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► **To cite this version:**

Mariam Maki Sy, Helene Rey-Valette, Charles Figuières, Monique Simier, Rutger de Wit. The impact of academic information supply and familiarity on preferences for ecosystem services. *Ecological Economics*, 2021, 183, pp.106959. 10.1016/j.ecolecon.2021.106959 . hal-03119760

HAL Id: hal-03119760

<https://hal.science/hal-03119760>

Submitted on 1 Feb 2021

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The Impact of Academic Information Supply and Familiarity on Preferences for Ecosystem Services

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18

19 **Abstract**

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

34 **Keywords:** preference elicitation, coastal lagoons, citizens' workshop, paternalism, cultural
35 ecosystem services (CES), veil of ignorance

36 **1 Introduction**

37

38 Ecosystems are essential for human well-being. Therefore, understanding the link between
39 ecological processes of ecosystems and human welfare is critical for a wide range of decision-
40 making contexts (Fisher et al., 2009). Gathering information on complex ecosystem functioning
41 and translating it into advantages society obtains from Nature has been widely carried out using
42 the concept of ecosystem services (ESs) and through its economic valuation (see Costanza et al.,
43 1997; Daily et al., 1997; Dendoncker et al., 2014; La Notte et al., 2015). ESs valuation includes
44 assessing trade-offs among different options (e.g. ESs, ecological restoration projects, planning
45 scenarios ...). Hence, in general, it is based on assigning relative importance to nature's diverse
46 benefits to humans (Jacobs et al., 2016), and this process could facilitate more adequate
47 conservation choices (Salles and Figuières, 2013).

48

49 In ecosystem goods and services related valuation practices, there is an ongoing debate about the
50 process on how to achieve the preference elicitation (e.g. Dendoncker et al., 2014; Kenter et al.,
51 2015; 2016; Jacobs et al., 2016; 2018). So far, little is known on how existing valuation methods
52 actually elicit the different values (Jacobs et al., 2018). In this area, increasing research attention
53 is focused on the development of non-monetary valuation methods in favor of multi-criteria
54 approaches allowing to better study the justification for compromises between objectives of
55 efficiency, fairness and sustainability (Costanza, 2020). Preferences elicitation can be a
56 challenging exercise for citizens involved in assessment surveys especially when it comes to
57 complex and unfamiliar goods or services. For instance, nature services like water purification or
58 climate regulation are generated by a complex interplay of natural cycles (Daily et al., 1997),
59 which is often hardly understood by the majority of the citizens. Even many researchers, often
60 highly specialized in their disciplines, may have difficulties in fully understanding the complex
61 interplay. In Economics literature, the easiest-to-study situation is when individuals have
62 preferences for goods and services with diverse characteristics about which they are well
63 informed, and when their preferences are exogenous and reliable (O'Neill and Spash, 2000). This
64 ideal situation is considered as the benchmark for which using a standard kind of rationality, it
65 has been postulated that individuals maximize their correctly understood self-interest i.e. personal
66 benefit (Yamagishi et al., 2014).

67

68 However, many findings show that respondents involved in preference elicitation surveys are
69 often not familiar and often do not hold appropriate information on the ecosystem goods and
70 services being assessed (Whitehead and Blomquist, 1991; Hanley and Munro, 1992; Spash and
71 Hanley, 1995; Blomquist and Whitehead, 1998; Lewan and Söderqvist, 2002; LaRiviere et al.,
72 2014; Brahic and Rambonilaza, 2015; Czajkowski et al., 2016; Ami et al., 2018; De Ville
73 D'Avray, 2018). Realistically, some ESs are clearly perceived by people while others are not (De
74 Groot et al., 2012). In contrast, we assume that at least part of the relevant knowledge emanates
75 from the citizens themselves, i.e. from their experience and the familiarity they have acquired
76 with the natural environment. Hence, not only indigenous people (Díaz et al., 2018), but also
77 citizens in Western countries that are familiar with ecosystems have often acquired local
78 knowledge that is complementary to the scientific knowledge. This may comprise both
79 knowledge about their ecology, i.e. the local ecological knowledge (LEK) identified in
80 ethnobiology (Narchi et al., 2014), and the knowledge of their benefits for society.

81

82 The citizens' preferences are based on perceptions, which sometimes hide a lack of knowledge
83 about ecosystems and the services they provide. These perceptions could, nevertheless, change
84 progressively as more information is provided. The external information that citizens often do not
85 possess *a priori* (Costanza, 2004) can be acquired either through increased familiarity with the
86 ecosystems, or from academic information, or from a combination of both. Citizens who live in
87 the proximity of the focal ecosystem or regularly visit it during holidays become familiar,
88 meaning that they are well acquainted with this ecosystem. Personal appreciations may be based
89 either on affection alone or on a combination of affection with increased knowledge (Van Giesen
90 et al., 2015). Depending on the individual, familiarity may result in increased affection for and
91 cognitive knowledge of the ecosystem. In contrast, the supply of academic information only
92 targets to increase the cognitive knowledge of the recipient citizens. For instance, Ami et al.
93 (2018) reported that the impact of scientific information about the effects of air pollution on
94 respondents' preferences, expressed as their willingness to pay (WTP) values, was strong. A
95 proportion of people (30%) receiving scientific information revised their WTP upwards relative
96 to the mean WTP value. Similarly, presenting survey participants with objective signal regarding
97 the accuracy of their knowledge about a public good caused a significant increase in their
98 preferences (i.e., their WTP) for it (LaRiviere et al., 2014). Also, Czajkowski et al. (2016)
99 observed the effects of different information sets on subjects' preferences for a public good.

