# Conserving and managing spawning aggregations: a report on the work and aims of the Society for the Conservation of Reef Fish Aggregations (SCRFA) and the importance of science in conservation and management

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## Introduction

Spawning aggregations of reef fishes are among the most remarkable biological phenomena found in shallow tropical marine waters. Each year, often for a just a brief period, hundreds or thousands of fish leave their regular shelters and travel across the reef, sometimes for hundreds of kilometers, to reproduce in vast reproductive gatherings. These aggregations are known as spawning aggregations and may only occur for a few weeks, often in the same place, year after year. Given their predictability in timing and location, that fishers have long targeted aggregations of some species as a welcome bonanza, for many fish can be caught easily and quickly. In the past, when fishing pressure was low and for subsistence only, aggregations could persist. However, as fishing pressure increased through improved fishing gear and growing demand for trade, aggregations declined and many no longer appear to form at all. As these aggregations become decimated, fish populations that depended on them dwindle. There is surprisingly little awareness or understanding of the biological importance and vulnerability of spawning aggregations or of their relevance to reef fish fisheries. Most importantly, they are virtually never managed.

Spawning aggregations are critical in the lives of many larger reef fishes as they are the only time that reproduction is known to occur. Overfishing has already seriously depleted a substantial number of aggregations of many species in the Caribbean and tropical western Atlantic, and some aggregations that once consisted of thousands of fish no longer form at all. While information is considerably less for the Indo-Pacific, we know from anecdotal evidence that spawning aggregations of groupers, snappers and other valuable reef fishes are also systematically targeted for both export and local use. The conservation of aggregations is an important part of ensuring the persistence of the fish populations that form them as well as the fisher livelihoods that depend on them. There is a pressing need to improve our ability to study and document these aggregations, using good scientific practice, to protect, manage and conserve them. Addressing such problems was the primary reason for the establishment, in June 2000, of the Society for the Conservation of Reef Fish Aggregations (SCRFA).

SCRFA was formed to unite a diverse group of concerned individuals, from regulatory bodies, NGO's, scientists and fishery managers, to educators and the private sector, to directly support, promote, influence and facilitate relevant initiatives directed towards the goal of aggregation protection and management. Specifically, we aim to raise awareness of the vulnerability of spawning aggregations to exploitation and the need for management. We also aim to identify options, facilitate policy development and ultimately build capacity for conservation and management. This case study reports on the aims, progress and preliminary outcomes of SCRFA's work.

The work of SCRFA is currently funded by the Packard Foundation and is run through the Pfleger Institute of Environmental Research and the University of Hong Kong. The work initially had main objectives.

*Objective 1*: **To create a global database documenting the status and history of reef fish spawning aggregations**

*Action:* To develop a comprehensive global database as an overview of the history and current status of exploited reef fish aggregations, from the literature, unpublished reports and accounts, and from field interviews and surveys, with emphasis on the western Pacific.

*Progress*: Over 350 aggregations have now been entered into an MS ACCESS database which will soon be searchable, using a website-based front-end. The database is intended for use by the public for research, preparation of proposals, projects, etc., and to identify data gaps and shortcomings, among other uses. The search engine being developed to allow the global database to be searchable will also facilitate data entry into the same site in a standardized manner. The exact locations of spawning aggregations in the database will be kept confidential, but will be maintained in SCRFA records to allow for analyses of time-series of data on specific sites. Scientific papers and popular articles are being prepared to draw attention to the issues in different sectors of society.

The format of the database is comprehensive and involves about 30 parameters as well as a set of detailed guidelines; these, and a preliminary summary of the database to date, appear on the SCRFA website (www.scrfa.org). The database took approximately 6 months to develop through the collaborative efforts of many SCRFA members and its final form benefited considerably from the wealth of experience and knowledge. A preliminary summary of the database already reveals some interesting patterns. Eighty-four species from at least 17 families aggregate to spawn although the majority of information is from the groupers (Serranidae) and the snappers (Lutjanidae). Of all the records that indicate aggregation status (about one third of total), 70% show declining numbers while the remaining ones, thought to be increasing or stable, are either little exploited or are protected. The majority of records, however, had no indication of current status, clearly an area that needs follow-up.

While the great majority of records are from the tropical western Atlantic and Caribbean, data are increasing from the Pacific and will be substantially augmented by our western Pacific field surveys, three of which have just been completed. The predominance of data from the tropical western Atlantic and Caribbean is more of a reflection of the regions where aggregation research is being conducted than a true indication of the relative numbers of aggregations in different regions. Few datasets have landings or catch per unit of effort data, clearly an area that needs more attention.

*Assessment*: The development of the database input and output needed considerable time and fine-tuning and benefited considerably from consultation among SCRFA members. As just one example, significant debate was needed to resolve the question of whether or not to maintain aggregation site locations confidential (when this information is not already widely accessible); on the one hand, knowledge of a site could enable it to be protected, on the other, protection is not common and in most places the appropriate legislation is not yet in place. This means that sites that are revealed prematurely are vulnerable to fishing and could rapidly be fished out before protection is put in place. There was a clear consensus that aggregation site locations should not be made widely available unless protective legislation is already in place.

