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Reshaping preferences over coastal and marine environment. Evaluating temporal effects on preferences raised by information campaigns

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ABSTRACT

The present study attempts to evaluate an allegedly promising instrument of environmental policy: public information campaigns for raising awareness, as reflected by enhanced environmental preferences. We evaluate an intensive campaign addressing plastic pollution in a coastal and marine environment, an issue of high environmental importance which is increasingly attracting public interest. Using stated preference surveys, we evaluate the effects of the campaign on preferences for ecosystem services and environmental goods. Our focus lies in the temporal effects across seasons, inducing different ecosystem services, approximating the effects of information on use and non-use values.

Our findings indicate that systematic provision of information can enhance preferences and, although a time-decay effect exists, awareness remains significantly enhanced after the end of the campaign albeit not uniformly across different (use and non-use) values. As the impacts on preferences are subject to variation of seasonal experience with ecosystems - implying variation in the intensity of use – additional to a time-decay effect, it emerges that although information is a necessary instrument of environmental policy, it cannot be a sufficient one. An effective policy, addressing the needs of future generations, also requires instruments that give economic signals (taxes) and constrain preferences (standards) with information provision enhancing their impacts.

1. Introduction

Preferences for ecosystem services (ES) can be influenced by information provision and environmental education, which may partially offset individuals' inherently limited knowledge and experience (Kikuchi-Uehara et al., 2016; Lang and Cavanagh, 2018; Chen and Cho, 2019). This has led environmental policy to consider environmental awareness as a major instrument tending sometimes to substitute "traditional" instruments such as taxes, standards, etc. Public information campaigns (PIC), in contrast to economic instruments, attempt to produce policy results without creating disincentives or applying command and control approaches (Weiss and Tschihart, 1994). Information provision through PICs usually aims at encouraging behavior changes and at helping citizens to become familiar with environmental goods and the associated ES, thus making informed trade-offs among goods. This is particularly critical for those ESs arising from coastal marine ecosystems whose contribution to social welfare is not clear for the public. Those ESs are usually non-marketed while coastal and marine environment is a dynamic and sensitive common resource.

The effects of environmental information and awareness on individual preferences have been partially analyzed as a component of valuation studies. The so-called "Information effects" and "information bias" indicate how environmental economics perceives the provision of information. To a large extent, such analysis examines the instantaneous effects of information being an integral part of the valuation study (Aravena et al., 2018). Willingness to pay (WTP) values have been found to be sensitive to the information provided, especially for unfamiliar (environmental) goods/services (Tisdell et al., 2008).

Recent literature investigates the stability of environmental preferences, however without information provision as a key driving factor. The stability of environmental preferences and values has been evaluated conducting test-retest stated-preference experiments over short time frames often using the same sample of respondents (Rolfe and Dyack, 2019). Such investigations assume that market conditions, and

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other factors that might influence value estimates, have not changed over time (Bishop and Boyle, 2019). Another group of studies focused on identifying whether values might vary temporally (Neher et al., 2017), due to fundamental changes in the economy, society or the environment which could affect preferences (e.g., average income). In this second group of studies, surveys were usually repeated over longer time periods (e.g., three years and more). Most of these studies use contingent valuation techniques and only a few recent studies have been based on choice experiment applications with multi-factor designs (Czajkowski et al., 2016; Brouwer and Logar, 2014; Schaafsma et al., 2014; Liebe et al., 2012; Brouwer et al., 2017). The prevailing conclusion is that environmental values are relatively stable over time spans up to 5 years (Skourtos et al., 2010), although this was not always the case (e.g., Bliem et al., 2012; Schaafsma et al., 2014; Matthews et al., 2017; Rigby et al., 2016). Notably, in all these studies, the fluctuations of values, when identified, were not evaluated against the role of information provision. As a result, there has been no systematic analysis of the durability of preferences, as shaped by the influence of PICs in raising environmental awareness. However, the duration and the magnitude of effects induced by PICs is crucial for environmental policy. Furthermore, the science of economics, when analyzing public goods, would also benefit from such an analysis.

The present study aims to examine the effects of information provision on environmental values in coastal and marine ecosystems, focusing on the duration of effects on preferences for ES induced by a content-intensive, long-term information campaign. The evaluation considers a time span of one and a half years, starting just a few days before information provision (before the information campaign) and finishing 6 months after the end of the campaign, while performing evaluation at four indicative time points. Short-run effects are compared with long-run ones, and we attempt to assess whether long-run effects are diminishing after the end of information provision. The study aspires to trace the effects on different types of values e.g., direct and indirect use, intrinsic etc. Furthermore, the study attempts to investigate how use intensity influences the effects of information. To do so, the effects at different seasons of the year, implying differentiated experience with the ES at hand, are investigated. The effect on citizens' willingness to pay has been adopted as the major index for evaluating the impacts of information on preferences. A discrete choice experiment (DCE) method was used, aiming to identify inter-temporal differences in WTP values for protecting various coastal and marine ES from plastic waste. Contrary to Tisdell et al. (2008), although information provision was an integral part of the study design, all respondents may not receive identical information. The study aimed at approximating real-world conditions, which endow the findings with policy relevance. Successive surveys interviewed different samples of individuals from the very same population which had been the subject of the information provision. In this way the study approximated the actual "average" preferences which determine actual behavior against ES as defined by the stance of the population. Designed as an integrated part of a natural experiment, the study took place on a Greek island whose population size permitted thorough coverage by the information campaign.

2. Methodology

2.1. Study area and the public information campaign

The study was carried out on the island of Syros, located 144 km south-east of Athens, in the Cyclades Islands, in the center of the Aegean archipelago in Greece. Syros is the most populated Cycladic Island, and its capital, Ermoupoli, is the center of the administrative region of the South Aegean. Syros is a popular tourist destination due to its proximity to Piraeus (the port of Athens) as well as to its well-developed tourism infrastructure. It was considered a typical Mediterranean island, representing a socio-economic system which is closely linked to several provisioning and cultural ecosystem services (ES) provided by the coastal and marine environment (e.g., fisheries, recreational activities, tourism etc.). These services enhance the local economy of the island, which is heavily dependent on the healthy functioning of marine ecosystems. Marine litter and especially plastic waste (washed ashore or discarded on beaches) may result in the loss of these ES and, therefore, have a profound impact on economic sustainability and social well-being.

To improve local citizens' knowledge of the problems created by plastic pollution (Leal Filho et al., 2019), and particularly by plastic bags, on coasts and in the marine environment, a long-term and content-intensive public information/education campaign took place on Syros, lasting about two years (May 2016–May 2018). The information campaign was conducted within the context of the LIFE DEBAG Project (Integrated information and awareness campaign for the reduction of plastic bags in the marine environment[1]). The main target groups were the citizens of Syros Island, regional local authorities, and certain stakeholders, such as business chambers and local business associations, owners of hotels and rented rooms, major supermarkets of the island, NGOs, etc.

The information campaign was based on disseminating information and data on the impacts of marine plastic pollution, as well as methods and actions which prevent such a threat. The information campaign exploited electronic media and the press, incorporating a series of activities such as an e-newsletter, a campaign in social networks (based on presentations and information provision on Facebook, Twitter, Instagram, YouTube, Vimeo), campaigns on TV and radio stations (via interviews with the project participants), and a campaign in print media (focused on article publications and informative interviews). Furthermore, a comprehensive integrated educational package was developed for primary and secondary schools of the island, including a teacher's guide (factsheets and worksheets), experiential learning seminars for teachers and the installation of upcycling toolboxes at schools. Improper plastic bag use and disposal, the sense of public ownership, participation in mitigation activities, and shifting from a throwaway type of society toward a more sustainable one, were the main components (goals) of the information campaigns.

The PIC focused on plastic bags for the following reasons: (a) plastic bags are one of the most common sources of plastic waste and one of the most common types of beach and marine litter (Ritch et al., 2009; Avio et al., 2017; Thushari and Senevirathna, 2020); (b) there exist perfect substitutes which offer the same level of utility (Edwards and Fry, 2011; Saibuatrong et al., 2017; Ahamed et al., 2021); (c) it is easy to apply the main principles of the circular economy to the user/consumer (i.e. waste reduction, substitutability, reusability and recycling of plastic litter and plastic bags) (Korhonen et al., 2018; Payne et al., 2019; Robaina et al., 2020); (d) plastic waste is associated with impacts on multiple categories of ES (i.e. several ES may benefit from its restriction) (Worm et al., 2017; Simul Bhuyan et al., 2020; Ali et al., 2021); (e) as recommended by the European Directive 2015/720, both restrictive (total or partial bans) and economic measures (pricing, taxes and levies) can be applied to reduce their consumption (Schnurr et al., 2018; Behuria, 2019; Adam et al., 2020).

