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FSM Spawning Aggregation Monitoring Training Workshop Report

Black Coral Island, Pohnpei, Federated States of Micronesia 31 January-6 February 2004

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Cover photo: Group photograph of participants at the 2004 FSM Spawning Aggregation Monitoring Training Workshop, Black Coral Island (K Koltes)

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BACKGROUND

Among coral reef fishes, some of the most susceptible to over-fishing are commercially important members of groupers (Serranidae) and wrasse (Labridae) that form spawning aggregations. These fishes, and many others, aggregate to spawn at predictable sites and times and are often heavily targeted by fishers. As a result of heavy fishing on spawning aggregations, aggregation loss, declines in genetic diversity and altered reproductive output have been recorded, with the potential for negative changes in trophic food webs and coral reef ecosystems.

The vulnerability of spawning aggregations to over-fishing is now widely recognized, as is the need to conserve and manage some fish populations at the aggregation level. To design meaningful management and conservation protocols and examine the effects of conservation actions on populations forming spawning aggregations, some form of monitoring is usually required. Toward this end, The Nature Conservancy is conducting spawning aggregation monitoring training workshops among areas of the western Pacific that are being affected by local or commercial overfishing. Workshops focus on areas affected primarily by the live reef food fish trade (LRFFT). The workshops are designed to promote an awareness of the importance of spawning aggregations and their vulnerability, and to introduce local resource managers and conservationists to basic monitoring techniques for identifying, recording and responding to changes within spawning populations.[1]

The following report highlights monitoring skills training exercises and findings from the 31 January-6 February 2004 monitoring training workshop conducted at Black Coral Island (Pohnpei, Federated States of Micronesia) and the Kehpara Marine Sanctuary (KMS) grouper spawning aggregation site, Kitti Municipality, Pohnpei. The monitoring training program introduced basic data-gathering techniques to practitioners for managing spawning aggregations, including the determination of reproductive season, identification of spawning aggregation sites, site mapping and area determination, species identification and aggregation behavior, species abundance and fish length estimation and data collection, processing and analysis. The workshop focused primarily on the use of underwater visual census techniques and was designed to accommodate local resource managers in the FSM interested in establishing long-term monitoring programs for management and conservation purposes.

[1] The workshops are a part of a larger project that The Nature Conservancy has received funding from the East Asia and Pacific Environmental Initiative (EAPEI), the David and Lucile Packard Foundation and the Oak Foundation to conserve coral reef biodiversity by reducing the depletion of aggregating reef fish in Pacific Island countries. This project aims to improve resource management and spawning aggregation site protection, increase awareness of these resources' vulnerability to over-exploitation, and enhance capacity to manage reef fish spawning aggregations and MPAs that incorporate these sites. It has three objectives: (1) to develop and facilitate the application of cost-effective management controls on the exploitation of aggregating reef fish resources; (2) to strengthen the capacity to assess, monitor, and manage aggregating reef fish resources; and (3) to raise the awareness and appreciation among stakeholders of the vulnerability of aggregating reef fish populations and associated ecosystems, the nature and significance of spawning aggregations, and options for improving management.

