Spawning Aggregation Survey in the Federated States of Micronesia

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1.1 Overview

The Federated States of Micronesia is comprised of the four states of Yap, Chuuk, Pohnpei and Kosrae distributed across 2700 km of open ocean. Each state is unique in terms of geology, culture, government, and marine resource utilization and conservation. All, however, share growing pressures on tropical reef fisheries and a need for more effective management, including that of spawning aggregations. Within the region, pressures on coastal fisheries are varied and include habitat loss, pollution, destructive fishing and the effects of El Niño. Perhaps the greatest threat, however, comes from the commercial sale and export of reef fishes whose population status is unknown and whose fisheries remain largely unmanaged, unregulated or unenforced. To exacerbate these threats, Micronesia is experiencing rapid population growth, expanding unemployment and a decrease in international aid that will likely increase the number of fishers on the reef, the amount of export and reduce the level of monitoring and enforcement by fisheries resource managers.

Within Micronesia, state marine resource managers have all expressed concern over the current status and future fate of fisheries resources and all appear willing to act to improve fisheries management. However, improvements to fisheries management are likely rely on incomplete data, since the state agencies responsible for marine resource conservation or management do not compile detailed reliable statistics on reef fisheries at any level, including market, export or fisher statistics. When statistics are taken, weights and abundance are combined and often include pelagics. No state keeps species-specific or family-specific catch or export records and none was fully aware of spawning or catch seasons and locations or fishing effort on most of the target species mentioned during fisher interviews. Improvements to the current situation are possible, but unlikely without improvements to technical skills and equipment and a substantial injection of directed financial resources to management agencies. Finally, complete management of spawning aggregations within the states is probably unrealistic given the wide geographic range over which islands and atolls are distributed within Micronesia.

Currently In Micronesia, there is little awareness of the vulnerability of aggregations to overfishing among fishers, fisheries managers or legislators, even though fishing on aggregations appears substantial. Without first knowing why spawning aggregations are important, no steps can be taken to protect them. Where rules do exist to conserve spawning fishes, ineffective enforcement and poaching remain because fishing communities have not been informed about management decisions and rationale.

Among the states, target species for aggregation within each state is fairly distinct. For example, whereas Kosrae targets smaller, herbivorous species within the inner lagoon, Chuuk and Pohnpei use combined methods, such as hook and line and nets, and focus largely on fishes along the outer reef. The primary families targeted among all states are siganids, acanthurids, serranids, lethrinids, mugilids and scarids. Although the effects of fishing on spawning aggregations of individual species requires further examination, fishers already report smaller catches, reduced sizes for target species and alterations in behavior among species during spawning periods, suggesting immediate management is

likely necessary. However, almost universally, fishers do not believe any level of fishing will result in aggregation extirpation, nor do they have an awareness that aggregations form from local populations. For example, many fishers believe spawning groups move sequentially from island to island or around an island to spawn at different locales at different times. Instead of being 'fished out' aggregations merely "move to another area".

Managers, conservation organizations and a substantial number of fishers approached during the surveys were highly receptive to ideas for improved marine resources management. For each of the states, the first step toward management and conservation of spawning aggregations is to provide a basic awareness of their function and their vulnerability to overfishing. This step can be administered through education and awareness campaigns at all levels (e.g. state, municipal) through public radio addresses, posters, or local television. These materials would be most effective if both English and local language options were available. Second, local marine resource agencies, NGOs, educators and decision-makers should be targeted through educational and awareness seminars to present and discuss general management, conservation, monitoring and enforcement options. Third, workshops should be held with these same groups to assist these groups in tailoring these options into effective management and conservation protocols. Local NGOs, academic institutions, dive shops and resource managers at all levels should be targeted to assist in the development, planning and implementation of activities to cater to local needs increase local participation. Fourth, SCRFA should consider appointing a regional coordinator or extension agent to continue work with local agencies on designing and improving spawning aggregation management and conservation protocols. Finally, a number of fishers interviewed were willing to mark dates on their calendars for when eggs were observed in catches. In Kosrae, the consultant designed a simple one-sheet spreadsheet listing the fish identified in interviews (in Latin and in local dialect) with a box beside each fish for each month of the year. Fishers simply tick the box when eggs are noted to give a basic idea of spawning season for each fish. A second sheet should be developed to identify sites. These types of simple tools to assist in defining spawning seasons and locations for fishes could be an effective mechanism to extract data for use in conservation development.

Section highlights

- Aggregation fishing is common throughout Micronesia.
- Target species or groups are fairly specific within states.
- Fisheries statistics for reef fishes are either unavailable or largely unreliable.
- Awareness of the vulnerability of spawning aggregations to overfishing is slight.
- Only Pohnpei has specific regulations to reduce spawning aggregation fishing pressure.
- In Micronesia, management of spawning aggregations should begin with awareness and education for fisheries managers, fishing communities and legislators.
- Workshops on management options should be provided to develop effective local protocols for aggregation protection and conservation.
- SCRFA should appoint a regional coordinator to assist in development and improvement of management and conservation protocols.

- SCRFA should develop a set of simple tools to enlist fishers in identifying spawning times and locations.
- Management, conservation and monitoring should enlist all available entities, including resource managers, conservationists, dive shops, academic institutions and local fishing communities.
- Complete protection of spawning aggregations is likely impossible owing to the wide geographic distribution of lands within with individual states.

Yap State, Federated States of Micronesia
Summary Report

Section 2

Kevin L. Rhodes
9-21 February 2003

2.1 Background

Yap Proper (N 9.3^{o}/E 138.1^{o}) consists of four major islands (Tomil-Gagil, Runmung and Maap) and numerous outer atolls that include Fais, Gaferut, Olimarao, West Fayo, Earuripak, Italik, Elato, Sorol, Satawal, Ulithi, Woleai, Nguluw and Lamotrek. The total land area for all islands and atolls is only 120 km^2. In total, Yap State is composed of approximately 134 islands, scattered among a few atolls that reach across 1200 km of the western Pacific Ocean. The number of islands, distance from Yap proper and variable mix of traditional and governmental laws governing marine resources in Yap State provides a considerable challenge for marine management, enforcement and monitoring.

In terms of marine resource management, power is ultimately entrusted to the state government. The state government is composed of the executive, legislative, judicial and customary branches, with each democratically elected entrusted with various duties (http://www.fsmlaw.org). In contrast to the other FSM states, the fourth branch of government—the customary branch—is supreme in matters of development, custom and behavior (Tafileichig and Inoue 2001) in order to uphold traditional rights, customs and beliefs, including those related to marine resources.

In Yap, oversight of marine resource management belongs to the Department of Resource and Development that is further subdivided into the Yap Fishing Authority (YFA) and Division of Marine Resources and Development (DMRD). Each of these organizations function under the Yap State Constitution, with the Yap Fishing Authority currently responsible for marine resource development, conservation and enforcement. Recently, at least two separate bills have been introduced to the Yap State Legislature to provide additional power to MRMD for marine resource conservation and management. Relevant sections of the Title and the bills submitted to the legislature in relation to amendments to Title XVIII (Conservation and Resources) are provided in Appendix A.

