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# Bottom trawling on a carbonate shelf: Can you get what you see?

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## Abstract :

Bottom trawling is a common fisheries method and also a widespread scientific sampling method for benthic and demersal species. Selectivity and catchability are usually estimated using different meshes and studies with alternative methods are rare. In this study, to improve the estimation of trawl selectivity, we compare bottom trawl catches and recordings made by a camera fitted on the top of the net. Scientific trawling was conducted along the Northeast Brazilian shelf, a typical carbonate shelf with presence of sponges, coralline bottoms and a high water visibility. In total, 23 taxa (19 species and four genera) were identified in the videos and 30 taxa (25 species and five genera) in the trawls, indicating a higher potential of trawling to record species richness. Overall, no significant differences were observed in the assemblage structure identified by trawling and underwater footages. However, divergences were observed in fish catchability between trawls and videos. Net sampling was more selective for fish with low swimming capacity, while species with shelter and fast swimming capacity seemed to be underestimated. Furthermore, underwater footages allowed for an assessment of the trawling impacts on erect sponges with the observation of the damage on large branching and tubular sponges. The vulnerability of those habitats that concentrate higher fish diversity to mechanical impact raise the need for creation of preventive measures to protect these sensitive areas from commercial fishing operations. The use of less destructive methods is an important survey alternative under special conditions, particularly in conservation areas. In this study the videos could not be used as a complete alternative for the trawls, which presented higher efficiency, however, videos had shown to be a useful complement. Possibly, the speed and height determined by the trawling operation affected the performance of video sampling, being performed in suboptimal conditions. Using dedicated video sampling, such as towed video, could significantly improve its efficiency and compensate the disadvantages observed from the videos.

## Highlights

► Video application in the evaluation of fish catchability by bottom trawling. ► Scientific trawling has shown higher performance in describing the fish community. ► Videos demonstrated to be useful complement for scientific trawling. ► The net impact on erect sponges raise the need for creation of preventive measures.

Keywords : Fish, Underwater footage, Fisheries, Catchability, Sponges, Northeast Brazil

## 44 **1. Introduction**

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Scientific trawling is one of the most used methods to obtain abundance indices for fisheries management (Trenkel et al., 2004b; Hoffman et al., 2009). It provides the identification of a broad diversity of commercial and non-commercial fish and benthic organisms (Brind'Amour et al., 2014). Bottom trawl effectiveness is related to catchability and selectivity. Catchability is the relation of the relative abundance indices provided by a fishing technique and the actual population density (Trenkel et al., 2004a). In other words, it

represents the interaction of the resource abundance and the effectiveness of the fishing gear (Arrenguín-Sanchez, 1996). Many factors can influence bottom trawl catchability, such as depth, season, fish behavior, fish vertical distribution, and gear selectivity (Beentjes et al., 2004; Yule et al., 2008). Selectivity is related to the probability of fish of a specific size to be captured by a fishing gear, providing measures of escapement (Arrenguín-Sanchez, 1996), which can occur both under and above the trawl net, also affecting trawl catchability (Pearcy et al., 1989).

Video recording methods are used to study the marine ecosystem for approximately 59 60 70 years (Barnes, 1952). They have demonstrated a satisfactory cost-effectiveness and they are non-destructive to the environment (Spencer et al., 2005, Mallet and Pelletier, 61 2014). Regarding trawling, videos have been used to compare the sampling effectiveness 62 among fish species using bottom trawl and visual methods (Pearcy et al., 1989; Adams et 63 al., 1995; McIntyre et al., 2015). However, the video footages were not simultaneous to the 64 trawling. Studies that have used video records during trawling were in most cases 65 investigating the behavior and escapement of a specific group of fish, such as flatfishes, 66 elasmobranchs or other target species (Godo et al., 1999; Albert et al., 2003; Chosid et al., 67 2012; Hannah and Jones, 2012; Bryan et al., 2014; Melli et al., 2019; Noack et al., 2019; 68 Young et al., 2019). 69

Here we compare the effectiveness of the two methodologies by performing them simultaneously during a scientific fish survey cruise. The study was performed over the Northeastern Brazilian continental shelf, which is dominated by carbonate sediments due to its low rate of precipitation and sedimentation (Camargo et al., 2015). This sedimentstarved aspect provides clear waters and allows the preservation of topographic features, resulting in the presence of benthic habitats that harbor diverse biological communities (Rocha et al., 2000; Camargo et al., 2015; Eduardo et al., 2018). Specifically, we compared

fish recorded by video with those captured by trawling, reported the noticeable fish reactions to the trawl net, and discussed on fish catchability according to their behavior and the characteristics of the habitat. We also recorded trawl impact on large size branching and tubular sponges, which in the region form conspicuous coral-sponge bottoms that present high biodiversity and represent a refuge for various commercial and sensitive fish species (Eduardo et al., 2018; Eduardo et al., 2020).