100

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

112

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

124

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

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

134

135 **2 Material and methods**

136 **2.1 Study area**

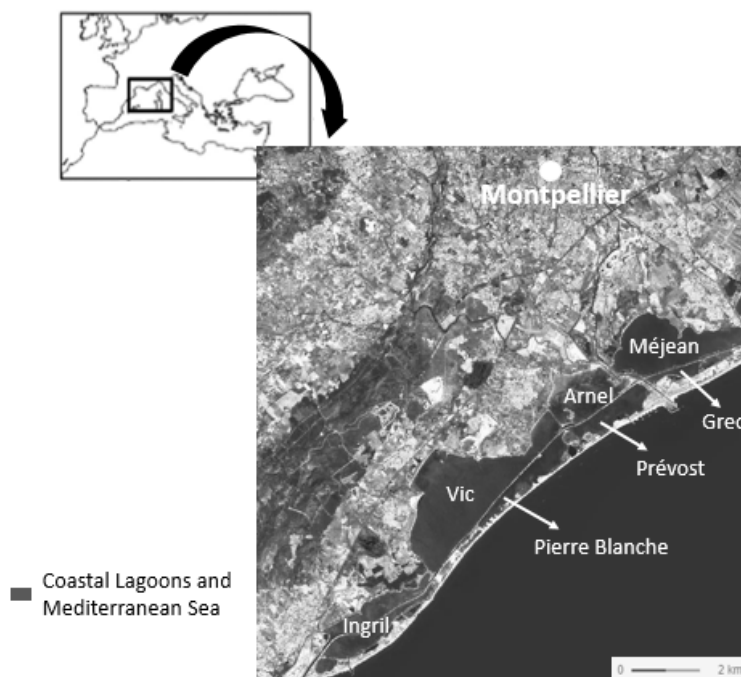
137 The Palavas lagoons complex is located in the southern part of France bordering the Gulf of Lion
138 in the Mediterranean Sea (see Figure 1). In addition to the lagoons, the study site comprises also
139 peripheral riparian zones such as wetlands, pasture and other natural areas. Palavas lagoons are
140 representative of shallow lagoons (mean depth < 2 m) nearby an urban area, predominantly
141 natural while used in the same time for recreational and fishing activities. Water quality in the
142 lagoons had been strongly impacted by human activities mainly due to nutrient over-enrichment
143 which occurred during more than four decades since the 1960's (De Wit et al., 2017; Sy et al.,
144 2018). Climate change effects, in particular sea level rise, the increase in temperature or the
145 variation in freshwater availability, could also have ecological consequences on the lagoons
146 (Kuhfuss et al., 2016). In response to these issues, ecological restoration targeting good water
147 quality and good ecological status were initiated by decision makers (De Wit et al., 2017; Leruste
148 et al., 2016; De Wit et al., 2020). For instance, in 2005, the implementation of an 11-km offshore
149 outfall system diverted the treated sewage effluents leading to a drastic reduction of
150 anthropogenic inputs of nitrogen and phosphorus into the lagoons (Leruste et al., 2016; De Wit et
151 al., 2020). Moreover, the area is a Natura 2000 site and also received the Ramsar designation as
152 wetland of international importance in 2008 (Sy et al., 2018). The main characteristics of the
153 Palavas lagoons are presented in Table 1 (adapted from Sy et al., 2018).

154

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

156 Note: (1) The Palavas lagoons complex comprises 7 different lagoons that were created by compartmentalization of a
 157 historic large lagoon; (2) Grec and Arnel lagoons; (3) Prévost lagoon; (4) Ingril lagoon; (5) Méjean and Grec
 158 lagoons; (6) FR9101410 - SCI = Site of Community Interest (Habitats Directive); (7) FR9110042 - SPA = Special
 159 Protection Area (Birds Directive). Note: the total area of the Natura 2000 site includes the Estagnol nature reserve.
 160

161



162

163 *Figure 1. Palavas lagoons complex. Satellite images from IGN-Géoportail.*
 164

165 2.2 Survey characteristics and data collection process

166 The surveys were conducted among randomly selected local citizens near the Palavas lagoons
167 and non-local citizens living in non-coastal municipalities in France (see Table 3). Local citizens
168 encountered either in the urban centers or walking on footpaths along the littoral zone of the
169 Palavas lagoons were invited to participate in citizen workshops. The invitation was often
170 received with interest and a certain degree of enthusiasm. However, despite our phone call the
171 day before the workshops, it turned out that only a small fraction of the people solicited accepted
172 and showed up at the citizen workshops (N = 38 in total, approximately 1 out of 10 of the solicited
173 individuals). We realized that this number represent a relatively small sample of the total
174 population, although workable for an analysis. This is the consequence of requesting more time
175 availability than in classical surveys. Therefore, we used Coarsened Exact Matching (CEM)
176 technique when this small sample was compared with the larger samples used for the internet
177 survey (see section 2.3.1). The citizen workshops were carried out in May and June in 2017 and
178 2018 with the 38 local residents living within a radius of 15 km from the study site. The
179 demographic characteristics of the surveyed local residents are presented in Table 2. We
180 compared the demographic characteristics of our sample to the ones of two municipalities,
181 Villeneuve-lès-Maguelone and Lattes, which are among the most represented municipalities in
182 our sample.

