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The impact of academic information supply and familiarity on preferences for ecosystem services

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Abstract :

Preferences elicitation can be a challenging exercise for citizens participating in assessment surveys. It is even more challenging when it comes to complex and unfamiliar ecosystems and the threatened ecosystem services they provide. Making people aware of the characteristics of the ecosystem services being valued is determinant for the assessment process. We investigated the impact of familiarity and academic information supply on people's preferences for twenty selected ecosystem services of French Mediterranean coastal lagoons. The results show that regardless of familiarity and information supply, there is a strong consensus about the highest importance of regulation and maintenance ecosystem services as well as environmental education and research opportunity ecosystem services. By contrast, nine of the cultural ecosystem services, together with two provisioning ecosystem services showed heterogeneous preferences among the different citizen groups. Using a combination of descriptive and inferential statistics these eleven ecosystem services split up into three clusters characterized as (i) contemplative leisure, (ii) heritage, and (iii) consumptive activities. Familiarity and academic information supply had a strong impact on the preferences for these three clusters of ecosystem services.

Keywords : Preference elicitation, Coastal lagoons, Citizens' workshop, Paternalism, Cultural ecosystem services (CES), Veil of ignorance

1 Introduction

Ecosystems are essential for human well-being. Therefore, understanding the link between ecological processes of ecosystems and human welfare is critical for a wide range of decision-making contexts (Fisher et al., 2009). Gathering information on complex ecosystem functioning and translating it into advantages society obtains from Nature has been widely carried out using the concept of ecosystem services (ESs) and through its economic valuation (see Costanza et al., 1997; Daily et al., 1997; Dendoncker et al., 2014; La Notte et al., 2015). ESs valuation includes assessing trade-offs among different options (e.g. ESs, ecological restoration projects, planning scenarios …). Hence, in general, it is based on assigning relative importance to nature's diverse benefits to humans (Jacobs et al., 2016), and this process could facilitate more adequate conservation choices (Salles and Figuieres, 2013).

In ecosystem goods and services related valuation practices, there is an ongoing debate about the process on how to achieve the preference elicitation (e.g. Dendonker et al., 2014; Kenter et al., 2015; 2016; Jacobs et al., 2016; 2018). So far, little is known on how existing valuation methods actually elicit the different values (Jacobs et al., 2018). In this area, increasing research attention is focused on the development of non-monetary valuation methods in favor of multi-criteria approaches allowing to better study the justification for compromises between objectives of efficiency, fairness and sustainability (Costanza, 2020). Preferences elicitation can be a challenging exercise for citizens involved in assessment surveys especially when it comes to complex and unfamiliar goods or services. For instance, nature services like water purification or climate regulation are generated by a complex interplay of natural cycles (Daily et al., 1997), which is often hardly understood by the majority of the citizens. Even many researchers, often highly specialized in their disciplines, may have difficulties in fully understanding the complex interplay. In Economics literature, the easiest-to-study situation is when individuals have preferences for goods and services with diverse characteristics about which they are well informed, and when their preferences are exogenous and reliable (O'Neill and Spash, 2000). This ideal situation is considered as the benchmark for which using a standard kind of rationality, it has been postulated that individuals maximize their correctly understood self-interest i.e. personal benefit (Yamagishi et al., 2014).

However, many findings show that respondents involved in preference elicitation surveys are often not familiar and often do not hold appropriate information on the ecosystem goods and services being assessed (Whitehead and Blomquist, 1991; Hanley and Munro, 1992; Spash and Hanley, 1995; Blomquist and Whitehead, 1998; Lewan and Söderqvist, 2002; LaRiviere et al., 2014; Brahic and Rambonilaza, 2015; Czajkowski et al., 2016; Ami et al., 2018; De Ville D'Avray, 2018). Realistically, some ESs are clearly perceived by people while others are not (De Groot et al., 2012). In contrast, we assume that at least part of the relevant knowledge emanates from the citizens themselves, i.e. from their experience and the familiarity they have acquired with the natural environment. Hence, not only indigenous people (Díaz et al., 2018), but also citizens in Western countries that are familiar with ecosystems have often acquired local knowledge that is complementary to the scientific knowledge. This may comprise both knowledge about their ecology, i.e. the local ecological knowledge (LEK) identified in ethnobiology (Narchi et al., 2014), and the knowledge of their benefits for society.

The citizens' preferences are based on perceptions, which sometimes hide a lack of knowledge about ecosystems and the services they provide. These perceptions could, nevertheless, change progressively as more information is provided. The external information that citizens often do not possess *a priori* (Costanza, 2004) can be acquired either through increased familiarity with the ecosystems, or from academic information, or from a combination of both. Citizens who live in the proximity of the focal ecosystem or regularly visit it during holidays become familiar, meaning that they are well acquainted with this ecosystem. Personal appreciations may be based either on affection alone or on a combination of affection with increased knowledge (Van Giesen et al., 2015). Depending on the individual, familiarity may result in increased affection for and cognitive knowledge of the ecosystem. In contrast, the supply of academic information only targets to increase the cognitive knowledge of the recipient citizens. For instance, Ami et al. (2018) reported that the impact of scientific information about the effects of air pollution on respondents' preferences, expressed as their willingness to pay (WTP) values, was strong. A proportion of people (30%) receiving scientific information revised their WTP upwards relative to the mean WTP value. Similarly, presenting survey participants with objective signal regarding the accuracy of their knowledge about a public good caused a significant increase in their preferences (i.e., their WTP) for it (LaRiviere et al., 2014). Also, Czajkowski et al. (2016) observed the effects of different information sets on subjects' preferences for a public good.

This study analyses the determinants of preferences for ESs of coastal lagoons related to the level and type of access to information. More precisely, the aim is to test the hypothesis according to which familiarity and academic information impact citizens' preferences for the relative importance of the different coastal lagoon ESs. This study of questions related to information strengthening the intrinsic motivations for ESs conservation allows us to integrate the issues of prioritizing measures of institutional, organizational and behavioral change. It is about studying the conditions of acceptance and the legitimacy of these changes following the logic of collective action and behavioral economics rather than public action based on financial incentives or technical measures. This represents a dynamic approach that emphasizes individual and collective learning within governance mechanisms and for which the role of perceptions and information is essential.

We used the Palavas lagoons' complex, which comprises seven coastal lagoons on the Mediterranean coast close to the city of Montpellier (South of France), as our case study. Coastal lagoons are shallow water bodies located at the continent-sea interface. They are permanently or temporarily connected to the sea through inlets and are subjected to a flow of fresh water from the watershed. In addition to supporting a rich flora and fauna, lagoon areas have always been of great interest to humans (Newton et al., 2014). For instance, they are often used for recreational and commercial activities such as amateur fishing, bird watching, professional fishing, shellfish farming, etc. In most cases, lagoon systems face anthropogenic stressors such as the destruction of ecological habitats along the coastline, the discharge of wastewater, chemical contaminants, overfishing, invasive species introduced by human activity, intensive aquaculture, climate change or tourism (Kennish et al., 2014; Turner et al., 2000).

To test the role of information on preferences, a survey was carried out among two types of populations: inhabitants near the Palavas lagoons complex and a panel of citizens at the national level living in non-coastal areas. In order to disentangle the impact of academic information and familiarity on preferences, we controlled as much as possible the factors of change between these populations (e.g. demographic characteristics). Preferences were elicited using non-monetary ESs assessment through the Majority Judgement approach borrowed from Social choice literature (Balinski and Laraki, 2010). We carried out an analysis combining descriptive statistics and an

econometric model to test our hypothesis. Section 2 details the material and methods used. Sections 3 to 5 present, discuss, justify and conclude the main results.

2 Material and methods

2.1 Study area

The Palavas lagoons complex is located in the southern part of France bordering the Gulf of Lion in the Mediterranean Sea (see Figure 1). In addition to the lagoons, the study site comprises also peripheral riparian zones such as wetlands, pasture and other natural areas. Palavas lagoons are representative of shallow lagoons (mean depth < 2 m) nearby an urban area, predominantly natural while used in the same time for recreational and fishing activities. Water quality in the lagoons had been strongly impacted by human activities mainly due to nutrient over-enrichment which occurred during more than four decades since the 1960's (De Wit et al., 2017; Sy et al., 2018). Climate change effects, in particular sea level rise, the increase in temperature or the variation in freshwater availability, could also have ecological consequences on the lagoons (Kuhfuss et al., 2016). In response to these issues, ecological restoration targeting good water quality and good ecological status were initiated by decision makers (De Wit et al., 2017; Leruste et al., 2016; De Wit et al., 2020). For instance, in 2005, the implementation of an 11-km offshore outfall system diverted the treated sewage effluents leading to a drastic reduction of anthropogenic inputs of nitrogen and phosphorus into the lagoons (Leruste et al., 2016; De Wit et al., 2020). Moreover, the area is a Natura 2000 site and also received the Ramsar designation as wetland of international importance in 2008 (Sy et al., 2018). The main characteristics of the Palavas lagoons are presented in Table 1 (adapted from Sy et al., 2018).

Table 1. Main characteristics of Palavas lagoons' complex.

	Palavas lagoons
Surface	
Total lagoon surface	3,880 ha
Fringing wetland surface	2,120 ha
Watershed surface	60,000 ha
Geographic coordinates	43.51°N – 3.88 °E
Average depth	0.4 m [(2)] to 1.2 m[(3)]
Population	
Main urban center (population size)	Montpellier (260,000 inhabitants)
Total population in watershed	420,000 inhabitants
Trophic status before management implementation	$Mesotrophic$[(4)] to $hypertrophic$[(5)]
Environmental management measures	
Natura 2000	SCI[(6)] - 6,600 ha (FR9101410); SPA[(7)] - 6,600 ha (FR9110042)
Ramsar	Since 2008

Note: (1) The Palavas lagoons complex comprises 7 different lagoons that were created by compartmentalization of a historic large lagoon; (2) Grec and Arnel lagoons; (3) Prévost lagoon; (4) Ingril lagoon; (5) Méjean and Grec lagoons; (6) FR9101410 - SCI = Site of Community Interest (Habitats Directive); (7) FR9110042 - SPA = Special Protection Area (Birds Directive). Note: the total area of the Natura 2000 site includes the Estagnol nature reserve.

