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ORIGINAL ARTICLE

Local and tourist perceptions of coastal marine habitats in Cap de Creus (NE Spain)

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Abstract

Direct human pressure on Marine Protected Areas (MPAs) adds to climate change impacts on marine habitats, especially in coastal biodiversity hot spots. Understanding MPA user perception towards the Coastal marine Habitats (CMHs) could improve awareness of the challenges that such areas have to face, eventually providing insights for the design of conservation and tourism management plans. We studied perception of ecosystem services, impacts and threats of CMHs by locals and tourists ($n = 624$) of Cap de Creus MPA (NW Mediterranean Sea). Overall, we found that perceptions of tourists and locals are similar. Respondents perceived that CMHs provide valuable regulating services, and they assigned less value to cultural services. Locals valued the food provision ecosystem service of CMHs significantly more than tourists, probably because of the historical importance of fisheries for subsistence. Respondents ranked marine pollution of inland origin, climate change and people's behaviour towards nature as the most impactful and threatening to CMHs, and invasive marine species as the least. Respondents also perceived that climate change impacts would increase soon, whilst the impact of people's behaviour towards nature would decrease. Tourists perceived mass tourism as significantly more impactful and threatening to CMHs than locals did. Overall, our study shows that conservation of CMHs is highly valued, so more effort needs to be directed toward this goal.

Keywords Anthropogenic pressure · Ecosystem services · Impact · Coastal marine habitat · Perception · Survey

Introduction

The Mediterranean Sea, despite representing only 0.8% of the surface world's ocean and 0.32% of its volume (Defant 1961), is a biodiversity hotspot (Lejeusne et al. 2010), where 4 to 18% of the world's marine species live, including a high percentage of endemic species (Bianchi et al. 2012). Mediterranean marine species range from 12,000 to 20,000 in number, a diversity only comparable with the southern coast of Australia (Coll et al. 2010; Bianchi et al. 2012; Boudouresque 2004). In the Mediterranean basin, biodiversity is mostly concentrated in coastal and continental shelves. The habitats distributed in these areas have higher biodiversity in the northwestern basin, where the uppermost seawater is relatively colder, fresher and more productive than in the rest of the Mediterranean Sea (Coll et al. 2010, 2012).

Northwestern coastal marine habitats (CMHs) play a crucial role in maintaining Mediterranean biodiversity, as a high number of species feed, nurse and are protected there, especially in the seagrass meadows (Duffy 2006; Boudouresque 2004) and the coralligenous (Valisano et al. 2019;

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Casas-Güell et al. 2015; Kipson et al. 2011). These CMHs also provide numerous ecosystem services to people, including food provision, control of pollutants, oxygen release, biological and climate regulation, coastal protection, ocean nourishment, recreation and symbolic and aesthetic values (Liquete et al. 2013; Barbier et al. 2011; Lloret 2010). As blue carbon sinks, CMHs also contribute to carbon sequestration (Mallo et al. 2019; Coppari et al. 2019; Krause-Jensen and Duarte 2016; Duarte et al. 2010).

As the coasts of the Mediterranean are highly populated (UNEP/MAP 2012) and the region is a major world tourist destination (Weston et al 2019), the Mediterranean faces enormous human pressure, and it is the sea with the greatest anthropogenic impacts on Earth (Claudet et al. 2020; Coll et al. 2010). Anthropogenic impacts (e.g. pollution, hypoxia, invasive species or bottom trawling; Coll et al 2012; Claudet and Fraschetti 2010) are particularly concentrated in coastal areas (Gray 1997), especially in the northwestern region (Coll et al. 2012). These stressors affect CMHs by decreasing their complexity, sometimes through fragmentation and patchiness, lowering water quality, decreasing biodiversity, altering food chains and decreasing their carbon sequestration potential. These changes, in turn, imply less habitat resilience to perturbations, less ability to mitigate climate change and a lower capacity for sustaining biodiversity (e.g.: Rossi 2019; Montefalcone et al. 2017; Rossi et al. 2017; Deudero and Alomar 2015; Micheli et al. 2013; Lacoue-Labarthe et al. 2016). From a social point of view, a habitat's low health status decreases the area's tourism attraction potential, affecting the local economy and livelihoods (Krelling et al. 2017; Rodrigues et al. 2015; Kirillova et al. 2014; Van der Merwe et al. 2011; Petrosillo et al. 2007; Liu et al. 1987).

In this article, we explore the ecosystem services, impacts (including stressors) and threats of CMHs in Cap de Creus (NE Spain) as perceived by the local population and tourists visiting the area. Understanding how the users of coastal marine areas perceive the ecosystem services, impacts and threats of CMHs would be a step forward towards effective marine life conservation and management policies of coastal areas, as awareness of the problems is a key step for proposing new conservation measures or maintaining the existing ones, including a better design of a sustainable tourism model (e.g. Llausàs et al. 2019).

Methods

Study area

We conducted research in the Cap de Creus peninsula (42° 33'N; 03°19'E), Costa Brava (Girona, Spain). Specifically, we collected data in Port de la Selva, Cadaqués and Roses, the three municipalities with marine jurisdiction in the 3073 ha of the Cap de Creus Natural Park, which was established in 1998 (Fig. 1). For this work, we focus on the three municipalities neigbouring a Marine Protected Area (MPA), the Natural Park of Cap de Creus, where the quality of the natural habitat plays a major role as tourist attractor.

