

Reef Fish Aggregations in Southern Brazil: Pró-Arribada and Meros do Brasil Initiatives

Agregaciones de Peces de Arrecife en el sur de Brasil: Las Iniciativas de los Proyectos Pró-Arribada y Meros do Brasil

Agrégations de Poissons de Récif dans le Sud du Brésil: Les Initiatives du Pro-Arribada et Meros do Brasil Projet

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ABSTRACT

Pró-Arribada Project represents the first Brazilian initiative toward the study of spawning aggregations of reef fish in four focal points along the Brazilian coast. Together with the support of “Meros do Brasil Project” its main objectives were to investigate the occurrences of spawning aggregations through the investigation of data on past fisheries landings, Local Ecological Knowledge, monitoring of biological aspects of selected species, making use of a Fisheries Voluntary Monitoring Program (known as MOPE) to obtain biological samples, and surveying suspected areas of occurrence and already known areas with scientific divers to document and study spawning aggregation events. Results presented here deal specifically with the southern Brazilian focal point of Pró-Arribada, where the goliath grouper (*Epinephelus itajara*) and the dusky-grouper (*Epinephelus marginatus*) were the focus of studies. Results report the reproductive and feeding habits of sampled dusky-grouper, as well as, a known annual aggregation of goliath groupers where circa 45 specimens were observed. Data obtained through Local Ecological Knowledge supported survey dives, indicating areas where invariably local reef fish community composition and habitat characteristics were reported. Results provided important maps to be delivered to the Brazilian Environmental Agency (ICMBio) and the Brazilian Environmental Ministry (MMA), suggesting spatial and temporal sensitive areas that should be considered for protection during spawning seasons, especially regarding future licensing processes of seismic surveys and activities of the Oil and Gas industry.

KEY WORDS: *Epinephelus itajara*, *Epinephelus marginatus*, Meros do Brasil, Pró-Arribada, Conservation, South Atlantic

INTRODUCTION

Pró-Arribada and *Meros do Brasil* Projects represent the first Brazilian initiatives toward the study of spawning aggregations of reef fish along the Brazilian coast. The *Pró-Arribada Project*, the most recent Brazilian initiative, was implemented late 2008 in order to provide basic scientific knowledge regarding mapping spawning/feeding aggregations (e.g. sites, seasons and important physical and biological characteristics) of commercially important reef fish to support the Brazilian Environmental Agency in the licensing processes of the Oil and Gas industry in Brazil, specially the seismic surveys needed to map subsurface oil/gas fields. The project was proposed to cover four macro areas called *Região Alvo* (RA) (Figure 1) and the results presented herein include only RA4, which encompasses South Brazil.

On the other hand, *Meros do Brasil Project* (www.merosdobrasil.org) has the goliath grouper, *E. itajara* (Figure 2), as the focus of its research interests, and is sponsored by PETROBRAS, through Programa Petrobras Ambiental. Since the species is considered Critically Endangered by the IUCN, as well as, the first fish species that has a moratorium in Brazil, the Project's research themes are (a) *biological research and conservation of the species* – monitoring of catches and gathering of biological samples (Figure 3a), mark-recapture inside estuaries (Figure 3b) and sea, genetics, aquaculture, interaction with fisheries, conservation of associated environments, spawning aggregations and photo identification (Figure 4a); (b) *governance* – articulation with local knowledge from fisheries communities (Figure 4b), institutional governance, public policy; (c) *educommunication and environmental education* – insert of coastal communities in the project's activities (Figure 5a), making goliath grouper as a conservation symbol (Figure 5b) of coastal environments.

Investigations Efforts Toward Reef fish Aggregations

Pró-Arribada started investigating previous landing peak patterns (CPUE) of species suspected to form aggregations in South Brazil. Most of the information came from official landing bulletins, from 2002 to 2012, and a total of at least nine species (Table 1) represented commercially important resources that may form aggregations throughout South Brazil.

Due to the lack of differentiation among landed species named Caranha and Cioba, they were united in a general group as Lutjanidae. The same identification problem was observed for the category Cherne, composed by many species, including the protected *Polyprion americanus* (Instrução Normativa N°37 – 6/OCT/2005).

