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Gain or Loss for the Inshore Trawling Ban within Three Miles? Preliminary Data

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Abstract: From 1 June 2010 in the Italian coastal waters of the Northern Adriatic Sea, trawl fishery within three nautical miles became banned. This activity was previously allowed for some species as an exception to legislation. In order to evaluate the consequences both on demersal resources and economic yields of the trawl which will oblige fishermen to trawl beyond three miles, a pilot study was performed. Twenty hauls comparing catch discard and income between hauls within and external to three nautical miles were performed. Results highlighted differences in catch composition both for landing and discard. Landing per unit of effort and discard per unit of effort did not differ in relation to distance from the coast, while income was higher for offshore hauls than inshore ones even if not significantly. Fishery management is a complex task, and the results of this study can contribute to the debate providing new insights into the consequences of the regulation on the trawling within three nautical miles. Considering the high amounts of discard, the habitat damages caused by otter trawling, the presence of juveniles in coastal waters and data regarding fishermen income, this study supports the actual European Community regulation on coastal trawling.

Keywords: trawl fishery; trawl ban; fishery management; coastal zone; sustainability

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Citation: Riginella, E.; Nalon, M.; Sinopoli, M.; Mazzoldi, C. Gain or Loss for the Inshore Trawling Ban within Three Miles? Preliminary Data. *Fishes* **2022**, *7*, 320. https://doi.org/10.3390/fishes7060320

Academic Editor: Dimitrios Moutopoulos

Received: 19 September 2022
Accepted: 26 October 2022
Published: 4 November 2022

1. Introduction

The issue of the sustainability of fishery is recognized worldwide [1,2]. The collapse of several stocks, poorly recovering despite the adoption of different management strategies, called for international agreements, among them, the Code of Conduct for Responsible Fisheries [3]. Nevertheless, we are far away from restoring fish stocks and meeting the deadline of 2015 given in the Johannesburg Plan of Implementation of 2002 [2,4].

Fishery management strategies including spatial closure measures such as OECMs (Other effective area-based conservation measures) are achieving the long term and effective in situ conservation, protecting marine biodiversity and habitats essential for life cycles of marine resources [5,6]. Coastal areas present high biodiversity, thanks to the presence of different habitats [7], provide essential goods and ecosystem services [8], and sustain a significant amount of the total marine fishery (Millennium ecosystem assessment, http://www.millenniumassessment.org (accessed on 25 October 2022)). Coastal ecosystems are among the most impacted areas by human activities [9–12], threatened further on by the growing development pressures (Millennium ecosystem assessment, http://www.millenniumassessment.org (accessed on 25 October 2022)). Coastal degradation and overexploitation are causing remarkable loss of biodiversity and, consequently, are reducing the provided services [13]. Disruptive fishing techniques, among all, bottom trawling, have been recognized to exert indirect impacts, due to the huge amount of discard and the consistent damage of habitat integrity [14]. Considering the low selectivity, bottom trawling also causes reduction of commercial fish stocks' abundance and decrease of diversity [15–17]. The high level of fishing mortality of immature fish causes a reduced number of fish reaching sexual maturity and older age with the consequences of low production of new offspring [17–19]. It has been demonstrated that the establishment of trawl ban areas allows for a quick recovery of demersal fish biomass from intense fishing [20,21]. These fishery exclusion zones provide control areas useful to investigate the dynamics of recovery from fishing [22–24].

Due to the collapse of marine resources, the fishery industry is facing a profound socio-economic crisis [1]). As a consequence, several fishery industries are consistently relying now on subsidies that are recognized to have negative effects on fisheries' sustainability [1]. Both socio-economic and conservation aspects must be taken into consideration in planning fishery management, balancing costs and benefits.

In Italy, several national and European regulations of trawl fishery are in force. Among others, in fact, the EC Reg. 1967/2006 in force since 2008 obliges the use of nets with mesh sizes of 40 mm and imposes different minimum landing sizes for several species. Trawl fishery is allowed for 5 days per week or less, and a fishing stop for at least 30 days is yearly applied since 2002. This fishing stop is usually applied in different periods in different areas. In addition to the fishery regulations in force in marine protected zones, some spatial closures to fisheries, usually in the form of No Take Zones, are established as well, as, for instance, in the Northern Adriatic Sea in the rocky outcrops called Tegnue di Chioggia established in 2002.

The use of trawling within 3 nautical miles or 50 m of depth from the coastline was banned in the Italian waters since 1968 (DPR 1639/1968) and in the Mediterranean Sea from 2007 (EU Council Regulation—EC No 1967/2006, 21 December 2006). Given the peculiar morphology of Italian coasts, up to 1 June 2010, a special dispensation was applied to Italian coasts of the Northern Adriatic Sea, from Trieste to Rimini (Figure 1). As long as this derogation was in effect, it allowed smaller boat otter trawling up to 15 m, seasonally targeting the sand smelt *Atherina boyeri* (from November and February; Figure 2b) or cuttlefish *Sepia officinalis* (from April to 15 of June Figure 2a).