The study area has a mild climate, characterised by moderate annual precipitations and temperatures. The coastal marine environment is influenced by an important river runoff from the Rhône, the Fluvià and the Muga, and an intense vertical mixing in winter due to typical dry, cold and strong winds, causing strong coastal currents (Rohling et al. 2015; Gili et al. 2011). Such features make the Cap de Creus coastal and offshore system one of the most productive marine areas of the Mediterranean Sea (Gili et al. 2011). Sandy bottoms characterise the marine vegetation in this system where seagrass meadows, especially *Posidonia oceanica*, dominate (Ruiz et al. 2015; Sardà et al. 2012). The shallow and deep rocky bottoms are dominated by coralligenous species, like *Paramuricea clavata*, *Eunicella* spp., *Axinella* spp. and *Corallium rubrum* (Sardà et al. 2012; Gili et al. 2011; Gori et al. 2011; Linares et al. 2018).

Traditionally, the main source of income in Roses, Cadaqués and El Port de la Selva were fisheries and agriculture. However, since the 1960s, these villages became strong tourist attractions, and today, tourism is the main source of income for the local population (Newsletter Costa Brava 2019). Recreational activities with potential impacts on the Cap de Creus Natural Park include recreational boating (anchoring), artisanal fishery, recreational fishing, non-regulated shellfish collection, spearfishing and inappropriate recreational scuba diving. Most of these activities happen during the summer months, affecting the seagrass meadows, the coralligenous and the infralittoral algal habitats (e.g. Hereu et al. 2018; Corrales et al. 2020; Vilas et al. 2020; Font and Lloret 2011; Lloret and Riera 2008).

Data collection

We conducted research in two phases combining qualitative and quantitative data collection methods. During December 2017 and July 2018, we performed exploratory semi-structured interviews. We used information from these interviews to design a survey to collect data during July and August 2019. Participation in our research was voluntary, and the Ethics Committee on Animal and Human Experimentation of the Autonomous University of Barcelona approved the research protocol (CEEAH 4792).

Semi-structured interviews

We used semi-structured interviews to assess how people who are directly or indirectly dependent on the CMHs