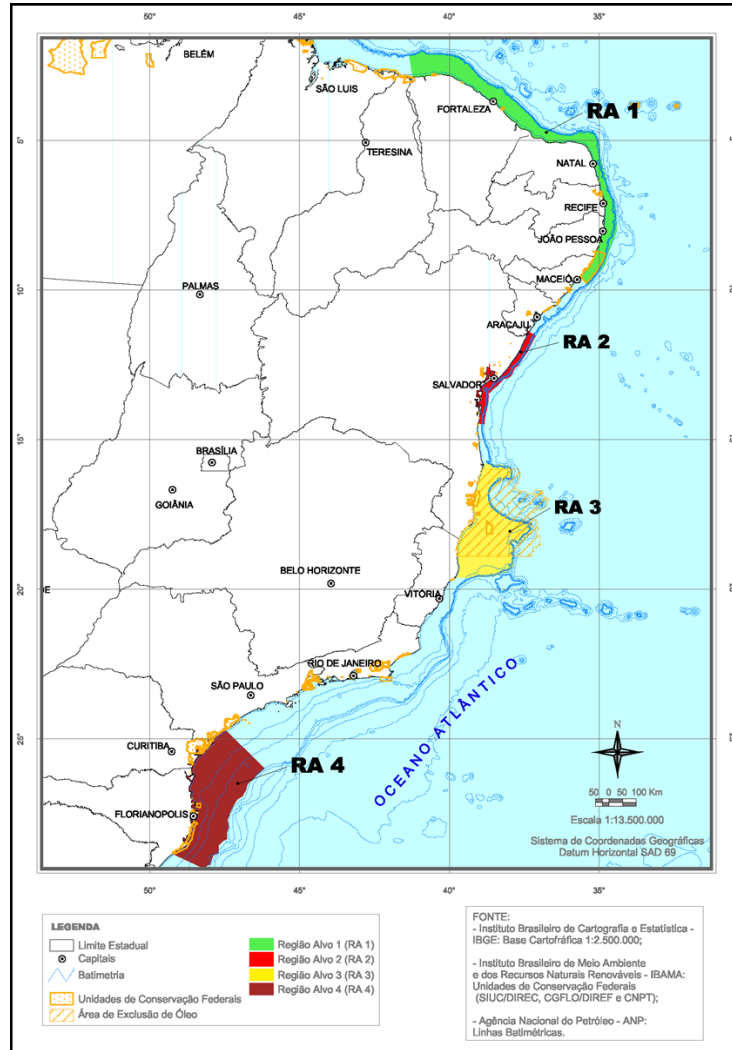


Figure 1. Macro areas (RA) surveyed by Pró-Arribada Project.

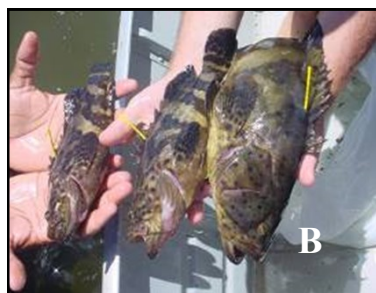


Figure 2. The goliath grouper in South Brazil. The species has a strong association with artificial reef structures, including the Oil & Gas industry structures. (Áthila Bertoncini)



Figure 3.