Although the campaign involved continuous activity throughout the whole period, it also included intensive milestones, called "Plastic Bag Free Week" targeting the general public, the regional local authorities and specific stakeholders. Their goal was to sensitize the citizens of Syros Island, small and medium-sized enterprises (SMEs) and relevant authorities to the importance of effective plastic waste control and recycling in contributing to an improved coastal/marine environment. An extensive door-to-door awareness raising campaign was implemented on Syros Island informing approximately 4300 households, 700 retail shops and SMEs associated with the use of plastic bags, concerning the impacts of the use and disposal of plastic bags. This face-to-face information provision was based on verbal presentations and the

[1] http://www.lifedebag.eu/?page_id=103&lang=en.

distribution of leaflets.

In addition, at least 400 owners of hotels and room rental facilities were informed in a similar way and provided with leaflets in five languages for placing in approximately 5000 rooms. It is thus estimated that approximately 30,000 permanent habitants and visitors/tourists were informed during these PICs. An evaluation indicated that most households and SMEs had been informed and a significant number of hotel owners had been approached. Some specific actions of the milestones (Plastic Bag Free Weeks) of the PICs are presented in Appendix A.

2.2. Conceptual framework

Previous findings indicate that PICs targeting environmental goods (or ecosystem services) are expected to have a positive effect on residents' WTP for ES (e.g., van der Wal et al., 2014; Szabó and Ujhelyi, 2015; Latinopoulos et al., 2018). Our a priori expectations (hypotheses) were that a better-informed society would be: (1) more aware of what exactly it is being asked to pay for (Brouwer et al., 2016), (2) more willing to act (e.g., waste reduction, participation in beach clean-ups) (Rayón Viña et al., 2019; Adam, 2021) and (3) more willing to pay for an environmental protection program. It was expected too that WTP may also be negatively affected as we move further away from the dates of the campaign (due to inability to retain information over time). This time decay effect could be interpreted as the result of forgetting information acquired during the campaign, especially if this information has not been called upon by individuals for some time (Wickelgren, 1972; Tisdell et al., 2008).

We considered utility perception and WTP as dynamic processes which are directly associated with information provision. Fig. 1 describes our theoretically expected evolution of the WTP for preserving coastal/marine ES due to information provision. As depicted in this graph, increasing exposure to information through the milestones of a public information campaign is likely to gradually increase WTP values. On the other hand, WTP in the long term may also decrease as time elapses after the end of the intensive milestones of the campaign. This decay effect may be induced by the physiology of people's memory capacity. It is difficult to predict the magnitude of this effect and how it defines the rate of WTP decline. For this reason, two alternative trajectory paths are assumed in Fig. 1 after the end of the campaign (i.e., after the 2nd milestone). The first suggests a strong decay effect as marked by the path **HJ,** while the second assumes a smooth decay effect reflected by path **HI.** As our study aims to explore the dynamic time path of WTP, as influenced by information provision, we wish to test which theoretical path prevails after the end of the campaign in the WTP for each ES under consideration, as well as in the (aggregate) WTP for preserving the whole coastal/marine environment.

To examine the effect of information provision on social preferences, four identical surveys were conducted in different periods between May 2016 and December 2017, representing specific time points in the framework of Fig. 1. The first survey (point A in Fig. 1) was conducted before the first milestone of the PIC (Plastic Bag Free Week, 2016) and the second one (point C in Fig. 1) just after the first milestone, while the last two surveys were conducted one month (point G in Fig. 1) and six months (point I or J in Fig. 1) after the second milestone (Plastic Bag Free Week, 2017), respectively. It should be noted that we chose not to evaluate the effects on preferences during the last five months of the campaign (January–May 2018) since a plastic bag levy was introduced in Greece on 1/1/2018. This was a fundamental structural change whose influence on social preferences might be profound, at least in the short run. Undertaking a survey after that date, it would have been impossible to separate the effects of the bag levy from the effects of the PIC.

In recent years, several non-market valuation studies have been employed to determine the monetary value of ecosystem services, but the stated preference approaches are of particular interest due to their ability to capture both use and non-use values by relying on individuals' preferences and values. These approaches are also useful for studying preferences, behavior change, and willingness to pay for policies that have not yet been implemented in order to improve future policy-making, as well as the current provision of ecosystem services. In this framework, we utilized the choice experiment method to elicit residents' WTP for preserving coastal/marine ecosystem services in the island of Syros. The analysis was done using a specification and estimator that allowed the exploration of individuals' heterogeneity on top of the temporal effects of a PIC (see sections 2.5 and 3).

2.3. Survey design

A stated preference framework based on the choice experiment method (Louviere et al., 2000) was used to elicit the preferences for ES in the coastal and marine environment of Syros Island, Greece. A discrete choice experiment was conducted to assess, in different time periods, the WTP for preserving various ES that are likely to be affected by plastic litter in the local coastal/marine environment (Latinopoulos et al., 2018). In order to elicit WTP, residents of the island were asked to choose among several alternative coastal protection programs (i.e., plastic waste management programs), with different costs "securing" different levels of coastal/marine ES.

The selection of attributes reflected the following key principles: (a)

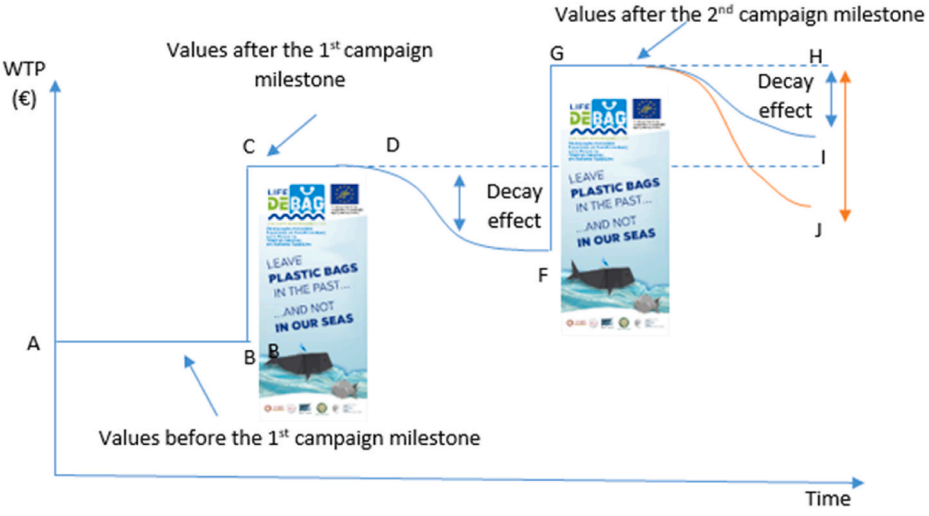

Fig. 1. Theoretical framework of a dynamic WTP function as influenced by the PIC (modified from Tisdell et al., 2008).

incorporation of the most relevant ES (including provisioning, cultural and regulating services) and linking them to use and non-use values, (b) permitting seasonal variation of citizens' experience with ES in order to elucidate how variation in the intensity of use influences the effect of information provision on different values, (c) being policy relevant to coastal/marine environment protection, and (d) being easy to explain to the general public. We investigated all three categories of harm caused by marine litter, as defined by Galgani et al. (2010): (a) social harm (e.g., reduction in aesthetic value and public safety), (b) economic harm (e.g., cost to tourism, damage to fishing activities, losses to fishery operations) and (c) ecological harm (impacts on marine biodiversity). In this framework, the following four attributes were selected (Latinopoulos et al., 2018):

- Recreational activities: This attribute is associated with the ES of recreation and (eco)tourism, which is defined as *"the recreational pleasure that people derive from natural or cultivated ecosystems"* (MEA, 2005), constituting an important cultural ecosystem service (CES) (Sukhdev et al., 2010). Recreational activities can be examined either as a set of attributes referring to particular activities or as a single attribute representing the whole recreational utility (Doherty et al., 2014). In our model the attribute of recreation is specified as indicating the quality of recreational activities, which may be affected by the concentration of plastic litter on beaches. These include bathing, water sports, sunbathing, etc. Recreational values (either in the form of tourism revenues or in the form of resident utility) are usually considered as use values incorporating mainly direct and some indirect use elements.
- Landscape quality: Coastal environments shape aesthetically attractive landscapes which can be appreciated by both tourists and residents. This attribute aims to capture the aesthetic value of coastal/marine ecosystems, which may be degraded due to the presence of plastic litter. We aim to evaluate residents' preferences for aesthetically attractive beaches and shorelines - with no organized activities on site (to avoid overlap with the previous attribute) - which are not "damaged" and subsequently degraded by plastic waste. Therefore, landscape quality in this study involves mainly indirect and some direct use values.
- Biodiversity: Plastic litter emerges as a severe threat to coastal and marine biodiversity. Several marine species and organisms are negatively affected by plastic debris (Campani et al., 2013; Rochman et al., 2013). We use the biodiversity attribute to capture the intrinsic (non-use) value of the marine/coastal ecosystem. This attribute was communicated to the public with direct reference to the ecosystem service of habitat protection/provision (De Groot et al., 2002). It should be noted that habitat protection/provision is not specifically categorized as an ES in MEA (2005) because it may overlap with other functional groups. However, given the way that this attribute was communicated, focusing exclusively on the ecologically important species/areas and the appropriate selection of the other three attributes, the risk of overlap is eliminated.
- Commercial fishing activity: Fishing and seafood provisioning are marine ES of primary interest to many coastal/island regions. An increasing concentration of plastics in the marine environment may affect this service through: (a) impacts on future fishery stocks and, hence, on fish catch, and (b) impacts on the food chain with potential consequences for human health (Meeker et al., 2009). In our questionnaire surveys, this attribute was communicated to the public in the context of lower risk both to fishermen's future revenues (and thus to the local economy and employment), as well as to seafood quality and safety. Both approaches are associated with direct and indirect use values, incorporating to some extent an option value, which is the value placed on the potential future use of fisheries.