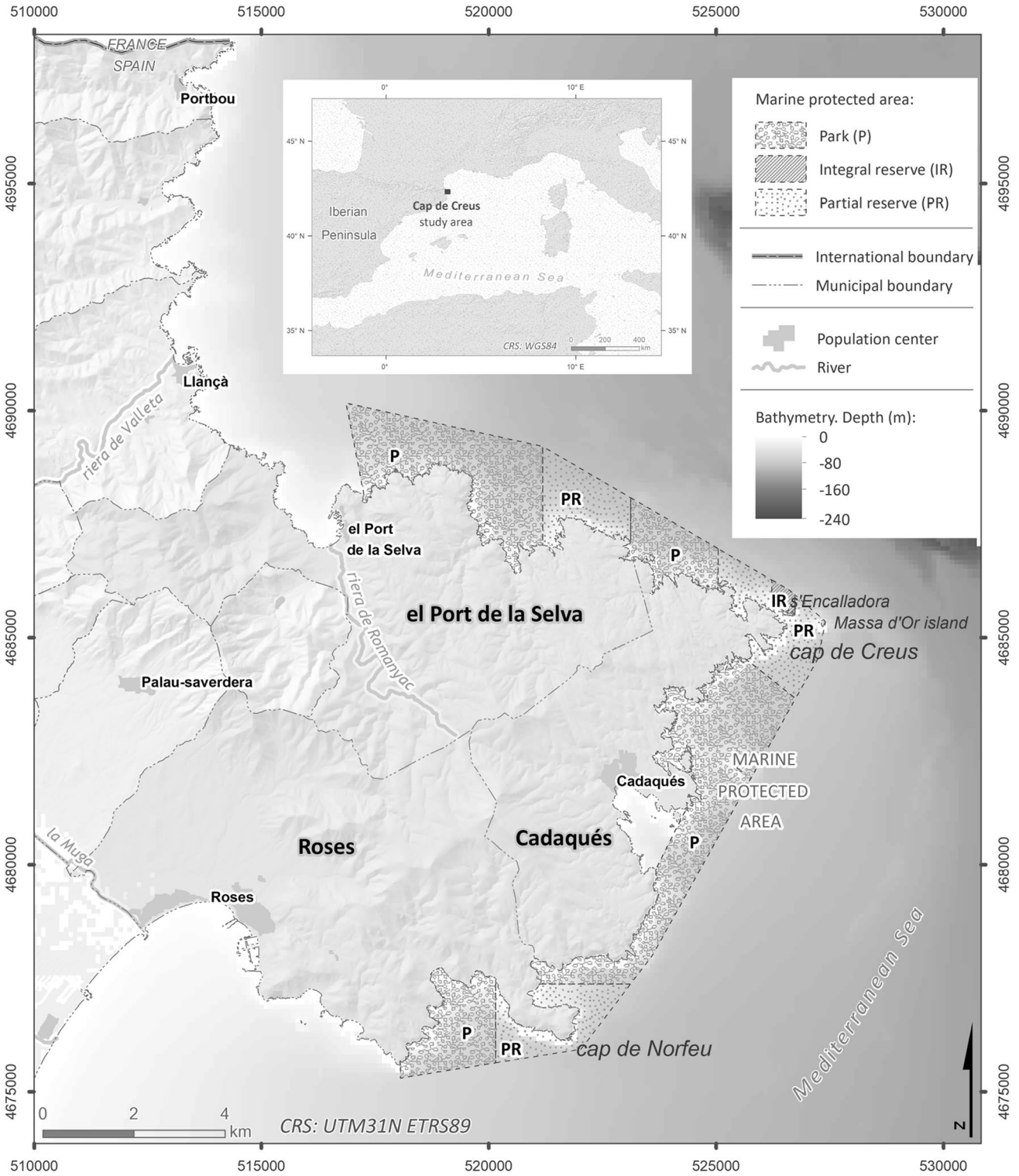

Fig. 1 Map of the study area

for their income perceive environmental changes and their impacts. The sample for semi-structured interviews included owners and managers of tourist accommodations, fresh seafood restaurants and scuba diving centres. To select the target sample, we first compiled a list of local businesses. We contacted the 93 potential candidates in our list, from which 40 (43%) agreed to be interviewed (see Online Resource 1).

We asked informants to list the changes perceived in the area since they had begun work there. We highlighted that we were interested in changes affecting them and/or other local inhabitants. Responses to our question included impacts, drivers and/or stressors (all named as "impacts" hereafter). We handwrote responses referring to environmental changes.

Survey

In the second phase of the research, we conducted a survey to assess people's perceptions of the ecosystem services provided by the local CMH, as well as the impacts and threats affecting it (Online Resource 2). To select survey respondents, we used convenience sampling. Our sample included adults found in the three municipalities of the study area, regardless of their place of residence (i.e. including tourists). We approached 1227 people, from which 624 (51%) agreed to respond to the survey (see Online Resource 1).

The survey collected information on respondent's sociodemographic status and perceptions of Cap de Creus CMH ecosystem services, impacts and threats (Online Resource 2; Online Resource 3). To form a list of CMH ecosystem services, we used published literature to select the six more relevant and easy to identify ecosystem services provided by CMH (Liquete et al. 2013). In our survey, we asked respondents to rank the six listed ecosystem services from the most (= 1) to the least (= 6) relevant. Respondents could put an "x" if they perceived that some ecosystem service(s) in our list were not relevant in the area.

To examine perceptions of the main impacts on local CMHs, we selected the eight negative environmental changes most frequently reported in the semi-structured interviews (Online Resource 4). We asked respondents to rank the selected impacts from the most (= 1) to the least (= 8) impactful. Respondents could also indicate that some elements in the list did not affect local CMHs (= x). To examine perceptions of the main threats affecting CMHs, we used the same procedure, but asked respondents to speculate how important would be the same eight selected impacts in 2050.

Data analysis

We calculated the mean and median value of each ecosystem service, impact and threat, considering the rank assigned by our pool of respondents. Given our scales, higher values account for less beneficial, less impactful and less threatening items than lower values. We then conducted three analyses for each element in our list: we compared the mean and median values of (i) the full sample, (ii) tourists vs. locals and (iii) tourists vs. locals but disaggregating the sample according to other sociodemographic characteristics of informants (Table 1). We considered respondents were local if they resided in the study area or the closest neighbouring towns (listed in Table 1), and tourists if they lived 120 km or further from the study area.

Ordinal answers of ecosystem services, impacts and threats questions have a non-normal and homoscedastic distribution according to the Shapiro–Wilk normality test (Shapiro and Wilk 1965) and the Levene's test for homogeneity of variance (Levene 1961), respectively. To know if the difference in average values of the different ecosystem services, impacts and threats across the two groups (e.g. local and tourist) was statistically significant, we did a Kruskal–Wallis rank sum test (Kruskal and Wallis 1952) establishing an alpha of 0.05. Subsequently, we used the Dunn test (Dunn 1964) with *p*-values adjusted with the Holm method (Holm 1979) as a post-hoc test to know which groups were statistically different between them. We performed all the analyses with the software programme R-Studio v1.2.5033 © 2009–2019 Rstudio, Inc.

Limitations

We acknowledge that, as other research based on survey data, the results presented here might be potentially affected by several types of biases including omitted variable bias (e.g. informants' identity or profession), complacency bias (e.g. when respondents answer what they think is socially correct rather than their own perception) or respondent's fatigue. A potential source of bias specific to this work is that, although we asked participants to provide responses in relation to the Cap de Creus Natural Park, their responses might have been conditioned by experiences in other coastal areas. Finally, our questionnaire might not have captured sensitive information with the same precision than more qualitative methods could do. For example, we asked respondents to rank elements in a predetermined list of ecosystem services, impacts and threats, which might not have fully captured the informants' complex perceptions of all the processes influencing the local CMH.

Results

Semi-structured interviews

The average age of semi-structured interview respondents was 51 years (± 12) and they had been running their businesses for 31 years (± 14) on average. Fourteen (37%) interviewees did not mention any environmental negative change, whilst the remaining interviewees reported 12 different types of changes. We used the list of the most reported changes to select the eight impacts used in the survey (Online Resource 4).