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## 84 2. Material and Methods

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## 86 2.1 Study Area

The study area (Fig.1) is situated in the Northeast Brazilian continental shelf, from 87 5°S to 9°S. The average of shelf width is 40 km, the shelf break is approximately at 60 m 88 deep and biogenic carbonate sediments predominantly cover the area, constituting 89 carbonate bottoms, typical of the region (Manso et al., 2003; Vital et al., 2010; Camargo et 90 al., 2015). This region contains high biodiversity and some Marine Protected Areas, such as 91 "APA dos Corais" and "APA Costa dos Corais", which are in the north and south part of the 92 study area respectively (Ferreira and Maida, 2007, Prates et al., 2007). APA is an area of 93 sustainable use, corresponding to category V of the IUCN Protected Areas Categories 94 (Lausche and Burhenne-Guilmin, 2011). 95



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Fig.1. Study area with the five stations (sampling points) where we could compare video and
trawling. Cartographic Base: IBGE, 2017. GCS\_SIRGAS2000.

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101 The study area (Fig.1) is part of the Northeastern Brazil Shelf-Edge Zone EBSA 102 (Ecologically and Biologically Significant Area) (Secretariat of the Convention on Biological 103 Diversity, 2014), that harbours coraline-sponge formations and may act as fish natural 104 corridors between habitats in mesophotic zones (Feitoza et al., 2005; Olavo et al., 2011).

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## 106 2.2 Sampling

Samples were collected on board the French R/V ANTEA, during the 'Acoustics
along the BRAzilian COaSt 2' (ABRACOS 2; Bertrand, 2017) survey performed on 9 April –
9 May 2017. Sampling was conducted using a bottom trawl (body mesh: 40 mm, cod-end

mesh: 25 mm, entrance dimensions horizontal x vertical: 28×10 m) and video footages by 110 an underwater camera (GoPro Hero 3+) attached in the upper part of the mouth of the net. 111 Videos were recorded from 14 trawls, however, only five trawls presenting videos with 112 adequate field of view (recording the entire net mouth) were considered here. Sampling 113 was thus restricted to depths between 36 and 64 meters, which correspond to mesophotic 114 depths (Rocha et al., 2018), and trawling was performed during approximately 6 min at 3.0 115 knots. Tow duration was based on video observations, from the moment of the arrival of the 116 net on the ocean floor to the lift-off time. To ensure the net was fishing correctly we utilized 117 118 SCANMAR sensors to monitor the net geometry, to give headline height, depth, and distance of wings and doors. In addition, bobbins were added to the ground rope 119 (rockhopper) to reduce net damage and impacts on benthic habitat. 120

For each haul, fish were identified, counted, and preserved with a solution of 4% formalin in seawater or by freezing until processing. For video identification and counting, trained people performed visual census based on fish identification guides (Lessa and Nóbrega, 2000; Humann and Deloach, 2002). Fish that could not be identified to species level were grouped to genus level. Fish species and families were classified according to Craig and Hastings (2007) and Nelson (2016).

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## 128 2.3 Data analyses

Data consisted of fish counts (N) identified at the lowest taxonomic possible level obtained from videos observations and trawling catches. The relative index of density (catch per unit of area – CPUA) was calculated considering the number of individuals per trawled area (ind.km<sup>-2</sup>). To estimate the trawled area, we multiplied the distance covered by

the net through the bottom (in meters) with the average mouth opening (13 m) (Table 1).

134	Species composition was estimated by number (relative abundance - %N). To
135	describe species dominance patterns we used the frequency of occurrence (FO) and the
136	relative numerical abundance in percentage (NP) (Garcia et al., 2006). Species that
137	presented NP greater/lower than the average were considered Abundant/Scarce. Similarly,
138	species that presented FO greater/lower than the average were considered Frequent/Rare.
139	Based on these criteria, the degree of species dominance was classified in four categories
140	of relative importance (relative importance index): (1) Abundant and Frequent, (2) Abundant
141	and Rare, (3) Scarce and Frequent and (4) Scarce and Rare (Garcia et al., 2006).

