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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

43

44 **1. Introduction**

45

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

52 represents the interaction of the resource abundance and the effectiveness of the fishing
53 gear (Arrenguín-Sanchez, 1996). Many factors can influence bottom trawl catchability, such
54 as depth, season, fish behavior, fish vertical distribution, and gear selectivity (Beentjes et
55 al., 2004; Yule et al., 2008). Selectivity is related to the probability of fish of a specific size
56 to be captured by a fishing gear, providing measures of escapement (Arrenguín-Sanchez,
57 1996), which can occur both under and above the trawl net, also affecting trawl catchability
58 (Pearcy et al., 1989).

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

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

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

83

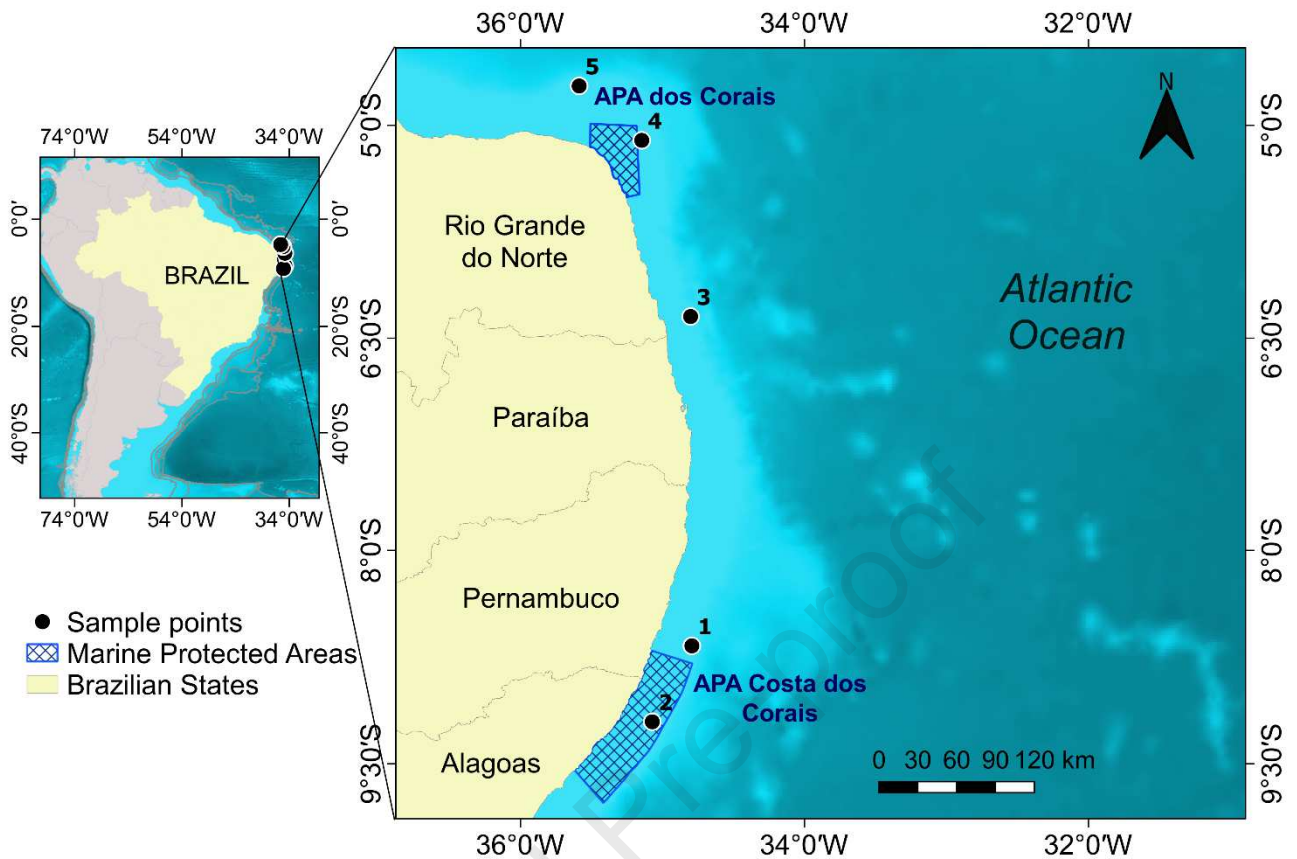
84 **2. Material and Methods**

85

86 *2.1 Study Area*

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

96



97

98 **Fig.1.** Study area with the five stations (sampling points) where we could compare video and
 99 trawling. Cartographic Base: IBGE, 2017. GCS_SIRGAS2000.

100

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 coralline-sponge formations and may act as fish natural
 104 corridors between habitats in mesophotic zones (Feitoza et al., 2005; Olavo et al., 2011).