2.2 Fishing in Yap

Local subsistence fishing in Yap is primarily conducted within the lagoon and inner reef using a combination of stone fish trap, spear, gillnet, throw net, and hook and line bottom fishing methods. Fishing is conducted seasonally on a variety of fish, including members of the Mugilidae, Mullidae, Siganidae, Lutjanidae, Labridae, Serranidae, Belonidae and Acanthuridae. During these periods, fishers appear to concentrate effort on fish during migrations, but not fish directly on spawning sites. Primarily the Yap Fishing Authority (see below) conducts fishing on the outer reef, where most larger species of transient spawners aggregate. There is inconclusive evidence, based on interviews, on whether fishing on spawning aggregations of outer reef spawners by YFA occurs. Some indications of aggregation fishing were provided by Leo Rulman (*see below: Interviews*) who noted higher catch of grouper in some outer islands between May and July.

Currently, there are few individual small-scale markets for the local sale of reef fishes, since most fishing is done for subsistence and limited to daily needs. The sale of fish

exploited from outer reefs and concentrated on outer atolls is by the Yap Fishing Authority. Export of reef fish to Guam and Hawaii appears to be small-scale and limited for personal consumption for relatives, although more focus needs to be applied to YFA's role in exports.

Some indication of subsistence fishing on reproductively active fishes was given during the survey interviews for rabbitfish [dusky (*Siganus fuscecens*) and lined rabbitfish (*Siganus lineatus*)], keeled (*Platybelone platyura*) and reef needlefish (*Strongylura incisa*)[1], honeycomb grouper (*Epinephelus merra*) and squaretail mullet (*Ellochelon vaigensis*). Fishing appears to follow the movement of fishes from outer reef regions to mangrove and seagrass areas (e.g. needlefish, humpback snapper). Fish are also taken when numbers of fish normally found outside are found concentrating inside (e.g. unicornfish, such as humpnose, bluespine and bignose unicornfish and bumphead parrotfish). Altered behavior (e.g. stupor) and eggs in honeycomb grouper and eggs in needlefish also suggest fish are reproductively active during certain fishing periods. Spot checks on camouflage grouper, brown-marbled grouper and river snapper, *Lutjanus argentimaculatus*, from market samples purchased or examined at the YFA market facility showed resting or immature stages of gonad development. These fish had arrived from Sorol Atoll, near the Chuuk-Yap border.

Customary marine tenure and traditional authority has controlled fishing in Yap in the past. However, much of that authority seems to have been lost or is no longer recognized, particularly in Yap proper. This type of authority is still practiced to varying degrees on outer atolls, but is slowly losing effectiveness as older fishers die and younger Yapese become exposed to Western customs and education. Most fishers fish for daily needs versus concentrating on a particular species or season (such as fishing during spawning aggregations). There also appears to be a severe decline in village-wide fishing events, with most fishing conducted individually or in parties of 2-3 fishers in motorized boats. Many of the traditional fishing methods, such as the use of stone fish traps or circle nets made of coconut and palm fronds, are no longer used. Instead, reliance on gillnets or cast nets made of monofilament line, modern spears and circle hooks is common, as is the use of motorized boats. This is in contrast to the use of mahogany or breadfruit wood dugout sailing canoes fitted with pandanus sails, coconut fiber nets and line, wooden pole spears and turtleshell U-hooks of the past. Flashlights for bottom fishing and spearing at night have replaced torches. Moreover, the availability of electricity on Ulithi and Woleai has allowed catch to be refrigerated and many fishers now "stuff" freezers with fish instead of fishing for daily needs. Sharing of catch among villagers and local chiefs, once a common practice, is declining. Lower caste Yapese, who were once provided for through a trickle down of fish through sharing by village fishers are now often left without fish, since they are often without boats, motors and modern fishing gear and are reliant on catch along the shore that is oftentimes already depleted. Fishing across boundaries, based on marine tenure and individual ownership, is increasing and punishment that was once meted out by village leaders is ineffective. In the past, pulling a line across

[1] In Chuuk, needlefish are captured in similar periods, but were not found to have eggs. Instead, these fish may be following schools of smaller fish that enter the lagoon and remain in the seagrass/mangrove area during these periods. Further examination of the phenomena needs to be conducted.

another's fishing grounds was permitted, but stopping to fish on another's reef or taking fish from another's net or fish trap was prohibited. This latter practice appears to be somewhat common now. Seasonal fishing effort may be timed with astronomical events (e.g. needlefish), lunar or related tidal events, such as maximum tidal flux, associated with full or new moon periods (e.g. goatfishes), or changes in weather patterns, such as calm sea periods consistent with summertime (e.g. grouper).

In contrast to the general loss in traditional knowledge and custom in Yap, the outer atolls still retain varying degrees of customary marine tenure (CMT) and traditional rights and responsibilities (TRR). Some of these customs and divisions of marine resources are well outlined in Tafileichig and Inoue (2001). For example, in Woleai, fishing for tuna is still accomplished by sailing canoes by pole. Also in Woleai, like some places in Chuuk, when an elder dies, particularly the chief, a one year moratorium on fishing is issued and no one is allowed to fish anywhere on the reef or the closed are during that period. Failure to conform results in various types of punishment, from community service to expulsion from the island. Additional explanations of fishing techniques on Woleai may be found in Smith and Dalzell (1993). Nonetheless, traditional knowledge of spawning seasons and fishing methods appears to be in decline.

Throughout the interviews, all fishers stated a decrease in catch volume over the years and there was some indication that certain fishes no longer appear in mangrove areas or are uncommon. Among those mentioned was the blacktip grouper, *Epinephelus fasciatus*, around Asor and Falalap, Ulithi and less abundance of needlefish during the fishing season (Feb-Apr). One exception is the report of the redmouth grouper, *Aethaloperca rogaa*, in Ulithi Atoll, which has apparently shown up in recent years[2]. Although fishers could not pinpoint exactly why fish were less abundant, most felt the change in fish catch was owing to access to modern vessels, the loss in traditional knowledge and the use of modern fishing gear. The change in fishing vessels now allows fishers to move against prevailing winds and currents to move long distances, whereas past fishing relied on the use of sailing canoes to transport them to locales generally nearby villages. Oil spills and pollution were also mentioned as contributing to changes in catch. Population increases or El Niño events (ENSO) were not mentioned as factors, nor was it ever mentioned that fishing on spawning aggregations might be a contributing cause. The use of *Derris* root may still be practiced as in the past, but the use of modern chemicals, such as Clorox® or cyanide, or explosives do not seem to occur.

Only two fishes were indicated to be of particular value to local chiefs: humphead wrasse (*Cheilinus undulatus*) and yellowlip emperor (*Lethrinus xanthochilus*). Humphead wrasse was only provided to the chief when the scales posterior to the pectoral fins measured greater than 4 fingers across (~6 cm) (J. Fanafal, Yap DRMR, *personal communication*).

Section highlights

- Fishing in Yap is concentrated inside the lagoon using a combination of traps, nets and spears.

[2] A separate interview indicated this was not so (Mario Sukulbeck, *personal communication*, Ulithi Atoll)

- Fishing during reproductive periods is focused on spawning migration away from spawning sites.
- Fishing, sales and export of fish from outer atolls by YFA demands further investigation.
- Fishing generally targets Mugilidae, Mullidae, Siganidae, Lutjanidae, Labridae, Serranidae, Belonidae and Acanthuridae.
- Customary marine tenure is eroding and fishing using traditional methods is diminishing.
- There is little awareness of the vulnerability of spawning aggregations to overfishing.
- Indications of overfishing, as reduced catch and size at catch were given.
- Humphead wrasse and yellowlip emperors are highly valued fish for traditional purposes.

