Endangered and Unlucky: Region-wide Action Needed for Recovery of the Nassau grouper, *Epinephelus striatus*

En Peligro de Extinción y Mala Suerte: Acción de Toda la Región es Necesario para la Recuperación del Mero de Nassau, *Epinephelus striatus*

En Voie de Disparition et Malchanceux : Action Régionale Nécessaire pour la Récupération de la Mérou de Nassau, *Epinephelus striatus*

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ABSTRACT

The threatened Nassau grouper, with a few important and notable exceptions, continues to decline throughout its geographic range. Unaddressed and emerging threats are set to worsen the situation. Without regional action that harmonizes management across the region, we risk the loss of this iconic species and the benefits it brings. Failure find the means and political will to save the Nassau grouper, sets the scene for sequential loss of other valuable and vulnerable species with serious consequences for food security and seafood independence for many communities in the region and ongoing threat to marine biodiversity.

KEY WORDS: Threatened fish, spawning aggregation, regional management

BACKGROUND

The Nassau grouper is one of the most threatened marine teleosts of once major commercial significance (Sadovy *et al*. 2013). It was listed as globally threatened in 1996, according to IUCN Red List criteria and categories, and again in 2003 (Cornish and Eklund 2003), and included as threatened by the American Fisheries Society (Musick et al. 2000, NOAA 2009). Its status is currently being assessed under the United States Endangered Species Act and reassessed under IUCN criteria. This summary builds predominantly on two reviews of the status of the species and its fishery condition (Sadovy and Eklund 1999, Sadovy 2012a – see original reports for full reference listings). The major threat, as far as can be determined, is uncontrolled overfishing especially on its spawning aggregations (e.g. Paz and Grimshaw 2001, Sala et al. 2001, Aguilar-Perera 2006, Semmens et al. 2007). In many respects, this species is 'unlucky' because of its biology and desirability: compared to other fishes in the multi-species fisheries of the region of which it was once a significant part (Sadovy 1993), it is relatively long-lived and large which means that it can only withstand relatively low fishing pressure on a sustainable basis. Its relatively large size at sexual maturation means that even juveniles are susceptible to the widely used fish trap mesh size used in the region. It is also highly susceptible to spear-fishing. Moreover, as a grouper, one of the most highly valued categories of reef fishes, it is a favoured target of fishers and traders (Sadovy et al. 2013)

Critically, the species is especially vulnerable to capture during its spawning season because of its habit of forming spatially and temporally predictable spawning aggregations and migrations that, once discovered, are usually subjected to intense and uncontrolled fishing pressure. While there are other commercial species that aggregate to spawn, the Nassau grouper is distinctive in having (at least historically) particularly large, relatively few (less than 100 documented throughout its range), and highly concentrated aggregations, evidently making the species especially prone to overfishing (e.g. Claro et al. 2009, Sadovy de Mitcheson 2012a). The majority of known aggregations (> 50%) evidently no longer form while those remaining are severely reduced compared to historic levels (Sadovy de Mitcheson 2012a). From estimates of tens of thousands of fish, single aggregations for which there is historic record have dwindled to a few thousand fish at best, usually less (Sadovy de Mitcheson 2012a).

At the national level, fishery landings have declined throughout the geographic range of the species. From a total annual take across all fisheries once exceeding 5,000 mt, the total is now estimated to be less than 500 mt (Sadovy de Mitcheson 2012a). Formerly traded internationally around the region, including out of the Bahamas, Belize and Honduras, remaining international trade currently appears to be largely into the United States from the Bahamas. Data suggest that since 1993 the proportion of total Bahamas commercial production of this species exported to the United States annually has consistently been about 10% (by weight). This is calculated based on NOAA statistics of imports of 'Grouper' into the United States (http://www.st.nmfs.noaa.gov/st1/trade/index.html) corrected by a factor of 73% which represents the proportion of all grouper commercially landed in the Bahamas (according to Bahamas national statistics) comprised of Nassau grouper (FAO 2009: http://www.fao.org/fishery/facp/12/en). This calculation assumes that the proportion of total grouper landed that is Nassau grouper is the same as the proportion of the grouper species in exports to the United States.

