance in a community relative to all other non-longline fisheries.

Community Social Vulnerability Indicators (CSVIs)

The Community Social Vulnerability Indicators (CSVIs) are a set of quantitative measures of objective well-being, developed to fulfill the MSA NS8 requirement to monitor place-based fishing communities. Twelve indicators were developed for communities at the appropriate scale across NOAA Fisheries regions (Census Designated Place (CDP), Minor Civil Division (MCD), or Census County Division (CCD)) using numerous variables from secondary data sources, primarily the U.S. Census American Community Survey 5-year estimates (NMFS Office of Science and Technology 2021). Each CSVI represents a different aspect of objective community well-being using multiple variables as defined in Table 2.

The Environmental Justice Indicators allow one to consider whether policies impose disproportionate impacts on disadvantaged communities. The **Personal Disruption Index** was calculated using variables related to an individual's vulnerability (e.g., low education levels or unemployment) that can collectively influence the community's overall well-being. Higher Personal Disruption Index scores can be associated with lower levels of well-being, e.g., when communities show higher unemployment rates, numbers of residents without a high school diploma, more residents in poverty, or more separated female residents. The **Population Composition Index** measures the presence of vulnerable populations within a community (e.g., minorities, those who speak English less than well, or a single parent living in a household with children). A higher Population Composition Index score indicates lower community well-being. The **Poverty Index** is an overall measure of poverty based on the degree to which several different groups are in poverty or receiving social assistance. A higher Poverty Index score implies higher vulnerability as more residents are found to be below national poverty levels.

Economic indicators characterize community labor conditions and housing, which could affect an individual or community's ability to adapt to change (Colburn et al. 2017). The **Labor Force Structure Index** measures the number of people employed in various sectors of the economy to determine the stability and overall makeup of the labor force. It is reverse scored—a higher index score means fewer opportunities or a more vulnerable population relying more on self-employment. The **Housing Characteristics Index** measures infrastructure vulnerability, including housing characteristics that may be vulnerable to coastal hazards. It is also reverse scored so that a high index score means a more vulnerable infrastructure and, therefore, a more vulnerable community.

Gentrification Pressure Vulnerability Indicators represent factors that over time may indicate changes in the viability of a vibrant commercial working waterfront as the composition of fishing communities changes to include more renters and retirees. The **Housing Disruption Index** utilizes factors that signify changes in the housing market, where rising home values and rents may displace established community residents. A high score means a community more likely to need affordable housing. The **Retiree Migration Index** reflects the concentration of retirees and elderly people in the population, which often brings higher rents and home values and an

increased need for services. A high score indicates a community more likely to be experiencing gentrification as retirees seek out the amenities of coastal living. The **Urban Sprawl Index** indicates communities experiencing increasing population density, home values, and land areas, which signify gentrification. Higher scores indicate communities more vulnerable to gentrification.

Index scores for each community were then categorized from high to low based on standard deviations (SD) from the mean, in comparison with all communities across the country. Communities in the high category had index scores 1 SD or above the mean, medium-high engagement had scores 0.50 to 0.99 SD above the mean, medium engagement was 0.00 to 0.49 SD above the mean, and low was below 0.00.

Table 2. Community Social Vulnerability Indicators.

Performance Indicator	Definition
Environmental Justice Indicators	
Personal Disruption	Percent unemployed Percent females separated Percent in poverty Percent with no diploma Crime Index
Population Composition	Percent female, single head of household Percent population, age 0-5 Percent that speak English, less than well Percent white alone
Poverty	Percent over 65 in poverty Percent under 18 in poverty Percent of families below poverty level Percent receiving assistance
Economic Indicators	
Labor Force Structure	Percent population in labor force Percent population receiving social security Percent of class of worker self-employed Percent females employed
Housing Characteristics	Median rent in dollars Median mortgage in dollars Median number of rooms Percent mobile homes
Gentrification Pressure Indicators	
Housing Disruption	Percent change in mortgage Percent change in home values Percent of owner's monthly costs, over 35% of income
Retiree Migration	Households with one or more individual over 65 Percent population receiving social security Percent receiving retirement income Percent in labor force
Urban Sprawl	Population density Nearest city (in miles) with at least 50,000 population Cost of living index Median home value

Results

Longline Fishery

Fishery Overview

The Hawai'i pelagic longline fishery had 143 active vessels in 2018. The fishery operates using two primary gear configurations based on target species: shallow-sets that target swordfish (*Xiphias gladius*) and deep-sets that maximize catches of bigeye tuna (*Thunnus obesus,* WPFMC 2019b).

Other commercially important species landed in this fishery include yellowfin tuna (*Thunnus albacares*), mahimahi (dolphinfish, *Coryphaena spp*), ono (wahoo, *Acanthocybium solandri*), blue and striped marlins (*Makaira mazara, Tetrapturus audax*), opah (moonfish, *Lampris spp.*) and monchong (pomfret, Family *Bramidae*). The Hawai'i longline fishery does not freeze its catch and supplies high quality fresh fish that seafood dealers and processors distribute to foodservice and retail markets in Hawai'i, Japan, and the U.S. mainland. The Hawai'i longline fishery produces over 80% of the Nation's domestic supply of bigeye and yellowfin *(Thunnus albacares)* tuna and 55% of swordfish (NMFS 2020).

On average, the Hawai'i longline fishery accounts for approximately 97% of Honolulu fishery revenues and over 85% of fishery revenues for the State of Hawai'i (NMFS 2020). In 2016, it is estimated that the commercial seafood industry in Hawai'i generated sales impacts of $867 million and income impacts of $269 million while supporting approximately 9,900 jobs in the State of Hawai'i. The commercial harvest sector generated nearly 3,700 jobs, $206 million in sales, $75 million in income, and $108 million in value added impacts (NMFS 2018).
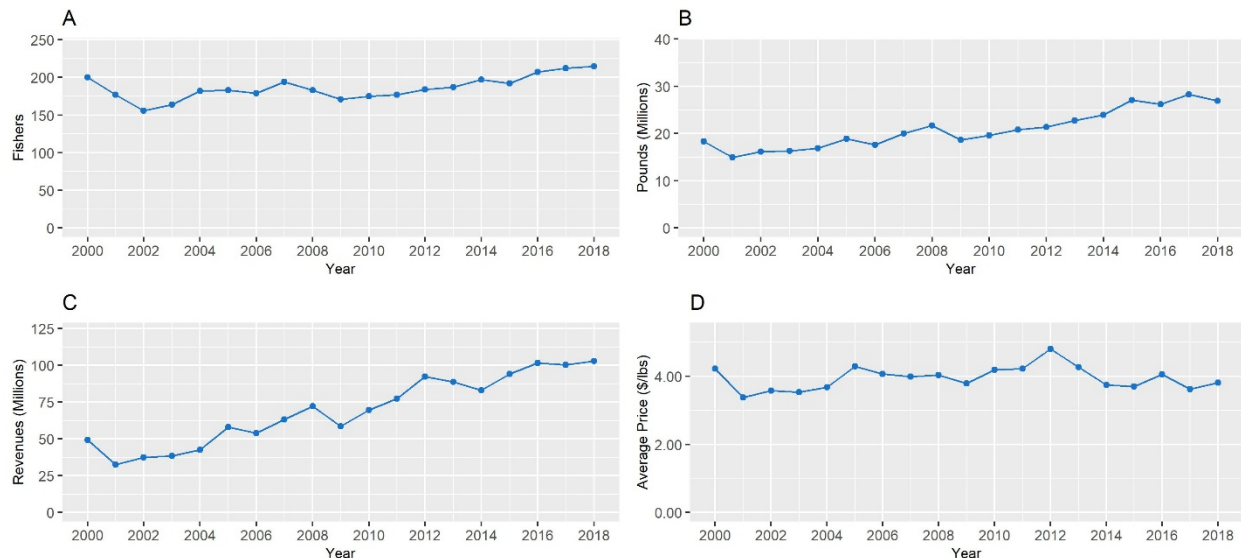
Figure 1. Longline fishery trends, 2000–2018: (A) number of active fishers reporting landings, (B) total pounds landed, (C) inflation-adjusted fishery revenue, (D) inflation-adjusted average prices.

Over the period of analysis (2000–2018) fishing participation[2] was relatively stable, while landings and inflation-adjusted revenues experienced steady increases (Figure 1 and Table 3). The longline fishery has faced numerous regulatory changes since 2000, affecting both the shallow-set and deep-set sectors of the fishery, confounding our ability to explore community-level impacts to individual actions. Therefore, we maintain a baseline period of 2000–2002 for our community performance indicators.

Table 3. Fishery Performance Overview: Hawai'i Longline Fishery.

	Baseline Average (2000–2002)	Average (2003–2018)	Minimum (Year)	Maximum (Year)
Fishers with landings	178	188	156 (2002)	215 (2018)
Fishers with sales	149	169	131 (2003)	185 (2007)
Landings (million pounds)	16.495	21.706	15.005 (2001)	28.279 (2017)
Ex-vessel revenue* (million $)	61.880	86.314	57.583 (2002)	106.179 (2016)
Average Price* ($ / pound)	3.72	3.98	3.38 (2001)	4.80 (2012)

* Adjusted to 2018 dollars using consumer price index for All Urban Consumers: All items in Urban Hawai'i (CBSA)

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[2] The Hawaii longline fishery employs skilled, documented foreign crew who are required to possess State of Hawaii commercial marine licenses. Crew size has been consistent over time with around 5 crew members per trip; however, fishing participation in this report is limited to individuals reporting fish landing or sales.

Trends for Top Participating Communities

Engagement

The fishery-specific commercial Fishing Engagement index (FEI) scores for the Hawai'i pelagic longline fishery are presented in Table 4. The index is an indicator of the community-level importance of longline fishing relative to other communities across the State of Hawai'i. It is a multi-variate measure of pelagic longline fishing activity within each community that includes pounds landed, revenue, number of commercially licensed fishers reporting landings from the fishery, and the number of dealers reporting purchases of longline catch. There were three communities highly engaged (1.0 standard deviation or more above the mean) in the longline fishery for at least one year from the baseline (2000–2002) through 2018 (Table 4).

Of the three communities listed in Table 4, one (Honolulu) was highly engaged for all years from the baseline through 2018. Honolulu engagement scores have held relatively stable over time (Figure 2). The 2018 engagement index value for Honolulu (12.2) is slightly above its baseline value (11.8). One community (Hilo) was highly engaged during the early years of the study period, but the engagement indicator score has declined over the past decade. The community of 'Ewa registered high engagement in the longline fishery for the last two years of the study period.

Table 4. Fishing Engagement Index scores of communities highly engaged in the longline fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Baseline	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honolulu (O'ahu)	11.839	11.595	11.571	11.526	11.596	11.549	12.085	12.087	12.062	12.401	12.411	12.406	12.223	12.412	12.060	12.268	12.168
Hilo (Hawai'i)	0.911	1.548	1.569	1.521	1.552	1.589	0.978	0.977	0.961	-0.378	-0.375	-0.359	0.649	-0.327	-0.387	-0.392	-0.391
'Ewa (O'ahu)	0.316	0.206	0.388	0.754	0.236	0.647	0.300	0.306	0.516	0.564	0.427	0.571	0.700	0.453	0.761	1.558	2.016

Note: Highlighted cells indicate high engagement
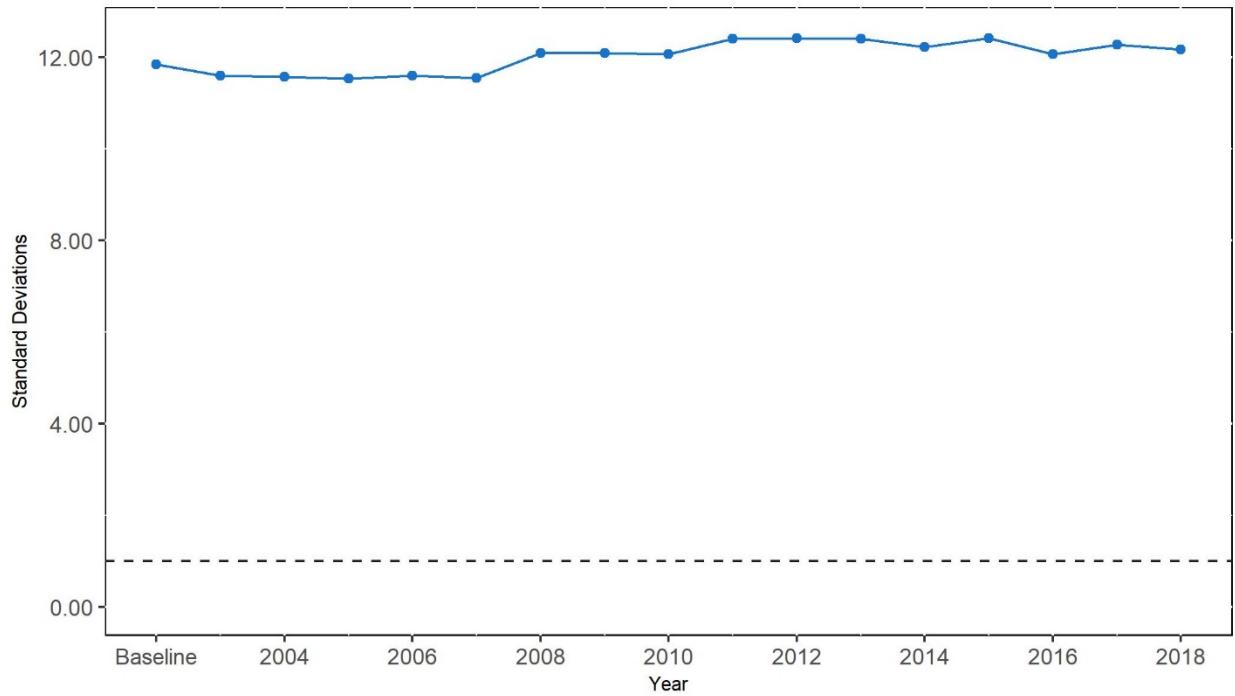
Figure 2. Fishing Engagement Index scores for Honolulu, the only community highly engaged in the longline fishery for all years from the baseline (2000–2002).

Communities that were highly engaged for at least one year from the baseline (2000–2002) through 2018 are depicted in Figure 3. Two communities met this designation, Hilo (Hawaiʻi) and ʻEwa (Oʻahu). Neither community was highly engaged during the baseline period, although the community of Hilo was highly engaged between 2003 and 2007, seeing a steady decline in engagement over the past decade. Trends in engagement for the community of ʻEwa have held relatively consistent during the time series, with a steady increase in engagement during the last two years of the study period.
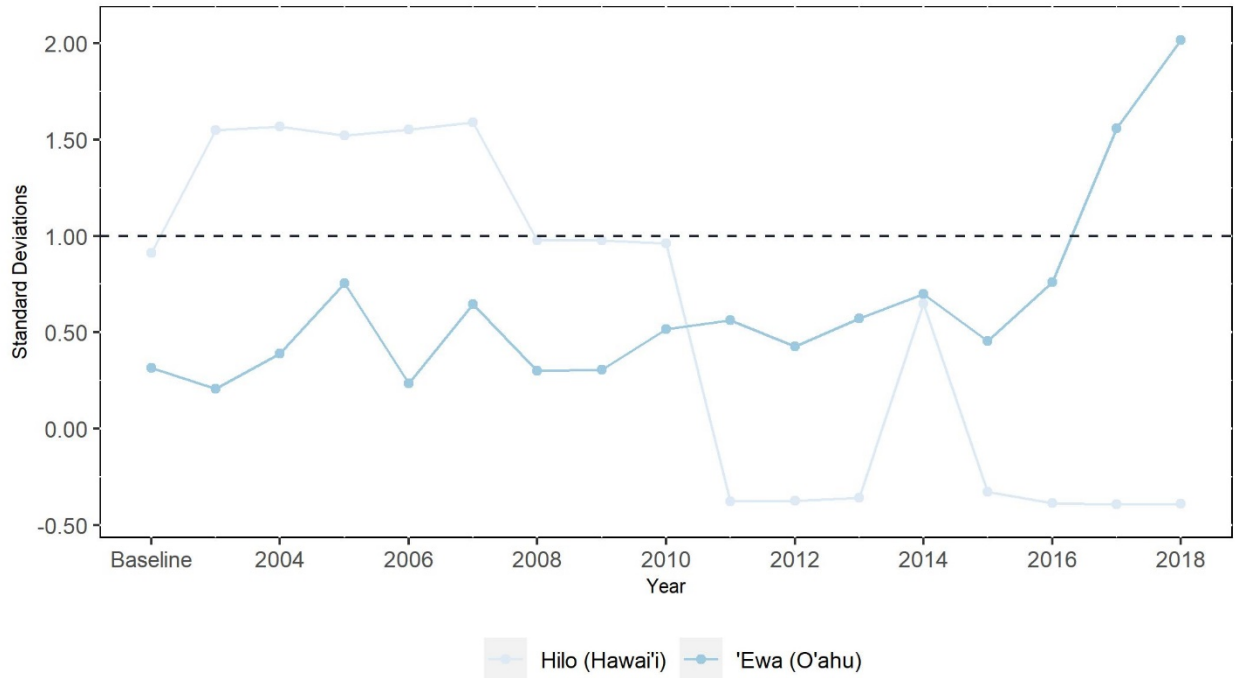
Figure 3. Fishing Engagement Index scores of communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

Regional Quotient

Another measure of a community's involvement in the longline fishery is its Regional Quotient. The Regional Quotient is the proportion (%) of longline fishery activity within a community to the total longline fishery across the State of Hawai'i. We present indicators of the percent contribution in active fishers, pounds landed, and revenue of longline fish landed within that community relative to the State of Hawai'i fishery. The Regional Quotient is reported individually only for those communities that were highly engaged for at least one year during 2003–2018, relative to the baseline (2000–2002) period. The remaining communities across the State of Hawai'i are combined as "Other Communities" in the figures to follow. Due to confidentiality considerations, values for Hilo (Hawai'i) are included in the "Other Communities" data (Figure 4, Figure 5, Figure 6).

The distribution of longline fishers across the State of Hawai'i is presented in Figure 4. The top communities in terms of Regional Quotient for commercial longline fishers aligns well with those identified as highly engaged in the fishery. During the baseline period, in terms of the calculated Regional Quotient for fisher participation, Honolulu (O'ahu) [73.9%] and 'Ewa (O'ahu) [7.1%] comprised a dominant share of active longline fishers that reported landings (crew are not included in these metrics). Contributions from these communities have held relatively stable over time. 'Ewa (O'ahu) has experienced the largest increase in the share of active fishers relative to the baseline period, with a Regional Quotient that has risen to 18.1% in 2018. The share of active fishers from "Other Communities" has remained steady over the time period, settling at just over 11% by 2018 (Figure 4). One community with a notable Regional

Quotient score for active fishers in 2018 not represented in Figure 4 is Koʻolaupoko (Oʻahu) [7.9%], a community with an average Regional Quotient over the study period of 7.4%.

Figure 4. Regional Quotient (FISHERS) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

The top communities in terms of Regional Quotient for pounds landed of longline fish are similar to those identified as highly engaged in the fishery and the Regional Quotient for active fishers reporting landings. During the baseline period, in terms of Regional Quotient for pounds landed, Honolulu (Oʻahu) [81.1%] and ʻEwa (Oʻahu) [6.1%] comprised the overwhelming majority of pounds landed, while "Other Communities" represented approximately 12.8% of landings. Contributions within these communities have held steady over time, in line with trends in the fishing engagement scores. ʻEwa has seen significant increases in the share of pounds landed in recent years, up to 18.9% in 2018 (Figure 5). Koʻolaupoko (Oʻahu) had a baseline value of 8.8%, although this community has experienced declining trends over time, with a 2018 value of 4.9%.

Figure 5. Regional Quotient (POUNDS) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

The top communities in terms of Regional Quotients for longline fishery ex-vessel revenues follows patterns shown in previous figures. During the baseline period, in terms of Regional Quotient for ex-vessel revenues, Honolulu (Oʻahu) [81.2%] and ʻEwa (Oʻahu) [4.8%], account for the majority of fishery revenues, while "Other Communities" represented 14.0% of fishery revenues. Contributions within these communities follow landings trends. ʻEwa has experienced the largest increase in their share of fishery revenues relative to the baseline period, growing from 4.8% to 19% in 2018. The share of fishery revenues from "Other Communities" has been relatively stable but experienced a declining trend in recent years (Figure 6). The community of Koʻolaupoko (Oʻahu), while not highly engaged in any individual year, had notable Regional Quotient scores for ex-vessel revenues during the baseline period (8.4%), but shares in fishery revenues declined to 4.6% in 2018, mirroring the landings trend for this community.
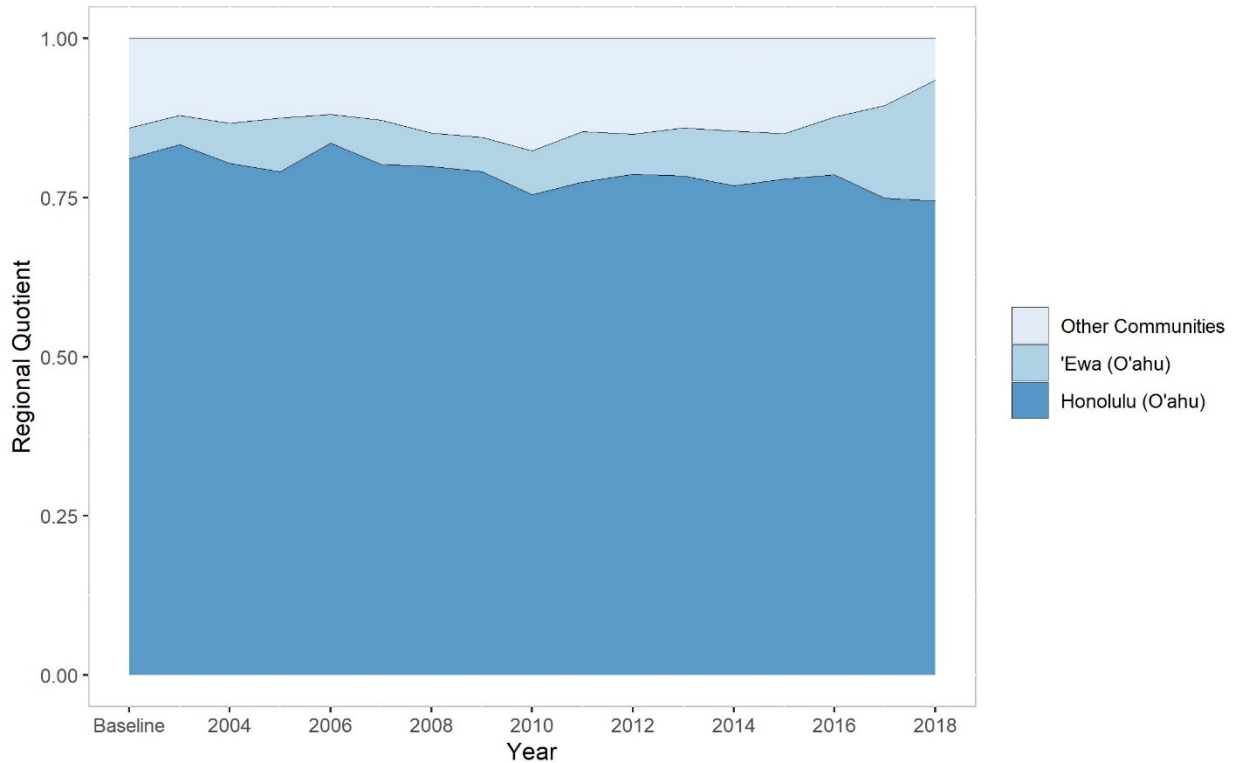
Figure 6. Regional Quotient (REVENUE) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

Local Quotient

The community Local Quotient is the percentage of longline activity by fishers within a community out of the total of all fishing activity within that community. We present indicators of the percent contribution in pounds landed and revenue of the longline fishery to the overall landings or revenue from fishers in a community from the baseline (2000–2002) to 2018 (Figure 7, Figure 8). The Local Quotient is reported individually for the communities of Honolulu (Oʻahu) and ʻEwa (Oʻahu) only; data from Hilo (Hawaiʻi) are suppressed due to confidentiality considerations.

The Local Quotients in Honolulu and ʻEwa show the significance and scale of the longline fishery in terms of landings. Over 90% of pounds landed by Honolulu fishers are from the longline fishery. The fishery has experienced a slight increase over time, with a baseline share of 91.1% of total pounds landed up to 97% in 2018. The community of ʻEwa has experienced more fluctuation as well as more growth from a baseline of 66.9% up to 92.8% in 2018. Although not reflected in Figure 7, Koʻolaupoko's (Oʻahu) baseline average of 60.6% increased to 81.7% in 2018, demonstrating the sheer scale of the longline fishery relative to other state fisheries.
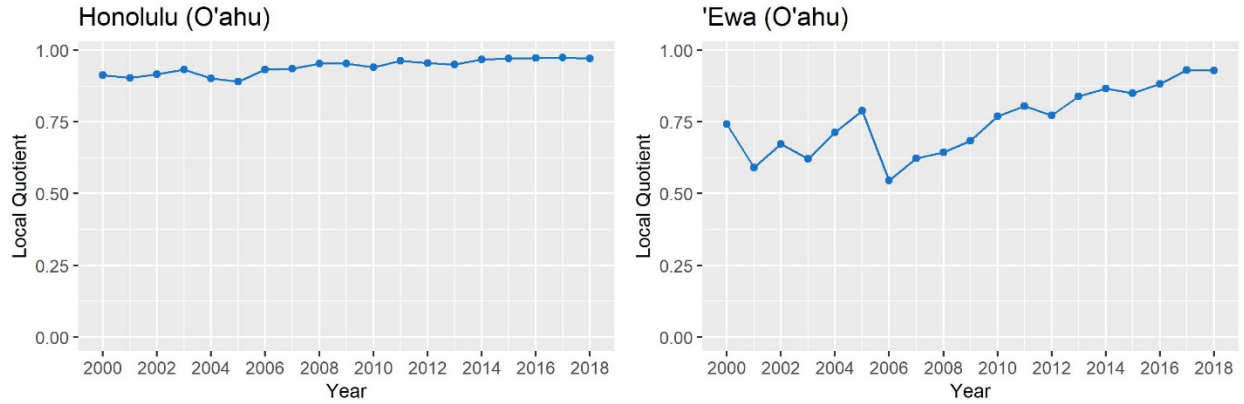
Figure 7. Local Quotient (POUNDS) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

The Local Quotient trends for longline fishery revenues closely follows those of fishery landings for the communities of Honolulu and ʻEwa. Both saw increases over the study period. In 2018, the share of all revenues from the longline fishery was 97.8% and 94.3%, respectively, clear evidence of the scale and significance of the longline fishery. Although not reflected in Figure 8, Koʻolaupoko (Oʻahu) had a fishery revenue value of 83.7% in 2018, up from a baseline average of 64.7%.
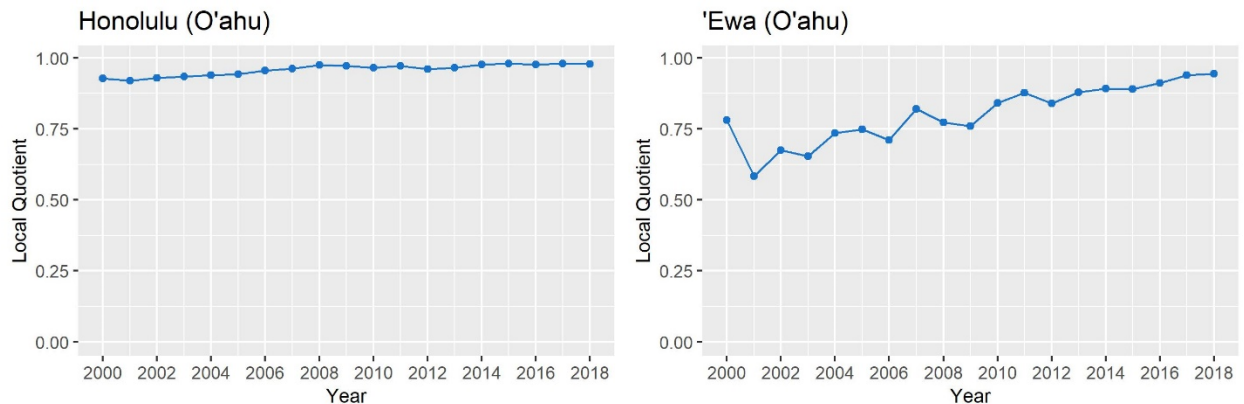
Figure 8. Local Quotient (REVENUE) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

Community Social Vulnerability Indicators (CSVIs)

The three categories of CSVIs discussed below include environmental justice, economic, and gentrification pressure. The environmental justice indicators (personal disruption, population composition vulnerability, poverty) consider whether fishery policies disproportionately affect disadvantaged communities. Economic indicators represent social factors that can shape either an individual's or community's ability to adapt to change (labor force structure and housing characteristics). The gentrification pressure indicators characterize factors that over time may

signify a threat to the viability of a vibrant commercial working waterfront including property and businesses (housing disruption, retiree migration, and urban sprawl).