General impressions: There seems to be a recurring theme that fishers don't follow season or lunar cycle except that they don't fish during full moon or when the moon is lighting the reef. There have been no indications from the fishers, which seems genuine, that they have observed or are aware of spawning aggregations. One possibility is that because they don't fish at full moon, they may not encounter spawning aggregations (if spawning occurs during that period). The general perception that spawning times are not known may also be related to their preference for smaller fishes, such as rabbitfish. No information was given on spawning aggregations inside the lagoon.

Section highlights

- Few fishers appear to know the timing, frequency or duration of spawning for target species in Yap.
- Fishing is conducted at night when light levels are low (e.g. new moon or no moon).
- Spawning times were suggested to coincide with breadfruit season (as in Pohnpei).
- Subsistence fishing concentrates on siganids, mullids, mugilids and belonids.
- Fishing by YFA concentrates of larger, outer reef species (serranids, lutjanids)
- Spawning season for grouper may be May through July.

2.3 Interviews (Deleted for confidentiality)

2.4 Recommendations

Of the four states, Yap may be the least affected in terms of aggregation fishing. However, to confirm that aggregation fishing pressure is indeed low, additional efforts need to be made to identify aggregation sites and seasons, prior to estimating fishing effort and effects. There seems to be some indication that fishers are not entirely aware of spawning seasons, frequency or duration since rabbitfish, which typically spawn monthly, were assigned to a certain season by several fishers. Perhaps this is in relation to movement of fishes among areas between seasons or distribution of fishing effort. Further study of spawning times and locations for these fishes may be necessary. Additionally, sufficient time should be dedicated to identify the activities of the Yap Fishing Authority, including exports, since these fishers concentrate on outer atolls and on larger transient spawners, such as serranids and lutjanids. If spawning aggregation fishing is occurring on these groups, it is likely YFA that is having the greatest impact. Finally, fishing activity or spawning seasons for outer atolls should be investigated more fully to understand the dynamics of and impacts to spawning aggregations in Yap. Stock analyses, including those of spawning aggregations, will require a substantial time and monetary contribution from international conservation and funding bodies, since none of the local government or conservation agencies currently have any baseline data on their stocks.

The identification of spawning aggregations in Yap should be given low priority since fishing is largely subsistence, there are few markets, and commercial fishing is largely restricted by traditional leaders. However, efforts to educate government, local marine resource and conservation agencies and the public on the problems associated with aggregation fishing should be initiated. In addition, Yap (DMRD) is currently working with the South Pacific Regional Environmental Programme and International Water Programme group (Samson Samasoni: samsons@sprep.org.ws) to develop five marine protected areas (MPA) in Yap in the coming year. Attention to identifying spawning aggregation sites within or in proximity to the proposed sanctuaries is warranted so that they may be incorporated into MPA boundaries. SCRFA can play a key role in this regard. Special attention should be given to providing awareness and education to fishers and traditional leaders in the outer atolls since these areas would be most affected by the loss of spawning aggregations and since they are also potential targets for the live reef fish trade.

Section highlights

- Further identification of spawning seasons and target species is required to formulate a management plan in Yap for spawning aggregations.
- The Yap Fishing Authority is likely exerting substantial pressure on spawning aggregations of larger carnivorous reef fishes and requires further investigation.
- Among the states, Yap is given lowest priority for spawning aggregation management action.
- Initial steps should be taken to educate local fishing entities on the vulnerability of spawning aggregations to overfishing.

- Assistance in identification of spawning aggregation sites and species near or within proposed MPAs is imperative and needed immediately.

2.5 Fishing seasons for 'commercially' important fishes (from interviews)

Wahoo: January-March
Dogtooth tuna: January-March
Yellowfin tuna: January-March
Mahi-mahi: January-March
Serranids: May-July
Lutjanids: January-March
Belonids: February-April
Siganids: March/April-May/June

2.6 Spawning aggregation locations and seasons (Deleted for confidentiality)

2.7 Fishes shown to have or reported to have eggs (Deleted for confidentiality)

2.8 Sites suggested for summertime grouper fishing (Ulithi Atoll) (Deleted for confidentiality)

2.9 Appendix A: Legislation

Title 18 (XVIII) of the Yap State Code deals with Conservation and Resources. Under the title, the Yap State Fishing Authority (YFA) was formed as a quasi-governmental agencies assigned to develop and conserve marine resources in Yap State waters within the 12 mile economic exclusion zone. The authority is also a public entity, enabled to exploit, sale and export fishes from catch. YFA was originally funded by loan from the Yap State government with repayment to be made as part of the requirements. YFA functions are: (1) to guide the establishment of marine resource development policy, (2) adopt and enforce rules related to its own operations and the exploitation of marine resources, (3) act as a conduit for public funds to establish and operate facilities related to commercial fisheries development, including participation in commercial fishing operations, (4) establish and support cooperative fishing among YFA and the public sector, (5) finance and support the development of privately owned enterprises related to marine resources, (6) act as an agent for the sale of provisions to foreign vessels operating in Yap, (7) develop and maintain facilities related to foreign fishing enterprises,, (8) engage into contracts related to its operation, (9) and is required to maintain records, libraries, research materials and facilities necessary to carry out its function. In addition, YFA may hire managers, experts or individuals to advise and assist in fisheries-related operations. Requirements related to YFA are that they operate in regards to exploitation of resources under explicit approval of use of said resources by permission of traditional rights owners.

Under Title XVIII, boundaries of fisheries and fishing are within 12 nautical miles of the outer boundary, either as the low water line of an island or the seaward edge of the barrier reef of an atoll.

YFA is also empowered with the duty of adopting regulations for the conservation, management and exploitation of living resources within the State Fishery Zone (12-mi zone) and waters internal to that. YFA is also permitted to negotiate agreements with foreign fishing interests according to Section 210 (Foreign Fishing Agreements), under consent of the Micronesian Maritime Authority and to issue permits to said interests. Foreign interests are required to carry permits prior to fishing in Yap State waters. Funds from foreign agreements are to be rebated or reinvested in the state to promote fishery development.

Foreign fishing vessels are required as a stipulation to their permits to allow enforcement officers to board and search or inspect any vessel at any time if fishing activities are suspect. Vessels must display permits in the wheelhouse and install and maintain position-fixing equipment. Observers are permitted on board and the interest is responsible for the full cost of the observers present. Foreign vessels are not allowed at any time to exceed their total allowable catch, based on maximum sustainable yield conditions for the targeted fishing zone. Violations are subject to penalty including license revocation of future licensing rights and suspension of the current permit. Foreign vessels must also abide by rights ownership agreements and boundaries.