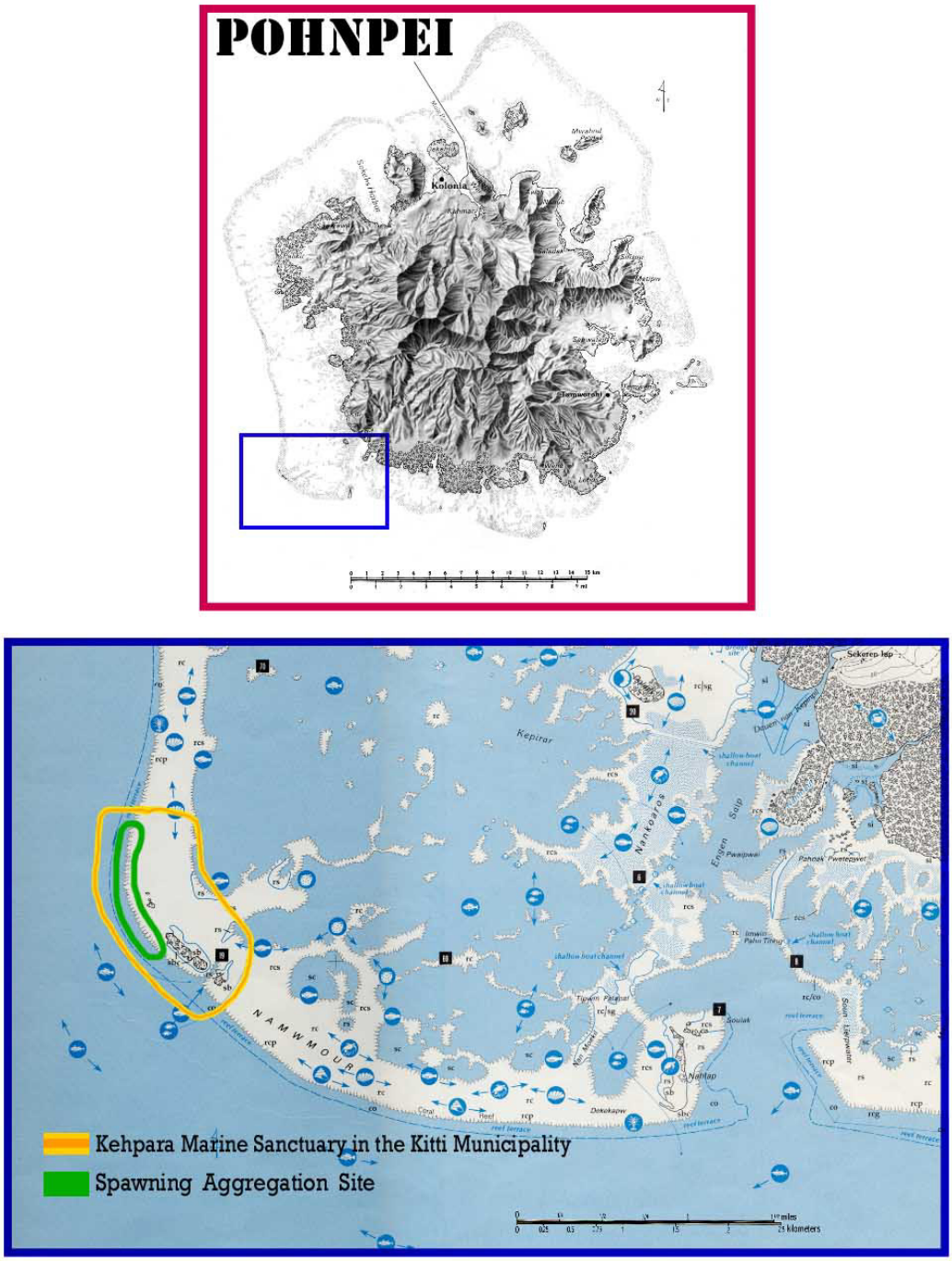

Figure 1: Map of the spawning site and marine sanctuary (from Pet *et al.* 2001)

TARGET FISH SPECIES

The monitoring training program focused on three species of grouper (Family Serranidae). Those species observed aggregating during training exercises include the brown-marbled grouper, *Epinephelus fuscoguttatus* (Figure 2.1) and squaretail coralgrouper, *Plectropomus areolatus* (Figure 2.2). Aggregations of the camouflage grouper, *E. polyphekadion* (Figure 2.3) were not observed during the training.

Figure 2.1

Latin: *Epinephelus fuscoguttatus*
FAO: Brown-marbled grouper
Pohnpei: rhrup-rhrup (mwangher)
Yap: smakaw
Chuuk: mattou
Kosrae: unknown

Figure 2.2

Latin: *Plectropomus areolatus*
FAO: Squaretail coralgrouper
Pohnpei: sawi
Yap: smakaw
Chuuk: sewi
Kosrae: unknown

Figure 2.3

Latin: *Epinephelus polyphekadion*
FAO: camouflage grouper
Pohnpei: widir (mwangher)
Yap: smakaw
Chuuk: eny
Kosrae: unknown

Figure 2: Target species for the KMS monitoring training workshop (A Smith and K Rhodes)

TRAINING SESSIONS AND MATERIALS

Workshop training sessions focused on the skills necessary to conduct basic monitoring of spawning aggregations. The skill sessions included:

