GWSG@IUCN

Newsletter of the Groupers and Wrasses Specialist Group of the International Union for the Conservation of Nature

Number 13 | June 2016

MESSAGE FROM THE CHAIRs

Greetings All!

After a long hiatus, we have finally assembled another newsletter for the Groupers & Wrasses IUCN Specialist group. This would not have possible without the leadership of Áthila Bertoncini, who formatted and compiled all of your contributions, Allen To and João Pedro Barreiros, we are most grateful for everybody's efforts.

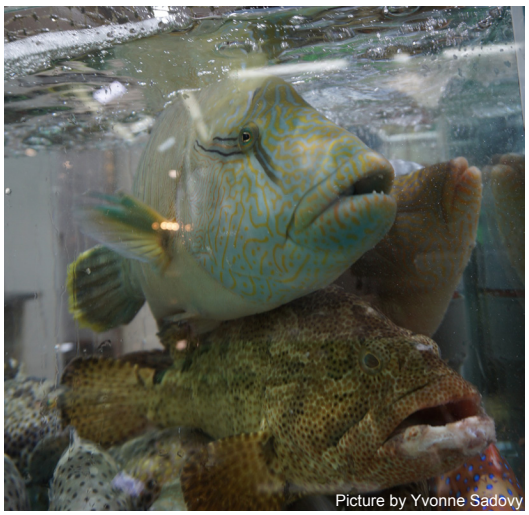
Áthila has also been busy updating our website and has created an email account for all future contributions to our newsletter. If you have something that you would like to share or see highlighted in the newsletter, please email to gwsg.iucn@gmail.com. Any type of article may be submitted including short reviews of recent publications or general grouper/wrasse news. With your help, we can regain momentum and activity for the GWSG as we gear up towards our workshop in November.

Our next workshop to re-assess groupers is scheduled for November, 2016, in Azores. We have finalized dates to fall between 16 and 21 November and a tentative list of about 25 attendees including two official IUCN workshop facilitators; more information will be circulated shortly when we have information on final funds available. We will shortly begin to pull together information from membership and beyond so that it can be summarized prior to the meeting to make the workshop more efficient. Since our assessments in 2007, a lot has been published on the life history, fisheries and population status of many of our species. We would ask that you send any publications or unpublished data that you are willing to share to one of us (matthew.craig@noaa.gov, yjsadovy@hku.hk).

We hope you enjoy this latest newsletter!

Yvonne Sadovy and Matthew Craig
Co-Chairs

Know about the most valuable species in the live reef food fish trade, the humphead wrasse, on page 12.



Picture by Yvonne Sadovy

Dr. Erisman brings news on spawning and movement patterns of the Gulf Grouper, on page 14.

Picture by David Castro

This Issue:

Recovery of spawning aggregations

Signs of recovery of a multi-species grouper spawning aggregation: lessons learned and implications for monitoring and management

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Evidence of initial recovery of a multi-species grouper spawning aggregation is reported in Palau, western Pacific, over a 5-year period. The aggregations of squaretailed coralgrouper (*Plectropomus areolatus*), camouflage (*Epinephelus polyphekadion*), and brown-marbled (*E. fuscoguttatus*) groupers are located in a no-take marine protected area (MPA) known as Ebiil at an outer reef channel in Western Palau. Fishermen interviews indicated declines in many of the grouper aggregations (Sadovy 2007). The Ebiil MPA had been under protection for many years with occasional enforcement, and had been monitored sporadically since the 1990s. However, due to inconsistent and inappropriate monitoring protocols it was impossible to follow changes in numbers of aggregating groupers and detect outcomes of protection. Seasonal management (i.e. months during which the groupers could not be caught) covered all spawning months for the camouflage and brown–marbled groupers, and all except one for the squaretailed coralgrouper.

In 2009, a robust underwater visual census (UVC) protocol was applied through collaboration between the 'Science and Conservation of Fish Aggregations' (www.SCRFA.org) and the Palau Conservation Society (PCS and SCRFA 2010, Colin et al., 2003), supported by the Coral Reef Research Foundation and funded by the Packard Foundation. This protocol ensured that the whole aggregation was monitored to include all three species. In 2014, a second survey was conducted during June and July, peak months. Enforcement at the MPA during the grouper reproductive improved considerably during the 5-year interim period and protection from fishing was also introduced in August for the squaretail coralgrouper. The 2014 survey revealed that numbers of the two *Epinephelus* species showed no change since 2009, while those of the squaretail coralgrouper increased by about 60%.

Different responses in abundance across the three grouper species were unexpected but are fully consistent with differences in their life history. The squaretailed coralgrouper lives less than 15 years and matures in 2-4 years (Rhodes et al., 2013), the camouflage grouper lives more than 20 years and takes >4 years to mature (Rhodes et al., 2011), while the brown-marbled grouper lives more than 40 years and takes >9 years to fully mature (Pears et al. 2006). Given these time frames, the squaretail coralgrouper is expected to be the first to show signs of population recovery. The study showed the importance of understanding aspects of grouper life history in the interpretation of observations and also highlighted the need for a long-term commitment in aggregation protection. A follow-up, third survey on the multi-species grouper spawning aggregations is recommended by 2020.

The Ebiil team 2014 | Asap Bukurrou (left), Stanley Shea (right) and Yvonne Sadovy (centre) just back from an underwater survey at Ebiil.

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To know more about Ebiil Conservation Area: www.palauconservation.org/cms/images/stories/resources/pdfs/EbiilConservationArea.pdf

Pondoland MPA provides refuge for depleted serranid stocks, enhancing fisheries

A decade of monitoring in a marine protected area provides valuable insight into grouper conservation

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In June 2004 a large marine protected area (MPA), known as the Pondoland MPA, was established in the South-West Indian Ocean off the coast of South Africa (Fig.1).
This MPA covers approximately 1380 km^2 of scattered reef and sand habitat, from the shoreline to the 1000m isobath beyond the continental shelf edge. Within this MPA is a large ~650 km^2 no-take zone which is fully protected from all forms of offshore (vessel based) exploitation, including industrial fishing such as trawling and longlining. The objectives of this area closure were to conserve biodiversity and rebuild important reef fish stocks, which have been depleted by overfishing. Following proclamation of the MPA, the Oceanographic Research Institute (ORI) based in Durban, South Africa established a monitoring programme, which was designed to evaluate the benefits of the area closure to vulnerable reef fish species.
Part of the monitoring included standardised research fishing, which was used to collect catch-per-unit-effort (CPUE) and length frequency data for important fish species occurring between 10 and 30 m depth of water within and outside of the MPA (see Maggs et al. 2013a). In addition, fish movement within and outside of the MPA was investigated by means of a tag-recapture experiment (Maggs et al. 2013b). Selected species were tagged during the fishing surveys with plastic dart tags (Hallprint Pty Ltd, Australia), each marked with a unique alpha-numeric code and contact details (ORI Cooperative Fish Tagging Project; Dunlop et al. 2013).