A. Sampling of longline fisheries inside Babitonga Bay, South Brazil. (VIDAMAR archive)



B. Tagging of juveniles inside estuarine areas of Bahia, Northeast Brazil. (ECOMAR archive)

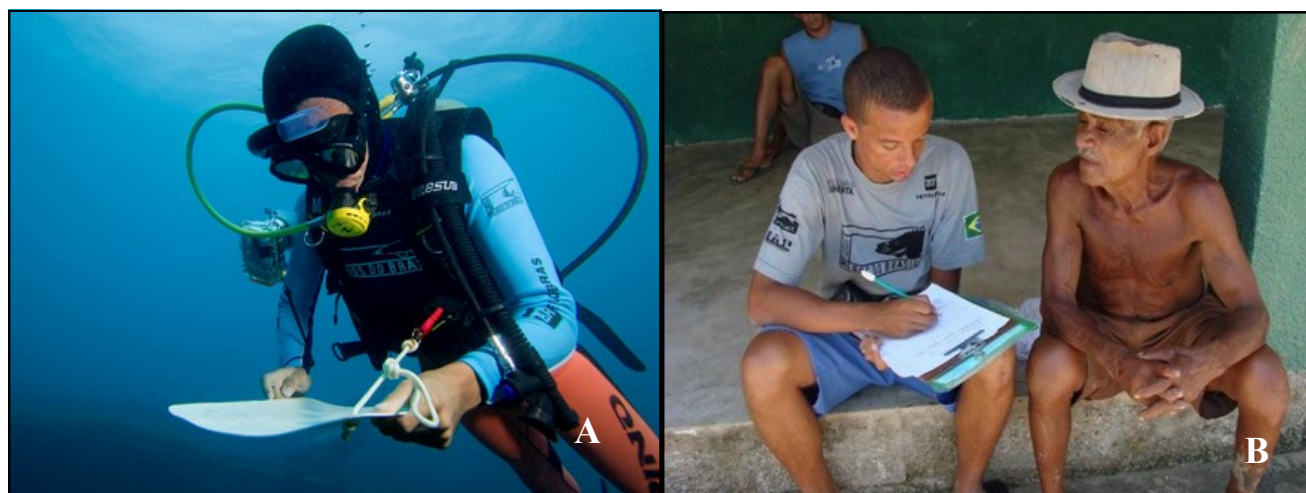


Figure 4. A. *In situ* research of goliath grouper. (Áthila Bertoncini) B. Ancient fisherman in Caravelas providing information through Local Ecological Knowledge, Northeast Brazil. (ECOMAR archive)



Figure 5. A. Cultural manifestations with the goliath grouper as part of spectacles in Caravelas, Northeast Brazil. (ECOMAR archive) B. Research of goliath grouper also aims to have the species as a conservation symbol of coastal ecosystems. (Áthila Bertoncini)

Table 1. Vernacular Portuguese names and scientific names associated to species reported in the bulletin of Grupo de Estudos Pesqueiros da UNIVALI (GEP/UNIVALI).

| Vernacular name | Scientific names | Family |
|----------------------|--|---------------|
| Cherne | <i>Epinephelus</i> spp. | Epinephelidae |
| Chene-galha-amarela | <i>Epinephelus flavolimbatus</i> | |
| Cherne-verdadeiro | <i>Epinephelus niveatus</i> | |
| Garoupa-verdadeira | <i>Epinephelus marginatus</i> | |
| Mero | <i>Epinephelus itajara</i> | |
| Caranha | <i>Lutjanus analis</i> ; <i>L. cyanopterus</i> ; <i>L. griseus</i> ; <i>L. jocu</i> ; <i>L. synagris</i> ; <i>L. purpureus</i> ; <i>L. vivanus</i> | Lutjanidae |
| Cioba | <i>Lutjanus</i> spp.; <i>Ocyurus chrysurus</i> | Polyprionidae |
| Cherne-polveiro | <i>Polyprion americanus</i> | |
| Borriquete/Mireguaia | <i>Pogonias cromis</i> | |
| Pescada-amarela | <i>Cynocion acoupa</i> | Scianidae |

Among the analyzed landings, *Pogonias cromis* (Black drum) and *Epinephelus itajara* (Goliath grouper) showed the most marked peak of landings. The former concentrated landing peaks during winter, and the latter during austral summer (Figure 6). Nonetheless, among all analyzed species, the dusky grouper (*E. marginatus*) is the grouper species explored not only by the industrial fleet, but by artisanal fisheries, once it is abundant along rockyshores in South Brazil. The landing peak in June reflects catches from a single year (2002), where the total catch was 25 ton, showing that some data do need to be better understood/explored, once the Brazilian Ministry of Fisheries did not provide catch maps of reported catches.

