

FSM FISHERIES CHARACTERIZATION

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Fisheries Characterization: Federated States of Micronesia

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Executive summary

The goal of this report is to provide a summary of publicly available and expertly informed information relevant to the Federated States of Micronesia's (FSM) offshore and coastal fisheries. Specific information reviewed includes fishery fleet characteristics, target species, gear types, stock health, management, and relevant data sources.

Fisheries play an integral role in the economy, food security, and maritime tradition of FSM and its people. As a whole, fisheries accounted for roughly 10% of FSM's national GDP in 2018 (FAO, 2018). For organization and clarity, this report classifies fisheries into offshore and nearshore categories to reflect differences in management authority and general patterns in fishery characteristics. However, it is important to note that no strict delineation between the sectors exists in the marine environment, and key linkages, such as shared target stocks and participants, must be accounted for in the sustainable management of both sectors. FSM's offshore fisheries feature industrial fleets of several gear-types targeting tuna and other pelagic species. Vessels that participate in the offshore fisheries are both domestically- (both FSM and foreign-flagged) and foreign-based (i.e. distant-water fleets). The offshore fisheries are managed by a complex layering of measures set by national and regional authorities. The multi-gear, multi-species nearshore fisheries are managed at the state, municipal, or local community level. Nearshore fishing activity in FSM is predominantly subsistence in nature but does include a limited commercial component around the main islands.

Information and data presented in this report were compiled from publicly available peer-reviewed publications, grey literature, and government and NGO reports, which were then validated and updated based on interviews with regional fisheries experts; all sources are referenced throughout. The report is meant to be a living document, which will be updated to reflect recent research, insights and knowledge as they become available. In cases where there is a recent report that already

synthesizes information on a relevant topic, it is cited and recommended that the source be consulted directly for detailed information.

1. OFFSHORE FISHERIES IN FSM



1. Offshore fisheries in FSM

1.1 Overview

Offshore fisheries in FSM, which we define here as waters more than 12 nautical miles (nm) from shore, consist of domestic- and foreign-flagged purse seine, longline, and pole-and-line fleets targeting tuna and tuna-like species (FAO, 2018). Offshore catch within FSM's exclusive economic zone (EEZ) represented 3-11% of total tuna catch in the Western and Central Pacific Fisheries Commission Convention Area (WCPFC CA) (FFA & NORMA, 2015), and had an estimated annual value of US\$407 million between 2017 and 2019 (FFA & SPC, 2020). Skipjack tuna caught by purse seiners accounts for the majority of catch in landed weight (84% in 2016) (NORMA, 2016).

In the following sections, we provide an overview of publicly available datasets, key target species and their biological status, and fleet characteristics of FSM's offshore fisheries. We organize our discussion of FSM's offshore fleets by gear type, and further group information within each gear type into four categories (Table 1): a) FSM-flagged vessels based in FSM, b) FSM-flagged vessels based abroad, c) foreign-flagged vessels based in FSM ("domestically-based"), and d) foreign-flagged vessels based abroad ("distant-water"). Not every gear type is composed of all four segments (e.g. the pole-and-line fleet is entirely distant-water fishing vessels flagged to Japan). Following the fleet

characterization, we provide an overview of the multiple jurisdictional layers of offshore fisheries management (regional, subregional, national) and available information concerning the economic importance of offshore fisheries in FSM.

1.2 Data availability and limitations

The three most important data sources for FSM's offshore fisheries are logbooks, vessel-monitoring systems (VMS), and the observer program. Logbook data contain the total catch, species composition, and location of each fishing set. These, along with the satellite-positioning VMS data, are collated by the National Oceanic Resource Management Authority (NORMA) at the national level before being delivered to The Pacific Community (SPC). FSM participates in the Regional Observer Program (ROP) as a member state under the Western and Central Pacific Fisheries Commission (WCPFC) and similar fisheries data are collected on observed fishing trips as well as data concerning compliance with a variety of conservation and management measures (CMMs). At present, none of these datasets are publicly available and therefore not included in this report.

Table 1. Fleet categories relevant to the discussion of offshore fisheries in FSM. A green circle indicates the presence of that flag-gear-location combination.

	FSM-flagged		Foreign-flagged (within EEZ)	
	Domestically-based	Foreign-based	Domestically-based	Distant-water
Purse seine				
Longline				
Pole-and-line				

In the public domain, WCPFC provides aggregated catch and effort data at a lower spatial resolution (1°-by-1° or 5°-by-5° depending on the fleet) to maintain vessel anonymity. Data are available broken out by gear type, vessel flag, and different temporal resolutions for all of the WCPFC CA dating back to 1950. In addition, the WCPFC provides Annual Catch and Effort (ACE) summary tables for each fleet as defined by a given flag and gear type combination. All of these data can be accessed via this WCPFC [data portal](#).

Information in this section draws heavily from these publicly available data sources (Table 2). It is worth noting that, while the most recent data were selected for this report, not all data are current. Further, given confidentiality and other requirements that demand data aggregation, we are often unable to disentangle fleet and/or area

specific fishery statistics. For example, these data do not permit us to disaggregate catch that occurs within or outside FSM's EEZ for many, if not most, of our fleet categories. Table 2 summarizes data that are currently publicly available and used in this report. This table may also highlight future research opportunities and enhanced data collection efforts.

Additionally, this report uses vessel-tracking satellite data provided by [Global Fishing Watch](#) (GFW) to characterize the fishing behavior of vessels equipped with automatic identification system (AIS) technology. GFW data may not capture all vessel activity and while it provides information on vessel flag-state and some vessel characteristics, it does not distinguish between locally-based and distant-water vessels.

Table 2. Primary sources of publicly-available offshore fisheries data referenced throughout this report.

Data	Years	Gears	Fleet segment(s)	Source
Vessel numbers, catch, catch by species, spatial distribution of catch (5 by 5° cells)	2015 - 2019	Purse seine, longline	FSM-flagged (domestic- and foreign-based aggregated)	WCPFC, 2020
Vessel numbers, catch, catch by species, spatial distribution of catch (5 by 5° cells)	2015 - 2019	Purse seine, longline	FSM-flagged (domestic- and foreign-based aggregated)	NORMA, 2020a
Vessel numbers, catch, catch by species, spatial distribution of catch (5 by 5° cells)	2015 - 2019	Purse seine, longline, pole-and-line	FSM-flagged (domestic- and foreign-based aggregated), foreign-flagged (domestic- and distant-water aggregated)	
Catch	2001 - 2018	Purse seine, longline	FSM-flagged purse seine, domestic-based longline (all flags aggregated)	Graduate School USA & EconMAP, 2019
Catch (within FSM's EEZ)	1998 - 2018	Purse seine, longline, pole-and-line	All segments aggregated	

1.3 Target species

The primary targets of offshore fishing vessels operating in FSM are skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and bigeye tuna (*Thunnus obesus*) (NORMA, 2016). Certain longline vessels also catch albacore tuna (*Thunnus alalunga*) (Campling et al., 2017). All four tunnid species (skipjack, yellowfin, bigeye, and albacore) are believed to be healthy, neither overfished nor experiencing overfishing (Table 3). However, there is a small statistical risk (1 in 8) that bigeye is experiencing overfishing (FFA & SPC, 2020) - highlighting the vulnerability of these stocks despite the encouraging indicators at present. The abundance of tuna is expected to progressively decline in FSM's (and other western Pacific nations') waters as stocks migrate east in response to climate change (Bell et al., 2013). The declines are projected to be most substantive for bigeye tuna in the near-term (2035-2050) (Bell et al., 2011).

Non-target and bycatch species

In addition to the four main tunnid species, the following non-target billfish and pelagic species

are caught incidentally by purse seine and longline vessels: black marlin, blue marlin, striped marlin, swordfish, sailfish, and wahoo (Brown et al., 2021; FAO, 2018; FFA & NORMA, 2015). Furthermore, incidental catch of juvenile bigeye and yellowfin occurs in the FAD-associated purse seine fishery, which has raised concerns about the sustainability of the bigeye stock (FFA & NORMA, 2015). Various species of shark are caught in small quantities as bycatch including blue, silky, and whale sharks among others (FAO, 2018). Small numbers of sea turtles, including endangered green turtles, have been incidentally caught within FSM's EEZ (Brown et al., 2021). Bycatch of seabirds is not considered a major issue (FFA & NORMA, 2015).

FSM follows WCPFC bycatch reporting requirements and Conservation and Management Measures, which can be found in the [Management Plan on Tuna Fisheries for the Federated States of Micronesia](#) (FFA & NORMA, 2015). For FSM-flagged purse seine vessels, both non-target and bycatch species comprised less than 0.1% of the total catch volume in 2019 with the silky shark (126 MT, 0.07%

Table 3. IUCN listing and most recent estimates of stock status for target tuna species caught within FSM's EEZ based on stock assessments conducted by the Scientific Committee of the WCPFC.

Common Name	Scientific Name	IUCN Listing	Year Assessed	$B_{current}/B_{MSY}$	$F_{current}/F_{MSY}$
Yellowfin tuna	<i>Thunnus albacares</i>	Near threatened	2020	2.6 (not overfished)	0.37 (not experiencing overfishing)
Bigeye tuna	<i>Thunnus obesus</i>	Vulnerable	2020	1.79 (not overfished)	0.62 (not experiencing overfishing)
Skipjack	<i>Katsuwonus pelamis</i>	Least concern	2019	2.47 (not overfished)	0.44 (not experiencing overfishing)
Albacore	<i>Thunnus alalunga</i>	Near threatened	2020	3.25 (not overfished)	0.61 (not experiencing overfishing)

Table 4. IUCN listing and most recent estimates of stock status for non-target and bycatch species caught within FSM's EEZ based on stock assessments conducted by the Scientific Committee of the WCPFC.

Common Name	Scientific Name	IUCN Listing	Year Assessed	$B_{current}/B_{MSY}$	$F_{current}/F_{MSY}$
Blue shark	<i>Prionace glauca</i>	Near threatened	2017	1.71 (not overfished)	0.37 (not experiencing overfishing)
Striped marlin	<i>Kajikia audax</i>	Near threatened	2019	0.67 (overfished)	1.07 (experiencing overfishing)
Blue marlin	<i>Makaira nigricans</i>	Vulnerable	2016	1.25 (not overfished)	0.87 (not experiencing overfishing)
Swordfish	<i>Xiphias gladius</i>	Least concern	2018	0.38 (overfished)	1.33 (experiencing overfishing)
Shortfin mako*	<i>Isurus oxyrinchus</i>	Endangered	2018	1.36 (not overfished)	0.62 (not experiencing overfishing)
Longfin mako	<i>Isurus paucus</i>	Endangered	NA	No formal assessment	
Bigeye thresher shark	<i>Alopias superciliosus</i>	Vulnerable	2017	unknown	Likely experiencing overfishing
Oceanic whitetip	<i>Carcharhinus longimanus</i>	Critically endangered	2019	0.09 (overfished)	4.17 (experiencing overfishing)
Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	2018	1.18 (not overfished)	1.16 (experiencing overfishing)
Whale shark	<i>Rhincodon typus</i>	Endangered	NA	No formal assessment	
False killer whale	<i>Pseudorca crassidens</i>	Near threatened	NA	No formal assessment	
Green turtle	<i>Chelonia mydas</i>	Endangered	NA	No formal assessment	

*There is substantial uncertainty in assessment results due to uncertainty associated with the estimated historical catches of SFMs.

of total) being the most landed species outside of the primary tunnid species (WCPFC, 2020). Blue marlin (4%), swordfish (1%), and other non-target billfish species made up slightly more than 5% of the total 2019 catch volume by FSM-flagged longliners. These vessels caught a very small quantity (4 MT, ~0.03%) of sharks in 2019.

The current status of non-target and bycatch species caught by offshore vessels in FSM is shown in Table 4. Stock assessments have not been conducted for black marlin, sailfish, wahoo, longfin mako, whale shark, false killer whale, and green turtle and their current status is unknown. In 2017, WCPFC released a reference and educational tool called "[Bycatch Information System](#)" to support the adoption and implementation of science-based management measures in the region. In 2019, FSM worked with the SPC on a sampling design for onshore bycatch sampling, which is currently in place in Pohnpei and ports in Yap and Kosrae (NORMA, 2020a).

1.4 Fleet characteristics

FSM- and foreign-flagged purse seine, longline, and pole-and-line fleets fish in FSM's EEZ. In total, 228 foreign-flagged vessels were licensed to fish within FSM's EEZ in 2019: 132 purse seine, 79 longline, and 17 pole-and-line vessels. The majority of catch comes from purse seine vessels, accounting for

97% of total catch (from both FSM-flagged and foreign-flagged vessels) within the EEZ in 2018 (Figure 1) (Graduate School USA & EconMAP, 2019).

Both the purse seine and longline fleets have vessels operating within FSM's EEZ that are FSM-flagged and foreign-flagged, but only the longline has foreign-flagged vessels that are domestically-based in FSM. Together with FSM-flagged longline vessels based in FSM, these China- and Chinese Taipei-flagged longline freezer vessels are owned and operated by the Chinese-based Shenzhen Liancheng Overseas Fishery Company (SZLC) (FAO, 2018; Sieben et al., 2018). The domestically-based longline fleet are the only offshore vessels to directly land their catch for sale/processing in FSM, while some vessels in other fleet categories will transship their catch in FSM ports (FAO, 2018; Sieben et al., 2018).