A key question of the study was the evaluation of the effects of PICs on different types of values with emphasis on the distinction between (direct and indirect) use and non-use values. Seasonal variation in the use of ES, influencing mainly use values, has been incorporated into the study aiming at evaluating the PIC's effect at different periods with different intensity of use of the ES at hand. In this context, "RECREATION" depicts a use value with significant seasonal variation between winter and summer. In contrast, "FISHERIES" incorporates a use value without variations among different periods of the year. "LANDSCAPE" reflects an ES with a medium level of variation between summer and winter, while the non-use values inherent to "BIODIVERSITY" evade the influence of any seasonal variation.

The attributes were categorized according to qualitative features and these categories were ranked and considered as levels on an ordinal scale ranging from very low to very high environmental impact. The aim is to describe the potential environmental benefits of the proposed waste management programs in terms of impact (risk reduction). Environmental benefits of such programs are difficult for participants to measure and compare with a baseline scenario. Therefore, we used risk reduction from the status quo attributes as a measure that can be easily understood and evaluated according to participants' perceived benefits. Following the recommendation of Johnston et al. (2017) the attribute levels were communicated using both textual and visual means. Waste management programs were incorporated as a policy attribute to explore residents' preferences regarding alternative policies. Specifically, a plastic pollution control policy attribute was used, to examine whether residents are more inclined to accept a ban or a restriction on plastic bags to improve the ecosystem services. It should be noted that there was no a priori expectation as to whether this policy attribute would affect preferences, nor in which direction (i.e., if it generates utility or disutility to residents). A cost attribute was also included to allow the estimation of the marginal WTP values for each ecosystem service. The payment vehicle for this survey was chosen to be the bi-monthly municipal taxes, which are collected as part of the electricity bills levied on all households. In particular, the cost attribute was specified as the additional cost that someone would pay through these levies. Thus, following Johnston et al. (2017), we used a payment vehicle that is realistic, credible, and familiar to respondents and applies to the entire sampled population, while also being consistent with the mechanism described to bring about the change to be valued.

A small-scale pilot study (30 questionnaires administered through in-person interviews) was conducted in order to ensure that the questionnaire was appropriate and comprehensible, and that the questions were clearly presented and understood in a consistent manner. The pilot survey revealed that: (a) respondents could easily understand the levels of attributes and their descriptions, and (b) respondents fully understood the hypothetical market and were able to make comparisons across the choices presented in their choice cards. It also revealed the need to shorten the length of the questionnaire, to improve some wording regarding the coastal marine pollution, and to reduce the upper level of the cost variable. All issues were addressed prior to conducting the first survey.

Table 1 presents the selected attributes, their levels, and the associated ES (where relevant). As shown in this table, "BIODIVERSITY", "FISHERIES", "LANDSCAPE" are specified with two levels (a poor level corresponding to the status quo and a realistic future improvement) to depict the different quality levels that could apply to these attributes. On the other hand, the attribute of "RECREATION" was specified with three levels to represent two distinct improvement scenarios (with different expected impact on different leisure activities). As already mentioned, the plastic pollution policy attribute (BAGS) was specified with three levels (no policy action, restricted use of plastic bags, and complete ban on the use of plastic bags), while five different levels were assigned to the COST attribute (0, €3, €6, €10 and €15). Given this set of attributes, an orthogonal design was employed to derive the choice sets. Then we combined these sets into choice cards, which consisted of two alternative choice sets (i.e., two alternative coastal/marine protection programs) and a status quo option (a zero-cost option without further

Table 1
Attributes, related ecosystem services (ES) and levels used in the choice experiment surveys.

Attribute	Associated ES	Attribute levels
Recreational activities (RECREATION)[b]	Recreation and tourism	No impact on recreation [a] Plastic waste has a relatively small impact on recreational enjoyment Plastic waste has a significant impact on recreation enjoyment
LANDSCAPE[b] quality	Aesthetic values	Significant aesthetic degradation due to plastic waste[a] No degradation
BIODIVERSITY	Habitat for species (protection/ provision)	Plastic waste is a major threat to coastal/marine biodiversity[a] Plastic waste is a minor threat to coastal/marine biodiversity
FISHERIES	Food provision (seafood)	Plastic waste is a major threat to local fisheries[a] Plastic waste is a minor threat to local fisheries
Policy tool	–	No measures taken[a] Restricted use of plastic bags (BAGS1) Complete ban on plastic bags (BAGS2)
Expected bi-monthly COST (€)	–	0*,3, 6, 10, 15

Note:
[a] Current attribute levels (status quo).
[b] Capital letters are used to denote the attribute names.

improvements in environmental protection and without restrictions or bans on plastic bags). This process resulted in 16 choice cards. However, since 16 cards are too many for one individual to evaluate, they were randomly divided into four different versions, so that each respondent was provided with four choice cards. Figure B1 in Appendix B presents a sample of the choice cards used in the questionnaire surveys.

The questionnaire also included questions related to knowledge, attitudes and opinions concerning local environmental issues, some follow-up questions (regarding difficulty in answering the choice cards, the reasons for opting out and the main motivation for their WTP), as well as questions regarding respondents' demographic and socio-economic characteristics. Since the campaign involved activities throughout the whole period and included intensive milestones, we assumed that the whole population was to some extent affected by the information provision, thus generating a positive information effect at the population level. Nevertheless, in order to examine the impact of the active exposure of residents to the campaigns' milestones, we incorporated some relevant questions.

2.4. Survey implementation and sample characteristics

Four identical surveys, offering the same choices to respondents, were conducted in the study area over a period of approximately one and a half years. The target population was the whole resident population of Syros Island. All surveys were conducted through face-to-face interviews. On-site surveys via face-to-face interviews may reach more respondents as they are not limited by technical constraints (internet access, bandwidth speed, etc.), the availability of respondents is often higher compared to telephone and online surveys, and skilled interviewers may attract respondents from certain target groups that are not likely to participate in online surveys (Duffy et al., 2005; Heerwegh and Loosveldt, 2008; Szolnoki and Hoffmann, 2013; Saloniki et al., 2019; Cernat and Revilla, 2020; Tran and Luong, 2020). The interviewers strove to ensure that the questions (choice-cards, etc.) were properly explained based on appropriate prompts, whilst excluding any biases. The samples were proportionally stratified according to age, gender, and education, which were characteristics considered likely to be important in shaping people's choices. Consequently, all samples can be reasonably considered to be representative of the island's population.

The first survey was conducted in early (4–6) May 2016, just before the launch of the information campaign, which started with its first milestone ("Plastic Bag Free Week, 2016"), which took place between 27 May and June 5, 2016. A total of 121 individuals completed this survey. The second survey, in which a total of 119 questionnaires were collected, was conducted a few days after the first milestone. The third survey was conducted between 15 and 24 June 2017, just after the second milestone of the campaign ("Plastic Bag Free Week, 2017")[2] that occurred between 8 and 14 May 2017. A total of 200 individuals completed this survey. The final (fourth) survey was conducted between 7 and 15 December 2017, six months after the second milestone of the campaign – which essentially marked the end of the campaign - and a total of 191 questionnaires were collected. The response rate (i.e., non-protest responces) in all surveys was very high, around 85% (ranging between 84% and 87%), thus minimizing the risk of bias due to non-response. However, it should be noted that in June 2016 the response rate was 75%. As such, the main results are reported with, and without protest bids for good measure.

