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Region

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**FISH SPAWNING AGGREGATIONS IN THE WIDER CARIBBEAN
WITH EMPHASIS ON THE NASSAU GROUPER**

Fish Spawning Aggregations in the Wider Caribbean with Emphasis on the Nassau Grouper

Background

1. Species that periodically and predictably congregate in large numbers on land or in the sea can be extremely vulnerable to overexploitation. Several commercially important coral reef fishes form spawning aggregations that are increasingly the target of fishing. In a recent compilation of information on the status and history of commercial reef fish aggregations globally, 80% of those that are sufficiently well documented were reported to be in decline, including many in the Caribbean and tropical western Atlantic (Sadovy et al., 2008; www.scrfa.org). This finding has important conservation implications for already threatened species, and fishery management implications for many that are commercially taken; for a number of species a significant proportion of annual landings come from fishing on their aggregations. Moreover, many of the fishes that exhibit the aggregating habit are species with other biological characteristics, such as long life and slow sexual maturation, that otherwise make them particularly vulnerable to fishing. As far as we know all of the annual reproduction occurs in the aggregations of these species. While currently there is little effective management of existing exploited spawning aggregations, the few success stories that do exist clearly demonstrate the benefits of effective aggregation management.
2. A major shift in perspective on spawning aggregations of reef fish, from being seen as opportunities for exploitation to acknowledging them as important life-history phenomena in need of management, is urgently needed, to remove threats from more vulnerable species and to restore affected fisheries. Almost all groupers proposed for listing as threatened on the World Conservation Union (IUCN) Red List form spawning aggregations (www.iucnredlist.org - Red List 2008).
3. Some of the larger species, predominantly the groupers and snappers in the Caribbean, that form spawning aggregations may also be particularly vulnerable to fishing outside of aggregations; combined with aggregation fishing populations can show marked declines. In some areas, increased protection is needed during the months before the fishes spawn or between spawning periods when they are also heavily fished. In some cases, even more complex threats arise that require solutions at the broader scale of coastal planning. For example, once-remote federal marine protected areas in the Mexican Caribbean, including some aggregations, are now compromised by the impact of major new tourism and coastal development pressures associated with the rapid increase in large cruise ships seeking new and unspoiled destinations (e.g., Arias et al., unpublished data). Coastal construction can seriously disrupt near-shore spawning runs. Many of the groupers and snappers are among the top predators in coral reef ecosystems; as such, they play an important role in limiting populations of other reef fishes and invertebrates (Hixon and Beets 1993; Eggleston *et al.* 1998) and affect coral reef fish community structure (Mumby *et al.* 2006). Their loss, therefore, is likely to have implications beyond the individual species.

Main issues for the Caribbean (both general and specific to Nassau grouper)

1. One of the best known examples of the demise of fish spawning aggregations due to over fishing is that of the Nassau grouper (*Epinephelus striatus*), which is now classified as 'Endangered' primarily due to aggregation fishing. This species is known from 38 countries/territories and was the first reef fish, and one of the only fully marine commercial species ever, to be listed as a species of concern under the U.S.A. Endangered Species Act. The species may travel more than 200 km from its resident reef to widely known aggregation sites, where all annual reproduction, as far as biologists are aware, predictably occurs over just a few days in one to two months each year. Many of its aggregations no longer form or do so with much reduced numbers and are not recovering despite various management measures. Poor or no enforcement and the small local spatial scale of management initiatives, appear to be largely to blame (Sadovy & Eklund 1999; Sala et al. 2001; Claro & Lindeman 2003; Sadovy et al. 2008). Despite a decade of management initiatives in many countries, few are enforced and most are only partial, in either time or space. **SEE TABLE.**
2. Nassau grouper spawning aggregations have historically been reported to attract tens of thousands of fish; nowadays however, few exceed a few hundred fish and many have disappeared completely; over 50% of all known aggregations appear to have stopped forming (Sadovy et al., 2008). While the Nassau grouper was once one of the most important fishery species throughout the islands of the Caribbean region, over-fishing, in particular of spawning aggregations, has reduced populations to such low abundances that the species is considered commercially extinct and no longer forms spawning aggregations over most of its range.
3. The Bahamas is probably the last country in which the species persists in any numbers, and may be an important key for the future of viable populations. Although data are limited, populations may be in reasonable condition in the Cayman Islands, Turks and Caicos Island and British Virgin Islands, either because of management or because there has not yet been a heavy focus on their aggregations. In light of the apparent importance of spawning aggregations for the maintenance of Nassau grouper populations, conservation strategies for Nassau grouper should include fishery closures during spawning times and protection of spawning aggregations, in addition to other fisheries restrictions and habitat protection measures, especially of nursery areas. Given the long-distance migratory habits of the species, strict region-wide measures are essential to be most effective. Although there are many protected areas in the region, a review of marine reserves in the Caribbean shows that only 10% of marine reserves explicitly consider spawning-aggregation management and fewer than this focused specifically on the Nassau grouper at the time of the review (Appeldoorn and Lindeman 2003).
4. The Nassau grouper is increasingly recognized for its economic importance in relation to dive tourism: encounters with large groupers, facilitated by the species' approachability, are very appealing to divers (Rudd and Tupper 2002). This non-extractive value may exceed its value as a fishery species in regions economically oriented towards marine-based tourism.

