

Evaluation of environmental stressors for a population of the long-snouted seahorse *Hippocampus guttulatus* through an innovative Citizen Science approach

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Abstract – In this paper we describe the sudden decrease of a *Hippocampus guttulatus* population in the Mar Piccolo di Taranto (MPT) (South-east Italy) under the combined effect of fishing activities and illegal trade. Until recently, the Mar Piccolo of Taranto has hosted one of the most interesting and large long-snouted seahorse population of the Mediterranean sea. However, as of 2016, the density of *H. guttulatus* population has shown a sudden and dramatic decrease. Disclosure and report of an online traffic of seahorses from Italy to China (<https://veraleaks.org>) occurred in February 2019 prompted us to carry out interviews with the main stakeholders operating in the Mar Piccolo of Taranto. The aim of this paper is to evaluate the extent of this illegal trade and the potential effects on the seahorses population.

I. INTRODUCTION

According to many documents and scientific papers, Illegal, Unreported and Unregulated (IUU) fishing and Illegal Wildlife Trade (IWT) are among the most serious threats for the sustainable fishing and aquatic animal

conservation worldwide [1,2]. To date, together with habitat loss and degradation, illegal trade is considered the most damaging hazard to wildlife species [3] and a fundamental driver for biodiversity loss both in aquatic and land habitats [4,2]. Seahorses (47 species of the *Hippocampus* spp. genus) are marine animals particularly threatened by IWT and the first marine bony fishes subjected to trade regulation on a global scale [5]. Seahorses are mainly traded dried for use in Traditional Chinese Medicine (TCM) and for curio and live for aquarium display [5] at a level that probably threatens the sustainability of many populations [6]. In this context [7] it is estimated that the global catch of seahorses counts about 37 million individuals per year, mainly of which sourced as by-catch from non-selective fisheries [6, 8]. In this paper we describe the sudden decrease of a *Hippocampus guttulatus* population in the Mar Piccolo di Taranto (South-east Italy) (hereafter called MPT) under the combined effect of the illegal fishing and trade. The MPT hosts one of the most interesting and large long-snouted seahorse population of the Mediterranean sea [9]. However, disclosure and report of an online traffic of seahorses from Italy to China (<https://veraleaks.org>) occurred in February

2019 prompted us to carry out interviews with the main stakeholders operating in the MPT. Often it is difficult to investigate the extent of an illegal market, if not indirectly. We therefore decided to go further, taking advantage of the knowledge of those who attend the MPT for various reasons. Through an online questionnaire distributed among operators and users of the MPT we have tried to reconstruct the history of seahorses investigating: the status of the long-snouted seahorse population, the trend of the population in the last nine years and the main stressors that have caused the population decreasing.

II. MATERIAL AND METHODS

Following the first report on the illegal trafficking of seahorses in the MPT and in conjunction with the observation of a occurred decrease in the population density of the seahorses recorded during a series of experiments on the home range (Pierri et al., in preparation), a questionnaire was prepared to assess the extent of the collection. From February to April 2020 the questionnaire was distributed among the main categories operating in the MPT (both for professional and recreative purposes). In particular, interviews were carried out with academy (the local University and National Council of Research of Taranto), environmental associations (WWF, Legambiente, Marevivo), press agency, military and governmental institutions (Coast Guard, Italian Military Navy, Italian Air force), artisanal fishermen, mussel farmers (Tab. 1). The survey of all the stakeholders sought information on five key topics: 1) General information about the interviewees (employment, activity carried out in the MPT, number of diving hours/year, average number of seahorse sighted/hour. 2) Temporal trend of seahorse population (increasing, decreasing, from what year). 3) Main causes of the change in population density (fishing activities, natural causes, pollution). 4) The features of legal and illegal fishing activities in the MPT (gear, season, areas fished, N° of vessels, N° days/year); 5) Eventual targeted fishing on the seahorses (number of vessels, commercial value). We have assessed the consistency of the answers in the sequence of questions in the questionnaire and only the congruent interviews were used for further analysis.

III. RESULTS

A total of 59 questionnaires have been filled in by the stakeholders operating at MPT. Eight questionnaires, which showed inconsistent responses, were eliminated and not considered in subsequent analysis. A total of seven operators categories were consulted but participation by categories potentially involved in the activities that could threaten seahorses population inside the MPT (artisanal fishermen, mussel farmers) were very rare and scanty (Table 1).

Table 1 - List of interviewed categories and number of respondents by category. N.A. = Not Available.

	Number of respondent per category
Surveillance (Government Official)	4
Disclosure Associations (Local NGO)	2
Mussel Farmers	2
Fishermen	1
Academic (Biologist, Researcher)	5
Ricreative Divers	34
N.A.	3

Figure 1 shows that more than 64 % of respondents reported a decrease of seahorse density and that the main stressor influencing the seahorse population is represented by the fishing activities carried out in the MPT (Figure 2).