The CSVIs for communities that were highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018 are included in Table 5–7. Honolulu was the only community highly engaged for all years from the baseline, highlighted in blue. It has the largest population of those communities participating in this fishery. In general, neighbor island communities have slightly higher social vulnerability indicator scores relative to O'ahu communities, with the exception of population composition and urban sprawl.

Table 5. Environmental justice indicators (2018) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

Community (Island)	Personal Disruption	Population Composition	Poverty
Honolulu (O'ahu)	Low	High	Low
Hilo (Hawai'i)	Medium	Med-High	Med-High
'Ewa (O'ahu)	Low	High	Low

Table 6. Economic indicators (2018) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.

Community (Island)	Population Size (2018)	Labor Force Structure	Housing Characteristics
Honolulu (O'ahu)	401,549	Low	Low
Hilo (Hawai'i)	48,774	Medium	Medium
'Ewa (O'ahu)	344,887	Low	Low

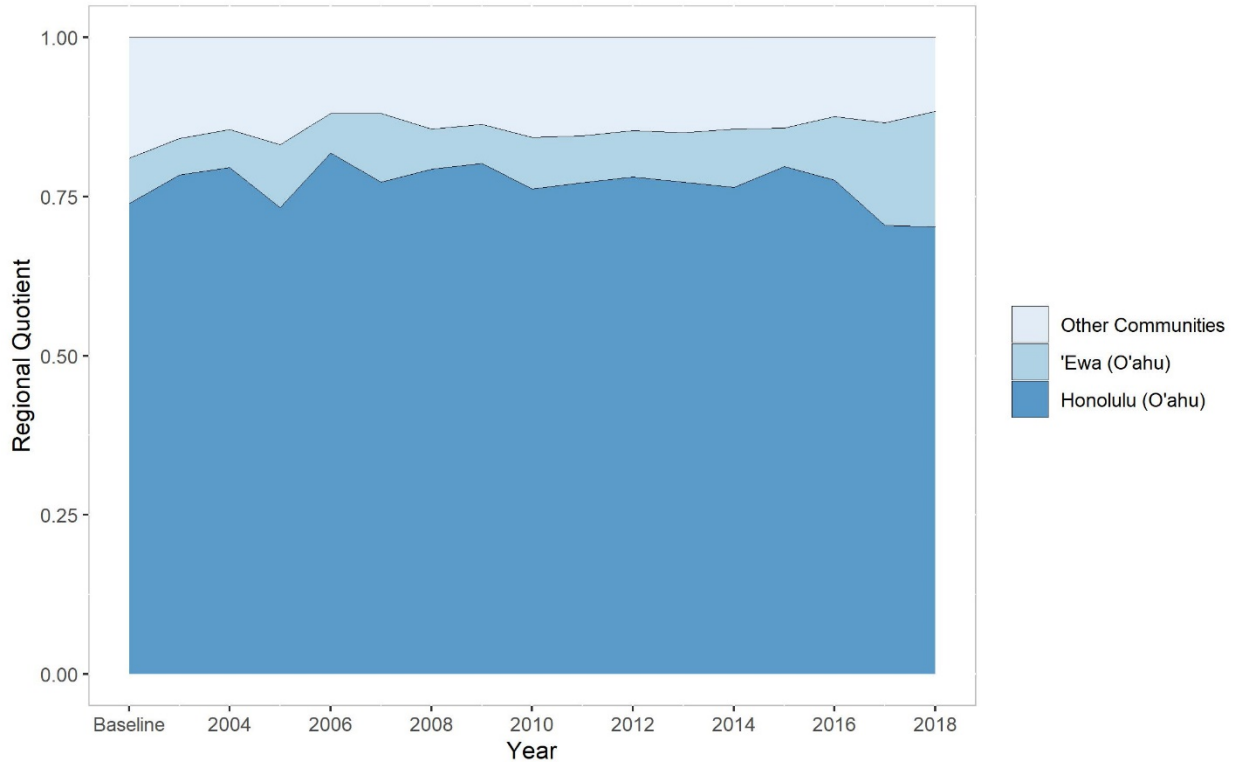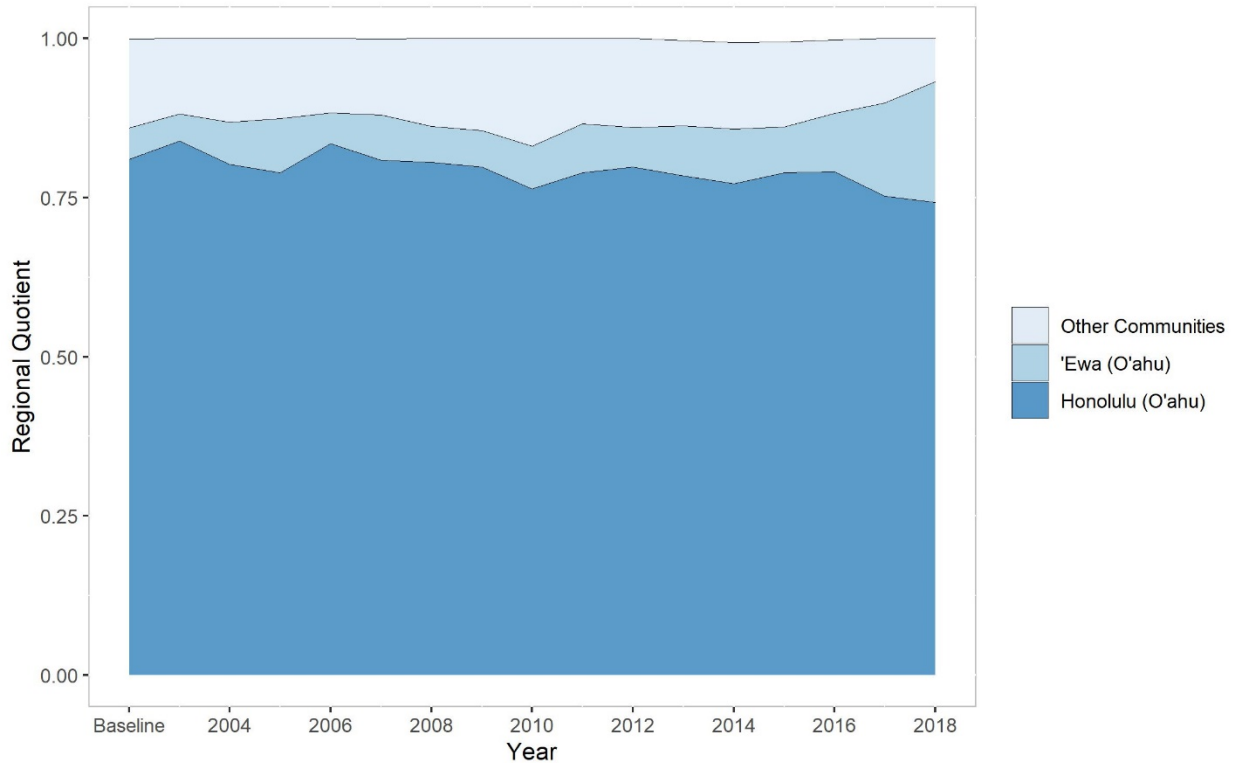**Table 7. Gentrification pressure indicators (2018) for communities highly engaged in the longline fishery for at least one year from the baseline (2000–2002) through 2018.**

Community (Island)	Housing Disruption	Retiree Migration	Urban Sprawl
Honolulu (O'ahu)	Low	Low	High
Hilo (Hawai'i)	Low	Medium	Low
'Ewa (O'ahu)	Low	Low	High

Highly Migratory Species (HMS) Fishery

Fishery Overview

The small boat HMS fishery in Hawai'i includes the main Hawaiian Islands (MHI) troll and handline, offshore handline, aku boat (pole and line), and charter sport fisheries. While these fisheries represent a much smaller percentage of state-level revenues from pelagic catch, the HMS fishery is the largest commercial fishery in terms of participation, reflecting the cultural and social importance of small boat fishing in the region. Many small boat fishers regularly fish for HMS as well as bottomfish and nearshore and reef fish. In addition, while catch is sold to offset costs of fishing, notable portions of catch are often retained for home consumption and to share with friends and family or fulfill other social and cultural obligations (WPFMC 2002).

The HMS fishery involves a wide range of gear that are variations of hook-and-line fishing. Species targeted include tunas, primarily yellowfin, other pelagic species such as mahimahi and ono, and billfish species such as marlins (particularly in the for-hire/charter sports fishery). Troll is the leading fishing gear in terms of pounds sold and revenue, followed by handline gear. These gear types primarily catch yellowfin tuna. Other methods include modern evolutions of traditional Polynesian techniques. For example, the *palu 'ahi* method mirrors the Polynesian drop stone technique to release chum at the desired depth to target sub-surface concentrations of tuna. The *ika shibi* method uses underwater bait attracting lights and additional chum to attract tuna at night.

Over the period of analysis (2000–2018) fishing participation has held relatively stable, with some ebbs and flows, while landings and inflation-adjusted revenues have seen slight declining trends over the past two decades (Figure 9, Table 8). The HMS fishery is managed locally by the State of Hawai'i, WPFMC, and PIRO. Stock assessment responsibilities for the pelagic species targeted in this fishery falls to Regional Fishery Management Organizations and the Hawai'i HMS fishery is not subject to any local Annual Catch Limits (ACLs). The fishery has faced few regulatory changes over the study period. Therefore, we maintain a baseline period of 2000–2002 for our community performance indicators.
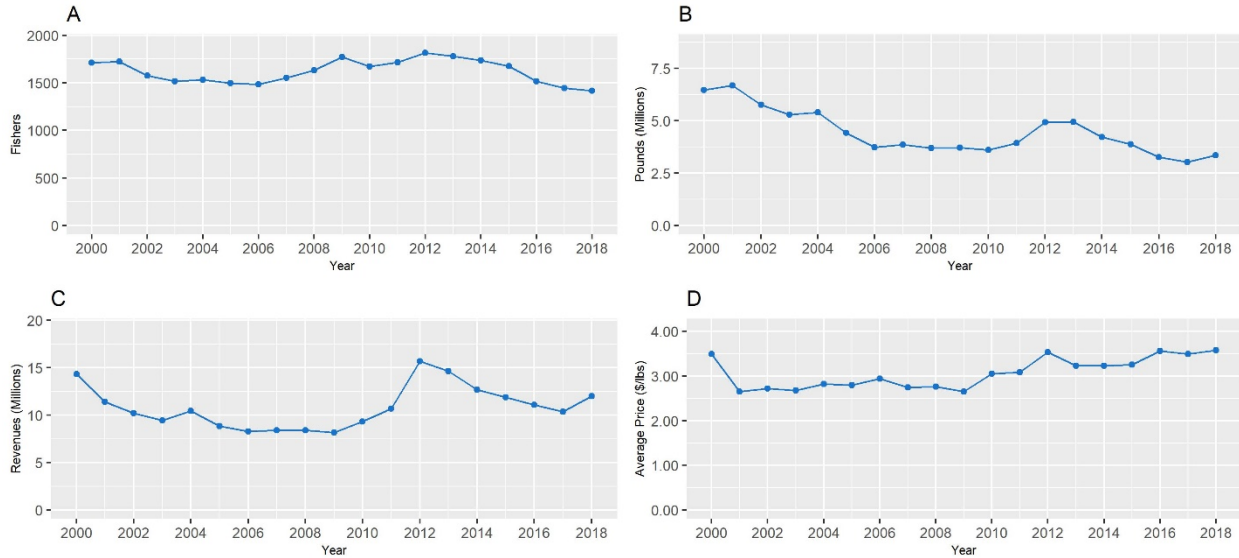
Figure 9. Trends for Highly Migratory Species (HMS) fishery, 2000-2018: (A) number of active fishers reporting landings, (B) total pounds landed (C) inflation-adjusted fishery revenue, (D) inflation-adjusted average prices.

Table 8. Fishery performance overview: Pelagic Highly Migratory Species (HMS).

	Average Baseline (2000–2002)	Average (2003–2018)	Minimum (Year)	Maximum (Year)
Fishers with landings	1669	1609	1414 (2018)	1814 (2012)
Fishers with sales	1747	1439	1302 (2017)	1832 (2000)
Dealers reporting sales	128	108	91 (2017)	135 (2001)
Landings (million pounds)	5.681	4.972	3.592 (2017)	6.283 (2012)
Pounds Sold (millions)	6.305	4.081	3.023 (2017)	6.694 (2001)
Ex-vessel revenue* (million $)	18.653	12.532	9.836 (2009)	22.554 (2000)
Average Price* ($ / pound)	2.95	3.09	2.65 (2001)	3.58 (2018)

* Adjusted to 2018 dollars using consumer price index for All Urban Consumers: All items in Urban Hawai'i (CBSA)

Trends for Top Participating Communities

Engagement

The fishery-specific commercial Fishing Engagement index (FEI) scores for the Highly Migratory Species (HMS) fishery (non-longline) are presented in Table 9. The index is an indicator of the community-level importance of HMS fishing relative to other communities across the State of Hawai'i. It is a multi-variate measure of HMS fishing activity within each community that includes pounds landed, revenue, number of commercial-licensed fishers reporting landings of HMS, and the number of dealers reporting purchases of HMS. There were seven communities highly engaged (1.0 standard deviation or more above the mean) in the HMS fishery for at least one year from the baseline (2000–2002) through 2018 (Table 9). These highly engaged communities are largely reflective of the major population centers across the State of Hawai'i.

Table 9. Fishing Engagement Index scores of communities highly engaged in the HMS fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Baseline	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
North Kona (Hawai'i)	9.026	8.151	8.474	8.594	7.628	7.462	7.093	8.210	8.538	8.923	9.190	9.258	9.659	9.276	9.058	8.433	8.780
Honolulu (O'ahu)	4.204	4.597	5.286	5.697	5.494	5.330	4.801	3.715	4.580	3.913	4.696	4.326	2.965	3.622	4.248	4.104	4.707
Hilo (Hawai'i)	2.435	2.438	2.519	2.521	2.634	2.748	2.826	2.247	3.379	2.641	2.293	2.254	1.992	1.963	1.865	2.569	2.430
Ko'olaupoko (O'ahu)	2.425	3.435	2.006	1.750	3.261	3.178	3.863	3.094	1.901	2.525	1.191	1.588	0.889	0.990	1.401	1.253	1.379
'Ewa (O'ahu)	1.469	2.032	2.450	1.550	2.453	2.488	2.966	2.632	2.323	2.097	1.877	1.862	1.767	2.124	1.776	2.111	2.314
South Kona (Hawai'i)	0.551	0.516	0.776	1.101	0.508	0.771	0.966	1.053	0.418	0.144	0.488	0.358	0.461	0.299	0.479	0.670	0.815
Kea'au-Mountain View (Hawai'i)	0.151	-0.186	-0.040	-0.093	-0.107	-0.140	0.161	0.745	0.698	0.894	0.293	0.979	1.751	1.743	1.640	2.032	1.716

Note: Highlighted cells indicate high engagement

The four communities highly engaged for all years from the baseline through 2018 are included (Figure 10). Despite some fluctuations, the engagement scores for these highly engaged communities appear to have relatively stable trends over the time series. The 2018 engagement scores for Hawai'i Island communities (North Kona and Hilo) are slightly below their baseline values, while the 2018 scores for O'ahu communities (Honolulu and 'Ewa) are slightly above their baseline.
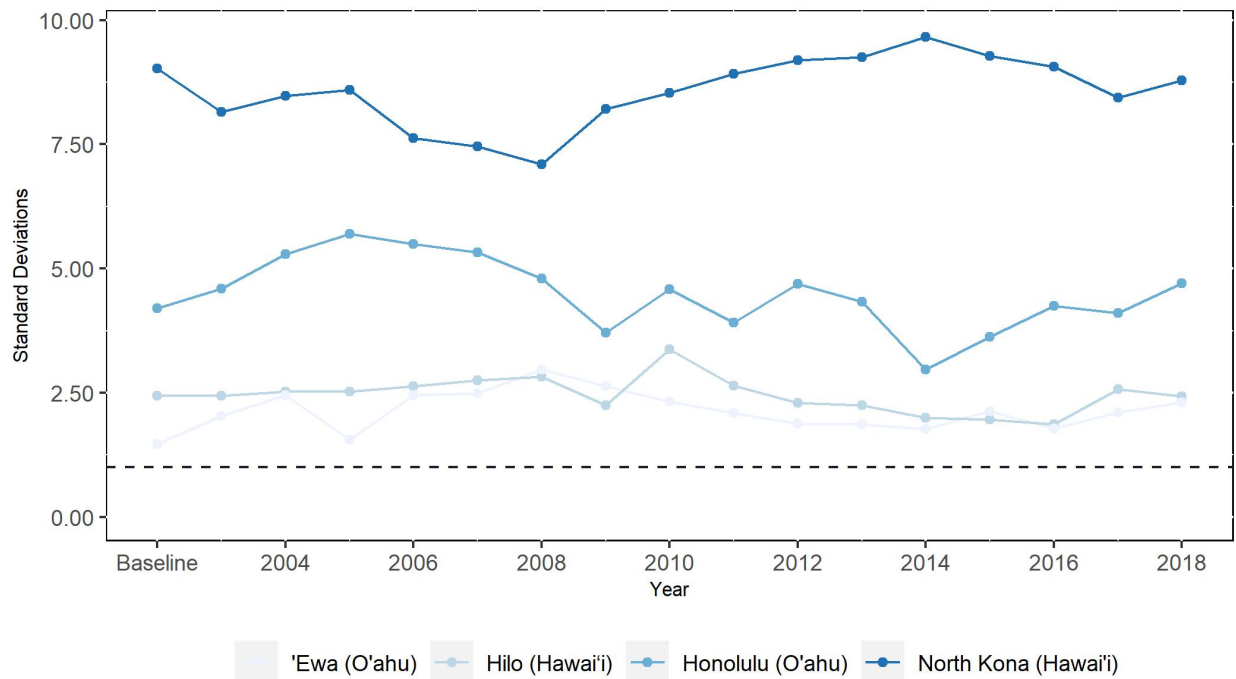
Figure 10. Fishing Engagement Index scores of communities highly engaged in the HMS fishery for all years from the baseline (2000–2002).

Three communities were highly engaged for more than one but less than all years from the baseline (2000–2002) through 2018 (Figure 11). One O'ahu community (Ko'olaupoko) and two Hawai'i Island communities (South Kona and Kea'au-Mountain View) met this designation. While highly engaged during the baseline period and early years in the time series, Ko'olaupoko has seen declining engagement over the years, hovering around the highly engaged threshold in recent years. While South Kona (Hawai'i) has held steady if just below the highly engaged threshold for most years, the community of Kea'au-Mountain View (Hawai'i) has recently experienced a sharp increase.
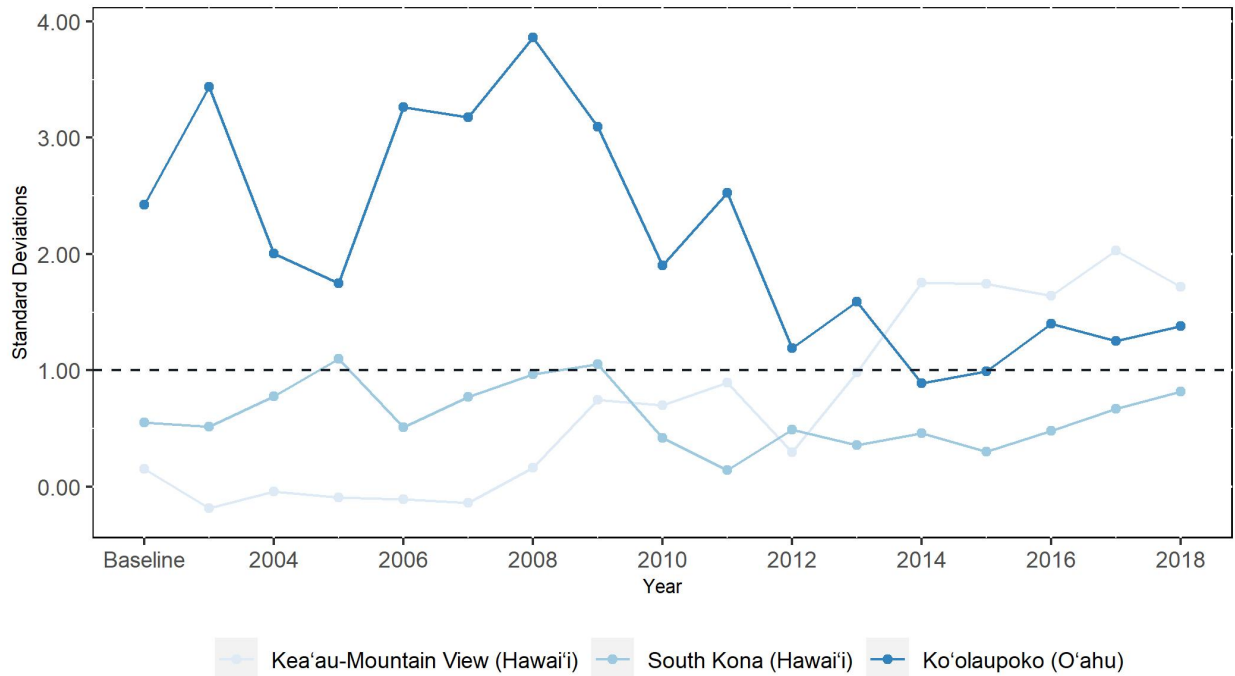
Figure 11. Fishing Engagement Index scores of communities highly engaged in the HMS fishery for more than one year from the baseline (2000–2002) through 2018.

Regional Quotient

Another measure of a community's involvement in the HMS fishery is its Regional Quotient. The Regional Quotient is the proportion of non-longline HMS activity within a community to the total HMS fishery across the State of Hawai'i. We present indicators of the percent contribution in active fishers, pounds landed, and revenue of HMS fish landed within that community relative to the State of Hawai'i fishery. The Regional Quotient is reported individually only for those communities that were highly engaged for at least 50% of years 2003–2018, relative to the baseline (2000–2002) period. The remaining communities across the State of Hawai'i are combined as "Other Communities" in the figures to follow. It should be noted that, given significant differences in scale and the fact that longline fishers (in general) do not participate in other regional fisheries, the Regional Quotient presented for the HMS fishery excludes longline fishers, landings, and revenues, and thus represents HMS relative to all other non-longline fisheries.