Recommendations

1. There is a need to manage commercially important species that aggregate to spawn and that are fished on their aggregations at a regional (i.e. international level) because of the long distance movements conducted by some species as adults between their resident reef and the aggregation site(s). Such movements mean that these species cannot be effectively protected by small MPAs. Where movements occur between countries, differential management effectiveness can undermine efforts in countries with better management practices.
2. Even though MPAs might occasionally include spawning aggregations, this is not a typical aspect of MPA design. Moreover, conventional fishery management approaches, whether spatial or through input-output fishery controls, do not typically include aggregation management. Even where measures do exist, enforcement is often inefficient. MPAs and management need to develop appropriate measures to encompass species that aggregate to spawn.
3. Fish continue to aggregate, even though a fish population is being fished, giving an impression of abundance until population levels become extremely reduced when they crash (e.g., hyperstability; Sadovy & Domeier 2005). This means that, if exploited, aggregations should always be identified for management consideration and monitoring protocols.
4. Declines in aggregations are not widely recognized or perceived as a problem. There is a need for a better understanding of aggregations in relevant socioeconomic sectors, including in government.
5. Multiple management measures, including non-aggregation management for targeted aggregating species, as well as aggregation protection, are needed. Particular attention should be paid to those species that aggregate for very short periods and occupy few known spawning sites, such as the Nassau grouper.
6. A lack of understanding of adult and larval connectivity among aggregating species makes it difficult to effectively apply spatial protective measures at a local level, and additional measures, such as regional protection, should be considered.
7. Aggregations typically are viewed as important fishing opportunities for high and efficient catch rates, rather than recognized as vulnerable life-history events that need priority protection; this perception needs to be changed by outreach and education.
8. In the case of the Nassau grouper, action is urgently needed to stem further declines until its fisheries significantly recover, or until effective management has been implemented at a regional level.
9. A precautionary approach is needed when a fishery targets aggregating species. This is in line with the FAO Code of Conduct for Responsible Fisheries, and under statements of concern or recommendations by IUCN delegates at the 3rd World Conservation Congress, ITMEMS2 and ICRI.

10. Governments of the Wider Caribbean and Contracting Parties to the SPAW Protocol may wish to consider initiating a process of review for the possible inclusion of Nassau grouper (and other critically important reef fish species) in Annexes II or III of the SPAW Protocol with a view of raising their protection status and ensuring their sustainable management.

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Table 1. Management measures for Nassau grouper *Epinephelus striatus*
(adapted from Craig Dahlgren, IUCN Shatter the Myth report, unpublished)

Jurisdiction	Management Measure	References
Bahamas	Minimum size limit of 3lbs/1.36kg established in 1980s; no-take marine reserve established in the Exuma Cays in 1984; seasonal closure of specific spawning aggregation sites first implemented in 1998; annual ca. two-month (variable according to full moon) first implemented in December 2003, and renewable annually.	Sadovy and Eklund (1999); DoF (2003); Fisheries Resources (Jurisdiction and Conservation) Regulations (Statutory Instrument N°10), 1986; SCRFA (2005b)
Belize	As of 1 November 2003, closed season (prohibition on take, purchase, sale and possession) in effect from 1 December through 31 March, except for traditional, licensed fishing at two sites; 11 no-take marine reserves, established in 2003, protect spawning aggregation sites for Nassau grouper and other species year-round, with exception for limited, specially licensed traditional fishing	Fisheries (Spawning Aggregation Site Reserves) Order (Statutory Instrument N°161), 2003; Fisheries (Nassau Grouper Protection) Regulations (Statutory Instrument N°162) of 2003
Bermuda	Completely protected through prohibition on take and possession; possibly benefits from numerous no-take marine reserves	Sadovy and Eklund (1999)
Cayman Islands	Effective 29 December 2003, fishing closed at 6 Nassau grouper spawning sites for a period of 8 years. In adopting this decision, the Marine Conservation Board noted that three of the six areas were “fished out and two in serious decline.” Additional legislation being considered.	SCRFA (2003b)
Cuba	Fishery quota established in mid-1980s; minimum size limit of 570g or 20cm in length entered into effect on 2 January 1997	Sadovy and Eklund (1999); Resolución N°561/96 del Ministerio de la Industria Pesquera
Dominican Republic	Prohibition on fishing during spawning season	Sadovy and Eklund (1999)
Mexico	Prohibition on spearfishing (implemented in 1990) and use of gillnets at spawning aggregation sites; A closed season for all grouper species from 15 February to 15 March was established for the first time in February 2003; it applies to all waters of the Mexican EEZ from Campeche and Yucatán (Gulf of Mexico) and Quintana Roo (Caribbean) states, as well as from Rio San Pedro, between Tabasco and Campeche states to the Belize border	Sadovy and Eklund (1999); SCRFA (2003a)
Puerto Rico	Take and possession in US federal waters (9-200 nautical miles) prohibited in November 1990; take, sale, and pursuit in state waters (up to 9 nautical miles) prohibited in March 2004	CFMC (1996); Puerto Rico Fisheries Regulation N°6768 (DENR)

Florida, USA	Take and possession prohibited in federal waters in November 1990 and in state of Florida in 1993; protected in Dry Tortugas Marine Reserve and Florida Keys National Marine Sanctuary; listed as Species of Concern by US National Marine Fisheries Service	Anon. (2004a, b)
Turks and Caicos Islands	One spawning aggregation site protected from fishing in Northwest Point Marine National Park, Providenciales	(DECR 2004); National Parks Ordinance and Subsidiary Legislation CAP. 80 of 1988
US Virgin Islands	The first spawning season fishery closure, from 3 December 2005 to 14 February 2006, was established for Nassau grouper and yellowfin grouper <i>Mycteroperca venenosa</i> at Grammanik Bank, St. Thomas; Hind Bank Marine Conservation District (14mi ²), St. Thomas, closed to fishing year-round in 1998, protects red hind spawning aggregation and former Nassau grouper spawning site; several no-take marine reserves; no take or possession from US federal waters (3–200 nautical miles offshore) entered into effect in 1990	CFMC (1996); www.scrfa.org ; DPNR (2005)