FSM-flagged vessels operate throughout the WCPFC CA (see "management" section below), which includes waters both inside and outside of FSM's EEZ (NORMA, 2016). There were 23 purse seine and 37 longline FSM-flagged fishing vessels licensed to fish in 2019 (NORMA, 2020a; WCPFC, 2020). The total catch of FSM-flagged vessels in the WCPFC CA was 173,862 mt in 2019, most of which (~92%) was caught by purse seine vessels (WCPFC, 2020). Available catch data from 2019 of the four primary tunnid target species suggest that roughly 88% of all catch volume by FSM-flagged vessels

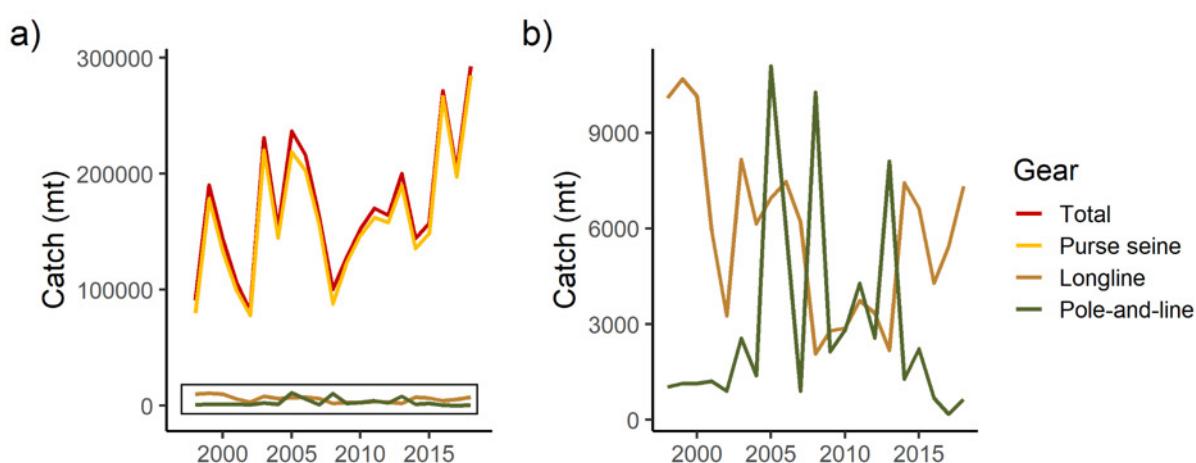


Figure 1. a) Total fish catch by gear within FSM's EEZ with an additional graphic rescaled to show b) only catch by longline and pole-and-line gear types for visual clarity. Data source: Graduate School USA & EconMAP, 2019.

Table 5. Catch (mt) by FSM-flagged vessels in 2019, disaggregated by gear and within/outside FSM's EEZ. Catch is only reported for the four target tunnid species: skipjack, yellowfin, bigeye, and albacore. Data source: NORMA, 2020a.

	Within EEZ	Outside EEZ	Total Catch
Purse seine	19,451	138,497	157,948
Longline	718	12,950	13,668
Total Catch	20,169	151,447	171,616

occurs outside the EEZ (Table 5), up from 55% in 2016 (NORMA, 2016, 2020a). This pattern reflects a general trend of low catch in 2019 within FSM's EEZ due to geographic shifts in tuna populations in response to El Niño (NORMA, 2020a). Catch from all FSM-flagged vessels is estimated to be worth US\$250 million per year on average (2017-2019) (FFA & SPC, 2020).

1.4.1 Purse seine fleets

Purse seine vessels targeting skipjack tuna comprise the bulk of offshore fishing activity in FSM by landed volume. The total within-EEZ purse seine catch by 132 vessels of target tuna species was estimated to be 132,737 mt in 2019 (NORMA, 2020a). Of this, Japan-flagged vessels caught the highest proportion of catch (30%), followed by Chinese Taipei-flagged vessels (23%) and FSM-flagged vessels (15%) (NORMA, 2020a). Yellowfin

tuna (26% of total purse seine catch volume) and bigeye tuna (1%) are the other species landed at high volume, in addition to skipjack (73%) (NORMA, 2020a). Purse seine fishing effort by all flag-states within the EEZ is concentrated in the equatorial southern and southeastern portions of the EEZ (Figure 2) (FAO, 2018; NORMA, 2016). Foreign-flagged purse seine vessels constituted 75% of the total within-EEZ purse seine fishing effort observable via AIS in 2020 (Figure 2) (Global Fishing Watch, 2020). Effort in Figure 2 and all other figures that visualize GFW data is displayed in "kilowatt hours" (kw*hours), a unit of fishing effort that captures both the duration of fishing (hours) and the vessel's engine power (kilowatts) as a proxy for fishing capacity.

FSM-flagged purse seine vessels fish both within FSM's EEZ and throughout the WCPFC CA more widely. In 2019, FSM's purse seine fleet consisted of

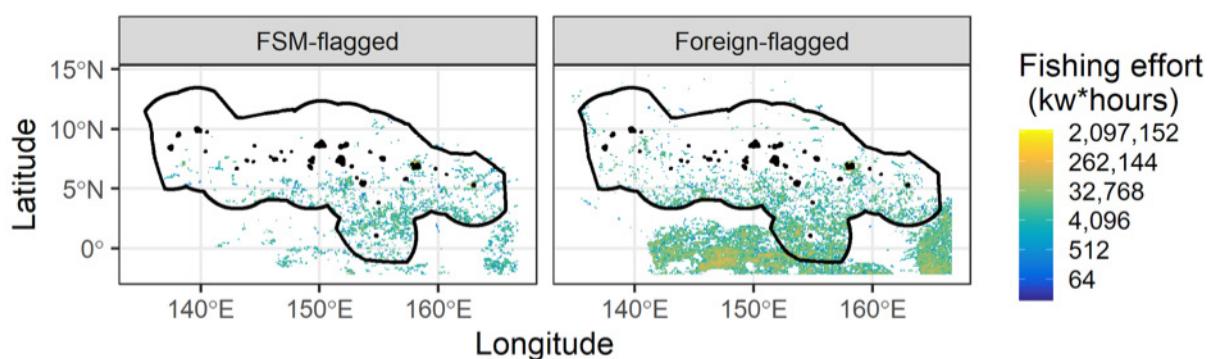


Figure 2. Observed fishing purse seine fishing effort (total kw*hours) in and around the EEZ of FSM in 2020. Data source: Global Fishing Watch, 2020.

23 vessels and recorded a catch of 159,400 mt, almost double the fleet size reported in 2015 and triple the reported catch (WCPFC, 2020) (Figure 3). The fleet's catch is distributed across the WCPFC CA with some catch occurring in the southeastern portion of FSM's EEZ (Figure 2, Figure 4) (NORMA, 2020a). Based on the spatial footprint of 2020 fishing activity derived from AIS geolocation information by GFW, the 23 FSM-flagged purse seine vessels were most active in the EEZs of FSM (37% of total effort in kw*hours), Papua New Guinea (14%), and Kiribati (13%), as well as the high seas (15%) (Figure 4) (Global Fishing Watch, 2020). WCPFC's fishing vessel registry indicates that many different companies own FSM-flagged purse seine vessels. The two with the most vessels are

Caroline Fisheries Corporation (6 vessels) based in Pohnpei and the Taiyo Micronesia Corporation (5 vessels), a joint venture between Taiyo A & F Corporation, a Japanese fishing company, and FSM's National Fisheries Corporation (Table 6).

In 2021, a Marine Stewardship Council (MSC) certification was awarded to FSM-flagged purse seine vessels owned and/or managed by Liancheng Overseas Fishery (FSM) Co. Ltd. (FZLC), Caroline Fisheries Corporation (CFC) and Da Yang Seafood (DYS) while operating within FSM's EEZ or high seas and targeting skipjack, yellowfin, and bigeye tuna (Sieben et al., 2021). For further information, please see the [2021 MSC public certification report](#).

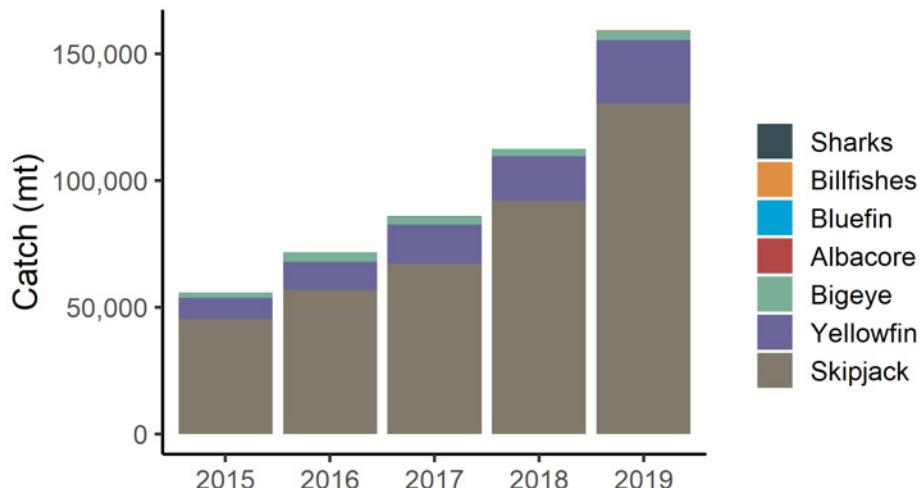


Figure 3. Annual catch by species or species group for FSM-flagged purse seine vessels for the entire WCPFC CA. Data source: WCPFC, 2020.

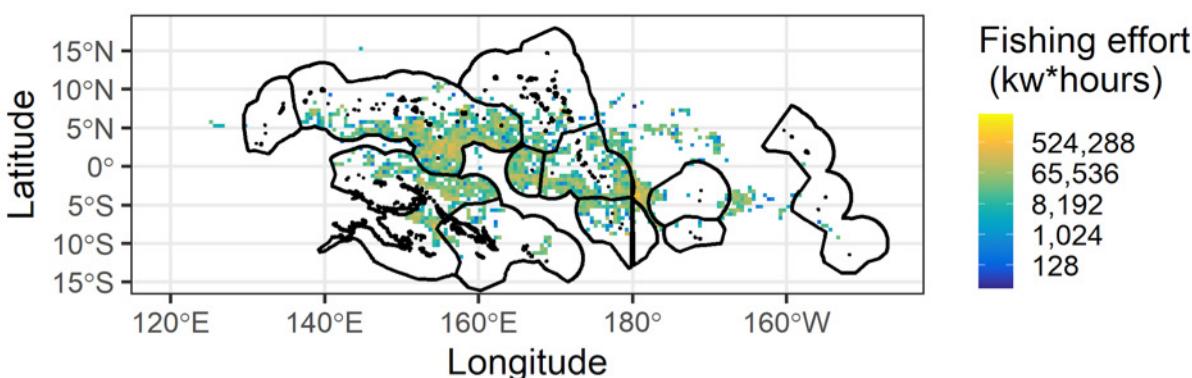


Figure 4. Observed fishing effort (total kw*hours) by FSM-flagged purse seine vessels within the WCPFC CA in 2020. The EEZs of the countries belonging to the PNA are outlined in black. Data source: Global Fishing Watch, 2020.

Table 6. Number of FSM-flagged purse seine vessels by owner. Data source: WCPFC, 2021.

Owner	No. of vessels
Caroline Fisheries Corp. Inc	6
Taiyo Micronesia Corporation	5
Ascension Fishery Incorporated Company	2
CityPro Management Limited	2
Kasar Fishing Corporation	2
Pohnpei Shipping Company Inc.	2
Diving Seagull, Inc.	1
Doda Limited	1
Great Ocean Seafood FSM Ltd.	1
Kosrae Best Fishery Ltd.	1
LS FSM Fishery Ltd.	1
Millefiori Limited	1
Yap Investment Trust	1

The landing sites of purse seine vessels tend to vary with flag state. Some foreign-flagged vessels deliver their catch directly to ports outside of FSM (e.g., Japanese vessels land their catch in Japan, and American vessels land their catch in Pago Pago, American Samoa), while other vessels deliver to canneries located in the Philippines (FAO, 2018). Finally, some foreign-flagged vessels, including Chinese Taipei and Korea, tranship their catch in FSM ports (FAO, 2018; NORMA, 2016).

1.4.2 Longline fleets

Longline fishing is the second most prevalent offshore fishing activity within FSM's EEZ (NORMA, 2016). The total within-EEZ longline catch by 79 vessels of target tuna species was estimated to be 2,324 mt in 2019 (NORMA, 2020a). Japan- (53%), FSM- (31%), and China-flagged (11%) vessels account for the largest portions of longline catch in FSM's EEZ by flag (NORMA, 2020a). Bigeye tuna

was the most caught species by longliners within the EEZ in 2019 (53% of total volume) followed by yellowfin (46%) and albacore (~2%) (NORMA, 2020a). Spatial patterns of longline fishing effort tend to vary by flag within the EEZ (FAO, 2018; FFA & NORMA, 2015). For example, vessels flagged to Japan and Chinese Taipei that are based in Guam tend to fish in the northern part of the EEZ (FAO, 2018), which is reflected in AIS fishing activity data (Figure 5).

