



# Typology of illegal fishing in transitional waters: Fisheries infringement records from Mesolonghi-Etolikon lagoons (Ionian Sea, Greece)



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## ABSTRACT

Minimizing illegal fishing is of paramount importance for fisheries sustainability. The present study focused on the fisheries infringements through the analysis of the official records in one of the largest Mediterranean lagoons, Mesolonghi-Etolikon, and the analysis of questionnaires answered by local fishermen to determine the true effectiveness of the control efforts. This double analysis represents a valuable case study for determining illegal fisheries practices, status of control, and efficacy of regulations. Results exhibited that: (a) the high contribution of the recorded infringements was due to absence of fishermen/vessel licenses, (b) fines are not proportionate with the type of illegal activity, and (c) the number of the recorded infringements represented a very small percentage of the estimated number of fishing days conducted by both professional fishermen and people not having fishing/vessel license. Findings indicated a situation with great presence of illegality that might completely weak any possibility for assessing the status of fisheries and resources and seriously hamper any definition of thresholds useful for sustainable management. Solutions are discussed especially in the light of revision of regulations and of transparency in the decision-making process.

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## 1. Introduction

### 1.1. Lagoon fisheries and management

Lagoons constitute an integral part of the coastal ecology and cultural heritage for the local communities and important drivers for the local economies (Pérez-Ruzafa et al., 2007). They represent intermediate zones between open sea and inland waters and are characterized by environmental heterogeneity not only from one lagoon to another but also within the same lagoon (for review see GFCM, 2015). Several fish stocks use these systems as a part of their life-history for spawning, foraging and shelter and thus they are areas of increased concentration of fishing activities (Matteus et al., 2016). In the Mediterranean, coastal lagoons have recently become

of environmental concern due to process of draining of wetlands, pollution, lack of management and illegal fishing activity (Pérez-Ruzafa et al., 2010), with the latter raising an important challenge for the lagoon fisheries sustainability, especially when addressing long-term economic benefits of fishing (Gall and Rodwell, 2016).

In this framework, although the conservation measures issued in the Mediterranean lagoons have a strong conservation status (GFCM, 2015), the hyper-complexity of the fisheries legislation accompanied with the lagoon ecosystem heterogeneity, the multi-species/gear nature of the traditional fisheries (Koutrakis et al., 2007) and the outdated legislation (Moutopoulos et al., 2016) reduce the effective implementation of policy guidelines and fisheries control and thus 'place at risk' the management of lagoon fisheries (Tingley et al., 2010). There are few cases demonstrating the implications that illegal fishing has on fisheries especially in the Mediterranean lagoons: (a) overfishing (i.e. Mediterranean lagoons: Pauly and Yanez-Arancibia, 1994) (b) species extinction (i.e. Venice lagoon: Libralato et al., 2002; Pranovi et al., 2003; Silvestri et al., 2006), (c) reduce of investments to the fisheries sector (Dolbeth et al., 2016) and (d) abandonment of the existing

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traditional fisheries exploitation (Anonymous, 2001). Such lack of information compromises the capacity to put in place effective policies, both in terms of stock assessment and fisheries management strategies (Beddington et al., 2007).

## 1.2. Study area

The study area includes the national marine protected area of Mesolonghi-Etolikon lagoons (131.5 km<sup>2</sup>; R1 to R6; Table 1) and the frontal area of the lagoons and the estuaries formed by the two local rivers (R7; Table 1) covering a total surface area of 630 km<sup>2</sup> that corresponds to the limits of the protected area (Fig. 1). The lagoon protected area is one of the largest lagoon systems in the northern Mediterranean coast and approximates 42% of the total surface of Greek lagoons (131.5 km<sup>2</sup>). System complexity is further increased by the presence of six distinct lagoons (R1 to R6; Fig. 1) with specific topographic and hydrological characteristics and different fish species composition (Katselis et al., 2003). Fisheries have been historically intertwined with the conservation of the lagoon environment and the well-being of the local communities (Koutrakis et al., 2007).

Similarly to most of the Mediterranean lagoons (e.g., Albania, Tunisia, Egypt: GFCM, 2015), most of the studied lagoons (R1 to R5; Fig. 1) are public domain and fishing rights are given to fisher's cooperatives or to private fishers. Within the leased part of these lagoons local fisheries are conducted with permanent traps (a total of 208 traps in the lagoons R1 to R5 in 2016) installed at the interface between lagoon and open sea following species-specific inshore-offshore seasonal migrations (Katselis et al., 2003). In the lagoon R6, in where no traps were installed and in certain leased parts of the lagoons R1 to R3, professional fishers exempted from need for lease license to fish within the lagoons are allowed fishing with longlines. Fisheries with other types of gears (i.e. netters, trawls and purse-seines) are allowed operating in the frontal area of the lagoons at certain distances from the traps depending on the gear (i.e. 250 m for small-scale fishing gears, 2 nautical miles for purse-seiners and 3 nautical miles for trawlers) and at a certain distances from the mouth of estuaries (i.e. 500 m for small-scale fishing gears, 2 nautical miles for purse-seiners and 3 nautical miles for trawlers).