142

## 143 Table 1

Time duration and area covered by bottom trawls and video footages in total and in all five stations (sample points). Trawls were performed along the Northeast Brazilian continental shelf (4°–9°S) and video footages were recorded simultaneously by a camera installed on top of the anterior part of the trawl net.

Stations	Time	Area (m²)
1	8min 25sec	10110
2	6min 9sec	7387
3	5min 50sec	7007
4	5min 17sec	6346
5	4min 38sec	5566
Total	30min 19sec	36416

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We investigated patterns of catchability based on the differences between the number of individuals sampled by videos and by trawls (net change). Furthermore, we used the CPUA to investigate the structure of fish assemblages from videos and trawls. To reduce the effect of shoals in the analyses, the CPUA data was log-transformed (Log(x+1)).

We built a resemblance matrix, based on Bray-Curtis similarity index. The non-metric multidimensional scaling method (nMDS) was used to represent the samples graphically in a two-dimensional plane and the non-parametric permutation procedure ANOSIM (Analysis of Similarity) was applied to test for differences between the structure of fish assemblages from videos and trawls (Clarke, 1993). These analyses were performed using the software PRIMER6 + Permanova (Anderson et al., 2008) with a significance level of 0.05. Finally, we also counted all erect sponges that appeared in the videos.

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## 161 **3. Results**

### 162

The five hauls analyzed in this study corresponded to a total effort of 30 min and 36,416 m<sup>2</sup> of trawled area (Table 1). From bottom trawls, 490 fishes distributed in 23 families and identified in 30 taxa, at the level of 25 species and 5 genera were captured. Whereas 370 fishes distributed in 19 families were identified through the videos, classified in 23 taxa at the level of 19 species and 4 genera (Table 2).

Approximately 70% of fish assemblages were represented by *Holocentrus adscensionis* (26% in videos and 29% in bottom trawls), *Pseudupeneus maculatus* (20% in videos and 170 15% in bottom trawls), *Diodon holocanthus* (0% in videos, 15% in bottom trawls), *Fistularia* 171 *tabacaria* (13% in videos and 4% in bottom trawls) and *Acanthurus* spp. (9% in videos and 172 4% in bottom trawls) (Fig. 2).

Of the total 34 taxa composing the fish community detected by the sum of both methods, 88.2% were captured by bottom trawls and 67.6% were identified in video observations. Four species were only observed in videos: *Caranx crysos, Halichoeres dimidiatus, Malacanthus plumieri* and *Calamus pennatula,* while 11 were only observed in trawl catches, the most abundant being *Diodon holocanthus* (Table 2).



Fig. 2. Relative abundance of fishes (%) sampled by two different methods along the Northeast
Brazilian continental shelf (4°–9°S): video and bottom trawl.

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## 183 Table 2

List of species, number of individuals (N), relative importance index (1: Abundant and frequent; 2: Abundant and rare; 3: Scarce and frequent; 4: Scarce and rare) for fishes sampled in all five stations by videos and bottom trawls along the Northeast Brazilian continental shelf (4°–9°S).

			NI	Relative Importance		
Family	Genera / Species		Ν		Index	
		Video	Bottom Trawl	Video	Bottom Trawl	
Acanthuridae	Acanthurus spp.	35	18	1	1	
Aulostomidae	Aulostomus maculatus	0	5		4	

Balistidae	Balistes sp.	1	2	4	3
Carangidae	Caranx crysos		0	4	
Chaetodontidae	Chaetodon ocellatus	9	19	3	1
	Chaetodon striatus	2	3	3	3
Dactylopteridae	Dactylopterus volitans	1	1	4	4
Dasyatidae	Hypanus guttatus	0	1		4
	Hypanus marianae	7	7	3	3
Diodontidae	Diodon holocanthus	0	74		1
Fistulariidae	Fistularia tabacaria	47	21	1	1
Gerreidae	Eucinostomus sp.	0	3		4
Haemulidae	Anisotremus virginicus	2	2	4	4
	Haemulon aurolineatum	9	13	4	4
	Haemulon plumierii	10	15	3	1
Holocentridae	Holocentrus adscensionis	97	144	1	1
Labridae	Halichoeres dimidiatus	1	0	4	
Lutjanidae	Lutjanus synagris	0	4		3
	Ocyurus chrysurus	1	2	4	4
Malacanthidae	Malacanthus plumieri	6	0	3	
Microdesmidae	Ptereleotris randalli	0	1		4
Monacanthidae	Aluterus monoceros	0	1		4
Mullidae	Pseudupeneus maculatus	75	74	1	1
Ostraciidae	Acanthostracion spp.	6	34	3	1
	Lactophrys trigonus	16	13	1	3
Pomacanthidae	Holacanthus ciliaris	6	6	3	3
	Pomacanthus paru	9	8	3	3
Pomacentridae	Stegastes pictus	0	1		4
Rhinobatidae	Pseudobatos percellens	0	1		4
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Scaridae	Sparisoma spp.	9	13	3	3	
Sciaenidae	Pareques acuminatus	0	1		4	
Serranidae	Alphestes afer	0	2		4	
	Cephalopholis fulva	15	1	1	4	
Sparidae	Calamus pennatula	5	0	3		