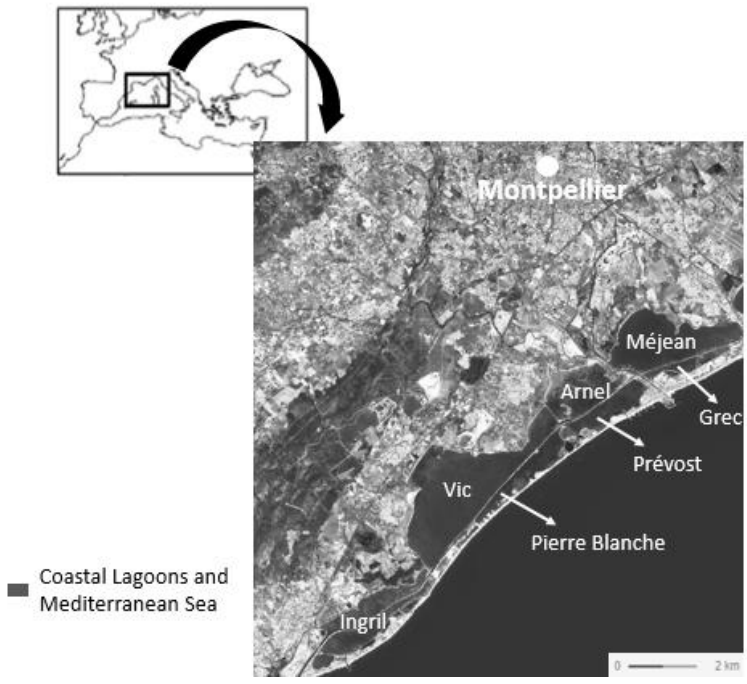

Figure 1. Palavas lagoons complex. Satellite images from IGN-Géoportail.

2.2 Survey characteristics and data collection process

The surveys were conducted among randomly selected local citizens near the Palavas lagoons and non-local citizens living in non-coastal municipalities in France (see Table 3). Local citizens encountered either in the urban centers or walking on footpaths along the littoral zone of the Palavas lagoons were invited to participate in citizen workshops. The invitation was often received with interest and a certain degree of enthusiasm. However, despite our phone call the day before the workshops, it turned out that only a small fraction of the people solicited accepted and showed up at the citizen workshops (N = 38 in total, approximatively 1 out 10 of the solicited individuals). We realized that this number represent a relatively small sample of the total population, although workable for an analysis. This is the consequence of requesting more time availability than in classical surveys. Therefore, we used Coarsened Exact Matching (CEM) technique when this small sample was compared with the larger samples used for the internet survey (see section 2.3.1). The citizen workshops were carried out in May and June in 2017 and 2018 with the 38 local residents living within a radius of 15 km from the study site. The demographic characteristics of the surveyed local residents are presented in Table 2. We compared the demographic characteristics of our sample to the ones of two municipalities, Villeneuve-lès-Maguelone and Lattes, which are among the most represented municipalities in our sample.

Generally, the citizens participating in the workshops represented a sample representative of local populations of Villeneuve-lès-Maguelone and Lattes for gender, education and median income (see Table 2). However, there was a difference in the proportions associated with age groups between this sample and the populations of the two municipalities. This difference might be explained by the fact that these municipalities are suburban with relatively more active young workers. Similarly, the difference in the median incomes can be explained by the fact that we have in our sample only individuals whose income are taxable, contrary to those of the populations of the considered municipalities.

Table 2. Demographic characteristics of the surveyed local residents

	Sample	Villeneuve	Lattes
	%	%	%
Gender			
Female	42.1	48.0	52.0
Age (years)			
18-39	18.4	46.0	40.8
40-59	28.9	26.0	23.6
> 60	52.6	28.0	35.6
Education			
Baccalaureate, certificates or none	47.4	51.0	58.6
Higher	52.6	49.0	41.4
Median income (euros/year)	29 723	21 720	24 370

Source :The National Institute of Statistics and Economic Studies (INSEE) - Data of 2017.

Note: the difference in the median incomes can be explained by the fact that we have in our sample only individuals whose incomes are taxable, contrary to those of the populations of Villeneuve-lès-Maguelone and Lattes.

The survey involving 803 non-local citizens was carried out online in June 2018. From the data set obtained, we retained the responses of two groups for the analysis. These groups were (i) a subsample of 115 non-local citizens that are familiar with the lagoons and (ii) a subsample of 289 non-local citizens that are unfamiliar with the lagoons. We introduced the notion of familiarity to indicate the proximity and frequency of visits of these lagoons. Non-local citizens who are familiar with the lagoons reported that they visit them very regularly (i.e. more than two times per year). Conversely, those who are unfamiliar with the lagoons never visited them. Hence, among the surveyed 803 non-local citizens, we did not include in our analysis those who only visited the lagoons once or twice.

Data were collected for both surveys using the same questionnaire (see the content of the questionnaire in Appendix A) which was composed of two series of questions as recommended in the literature on perceptions of ESs (see Blayac et al., 2014): open and spontaneous as well as closed questions, mainly on perceptions of the activities and the characteristics of the lagoons area (see Table 3).

Table 3. Characteristics of the surveys and the surveyed population types

Population type	**Non-Local Residents**		**Local Residents**	
	Unfamiliar	Familiar	Local	Local bis
Number of surveyed individuals	289	115	38	
Familiarity with the study site	Never visited	Regularly visit	Familiar	
Data collection method	On line		Workshop	
Survey period	June 2018		May-June 2017 and 2018	
Perception type	Existing		Existing	Constructed
Information supply	None		None	Academic
Questionnaire type	Open, spontaneous and closed questions (37 questions)			
Categories of the questions	Familiarity and use of the lagoons complex, preference elicitation questions for ecosystem services provided by the lagoons complex, level of knowledge of the lagoons complex and the services they provide, socio-demographic related questions			

A list of twenty ESs (see Table B in Appendix B) was selected before by focus groups of scientists and lagoon managers. These ESs was considered as the relatively most important ESs, in terms of conservation, provided by Palavas lagoons based on an original selection of 31 ESs (see Sy et al., 2018). The general definition of the ESs was adapted from Liquete et al. (2013), who provided a classification of coastal ES that is now integrated in CICES 5 (Haines-Young and Potschin, 2018). The twenty selected ESs were presented in a randomized order in the survey, without any reference to ES categories. Preferences were elicited for the different ESs using the Majority judgment (MJ), a voting method introduced by Balinski and Laraki (2010). We borrowed MJ from Social Choice theory and to our knowledge it has never been used in research related to environmental issues. Our MJ for ESs ranking is an absolute non-monetary method in the sense that each ES is judged by its merit or grade in a common language independently from the other services. According to work in the field of Social Choice, this type of ranking is considered to offer a more robust selection basis (Balinski and Laraki, 2010).

The respondents indicated their individual preferences for the different ESs by answering the following question: “What do you think are the most important roles of the Palavas lagoons in terms of conservation priority? Please check the box associated with each role according to its level of conservation priority”. The list of the considered ESs (i.e. the roles) was presented in the rows of a table and the columns presented different levels of conservation priority i.e. ‘high priority’, ‘priority’, ‘neutral’, ‘low priority’, ‘not a priority’.

Responses of the local citizens were obtained during a workshop. Several workshop sessions were organized to vary the meeting places and facilitate discussions between participants (see Table 4). They were scheduled at the end of the day at 6.30 p.m. in order to allow the participation of people with a job. There were between 4 and 6 experts for each session, including three co-authors of the paper, so that they could easily facilitate and observe the discussions in the groups.

Table 4. Workshop organization

Municipalities	Date	Number of participants	Workshop duration
Villeneuve-lès-Maguelone	May 22, 2017	20	3h
Lattes	June 19, 2017	8	2h30
Mireval	May 24, 2018	10	2h30

The course of the workshop sessions is shown in Fig. 2. After an introduction, the respondents completed, individually and unaided, the questionnaire on paper. This latter part lasted between 30 and 45 minutes. Subsequently, the academic information was provided by the experts in the form of oral presentations with the use of a PowerPoint support. A moment of conviviality around a drink closed each session by informally collecting the impressions of the participants regarding the interest of the session. In total the sessions lasted between 2:30 and 3 hours.

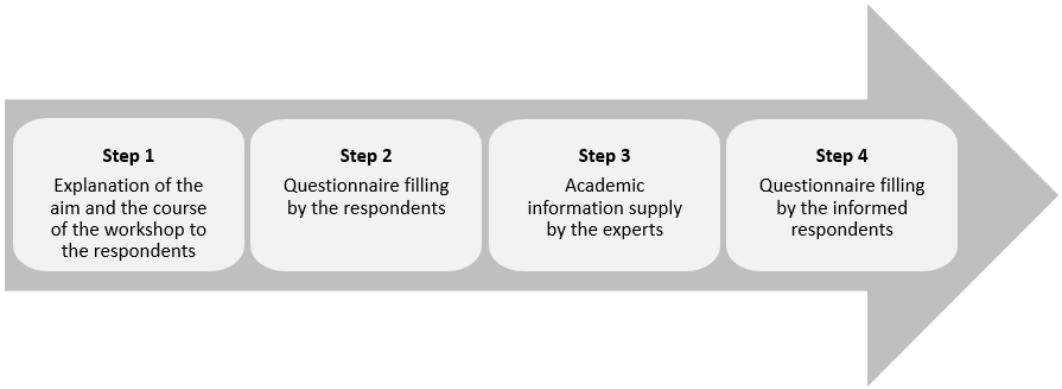

Figure 2. The course of the workshop session.

The academic information supply session lasted about an hour. The presentations focused on ESs as well as aspects related to the ecological functioning, socio-economic dynamics and management of the Palavas lagoons and their immediate surrounding areas see Table 5.

Table 5. Details of the academic information provided

Information type	Details
Ecological functioning of the Palavas lagoons complex	General information on the lagoons: definition, Mediterranean lagoons, natural history
	Salinity, hydrogeological functioning, ecological interest
	Issues: global warming and sea level rise, eutrophication, artificialization of the coast, the costs of restoring the lagoons
	Some emblematic species of the Palavas lagoons complex
Socio-economic dimensions of the Palavas lagoons complex management	Definition of the concept of value The distinction between use and non-use values and the total economic value
	Evolution of the lagoons' management policies: the effects of the management policies, from causes at sectoral scales to ecosystem-based and concerted approaches
	Frameworks for analyzing interactions between nature and society: DPSIR (drivers, pressures, state, impact and response model of intervention) and ecosystem services
	Local well-being assessment frameworks The contributions of the lagoons to territorial well-being Ways to measure the connection and attachment to nature

2.3 Data treatment process

The overall work flow for data collection and treatment is presented in Figure 3. First, disparities in sample sizes and characteristics of the different resident groups (see section 2.2) were corrected using Coarsened Exact Matching (CEM) (see section 2.3.1). The second step consisted of identifying ESs for which preferences were either homogeneous or heterogeneous among the different groups of respondents. Then, we assumed that there were no impacts of academic information and familiarity on those ESs for which preferences were homogeneous (see sections 2.3.2). The final step of the analysis consisted of identifying factors explaining the heterogeneity of preferences for the remaining ESs using a logit multinomial model (see section 2.3.3).