1. Fish species identification
   - Still photographs
   - Plastic identification cards (SPC/TNC/IMA)
   - PowerPoint® presentations
   - Underwater video (Pohnpei and Palau)
   - Printed references (e.g. Micronesian Reef Fishes, Robert Myers; LRFFT Awareness package, SPC/TNC/IMA)

2. Fish length estimation
   - Wooden fish models

3. Spawning signs
   - Underwater video (Pohnpei and Palau)
   - PowerPoint® presentations
   - On-site training and recognition

4. Abundance counts
   - Underwater monitoring on aggregation sites
   - Classroom presentation using video

5. Site mapping: tools and techniques
   - Classroom presentations
   - Site-based mapping

6. Gonad development
   - Market specimens
   - PowerPoint® presentations

WORKSHOP PARTICIPANTS

Participants from national and state government agencies and local non-government organizations (NGOs) participated in the workshop. Participants and their affiliations are as follows (contact details given in Appendix 1):

1. Conservation Society of Pohnpei (CSP)—Eugene Joseph, Bradley Phillip, Benjamin Chen, Erin Dodd, Kirino Olpet, Anna Pakenham
2. Kosrae State Department of Agriculture, Land and Fisheries—Maxwell Salik, Steve Palik
3. Chuuk State Department of Marine Resources—Chimress Teresio
4. Chuuk Guide and Assist Through Awareness (GATA)—Ivan Alafanso
5. Yap State Department of Resource and Development—Joe Fanafal, Mike Hasurmai
6. Pohnpei State Department of Land and Natural Resources—Dave Mathias, Scotty Malakai
7. US Department of Interior—Karen Koltes

MONITORING TRAINING AND OBSERVATIONS

At Kehpara Marine Sanctuary, spawning aggregations of two of the three target species were observed during the workshop period: squaretail coralgrouper and brown-marbled grouper. Brown-marbled grouper aggregation abundance was low relative to peak aggregation months and formed below the depths for safe monitoring training (i.e., >30 m). The months of potential aggregation formation for brown-marbled grouper, based on recent monitoring by the Conservation Society of Pohnpei (CSP) is from January-April. In contrast, the aggregation of squaretail grouper was sufficient in size and scope to conduct the training exercises and was located from 15-50 m depth. Spawning aggregations of the species were observed between 2001 and 2003 between January and May. Camouflage grouper were absent from the site during the workshop period, suggesting the reproductive season for the species in 2004 will be March and April, based on past monitoring observations.

TRAINING SKILLS: MAPPING AND TRANSECT PLACEMENT

For the workshop training, participants began with site mapping. Site mapping began with presentations on the use of standardized protocols for monitoring. Practitioner skills training involved (1) recognizing aggregation boundaries, (2) recognizing permanent transect areas, (4) marking transect boundaries using underwater markers and (4) measuring and calculating aggregation areas based on the markers.

During the training workshop, site mapping was conducted prior to the days of peak abundance owing to time constraints to complete all skills training. (Optimally, site mapping should be initiated and completed during the days of maximum abundance for each individual species.) Accordingly, the total areas for the squaretail coralgrouper aggregation was calculated as approximate for the purpose of estimating total abundance. Estimates for the squaretail coralgrouper aggregation area were 450 m (linear distance) x 35 m (top-to-bottom) (15,750 m^2) based on the mapping exercises. The linear distance of the aggregation along the reef was similar to that first measured in 2001 (500 m), but excluded the reef flat area in 2004, as the fish were not present there during the initial mapping exercise.

The second mapping exercise was to determine optimal locations for transect placement. Since permanent transects are already present within the squaretail coralgrouper aggregation, the need to place more transect markers at the site (rebar) was eliminated. As such, the group discussed the rationale behind the placement location of existing transects and discussed ways to improve monitoring accuracy (e.g. making boundaries more visible, extending transect lengths, reducing transect width, verification of fish densities within aggregations).

TRAINING SKILLS: LENGTH ESTIMATION AND ABUNDANCE COUNTS

Length estimation skills training was conducted on a single day using both dry training and wet training with wooden fish models (Figure 3). Length estimation was not performed on the aggregations owing to time restrictions and the need for advanced training not provided in the basic monitoring workshop.