183

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

192

193 *Table 2. Demographic characteristics of the surveyed local residents*

	Sample	Villeneuve	Lattes
	%	%	%
Gender			
<i>Female</i>	42.1	48.0	52.0
Age (years)			
<i>18-39</i>	18.4	46.0	40.8
<i>40-59</i>	28.9	26.0	23.6
<i>> 60</i>	52.6	28.0	35.6
Education			
<i>Baccalaureate, certificates or none</i>	47.4	51.0	58.6
<i>Higher</i>	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.*

194
 195 Note: the difference in the median incomes can be explained by the fact that we have in our sample only individuals
 196 whose incomes are taxable, contrary to those of the populations of Villeneuve-lès-Maguelone and Lattes.
 197

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

207
 208 Data were collected for both surveys using the same questionnaire (see the content of the
 209 questionnaire in Appendix A) which was composed of two series of questions as recommended
 210 in the literature on perceptions of ESs (see Blayac et al., 2014): open and spontaneous as well as
 211 closed questions, mainly on perceptions of the activities and the characteristics of the lagoons
 212 area (see Table 3).

213

214 *Table 3. Characteristics of the surveys and the surveyed population types*
 215

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			

216
 217
 218 A list of twenty ESs (see Table B in Appendix B) was selected before by focus groups of
 219 scientists and lagoon managers. These ESs was considered as the relatively most important ESs,
 220 in terms of conservation, provided by Palavas lagoons based on an original selection of 31 ESs
 221 (see Sy et al., 2018). The general definition of the ESs was adapted from Liqueste et al. (2013),
 222 who provided a classification of coastal ES that is now integrated in CICES 5 (Haines-Young and
 223 Potschin, 2018). The twenty selected ESs were presented in a randomized order in the survey,
 224 without any reference to ES categories. Preferences were elicited for the different ESs using the
 225 Majority judgment (MJ), a voting method introduced by Balinski and Laraki (2010). We
 226 borrowed MJ from Social Choice theory and to our knowledge it has never been used in research
 227 related to environmental issues. Our MJ for ESs ranking is an absolute non-monetary method in
 228 the sense that each ES is judged by its merit or grade in a common language independently from
 229 the other services. According to work in the field of Social Choice, this type of ranking is
 230 considered to offer a more robust selection basis (Balinski and Laraki, 2010).

231
 232 The respondents indicated their individual preferences for the different ESs by answering the
 233 following question: “What do you think are the most important roles of the Palavas lagoons in
 234 terms of conservation priority? Please check the box associated with each role according to its
 235 level of conservation priority”. The list of the considered ESs (i.e. the roles) was presented in the
 236 rows of a table and the columns presented different levels of conservation priority i.e. ‘high
 237 priority’, ‘priority’, ‘neutral’, ‘low priority’, ‘not a priority’.

238

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

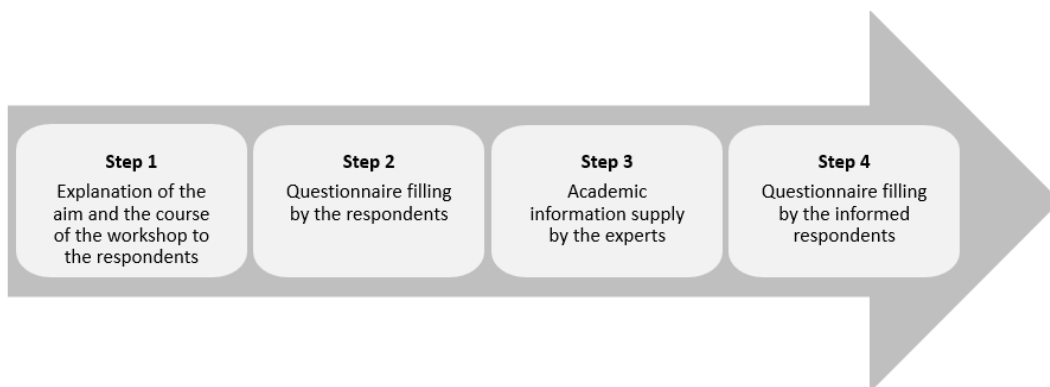
245

246 *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

247

248 The course of the workshop sessions is shown in Fig. 2. After an introduction, the respondents
249 completed, individually and unaided, the questionnaire on paper. This latter part lasted between
250 30 and 45 minutes. Subsequently, the academic information was provided by the experts in the
251 form of oral presentations with the use of a PowerPoint support. A moment of conviviality
252 around a drink closed each session by informally collecting the impressions of the participants
253 regarding the interest of the session. In total the sessions lasted between 2:30 and 3 hours.



