

Occurrence of a lost fishing net within the marine area of the Port-Cros national Park (Provence, northwestern Mediterranean Sea)

Thierry HOUARD¹, Charles F. BOUDOURESQUE^{2*}, Alain BARCELO¹, Jean-Michel COTTALORDA³, Jean-Yves FORMENTIN⁴, Eric JULLIAN¹, Bernard KERLIDOU¹, Eric PIRONNEAU⁵

¹*Parc national de Port-Cros, Allée du Castel Sainte Claire, BP 70220, 83406 Hyères Cedex, France*

²*Mediterranean Institute of Oceanography (MIO), UMR CNRS 7294, Aix-Marseille University, Campus of Luminy, case 901, 13288 Marseille Cedex 9, France*

³*Université Nice Sophia Antipolis, EA 4228 ECOMERS, Faculté des Sciences, Parc Valrose, 06108 Nice Cedex 2, France*

⁴*Club de plongée IERO, Avenue du docteur Robin, Le port, 83400 Hyères, France*

⁵*Telo Sub Toulon, 61 Rue Frédéric Passy, 83100 Toulon, France*

**Corresponding author: charles.boudouresque@univmed.fr*

Résumé. **Présence d'un filet de pêche perdu dans la zone marine du Parc national de Port-Cros (Provence, Nord-Ouest de la Méditerranée).** Les données officielles sur la pêche sont souvent considérées comme fortement sous-évaluées. La pêche fantôme (filets perdus ou abandonnés qui continuent à pêcher), la sous-déclaration des prises, les rejets à la mer d'espèces ou d'individus non-cibles, la pêche illégale et la pêche récréative constitueraient en quelque sorte la partie immergée de l'iceberg. Cette sous-évaluation des prises peut conduire à la surpêche. En juin 2010, un filet perdu de 200 m de long a été découvert à Port-Cros et retiré par des plongeurs. 16 individus de crustacés et de téléostéens étaient pris dans ses mailles. A Port-Cros, les pêcheurs bénéficient de l'interdiction de plusieurs activités fortement compétitrices de la pêche artisanale : le chalutage (qui détruit les habitats, les frayères et les nurseries), la chasse sous-marine et la plus grande partie de la pêche de loisir ; ils bénéficient également de l'absence du braconnage. Ils bénéficient enfin, indirectement, de la charte de la pêche, qui leur assure un stock plus important et des individus de plus grande taille. Si la relative rareté de la pêche fantôme à Port-Cros se confirmait, cela constituerait un autre exemple des bénéfices que la pêche artisanale retire de la protection, dans le contexte d'une pêche durable.

Mots-clés : Pêche fantôme, Filets fantômes, Aires Marines Protégées (AMP), Pêche artisanale.

Abstract. Official data on fishery captures are often regarded as greatly underestimated. Ghost fishing (lost or abandoned fishing nets which continue to catch fish), in addition to underestimated reporting of catches, discards, illegal fishing and recreational fishing,

probably represents the hidden part of the iceberg, and are therefore a cause of underestimation of the actual captures, leading to overfishing. In June 2010, a 200-m long trammel net was discovered and removed from the marine area of the Port-Cros national Park. 16 individuals of crustaceans and teleosts were observed caught in the net. Within the Marine Protected Area (MPA) of the Port-Cros national Park, artisanal fishers benefit from the banning of trawling, spear fishing and most of recreational fishing, together with the absence of illegal fishing and poaching. Artisanal fishers also indirectly benefit from the commercial fishing regulations enshrined in the Port-Cros fishing charter, which give them a greater stock and larger fishable individuals. If the relative rarity of lost nets at Port-Cros, compared to other Mediterranean areas, is confirmed, this would be another example of the benefits that artisanal fishers derive from the Port-Cros MPA, within the framework of sustainable fishing.

Keywords: Ghost fishing, Ghost nets, Marine Protected Area (MPA), Artisanal fishing.