Thirty-seven FSM-flagged longline vessels caught a total of 14,421 mt in 2019, doubling the total number of vessels and almost tripling catch reported in 2015 (WCPFC, 2020) (Figure 6). Freezer longliners that operate out of Pohnpei primarily target bigeye and yellowfin in the central and eastern portions of FSM's EEZ (FAO, 2018; FFA & NORMA, 2015), but will also seasonally target albacore in the eastern waters of the Cook Islands' EEZ and land their catch in Pago Pago, American

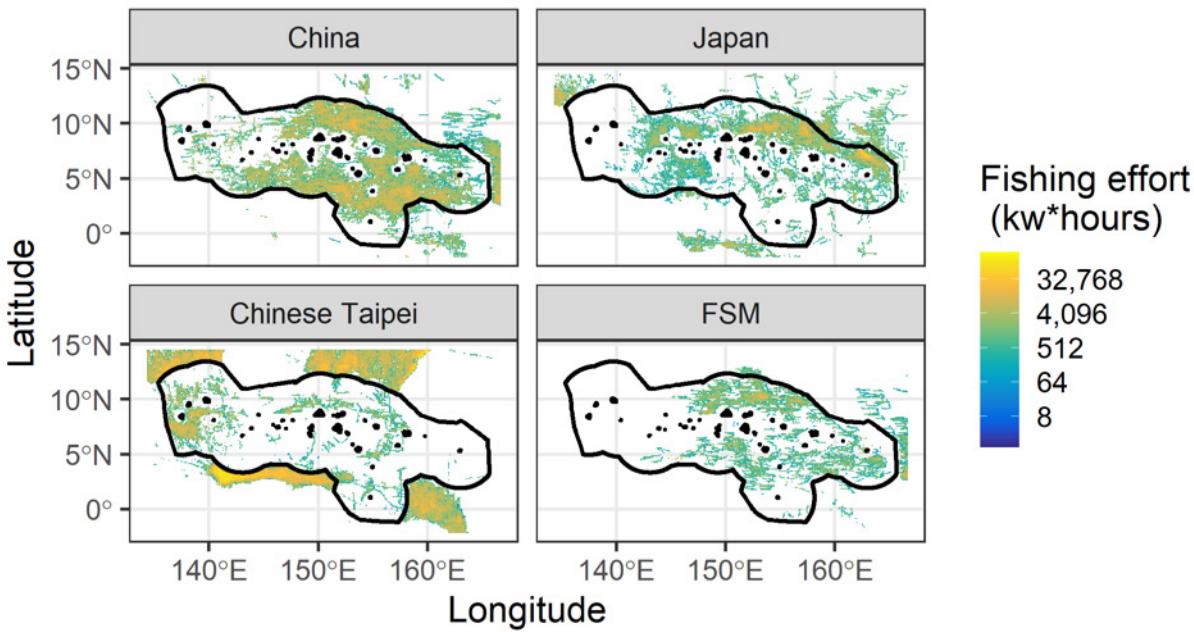


Figure 5. Longline fishing effort (kw*hours) in and around FSM's EEZ in 2020 for the four most active vessel flags. Vessels flagged to these four nations constituted roughly 98% of within-EEZ longline fishing effort. Data source: Global Fishing Watch, 2020.

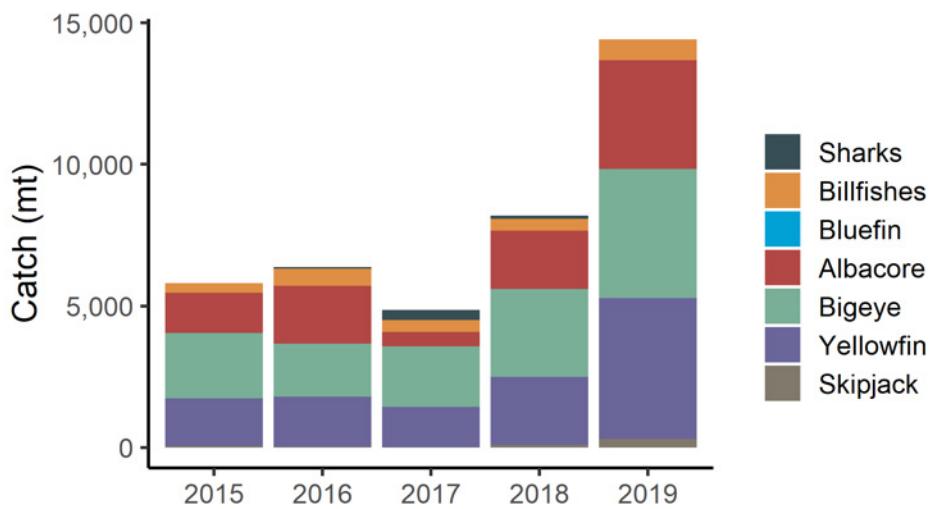


Figure 6. Annual catch (mt) by species or species group for FSM-flagged longline vessels for the entire WCPFC CA. Data source: WCPFC, 2020.

Samoa (NORMA, 2018). There is also a small contingent of “fresh” longline vessels (longliners that keep fish in the hold in the fresh/wet condition) flagged to FSM that are based in the Marshall Islands and target both bigeye and yellowfin (NORMA, 2018). GFW data of 14 FSM-flagged longline vessels in 2020 indicate that ~49% of observed fishing effort (kw*hours) occurred within the Marshall Islands’ EEZ, 49% in FSM’s EEZ, and the

remainder (~2%) took place in the high seas (Figure 7) (Global Fishing Watch, 2020). Yellowfin (35%), bigeye (32%), and albacore (27%) were the most caught species by FSM longliners in 2019 but blue marlin (4%), swordfish (1%) and other incidentally caught billfishes made up a non-trivial ~5% of the total catch composition.

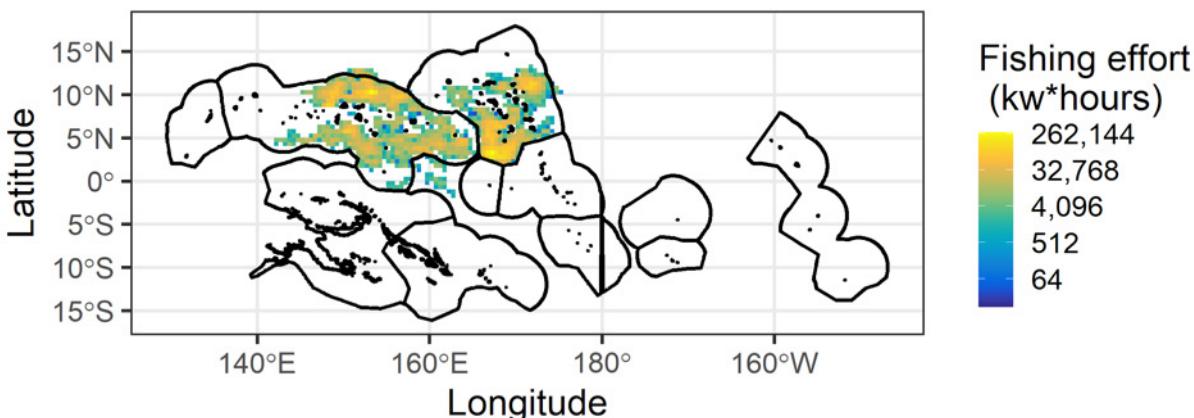


Figure 7. Observed fishing effort (kw*hours) by FSM-flagged longline vessels within the WCPFC CA in 2020. The EEZs of the countries belonging to the PNA are outlined in black. Data source: Global Fishing Watch, 2020.

FSM-flagged freezer longliners based in FSM are part of a larger conglomerate of vessels owned and operated by the Chinese fishing company SZLC. Historically, these domestic-based longliners are responsible for up to 45-65% of the annual longline catch volume in FSM's EEZ (Gillett, 2016). They primarily land their catch in Kosrae and Pohnpei for air export to Japan via Guam, but they will land catch abroad on occasion (FAO, 2018; Sieben et al., 2018). This specific fleet has a Marine Stewardship Council (MSC) certification for bigeye and yellowfin tuna from 2018 through 2024 (Sieben et al., 2018, p. 20). See the [MSC first surveillance audit report](#) (Sieben & Watt, 2020) for further information.

1.4.3 Pole-and-line fleet

Japan-flagged fishing vessels comprise the entirety of the commercial offshore pole-and-line fishing fleet operating within FSM's EEZ. In 2019, the pole-and-line fleet's catch of target tuna species totaled 441 mt, which was overwhelmingly skipjack (92%) with some yellowfin (6%) and bigeye (2%) (NORMA, 2020a). These vessels primarily operate in the middle and western parts of the EEZ (NORMA, 2020a), and land their catch in Japan (FAO, 2018).

For more information, the [Management Plan on Tuna Fisheries for the Federated States of Micronesia](#), the [NORMA 2014-2016 Annual Report](#), and the [NORMA 2018-2023 Strategic Plan](#) detail

many of the most recent statistics pertinent to offshore fishing activity in FSM.

1.5 Management

To put it simply, fisheries management within FSM is complicated. Offshore fisheries in FSM, which tend to target wide-ranging tunas and tuna-like species, are managed at multiple scales and by multiple institutions. Further still, each of these institutions have their own management measures and agreements that dictate how fisheries should be managed. Below, we describe the relevant management authorities at each scale (regional, subregional, and national), as well as relevant management measures established by these entities.

1.5.1 Regional

The [Western and Central Pacific Fisheries Commission \(WCPFC\)](#) was established by the "Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean" in 2004. As a regional fisheries management organization, the WCPFC is the central management authority for tuna and tuna-like species in the entire Western and Central Pacific Ocean (WCPO). The WCPFC CA covers roughly 20% of the earth's surface (Post and

and Squires 2018) (Post & Squires, 2020). The WCPFC has four subsidiaries: the Scientific Committee, the Technical and Compliance Committee, the Northern Committee, and the Finance and Administration Committee. Of these four it is important to highlight that the Scientific Committee ensures that WCPFC has the best available scientific information and the Technical and Compliance Committee ensures that members are adhering to WCPFC management measures.

The WCPFC also received technical and policy assistance from the Secretariat to the Pacific Community (SPC). SPC compiles and processes all WCPFC catch and effort data, provides statistical support, and conducts regional stock assessments for stocks managed by the WCPFC.

The WCPFC's primary means of management are Conservation and Management Measures (CMMs), which are usually decided based on consensus amongst members and are legally binding. CMMs apply to all WCPFC members, including the cooperating non-members, and the entire WCPFC CA. They set measures for fishing vessels targeting bigeye, yellowfin, and skipjack tunas that predominantly use longlines and purse seines. Nearly 50 CMMs have been set related to catch retention, FAD closures, non-target species, gear restrictions, transshipment, observer coverage, and monitoring. A full list of current CMMs can be found [here](#).

Some notable CMMs are:

- Catch limits: The WCPFC has placed flag-based bigeye tuna catch limits for longlining vessels in hopes of conserving and managing catch of this species, but similar limits have not been placed on purse seine vessels or for other species.
- Observer coverage: The WCPFC has mandated that purse seine vessels have a 100% observer coverage and that longlining vessels have 5% observer coverage. 100% observer coverage is required for any at-sea transshipment

- Transshipment: Purse seine vessel transshipment is prohibited outside of ports and in the high seas. Longline, pole-and-line, and trolling vessels are permitted to transship in EEZs in accordance with national regulations, and in the high seas.

1.5.2 Subregional

Pacific Islands Forum Fisheries Agency (FFA)

The Pacific Islands Forum Fisheries Agency (FFA) is a sub-regional coalition consisting of 17 countries from the WCPO. Through regional cooperation, FFA aims to help members secure the maximum possible social and economic benefits from fisheries resources in the region. They provide members with scientific advice and technical assistance to help them make informed and sovereign decisions regarding their fisheries resources. The FFA also oversees regional treaties and arrangements between members, and the governing body of the FFA - the Forum Fisheries Committee - provides input to the WCPFC regarding proposed CMMs.

The Tokelau Arrangement was developed in 2014 by 11 Pacific Island countries. It was a voluntary management agreement that aimed to place more stringent limits on distant-water vessels from nations outside the region participating in the South Pacific albacore fishery. FFA countries were concerned about the declining economic yields and the future health of the stock, despite its current classification as healthy. Declining economic productivity of the fishery is likely due to increases in the number of vessels entering the fishery, particularly from China (Campling et al., 2017). Despite interest from Pacific Island countries, distant-water fishing nations have been reluctant to support any management measures introduced to the WCPFC related to South Pacific albacore (Grieg, 2017). Due to disagreements about how to best manage albacore allocations, negotiations broke down in December 2017. Following the dissolution of this arrangement, WCPFC members are continuing to work towards an agreement on the management of the South Pacific albacore stock (limits, allocations, and official CMM) (Tauafiafi, 2019).

Parties to the Nauru Agreement (PNA)

At the sub-regional level, the primary management authority is the Parties to the Nauru Agreement (PNA), which comprises FSM, Kiribati, Marshall Islands, Nauru, Papua New Guinea, Palau, Solomon Islands, and Tuvalu. These Pacific Island countries work together to collectively and collaboratively manage the tuna stocks in their waters. Their primary focus is on the purse seine and longline fisheries. The PNA has received recognition as a global leader in tuna management and conservation and has implemented some very progressive conservation measures.