Upon completion of transect placement and site mapping exercises, trainees learned to perform abundance counts (Figure 4) on coralgrouper, based on a single permanent 360 ft by 50 ft transect (18000 sq. ft) placed within the aggregation core between 40 -90 ft (Figure 5). Trainees were familiarized with simple methods for counting fish in large aggregations using group counts of 1, 5, 10, 20 or 50 individuals.

Figure 3: Length estimation training at Black Coral using wooden fish models (K Koltes)

Figure 4: Trainee counting fish within a transect at the KMS spawning aggregation (D Mathias)

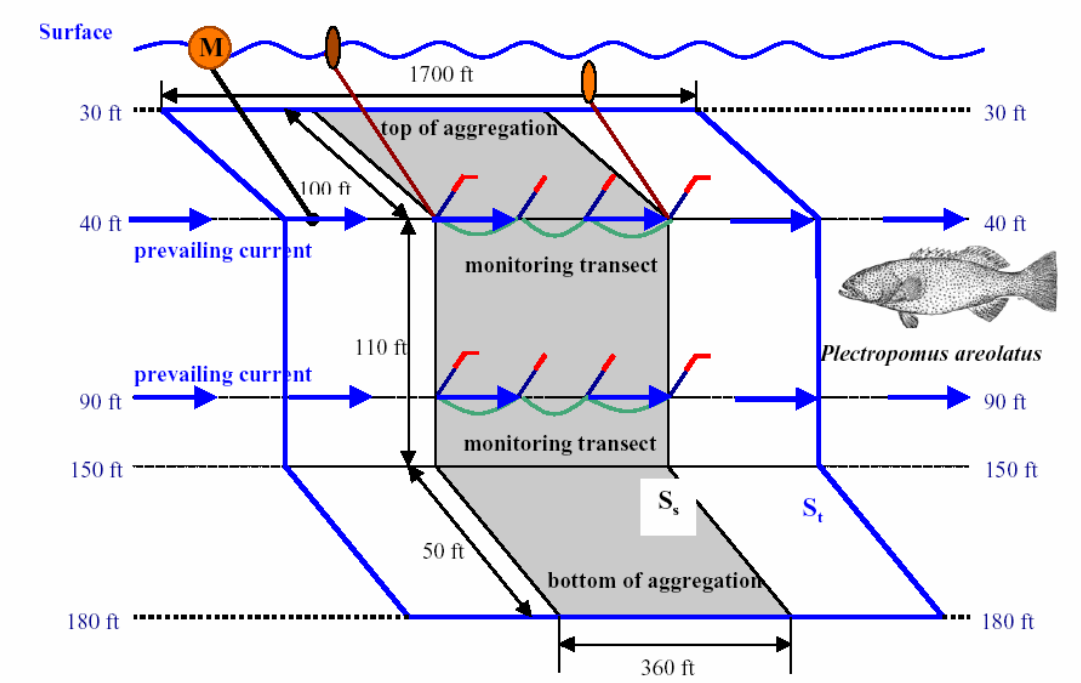

Figure 5: A diagrammatic representation of the squaretail coralgrouper, *Plectropomus areolatus*, monitoring scheme and transect placement (taken from Pet *et al.* 2001). Note that distances are in feet.

Table 1: Sample abundance data sheet (truncated) taken from actual counts of squaretail coralgrouper at KMS on lunar day 12.

Site #: 1, KMS	Time: 1500	Date: 05/02/04
Species #: 1, *Plectropomus areolatus*		Transect #: 1
Observer: Maxwell Salik	Visibility: 30 m	Lunar date: 12

Group	Frequency	Total
1	IIIII II	7
5	III	15
10	IIII	40
20	I	20
50		0
Total		82

Table 2: Abundance counts (no. per 18 000 sq. ft) for squaretail coralgrouper from KMS during the training exercise.