A debriefing question concerning the reason for not being willing to pay any amount for a waste management program was used in each survey to classify the zero-bid (opt-out) responses as either true-zero or protest votes. Individuals were identified as giving a protest answer if they chose the following justification: "It is the state's/municipality's responsibility to pay for the proposed program". The percentage of protesters was quite different among the four surveys, with a declining trend over time (see Table 2). This may be interpreted as indicating that the protest rate declines as more information becomes available (Borzykowski et al., 2015).[3]

Next, we used a logit analysis to examine the differences between the protest responses in all four samples as shown in Table C3 in the Appendix. In terms of ex-ante framing methods, a cheap talk script was incorporated together with an opt-out reminder aiming to eliminate hypothetical bias and ensuring incentive compatibility and consequentiality, whilst moving the elicited estimates of value closer to the true values (Ladenburg and Olsen, 2014; Varela et al., 2014; Mariel et al., 2021). Even though cheap talk scripts have been criticized on account of reducing stated willingness to pay (Lusk 2003; Tonsor and Shupp, 2011) or increasing hypothetical bias (Aadland and Caplan, 2006), the combination of ex-ante framing methods may contribute significantly to reducing hypothetical bias (Carlsson et al., 2004; Ladenburg and Olsen, 2014; Silva et al., 2011; Zawojska; Czajkowski et al., 2016; Mariel et al., 2021).

In relation to the main socio-economic characteristics of the respondents in each of the four samples, as well as their main attitudes, opinions and perceptions concerning the local coastal/marine environment, the samples are quite similar (see Table 2).[4] The only important difference between the samples is income distribution, as the proportion belonging to the higher income groups was smaller in the 4th survey (Dec-17). Furthermore, in Table C1 in the Appendix indicates that there is a difference between the age groups across specific waves, but this difference is not significant in the joint test across all waves. This outcome is associated with the lower percentage of respondents working in tourism during that period, as some employers and employees in the tourism sector leave the island for the winter. Despite this variation, and

[2] More information can be found at http://www.lifedebag.eu/?page_id=103&lang=en.
[3] However, this is just a suggestion; no analysis was conducted on that matter.
[4] More information on the comparison tests of the demographic variables can be found in Table C1 in the Appendix.

Table 2
Basic descriptive statistics.

	Total sample	May-16	Jun-16	Jun-17	Dec-17
Sample size	**631**	121	119	200	191
Protest rate	**16%**	25%	16%	15%	13%
Education					
Primary or none	**5%**	3%	11%	3%	5%
Secondary-lower	**8%**	6%	13%	5%	9%
Secondary-higher	**38%**	32%	39%	42%	39%
BSc	**42%**	50%	34%	44%	41%
MSc & PhD	**7%**	9%	4%	7%	6%
Income					
No answer	**0%**	0%	0%	1%	0%
0 - 5000€	**16%**	10%	11%	17%	20%
5.000€ - 10.000€	**22%**	18%	22%	24%	24%
10.000€ - 15.000€	**35%**	35%	35%	35%	36%
15.000€ - 20.000€	**15%**	17%	13%	13%	17%
20.000€ - 25.000€	**9%**	16%	11%	8%	3%
>25.000€	**3%**	4%	8%	3%	0%
Gender					
Female	**48%**	53%	41%	49%	48%
Male	**52%**	47%	59%	51%	52%
Age					
18–34	**21%**	26%	3%	28%	23%
35–64	**70%**	70%	83%	65%	66%
65–89	**9%**	3%	13%	8%	11%
Recycling	**93%**	91%	91%	97%	93%
Working in tourism	**33%**	39%	44%	31%	24%

assuming that the last survey is representative of Syros' population during the winter months, it is quite safe to say that all the samples can be considered sufficiently similar - in terms of all the predictors of interest - to rule out any sampling bias.[5]

2.5. Modelling heterogeneity

Given the panel structure[6] of our data, and the expectation of heterogenous preferences between respondents, we employ the Mixed Logit (MXL) estimator in the preference space (Fadden and Train, 2000; Hensher and Greene 2003). Based on Train (2009) and Hole (2007), given J alternatives the utility of an individual n from alternative j is:

$$U_{njt} = \beta_n^{'} x_{njt} + \varepsilon_{njt} \tag{1}$$

where β_n is a vector of the individual-specific coefficients, x_{njt} is a vector of observed attributes relating to individual n and alternative j on choice occasion t, and ε_{njt} is a random term that is assumed to be an iid extreme value over time individuals and alternatives.

The probability conditional on β of respondent n choosing alternative i on choice occasion t is:

$$L_{nit}(\beta_n) = \frac{\exp\left(\beta_n^{'} x_{nit}\right)}{\sum_{j=1}^{J} \exp\left(\beta_n^{'} x_{njt}\right)} \tag{2}$$

If we observe a sequence of choices the probability that the person makes this sequence of choices is the product of logit formulas $L_{nit}(\beta_n)$ which is

$$L_{ni}(\beta_n) = \prod_{t=1}^{T} \frac{\exp\left(\beta_n^{'} x_{nit}\right)}{\sum_{j=1}^{J} \exp\left(\beta_n^{'} x_{njt}\right)} \tag{3}$$

Given that, the unconditional probability would be:

$$P_n(\theta) = \int L_{ni}(\beta)(\beta|\ \theta) d\beta \tag{4}$$

The MXL assumes that there is a mixing distribution $f(\beta_n|\ \theta)$, for β_n, where θ is a vector of parameters, and β_n are preference parameters that may vary across individuals (von Haefen et al., 2018). Based on that, the MXL introduces the unobserved heterogeneity for attributes through random coefficients, thus relaxing the strict independence of irrelevant alternatives (IIA) assumption. All presented results are based on the preference space estimation of the MXL.[7]

As our main concern is the effect of information on WTP, we estimate our model including all four periods of the surveys. In our analysis we have assumed that all attributes have normally distributed random coefficients (i.e., change by individual and through time), and only the socioeconomic characteristics have fixed coefficients. After estimating the total model using the MXL estimator,[8] we calculate the individual-level parameters (see Revelt and Train, 2000; Train, 2009) based on 10000 Halton draws.

As described by Train (ch11, 2009), and Hole (2007) using the method of Revelt and Train (2000) individual-level parameters corresponding to the variables used in the model can be calculated. We are using this methodology to split the distribution of the population into subpopulations by date in order to estimate based on these distributions the mean WTP.

Then, based on the individual level parameters the Marginal WTP and the Total WTP (log-sum expression) are estimated. The marginal WTP (MWTP) for a single attribute (k) was calculated as:

$$MWTP_{kt} = -\frac{\beta_{kt}}{\beta_{price,t}} \tag{5}$$

where β_{kt} is the coefficient of attribute k in time t, and β_{price} is the bid coefficient.

The Total WTP (from inclusive value) arises from all attributes as the sum of the utility in several states of the world, weighted by the probability that each state occurs (Ryan et al., 2007; Lancsar and Savage, 2004). The formula for the Total WTP is:

$$WTP = -\frac{1}{\beta_{price}}\left[\ln\left(\sum_{j=1}^{3} e^{\mu V_j}\right)\right] \tag{6}$$

where the inclusive value is divided by the bid coefficient. V_j represents the indirect utility function, μ is a scaling parameter depending on the attributes' coding ($\mu = 1$ for continuous and dummy variables, $\mu = 2$ for effect-coded variables), and j represents each alternative.

This estimation approach, in contrast to splitting the estimation by date, allows for a more flexible analysis of heterogenous treatment effects inter-temporally under the same conditions. Our analysis explicitly models the heterogeneity in the preferences of each respondent, thus incorporating the time dimension in the same regression. There, without making strict assumptions concerning the differences between periods, we allow one model that includes all the information to optimize and extract each period's estimates from the individual-level parameters of the respondents of this period.

[5] Moreover, the differences in age and income are of small importance in our analysis since income in our results is insignificant and age is not included in the final model.

[6] Multiple responses per individual in one round for multiple years.

[7] Additionally, estimation of mixed logit model in WTP space (Hole and Julie, 2012) has been tested and the results are available for comparison.

[8] using the mixlogit module for STATA developed by Hole (2007) in Stata 17.

3. Results

3.1. Interpretation of estimation results

The inter-temporal effect of extensive and lengthy information provision on individuals' preferences was explored by comparing the estimates from the four successive DCE surveys. We assumed a heterogeneous information effect of the PIC's milestones on the whole sample. Table 3 presents the regression results for the MXL model. All coefficients were found to be highly significant, except income, and the signs were as expected a priori. Collinearity and other tests were used to exclude problems between income and education and the unexpected sign. Since we found no issue, we assume that there is another mechanism at play here. One explanation is that individuals misreported their actual income because of tax evasion, but this is a mere speculation.

Next, we tested the inter-temporal impact of PIC on people's preferences for ES, by using a *t*-test of the mean values for each period using the Bonferroni comparison (see Table 4). The Bonferroni comparison of these estimates is used to test parametrically whether the results for each period and attribute differ significantly from all other periods and attributes. The results of this procedure showed that significant differences between periods-surveys and therefore the information effect is likely to be significant in either short (1–6 months) or longer time periods (12–18 months). Thus, the results indicate that the MWTP of all attributes and the Total WTP are most likely to be influenced by the information provision.