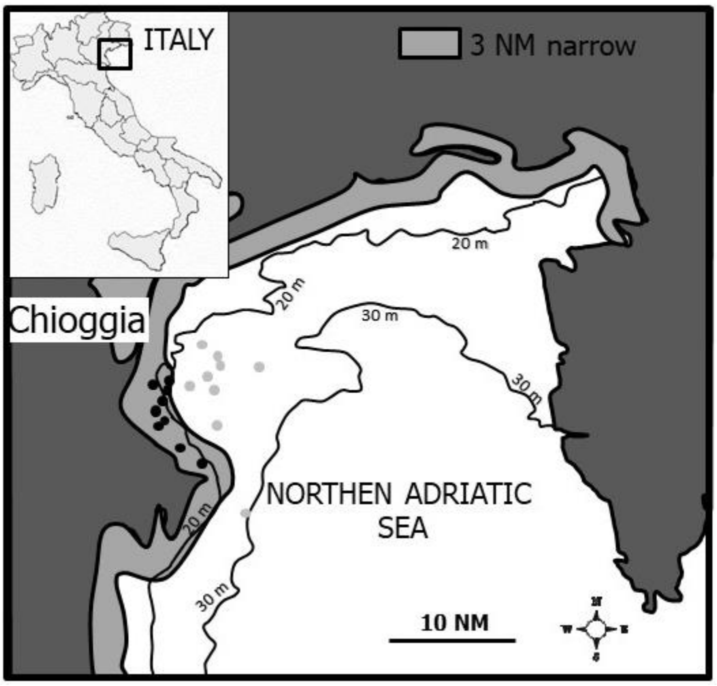

Figure 1. Study area; the three miles area subjected to the trawl fishery ban is marked in gray; the 20 and 30 m isobaths are also reported.

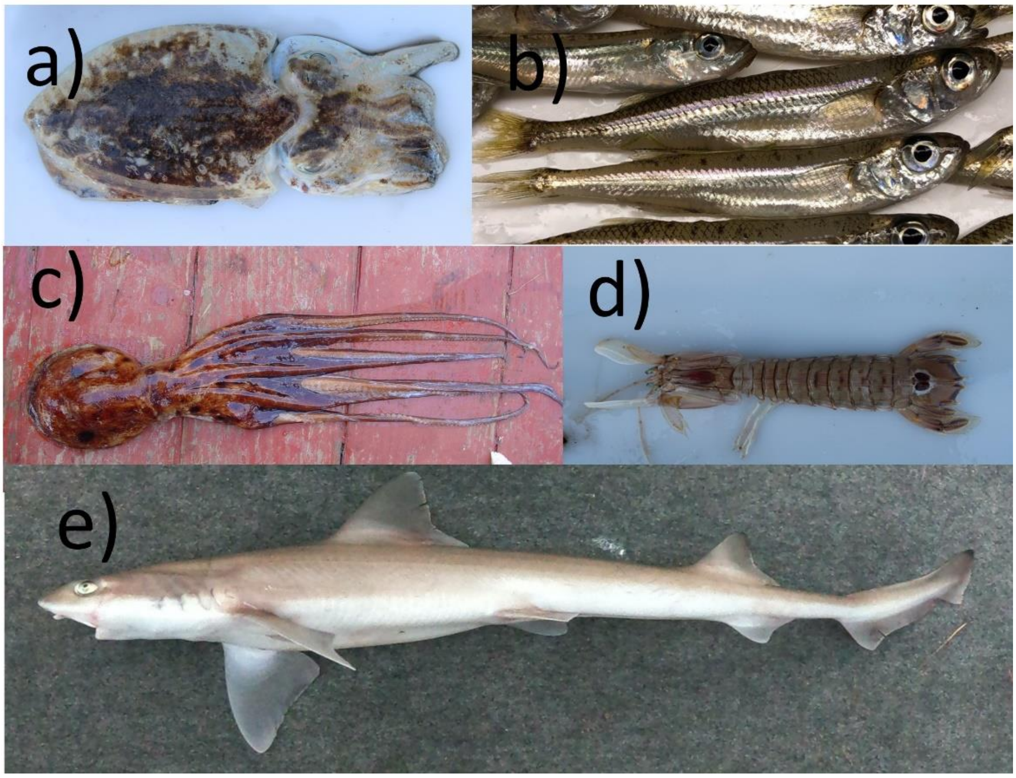

Figure 2. Species considered for the dispensation from the ban on trawling within three miles in force until 2010; (**a**) *Sepia officinalis* (Ph Serena Zampardi; (**b**) *Atherina boyeri* (Ph Federica Poli). Species more abundant in terms of CPUE; (**c**) *Eledone moscata* (Ph Pierpaolo Consoli); (**d**) *Squilla mantis* (Ph *Marco Ranù*), and (**e**) *Mustelus mustelus* (Ph Lorenzo Minoia).