Table 1 Sociodemographic variables used for the statistical analysis. The question(s) we took from them are as follows: how we refer this variable in the article, what methods we used to group them and which categories we considered for the analysis

Question at the survey questionnaire (Online Resource 2)	Referred in the article as	Grouped as/named as	Grouping method	Discarded for the statistical analysis
Town/city of residence	Local/tourist	Local, tourist	Locals are from: Roses, Cadaqués, El Port de la Selva, Cala Jòncols, Castelló d'Empuries, Empuriabrava, Llançà, Selva de Mar, and Vilajuïga. Tourists: the ones living more than 120 km away from the area. The respondents that lived closer than this distance but were not locals are not included in this study	
Town/city of residence	Residence respect sea proximity	Coastal, near coast, inland	Coastal = the town/city of residence limits with the sea. Near coast = it takes less than 1 h to arrive to the closest coast by car (calculated with © Google Maps). Inland = it takes more than 1 h to arrive to the closest coast	Near coast locals due to low sample size
How often do you visit this area? AND What was the decade of your first visit?	Frequency and antiquity	Born locals, not born locals, frequent, infrequent, first timers	Born locals = Locals born in the study area. Not born locals = Locals not born on the study area but living there for more than a decade. Frequent = Tourists that visit the study area since more than a decade, either frequently or once per year. Infrequent = Locals not born on the study area with less than a decade living there, or tourists that visit the study area since less than a decade (either frequently or once per year), or tourists that visit the study area infrequently. First_timers = Tourists that visit the study area for the first time	Not born locals and infrequent locals due to low sample size
To what extent do you think you depend on the marine environment in your daily life, either for your work and/or income or for your leisure activities?	Affinity/dependance	Depend, joy, indifferent, avoid	We grouped the first two answers into one category: Depend = "Strongly. I need it frequently" and "I need it once in a while, I cannot spend too much time without it." Joy = "I enjoy it, but I do not depend on it." Indifferent = "Indifferent. It has nothing to do with me." Avoid = "I avoid it."	Indifferent and avoid (locals and tourists) due to low sample size
Age group	Age group	Young, middle, older	Young = 18–29 years. Middle = 30–49 years (30–39 and 40–49 grouped). Older = > 50 years (50–59, 60–69, 70–79, 80–89, > 90 grouped)	
What is the highest level of education that you have completed?	Education level	Low, medium, high	Low = "No schooling completed," "Primary school" and "Middle school" grouped. Medium = "High school" and "Professional degree/technical school training" grouped. High = "University," "Master, postgraduate" and "Doctorate/PhD" grouped	
Choose one of the following that best indicate your average yearly income. If you are retired think in your income when you were working	Income	Low, Mid, High	Low = < 14,000 €/year. Mid = 14–35,000 €/year. High = > 35,000 €/year (35–56,000 and > 56,000 €/year grouped)	No income (locals and tourists) due to low sample size

Survey

Survey respondents were quite homogeneously distributed across the three study sites: Cadaqués (34.1%), El Port de la Selva (33.8%) and Roses (32.1%). Most respondents had Spanish nationality (67.8%), followed by French (19.7%). The rest of the sample belonged to 28 other countries, each representing less than 2% of the sample. Local people represented 34.3% of the sample and tourists 65.7%, which should be taken into account when interpreting survey results (Online Resource 3).

Whilst almost all local respondents lived in coastal areas, only 31% of tourists did (Fig. 2a). Overall, our sample had a balanced distribution regarding frequency and antiquity visiting the area (Fig. 2b) and dependence on CMHs for their living or well-being (Fig. 2c; Table 1). A higher percentage of locals (61%) than of tourists (40%) considered themselves dependent on CMHs (Fig. 2c). The distribution of the sample is less balanced regarding age, education and income level. The youngest age group (18–29 years) is the most represented in our sample (30.5%), whilst the oldest age group (≥ 80 years) is the least represented (2%; Fig. 2d). The share of tourists in the group with highest education level was higher than that of locals (Fig. 2e) and, whilst most of our respondents (67%) earn less than 35,000 €/year, the share of tourists in high income categories was larger than the share of locals (Fig. 2f).

Finally, we noted that only a minority of respondents used the "x" option (17%) when ranking, and some misunderstood the use of "x" and used it like "N/A"; therefore, we did not take into account these responses in the analysis.

Perceived ecosystem services

The question on the ecosystem services of the CMH was answered by 98.1% of respondents. On average, respondents ranked biodiversity protection and preservation (mean 2.45) and climate regulation (2.81) as the most important ecosystem services provided by the local CMH. Conversely, aesthetic (4.25) and recreation (4.81) were ranked as the least important ecosystem services (Fig. 3a).

The only significant difference between tourists and locals regarding their ranking of CMH ecosystem services was that locals valued the food provision ecosystem service more than tourists did ($p = 0.017$; Fig. 3a). Other less important differences between the two groups refer to biodiversity protection and aesthetic value. Thus, although the biodiversity protection ecosystem service was generally valued by all people in the sample, locals with a high education level value it more (2.32) than tourists with a low education level (3.02). Additionally, whilst aesthetics was one of the lesser valued ecosystem services provided by CMHs, tourists who came frequently to the study area ranked this ecosystem service higher (4.00) than locals born there (4.51, Table 2; Online Resource 5).