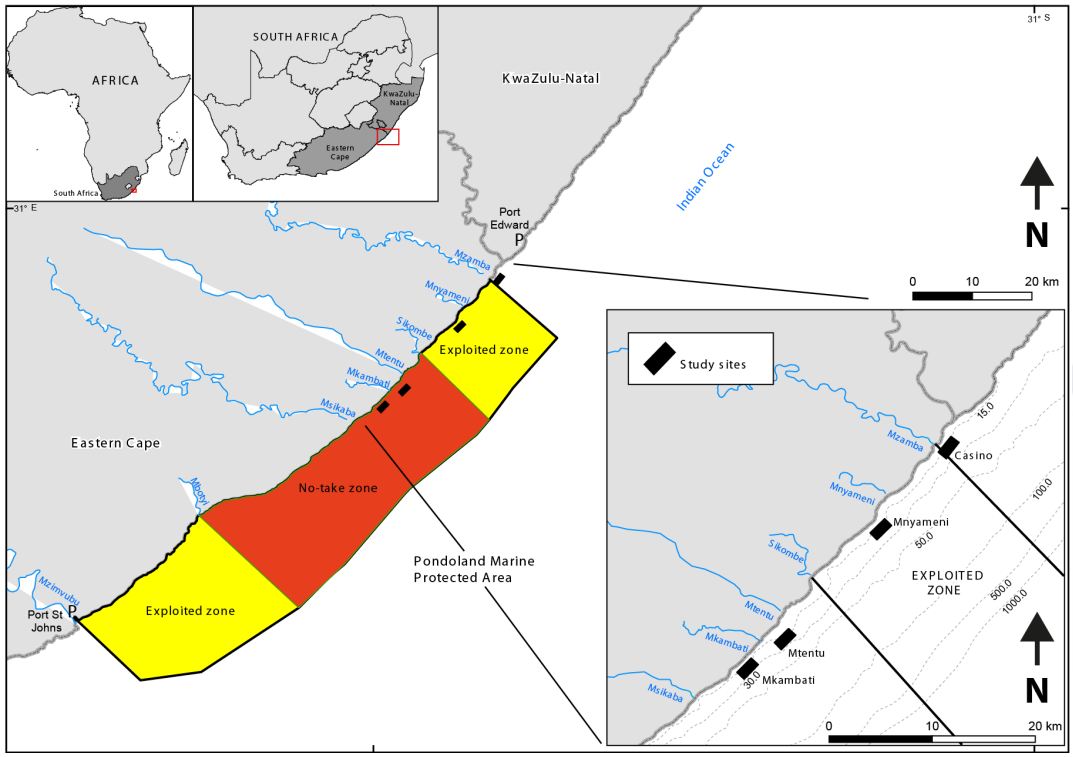

Figure 1. Map of the Pondoland MPA showing offshore zonation. Red shading represents the restricted no-take zone for all vessel-based exploitation. Yellow shading represents the controlled use zone where certain types of exploitation are permitted.

From 2006 to 2016, 1438 serranids (seven species) were recorded in the controlled angling surveys (CAS) (Maggs and Mann 2016). These were *Epinephelus marginatus* (n=514), *E. andersoni* (n=474), *E. rivulatus* (n=443), *E. malabaricus* (n=3), *Cephalopholis sonnerati* (n=2), *E. albomarginatus* (n=1) and *Acanthistius sebastoides* (n=1).
Interesting comparative results between the no-take zone and the adjacent exploited area were observed. Overall, CPUE of serranids caught in the no-take area (0.76 fish/angler/hour) was very similar to the exploited area (0.78 fish/angler/hour). This result was unexpected as most serranids are vulnerable to overfishing. However, on further investigation of the CPUE for the three most commonly caught species, *E. marginatus* was clearly more abundant in the no-take zone (1.04 fish/angler/hour) compared to the exploited area (0.48 fish/angler/

hour). In contrast, both *E. andersoni* and *E. rivulatus* were more abundant in the exploited area (0.91 fish/angler/hour and 0.81 fish/angler/hour) than in the no-take zone (0.55 fish/angler/hour/ and 0.54 fish/angler/hour) respectively.

This result is surprising as both species are heavily targeted by anglers in exploited areas of South Africa. It is possible that these two species have similar life histories, such as a faster growth rate, which makes them more resilient to overfishing. Furthermore, there is some evidence that suggests that both species have a roaming/pioneer movement strategy which could account for more individuals being caught in the exploited area. Despite there being a higher abundance of *E. andersoni* and *E. rivulatus* in the exploited area, length frequencies of all three species reach larger body sizes in the no-take area, which is strongly indicative of the protection provided by the no-take zone (Fig.2).

In total 978 serranids have been tagged and released, of which 248 (25%) have been recaptured (Maggs and Mann 2016). If multiple recaptures are included, the overall recapture rate is 41%. Individual recapture rates (including multiple recaptures) for *E. marginatus* (51%), *E. andersoni* (44%), and *E. rivulatus* (24%) were exceptionally high, indicating a high degree of residency among these heavily targeted species. Besides resident behaviour within individual home ranges, which is typical of these reef-associated species, it was found that these species also undertook longer-distance movements of more than 1000 m (5% of all recaptures). These movements ranged from 1-490 km, often taking the fish well beyond the borders of the MPA into