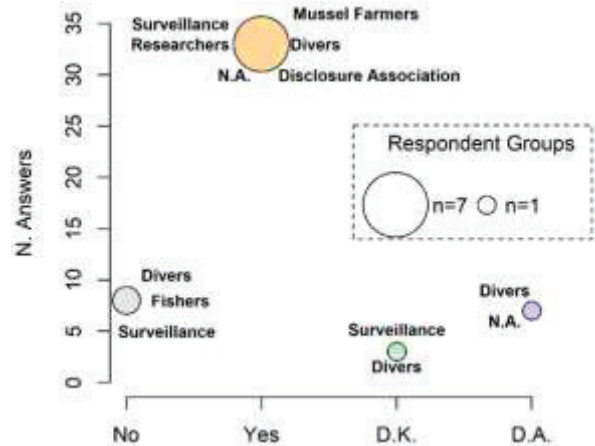


Figure 1 – Perception of density decrease of *H. guttulatus* population. The size of the circle is proportional to the number of responding categories. D. K. = doesn't know; D.A. = doesn't answer.

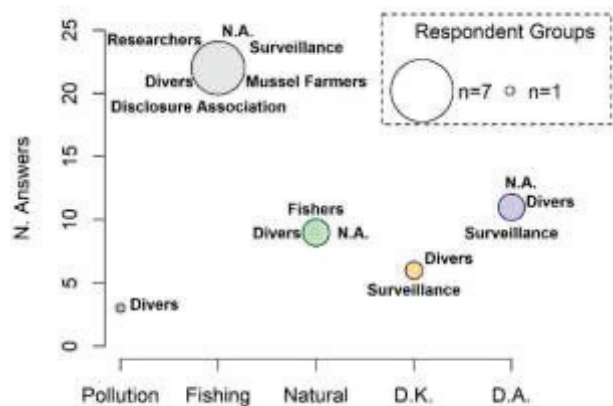


Figure 2 – Main causes responsible for the decrease in the density of the *H. guttulatus* population. The size of the circle is proportional to the

number of responding categories. D. K. = doesn't know; D.A. = doesn't answer.

Fishing activities are conducted with different traditional techniques (trammel nets, small purse seine, small skid gears (called "firchjar"), divers (to collect by hands *Sepia* spp. juveniles)) and the main part of these fishing techniques capture seahorses as by catch [10]. However, only the 19,4 % of the respondents to the questionnaire underlines that seahorse specimens caught by the professional fishermen are retained as curio or for sale in the illegal market. By the way, decreasing of seahorse density was felt starting in 2016 and continued until 2019.

Our interviews only partially confirmed fishing activities specifically targeted on seahorses. 41,1 % of respondents 39,2 % have never been a direct witness of this illegal activity while 39,2 % of respondents confirm that this activity it is usually practiced in MPT (Figure 3). Among these the 35 % say that the fleet that practices this kind activity it's composed by 3/5 boats, the 20 % by 2 boats and the 10 % by 5/8 boats. The remaining 30 % does not provide a number of boats that operate this fishing. Only 9 out of 51 questionnaires provided information on the commercial value of illegal seahorses fishing ranging from 1 to 20 €/individual or from 500 to 600 €/Kg.

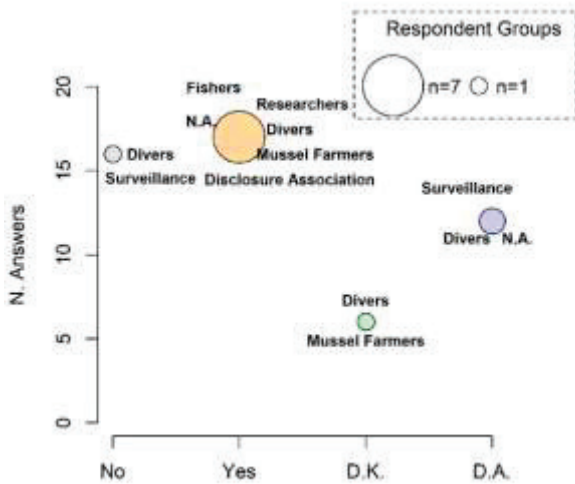


Figure 3 – Presence, in the MPT, of a targeted fishing on *H. guttulatus*. The size of the circle is proportional to the number of responding categories. D. K. = doesn't know; D.A. = doesn't answer.