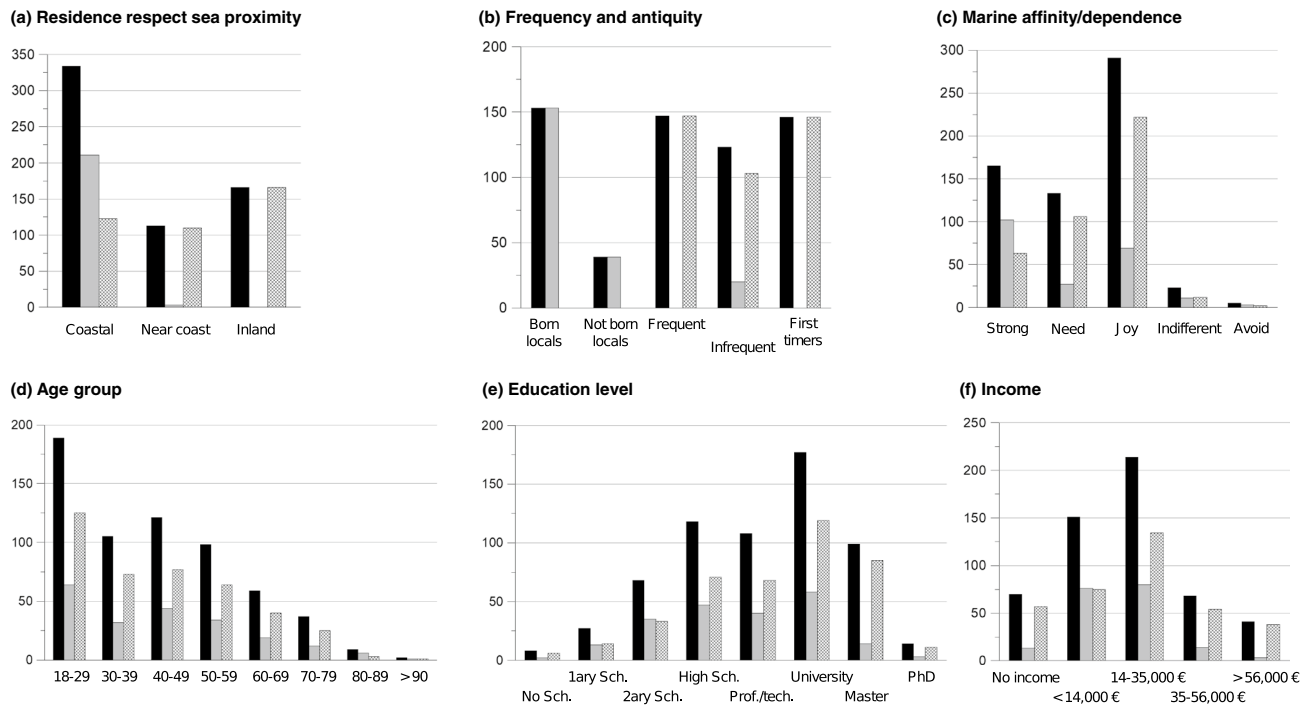

Fig. 2 Sample distribution across sociodemographic characteristics. Black boxes: total sample. Grey boxes: locals. Crossed boxes: tourists

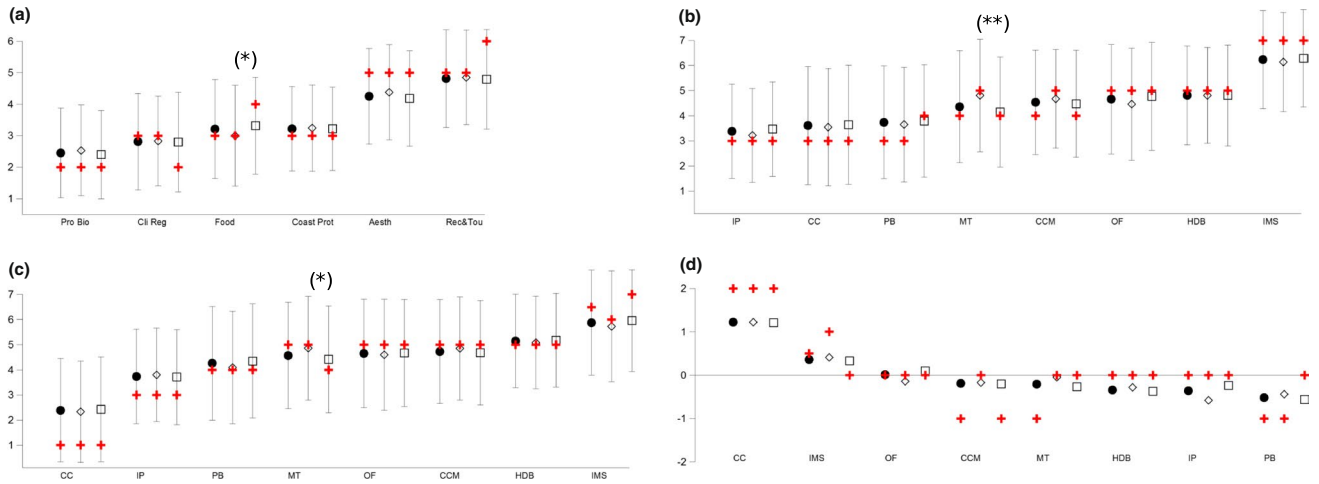

Fig. 3 Average rank values for **a** ecosystem services, **b** impacts and **c** threats. The difference between **b** and **c** is shown in **d**. Ecosystem services range from 1 to 6 and impacts and threats range from 1 to 8. A number closer to "1" in **a**, **b** and **c** means more beneficial/impactful/threatening than higher values. In graph **d**, zero represents no change; positive numbers are the ones with a lower average in threats than impacts, whilst the negative values mean the opposite. Average = black circles (total sample), diamonds (locals) and squares (tourists). Median = red crosses. Standard deviation is shown in vertical bars. Significant *p*-values from the Kruskal–Wallis rank sum test within locals and tourists: (*) = $p < 0.05$, (**) = $p < 0.01$. Pro Bio: protection and preservation of biodiversity. Cli Reg: climate regulation. Food: food provision, Coast Prot: coastal protection. Aesth: aesthetic value. Rec&Tou: recreation and tourism. IP: inland pollution discharging in the sea, CC: climate change, PB: people's irresponsible behaviour, MT: mass tourism, CCM: coastal construction and modification, OF: overfishing, HDB: habitat degradation due to boat transit and anchoring, IMS: invasive marine species

Perceived impacts and threats

The questions on impacts and threats were answered by 96.3% and 84.1% of the respondents, respectively. We found that 147 respondents (28%) provided the same responses to the impacts and threat questions, which calls for caution in the interpretation of these results.