254

255 *Figure 2. The course of the workshop session.*

256

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

260

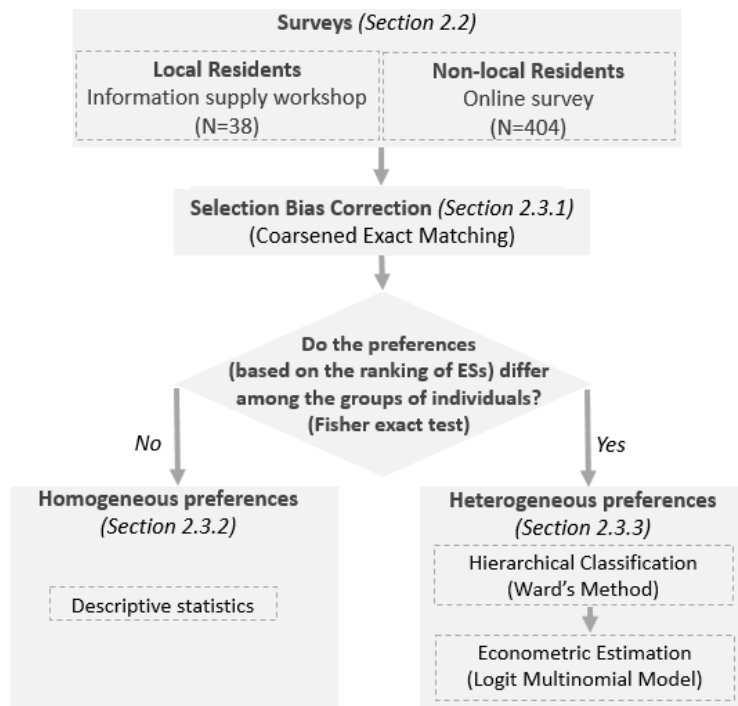
261 *Table 5. Details of the academic information provided*

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

262

263 2.3 Data treatment process

264 The overall work flow for data collection and treatment is presented in Figure 3. First, disparities
 265 in sample sizes and characteristics of the different resident groups (see section 2.2) were
 266 corrected using Coarsened Exact Matching (CEM) (see section 2.3.1). The second step consisted
 267 of identifying ESs for which preferences were either homogeneous or heterogeneous among the
 268 different groups of respondents. Then, we assumed that there were no impacts of academic
 269 information and familiarity on those ESs for which preferences were homogeneous (see sections
 270 2.3.2). The final step of the analysis consisted of identifying factors explaining the heterogeneity
 271 of preferences for the remaining ESs using a logit multinomial model (see section 2.3.3).



272

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

274

275 2.3.1 Correcting selection bias

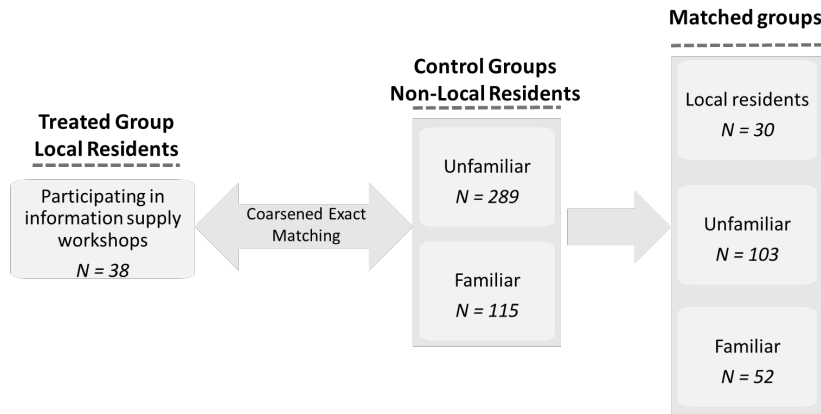
276

277 The characteristics and number of observations of the surveyed populations are different (see
 278 Table 3). This selection bias was corrected using the CEM approach introduced by Iacus et al.
 279 (2011). The main results are presented in the online supplementary material. The key goal of
 280 matching is to prune observations from the data so that the remaining data have better balance
 281 between the matching groups (Iacus et al., 2012). The authors demonstrated how CEM generates
 282 matching solutions that are better balanced than methods under the older existing class based on
 283 propensity scores, Mahalanobis distance, nearest neighbors, and optimal matching (Iacus et al.,
 284 2011).

285

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

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



296

297 *Figure 4. Coarsened Exact Matching (CEM) of the control and treated groups*
 298

299 2.3.2 Identification of ecosystem service presenting homogeneous preferences

300

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

309

310 2.3.3 Analysis of ecosystem services presenting heterogeneous preferences

311

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

318 end we used a logit multinomial model as in Blayac et al. (2014). The dependent variable that
 319 comprised different levels of ES categories was created through identifying different clusters (or
 320 categories) of these ESs using Principal Component Analysis (PCA) followed by Ward's
 321 hierarchical classification (HC) method. Hence this clustering of ESs, in contrast to the use of
 322 standard classification schemes (e.g. Liqueste et al., 2013; Millenium Ecosystem Assessment,
 323 2005; TEEB, 2010), emerged from the respondents' preferences, based on the attributed levels of
 324 priority. Only ESs within the identified clusters that contributed the most to the PCA axis were
 325 retained. The dependent variable was then constructed by calculating an average score for each
 326 cluster of ESs which were generated using Ward's HC method. The preference for a cluster of
 327 ESs for each respondent corresponded to the one with the maximum mean score.