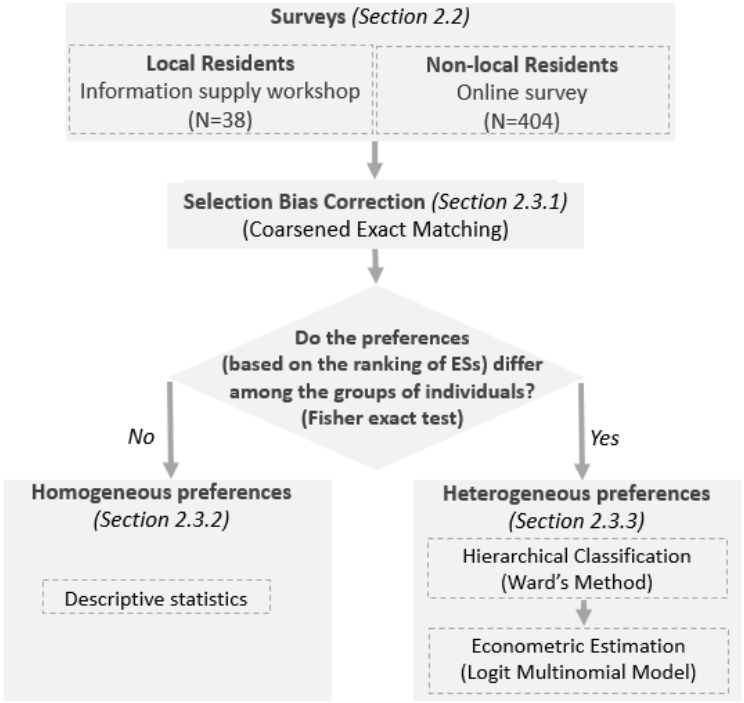

Figure 3. The work flow for data collection and treatment processes

2.3.1 Correcting selection bias

The characteristics and number of observations of the surveyed populations are different (see Table 3). This selection bias was corrected using the CEM approach introduced by Iacus et al. (2011). The main results are presented in the online supplementary material. The key goal of matching is to prune observations from the data so that the remaining data have better balance between the matching groups (Iacus et al., 2012). The authors demonstrated how CEM generates matching solutions that are better balanced than methods under the older existing class based on propensity scores, Mahalanobis distance, nearest neighbors, and optimal matching (Iacus et al., 2011).

We applied CEM using four main covariates which are age, gender, level of education and income. First, each covariate was coarsened using discrete values associated to the corresponding nominal categories. For instance, the covariate age was coarsened replacing the nominal categories 18 – 39 years, 40 – 59 years and 60 and over by 0, 1 and 2 respectively. Second, exact matching between the treated and control groups was applied using the values of the coarsened covariates. This step required sorting each observation into a stratum which includes unique values of the coarsened covariates. Finally, the selected strata were those containing at least one

control and treated units. The strata with only control units were discarded. Treatment units that did match simultaneously with control units from both the non-local resident groups were also discarded. The control and treated groups are specified in Figure 4.

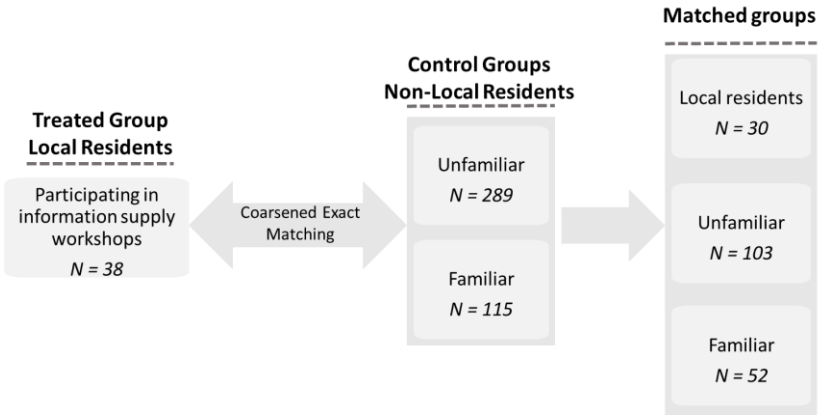

Figure 4. Coarsened Exact Matching (CEM) of the control and treated groups

2.3.2 Identification of ecosystem service presenting homogeneous preferences

Cross-tabulations and Fisher's exact tests allowed to test the correlation of each ES with the variable corresponding to the typology of the surveyed populations. In other words, the aim was to identify ESs for which preferences were homogeneous regardless of population type. The groups of respondents in question were the matched 30 local residents (before receiving academic information), the same 30 matched local residents after receiving academic information), 52 matched familiar and 103 matched unfamiliar non-local citizens with the Palavas lagoons (see Figure 4). Further Fisher's exact tests were realized to analyze the relation between the identified homogeneous preferences for ESs and the other explanatory variables presented in Table 6.

2.3.3 Analysis of ecosystem services presenting heterogeneous preferences

The remaining ESs that did not present homogeneous preferences for ESs among the groups of respondents were analyzed separately. The aim was to identify explanatory factors that might explain heterogeneity in preferences for the considered ESs. More precisely, we tested the impact of several explanatory variables on the respondent choices for these ESs. The considered explanatory variables included the variable "population type" (informed, uninformed, familiar or unfamiliar), "age", "gender", "level of knowledge of Palavas lagoons" … (see Table 6). To this

end we used a logit multinomial model as in Blayac et al. (2014). The dependent variable that comprised different levels of ES categories was created through identifying different clusters (or categories) of these ESs using Principal Component Analysis (PCA) followed by Ward's hierarchical classification (HC) method. Hence this clustering of ESs, in contrast to the use of standard classification schemes (e.g. Liquete et al., 2013; Millenium Ecosystem Assessment, 2005; TEEB, 2010), emerged from the respondents' preferences, based on the attributed levels of priority. Only ESs within the identified clusters that contributed the most to the PCA axis were retained. The dependent variable was then constructed by calculating an average score for each cluster of ESs which were generated using Ward's HC method. The preference for a cluster of ESs for each respondent corresponded to the one with the maximum mean score.

A multinomial logit model was then used to estimate the preference for a cluster of ESs given a set of qualitative explanatory variables (see Table 6). The model corresponds to choice probabilities for the different ESs clusters (Blayac et al., 2014). Formally, the choice probabilities are:

$$Prob(Y = Cluster\ 1) = \frac{exp(Z_{Cluster\ 1})}{1 + exp(Z_{Cluster\ 1}) + exp(Z_{Cluster\ 2})}$$

$$Prob(Y = Cluster\ 2) = \frac{exp(Z_{Cluster\ 2})}{1 + exp(Z_{Cluster\ 2}) + exp(Z_{Cluster\ 1})}$$

$$Prob(Y = Reference\ cluster) = \frac{1}{1 + exp(Z_{Cluster\ 1}) + exp(Z_{Cluster\ 2})}$$

where Z is the coefficient vector including the intercept.

At first, we had a list of fourteen explanatory variables. To verify whether or not there was a multicollinearity (correlation within the explanatory variables), we performed the Cramer's V test. After the test, we retained eight explanatory variables (see Table 6) out of the fourteen previously listed. Moreover, interaction effects were observed for the retained variables 'population type' and 'donation to an environmental association' as well as both variables characterizing levels of knowledge. In addition, there were interaction effects between the variables 'donation to an environmental association' and both variables characterizing levels of knowledge. Finally, there was an interaction effect between both variables characterizing levels of knowledge.

Table 6. Factors explaining preferences for ecosystem services. The referent levels are indicated in bold.

Variable	Sub-Category	Full name	Level
Dependent	Ecosystem services clusters	Ecosystem services clusters	Cluster 1
			Cluster 2
			Reference cluster
Explanatory	Population type	Type	**Unfamiliar non-local residents**
			Familiar non-local residents
			Local residents
			Informed local residents
	Sociodemographic characteristics	Age *(years)*	**18-39**
			40-59
			60 and up
		Gender	Female
			Male
		Education	**High school degree or none**
			Bachelor
			Master and up
		Income *(euros per month)*	**750-1500**
			1500-3000
			3000 and up
	Behavior towards environment	Donation to an environmental association	**No**
			Yes
	Level of knowledge	Perceived knowledge of Palavas lagoons	**Limited**
			Average
			Good
		Heard of the concept of ecosystem services	**No**
			Yes

The overall quality of the multinomial logit model was verified using Akaike Information Criterion (AIC). The aim was to progressively remove interaction effects and single explanatory variables that have no significant impact on the dependent variable from the general model, until the final model with the lowest AIC criterion was reached. The obtained final nested model was then validated based on two hypotheses testing i.e. the Likelihood ratio test and the Hausman and McFadden test. First, the choice for the nested model relative to the initial model was verified through the Likelihood ratio test. The null hypothesis consisted of choosing the final nested model. Secondly, the final nested model was validated through the independence of irrelevant alternatives (IIA) assumption using the Hausman and McFadden test (Hausman and McFadden, 1984). This hypothesis is tested to ensure that removing any alternative (here, a cluster of ESs) from the dependent variable does not affect the odds of the remaining alternatives.

3 Results

3.1 Coastal lagoon ESs: homogenous versus heterogeneous preferences of ESs among groups of respondents

Table 7 lists the results of the Fisher's exact tests, which allowed us to identify whether the preferences for these different ESs were homogeneous among the four groups (ESs marked in italics, H_0 retained, p> 0.05) or heterogeneous (ESs marked in bold, H_0 rejected, p < 0.05). Eleven out of the twenty ESs presented heterogeneous preferences, and the remaining nine ESs presented homogeneous preferences. Interestingly, the latter included all five regulation and maintenance ESs as well as both environmental education and research opportunity ESs. Thus, regardless of familiarity and academic information supply, regulation and maintenance services as well as cognitive effects related services were judged as a priority by at least 90% of the respondents (see Table C in Appendix C). In addition, preferences of recreational hiking and walking ES and of fish resources ES were homogeneous, although both ESs were favored to a lesser degree compared to the former ones. The same results were also observed for the unmatched data (see Table C in Appendix C). Thus, preference elicitation of these services was very robust and did not change after applying CEM.

Specific questions allowed to study the pertinence of possible factors explaining choices for those ESs presenting homogeneous preferences among the four groups of citizens (see Table 8). Hence, more than 98% of the respondents, who declared having either a good or a limited level of knowledge of the Palavas lagoons and the associated ESs, favor the regulation and maintenance ESs. The level of priority attributed to environmental education and research opportunity ESs increases with age. For instance, 70.6% of the respondents that are 18–39 years old favor these services against up to 90.6% for the 60 years and above.

Table 7. The set of the twenty ecosystem services (ESs) used in this study. The ESs have been categorized according to the classification designed for coastal and marine ESs by Liquete et al. (2013) and currently included in CICES version 5.1 (Haines-Young and Potschin, 2018). Fisher's exact tests were performed to test for the homogeneity of preferences among the four groups of citizens (see section 2.2). Hence, ESs in italics presented homogeneous preferences among the four groups of citizens. ESs in bold presented heterogeneous preferences among the four groups.