The top communities in terms of Regional Quotient for commercial fishers reporting landings of HMS (Figure 12) aligns well with those identified as highly engaged in the fishery. During the baseline period, the communities with greatest Regional Quotients for fisher participation were North Kona (Hawai'i) [19.1%], 'Ewa (O'ahu) [9.4%], and Honolulu (O'ahu) [8.9%], while "Other Communities" represented 49.3% of active fishers. Contributions from these communities have held relatively stable over time. North Kona (Hawai'i) has experienced a slight decline in the share of active fishers relative to the baseline period, with a Regional Quotient down to 16.2% in 2018. Notable communities just outside this top three in active

fishers in 2018 and not represented in Figure 12, are South Kona (Hawaiʻi) [4.9%], Keaʻau-Mountain View (Hawaiʻi) [3.7%], and Waiʻanae (Oʻahu) [3.7%].
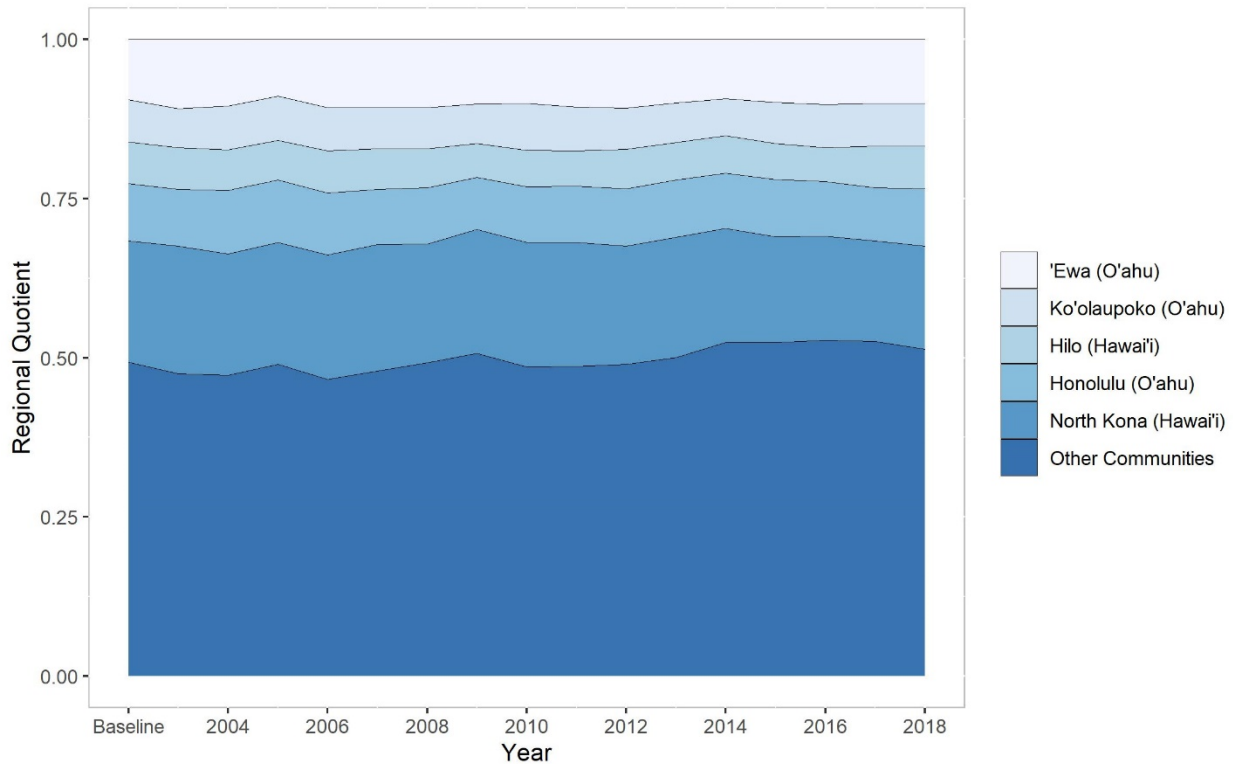
Figure 12. Regional Quotient (FISHERS) for communities highly engaged in the HMS fishery for at least 50% of the years from the baseline (2000-2002).

The dominant communities in terms of Regional Quotient for pounds landed (Figure 13) of HMS aligns well with those identified as highly engaged for all years in the fishery. During the baseline period, the three communities with highest Regional Quotients for pounds landed were North Kona (Hawaiʻi) [30.9%], Koʻolaupoko (Oʻahu) [13.3%], and Honolulu (Oʻahu) [9.4%]. In the baseline period "Other Communities" represented 35.2% of state-wide landings. Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. The most notable changes are declines in contributions from Koʻolaupoko (Oʻahu) and North Kona (Hawaiʻi). The share of pounds landed from "Other Communities" has increased over the time period to just over half (55.8%) by 2018 (Figure 13). Two communities with notable Regional Quotient scores for 2018 not represented in Figure 13 are Keaʻau-Mountain View (Hawaiʻi) [7.5%] and Kapaʻa (Kauaʻi) [4.9%], representing the third and fifth highest shares in the state, respectively, in 2018.
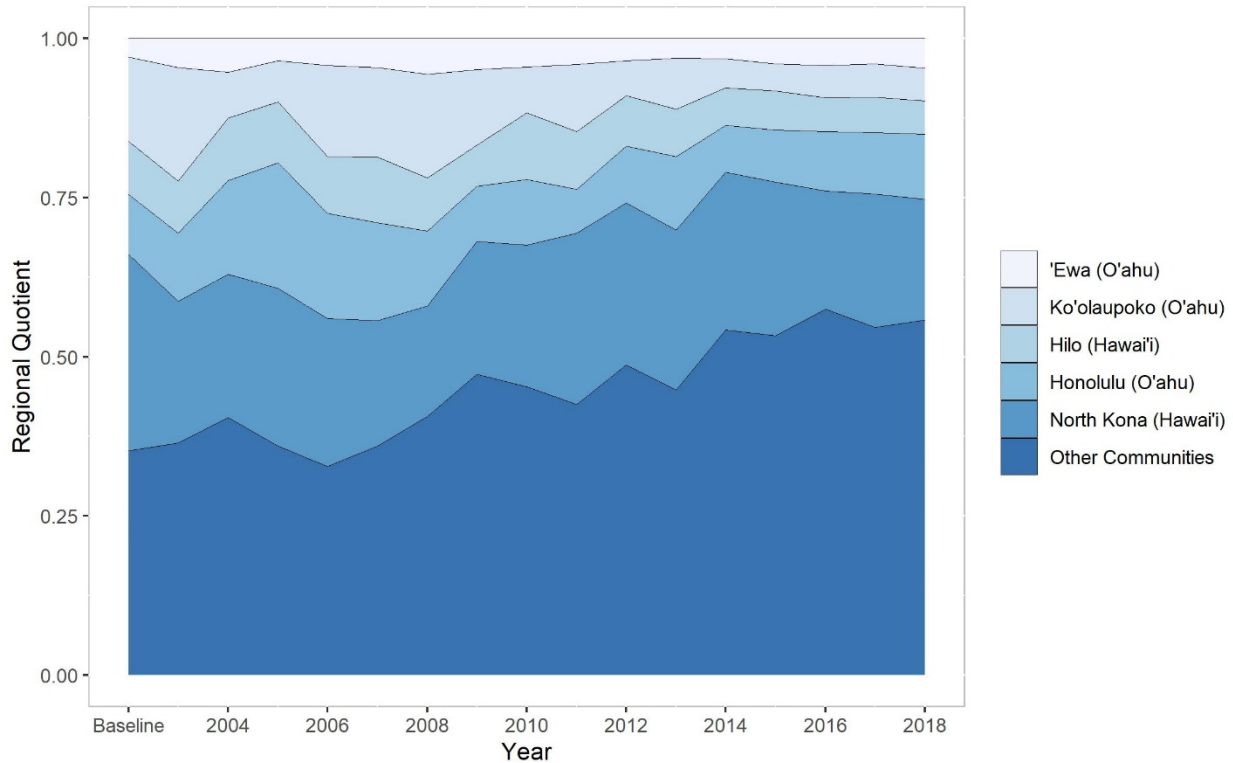
Figure 13. Regional Quotient (POUNDS) for communities highly engaged in the HMS fishery for at least 50% of the years from the baseline (2000–2002).

The top communities in terms of Regional Quotient for ex-vessel revenues (Figure 14) of HMS align well with those identified as highly engaged in the fishery for all years. During the baseline period, the three communities with highest Regional Quotients for ex-vessel revenues were North Kona (Hawaiʻi) [24.6%], Honolulu (Oʻahu) [12.7%], and Koʻolaupoko (Oʻahu) [12.2%]. In the baseline period, "Other Communities" represented 38.9% of fishery revenues. Contributions within these communities have fluctuated slightly over time in line with trends in the fishing engagement scores and similar to trends for the Regional Quotient of pounds in Figure 13. "Other Communities" have experienced an increase in the share of fishery revenues relative to the baseline period, increasing to nearly 58% in 2018. All four communities highly engaged for all years have seen declines in their contributions to fishery revenues during the study period. In 2018, Keaʻau-Mountain View (Hawaiʻi) represented 9.2% of fishery revenues, the second highest share in the State of Hawaiʻi in 2018.
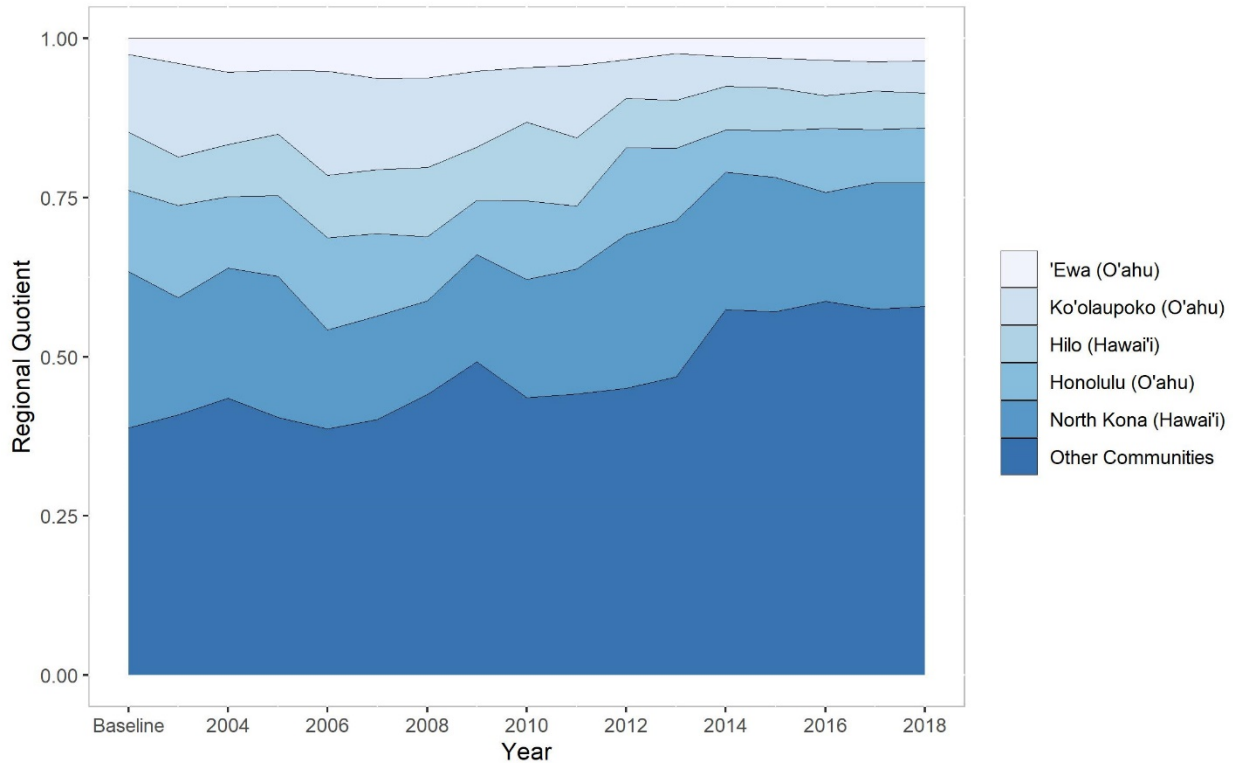
Figure 14. Regional Quotient (REVENUE) for communities highly engaged in the HMS fishery for at least 50% of the years from the baseline (2000–2002).

Local Quotient

The community Local Quotient is the percentage of HMS fishing activity within a community out of the total of all fishing (non-longline) activity within that community. It is an indicator of the contribution in pounds landed or revenue of the HMS fishery to the overall landings or revenue in a community (Figure 15, Figure 16). The Local Quotients are reported individually only for those communities that were highly engaged for at least 50% of the years during 2003–2018, relative to the baseline period. Similar to the HMS Regional Quotient, it should be noted that, given significant differences in scale and the fact that longline fishers (in general) do not participate in other regional fisheries, the Local Quotient presented for the HMS fishery excludes longline landings and revenues, and thus represents HMS relative to all other non-longline fisheries within a community.

The Local Quotient for HMS pounds landed in highly engaged communities highlights the importance that HMS play in Hawai'i fishing communities. Honolulu (O'ahu) saw the most significant increase in Local Quotient scores relative to the baseline period over the time series rising from approximately 45% to just over 83%. North Kona (Hawai'i) and Hilo (Hawai'i) held relatively stable throughout our period of analysis with 2018 Local Quotients nearly identical to their respective baseline values. 'Ewa (O'ahu) saw a slight increase, whereas Ko'olaupoko (O'ahu) has seen a rebound in recent years after a period of significant decline.

It should be noted that none of these highly engaged communities were in the top five for community-level Local Quotient values in HMS landings for 2018, suggesting that there are communities with higher levels of HMS reliance and lower levels of commercial fisheries diversification. In 2018, the top five communities for HMS pounds kept Local Quotients were North Kohala (Hawai'i) [96.8%], Kea'au-Mountain View (Hawai'i) [96.8%], Pā'auhau-Pa'auilo (Hawai'i) [95.1%], Ha'ikū-Pa'uwela (Maui) [93.4%], and Kapa'a (Kaua'i) [93.3%].
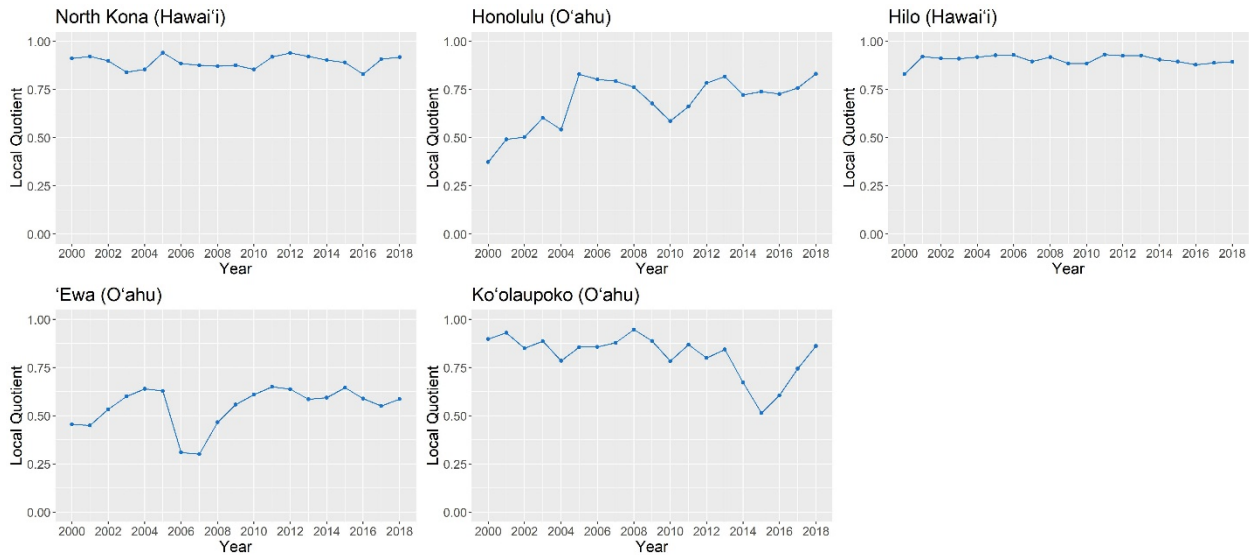
Figure 15. Local Quotient (POUNDS) for communities highly engaged in the HMS fishery for at least 50% of the years from the baseline (2000–2002).

Similar to the Local Quotient for landings, shares of fishery ex-vessel revenues for highly engaged communities fluctuated during the study period, but nearly all 2018 values were above baseline, with the exception of Ko'olaupoko (O'ahu) (Figure 16). Trends tend to follow FEI scores and trends in the Local Quotient for landings. Interpreting trends in ex-vessel revenue Local Quotients provides important insights into the role of revenue from HMS relative to other fisheries in each community. HMS comprise a significant share of community revenues across the State of Hawai'i, especially for highly engaged communities.

Similar to findings in HMS landings, none of these highly engaged communities were in the top five for community-level Local Quotient values in HMS revenue for 2018, suggesting that there are communities with higher levels of HMS reliance and low levels of fisheries diversification. In 2018, the top five communities in terms of HMS revenue Local Quotient were Kea'au-Mountain View (Hawai'i) [94.2%], Koloa-Poipu (Kaua'i) [93.8%], North Kohala (Hawai'i) [93.4%], Wailua-Anahola (Kaua'i) [93.0%], and Kapa'a (Kaua'i) [92.8%]. These are important results to consider when assessing potential community impacts of fishery management alternatives.
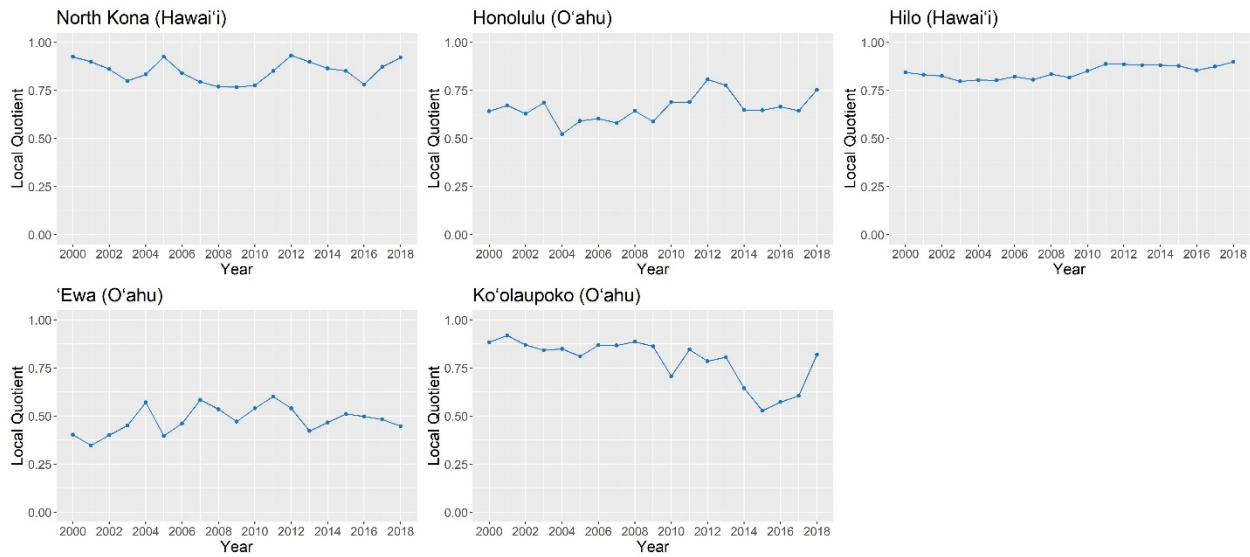
Figure 16. Local Quotient (REVENUE) for communities highly engaged in the HMS fishery for more than one year from the baseline (2000–2002).

Community Social Vulnerability Indicators (CSVIs)

The three categories of CSVIs discussed below include environmental justice, economic, and gentrification pressure. The environmental justice indicators (personal disruption, population composition vulnerability, poverty) consider whether fishery policies disproportionately affect disadvantaged communities. Economic indicators represent social factors that can shape either an individual's or a community's ability to adapt to change (labor force structure and housing characteristics). The gentrification pressure indicators characterize factors that over time may signify a threat to the viability of a vibrant commercial working waterfront including property and businesses (housing disruption, retiree migration, and urban sprawl).

The CSVIs for communities that were highly engaged in the HMS fishery for one or more years from the baseline (2000–2002) through 2018 are included in Tables 10-12. Communities highly engaged for all years from the baseline are highlighted in blue. In general, neighbor island communities have slightly higher vulnerabilities among the indices than Oʻahu communities, with the exception of population composition and urban sprawl.

Table 10. Environmental justice indicators (2018) for communities highly engaged in the HMS fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Personal Disruption	Population Composition	Poverty
North Kona (Hawaiʻi)	Low	Medium	Low
Honolulu (Oʻahu)	Low	High	Low
Hilo (Hawaiʻi)	Medium	Med-High	Med-High
Koʻolaupoko (Oʻahu)	Low	Medium	Low
ʻEwa (Oʻahu)	Low	High	Low
South Kona (Hawaiʻi)	Low	Med-High	Medium
Keaʻau-Mountain View (Hawaiʻi)	Medium	Med-High	Med-High

Table 11. Economic indicators (2018) for communities highly engaged in the HMS fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Population Size (2018)	Labor Force Structure	Housing Characteristics
North Kona (Hawaiʻi)	43,631	Low	Low
Honolulu (Oʻahu)	401,549	Low	Low
Hilo (Hawaiʻi)	48,774	Medium	Medium
Koʻolaupoko (Oʻahu)	112,189	Low	Low
ʻEwa (Oʻahu)	344,887	Low	Low
South Kona (Hawaiʻi)	10,768	Medium	Medium
Keaʻau-Mountain View (Hawaiʻi)	35,553	Low	Med-High

Table 12. Gentrification pressure indicators (2018) for communities highly engaged in the HMS fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Housing Disruption	Retiree Migration	Urban Sprawl
North Kona (Hawaiʻi)	Med-High	Low	Low
Honolulu (Oʻahu)	Low	Low	High
Hilo (Hawaiʻi)	Low	Medium	Low
Koʻolaupoko (Oʻahu)	Med-High	Medium	Low
ʻEwa (Oʻahu)	Low	Low	High
South Kona (Hawaiʻi)	Medium	Medium	Low
Keaʻau-Mountain View (Hawaiʻi)	Medium	Low	Low

Main Hawaiian Islands (MHI) Deep 7 Bottomfish Fishery

Fishery Overview

The MHI Deep 7 bottomfish fishery comprises seven species of deep-slope snappers and a single species of grouper that are found at depths of 180–900 feet. They are: ʻōpakapaka (pink snapper, *Pristipomoides filamentosus*), onaga (long-tail red snapper, *Etelis coruscans*), ehu (ruby snapper, *Etelis carbunculus*), hapuʻupuʻu (Hawaiian grouper, *Epinephelus quernus*), gindai (oblique-banded snapper, *Pristipomoides zonatus*), kalekale (Von Siebold's snapper, *Pristipomoides seiboldii*), and lehi (silver mouth snapper, *Aphareus rutilans*).

While the MHI bottomfish fishery is at a much smaller economic scale than the pelagic fisheries in the region, it is comparable in terms of rich tradition and cultural significance (see WPFMC 2019a for review). Like the HMS fishery, the MHI Deep 7 fishery represents a complex mix of commercial, recreational, cultural, and subsistence motivations, reflected in varied disposition of catch, including sale, retention for home consumption, sharing with friends and family, and to give away for cultural reasons. Much of the gear and techniques used today are modeled after the same Polynesian drop stone method as the HMS fishery, but in this case are used to release chum along the deep seamount slopes where bottomfish feed and are referred to as *make dog*. Many bottomfish harvested in Hawaiʻi are red, which is considered an auspicious color (Calhoun et al. 2020). Whole red fish are sought for celebrations such as birthdays, graduations, and weddings, and during the winter holiday season (Christmas through Lunar New Year) when prices can increase to over $25 per pound. Many restaurants also serve fresh bottomfish, which are sought by tourists.

The fishery is managed under both state and federal rules, and vessels must be registered with the State of Hawaiʻi Department of Land and Natural Resources. In the late 1990s, spatial closure areas known as bottomfish restricted fishing areas (BRFAs) were implemented in response to declines in domestic production. Fishery performance trends indicate continued slight declines in participation and landings in the early 2000s (Figure 17). In 2006, NMFS determined that overfishing was occurring (Moffitt et al. 2006) and the fishery experienced an emergency summer closure in May 2007. It reopened in September 2007, under a total allowable catch (TAC) quota management regime. In 2015, the MHI Deep 7 bottomfish stock complex was categorized as not overfished and not experiencing overfishing, which has resulted in gradual reopening of the BRFAs and continued sustainable harvest with increases in annual catch limits over the years (Langseth et al. 2018). Fishery performance trends since 2007 reflect stable landings and revenue, albeit at lower than historical levels (Table 13).

The MHI Deep 7 bottomfish fishery was the first fishery in the main Hawaiian Islands managed under a quota system. Given the transition to quota management in 2007, we have established a baseline of 2004–2006, the three years prior to TAC implementation, for analyses of the community performance indicators for this fishery.
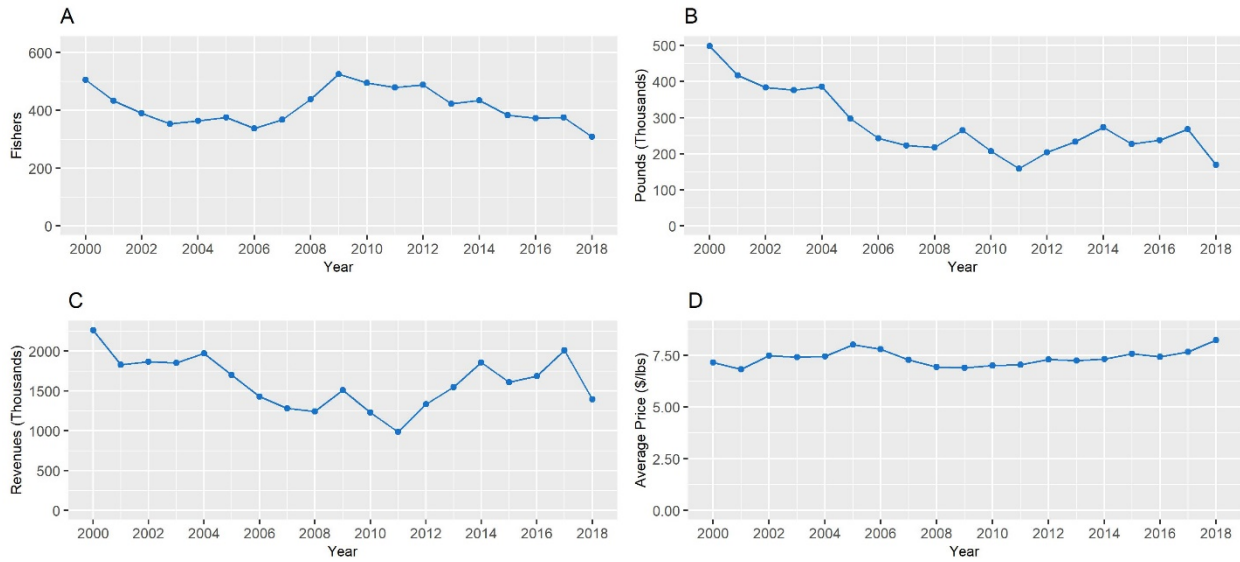
Figure 17. Trends for MHI Deep 7 bottomfish fishery, 2000–2018: (A) number of active fishers reporting landings, (B) total pounds landed, (C) inflation-adjusted fishery revenue, (D) inflation-adjusted average prices.

Table 13. Fishery Performance Overview: MHI Deep 7 Bottomfish.