3.1.1. Effects of the PIC on the significance and magnitude of the ecosystem service estimates

The temporal changes in preferences can be traced on the basis of the estimates, as shown in Tables 3 and 5A. BIODIVERSITY, Commercial fishing activity (FISHERIES), landscape quality (LANDSCAPE), and optimal protection of coastal and marine recreational activities (RECREATION) were all found to be positive and statistically significant at the 1% level in all surveys.[9]

The positive value for all ES was in line with a priori expectations, suggesting that the citizens of Syros are more likely to choose alternatives that reduce the impacts of plastic pollution on the selected ES. As theory predicts, the price coefficient was negative and highly significant in all models, indicating a lower marginal utility for a program when the cost of this program increases. Inspection of Table 5A indicates that: (a) PIC might have a positive effect on the recognition of the multidimensionality of environmental functions and problems, as well as (b) a diminishing effect over time (i.e., a decay effect, as depicted theoretically in Fig. 1) on respondents' preferences/values as we move away from the date of their last participation in the PIC, with the notable exception of the ES of Biodiversity.

3.1.2. Effects of the PIC on acceptance of command-and-control instruments (bag constraints/bag bans)

According to Tables 3 and 5A, the policy actions of a partial or total bag constraint (BAGS1 and BAGS2, respectively) had a positive and statistically significant value (at 1% level) in all the surveys, indicating that residents had positive preferences towards the implementation of this policy which are not significantly influenced by PIC activities.

3.1.3. Effects of the PIC on environmental concern

An important finding is shown in the first row of Table 3, where the ASC (alternative specific constant) coefficient of the four surveys is recorded. The role of this coefficient is to capture the variation in choices that cannot be explained by either the attributes or the socio-economic variables (Bennet and Adamowicz, 2001). The ASC was coded so that positive values indicate a positive marginal utility associated with moving with the status quo situation (i.e., not taking the measures to protect the environment). Furthermore, smaller and positive ASC means less likely to stay at the status quo. Hence, this term represents a desire to maintain the current situation (a situation where no management actions would be undertaken and, therefore, ES would not be improved), for reasons not reflected by the selected attributes. We are interested in seeing the changes over time for this variable that we assumed to be fixed and not random. In order to do so we have recreated the estimation specification used in Table 3, but the ASC is split by period in order to derive the intended result using again a MXL estimator. As can be seen in Table C2 in the Appendix, this variable changes gradually over time, indicating a negative trend with increasing information. These coefficients are found significantly different from each other, based on Walt test using the no adjustment, the Bonferroni's and Sidak's method for the p-values.

This effect is confirmed in Fig. 2, where the ASC coefficient and the percentage of respondents who did not always choose the opt-out (status quo) alternative, are plotted (serving both as a proxy of respondents' willingness to act[10]). As evidenced by the data presented in the figure, the ASC value is affected by information provision. Specifically, the ASC has decreased from 4.114 (as observed in the first survey) to 2.345 (as observed in the fourth survey) due to the impact of PICs. It should be also noticed that according to our findings (table C2, Appendix) all ASC results are highly statistically significant. Furthermore, the opt-out share was slightly higher in the first two surveys compared to the last two. Hence, by increasing access to information and enhancing awareness, respondents' preferences seem to change pro-environmentally (i.e. a higher percentage of respondents are willing-to-act after information provision). According to our model setting, this move means that individuals are becoming more willing to move away from the status quo and pay a premium to protect the local coastal/marine environment (for other reasons than the attributes presented in the choice questions). These results suggest that environmental information/awareness may help to evoke concern and attention among individuals (Daudi, 2008) and enhance pro-environmental concern.

3.2. The influence of PIC on WTP for protecting ecosystem services

In order to examine the influence of PIC on the ecosystem services' values, we estimated the WTP values for all the environmental attributes, across the four surveys. Table 5A presents the Marginal annual WTP as well as the Total WTP (see section 2.4). The choice of reporting the values in annual terms is induced by the payment vehicle of the municipal taxes. Municipal taxes in Greece are collected through the electricity bill every two months, therefore, the payment vehicle question was on a bimonthly basis. To make our results comparable to the annual income taxes, we transformed the WTP to annual values by multiplying the estimated values by 6. Fig. 3 gives the Total WTP and the individuals' (circles) MWTP respectively.

Our focus is to compare the results from the first two surveys (showing the change from A to C in Fig. 1), from the last two surveys (to show the change from either G to I or G to J in Fig. 1), and from the second and the last surveys (to show whether it is I or J in Fig. 1). Comparing results from the second and the third surveys is less clear as the potential decay effect is confounded with the effect of the second PIC. This is shown in Table 5B that contains the percentage changes between the periods described above given the results of Table 5A. According to Table 5B, the Total WTP increases by 22% (corresponding to 38€ in absolute terms) between the 1st and 2nd survey and by 36% (corresponding to 76€ in absolute terms) between the 2nd and 3rd

[9] Both in the total estimation (Table 3) and the individual level analysis (Table 5A).

[10] We interpret Willingness to Act (WTAct) as an index that indicates the tendency of an individual to undertake monetary sacrifices in order to achieve environmental improvement/protection (Ramdas and Mohamed, 2014).

Table 3
Mixed logit model results for all DCE surveys (main-effects-only specification excluding protesters).

Variable	Coefficient	SE	P_{value}	Coefficient	SE	P_{value}
	Mean			SD		
ASC	3.937	0.897	<0.001	–	–	–
Education	−1.311	0.234	<0.001	–	–	–
Income	0.125	0.151	0.409	–	–	–
Cost	−0.341	0.047	<0.001	0.523	0.065	<0.001
BAGS2	1.863	0.360	<0.001	4.002	0.655	<0.001
BAGS1	2.364	0.348	<0.001	2.505	0.481	<0.001
RECREATION	1.926	0.410	<0.001	4.051	0.599	<0.001
LANDSCAPE	0.715	0.199	<0.001	2.377	0.393	<0.001
BIODIVERSITY	1.903	0.305	<0.001	2.689	0.413	<0.001
FISHERIES	1.689	0.297	<0.001	3.126	0.463	<0.001
Log likelihood = −1811, Respondents 552, Observations 6624						

Table 4
Comparison of mean WTP estimates by date.

Analysis of variance					
Source	SS	df	MS	F	Prob > F
Between groups	12721878	3	4240626	174.93	**<0.001**
Within groups	1.6E+08	6620	24242.32		
Total	**1.73E+08**	**6623**	**26152.21**		
Bartlett's equal-variances test: chi2(3) = 42.0207 **Prob > chi2 = <0.001**					

Bonferroni comparison			
Col Mean	May-16	Jun-16	Jun-17
Jun-16	39.513		
	<0.001		
Jun-17	114.108	74.595	
	<0.001	<0.001	
Dec-17	90.100	50.587	−24.008
	<0.001	<0.001	<0.001

survey. In contrast, by repeating the survey 6 months after the last milestone of the PIC, and with the 4th survey taking place in wintertime, the WTP is reduced to a level lower than the 3rd survey's estimate, although remaining considerably higher that the initial one (i.e., 51% higher than the mean WTP before the campaign).

Fig. 3 presents the trajectories of the Total WTP estimates and permits comparison against the theoretical paths of Fig. 1. First, the trajectory of Fig. 3 does not confirm the decay effect after the first campaign milestone; the estimates do not confirm the decay effect marked as trajectory **DF**. After the end of the campaign, the trajectories of total WTP pertain to the second trajectory path (HJ), which was presented in Fig. 1. The continuous information provision through the PIC has a positive effect on the WTP which is gradually increasing until the end of the campaign marked by the point **H**. After the end of the campaign the estimates of Fig. 3 resemble the trajectory **HJ** of Fig. 1. WTP values undertake a decay which is however relatively smooth. Nevertheless, the WTP values remain higher than those before the 2nd campaign.

As shown in Tables 5A and 5B, our findings suggest that there is a substantial increase in WTP, after the provision of the first bulk of information, through the 1st milestone, as indicated by its difference between the first and the second surveys. This increasing trend persisted between the second and third survey covering one year with information provision through intensive PIC's milestones. This result corresponds to a substantial total increase of WTP for all attributes, as reflected in the 2nd column of Table 5B. Remarkably, there is a significant variation in the marginal effects across different attributes, suggesting different impacts between use and nonuse values. Direct use values as mainly depicted by RECREATION, and to some extent by FISHERIES, present the highest impact followed by LANDSCAPE - which is assumed to

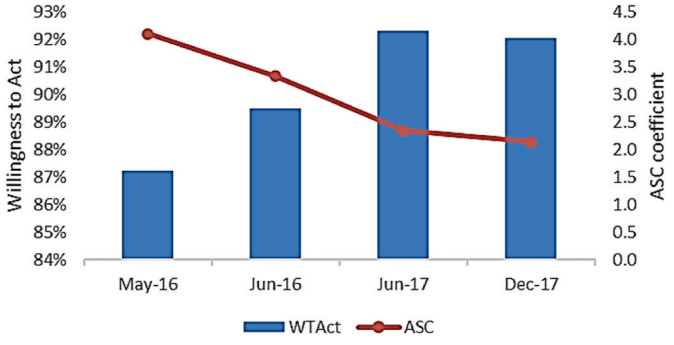

Fig. 2. Willingness of respondents to act by moving away from the status quo (i.e., intention to pay for improved ES) as influenced by the PIC (see Appendix Table C2).