105

106 2.2 Sampling

107 Samples were collected on board the French R/V ANTEA, during the 'Acoustics
 108 along the BRAzilian COaSt 2' (ABRACOS 2; Bertrand, 2017) survey performed on 9 April –
 109 9 May 2017. Sampling was conducted using a bottom trawl (body mesh: 40 mm, cod-end

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

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

127

128 *2.3 Data analyses*

129 Data consisted of fish counts (N) identified at the lowest taxonomic possible level
130 obtained from videos observations and trawling catches. The relative index of density
131 (catch per unit of area – CPUA) was calculated considering the number of individuals per
132 trawled area (ind.km^{-2}). To estimate the trawled area, we multiplied the distance covered by
133 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

Table 1

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

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

148

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

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

160

161 3. Results

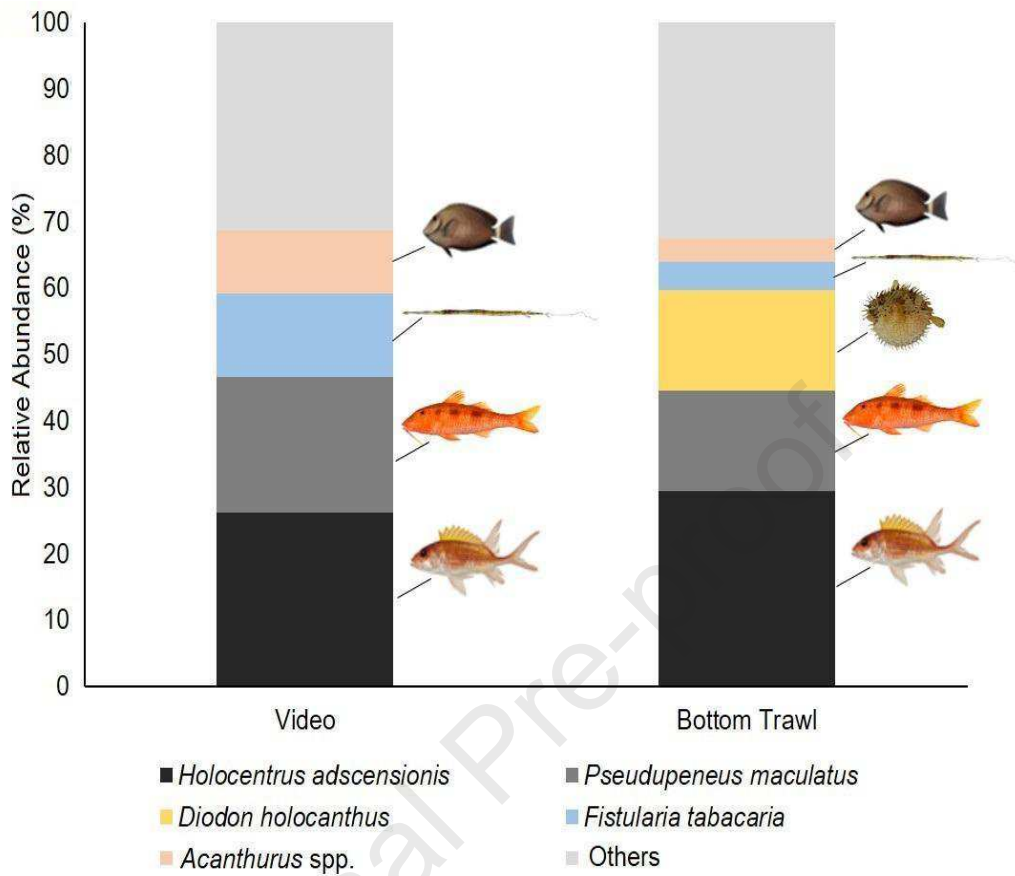
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163 The five hauls analyzed in this study corresponded to a total effort of 30 min and 36,416
164 m² of trawled area (Table 1). From bottom trawls, 490 fishes distributed in 23 families and
165 identified in 30 taxa, at the level of 25 species and 5 genera were captured. Whereas 370
166 fishes distributed in 19 families were identified through the videos, classified in 23 taxa at
167 the level of 19 species and 4 genera (Table 2).

168 Approximately 70% of fish assemblages were represented by *Holocentrus adscensionis*
169 (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).