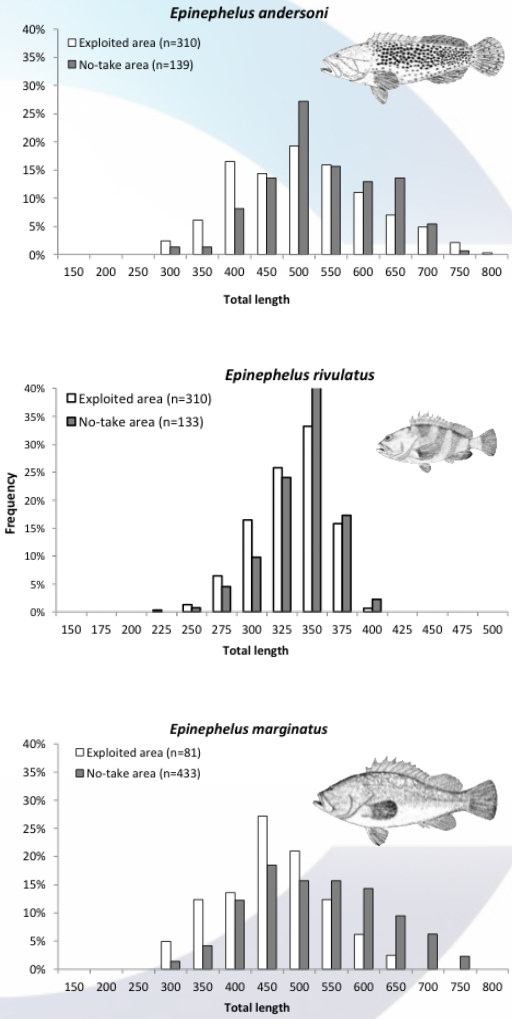

Figure 2. A comparison of length frequency distributions between the no-take zone and the exploited area of the Pondoland Marine protected Area for the three most abundant serranid species caught during the controlled angling surveys.

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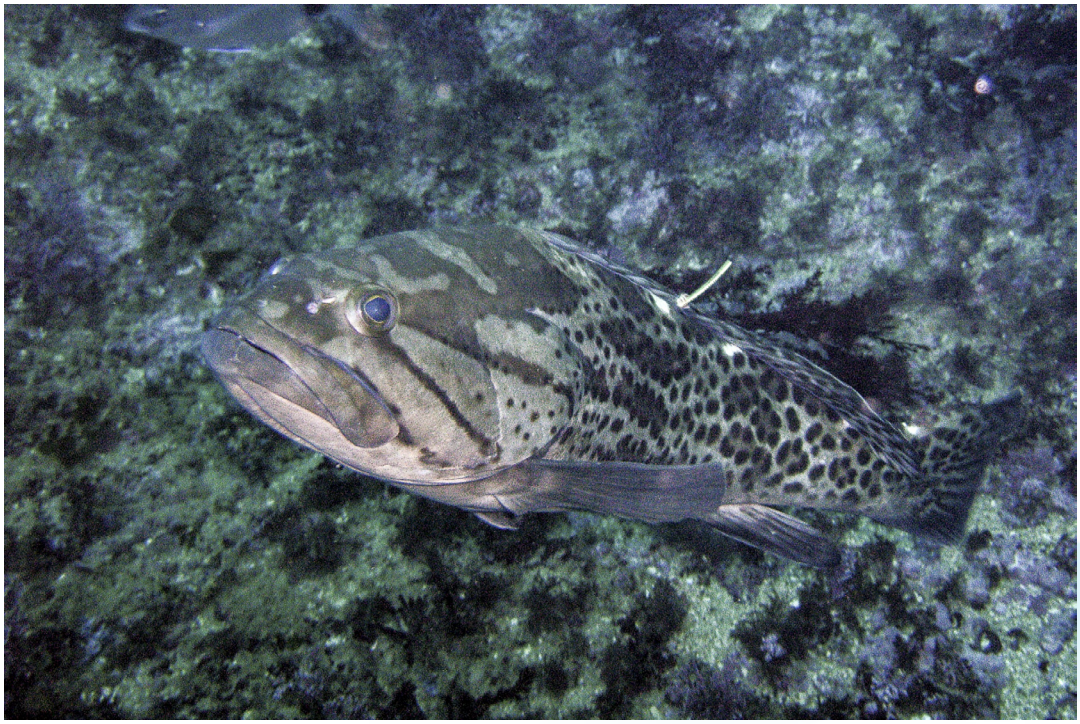

Figure 3. A tagged *Epinephelus andersoni* (endemic to south-east Africa) in the Pondoland Marine Protected Area, South Africa | Picture by Pam Le Noury.

adjacent fished areas. Interestingly, all these long-distance movements were in a north-easterly direction. Of fish tagged in the no-take zone of the MPA, eight *E. marginatus* were recaptured between 149 km and 335 km from their original capture locality. Similarly, three *E. andersoni* were recaptured between 76 km and 411 km away. To date no *E. rivulatus* originally tagged in the no-take area have been recaptured beyond the borders of the no-take area. Considering that all of the above species are normally highly resident, these recaptures are quite remarkable and have greatly added to our knowledge on the movement behaviour of these serranids. Furthermore, the movements of fish from the MPA no-take zone northward to become available to the fishery indicate some measure of the potential of the Pondoland MPA to enhance adjacent fisheries.

In conclusion, monitoring in the Pondoland MPA has provided convincing evidence that the no-take zone is providing refuge for depleted serranid stocks, thereby achieving its primary objectives and establishing the basis for the enhancement of adjacent fisheries. Little evidence exists of spawning among the serranid species caught in the no-take zone, but this area clearly provides temporary protection to adults before migrating northward to spawning grounds. Future research in the Pondoland MPA should focus on population connectivity including the northward migration of the region's key reef fishes and the spawning potential within the no-take zone itself. Considering the strong possibility of ontogenetic habitat shift into deeper water, research should also be conducted on the abundance and size structure of key fishery species on the deeper reef habitat within the no-take zone.

Evidence from tagging study suggested that MPAs could protect reproductive populations.

Home range estimates for squaretail coralgrouper, *Plectropomus areolatus*

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Evidence from a tagging study on aggregating grouper suggested that Marine Protected Areas (MPAs) of moderate scale (10s of km2) that include aggregation sites, migratory corridors and adjacent home range habitats could protect reproductive populations. In a 4-month study in Pohnpei, 15 squaretail coralgrouper (*Plectropomus areolatus*) (Rüppell 1830) were captured at the spawning aggregation site located within the Kehpara Marine Sanctuary (KMS). Acoustic tags were applied to all of these fish. Searches were made 8 – 10 hours daily during the study period, using on-board acoustic receiver and omni-directional hydrophone. About one-third of Pohnpei's total reef area (153 km^2) was searched throughout the period. GPS readings were recorded for all sighting locations of tagged fish. Six out of the 15 fish were successfully tracked in the study period. Among these six fish, four (3 males and 1 female) were found in coral-rich outer reef areas at 10 – 50 m depth and within 0.02 – 1.4 km of the aggregation. Another male was located inside the lagoon on a coral-rich patch reef (~ 25 m in diameter) 6 km northeast of the aggregation. One female was located 23 km north of the aggregation. Analyses indicated that fish maintained individual home ranges of 0.004–0.12 km^2 (0.048 ± 0.018 km^2). For *P. areolatus* in Pohnpei, findings from this study suggested that about 40% of the KMS reproductive population could be protected with a 40 – 50 km^2 MPA.