Review of available data clearly revealed gaps and directions for future initiatives as well as a need to tighten terminology and ensure greater scientific rigor, especially in assessing fishery-dependent data from aggregations. For example, in developing the database, it became clear that guidelines were necessary to distinguish spawning aggregations from other types of aggregations (fishes may aggregate for reasons other than spawning) and that there were many examples of aggregations being reported with little supporting evidence. Also of interest was the finding, that relatively few publications featured spawning aggregations until the 1990s when there was a surge in work and publication of studies; of all publications reviewed, approximately 25% were produced before 1990. This is one reason for the lack of awareness of or interest in aggregation management until the last decade.

The overview of information on spawning aggregations provided by the database makes a strong and clear collective case for managing and protecting reef fish spawning aggregations. This has resulted in the development of a Statement of Concern (Appendix – see Objective 3). Moreover, the many inconsistencies in data reporting and wide range of methods applied led to recognition of the need for a comprehensive Methods Manual to guide workers (see Objective 4). It is hoped that carefully designed monitoring protocols can reduce waste of time and money and enhance the ability to assess the effects of management.

*Objective 2*: **To provide a widely accessible source of aggregation-related information**

*Action*: To develop a website with a range of information readily accessible and usable by workers, managers, students, policy-makers and the general public.

*Progress*: The new SCRFA website (www.scrfa.org) provides a range of information, materials and links on aggregation-related issues, as well as a Newsletter that will be produced four times a year (No. 1 came out in December 2002: http://www.scrfa.org/doc/newsletter.pdf). Educational materials are being prepared ranging from the biology of aggregating species, case histories, FAQs, management options, lesson plans, teaching packs, etc.

*Assessment*: Interest in the website has been good with almost 500 hits since launching in late January 2003. This is very much work in progress.

*Objective 3*: **To provide information and guidance to policy and the development of fishery and conservation guidelines**

*Action*: To participate in local, regional and international workshops, conferences and other forums to raise awareness about spawning aggregations and their management and conservation. By so doing, to foster and promote the development of standards and guidelines for managing and conserving reef fish spawning aggregations.

*Progress*: SCRFA has provided input on draft management plans, research proposals, made presentations at international conferences and variously submitted Society support for management and conservation initiatives. Specifically, Society support for aggregation protection has been submitted to the governments of Australia, Bahamas, New Caledonia and Pohnpei, while project review and information have been provided to several nations in the Indo-Pacific seeking to learn about and manage their local reef fish spawning aggregations.

SCRFA input has been provided in the development of a set of Voluntary Standards (an initiative spearheaded by several NGOs in the Indo-Pacific) being developed for the live reef food fish trade. The standards will recommend that it is inappropriate for spawning aggregations to be exploited for the live reef food fish export trade. Aggregation protection is also now a priority for the IUCN Specialist Group on Groupers and Wrasses.

Presentations on the work of SCRFA and on the need to protect and manage spawning aggregations have been given in Fiji, Australia, USA, Canada, Italy and Hong Kong. During field surveys, presentations are given, as opportunity arises, to communities, government officials and other interested groups on the biological importance and vulnerability of spawning aggregations. During 2003 so far, talks have been given in Papua New Guinea, the Solomon Islands and within the Federated States of Micronesia.

A Statement of Concern on spawning aggregations has been developed (see Appendix).

*Assessment*: The developing understanding of spawning aggregations and their biological importance and vulnerability is relatively recent and aggregations are rarely managed. Spawning aggregations were listed as one of the top priorities in a 2001 workshop on the IUCN marine program. The information and various responses and inputs emerging from the results of our work and participation in various forums is contributing to the increasing inclusion of aggregations into debate and guidelines on reef fish management. Aggregations also appear to have a higher profile in discussions on MPA planning than a few years ago.

*Objective 4*: **To develop a comprehensive Methods Manual for studying and monitoring spawning aggregations**

*Action*: To develop a Methods Manual as a comprehensive reference that brings together available methods and approaches applied to studying aggregations. Also, to promote the use of good science in aggregation-based research and assessment.

*Progress*: A wide variety of methods are used to document and study spawning aggregations. These are often inconsistent and may not always meet acceptable levels of scientific rigor. None of the recent manuals on reef fish assessment provide specific guidelines for dealing with aggregations. SCRFA recognized the need for a comprehensive manual that examines methods for studying and assessing spawning aggregations, makes recommendations for standardizing this field of research and that can act as a reference for the development of practical guides and protocols tailored to address specific needs and circumstances. This manual (*Manual for the Study and Conservation of Reef Fish Spawning Aggregations*, prepared by Pat Colin, Yvonne Sadovy and Michael Domeier is SCRFA Special Publication No. 1.) is now available on the SCRFA website (www.scrfa.org), and is being distributed as hard copy and on CD.