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

178



179

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

182

183 **Table 2**

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

Family	Genera / Species	N		Relative Importance Index	
		Video	Bottom Trawl	Video	Bottom Trawl
Acanthuridae	<i>Acanthurus</i> spp.	35	18	1	1
Aulostomidae	<i>Aulostomus maculatus</i>	0	5		4

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

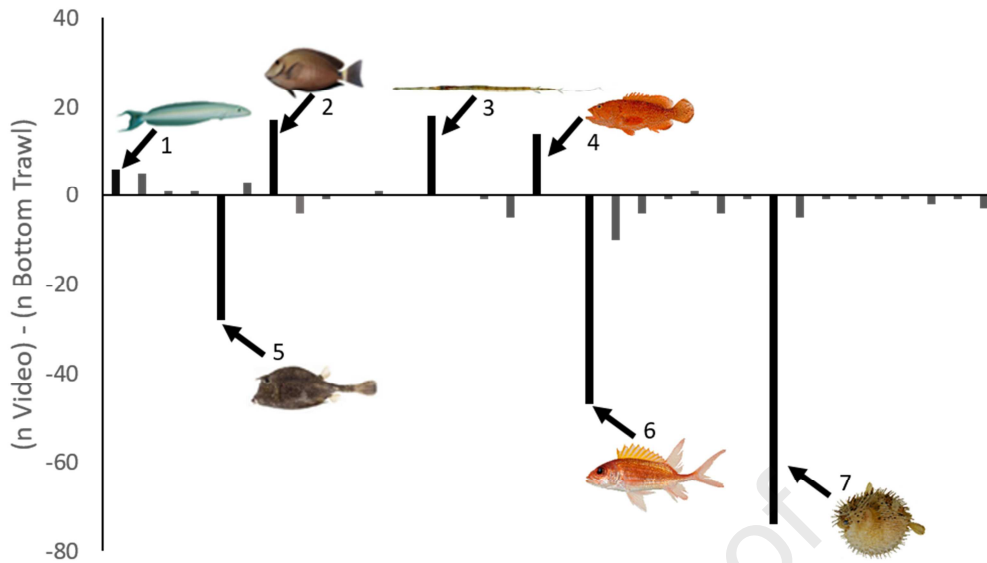
Scaridae	<i>Sparisoma</i> spp.	9	13	3	3
Sciaenidae	<i>Pareques acuminatus</i>	0	1		4
Serranidae	<i>Alphestes afer</i>	0	2		4
	<i>Cephalopholis fulva</i>	15	1	1	4
Sparidae	<i>Calamus pennatula</i>	5	0	3	

187

188 Most species only registered either in videos or in trawl samples were considered
 189 scarce and rare in terms of relative importance index. Four species were considered
 190 abundant and frequent in both sampling methods (*Acanthurus* spp., *Fistularia tabacaria*,
 191 *Holocentrus adscensionis* and *Pseudupeneus maculatus*) and five were scarce and
 192 frequent (*Chaetodon striatus*, *Hypanus marianae*, *Holacanthus ciliaris*, *Pomacanthus paru*
 193 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 holacanthus* (which was only
 198 identified on trawls) were predominant (Fig. 3).

199



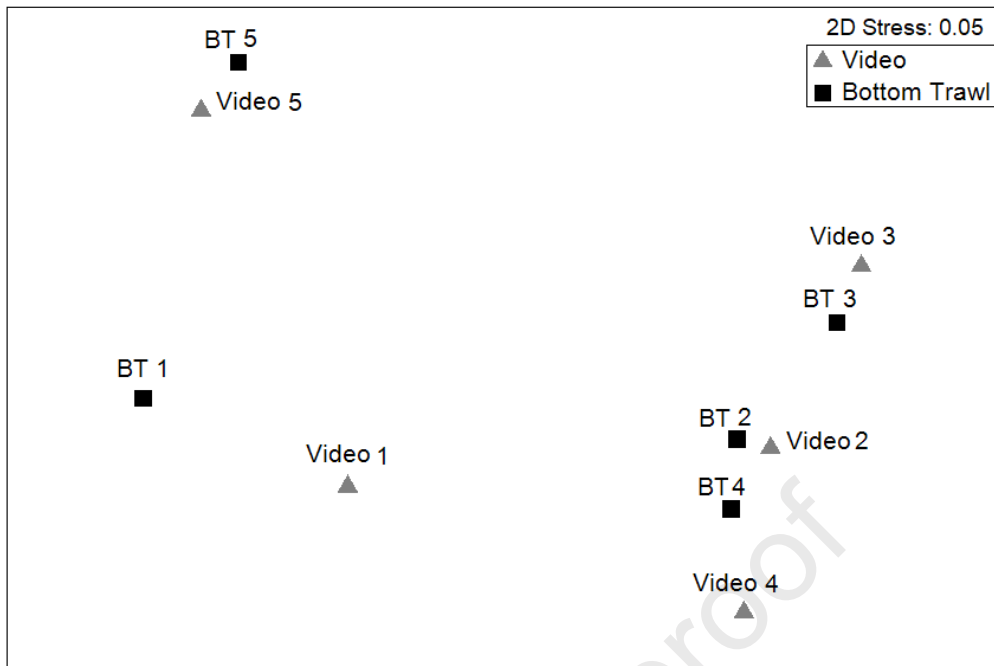
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201 **Fig. 3.** Net change between fish sampled by videos and by bottom trawls along the Northeast
 202 Brazilian continental shelf (4°–9°S). The main differences are highlighted (1. *Malacanthus plumieri*;
 203 2. *Acanthurus* spp.; 3. *Fistularia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