The PNA's primary means of management is a vessel day scheme (VDS), a system by which the member states of the PNA and Tokelau, a participating party outside of the PNA, sell fishing access to the vessels of the offshore fleet that fish within their EEZs. Within this system, the entire PNA is allocated a Total Allowable Effort (TAE) on an annual basis which is further subdivided to each EEZ in the form of the Parties Allowable Effort (PAE). One important allowance within the VDS is that fishing days may be traded among participating countries.

Due to the success of the purse seine VDS, a separate but similar VDS was established for the longline fleet in 2017, but it has yet to achieve the same economic success for member countries. While similar in their foundation, the purse seine and longline VDS are discussed separately below.

Purse Seine VDS

The PNA first established a VDS for the purse seine fleet in 2007, which has been considered wildly successful with annual revenues for participating parties totaling nearly US\$500 million in 2019. Within the purse seine VDS, TAE is capped at 44,033

vessel-days, but an additional 972 vessel-days were added to the PNA TAE when Tokelau joined. Each country's PAE is based on their historical fishing effort and distribution of the stock biomass within their EEZ (Havice et al., 2019). A minimum benchmark price for the purchase of a single purse seine vessel-day in the region is set each year, but vessel days can sell for much higher than the benchmark price. In 2018, the minimum benchmark price of a vessel day was US\$8,000 but days sold for prices on the order of US\$9,000 - 11,000 (Havice et al., 2019). In addition to the VDS system, the PNA also sets out additional management measures, related to purse seiners. These include: 1) onboard retention of all bigeye, yellowfin, and skipjack catch, 2) seasonal ban on FAD fishing (July-September), 3) 100% observer coverage, 4) no fishing in high seas pockets, 5) no transshipment on the high seas, and 6) comprehensive vessel tracking, among others (Havice et al., 2019).

Focusing at the national-level, FSM was allocated roughly 16% (7,309 vessel-days) of the TAE in 2016. FSM's allocations from 2014-2016 are seen in Table 7. Revenues from purse seine fishing access totaled approximately ~US\$61 million in 2016, accounting for 95% of FSM's total fisheries revenues (NORMA, 2016).

Longline VDS

Due to the success of the purse seine VDS, a separate but similar VDS was established for the longline fleet in 2017. At present, all PNA countries and Tokelau participate in the longline VDS, but participating countries are at different stages of implementation, which will take some time (Campling et al., 2017). To date, the longline VDS has yet to achieve the same economic success for member countries as its purse seine counterpart,

Table 7. PNA-wide TAE and the PAE of FSM for the purse seine VDS. Data source: NORMA, 2016.

	2014	2015	2016
TAE	33,700	45,610	45,881
PAE	5,430	7,266	7,309

partially due to the low vessel-day price of US\$100-150 (Campling et al., 2017).

While similar in fundamental ways, there are notable differences between the purse seine and longline VDS systems. The two major differences are that 1) TAEs are aspirational and not scientifically backed, leading to underutilized PAEs and diminishing the benefits of access scarcity to the longline fishery (Campling et al., 2017), and 2) the high seas are not closed to longline fishing, allowing unmanaged and free fishing to occur. Additionally, there are several smaller differences between the two VDS systems, namely that the longline VDS 1) permits at-sea transshipment, 2) does not make allowances for non-fishing days, and 3) each vessel must use vessel-days specifically allocated to it, there is no option for pooling vessel-days by a fishing company (Campling et al., 2017).

In 2016, PNA (+Tokelau) parties agreed to a five-year TAE from 2017-2021, totaling 123,535 vessel-

days. FSM was allocated the second-highest number of days amongst the longline VDS participating countries (30,928 fishing days) (Table 8) (Campling et al., 2017). Only 15% of FSM's PAE was utilized in 2017, partly due to the choice of the Japanese longline fleet not to participate (Sieben et al., 2018).

1.5.3 National

At the national level, there is a two-tiered management system - state and federal. The [National Oceanic Resource Management Authority \(NORMA\)](#) has jurisdiction over all fishery resources in FSM's waters extending from 12-200 nm from the island baselines (i.e., outside of the state-managed territorial sea). Overall, NORMA is responsible for the development and management of all marine resources, including the issuance of fishing, research and training vessel permits, compliance with national and regional management measures and regulations, and management of all fisheries-related data. Information on state level management (0-12 nm from the island baselines) will be discussed in the "nearshore fisheries" section that follows in this report.

Spatial management

Industrial fishing from offshore fisheries fleets is not permitted in the territorial sea (0-12 nm). Similarly, commercial foreign fishing (and other natural resource exploitation) is prohibited between 12-24 nm, the contiguous zone, from the island baselines due to a closed area. Furthermore, FSM's entire EEZ has been declared a shark sanctuary and commercial shark fishing is strictly prohibited. FSM's locally-based longline fleet must use circle hooks to avoid shark and sea turtle bycatch. They are prohibited from using shark lines and from retaining any elasmobranch (sharks and rays) bycatch (Sieben et al., 2018).

Licensing

FSM government requires fishing licenses for all "research vessels, domestically based local vessels, domestically based foreign vessels, foreign fishing partners, and other support vessels" under Title 24 of the Federated States of Micronesia Code (FSMC) (NORMA, 2016). The flag nation of foreign fishing

Table 8. Country PAEs under the PNA longline VDS for 2017-2021. Data source: Campling et al., 2017.

EEZ	PAE (fishing days)
FSM	30,928
Kiribati	41,597
Marshall Islands	13,730
Nauru	5,000
Papua New Guinea	20,000
Palau	12,035
Solomon Islands	29,342
Tokelau	5,000
Tuvalu	7,500
Total TAE	165,132
Total TAE less Kiribati	123,535

vessels, whether domestically based or not, must have an access agreement with the government of FSM before a permit can be issued to any vessel of that flag. Most foreign nations are granted access to FSM's EEZ via bilateral agreements but the U.S. purse seine fleet receives access via a multinational treaty. See Table 7 of the [NORMA 2014-2016 annual report](#) for a full list of access agreements.

In 2016, a total of 428 fishing and fishing-related licenses were granted to foreign and domestically-flagged vessels. Most fishing licenses were granted to carrier vessels (43%), followed by purse seine (27%), pole and line (13%), longliners (10%), and bunkers (3%) (NORMA, 2016). Korea (26%), followed by Panama (23%), Japan (16%), China (10%), and Kiribati (7%) received the largest number of licenses in 2016 (NORMA, 2016). These licenses generate a significant amount of revenue for FSM. More information on these revenues can be found in the "economic indicators" section below.

Monitoring and enforcement

FSM is committed to having full-transparency for all fleets operating within their waters by 2023 through enhancing existing observer coverage with the implementation of electronic monitoring technology (Carreon, 2018). Observer coverage, as mandated by the WCPFC, is required on all purse seine vessels and 5% of longline vessels. Historically, NORMA has had difficulty in meeting the 5% requirement for longliners as FSM cannot place its observers on its flag vessels, but observers from the Marshall Islands Marine Resource Authority (MIMRA) have helped FSM meet that coverage goal in past years, including 2019 (NORMA, 2020a). The FSM National Fisheries Observer Program (NFOP) had 166 placements last year which included 157 purse seiners and 3 longliners among other vessels (NORMA, 2020a).

The Executive Director of NORMA, Eugene Pangelinan, has said that the reality of placing observers on one-way longline fishing trips that last for months has created logistical challenges in meeting the coverage goal (Carreon, 2018). In hopes of increasing observer coverage, FSM implemented an electronic monitoring trial for locally-based longline vessels (5 vessels) in 2017

and has signed an MOU with Japan to trial the EM system on 3 of their longline vessels in 2021 (NORMA, personal communication, 2021). However, at this time, electronic monitoring data does not count towards the WCPFC minimum coverage rate per current regulations (Sieben et al., 2018).

International agreements/commitments

The Compact of Free Association, a 1986 treaty, establishes a relationship between the United States, FSM, and the Marshall Islands (RMI). Through this agreement, the United States provides financial/economic assistance, defense and other benefits to FSM (and RMI) in exchange for certain operating rights in FSM (and RMI) and EEZ access restrictions to other nations. This Compact was amended again in 2004 for each country separately. Over the duration of the amended Compact (2004-2023), the US will provide US\$3.6 billion in economic assistance to FSM and RMI (GAO, 2019). With the Compact set to expire in 2023, FSM is very focused on how to maximize revenues from their oceanic resources to make up for the loss of US economic assistance (NORMA, 2018).

FSM is committed to the Micronesia Challenge - a multi-national commitment with Palau, RMI, Guam, and Northern Mariana Islands to effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020. The Micronesia Challenge has recently been extended to 2030 with conservation targets set for 50% of marine resources and 30% of terrestrial resources.

1.6 Economic indicators

An all-encompassing estimate of the value of the offshore tuna fishery is not available but the relevant revenue streams coming into FSM would include the value of catch, fishing license fees, fishery access via VDS days, exports, taxes, and fees related to port activities (FFA & NORMA, 2015).

The value of catch by commercial offshore fishing vessels within FSM's EEZ was estimated to be US\$407 million per year for 2017-2019 (FFA & SPC,

2020). While a breakdown by fleet was not available, FSM-flagged vessels have, historically, been responsible for 5-7% of this value (FFA & NORMA, 2015) and the larger contingent of vessels based domestically in FSM (both FSM-flagged and foreign-flagged) have contributed up to 27% in total (Gillett, 2016).

Revenue from fishing license fees and the sale of VDS days are a significant contributor to FSM's national income (FSM National Government, 2002). Across all FFA member nations, the total revenue in 2019 hit an all-time high of US\$550 million, up 21% from 2015 (FFA & SPC, 2020). FSM's share of this revenue is worth roughly US\$70 million annually (FFA & SPC, 2020) and is largely generated by the purse seine fleet (95% from 2014-2016) (NORMA, 2016).

Tuna products derived from the catch of FSM-flagged vessels were estimated to be worth US\$71 million from 2016-2018 (FFA & SPC, 2020). The main export destinations for tuna products from the region are: the EU, Japan, Thailand, and the United States (FFA & SPC, 2020).

Transshipment is a very important economic component of FSM's tuna industry and accounted for the second largest portion of transshipments in the WCPFC between 2015-2018 (second to Majuro). In 1993, Pacific Island Countries implemented a ban on transshipment except for at designated ports. Due to COVID, transshipment is currently occurring $> 3\text{nm}$ from shore in designated areas as a safety precaution (NORMA, 2020b). The main transshipment port in FSM is located in Pohnpei, there is also a transshipment port in Kosrae, and some offloading occurs in Yap (Jaynes, 2018). Transshipment in FSM results in economic benefits through port charges, and to the private sector for services and supplies. In 2015, 9,728 mt of tuna were transshipped through FSM ports by distant-water and national purse seine vessels. Approximately 3,900 mt of tuna were transshipped from longline vessels (FAO, 2018).

Tuna fisheries and related sectors provided an annual estimated average of 1,105 jobs for 2017-2019 in FSM (FFA & SPC, 2020). SZLC, the company

that operates the domestically-based longline fleet, employs roughly 100-200 people in processing and fisheries-related jobs alone (Sieben et al., 2018). In terms of rank among FFA member states, FSM has a much lower processing capacity relative to the amount of fish caught within its EEZ. It had an estimated annual processed volume of tuna products of 5,331 mt for 2016-2018, sixth-most in the FFA for that time period (FFA & SPC, 2020).

Understanding the social contribution of the offshore fishing sector, namely to local employment, food security, and funding for local programs and infrastructure (e.g. education), is key; however, these data were not available at the time of publication.

2. NEARSHORE FISHERIES IN FSM



2. Nearshore fisheries in FSM

2.1 Overview

Nearshore fishing activity, which we define as that within the territorial state waters (<12 nm), is as diverse as it is ubiquitous throughout FSM. Nearshore fisheries in FSM are multi-gear and multi-species in nature. Nearshore fishing is largely for subsistence but there is a limited amount of commercial activity (Integrated Aquatic Solutions Inc., 2018). Just over half of all households (55%) in FSM reported engaging in fishing activities and only 15% of households reported selling any of their catch outside of their subsistence needs to small markets and retail outlets (Department of Resource and Development, 2019). The majority of nearshore fisheries production is consumed domestically in FSM, but there is also substantial export of reef fish to neighboring islands, including Guam (Cuetos-Bueno & Houk, 2018; Integrated Aquatic Solutions Inc., 2018). FSM residents fish recreationally, but there is no formal management of this sector (FAO, 2018). Regulatory authority of the nearshore territorial waters (0-12 nm) is delegated to each State but the management of these waters may take place at the state, island, and/or community level in practice (Integrated Aquatic Solutions Inc., 2018).

The [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) (2018) provides an overview of the status and management of nearshore fisheries in FSM. It was developed during an extensive series of stakeholder interviews and meetings (538 stakeholders, 105 national government and regional agencies) during the latter half of 2017. This section heavily draws upon its findings, augmented with additional resources where available.