ES category	Ecosystem service	Fisher exact test (p value)
Provisioning	**Biomass for grazing**	p < 0.001***
	Shellfish farming	p < 0.001***
	Fish resources	0.264
Regulation and maintenance	*Water purification capacity*	0.298
	Flooding and other extreme events regulation and protection	0.235
	Banks reinforcement	0.196
	Microclimate regulation	0.393
	Nursery and biodiversity maintenance	0.281
Cultural	**Aesthetic value of landscapes**	p < 0.001***
	Local identity	p < 0.001***
	Aesthetic value of habitats or species	p < 0.001***
	Historical sites	p < 0.001***
	Non-motorized water sport	p < 0.001***
	Bird watching	p < 0.001***
	Waterfowl hunting	p < 0.001***
	Sentiment of relaxation	0.002**
	Recreational hiking and walking	0.289
	Recreational fishing	p < 0.001***
	Research opportunity	0.869
	Environmental education	0.464

3.2 Descriptive and inference statistics for ESs showing heterogeneous preferences among groups of respondents

The clustering of the eleven ESs, for which preferences were heterogeneous among the respondents, resulted in the identification of three clusters i.e. three levels of the dependent variable (see Figure 5). We attributed descriptive qualifications to these three clusters based on the following interpretations. The cluster comprising two cultural ESs, i.e. historical site and local identity, is referred to as cultural heritage and was, therefore, named as 'Heritage'. The cluster comprising the cultural ESs 'aesthetic value of habitats or species', 'aesthetic value of landscapes', 'bird watching' and 'sentiment of relaxation' relates to leisure activities based on the contemplation of the lagoon ecosystem rather than on the consumption of its resources. Therefore, this cluster has been defined as 'contemplative leisure'. The cluster with the remaining

five ESs all of which imply consumption of natural resources, either for provisioning or for leisure, has been defined as ‘consumptive activities’.

Table 8. Factors explaining the level of priority attributed to ecosystem services presenting homogeneous preferences among groups of citizens. P, N and NP stand for “Priority”, “Neutral” and “Not a priority” respectively.

Explanatory variable	Level	Regulation and maintenance			Fish resources			Recreational hiking and walking			Environmental education and research opportunity		
		P *(%)*	N *(%)*	NP *(%)*	P *(%)*	N *(%)*	NP *(%)*	P *(%)*	N *(%)*	NP *(%)*	P *(%)*	N *(%)*	NP *(%)*
Heard of the concept of ecosystem services	*P-Value*	***0.030****			*0.964*			*0.808*			*0.121*		
	Yes	98.8	1.2	0.0	38.4	41.9	19.8	60.5	25.6	14.0	90.7	8.1	1.2
	No	91.5	8.5	0.0	37.2	41.1	21.7	59.7	28.7	11.6	80.6	14.7	4.7
Perceived knowledge of Palavas lagoons	*P-Value*	***0.002****			*0.746*			*0.884*			*0.543*		
	Good	98.6	1.4	0.0	31.9	45.8	22.2	58.3	29.2	12.5	88.9	8.3	2.8
	Average	86.8	13.2	0.0	42.1	39.5	18.4	61.8	23.7	14.5	81.6	13.2	5.3
	Limited	98.5	1.5	0.0	38.8	38.8	22.4	59.7	29.9	10.4	83.6	14.9	1.5
Age (years)	*P-Value*	*0.718*			*0.667*			*0.474*			***0.012****		
	60 and up	94.2	5.8	0.0	40.6	39.9	19.6	61.6	28.3	10.1	90.6	7.2	2.2
	40-59	93.3	6.7	0.0	35.0	41.7	23.3	60.0	23.3	16.7	75.0	20.0	5.0
	18-39	100.0	0.0	0.0	23.5	52.9	23.5	47.1	35.3	17.6	70.6	23.5	5.9

Note: the rows of the table correspond to the factors explaining the level of priority attributed to ecosystem services presenting homogeneous preferences among groups of citizens. For the first row and first column for instance, the table is read as follow: up to 98.8% of the responds who already heard of the concept of ESs before the survey significantly consider regulation and maintenance services as a priority in terms of conservation. Likewise, 1.2% and 0% of these respondents are neutral about the conservation of regulation and maintenance services and consider them as not of a priority for conservation, respectively.

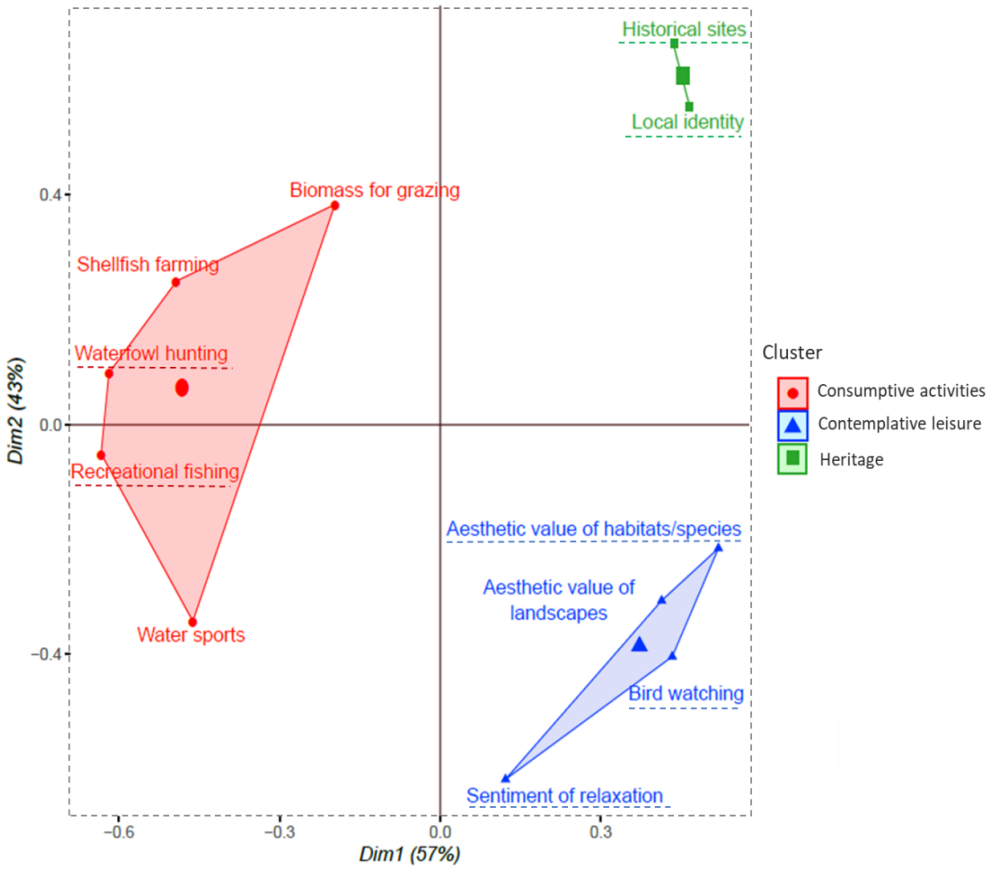

Figure 5. Classification of the 11 ecosystem services (presenting heterogeneous preferences among the groups of respondents, in bold in Table 7) based on the results of the principal component analysis (PCA). The underlined

ecosystem services are the ones that contributes the most to the two axes. See Table B in Appendix B for the definitions of the corresponding ecosystem services.

The general logit multinomial model includes all the explanatory variables listed in Table 6. The reference variables are indicated in bold. Also, the 'heritage' cluster was used as the reference level of the independent variable. The final nested logit multinomial model was validated based on the results of the two hypotheses testing, i.e., the Likelihood ratio test and the IIA test. The econometric estimations are presented in Table 9. First, the choice for the nested model relative to the initial model was verified through the Likelihood ratio test. The null hypothesis consisted of choosing the final nested model. It was accepted based on the fact that the likelihood ratio test statistic (see "Chi2" in Table 9) was smaller than the theoretical chi-square with a margin of error of 5% and a degree of freedom (Df) of 54 in our case. Secondly, for the IIA assumption using the Hausman and McFadden test, the test statistic relative to the cluster consumptive activities was negative (-0.015, in Table 9). This is evidence that the IIA holds (Hausman and McFadden, 1984, P.1226 cited in Franses and Paap, 2003).

According to this final nested model (Table 9), compared to the unfamiliar non-local residents, the local residents are 5.8 times more likely to choose the 'contemplative leisure' ESs over 'heritage' ESs. However, this odds ratio decreased to 2.8 after academic information supply during the citizens' workshops. In other words, relative to the 'heritage' ESs cluster and after receiving academic information, local residents' preferences of the level of priority towards 'contemplative leisure' ESs decreased. Moreover, unfamiliar non-local residents were 0.23 and 0.21 times less likely to choose contemplative leisure ESs and 'consumptive activities' ESs, respectively.

Table 9. The final nested model issued from the econometric analysis. It explains the choices for the three clustered categories of ecosystem services that presented heterogeneous preferences among the groups of citizens.

Variable	Contemplative leisure vs. Heritage				Consumptive activities vs. Heritage			
	Estimate (SE)	Odds Ratio	Z value	Pr (>|Z|)	Estimate (SE)	Odds Ratio	Z value	Pr (>|Z|
Type								
Unfamiliar	Ref.				Ref.			
Familiar	0.014 (0.471)	1.014	0.029	0.9771	-0.054 (0.502)	0.947	-0.1084	0.9136
Informed local residents	1.055 (0.476)	2.872	2.217	0.0265*	-0.584 (0.791)	0.557	-0.7309	0.4648
Local residents	1.759 (0.461)	5.807	3.817	p < 0.001***	-7.281 (23.018)	0.001	-0.3163	0.7517
_intercept	-1.490 (0.277)	0.225	-5.386	p < 0.001***	-1.555 (0.284)	0.211	-5.4725	p < 0.00

Final nested model validation tests	**Df**	**Chi2**	**P-value**
Likelihood ratio test	54	62.544	0.199
Independence of irrelevant alternatives (IIA) assumption			
Heritage	1	< 0.001	0.999
Contemplative leisure	1	< 0.001	0.999
Consumptive activities	4	-0.015	

4 Discussion

This study focused on the role of information and familiarity in the individual preferences of ESs in Mediterranean coastal lagoons with the aim of assisting the design of public policies. Therefore, we studied how different variables impact the preferences of the respondents, using a logit multinomial model. We considered (i) the level of respondents' knowledge, i.e., whether they are informed and/or familiar or not, (ii) their behavior towards environment and (iii) their sociodemographic profile (see Table 6).

4.1 Identification of consensus and understanding of the heterogeneity of preferences

Surveys for ES assessments need to restrict the number of ESs under consideration for practical reasons. In our study, we used a list of 20 ESs selected from an original collection of 31 ESs (Sy et al., 2018) under the guidance of a focus group. A longer list in these questionnaires could introduce confusion and fatigue. Hence, the selection of ESs for ES assessments, including those

based on preference elicitation, is a major issue to facilitate the use of these assessments in public policies. Thus, it has been invoked that ES assessments should concentrate only on a limited number of ESs by selecting those that are most susceptible to variations induced by the different management options (Pendleton et al., 2015). Nevertheless, a longer list without a priori judgments by the policy makers is needed to reveal the preferences based among the populations to respect their different worldviews and multiple values of nature (Diaz et al., 2019). The Q-method, which as a serious card game is more ludic than questionnaires, easily allows considering a larger set of ESs under study without creating confusion (e.g. 31 ESs in the study of Sy et al., 2018). However, such a Q-method cannot be easily implemented for an on-line survey.