Overall, inland pollution discharging into the sea was the highest ranked impact on the CMH (mean 3.38), followed by climate change, (3.61) and people's irresponsible behaviour towards nature (3.74; Fig. 3b). These three impacts were also considered as the greatest threats, although the order was different, with climate change receiving the highest rank as a threat (2.39; Fig. 3c). Indeed, the average ranking of climate change from impact to threat increased by 1.22 and its median by 2 points in our scale (Fig. 3d). On the other side of the scale, invasive marine species had the lowest ranking as an impact (6.24; Fig. 3b), and also received the lowest rank as threat by 2050, although with a lower mean (5.88; Fig. 3c). Indeed, after climate change, invasive marine species was the element with the largest ranking increase (+0.36; i.e. getting more threatening), whereas people's irresponsible behaviour towards nature was the element with the largest ranking decrease (−0.52; Fig. 3d).

Overall, tourists and locals share similar perceptions regarding the importance of current impacts and future threats on CMHs, with one significant exception: locals perceive mass tourism as less impactful ($p = 0.001$; Fig. 3b) and less threatening ($p = 0.028$; Fig. 3c) to the local CMH than tourists do. However, this overall similarity between local and tourist perceptions of the impacts and threats to the local CMH hides some subsample differences, mostly related to age and education level. Thus, when asked about future threats, locals over 50 years of age ranked people's behaviour higher than tourists of the same age category and than the youngest respondents (Table 2; Online Resource 5). Additionally, climate change was perceived as more impactful by respondents with low education levels, whilst respondents with the highest education level perceive it as less impactful. This difference was significant for both local and tourist education level subgroups. In addition, elder locals and locals with low education levels considered invasive marine species as more impactful than younger tourists and tourists with medium and high education levels.

Discussion

Results from this work suggest that locals and tourists have similar perceptions regarding the ecosystem services, impacts and threats of the Cap de Creus CMH, with three exceptions (food provision ecosystem service, and mass tourism impact and threat). In this discussion, we comment on the overall ranking of CMH ecosystem services, impacts and threats and discuss differences between locals and tourists.

Table 2 *p*-values from the Kruskal–Wallis rank sum test from crossing the parameter "Local/Tourist" with the six sociodemographic parameters that give title to the columns and with the dependent variables (ecosystem services, impacts, threats). Significantly different values are shown with asterisks: (*) $p<0.05$, (**) $p<0.01$. Significant values in bold are the ones that, after a post-hoc Dunn test, a significant difference is found between at least one subgroup of locals and tourists (see Online Resource 5 for more detail)

	Local/tourist X residence respect sea proximity	Local/tourist X frequency and antiquity	Local/tourist X affinity/dependence	Local/tourist X education level	Local/tourist X income	Local/tourist X age group
Ecosystem services						
Food provision	0.007**	0.186	0.111	0.027*	0.003**	0.000**
Coastal protection	0.963	0.946	0.823	0.932	0.125	0.338
Climate regulation	0.045*	0.084	0.648	0.257	0.054	0.003**
Protection and preservation of biodiversity	0.187	0.229	0.92	0.002**	0.023*	0.025*
Aesthetic value	0.241	0.024*	0.321	0.082	0.468	0.9
Recreation and tourism	0.76	0.814	0.972	0.409	0.061	0.095
Impacts						
Climate change	0.556	0.813	0.325	0.000**	0.628	0.385
Overfishing	0.26	0.032*	0.328	0.409	0.334	0.072
Invasive marine species	0.279	0.748	0.772	0.000**	0.946	0.011*
Habitat degradation due to boat transit and anchoring	0.005**	0.302	0.998	0.562	0.247	0.737
Inland pollution that ends up in the sea	0.033*	0.234	0.25	0.248	0.766	0.495
Coastal construction and modification	0.49	0.253	0.431	0.15	0.509	0.843
Mass tourism	0.005**	0.002**	0.001**	0.001**	0.004**	0.024*
People's irresponsible behaviour/lack of respect towards nature	0.833	0.55	0.245	0.482	0.335	0.368
Threats						
Climate change	0.211	0.574	0.1	0.834	0.366	0.965
Overfishing	0.359	0.639	0.835	0.618	0.509	0.214
Invasive marine species	0.208	0.1	0.963	0.143	0.114	0.02*
Habitat degradation due to boat transit and anchoring	0.011*	0.938	0.514	0.503	0.315	0.51
Inland pollution that ends up in the sea	0.023*	0.642	0.889	0.063	0.833	0.987
Coastal construction and modification	0.386	0.319	0.064	0.712	0.263	0.808
Mass tourism	0.042*	0.258	0.004**	0.065	0.171	0.247
People's irresponsibl behaviour/lack of respect towards nature	0.53	0.442	0.006**	0.282	0.708	0.004**

Ecosystem services

Results from our survey show that the most valued CMH ecosystem services perceived by our informants were biodiversity protection and preservation and climate regulation (regulating services), whilst the least valued ecosystem services were aesthetics and recreation and tourism (cultural services). These results are in line with results from previous studies in other coastal areas (Blayac et al. 2014; Ursi and Towata 2018; Cárcamo et al. 2014; Blasiak et al. 2015). For example, regulating services were the most important services for pond fish farmers and other users in Lorraine, France (Blayac et al. 2014), and cultural services were the least prioritised services by local stakeholders of three Pacific Chilean islands (Cárcamo et al. 2014). Our results add to a growing body of literature suggesting that users of coastal marine areas value the regulatory services these areas provide more than their provision and cultural services.