Investigations of Local Ecological Knowledge provided important information regarding time and space of aggregations of the dusky grouper (*E. marginatus*) and the cubera snapper (*Lutjanus cyanopterus*) (Carvalho, 2012),

complementing previous research efforts on the goliath grouper (*E. itajara*) provided by Gerhardinger et al. (2006).

Informants provided a total of 14 reports of high catches of the dusk grouper (*E. marginatus*) in short periods of time, in 26 sites placed along the coast of the state of Santa Catarina (from 26°14'S to 28°45'S), South Brazil.

Regarding the cubera snapper (*L. cyanopterus*) informants provided a total of 14 sites, pointing out the lost of an important aggregation that used to take place inside a coastal lagoon (Conceição Lagoon) situated at Santa Catarina Island (27°33'S, 048°23'W), South Brazil. This lost aggregation used to be explored from December to March, during the full moons, with small boats that fished them with spears (Figure 7). A single summer aggregation, explored by one of the informants, was estimated in the amount of 300 cubera snappers.

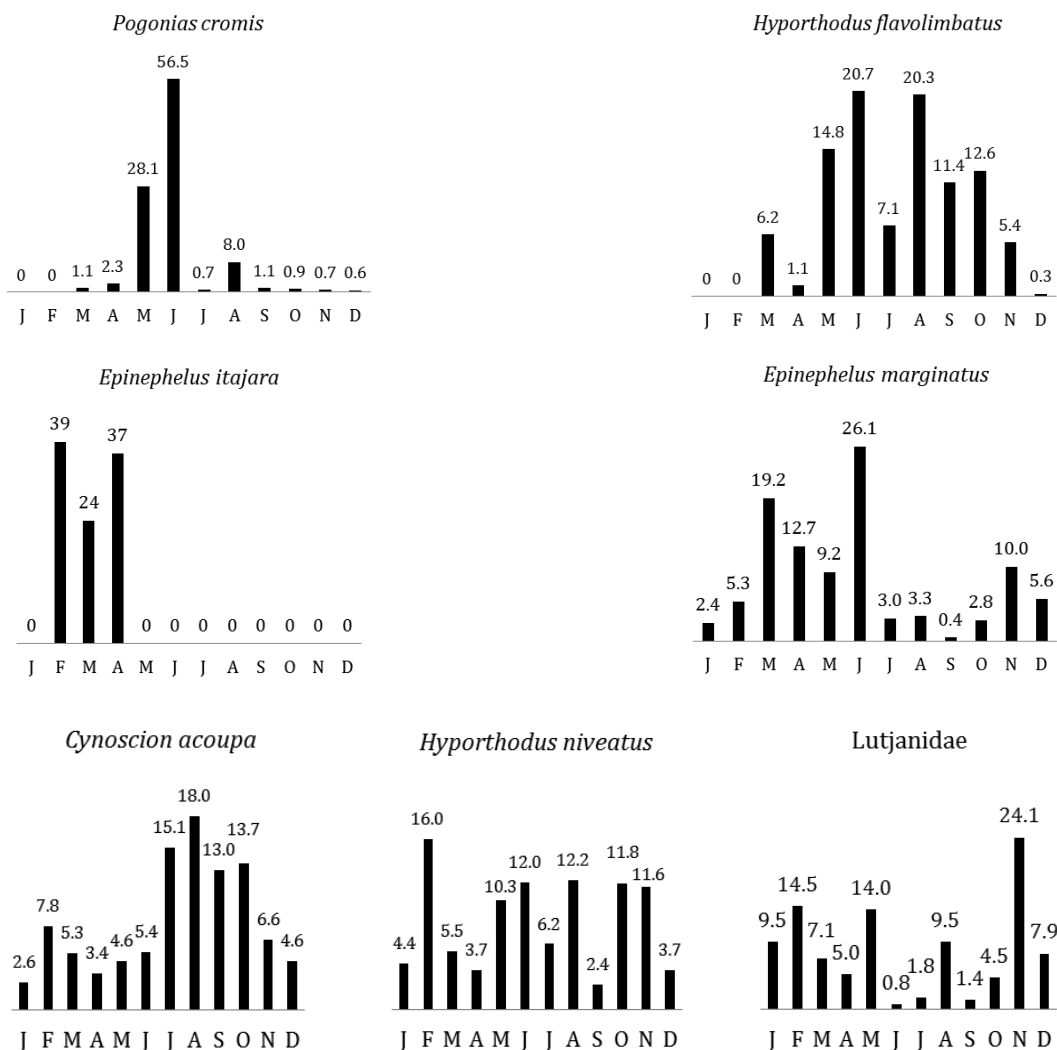


Figure 6. Distribution of percentages of total catch sum (2000 – 2012) along the months (starting in January = J), by the industrial fleet that lands in Santa Catarina, South Brazil.

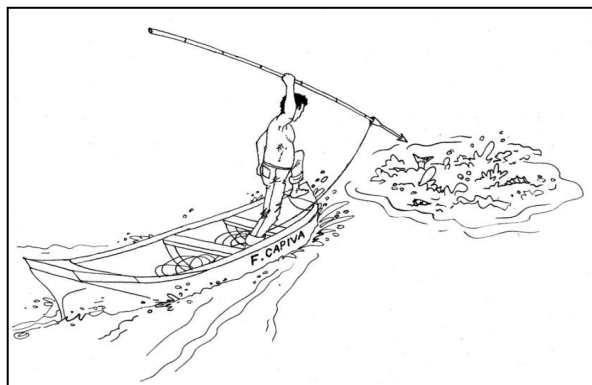


Figure 7. Illustration of the extinguished cubera snapper (*Lutjanus cyanopterus*) fisheries during full moon aggregations at Conceição Lagoon, South Brazil. (Gustavo Melim Gomes)

Data obtained through Local Ecological Knowledge also supported survey dives, indicating areas where invariably local reef fish community composition and habitat characteristics were reported. Many of the pointed out areas still lack *in situ* visits by the scientific divers team, and some of the prospected ones lack visits during the most probable date of aggregation occurrences.