The topic of the consequences of the trawl ban within three miles both on resources but also from a socio-economic point of view has been addressed for a long time. The first studies focused on the effects of seasonal derogations on resources [25,26]. Despite these studies which confirmed the sustainability of the harvests of the sand smelt and the cuttlefish, limited to this short period, in 2010, these dispensations were eliminated. Following this, a socio-economic study was conducted on the effects of closure, including the end of the possibility of derogations [27]. All these studies were based either on bibliographic data or on analyses of landings; however, no data on the total catch, including the discard, have been analyzed, nor have experimental comparisons been performed. More generally, these studies have focused on the two species considered both as a biological and economic resource; however, the consequences at the ecosystem level of the fishing trawls targeting these two species were not explicitly evaluated.

This study was aimed at evaluating the consequences of the closure of trawling within 3 nautical miles (hereafter NM), considering conservation and fishers' perspectives, in a heavily fished Mediterranean area, the Northern Adriatic Sea. Specifically, we performed an experimental study using a commercial otter trawler during cuttlefish fishery season, comparing landed and discarded catch, and income of hauls performed within and external to 3 NM, before the ban of this fishing activity. In this study, we expected differences in catch composition between the different distances from the coast with a major presence of more vulnerable individuals and discard (i.e., juveniles) within 3 NM. On this base, we expected major economic income and ecological benefits within the trawl ban of 3 miles, even if we did not expect differences in landing between the different distances from the coast.

2. Materials and Methods

2.1. Study Area

The study was conducted along the North-western coasts of the Adriatic Sea, specifically close to the Venetian lagoon. The Northern Adriatic Sea (Figure 1) is a semi-enclosed basin of about 32,000 km^2, with a maximum width of 200 km and an average depth of just 29 m [28,29]. Due to its high productivity, it is one of the most fished basins of the Mediterranean Sea, mainly exploited by the large fishing fleet of Chioggia (Venice) [30]. In 2010, the fleet was composed of 264 fishing boats equipped with one or more fishing gears (mid-water trawl number of licenses n = 43, beam and otter trawl n = 140, hydraulic dredge n = 69, traps, gill nets, longline, and other artisanal fishery n = 123; [31], with a total landing in 2010 of 10,878.86 tonnes, including around 200 species [31,32]. The fishing boats relevant to this study, 43 otter trawling targeting cuttlefish, were allowed to fish within 3 NM from 1 April to the 15 June. The average characteristics of the fishing boats are: length: 14.2 ± 2.6 m; width 3.7 ± 1.0 m; Gross Tonnage 16.4 ± 13.5 GT; engine 180.4 ± 56.5 Hp (declared). Most of these fishing boats did not fish within 3 NM daily during the allowed period, but only for two to three days per week (personal observation in 2016).

2.2. Data Collection

Twenty experimental hauls were performed from 29 April to 28 May 2010, on a commercial trawl of the Chioggia's fleet. The fishing boat was a commercial wooden otter trawling vessel with characteristics representing the average values of the fleet (with the exception of a slightly low value of GT). The vessel is 14 m long, 3.6 m large, and had a Gross Tonnage of 11 GT. The engine (182 Hp) allows a constant trawling speed of 2.25 knots at about 1120 rpm. The net was the same used by local commercial trawling and 52 m long from the wing tips to the cod-end: 16 m of wings and 36 m from the mouth of the net to the cod-end. Trawl wings were equipped with a 60 m footrope, 24 mm thick weighting 60 kg, and 60 m of headline, 16 mm thick that weighs about 42 kg. The mouth of the net was 17 m long on the lower part, made heavier by leads (sinker line) and by a 20 m long and 10 mm thick calibrated iron chain (total weight about 24 kg), 8.5 m long on the upper part (float line), made lighter by floats, and 15 m long on each lateral part. Trawl rigging included 155 m of warps and two otter boards weighting 200 kg each. The cod-end used was 5 m long with a diameter of 2.5 m and had a mesh of 10 mm. During 5 hauls (nighttime external), an additional 17 m long and 8 mm thick calibrated iron chain (total weight about 17 kg) was twisted on the lower part of net mouth and on the part of the wings closer to the mouth, in order to catch target species. In order to estimate costs and benefits of fishery restriction, fishers were requested to perform normal fishery procedures in the experimental trawling, performed within and external to 3 NM.

Ten experimental hauls were performed within 3 NM (mean ± standard deviation: 0.99 ± 0.28 NM; range: 0.6–1.5 NM) at a mean depth of 11.08 (± 1.04) meters and 10 external to 3 NM (5.63 ± 0.83; range: 4.5–7.1 NM) at a mean depth of 11.08 (± 1.04) meters (see also, Table S1). During each fishing trip, hauls were performed both within and external to 3 NM. Trawling was performed from 23:55 to 13:50, for a total of 11 hauls at nighttime (five within and six external to 3 NM) and 9 at daytime (four within and five external to 3 NM). Duration of towing was from 1 h 3 min to 4 h 15 min, depending on weather conditions, with an average of 2 h 40 min ± 52 min. Duration of towing did not differ between hauls performed within or external to 3 NM (ANOVA analysis of variance: p = 0.905) or at nighttime and daytime (ANOVA analysis of variance: p = 0.581). At the end of each haul, all catch was sorted and commercial species were separated from discard. Commercial and discard species were taken apart according to fishers' decisions.