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

$$332 \quad Prob(Y = Cluster\ 1) = \frac{\exp(Z_{Cluster\ 1})}{1 + \exp(Z_{Cluster\ 1}) + \exp(Z_{Cluster\ 2})}$$

$$333 \quad Prob(Y = Cluster\ 2) = \frac{\exp(Z_{Cluster\ 2})}{1 + \exp(Z_{Cluster\ 2}) + \exp(Z_{Cluster\ 1})}$$

$$334 \quad Prob(Y = Reference\ cluster) = \frac{1}{1 + \exp(Z_{Cluster\ 1}) + \exp(Z_{Cluster\ 2})}$$

335 where Z is the coefficient vector including the intercept.

336
 337 At first, we had a list of fourteen explanatory variables. To verify whether or not there was a
 338 multicollinearity (correlation within the explanatory variables), we performed the Cramer's V
 339 test. After the test, we retained eight explanatory variables (see Table 6) out of the fourteen
 340 previously listed. Moreover, interaction effects were observed for the retained variables
 341 'population type' and 'donation to an environmental association' as well as both variables
 342 characterizing levels of knowledge. In addition, there were interaction effects between the
 343 variables 'donation to an environmental association' and both variables characterizing levels of
 344 knowledge. Finally, there was an interaction effect between both variables characterizing levels
 345 of knowledge.

346

347 *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
Explanatory	Population type	Type	Reference cluster
			Unfamiliar non-local residents
			Familiar non-local residents
			Local residents
			Informed local residents
	Sociodemographic characteristics	Age (<i>years</i>)	18-39
			40-59
			60 and up
		Gender	Female
			Male
		Education	High school degree or none
	Bachelor		
	Income (<i>euros per month</i>)	Master and up	
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	
	Heard of the concept of ecosystem services	Good	
		No	
		Yes	

348
349 The overall quality of the multinomial logit model was verified using Akaike Information
350 Criterion (AIC). The aim was to progressively remove interaction effects and single explanatory
351 variables that have no significant impact on the dependent variable from the general model, until
352 the final model with the lowest AIC criterion was reached. The obtained final nested model was
353 then validated based on two hypotheses testing i.e. the Likelihood ratio test and the Hausman and
354 McFadden test. First, the choice for the nested model relative to the initial model was verified
355 through the Likelihood ratio test. The null hypothesis consisted of choosing the final nested
356 model. Secondly, the final nested model was validated through the independence of irrelevant
357 alternatives (IIA) assumption using the Hausman and McFadden test (Hausman and McFadden,
358 1984). This hypothesis is tested to ensure that removing any alternative (here, a cluster of ESs)
359 from the dependent variable does not affect the odds of the remaining alternatives.

360 3 Results

361 3.1 Coastal lagoon ESs: homogenous versus heterogeneous preferences of ESs among groups 362 of respondents

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

376
377 Specific questions allowed to study the pertinence of possible factors explaining choices for those
378 ESs presenting homogeneous preferences among the four groups of citizens (see Table 8). Hence,
379 more than 98% of the respondents, who declared having either a good or a limited level of
380 knowledge of the Palavas lagoons and the associated ESs, favor the regulation and maintenance
381 ESs. The level of priority attributed to environmental education and research opportunity ESs
382 increases with age. For instance, 70.6% of the respondents that are 18–39 years old favor these
383 services against up to 90.6% for the 60 years and above.

384

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

ES category	Ecosystem service	Fisher exact test (p value)
Provisioning	Biomass for grazing	p < 0.001***
	Shellfish farming	p < 0.001***
Regulation and maintenance	<i>Fish resources</i>	0.264
	<i>Water purification capacity</i>	0.298
	<i>Flooding and other extreme events regulation and protection</i>	0.235
	<i>Banks reinforcement</i>	0.196
	<i>Microclimate regulation</i>	0.393
Cultural	<i>Nursery and biodiversity maintenance</i>	0.281
	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**
	<i>Recreational hiking and walking</i>	0.289
	Recreational fishing	p < 0.001***
	<i>Research opportunity</i>	0.869
	<i>Environmental education</i>	0.464

391

392 3.2 Descriptive and inference statistics for ESs showing heterogeneous preferences among 393 groups of respondents