Besides the Local Ecological Knowledge investigations, the MOPE program (Fisheries Voluntary Monitoring Program) provided biological material through a network of collaborators (n = 17), which also involved the Federal Police providing biological material from their seizure operations (*E. itajara* samples). Most of collaborators were local fishshops, fishermen, restaurants and spearfishing associations. Fishshops staff received training, besides all the necessary material (Figure 8a) to conduct a sampling of Epinephelids, Lutjanids and Sciaenids that were sold, accompanied periodically by MOPE team that were responsible to conduct the samples (first stored at the fishshop) to the laboratory to proceed with analyzes.

Furthermore, MOPE team also accompanied spearfishing competitions, performing the sampling of all fish obtained by participants (Figure 8b), with a focus on Epinephelids and Lutjanids.

A 12-months-sampling provided 229 specimens, where the most abundant species were *E. marginatus* and *M. acutirostris* (comb grouper) (Figure 9). Sampling enabled to follow up with the dusky grouper research on feeding and reproduction ecology, which have been periodically studied (Bertoncini et al. 2003m Machado et al. 2008, Gerhardinger et al. 2007), providing new evidences of spawning (Figure 10a) and new information never observed before in Santa Catarina, regarding the sequential hermaphroditism of this species (Figure 10b).

Finally, goliath grouper (*E. itajara*) aggregations, reported at five locations in South Brazil, are the main target of study (Bueno et al., In preparation): three associated to artificial reef structures, and two associated to natural rockyreefs, being all of them in shallow areas (> 30 m). Information on their distribution and abundance on natural habitat has been more limited, even being visited frequently by many of the spearfishermen that make and report observations. Remarkable was a single opportunity where circa 45 goliath groupers were spotted (Figure 11), and several color displays observed (Leite et al. 2012). Such aggregation took place in February, and although it is located in a well known site by fisherman, access is restricted, once is considered as a national security area by the Brazilian Navy. On the other hand, little enforcement and patrolling exist in the area, and goliath groupers are known to be captured in the area.