Fisheries legislation in the studied system includes: (a) special provisions for the leasing of areas of the lagoon (Greek Fishing Code 420/70), (b) issues for the activity of the small-scale fishery within certain leased parts of the lagoons (Table 1; Greek Fishing Code 420/70; Royal Decree 435/70), (c) the prohibition of trawls and purse-seines within the lagoons and at limited distance from the frontal area (Presidential Decree (PD) 68/2006, FEK 71A/06), (d)

prohibition of vessel-based recreational fishery within the lagoons (PD 373/85) and (e) a gear restrictions for all fisheries all year round at certain distances (described above) from the two estuaries of the system (R7; Fig. 1). The implementation of the above issued laws is supervised by the Ministry of Mercantile Marine through the local coast guard authority.

Despite the strong legislative framework of the Mesolonghi-Etolikon lagoons the ineffective enforcement of the fishing control has been recognized as a major problem (38.2% of them consider it as the most important issue in the state of the fishery) (Anonymous, 2001) in the study area through interviews conducted to professional fishermen (i.e. members of the fishermen co-operatives leased the lagoons and professional fishers exempted from need for lease license to fish within the lagoons). In that study, apart from certain fishery operational issues, the fishermen state their opinion for the overall status of the lagoon, the major problems that they were faced during fishing activities, and alternative solutions on to their problems. It seemed that illegal fishery in a high fishery productive system as the lagoons might be encouraged by high revenue fisheries and by "de facto" open access exploitation. On the other hand, illegal fishery likely results in the lowering of the prices for legal fish, because illegal fishers sell their catch on the black market, creating unfair competition with professional fishers (European Commission, 2008a). The above-mentioned is of vital importance for the fishing communities of such a fishery-dependent area (Tzanatos et al., 2005) and might have a domino effect among professionals and stakeholders (Arias, 2015).

## 1.3. Aim of the study

The goal of the present study is to determine illegal practices, status of control and efficacy of regulations in the Mesolonghi-Etolikon lagoons through a typology of the technical, temporal and spatial characteristics of the recorded fisheries infringements and fines imposed by the local coast guard authority. The in-depth understanding of the quantitative (number of recorded infringements per each category of infringement) and qualitative (spatial patterns of the different categories of illegal fishery) characteristics of the illegal fishery has not been thoroughly studied. Moutopoulos et al. (2016) identify spatio-temporal patterns of fisheries infringements, and analyse the characteristics of fines and penalties imposed from the official recorded infringements conducted in Greek waters. In that study, Mesolonghi-Etolikon lagoons diversify from all Greek waters due to their highest ratio of the recorded infringements per small-scale vessel and the highest representation of infringements due to the illegal fishing with netters. Hence, the present study expands on Moutopoulos et al.

**Table 1**

Surface area, type of the lagoon, allowed fisheries, total and mean (SD) number of recorded infringements and ratio of the recorded infringements per surface area (km<sup>2</sup>) for each lagoon of the Mesolonghi-Etoliko lagoon system (for code legends see Fig. 1) during 2003–2013. \* approximate surface area of the frontal area of Mesolonghi-Etoliko that is protected by National Law. Letters in parenthesis follow the legends from Fig. 1. \* Non leased lagoon.

Area	Area (km <sup>2</sup> )	Type of lagoon	Small-scale fishing allowance	Non-professional		Professional fishery		Total		Infringements/km <sup>2</sup>
				Without vessel/fishing license	Small scale	Open sea vessels	Annual Mean	SD		
East Klisova (R1)	4.4	Closed	Yes	4	4		8	1.6	1.3	1.82
Klisova (R2)	22.3	Closed	Yes	3			3	1.5	0.7	0.13
Central (R3)	68.6	Open	Yes	100	37		137	12.5	8.8	2.00
Tholi (R4)	11.0	Closed	Prohibited	3			3	1.0	0.0	0.27
Palaiopotamos (R5)	8.5	Closed	Prohibited	1			1	1.0	0.0	0.12
Etolikon (R6)*	17.2	Closed	Yes	14	3		17	2.8	1.7	0.99
Frontal area-Estuaries (R7)	470		Yes	34	15	14	63	5.7	3.8	0.13
Total of the lagoon	131.5			125	44	0	169	15.4	9.9	1.28
Total of the study area	630.5			159	59	14	232	21.1	12.1	0.39

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