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

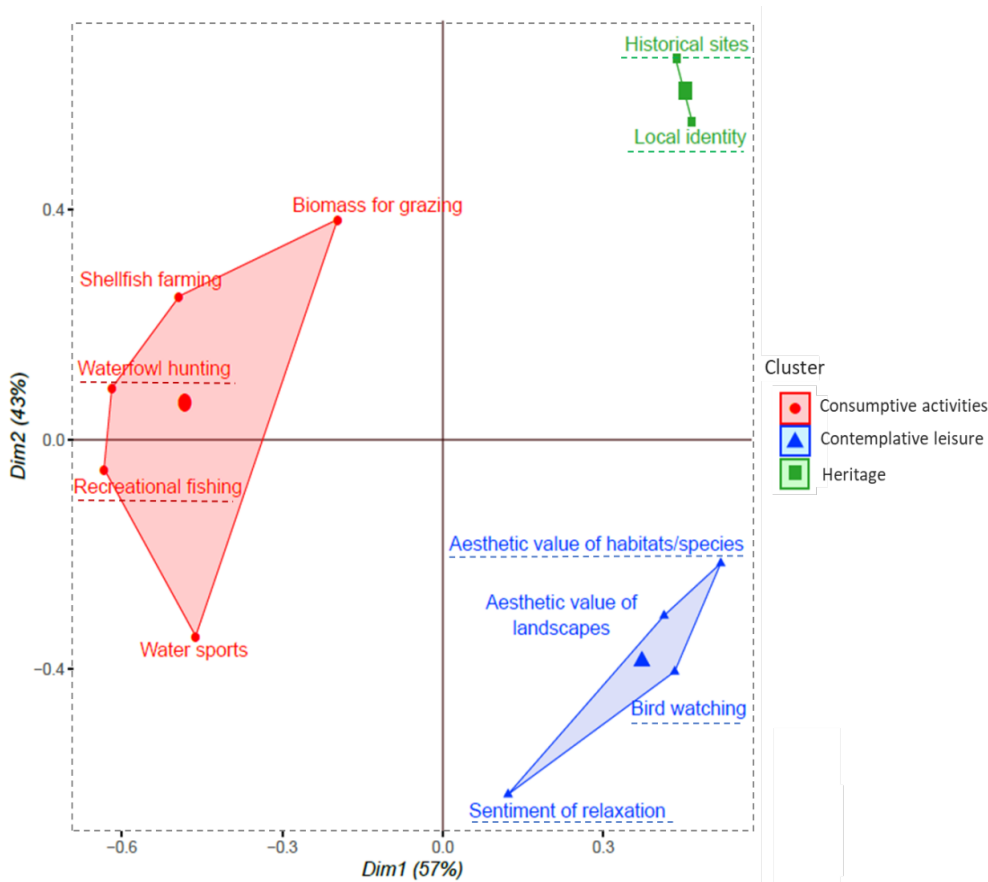
403 five ESs all of which imply consumption of natural resources, either for provisioning or for
 404 leisure, has been defined as ‘consumptive activities’.

405 *Table 8. Factors explaining the level of priority attributed to ecosystem services presenting homogeneous*
 406 *preferences among groups of citizens. P, N and NP stand for “Priority”, “Neutral” and “Not a priority”*
 407 *respectively.*
 408

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	<i>P-Value</i>	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	<i>P-Value</i>	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)	<i>P-Value</i>	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

409 Note: the rows of the table correspond to the factors explaining the level of priority attributed to ecosystem services
 410 presenting homogeneous preferences among groups of citizens. For the first row and first column for instance, the
 411 table is read as follow: up to 98.8% of the responds who already heard of the concept of ESs before the survey
 412 significantly consider regulation and maintenance services as a priority in terms of conservation. Likewise, 1.2% and
 413 0% of these respondents are neutral about the conservation of regulation and maintenance services and consider them
 414 as not of a priority for conservation, respectively.
 415

416



417

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

420 *ecosystem services are the ones that contributes the most to the two axes. See Table B in Appendix B for the*
421 *definitions of the corresponding ecosystem services.*
422

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

435

436 According to this final nested model (Table 9), compared to the unfamiliar non-local residents,
437 the local residents are 5.8 times more likely to choose the ‘contemplative leisure’ ESs over
438 ‘heritage’ ESs. However, this odds ratio decreased to 2.8 after academic information supply
439 during the citizens’ workshops. In other words, relative to the ‘heritage’ ESs cluster and after
440 receiving academic information, local residents’ preferences of the level of priority towards
441 ‘contemplative leisure’ ESs decreased. Moreover, unfamiliar non-local residents were 0.23 and
442 0.21 times less likely to choose contemplative leisure ESs and ‘consumptive activities’ ESs,
443 respectively.

444

445 *Table 9. The final nested model issued from the econometric analysis. It explains the choices for the three clustered*
 446 *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								
<i>Unfamiliar</i>	Ref.				Ref.			
<i>Familiar</i>	0.014 (0.471)	1.014	0.029	0.9771	-0.054 (0.502)	0.947	-0.1084	0.9136
<i>Informed local residents</i>	1.055 (0.476)	2.872	2.217	0.0265*	-0.584 (0.791)	0.557	-0.7309	0.4648
<i>Local residents</i>	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								
<i>Heritage</i>	1	< 0.001	0.999					
<i>Contemplative leisure</i>	1	< 0.001	0.999					
<i>Consumptive activities</i>	4	-0.015						

447
 448 **4 Discussion**
 449 This study focused on the role of information and familiarity in the individual preferences of ESs
 450 in Mediterranean coastal lagoons with the aim of assisting the design of public policies.
 451 Therefore, we studied how different variables impact the preferences of the respondents, using a
 452 logit multinomial model. We considered (i) the level of respondents' knowledge, i.e., whether
 453 they are informed and/or familiar or not, (ii) their behavior towards environment and (iii) their
 454 sociodemographic profile (see Table 6).