	Participants										
Lunar Day	Chim	Jimbo	Max	Steve	Joe	Mike	Brad	Ben	Erin	Mean	SD
11	178	125	22	97	57	86	12	10	8	60	49.2
12	89	65	82	59	62	56	19	16	16	52	28.0
13	47	60			71	15				48	24.2

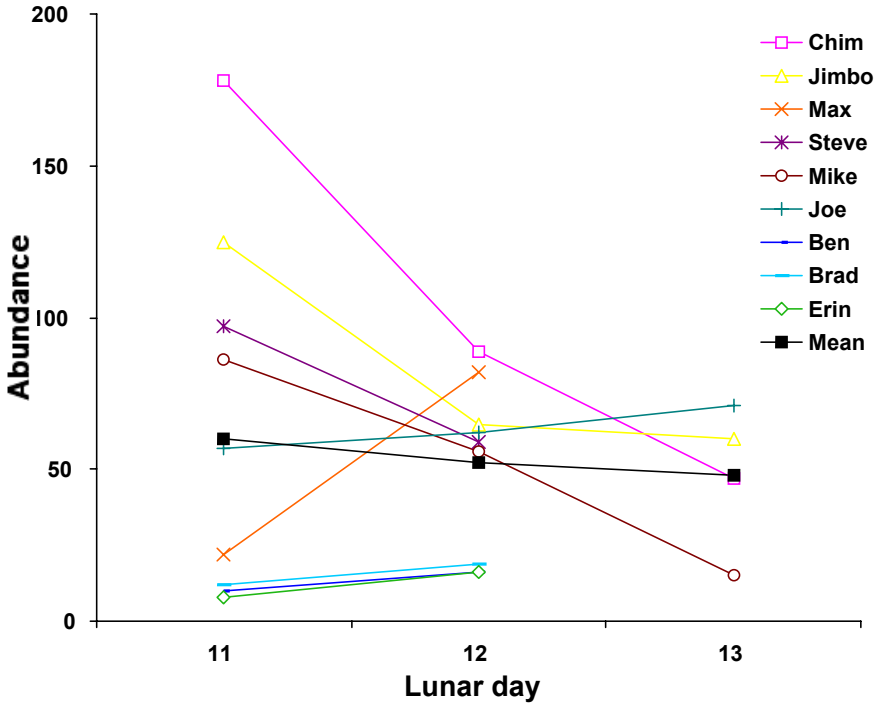

Figure 6: Abundance data trends (no. per 18 000 sq. ft) for squaretail coralgrouper taken from counts by participants at KMS. The wide count spread between trainees shows the importance of focusing on counts in initial training and conducting length frequency training in subsequent advanced monitoring workshops.

TRAINING SKILLS: SPAWNING SIGNS AND BEHAVIOR ASSOCIATED WITH AGGREGATIONS

Trainees also learned to observe and record spawning signs and behaviors associated with aggregations. Within aggregations at KMS, color change and color phases (Figures 7, 8 and 9), courtship and aggression (Figure 10) were observed for squaretail coralgrouper. Gravid females and bite marks were not observed. Only two observational dives were conducted on brown-marbled grouper with grouping and color change (Figure 11) observed, but not recorded.

Figure 7: Barred phase squaretail coralgrouper, *Plectropomus areolatus* (K Rhodes)

OBSERVATIONS: DISTRIBUTION, DENSITY AND ABUNDANCE

At KMS, distribution, density and abundance of coralgrouper varied daily. Initial observations showed coralgrouper to be distributed from approximately 20-25 m depth to 50 m depth and primarily along the wall. As the full moon approached, coralgrouper distribution came to include areas along the reef flat above the wall and toward the lagoon for approximately 30 m from the wall-flat interface. In addition, the species individuals were commonly distributed along the wall-flat interface up to 15 m depth (15-50 m).