General prohibitions for any person or entity fishing in the 12-mile zone are: (1) violations by provision set under Title XVIII of the Yap State Code, (2) use of fishing vessels once fishing permits have been revoked, (3) refusal to permit boarding by any enforcement officer, (4) violations by foreign fishing vessels under the title code, (5) forcible assault of officers or resistance or impedance during a search, (6) resisting arrest, (7) knowingly ship, transport, offer for sale, sell, purchase, import of have custody, control or possess any fish taken or in violation of the title section, interfere in any way with the arrest of fishing violators, and (9) conceal or destroy registration, certification, catch logbook or navigational documents. Civil penalties are not to exceed $75,000 per violation. Forfeitures of vessels and all its possessions are possible for violations of Section 212.

Pending Acts related to Title XVIII:

Bill No. 5-187: Amendments to Title XVIII, The Coastal and Aquatic Resources Conservation Act

The major provisions of the amendment are as follows:

> Chapter 12: Chapter 12 is to be added to the Title to include provisions for the conservation of coastal and aquatic resources.
>
> Section 1202: Empowerment of the Department of Marine Resources Management, Division of the Department of Resources and Development (MRMD) top conserve Yap's marine biodiversity and conserve said resources for future generations.
>
> Section 1204 Powers and duties of MRMD: (1) establishment of coastal and/or aquatic preserves, (2) establish seasons, limits and protection of fish stocks or areas of fishing in Yap, (3) designate illegal and legal fishing devises, methods and equipment, (4) prohibit activities adversely affecting aquatic resources and biodiversity within coastal waters, (5) approve or disapprove fishing agreements made through YFA and have the right to make modifications to approve agreements of YFA, (6) establish rules and regulations for exotic species introductions, (7) monitor, research and assess stock health, (8) establish rules in CPUE, catch data or monitoring methods for fish stocks or ecosystems, and (9) facilitate and perform education of conservation and preservation needs and benefits.
>
> Section 1206 Enforcement: MRMD is authorized to detect fisheries violations through inspection, confiscation or surveys.

Bill No. 5-188: Amendments to Title XVIII regarding the responsibilities of the Yap Fishing Authority. There are some general changes to the Sections and subsections of the Title that can be found in the bill. Major changes will be listed in the following sections.

Section 3, Subsection 1 of Section 12 is proposed to be amended to include a review of projects undertaken through YFA by the Project Review Process (Chapter6, Title 20)

Section 202 Purpose. The purpose of fisheries management and development is proposed to change from an exploitation focus to a long-term conservation and suitable utilization focus. Implicit within the section is the statement that over-exploitation must be avoided and that biodiversity and resource protection must be emphasized. The protection, through maintenance and conservation, are essential.

Section 203 Definitions is proposed to include a provision for "fish" to include eggs and offspring.

Section 204 Management approach: All State fisheries shall be managed using the *precautionary approach*. The approach involves 'the application of prudent foresight, recognizing that changes in fisheries systems are only slowly reversible…..and the need to take action with incomplete knowledge'. In addition, all fishing activities must have prior management authorization and be subject to periodic review.

Section 208 Yap Fishing Authority: The YFA is to adopt regulations based on the precautionary approach for the conservation, management and development of fishery resources within the state (changed from exploitation).

Section 209 Limits on fishing and aquaculture: The section highlights that (1) commercial fishing is prohibited unless under a valid and applicable permit, (2) fishing can only be done by a citizen or visitor for personal consumption and only if said visitor is accompanied by a State citizen, (3) uncooked fish may not be exported, (4) shark fishing is prohibited.

Pending Acts related to Title XX: The addition of Chapter 7 creating a Yap State Natural Resources Advisory Council

Section 703: The NRAC shall (1) assess the status of Yap's natural resources, (2) assess the concerns and need of the people regarding planning in relation to conservation, development and resource use, and (3) make recommendations pertaining to natural resource use and conservation.

Section 704: The NRAC shall be composed of 7 members fairly representing the villages, municipalities and islands within its jurisdiction.

Chuuk State, Federated States of Micronesia
Summary Report

Section 3

Kevin L. Rhodes
22 February-2 March 2003

3.1 Background

Chuuk (~ E 152^{o}/ N 08^{o}) is the most populous state in the FSM. Approximately 53,000 people are currently living in the state, while more than 40,000 people live among the Chuuk Islands. The state is composed of six major reef complexes, including the Chuuk Islands, the Upper (Nema and Losap Atoll) and Lower (Namoluk, Etal, Lukonoch and Satowan Atolls) Mortlocks, Western Islands (Houk, Pollap and Polowat Atolls), Namonuito Atoll and Hall Islands (Murilo and Nomwin Atolls). The main group, the Chuuk Islands, consists of a number of larger islands (Moen, Dublon, Fefan, Uman, Udoit and Tol), as well as a substantial number of smaller islands and reef complexes. In total, approximately 290 islands comprise Chuuk, although the total land area is only 125 km^{2}. Chuuk Lagoon is one of the largest in the world and is encircled by approximately 225 km of barrier reef. In relation to the large population centered within the Chuuk Island complex, high unemployment and a huge demand in reef fish exports from Guam, there is tremendous pressure on marine resources within the lagoon and barrier reef. As in Yap, limited economic resources, technical training and manpower, combined with the tremendous number of islands spread across a wide geographic range places great stress on resource managers within the state. Habitat destruction is also substantial following 50+ yrs of dynamite fishing within the lagoon. The live reef fish trade, although not currently operating in Chuuk, has been licensed in the Hall Islands in the recent past. The effects of live reef fishing on these aggregations is unknown.

Marine resources are managed primarily by the Chuuk Department of Marine Resources (CDMR) as established under the Chuuk State Code, Title IX (http://www.fsmlaw.org). The department is composed of four divisions that include Operations and Technical Support, Conservation and Management, Research and Development and the Tonoas Fisheries Complex, with the latter responsible for pelagic resources. The Conservation and Management division is the legal arm of the department and is largely responsible for monitoring and enforcement, including inspections and monitoring of boats, exports and sales. As in the other states of Micronesia, there is little awareness of the problems associated with aggregation fishing. Statistics on catch, effort, fishers and boats, export or sales are scant or nonexistent. Within the CDMR, there is no available literature on statistics, recent or past studies on fish or fisheries conducted in Chuuk. Although some statistics exist on export volume, pelagics are mixed with reef fishes, making a detailed assessment of actual export volumes of reef fishes impossible. However, CDMR does employ twenty conservation officers who monitor markets, local waters and exports for dynamite use, such that statistics could be greatly improved to provide details on a number of aspects of the fishery with minimal cost or effort.

3.2 Fishing in Chuuk

Fishing in Chuuk is conducted both for subsistence and commercial purposes and the state is the largest exporter of reef fish to Guam in the FSM (R. Osiena, Acting Director,

CDMR, *personal communication*)[3]. Export of fish is conducted by individuals, locally owned markets and the Truk Trading Company (TTC), which focuses primarily on pelagic species, such as wahoo, tuna and mahi-mahi. As reported by the Acting Director of CDMR, there is currently no licensing requirement for individuals or local markets to export marine products, no limit on export volume and no prohibitions on export of individual species. Fishers are not required to be licensed and boats are currently unregistered, such that the State or the CDMR have no statistics on the either number of fishers or boats fishing in coastal waters in the state. Reports suggest that the South Pacific Commission has recently conducted some assessment of reef fish resources in Chuuk, but this has not been confirmed.