	Average Baseline (2004–2006)	Average (2007–2018)	Minimum (Year)	Maximum (Year)
Fishers with landings	359	425	309 (2018)	525 (2009)
Fishers with sales	336	339	267 (2018)	462 (2000)
Dealers reporting sales	56	60	47 (2018)	68 (2011,2012)
Landings (million pounds)	0.337	0.260	0.181 (2018)	0.507 (2000)
Pounds Sold (millions)	0.309	0.224	0.159 (2011)	0.498 (2000)
Ex-vessel revenue* (million $)	2.380	1.634	1.120 (2011)	3.558 (2000)
Average Price* ($ / pound)	7.74	7.32	6.81 (2001)	8.22 (2018)

* Adjusted to 2018 dollars using consumer price index for All Urban Consumers: All items in Urban Hawai'i (CBSA)

Trends for Top Participating Communities

Engagement

The fishery-specific commercial Fishing Engagement index (FEI) scores for the main Hawaiian Islands (MHI) Deep 7 bottomfish fishery are presented in Table 14. The index is an indicator of community-level importance of Deep 7 bottomfish fishing relative to other communities across the State of Hawaiʻi. It is a multi-variate measure of MHI Deep 7 bottomfish fishing activity within each community that includes pounds landed, revenue, number of commercial-licensed fishers reporting landings of Deep 7 bottomfish, and the number of dealers reporting purchases of Deep 7 bottomfish. There were fourteen communities highly engaged (1.0 standard deviation or more above the mean) in the MHI Deep 7 bottomfish fishery for at least one year from the baseline (2004–2006) through 2018 (Table 14). These communities are fairly well distributed across the State of Hawaiʻi, although half are on the island of Maui. Using our FEI methodology, the islands of Kauaʻi and Lānaʻi do not have any communities highly engaged in the MHI Deep 7 bottomfish fishery.

Of the fourteen communities listed in Table 14, four were highly engaged for all years from the baseline through 2018 (Honolulu, North Kona, ʻEwa, Makawao-Pāʻia). Four communities have been highly engaged for at least 50% of the period under consideration, and six communities have been highly engaged for at least one year, but less than 50% of the period of analysis. The composition of highly engaged communities in 2018 differs slightly from those highly engaged during the baseline period, with some (Wailuku, East Molokaʻi, Waiheʻe-Waikapū) experiencing notable increases in fishery engagement in recent years.

Table 14. Fishing Engagement Index scores of communities highly engaged in the MHI Deep 7 Bottomfish fishery for one or more years from the baseline (2004–2006) through 2018.

Community (Island)	Baseline	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honolulu (Oʻahu)	8.395	8.837	7.678	6.425	7.191	6.881	7.139	5.627	5.664	4.468	4.768	5.523	4.725
North Kona (Hawaiʻi)	4.200	4.690	5.518	5.743	4.437	3.250	4.541	5.480	6.462	6.741	8.290	5.302	3.223
ʻEwa (Oʻahu)	2.737	2.013	2.291	2.510	1.541	1.641	1.916	1.447	1.392	1.094	1.446	1.822	1.817
Makawao-Pāʻia (Maui)	2.503	1.010	2.164	2.751	2.569	1.635	2.700	1.315	1.598	1.615	1.006	3.787	3.514
Hilo (Hawaiʻi)	1.848	1.680	1.151	1.674	1.710	2.496	1.206	1.140	0.854	1.206	1.066	1.162	1.723
Lahaina (Maui)	1.471	0.857	1.115	2.503	3.215	2.484	1.256	0.669	0.055	0.718	0.151	-0.343	-0.021
Wailuku (Maui)	0.843	2.134	1.936	-0.171	0.438	2.005	1.843	1.992	2.747	3.541	2.102	2.933	4.571
Koʻolaupoko (Oʻahu)	0.776	0.395	0.951	0.772	1.931	1.926	1.486	1.561	1.923	1.500	0.848	1.299	0.645
Kahului (Maui)	0.576	0.839	1.365	1.357	0.884	1.166	1.362	2.713	1.449	1.623	1.373	1.513	1.199
Waiheʻe-Waikapū (Maui)	-0.308	0.234	0.148	-0.722	-0.565	0.158	-0.045	0.040	0.500	0.878	0.286	0.598	1.507
South Kona (Hawaiʻi)	-0.344	-0.199	0.736	1.070	-0.095	-0.644	-0.703	0.071	-0.231	-0.582	-0.457	-0.592	-0.372
Kula (Maui)	-0.728	-0.869	-0.743	0.131	-0.148	0.738	1.452	1.661	-0.229	-0.066	-0.294	-0.596	-0.849
East Molokaʻi (Molokaʻi)	-0.740	-0.843	-0.544	-0.143	0.601	2.419	0.708	1.860	1.429	1.347	0.626	0.954	1.879
South Kohala (Hawaiʻi)	-0.762	-0.333	0.021	0.778	-0.166	-0.444	0.354	0.457	0.156	0.111	1.443	0.521	0.491

Note: Highlighted cells indicate high engagement

The scores for the four communities highly engaged for all years from the baseline through 2018 suggest a downward trend in engagement for Oʻahu communities (Honolulu and ʻEwa) (Figure 18). Makawao-Pāʻia (Maui) saw a sharp increase from 2016 to 2017 after years of slight declines. North Kona (Hawaiʻi) has demonstrated volatility, with a cyclical increasing trend peaking in 2016, followed by a sharp drop to its lowest levels of engagement over the period of analysis in 2018.
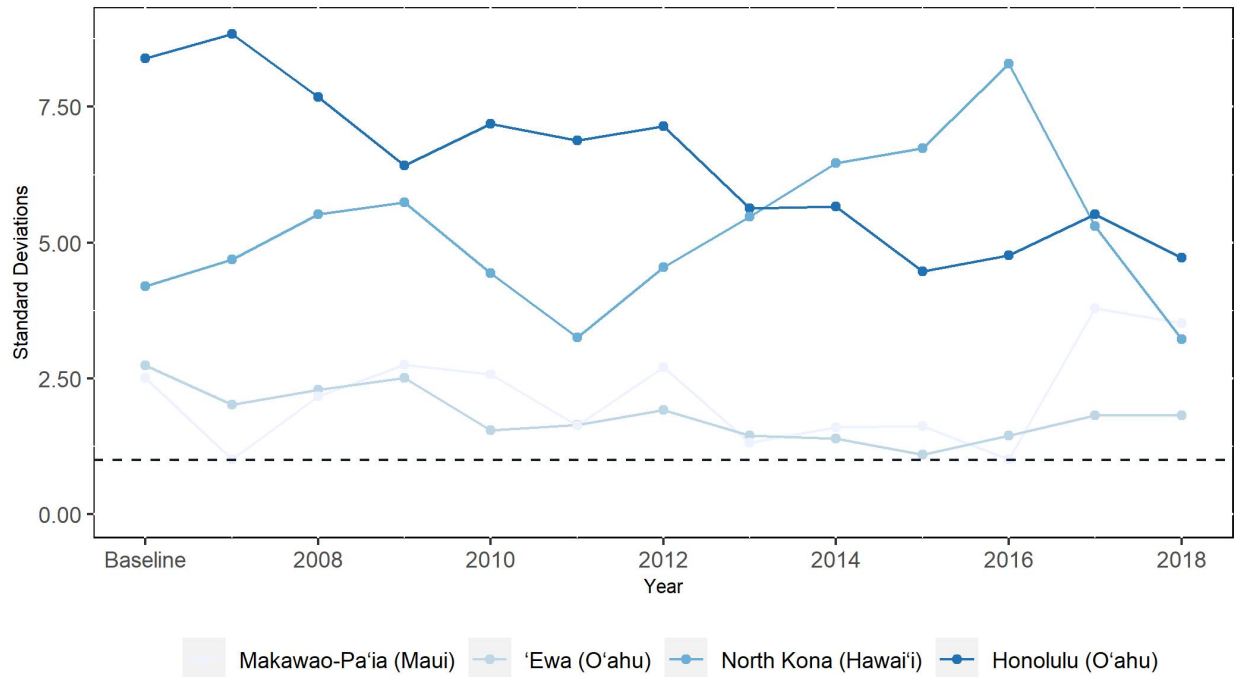
Figure 18. Fishing Engagement Index scores of communities highly engaged in the MHI Deep 7 Bottomfish fishery for all years from the baseline (2004–2006).

Four communities were highly engaged for at least 50% of years from the baseline (2004–2006) through 2018 (Figure 19). Despite some volatility, the community of Wailuku (Maui) has seen an increase in engagement during the period of analysis with sharp increases in the last two years, achieving the second highest engagement score in the state during 2018. Fishing engagement for the communities of Hilo (Hawaiʻi), Koʻolaupoko (Oʻahu), and Kahului (Maui) have held relatively stable throughout the time series hovering around the highly engaged threshold of 1.0. Each experienced a peak between 2010 and 2013. In 2018, the top three communities in terms of fishing engagement were Honolulu (Oʻahu), Wailuku (Maui), and Makawao-Pāʻia (Maui).
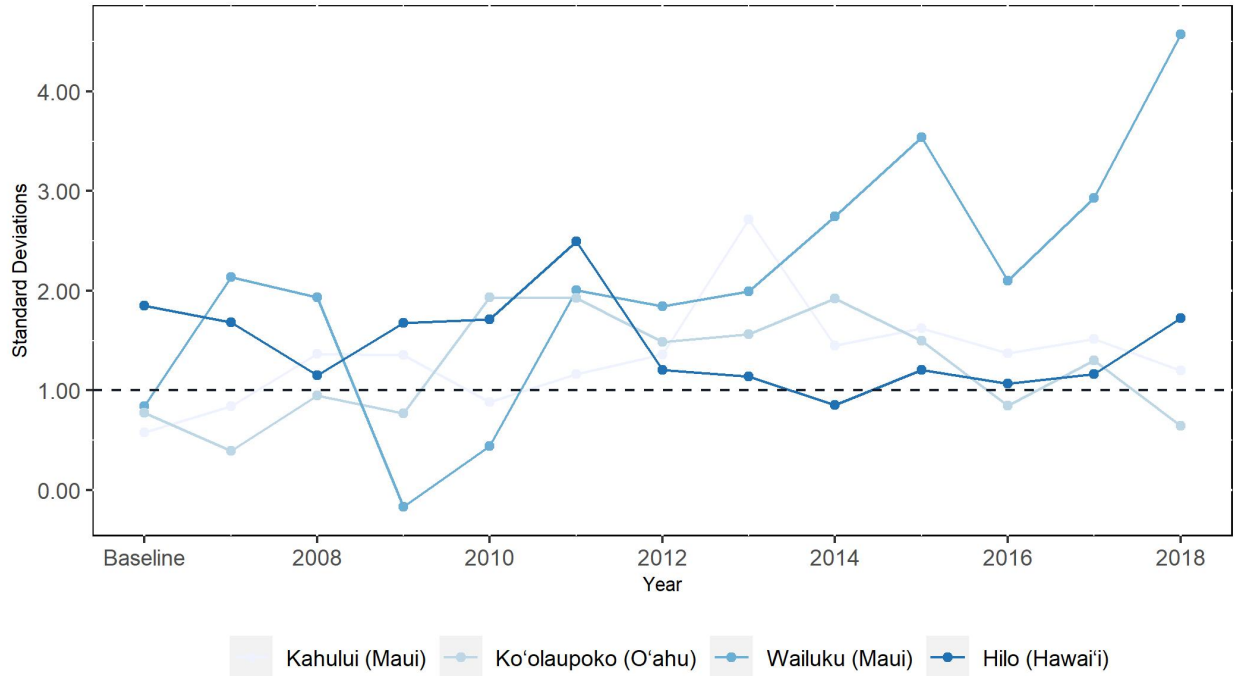
Figure 19. Fishing Engagement Index scores of communities highly engaged in the MHI Deep 7 bottomfish fishery for at least 50% of years from the baseline (2004–2006) through 2018.

Six communities were highly engaged in the main Hawaiian Islands Deep 7 Bottomfish fishery for at least one year but fewer than 50% of years from the baseline (2004–2006) (Figure 20). While most observations fall below the highly engaged threshold, there are sizable fluctuations in engagement over the years for the majority of these communities. The communities of Waiheʻe-Waikapū (Maui), East Molokaʻi (Molokaʻi), and South Kohala (Hawaiʻi) have experienced steady increases in engagement over time. Lahaina (Maui) peaked in 2010, with the third highest engagement level for the year, but has steadily declined since. Kula (Maui) and South Kona (Hawaiʻi) exhibited peaks at different times during the time series but exhibit relatively similar trends in growth and retraction over the years, with 2018 levels of engagement similar to the baseline period.

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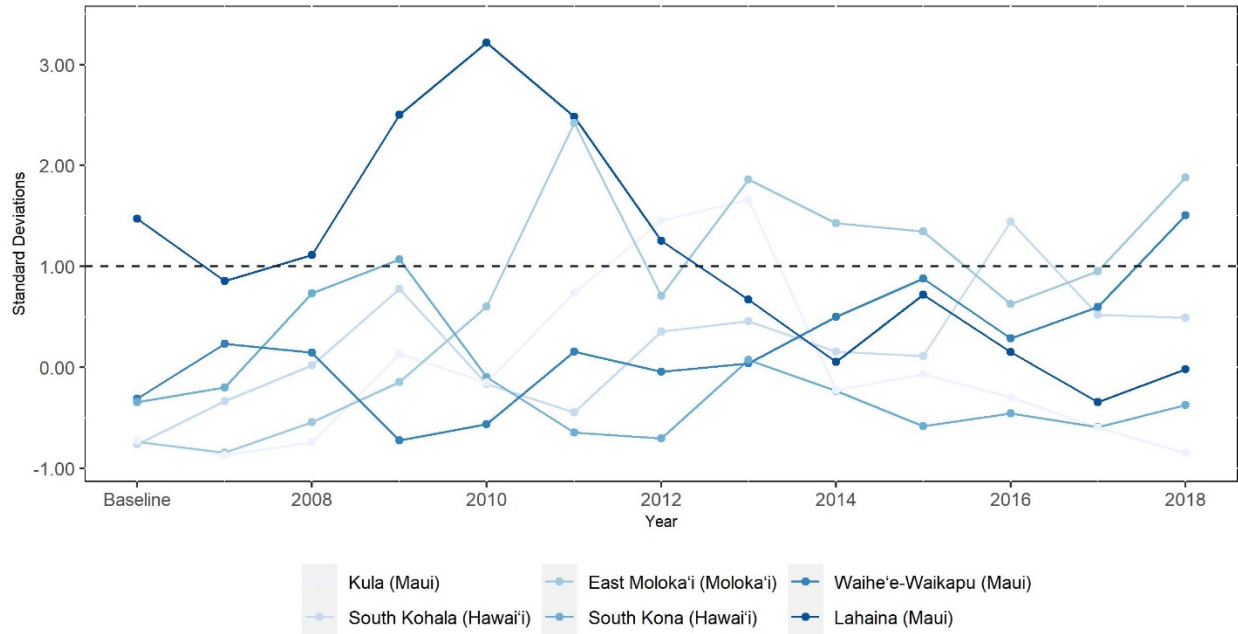
Figure 20. Fishing Engagement Index scores of communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least one year but fewer than 50% of years from the baseline (2004–2006).

Regional Quotient

Another measure of a community's involvement in the MHI Deep 7 bottomfish fishery is its Regional Quotient. The Regional Quotient is the proportion of Deep 7 bottomfish activity within a community to the total Deep 7 bottomfish fishery across the State of Hawai'i. We present indicators of the percent contribution in active fishers, pounds landed, and revenue of Deep 7 bottomfish landed within that community relative to the State of Hawai'i fishery. The Regional Quotient is reported individually only for those communities that were highly engaged for at least 50% of years during 2007–2018, relative to the baseline period (2004–2006). The remaining communities across the State of Hawai'i are grouped as "Other Communities" in the figures.

The distribution of MHI Deep 7 bottomfish fishers is quite different from the distribution of Deep 7 bottomfish landed and revenue in communities across the State (Figure 21, Figure 22, Figure 23). The communities with high Regional Quotients for commercial fishers reporting landings of MHI Deep 7 bottomfish aligns well with those identified as highly engaged in the fishery. During the baseline period, the top three communities in terms of Regional Quotient for fisher participation were Honolulu (O'ahu) [13.1%], 'Ewa (O'ahu) [11.7%], and North Kona (Hawai'i) [11.5%], while "Other Communities" represented 40.5% of active fishers. Contributions within these communities have held relatively stable over time. 'Ewa (O'ahu) has experienced the largest decrease in share of active fishers relative to the baseline period, with a Regional Quotient down to 9.2% in 2018. The share of active fishers from "Other Communities" has held stable over the time period settling at about 41.9% by 2018 (Figure 21). One community

with sizable share of fishers reporting sales not represented in Figure 21 is Keaʻau-Mountain View (Hawaiʻi) [5.6%] indicating the potential for higher levels of commercial motivation for MHI Deep 7 fishers in that community.

Figure 21. Regional Quotient (FISHERS) for communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least 50% of years from the baseline (2004–2006).

The top communities in terms of Regional Quotient for pounds landed of MHI Deep 7 bottomfish align well with those identified as highly engaged in the fishery. During the baseline period, the three communities with greatest Regional Quotients for pounds landed were Honolulu (Oʻahu) [26.9%], Makawao-Pāʻia (Maui) [10.9%], and North Kona (Hawaiʻi) [9.3%], while "Other Communities" represented 33.9% of pounds kept. Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. The share of pounds landed from "Other Communities" has increased over the time period at 43% by 2018 (Figure 22). Two communities with notable Regional Quotient scores for 2018 not represented in Figure 22 are Waiheʻe-Waikapū (Maui) [7.6%] and East Molokaʻi (Molokaʻi) [7.1%]. These communities have seen increases in fisheries engagement in recent years (see Figure 20 previous section).

Figure 22. Regional Quotient (POUNDS) for communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least 50% of years from the baseline (2004–2006).

The communities with high Regional Quotient values for ex-vessel revenues of MHI Deep 7 bottomfish align well with those identified as highly engaged in the fishery. During the baseline period, the three communities with highest Regional Quotients for ex-vessel revenues were Honolulu (Oʻahu) [24.3%], ʻEwa (Oʻahu) [10.7%], and Makawao-Pāʻia (Maui) [10.5%], while "Other Communities" represented 31.9% of fishery revenues. Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. Wailuku (Maui) has experienced the largest increase in share of fishery revenues relative to the baseline period, whereas ʻEwa (Oʻahu) and Honolulu (Oʻahu) have seen declines in their contributions to fishery revenues. The share of fishery revenues from "Other Communities" has increased over the time period to nearly 45% by 2018 (Figure 23). Two communities with notable Regional Quotient scores for ex-vessel revenues in 2018 not represented in Figure 23 are East Molokaʻi (Molokaʻi) [10.4%] and Waiheʻe-Waikapū (Maui) [7.7%]. These communities have seen increases in fisheries engagement in recent years (see Figure 20, previous section).
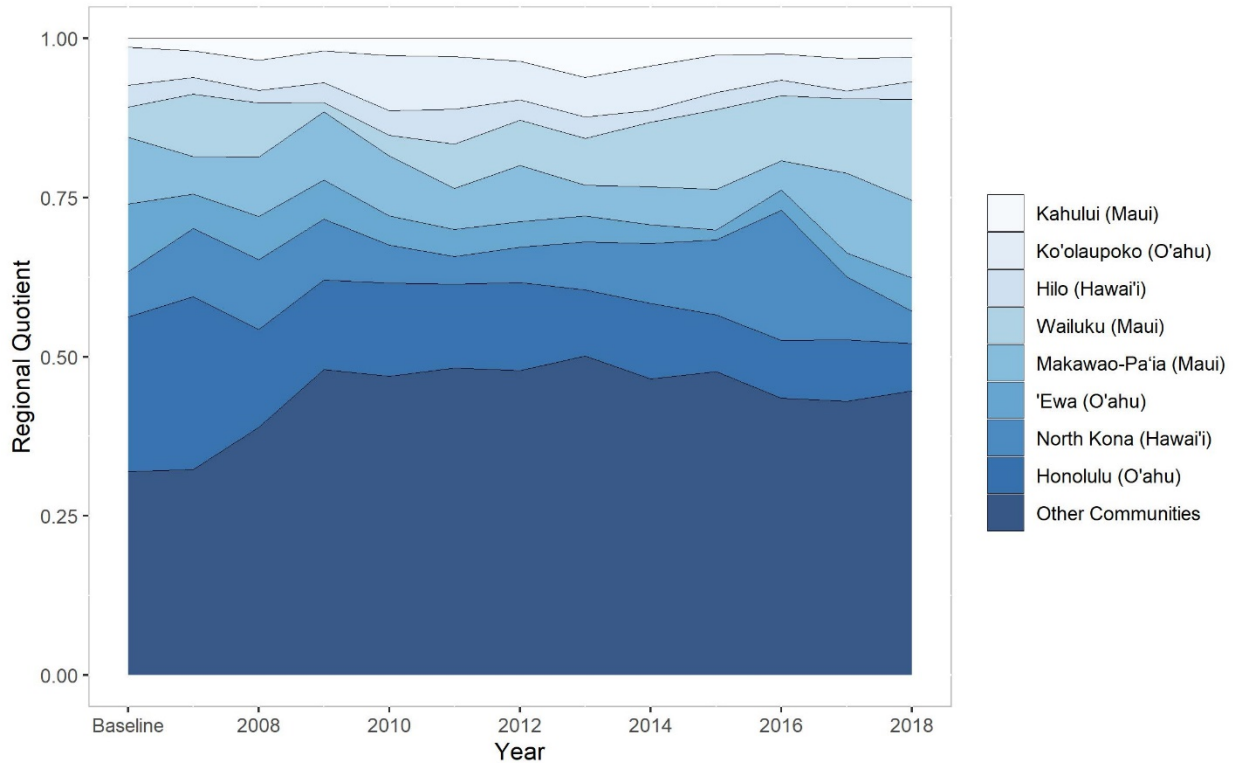
Figure 23. Regional Quotient (REVENUE) for communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least 50% of years from the baseline (2004–2006).

Local Quotient

The community Local Quotient is the percentage of Deep 7 bottomfish fishing activity within a community out of the total of all fishing (non-longline) activity within that community. The Local Quotient is an indicator of the contribution in pounds landed or revenue of Deep 7 bottomfish to the overall landings or revenue in a community (Figure 24, Figure 25). The Local Quotient is reported individually only for those communities that were highly engaged for at least 50% of years 2007–2018, relative to the baseline period.

The Local Quotient for pounds landed in the top eight communities in terms of fishing engagement fluctuated during the study period but nearly all 2018 values for highly engaged communities were below baseline values. Trends tend to mirror fishing engagement index scores. These values provide important insights into the role of Deep 7 bottomfish relative to other fisheries in each community. It is interesting to note that in five of the top eight highly engaged communities, Deep 7 bottomfish comprise well less than 10% of fishery landings in the community. Deep 7 bottomfish community landings have declined approximately 50% in Makawao-Pāʻia (Maui) over the study period. The contribution of Deep 7 bottomfish to Wailuku (Maui) fishers fluctuated considerably over our analysis, exceeding the baseline contribution in about half the years, approaching 50% of local landings in 2015, and dipping to just below the baseline value in 2018. During 2018, there were three notable communities not reflected in Figure 24 where Deep 7 bottomfish comprised a significant share of local landings for the

community: Waiheʻe-Waikapū (Maui) [25.9%], West Molokaʻi (Molokaʻi) [18.7%], and Kahului (Maui) [16.1%].
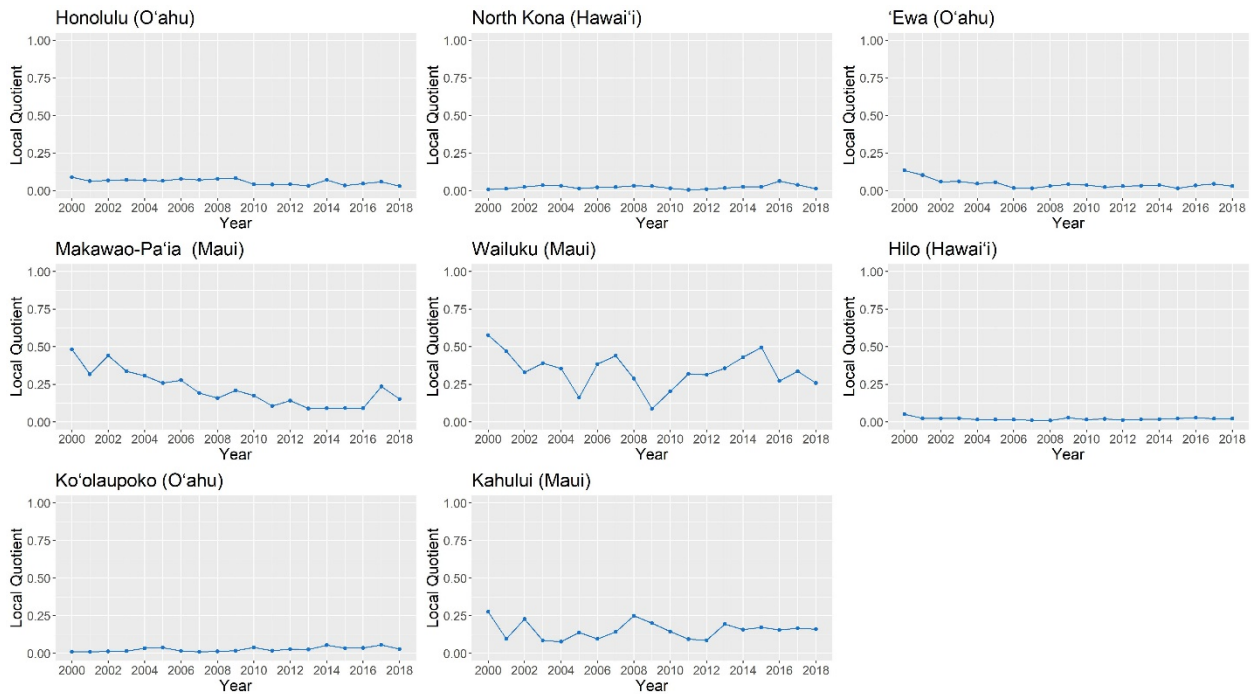
Figure 24. Local Quotient (POUNDS) for communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least 50% of years from the baseline (2004–2006).

Similar to the Local Quotient for landings, fishery ex-vessel revenues Local Quotients for the top eight communities in terms of fishing engagement fluctuated during the study period, but nearly all 2018 values for highly engaged communities were below baseline values. Trends tend to mirror those in fishing engagement index scores and in the Local Quotient for landings, albeit scaled up slightly in nominal terms. This scaling up reflects the high value Deep 7 bottomfish command in the markets. Trends in ex-vessel revenue Local Quotients provide important insights into the role of revenues from Deep 7 bottomfish relative to other fisheries in each community. In five of the top eight highly engaged communities, Deep 7 bottomfish comprise less than 20% of fishery revenues in the community. However, revenue Local Quotients exceed 20% in three Maui communities, with Wailuku (Maui) regularly exceeding 50% (Figure 25). In 2018, there were three notable communities not reflected in Figure 25 where Deep 7 bottomfish comprise a significant share of local fishery revenues: Waiheʻe-Waikapū (Maui) [45.4%], Kīhei (Maui) [18.3%], and Wahiawā (Oʻahu) [15.4%]. These are important findings to consider when assessing potential community impacts of fishery management alternatives or for monitoring future community dynamics in the MHI Deep 7 bottomfish fishery.