Most species only registered either in videos or in trawl samples were considered scarce and rare in terms of relative importance index. Four species were considered abundant and frequent in both sampling methods (*Acanthurus* spp., *Fistularia tabacaria*, *Holocentrus adscensionis* and *Pseudupeneus maculatus*) and five were scarce and frequent (*Chaetodon striatus*, *Hypanus marianae*, *Holacanthus ciliaris*, *Pomacanthus paru* and *Sparisoma* spp.). We did not find any abundant and rare species (Table 2).

194 Considering the net change between fish sampled by the two different methods, the 195 species that prevailed in the videos were *Malacanthus plumieri* (which was identified only 196 by videos), *Acanthurus* spp., *F. tabacaria* and *Cephalopholis fulva*, while in the bottom 197 trawls *Acanthostracion* spp., *H. adscensionis* and *Diodon holocanthus* (which was only 198 identified on trawls) were predominant (Fig. 3).



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Fig. 3. Net change between fish sampled by videos and by bottom trawls along the Northeast
Brazilian continental shelf (4°–9°S). The main differences are highlighted (1. *Malacanthus plumieri*;
2. Acanthurus spp.; 3. Fistularia tabacaria; 4. Cephalopholis fulva; 5. Acanthostracion spp.; 6.
Holocentrus adscensionis; 7. Diodon holocanthus).

The segregation between samples is more noticeable than between methods (Fig. 4). Additionally, the ANOSIM analysis, based on the log-transformed CPUA dataset, did not reveal a significant difference between the structure of fish assemblages from video and bottom trawl (R = -0.092; p = 0.72).



Fig. 4. Non-metric multidimensional scaling method (nMDS) of the CPUA data (ind.km<sup>-2</sup>) of the fish assemblages sampled by videos and by bottom trawls along the Northeast Brazilian continental shelf (4°–9°S). The numbers (1; 2; 3; 4; 5) represent the stations (sample points); BT: Bottom trawl.

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In total, 126 individual sponges were observed in videos, where 119 were classified as belonging to family Aplysinidae (94%). Of those, most resemble genera *Aplysina* and a few could be *Aiolochroia*. Remaining, seven organisms were classified as class Demospongiae, possibly belonging to the genera *Aplysina, Aiolochroia, Oceanapia* or *Geodia* All sponges hit by the trawl were damaged (Fig. 5).



Fig. 5. Images examples of the sponges dragged by the trawl net along the Northeast Brazilian continental shelf (4°–9°S).

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## 226 4. Discussion

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This study is the first analyzing and comparing the fish community structure as observed from videos and bottom trawls carried out simultaneously. In total, 29 species were recorded by our subset of 5 hauls and video sampling, corresponding to 24% of the total number of species (120) recorded during the 35 hauls of the entire survey (Eduardo et al., 2018), which included trawling at depths as shallow as 10 meters.

Differences between the structure of fish assemblages sampled by videos and bottom trawls were not significant, probably due to small sample size and differences between samples sets. Previous studies have demonstrated differences among species when comparing visual surveys and bottom trawl sampling efficiency (Adams et al.,1995; McIntyre et al., 2015). In this study, despite the non-significant difference between the overall fish assemblages sampled by the two methods, it was clear that the bottom trawls were more efficient to describe the fish community, as indicated by the higher number of

species caught by this method. It is noteworthy, however, that in the present study the results from videos were determined by trawls' height and speed, possibly limiting the efficiency of the method per se. Species captured only by trawls were mostly those considered scarce and rare. However, their detection is important, as rarity is a common feature in reef fish communities and they might be highly important in the ecosystem despite they are not the most abundant or frequent (Grande et al, 2019).