Fishers are reported to use a variety of methods, including some traditional ones. Methods include, spear, hook and line, gillnet, cast net, drive net, scoop net and arrow trap. The use of explosives was rampant in the state, but may be waning in part due to a recent enhancement of enforcement and monitoring powers given to the Division of Conservation and Management (DCM). This action (Act No 6-06 of Chapter 1, Title 9, April 2001) effectively gives DCM power to inspect catch at markets, point of catch and at the airport for indications of explosives use. Officers are permitted to board vessels for inspection and are authorized to inspect any fish for signs of explosive use. The Act also covers the use of chemicals, including cyanide. Penalties include confiscation of catch and vessels, fines ($1000-5000) and/or imprisonment (1-5 yr). Markets caught selling dynamite fish may be closed with license revocation. Monitoring appears to be regular and daily, with all exports of fish to Guam inspected by DCM for evidence of dynamite fishing.

Fishing within Chuuk seems to be concentrated on areas inside the lagoon, although aggregation fishing is suggested for barrier reefs and lagoon areas. For grouper and snapper, fishing is conducted during aggregation periods both inside and outside the lagoon using spear and hook and line and a variety of baits. Determinations of explosives use on aggregations could not be made at the time of this report. For some fish, specialized methods are used, such as the use of scoop nets baited with copra for halfbeaks (*Hemiramphus* sp.). Arrow traps are used for goatfish (Mullidae) during summer months when fish come close to shore. Gillnets, spear and hook and line appear to be the common methods for most other fish.

Although open access to fishing grounds seems to be common for the Chuuk Islands, traditional, or customary, marine tenure (CMT) still seems to be in place in at least some of the outer islands and atolls. For example, CMT may still be strong in the Western Islands. For example, in Polowat Atoll, fishing of humphead wrasse (*Cheilinus undulatus*) is prohibited, except for use by the chief and traditional boundaries are still enforced. Other tabus (taboos) include the prohibition of fishing when a wife is menstruating, prohibitions on fishing for 1-2 d after getting drunk and a ban on fishing within certain areas after an elder or chief dies. In the latter case, the period may be 6 mo-

[3] During the interview period exports to Guam through the airport were 1 ton d^{-1}, combined pelagic and reefs fish. Fish are mainly destined to Guam, with lesser quantities to Hawai'i. Most fish is intended for sale.

1 yr and markers are placed at the borders of affected areas. The use of traditional sailing vessels and canoes seems to be limited and most individuals currently use 19-23 ft. Mexican skiffs powered by 30-40 hp 2-cycle outboard motors. Nets or lines made of traditional materials are rare.

In contrast to Yap, fishers in Chuuk appear to be aware of spawning sites and seasons for a number of species and are actively fishing them during spawning times. Most interviewees provided information on season and catch for typically commercial species, such as grouper and snapper. Catch locations, species and season were consistent throughout interviews. Difficulties in remembering particular seasons or lunar cycles were common for most other species and few individuals gave any indications of fishing during the period from September-December when seas are unfavorable. Instead, the main period discussed was during February-August when seas are calm, particularly May-July (breadfruit season). During this period, fishing appears to be intense and a number of species are fished, many that may be forming aggregations. Some locations, such as the main pass at Kuop Atoll, are known as 'no smoking zones' owing to the fact that when fish are biting, there is no time even to smoke. The fish usually captured at these sites are emperors during May through June or July. For the survey in Chuuk, fishers were chosen based on their skill and reliability by members of the Marine Resources staff. Marine resource personnel indicated that market owners and dive operators likely had little or no information on spawning times or sites, such that interviews were directly toward elder fishers. Similarly, the staff suggested that younger fishers did not rely on traditional knowledge or fish on specific fish at specific times, but instead were opportunistic in their fishing methods.

Section highlights

- Chuuk is reportedly the largest exporter of reef fish to Guam, although no statistics are available
- Spawning aggregation sites are widely known among fishers, but are undocumented by resource managers, such that their status is unknown.
- Fishing on spawning aggregations is substantial and likely occurs on all islands and atolls.
- Dynamite fishing on spawning aggregations may occur, but the level is unknown.
- Customary marine tenure may still be in effect in some outer islands and may assist in conservation of remaining spawning aggregations.
- For the Chuuk Islands, spawning season for groupers may be February through May.

3.3 Interviews (Deleted for confidentiality)

Section highlights

- Aggregation fishing is conducted primarily with hook and line, spear and net.
- Spawning aggregations are widely known around Chuuk and appear heavily targeted.
- Spawning season for commercially important groupers is February to March.
- Similar to Yap, fishers indicated seasonal (summertime) spawning for rabbitfish.
- Fishing on spawning aggregations seems to be concentrated at channels.
- The level of dynamite fishing on spawning aggregations is unknown from interviews[4].

3.4 Recommendations

The current perception in Chuuk is that fish abundance (as catch) is declining. All interviewees stated that fish abundance was either greatly reduced or in some cases largely extirpated, such as the humphead wrasse in Satowan. For Satowan, the abundance of parrotfish in the lagoon has declined substantially. Market surveys showed a number of species sold at markets were composed primarily of immature individuals (e.g. *Plectropomus areolatus*). With this in mind, the Acting Director of CDMR, Romio Osiena, appears to recognize the need for strong and immediate conservation and management of reef fish stocks. Currently, CDMR's Division of Conservation and Management is conducting monitoring and enforcement according to the guidelines established by the April 2001 prohibition on the sale or export of dynamite-captured fish and is conducting active monitoring at markets, airports and around the lagoon. This type of monitoring provides an opportunity for additional market-based regulations, such as limits on size at catch, species catch and sales bans, and provides avenues for reproductive life history analysis of several key species. What is needed to perform these tasks is combined monetary, educational and technical support from NGOs (SCRFA, TNC and IMA), fisheries development and advisory agencies (SPC) and international funding bodies (UNDP, USAID, World Bank, ADB). A workshop on all aspects of spawning aggregation monitoring and management is needed immediately. Similarly, the success of any newly introduced conservation or management program can be greatly enhanced through education and awareness materials provided for public viewing on local public television, at community meetings or similar outreach programs and schools at all levels.

Awareness of the vulnerability of aggregations to overfishing was low prior to the visit. Following discussions and presentations about the effects of fishing on spawning aggregations with marine resource personnel and conservation officers, awareness has

[4] Interviews were conducted at the CDMR acting director's office. As dynamite fishing is illegal, fishers would not have been willing to share information on illegal fishing at that venue.

increased and there is a perception that immediate action needs to be taken. Conservation and management protocols discussed were (1) spawning aggregation-based marine protected areas, (2) sales bans during spawning seasons for aggregating fishes, (3) catch bans for aggregating species during spawning season, and (4) export ban during spawning season for targeted aggregating fish. There were additional discussions on the effects of fishing immature individuals and on targeting spawners *en route* to spawning sites. Mr. Osiena expressed an interest in all of these options and would welcome additional input into the management process. Siting MPAs, determining the target species to include in bans and assessments of size at sexual maturity for aggregation spawners will require technical training and assistance, but has a good chance of succeeding owing to the current monitoring already in place.