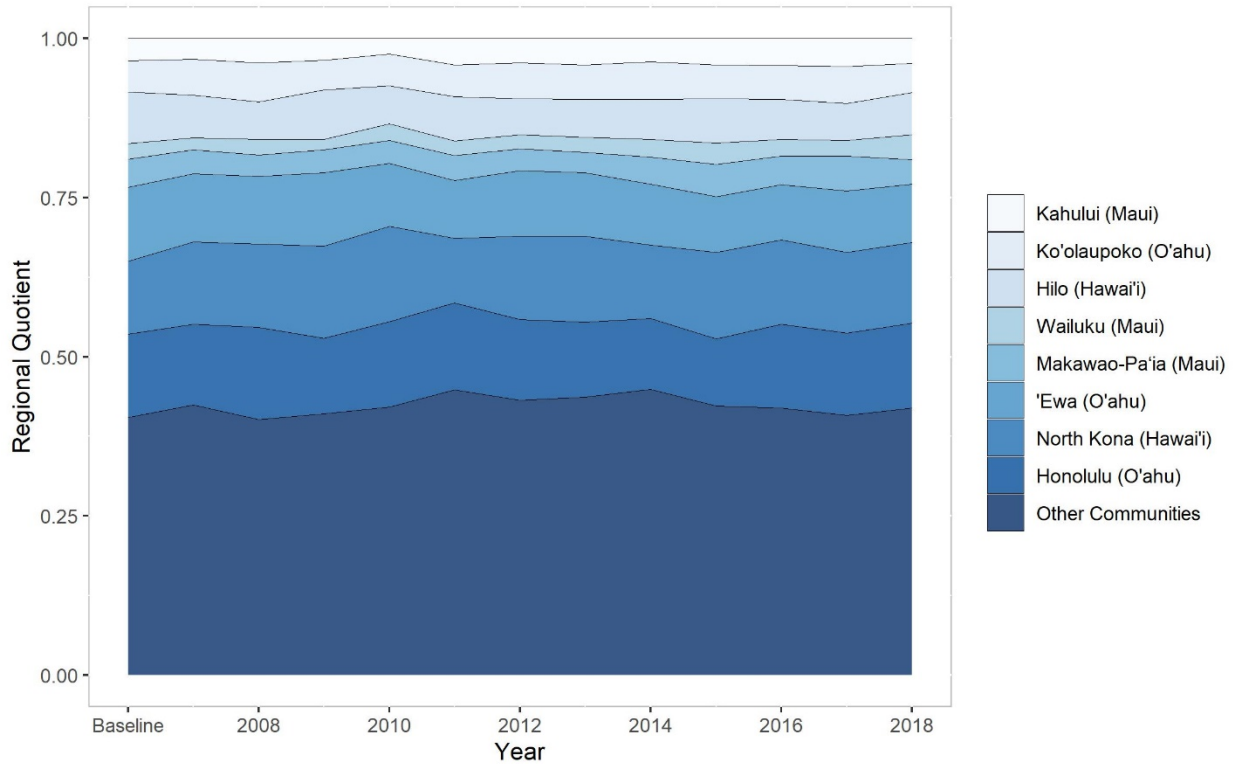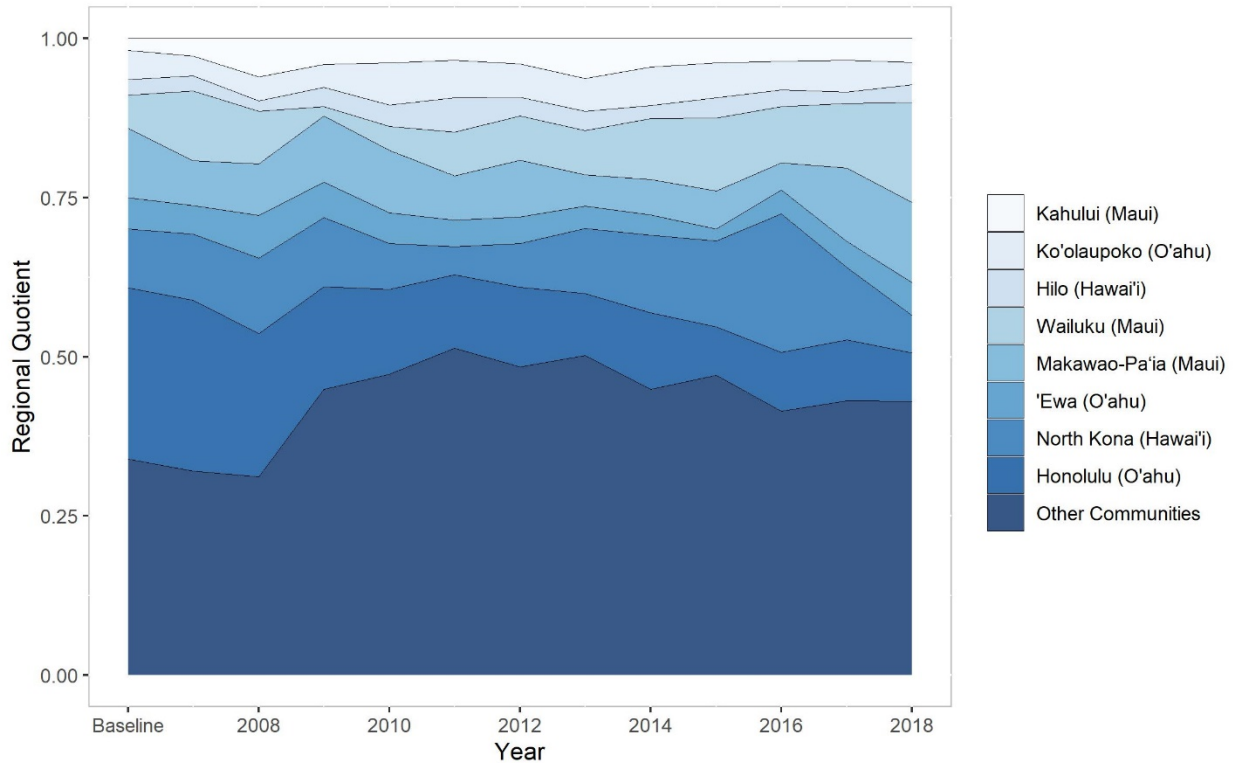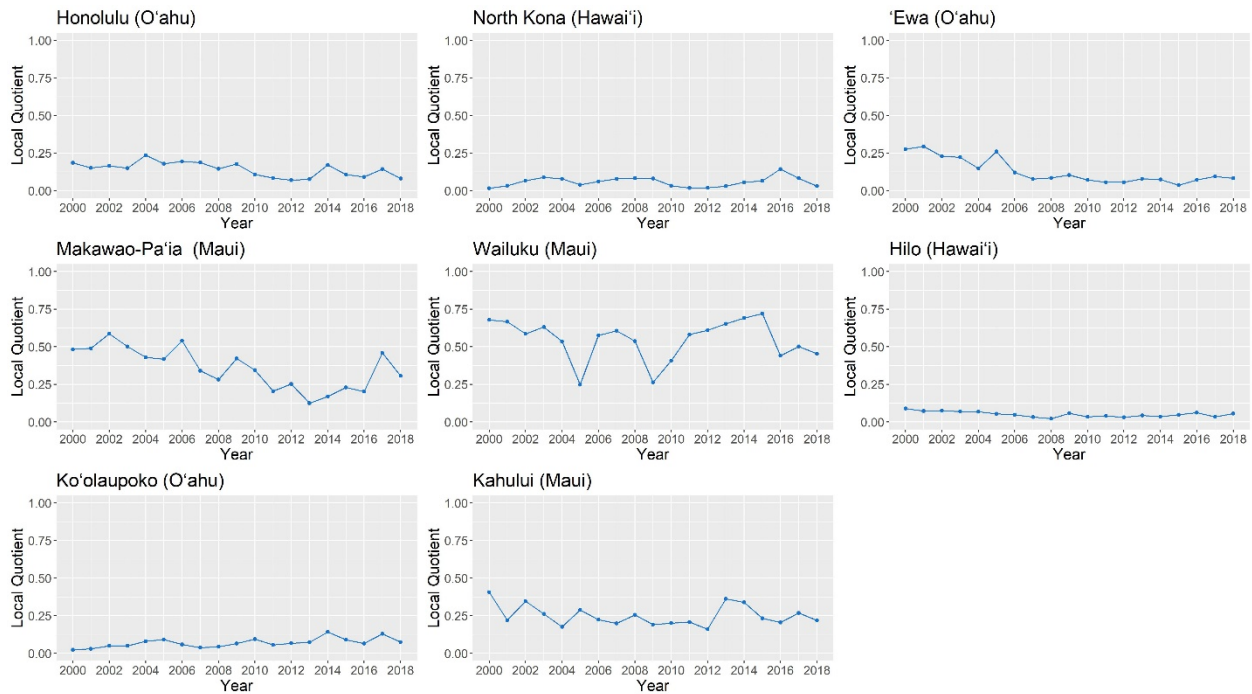**Figure 25. Local Quotient (REVENUE) for communities highly engaged in the MHI Deep 7 Bottomfish fishery for at least 50% of years from the baseline (2004–2006).**

Community Social Vulnerability Indicators (CSVIs)

The three categories of CSVIs discussed below include environmental justice, economic, and gentrification pressure. The environmental justice indicators (personal disruption, population composition vulnerability, poverty) consider whether fishery policies disproportionately affect disadvantaged communities. Economic indicators represent social factors that can shape either an individual's or community's ability to adapt to change (labor force structure, and housing characteristics). The gentrification pressure indicators characterize factors that over time may signify a threat to the viability of a vibrant commercial working waterfront including property and businesses (housing disruption, retiree migration, and urban sprawl).

The CSVIs for communities that were highly engaged in the main Hawaiian Islands Deep 7 bottomfish fishery for one or more years from the baseline (2004–2006) through 2018 tend to have larger than average populations compared to others participating in this fishery as well as relatively low social vulnerability index scores, except for population composition and housing disruption (Table 15, Table 16, Table 17). Communities highly engaged for all years from the baseline are highlighted in blue.

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Table 15. Environmental justice indicators (2018) for communities highly engaged in the MHI Deep 7 bottomfish fishery for one or more years from the baseline (2004–2006) through 2018.

Community (Island)	Personal Disruption	Population Composition	Poverty
Honolulu (Oʻahu)	Low	High	Low
North Kona (Hawaiʻi)	Low	Medium	Low
ʻEwa (Oʻahu)	Low	High	Low
Makawao-Pāʻia (Maui)	Low	Medium	Low
Hilo (Hawaiʻi)	Medium	Med-High	Med-High
Lahaina (Maui)	Low	Med-High	Low
Wailuku (Maui)	Low	Med-High	Low
Koʻolaupoko (Oʻahu)	Low	Medium	Low
Kahului (Maui)	Low	High	Low
Waiheʻe-Waikapū (Maui)	Low	Med-High	Low
South Kona (Hawaiʻi)	Low	Med-High	Medium
Kula (Maui)	Low	Low	Low
East Molokaʻi (Molokaʻi)	Low	Med-High	Low
South Kohala (Hawaiʻi)	Low	Med-High	Low

Table 16. Economic indicators (2018) for communities highly engaged in the MHI Deep 7 bottomfish fishery for one or more years from the baseline (2004–2006) through 2018.

Community (Island)	Population Size (2018)	Labor Force Structure	Housing Characteristics
Honolulu (Oʻahu)	401,549	Low	Low
North Kona (Hawaiʻi)	43,631	Low	Low
ʻEwa (Oʻahu)	344,887	Low	Low
Makawao-Pāʻia (Maui)	20,436	Low	Low
Hilo (Hawaiʻi)	48,774	Medium	Medium
Lahaina (Maui)	23,233	Low	Low
Wailuku (Maui)	22,782	Low	Low
Koʻolaupoko (Oʻahu)	112,189	Low	Low
Kahului (Maui)	32,312	Low	Low
Waiheʻe-Waikapū (Maui)	7,427	Low	Low
South Kona (Hawaiʻi)	10,768	Medium	Medium
Kula (Maui)	13,477	Low	Low
East Molokaʻi (Molokaʻi)	4,380	Medium	Med-High
South Kohala (Hawaiʻi)	19,855	Low	Low

Table 17. Gentrification pressure indicators (2018) for communities highly engaged in the MHI Deep 7 bottomfish fishery for one or more years from the baseline (2004–2006) through 2018.

Community (Island)	Housing Disruption	Retiree Migration	Urban Sprawl
Honolulu (Oʻahu)	Low	Low	High
North Kona (Hawaiʻi)	Med-High	Low	Low
ʻEwa (Oʻahu)	Low	Low	High
Makawao-Pāʻia (Maui)	High	Low	Low
Hilo (Hawaiʻi)	Low	Medium	Low
Lahaina (Maui)	Medium	Low	Low
Wailuku (Maui)	Medium	Low	Low
Koʻolaupoko (Oʻahu)	Med-High	Medium	High
Kahului (Maui)	Med-High	Medium	Low
Waiheʻe-Waikapū (Maui)	Low	Low	Low
South Kona (Hawaiʻi)	Medium	Medium	Low
Kula (Maui)	Med-High	Medium	Low
East Molokaʻi (Molokaʻi)	Medium	Med-High	Low
South Kohala (Hawaiʻi)	Medium	Low	Low

Uku Fishery

Fishery Overview

Uku are wide-ranging reef-associated snapper known by several common English names in other regions, typically "green jobfish" or "gray snapper" (Nadon et. al 2020). In the main Hawaiian Islands (MHI), uku inhabit the coastal waters, including deep lagoons, channels, and inshore reefs and feeds in the water column at depths ranging from 20–200 meters (WPFMC 2019a; Nadon et al. 2020).

Uku reach sexual maturity during the spring and summer and aggregate in shallow waters during the summer months for spawning purposes. They are typically targeted and caught when they aggregate for spawning (WPFMC 2019a). In addition to the commercial uku fishery, there is a vibrant non-commercial fishery targeting uku. It is estimated that non-commercial fishing accounts for nearly half (52%) of total uku caught; the majority is caught by boat (78%) compared to shore-based fishing (22%) (Nadon et al. 2020). They are targeted using both heavy (deep-sea handline, 63% of total commercial catch) and light (inshore handline, 15%) tackle and troll gear (10%, Nadon et al. 2020).

The commercial uku fishery has demonstrated some slight cyclical patterns over our period of analysis (Figure 26, Table 18), although averages in the past 15 years closely approximate baseline values (Table 18). Between 2012 and 2018, uku was included in a non-Deep 7 bottomfish management unit species complex that received an annual catch limit (ACL); however, this ACL was never binding, and the commercial fishery has not experienced any closures. Beginning in 2020/2021, uku will be managed as its own fishery, with an individual species annual catch limit. Given that the fishery has faced few regulatory changes over the study period, we maintain a baseline period of 2000–2002 for our community performance indicators.
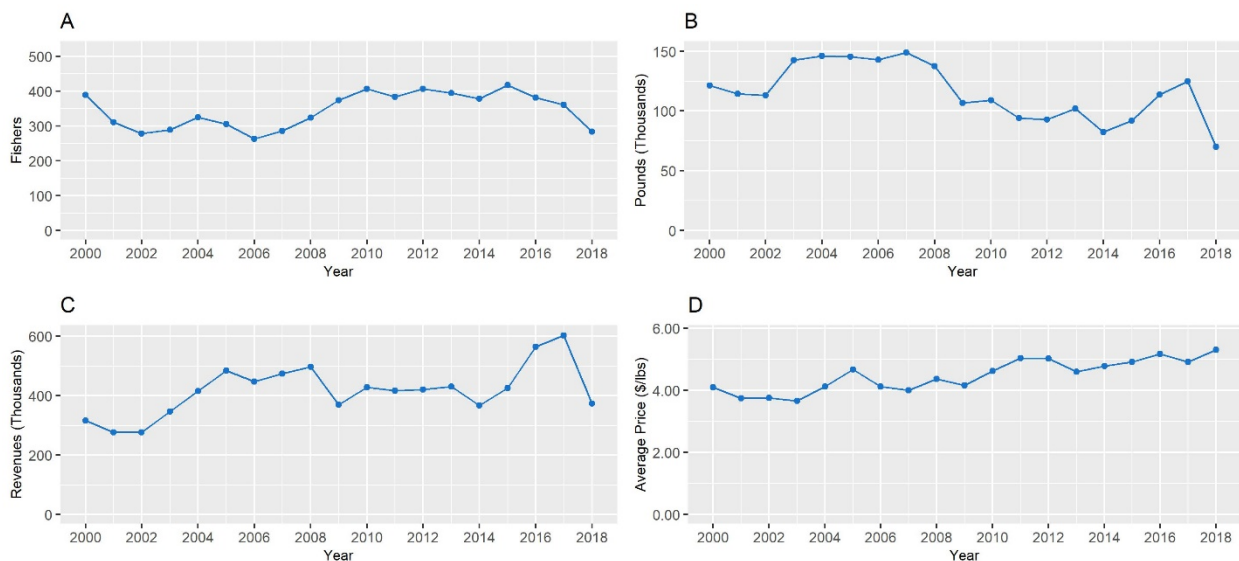
Figure 26. Trends for uku fishery, 2000-2018: (A) number of active fishers reporting landings, (B) total pounds landed, (C) inflation-adjusted fishery revenue, (D) inflation-adjusted average prices.

Table 18. Fishery Performance Overview: Uku.

	Average Baseline (2000–2002)	Average (2003–2018)	Minimum (Year)	Maximum (Year)
Fishers with landings	327	349	264 (2006)	418 (2015)
Fishers with sales	291	285	214 (2006)	347 (2000)
Dealers reporting sales	53	52	41 (2007)	60 (2015)
Landings (thousand pounds)	119	128	75 (2018)	164 (2007)
Pounds Sold (thousands)	116	116	70 (2018)	149 (2007)
Ex-vessel revenue* (million $)	0.451	0.523	0.373 (2018)	0.679 (2005)
Average Price* ($ / pound)	3.87	4.60	3.66 (2003)	5.31 (2018)

* Adjusted to 2018 dollars using consumer price index for All Urban Consumers: All items in Urban Hawai'i (CBSA)

Trends for Top Participating Communities

Engagement

The fishery-specific commercial Fishing Engagement Index (FEI) is an indicator of the community-level importance of uku fishing relative to other communities across the State of Hawai'i. It is a multi-variate measure of uku fishing activity within each community that includes pounds landed, revenue, number of commercial-licensed fishers reporting landings of uku, and the number of dealers reporting purchases of uku. There were fourteen communities highly engaged (1.0 standard deviation or more above the mean) in the uku fishery for at least one year from the baseline (2000–2002) through 2018 (Table 19). These communities are fairly well distributed across the State of Hawai'i. The islands of Lāna'i and Moloka'i do not have any communities highly engaged in the uku fishery using our FEI methodology.

Three communities were highly engaged for all years from the baseline through 2018 (Honolulu, North Kona, and 'Ewa) (Figure 27, Table 19). One community (Kaumakani-Hanapepe) was highly engaged during the baseline period, again in 2006, but not during any other year in the analysis. There were four communities (Koloa-Poipu, Lahaina, Wailuku, Kapa'a) highly engaged for three or more years during the period of analysis. Engagement was sporadic across the remaining seven communities, each with 1–2 years of high engagement during the period of analysis. The composition of highly engaged communities in 2018 differs slightly from those highly engaged during the baseline period, with two Kaua'i communities no longer highly engaged (Koloa-Poipu, Kaumakani-Hanapepe), replaced with two other Kaua'i communities (Kapa'a, Hanalei) which have seen increased engagement in recent years.

Table 19. Fishing Engagement Index scores of communities highly engaged in the uku fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Baseline	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honolulu (Oʻahu)	8.357	7.217	7.420	8.694	8.734	9.206	8.706	8.898	6.521	8.658	7.905	8.552	6.851	8.622	7.624	8.250	9.364
North Kona (Hawaiʻi)	3.855	6.401	6.247	1.838	3.939	2.941	3.866	3.042	6.816	4.502	3.162	2.506	3.339	4.520	4.328	2.653	1.880
ʻEwa (Oʻahu)	2.983	2.351	3.022	4.958	3.662	2.158	2.907	3.346	2.394	2.957	5.006	4.545	5.623	3.214	4.329	4.792	4.380
Koloa-Poipu (Kauaʻi)	1.824	2.949	1.750	0.101	-0.080	0.452	1.229	0.248	2.059	0.485	0.815	0.853	0.933	0.937	0.224	0.951	0.308
Kaumakani-Hanapepe (Kauaʻi)	1.346	0.898	0.573	-0.288	1.071	0.141	0.554	0.890	0.062	0.617	0.666	0.350	0.427	0.209	-0.737	-0.477	-0.641
Hilo (Hawaiʻi)	0.666	1.016	0.145	0.858	0.627	0.874	0.655	0.737	-0.195	0.157	0.278	0.853	-0.107	0.206	0.733	0.333	0.176
Lahaina (Maui)	0.463	0.624	0.900	0.410	0.223	0.175	1.228	1.036	1.673	1.199	0.928	1.268	0.714	1.456	0.384	0.254	0.569
Wailuku (Maui)	0.416	-0.349	0.203	-0.369	0.291	1.288	0.908	0.030	-0.082	0.430	0.383	0.144	0.524	0.748	2.192	1.349	0.418
Kahului (Maui)	0.326	0.220	0.404	0.425	0.220	0.386	-0.279	0.222	0.514	0.203	1.058	0.471	0.726	0.694	1.581	0.989	0.762
Līhuʻe (Kauaʻi)	0.252	0.091	0.507	0.243	-0.052	0.612	0.463	0.351	0.647	1.141	0.778	0.520	0.411	0.687	0.383	0.433	0.306
Hanalei (Kauaʻi)	0.033	-0.003	0.381	0.399	0.553	-0.086	0.012	0.004	-0.325	0.095	-0.435	-0.209	-0.506	-0.551	-0.447	-0.338	1.039
Kapaʻa (Kauaʻi)	-0.106	-0.814	-0.798	-0.116	-0.614	-0.635	-0.452	-0.263	-0.394	-0.448	-0.250	0.447	1.247	0.163	0.205	1.144	1.305
Koʻolaupoko (Oʻahu)	-0.155	0.377	0.448	1.267	0.014	-0.368	-0.235	-0.162	0.313	0.415	0.115	0.854	0.831	0.283	0.144	0.297	0.007
Kekaha-Waimea (Kauaʻi)	-0.411	-0.127	-0.246	-0.781	-0.112	-0.014	0.986	0.855	2.238	-0.134	0.729	0.792	1.094	-0.049	-0.652	-1.086	-0.878

Note: Highlighted cells indicate high engagement

Three communities were highly engaged for all years from the baseline through 2018 (Figure 27). The engagement scores for these highly engaged communities fluctuated a fair amount over the time series, but the Oʻahu communities of Honolulu and ʻEwa suggest stable to slight increases in engagement over time. The trend for North Kona (Hawaiʻi) demonstrated a slight downward trend in engagement over time, despite some individual years of increased engagement. Trends for Oʻahu communities seem to move together, whereas North Kona (Hawaiʻi) tends to move in an almost mirror reflection pattern to Honolulu. Additional research could explore potential environmental or market relationships behind these trends.

Figure 27. Fishing Engagement Index scores of communities highly engaged in the uku fishery for all years from the baseline (2000–2002).

Six communities were highly engaged for more than one year from the baseline (2000–2002) through 2018 are depicted in (Figure 28). The Maui communities of Wailuku, Kahului, and Lahaina have seen relatively stable trends in engagement levels despite some variation during the period of analysis. The community of Koloa-Poipu (Kauaʻi) with four years of high engagement has, on average, experienced a slight declining trend in engagement over the years. Kapaʻa (Kauaʻi) has experienced recent increases in fishing engagement during the last two years of the time series and represents one of the four communities highly engaged in the uku fishery during 2018. Kekaha-Waimea (Kauaʻi) experienced steady growth in the early years of the study period, peaking in 2010, followed by a steady decline in recent years. The communities of Hilo (Hawaiʻi), Līhuʻe (Kauaʻi), Hanalei (Kauaʻi), and Koʻolaupoko (Oʻahu) were highly engaged in the uku fishery for only one year since the baseline (Figure 29). Kaumakani-Hanapepe (Kauaʻi) was highly engaged exclusively during the baseline period.