The logic of our survey is consistent with the socio-cultural approach developed by Martin-Lopez et al. (2014). Our results show in the first place a large consensus for 9 of the 20 studied ESs, shown by homogeneity of preferences (see Table 7). These nine ESs included all 5 ESs of the category Regulation and maintenance services, 1 out of 3 provisioning services (i.e., fisheries) and only 3 out of 12 cultural ESs. This pattern of preferences was thus independent of familiarity and information supply and appeared to be accepted *a priori* by an overwhelming majority. This may reflect that nowadays, particularly within the French society, a large majority (85 %) of the general public attaches a high importance to biodiversity and is convinced of the need for its conservation (Croutte, 2015). But while recognizing the importance of biodiversity for supporting life on earth, knowledge of biodiversity and awareness of its importance for well-being is less developed among the general public (Croutte, 2015). It appears that, even when possessing little precise knowledge, the general public trusts and supports the messages delivered by the biodiversity experts. The latter may explain that the ESs research opportunities and environmental education were also homogeneously perceived as relatively very important (see Table 7). Similar results were obtained according the socio-economic approach in the study of Martín-López et al. (2014), which also showed that comparably their monetary assessments tended to underestimate most of the regulating ESs and the ESs research opportunities and environmental education. A study using Q-methodology among highly-involved stakeholders, including different experts, in Palavas lagoons also showed a strong consensus concerning the major relative importance of regulation and maintenance ESs (Sy et al., 2018). Hence, concerning biodiversity and the regulation and maintenance ESs of emblematic ecosystems, there is no major conflict of preferences and opinions between the general public and the experts.

In contrast, the concept of Cultural ESs (CES) has been subjected to a large debate and controversy in the literature. Some authors suggest revising and broadening the standard frameworks of the concept or discarding the term "cultural" itself (Chan et al., 2012a, 2012b; Winthrop, 2014; Fish et al., 2016; Small et al., 2017) or even abandoning the concept (Kirchhoff, 2019). One of the main criticism is that it tries to combine all notions of cultural value (e.g. moral, religious, aesthetic) under a single term (Small et al., 2017). In addition, Díaz et al. (2018) insisted on the role of culture and local knowledge in the way people understand the importance of all ESs, including those that have been classically categorized as provisioning and regulating services. Indeed, the notion of nature's contribution to people (NCP), which is one of the more recent key elements of the IPBES conceptual framework, recognizes the central and pervasive role that culture and local knowledge play in defining and understanding all links between people and nature (Diaz et al., 2018). Therefore, the cultural background strongly determines how people assess the need for ESs conservation. The paramount role of these cultural factors justifies understanding the preferences and levels of knowledge. This involves psychological and sociological approaches in order to explain determinants of these preferences. The anthropocentric nature of ES is often put forward for its ability to rally individuals more easily in favor of their conservation, while the link between well-functioning ecosystems and their ability to provide ESs is not always well understood. Furthermore, this relationship is not necessarily equivalent depending on the type of ESs, the contexts or the state of conservation of the ecosystems (Barnaud and Antona, 2014). In addition to the lack of information on ecological processes, individuals have a limited ability to process information. And the instability of their preferences over time and the varying context should also be taken into account.

Our interpretation of the results of this study gave rise to an original typology of CES. The distinction among those CES refers to different motivations regarding conservation depending on whether they are hedonic (i.e. motivations that fulfill personal pleasure or benefit) or stemming from a broader interest in favor of the quality and the identity of the territory. Inductive approaches have been used to empirically study people's preferences about CES (Dou et al., 2019; Maraja et al., 2016; Pike et al., 2015; Stålhammar and Pedersen, 2017). Comparably, we used such an inductive approach for the 11 ESs with heterogeneous preferences, which indicated that the 9 CES split up into 3 main clusters based on people's preferences. The eleven remaining ESs were clustered through a PCA followed by Ward's hierarchical classification method. A multinomial logit model was then developed to determine factors explaining the choice for the identified clusters issued from these eleven ESs. Thus, our results propose a categorization of

CES according to whether they imply individual or collective benefits, and whether these are consumptive (implying consumption of natural resources and often creating a higher level of disturbance) or contemplative (enjoyment of nature based on observation and sensitivity for surroundings causing only minor disturbance). Interestingly, the two provisioning services (biomass for grazing, shellfish farming) were grouped together with consumptive leisure ESs to constitute the cluster 'consumptive activities'.

We assume that hedonic motivations (i.e. motivations that fulfill personal pleasure or benefit) for ESs are directly related to the use of the lagoons and therefore to familiarity. On the other hand, we assume that the heritage services and the impacts of the uses on the lagoons involve cognitive knowledge which can be acquired through academic information. Thus, our results show that local residents strongly favored contemplative leisure compared to the unfamiliar citizens (see Table 9). However, this trend decreased with academic information supply which led the local citizens to prioritize more the collective services (heritage services) at the expense of the self-centered ESs (i.e. those ESs that contribute to personal well-being, here contemplative leisure). Interestingly, consumptive leisure (hunting and recreational fishing) as well as provisioning services, grouped together in the cluster 'consumptive activities', were relatively less favored by the respondents (see Table 9). This is probably related to the fact that these ESs benefit only a limited number of practitioners in the Palavas lagoons site. Also, their activities often induce disturbances to the natural system and nuisance to other people.

4.2 Role of information for public policies focusing on learning and engagement of users and residents

As mentioned in the introduction, several studies have shown the role of intrinsic motivations on the personal engagement of individuals with respect to conservation issues, beyond the sociodemographic variables and specific knowledge levels (Wilson, 1984). In addition to the positive impact of nature on health (Capaldi et al., 2014 ; Sandifer et al., 2015), several studies show the role of positive feelings, attachment and bonding with nature on the intrinsic motivations in favor of nature conservation (De Young, 1985 ; Kollmuss and Agyeman, 2002 ; Mayer et al., 2009 ; MacKerron and Mourato, 2013 ; de Bell, 2017, Lapointe et al., 2020 ; Lima and Bastos, 2020 ; Kaltenborn et al. 2020). Hence different situations need to be identified for designing the measures in public policies, particularly those enhancing learning processes.

Our assessments of the role of information from academic and empiric sources aim at contributing to develop pro-environmental behavior of citizens based on their intrinsic motivations. These can be influenced by a better knowledge by the citizens of the ecosystems. This way, our approach is opposed to an attitude of paternalism (for a philosophical study, see Dworkin, 1972) adopted by some scientists and public authorities who plead for a predominating role of experts in environmental decision making. Such paternalism reflects the belief that public policies ought to be grounded on scientific-based assessments, rather than on citizens' perceptions that could lead to "erroneous" preferences. This paternalistic approach clearly conflicts with the democratic ideal. However, hybrid forms do exist as in the work of Thaler and Sunstein (2008) on nudges falls halfway between paternalism and liberalism. It exploits the most recent advances of behavioral economics to design an architecture of choices in a way that preserves freedom of choice and at the same time navigates people towards the goals that are considered socially desirable. However, Thaler and Sunstein (2008) underline the need for information, highlighting that "people make good choices in contexts in which they have experience, good information, and prompt feedback". Moreover, they emphasized conversely that "people are most likely to need nudges for decisions that are difficult, complex, and infrequent, and when they have poor feedback and few opportunities for learning". The procedure adopted during the citizen workshops, allowed a respect for freedom of choice with the engagement of a dialogue with experts and that the information thus supplied could be used as nudges.

In this context, our research aims to better understand the types of knowledge needs in terms of ESs and individual profiles in order to propose learning processes, which, by improving this knowledge, generate greater motivation to preserve ESs. As such, this type of survey comprises a way to associate the general public, the local populations in public policies and develop participative scenarios allowing for a better management for the conservation and ecological restoration of protected areas as recommended by the IPBES global assessment report assessment of biodiversity and ecosystem services of 2019. Accordingly, this should lead to better managing the trade-offs between social objectives that represent different worldviews and multiple values of nature (Diaz et al., 2019). The learning processes thus lead to understand the involvement of populations in ecosystem management as a co-evolution process Delagado et al. (2019). And, knowing that collective learning through participatory approaches combining experience and expertise (Pendleton et al., 2015; Beaumont et al., 2017) promote the creation of new values in

favor of ESs conservation (Strokosch and Osborne, 2020). The issue is then to question learning processes, which, may be the result of single or double loop processes (Argyris and Schön, 1996). Single loop refers to learning that is applied straightforwardly, while double loop refers to learning that provokes a profound change in the reference systems of individuals and their understanding of the subject (definitions adapted from Argyris and Schön (1996)).

The central questions we addressed concerned the impact of information on preferences taking into account how the information was acquired by the citizens. Information acquired by familiarity with a natural environment according to the frequency of visits can be differentiated from those resulting from academic trainings or those that are more contextualized and are offered as awareness-raising measures. Hence, information supply can reduce bias by making individual choices more informed and may lead to the reorganization of preferences. This may even lead to changing the value systems of the citizens (i.e., double loop processes). In the case of knowledge related to the functioning of ecosystems and the contribution of ESs to the well-being of society in general, individuals' preferences are influenced by cultural dimensions that must be taken into account. These include the links of individuals to nature as well as their cultural proximity to ESs (i.e. these ESs are part of their culture). Hence, the fact that unfamiliar populations attributed a greater consideration for heritage services is striking. We think that this is because these populations are neither directly concerned by the direct consumptive nor by the contemplative benefits of these ecosystems and therefore not influenced by their own interest and affection for these natural areas. This lack of concernment can be linked to the notion of veil of ignorance popularized by Rawls (Rawls, 1971). According to the ethics suggested by Rawls, parties who judge policy and management options are supposed to adopt a veil of ignorance. This implies a thought experiment for the participants, which purpose is to fully neutralize the influence of their specific individual interests. Under such a veil of ignorance, the parties will hopefully tend to evaluate the options only on the basis of considerations of general interest (Rawls, 1971). It appears that the unfamiliar populations, that might not be aware of how the various alternatives will affect their own particular case, seem to evaluate the ESs spontaneously in accordance with this veil of ignorance. This observation advocates the interest to involve diverse populations in preference elicitation surveys. Indeed, mobilizing only local knowledge when carrying out ESs assessment might present a risk of favoring particular individual and local interests.