In general, in this study area, the commercial part of the trawl catch was constituted by adults or subadults of fish (according also to minimum landing size, if present), cephalopods and crustaceans. Fishers, instead, generally discarded under-sized juveniles of fish, cephalopods and crustaceans, benthonic macroinvertebrates, and benthonic macroalgae. In this pilot (experimental) study, discard corresponds to the discard that fishers normally produce in their working activities.

All commercial catch was identified to species or, for a few species, to genus, and weighted. Discard was put in buckets and each bucket was weighted. Rare species were considered individually and the content of one bucket per trawling was brought to the lab and frozen for subsequent analyses of discard composition. Specimens were identified to the lowest taxonomic level, depending on their integrity. Algae and phanerogams were pooled in one category since it was not possible to weight them separately. Total discard for each taxon was estimated from the ratio weight of each taxon/bucket weight multiplied by total discard weight. A subsample of commercial catch and discard was measured with a ruler to the nearest mm. Fish size was measured as total length, cephalopod size as mantle length, and crustacean size as carapace length and width.

2.3. Data Analyses

All data are reported as mean ± standard deviation. Catch per unit of effort for both commercial catch (CPUE; kg/km^2)) and discard (DPUE, kg/km^2), and income per unit of effort (IPUE, euros/km^2) have been calculated dividing catch/income by swept area. This was obtained by multiplying towing speed by haul duration. To analyze income for fishers, we used the prizes of year 2010 at the fish market for each commercial species, provided by the Fish Market of Chioggia. We did not consider in our analysis gasoline costs, since fishery areas may change from day to day, making it difficult to include general costs to reach fishery grounds. In this sense, we refer to relative to gross income and not net income. Since daytime and nighttime hauls could differ in catch, in all the analyses we considered two factors (fixed and orthogonal): Distance (within 3 NM, external to 3 NM) and Time (daytime and nighttime). CPUE, DPUE, and income per unit of effort (IPUE, arcsine transformed data) were analyzed using ANOVA analysis of variance considering the two fixed and orthogonal factors distances (within 3 NM, external to 3 NM) and times (daytime and nighttime) and their interaction. DPUE was analyzed excluding debris and garbage, representing on average 6.51 ± 4.36% of total discard. We applied multivariate analyses in order to highlight differences in the composition of commercial catch (CPUE) and discard (DPUE). Principal Coordinates Analysis (PCoA) on Bray–Curtis similarity matrices was applied to highlight similarities between samples. Correlation (Spearman) between species and PCoA axes were computed [33]. Permutational Multivariate Analysis of Variance (PERMANOVA) applied to Bray–Curtis similarity matrices [33] was applied to test differences in catch and discard composition considering the two fixed and orthogonal factors distances (within 3 NM, external to 3 NM) and times (daytime and nighttime) and their interaction. The size of individuals in commercial catch and discard of hauls within and external to 3 NM was compared only for taxa with sample size > 10 per group. If the same species was present both in commercial catch and discard, data were pooled. Parametric (*t*-test) or non-parametric (Mann–Whitney U-test) tests were applied according to data distribution and test assumptions.

3. Results

Commercial catch comprised 30 taxa (Figure 3), while discard comprised 79 taxa. Commercial catch did not differ between hauls performed within and external to 3 NM, with a tendency to higher CPUE in hauls external to 3 NM (within: 1.59 ± 0.81 kg/km^2; external: 2.35 ± 1.31 kg/km^2; Table 1a). Nighttime hauls gave significantly higher CPUE than daytime ones (nighttime: 2.39 ± 0.79 kg/km^2; daytime: 1.46 ± 1.31 kg/km^2; Table 1a). DPUE and the percentage of discard on total catch were not significantly different between distances (Table 1b,c), while DPUE was significantly higher in nighttime than daytime hauls (nighttime: 19.37 ± 10.79 kg/km^2; daytime: 6.39 ± 3.71 kg/km^2, Table 1b). Discard represented on average 85.26 ± 6.73% of the total catch. IPUE showed a tendency to higher values external to 3 NM than within 3 NM even if not significant difference were found (within: 19.61 ± 7.99 euros/km^2; external: 29.47 ± 13.33 euros/km^2 Table 1d), while no differences were found between nighttime and daytime hauls (Table 1d).