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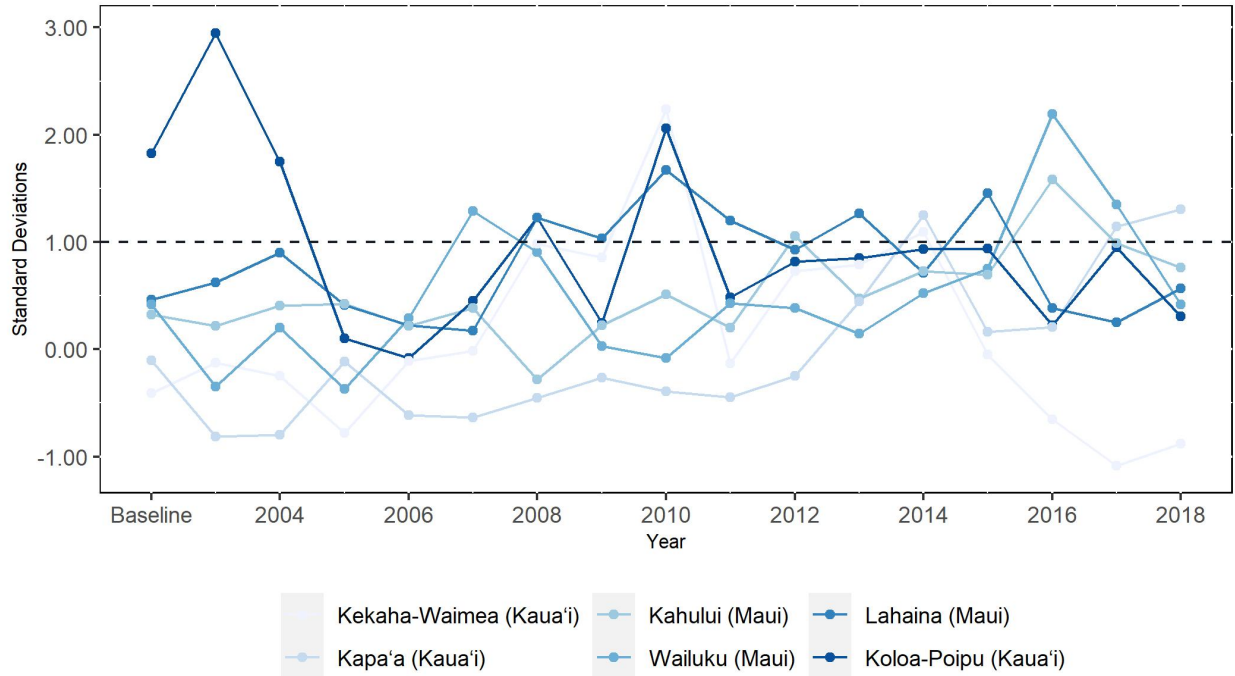
Figure 28. Fishing Engagement Index scores of communities highly engaged in the uku fishery for more than one year from the baseline (2000–2002) through 2018.
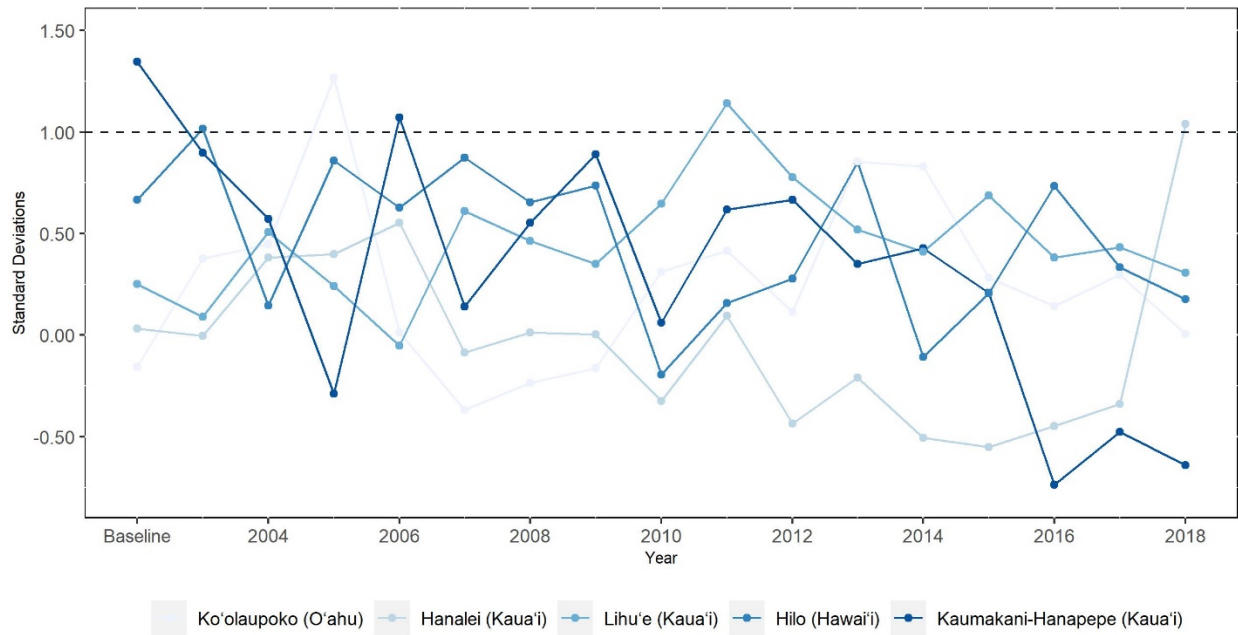
Figure 29. Fishing Engagement Index scores of communities highly engaged in the uku fishery for one year from the baseline (2000–2002) through 2018.

Regional Quotient

Another measure of a community's involvement in the uku fishery is its Regional Quotient. The Regional Quotient is the proportion of uku fishery activity within a community to the total uku fishery across the State of Hawaiʻi. We present indicators of the percent contribution in active fishers, pounds landed, and revenue of uku landed within that community relative to the State of Hawaiʻi fishery. The Regional Quotient is reported individually only for those communities that were highly engaged for three or more years during 2003–2018, relative to the baseline (2000–2002) period. The remaining communities across the State of Hawaiʻi are grouped as "Other Communities" in the figures.

The top communities in terms of Regional Quotient for commercial fishers reporting landings of uku (Figure 30) align well with those identified as highly engaged in the fishery. During the baseline period, the three communities with highest Regional Quotients for fisher participation were North Kona (Hawaiʻi) [13.3%], Honolulu (Oʻahu) [9.9%], and ʻEwa (Oʻahu) [9.0%], while "Other Communities" represented 54.8% of active fishers. Contributions within these communities have held relatively stable over time. North Kona (Hawaiʻi) has experienced the largest decrease in share of active fishers relative to the baseline period, with a Regional Quotient down to 8.6% in 2018. A few communities with notable Regional Quotient scores for active fishers in 2018 not represented in Figure 30 are Koʻolaupoko (Oʻahu) [5.2%], Hilo (Hawaiʻi) [4.9%], and South Kohala (Hawaiʻi) [4.1%]. Communities with sizable shares of fishers reporting sales of uku in 2018 not represented in Figure 30 are Koʻolaupoko (Oʻahu) [5.3%] and a handful of communities at 4.4%, including Hilo (Hawaiʻi), Keaʻau-Mountain View (Hawaiʻi), South Kohala (Hawaiʻi), and Makawao-Pāʻia (Maui). These findings suggest the potential for higher levels of commercial motivation for uku fishers in these communities.

Figure 30. Regional Quotient (FISHERS) for communities highly engaged in the uku fishery for three or more years from the baseline (2000–2002).

The leading communities in terms of Regional Quotient for pounds landed of uku align well with those identified as highly engaged for all years in the fishery. During the baseline period, the top three were Honolulu (Oʻahu) [34.2%], ʻEwa (Oʻahu) [11.6%], and Koloa-Poipu (Kauaʻi) [10.2%], while "Other Communities" represented 29.3% of state-wide landings. Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. The most notable change is the large reduction in landings contributions from North Kona (Hawaiʻi) during the time series, seemingly replaced with increases from ʻEwa (Oʻahu). The share of pounds landed from "Other Communities" has increased over the time period to approximately 40% by 2018 (Figure 31). One community with a notable Regional Quotient score for 2018 not shown in Figure 31 is Hanalei (Kauaʻi) [7.2%], representing the third highest share in the state for the year.

Figure 31. Regional Quotient (POUNDS) for communities highly engaged in the uku fishery for three or more years from the baseline (2000–2002).

The communities with high Regional Quotient values for ex-vessel revenues of uku align well with those identified as highly engaged in the fishery during all years. During the baseline period, the top three were Honolulu (Oʻahu) [33.5%], ʻEwa (Oʻahu) [14.1%], and Koloa-Poipu (Kauaʻi) [8.1%], while "Other Communities" represented 31.6% of fishery revenues. Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores (Figure 32). "Other Communities" have experienced an increase in the share of fishery revenues relative to the baseline period, increasing to nearly 41% in 2018. North Kona (Hawaiʻi) and Koloa-Poipu (Kauaʻi) have seen steady declines in their contributions to fishery revenues during the study period. Two communities embedded within the "Other Communities" category had roughly 5% or more revenue share in 2018, Kahului (Maui, 6.7%) and Kīhei (Maui, 4.8%). These figures are greater than three of the highly engaged communities included in Figure 32.

Figure 32. Regional Quotient (REVENUE) for communities highly engaged in the uku fishery for three or more years from the baseline (2000–2002).

Local Quotient

The community Local Quotient is the percentage of uku fishing activity by fishers within a community out of the total of all fishing (non-longline) activity within that community. It is an indicator of the contribution in pounds landed or revenue of uku to the overall landings or revenue in a community (Figure 33). The Local Quotients are reported individually only for those communities that were highly engaged for three or more years during 2003–2018, relative to the baseline period.

The Local Quotient for pounds landed for the top seven communities in terms of fishing engagement fluctuated during the study period but nearly all 2018 values for highly engaged communities (with the exception of Kapaʻa (Kauaʻi)) are below baseline values. Trends tend to follow trends in fishing engagement index scores. These values provide important insights into the role of uku relative to other fisheries in each community. In the top seven highly engaged communities, uku comprise less than 20% of fishery landings in the community for any given year, but this does not mean it is insignificant. It should be noted that in 2018, none of the top five communities in terms of their Local Quotient score for uku landings are reflected in Figure 33. Three high LQ communities were Kahului (Maui) [7.1%], Hanalei (Kauaʻi) [6.6%], and Kīhei (Maui) [5.2%]. Notably, two additional communities in 2018 had landings Local Quotient scores of 41.4% and 7.5%, but their names are withheld due to confidentiality considerations.
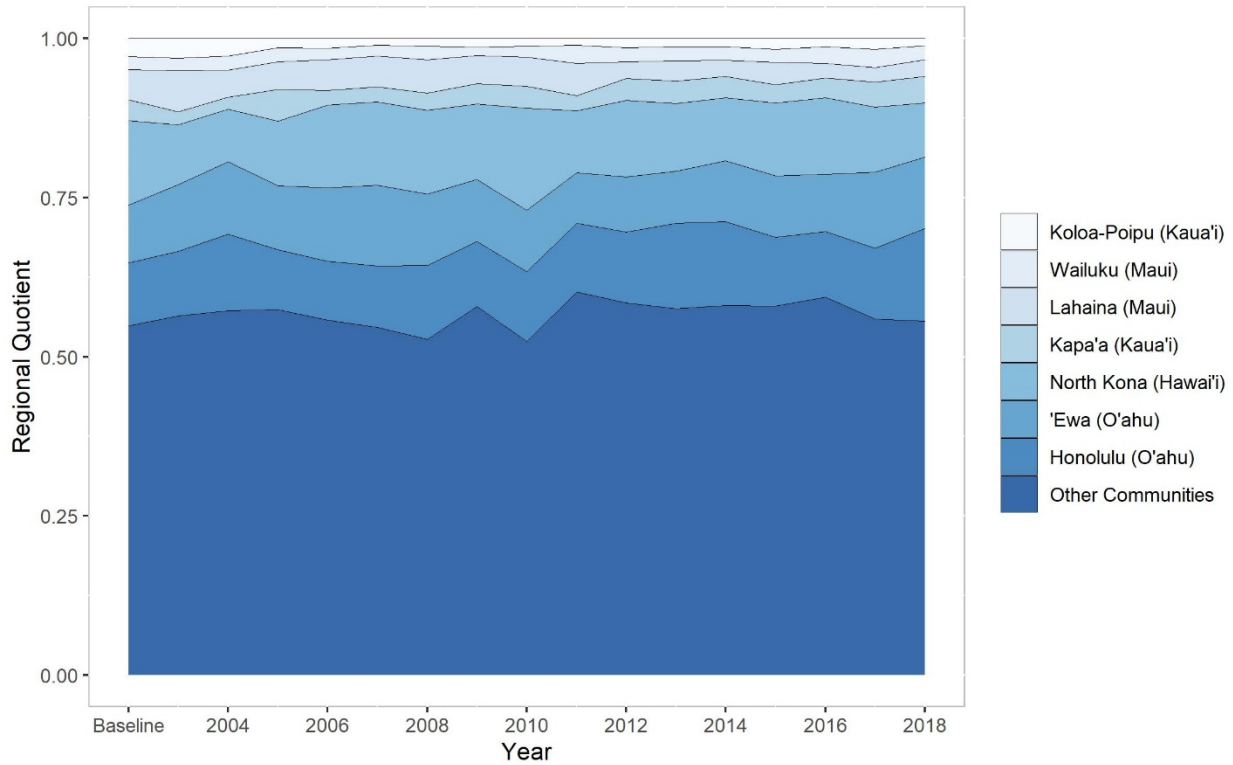
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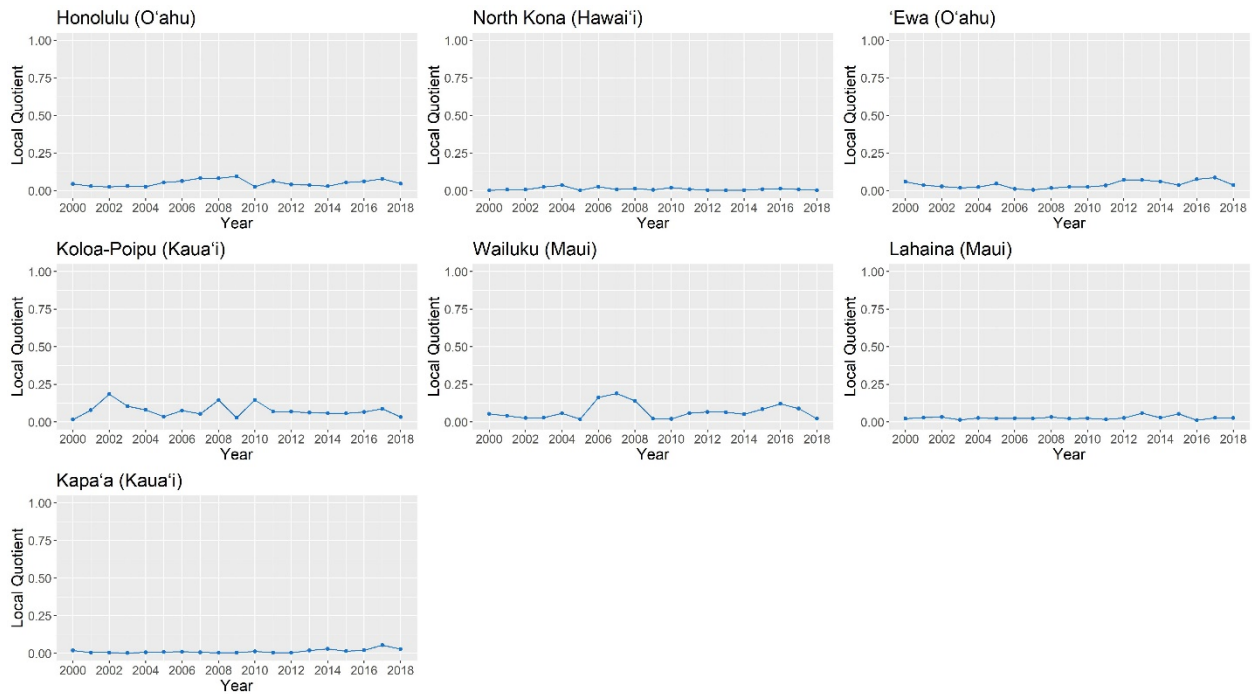
Figure 33. Local Quotient (POUNDS) for communities highly engaged in the uku fishery for three or more years from the baseline (2000–2002).

Similar to the Local Quotient for landings, fishery ex-vessel revenues for the top seven communities in terms of fishing engagement fluctuated during the study period, but nearly all 2018 values for highly engaged communities are below baseline values, except for 'Ewa (O'ahu) and Kapa'a (Kaua'i). Trends tend to follow patterns in fishing engagement index scores and trends in the Local Quotient for landings. Interpreting trends in ex-vessel revenue Local Quotients provides important insights into the role of revenues from uku relative to other fisheries in each community. Similar to the findings for community landings, uku comprise a relatively small share of community revenues across the State of Hawai'i. In 2018, there were two notable communities not reflected in Figure 34 where uku comprise a moderate share of local fishery revenues for the community: Kahului (Maui) [13.5%] and Kīhei (Maui) [10.2%]. Two additional communities had revenue Local Quotient scores of 35.4% and 16.4% in 2018, but their names are withheld due to confidentiality considerations. These are important findings to consider when assessing potential community impacts of fishery management alternatives.
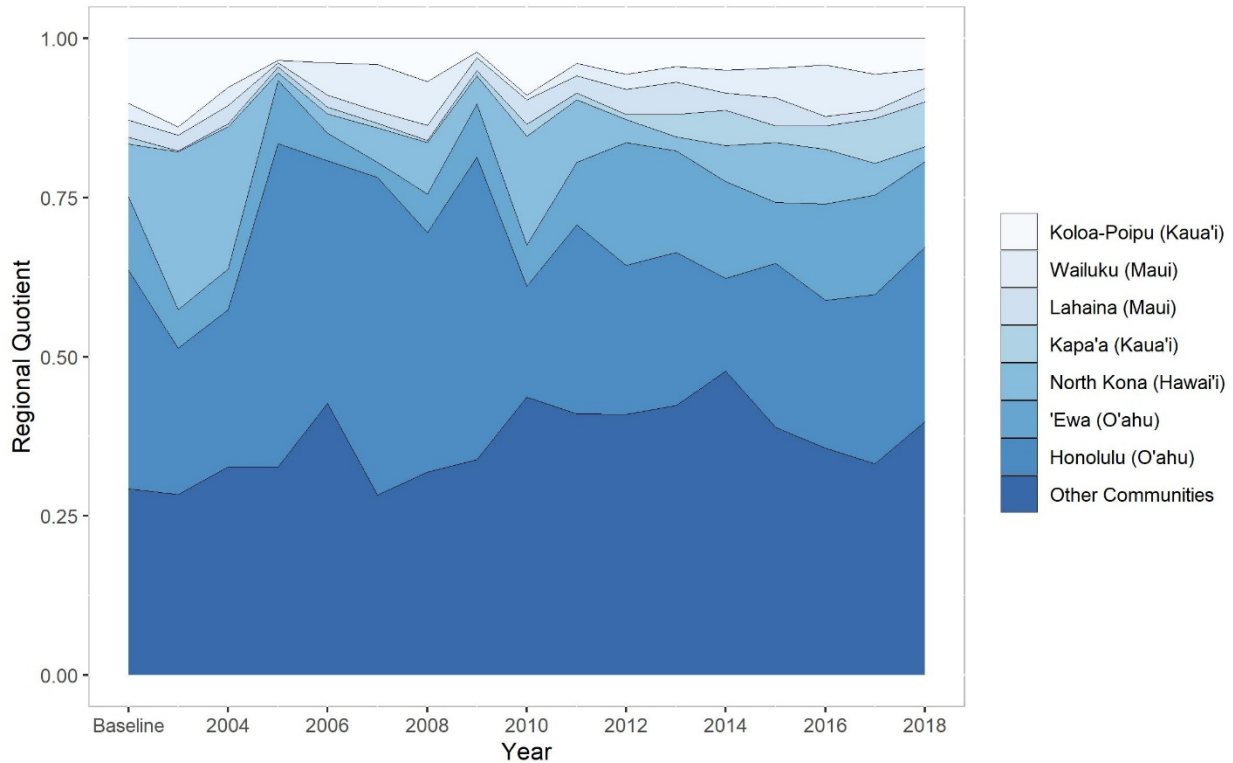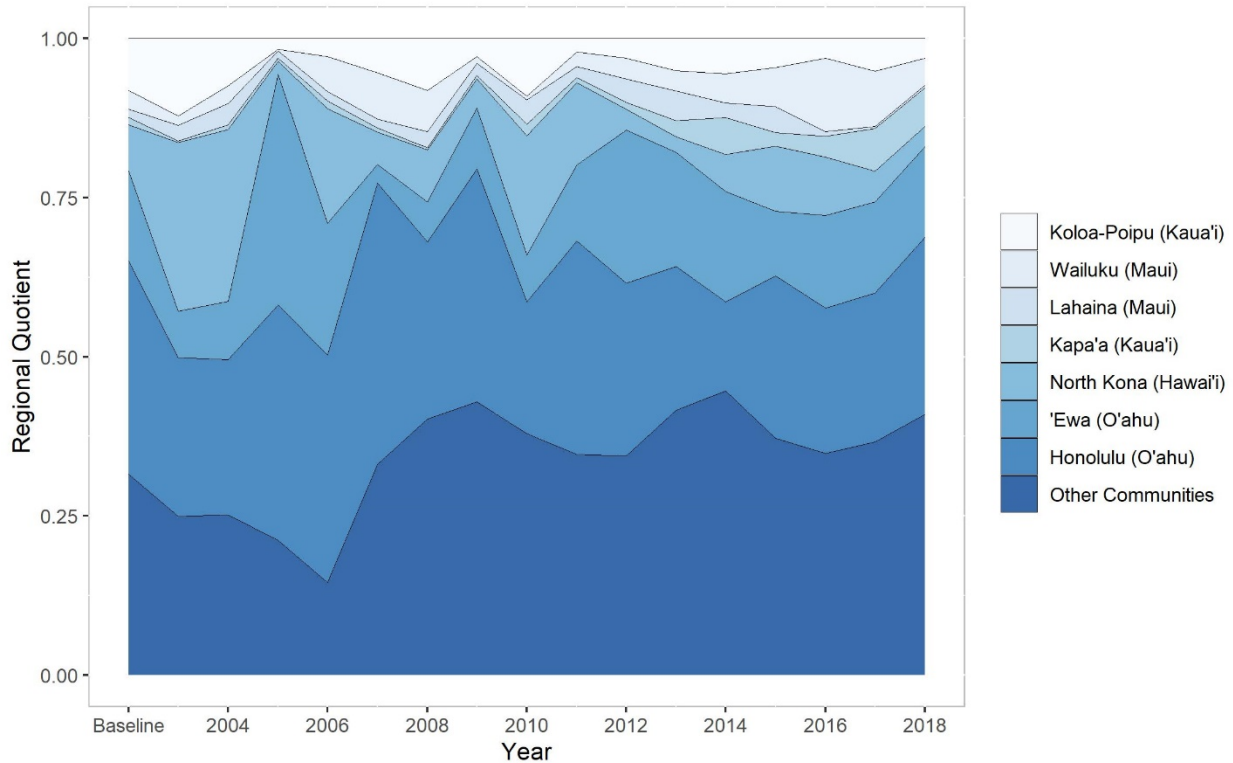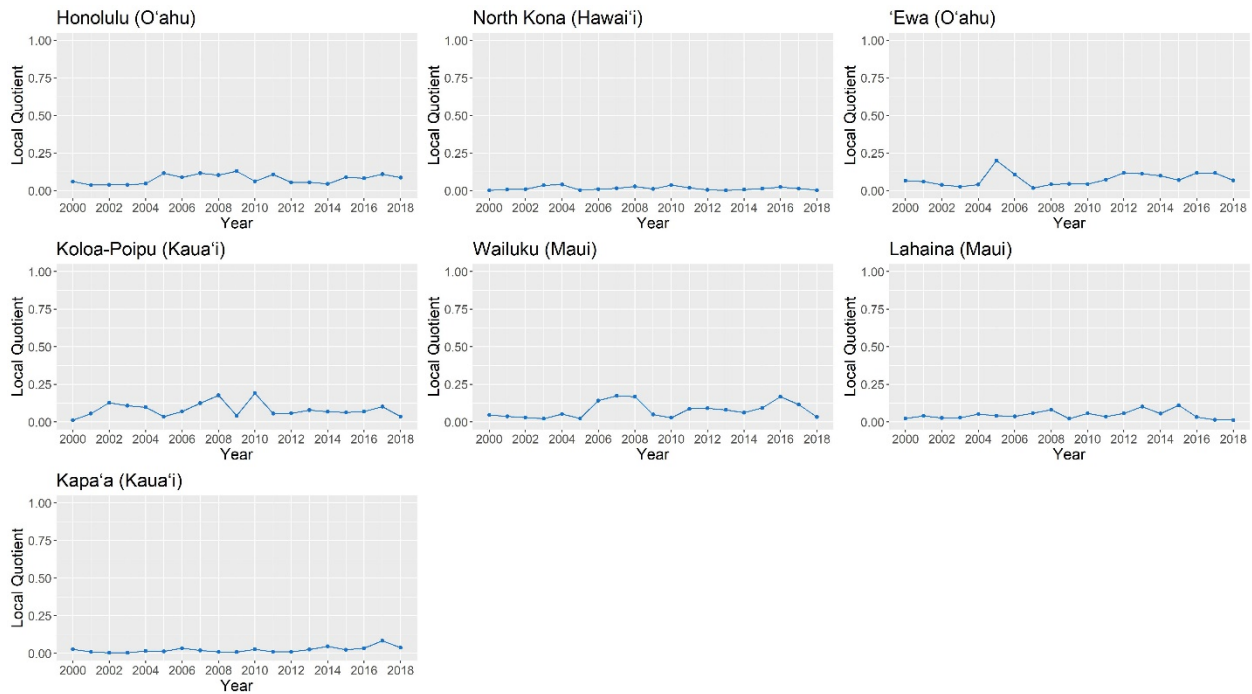
Figure 34. Local Quotient (REVENUE) for communities highly engaged in the uku fishery for three or more years from the baseline (2000–2002).

Community Social Vulnerability Indicators (CSVIs)

The three categories of CSVIs discussed below include environmental justice, economic, and gentrification pressure. The environmental justice indicators (personal disruption, population composition vulnerability, poverty) consider whether fishery policies disproportionately affect disadvantaged communities. Economic indicators represent social factors that can shape either an individual's or community's ability to adapt to change (labor force structure, and housing characteristics). The gentrification pressure indicators characterize factors that over time may signify a threat to the viability of a vibrant commercial working waterfront including property and businesses (housing disruption, retiree migration, and urban sprawl).

There were fourteen communities that were highly engaged in the uku fishery for one or more years from the baseline (2000–2002) through 2018 (Table 20, Table 21,Table 22). Those that were highly engaged for all years from the baseline are highlighted. These communities tend to have larger than average populations compared to others participating in this fishery. Overall, communities participating in this fishery generally had relatively low social vulnerability index scores, except for population composition. Gentrification pressure was more variable, with neighbor islands scoring higher on housing disruption and retiree migration and O'ahu communities experiencing high urban sprawl.

Table 20. Environmental justice indicators (2018) for communities highly engaged in the uku fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Personal Disruption	Population Composition	Poverty
Honolulu (Oʻahu)	Low	High	Low
North Kona (Hawaiʻi)	Low	Medium	Low
ʻEwa (Oʻahu)	Low	High	Low
Koloa-Poipu (Kauaʻi)	Low	Medium	Medium
Kaumakani-Hanapepe (Kauaʻi)	Low	High	Low
Hilo (Hawaiʻi)	Medium	Med-High	Med-High
Lahaina (Maui)	Low	Med-High	Low
Wailuku (Maui)	Low	Med-High	Low
Kahului (Maui)	Low	High	Low
Līhuʻe (Kauaʻi)	Low	Medium	Low
Hanalei (Kauaʻi)	Low	Low	Low
Kapaʻa (Kauaʻi)	Low	Med-High	Low
Koʻolaupoko (Oʻahu)	Low	Medium	Low
Kekaha-Waimea (Kauaʻi)	Low	Med-High	Low

Table 21. Economic indicators (2018) for communities highly engaged in the uku fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Population Size (2018)	Labor Force Structure	Housing Characteristics
Honolulu (Oʻahu)	402,452	Low	Low
North Kona (Hawaiʻi)	41,369	Low	Low
ʻEwa (Oʻahu)	344,153	Low	Low
Koloa-Poipu (Kauaʻi)	6,208	Low	Low
Kaumakani-Hanapepe (Kauaʻi)	4,133	Low	Medium
Hilo (Hawaiʻi)	48,774	Medium	Medium
Lahaina (Maui)	23,568	Low	Low
Wailuku (Maui)	22,234	Low	Low
Kahului (Maui)	30,706	Low	Low
Līhuʻe (Kauaʻi)	7,212	Low	Low
Hanalei (Kauaʻi)	6,232	Low	Low
Kapaʻa (Kauaʻi)	8,105	Low	Low
Koʻolaupoko (Oʻahu)	115,160	Low	Low
Kekaha-Waimea (Kauaʻi)	5,337	Low	Medium

Table 22. Gentrification pressure indicators (2018) for communities highly engaged in the uku fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Housing Disruption	Retiree Migration	Urban Sprawl
Honolulu (Oʻahu)	Low	Low	High
North Kona (Hawaiʻi)	Med-High	Low	Low
ʻEwa (Oʻahu)	Low	Low	High
Koloa-Poipu (Kauaʻi)	Med-High	Medium	Low
Kaumakani-Hanapepe (Kauaʻi)	Medium	Medium	Low
Hilo (Hawaiʻi)	Low	Medium	Low
Lahaina (Maui)	Medium	Low	Low
Wailuku (Maui)	Medium	Low	Low
Kahului (Maui)	Med-High	Medium	Low
Līhuʻe (Kauaʻi)	High	Low	Low
Hanalei (Kauaʻi)	High	Medium	Low
Kapaʻa (Kauaʻi)	Med-High	Low	Low
Koʻolaupoko (Oʻahu)	Med-High	Medium	High
Kekaha-Waimea (Kauaʻi)	Medium	Low	Low

Note: Highlighted cells indicate communities that were highly engaged in the uku fishery for all years.