In terms of public policy, the splitting up of the CES and the differential impacts of familiarity and information supply on preferences for the different CES raises the question on the mechanisms which allow the citizens to perceive and value these CES. Information economists dealing with goods traded on markets have adopted a classification scheme based on the difficulty with which consumers can assess their quality or obtain the pertinent information. Accordingly, at least three types of goods have been identified i.e. (i) *search goods*, (ii) *experience goods* and (iii) *credence goods*. The *search goods* category (Nelson, 1970) comprises the goods for which the attributes can be ascertained *prior* to consumption, i.e. by inspection and information gathering. This category comprises most products and typical examples include clothing and staple food. *Experience goods* (Nelson, 1970) can be accurately evaluated only *after* they have been used or consumed (e.g. restaurant, holiday). Finally, *credence goods* (Darby and Karni, 1973) are difficult or impossible to evaluate even after consumption has occurred. That is, the consumer might lack the knowledge or the expertise, or because the information is too costly to acquire compared to its expected benefits (e.g. medical treatments). This approach may be inspiring when assessing ESs. To our knowledge, non-market goods and services and particularly ESs have never been investigated through the lens of this typology. We propose that future studies could be useful to develop a similar typology for ESs. For example, it appears obvious that the sentiment of relaxation can be considered as an experience ESs. Many of the maintenance and regulation ESs, for which most citizens lack the detailed ecological knowledge, can perhaps been categorized as credence ESs. However, for the ESs microclimate regulation and flooding and other extreme event regulation the situation is more ambivalent. Most people living in the coastal zone experience how the lagoons contribute to temper the climate (lower maximum and higher minimum temperatures than in more continental settings), which means that microclimate regulation could also be considered as an experience ES. Some people that live in the coastal area since a long time may recall disastrous extreme flash floods from rivers and have experienced how coastal lagoons can store large quantities of water and thus prevent dangerous submersions. Their experience of such dramatic events often has a long-lasting impact on their preferences. Finally, for some ESs it will be easier for the citizens to search for information, e.g. particularly for several provisioning services which could therefore be categorized as search ESs. Hence, the development of a comparable classification of ESs will allow to consider the access to information and knowledge (familiarity and academic) for the different ESs in order to better target programs and forms of awareness raising.

5 Conclusion

In this study, we assumed that local populations are familiar with the focal ecosystem and that they possess knowledge about their ecology and benefits for society. The main results that emerged from our analysis show that there is a high interest for regulation and maintenance as well as environmental education and research opportunity services regardless of population type. By contrast, nine of the cultural ESs (CES) together with two provisioning ESs showed, however, heterogeneous preferences among the different groups of citizens. These eleven ESs were split up into three clusters comprising (i) contemplative leisure, (ii) heritage and (iii) consumptive activities.

We addressed two main questions: (i) does familiarity impact citizens' preferences of the relative importance of the different coastal lagoon ESs? and (ii) do the preferences of familiar citizens change after receiving academic information? Familiarity with the ecosystem particularly impacted the CES. Thus, familiar local citizens valued the contemplative leisure much more than others, presumably because of their hedonic self-centered approach based on personal pleasure or benefit. This effect was attenuated by academic information supply. Finally, non-locals who never visited Palavas lagoons attribute greater priority to heritage services compared to consumptive activities and contemplative leisure. Hence, our hypothesis about the impact of academic information supply and familiarity on preferences is supported by our observations for heritage services, contemplative leisure and consumptive activities.

The analysis of perceptions of the ESs provided by ecosystems is increasingly demanded by environmental policy managers. Therefore, the surveys reported in this article were designed in collaboration with local managers. The perceptions revealed by the surveys represent a proxy allowing a better understanding of the demand for ESs that, so far, has been poorly addressed compared to the supply of ESs. For example, the MAES working group (Mapping and Assessment of Ecosystems and their Services - Burkhard and Maes, 2017; Burkhard et al., 2018) produced maps of ESs supply that allow identifying trade-offs and links among ESs, using the concept of ES bundles. The combination of these ES supply maps with land use maps in territorial planning documents is increasingly practiced for a better integration of development policies and ecosystem conservation policies (Le Clec'h et al., 2014; Furst et al., 2014; Maes et

al., 2015). These maps strengthen the ability to identify strategic areas for integrated territorial management. Nevertheless, this approach in spatial planning, which often results in zoning, does not a priori accommodate the questions about the social acceptability of conservation measures. To increase the social acceptability, information about the perceptions of the populations of ESs and their demands is of paramount importance for spatial planning. Taking into account the plural forms of access to ES knowledge (Nelson, 1970), familiarity with ecosystems, when based on a reasoned use of these ecosystems, appears to be a determining factor for reinforcing the intrinsic motivations for pro-environmental behavior (Kollmuss and Ageyman, 2002).

6 Appendix

Appendix A: The content of the survey

The questionnaire was composed of open, spontaneous and closed questions (37 questions). It included four main categories:

A. The 'Familiarity and use of the lagoons complex' category included questions like:

- What is your city of residence and for how long have you been living there?
- Approximately how often do you go near the lagoons? (Never, 1 or 2 times a year, About once a week except winter, About once a week all year long, More often),
- What activities do you do, frequently, from time to time or never, around the lagoons? Check each activity according to the frequency. The activities listed were, among others: jogging, horse riding, water sports…

B. The 'preference elicitation' category included one question which was formulated as follow:

'What do you think are the most important roles of the Palavas lagoons in terms of conservation priority'? Please check the box associated with each role according to its level of conservation priority.

The roles (i.e. the list of the ecosystem services considered in the study) was presented in the rows of a table and the columns presented different levels of conservation priority i.e. 'high priority', 'priority', 'neutral', 'low priority', 'not a priority'.

C. The 'level of knowledge of the lagoons complex and the services they provide' category included questions as:

- Have you ever heard of the term "ecosystem service" before this survey?
- How would you rate your level of knowledge regarding the ecological functioning and the services provided by the Palavas lagoons complex?
- Which of the following statements are true or false for the Palavas lagoons complex? Please answer "I don't know" for neither case. [There was a total of twelve statements]
    - *"The Palavas lagoon complex provides a natural environment for many activities such as fishing, non-motorized water sport, discovery of natural spaces, waterfowl hunting, …"*
    - *"The Palavas lagoons complex is the property of the French Department of Hérault"*
    - *"The Palavas lagoons complex provides natural resources (fish, shellfish, fodder, etc.) necessary for the functioning of many economic activities such as professional fishing, tourism, etc".*
    - *"Shellfish farming is the most important economic activity of the Palavas lagoons complex area"*

- *“The Palavas lagoons complex prevents the runoff of flood water”*
- *“The Palavas lagoons complex plays an important role in the cycle of nutrients (nitrogen and phosphorus) which are essential for the maintenance of aquatic life”.*
- *“The Palavas lagoons complex is an essential habitat for bird nesting and the life cycle of many species”.*
- *Etc.*

D. Finally, the ‘sociodemographic profile’ category included questions about, for instance, the respondents’ age, gender, and behavior towards environment (whether she or he is a member or donates to an environmental association for instance, respondents’ connectedness to nature …).

Appendix B: the list of the ecosystem services used in the study

Table B. The set of the twenty ecosystem services (ESs) used in this study. The ESs have been categorized according to the classification designed for coastal and marine ESs by Liquete et al. (2013) and currently included in CICES version 5.1 (Haines-Young and Potschin, 2018).

ES category	ES subcategory	Ecosystem services	General definition
Provisioning	Food provision	Biomass for grazing Shellfish farming Fish resources	The provision of biomass for human consumption and the conditions to grow it. It mostly relates to cropping, animal husbandry and fisheries.
Regulation and maintenance	Water provision	Water purification capacity	Biochemical and physicochemical processes involved in the removal of wastes and pollutants from the aquatic environment.
	Coastal protection	Flooding and other extreme events regulation and protection Banks reinforcement	Protection against floods, droughts, hurricanes, erosion and other extreme events.
	Climate regulation	Microclimate regulation	Regulation of greenhouse and climate active gases. The most common proxies are the uptake, storage and sequestration of carbon dioxide.
	Life cycle maintenance	Nursery and biodiversity maintenance	Biological and physical support to facilitate the healthy and diverse reproduction of species.
Cultural services	Symbolic and aesthetic values	Aesthetic value of landscapes Local identity Aesthetic value of habitats or species Historical sites	Heritage and aesthetic values of the natural environment.
	Recreation and tourism	Non-motorized water sport Bird watching Waterfowl hunting Sentiment of relaxation Recreational hiking and walking Recreational fishing	Opportunities that the natural environment provide for relaxation and amusement.
	Cognitive effects	Research opportunity Environmental education	Trigger of mental processes like knowing, developing, perceiving, or being aware resulting from natural landscapes or living organisms.

Appendix C. Levels of priority of ecosystem services presenting homogeneous preferences among the groups of respondents according to familiarity and academic information supply

Table C. Levels of priority of ecosystem services presenting homogeneous preferences among the groups of respondents according to familiarity and academic information supply. The corresponding level of priorities are indicated in the table as P, N and NP which stand for "Priority", "Neutral" and "Not a priority", respectively.

Ecosystem services presenting homogeneous references	P-Value	Level of priority	Local residents		Matched observations for non-local residents		Initial observations for non-local residents	
			Local	Informed Local	Matched Familiar	Matched Unfamiliar	Familiar	Unfamiliar
Regulation and maintenance	*0.431*							
		P	93.3%	100.0%	96.2%	92.2%	95.7%	93.4%
		N	6.7%	0.0%	3.8%	7.8%	4.3%	6.6%
		NP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fish resources	*0.264*							
		P	26.7%	26.7%	51.9%	36.9%	47.0%	25.6%
		N	50.0%	50.0%	30.8%	41.7%	30.4%	43.6%
		NP	23.3%	23.3%	17.3%	21.4%	22.6%	30.8%
Recreational hiking and walking	*0.288*							
		P	53.3%	46.7%	67.3%	62.1%	76.5%	61.6%
		N	26.7%	36.7%	19.2%	29.1%	15.7%	31.1%
		NP	20.0%	16.7%	13.5%	8.7%	7.8%	7.3%
Environmental education and research opportunity	*0.741*							
		P	93.3%	90.0%	92.3%	90.3%	96.5%	91.7%
		N	3.3%	10.0%	7.7%	8.7%	3.5%	7.6%
		NP	3.3%	0.0%	0.0%	1.0%	0.0%	0.7%

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8 References

Ami, D., Aprahamian, F., Chanel, O., Luchini, S., 2018. When do social cues and scientific information affect stated preferences? Insights from an experiment on air pollution. J. Choice Model. 29, 33–46. doi:10.1016/j.jocm.2018.09.001

Argyris, C., Schön, D.A., 1996. Organizational learning II: Theory, method and practice Reading, Addison-Wesley. Massachusetts. 305 p.