Several additional possible threats are emerging. As demand for seafood grows globally and wild fish populations of favoured reef fish species decline in many areas, several activities are emerging that have significant potential to add to the

pressures of overfishing if management does not contain them. Compressor-supply diving is being considered or introduced to extend fishing depths and in search of high commodity items such as sea cucumber (*beche de mer*). This opens up areas previously inaccessible to traditional fishing gear, remaining natural refuges for many species, and is easily co-opted to other fishing sectors. International trade is ever easier due to improving transport links and demand is increasing for wild fish with a wealthy customer base that makes expensive air transportation economically viable (examples are the shark fin and live reef food fish trades of Chinese communities) (Sadovy de Mitcheson 2012b). As stocks of favoured finfish species decline, pressure grows to catch fish at a smaller size and retain them in captivity until they reach market size. This practice, known as fattening, ranching or capture-based aquaculture is widespread in Asia for valuable fish species and potentially could be introduced in the Caribbean, if economically viable, where it could drive further growth and recruitment overfishing.

CURRENT MEASURES

A growing suite of management measures reflect ongoing concerns, with a few yielding encouraging signs of recovery or stabilization. Protective action introduced to stem declines range from size limits, gear controls, and spatial protection to seasonal controls and landing specifications, although enforcing such protection is proving to be a major challenge. On the other hand, through concerted, focused, and long-term efforts, indications of recovery are extremely promising. In the Cayman Islands (Cayman Islands Department of Environment 2011), and possibly one location in the U.S. Virgin Islands, numbers of aggregated fish appear to be increasing relative to recorded lows (Sadovy de Mitcheson 2012a, Rick Nemeth, personal communication). It is also very likely that measures have, at the very least, averted further decline in some places in Belize where a multi-sector working group has made excellent progress in gaining public support and conducting long-term monitoring (http://www.spagbelize.org/LinkClick.aspx?fileticket=7doBoeM1PRk%3d&tabid=2807&language=en-US). In the Bahamas, public education campaigns complement the seasonal protection of the species, although, while a commercial fishery is still viable, landings appear to be slowly declining according to official landings figures and fisheries assessment (Cheung et al. 2012).

Elsewhere that information is available, however, there is little indication of recovery and signs of ongoing declines (since 2000 Sadovy and Eklund review, Sadovy de Mitcheson 2012a). Stocks from Hispaniola appear to have completely disappeared while the status of the species remains unclear in Mexico and Cuba, formerly of major importance for the species. Once large aggregations in Mexico (Mahahual) and the Bahamas (Bimini), resurveyed recently, appear to have completely disappeared (SCRFA Newsletter 17: www.SCRFA.org). Although few datasets specifically or comprehensively document CPUE, or otherwise indicate abundance of the species, strong indications of ongoing declines come from aggregation monitoring, fisherman interviews, biological studies, fishery modelling, prices, and catches. Moreover, poaching is occurring or is suspected, particularly out of Honduras, by the Dominican Republic in southern Bahamas water and between the Bahamas and Florida (e.g. Sadovy de Mitcheson 2009, Cheung et al. 2012, Casuarina McKinney, personal communication).

As the Nassau grouper's fishery importance declines, along with the associated drop in overall economic worth, food security and other benefits, so, evidently, does the interest of most countries in its management (personal observation). Given that it is one of the most vulnerable components of the reef ecosystem, its plight, if not addressed, is a harbinger of what will happen to the next most vulnerable species and so on through the fish assemblage. It is critically important, therefore, that the means and political will to stem declines and promote recovery are developed. New approaches and changes in perspectives that will allow for Nassau grouper recovery will also have positive effects down the line on other species. The Nassau grouper is not only an iconic species of western Atlantic and Caribbean reefs, it may yet prove symbolic of our ability or otherwise to control ourselves and continue to enjoy benefits from our reef ecosystem long into the future. It is also symbolic of how little we know our coastal fisheries, how poor is our monitoring and management, and how little attention we are paying to our nearshore areas.

