

RESEARCH ARTICLE

Not everyone's cup of tea: Public perception of culling invasive lionfish in Cyprus

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Abstract

The selective removal of the invasive lionfish *Pterois miles* is among the alternative methods available to reduce, at least locally, the abundance of this invasive species. The present study provides information regarding people's perceptions on the lionfish establishment in Cyprus focusing on culling as a management option. A series of informal interviews of 415 individuals from different sectors of the society were conducted in-person and through social media platforms from 2012 to 2017. The majority of the interviewees (65%) were aware about the lionfish; within this group, 23% considered the species to be good for the environment, 39% bad and 38% did not know. Not surprisingly, most of the interviewees that consider the species bad supported culling (75%) and those that considered it good condoned any culling activities (62%). The reasons given for not supporting culling were because the species enhance marine diversity (38%), is dangerous (28%), is beautiful (25%), and has the right to live (9%). Contradictory opinions (e.g. even though the lionfish is bad for the environment culling is not an alternative) seem to be explained by the absence of data on the ecological effects of the species as well as general misconceptions about the marine ecology of the Levantine Sea.

Key words: *Pterois miles*, management, selective removal, non-indigenous species, interviews, Mediterranean

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Introduction

Biological invasions are driving agents of global change affecting marine and terrestrial ecosystems. They are seen as threats to ecosystem functioning and responsible for biodiversity loss (Sinberloff *et al.* 2013). The consequences are

immense economic losses augmented by costs related with management (Rilov and Crooks 2009; Pimentel 2011). For example, the invasion history and ecological consequences of the lionfish *Pterois miles* and *Pterois volitans* in the Western Atlantic, Gulf of Mexico and Caribbean Sea are well documented. Since 1985, the species established itself in about four million square kilometres (Hoag 2014) with dire effects on important native fish species (already overfished), accelerating marine habitats' deterioration (Albins and Hixon 2013; Bellwood and Goatley 2017).

The confirmed invasion, successful establishment and dispersion of *Pterois miles* in the Levantine Sea (Bariche *et al.* 2013; Turan *et al.* 2014; Oray *et al.* 2015; Jimenez *et al.* 2016; Kletou *et al.* 2016), as well as other regions in the Mediterranean (Crocetta *et al.* 2015; Dailianis *et al.* 2016), is happening while the authorities and decision makers in general are not prepared, with no contingency plan as of yet to be elaborated. Options to tackle the on-going dispersion and establishment of the lionfish in the Mediterranean are not clearly defined and usually are not feasible in the absence of a proper legislation to implement activities. The selective removal is among the alternatives available to reduce, at least locally, the abundance of these invasive species. Lionfish culling has already been enforced in other regions, with mixed results (e.g. Albins and Hixon 2013; Côté *et al.* 2014; Hoag 2014). No matter what the ecological reasons to justify culling are, this activity as a mean for population control is a very controversial option for managers worldwide (Carballo-Cárdenas 2015; Carballo-Cárdenas and Tobi 2016).

Since public perception has proven to be highly influential and often confrontational when determining management and conservation policies of species (Nuñez *et al.* 2012; Gozlan *et al.* 2013; Clavero 2014; Carballo-Cárdenas 2015), the present study provides necessary information regarding people's perceptions on the lionfish establishment in Cyprus (e.g. ecological and economic potential threat), and focusing on whether culling is beneficial.

Materials and Methods

Starting in October 2012, with the first sightings of lionfish in Cyprus (Jimenez *et al.* 2016), and until February 2017, a series of informal interviews were conducted to stakeholders, such as recreational/commercial divers and fishermen, laypeople, academics (e.g. students, scientists, teachers) and civil servants (e.g. governmental employees), through in-person contact as well as social media platforms. Four basic questions were asked in order to evaluate awareness:

1. Are you aware of the lionfish in Cyprus?
2. Do you think the lionfish has an impact on the marine ecosystems of Cyprus?

3. Willingness to support population control options, specifically removal (Would you support culling of this species? Why?).

The answers were grouped in major categories (e.g. good/bad for the environment). Since the interviews were not made on a systematic basis, nor using structured questionnaires with a priori sampling design to guarantee an adequate representation of stakeholders' background, the results can't be statistically analysed for temporal or individual trends or to compare between groups (e.g. stakeholders' background). Number of participants was not similar for each stakeholder category limiting the extent of the analysis. In consequence, data are pooled independently of the year. In spite of these limitations, these qualitative results provide important information on people's perception and it is the first effort in the Mediterranean to document support/rejection of culling of lionfish.