205

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

210



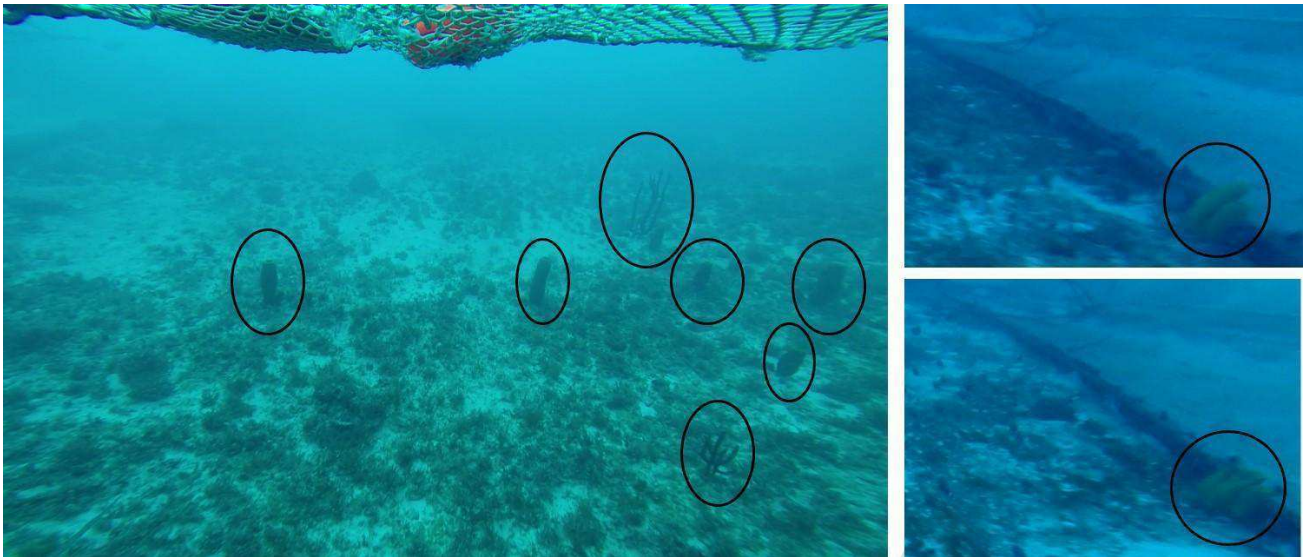
211

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

215

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

221



222

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

225

226 4. Discussion

227

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

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

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

246 Furthermore, species-specific patterns were observed. For instance, *Cephalopholis*
247 *fulva*, *Malacanthus plumieri*, *Calamus pennatula*, and *Halichoeres dimidiatus* were present
248 in videos but escaped the trawl net passage due to their ability to hide in caves, to take
249 refuge underneath coral rubble or to dive into the sand (Clark et al., 1988; Fiorentini et al.,
250 1999; Claydon and Kroetz, 2007; Guidetti et al., 2008). Noteworthy, the rockhopper
251 prevented the net of digging into the bottom. The Surgeonfishes *Acanthurus* spp. were also
252 able to evade capture possibly because of their shelter attempts (Benevides et al., 2016).

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

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

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

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

283 Catchability differences were noted as discussed above and were possibly
284 associated with fish behavior, swimming ability, density and distribution (He, 1993; Godo et
285 al., 1999; Beentjes et al., 2004; Trenkel et al., 2004a; Yule et al., 2008; McIntyre et al.,
286 2015). Escaping was also associated to habitat complexity, which was offered by the
287 rugose carbonate bottom that forms crevices and by coral-sponge formations, typical of the
288 carbonate shelf.

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

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

310 Additionally, trawlers frequently operate illegally in areas where fishing is prohibited
311 according to federal fishery laws, including ecologically sensitive zones (Brandini, 2014;
312 Isaac and Ferrari, 2016). Therefore, although bottom trawling is not currently disseminated
313 on carbonate bottoms in the Northeast Brazilian continental shelf, fishing operations may

314 develop faster than regulatory agencies can respond (Berkes et al., 2006), thus preventive
315 measures and regulations are important to this region.

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

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

331

332 **5. Conclusion**

333

334 Here, we compared the fish community on a carbonate shelf as observed using
335 bottom trawl and video footage simultaneously. Overall, the difference in fish assemblages
336 structure was not significant. However, trawling has shown higher performance in relation to
337 the number of species captured and thus in describing the fish community. Catchability
338 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.

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

352

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365

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367 None.

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375

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- 624

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 Pre-proof

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.

Maria Jacqueline Gomes de Barros

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Declaration of interests

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

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