CPUE composition differed between distances and times (Figure 4 and Table 2a). CPUE of nighttime and daytime hauls were separated along the first PCoA axis, while hauls within and external to 3 NM were separated along the second PCoA axis (Figure 4). The species mainly associated with hauls performed within 3 NM was *Squilla mantis* (Figure 3d), while species associated with external hauls were *Merlangius merlangus*, *Mustelus* spp. (*M. mustelus* and *M. punctulatus*; Figure 3e), Triglidae (including *Chelidonichthys lucerna* and *Trigloporus lastoviza*), and *Eledone moschata* (Figure 4). *E. moschata* (Figure 3c), *S. mantis*, and *Sepiola rondeletii* were mainly caught in nighttime hauls, while *Alloteuthis media*, *Mustelus* spp., and *M. merlangus* in daytime ones (Figure 3).

DPUE composition showed a significant interaction Distance x Time (Table 2). Then, the first PCoA axis separated mainly hauls performed within and external to 3 NM, while the second separated nighttime and daytime ones (Figure 5). The interaction Distance x Time is well represented in PCoA too, with nighttime hauls performed external to 3 NM grouping together close to the 0 values of PCoA. External nighttime hauls were associated with by-catch of Actinaria, Anomura, *Arnoglossus* sp., Ascidiacea, *Gracilechinus acutus*, Holoturoidea, Nudibranchia, Ophiuroidea, *Pagellus erythrinus*, *Pilumnus hirtellus*, *Serranus hepatus*, scallops, sponges, while nighttime hauls performed within 3 NM were associated with Asteroidea, *Aurelia aurita*, *Crangon crangon*, *Carcinus aestuarii*, *Engraulis encrasicolus*, *Gobius* spp., *Liocarcinus* spp., Nassaridae, *S. rondeletii*, and *S. mantis*.

Five taxa, within a total of 12 analyzed, showed differences in size between hauls performed within and external to 3 NM; three pelagic species were smaller within 3 NM (*E. encrasicolus*, *Sardina pilchardus* and *Sprattus sprattus*), while the remaining (*Mustelus* spp. and *Pegusa lascaris*) were smaller external to 3 NM (Table 3).

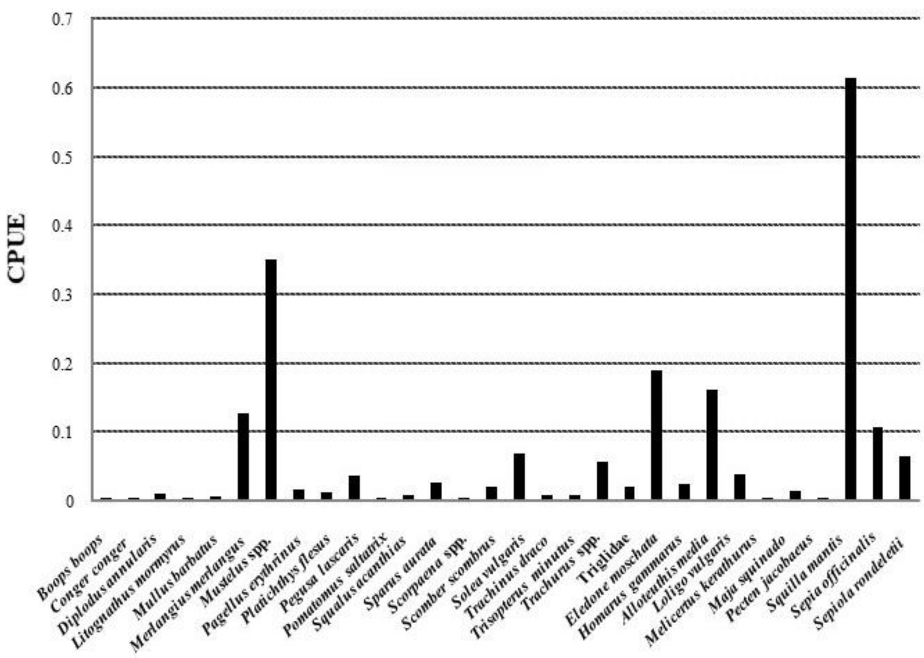

Figure 3. List and CPUE (Catch Per Unit Effort; kg/km^2) of the of the commercial species calculated for all the survey data.

Table 1. Four ANOVA (Analysis of Variance) performed on the two factors distance from the coast (Within and External) and time (Day and Night) for the four variables: (**a**) CPUE (Catch per Unit Effort; (**b**) DPUE (Discard per Unit Effort; (**c**) % discard/total catch, and (**d**) IPUE (Income per Unit Effort. ns = not significant, * = $p < 0.05$, ** = $p < 0.01$.