Furthermore, species-specific patterns were observed. For instance, *Cephalopholis fulva, Malacanthus plumieri, Calamus pennatula,* and *Halichoeres dimidiatus* were present in videos but escaped the trawl net passage due to their ability to hide in caves, to take refuge underneath coral rubble or to dive into the sand (Clark et al., 1988; Fiorentini et al., 1999; Claydon and Kroetz, 2007; Guidetti et al., 2008). Noteworthy, the rockhopper prevented the net of digging into the bottom. The Surgeonfishes Acanthurus spp. were also able to evade capture possibly because of their shelter attempts (Benevides et al., 2016).

Although squirrelfish Holocentrus adscensionis frequently hide in coral crevices at 253 daytime (Greenfield, 1981), and thus potentially had the ability to escape, they did not 254 escape and were more abundant in the trawl catches than in video. This is related to the 255 occurrence of a large aggregation event in one of the stations, probably a spawning 256 aggregation since most individuals were spawn ready (BPF, pers. obs.), which leaves them 257 more vulnerable (Chollett et al., 2020). In a shoal, the behaviour of an individual fish can be 258 influenced by the movement of the surrounding fishes, resulting in different reactions of the 259 fish in front of the trawl and consequently enabling a tendency to have high catchability at 260 high densities and low catchability at low densities (Godo et al., 1999). In most cases, 261 Holocentrus adscensionis appeared in videos trying to hide into the corals and sponge's 262 structures. However, aggregating individuals behaved swimming away from the net with 263

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other fish. The aggregation may also have induced a bias in fish counting, causing underestimated abundance in the video census (Tessier et al., 2005; Lowry et al., 2012).

The blue runner *Caranx crysos* (Mitchill, 1815) was not captured in the trawls. Probably, its fast-swimming capacity allowed the fish to keep its position ahead of the net, eventually escaping the net during or at the end of the haul (Beentjes et al., 2004). Similarly, the cornetfishes *Fistularia tabacaria* (Fritzsche, 1976) has high swimming endurance and this possibly contributed to their escapement from the trawl net (Beentjes et al., 2004).

On the other hand, the porcupine puffer fish Diodon holocanthus was not identified in 272 videos but was the most abundant fish in the bottom trawls catches. This species was likely 273 not detected in videos since the upper vision of the camera make difficult to identify the fish 274 due to its camouflage with the substrate and immobility. Also, they react to threats inflating 275 or expanding their body with air or water (Shipp, 2003). Thus, we believe that when the 276 porcupine puffer fish felt threatened by the trawl net they were not in the camera's field of 277 view anymore, and as a consequence of their immobility and behavior they were 278 immediately dragged to the end of the net. The boxfishes Acanthostracion spp. are also 279 slow swimming benthic-dwelling (Matsuura, 2003) and present a good camouflage with the 280 substrate, which similarly contribute to their high catchability and complicate their 281 identification in video census (Beentjes et al., 2004). 282

Catchability differences were noted as discussed above and were possibly associated with fish behavior, swimming ability, density and distribution (He, 1993; Godo et al., 1999; Beentjes et al., 2004; Trenkel et al., 2004a; Yule et al., 2008; McIntyre et al., 2015). Escaping was also associated to habitat complexity, which was offered by the rugose carbonate bottom that forms crevices and by coral-sponge formations, typical of the carbonate shelf.

Videos illustrated strong bottom-trawl impact with the destruction of erect sponges. 289 Indeed, all observed sponges touched by trawling gear were destroyed or damaged. Trawl 290 291 nets remove rocks and corals and smooth out natural topography, consequently reducing the structural heterogeneity, which is an important factor to the recruitment and survival of 292 countless fish (Auster et al., 1996; Pilskaln et al., 1998; Kumar and Deepthi, 2006). 293 Sponges together with corals and other benthic organisms play an important role in the 294 formation of mesophotic ecosystems and are vulnerable to different fishing activities 295 (Portela et al., 2015; Chimienti et al., 2019). In some areas of the Northeast Brazilian 296 297 continental shelf, the sponge community represents the only shelter for various fish species and functions as an habitat 'oases' (Rocha et al., 2000). The direct damage to benthic 298 organisms may affect a variety of demersal fishes because of the depletion of food supply 299 and shelters, which exposes the fishes to predation (Kumar and Deepthi, 2006). 300