Results

A total of 415 individuals participated in the interviews; based on YES or NO answer, the majority (N=268, 64.6%) were aware of the lionfish in Cyprus. According to interviewees' background (Table 1), Civil Servants and Divers were the stakeholders being most aware (75% and 69.3%, respectively) of the lionfish in Cyprus with Fishermen being the least aware (50.9%). In all categories the majority (>50% was aware of the presence of the lionfish in Cyprus, although, a few Civil Servants did not know about the lionfish (4.8%).

Table 1. Stakeholder awareness of the presence of lionfish in Cyprus (based on YES or NO answer)

Background	Aware	Not aware	Total	Aware (%)	Not aware (%)
Academia	44	23	67	65.7	34.3
Diver	95	42	137	69.3	30.7
Fishers	28	27	55	50.9	49.1
Civil Servants	21	7	28	75	25
Laypeople	80	48	128	62.5	37.5
TOTAL	268	147	415	64.6	35.4

The following results are derived from the stakeholders that were aware of the lionfish in Cyprus; the group Not Aware is excluded. The perceived impact of the lionfish on the environment (Figure 1) was considered bad by 39.5% of the stakeholders and 22.8% considered it good. A substantial percentage of stakeholders (37.7%) did not know. Divers are the stakeholders that on equal numbers considered positive and negative the impact of the lionfish and the majority (38.9%) did not know. The highest percentages of interviewees in the Academia and Laypeople considered the impact bad (50% and 43.8%, respectively). After Divers, the stakeholders with a more positive perception on

the environmental impact of lionfish are Civil Servants and Laypeople (23.8% and 21.3%, respectively).

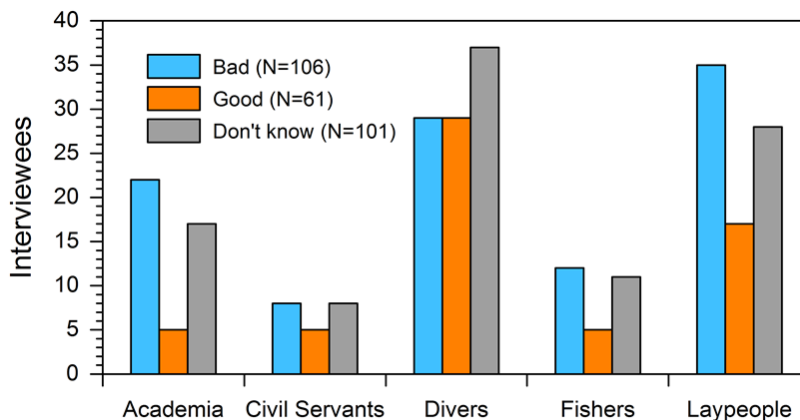


Figure 1. Stakeholder perceptions on the environmental impact of the lionfish in Cyprus (based on BAD, GOOD, DON'T KNOW answer)

Lionfish culling was not accepted by the majority of the stakeholders. Regardless of their background, about 32% were supportive while 48% opposed it while 20% did not know. According to interviewees' background (Table 2), Fishers and Academics were the stakeholders most opposed to culling (54% and 50%, respectively). The only group where the majority agreed with culling were the Civil Servants (52% YES vs 33% NO).

Table 2. Stakeholder support of lionfish culling in Cyprus (based on YES, NO, DON'T KNOW answer)

	No	Yes	Don't know	Total	No (%)	Yes (%)	Don't know (%)
Academia	22	9	13	44	50	20.5	29.5
Civil Servants	7	11	3	21	33.3	52.4	14.3
Divers	46	30	19	95	48.4	31.6	20
Fishers	15	9	4	28	53.6	32.1	14.3
Laypeople	38	28	14	80	47.5	35	17.5
TOTAL	128	87	53	268	47.8	32.5	19.8