MOVING FORWARDS

Several discussions and meetings have again examined the status of the species and highlighted the need for action. In 2005, a panel of experts met to discuss concerns for the Nassau grouper at the annual GCFI meeting held in San Andrés, Colombia. The experts prioritized management alternatives with highest priority first: closed reproductive seasons; closed spawning areas, limited entry to fishery, MPAs and total closures (moratoria) or any landings with skin on fillet to identify species. Due to growing concerns for the species, the FAO WECAFC (Western Central Atlantic Fishery Commission) meeting in October 2008 in Cartagena recommended that more information be collected on the species and that:

> *"... management of Nassau grouper is more effective at the national level and countries should take national actions to be harmonized at the regional level. The meeting recognized that closed seasons is one of the most effective ways of protecting spawning aggregations when this species is more vulnerable to fishing….Countries that already have closed seasons during part or*

all of this season should try to enforce it. Countries that do not have closed seasons during any or all of this period should consider establishing closed seasons during the full three month period….".

And in Panama, 6 – 9th February 2012, the CFMC/ WECAFC/ OSPESCA/CRFM Working Group on Spawning Aggregations was formed as an expanded version of the Nassau grouper working group, initially formed at the 2008 WECAFC meeting. At the 2008 meeting it was determined that *Concerted and urgent action is needed to allow the Nassau grouper to recover to viable fishery levels with benefits for food security, livelihoods and the reef ecosystem*. In 2013, a meeting is being convened by the CFMC (Caribbean Fishery Management Council) and WECAFC on commercial species that aggregate to spawn and their management.

Given concerns over the status of the Nassau grouper, experiences in managing it, major and emerging threats and our growing understanding of its biology, it is now evident that a regional approach to management is needed that addresses both trade and the biology of the species (Garcia-Moliner and Sadovy 2008). In addition to national and regional measures, other possible actions include the use of international instruments SPAW or CITES. To address the problem of overfishing of the Nassau grouper, 12 measures are relevant:

i) *Prevention of over-fishing during the reproductive season* — overfishing is evidently a major factor in declines in the species, especially during the reproductive season. Options to address overfishing during the reproductive season include one or combination of protecting spawning aggregation sites from fishing, fishing and sales bans during the spawning season and inclusion of aggregation sites in permanent no-take MPAs, or some combination of these measures. All measures have been applied in the case of aggregating fish species and are variously effective. Seasonal or site protection during aggregation are relatively easy to enforce because of the limited time period involved. In general, and beyond the Nassau grouper, experience has shown time and again that the unmanaged fishing of spawning aggregations typically leads to reduced fisheries and that, as a matter of course, spawning aggregations should now be viewed as times to protect spawning biomass rather than as a focus of fisheries. It is also evident that a challenge to assessing stock status is the habit of fish to continue to aggregate eve though a fish population is on the decline, this gives the impression of abundance (e.g., hyperstability; Sadovy and Domeier 2005) and masks overall population declines until the fishery becomes seriously reduced. This has happened in the case of the Nassau grouper (e.g. Cuba; Claro et al. 2009).

ii) *Regional management* — given that the Nassau grouper is either panmictic or has population sub-structuring (Hateley 2005, Alexis Jackson, unpublished data) at the regional level, regional management approaches are relevant. The SPAW (Specially Protected Areas and Wildlife) protocol is applicable to such species. Marine protected areas, an approach widely applied or advocated for reef fisheries, are of limited effectiveness for this species as a sole management measure, due to its extensive adult movements associated with spawning each year and the typically small sizes of MPAs. Adults of the species can be wide-ranging (more than 200 km annual movements) and larval connectivity is largely unknown. Regional measures are needed to stem further declines and it is therefore recommended to consider the inclusion of this species in Annex II or III of the SPAW protocol until its fisheries significantly recover, or until effective management is implemented at a regional level by harmonizing national measures across the region. CITES (see below) is another possible option although international trade in the species is evidently limited.

iii) *Monitoring of fisheries* — to understand current status, long-term trends and outcomes of management in fisheries, regular monitoring is needed. For Nassau grouper this is best conducted on fisheries CPUE and by scientifically rigorous and standardized protocols on spawning aggregations (Sadovy de Mitcheson et al. 2008). Underwater visual census surveys across reefs during non-spawning periods are also valid as long as transects are long enough to be representative.