Plectopomus areolatus | Picture by Gianemilio Rusconi.

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Characterization of the Goliath grouper *Epinephelus itajara* fishery of southern Belize for conservation planning

Declining catches, mean size and abundance of Belize's Goliath groupers are investigated

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The Goliath grouper *Epinephelus itajara* (Lichtenstein, 1822) is an integral part of traditional coastal fisheries in Belize; however, recent anecdotal reports suggest declining catches, mean size and abundance, particularly of large adults. Quantifying Goliath grouper abundance in the waters of Belize is an important first step in developing management plans that can protect stocks of the species as well as local fishing communities. To characterize the benefits these bring to the status of the Goliath grouper in southern Belize, we used a 2 yr market survey, fishery-dependent data collection and passive tagging. Reductions in mean size, age or size at sexual maturity within populations, or accelerated rates of growth, are often responses of populations to overfishing (Grift et al. 2003, Olsen et al. 2004, 2005). These changes reflect efforts by populations to maintain reproductive output in compensation for the loss of spawning stock, particularly larger, more fecund females (Sadovy 2005). To gauge whether such changes are occurring, some preliminary estimates of size distribution, growth and size at sexual maturity are needed. In addition, targeting management appropriately, details of the fishery are generally required, including documentation of size at capture, fishing gears and targeted areas.

The primary objective of the present study was to establish a baseline record for the Goliath grouper fishery in southern Belize where no quantitative information currently exists. To accomplish this, we used a combination of market assessments, anecdotal fisher information, fisheries-dependent collections, and tag recapture to assess the size structure of the Goliath grouper stocks in southern Belize.

Additional fieldwork and market data from northern Belize are needed to provide data for the development of a national management plan for Goliath grouper. Meanwhile, continued dialogue with stakeholders, including trans-boundary fishers, towards a temporary management solution, such as slot limits, with continued market monitoring may allow more stringent measures to be adopted under an adaptive management agreement. Regardless, it is now apparent that some level of management for the species is needed if populations are to persist in southern Belize. Moreover, human health concerns in association with the elevated mercury levels found in many Goliath grouper— both juveniles and adults—sampled from southern Belize (Evers et al. 2009) may provide further impetus to curb fishing pressure and protect this species. Further inaction and continued habitat loss will likely result in the demise of the species and further erode this fishery in southern Belize.

Picture by Rachel T. Graham.

Picture by Rachel T. Graham.

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Empowering communities to take proactive management actions

Dispersal of Grouper Larvae Drives Local Resource Sharing in a Coral Reef Fishery

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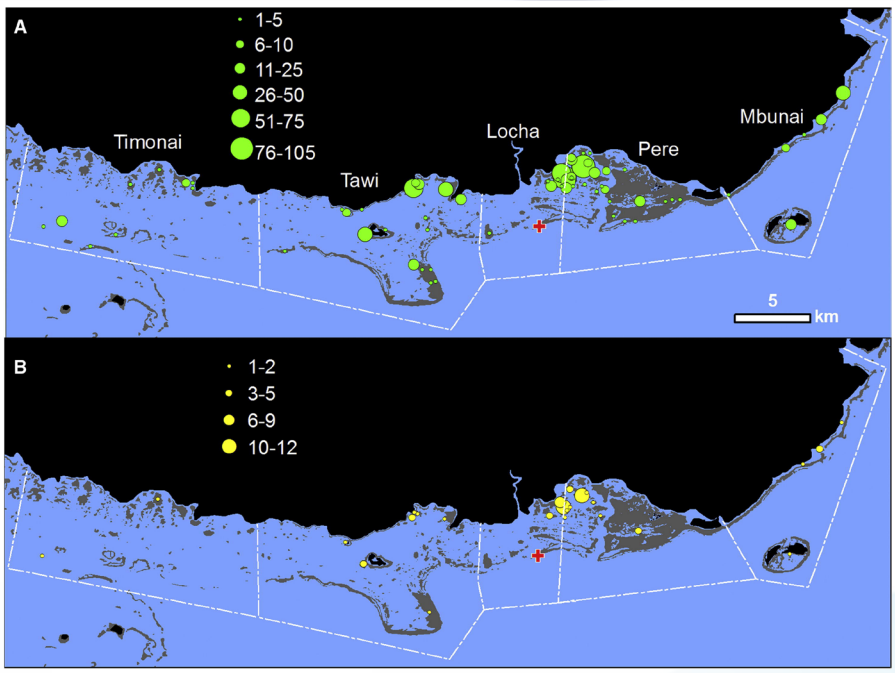
In many tropical nations, fisheries management requires a community-based approach because small customary marine tenure areas (CMT) define the spatial scale of management (Johannes 2002). However, the fate of larvae originating from a community's tenure is unknown, and thus the degree to which a community can expect their management actions to replenish the fisheries within their tenure is unclear (Russ 2002, Sale et al. 2005). Furthermore, whether and how much larval dispersal links tenure areas can provide a strong basis for cooperative management (Palumbi 2004, White & Costello 2011). Using genetic parentage analysis, we measured larval dispersal from a single, managed spawning aggregation of squaretail coral grouper (*Plectropomus areolatus*) and determined its contribution to fisheries replenishment within five community tenure areas up to 33 km from the aggregation at Manus Island, Papua New Guinea. Within the community tenure area containing the aggregation, 17%–25% of juveniles were produced by the aggregation. In four adjacent tenure areas, 6%–17% of juveniles were from the aggregation. Larval dispersal kernels predict that 50% of larvae settled within 14 km of the aggregation. These results strongly suggest that both local and cooperative management actions can provide fisheries benefits to communities over small spatial scales.