			CPUE		
(a)	**df**	**SS**	**MS**	**F**	***p***
Distance	1	3.57	3.57	3.53	ns
Time	1	5.02	5.02	4.96	*
Distance × Time	1	0.03	0.03	0.03	ns
Residual	16	16.20	1.01		
			DPUE		
(b)	**df**	**SS**	**MS**	**F**	***p***
Distance	1	40.52	40.52	0.56	ns
Time	1	792.68	792.68	10.91	**
Distance × Time	1	59.60	59.60	0.82	ns
Residual	16	1162.48	72.65		
			% discard/total catch		
(c)	**df**	**SS**	**MS**	**F**	***p***
Distance	1	0.02	0.02	2.49	ns
Time	1	0.004	0.004	0.41	ns
Distance × Time	1	0.01	0.01	1.28	ns
Residual	16	0.16	0.01		
			IPUE		
(d)	**df**	**SS**	**MS**	**F**	***p***
Distance	1	470.28	470.28	3.89	ns
Time	1	102.23	102.23	0.84	ns
Distance × Time	1	133.10	133.10	1.10	ns
Residual	16	1993.97	120.87		

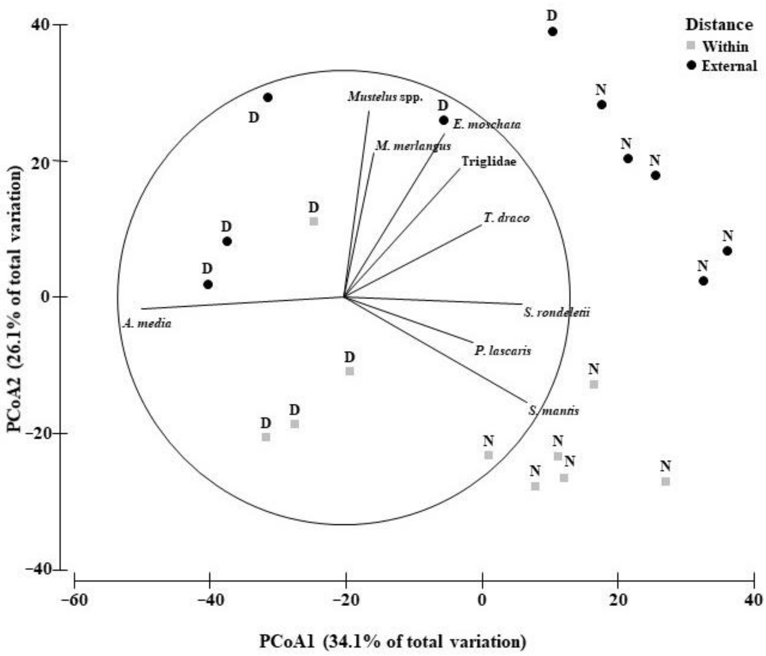

Figure 4. PC (Principal Coordinates Analysis) performed on CPUE (Catch Per Unit Effort) data. N = Night, D = Day, gray quadrat = Within, Black circles = External.

Table 2. PERMANOVA (Permutational Analysis of Variance) performed on the two factors of distance from the coast (Within and External) and time (Day and Night) for the variables: (**a**) CPUE (Catch per Unit Effort and (**b**) DPUE (Discard per Unit Effort; ns = not significant, ** = $p < 0.01$.

			CPUE		
(a)	**df**	**SS**	**MS**	**pseudo-F**	***p***
Distance	1	7192.0	7192.0	6.98	**
Time	1	9703.6	9703.6	9.42	**
Distance × Time	1	1672.7	1672.7	1.62	ns
Residual	16	16,486.0	1030.4		
			DPUE		
(b)	**df**	**SS**	**MS**	**pseudo-F**	***p***
Distance	1	9781.2	9781.2	11.68	**
Time	1	5563.9	5563.9	6.64	**
Distance × Time	1	2068.4	2068.4	2.47	**
Residual	16	13,400	837.5		
Pairwise comp.					
	External Night ≠ Day		Within Night = Day		