iv) *Protecting sub-adult fish from capture* — ideally capture size limits for Nassau grouper should be established throughout its range to protect spawning biomass. Minimum sizes at or above the size of sexual maturation (about 400 mm) and maximum size limits to protect the most fecund females would be ideal, and both have been introduced in Belize. Minimum size limits are in place in several countries (e.g. Bahamas, Cuba, Belize, etc.) although in a multi-species fishery such measures may be difficult to enforce since no fisherman likes to return fish to the water and groupers of all sizes are susceptible to a wide range of hook sizes. Similarly, minimum size limits are likely of limited usefulness

because of monitoring difficulties (Rudd 2004). Care is also needed should juveniles become a target of fishing for grow-out in culture or fattening operations, a practice widespread in SE Asia, and carried out with the valuable bluefin tuna. Such juvenile growout may occur as adults become harder to find and if the species continues to be valuable economically, and can further exacerbate both growth and recruitment overfishing.

v) *Quotas* — a widely applied management measure is the 'quota' which limits the amount of fish that can be taken to within theoretically sustainable limits. In multi-species tropical fisheries this is a considerable challenge since it is typically a difficult measure to enforce given high numbers of landing sites and fishers. However, the concept of Total Allowable Catch is increasingly discussed as one means to move towards more sustainable resource use and incentive to manage, and may be a measure to seriously consider in tropical coastal fisheries in future. Export quotas are another possible approach in the facing of growing pressures for international trade in seafood.

vi) *Protecting remnant populations/refuges* — this is necessary in locations where Nassau grouper populations are reduced to the point where there is little evidence of reproductive activity, or where there remain few refuges for spawning stock, and could include nursery, residential, and spawning areas as well as corridors between them. Starr et al. (2007) indicated that the preservation of the Nassau grouper in the Caribbean requires that fisheries closures be maintained during the predictable window of time when all individuals migrate to spawning grounds, that deeper reefs be included in this protection, and that closures be long enough to account for multiple spawning events each year. The increasing use of compressor-fed fishing poses a serious threat to deeper refuges and remaining areas that are currently not yet fished or are not readily accessible. Compressor diving is severely problematic in the Pacific (Gillett and Moy 2006).

vii) *Ecosystem approach to management* — addressing key aspects of the Nassau grouper within the wider ecosystem and the assemblage it forms part of will be key to its long-term persistence as a viable fishery, and as a member of the reef ecosystem in which it lives. For example, since Nassau grouper are often captured as part of a multi-species snapper/grouper fishery, and since returning undersize fish (below minimum legal size) is often not acceptable to fishers, no-take zones are one important measure to prevent undersize individuals from being taken as unwanted bycatch, as well as providing a haven from spearfishing. Given that Nassau grouper make ontogenetic habitat shifts from nearshore to deeper reef areas, MPA design for this species needs to take such considerations into account as well as key areas in life history such as spawning aggregation sites and migration routes to and from them.

viii) *Improved compliance with fishery regulations* — better enforcement of fishery closures and other existing controls on capture of Nassau grouper is needed. This includes addressing problems of illegal unmonitored and unregulated trade in the Bahamas, especially by the Dominican Republic, and elsewhere, and better compliance generally under the Port-State agreement. Monitoring and control of sales during closed seasons or of illegal sized fish could be improved by requiring all sales to be of whole fish or with skin patches remaining on filets (as in Belize).

ix) *Prioritize food security over international trade* — decisions may be needed in countries with remaining viable populations of Nassau grouper regarding whether this species should be retained for local trade and food security as opposed to being part of a significant export trade. It is very likely that the most productive management approach is to preserve aggregations for reproduction without any fishing and for the benefits from the eggs and larvae produced to maintain the fishery and contribute to local food security at other times of the year. In some countries, the value of Nassau grouper for divers rather than restaurants could be explored: high Nassau grouper abundance is an attraction for the dive tourism industry in the Turks and Caicos Islands (Rudd 2003). In other places, such as The Bahamas, the Nassau grouper is highly considered for the restaurant market as a high quality food fish for tourists.