FSM. A fisheries monitoring network has not yet been formalized, but monitoring protocols and records of initial baselines have been established in all four states (Cuetos-Bueno et al., 2018; J. Cuetos-Bueno, personal communication, 2021; Hernandez-Ortiz, 2019; Houk et al., 2017; Integrated Aquatic Solutions Inc., 2018). Data from national surveys and scientific studies provide some snapshots of the nearshore fishery and its importance to subsistence and livelihoods across FSM. The [Integrated Agriculture Census 2016](#) summarizes the most recent household survey data regarding target species, gear types, frequency of fishing trips, and the amount of catch sold locally. The [2013/2014 Household Income and Expenditure Survey \(HIES\)](#) contains prior estimates of many of the same statistics as well as more detailed information regarding the importance of nearshore fisheries to subsistence and livelihoods. [Gillett \(2016\)](#) uses [HIES](#) survey data to estimate total nearshore catch and the export volume of nearshore fisheries products. [Rhodes et al. 2018](#), [Cuetos-Bueno et al. 2018](#), [Houk et al. 2017](#), and Cuetos-Bueno's unpublished data collected extensive standardized nearshore commercial fishery market, effort, and catch data in all four FSM states from 2014 to 2019 (J. Cuetos-Bueno, personal communication, 2021; Integrated Aquatic Solutions Inc., 2018). The key datasets from the sources linked in this paragraph are summarized in Table 9.

Other assessments of the status and health of nearshore resources in FSM have been performed, including widespread coral reef monitoring in response to the Micronesia Challenge (e.g. Houk et al., 2016). Summaries of the most recent of these scientific studies are included in Table 10.

2.2 Data availability and limitations

In general, nearshore fisheries data are limited in

Table 9. Key sources of publicly-available nearshore fisheries catch, effort, and market data referenced in this report.

Data	Year(s)	Spatial resolution(s)	Source
Target species groups, gear type usage frequency, fishing trips per month, percentage of catch sold	2016	National, State	Department of Resource and Development, 2019
Participation rate by household, age, gender, and wealth group; gear type usage frequency; fishing trips per month and hours per trip; catch by species group; household income and subsistence from fisheries; household consumption and expenditure on fisheries products	2013 - 2014	National, State	Sharp, 2017
Coastal catch (subsistence/commercial) volume and value, volume and value of fishery products exports	2013 - 2014	National	Gillett, 2016
Gear type usage frequency; catch and revenue per unit effort by gear; average number of fishers and hours per trip by gear; percent of catch, mean length at catch, and percent mature at catch by species	2005, 2016	State (Pohnpei only)	Rhodes et al., 2018
Total catch volume and value, catch volume by gear, average daily catch by gear, fishing costs by gear, catch per unit effort by gear, percent of catch by species	2013 - 2014	State (Chuuk only)	Cuetos-Bueno et al., 2018
Landings by species (for consumption and sales), fishing location, number of fishers, fishing method/gear, fish length	2014-2015	State (Kosrae only)	Houk et al., 2017

2.3 Target species

FSM's nearshore fisheries are multispecies and opportunistic in nature, and total nearshore fisheries catch is composed of roughly 100-200 different species throughout FSM (FSM National Government, 2002; Integrated Aquatic Solutions Inc., 2018). Reef-associated, demersal, intertidal, and nearshore pelagic species are all caught (Integrated Aquatic Solutions Inc., 2018) (Figure 8). Invertebrates such as mangrove crabs and sea cucumbers are among the most valuable

commercial species while rabbitfish, parrotfish, and other large-bodied herbivores are a few of the finfish preferred for subsistence (Cuetos-Bueno et al., 2018; FAO, 2018). Other invertebrate and non-finfish species that are harvested include giant clams, trochus, octopus, lobster, turtles and seaweeds (FAO, 2018). The contribution to overall landings from the important commercial nearshore species across Micronesia, including FSM, are shown in Figure 9.

Percent of households that reported catching:

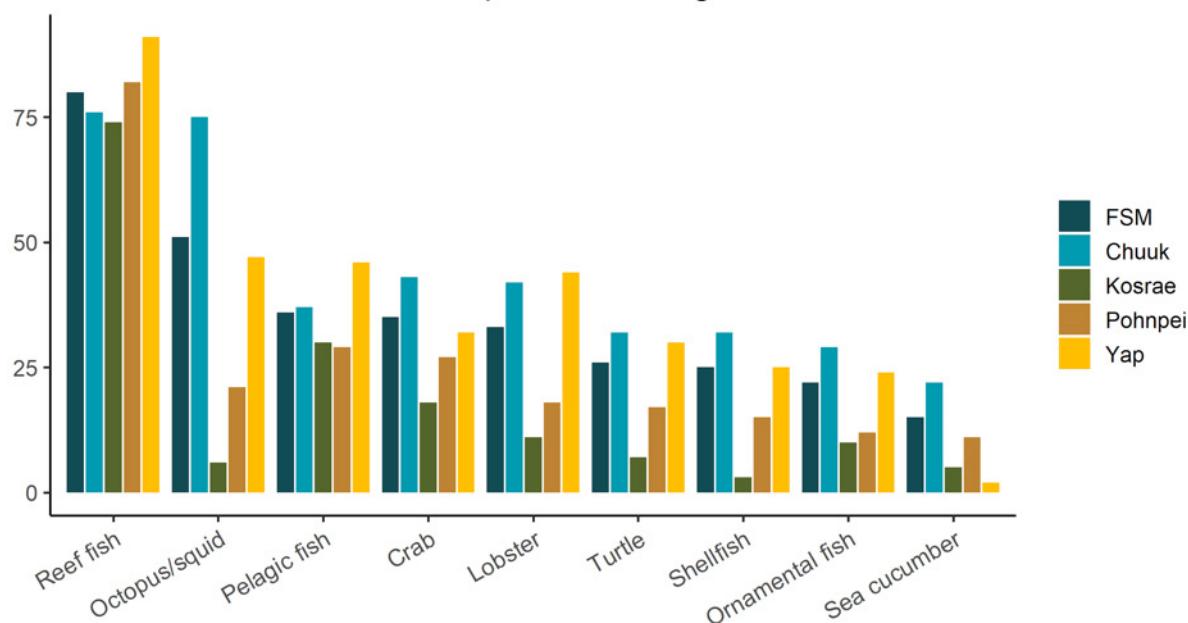


Figure 8. Percentage of households that reported catching a given species group by state. Data source: Department of Resource and Development, 2019.

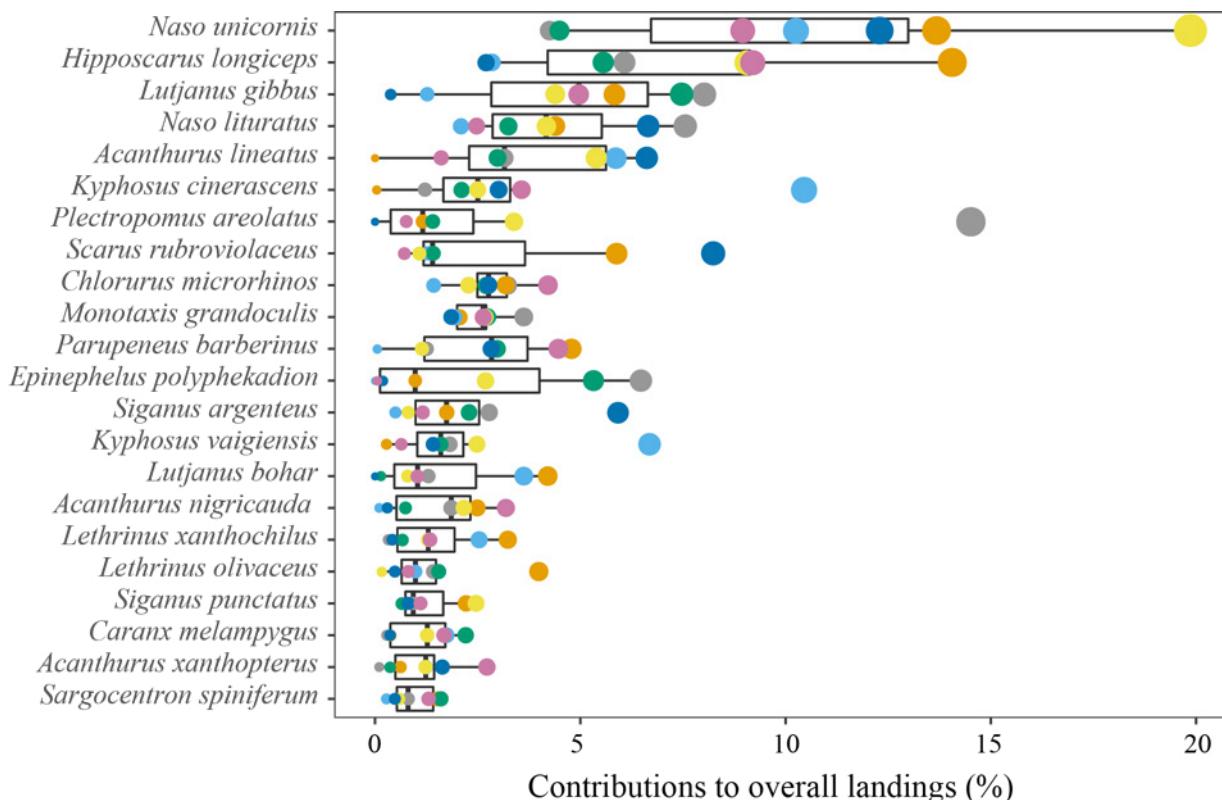


Figure 9. Contribution to commercial coastal landings of the top 22 species that accounted for at least 1% of overall island landings in three or more islands across Micronesia (including, but not limited to, FSM). Colors indicate islands: Chuuk (grey), Koror (orange), Kosrae (light blue), Majuro (green), Pohnpei (yellow), Saipan (dark blue), and Yap (pink). Data source: Javier Cuetos-Bueno et al., submitted.

2.4 Fleet characteristics

The exact nature of nearshore fishing varies across states, from inner to outer islands, and even among communities on the same island. In this section, we use statistics averaged or aggregated at the national level in order to provide a general overview of nearshore fishing activities across FSM. However, the “cross-state comparison” section uses data available at the state level to highlight key similarities and differences between states.

Nearshore fishing is carried out from skiffs with outboard motors (6-9 m), traditional canoes/rafts/kayaks, or coastal/nearshore waters accessed on foot (Integrated Aquatic Solutions Inc., 2018). Approximately 16% of households reported owning a boat with an engine and 12.7% of households reported owning a boat/canoe without an engine during the 2010 census (Integrated Aquatic Solutions Inc., 2018). Coastal reefs (75% of households), lagoons (53%), and outer reefs (45%) are the three most common fishing locations based on the percentage of households engaged in fishing activities there (Department of Resource and Development, 2019). Subsistence fishing primarily occurs in coastal and inshore habitats (i.e., mangroves, reef areas, and lagoons) and reef-based commercial fishing almost exclusively targets barrier reefs (J. Cuetos-Bueno, personal communication, 2021; Integrated Aquatic Solutions Inc., 2018). Nearshore pelagic finfish (e.g. tuna) are targeted mostly using handline trolling, and drop stone (Pohnpei) fishing techniques in the open waters outside of reefs and on the outer reef slopes, sometimes with the assistance of fish-aggregating devices (FADs) (Integrated Aquatic Solutions Inc., 2018). Most bottom fishing occurs at shallower depths (<100 m) as constrained by the higher cost of specialized gear to target deepwater species, no local high-end market for deepwater species, and a general absence of demersal habitat beyond 100 meters in depth (J. Cuetos-Bueno, personal communication, 2021; FSM National Government, 2004).

2.4.1 Participation

The dispersed and largely informal nature of

nearshore fisheries makes it difficult to quantify the exact number of individual participants. The [Integrated Agriculture Census of 2016](#) estimates that about half of all households reported engaging in fishing activities, defined by the survey as having undertaken “fishing activities in the previous three months, irrespective of whether the activity was on a one-off or regular basis” (Department of Resource and Development, 2019; Sharp, 2017). Chuuk (68%) and Yap (61%) had the highest household participation rates by state in 2016 (Department of Resource and Development, 2019). Eighteen percent of all individuals aged 15 or older reported fishing as their primary or secondary occupation (Department of Resource and Development, 2019). Both men and women participate in nearshore fisheries, but 85% of individuals engaged in household fishing activities identified as male (Department of Resource and Development, 2019). Fishery participation by women varies from community to community, but it is common for women to play a larger role in coastal/nearshore invertebrate and intertidal reef gleaning activities (Integrated Aquatic Solutions Inc., 2018). The most common fishing activities performed by women are tidal gleaning/hand collecting and the use of gill nets in shallow water (Integrated Aquatic Solutions Inc., 2018).

For more information regarding nearshore fisheries participation and livelihoods, please refer to the [Integrated Agriculture Census 2016](#) and [2013/2014 Household Income and Expenditure Survey \(HIES\)](#).

2.4.2 Gear types

A wide range of gear types are deployed by nearshore fishers in FSM. The most common nearshore fishing activity is spearfishing, especially at night, and 68% of households reported engaging in spearfishing (Department of Resource and Development, 2019; Integrated Aquatic Solutions Inc., 2018). Other common nearshore fishing activities include: bottom fishing (including drop stone) (46% of households), trolling (39%), handline and pole-and-line fishing (39%), cast net (33%) and gathering/reef gleaning (18%).

(Department of Resource and Development, 2019). Preferred gears are fairly consistent across states, and most fishers report using more than one type (Department of Resource and Development, 2019).