We quantified how larvae dispersing from a coral grouper FSA contribute to recruitment to five CMT areas. We found that 17%–25% of recruitment to the CMT area that contains the sampled FSA came from that same FSA and that in each of the four adjacent CMT areas, 6%–17% of recruitment was from the sampled FSA. Finally, the two best-fit dispersal kernels based on these data predict that 50% of larvae settled within 14 km of the FSA. Our study highlights how restricted larval dispersal could allow communities to benefit from efforts to protect spawning stock, even when management units are small. Our results therefore suggest that use of small MPAs to protect critical areas such as spawning aggregations can be defensibly justified on the basis of direct local benefits (Hamilton et al. 2011). Ultimately, our results can empower and incentivize communities to take proactive management actions, both independently and in coordination with their neighbors.



Location and Abundance of Sampled and Assigned Juveniles. Spatial patterns of coral grouper (*Plectropomus areolatus*) (A) juvenile sample collection and (B) juvenile parentage assignments. Green (A) and yellow (B) circles are scaled to the number of juveniles. Adults were sampled from a single fish spawning aggregation (red cross), and juveniles were collected from 66 individual reefs (green circles in A). *Extracted from the original article.*

To know more about Dispersal of grouper larvae and references in the text: http://dx.doi.org/10.1016/j.cub.2013.03.006

In the spotlight!

Cephalopholis argus Schneider 1801

Peacock grouper (E), mérou celeste (F), cherna pavo real (S)

Maximum Recorded Size

50 cm TL

Population Trend

Stable

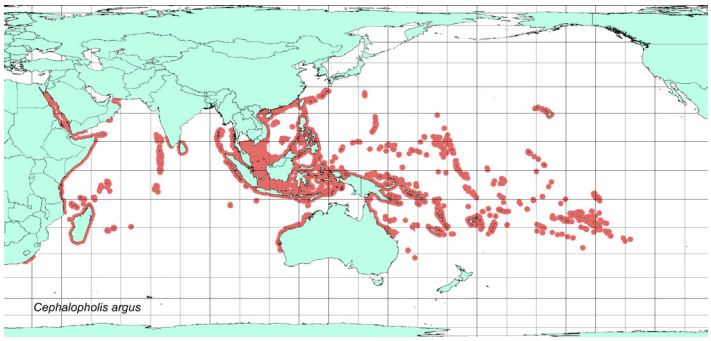
Population

Despite noted declines in fisheries locally, such as in the Maldives, the species is generally abundant throughout its range. Studies in the GBR Australia, the Seychelles and American Samoa reported fish densities at between 1.7 and 14.8 fish per 1,000 m^2. Since introduction to Hawaii, the species has established large populations.

Picture by Allen To | shot in Kadavu archipelago | Fiji

Distribution

The most widely distributed of the groupers, occurring from the Red Sea to South Africa, extending east to French Polynesia and the Pitcairn group, south to Lord Howe Island and north to southern Japan. Introduced to the Hawaiian Islands in the 1950s.



Source of information: Craig M, de Mitcheson YS, Heemstra PC 2012. Groupers of the World: a Field and Market Guide. 356 p. Boca Raton: CRC Press.

Habitat and ecology

The species occurs in a variety of habitats but is most commonly associated with exposed reef-front habitats in depths of up to 40 m. It is a crepuscular feeder and feeds on fishes and crustaceans. Its demography is highly plastic and shows great variation over its distributional range, for example the estimated maximum longevity ranges from 14 – 40 years. The species occurs in social groups comprising a single male with several females. Social groups comprising one dominant male and up to 12 females has been reported in the Gulf of Aqaba.

Major Threat

Fishing is the primary known threat and this species is taken by both the chilled and live fish trades. Marketing of this species, however, is often difficult due to its association with ciguatera poisoning in many places.

2008 IUCN Red List Status

Least Concern

Lack of specific management measures for the Nassau grouper in Mexico

Changes in Management Plans undermine conservation efforts

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In 2012, the Mexican fishery authority proposed a management plan (MP) for the red grouper (*Epinephelus morio*), and 14 grouper species with its fishery, in waters of the Yucatan Peninsula (Southern Gulf of Mexico and Mexican Caribbean). Among the most important remarks on this MP was to extend the grouper ban from one month (15 February to 15 March), as established since 2005 (DOF 2005), to two months (January 15 to March 14) each year for the red grouper and 14 grouper associated species off the Southern Gulf of Mexico. Another remark on the MP was to consider a concurrent grouper ban of two months (January 1 to February 28), with emphasis on protecting the Nassau grouper (*Epinephelus striatus*) in the Mexican Caribbean.

According to Mexican legal regulations, in order to make official any state or federal action (such as a ban or modification), it is necessary that the authority announce details of the regulation as an agreement and published it in the Official Journal of the Federation (DOF in Spanish). Unfortunately, despite being proposed in 2012 the MP was not approved until it was publish and remove in the DOF as an agreement in 2014. In the meantime, the old one-month ban applied during 2013, 2014, and 2015. Early in 2015, the fishery authority published another agreement announcing the two-months ban period, but instead of being from January 15 to March 14 (as proposed in the MP) was established from February 1 to March 31 and applied during 2016 for all grouper species in the Southern Gulf of Mexico and Mexican Caribbean (DOF 2015). In this published agreement, the special ban period (January 1 to February 28) proposed by the MP for the Nassau grouper in the Mexican Caribbean was not considered. Early in 2016, when the new ban period (February 1 to March 31) was still in place, various cooperative fishermen leaders in the Yucatan convinced the federal fishery authority to modify the new ban in place. Thus, another official agreement was published in a rush in the DOF but indicating an amendment to the ban which would end on March 11; with the remaining two weeks being relocated during the period of 15 December 2016 to January 3 of 2017. This official agreement also announced the grouper ban as of 2017 would be from February 1 to March 31. These administrative changes in the original MP, the modifications to the ban, and the apparent inertia from the fishery authority, severely undermine any conservation measure not only for the Nassau grouper but also for all groupers in waters off the Yucatan Peninsula. Consequently, the future for an effective regulation on the grouper fishery and conservation under the current scenario is uncertain.

Picture by Stanley Shea | shot in St. Maarten.

References

DOF: 26/01/2005. ACUERDO por el que se establece veda para la captura de todas las especies de mero en las aguas de jurisdicción federal del Golfo de México correspondientes al litoral de los estados de Campeche, Yucatán y Quintana Roo.

DOF: 25/11/2014. ACUERDO por el que se da a conocer el Plan de Manejo Pesquero de Mero (*Epinephelus morio*) y especies asociadas en la Península de Yucatán.