Table 5a
Main results: MWTP estimates (€/year) and Total WTP(€/year) of the average respondent for the four surveys (SE in the parenthesis).

Excluding protesters					Including protesters				
	May-16	Jun-16	Jun-17	Dec-17		May-16	Jun-16	Jun-17	Dec-17
Attributes	Before the 1st milestone (n = 102)	Just after the 1st milestone (n = 90)	Just after the 2nd milestone (n = 169)	6 months after the 2nd milestone (n = 167)	**Attributes**	Before the 1st milestone (n = 121)	Just after the 1st milestone (n = 119)	Just after the 2nd milestone (n = 200)	6 months after the 2nd milestone (n = 191)
BAGS1	34.5 (0.62)	42.2 (0.66)	46.6 (0.48)	42.3 (0.49)	BAGS1	35.8 (0.70)	43.5 (0.74)	47.9 (0.56)	43.7 (0.56)
BAGS2	20.3 (1.10)	30.5 (1.29)	39.8 (0.97)	37.2 (0.93)	BAGS2	20.8 (1.23)	31.5 (1.41)	41.2 (1.08)	39.3 (1.05)
RECREATION	33.9 (0.59)	53.7 (0.58)	66.8 (0.45)	54.9 (0.44)	RECREATION	39.4 (0.67)	67.0 (0.66)	82.8 (0.54)	66.3 (0.50)
LANDSCAPE	9 (0.71)	10.2 (0.67)	16.3 (0.49)	13.5 (0.49)	LANDSCAPE	9.8 (0.70)	10.8 (0.69)	16.4 (0.50)	13.7 (0.57)
BIODIVERSITY	25.8 (0.86)	33.6 (0.82)	33.9 (0.57)	39 (0.64)	BIODIVERSITY	27 (1.09)	35.8 (1.05)	35.5 (0.73)	43 (0.82)
FISHERIES	18.4 (0.98)	18.5 (1.15)	37.7 (0.87)	34.5 (0.79)	FISHERIES	17.1 (1.24)	16.2 (1.46)	39.6 (1.09)	36.2 (1.00)
Total WTP	€ **175** (6.52)	€ **213** (5.92)	€ **289** (3.88)	€ **265** (4.01)	**Total WTP**	€ **171** (7.16)	€ **206** (6.45)	€ **280** (4.26)	€ **261** (4.35)

All estimated results shown are significant at 1%, see Table 3.

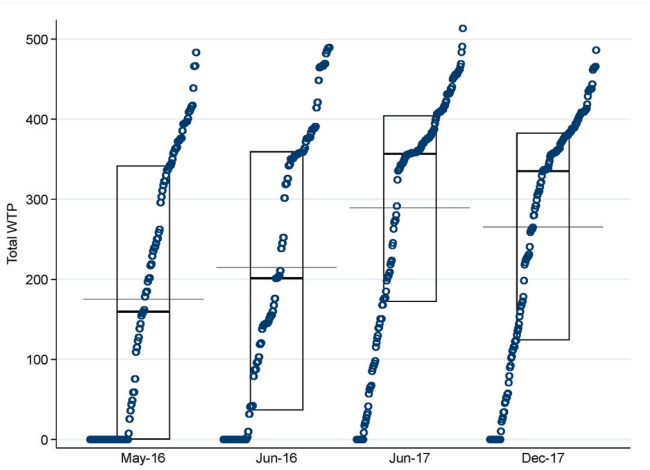

Fig. 3. Box plots of Total WTP of all individuals over time. The vertical box plots show the 75th percentile (upper hinge), the median (within box bold line), and the 25th percentile (lower hinge) of the estimated WTP distributions. The throughout line shows the estimated mean of the WTP by date.

mainly involve indirect use values - while the non-use value of BIODIVERSITY exhibits the lowest impact at this point of time.

It is also worth noting that a decreasing trend persisted between the third (marking the end of the campaign) and the fourth survey, for all attributes except for BIODIVERSITY whose WTP values increased substantially. Two reasons underlie the difference between the third and the fourth survey: the time decay effect, induced by the end of the information campaign, and the seasonal variation induced by the timing of the fourth survey in winter. The seasonal variation concerns mainly RECREATION and LANDSCAPE whose seasonal characteristics determine the intensity of their use by the island's citizens. FISHERIES have a lower seasonal variation induced by the limits imposed on both fishermen and consumers by extreme weather conditions during winter. BIODIVERSITY, a regulating ES with no influence from seasonal variation in the experience of citizens, seems to gain interest gradually and to maintain this increasing trend after the end of the campaign. This result may have been triggered by the recognition of BIODIVERSITY's importance, which seems to be appreciated by the more informed citizens. The effects of BIODIVERSITY become more remarkable when the behavior of protesters is considered. Namely, the increase in WTP value after the end of the campaign is significantly higher (21% against 15%) when protesters are included in the estimates. This finding indicates that the so-called protesters are gradually shifting their economic behavior and are willing to make financial sacrifices to protect important regulatory ES such as biodiversity. The very same protesters do not show similar behavioral change for the other direct/indirect use ecosystem services.

FISHERIES, with its inherent use values which are not subject to significant impacts from seasonal variations, presents the lowest decrease among provisioning and cultural ES, after the end of the campaign; nevertheless, FISHERIES undertake a decrease which can be attributed to the time decay effect. In contrast, the reduction of RECREATION and LANDSCAPE has been induced by both the time decay as well as the seasonal variation since coastal recreational activities and outdoor enjoyment are very limited during winter. As a result, RECREATION and LANDSCAPE present high increases during the information campaign while their decrease after the end of the campaign is induced by the driving forces of decay effect and the limited use intensity during wintertime.

To conclude, the findings of the analysis suggest that non-use values gain attention and maintain it as citizens became aware of their biological-ecological significance. On the other hand, use values also gain attention, even higher compared to non-use values. However, their value is subject to high sensitivity over seasonal variation of use, as well as to a time decay effect shrinking the impacts of the information provision. The role of seasonal variation in use intensity is confirmed by the smoother reduction of those use values which evade the impacts of seasonal variations. The difference between FISHERIES and the pair of RECREATION-LANDSCAPE is revealing in this perspective. As a result, the value and the relative importance of an ES which is only provided during the summer months, is likely to be lower in the wintertime. This reflects variations in a use value, which follows close variations in the use of an ecosystem service, a trajectory which may be present in the analysis of values assigned to recreational ES. This finding confirms the analysis of Rolfe and Dyack (2019).

Overall, based on the above analysis, we can conclude that intensive information provision is likely to affect people's preferences, as reflected by a generally increasing trend in WTP. This influence reduces after the end of the campaign but still remains much higher compared to its level before the campaign took place. Estimates in the last row of Table 5A, reflecting the total WTP for all attributes of the problem at hand, confirm this trend.

An important finding of the study is the drastically declining rate of protesters, which fell to 12.6% in the fourth survey, having been about 25% in the first. PICs influence individuals with strong ethical environmental values. Although initially these individuals refused to pay for protecting ES gradually, they were persuaded to contribute payment although they still retained their ethical considerations. Very probably, PICs could induce individuals, classified as protesters, to undertake financial sacrifices in order to participate in a scheme protecting the environment. Furthermore, by comparing the first and last samples, as depicted in Table C3 of the Appendix, we concluded that: (a) less educated citizens became less likely to protest (i.e., information provision may hold promise for fostering pro-environmental behavior of less educated citizens); (b) after two milestones people working on tourism were found less likely to protest (maybe due to the particular emphasis of the campaign on the impacts of plastic waste on recreation/tourism); (c) women were eventually relatively less likely to protest than men (no difference between men and women was found during the first two surveys), indicating that the PICs may had a greater influence on women than men. Protest voting can also be interpreted as a "positive" effect of

Table 5b
Main Results: Percentage changes from the first survey (May 2016), before information provision, and between the last two surveys.