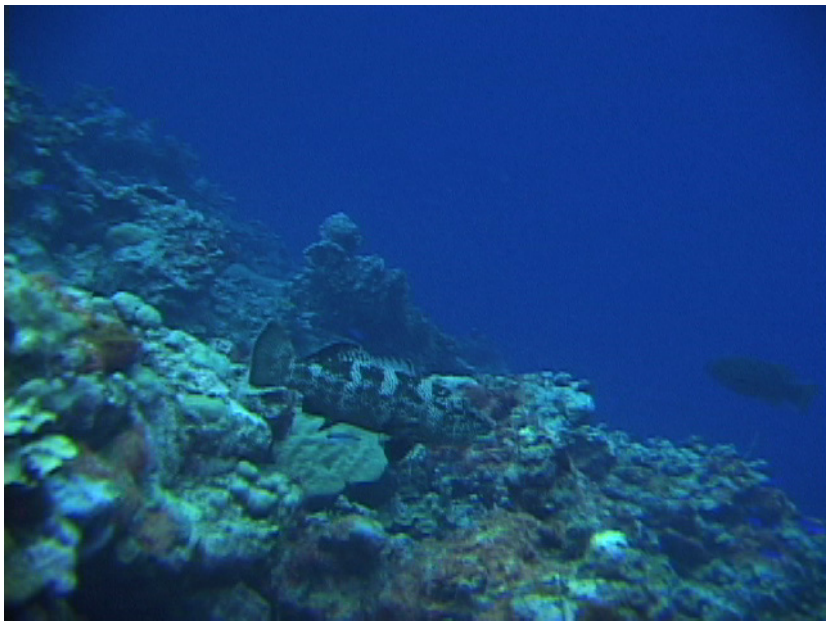

Figure 8: Camouflage phase squaretail coralgrouper, *Plectropomus areolatus* (K Rhodes)

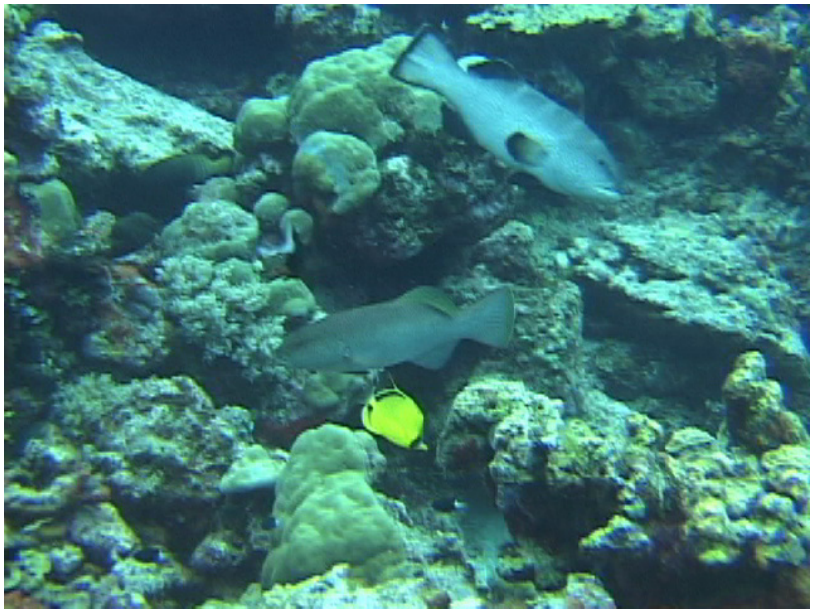

Figure 9: Yellow-green (female- bottom left) and bi-color (males, female-upper right) squaretail coralgrouper, *Plectropomus areolatus* (K Rhodes)

Figure 10: A yellow-green (left) individual being chased by a barred individual (right) squaretail coralgrouper, *Plectropomus areolatus* (K Rhodes)

Figure 11: Color change in a male brown-marbled grouper (A Smith)

In contrast to observations in previous years, coralgrouper were distributed farther to the north and within the traditional aggregation site for camouflage grouper (absent during the workshop period) and over a shorter linear distance along the reef (450 m vs. 500 m). Otherwise, the aggregation shape (square) and dimensions were similar to previous observations.

Brown-marbled grouper were not targeted during the workshop period for training, but the aggregation was dived upon on lunar day 11 and 14. Individuals were sparsely distributed and the upper boundary deeper than observations in previous years (25-50 m). The shape of the aggregation and fish density was not noted.

RECOMMENDATIONS BASED ON FINDINGS

Monitoring spawning aggregation sites is an important component of effective marine resource management, particularly for documenting the effects of aggregation fishing and management effectiveness. Aggregations are site-specific and are typically comprised of a substantial portion of the total number of fish spawning within the local population. Formation of these aggregations is typically brief, e.g., 1-2 weeks over only a few months and around particular lunar phases. The loss of these aggregations from overfishing can have severe negative effects on local and regional populations, as well as the local communities that depend on these resources for food and income.