Along the Northeastern Brazilian coast, artisanal and commercial bottom trawling 301 302 operations target mostly shrimp, being thus restricted to muddy or sandy-muddy bottoms and generally in shallow and coastal waters (Dias-Neto, 2011; Bandini, 2014; Port et al., 303 2016; Bomfim et al., 2019; Silva-Júnior et al., 2019). However, bottom trawling operations 304 on carbonate bottoms and in mesophotic depths (under 30 meters deep) is reported in 305 other parts of the world (Colman et al., 2005; Eigaard et al., 2016; Chimienti et al., 2019). In 306 Brazil, experimental fishing operated by international vessels has already been conducted 307 on northeastern Oceanic banks (MMA, 2006), so there is reason for concern that this kind 308 of fishing may be eventually implemented over carbonate bottoms of continental shelves. 309

Additionally, trawlers frequently operate illegally in areas where fishing is prohibited according to federal fishery laws, including ecologically sensitive zones (Brandini, 2014; Isaac and Ferrari, 2016). Therefore, although bottom trawling is not currently disseminated on carbonate bottoms in the Northeast Brazilian continental shelf, fishing operations may develop faster than regulatory agencies can respond (Berkes et al., 2006), thus preventive
 measures and regulations are important to this region.

We acknowledge the limits of our study including the restricted sample size. This study, however, represents a first contribution combining simultaneously video and bottom trawling and thus provides insight into the performance of two dissimilar sampling methods and an evaluation of a potential fishing impact. Thus, the video observations on sponge depletion and also on fish behavioral reactions are important to assist in taking preventative actions.

Certainly, scientific trawl surveys are much less destructive than commercial 322 operations and are useful to collect biological samples for diet and ageing studies, allowing 323 the estimation of population age structures, the calculation of growth and mortality rates, 324 325 which are essential for the management and monitoring of fish populations (McIntyre et al., 2015). However, despite the higher efficiency of bottom trawls, our study has shown that 326 videos may be an important addition to bottom trawl methods, recording elusive species 327 and also detecting impacts, complementing previous studies showing that video is an 328 appropriate method for studies aiming at analyzing the distribution of fish or community 329 structure (Assis et al., 2007; Stoner et al., 2007; Schaner et al., 2009; Mérillet et al., 2018). 330

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## 332 **5.** Conclusion

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Here, we compared the fish community on a carbonate shelf as observed using bottom trawl and video footage simultaneously. Overall, the difference in fish assemblages structure was not significant. However, trawling has shown higher performance in relation to the number of species captured and thus in describing the fish community. Catchability differences were noticeable for some species, associated with behavioural and ecological

339 characteristics. In addition, video footages allowed the observation of sponges' destruction 340 by the trawls net. Although bottom trawl fishing is not under operation in the region, we 341 recommend that preventative measures and regulations should be addressed to these 342 vulnerable bottom type areas, as the regulatory agencies are often slow to react to the fast 343 development of fishing activities.

The videos analyzed in this study do not represent a complete alternative for 344 scientific bottom trawling, however, it demonstrated to be a useful complement, allowing the 345 observation of species that were captured by the trawls and species-specific reactions to 346 the net. Furthermore, the implementation of less destructive methods may be necessary, 347 especially in conservation areas. Possibly, video sampling was performed in suboptimal 348 conditions, that is, at the speed and height determined by the trawling operation. A use of 349 dedicated video sampling (such as towed video) could significantly improve the 350 performance and compensate the disadvantages of the videos observed in this study. 351

352

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## Highlights

- Video application in the evaluation of fish catchability by bottom trawling;
- Scientific trawling has shown higher performance in describing the fish community;
- Videos demonstrated to be useful complement for scientific trawling;
- The net impact on erect sponges raise the need for creation of preventive measures.

Journal Prevention

## Conflict of Interest Statement

This manuscript has not been published and is not under consideration for publication elsewhere. The authors have no conflict of interest. All authors approved the submission of the present manuscript version and have participated in the manuscript preparation: Beatrice Padovani Ferreira conceptualize this study, Arnaud Bertrand and Flávia Lucena Frédou coordinated the research project. Maria Jacqueline Gomes de Barros performed analyses and wrote the manuscript with contributions of Leandro Nolé Eduardo, Arnaud Bertrand, Flávia Lucena Frédou, Thierry Frédou, Alex Souza Lira and Beatrice Padovani Ferreira. All authors contributed substantially on biological analyses.

Sincerely.

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## **Declaration of interests**

 $\boxtimes$  The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

none