As seen in previous studies, our results also suggest that valuations vary within the group of respondents. For

example, Blayac et al. (2014) found that highly educated respondents prioritise the regulating over the provisioning ecosystem services. Our results about protection and preservation of biodiversity, where respondents with a higher education level valued this ecosystem service more than respondents with a lower education level, are in line with these previous findings. However, we do not find the same trend on the other two regulating services (climate regulation and coastal protection; Online Resource 5).

An interesting element in CMH perception refers to the different valuation of the food provision service assigned by locals and tourists, with locals' valuing CMH food provision ecosystem services significantly more than tourists. This is particularly the case for older locals, who ranked the food provision service higher than middle-aged and young tourists. We explain this result within the context of the past relevance of Cap de Creus fisheries, before the tourist boom of the 1960s, when fisheries were the main source of income and food provision in the area (Gómez and Riera Aragó 2007). Indeed, the local population continues to maintain strong ties with fishing activities (including recreational fishing). A similar interpretation has been provided in other studies that have also found that elders valued significantly more the provisioning function than younger informants (e.g. Blayac et al. 2014), and that artisanal fishermen perceive the food provision service as essential both economicaly and socially (Queiroz et al. 2020; Hussain and Badola 2010).

Our survey also provided some previously unreported results. We found that tourists with a low education level ranked the biodiversity protection and preservation ecosystem service lower than locals with a high education level. This could be due to the fact that formal education emphasises the importance of species preservation for the well functioning of a habitat, which gains even more importance when related to the respondent's home area. We also found that locals do not value the beauty of their surroundings as much as visitors do, perhaps because they have always known the landscape and therefore it provides no novelty effect for them.

Impacts and threats

The impacts receiving the highest ranking in our survey were, in order, inland pollution discharging on the sea, climate change and people's behaviour towards nature. The impact receiving a lowest ranking was invasive marine species. A similar ranking was found amongst threats, although climate change received the highest ranking as threat. When subtracting the averages of impacts minus threats of each item, the values of climate change and invasive marine species increased most, whereas people's behaviour towards nature decreased. Tourists and locals ranked impacts and threats similarly, with the exception of mass tourism.

Marine pollution

Using a combination of a literature review and expert opinions, Coll et al. (2010) ranks pollution as the third most important impact on Mediterranean marine life. Marine pollution is generally associated with human concentration on the adjacent coast (Kocasoy 1995, 1989). Although this is not the case in Cap de Creus, which displays a lower population density than other areas of the region (Statistical Institute of Catalonia 2020), respondents' perceptions of the high impact of pollution on the local CMH find echoes in the literature analysing pollution levels on Cap de Creus' CMH. Previous studies conducted in the area have documented sea pollution derived from macro-litter, microplastics and fishing gears (Garcia-Garin et al. 2020; Sardà et al. 2012; de Haan et al. 2019; Purroy et al. 2014). For example, fishing gears are reported to affect 70% of the Cap de Creus MPA and were present in all the *P. oceanica* beds of the area (Purroy et al. 2014).

The importance of pollution has been also reported in surveys conducted elsewhere. For example, a survey in the UK reported that litter was the main element of an unhealthy marine environment (reaching 60% of reports; Jefferson et al. 2014). The authors of the previous study argued that litter is easier to spot by non-experts than other drivers of change, which is also the case in our study area (e.g. Garcia-Garin et al. 2020; Purroy et al. 2014), which may explain why pollution received the highest rank as a CMH impact.

Climate change

Climate change received the second highest rank as an impact and the highest as a threat, a finding which is generally in line with expert opinions. According to Coll et al. (2010), experts expected climate change effects on marine taxa would grew by 10.8% in a decade. Similarly, our respondents expected that the threat would growth by 66.2% in 30 years. The tourists are indeed willing to to ameliorate the CMH, being climate change one of the main concerns for the near future (Rodrigues et al. 2015). We suggest that the overall perception of the importance of climate change as an impact and threat to the CMH reflects both personal observations and mass media information.

Some people in the sample could have directly observed climate change impacts through their direct interactions with the local environment (e.g. scuba diving, fishing, snorkelling). For example, informants might have observed thermophilic species increasing their landings on the MPA (Lloret and Riera 2008; Gómez et al. 2006), or benthic species increasingly dying (Hereu et al. 2018) due to increasing warm waters (Calvo et al. 2011). Indeed, during data collection, some informants reported that summer seasons are now hotter and longer than they used to be and some

respondents recalled an increase of weather extreme events, especially storms.

The effects of climate change, however, might be manifested slowly (decadal or multi-decadal scale) and gradually and are expressed in multiple processes that can not always be detected through personal observations (Weber 2016, 2010). Moreover, complex ongoing ecosystem transformations and community shifts may not always result in dramatic changes, so they are perceived as part of the natural adaptation to current social and economic needs (Bearzi 2009). This is why we argue that the high rank received by climate change as an important CMH impact is also a result of the fact that climate change and its impacts on the marine environment have been heavily reported by the media (Weber 2016, 2010). Indeed, previous work shows that mass media communication shapes perceptions of the importance of climate change (e.g. Graziano 2019; Tsfati and Cohen 2013; Bos et al. 2011; Loos 2003).