Arias-Arévalo, P., Gómez-Baggethun, E., Martín-López, B., Pérez-Rincón, M., 2018. Widening the Evaluative Space for Ecosystem Services: A Taxonomy of Plural Values and Valuation Methods. Environ. Values 27, 29–53. doi:10.3197/096327118X15144698637513

Arias-Arévalo, P., Martín-López, B., Gómez-Baggethun, E., 2017. Exploring intrinsic, instrumental, and relational values for sustainable management of social-ecological systems. Ecol. Soc. 22, art43. doi:10.5751/ES-09812-220443

Balinski, M., Laraki, R., 2010. Majority Judgment - Measuring, Ranking and Electing, The MIT Pr. ed. Massachusetts. doi:10.1017/CBO9781107415324.004

Barnaud, C., Antona, M., 2014. Deconstructing ecosystem services: Uncertainties and controversies around a socially constructed concept. Geoforum 56, 113–123. doi:10.1016/j.geoforum.2014.07.003

Beaumont, N.J., Mongruel, R., Hooper, T., 2017. Practical application of the Ecosystem Service Approach (ESA): lessons learned and recommendations for the future. Int. J. Biodivers. Sci. Ecosyst. Serv. Manag. 13, 68–78. doi:10.1080/21513732.2018.1425222

Blayac, T., Mathé, S., Rey-Valette, H., Fontaine, P., 2014. Perceptions of the services provided by pond fish farming in Lorraine (France). Ecol. Econ. 108, 115–123. doi:10.1016/j.ecolecon.2014.10.007

Blomquist, G.C., Whitehead, J.C., 1998. Resource quality information and validity of willingness to pay in contingent valuation. Resour. Energy Econ. 20, 179–196. doi:10.1016/S0928-7655(97)00035-3

Brahic, E., Rambonilaza, T., 2015. The impact of information on public preferences for forest biodiversity preservation: A split-Sample test with choice experiment method. Rev. Econ. Polit. 125, 253–275. doi:10.3917/redp.252.0253

Burkhard, B., Maes, J., 2017. Mapping Ecosystem Services, Mapping Ecosystem Services. Pensoft Publishers. doi:10.3897/ab.e12837

Burkhard, B., Santos-Martin, F., Nedkov, S., Maes, J., 2018. An operational framework for integrated Mapping and Assessment of Ecosystems and their Services (MAES). One

Ecosyst. 3, e22831. doi:10.3897/oneeco.3.e22831
Capaldi, C.A., Dopko, R.L., Zelenski, J.M., 2014. The relationship between nature connectedness and happiness: a meta-analysis. Front. Psychol. 5. doi:10.3389/fpsyg.2014.00976
Chan, K.M.A., Guerry, A.D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B.S., Hannahs, N., Levine, J., Norton, B., Ruckelshaus, M., Russell, R., Tam, J., Woodside, U., 2012a. Where are Cultural and Social in Ecosystem Services? A Framework for Constructive Engagement. Bioscience 62, 744–756. doi:10.1525/bio.2012.62.8.7
Chan, K.M.A., Satterfield, T., Goldstein, J., 2012b. Rethinking ecosystem services to better address and navigate cultural values. Ecol. Econ. 74, 8–18. doi:10.1016/j.ecolecon.2011.11.011
Costanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253–260. doi:10.1038/387253a0
Costanza, R., 2004. Value Theory and Energy, in: Encyclopedia of Energy. Elsevier, pp. 337–346. doi:10.1016/B0-12-176480-X/00118-2
Costanza, R., 2020. Valuing natural capital and ecosystem services toward the goals of efficiency, fairness, and sustainability. Ecosyst. Serv. 43, 101096 https://doi.org/10.1016/j.ecoser.2020.101096
Croutte, P., 2015. L'opinion des Français sur la participation des citoyens à une agence pour la biodiversité, Crédoc. N°SOU2015-4237.
Czajkowski, M., Hanley, N., LaRiviere, J., 2016. Controlling for the Effects of Information in a Public Goods Discrete Choice Model. Environ. Resour. Econ. 63, 523–544. doi:10.1007/s10640-014-9847-z
Daily, G., Alexander, S., Ehrlich, P., Goulder, L., Lubchenco, J., Matson, P., Mooney, H., Postel, S., Schneider, D., Woodwell, G., 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems, Ecology Society of America. Ecological Society of America.
Daily, G.C., Polasky, S., Goldstein, J., Kareiva, P.M., Mooney, H. a, Pejchar, L., Ricketts, T.H., Salzman, J., Shallenberger, R., 2009. Ecosystem services in decision making: time to deliver. Front. Ecol. Environ. 7, 21–28. doi:10.1890/080025
Darby, M.R., Karni, E., 1973. Free Competition and the Optimal Amount of Fraud. J. Law Econ. 16, 67–88. doi: 10.1086/466756
De Bell, S., Graham, H., Jarvis, S., White, P., 2017. The importance of nature in mediating social and psychological benefits associated with visits to freshwater blue space. Landsc. Urban Plan. 167, 118–127. doi:10.1016/j.landurbplan.2017.06.003
De Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P., van Beukering, P., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst. Serv. 1, 50–61. doi:10.1016/j.ecoser.2012.07.005
De Ville D'Avray, L.T., 2018. Identification et évaluation des services écosystémiques rendus par les habitats coralligènes. Aix-Marseille Université.306 p.
De Wit, R., Rey-Valette, H., Balavoine, J., Ouisse, V., Lifran, R., 2017. Restoration ecology of coastal lagoons: new methods for the prediction of ecological trajectories and economic valuation. Aquat. Conserv. Mar. Freshw. Ecosyst. 27, 137–157. doi:10.1002/aqc.2601
De Wit, R., Leruste, A., Le Fur, I., Sy, M.M., Bec, B., Ouisse, V., Derolez, V., Rey-Valette, H., 2020. A Multidisciplinary Approach for Restoration Ecology of Shallow Coastal Lagoons, a Case Study in South France. Front. Ecol. Evol. 8:108. doi: 10.3389/fevo.2020.00108

De Young, R., 1985. Encouraging Environmentally Appropriate Behavior: The Role of Intrinsic Motivation. J. Environ. Syst. 15, 281–292. doi:10.2190/3FWV-4WM0-R6MC-2URB
Delgado, L.E., Rojo Negrete, I.A., Torres-Gómez, M., Alfonso, A., Zorondo-Rodríguez, F., 2019. Social-ecological Systems and Human Well-Being, in: Social-Ecological Systems of Latin America: Complexities and Challenges. Springer International Publishing, Cham, pp. 53–69. doi:10.1007/978-3-030-28452-7_4
Dendoncker, N., Keune, H., Jacobs, S., Gómez-Baggethun, E., 2014. Inclusive Ecosystem Services Valuation, in: Jacobs, S., Dendoncker, N., Keune, H. (Eds.), Ecosystem Services. Elsevier, Amsterdam, pp. 3–12. doi:10.1016/B978-0-12-419964-4.00001-9
Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M.A., Baste, I.A., Brauman, K.A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P.W., van Oudenhoven, A.P.E., van der Plaat, F., Schröter, M., Lavorel, S., Aumeeruddy-Thomas, Y., Bukvareva, E., Davies, K., Demissew, S., Erpul, G., Failler, P., Guerra, C.A., Hewitt, C.L., Keune, H., Lindley, S., Shirayama, Y., 2018. Assessing nature's contributions to people. Science 359, 270–272. doi:10.1126/science.aap8826
Díaz S, Settele J, Brondizio ES, Ngo HT, Guèze M, Agard J, Arneth A, Balvanera P, Brauman KA, Butchart SHM, et al., editors. IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the intergovernmental science-policy platform on biodiversity and ecosystem services. Bonn (Germany): IPBES secretariat; p. 56.
Dou, Y., Zhen, L., Yu, X., Bakker, M., Carsjens, G.-J., Xue, Z., 2019. Assessing the influences of ecological restoration on perceptions of cultural ecosystem services by residents of agricultural landscapes of western China. Sci. Total Environ. 646, 685–695. doi:10.1016/j.scitotenv.2018.07.205
Dworkin, G., 1972. Paternalism. Monist 56, 64–84. doi:10.5840/monist197256119
Fish, R., Church, A., Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. Ecosyst. Serv. 21, 208–217. doi:10.1016/j.ecoser.2016.09.002
Fisher, B., Turner, R.K., Morling, P., 2009. Defining and classifying ecosystem services for decision making. Ecol. Econ. 68, 643–653. doi:10.1016/j.ecolecon.2008.09.014
Franses, P.H., Paap, R., 2003. Quantitative Models in Marketing Research. Cambridge University Press, UK.
Fürst, C., Opdam, P., Inostroza, L., Luque, S., 2014. Evaluating the role of ecosystem services in participatory land use planning: proposing a balanced score card. Landsc. Ecol. 29, 1435–1446. doi:10.1007/s10980-014-0052-9
Gowdy, J., Erickson, J.D., 2005. The approach of ecological economics. Cambridge J. Econ. 29, 207–222. doi:10.1093/cje/bei033
Haines-Young, R., Potschin, M.B., 2018. Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure, European Environment Agency. 53 p.
Hanley, N., Munro, A., 1992. The Effects of Information in Contingent Markets for Environmental Goods: A Survey and Some New Evidence. Queen's Econ. Dep. Work. Pap. 3, 1–24. doi:10.22004/ag.econ.275222
Hausman, J., McFadden, D., 1984. Specification Tests for the Multinomial Logit Model. Econometrica 52, 1219. doi:10.2307/1910997
Iacus, S.M., King, G., Porro, G., 2012. Causal Inference without Balance Checking: Coarsened Exact Matching. Polit. Anal. 20, 1–24. doi:10.1093/pan/mpr013
Iacus, S.M., King, G., Porro, G., 2011. Multivariate Matching Methods That Are Monotonic Imbalance Bounding. J. Am. Stat. Assoc. 106, 345–361. doi:10.1198/jasa.2011.tm09599
Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gomez-Baggethun, E., Boeraeve,

F., McGrath, F.L., Vierikko, K., Geneletti, D., Sevecke, K.J., Pipart, N., Primmer, E., Mederly, P., Schmidt, S., Aragão, A., Baral, H., Bark, R.H., Briceno, T., Brogna, D., Cabral, P., De Vreese, R., Liquete, C., Mueller, H., Peh, K.S.-H., Phelan, A., Rincón, A.R., Rogers, S.H., Turkelboom, F., Van Reeth, W., van Zanten, B.T., Wam, H.K., Washbourne, C.-L., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22, 213–220. doi:10.1016/j.ecoser.2016.11.007

Jacobs, S., Martín-López, B., Barton, D.N., Dunford, R., Harrison, P.A., Kelemen, E., Saarikoski, H., Termansen, M., García-Llorente, M., Gómez-Baggethun, E., Kopperoinen, L., Luque, S., Palomo, I., Priess, J.A., Rusch, G.M., Tenerelli, P., Turkelboom, F., Demeyer, R., Hauck, J., Keune, H., Smith, R., 2018. The means determine the end – Pursuing integrated valuation in practice. Ecosyst. Serv. 29, 515–528. doi:10.1016/j.ecoser.2017.07.011

Kaltenborn, B.P., Linnell, J.D.C., Gómez-Baggethun, E., 2020. Can cultural ecosystem services contribute to satisfying basic human needs? A case study from the Lofoten archipelago, northern Norway. Appl. Geogr. 120, 102229. doi:10.1016/j.apgeog.2020.102229

Kennish, M.J., Brush, M.J., Moore, K.A., 2014. Drivers of Change in Shallow Coastal Photic Systems: An Introduction to a Special Issue. Estuaries and Coasts 37, 3–19. doi:10.1007/s12237-014-9779-4

Kirchhoff, T., 2019. Abandoning the Concept of Cultural Ecosystem Services, or Against Natural–Scientific Imperialism. Bioscience 69, 220–227. doi:10.1093/biosci/biz007

Kjerfve, B., 1994. Chapter 1 Coastal Lagoons, in: Elsevier Oceanography Series. Elsevier, pp. 1–8. doi:10.1016/S0422-9894(08)70006-0

