**Fishers’ socio-economic behavior in relation to discarding practices: How will the landing obligation affect the management of Greek bottom trawl fisheries?**

**Maria Christou1,2, Dimitrios Damalas1, Christos Maravelias1, Konstantinos Stergiou1,2**

1Hellenic Center of Marine Research, Institute of Marine Biological Resources and Inland Waters, 19013, Anavissos, Attica, Greece

2Aristotle University of Thessaloniki, Department of Biology, Lab of Zoology, 54124, Thessaloniki, Greece

Corresponding author: mchristou@hcmr.gr

**ABSTRACT**

In the present study the possible implications of the landing obligation (Article 15 of the Regulation (EU) No 1380/2013) introduced by the reformed Common Fisheries Policy, concerning the socioeconomic facet of the bottom trawl fishery in the Greece, were investigated, using a qualitative analysis of questionnaire data. Emphasis was placed upon the frequency of discarding practices followed by fishers and the importance of different incentives proposed for the implementation of the regulation, as these may be used to support future management plans. In general, the regulation was not widely known among fishers surveyed and the majority of respondents expressed concerns towards its realization, arguing that technical restrictions is the main driver of discards. The true challenge will be the incorporation of fishers’ behavior into the management plans that will be enforced, and the suggestion of incentives that take into account local attributes of each EU member state.

**Keywords:** Socioeconomics, Common Fisheries Policy, Landing obligation, Mediterranean, Bottom trawl, Discards

**INTRODUCTION**

The rising pressure for more selective fisheries (Eliasen & Bichel 2016) that will secure the future of currently depleted fish stocks (Vasilakopoulos *et al.* 2014; Tsikliras *et al.* 2015) has led to the notion of gradual elimination of discarding, a practice perceived (Bellido *et al.* 2011) as a waste of food. The newly introduced Common Fisheries Policy (CFP) initiates distinct amendments to halt gradually the at-sea disposal of markedly valuable marine resources through the so called “landing obligation” (LO) (Article 15 of the regulation (EU) No 1380/2013). Therefore is critical to explore the forthcoming implications that the regulation will bring to the fishers’ activity, prior to its official enforcement date (01 January 2017) for some of the demersal species in the Mediterranean. The investigation of factors that shape fishers’ behavior is essential for the successful implementation of any regulation (de Vos *et al*. 2016). Fishers are often characterized as profit maximizers (Tsitsika & Maravelias 2008) and microeconomic decisions are critical to their livelihood since they determine the outcome of each fishing trip in terms of catch and return rate. However, fishing trips are conducted in relation to several factors, not only based on monetary decisions, such as, e.g., spatial considerations, species abundance, knowledge inheritance, experience and weather conditions (Tsitsika & Maravelias 2008; Eliasen & Bichel 2016). Thereby, policy makers ought to underpin and examine factors that influence the whole decision process. To this end, a prior exploration of the fishers’ attitudes towards the proposed regulation will guide managers in the selection of a suitable management regime to fulfill the objectives of the CFP and guarantee sustainability within the fishing industry (Sardà *et al.*2015).

The scope of this study was to elucidate the present socioeconomic conditions of the bottom trawl fishery in both Aegean and Ionian Seas in relation to the LO. The fishery is multispecies regulated by technical and effort restrictions and by definition there are not any clearly defined target species, something that hardens the application of the regulation in the Mediterranean (Damalas 2015; Sardà *et al.* 2015), which already suffers from ineffective management (Vasilakopoulos *et al*. 2014). Bottom trawl is responsible for the bulk of discards in the Mediterranean (Tsagarakis *et al*. 2014) and demersal stocks, which are targeted by this gear, are important both ecologically and commercially. Therefore, any management measures taken for bottom trawlers may affect ecosystem resilience and demersal stocks dynamics (van Denderen *et al.* 2013). Herein, the frequency of three discarding practices applied to commercial stocks and fishers’ perception on the importance of several incentives is explored. Usage of such information will be beneficial to the European Union because it will give insight into the future implications of the LO and may aid to channel decisions towards management plans seeking the stewardship of fisheries resources in a socioeconomic context.

**MATERIALS AND METHODS**

The study was conducted between December 2015 and March 2016 and involved the collection of data through personal interviews. Face-to-face, as well as phone interviewing (i.e when fishers were not on shore) was conducted. Interviews were based on a semi-structured questionnaire, constructed under the framework of the MINOUW project (MINOUW 2015). Although the questionnaire included 11 sets of questions, the present work focused only on the discard drivers and incentives that may influence fishers’ tactics, as these drivers may be important to support the effectiveness of future management proposals.