Introduction

The real quantities of marine fishery captures is largely unknown. The reason is that, besides the commercial fishery data which are published by the Food and Agriculture Organization (FAO), part of the captures are not included in the official statistics. As far as these official statistics are concerned, world captures have been more or less stable since 1988 and range between 76 and 86 Mt WM (wet mass) per year (FAO, 2010), or have been steadily declining at a rate of 0.5 Mt WM a⁻¹ (Pauly *et al.*, 2003; Ward and Hegerl, 2003; Chassot *et al.*, 2010).

Several factors may explain why the FAO statistics largely underestimate the actual captures. **(i)** Under-reporting by fishers, then by states, who provide data for the FAO's statistics (Willis and Millar, 2005); for the French Mediterranean fisheries, under-estimation could be as high as 30% (Rey, 1996); for the American Samoa Islands (Pacific Ocean), reconstruction of catch estimates suggests a 17-fold difference between reconstructed estimates and reported FAO statistics (Zeller *et al.*, 2006). **(ii)** Discarded catch is the part of the catch which is returned to the sea for economic, legal or personal reasons (fishers reaching their quota limit for a target species, undersized specimens of target species, non-target species) (Hall, 1999); conservative estimates range between 25 and 30 Mt WM a⁻¹ (Pauly *et al.*, 2003; Kaiser and Hiddinck, 2007). At Port-Cros, discards only represent ca. 1% of the catches (Bonhomme *et al.*, 2009). **(iii)** Illegal, unreported and unregulated fishing (IUU) refers to a variety of activities, e.g. fishing conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations; fishing conducted in violation of national laws or international obligations. This represents between 11 and 26 Mt WM a⁻¹ (excluding the artisanal unreported catches; see above) (Agnew *et al.*, 2009; DFID and DEFRA, 2009). **(iv)** Recreational fishing catches, whether by spear-fishing, angling from the shore or angling from a boat; these are far from negligible, compared with the catches of the artisanal fishing industry (Coleman *et al.*, 2004; Cadiou *et al.*, 2009). In Mediterranean coastal

areas, recreational fishery catches can represent 50% of, or be equal to, those of artisanal fishers (Bonhomme *et al.*, 1999; Chavoïn and Boudouresque, 2004; Boudouresque *et al.*, 2005; Cadiou *et al.*, 2009). (v) Finally, ghost fishing occurs when passive gear, such as gillnets, trammel nets and traps, are lost or abandoned on the seabed, and continue to catch fish; this leads to the mortality of target or non-target species (Pawson, 2003; Adey *et al.*, 2008; Sacchi, 2008).

There is a lack of information about the amount of lost gear, possibly resulting from the reluctance of fishers to report such incidents, and therefore about the impact of the ghost fishing upon the resource and its overexploitation (Pawson, 2003). Here, we report the occurrence of a lost fishing net, with evidence of ghost fishing, within the marine area (1 300 ha) of the Port-Cros national Park (Provence, France, Mediterranean Sea).

Methods and results

On June 11th, 2010, between the southernmost point of Bagaud Island and the deep reef named Sec des Catalans, in the channel between Bagaud Island and Port-Cros Island (marine area of the Port-Cros national Park), an abandoned trammel fishing net was found (Fig. 1). Only one surface signal was present, and the identification data of the fisher were not visible. The net was 200-m long and 1.5-m high, with a 4-cm mesh size (inner net), i.e. 8-cm length of mesh side. The net was wrapped around a 22-m depth reef emerging from a *Posidonia oceanica* (Linnaeus) Delile seagrass meadow and was firmly snagged onto the rocks. The circular position of the fishing net (surrounding a reef rather than linear) and its length (shorter than usual) probably indicate attempts by the fisher to disentangle the net, sailing around the reef, then the cutting the net in order to recover its free part.