One additional finding deserves attention. We found that climate change received a higher ranking amongst informants with low levels of education compared with higher-schooled respondents (Online Resource 5). The finding is not knew, as previous work has shown that highly educated people have a lower climate risk perception, typically because they are less involved in primary works and are less dependent on natural resources and natural fluctuations (like droughts or floods) for their livelihoods (O'Connor et al 1999; Bearzi 2020; García-del-Amo et al. 2021). The finding, however, emphasises the importance of being connected to nature to understand how it changes.

Invasive marine species

The literature also provides support to the importance given by our respondents regarding the relatively low impact of invasive marine species. Indeed, research shows that the northwestern Mediterranean region is the area with the highest native marine species biodiversity and lowest incidence of marine alien species (Katsanevakis et al. 2014). The presence of marine invasive species at the MPA of Cap de Creus is very recent (Rodríguez 2019), as the last reports investigating the presence of invasive marine species did not find any (Hereu et al. 2018, 2016).

Interestingly, although the presence of alien species in Cap de Creus is low and recent (Rodríguez 2019), 90% of people in our sample ranked them as having some impact. We do not have a clear explanation for this finding, but we can think of two potential reasons for this finding. First, it is possible that, as for climate change, people's perception of invasive marine species is shaped by media communications. As the importance and effects of invasive marine species have recently received large media coverage, people's responses might just be influenced by such reports (e.g. Piazzi et al. 2016; Zenetos and Galanidi 2020). Second, it is also possible that local people have noted invasive alien species presence, even if this has not been reported in the literature. In fact, this sometimes has been the case elsewhere, reinforcing the value of local ecological knowledge in ecological monitoring (e.g. Coll et al. 2014; Reyes-García et al. 2019, 2016; Aswani and Lauer 2014). Particularly, elders and locals working in direct contact with nature (e.g. fishermen) are in a suitable position to detect changes in marine fauna, which indeed dovetails with our empirical result that older locals and locals with low education levels rank invasive marine species as significantly more impactful than young and higher educated tourists (Online Resource 5). Another issue that could be noticed by some locals is the use of non-native species as live bait, and the dumping of their packing composed of live seaweed by recreational shore anglers in the area, which might settle invasives in the marine habitat (Font and Lloret 2011).

Finally, although invasive marine species does not rank high as a threat, its ranking did increase. Again, the finding is in line with the scientific literature suggesting that the accelerated Mediterranean Sea warming (i.e. Mediterranean tropicalization; Bianchi 2007) provides an advantange to the thermophilic invasive species over the Mediterranean biota, helping them to expand and establish themselves (Zenetos and Galanidi 2020). Our survey, however, did not allow us to test to what extent respondents were aware of this threat.

People's irresponsible behaviour/lack of respect towards nature

Overall, survey respondents considered that people's behaviour towards nature would become less impactful in the future. The result shows an optimistic view of how humans relate to nature, arguably because of the effect of sensibilization campaigns (e.g. Jacquet and Pauly 2007), especially incident in natural parks (Petrosillo et al. 2007). Interestingly, older locals consider people's irresponsible behaviour as more threatening than other groups (Online Resource 5). Older locals might feel more rooted to their traditions and the socio-cultural frame of their area, thus feeling more threatened by the increasing tourism phenomena in the area and the potential impact of tourist behaviour on the CMH.

Mass tourism

Irrespective of other sociodemographic characteristics, tourists consider mass tourism in Cap de Creus significally more impactful and threatening for the CMH than locals

do. This finding is in line with findings from other studies showing that tourists perceive themselves as more impactful than locals (Priskin 2003; Petrosillo et al. 2007), and those locals perceive themselves as partly responsible for impacts to their surroundings (Liu et al. 1987). Other factors could have affected the answers of locals regarding the impact of tourism to the CMH: the economic ecosystem service of the tourism industry for the local inhabitants (Perdue et al. 1990), and/or the maintenance and improvement of recreational and public facilities to maintain a strong attractiveness for tourism in the area (Liu et al. 1987).

Conclusion

Overall, our study shows that conservation of CMHs is highly valued both by local and tourist. People in our sample acknowledge that the Cap de Creus CMH provides important ecosystem services, with the regulating services of the CMH being valued the most. Respondents also acknowledge that the CMH is impacted and threatened by different processes, mainly pollution and climate change. To a greater extent than locals, tourists in the sample consider mass tourism an important impact. The only impact perceived to improve in the future is people's respect towards nature. From these results, we conclude that more efforts toward conservation of the area need to be developed.

Assessing the different perceptions of inhabitants and visitors of locations where the protection and use of nature are confronted, such as key natural areas where tourism is economically important, is crucial to design more adjusted and realistic conservation and management policies in line with user perception. Such research is also crucial for providing information that can improve the sustainability of the tourism model. Our study contributes towards this path.

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Declarations

Ethis approval and consent to participate The Ethics Committee on Animal and Human Experimentation of the Autonomous University of Barcelona (CEEAH 4792) approved the research protocol. Before conducting the survey, we asked potential participants for their free, prior and informed consent (FPIC).

Conlict of interest The authors declare no competing interests.

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