455
 456 **4.1 Identification of consensus and understanding of the heterogeneity of preferences**
 457 Surveys for ES assessments need to restrict the number of ESs under consideration for practical
 458 reasons. In our study, we used a list of 20 ESs selected from an original collection of 31 ESs (Sy
 459 et al., 2018) under the guidance of a focus group. A longer list in these questionnaires could
 460 introduce confusion and fatigue. Hence, the selection of ESs for ES assessments, including those

461 based on preference elicitation, is a major issue to facilitate the use of these assessments in public
462 policies. Thus, it has been invoked that ES assessments should concentrate only on a limited
463 number of ESs by selecting those that are most susceptible to variations induced by the different
464 management options (Pendleton et al., 2015). Nevertheless, a longer list without a priori
465 judgments by the policy makers is needed to reveal the preferences based among the populations
466 to respect their different worldviews and multiple values of nature (Diaz et al., 2019). The Q-
467 method, which as a serious card game is more ludic than questionnaires, easily allows
468 considering a larger set of ESs under study without creating confusion (e.g. 31 ESs in the study of
469 Sy et al., 2018). However, such a Q-method cannot be easily implemented for an on-line survey.
470

471 The logic of our survey is consistent with the socio-cultural approach developed by Martin-Lopez
472 et al. (2014). Our results show in the first place a large consensus for 9 of the 20 studied ESs,
473 shown by homogeneity of preferences (see Table 7). These nine ESs included all 5 ESs of the
474 category Regulation and maintenance services, 1 out of 3 provisioning services (i.e., fisheries)
475 and only 3 out of 12 cultural ESs. This pattern of preferences was thus independent of familiarity
476 and information supply and appeared to be accepted *a priori* by an overwhelming majority. This
477 may reflect that nowadays, particularly within the French society, a large majority (85 %) of the
478 general public attaches a high importance to biodiversity and is convinced of the need for its
479 conservation (Croutte, 2015). But while recognizing the importance of biodiversity for supporting
480 life on earth, knowledge of biodiversity and awareness of its importance for well-being is less
481 developed among the general public (Croutte, 2015). It appears that, even when possessing little
482 precise knowledge, the general public trusts and supports the messages delivered by the
483 biodiversity experts. The latter may explain that the ESs research opportunities and
484 environmental education were also homogeneously perceived as relatively very important (see
485 Table 7). Similar results were obtained according the socio-economic approach in the study of
486 Martín-López et al. (2014), which also showed that comparably their monetary assessments
487 tended to underestimate most of the regulating ESs and the ESs research opportunities and
488 environmental education. A study using Q-methodology among highly-involved stakeholders,
489 including different experts, in Palavas lagoons also showed a strong consensus concerning the
490 major relative importance of regulation and maintenance ESs (Sy et al., 2018). Hence, concerning
491 biodiversity and the regulation and maintenance ESs of emblematic ecosystems, there is no major
492 conflict of preferences and opinions between the general public and the experts.
493

494 In contrast, the concept of Cultural ESs (CES) has been subjected to a large debate and
495 controversy in the literature. Some authors suggest revising and broadening the standard
496 frameworks of the concept or discarding the term “cultural” itself (Chan et al., 2012a, 2012b;
497 Winthrop, 2014; Fish et al., 2016; Small et al., 2017) or even abandoning the concept (Kirchhoff,
498 2019). One of the main criticism is that it tries to combine all notions of cultural value (e.g.
499 moral, religious, aesthetic) under a single term (Small et al., 2017). In addition, Díaz et al. (2018)
500 insisted on the role of culture and local knowledge in the way people understand the importance
501 of all ESs, including those that have been classically categorized as provisioning and regulating
502 services. Indeed, the notion of nature’s contribution to people (NCP), which is one of the more
503 recent key elements of the IPBES conceptual framework, recognizes the central and pervasive
504 role that culture and local knowledge play in defining and understanding all links between people
505 and nature (Diaz et al., 2018). Therefore, the cultural background strongly determines how people
506 assess the need for ESs conservation. The paramount role of these cultural factors justifies
507 understanding the preferences and levels of knowledge. This involves psychological and
508 sociological approaches in order to explain determinants of these preferences. The
509 anthropocentric nature of ES is often put forward for its ability to rally individuals more easily in
510 favor of their conservation, while the link between well-functioning ecosystems and their ability
511 to provide ESs is not always well understood. Furthermore, this relationship is not necessarily
512 equivalent depending on the type of ESs, the contexts or the state of conservation of the
513 ecosystems (Barnaud and Antona, 2014). In addition to the lack of information on ecological
514 processes, individuals have a limited ability to process information. And the instability of their
515 preferences over time and the varying context should also be taken into account.