Ten days later, on June 21st, a team of 5 SCUBA divers observed the fishing net, identified the caught species and raised the net up to the sea surface. The fishing net was not covered with conspicuous encrusting and other fouling biota. Taking into consideration the shallowness of the site and the season, which increase the likelihood of fouling, and the frequency of the patrols of the national Park rangers, it is unlikely that the net had been in the water for more than 2 weeks.

16 individuals of crustaceans and teleosts were observed caught in the net: 6 European spider crab *Maja squinado* (Herbst, 1788); four of them, still alive, were released; 3 red scorpionfish *Scorpaena scrofa* (Linnaeus, 1758); 5 small red scorpionfish *S. notata* Rafinesque, 1810 and/or black scorpionfish *S. porcus* Linnaeus, 1758; and 2 unidentified teleosts, partly eaten by scavengers.

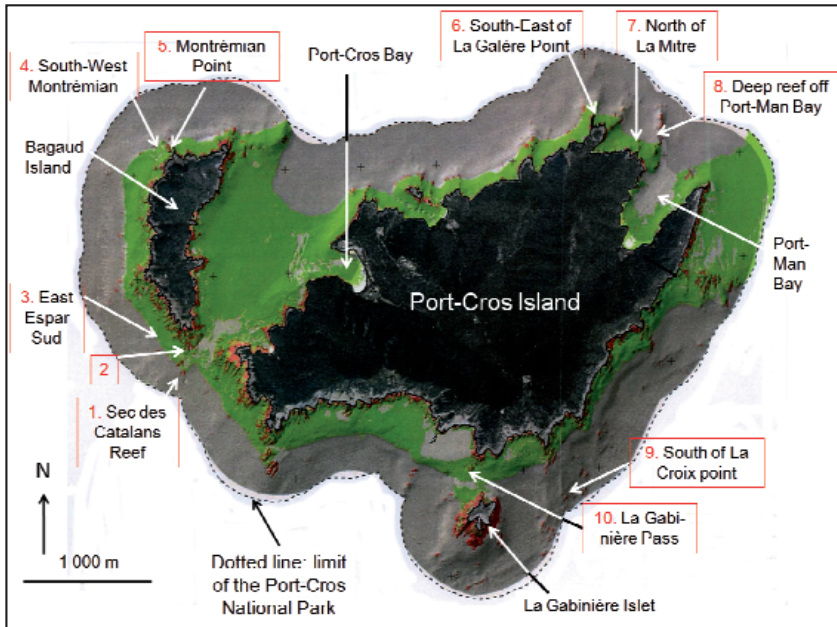


Figure 1. Map of the Port-Cros national Park bottom assemblages (from Bonhomme *et al.*, 2011). Green: *Posidonia oceanica* seagrass meadow; pink to reddish: hard bottom assemblages; grey: soft bottom assemblages. Red numbers (1 through 10): localization of lost fishing nets (see Table I for detailed data).

Discussion

The removal, probably deliberate, of the identification marks of the Port-Cros lost trammel net illustrates the reluctance of fishers to report such incidents (Pawson, 2003), even within a national park where they are in close contact with park officers.

The main causes of net loss are **(i)** snagging on bottom structures due to rough weather, **(ii)** entangling with other gear, e.g. between gill or trammel nets and trawling and **(iii)** dumping at sea of unwanted gear rather than disposal onshore (Santos *et al.*, 2003; Sacchi, 2008; Macfadyen *et al.*, 2009). Within the Port-Cros national Park area, trawling has been banned since 1963 CE (CE = Common Era), so that the second explanation is unlikely.