The reasons given to reject or support culling fall in seven categories (Table 3); only one (Dangerous) is given to support (e.g. the fish needs to be removed because of safety issues) but also to reject culling (e.g. since lionfish is poisonous it is not safe to hunt it). Aesthetics includes the concepts of beauty

and attractiveness of the species as well as improvement of the attraction of Cyprus' marine seascape. Bad includes the notion that is negative for the environment. Ethics is more complex since it includes moral concerns, such as the lionfish right to live, the ultimate rightfulness of culling (or of any species) and, on a few cases, the uncertainty of the scientific reasons to promote culling. Enhance Diversity (H) includes answers such as "enrichment of the otherwise poor fish fauna" and increase of "fish abundance" and "number of species". Food includes reasons such as "human consumption", "delicacy for the market", "food export", and on one instance "animal fodder". Sport includes spearfishing and, on two instances, angling.

The lionfish apparent enrichment or enhancement of the marine biodiversity was the most common reason (37.9%) to oppose culling (Table 3); Dangerous was the second most common reason (27.6%) followed by Aesthetics (25.3%). Culling was mostly supported because the lionfish is considered Bad (35.9%) or for Sport (32.8%) and for Food (22.9%).

Table 3. Stakeholder reasons to reject (NO) or support (YES) lionfish culling (based on answers in the interview). See text for explanations on the reasons.

	No	Yes	Total	No (%)	Yes (%)
Aesthetics	22	-	22	100	-
Bad	-	47	47	-	100
Dangerous	24	11	35	68.6	31.4
Ethics	8	-	8	100	-
Enhance H*	33	-	33	100	-
Food	-	30	30	-	100
Sport	-	43	43	-	100
TOTAL	87	131	218	39.9	60.1

*Enhance H=Enhance marine biodiversity.

With respect to the stakeholders background (Figure 2), the reasons given to reject or support culling were somehow expected but also interesting associations were found. Considering the reasons to reject culling (Figure 2a), Enhance Diversity (H) was the main argument for the interviewees in the Academia. Civil Servants were more wary of the fish posing a threat to safety (Dangerous). The majority of Divers opposed culling due to the apparent enhancement of fish diversity but also for aesthetical reasons (very attractive fish) and only very few were concerned with ethical (moral) or safety issues. The few Fishers represented in the survey who were aware of the lionfish (Table 2) cited primarily safety concerns and then Aesthetics and Enhancement of fish diversity. Most of the Laypeople considered first the safety issues followed by Aesthetics.

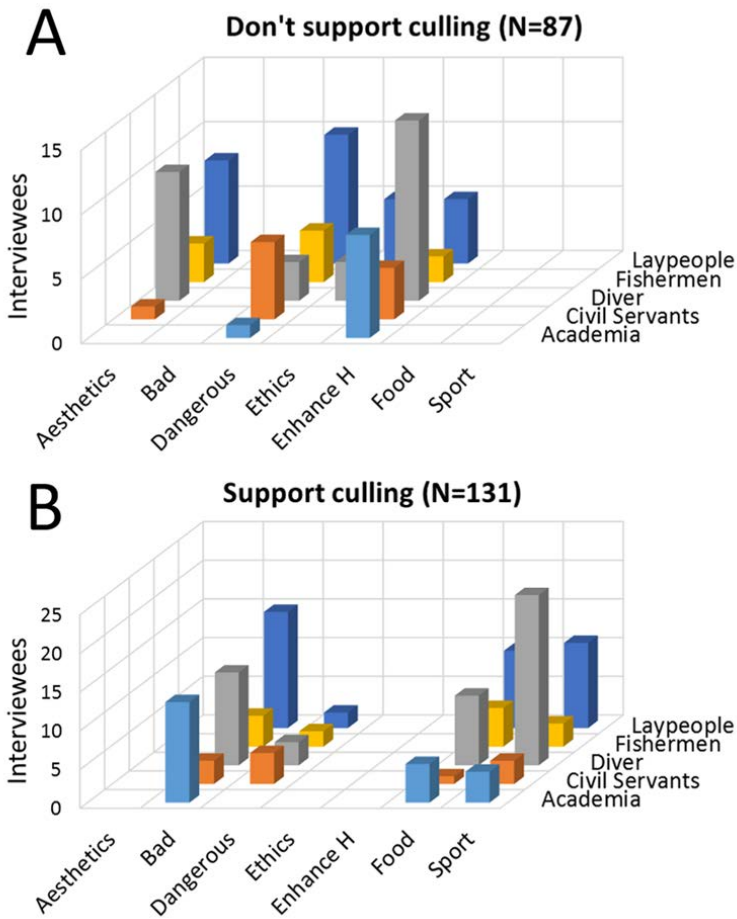


Figure 2. Stakeholder reasons to reject or support lionfish culling in Cyprus (based on answers in the interview)