So far, none aggregations of the dusky grouper were spotted, beyond the data provided by the Local Ecological Knowledge surveys. This constitutes one of the main research needs to be carried on in parallel to the research efforts for the study of goliath grouper aggregations. An ultrasonic tag program is to be implemented in the next years to better understand the goliath grouper dynamics in the aggregation area.

Results from this joint effort of Meros do Brasil Project and Pró-Aribada so far provided important information that are being translated into maps to be used by the Brazilian Environmental Agency (ICMBio) and the Environmental Ministry (MMA), where spatial and temporal sensitive areas are indicated for protection during spawning seasons, subsidizing future licensing processes of seismic surveys and the Oil and Gas industry.



Figure 8. A. Sampling kit provided by MOPE Program to fishshops and collaborators; B. sampling of comb grouper (*Mycteroperca acutirostris*) during a spearfishing event (Fabiano Grecco).

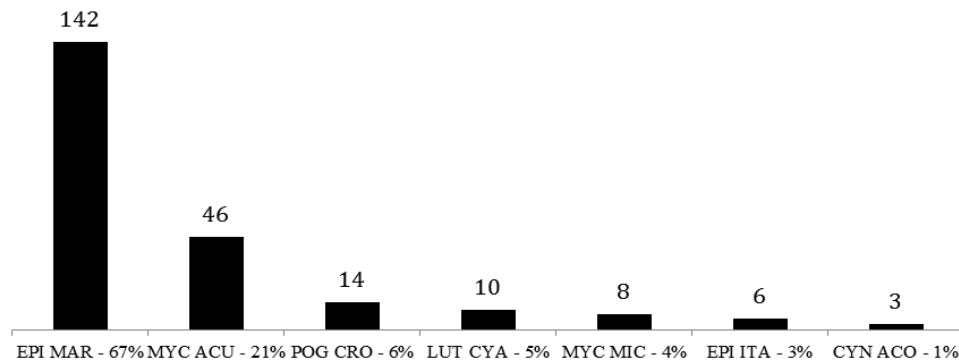


Figure 9. Total number (and percentages) of sampled species from MOPE Program during 12-month. EPI MAR = *Epinephelus marginatus*; MYC ACU = *Mycteroperca acutirostris*; POG CRO = *Pogonias cromis*; LUT CYA = *Lutjanus cyanopterus*; MYC MIC = *M. microlepis*; EPI ITA = *E. itajara* and CYN ACO = *Cynoscion acoupa*.

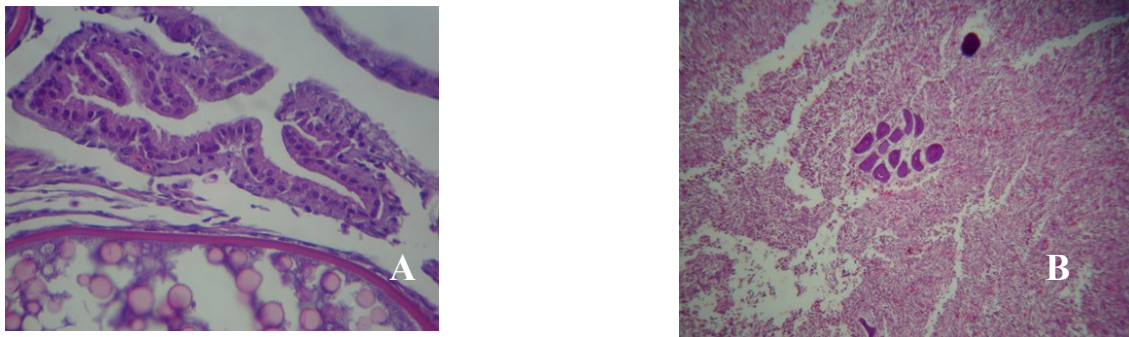


Figure 10. A. Presence of post ovulatory follicles (40x) in a gonad section of *E. marginatus*; B. Evidence of hermaphrodite male, with remaining female oocytes (40x) of *E. marginatus*. (Matheus Freitas)

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Figure 11. Goliath grouper (*Epinephelus itajara*) aggregation at an artificial reef, during February, South Brazil. (Áthila Bertoncini)