Lost gear, especially fishing nets, is widely suspected to have a serious and long-lasting impact on marine populations (Dayton *et al.*, 1995; Macfadyen *et al.*, 2009). However, in the United Kingdom, Revill and Dunlin (2003) regard its actual effect as negligible. A similar conclusion is defended by Hamon *et al.* (1997). Nevertheless, it should be emphasized that the authors only consider the effect of ghost fishing on the fish resource. In addition to such a possible effect, its impact on

the overall functioning of the ecosystem should be considered. Like discards and trawling (Andrew and Pepperell, 1992; Hall, 1999; Catchpole *et al.*, 2006; Kaiser and Hiddink, 2007), lost nets provide scavengers with an additional resource and therefore increase the role this functional compartment plays. They may also catch predators and/or scavengers attracted by entangled species, such as sea turtles, dolphins and fish (Cottalorda, 2011). Furthermore, lost nets, when entangled in fragile biota such as gorgonians, bryozoa, *Cystoseira* spp. and foliose corallines, can severely damage the benthic assemblage (Fig. 2).



Figure 2. A lost fishing net (see Table I, locality 4; South-West of Montrémian, Bagaud, Port-Cros national Park), October, 2011. Photo Jean-Michel Cottalorda.

On Georges Bank, Canada, it was found that the length of time a prey persisted (before being completely eaten) in lost nets averaged 2-5 days (Brothers, 1992). On the basis of such a high turnover rate, the Port-Cros lost net would have captured some 64 individuals over ca. 2 weeks, which is probably an over-estimate since the survival time of the caught spider crabs is probably much longer than 5 days.

At Port-Cros, the maximum authorized soak time at a depth < 30 m ranges between 17 and 24 h (Cadiou *et al.*, 2009). The average number of prey captured by a 200-m fishing net during such a period is ca. 12 (Bonhomme *et al.*, 2009). The relatively low number of prey entangled in the lost net studied (16), after more than 10 days, whatever the turnover time, could suggest that catches decline rapidly over the first few days, as observed by Carr *et al.* (1992) in New England. In Turkey, fish learned to escape from an abandoned circular fish trap after the 10th day and ghost fishing was no longer observed after the first month (Ayaz *et al.*, 2006). In UK coastal waters, two gillnets deliberately abandoned and subsequently monitored demonstrated a loss in fishing capacity of more than 50% during the first few weeks of immersion (Revell and

Dunlin, 2003). A fishing time of 3-6 months for lost gear is suggested by Sacchi (2008). Finally, in Norway, a net lost in 1983 was still fishing in 1990, 7 years after the incident (Dayton *et al.*, 1995).

Authors have reported high density of lost nets in several regions of the world ocean (Macfadyen *et al.*, 2009). Off New England, 9 lost gillnets were found in 40 ha, still catching fish and crabs (Carr and Cooper, 1987). In the Gökova special environmental protection area (Turkey), 157 m of lost gill and trammel nets per hectare were observed, most of them ghost fishing (Ayaz *et al.*, 2010). A ROV (Remotely Operated Vehicle) survey off California reported about 1% of the bottom littered with fishing debris, most of it actively fishing (Dayton *et al.*, 1995). Off the Algarve (southern Portugal), the average rate of net loss ranged between 160 m/fisher/year and 370 m/fisher/year for small vessels < 9 m operating in shallow waters and larger vessels targeting mostly hake *Merluccius merluccius*, respectively (Santos *et al.*, 2003). Off the French Mediterranean coast, the average gillnet loss represents 700 m/fisher/year for the red mullet *métier* (*Mullus barbatus*, *M. surmuletus*) and 1 200 m/fisher/year for the hake *métier* (*Merluccius merluccius*) (Macfadyen *et al.*, 2009). In the eastern French Riviera (*‘Département des Alpes-Maritimes’*), 150 km of lost nets have been recorded, 40% of which are suspected to be ghost fishing (Clément and Espla, 2000). At Port-Cros (1 300 ha), where 10-17 vessels of artisanal fishers are active (Bonhomme *et al.*, 2009; Cadiou *et al.*, 2009), the loss or discarding of fishing nets seems to be a rarer event than is indicated by data in the literature. In addition to the finding of a lost net mentioned above, only a few lost nets have been observed at Port-Cros, most of them densely covered with concretions, probably very ancient and therefore no longer ghost fishing (Table I, Fig. 1). The relative rarity of lost nets at Port-Cros is probably not an artifact, taking into consideration the high SCUBA diving pressure, whether recreational or for scientific purposes (e.g. Harmelin and Ruitton, 2007; Harmelin *et al.*, 2010; Ruitton and Harmelin, 2010; Bonhomme *et al.*, 2011), and therefore the number of opportunities for detecting them. This impression is confirmed by SCUBA divers who actively frequent the French Mediterranean coast, both within and outside the Port-Cros national Park (e.g. Sandrine Ruitton, pers. comm.).