516
517 Our interpretation of the results of this study gave rise to an original typology of CES. The
518 distinction among those CES refers to different motivations regarding conservation depending on
519 whether they are hedonic (i.e. motivations that fulfill personal pleasure or benefit) or stemming
520 from a broader interest in favor of the quality and the identity of the territory. Inductive
521 approaches have been used to empirically study people’s preferences about CES (Dou et al.,
522 2019; Maraja et al., 2016; Pike et al., 2015; Stålhammar and Pedersen, 2017). Comparably, we
523 used such an inductive approach for the 11 ESs with heterogeneous preferences, which indicated
524 that the 9 CES split up into 3 main clusters based on people’s preferences. The eleven remaining
525 ESs were clustered through a PCA followed by Ward’s hierarchical classification method. A
526 multinomial logit model was then developed to determine factors explaining the choice for the
527 identified clusters issued from these eleven ESs. Thus, our results propose a categorization of

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

534

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

548 4.2 Role of information for public policies focusing on learning and engagement of users and 549 residents

550

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

560

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

580

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

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

598
599 The central questions we addressed concerned the impact of information on preferences taking
600 into account how the information was acquired by the citizens. Information acquired by
601 familiarity with a natural environment according to the frequency of visits can be differentiated
602 from those resulting from academic trainings or those that are more contextualized and are
603 offered as awareness-raising measures. Hence, information supply can reduce bias by making
604 individual choices more informed and may lead to the reorganization of preferences. This may
605 even lead to changing the value systems of the citizens (i.e., double loop processes). In the case
606 of knowledge related to the functioning of ecosystems and the contribution of ESs to the well-
607 being of society in general, individuals' preferences are influenced by cultural dimensions that
608 must be taken into account. These include the links of individuals to nature as well as their
609 cultural proximity to ESs (i.e. these ESs are part of their culture). Hence, the fact that unfamiliar
610 populations attributed a greater consideration for heritage services is striking. We think that this
611 is because these populations are neither directly concerned by the direct consumptive nor by the
612 contemplative benefits of these ecosystems and therefore not influenced by their own interest and
613 affection for these natural areas. This lack of concernment can be linked to the notion of veil of
614 ignorance popularized by Rawls (Rawls, 1971). According to the ethics suggested by Rawls,
615 parties who judge policy and management options are supposed to adopt a veil of ignorance. This
616 implies a thought experiment for the participants, which purpose is to fully neutralize the
617 influence of their specific individual interests. Under such a veil of ignorance, the parties will
618 hopefully tend to evaluate the options only on the basis of considerations of general interest
619 (Rawls, 1971). It appears that the unfamiliar populations, that might not be aware of how the
620 various alternatives will affect their own particular case, seem to evaluate the ESs spontaneously
621 in accordance with this veil of ignorance. This observation advocates the interest to involve
622 diverse populations in preference elicitation surveys. Indeed, mobilizing only local knowledge
623 when carrying out ESs assessment might present a risk of favoring particular individual and local
624 interests.

625

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

658

659 **5 Conclusion**

660

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

669

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

680

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

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

699

700

701 **6 Appendix**

702

703 Appendix A: The content of the survey

704

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

707 **A. The ‘Familiarity and use of the lagoons complex’ category included questions like:**

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

714

715 **B. The ‘preference elicitation’ category included one question which was formulated as**
716 **follow:**

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

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

723

724 **C. The ‘level of knowledge of the lagoons complex and the services they provide’ category**
725 **included questions as:**

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

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

748

749 **D. Finally, the ‘sociodemographic profile’ category included questions about, for instance,**
750 the respondents’ age, gender, and behavior towards environment (whether she or he is a member
751 or donates to an environmental association for instance, respondents’ connectedness to nature
752 ...).

753

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

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

ES category	ES subcategory	Ecosystem services	General definition	
Provisioning	Food provision	Biomass for grazing	The provision of biomass for human consumption and the conditions to grow it. It mostly relates to cropping, animal husbandry and fisheries.	
		Shellfish farming Fish resources		
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.	
Cultural services	Life cycle maintenance	Nursery and biodiversity maintenance	Biological and physical support to facilitate the healthy and diverse reproduction of species.	
	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.

758

759

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

762

763 *Table C. Levels of priority of ecosystem services presenting homogeneous preferences among the groups of*
 764 *respondents according to familiarity and academic information supply. The corresponding level of priorities are*
 765 *indicated in the table as P, N and NP which stand for “Priority”, “Neutral” and “Not a priority”, respectively.*
 766

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%

767

768

769

770 **7 Acknowledgments**

771 Mariam Maki Sy benefitted from a PhD fellowship from the DRIIHM LabEx (ANR-11-LABX-
772 0010_DRIIHM), “Device for Interdisciplinary Research on human-environments Interactions”
773 within the framework of the Human-environment observatory “Mediterranean coastline”. The
774 authors thank the members of the former Syndicat Mixte des Etangs Littoraux (SIEL) for their
775 support and advice during the data collection process. Mylène Farge and Nicole Lautrédou-
776 Audouy are thanked for their help in organizing the citizen workshops. We are most thankful to
777 the thirty-eight citizens who participated in the citizens’ workshop on a voluntary basis and
778 genuinely provided their time for this study. We also acknowledge the participation of the
779 respondents in the internet survey. All data have been treated anonymously in compliance with
780 the EU General Data Protection Regulation (GDPR).

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