A total of 41 respondents participated in the study, comprising 14.5% of the Hellenic trawl fleet. All fishers, who were either skippers and/or owners of the vessels, were contacted on a random basis. Face-to-face interviews were conducted with direct communication with the interviewee in situ, at the port of activity. Overall, six ports in the Aegean Sea- GSA22 (Piraeus, Nea Michaniona, Chalkis, Naxos, Paros, Aegina), and four ports in the E. Ionian Sea- GSA 20 were visited, one port in the Ionian Sea (Kerkira), two ports in the Patraikos Gulf (Kyllini, Patras) and one port in the Korinthiakos Gulf (Galaxidi).

The following information was recorded: identity of the fisher, vessel, gear characteristics, and other information relevant to the fishing tactics followed. The survey went through eight different statements[[1]](#footnote-2) that may be of interest to the fishers, in the form of incentive-based compensation for the smooth implementation of the regulation. Each statement was given in a 5 point symmetric Likert-type scaling whose values in our study fell between “Not important at all: 1” and “Very important: 5”. Finally, an average value and its standard error of the 41 responses for each statement were obtained through the *'likert'* package in R (Speerschneider & Bryer, 2013).

**RESULTS AND DISCUSSION**

The target group comprised of middle age men (44.1 ± 1.3 years) with bottom trawl fishing being their only income source. All participants came from a fishing family and they ran a business that has gone through generations of fishers. The vessels operated by the 41 fishers had an average length of 26.2 ± 0.6 m. The average gross tonnage of the vessels was 109.3 ± 7.5 t with an average engine power of 391 ± 17.8 hp and an average estimated vessel value of 585609.8 ± 41020.6 €. Around half of the fishers surveyed (51.2%) had ice machines that allowed small trips offshore, with the typical fishing trip having an average duration of 1 (1.4±0.1) day, with an average of 4 (3.7 ± 0.1) hauls/day, each lasting 4 (3.9± 0.1) hours with average weekly landings of 2415.6 ± 104.2 kg. The weekly fuel consumption was on average 5755.4 ± 328.5 l and annual average fixed costs equaled to 62454.6 ± 14826.65 €. A key finding of the survey is that the LO was not widely known among the fishers surveyed (i.e. only 53.7% was aware that discarding of unwanted catches (UWC) will be banned in European waters progressively in

**Figure 1. Fishers’ tactics and unwanted catches (UWC).**

**Εικόνα 1. Οι στρατηγικές αλιείας σχετικά με τα ανεπιθύμητα αλιεύματα (UWC).**

the period 2015 – 2019). Fishers were asked as well to express their opinion on the production of UWC (Figure 1) and 87.8% of them stated that Minimum Landing Size (MLS) legislation was the major driver that generates UWC in the Greek bottom trawl fishery. Fishers were totally opposed to the implementation of the regulation believing that it will cause widespread damage to marine ecosystems. Moreover, fishers agreed that the LO will affect their occupation because of an increase in expenses mainly for storage and transportation.

**Rplot11.emf**

**Figure 2. Incentives importance heatmap. Frequency, mean value and standard deviation (in the parenthesis) are presented depending on the level of importance (1-5) of the proposed incentives.**

**Εικόνα 2. Χάρτης θερμότητας που απεικονίζει τις συχνότητες, τη μέση τιμή και το τυπικό σφάλμα (σε παρένθεση) ανάλογα με το επίπεδο σημασίας (1-5) των προτεινόμενων κινήτρων.**

Previous studies have acknowledged the importance of looking into the factors behind discarding (Tsagarakis *et al*. 2014). Vestergaard (1996) states that discarding is a consequential result of mismanagement and arises when managers fail to apply measures that take into account fishers’ tactics. Our results showed that technical restrictions such as MLS, are critical for the decision to discard or not UWC. Discarding in respect to economic reasons (Damalas 2015) was not the main strategy followed by the fishers involved in the bottom trawling fishery in Greece, even if Mediterranean fisheries are in principle market regulated and influenced by legal regulations to a lesser extent (Tsagarakis *et al*. 2014).

Fishers’ perceptions on the management tools that should be proposed in conjunction with the implementation of the regulation are presented in Figure 2 through mapped average responses. There was a wide difference of opinion among fishers for the majority of proposed incentives (a-g), with respondents being clearly clumped in two groups: those who lean to the support of these incentives and those opposing them. However, an overwhelming 83.9% of fishers’ replies demonstrated that working on new control and monitoring techniques (incentive h) was the least important for the implementation of the regulation. On the other hand, improving the system of selling products (68.3%), reducing taxes (65.9%) and increasing fishers’ awareness through workshops and courses (63.4%) were the statements that fishers were more willing to adopt. The first two statements are related to economic stimuli (Figure 2). Preference of these incentives is indicative of the fishers’ appreciation of their function as management levers. Clearly, the results of the current study illustrate that the LO will not be easily implemented in Greece, as anticipated, and a successful introduction will be contingent only if solid guidance and support is provided to fishers. Hence, economic compensation in any form, educational seminars and further training will aid the take up of the regulation, even if the respondents’ expressed disapproval of the regulation and the incentives proposed herein.