Harmful/destructive fishing gears and methods that threaten the sustainability of FSM's coastal fisheries are notable, but increasingly rare. The use of chemicals/poisons (bleach, cyanide, and natural compounds derived from roots and leaves of the *Derris* sp. plant) was previously practiced, but it is now uncommon and banned under state/national legislation (Integrated Aquatic Solutions Inc., 2018). Illegal fishing with dynamite was once a threat to local ecosystems in Chuuk, but it is believed to have stopped due to low access to dynamite and strict enforcement (Integrated Aquatic Solutions Inc., 2018; State Governments, personal communication, July 12, 2021). From a conservation perspective, small-mesh gill nets and nighttime spearfishing can have negative ecological consequences and have been flagged by nearshore marine resource users as needing possible management intervention (Integrated Aquatic Solutions Inc., 2018). Interviews with commercial fishers in Pohnpei revealed that these two gear types increased in use from 75.5% to

81.9% of participating fishers from 2005 - 2016 (Rhodes et al., 2018).

2.4.3 Catch and effort

There are no institutions or programs in place to track the catches or effort of nearshore fisheries in a comprehensive way throughout all of FSM, but a few rough approximations have been made. [Gillett \(2016\)](#) estimated total nearshore fishery production in 2014 using the estimated household expenditure on nearshore fishery products from the [HIES](#) data, the estimated market prices of those products in each state, and coarse nearshore fishery export data tracked by the National Statistics Division. This resulted in a total estimated catch of 5,280 mt in 2014 with roughly two-thirds of that production being subsistence in nature (3,555 mt), the remaining 1,725 mt of production derived from commercial activities, and 426 mt of the commercial harvest being exported (Gillett, 2016). Of the estimated 4,854 mt consumed domestically, reef fish were the most prevalent (70%), followed by pelagic fish (24%) and invertebrates (6%) (Figure 10) (Gillett, 2016).

Cumulative nearshore fishing effort by all

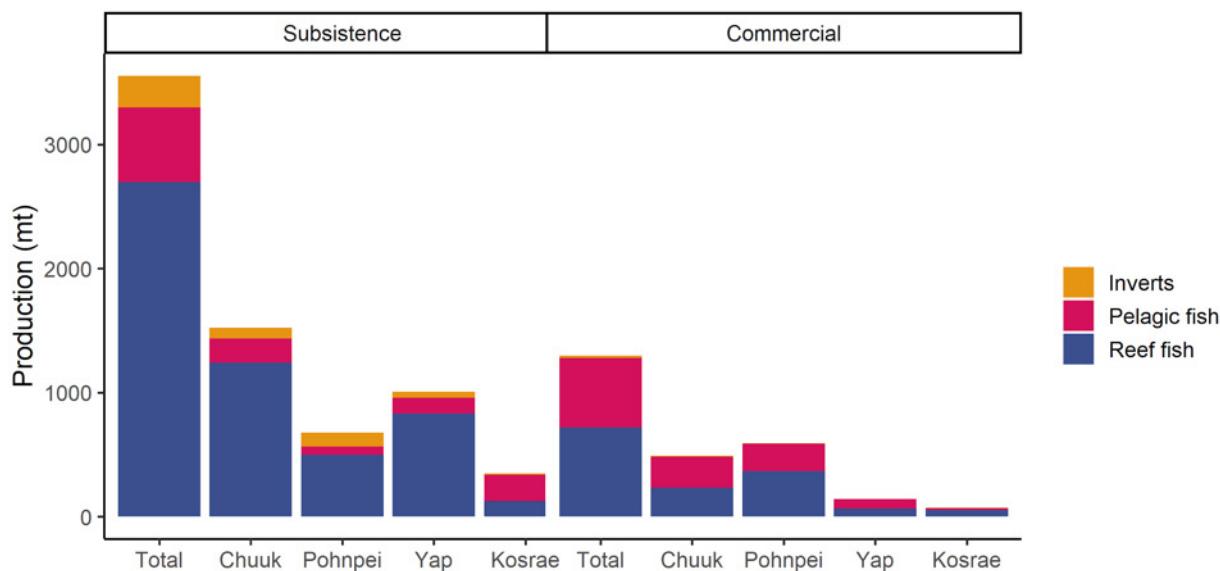


Figure 10. Estimated nearshore fisheries production by state and species archetype in 2014. Data source: Gillett, 2016.¹

¹ Cuetos-Bueno's unpublished data from 2014-2019 may provide updated estimates of nearshore fisheries production (J. Cuetos-Bueno, personal communication, 2021)

households across FSM is estimated to be ~341,000 hours per month (Sharp, 2017). The [HIES](#) has additional details on the mean number of fishing trips per month, duration of fishing trips, and fishing effort per household.

2.4.4 Status

Interviews with nearshore fisheries stakeholders suggest that overharvesting of nearshore resources is occurring through various parts of all four states, especially near population centers (Cuetos-Bueno et al., 2018; Hernandez-Ortiz, 2019; Houk et al., 2017; Integrated Aquatic Solutions Inc., 2018). Indicators of overfishing include: declining catches, loss of spawning aggregations, and increasing levels of required fishing effort. These trends have been particularly noted for species important to both subsistence and commercial nearshore fishing activities including those of high economic value (e.g. sea cucumbers, mangrove crabs), finfish

groups preferred for food and markets (e.g. rabbitfish, and grouper), highly vulnerable species (e.g. bumphead parrotfish, humphead wrasse), and species that are highly susceptible to a given fishing method (e.g. parrotfish and nighttime spearfishing) (Integrated Aquatic Solutions Inc., 2018). Houk et al., 2015 performed biological surveys of reefs across FSM to detail progress towards the goal of conserving 30% of marine resources by 2020 as set forth by the Micronesia Challenge. This study found that 42% of reefs surveyed met the “effectively conserved” threshold as dictated by the Micronesia Challenge criteria but that a representative 30% of each reef type (outer, channel, inner) in each state did not meet that threshold. Fishing pressure was identified as the most significant stressor in determining reef health outcomes.

Survey findings detailing the health, status, and trends of nearshore fisheries within specific geographies of FSM are summarized in Table 10.

Table 10. Literature describing the status and trends of nearshore marine resource health at sites across FSM. An asterisk (*) indicates the finding is relative to nearby reference sites outside the protected area(s).

Subject	Location	Findings	Reference
Commercial catch and effort data	Chuuk	International demand drives daily commercial landings more so than environmental variables (e.g. wind speed, lunar illumination) known to affect catch success rate. Higher vulnerability of commercial target species relative to subsistence ones despite commercial catch being smaller in volume. Effective interventions vary with species and may include size limits, gear bans, quotas, and area closures	Cuetos-Bueno et al., 2018
Reef-associated species assessment	Chuuk	Decline in population sizes of sea cucumbers and large-bodied fishes (2008 - 2016).	Houk et al., 2016
Coral reef condition assessment	Chuuk, Kosrae, Pohnpei, Yap	Only 42% of reefs surveyed met the conservation thresholds set by the Micronesia Challenge criteria.	Houk et al., 2015

Table 10 continued.

Subject	Location	Findings	Reference
Houk et al., 2015 MPA biological survey	Chuuk Lagoon	Increased fish density, biomass, and species richness at one of three MPA sites*.	Andrew et al., 2011
Reef fish assessment	Kosrae	Overfishing led to a shift in reef fish composition to smaller species of lower trophic levels, with a loss of larger herbivores and predators (1986 - 2015).	McLean et al., 2016
MPA biological survey	Nimpal Channel, Yap	Higher fish biomass and densities within the Marine Conservation Area*.	Olsudong et al., 2012
Commercial catch and effort data	Pohnpei	Overexploitation of commercial nearshore resources indicated by several trends (2005 - 2016): 20% decrease in reef fish sales volume, increased prevalence of nighttime spearfishing and small-mesh gill nets, decreased catch per unit effort, and an increased portion of catch was from lower trophic group fish families (i.e. "fishing down the food chain"). Additionally, the average duration and number of fishers per trip increased and that the spatial distribution of effort shifted to outer reefs away from areas of higher population density.	Hernandez-Ortiz, 2019; Rhodes et al., 2018
Sea cucumber assessment	Pohnpei Island & Ant Atoll	Signs of overharvesting include lower relative species richness and population density.	Bosserelle et al., 2017
MPA biological survey	Pohnpei Lagoon	Elevated fish biomass at two of three MPA sites*.	Koshiba et al., 2011

2.4.5 Cross-state comparison

Nearshore fishing effort predominantly targets reef-associated species groups such as scarids (parrotfishes), acanthurids (surgeonfishes, tangs, and unicornfishes), and lutjanidae in every state and spearfishing is the favored gear type in all states. The health of nearshore marine resources varies both within and across states, but nearshore stocks are believed to be overexploited in general. The roles of women in fisheries similarly varies widely both within and across states, but women have additionally taken on lead administrative and managerial roles with regards to marine protected areas (MPAs) in Chuuk and Yap (Integrated Aquatic

Solutions Inc., 2018). Pohnpei and Chuuk have the highest estimated nearshore fishery production as well as the most available data regarding the export of nearshore fisheries products. Key similarities and differences in the nearshore fisheries across states are summarized in Table 11. While Table 11 highlights how certain dimensions of nearshore fisheries appear similar when viewed with a national or state-level perspective, it should be noted that in practice nearshore fishing activity is incredibly diverse from community to community and local context will be important in determining the success of nearshore management interventions.

Table 11. Summary of nearshore fishing activity in FSM by state. Information synthesized from the [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) unless otherwise noted. An asterisk (*) indicates that disaggregated price information for reef and pelagic fish was not available.

State	Chuuk	Kosrae	Pohnpei	Yap
Number of commercially harvested nearshore species	132 finfish alone (J. Cuetos-Bueno, personal communication, 2021)	NA	165	150
Most common gear type (Department of Resource and Development, 2019)	Spearfishing	Spearfishing (J. Cuetos-Bueno, personal communication, 2021)	Spearfishing	Spearfishing
Dominant reef-caught species groups	Groupers, surgeonfishes, parrotfishes (Cuetos-Bueno et al., 2018)	Marine ray-finned fish, surgeonfishes, jacks (Houk et al., 2017)	Surgeonfishes, parrotfishes, groupers (Rhodes et al., 2018)	Surgeonfishes
Women in fisheries	<ul style="list-style-type: none"> •Specialize in invertebrate fisheries •Fishing areas: nearshore habitats •Gears: gleaning, gill nets, hand lines from shore •Lead administration and management of MPAs 	<ul style="list-style-type: none"> •Fishing areas: inshore reef, rivers, mangroves •Gears: gleaning, rod and reel, gill nets •Specific women's fishery for sea cucumber 	<ul style="list-style-type: none"> •Subsistence fisheries •Fishing areas: fringing reef & nearshore habitats •Gears: gleaning and netting •Lack of training for women in fisheries 	<ul style="list-style-type: none"> •Roles vary from Yap proper to outer islands, fishing is taboo for women in some locales •Gears: Fishing from shore, throwline, floatline, gleaning •Lead MPA management and monitoring activities
Estimated nearshore fishery production (mt/year) (Gillett, 2016)	1564	194	983	947

Table 11 continued.

State	Chuuk	Kosrae	Pohnpei	Yap
Average price of reef fish* (USD/lb)	<ul style="list-style-type: none"> Market retail price* (Steven Palik, personal communication, 2021): 2.75 Price to fishers*: 1.00 - 1.10 	<ul style="list-style-type: none"> Market retail price: 1.75 - 2.75 Price to fishers: 1.15 - 2.25 	<ul style="list-style-type: none"> Market retail price*: 1.65 - 1.75 Price to fishers*: 1.25 - 1.45 	<ul style="list-style-type: none"> Market retail price: 1.15 - 1.50 Price to fishers*: 1.15 (YFA skipper), 1.00 (others)
Export markets	<ul style="list-style-type: none"> Exports have declined from peak of ~200mt in 2010 Most comprehensive export records of all FSM states Primary destination: Guam 	<ul style="list-style-type: none"> Export of finfish, lobsters, and mangrove crabs Widely accepted that “personal consumption” exports are actually commercial activity Export increasing with number of international flights (Air Nauru) 	<ul style="list-style-type: none"> Banned: lobsters & coconut crabs, mangrove crabs with permit only 3.8 - 28% of marketed reef fish are exported (Rhodes et al., 2018) Primary destinations: Hawaii, Guam, US mainland 	<ul style="list-style-type: none"> Banned: certain corals, humphead wrasse, bumphead parrotfish No active recordkeeping or inspection of exports
Status of nearshore fishery	<ul style="list-style-type: none"> Overexploited Decline in biomass near population centers Immature fish make up a substantial portion of catch 	<ul style="list-style-type: none"> Overexploited Catch declining in size and numbers Herbivores dominate catch 	<ul style="list-style-type: none"> Overexploited Composition of catch has changed from piscivores to herbivores Effort moving from lagoon areas to outside reefs 	<ul style="list-style-type: none"> Overexploited Total harvest has decreased since the 1980s
Estimated nearshore pelagic production (mt/year)	65 mt commercial in 2014 (J. Cuetos-Bueno, personal communication, 2021)	64.12	90.3 (underestimate)	0.23

Table 11 continued.