DOF: 24/02/2015. ACUERDO por el que se modifica el similar por el que se establece veda para la captura de todas las especies de mero en las aguas de jurisdicción federal del Golfo de México correspondientes al litoral de los estados de Campeche, Yucatán y Quintana Roo, publicado el 14 de febrero de 2007.

DOF: 11/03/2016. ACUERDO por el que se modifica el similar por el que se establece veda para la captura de todas las especies de mero en las aguas de jurisdicción federal del Golfo de México correspondientes al litoral de los estados de Campeche, Yucatán y Quintana Roo, publicado el 14 de febrero de 2007.

The first ever success of the Humphead Wrasse (*Cheilinus undulatus*) hatchery in captivity in China

Research team is looking for funding to develop important strategic research components.

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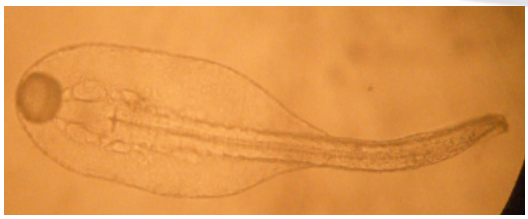
After eight years of trials, the research team from Hainan University finally obtained fertilized eggs (about 5.37 kg) from 16 broodstock of the humphead wrasse through natural spawning, consisting of 11 females (average body weight 11.5 kg / fish) and 5 males (average body weight 34.2 kg / fish). The broodstock were reared in floating cages in Sanya City (Hainan Province) and spawned daily for 14 days from late-May to early-June in 2014 (Fig. 1). Water temperatures were around 26-29 °C during the spawning period.

Fig. 1. Floating cages for holding broodstock of the humphead wrasse in Sanya, Hainan Province, China. Picture by Min Liu.



The average diameter of the fertilized eggs was about 630 um, and the embryos took 15-17 hours to hatch under 26-29 °C (Fig. 2). The fertilized eggs were collected from the floating cages daily and the average total length (TL) of the newly-hatched larvae was about 1.3 mm (Fig. 3). The newly-hatched larvae were transferred into ponds; the larvae first fed on small organisms such as protozoan instead of rotifers. The larvae completed their metamorphosis at Day 25-27 and shifted from pelagic to benthic habitats. The growth rate of the humphead wrasse was relatively slow; the average size was about 6.2 mm TL at Day 23 after hatching and 37.0 mm TL at Day 131 (Figs. 4). Currently more than 1,000 juveniles survive and are kept in indoor tanks (Fig. 5); they feed on minced fresh fish and crab meats. A major challenge in the culture of this species is the

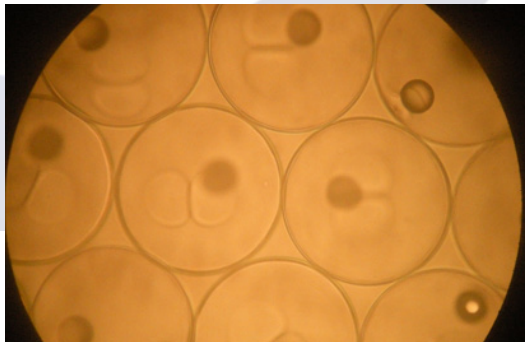


Fig. 2-3. Above, fertilized eggs at two-cell stage with average diameter of 630 um and on the left, newly-hatched larva with total length of 1.31 mm. Picture by Guohua Chen.

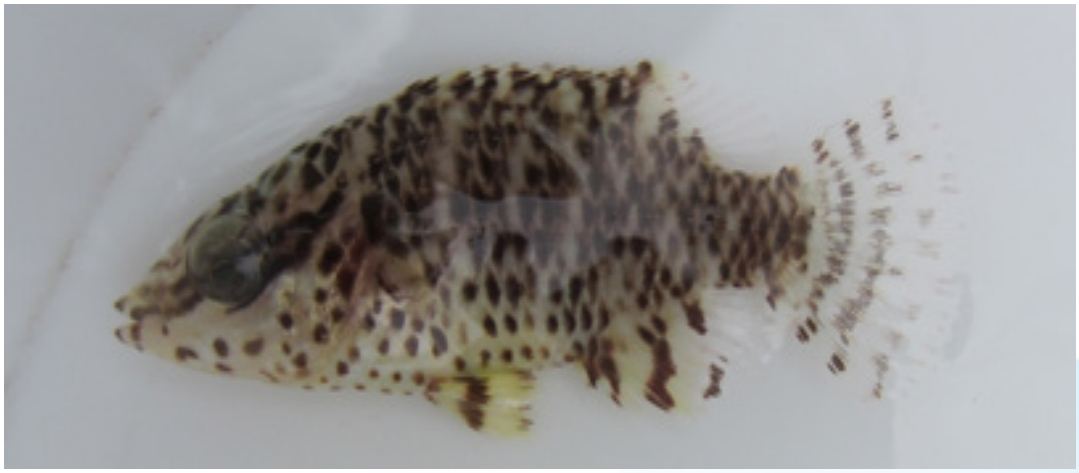


Fig. 4. A juvenile (Day 131 after hatching, 40 mm TL) of the humphead wrasse reared from a fertilized egg in Sanya, Hainan Province, China. Picture by Min Liu.

small size of mouth in post-hatch juveniles.
This is the first ever success of the humphead wrasse hatchery conducted in captivity in China. The research team will further work on the nutrient requirements of the broodstock, enhancement of fertilizaton rates, first feeding feeds, etc. The research team is looking for more funding to continue the project.

Fig 5. Juveniles of the humphead wrasse are currently reared in tanks in Sanya, Hainan Province, China. Picture by Min Liu.

The Pacific Goliath grouper

A brief review of new research on the Pacific Goliath grouper (*Epinephelus quinquefasciatus*)

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In 2008, Craig et al. recognized the Pacific Goliath grouper as a distinct species (*Epinephelus quinquefasciatus*) from its Atlantic sister species (*Epinephelus itajara*). Because the two species were treated as one, and all life history data stock information was extrapolated from work on the Atlantic Goliath grouper, very little is known about the Pacific Goliath grouper. Over the past several years, I have been compiling information on the Pacific Goliath grouper with the help of several people including Gustavo Castellanos (WWF, Colombia), Ross Robertson (STRI, Panama), and Brad Erisman (Univ. of Texas, USA). What we have found is rather surprising and points to an overall positive evaluation of the species stock.