IV. DISCUSSION

Long-snouted seahorse population of MPT until 2015 represented one of the most large population in all the Mediterranean sea and European waters [8]. In this semi-enclosed marine area abundance of *H. guttulatus* was comparable to that recorded at Ria Formosa (Portugal), (0.073 seahorse/m²) [11] and Mar Menor (Spain) (www.asociacionhippocampus.com). For some of these

seahorse populations wide density fluctuations have been described on large time series and were positively correlated with habitat changes and the related percentage of available holdfast coverage [12] and with eutrophication processes (www.asociacionhippocampus.com). However, from Autumn 2015 to Spring 2016 *H. guttulatus* density (individuals/m²) in some portion of MPT has decreased dramatically by about 90%. Nevertheless, in the studied period no apparent changes have occurred in the habitats spatial distribution and in holdfast availability. However, interviews carried out with the main stakeholders operating in MPT allowed us to describe an increasing of fishing activities in MPT. Although interviews underline that usually fishermen reject alive to the sea the main part of the caught seahorses, we believe that the combined effect of fishing gears on the seabed and the displacement of a substantial number of individuals released into the sea after capture (in locations and habitats other than those of the capture) may have had an important impact on the population. As suggested by [13] the ability of a seahorse to return to the starting point after being moved is rather weak and strongly affected by the conditions of the new environment. Due to the illegal and clandestine nature of this activity, it is very difficult to pinpoint its beginning. However, the interviews carried out at MPT allowed us to highlight that, starting from about the beginning of 2016, an international seahorses trading have been considerably affecting the long-snouted population and the perspective for its conservation. Until few years ago, fishing along the Italian coasts was generally considered a negligible danger for seahorse populations, rather threatened by the degradation and fragmentation of coastal habitats [8]. Nevertheless, as described in this paper, the combination of increase of fishing pressure and renewed market demand has highlighted a new threat to the seahorses population. Surprisingly, we have to register a new trade route for the illegal trafficking of wild animals with the Mediterranean as the source and Asia as the final market. According to [13], we highlight that wildlife trade routes show a dynamic network. Until a few years ago, in fact, Europe was considered as an end market and transit hub for illegal wildlife trade, with European sea and airports commonly used when smuggling illicit wildlife products from Africa to Asia (www.traffic.org).

This paper contributes to shed light in a new scenario characterised by a constant demand for seahorses from the eastern countries in strong economic expansion and a renewed offer from western countries subject, in the recent past, to an evident economic recession. This unexpected and unpredictable condition represents a new and fearful threat to the populations of Mediterranean seahorses. A more intense and effective action to prevent and combat illegal processes and continuous and close monitoring to

assess the state of the populations need urgent and close tracking.

regulations – A case study of seahorses. *Marine Policy* 88 (2018) 48–57

REFERENCES

- [1] FAO, The State of World Fisheries and Aquaculture, 2016. (<http://dx.doi.org/92-5-105177-1>).
- [2] Margulies JD, Bullough L-A, Hinsley A, et al. Illegal wildlife trade and the persistence of “plant blindness”. *Plants, People, Planet.* 2019;1:173–182. <https://doi.org/10.1002/ppp3.10053>
- [3] Zimmerman, M.E. 2003. The black market for wildlife: combating transnational organized crime in the illegal wildlife trade. *J. Transnat. Law* 36: 1657–1689.
- [4] Harris, J.B.C., Tingley, M.W., Hua, F., et al. (2016). Measuring the impact of the pet trade on Indonesian birds. *Conserv. Biol.* DOI: 10.1111/cobi.12729
- [5] Sarah J. Foster, Ting-Chun Kuo, Anita Kar Yan Wan, Amanda C.J. Vincent 2019 - Global seahorse trade defies export bans under CITES action and national legislation. *Marine Policy* 103, 33–41
- [6] Vincent ACJ, Foster SJ, Koldewey HJ. 2011. Conservation and management of seahorses and other Syngnathidae. *Journal of Fish Biology* 78: 1681–1724. Lawson et al. (2017)
- [7] Foster, S.J. 2016. Seahorses (*Hippocampus* spp.) and the CITES Review of Significant Trade. *Fisheries Centre Research Reports* 24(4): 48 pp.
- [8] Gristina M, Cardone F, Carlucci R, Castellano L, Passarelli S, Corriero G. 2015. Abundance, distribution and habitat preference of *Hippocampus guttulatus* and *Hippocampus hippocampus* in a semi-enclosed central Mediterranean marine area. *Marine Ecology* 36: 57–66.
- [9] Curtis JMR, Vincent ACJ. 2005. Distribution of sympatric seahorse species along a gradient of habitat complexity in a seagrass – dominated community. *Marine Ecology Progress Series* 291: 81-91.
- [10] Lawson J.M. 2017. The Global Search for Seahorses in Bycatch. *Fisheries*, 42:1, 34-39
- [11] Correia M, Caldwell I, Koldewey H, Andrade JP, Palma J (2015) Seahorse (*Hippocampinae*) population fluctuations in the Ria Formosa lagoon, South Portugal. *J Fish Biol* 87:679–690
- [12] Caldwell JR, Vincent ACJ. 2012. Revisiting two sympatric European seahorse species: Apparent decline in the absence of exploitation. *Aquatic Conservation: Marine and Freshwater Ecosystems* 22: 427–435.
- [13] Kuo, T.C. and A. Vincent 2018. Assessing the changes in international trade of marine fishes under CITES