The recommended role for SCRFA in Chuuk is continued contact to keep the level of interest and awareness high regarding the need for protection measures for spawning aggregations. Direct support can be made to Marine Resources and Mr. Osiena by way of literature on spawning aggregation vulnerability to overfishing. Information on how other countries have responded to aggregation overfishing would also be quite useful in lobbying efforts to political groups (e.g. state legislature). SCRFA or one of its partners is urged to compose and distribute an educational video for public television in Micronesia and elsewhere on the dangers of aggregation fishing. Assistance should be given, where possible, for developing videos in the local language, as many fishers are older and are not proficient in English. The video should include mention of the potential for alternatives provided through vocational re-training and industry development (e.g. dive tourism, flyfishing). Future visits to Chuuk should focus on identifying the main spawning period(s) for grouper (Feb-Mar) and snappers (May-June/July) through market assessments and site identification, based on field surveys. Field surveys can also be used to begin boundary assessments for proposed MPAs (e.g Piaanu Pass), including migratory pathways for aggregating fishes. If feasible, diver operators and local NGOs should be enlisted wherever possible to assist in surveys and possibly future monitoring.

As a first step, Chuuk should be provided with materials that can be used to televise the importance of spawning aggregations. SCRFA should work with local marine resource personnel to tailor the presentations to their needs. In terms of legislation-based conservation and management, until details of the actual spawning sites and times are known, Chuuk should enact a catch ban of the known aggregating species (camouflage and brown-marbled grouper, squaretail coralgrouper) during the suggested spawning season (Feb-Mar) along with a sales and export ban of these same species during the same period. Since conservation officers regularly and systematically conduct open water, market and airport monitoring, the recommended approach would be easy to implement and should be successful. Incidental catch of these species (e.g. 5 individuals/trip) using hook and line should not result in prosecution. However, catch and possession of these species by spear should result in punishment. The spawning site at Piaanu Pass should be closed as either a seasonal or permanent no-take zone. The boundaries should be determined through dive assessments during spawning seasons to include migratory pathways and actual spawning sites. CMRD should work with community leaders and fishers to gather support and recommendations for the marine

protected area suggested for Piaanu Pass. Similar spawning aggregation site MPAs should be considered for species of snapper likely spawning during May and June and other sites should be considered for known aggregation sites at Satowan and Namonuito Atoll. Finally, additional interviews should be conducted on all outer atolls where spawning aggregation sites likely occur. Suggested periods for these interviews are, again, during likely spawning periods for grouper and snapper (February-June).

Section highlights

- Provide a workshop on reproductive analysis of fishes, e.g. egg development, cannulation, and promote the existing use of conservation officer monitoring of markets to identify reproductive seasons for major target fishes.
- Assist local agencies directly or in locating monetary, educational and technical support for spawning aggregation monitoring and educational awareness.
- Provide states with educational media in support of spawning aggregation protection.
- Continue working with Loa marine resource agencies and legislators in developing meaningful management and legislative guidelines for spawning aggregation protection.
- Given the current level of market and airport monitoring, promote the use of seasonal catch, sales and export bans following determination of reproductive season for target species.
- Assist Marine Resources in defining migration and spawning areas for groupers at Piannu Pass for effective MPA development.

3.5 Local fish names (from interviews)

Latin	***Local***
Hemiramphus sp.	chopuchop
Myripristis berndti	mwooon
Epinephelus fuscoguttatus	mattou
Epinephelus polyphekadion	eny
Plectropomus areolatus	sewi
Plectropomus laevis	sewiaan
Variola sp.	pwene
Lutjanus argentimaculatus	sanap
L. gibbus	mesechcha
L. bohar	meen
Lethrinus olivaceus	eetik
L. xanthochilus	meetin
Gymnocranius sp.	ikeino
Monotaxis grandoculis	masamas
Mullids	omai
Mulloidichthys vanicolensis	soptik
Parupenaeus barberinus	feinisi
Cheilinus undulatus	maam (large)

	merrer (small)
Siganids	umuno
Siganus doliatus	mwaramwar
S. vermiulatus	kuo
S. spinus	peniwa
S. punctatus	meichocho
Zanclus cornutus	nifoufouias
Acanthurus lineatus	finang/fitichu
Ctenochaetus binotatus	arong
Acanthurus triostegus	kirach
Naso thynniodes	pon
Acanthurids (unicornfish)	pon

3.6 Spawning aggregation locations and seasons (from interviews)

(Deleted for confidentiality)

Pohnpei State, Federated States of Micronesia
Summary Report

Section 4

Kevin L. Rhodes, Ph.D.
3-19 March 2003

4.1 Background

Pohnpei State (N 6°97'/E 158°22') is composed of a single basaltic high island (Pohnpei) and eight atolls ranging in size and spread across approximately 900 km of open ocean. The outer atolls include Pakin, Oroluk, Mwoakilloa, Ahnd, Pingelap, Nuguouro, Sapwauhfik and Kapingamaringa. In total, Pohnpei has a total land area of 340 km^2 with > 90% of that in Pohnpei Island. Over 34, 500 inhabitants reside in Pohnpei, with most on Pohnpei Island, including about 8,000 residents from the outer islands.

Marine resources in Pohnpei are managed through the Pohnpei State Department of Land and Natural Resources (DLNR). The DLND is further divided into the Division of Forestry and Marine Conservation that overseas the Division of Resource Management and Development (DRMD), with the latter in charge of monitoring, enforcement and statistics. The various departments and divisions are provided authority and responsibilities under the Pohnpei State Code, which is currently being revised from the US Trust Territory Code. Nonetheless, Title 26 (Conservation and Resources) and Title 29 (Foreign Fishing) provide for various duties and legal authorities to control conservation and resource enforcement, endangered species, marine conservation and wildlife (*supplementary document*). In addition to these titles, the Fishing Act of 1995 and subsequent amendments provide definitions and provisions for fishing in Pohnpei waters, including sanctuaries. Currently, the rules and regulations for marine sanctuaries, including protection, enforcement and monitoring, are being revised to provide for more effective monitoring and enforcement and to add additional restrictions on their usage.

In Pohnpei, the actual amount of fish resources being captured is unknown. There have been no recent assessment of reef fish stocks within the state. Export, catch and sales statistics have not been taken since at least 1997. There are no licensing requirements for fishers, no registration of boats and no rules or regulations on export by species or volume.

Pohnpei is one of only two states in the Pacific to provide specific protection of spawning aggregations. These protections are through a 1 March through 30 April sales ban on grouper (Title 26, Chapter 6, Part F) and the establishment of the Kehpara Marine Sanctuary (Title 26, Chapter 5, Section 5-120) that protects three species of spawning grouper throughout the year. A separate sanctuary is being proposed for Ant Atoll where grouper spawning aggregations will be encompassed by adopting sanctuary boundaries at two separate sites—Ant Channel and a second site between Wolauna (Bird) Island and the western tip of Pamuk Imwintaiti Island. At Kehpara, these protections are currently being enforced, although there are some legal technicalities currently prohibiting effective prosecution of poachers. These technicalities are in relation to the executive order issued to extend the sanctuary, which has not been formally passed into law by the legislature. The Attorney General is currently working to push the legislation through. In the interim, poachers are actively chased from the site and poaching is by a small number of boats and individuals over brief fishing bouts. In addition, to the current protections, the Marine Sanctuary and Wildlife Refuge Act of 1999 is currently being amended to enhance enforcement and monitoring.