Conclusions

Official data on fishery captures are often regarded as the tip of the iceberg. Ghost fishing, in addition to under-reporting of catches, discards, illegal fishing and recreational fishing, probably represents the hidden part of the iceberg, and is a cause of under-estimation of the actual captures. This under-estimation probably leads to overfishing.

Within the Marine Protected Area (MPA) of the Port-Cros national Park, artisanal fishers benefit from the banning of the trawling, a practice that severely damages habitats, spawning grounds and nurseries. They also benefit from the banning of spear fishing and of most recreational fishing, together with the absence of illegal fishing and poaching, practices which strongly compete with artisanal fishing. Finally, artisanal fishers indirectly benefit from the commercial fishing regulations enshrined in the Port-Cros fishing charter (e.g. a larger net mesh and a shorter net length), which give them a greater stock and larger fishable individuals.

Table 1. Observation of lost fishing nets, both ghost fishing and ancient (i.e. no longer fishing), in the Port-Cros national Park. Locality numbers refer to Figure 1.

Locality	Date of observation	Depth (m)	Net length (m)	Ghost fishing when observed	Reference and/or source
1. Sec des Catalans Reef	September-October, 2010	35	Small remnants	No: heavily covered with concretions	Jean-Michel Cottalorda (unpublished data), Bonhomme <i>et al.</i> , 2011
2. Between southernmost point of Bagaud Island and Sec des Catalans Reef	June, 2010	22	200 m	Yes: see text	This work
3. East Espar Sud (Bagaud Island)	October, 2010	30	Small remnants	No: heavily covered with concretions	Bonhomme <i>et al.</i> , 2011, Patrick Astruch (pers. comm.)
4. South-West of Montrémian (Bagaud Island)	October, 2011	26-28	~20	No: slightly covered with concretions. 7 uprooted gorgonians <i>Paramuricea clavata</i> (Risso, 1828), bryozoans, <i>Posidonia oceanica</i> shoots (Fig. 2)	Jean-Michel Cottalorda (unpublished data)
5. Montrémian Point (Bagaud Island)	May, 2010	25-30	50 ?	No: heavily covered with concretions	Eric Jullian, Jean-Michel Cottalorda (unpublished data)
6. South-East of La Galère Point	October, 2011	33	~20	Yes: <i>Mobula mobular</i> (Bonnaterre, 1788) and a large <i>Conger conger</i> (Linnaeus, 1758)	Eric Jullian and Sandrine Ruitton (unpublished data)
7. North of La Mitre	May, 2010	30	Small remnants	No: heavily covered with concretions	Bonhomme <i>et al.</i> , 2011, Patrick Astruch (pers. comm.)
8. Deep reef off Port-Man Bay	June, 2010	30-40	~30	No: slightly covered with concretions	Jean-Michel Cottalorda (unpublished data)
9. South of La Croix Point	June, 2010	70-80	Small remnants	No: heavily covered with concretions	Bonhomme <i>et al.</i> , 2011, Patrick Astruch (pers. comm.)
10. La Gabinière Channel	May, 2010	25	> 10	Yes, but without caught organisms	Bonhomme <i>et al.</i> , 2011, Patrick Astruch (pers. comm.)

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