Kollmuss, A., Agyeman, J., 2002. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? Environ. Educ. Res. 8, 239–260. doi:10.1080/13504620220145401

Kuhfuss, L., Rey-Valette, H., Sourisseau, E., Heurtefeux, H., Rufray, X., 2016. Evaluating the impacts of sea level rise on coastal wetlands in Languedoc-Roussillon, France. Environ. Sci. Policy 59, 26–34. doi:10.1016/j.envsci.2016.02.002

La Notte, A., Liquete, C., Grizzetti, B., Maes, J., Egoh, B., Paracchini, M., 2015. An ecological-economic approach to the valuation of ecosystem services to support biodiversity policy. A case study for nitrogen retention by Mediterranean rivers and lakes. Ecol. Indic. 48, 292–302. doi:10.1016/j.ecolind.2014.08.006

Lapointe, M., Gurney, G.G., Cumming, G.S., 2020. Urbanization alters ecosystem service preferences in a Small Island Developing State. Ecosyst. Serv. 43, 101109. doi:10.1016/j.ecoser.2020.101109

LaRiviere, J., Czajkowski, M., Hanley, N., Aanesen, M., Falk-Petersen, J., Tinch, D., 2014. The value of familiarity: Effects of knowledge and objective signals on willingness to pay for a public good. J. Environ. Econ. Manage. 68, 376–389. doi:10.1016/j.jeem.2014.07.004

Laurans, Y., Rankovic, A., Billé, R., Pirard, R., Mermet, L., 2013. Use of ecosystem services economic valuation for decision making: Questioning a literature blindspot. J. Environ. Manage. 119, 208–219. doi:10.1016/j.jenvman.2013.01.008

Le Clec'h S., Dufour S., Oszwald J., Grimaldi Michel, Jégou N., 2014. Spatialiser des services écosystémiques, un enjeu méthodologique et plus encore. In: Arnauld de Sartre A. (ed.), Castro M. (ed.), Dufour S. (ed.), Oszwald J. (ed.) Political ecology des services écosystémiques. Bruxelles : P. Lang. 21, 205-223. (Ecopolis ; 21). ISBN 978-2-87574-197-4

Leruste, A., Malet, N., Munaron, D., Derolez, V., Hatey, E., Collos, Y., De Wit, R., Bec, B., 2016. First steps of ecological restoration in Mediterranean lagoons: Shifts in phytoplankton communities. Estuar. Coast. Shelf Sci. 180, 190–203. doi:10.1016/j.ecss.2016.06.029

Lewan, L., Söderqvist, T., 2002. Knowledge and recognition of ecosystem services among the general public in a drainage basin in Scania, Southern Sweden. Ecol. Econ. 42, 459–467. doi:10.1016/S0921-8009(02)00127-1

Liquete, C., Piroddi, C., Drakou, E.G., Gurney, L., Katsanevakis, S., Charef, A., Egoh, B., 2013. Current Status and Future Prospects for the Assessment of Marine and Coastal Ecosystem Services: A Systematic Review. PLoS One 8, e67737. doi:10.1371/journal.pone.0067737

Liu, S., Costanza, RobertValuing ecosystem services Theory, practice, and the need for a transdisciplinary synthesis, Farber, S., Troy, A., 2010. Valuing ecosystem services Theory, practice, and the need for a transdisciplinary synthesis. Ann. N. Y. Acad. Sci. 1185, 54–78. doi:10.1111/j.1749-6632.2009.05167.x

MacKerron, G., Mourato, S., 2013. Happiness is greater in natural environments. Glob. Environ. Chang. 23, 992–1000. doi:10.1016/j.gloenvcha.2013.03.010

Maes, J., Fabrega, N., Zulian, G., Barbosa, A., Ivits, E., Polce, C., Vandecasteele, I., Marí, I., Guerra, C., Castillo, C.P., Vallecillo, S., Baranzelli, C., Barranco, R., Batista, F., Trombetti, M., Lavalle, C., 2015. Mapping and Assessment of Ecosystems and their Services Trends in ecosystems and ecosystem - JRC report number JRC94889. doi:10.2788/341839

Maraja, R., Jan, B., Teja, T., 2016. Perceptions of cultural ecosystem services from urban green. Ecosyst. Serv. 17, 33–39. doi:10.1016/j.ecoser.2015.11.007

Marre, J.B., Thebaud, O., Pascoe, S., Jennings, S., Boncoeur, J., Coglan, L., 2015. The use of ecosystem services valuation in Australian coastal zone management. Mar. Policy 56, 117–124. doi:10.1016/j.marpol.2015.02.011

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220–228. doi:10.1016/j.ecolind.2013.03.003

Martinez-Alier, J., Munda, G., O'Neill, J., 1998. Weak comparability of values as a foundation for ecological economics. Ecol. Econ. 26, 277–286. doi:10.1016/S0921-8009(97)00120-1

Mayer, F.S., Frantz, C.M., Bruehlman-Senecal, E., Dolliver, K., 2009. Why Is Nature Beneficial? Environ. Behav. 41, 607–643. doi:10.1177/0013916508319745

Mcgranahan, G., Balk, B., Anderson, B. (2007). The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. Environment & Urbanization 19(1): 17–37. DOI: 10.1177/0956247807076960

Millenium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Washington, DC.

Narchi, N.E., Cornier, S., Canu, D.M., Aguilar-Rosas, L.E., Bender, M.G., Jacquelin, C., Thiba, M., Moura, G.G.M., de Wit, R., 2014. Marine ethnobiology a rather neglected area, which can provide an important contribution to ocean and coastal management. Ocean Coast. Manag. 89, 117–126. doi:10.1016/j.ocecoaman.2013.09.014

Nelson, P., 1970. Information and Consumer Behavior. J. Polit. Econ. 78, 311–329. doi:10.1086/259630

Neumann B., Vafeidis A.T., Zimmermann J., Nicholls R.J., 2015. Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. PLoS One 10, e0118571. doi:10.1371/journal.pone.0118571

Newton, A., Icely, J., Cristina, S., Brito, A., Cardoso, A.C., Colijn, F., Riva, S.D., Gertz, F., Hansen, J.W., Holmer, M., Ivanova, K., Leppäkoski, E., Canu, D.M., Mocenni, C., Mudge, S., Murray, N., Pejrup, M., Razinkovas, A., Reizopoulou, S., Pérez-Ruzafa, A., Schernewski, G., Schubert, H., Carr, L., Solidoro, C., PierluigiViaroli, Zaldívar, J.M., 2014. An overview of ecological status, vulnerability and future perspectives of European large shallow, semi-enclosed coastal systems, lagoons and transitional waters. Estuar. Coast. Shelf Sci. 140, 95–122. doi:10.1016/j.ecss.2013.05.023

O'Neill, J., Spash, C.L., 2000. Conceptions of Value in Environmental Decision-Making. Environ. Values 9, 521–536. doi:10.3197/096327100129342191

Pendleton, L., Mongruel, R., Beaumont, N., Hooper, T., Charles, M., 2015. A triage approach to improve the relevance of marine ecosystem services assessments. Mar. Ecol. Prog. Ser. 530,

183–193. doi:10.3354/meps11111
Pereira Lima, F., Pereira Bastos, R., 2020. Understanding landowners' intention to restore native areas: The role of ecosystem services. Ecosyst. Serv. 44, 101121. doi:10.1016/j.ecoser.2020.101121
Pike, K., Wright, P., Wink, B., Fletcher, S., 2015. The assessment of cultural ecosystem services in the marine environment using Q methodology. J. Coast. Conserv. 19, 667–675. doi:10.1007/s11852-014-0350-z
Rawls, J., 1971. A theory of justice, Original e. ed. The Belknap Press of Harvard University Press, Cambridge.
Rey-Valette, H., Mathé, S., Salles, J.M., 2017. An assessment method of ecosystem services based on stakeholders perceptions: The Rapid Ecosystem Services Participatory Appraisal (RESPA). Ecosyst. Serv. 28, 311–319. doi:10.1016/j.ecoser.2017.08.002
Salles, J., Figuieres, C., 2013. Current issues in ecosystem services valuation (ESV), in: European Association of Environmental and Resource Economists 20th Annual Conference, 26 - 29 June,. pp. 1–22.
Sandifer, P.A., Sutton-Grier, A.E., Ward, B.P., 2015. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. Ecosyst. Serv. 12, 1–15. doi:10.1016/j.ecoser.2014.12.007
Small, N., Munday, M., Durance, I., 2017. The challenge of valuing ecosystem services that have no material benefits. Glob. Environ. Chang. 44, 57–67. doi:10.1016/j.gloenvcha.2017.03.005
Spash, C.L., Hanley, N., 1995. Preferences, information and biodiversity preservation. Ecol. Econ. 12, 191–208. doi:10.1016/0921-8009(94)00056-2
Stålhammar, S., Pedersen, E., 2017. Recreational cultural ecosystem services: How do people describe the value? Ecosyst. Serv. 26, 1–9. doi:10.1016/j.ecoser.2017.05.010
Strokosch, K., Osborne, S.P., 2020. Co-experience, co-production and co-governance: an ecosystem approach to the analysis of value creation. Policy Polit. 48, 425–442. doi:10.1332/030557320X15857337955214
Sy, M.M., Rey-Valette, H., Simier, M., Pasqualini, V., Figuières, C., De Wit, R., 2018. Identifying Consensus on Coastal Lagoons Ecosystem Services and Conservation Priorities for an Effective Decision Making: A Q Approach. Ecol. Econ. 154, 1–13. doi:10.1016/j.ecolecon.2018.07.018
TEEB, 2010. The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Earthscan, London and Washington, London and Washington.
Thaler, R.H., Sunstein, C. ass R., 2008. Nudge: Improving Decisions about Health, Wealth and Happiness. New Haven, Yale University Press.
Turner, R.K., van den Bergh, J.C.J.M., Söderqvist, T., Barendregt, A., van der Straaten, J., Maltby, E., van Ierland, E.C., 2000. Ecological-economic analysis of wetlands: scientific integration for management and policy. Ecol. Econ. 35, 7–23. doi:10.1016/S0921-8009(00)00164-6.
Van Giesen, R.I., Fischer, A.R.H., van Dijk, H., van Trijp, H.C.M., 2015. Affect and Cognition in Attitude Formation toward Familiar and Unfamiliar Attitude Objects. PLoS One 10, e0141790. doi:10.1371/journal.pone.0141790
Whitehead, J.C., Blomquist, G.C., 1991. Measuring Contingent Values for Wetlands: Effects of Information About Related Environmental Goods. Water Resour. Res. 27, 2523–2531. doi:10.1029/91WR01769
Wilson E.O., 1984. Biophilia, Harvard University Press. 176 p
Winthrop, R.H., 2014. The strange case of cultural services: Limits of the ecosystem services paradigm. Ecol. Econ. 108, 208–214. doi:10.1016/j.ecolecon.2014.10.005

Yamagishi, T., Li, Y., Takagishi, H., Matsumoto, Y., Kiyonari, T., 2014. In Search of Homo economicus. Psychol. Sci. 25, 1699–1711. doi:10.1177/0956797614538065