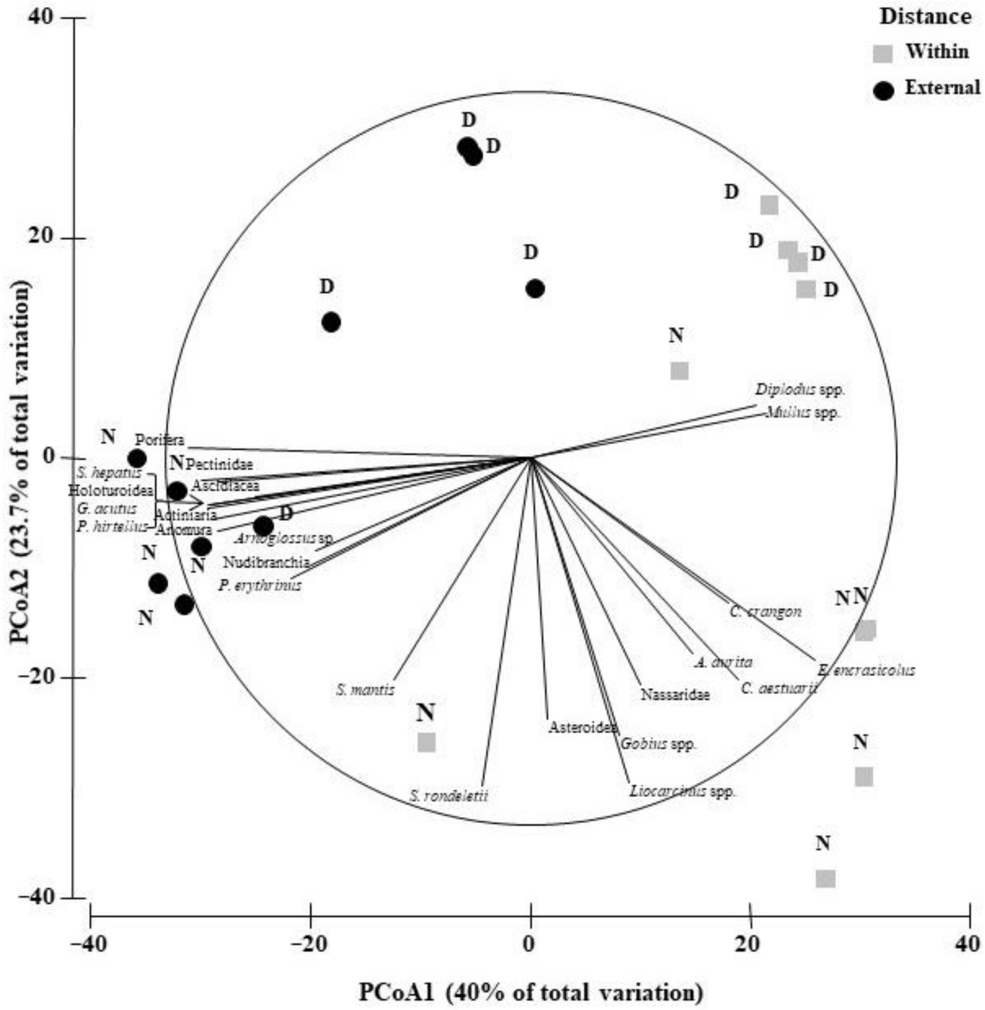

Figure 5. PCoA (Principal Coordinates Analysis) performed on DPUE (Discard Per Unit Effort) data. N = Night, D = Day, gray quadrat = Within, Black circles = External.

Table 3. Species showing differences in size between hauls performed within and external to 3 NM. *** = $p < 0.01$; ** = $p < 0.02$; * = $p < 0.05$.

Taxon	Within 3 NM (TL, cm)		External 3 NM (TL, cm)		Statistical Test	
	Mean ± Std. Dev.	*n*	Mean ± Std. Dev.	*n*	Test Value	*p* Value
Engraulis encrasicolus	9.64 ± 1.03	22	10.57 ± 1.08	45	t = 3.36	0.001 ***
Mustelus spp.	89.18 ± 27.94	11	55.38 ± 23.66	13	t = 3.21	0.004 **
Pegusa lascaris	21.71 ± 5.99	21	14.58 ± 0.95	13	Z = 4.29	<0.001 ***
Sardina pilchardus	12.18 ± 2.71	19	14.18 ± 1.15	30	Z = 2.88	0.004 **
Sprattus sprattus	8.33 ± 2.50	39	9.87 ± 3.16	36	t = 2.35	0.021 *

4. Discussion

During this study, unexpectedly, the two species considered for the dispensation from the trawling ban, the cuttlefish and the sand smelt, were an average abundant species and a species absent from the catches, respectively. Cuttlefish catch in 2010 was particularly low [31,34] and consequently, data on this species are likely to be biased by the peculiarity of this year. This annual variation in cuttlefish catches was not confirmed in other studies which reported only seasonal and not annual significant variations [27]. This latest study reported a significant decrease in cuttlefish landings when the area within 3 miles was excluded from trawling. Cuttlefish was also not responsible for the differences in catches between hauls conducted inside and outside 3 NM. This is despite the fact that the species during spring months comes close to shore to breed [35]. The absence of *A. boyeri* from the catches is instead likely related to its seasonality and interannual variations as reported in other studies [27].

The results of this pilot study highlighted differences between hauls performed at different distances from the coast (within or external to 3 NM). Only one species, *S. mantis*, resulted correlated with hauls performed close to the coast. This result was consistent with data from another study showing a decrease in landings of *S. mantis* in the period following the fishing ban within three miles from the coast [27], and can be justified with the distribution of the species in shallow waters and areas close to the coast [36]. The whiting, *M. merlangus*, the smooth-hounds, *Mustelus* spp., the gurnards, and the musky octopus, *E. moschata*, were caught mainly offshore. No data are available for the above reported species comparing catch within or over three miles but a major abundance of this species can correspond to the distribution in deeper and offshore waters [37–39].