Excluding protesters					Including protesters				
	May-16 to Jun-16	May-16 to Jun-17	May-16 to Dec-17	Jun-17 to Dec-17		May-16 to Jun-16	May-16 to Jun-17	May-16 to Dec-17	Jun-17 to Dec-17
BAGS1	22%	35%	23%	−9%	**BAGS1**	22%	34%	22%	−9%
BAGS2	50%	96%	83%	−7%	**BAGS2**	51%	98%	89%	−5%
RECREATION	58%	97%	62%	−18%	**RECREATION**	70%	110%	68%	−20%
LANDSCAPE	13%	81%	50%	−17%	**LANDSCAPE**	10%	67%	40%	−16%
BIODIVERSITY	30%	31%	51%	15%	**BIODIVERSITY**	33%	31%	59%	21%
FISHERIES	NS	105%	88%	−8%	**FISHERIES**	NS	132%	112%	−9%
Total WTP	22%	65%	51%	−8%	**Total WTP**	20%	64%	53%	−7%

All estimated differences shown are significant at 1%. NS indicates that the difference between the two periods is insignificant.

the PIC which persuaded local residents that coastal/marine environmental protection is not only their right, but also their duty.

The study also tested the sensitivity of individual opinions regarding policy actions to control plastic waste. Information provision makes people better prepared to accept and adopt policies intended to reduce plastic use and, hence, waste. In this respect, it is possible that some findings of our study were in some way influenced by the state announcement of a charge on the use of plastic bags, as discussed during the last months of 2017 (i.e., between our 3rd and 4th surveys). Plastic bags would be charged at 0.04€ from January 2018, without however yet associating this charge with their negative impact on coastal/marine environment. This evolution may have further enhanced the information effect on the acceptance of policies and programs related to a complete ban on plastic bags.

4. Conclusions

Environmental awareness induced by suitably designed PICs emerges as a promising non-economic instrument, which may enhance the effectiveness of environmental policy and serve sustainability objectives, by enriching individuals' preferences for the environment. Information campaigns have been considered a decisive policy instrument for the protection of coastal marine environments especially from plastic waste. Being open access, common resources coastal and marine ecosystems make usually difficult the implementation of economic instruments, especially for non-source pollution. Environmental awareness emerges then as a popular instrument all over the world.

A DCE method has been applied to evaluate the effects of information on citizens' preferences, inspired by previous experiences with this method investigating similar questions (Chen and Cho, 2019). Two issues have been the focus of the study: (a) how preferences change under the influence of an increasing provision of information, and (b) how durable is this influence after the end of information provision. The study investigates the effects on different environmental values following the usual, but not always practical, grouping of use and non-use values. We incorporate use values constant in time and use values with seasonal variations in order to evaluate how the impact of information is influenced by the intensity of use. Our analysis supported the initial hypothesis that environmental awareness and information can affect environmental preferences and change environmentally based values. This conclusion gives a new perspective on previous evidence assuming preference stability over time (e.g., Czajkowski et al., 2016; Brouwer and Logar, 2014; Liebe et al., 2012). The question that arises is whether such an influence persists and how it is differentiated among different categories of values.

Information makes clear the direct welfare arising from the coastal and marine environment. After the end of the information the preferences for ES linked with use values are relaxed and the interest decreases somewhat. This confirms a time decay effect, which is found to be more severe when the intensity of use is reduced. Citizens are driven by the utility arising from direct use of the environment and information provision makes citizens willing to "secure" this utility. Once information provision is completed, the interest in "securing" this utility remains substantially higher than before the information, although it is gradually decreasing. Once use is interrupted, the interest diminishes further. Hence, a time decay effect is observed for all use values, which is likely to be more pronounced for those uses which are interrupted, with seasonal variation in use intensity likely to be among the underlining reasons.

Preferences concerning ES linked to non-use are enhanced smoothly with a rate much lower compared to use values, as long as information provision lasts. Remarkably, non-use values continue to increase their interest even after the end of the campaign, evading thus the time decay effect at least within the time frame of six months that was tested in the present study.

Protesters are also influenced by information on the regulatory ES. Although citizens characterized as protesters before information provision retain the characteristics of a protester after PICs, they would undertake financial sacrifices for protecting regulatory ES. This willingness persists after the end of the campaign, avoiding the time decay effect, suggesting enhanced consciousness concerning the role of regulatory services.

The extended experiment of the present study could be considered as being among the first scientific endeavors to assess the efficiency of the policy instrument of information provision. Information provision is becoming a popular policy instrument for public authorities, NGOs and international bodies such as the IPCC. Our study, in agreement with some previous studies (Chen and Cho, 2019; Kikuchi-Uehara et al., 2016), indicates that information provision can contribute to increasing interest in the environment by reshaping the spectrum of individual preferences. The influence on preferences is important, and probably decisive. On the other hand, those outcomes are subject to two forces: the seasonal experience defining the intensity in the use and time decay which is strongly present for provisioning and cultural ES.

These effects probably indicate the limitation not only of the information linked to environmental awareness but, more importantly, of the monetary valuation of the environment in the context of environmental policy. These limitations are defined by the ultimate target of environmental policy being the sustainability of ES (i.e., ES should be available to current and future generations). A policy based on monetary values reflects the preferences and interests of current generations exclusively. These preferences are subject to occasional conditions, such as the availability and the intensity of information and the intensity of use, to mention only those related to the present study. This makes monetary values, as influenced by information provision, of only partial importance for sustainability design. An effective policy should incorporate concerns over the interests and needs of future generations (Bithas, 2011), thus widening its pool of policy instruments in order to secure sustainability in the long run (Mavrommati et al., 2016).

The non-economic instrument of information provision is a necessary policy tool for (coastal and marine) environmental protection, which nevertheless cannot be a sufficient one. Information makes individuals aware of the properties of the (coastal and marine) environment and the associated sources of utility. They can then make more informed decisions. On the other hand, (coastal and marine) environmental protection requires instruments that restrict individual decisions and guide choices towards public interest, such as environmental protection and sustainable management with a long-run perspective. Hence, economic and command and control instruments cannot be replaced but should be complemented by enhanced environmental awareness induced by information provision.

The present study is not without limitations. One limitation was the fact that due to the relatively small size and population of the island of Syros, we considered that everyone in the island would be affected by the PICs; this made it impossible to have a control sample of people who were not exposed to information in order to confirm that the WTP changes could be attributed to the information provision. This study can be seen as a "natural" experiment with policy relevant findings. As such, it offers certain insights which ought to be interpreted carefully; however, it remains valuable for the design of environmental policies. For future research the effects of information provision in monetary terms should be compared across non-monetary measures as in Sy et al. (2021) in order to provide a complete policy relevant information. Another future research direction could be the exploration of the long-term effects of PIC on the presence (or not) of supportive (plastic) waste management policies and (economic) incentives.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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APPENDIX A

Main actions of the milestones (Plastic Bag Free Weeks) of the information campaigns which took place on Syros:

- presentations to local authorities and stakeholders about the negative impacts of plastic waste pollution,
- information provision to owners and employees of local shops concerning: (a) the impacts of the single-use plastic bags on the coastal/marine environment and (b) the alternative options they could adopt,
- free distribution of reusable bags to citizens, supermarkets, retail shops owners and visitors (tourists), along with information leaflets on the environmental impacts of plastic bags on the coastal/marine environment,
- operation of information kiosks to effectively inform both residents and tourists on the impact of plastic bags,
- special workshops on the latest developments in environmental legislation (concerning single-use plastic bags), as well as on the environmental problem at hand,
- training seminars for primary and secondary school teachers,
- lectures on environmental education and good environmental practices regarding plastic waste in 21 schools with approximately 3500 students,
- extended mass media presence on various national and local television networks, news media, newspapers, magazines and social networking websites (YouTube channel, Facebook, twitter, Instagram)

APPENDIX B

	Option A	Option B	Option C (Status quo)
Recreational activities (e.g. bathing, sunbathing, etc)	No impact 	Small impact 	Large impact 
Aesthetics quality	Significant degradation 	No degradation 	Significant degradation 
Biodiversity	Minor threat 	Major threat 	Major threat 
Fisheries	Major threat 	Minor threat 	Major threat 
Policy tool	Complete ban of plastic bags 	Partial ban/restriction of plastic bags 	No restrictions 
Expected bi-monthly cost	€15 	€6 	€0 
Choice	☐	☐	☐

Fig. B1. Example of a choice card used in the questionnaire survey.