Any shifts into new management policies imply socioeconomic costs, a burden that must be evenly shared among fisheries bodies and other stakeholders involved in the fishing sector (Vasilakopoulos *et al*. 2014). Some fisheries and associated communities are going to experience these costs to a greater extent if the same pattern of exploitation is maintained. A solution to this is the promotion of more selective fisheries, by securing the avoidance of entering nursery grounds and the improvement of gear selectivity. Specific guidelines should be given to achieve the minimization of UWC. Of course, any guideline should be accompanied with a careful documentation, which would include proposals in respect to the high survivability and *de minimis* exemptions, to ease the implementation of the regulation and attain fisheries sustainability. Our results could be of assistance to fish managers in Greece and other Mediterranean countries in general, given that the regulation will provide an option to each EU country to act regionally and provide management decisions with respect to the local particularities (see de Vos *et al*. 2016). In order to achieve a smoother transition towards a management framework with action taken at the catch rather than the landed level, more research is needed to identify the true roots of discarding. The conduction of survival experiments and the enhancement of capital participation in public investment projects to support technical issues that may arise is also an imperative task (Sardà *et al.* 2015). Further investigation of discard behavior will help to forecast possible impacts, future landing profiles, fuel prices and market development of Greek trawl fisheries under the obligation. The key to make “possible” the mission of the new CFP (Damalas 2015) is fishers’ compliance based on a well-structured management design that will not provoke any socioeconomic barriers for fishers but protect stocks in the framework of ecosystem based approach.

**ACKNOWLEDGEMENTS**

This research has received funding from the European Commission’s Horizon 2020 Research and Innovation Programme under Grant Agreement No. 634495 for the project Science, Technology, and Society Initiative to minimize Unwanted Catches in European Fisheries (MINOUW)". The authors thank the fishers who cooperated during the survey and two anonymous reviewers whose suggestions helped to improve this manuscript.

**BIBLIOGRAPHY**

Bellido JM, Santos MB, Pennino MG, Valeiras X, Pierce GJ (2011) Fishery discards and bycatch: solutions for an ecosystem approach to fisheries management? Hydrobiologia 670: 317–333

Damalas D (2015) Mission impossible: Discard management plans for the EU Mediterranean fisheries under the reformed Common Fisheries Policy. Fisheries Research 165: 96-99

de Vos B, Döring R, Aranda M, Buisman FC, Frangoudes K, Goti L, Macher C, Maravelias C, Murillas A, van der Valk O, Vasilakopoulos P (2016) New modes of fisheries governance: Implementation of the landing obligation in four European countries. Marine Policy 64: 1-8

Eliasen SQ, Bichel N (2016) Fishers sharing real-time information about “bad” fishing locations. A tool for quota optimisation under a regime of landing obligations. Marine Policy 64: 16-23

ΜINOUW (2015) [ONLINE] Available at: <http://minouw.icm.csic.es/>. [Accessed 13 April 2016]

Sardà F, Coll M, Heymans JJ & Stergiou KI (2015) Overlooked impacts and challenges of the new European discard ban. Fish and Fisheries 16: 175–180

Speerschneider KK, Bryer JM (2013) likert: An R Package for Visualizing and Analyzing Likert-Based Items In: The R User Conference, useR! 2013, Book of Cotributed Abstracts. Albacete, Spain: University of Castilla-La Mancha, p. 120

Tsagarakis K, Palialexis A, Vassilopoulou V (2014) Mediterranean fishery discards: review of the existing knowledge. ICES Journal of Marine Science 71: 1219-1234

Tsikliras AC, Dinouli A, Tsiros V-Z, Tsalkou E (2015) The Mediterranean and Black Sea Fisheries at Risk from Overexploitation. PLoS ONE 10: e0121188

Tsitsika EV, Maravelias CD (2008) Fishing strategy choices of purse seines in the Mediterranean: Implications for management. Fisheries Science 74: 19 – 27

van Denderen PD, van Kooten T, Rijnsdorp AD (2013) When does fishing lead to more fish? Community consequences of bottom trawl fisheries in demersal food webs. Philosophical Transactions of the Royal Society B: Biological Sciences 280: 20131883

Vasilakopoulos P, Maravelias CD, Tserpes G (2014) The alarming decline of Mediterranean fish stocks. Current Biology 24: 1–6

Vestergaard N (1996) Discard Behavior, Highgrading and Regulation: The Case of the Greenland Shrimp Fishery. Marine Resource Economics 11: 247-26

1. a) changing the current fisheries management system, b) improving enforcement of fisheries regulations, c) improving the system of selling fisheries products, d) increase fishers’ awareness through workshops and courses, e) increasing the cases of exemptions to the LO, f) reducing taxes to fishers, g) working at the consumer level to promote consumption of “discards-free” fisheries product and h) working on new control and monitoring techniques that give a premium to compliant fishers. [↑](#footnote-ref-2)