Pacific Goliath grouper have a known distribution from the Gulf of California to Peru, although as with many fishes having this range, they are naturally rare at the extremes of this range. Having a reliance upon mangrove habitat for juvenile settlement, populations of the Pacific Goliath grouper are expected to be higher in areas with abundant mangroves. It is therefore not surprising that we have found active fisheries for Pacific Goliath grouper in Panama and Colombia (Panama City, Panama, and Buena Ventura, Colombia), two ports within range of large mangrove areas. We were surprised by frequent landings of the species with individuals up to ~2 m total length. While we have not analyzed all of the data as yet, the oldest individual aged was 13 years old (186 cm total length). This is slightly larger than the average size of 13 year old Atlantic grouper reported by Bullock et al. (1992; 162 cm for males and 165 cm for females) in the Atlantic and may indicate a faster growth rate for Pacific Goliath grouper. The year-round presence of these fish in major fishing ports in a promising sign for the population of Pacific Goliath grouper if landings can be used as a proxy for abundance. In both Panama and Colombia, landings of the species appear to be opportunistic rather than targeted. In Colombia this is particularly promising. Colombia's Pacific coast has long stretches of undeveloped mangrove habitat and the per capita consumption of fish is among the lowest in Central and South America. If the demand continues to remain low, landings of Pacific Goliath grouper remain sporadic and opportunistic, and the coastline remains undeveloped, this may indicate that Colombia's Pacific coast can act as a refuge for the species.

Removing otoliths from a large Pacific Goliath grouper head. Picture by Brad Erisman.

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The challenges of IUU for the CITES II listed HHW

The Napoleon fish, the largest labrid in the world, shows promising recovery signs in protected areas

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The Napoleon or humphead wrasse (HHW), *Cheilinus undulatus*, is the largest labrid in the world, reported to exceed 1.5 m and over 150 kg. It fits several definitions of megafauna (e.g. exceptionally large for the taxon and exceeding 100 kg), and like many terrestrial megafauna, is highly susceptible to exploitation (Sadovy et al. 2003). The species is listed as Endangered on the IUCN Red List and is one of the most valuable species in the live reef food fish trade (LRFFT), a luxury seafood trade centred in Hong Kong and Mainland China (Fig. 1). In 2004 it was listed on the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) Appendix II (which requires exports to be sustainable) because of heavy targeting for this luxury trade; the species can fetch in excess of 600 US$/kg at retail (Michael Fabinyi, Beijing) and is highly profitable for traders.

Fig. 1. Frozen humphead wrasse sold in a Malaysian supermarket. Picture by Allen To.

While international trade in the species has declined somewhat in Hong Kong in recent years, a joint TRAFFIC/IUCN study demonstrated that most individuals likely enter the city illegally (TRAFFIC/IUCN 2016). Moreover, given that imports into Mainland China are not reported or accounted for by permits (as required under CITES), the tens of thousands of fish estimated from interviews and market surveys to be on sale there are all likely to be illegal, unmonitored and unregulated (IUU). Currently, the major source countries for this species are Indonesia (which has an export quota of < 2000 fish annually) and the Philippines (which does not legally export any CITES II listed species at present, although this regulation is under review). Malaysia also exports HHW to Hong Kong but most of these are reportedly smuggled over the border from the Philippines. Most of the fish in trade are caught as small juveniles and grown out to market (or 'plate' size of about 500-800g) before export. More recently, a trade in frozen HHW has been identified with even chilled fish gaining good market prices (Fig. 2). A sustainable management approach was developed in collaboration with FAO (Sadovy et al., 2007). We have now completed studies to determine the effect of protection in Indonesia on HHW abundance in the field, while work is ongoing in Hong Kong to understand the business and trade networks. Six study sites in Indonesia were monitored both shortly after the CITES listing and 5 to 7 years later. The results suggest recovery in protected areas or where fishing stopped and further declines in abundance with ongoing fishing (Yvonne Sadovy de Mitcheson and Santi Suharti, in prep; RTHK podcast 2014). Trade networks in Hong Kong appear to involve some organized crime links, while imports by Hong Kong vessels are largely uncontrolled and unmonitored. The Hong Kong government is aware of this IUU and is tightening its surveillance. Some of this work is being funded by the CITES Secretariat and the findings will be presented at upcoming CITES meetings.

Live humphead wrasse taken in Hong Kong live fish outlet. Picture by Yvonne Sadovy.

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TRAFFIC/IUCN 2016. HUMPHEAD (NAPOLEON) WRASSE *Cheilinus undulatus* trade into and through Hong Kong. http://goo.gl/xyJpC1

To know more about the Napoleon wrasse, visit our GWSG special page at http://goo.gl/ba1tZr

Landings of the Atlantic Goliath grouper, *Epinephelus itajara*, in Brazil

Despite prohibition for over ten years, fishing continues

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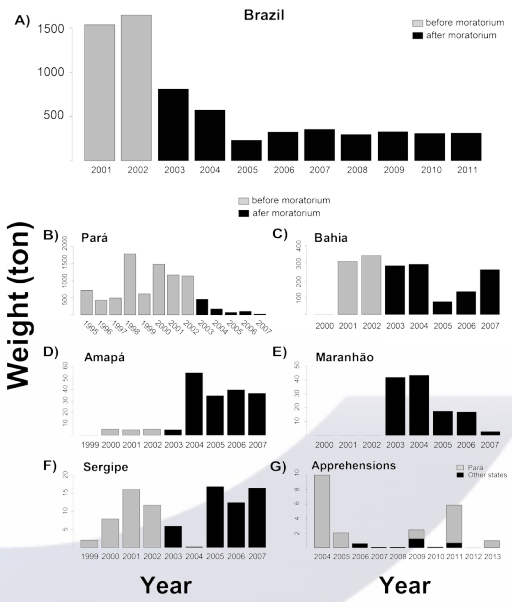
The Atlantic Goliath grouper, *Epinephelus itajara* (Litchtenstein, 1822) is one of the largest groupers (2.5 m length and > 400 kg) and one of the most endangered in the Atlantic Ocean. The species is often a target of recreational, small-scale commercial and subsistence fisheries (Sadovy & Eklund, 1999). In Brazil, the decrease of Goliath grouper catches led managers to establish a precautionary five-year moratorium on fishing of the species in 2002.