The reasons given to support lionfish culling, sorted according to the background of stakeholders (Figure 2b), show that negative impact (Bad) is the main explanation in the Academia, followed by Food. Civil Servants explained their support mainly on safety concerns and, on equal frequency, the impact that lionfish will have to the environment and Sport. The majority of divers justified lionfish removal (in decreasing order) for Sport reasons, impacts to the environment and Food; only few divers had safety concerns. Food was the main justification for Fishers followed by impacts to the environment and Sport; similar to Divers, only few Fishers had safety concerns. Environmental concerns

were given by Laypeople as the main explanation, followed by Food and Sport and, on two instances, threats to safety.

Discussion

The results of this study, even though qualitative, are important since they show people's perception regarding lionfish selective removal, an almost unavoidable (though controversial) management alternative to tackle the spread and establishment of this highly invasive species. Our findings support that Civil Servants are the stakeholder group most in favour of culling, which may be explained by their previous experience with the management of invasive *Lagocephalus sceleratus*. The motivation for the mobilization towards *Lagocephalus* culling was primarily the loss of income by the small-scale fishery sector that was forced to change/repair gear due to the species presence (Rousou *et al.* 2014); a factor which is not expected to have equal influence on Fishers' perception of the lionfish. If lionfish culling will be officially encouraged by authorities, a clear understanding of the reasons for this measure is crucial in order to gain public support. The latter is far from trivial, it is indeed very important since culling is a long-term activity that requires intensive and constant involvement from volunteers, as observed in other initiatives for conservation (e.g. Carballo-Cárdenas and Tobi 2016). In addition, to enrol in culling activities, volunteers are also needed for monitoring and to continue with detection surveys (Kiwik 2012; Scyphers *et al.* 2014).

There is an innate bias against alien species in the society (Katsanevakis *et al.* 2014). However, it is not straight forward when other attributes of the species confound people's perceptions. The case of the lionfish clearly illustrates how important it is to properly inform and educate stakeholders on the ecological impacts of this attractive fish species. Like the lionfish in the Americas (see Hoag 2014), the species is considered "beautiful", an important addition to the Levantine's impoverished fish diversity. In general, stakeholders regard lionfish as a stunning species, highly photogenic, that adds to the aesthetic qualities of the seascape. For a significant number of divers, the attraction and commercial value of the lionfish is far from negligible. Recreational divers are anticipating to detect and observe this "dangerous" but beautiful fish. It is a new thrill for divers in Cyprus and dive operators are somehow more reticent to culling since the species is an asset to their dive programs. Who wants to kill the "panda bear" of the invasive species in Cyprus? It has been reported elsewhere (Nuñez *et al.* 2012; Carballo-Cárdenas and Tobi 2016) how the initial view of the lionfish as a threat can change as the recreational or economic value for the species increases.

In the Mediterranean, dissemination of sensationalistic information in the media on the ecological effects and the venomous nature of the lionfish have created a confusing picture of the on-going invasion and the options to manage it. This

situation could explain the instances where stakeholders in Cyprus question the validity of the scientific information to justify culling. Similarly to our finds, there is a fraction of the public sector in the Caribbean that questions the effectiveness, safety and morality (ethics) of lionfish culling (Carballo-Cárdenas 2015). Lionfish clearly have the potential to become major predators and, in consequence, affect key native species, such as the endangered Mediterranean dusky grouper (*Epinephelus marginatus*). However, in this early phase of the invasion, there are no ecological surveys in the Mediterranean to properly assess and evaluate the risks posed by the lionfish to local fish communities and habitats.

In summary, perceived impacts of the lionfish on the native Mediterranean species and habitats are important predictors of support for management options, such as culling of this species in Cyprus. Official initiatives, such as culling, that aim to tackle possible environmental impacts associated to the invasive lionfish need public support. The latter is particularly essential, if voluntary participation is required, as well as securing funds for the monitoring and evaluation of these activities.

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