In relation to the sales ban, the spawning season for the squaretail coralgrouper, *Plectropomus areolatus,* has been determined from monthly monitoring by the Conservation Society of Pohnpei (CSP) and the DMRD. *Plectropomus areolatus* spawns between January through May. The brown-marbled grouper, *Epinephelus fuscoguttatus,* spawns from February to May. The monitoring has been ongoing since March 2001 following The Nature Conservancy's spawning aggregation monitoring training program. Monthly monitoring has been conducted sine March 2001 for both new moon and full moon periods. Only the three species previously mentioned have been observed to form spawning aggregations at the site. Although these fish are protected at Kehpara, other spawning aggregations of these fishes may be vulnerable during the spawning period, particularly outside the marine sanctuary system, such as those at Ant Atoll. Therefore, the sales ban should be tailored to the spawning season of individual species to fully protect the species, as well as the institution of a catch ban for all purposes, either commercial or subsistence. Marine protected areas should be placed where significant spawning aggregations are found and where monitoring and enforcement can be effective. In concert with community awareness, education and participation during the design process.

4.2 Fishing in Pohnpei

Fishing for reef fishes in Pohnpei is conducted both for subsistence and commercial purposes, with the majority of fishing done for sale to local markets. Gears include gillnet, cast net, spear and hook and line. Night spearfishing is perhaps the most common form of fishing in Pohnpei and supplies an abundance of fish for the local markets. These markets, although small-scale, while number in the 10s and concentrated primarily in the capitol Kolonia, are rapidly growing, particularly as the total dollar amount of US-Freely Associates States Compact Agreement is diminishing and Pohnpeians seek to find alternative means of income. Undersized fish are common in the catches made using this method. In addition to other types of fishing methods, the use of *Derris* root may still be used for catching certain species within the mangroves, but is probably rare.

Pohnpeians fish for a wide variety of species, but concentrate on members of the Scaridae, Serranidae, Lethrinidae, Acanthuridae, Lutjanidae and Siganidae. Traditional fishing methods have been largely abandoned and few fishers abide by customary marine tenure. Marine tenure or traditional forms of conservation are still practiced to varying degrees on some of the outer atolls. Most fishers still fish close to their villages and, although much of the fishing lore and natural phenomena that signaled fishing in the past is gone, most fishers are still aware that many fish spawn during the breadfruit season (March-May) and that this is the best time to catch fish. Emperors are captured in winter when the hibiscus flowers fall, although few people are still aware of the connection. Also noteworthy is poaching on Oroluk Atoll within the marine sanctuary, which borders Chuuk State. Locals are prohibited from fishing in the sanctuary except for subsistence purposes.

In general, interviewees gave consistent reports of possible spawning periods for fishes. As with interviews in other states, many fishers recalled seeing eggs at the time the fish was captured, but many had difficulty remembering the specific times. Specific time periods associated with spawning was most commonly provided by elder fishers to whom most interviews were directed. Attempts were not made to interview market personnel or dive operators, since past experience showed that these individuals had little or no information on spawning times or sites.

4.3 Interviews (Deleted for confidentiality)

4.4 Recommendations

The Society for Conservation of Reef Fish Aggregation can play an active role in Pohnpei by assisting existing marine resource agencies and local NGOs in providing educational materials for government and community awareness. Local TV and radio are widely accessible to all Pohnpei residents on the main island and provide an excellent forum for these proposed activities. In addition, educational and awareness seminars should be given to the legislature during appropriate periods, including both the marine resource committee and the full legislature. The recommended time frame for these activities is in December or January following the upcoming elections. Seminars and presentation materials should be made in cooperation with the Conservation Society of Pohnpei and DMRD and translated into Pohnpeian through the assistance of either CSP or another local agency familiar with scientific and conservation jargon, such as the Peace Corps or College of Micronesia. In addition to educational and awareness, DMRD and CSP could both benefit from training on the identification of spawning sites and life history information regarding sexual patterns for some spawners, such as serranids, labrids and scarids. Further recommendations should be issued to prioritize future legislative actions that promote the protection of spawning aggregations, such as the incorporation of sales and catch bans during reproductive periods for individual species.

For conservation and management of spawning aggregations to work in Pohnpei, a far greater role is needed by municipalities in limiting fishing or controlling poaching on aggregations. During a recent meeting on rules and regulations for marine protected areas in Pohnpei, suggestions were made to enlist municipal fishers as fisheries conservation officers to monitor sanctuaries and note violations within these areas, similar to the rangers used in Palau to patrol coastal marine areas. Although there is uncertainty whether this tactic might work, current monitoring and enforcement by the state is lax and insufficient to prevent frequent violations of fishing on spawning aggregations even within sanctuaries. In key fishing communities, such as Kitti near the Kehpara Marine Sanctuary, capacity-building in local empowerment over local resources may enhance existing management of spawning aggregations.

The identification of spawning aggregations and seasons within Pohnpei should continue. The Conservation Society of Pohnpei recently acquired financial assistance to hire and train a market analyst whose focus is to determine reproductive season for at least 10 key

market species, including grouper and snapper. These types of activities should be encouraged and assistance should be provided to local NGOs where and when possible since management and conservation of marine resources will increase. However, CSP is a multi-focus NGO, with marine resource conservation only one of several foci. Assistance by SCRFA on marine issues should be provided as necessary. Finally, although the use of MPAs is growing in Pohnpei, the resources available for enforcement and monitoring is and will continue to be insufficient. Market-based management should be prioritized as a management and conservation measure.

Section highlights

- Education on the need and function of spawning aggregation management and conservation should be given top priority.
- Activity coordination and development should me made in concert with the Conservation Society of Pohnpei.
- SCRFA should focus attention on education and capacity-building among municipal governments and fishers in key fishing communities (e.g. Kitti Municipality).
- SCRFA can play a substantial role in management and conservation development in Pohnpei.
- Market-based management, monitoring and enforcement should be prioritized.

4.5 Local Fish Names

Species/Family	**local name**
Mugilidae	limwer
Epinephelus maculatus	mwangher goal
E. merra/E. spilotoceps	mwangher pwet
E. polyphekadion	widir
E. fuscoguttatus	rhup-rhup
E. lanceolatus	mout
Plectropomus areolatus	souwi
P. laevis	ohwin souwi
Carangidae	oarong
Lutjanus argentimaculatus	asemel
L. bohar	kir
L. gibbus	pwalal
L. fulvus	pweu
Plectorhincus albovittatus	koal
Lethrinus erythopterus	samwe
L. olivaceus	kadik
Monotaxis grandoculis	masokod
Kyphosus cinerascens	korkor
Cheilinus undulatus	
Largest (chief)	pinin-pokon
Large (common)	merrer
Small	poros

Bulbometopon muricatum	kaomoaik
Chlororus microrhinus	mahn-lik
C. frontalis	mahn-pwur
Hipposcarus longiceps	mwahmw-moai
Siganids	kiaok
Siganus puellus	pahlapal
S. argenteus	uhmwilei
S. vermiculatus	kiaok
Ctenochaetus striatus	darup
Naso lituratus	bulaking
N. brachycentron	bulak

4.6 Spawning aggregation locations and seasons (Deleted for confidentiality)

Kosrae State, Federated States of Micronesia
Summary Report

Section 5

Kevin L. Rhodes
19-26 March 2003

5.1 Background

Kosrae State (N 5°2" /E 163°) consists of a single high island, with a total land area of approximately 100 km^2, much of which is steep mountainous terrain to a height of 700 m above sea level. Kosrae is surrounded by a fringing reef, a narrow lagoon and an extensive mangrove system. The island has a single harbor, a few small embayments. The mangroves drain through the small channels at Lelu Harbor and a few smaller channels around the island. The island is divided into four municipalities—Utwe, Malem, Tafunsak and Lelu—with the capitol Tofol in Lelu Municipality. In 2000, the population was estimated at approximately 7,700 people dispersed around the coastal zone. Currently, there is only one large fish market and a few smaller ones supplying the islands residents, although they are general devoid of catch for sale. The export of reef fish to Guam is small-scale, particularly in comparison to Pohnpei and Chuuk. No licensing of commercial reef fish export exists.