Nearshore and Reef Fish Fishery

Fishery Overview

The nearshore and reef fish fishery includes thousands of nearshore and coral reef-dependent species. While the direct monetary value of the nearshore fishery is only a small percentage of all commercial fisheries, it is culturally and socially important. Over one third of Hawai'i households report participating in nearshore reef fishing, and recreational and subsistence fishing are estimated to substantially exceed commercial fishing activities (Nadon 2017).

Coral reef species have played a central role in many aspects of Hawaiian culture from customary diets to religious beliefs and practices, to modern recreational activities (see WPFMC 2019a and Nadon 2017 for review). For many, learning to fish is an important part of growing up near the ocean. Fishing also is a means of providing food or extra income during times of hardship. The nearshore and reef fishery continues to play an important role in subsistence, strengthening social networks, and maintaining cultural ties.

This fishery primarily involves shore-based fishing in state waters around the MHI using a variety of gears, including spears, hook-and-line, traps, and small gill and cast nets. Some coral reef species are also harvested in federal waters, e.g., around offshore banks. Common harvested species are the akule (*Selar crumenophthalmus*), halalū (juvenile akule), 'ōpelu (*Carangidae* family), ama'ama (*Mugilidae* family), and weke (*Mullidae* family, WPFMC 2019a).

In general, the State of Hawai'i has seen declining trends in commercial nearshore and reef species participation and landings over time (Figure 35, Table 23). A recent stock assessment indicated that 11 of 27 assessed species may be experiencing overfishing (Nadon 2017). Surgeonfishes had the most species in this category, followed by other species with long lifespans (large parrotfishes) or that were highly targeted (i.e., jacks). Species with shorter lifespans, such as goatfishes, generally fared better.

Nearshore and reef fish fisheries have faced numerous state-level regulatory changes since 2000, including spatial closures and gear/catch restrictions at different scales across the island chain affecting many different aspects of the commercial nearshore and reef fisheries. Between 2012 and 2018, most nearshore and reef fish were subject to federal annual catch limits at species or family level. These diverse management actions confound our ability to explore community-level impacts to any individual actions. Therefore, we maintain a baseline period of 2000–2002 for our community performance indicators.
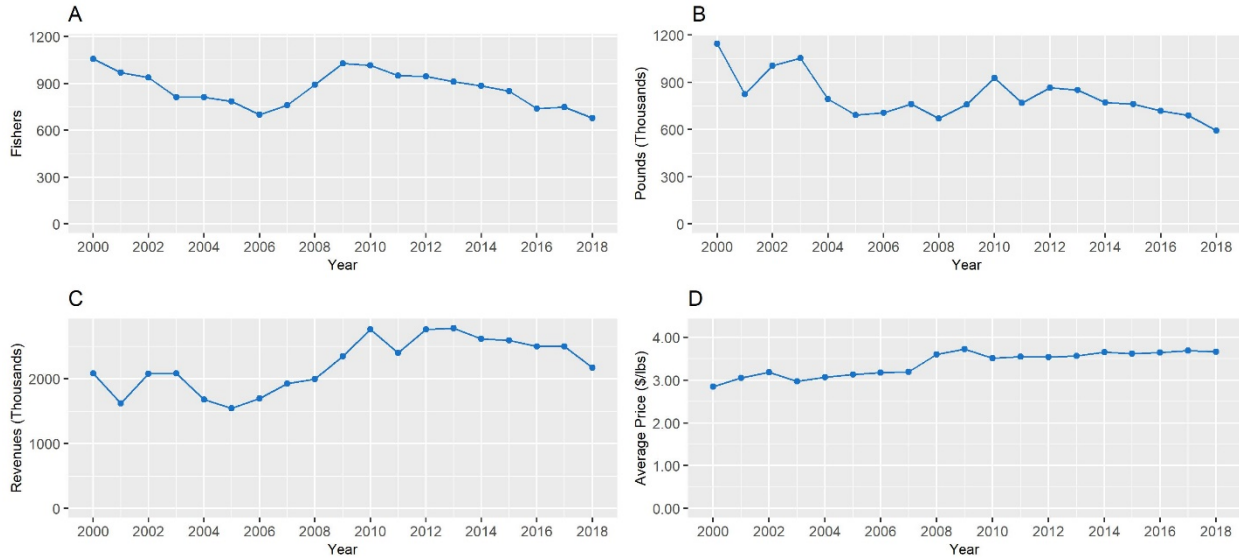
Figure 35. Trends for nearshore and reef fish fishery, 2000–2018: (A) number of active fishers reporting landings, (B) total pounds landed, (C) inflation-adjusted fishery revenue, (D) inflation-adjusted average prices.

Table 23. Fishery Performance Overview: Nearshore and reef fish fishery.

	Average Baseline (2000–2002)	Average (2003–2018)	Minimum (Year)	Maximum (Year)
Fishers with landings	989	845	679 (2018)	1027 (2009)
Fishers with sales	785	616	495 (2006)	849 (2000)
Dealers reporting sales	105	90	68 (2017)	111 (2001)
Landings (million pounds)	1.446	1.103	0.649 (2018)	1.727 (2000)
Pounds Sold (millions)	0.991	0.774	0.593 (2018)	1.146 (2000)
Ex-vessel revenue* (million $)	2.993	2.665	2.166 (2005)	3.269 (2000)
Average Price* ($ / pound)	3.03	3.45	2.85 (2000)	3.72 (2009)

* Adjusted to 2018 dollars using consumer price index for All Urban Consumers: All items in Urban Hawai'i (CBSA)

Trends for Top Participating Communities

Engagement

The fishery-specific commercial Fishing Engagement index (FEI) scores for the Hawai'i nearshore and reef fishery are presented in Table 24. The index is an indicator of the community-level importance of nearshore and reef fishing relative to other communities across the State of Hawai'i. It is a multi-variate measure of nearshore and reef fishing activity within each community that includes pounds landed, revenue, number of commercially-licensed fishers reporting landings of nearshore and reef fish species, and the number of dealers reporting purchases of nearshore and reef fish. There were ten communities highly engaged (1.0 standard deviation or more above the mean) in the Hawai'i nearshore and reef fish fishery for at least one year from the baseline (2000–2002) through 2018 (Table 24). These communities are fairly well distributed across the State of Hawai'i. The islands of Kaua'i, Lāna'i, and Moloka'i do not have any communities highly engaged in the commercial nearshore and reef fish fishery using our FEI methodology.

Five communities were highly engaged for all years from the baseline through 2018 (Honolulu, 'Ewa, North Kona, Wai'anae, and Hilo). The remaining five communities were highly engaged for at least one year during the period of analysis, but observations of high engagement were sporadic, except for Ko'olaupoko (O'ahu) which was highly engaged in each of the last 8 years of the study period. The composition of highly engaged communities in 2018 is consistent with the baseline period, with an addition of Ko'olaupoko (O'ahu).

Table 24. Fishing Engagement Index scores of communities highly engaged in the nearshore and reef fish fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Baseline	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Honolulu (O'ahu)	7.730	7.678	6.108	7.699	5.061	4.662	4.148	3.476	3.922	5.897	4.503	4.326	4.302	4.187	4.326	4.904	3.832
'Ewa (O'ahu)	4.344	4.641	4.642	4.472	4.000	7.073	6.997	6.669	5.677	4.394	4.250	4.289	4.695	4.166	4.422	4.232	4.445
North Kona (Hawai'i)	3.644	3.674	3.847	2.897	3.215	3.093	3.750	3.823	4.310	4.485	4.112	3.219	3.612	3.390	3.249	2.739	1.749
Wai'anae (O'ahu)	3.009	3.031	4.203	3.744	5.383	3.461	3.496	4.660	4.953	4.644	5.500	6.067	5.847	5.744	4.941	4.053	5.971
Hilo (Hawai'i)	1.769	1.313	1.773	2.166	1.857	1.414	2.149	1.887	1.328	1.670	1.140	1.650	1.369	1.323	1.291	1.238	1.841
Ko'olaupoko (O'ahu)	0.703	0.962	1.712	1.105	0.996	1.573	1.277	0.785	0.858	1.326	1.356	1.431	1.467	2.102	3.997	3.347	1.757
South Kona (Hawai'i)	0.429	0.699	1.005	0.180	0.293	0.506	0.241	0.495	0.929	0.295	0.896	1.243	0.527	0.465	0.407	0.541	0.651
Waialua (O'ahu)	0.355	0.496	0.483	0.417	2.258	0.733	0.648	0.959	1.284	0.494	0.787	0.255	0.723	1.250	0.578	0.479	0.414
Kahului (Maui)	0.336	0.244	-0.043	0.112	0.112	0.009	0.355	0.250	0.592	0.119	0.567	0.595	0.837	1.037	0.787	0.919	0.931
Lahaina (Maui)	0.016	-0.170	1.092	0.131	-0.387	0.381	0.242	0.282	1.083	0.873	0.725	0.044	0.229	0.166	0.398	2.102	0.775

Note: Highlighted cells indicate high engagement

The engagement scores for the five communities highly engaged for all years from the baseline through 2018 fluctuated a fair amount over the time series, but the communities of Honolulu (Oʻahu) and North Kona (Hawaiʻi) exhibited declining trends in engagement over time, while Waiʻanae (Oʻahu) experienced a steady increase over the years (Figure 36). The communities of Hilo (Hawaiʻi) and ʻEwa (Oʻahu) held rather stable over the period of analysis, although ʻEwa (Oʻahu) saw a sharp increase in 2007, followed by five years of decline to previous levels of engagement which have remained stable in recent years.

Figure 36. Fishing Engagement Index scores of communities highly engaged in the nearshore and reef fish fishery for all years from the baseline (2000–2002).

Five communities were highly engaged for more than one year from the baseline (2000–2002) through 2018 (Figure 37). The Maui communities of Kahului and Lahaina and South Kona on Hawaiʻi Island have seen relatively stable trends in engagement levels despite some variation during the period of analysis. The community of Waialua (Oʻahu) experienced a peak in 2006, but has held relatively stable since the baseline period. The community of Koʻolaupoko (Oʻahu) has seen an increasing trend in engagement over the period of analysis maintaining high engagement since 2011 and particularly high levels of engagement in 2016 and 2017, followed by a decline in 2018.
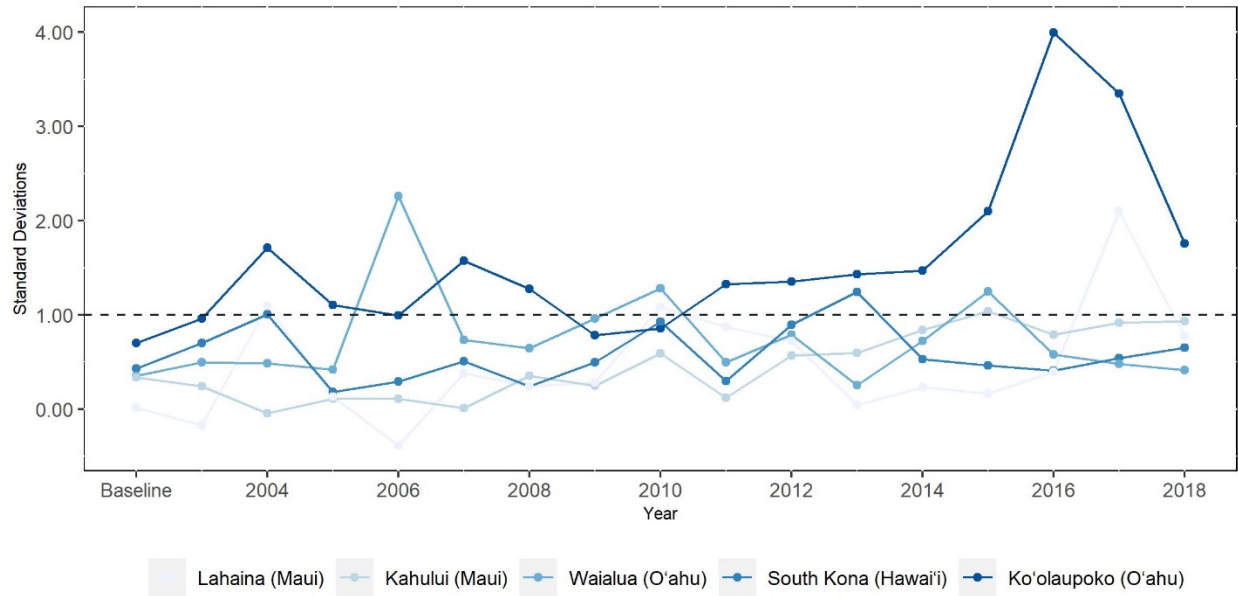
Figure 37. Fishing Engagement Index scores of communities highly engaged in the nearshore and reef fish fishery for one year or more from the baseline (2000–2002) through 2018.

Regional Quotient

Another measure of a community's involvement in the nearshore and reef fish fishery is its Regional Quotient. The Regional Quotient is the proportion of nearshore and reef fish activity within a community to the total nearshore and reef fish fishery across the State of Hawai'i. We present indicators of the percent contribution in active fishers, pounds landed, and revenue of nearshore and reef fish landed within that community relative to the State of Hawai'i fishery. The Regional Quotient is reported individually only for those communities that were highly engaged for more than 50% of years during 2003–2018, relative to the baseline (2000–2002) period. The remaining communities across the State of Hawai'i are grouped as "Other Communities" in the figures.

The top communities in terms of Regional Quotient for commercial fishers reporting landings of nearshore and reef fish species align well with those identified as highly engaged in the fishery. During the baseline period, the top three communities in terms of Regional Quotient for fisher participation were 'Ewa (O'ahu) [12.5%], North Kona (Hawai'i) [9.7%], and Honolulu (O'ahu) [8.9%], while "Other Communities" represented 52.1% of active fishers (Figure 38). Contributions within these communities have held relatively stable over time. A few communities with notable Regional Quotient scores for active fishers in 2018 not represented in Figure 38 are Kea'au-Mountain View (Hawai'i) [4.1%], and at around 3%, South Kohala (Hawai'i), South Kona (Hawai'i), and Kahului (Maui). The community with the highest share of fishers reporting sales of nearshore and reef fish species was 'Ewa (O'ahu) [12.9%]. Communities with sizable shares of fishers reporting sales of nearshore and reef fish species in 2018 not represented in Figure 38 are Kea'au-Mountain View (Hawai'i) [5.7%], South Kona

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(Hawaiʻi) [3.5%], and Kahului (Maui) [3.1%]. These findings suggest the potential for higher levels of commercial motivation for nearshore and reef fish fishers in these communities.

Figure 38. Regional Quotient (FISHERS) for communities highly engaged in the nearshore and reef fish fishery for at least 50% of years from the baseline (2000–2002).

The top communities in terms of Regional Quotient for pounds landed of nearshore and reef fish species align well with those identified as highly engaged for all years in the fishery. During the baseline period, the three communities with highest Regional Quotients for pounds landed were Honolulu (Oʻahu) [33.1%], Waiʻanae (Oʻahu) [11.1%], and ʻEwa (Oʻahu) [8.7%], while "Other Communities" represented 31.9% of state-wide landings (Figure 39). Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. The most notable change is the large reduction in landings contributions from Honolulu (Oʻahu) during the time series declining to 4.8% in 2018. The largest increase was seen in "Other Communities" shares up to just over 45%, along with Waiʻanae (Oʻahu) rising to 23.8% in 2018. Two communities with notable Regional Quotient scores for 2018 not represented in Figure 39 were South Kona (Hawaiʻi) [7.3%] and Waialua (Oʻahu) [6.9%], representing the third and fifth highest share in the state, respectively.

Figure 39. Regional Quotient (POUNDS) for communities highly engaged in the nearshore and reef fish fishery for at least 50% of years from the baseline (2000–2002).

The communities with high Regional Quotient values for ex-vessel revenues of nearshore and reef fish species align well with those identified as highly engaged in the fishery during all years. During the baseline period, the top three communities in terms of Regional Quotient for ex-vessel revenues were Waiʻanae (Oʻahu) [17.8%], Honolulu (Oʻahu) [14.4%], and ʻEwa (Oʻahu) [11.1%], while "Other Communities" represented 40.2% of fishery revenues (Figure 40). Contributions within these communities have fluctuated slightly over time, in line with trends in the fishing engagement scores. The most notable change over time was the increased contributions from Waiʻanae (Oʻahu), up to 32.5% in 2018, and the drop in contributions from Honolulu (Oʻahu), down to 4.7% in 2018. An example of one "Other Community" with significant revenue share in 2018 is Waialua (Oʻahu) at 6.6% (the third highest share in the State for 2018).
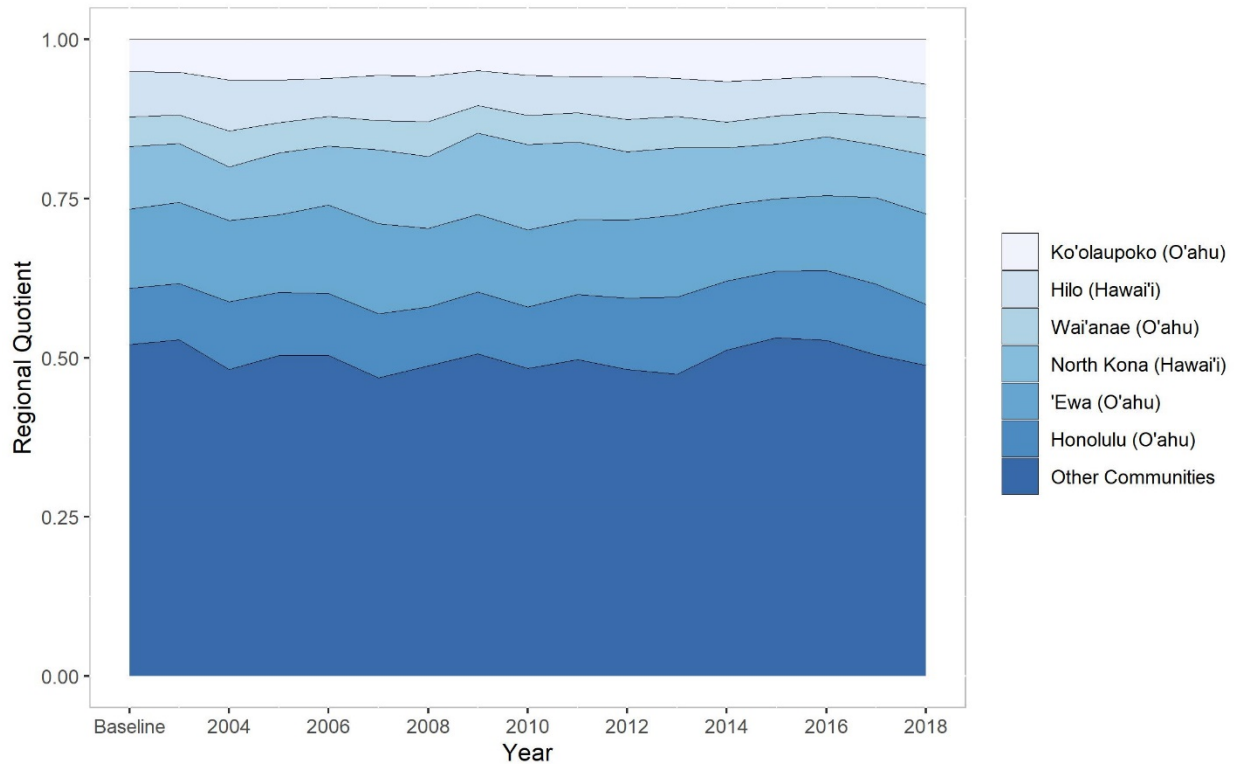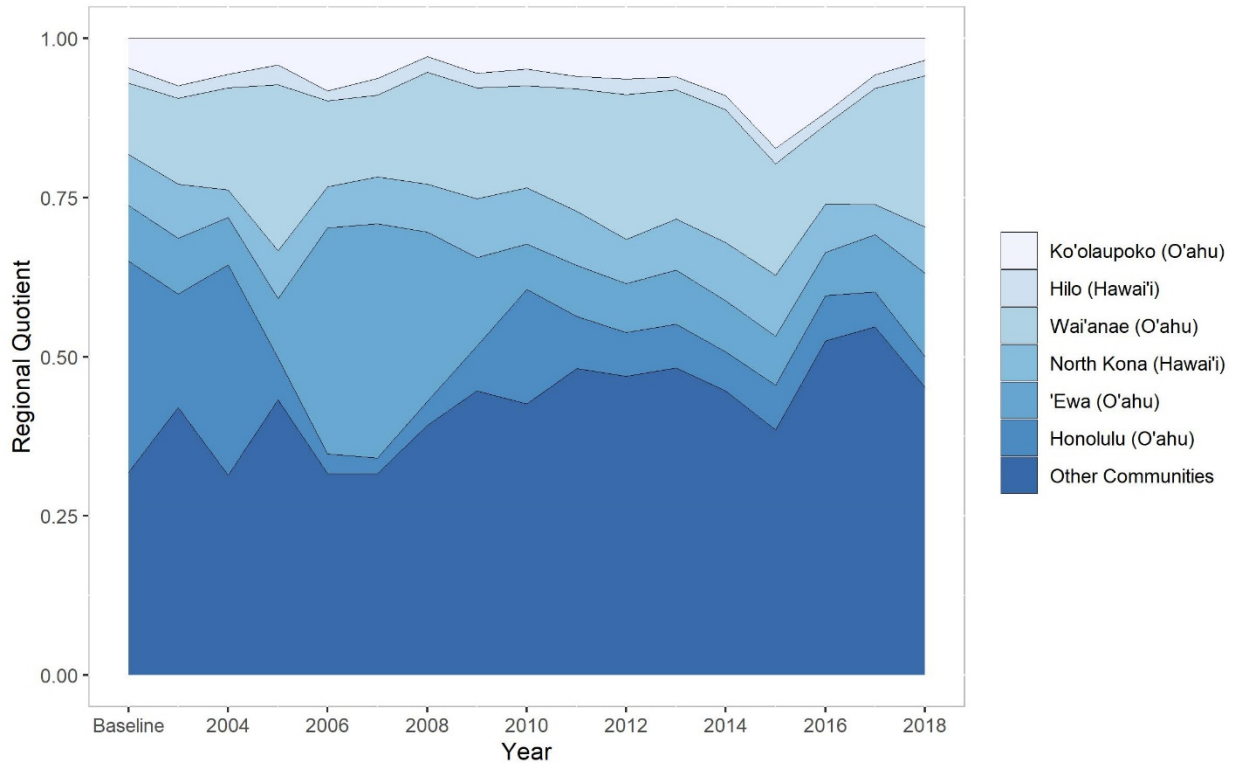
Figure 40. Regional Quotient (REVENUE) for communities highly engaged in the nearshore and reef fish fishery for at least 50% of years from the baseline (2000–2002).

Local Quotient

The community Local Quotient is the percentage of nearshore and reef fish fishing activity within a community out of the total of all fishing (non-longline) activity within that community. It is an indicator of the contribution in pounds landed or revenue of nearshore and reef fish to the overall landings and revenue in a community (Figure 41, Figure 42). The Local Quotients are reported individually only for those communities that were highly engaged for at least 50% of years during 2003–2018, relative to the baseline period.

The Local Quotient for pounds landed for the top six communities in terms of fishing engagement fluctuated during the study period, with some experiencing significant declines (Honolulu), variable but slight declines over time ('Ewa), variable with increases over time (Waiʻanae, Koʻolaupoko), and others that held relatively stable (North Kona, Hilo). Trends tend to follow changes in fishing engagement index scores. These values provide important insights into the role of the nearshore and reef fish fishery relative to other fisheries in each community. The role of nearshore and reef fish varies across highly engaged communities with small contributions in some (Honolulu, North Kona, Hilo) and notable (Koʻolaupoko, ʻEwa) to significant contributions in others (Waiʻanae). It should be noted that in 2018, four of the top five communities in terms of their Local Quotient scores for nearshore and reef fish species landings are not reflected in Figure 41: Waialua (Oʻahu) [47.1%], Kahului (Maui) [42.1%], Kīhei (Maui) [41.9%], and Lahaina (Maui) [41.4%]. This reflects the importance of these species to community landings, may represent changing dynamics in fishing communities, and should

warrant consideration for potential community impacts to management alternatives in the nearshore and reef fish fishery.
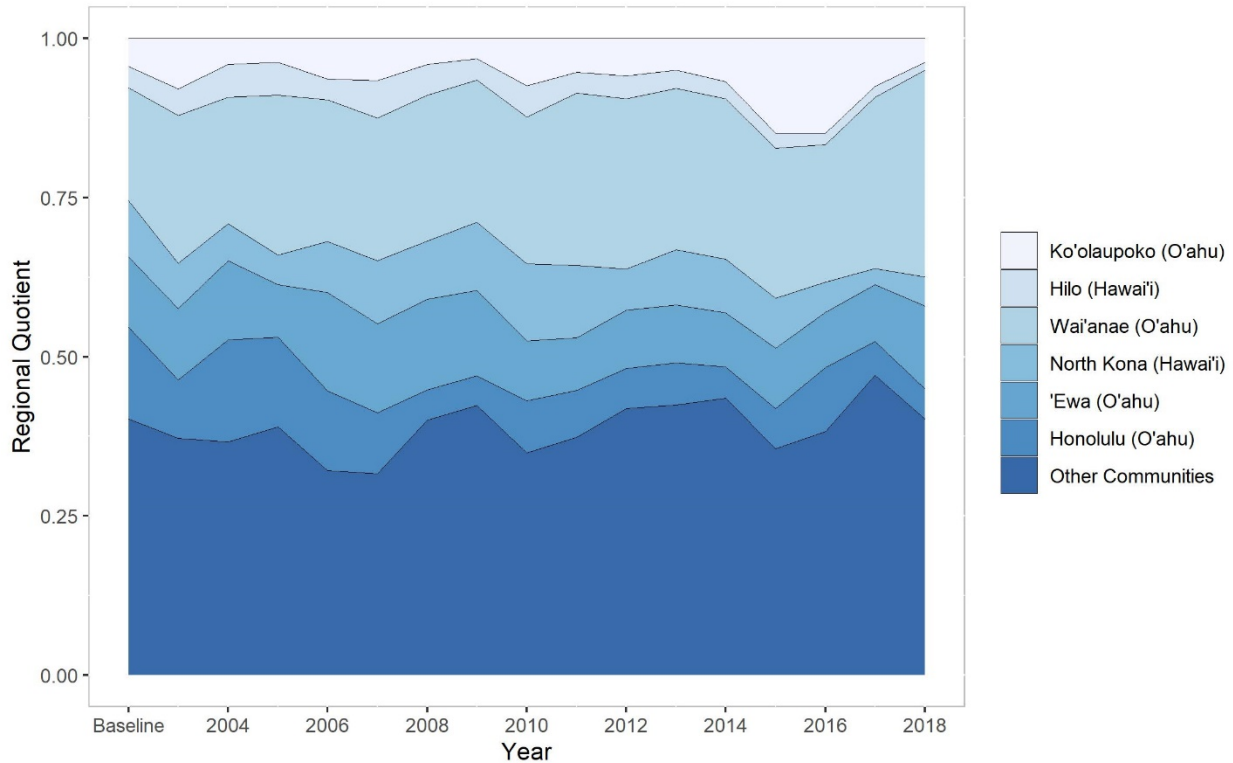

Figure 41. Local Quotient (POUNDS) for communities highly engaged in the nearshore and reef fish fishery for at least 50% of years from the baseline (2000–2002).