MONITORING

Investigations of abundance and distribution of spawning aggregations of grouper at KMS have been conducted since 2001 and provide invaluable data for management and conservation of aggregating species (*Epinephelus polyphekadion*, *E. fuscoguttatus*, *Plectropomus areolatus*). As discussed during the workshop training, short-term monitoring (2001-2003) results provided by CSP and the Department of Marine Resources and Development have provided managers with information on (1) the seasonal reproductive patterns of the three species at the site (2) variation in site and habitat use among and within spawning months, and (3) short-term abundance and length frequency of individuals within the sites and (4) seasonal variations in abundance and length frequency within the reproductive seasons.

Based on this evidence, management can now alter their current sales ban strategy from a blanket ban on all grouper species during March and April, inclusive, to one that targets specific spawning times for individual grouper.

RECOMMENDED CHANGES TO THE SALES BAN, BASED ON MONITORING FINDINGS (2001-2003)

Short-term monitoring by the Department of Marine Resources and Development and the Conservation Society of Pohnpei have provided data on spawning season for three aggregating groupers at the Kehpara Marine Sanctuary. Based on these findings, the State should now consider the following species-specific changes to the sales ban on groupers.

Plectropomus areolatus: A sale and catch ban should be instituted for this species from January until May. A substantial number of mature individuals were available in the market during the workshop period (February 2004), providing indirect evidence that at least one other aggregation of squaretail coralgrouper exists in Pohnpei's coastal waters. Although the species appears to be protected at Kehpara Marine Sanctuary throughout the spawning season, other aggregation sites remain vulnerable, particularly during the periods not currently covered by the sales ban (Jan-Feb and May) when squaretail coralgrouper are likely spawning.

Epinephelus fuscoguttatus: A sales and catch ban should be instituted during the spawning season for brown-marbled grouper, which from monitoring results, appears to be from January-April. Similar to squaretail coralgrouper, aggregations outside KMS are vulnerable to fishing during January and February and should be provided protection through and extended, species-specific sales ban, combined with a catch ban.

Epinephelus polyphekadion: Consistent with previous recommendations from 1998-present, a sales and catch ban should be extended for camouflage grouper to include February, as well as March-April.

At a minimum, the sales ban should be changed to 1 February-April 30 and a catch ban should be combined with the sales ban for all species of aggregating grouper to improve management.

DIVER DISTURBANCE

Diver disturbance on the aggregation was noted on several occasions. Disturbance resulted in fish movement away from their established territories, causing disputes between these and other fish in adjacent territories. During courtship, these types of disturbances could result in negative impacts in pairing between mates. The impacts to reproductive output are unknown. Spawning in these species occurs nocturnally and diver disturbance to impact spawning is likely negligible. The current ban on diving over the period from January-June should continue until further evidence is available on diver disturbance to spawning behavior, but should be limited only to areas where aggregations are known to occur. In short, the area around the channel mouth (Kehpara Channel) and to the south of the channel should be open to divers.

ENFORCEMENT AND LICENSING

Enforcement at Kehpara Marine Sanctuary is inadequate. Proposed improvements to move conservation officers under the command of the Pohnpei Office of the Attorney General may provide an improvement to the current situation if, and only if, nighttime patrols become regular at KMS and violators are punished. More than a single conservation patrol is needed to catch violators at the site, i.e. at least two boats are needed to pursue suspects. Licensing all boats in Pohnpei will assist conservation officers in identifying violators.

CONCLUDING REMARKS

Pohnpei has established itself as a regional leader in spawning aggregation conservation and management. Although preliminary, the measures that Pohnpei has implemented to manage and conserve spawning fish appears to be producing substantial benefits. Preliminary findings from monitoring suggest abundance of spawning fish at KMS are stable, although long-term data is needed to determine the overall effects of protection. Therefore, to verify the effects of conservation and management continued monitoring is needed.

The recent monitoring workshop at Black Coral Island provided the necessary training for monitoring at KMS and other local spawning aggregation sites. The first step is to use skills training from the BCI workshop to determine spawning seasons and species for each respective state. The next step is for trainees to use monitoring skills in locating aggregations in their individual states and design and implement monitoring and management at those sites.

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APPENDICES

APPENDIX 1: Workshop Participants Contact Information

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