State	Chuuk	Kosrae	Pohnpei	Yap
Average price of pelagic fish (USD/lb)*	<ul style="list-style-type: none"> •Market retail price* (Steven Palik, personal communication, 2021): 2.5 •Price to fishers*: 1.00 	<ul style="list-style-type: none"> •Market retail price (Steven Palik, personal communication, 2021): 1.25 - 1.75 •Price to fishers (Steven Palik, personal communication, 2021): 1.00 - 1.50 	<ul style="list-style-type: none"> •Market retail price*: 1.65 - 1.75 •Price to fishers*: 1.25 - 1.45 	<ul style="list-style-type: none"> •Market retail price: 1.75 •Price to fishers*: 1.00 - 1.15

2.5 Management

The management of nearshore marine resources in FSM is layered across local, state, and national entities and is also influenced by the activities of external research and NGO organizations in the space. Management of the territorial seas (0-12 nm from shore) falls under the jurisdiction of the individual states and each state has its own fisheries management agency. These agencies are supported at the national level by FSM's Department of Resources and Development (FSM R&D), which acts as a middle point between the states and external NGOs, philanthropic groups, and research organizations (Integrated Aquatic Solutions Inc., 2018).

In practice, nearshore resources in the territorial seas are managed by a mix of state agencies, municipal governments, and local community entities such as chiefs or traditional reef owners, whose relative influence varies geographically (Integrated Aquatic Solutions Inc., 2018). Pohnpei and Kosrae both feature open access fisheries with resources managed by state agencies, whereas nearshore resources are left to the jurisdiction of reef owners in Chuuk and communities in Yap (Integrated Aquatic Solutions Inc., 2018). In addition, three states (Chuuk, Pohnpei, and Yap) have outer islands and atolls, many of which are under traditional management where the enforcement of regulations is largely dependent

on chiefs/reef owners (Integrated Aquatic Solutions Inc., 2018).

Finally, many NGOs and fisheries and economic development authorities are active in the nearshore space of FSM, further complicating management in terms of aligning objectives and activities (Integrated Aquatic Solutions Inc., 2018).

2.5.1 Customary marine tenure/ community-based management

There is a strong tradition of customary marine tenure (CMT) in FSM, especially in Chuuk and Yap states. CMT is a "socially defined agreement where individuals, groups, or communities are recognized by local or customary laws as having ownership over marine areas and aquatic species in that area. Marine tenure arrangements govern the right of access and rules of use over marine areas and aquatic species" (Rhodes et al., 2011). The state-acknowledged traditional authority over nearshore area resources has led to the prevalence of community-based management (CBM) as a foundation for the management of nearshore fisheries (Integrated Aquatic Solutions Inc., 2018). Rhodes et al., 2011 details some examples of traditional CBM in Yap which include: reef tenure rights, the use of spatial and temporal closures,

species and gear restrictions, the exclusion of fishing rights to those outside the community, and protections for spawning aggregations. The influence of community systems has eroded in parts of FSM, especially those closest to large population centers. This has been linked to economic development and the loss of traditional fisheries management knowledge. These are the same areas in which nearshore stocks are threatened the most (Integrated Aquatic Solutions Inc., 2018). However, even in areas where the strength of traditional communities has been diluted, the buy-in of chiefs and community leaders is an essential component in implementing any initiative (Integrated Aquatic Solutions Inc., 2018).

The [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) discusses how traditional management, in many forms, has led to varying fisheries outcomes across different geographies. Falalop (Yap), Onei (Chuuk), and Mokil (Pohnpei) were highlighted as examples of successful CBM with relatively healthy nearshore fish stocks. It is noted that all three limit the prevalence of nighttime spearfishing and small-mesh gill nets to some degree. Meanwhile, CBM has been less successful in other locales, often linked to the waning influence of chiefs and local community systems: fishers in Romanum (Chuuk) must poach resources from neighboring resources in response to depleted local stocks, Fais (Yap) has experienced decreases in abundance of their favorite target species, the blacktip grouper (*Epinephelus fasciatus*), and fishers in Sapwuahfik (Pohnpei) have reported decreases in the abundance of fish stocks such as the Green humphead parrotfish (*Bolbometopon muricatum*) and groupers that are possibly linked to the unsustainable harvest of spawning aggregations (Integrated Aquatic Solutions Inc., 2018).

2.5.2 State management

Across fisheries management in each state, a few commonalities arise. State management agencies largely lack the resources or staff capacity to monitor nearshore ecosystems and enforce existing regulations (Integrated Aquatic Solutions Inc., 2018). Neither the national or state

governments issue or require fishing licenses to participate in the nearshore fisheries. While extensive efforts have been taken during the last decade to develop coastal fisheries monitoring frameworks, standardized protocols, local capacity, and strong ecological monitoring frameworks, no formal monitoring program is in place yet. In this section, a brief description of nearshore marine resources usage and management in each state is provided for context, followed by a table that highlights the key dimensions of nearshore resource management in each state such as management authorities, extant regulations, and priorities (Table 12).

Chuuk has historically had the largest fishery agency of any state in FSM but a growing population density and export market has put increasing pressure on nearshore resources (FAO, 2018). Enforcement is a challenge due to limited staff capacity and equipment as well as the geographical layout of the state (State Governments, personal communication, July 12, 2021). Therefore, traditional reef owners play a large role in surveillance, monitoring and enforcement throughout Chuuk (Integrated Aquatic Solutions Inc., 2018; State Governments, personal communication, July 12, 2021). A few recent surveys suggest that nearshore marine resources are relatively healthy (Integrated Aquatic Solutions Inc., 2018). However, the strength of CMT has eroded near population centers, making it difficult to limit access to fish stocks (FAO, 2018). Lower income families have higher relative participation in nearshore fisheries in Chuuk, suggesting that fisheries might play a larger role in income substitution and food security there (Sharp, 2017). The presence of consistent air travel has increased connectivity to export markets in Guam, resulting in additional commercial pressure on reef resources (FAO, 2018).

Kosrae has more streamlined nearshore fisheries management due to its smaller size, relative remoteness, and disconnect from larger commercial markets (FAO, 2018). In fact, many of the issues are driven by the limited nature of its nearshore resources (FAO, 2018). Due to the smallness of stock sizes in Kosrae, it has been suggested that future

resource allocation should be directed toward refining the management of current fisheries in place of developing new ones (e.g. sea cucumber harvest, mangrove crab export) (Integrated Aquatic Solutions Inc., 2018). Others are linked to nearshore development (e.g. pollution and sedimentation), but the state has a fairly robust nearshore management system which features environmental reviews for development projects (FAO, 2018).

Pohnpei is perceived as an intermediate in terms of management and stock status of nearshore resources (FAO, 2018). Enforcement of marine policy by government agencies is largely ineffective due to a lack of resources and capacity and the absence of strong CMT could impede CBM solutions (FAO, 2018). While nearshore resources may not yet be in critical condition, they may be soon if effective management is not put in place (FAO, 2018). Participation in nearshore fisheries increases with wealth in Pohnpei which could be indicative that there is a greater aspect of recreation tied to

nearshore fishing activity there (Sharp, 2017). Terrestrial development is a pronounced problem on Pohnpei, with deforestation driving increased sedimentation and coral reef degradation (FAO, 2018).

Yap has the strongest preservation of traditional management and CMT (FAO, 2018), albeit its influence has waned in recent years (Integrated Aquatic Solutions Inc., 2018). The state government features a “customary” fourth branch that is headed by the Council of Chiefs who have veto authority over any regulations that interact with community customs or traditions (Tafileichig & Inoue, 2001). Yap has larger nearshore fisheries stocks and a smaller population relative to other states, so its resources are believed to be less depleted as a state overall (FAO, 2018). However, CBM does not guarantee successful outcomes and populations of some species like sea cucumbers and clams and other species near the main island of Yap have been overexploited (FAO, 2018).

Table 12. Summary of nearshore marine management in FSM by state. Information synthesized from the [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) unless otherwise noted.

State	Chuuk	Kosrae	Pohnpei	Yap
Management authority	Chuuk State Department of Marine Resources	Department of Resources and Economic Affairs (DREA); Division of Fisheries and Marine Resource; Kosrae Island Resource Management Authority (KIRMA)	Pohnpei State Department of Resources and Development	Yap State Marine Resources Management Division (State Fishery Zone) and Chiefs manage internal waters

Table 12 continued.

State	Chuuk	Kosrae	Pohnpei	Yap
Enforcement authority	Chuuk State Department of Marine Resources + Public Safety	KIRMA; Kosrae Conservation Enforcement Taskforce (includes 23 deputies from the state police, KIRMA, DREA, and local police) (J. Cuetos-Bueno, personal communication, 2021)	Division of Wildlife and Enforcement	Yap Fishing Authority and Division of Public Safety
Gear restrictions	No dynamite fishing, prohibits the sale of gillnets with < 3 inch mesh size	No poison, explosive, electric charge device used for fishing; ban on drift nets; no scuba fishing	No fishing with explosives, poisons, or chemicals	No fishing with explosives, poisons or chemicals
Seasonal closures	Grouper, trochus, turtles, black-lipped pearl, turtles (J. Cuetos-Bueno, personal communication, 2021)	Turtles	No taking of mangrove crabs with eggs, groupers, turtles	Coconut crab, turtles (J. Cuetos-Bueno, personal communication, 2021)
Species bans/ protection	Ban on taking of sharks and marine mammals, bumphead parrotfish (State Governments, personal communication, July 12, 2021)	Trochus, berried lobsters, bumphead parrotfish, lack lip mother of pearl oyster	Black coral, Bumphead Parrotfish, no exporting of mangrove crabs, coconut crabs, or lobster	Trochus; turtles and turtle eggs; manta rays; CITES listed species, bumphead parrotfish (State Governments, personal communication, July 12, 2021)

Table 12 continued.

State	Chuuk	Kosrae	Pohnpei	Yap
Minimum sizes	Trochus, turtles, black-lipped pearl	Turtles, trochus (Steven Palik, personal communication, 2021), lobsters, black lip mother of pearl oyster, mangrove crab, sea cucumber	Bluespine unicornfish, blunt-head parrotfish, humpback red snapper, longnose parrotfish, all groupers, all trevally and jacks, all sweetlips, all rudderfish (Houk et al., 2015), Black-lip mother of pearl oyster shell, turtles	
MPA area (Ha)	31,452.34	633 (7 MPAs, not all gazetted)	59,297.33	NA (11 MPAs-estimated areas not available)
Management priorities	<ul style="list-style-type: none"> • Create a comprehensive management plan and strategy that provides improved structuring for additional management and enforcement potential • More minimum size regulations and additional bans on fishing spawning aggregations 	<ul style="list-style-type: none"> • Review and update all existing fisheries regulations and associated management plans • Review and further develop long term monitoring programs and data collection • Improve enforcement • Improve empowerment of community-based initiatives 	<ul style="list-style-type: none"> • Update marine resource legislation into a comprehensive fishery management plan • Increase sharing power between the state and municipal government • Improve data collection • Stricter regulations and enforcement concerning nighttime spearfishing, use of small gill nets, targeting undersize species and spawning aggregations 	<ul style="list-style-type: none"> • Develop comprehensive management and enforcement plan, strategic action plan, and SOP for enforcement • Develop fisheries management plan (sea cucumber already developed) • Collect data on critical habitats and species targeted by fishery • Further support for traditionally owned areas

2.5.3 NGO involvement

Non-governmental organizations (NGOs) also play a critical role in the management and monitoring of nearshore fisheries in FSM. Below, we briefly describe the NGOs most active at the national level in FSM and their relevant projects. More information about NGOs involved in nearshore fisheries management can be found in NORMA's [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#).

Micronesian Conservation Trust (MCT) is a regional private corporation that provides funding and grants to support biodiversity conservation, climate resilience, and sustainable development throughout Micronesia and other Pacific Island nations. Many of the projects that MCT funds work towards the objectives laid out by the Micronesia Challenge (see the "national" management section for more information about this Challenge). In FSM, MCT works with a number of NGOs, government agencies, and funders to support and execute projects. Projects (past and current) funded by MCT that may be of interest for fisheries management include:

- Enhance coral reef management and monitoring capacity: MCT funds six marine monitoring teams that collect standardized monitoring data for coral reef ecosystems (including fish) across the region. Data can be found in the online, long-term Micronesia Challenge marine database hosted by the University of Guam Marine Lab.
- Build and support climate adaptive fishing communities: This project collected data on the social adaptive capacity of fishing communities in Micronesia. Ultimately, this project provides a framework for sustainable fisheries management and climate adaptation planning.
- Reduce community vulnerability to climate change: This project aims to build social, ecologic, and economic resilience within FSM's communities through supporting marine protected area management and nearshore fishery recovery, improving climate adaptive capacity within

communities, and developing a knowledge management system to improve and expand effective, community-led marine management.

- Adopt ecosystem-based adaptation measures: This project aims to get fisheries-dependent communities to implement ecosystem based adaptation measures in hopes of restoring and sustaining small-scale fisheries, critical ecosystems and associated ecosystem services.
- Harmonize state and federal shark regulations: MCT sought to harmonize FSM's state laws pertaining to sharks with those set at the national level. As a result of this project, FSM's state laws have been amended and a proposed amendment has been made to the national law.

For information specific to the projects funded by MCT, please see their [annual report](#).