Similar to the Local Quotient for landings, fishery ex-vessel revenues for the top six communities in terms of fishing engagement fluctuated during the study period. Trends tend to align with trends in fishing engagement index scores and trends in the Local Quotient for landings although with less year-to-year variability. Interpreting trends in ex-vessel revenue Local Quotients provides important insights into the role of revenues from nearshore and reef fish species relative to other fisheries in each community. Similar to the findings for community landings, nearshore and reef fish species comprise a diverse share of community revenues across highly engaged communities in the State of Hawai'i. In 2018, there were three notable communities not reflected in Figure 42 where nearshore and reef fish comprise a significant share of local fishery revenues for the community: Waialua (O'ahu) [50.6%], Lahaina (Maui) [45.5%], and Kīhei (Maui) [38.1%]. These again, are important findings to consider when assessing potential community impacts of fishery management alternatives.
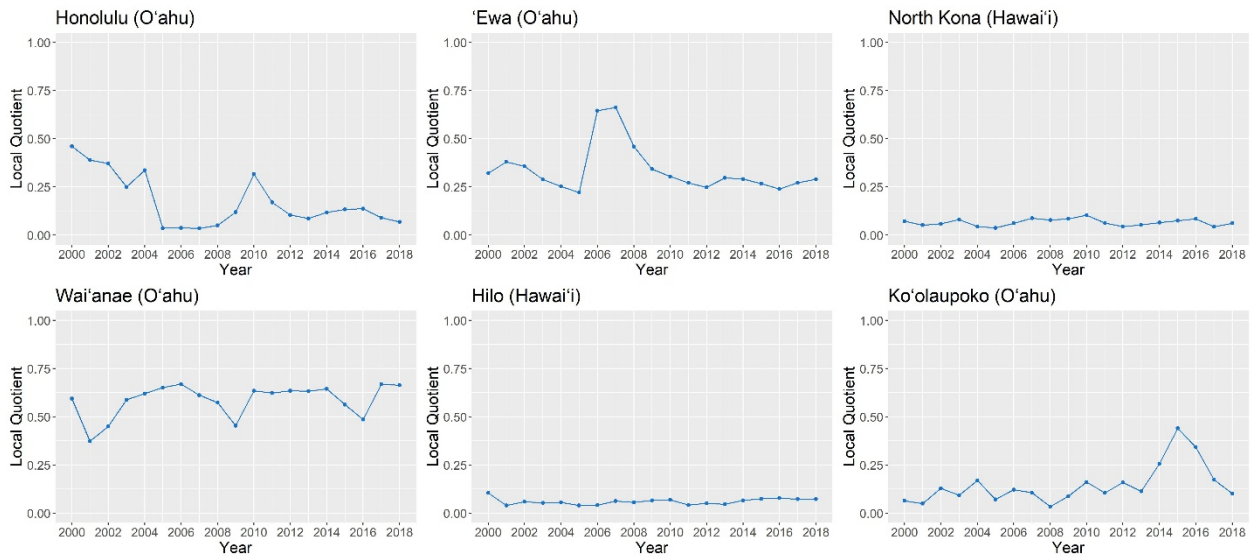
Figure 42. Local Quotient (REVENUE) for communities highly engaged in the nearshore and reef fish fishery for at least 50% of years from the baseline (2000–2002).

Community Social Vulnerability Indicators (CSVIs)

The three categories of CSVIs discussed below include environmental justice, economic, and gentrification pressure. The environmental justice indicators (personal disruption, population composition vulnerability, poverty) consider whether fishery policies disproportionately affect disadvantaged communities. Economic indicators represent social factors that can shape either an individual's or community's ability to adapt to change (labor force structure and housing characteristics). The gentrification pressure indicators characterize factors that over time may signify a threat to the viability of a vibrant commercial working waterfront including property and businesses (housing disruption, retiree migration, and urban sprawl).

The CSVIs for communities that were highly engaged in the nearshore and reef fish fishery for one or more years from the baseline (2000–2002) through 2018 are included in Tables 25-27; those highly engaged for all years from the baseline are highlighted in blue. These communities tend to have larger than average populations compared to others participating in this fishery. In general, neighbor island communities have slightly higher vulnerabilities among the indices relative to Oʻahu communities, except for population composition and urban sprawl.

Table 25. Environmental justice indicators (2018) for communities highly engaged in the nearshore and reef fish fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Personal Disruption	Population Composition	Poverty
Honolulu (Oʻahu)	Low	High	Low
ʻEwa (Oʻahu)	Low	High	Low
North Kona (Hawaiʻi)	Low	Medium	Low
Waiʻanae	Med-High	High	High
Hilo (Hawaiʻi)	Medium	Med-High	Med-High
Koʻolaupoko (Oʻahu)	Low	Medium	Low
South Kona (Hawaiʻi)	Low	Med-High	Medium
Waialua (Oʻahu)	Low	Med-High	Low
Kahului (Maui)	Low	High	Low
Lahaina (Maui)	Low	Med-High	Low

Table 26. Economic indicators (2018) for communities highly engaged in the nearshore and reef fish fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Population Size (2018)	Labor Force Structure	Housing Characteristics
Honolulu (Oʻahu)	402,452	Low	Low
ʻEwa (Oʻahu)	344,153	Low	Low
North Kona (Hawaiʻi)	41,369	Low	Low
Waiʻanae	50,127	Medium	Low
Hilo (Hawaiʻi)	48,774	Medium	Medium
Koʻolaupoko (Oʻahu)	115,160	Low	Low
South Kona (Hawaiʻi)	10,768	Medium	Medium
Waialua (Oʻahu)	13,442	Low	Low
Kahului (Maui)	30,706	Low	Low
Lahaina (Maui)	23,568	Low	Low

Table 27. Gentrification pressure indicators (2018) for communities highly engaged in the nearshore and reef fish fishery for one or more years from the baseline (2000–2002) through 2018.

Community (Island)	Housing Disruption	Retiree Migration	Urban Sprawl
Honolulu (Oʻahu)	Low	Low	High
ʻEwa (Oʻahu)	Low	Low	High
North Kona (Hawaiʻi)	Med-High	Low	Low
Waiʻanae (Oʻahu)	Med-High	Medium	Med-High
Hilo (Hawaiʻi)	Low	Medium	Low
Koʻolaupoko (Oʻahu)	Med-High	Medium	High
South Kona (Hawaiʻi)	Medium	Medium	Low
Wailalua (Oʻahu)	High	Low	High
Kahului (Maui)	Med-High	Medium	Low
Lahaina (Maui)	Medium	Low	Low

Discussion

This report provides a comprehensive review of community participation trends in Hawaiʻi commercial fisheries from 2000 to 2018. We present community performance indicators to monitor community dependence on fisheries through a suite of metrics describing fisheries engagement and social vulnerability as applied to five select commercial fisheries. These indicators provide a valuable understanding of current status and trends for community fisheries activity and well-being. Fishery managers can use these metrics to: (i) satisfy MSA National Standard 8 requirements; (ii) improve assessments required under the National Environmental Policy Act (NEPA), such as Social Impact Assessments; (iii) provide insights to support community engagement and outreach (Colburn et al. 2017).

Commercial Fishing Engagement

The fishing engagement index measures community-level fishery participation. The communities of Honolulu (Oʻahu), North Kona (Hawaiʻi), and ʻEwa (Oʻahu) were found to be consistently highly engaged across nearly all fishery-specific fishing engagement indices. The Oʻahu communities are the two most populous CCD communities in the State of Hawaiʻi so these results may not be surprising based on the composition of the FEI. North Kona, while a small community in terms of population, is the heart of the State's vibrant charter sport fishery and home to a major fishing port providing access to the favorable waters off West Hawaiʻi Island.

Pelagic fisheries are the State's largest and most commercially valuable fisheries. Given infrastructure related to markets and vessel moorage, the Hawaiʻi longline fishery is firmly centered in Honolulu, and its FEI has remained stable at significantly high levels. However, there are some notable trends in fishing engagement across communities in non-longline pelagic fisheries. The small boat HMS fishery has seen stable fishing engagement from highly engaged communities over time, although the Hawaiʻi Island community of Keaʻau-Mountain View is a relative newcomer, demonstrating high engagement over the most recent five years.

Insular fisheries comprise a small share (roughly 10%) of fishery landings and revenues in the State of Hawaiʻi, but because of their cultural and social importance, monitoring community participation is vital. The MHI Deep 7 bottomfish fishery and has seen significant management changes during our study period, and the composition of highly engaged communities has changed in important ways. We found more communities are highly engaged in 2018 relative to the baseline period (2004–2006), including three new Maui communities and East Molokaʻi. Honolulu's FEI has declined by nearly 45% since the baseline period, while many Maui communities have seen significant increases, most notably Wailuku (Maui) with a nearly 5-fold increase in its FEI score since the transition to quota-based management. The uku fishery has experienced volatile FEI scores for its three communities highly engaged in all years, but values in 2018 closely approximate values in the baseline (2000–2002) period. Oʻahu (Honolulu and ʻEwa) communities have seen a slight increase in their FEI scores since the baseline period, while North Kona (Hawaiʻi) has seen a slight decline. The uku fishery has seen individual years of high engagement from many Maui and Kauaʻi communities, indicating the fishery likely plays an important role in these communities, even if these communities do not consistently achieve the highly engaged FEI threshold. The nearshore and reef fish fishery has five highly engaged communities in all years, with Honolulu (Oʻahu) and North Kona (Hawaiʻi) experiencing

significant declines in engagement since the baseline (2000–2002) period, while the community of Waiʻanae's (Oʻahu) engagement increased significantly since the baseline. While Koʻolaupoko (Oʻahu) was not highly engaged in the baseline period, it has been highly engaged in ten of the past 12 years, with a significant spike in 2016 and 2017.

Regional Quotient

The Regional Quotient is a reflection of a community's engagement in a fishery, and this report presented Regional Quotient values for active fishers, pounds landed, and revenue. One could interpret the Regional Quotient to measure a community's importance to the fishery. We found high levels of stability in Regional Quotient values for the number of active fishers in Hawaiʻi communities, suggesting that fishing community composition was consistent, but fishery landings and revenues did not demonstrate similar levels of stability. On the other hand, trends in community-level Regional Quotient values for pounds landed and revenue closely follow trends in community FEI scores. While communities that were highly engaged for all years, or a specified portion of years, comprised a significant share of landings and revenue for Hawaiʻi fisheries, trends in "Other Communities" can provide insights into changing fishery dynamics. The small boat HMS fishery, MHI Deep 7 bottomfish, and uku fisheries all saw notable increases in contributions from "Other Communities" since the baseline period, with some individual communities identified as being in the top five in terms of pounds landed or revenues in 2018, despite not reaching the highly engaged FEI threshold. Monitoring the Regional Quotient can provide valuable information, outside of the FEI, for fishery managers to target outreach and education, particularly in communities that lack elements important to the FEI (such as number of dealers or fishers in the community) for them to be considered highly engaged.

Local Quotient

The Local Quotient metric provides a glimpse into the importance of a fishery to an individual community by measuring the share of fishery activity relative to all fishing in a community. Local Quotient values shed light on the levels of fishery diversification in a community; high values indicate high levels of reliance for a community in that fishery. In 2018, the Hawaiʻi pelagic longline fishery was responsible for approximately 90% of landings and 98% of revenue from Honolulu fishers. Given the scale of the longline fishery and the fact that longline fishers generally do not participate in other regional fisheries, we exclude longline landings and revenue when considering Local Quotient measures for non-longline fisheries.

The small boat HMS fishery is the largest non-longline fishery in the State of Hawaiʻi in terms of participation, landings, and revenue. Local Quotient estimates for communities highly engaged for all years in the HMS fishery varied somewhat. Between 2003 and 2018, Hawaiʻi Island communities (North Kona and Hilo) had an average Local Quotient of approximately 90% for landings and 85% for revenues, confirming these communities are highly reliant on pelagic species. Oʻahu communities (Honolulu, ʻEwa, Koʻolaupoko) saw more variation over the years; with Honolulu and Koʻolaupoko seeing average HMS landings Local Quotients of 72% and 80%, respectively, and ʻEwa at 56%. Average HMS revenue Local Quotients for the communities of Honolulu, Koʻolaupoko, and ʻEwa were 77%, 66%, and 50%, respectively, suggesting more fishery diversification in these communities. However, it should be noted that

only one of these highly engaged communities (North Kona) was in the top ten in terms of community-level Local Quotient scores in 2018 for HMS fisheries. In 2018, the average Local Quotient score for HMS landings and revenues in Hawai'i communities was 73% and 68%, respectively, indicating a very strong reliance on pelagic resources. Just over half (54%) of Hawai'i communities had HMS fishery Local Quotient scores greater than or equal to 80% for both landings and revenues in 2018.

Although most communities rely heavily on pelagic fisheries, it does not diminish the economic, cultural, and social value that insular fisheries such as the MHI Deep 7 bottomfish, uku, and nearshore and reef fish fisheries provide Hawai'i fishing communities. The MHI Deep 7 bottomfish fishery is a low volume, high value fishery and one finds that Local Quotient revenue scores for most communities exceed landings scores. Post-baseline (2007–2018) trends in Local Quotient scores shed light on community level responses to the transition to quota-based management (Figure 24, Figure 25). Catch composition in fishing communities has changed over time. In 2018, the average Local Quotient scores for MHI Deep 7 bottomfish landings and revenues in Hawai'i communities were 7% and 13%, respectively. Three communities had MHI Deep 7 bottomfish fishery Local Quotient scores greater than 25% for landings and six communities had Local Quotient scores greater than 40% for revenue. Only three highly engaged communities were in the top ten in terms of landings or revenue Local Quotient scores in 2018. While reliance is less far spread in Hawai'i communities for the Deep 7 bottomfish fishery, select communities do rely heavily on Deep 7 fishery resources. The uku fishery is relatively minor in the portfolio of Hawai'i fisheries, with an average community-level Local Quotient score for landings and revenue of about 4% in 2018. However, there are five communities with Local Quotient revenue scores greater than 10%, making it an important contributor to fishery diversification in these communities. Trends in the nearshore and reef fish fishery Local Quotients for highly engaged communities were stable (Honolulu, 'Ewa, North Kona, Hilo) to increasing (Wai'anae, Ko'olaupoko). In 2018, the average community-level Local Quotient score for nearshore and reef fish landings and revenue was approximately 15%. Similar to findings for all other fisheries, there were numerous communities with moderate reliance on nearshore and reef resources that did not meet the highly engaged FEI threshold, as ten Hawai'i communities had Local Quotient scores greater than 25% for both landings and revenue (only two of which were highly engaged communities).

The findings in this section highlight the added value of the Local Quotient as a measure of fishery reliance that can be coupled with the FEI. It allows managers to consider alternative perspectives when considering potential impacts from management alternatives.

Community Social Vulnerability Indicators

The Community Social Vulnerability Indicators are created from metrics of the broader socioeconomic status of communities. As such, there is no direct link between the indices for social vulnerability and gentrification pressure and the fishing activity within a community. However, understanding the additional social pressures experienced by communities that are highly engaged in certain fisheries provides broader context that should be considered when developing fishery management measures. Communities that are experiencing higher levels of social vulnerabilities may have a harder time adapting to any changes in operations affecting their livelihoods. For example, more rural communities may have fewer alternative opportunities

compared to larger urban areas. Similarly, gentrification pressures indicate potential development pressures related to shifting demographics and changes in property values. This can lead to higher value being placed on non-traditional uses unrelated to fishing.

For all fisheries, the communities in Hawaiʻi that were more highly engaged across more years tended to have larger than average populations and lower social vulnerability and gentrification scores than communities less consistently engaged over the time period examined. This was particularly notable for the two pelagic fisheries, where the highly engaged communities were closer to large urban centers and the main ports where much of the distribution and processing occurs. The two indices that did not follow this pattern were population composition and urban sprawl. Population composition indices were more mixed but generally on the higher end across the board, likely reflecting the range of Asian and Pacific Island cultures common in this region compared to the rest of the United States. While urban sprawl was high across Oʻahu communities, the larger populations and other affordances brought by urbanization likely contributed to those communities otherwise remaining relatively stable in terms of their participation in fisheries.

Neighbor island communities tended to have slightly higher social vulnerability indicator scores relative to Oʻahu communities, again with the exception of population composition and urban sprawl. Neighbor island communities were more prevalent in the insular fisheries, especially the MHI Deep 7 bottomfish and uku fisheries. This likely reflects the cultural and social importance of fishing across Hawaiʻi communities, where many fishers may engage in a mix of commercial and non-commercial fishing. Fishing engagement indices based only on commercial fishing metrics may miss the important non-commercial contributions of fishing to these communities.

Future Work

The findings in this report lay an important foundation for understanding community participation in Hawaiʻi commercial fisheries and create opportunities for future work. The community performance indicators, which are flexible enough to be applied to individual species or species groups, can inform future management alternatives. These indicators can serve as inputs to ecosystem models, support climate vulnerability assessments, and inform management strategy evaluations. Given the prevalence of mixed commercial and non-commercial fisheries in Hawaiʻi, future work to develop non-commercial FEIs and relevant measures of reliance for the non-commercial fisheries would provide added insights to the commercial fishing community performance indicators presented in this report.

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(WPFMC) Western Pacific Regional Fishery Management Council. 2019b. Annual Stock Assessment and Fishery Evaluation Report for U.S. Pacific Island Pelagic Fishery Ecosystem Plan 2018. Remington, T., Fitchett, M., Ishizaki, A., (Eds.) Western Pacific Regional Fishery Management Council. Honolulu, Hawaii 96813 USA.375 pp. + Appendices. http://www.wpcouncil.org/wp-content/uploads/2019/07/Pelagic-FEP-SAFE-Report-2018-Optimized-v4.pdf

Appendix: Census County Division Maps

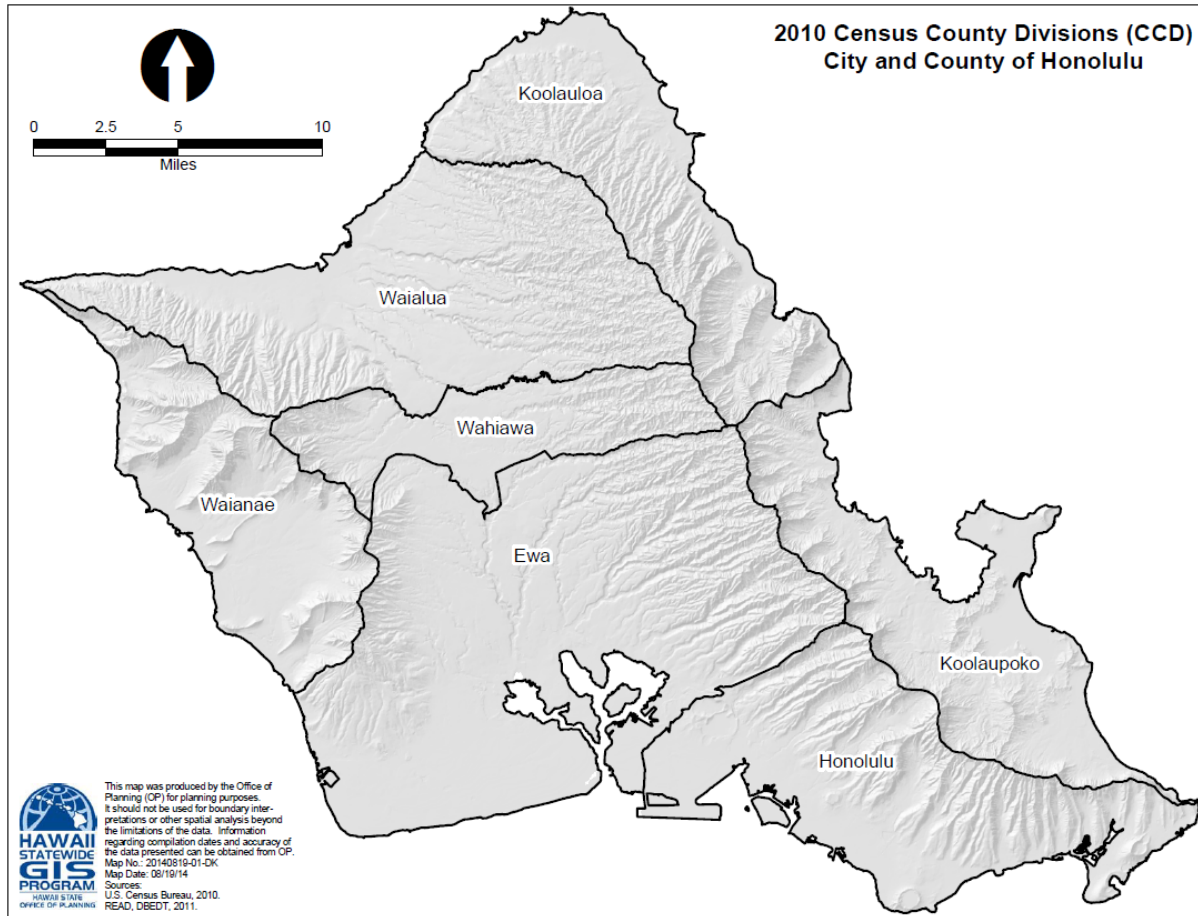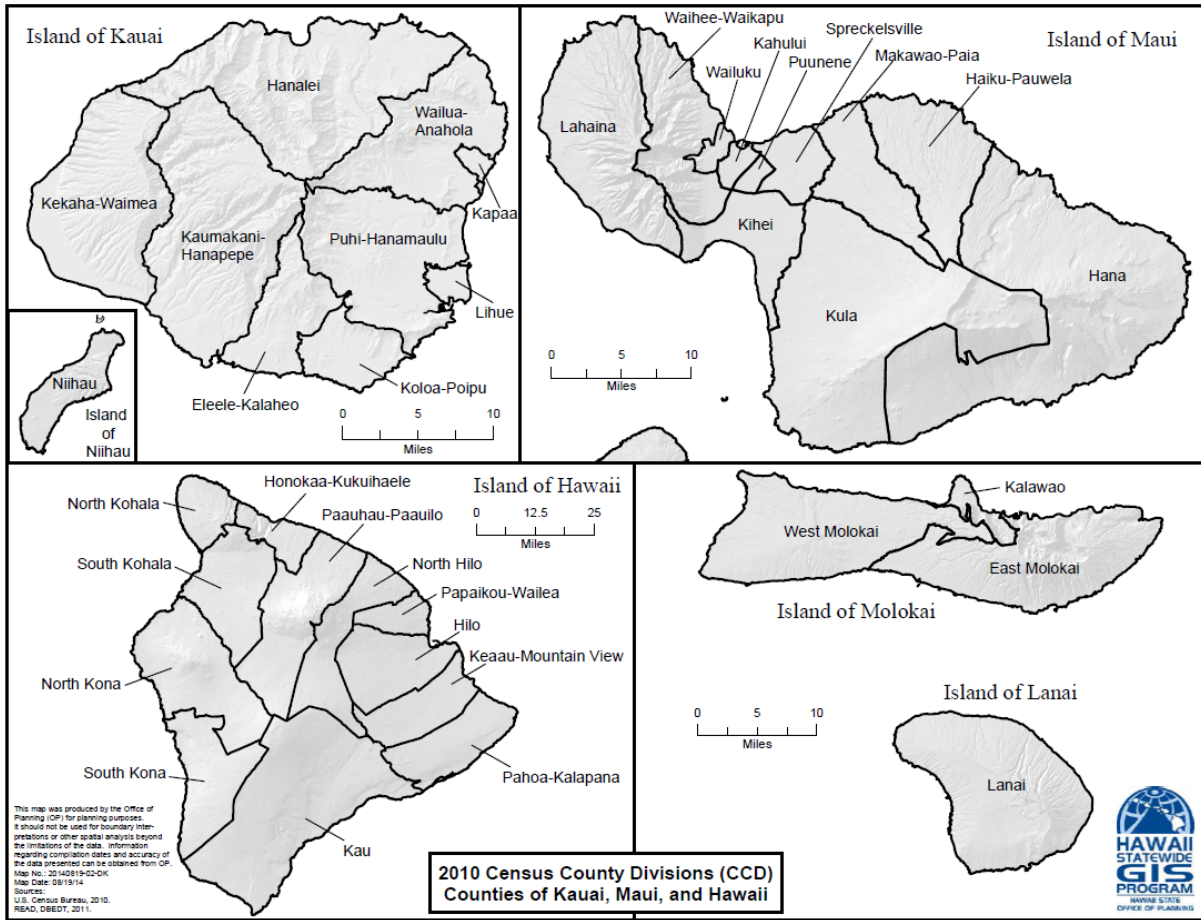Census County Division Maps for communities by island.

Figure A 1. Communities on Oʻahu.

Figure A 2. Communities on neighbor islands.