We documented commercial landings and prices of Goliath grouper before and after the moratorium establishment in Brazil, published in governmental fisheries landing reports. Apprehensions by surveillance agencies were also described. We verified a reduction of 70% in catches after moratorium establishment, however annual catches kept an average of 393 tons and showed no declines in recent years, contrary to expected. The commercial value showed a general increase in price per Kg after 2002. To circumvent the scrutiny, Goliath grouper has been mischaracterized by filleting and being sold as other Epinephelinae species. Poaching is observed mainly in the state of Pará which also reported the highest catches before and after the moratorium establishment.

Worryingly, results of this survey cannot reflect the amount of poached Goliath groupers, which is believed to be higher, because fishermen process fishes before landing to avoid detection. Poaching might be undermining the recovery of the species contrary to the intention of the fishing moratorium, which was renewed in 2007 and again in 2013 and is expected to end by 2018.



(A) Total volume of Goliath grouper catches per year in Brazil. Landings of five most representative States: (B) Pará;(C) Bahia; (D) Amapá; (E) Maranhão and (F) Sergipe. (G) poaching apprehensions in Brazil. *Extracted from the original article.*

Dr. Sampaio from UFAL, measures a 1.9m Goliath grouper stranded in Barra Grande, Brazil | Picture by Áthila Bertoncini.

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To know more about this study read full paper Landings of Goliath grouper, *Epinephelus itajara*, in Brazil: despite prohibited over ten years, fishing continues. Natureza & Conservação (2014) 12(2):118–123

Spawning and movement patterns of the endangered Gulf Grouper in Mexico

Telemetry results revealed that tagged individuals exhibited seasonal residency

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The Gulf Grouper (*Mycteroperca jordani*) is a large-bodied (reaches lengths of 2 m) apex predator endemic to the Gulf of California, Mexico. Once the most important grouper to regional fisheries, widespread overfishing has reduced population abundance to less than 1% of historical levels, rendering the Gulf Grouper as endangered throughout its geographic range (Sáenz-Arroyo et al. 2005; Craig et al. 2008). Despite these declines, no species-specific harvest restrictions exist for commercial fisheries, and recreational fishers are allowed to legally harvest two Gulf Grouper per day by hook and line or spearfishing while free-diving (Dennis 2015). Moreover, almost no information exists on their life history, ecology, and behavior. Nowadays, the no-take marine reserve at Cabo Pulmo National Marine Park (CPNP), located at the southern tip of the Baja California peninsula, is the only location where large numbers of Gulf Grouper can be consistently observed (Aburto-Oropeza et al. 2011), offering the rare opportunity to study this species and assist conservation efforts.

In 2014, researchers from the Gulf of California Marine Program at Scripps Institution of Oceanography (Tim Rowell, Octavio Aburto), the University of Texas at Austin (Brad Erisman), Cabo Pulmo Divers (David Castro), El Centro para la Biodiversidad Marina y la Conservación A.C. (Juan Cota-Nieto), and California State University Northridge (Mark Steele) teamed up with Park Director Carlos Godinez to study patterns of movement, habitat usage, residency, and spawning behavior of Gulf Grouper inside and outside CPNP. The project utilizes a variety of techniques and approaches, including ongoing visual surveys to monitor abundance and spawning behavior, an array of acoustic telemetry receivers to monitor movement patterns of 20 tagged grouper among reefs within the park, and an array of acoustic data loggers strategically placed at potential spawning sites to monitor patterns of sound production in relation to courtship and spawning.

Initial telemetry results revealed that tagged individuals exhibited seasonal residency at the reefs of Los Morros and El Bajo for one to four months starting in November 2014 (Rowell et al. 2015). As of March 2015, none of the tagged individuals had returned to the reefs; however, acoustic recordings and diver surveys in May 2015 identified the return of Gulf Grouper to a specific site within the park, which was soon confirmed as a spawning aggregation. Following the full moon in May, male Gulf Grouper were observed pair spawning with females at Los Morros in the late afternoon and evening hours before sunset (Figure 1). Male sound production was recorded and identified in direct association courtship and spawning (i.e. gamete release), allowing for the use of passive acoustic recordings to monitor temporal and seasonal patterns of spawning.

These results indicate that CPNP offers, at minimum, seasonal protection for a susceptible population of Gulf Grouper, serves as the only known location of a protected spawning aggregation, and functions as a refuge and frontline for the conservation and restoration of this iconic species.

A sequence of a male (left) and female (right) Gulf Grouper separating just below the surface shortly after completing a spawning rise | Photos David Castro.

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Future events

2016 Ecological and Evolutionary Ethology of Fishes

When: from 14 to 16 June 2016

Where: Tallahassee, Florida (USA)

Visit: marinelab.fsu.edu/eeef/

13th International Coral Reef Symposium

When: from 19 to 24 June 2016

Where: Honolulu, Hawai'i (USA)

Visit: sgmeet.com/icrs2016

VI Congresso Ibérico de Ictiología

When: from 21 to 24 June 2016

Where: Murcia, Spain

Visit: www.um.es/sibic6/

International Meeting on Marine Research 2016

When: from 14 to 15 July 2016

Where: Peniche, Portugal

Visit: www.immr.ipleiria.pt

IUCN World Conservation Congress

When: from 1 to 10 September 2016

Where: Hawai'i (USA)

Visit: www.iucnworldconservationcongress.org

International Grouper Workshop

When: from 07 to 08 October 2016

Where: Bodrum, Turkey

Visit: www.epipopgen.com

Meeting of the Groupers and Wrasses Specialist Group

When: November 2016

Where: Azores (Faial Island)

Contact: gwsg.iucn@gmail.com

69th GCFI - Grand Cayman Island

When: from 07 to 11 November 2016

Where: Grand Cayman

Visit: www.gcfi.org

XXII Congresso Brasileiro de Ictiologia

When: from 29 January to 03 February 2017

Where: Porto Seguro, Brazil

Visit: www.ebi2017.com.br

6th International Conference on Biodiversity

When: from 20 to 21 July 2017

Where: Chigaco, USA

Visit: biodiversity.conferenceseries.com

The World Conference on Marine Biodiversity (WCMB)

When: from 20 to 23 May 2018

Where: Montréal, Canada

Visit: wcmb2018.org

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Groupers & Wrasses Art Gallery

Send your visual art work for our next newsletter!

This fine indian ink drawing depicting the dusky grouper, *Epinephelus marginatus*, was prepared by Dr. João Pedro Barreiros for a publication in 1994. Dr. Barreiros is a passionate scientist, who lives in the Azores (Portugal) and has a talent for painting/drawing arts. He also plays the guitar.

Editorial
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