The Nature Conservancy (TNC) is an international NGO that has a regional focus on the Pacific, specifically Palau, FSM, Guam, Northern Mariana Islands, RMI, Papua New Guinea, and Solomon Islands. In the Pacific, TNC has partnered with local communities, other NGOs, governments and donors to advance the Micronesia Challenge to develop community management plans, establish protected areas, improve fisheries, leverage funding opportunities, build capacity, introduce innovative conservation finances, and confront climate change. Since the Micronesia Challenge has been extended to 2030, TNC is currently working on a 10-year plan to help achieve the Challenge's community-based conservation goals. For FSM specifically, TNC has conducted spatial analyses to advance the protected area and fisheries management area networks in [Pohnpei](#), [Yap](#), [Chuuk](#), and [Kosrae](#). They have also conducted a stock assessment of corals in Chuuk, and worked with the communities of Oneisomw (Chuuk) to sustainably manage their reef fisheries and establish a MPA to rebuild fish stocks, preserve coral ecosystems, and enhance enforcement. More recently, TNC has led coastal fisheries monitoring efforts across all four FSM states, and coordinated

regional efforts to consolidate a regional Micronesia Challenge Fisheries Monitoring Network inclusive of standardized protocols, local monitoring teams, regional fisheries database and information sharing platforms, and sustainable funding mechanisms.

RARE Inc. is an international NGO that seeks to protect resources through behavioral change. In FSM, RARE works with MCT and fisheries-dependent communities to implement ecosystem-based adaptation strategies to buffer against climate change. Additionally, RARE is working in Pohnpei to help catalyze the collection of important ecological, fisheries, and socioeconomic data to inform community-based fisheries management as part of their Fish Forever program. Relevant survey data, including the extent of important marine habitats within established and proposed marine reserves and management areas can be found at their [online data portal](#).

2.6 Economic indicators

Up-to-date catch and price data with complete geographic coverage of nearshore fisheries in FSM are not publicly available, making it difficult to precisely estimate the value of nearshore fisheries catch. Therefore, available estimates of economic indicators for nearshore fisheries are instead taken directly or derived from the 2013/2014 [HIES](#). Rough approximations of the 2014 total value of nearshore fisheries inclusive of subsistence and commercial activities vary from US\$7.5 million (Integrated Aquatic Solutions Inc., 2018) to US\$13.8 million (Gillett, 2016).

The contribution of nearshore fisheries to household income in FSM provides additional insight into the economic importance of this sector. Household income from nearshore fisheries takes three forms: (1) subsistence income - the value of fish that is caught and later consumed by that household, (2) revenue generated by the sale of fisheries products, including exports, and (3) direct salaries and wages. The growth of a charter/sport fishing sector in nearshore waters could provide an additional income stream in some households. The subsistence consumption of home-caught fish

constitutes 70% of total household expenditures on fish (Sharp, 2017) and 28% of the total value of subsistence income in FSM. The latter figure varies considerably by state with Chuuk having the highest fisheries component of subsistence income (40%) and Pohnpei the lowest (14%) (Sharp, 2017). In general, fisheries products are a major part of total household food expenditure with reef fish (11%) and tuna (5%) being the two most common groups (Sharp, 2017).

The sale of nearshore fisheries products comprised 1.4% of total household cash income throughout FSM with reef fish making up 56% of this value (Sharp, 2017). There is considerable uncertainty in the total amount of private exports by citizens of nearshorefisheryproducts, but the total recorded by the National Statistics Division of FSM R&D equaled approximately 104 mt in 2016 (Table 13) (Integrated Aquatic Solutions Inc., 2018). Past estimates of the exports of nearshore fisheries products ranged from 165-261 mt annually, which corroborate this point estimate (Gillett, 2016). However, the true magnitude of this estimate is unknown as many exports go unreported as "personal cargo" when being flown out of the country (Integrated Aquatic Solutions Inc., 2018). Some of the target export species, such as sea cucumber that is exported to China, are among those most vulnerable currently (Integrated Aquatic Solutions Inc., 2018).

The [HIES](#) survey estimated the total amount of direct salaries and wages to be US\$1.9 million in 2014, paid out to 273 business owners and employees in fisheries-related businesses. A few hotels offer charter fishing activities to their guests and there is a fishing club in Pohnpei (~50 members), many of whom are expatriates (FAO, 2018).

Table 13. Recorded private exports (kg) by state and species group in 2016. Data source: Integrated Aquatic Solutions Inc., 2018. Note: 1 mt = 1000 kg.

	Chuuk	Kosrae	Pohnpei	Yap
Reef fish		3,289	2,378	8,070
Clams		7,345	673	
Sea Cucumber				
Crabs and lobsters	684.55	474	925	510
Tuna (licensed local)			40	16,071
Fish (unspecified)	61,995			
Others (marine)		1,222	368	

2.7 State-level aquaculture

In 2004, FSM adopted a strategic goal to “increase aquaculture activities to supplement and enhance marine stocks for subsistence and marketing.” In efforts to achieve this, FSM has developed an Aquaculture Management and Development Plan to inform and guide private sector development. FSM increasingly views aquaculture as a way to develop the national economy in the face of the conclusion of the Amended Compact of Free Association with the US in 2023 (FSM National Government Department of Resources and Development & Pacific Community, 2019).

Aquaculture in FSM is presently focused in Kosrae, Pohnpei, and Chuuk, although various research trials and pilot projects have been conducted in Yap (FSM National Government Department of Resources and Development & Pacific Community, 2019; Integrated Aquatic Solutions Inc., 2018) (Table 14). Most projects have been government or donor driven and have been focused on restocking depleted wild populations and improving local food security and livelihoods (Integrated Aquatic Solutions Inc., 2018). As of 2019, the Micronesia Market and Management Enterprises aquaculture

operation on Kosrae was reported to be the only true commercial aquaculture operation in the country (FSM National Government Department of Resources and Development & Pacific Community, 2019; Integrated Aquatic Solutions Inc., 2018), but recent interviews indicate that the Marine and Environmental Institute of Pohnpei may also have a commercial operation exporting live corals to PetCo in the United States (*Marine and Environmental Institute of Pohnpei*, personal communication, September 30, 2020).

While aquaculture has been widely promoted in FSM both as a commercial enterprise and as a way to help replenish declining fish resources, it has had little success in FSM to date (Integrated Aquatic Solutions Inc., 2018). This has been attributed to limited domestic markets, low capacity to adapt to market trends and fluctuations, high transportation costs, high risk of climate change and other natural disasters, and a lack of infrastructure, capital and skilled labor (Integrated Aquatic Solutions Inc., 2018). According to the [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#), aquaculture in FSM is unlikely to

become economically viable using the current homegrown approach, but there may be potentially beneficial opportunities if foreign investment is allowed (Integrated Aquatic Solutions Inc., 2018).

Below, we provide a high-level summary of aquaculture activities at a state level, both past and present.

Table 14. Summary of aquaculture in FSM by state. Information in this table is synthesized from the [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) and [Federated States of Micronesia Aquaculture Management and Development Plan](#).

	Chuuk	Kosrae	Pohnpei	Yap
Current operations	Giant clams	Giant clams and corals	Sponges, corals, marine ornamental fish, sea cucumber, mangrove crab, giant clam, and pearl oyster	None
Past operations	Sponges	Mangrove crab, trochus and green snail (<i>Turbo marmoratus</i>)	Seaweed, milkfish	Sea cucumber, giant clam, sponges
Priority species	Sponge, corals, trochus, pearls, sea cucumbers	Corals, giant clams, trochus, sea cucumbers, marine food fish	Sponges, pearls, marine food fish, sea cucumbers, giant clams, seaweed	Giant clams, trochus, sponges, marine food fish, sea cucumbers, corals
Top challenges	Governance and policy - lack of laws and regulations that promote aquaculture development	Economic viability - limited access to funding	Governance and policy - poor planning and management, inadequate legislation and regulations, and lack of awareness and support for aquaculture development	Capacity and technical skills - limited access to facilities and hatcheries, and limited access to technical assistance and skills

Table 14 continued.

	Chuuk	Kosrae	Pohnpei	Yap
Relevant management authorities	<ul style="list-style-type: none"> • Chuuk State Department of Resources and Development • Chuuk State Environmental Protection Agency • Chuuk State Foreign Investment Board • Chuuk State Small Business Development Center 	<ul style="list-style-type: none"> • Kosrae Department of Administration and Finance • Kosrae Department of Resources and Economic Affairs • Kosrae Island Resource Management Authority • Kosrae Small Business Development Center 	<ul style="list-style-type: none"> • Pohnpei Small Business Development Center • Pohnpei State Environmental Protection Agency • Pohnpei State Foreign Investment Board • Pohnpei State Office of Fisheries and Aquaculture 	<ul style="list-style-type: none"> • Council of Chiefs • Office of the Governor • Yap Community Action Program • Yap Department of Resources and Development • Yap Environmental Protection Agency

Chuuk: A lack of domestic capacity and infrastructure challenge the viability of long-term aquaculture operations in Chuuk (Integrated Aquatic Solutions Inc., 2018). At present, a pilot sponge farm has been established in Chuuk; however, the current status of this farm is not known (FSM National Government Department of Resources and Development & Pacific Community, 2019). Additionally, there is an ongoing operation raising juvenile giant clams in conjunction with the Cooperative Research Extension program of the College of Micronesia (State Governments, personal communication, July 12, 2021). Sponge, corals, trochus, pearls, and sea cucumbers have been identified as priority commodities that are ripe for development in Chuuk (high feasibility and high impact) (FSM National Government Department of Resources and Development & Pacific Community, 2019). Development plans for these commodities can be found in FSM's Aquaculture Management and Development Plan (FSM National Government Department of Resources and Development & Pacific Community, 2019).

Kosrae: Over the last 30 years, Kosrae has undertaken a number of aquaculture development

projects (Integrated Aquatic Solutions Inc., 2018). The National Aquaculture Centre (NAC), which was originally intended to restock giant clams on reefs throughout FSM and explore the potential for small-scale farming for food and income generation, has been based in Kosrae since the 1980s (Integrated Aquatic Solutions Inc., 2018). In 2005, NAC was leased to a private sector company, Micronesia Management and Marketing Enterprises, which grows giant clams and corals for the international marine aquarium trade (Integrated Aquatic Solutions Inc., 2018). This is currently FSM's only true commercial aquaculture operation (FSM National Government Department of Resources and Development & Pacific Community, 2019). Other aquaculture development projects have been attempted, such as the mangrove crab from 2002-2010 but have been unsuccessful (FSM National Government Department of Resources and Development & Pacific Community, 2019; Integrated Aquatic Solutions Inc., 2018). Recently, corals, giant clams, trochus, sea cucumbers, and marine food fish have been identified as priority commodities that are ripe for development in Kosrae (high feasibility and high impact) (FSM National Government Department of Resources and Development & Pacific Community, 2019).

and Development & Pacific Community, 2019). Development plans for these commodities can be found in FSM's Aquaculture Management and Development Plan (FSM National Government Department of Resources and Development & Pacific Community, 2019).

Pohnpei: The Marine Environment Research Institute of Pohnpei (MERIP) runs an aquaculture operation (~65 part-time employees) in Pohnpei that produces sponges for export and marine ornamental fish for the aquarium trade (Integrated Aquatic Solutions Inc., 2018). MERIP also supports community-based coral farming (FSM National Government Department of Resources and Development & Pacific Community, 2019). A recent interview indicated that MERIP may be exporting live corals to PetCo in the United States (*Marine and Environmental Institute of Pohnpei*, personal communication, September 30, 2020). Nukuoro Black Pearls is revitalizing their pearl farms around Pohnpei (FSM National Government Department of Resources and Development & Pacific Community, 2019). The College of Micronesia Land Grant has programs that support sea cucumber, mangrove crab, and giant clam breeding and grow-out operations, as well as pearl oyster farming (FSM National Government Department of Resources and Development & Pacific Community, 2019; Integrated Aquatic Solutions Inc., 2018). Previous aquaculture development programs centered on milkfish and seaweed but were not successful (FSM National Government Department of Resources and Development & Pacific Community, 2019). Recently, sponges, pearls, marine food fish, sea cucumbers, giant clams, and seaweed have been identified as priority commodities that are ripe for development in Pohnpei (high feasibility and high impact) (FSM National Government Department of Resources and Development & Pacific Community, 2019). Development plans for these commodities can be found in FSM's Aquaculture Management and Development Plan (FSM National Government Department of Resources and Development & Pacific Community, 2019). Interviews have also indicated that coral grouper aquaculture is occurring in Pohnpei for local consumption.

Yap: No private sector aquaculture has taken place

in Yap (Integrated Aquatic Solutions Inc., 2018). Recent aquaculture projects in Yap include a US government demonstration farm for sponges in Ulithi, a College Micronesia Land Grant sea cucumber hatchery, and a giant clam hatchery but the fate of these projects remains uncertain (Integrated Aquatic Solutions Inc., 2018). There is interest in establishing a shrimp farm in Nimpal (Integrated Aquatic Solutions Inc., 2018). Giant clams, trochus, sponges, marine food fish, sea cucumbers, and corals have been identified as priority commodities that are ripe for development in Yap (high feasibility and high impact) (FSM National Government Department of Resources and Development & Pacific Community, 2019). Development plans for these commodities can be found in FSM's Aquaculture Management and Development Plan (FSM National Government Department of Resources and Development & Pacific Community, 2019).

3. FISHERIES STAKEHOLDERS IN FSM



3. Fisheries stakeholders in FSM

The [Final Report of the Federated States of Micronesia Coastal Fisheries Assessment](#) has a very extensive list (Appendix I, pp. 202) of fisheries stakeholders at both a national and state level including: national and state government agencies, regional and global NGOs, and research institutions. This appendix contains contact information for the stakeholders consulted during the preparation of the linked report.

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