APPENDIX C

Table C1
Main demographic variables comparison tests

	t-test						
	Differences						
Education	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)	F-test for joint orthogonality
Primary and none	0.025**	0.026**	0.019*	0.001	−0.006	−0.007	2.406*
Secondary-lower	0.023*	0.025**	0.012	0.003	−0.010	−0.013	2.080
Secondary-higher	0.021	−0.009	−0.000	−0.031*	−0.022	0.009	0.966
BSc	−0.053**	−0.033*	−0.026	0.020	0.027	0.007	2.246*
MSc & PhD	−0.016	−0.009	−0.005	0.007	0.011	0.004	0.886
Income							
No answer	−0.000	−0.002	0.000	−0.002	0.000	0.002	0.600
0 - 5000€	0.003	−0.020	−0.031**	−0.023*	−0.034**	−0.011	2.999**
5.000€ - 10.000€	0.015	−0.005	−0.004	−0.019	−0.019	0.000	0.683
10.000€ - 15.000€	0.001	0.001	−0.004	0.000	−0.005	−0.005	0.036
15.000€ - 20.000€	−0.014	−0.001	−0.013	0.013	0.001	−0.012	0.625

(*continued on next page*)

Table C1 (*continued*)

	t-test						
	Differences						
Education	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)	F-test for joint orthogonality
20.000€ - 25.000€	−0.017	0.010	0.027**	0.027**	0.043***	0.016**	6.236***
>25.000€	0.009	0.009	0.017**	0.000	0.008*	0.008**	4.977***
Gender							
Female	−0.117*	−0.078	−0.070	0.039	0.047	0.008	1.175
Male	–	–	–	–	–	–	–
Age							
18–34	−0.231***	−0.246***	−0.192***	−0.016	0.039	0.055	25.772***
35–64	0.129**	0.187***	0.167***	0.057	0.038	−0.020	6.026***
65–89	0.101***	0.059	0.025	−0.042*	−0.077***	−0.035	4.180***
Recycling	−0.010	−0.057*	−0.019	−0.048*	−0.009	0.038*	2.142*
Working in tourism	0.049	0.142**	0.196***	0.093*	0.148***	0.054	5.347***

***, **, and * indicate significance at the 1, 5, and 10 percent critical level respectively.

Table C2
Main model results including protesters

Mixed logit model				Number of obs		7491
				LR chi2(7)		864.83
Log likelihood	−2008.69			Prob > chi2		0
choice	**Coefficient**	**SE**	**z**	**P_{value}**	**[95% conf. interval]**	
Mean						
ASC	6.867	1.286	5.340	0.000	9.387	4.347
Education	−1.854	0.329	−5.640	0.000	−2.498	−1.210
Income	0.070	0.206	0.340	0.733	−0.334	0.474
Cost	−0.453	0.068	−6.640	0.000	−0.587	−0.319
BAGS2	2.269	0.492	4.610	0.000	1.305	3.233
BAGS1	3.007	0.488	6.160	0.000	2.050	3.965
RECREAT2	0.745	0.209	3.570	0.000	0.336	1.154
RECREAT1	0.403	0.208	1.940	0.052	−0.004	0.810
LANDSCAPE	0.767	0.263	2.910	0.004	0.251	1.283
BIODIVERSITY	2.303	0.431	5.340	0.000	1.458	3.148
FISHERIES	1.687	0.353	4.780	0.000	0.996	2.378
SD						
BAGS2	5.838	0.973	6.000	0.000	3.932	7.744
BAGS1	3.751	0.711	5.270	0.000	2.357	5.145
RECREAT2	1.905	0.356	5.350	0.000	1.208	2.602
RECREAT1	2.933	0.419	7.010	0.000	2.112	3.753
LANDSCAPE	3.251	0.520	6.250	0.000	2.231	4.270
BIODIVERSITY	4.417	0.696	6.340	0.000	3.052	5.782
FISHERIES	5.096	0.734	6.940	0.000	3.658	6.534

Table C3
Main model results excluding protesters, with time specific ASC

Mixed logit model				Number of obs		7491
				LR chi2(7)		864.83
Log likelihood	−2008.69			Prob > chi2		0
choice	**Coefficient**	**SE**	**z**	**P_{value}**	**[95% conf. interval]**	
Mean						
ASC	6.867	1.286	5.340	0.000	9.387	4.347
Education	−1.854	0.329	−5.640	0.000	−2.498	−1.210
Income	0.070	0.206	0.340	0.733	−0.334	0.474
Cost	−0.453	0.068	−6.640	0.000	−0.587	−0.319
BAGS2	2.269	0.492	4.610	0.000	1.305	3.233
BAGS1	3.007	0.488	6.160	0.000	2.050	3.965
RECREAT2	0.745	0.209	3.570	0.000	0.336	1.154
RECREAT1	0.403	0.208	1.940	0.052	−0.004	0.810

(*continued on next page*)

Table C3 (*continued*)

Mixed logit model				Number of obs		7491
				LR chi2(7)		864.83
Log likelihood	−2008.69			Prob > chi2		0
LANDSCAPE	0.767	0.263	2.910	0.004	0.251	1.283
BIODIVERSITY	2.303	0.431	5.340	0.000	1.458	3.148
FISHERIES	1.687	0.353	4.780	0.000	0.996	2.378
SD						
BAGS2	5.838	0.973	6.000	0.000	3.932	7.744
BAGS1	3.751	0.711	5.270	0.000	2.357	5.145
RECREAT2	1.905	0.356	5.350	0.000	1.208	2.602
RECREAT1	2.933	0.419	7.010	0.000	2.112	3.753
LANDSCAPE	3.251	0.520	6.250	0.000	2.231	4.270
BIODIVERSITY	4.417	0.696	6.340	0.000	3.052	5.782
FISHERIES	5.096	0.734	6.940	0.000	3.658	6.534

Table C4
Logit regression on probability of protesting in each survey

Variables	1st survey		2nd survey		3rd survey		4th survey	
	Coefficient	z-stat	Coefficient	z-stat	Coefficient	z-stat	Coefficient	z-stat
Age	0.322	74.81***	0.325	63.55***	0.175	14.47***	0.221	28.33***
Gender	0.014	0.19	−0.057	2.18	0.205	18.49***	0.279	46.97***
Income	0.156	0.39	−0.075	2.86*	−0.207	15.38***	−0.136	10.59***
Education	−0.166	24.59***	−0.342	67.71***	−0.114	11.53***	−0.053	1.41
Family Size	0.062	3.21*	−0.069	2.78*	0.086	3.479*	0.144	12.93***
Working On Tourism	0.128	14.88***	−0.151	14.52***	−0.029	0.415	−0.021	1.27

Note: *** = Significant at 1% level; ** = Significant at 5% level; * = Significant at 10% level.

Table C5
Mixed logit model results in WTP space

choice	Coefficient	SE	z	P > z	[95% conf. interval]	
ASC	−12.405	2.780	−4.460	0.000	−17.853	−6.957
Education	−4.123	0.683	−6.030	0.000	−5.462	−2.783
Income	0.241	0.433	0.560	0.578	−0.608	1.090
BAGS2	6.387	0.931	6.860	0.000	4.562	8.212
BAGS1	6.820	0.787	8.660	0.000	5.277	8.363
LANDSCAPE	2.238	0.571	3.920	0.000	1.119	3.358
BIODIVERSITY	5.836	0.674	8.660	0.000	4.516	7.156
FISHERIES	4.963	0.676	7.340	0.000	3.639	6.287
RECREATE	1.877	0.438	4.280	0.000	1.018	2.736
Cost	−1.492	0.092	−16.230	0.000	−1.672	−1.312
SD						
BAGS2	11.099	1.451	7.650	0.000	8.255	13.943
BAGS1	−6.017	1.094	−5.500	0.000	−8.162	−3.872
LANDSCAPE	−5.926	0.840	−7.060	0.000	−7.572	−4.280
BIODIVERSITY	6.989	0.832	8.400	0.000	5.358	8.621
FISHERIES	9.319	0.851	10.950	0.000	7.651	10.986
RECREAT2	3.473	0.601	5.780	0.000	2.295	4.650
RECREAT1	−5.514	0.575	−9.590	0.000	−6.641	−4.387
Cost	0.131	0.110	1.190	0.234	−0.084	0.345

Number of obs = 6615.
Wald chi2(11) = 504.69.
Log likelihood = −1826.6481, Prob > chi2 = 0.0000.

Table C6
Marginal WTP estimates based on separate regressions by date of questionnaire

	By monthly					Yearly			
	May-16	Jun-16	Jun-17	Dec-17		May-16	Jun-16	Jun-17	Dec-17
BAGS2		2.57	11.65	6.01	**BAGS2**		15.44	69.92	36.04
BAGS1	0.53	6.03	16.77	6.47	**BAGS1**	3.19	36.19	100.59	38.80
RECREATE	0.82	0.37	6.51	1.35	**RECREATE**	9.89	4.49	78.10	16.25

(*continued on next page*)

Table C6 (*continued*)

	By monthly					Yearly			
	May-16	Jun-16	Jun-17	Dec-17		May-16	Jun-16	Jun-17	Dec-17
LANDSCAPE	2.05		6.65		**LANDSCAPE**	12.28		39.93	
BIODIVERSITY	4.89	4.53	9.12	7.02	**BIODIVERSITY**	29.32	27.16	54.72	42.13
FISHERIES	1.49		10.85	5.65	**FISHERIES**	8.91		65.10	33.87

All presented results are significant at least at 5%.

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