Differences between hauls were found also in discard composition. Some species included in the discard were either commercial species discarded if undersized, damaged or not a target of the otter trawling, for instance, the anchovy, or species with no commercial value. This result is, in general, consistent with the discard analysis in Mediterranean areas [40,41]. The significant interaction emerged in discard analyses between time and distance was probably due to the additional chain, applied in order to fish closer to the bottom. During nighttime hauls performed external to 3 NM, discard was mainly composed of benthic species such as sponges, Ascidiacea, Actinaria, and several echinoderms. Discard of hauls performed within 3 NM comprised some typical inshore or lagoon water species, such as *C. aestuarii* and *C. crangon* [42]. The variation of the amount of discard according to the fishing net setting (i.e., addition of weight to the base) was also highlighted in other contributions [43]. The use of the additional chains, in addition to generating confusion in the comparison of the data for the present study, highlights a greater quantity of discard without a significant increasing of the commercial catches. This practice is to reduce the impact on the trawled bottom [43].

Despite differences in catch composition, total CPUE did not differ between hauls performed within and external to 3 NM; moreover, a tendency towards higher IPUE in offshore hauls emerged. Otter trawling fishery within 3 NM was specifically allowed in order to exploit the cuttlefish spawning movement towards coastal waters [35]. The low amount of cuttlefish landing of 2010 may have contributed to the low income of inshore hauls. However, such low values were not unique, with cuttlefish landing showing low values similar to 2010, for instance, also in 2001, 2002, and 2004, if considering only the last ten years before this study [31,34]. Therefore, even if data can be biased due to the low landing of cuttlefish in 2010, this cannot be regarded as a unique episode, and the availability of this resource appears to be quite variable among years.

Inshore hauls showed a large catch of Mantis shrimp. Even if this species is not declared as a target of inshore trawling, its presence in coastal waters [36] makes *S. mantis* an easy catch of inshore trawling. The ban of trawling within 3 NM is regarded as an insurance for Mantis shrimp, protecting a significant portion of its habitat, and preventing the damage of its burrows [36].

The analyses of species sizes within and external to 3 NM did not highlight large differences, even if significant. It is well known that juveniles of several species are present in coastal waters of the Northern Adriatic Sea in spring, in particular from May [26]. In this study, we did not find large numbers of juveniles, despite the use of small mesh size, suggesting that their appearance may vary in time from year to year.

This study has some limits related to the short time scale and lack of time, spatial, and boat replication. Even if this preliminary study is limited to one fishing boat, this was representative of the average boat of the fleet and some considerations can be taken. The results indicate that the ban of trawls within 3 NM may not necessarily imply economic losses for fishers, in particular for larger boats that usually exploit offshore waters as fishing grounds. However, to perform a more complete analysis of costs and benefits, it would be necessary to add the costs of gasoline which are greater for exclusive fishing beyond three miles.

This study compared the catch, discard, and income at the establishment of the ban of the 3 NM. To properly evaluate the medium- and long-term effect of this closure, a similar sampling plan should be performed at a long time scale. This would allow both to validate the comparison data between trawled and a untrawled areas but also to evaluate the effects of the trawl closure in the area within 3 miles after more than 10 years. This analysis should also evaluate, at broader spatial scale, the effects at ecosystem level, as well as any long-term benefits also for the fishery.

Our results have outlined some management indications. Considering that there was not a reduction in the CPUE or IPUE fishing outside three miles, this study supports, at least for the season when it was conducted, the stop of the dispensation of the trawl fishery within three miles. Indeed, fishing within three miles has a greater pressure on benthic and juvenile under-sized organisms, compared to its occurrence beyond three miles. Trawling practiced at distances greater than three miles has comparable yields to those within three miles but captures species in a less vulnerable phase of their life cycle. On the other side, in this study, we did not consider the winter period, when the sand smelt was mainly fished within 3 NM. Small-sized boats may face higher difficulties in fishing offshore during this period, due to the occurrence of adverse conditions. The costs and benefits of the closure of the coastal areas may therefore change in winter. Alongside this consideration that deserves attention, this study confirms how the nearshore restriction measures have a solid basis and their application to other geographical areas and other nations is widely justified. In fact, trawl bans tied to the proximity of the coast are in force in several areas as the neighboring Croatia [44] or the coastal areas of Japan and many countries in South and Southeast Asia, and other areas worldwide [45,46]. Moreover, the ban of coastal trawling will minimize the conflicts between artisanal fishing gears and trawls [26]. Given that, as stated also in Code of Conduct for Responsible Fisheries [3] “the interests of fishers, including those engaged in subsistence, small-scale and artisanal fisheries” should be “taken into account”, an effort to convert small trawling boats into more sustainable fishery activities should be promoted.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/fishes7060320/s1, Table S1: Dates, depths, coordiantes, distance from the shore and day period of the 20 hauls performed in the study.

Author Contributions: Conceptualization, C.M., E.R. and M.N.; methodology, C.M., E.R. and M.N.; formal analysis, C.M., E.R., M.N. and M.S.; investigation, C.M., E.R. and M.N.; data curation, E.R., M.N. and M.S.; writing—original draft preparation, C.M., E.R., M.N. and M.S.; writing—review and editing, C.M. and M.S.; supervision, C.M. and M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This study was financially supported by Regione Veneto (Clodia Project, Interventi Legge540 Regionale 15/2007). We wish to thank the fishers involved in experimental trawlings for their support.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Data sharing not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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