It is hoped that this manual will encourage researchers, managers and other workers to adhere to reasonable standards of documentation of aggregation and spawning studies and assessments so their information can be accepted into the pool of scientific knowledge and become valuable conservation tools.

The objective in producing a comprehensive manual is to have workers use methods, whenever possible, that are standardized, comparable and reproducible, as well as scientifically sound. Fishery-dependent and fishery-independent means of assessing aggregations can be challenging to develop and need to be carefully designed. Moreover, there is a wide range of available research tools, such as low-light sensitive underwater video cameras, reliable diving equipment, advanced telemetry, instrumentation and navigational equipment that many workers may not be aware of. The manual discusses the problems and advantages of the various approaches, appropriate scientific methodology and application and constraints of results.

*Assessment*: Developing the manual revealed some of the considerable difficulties inherent in assessing and monitoring aggregations; further work will address an appropriate protocol. Feedback has revealed that the Methods Manual is proving to be extremely useful as a tool for working on aggregations and as a result will be distributed in hard copy as well as in the web-based format originally intended. Limitations in server capacities in some areas meant that even the sub-divided web-based sections of the manual could not be downloaded and hard copies were made available to address this problem. The Manual can be used as a basis to develop protocols to tailor many different research and monitoring needs while making best use of available funding/manpower.

## Lessons learned

The compilation of information and the development of various means of making it accessible to a diverse readership on the little understood issue of spawning aggregations and their biology and management has had several important outcomes. SCRFA can play an important role as an impartial, independent and focal point for information on aggregating species to a wide range of people, from students and teachers to government officials, to researchers and NGOs. The Methods Manual can be used to standardize information and promote the use of good science in aggregation research, assessment and management. The global database has enabled us to identify data gaps and areas where further initiatives can be developed, and to develop a Statement of Concern to try to advance an agenda of aggregation conservation.

The open engagement of a knowledgeable and experienced group of workers in compiling materials and discussing options (as in the SCRFA membership in this case) can be time-consuming and frustrating but ultimately produces a comprehensive and informed perspective. The easiest approach to aggregation conservation almost certainly involves complete protection from fishing either through protection of the aggregation site itself or through seasonal protection. However, it is clear there is no one approach that can be adopted successfully in all cases to protect aggregations, such that an agenda which seeks to operate top-down too rigidly by advocating a specific approach or solution to this complex problem is unlikely to achieve widespread success. SCRFA has much to learn of the challenges of managing aggregations that continue to be fished.

## Recommendations

- Ensure that conservation, monitoring and management initiatives have a sound scientific foundation and are practical, and that science plays an important role in developing solutions to problems of conservation. Good data will reflect changes in exploited resources over time and improve the chances that conservation goals are achieved and the effects of management can be assessed.
- Continue to disseminate information via the website, popular articles, regional meetings and conferences so the need for conserving spawning aggregations becomes regularly considered in fisheries management and MPA design.
- Identify projects that address data and other shortcomings identified and move the agenda on aggregation protection forward.

# APPENDIX

## Statement of Concern:
## Reef Fish Spawning Aggregations need Protection

The sustainable and equitable use of coral reef fish fisheries poses difficult challenges. Many reef fishes are already overfished, some face serious pressure from habitat destruction and a few are threatened with local extinctions. Reef fishes are increasingly sought by rapidly expanding export trades in high value consumer markets, yet many cannot sustain heavy fishing pressure because of their life history characteristics, and in particular their reproductive strategies.

Most commercially valuable reef fishes are especially vulnerable to overexploitation because they form short-term spawning aggregations that are highly predictable in time and location. These aggregations, and in some cases their migration routes to the spawning sites, are easy to find and target by fishers. The evidence is unequivocal that spawning aggregations can be decimated within a few years by heavy fishing, resulting in serious declines in the fish populations they serve. An extreme, and now well-known, example is that of the Nassau grouper, *Epinephelus striatus*, a species seriously threatened by aggregation-fishing in the tropical western Atlantic. A significant number of Nassau grouper aggregations are depleted in the tropical western Atlantic, and some have possibly disappeared completely. The species is listed as endangered on the IUCN Red List of Threatened Species. Evidence is growing of similar cases for other reef fish species throughout the tropics.

Reef fish spawning aggregations are seldom managed or protected. Management and conservation initiatives must specifically address protection measures for times and sites at which spawning aggregations occur. It is vital to ensure successful reproduction and recruitment of aggregating fishes to ensure the persistence of the fish populations involved. Management options include short-term closure of aggregation sites, incorporation of aggregation sites into marine protected areas, protection of aggregating species during the spawning season and judicious control of fishing catch and effort. Protection and management of aggregation sites and of aggregating reef fish species are essential to ensure a healthy reef ecosystem, as well as for the long-term well-being of the coastal communities that depend on them.

***Key recommendation*** **is for all fish spawning aggregation sites to be conserved, through judicious management or complete protection, to ensure persistence of the populations and species that form them, the integrity of reef ecosystems and the livelihoods and food supply of coastal communities that depend on aggregating species.**