Marine resources are maintained by the Kosrae State Department of Agriculture, Land and Fisheries (DALF). The DALF is further divided into six divisions: Crop Production & Research, Livestock Production & Research, Mapping & Survey, Land Management & Preservation, Marine Surveillance and Fisheries Development. The Kosrae State Code provides for management, monitoring and enforcement of marine resources in the state under Title 19 (Marine Resources) and Title 11 (Land and Environment). Chapter 4 of Title 19 defines prohibited acts, such as the use of explosives, poisons and electrical devices to catch fish (Section 19.101). Under Chapter 4, export of reef fish is prohibited without a permit from the Director. Other prohibitions on fishing are given in specific section (http://www.fsmlaw.org). There are no bans on any species of fish or season, size regulations, catch volume of mesh size of nets.

5.2 Fishing in Kosrae

Fishing in Kosrae is primarily for subsistence purposes and to supply the small-scale export of fishes mostly to relatives residing in Guam or elsewhere. Fishing is conducted primarily by netting, including gillnets (*koa*) and seines, spear and hook-and-line (*aya*), with nets being the primary method. Night spearfishing is conducted, but is uncommon. Trolling for pelagics is frequent among Kosraeans. Poisons, including *Derris* root and leaves of the *Callicarpa* plant are used for a variety of inshore species, but the frequency of these methods is not known. (The effects of *Callicarpa* last a few days, while that of *Derris* is short-term, e.g. 1 d) Most fishing, as in the past, is conducted by women inside the lagoon and along the mangroves. Fishing by women is traditional and can be recorded back to recorded history of the island. As such women are generally more in-tune to the timing for maximizing catch. In general, fishing is done for rabbitfish, rudderfish, mullets, some snappers and a few types of emperor. Fishing is also conducted by constructing artificial reef habitat out of coral heads (*ta*) and then netting the fish with hand nets when the fish were scared from the 'reef' or when the stones were removed. This method is rarely used today. Until the introduction of refrigeration, preservation of fish was by salting, smoking or drying. Bottom fishing is conducted primarily be a few

fishers for commercial purposes, while most bottom fishers are fishing recreationally or for short-term subsistence. When bottom fishing is done, it is mostly concentrated on outer reefs during the calm season that begins in May and ends on August. Bottom fishing is primarily for snappers, grouper, emperors and occasionally unicornfish. Bottom fishing depths are also considerably deep, with most reports of grouper fishing at 100 m or greater.

Conservation was done in the past by having the fish taken to the local chief who distributed the fish into a basket for the family, with only one basket was allowed per family. Fishers are said to also release a portion of their catch, release the smaller fish and release non-target species. This practice is not as common today as in the past. Convention conservation is though the Utwe-Walung Marine Park in Malem Municipality. Kosrae also has an extensive dive buoy system (56 buoys)—the most extensive in Micronesia—throughout the island to protect reef habitat for both fish and divers.

5.3 Interviews (Deleted for confidentiality)

5.4 Recommendations

Kosrae Division of Fisheries Development (KDFD) has a keen interest in spawning aggregation education and conservation. The focus of spawning aggregation fishing is the state is primarily for small herbivorous inner-lagoon species, such as rabbitfish, and the pressure on these species is substantial. Many of the target species appear to be resident spawners that spawn monthly, but their patterns of movement to spawning sites is well known and they are heavily targeted during these periods. Management of these fishes should begin with educational and awareness campaigns. Subsequent management direction and initiatives should be developed in coordination with KDFD, but may include changes to regulations specific to gear types (e.g. mesh size) or catch limits. Fishers in Kosrae depend heavily on catch for daily subsistence needs, such that the effective use and popularity of temporal sales and catch bans is unlikely. Larger, more mobile transient spawners, such as serranids and lutjanids, are not a major target of fishers. Aggregations are suspected of being deep (up to 100 m), such that their immediate management needs is minor in comparison to inshore (lagoon) stocks. In Kosrae. SCRFA can play a key role in development of management and conservation of resident spawning aggregations.

5.5 Local fish names (from interviews)

Latin		***Local***
Siganus randalli		malap (larger individuals)
		basr (smaller individuals)
S. vermiculatus		malap (larger individuals)
		basr (smaller individuals)
S. puellus		miosr rung-rung
S. argenteus		miesron
Acanthurus guttatus		pal-pal
A. maculiceps		kepat
A. lineatus		kwi
A. triostegus		lasr-fol
Ctenochaetus striatus		ik sral-sral
Naso vlamingii		wi-wi
Myripristidae		ol-ol
Neoniphon sammara		makas
Serranidae (red ones)		kalsrik sral-sral
Epinephelus merra		ik marin
Selar crumenopthalmus		atol
Carangids (jacks/trevally)		srap-srap (small species)
Caranx ignolbilis		srap
Caranx sexfasciatus		atom
Caranx lugubris		srome
Lutjanus fulvus		ngila
Lutjanidae (spot snappers)		srinac
Lutjanus kasmira		srinac rung-rung
L. gibbus		tap
Lethrinus xanthochilus		srinkab
Lethrinidae (large species)		katuk
Monotaxis grandoculis		metkosr
Mullidae		fwut-fwut
Mulloidichthys vanicolensis		apwil
Scaridae		misrik
Kyphosidae	(small individuals)	ik kinsok
	(medium individuals)	won
	(large individuals)	elo
Mugilidae	(small individuals)	epal
	(large individuals)	epal-e

5.6 Spawning seasons (from interviews)

Species	Season
Siganids	monthly (new moon)
Mugilids	monthly (new moon)
Kyphosids	monthly (new moon)
Lethrinids (*L. xanthochilus, L. olivaceus*)	monthly (new moon)
Serranids (*E. maculatus*)	April-July (?)
Epinephelus merra	monthly
E. spilotoceps	monthly

Section 6

6.1 References

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Information on population, lat/long coordinates, history: <http://www.angwin.csl.uiuc.edu/pohnpei/>

More population statistics: <http://www.fsmgov.org/info/people.html>

Geography, land area: <http://www.fsmgov.org/info/geog.html>

Economic trends: <http://www.abd.org/Documents/Books/ADO/2001/fsm.ap>

Addtl. info on pop, gov structure, etc.: <http://www.cia.gov/cia/publications/factbook/geos/fm.html>