x) *Education, outreach and consensus building* — a better understanding of the need to manage this species, to respect regulations (such as no purchase or consumption during protected seasons) and understand the value and importance of healthy fish populations for food security and livelihoods, the importance of spawning aggregations to fish population persistence, and the value of maintaining intact ecosystems (for example the possible role of

large groupers in bio-predation of lionfish). In general there is a need to awaken interest in the need to manage this species for a range of benefits and the urgency for action to prevent its functional loss from reef ecosystems. Non-governmental organizations have an important role to play in public education and outreach, providing a watchdog role for appropriate government action and also as a platform for consensus building. An excellent example of the latter is the Belize Working Group on Spawning Aggregations established in 2001 to convene multi-sectoral discussion and working plan on spawning aggregations of the Nassau grouper in recognition of their marked declines (http://collaborations.wcs.org/Default.aspx?alias=collaborations.wcs.org/spag&).
The consensus built by the work of this group has achieved major advances in the management of this species in Belize. Examples of excellent education initiatives are also available from work in the Bahamas and the Cayman Islands.

xi) *Research needs* — a better understanding of the biology and ecology of the species would assist management and conservation initiatives. In particular further work is needed on the following:

- o regional population structure
- o the impact of low population numbers on reproductive output; is depensation occurring?
- o habitat needs for different life history phases
- o monitoring of spawning aggregations using robust and standard sampling protocols to identify long-term trends in aggregating numbers
- o catchment areas served by specific aggregations, in particular location and dimensions
- o role of Nassau grouper in predation of lionfish
- o effective and simple protocol for assessing numbers in spawning aggregations reassessment of studied and managed aggregations

xii) *Precautionary approach* — given the history of declines in this species, the statements of concern and management recommendations for aggregating species generally (see below), and Convention on Biodiversity Diversity (CBD) obligations, it is clear that a precautionary approach is needed in addressing its management and conservation needs and is in line with the FAO Code of Conduct for Responsible Fisheries.

INTERNATIONAL STATEMENTS OF CONCERN AND RELEVANT INSTRUMENTS FOR PROTECTION OF SPAWNING AGGREGATIONS

International Coral Reef Initiative

ICRI Statement 2006: ICRI encourages ICRI Operational Networks and Members, as well as other intergovernmental, governmental and non-governmental organizations and the private sector, to contribute……..to the implementation of the recommendation through appropriate projects, initiatives and campaigns that promote the conservation and sustainable management of reef fish spawning aggregations.

United Nations FAO Code of Conduct for Responsible Fisheries

Clause 6.8 All critical fisheries habitats in marine and fresh water ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas, should be protected and rehabilitated as far as possible and where necessary. Particular effort should be made to protect such habitats from destruction, degradation, pollution and other significant impacts resulting from human activities that threaten the health and viability of the fishery resources.

Statement of Concern adopted by the second Inter-Tropical Marine Ecosystem Management Symposium in March 2003

Spawning aggregations should be conserved, through judicious management or complete protection, to ensure persistence of the fish populations and species that form them, the integrity of reef ecosystems and the livelihoods and food supply of communities that depend on aggregating species.

International Union for Conservation of Nature

In November 2004, a Recommendation to better protect and manage reef fish spawning aggregations was adopted by the 4th IUCN World Fisheries Congress. See Recommendation 3.100, on p. 127 of the Resolutions and Recommendations on Reef-Fish Spawning Aggregations.

CONCLUDING COMMENTS

Striving to restore a threatened species of commercial importance is not just about conserving biodiversity, or about a single species, it also highlights the critical issues of food security, the problems of illegal trade, and the need for political will to tackle the challenge of natural renewable resources today. Issues that need attention for the Nassau grouper are also relevant to many other fisheries, such as the growing use of compressor diving, the practice of grow-out of juveniles in the case of economically valuable and increasingly scarce species, and the growing pressure from international trade. If our systems fail for the Nassau grouper, they will almost certainly fail for other species. We need wild fish populations to allow ready

access for coastal communities in many countries and for maintaining ecosystem integrity. While mariculture must help to fill the demand-supply gap for marine fishes, it is not solving overfishing and still requires the maintenance of genetic diversity for broodstock. The Nassau grouper is testing our ability to tackle the core challenge of fishery management — balancing current use against long-term population maintenance. Time will tell if it comes to symbolize our success or failure.

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