Promoting conservation in shellfish fisheries: the role of economic incentives and social norms

Abstract: The shellfish sector in a clear example of worldwide over-exploitation. In this study, our aim is to analyze through a choice experiment (CE) the preferences of the own fishers with respect to a proposed conservation management program, assessing in this context, the role of time preferences, social norms and economic incentives. With regards to time preferences, we find that current users are quite impatient in their extraction levels today, while in terms of social norms, when the fulfillment of rules is the norm, establishing a costly payment is accepted without producing a reduction in fishers´ utility.

Keywords: shellfisheries, time preferences, social norms, economic incentives

JEL: Q27

1. Introduction

The Food and Agriculture Organization (FAO, 2012) presents evidence in several reports about the overexploitation and depletion for many fish populations, encouraging the need to recover species. Specifically, FAO (2006) had estimated that since 1990, 17% of fish stocks have been overexploited, 7% have been depleted, and 1% is recovering from depletion. In addition, the technological progress has increased the fishermen capacity to exploit more intensively a greater number of fish resources being these factors related to the current crisis (Beddington *et al.* 2007). Previous studies have highlighted the need to understand individual behavior in order to achieve a correct management of the resource. In this sense, a FAO report (2010) indicated that it is very important that managers or responsible agents of fisheries management understand that when stocks are overexploited or when fishermen take on an irresponsible exploitation, the absence of measures will have consequences in the future; showing losses of potential benefits in the form of food, income, and jobs, among others. In this sense, De la Torre Castro and Lindström (2010) show that the origin of the problem of fishery management is based on the interactions of human and natural domains.

Therefore, it is important not only to consider economic incentives but also the involvement of users in the management process, and to understand the motives managers may have in order to conduct some practices that cause an overexploitation of resources. In this line, Pretty and Smith (2004) state that, economic incentives are important, but sometimes these are not sufficient in order to achieve a certain goal. This study focuses on analyzing the incentives and social norms that affect extraction decisions of on-foot shellfish fisheries in traditional sea dependent communities. Currently, the main problems

faced by this sector in the area of study are the illegal activity and the over-exploitation of resources. This is a worrying situation that occupies front pages of the major newspapers nationwide. This occurs because poaching causes episodes of violence among poachers and guard agents (El Pais, 2012; La Voz de Galicia, 2013 and 2014)

This sector is regulated by strict laws that limit the quantity of product that can be extracted per catcher per day, establishes also minimum sizes. Furthermore, these regulations also limit the amount of days where harvest can take place. However, both problems (over-harvesting and illegal poaching) are still very relevant today; and it appears that the "tragedy of the commons" proposed by Hardin (1968) still takes place. In this sense, traditional economic theory that assumes that people are selfish and rational individuals, considering the question of public goods provision and the management of common property, it predicts that the most common result is non-cooperation and free-riding behavior. In addition, traditional economic literature has argued that one way to avoid the "tragedy of the commons" was the establishment of rules and the existence of an authority that impose rules to users because themselves are not capable to self-limiting their extraction or used. In the present case study this solution has not been effective yet because overexploitation and illegal fishing exists currently. However in practice, field experiments have shown that some groups manage their commons with different degrees of success. Specifically, Ostrom (2000) indicated that the "zero contribution thesis", however, contradicts observations of everyday life. Thus, it is important to consider Ostrom´s work (1999) which stated that in a system where there exists a relative autonomy, a self-organized resource governance is best to manage a common pool resource, instead of a central authority. Moreover, Dietz et al. (2003) also showed that the strategies to address global problems like climate change, tropical deforestation or

transboundary pollution should include communication among all the involved parties, officials and scientists because it will facilitate the processes of experimentation, learning and change.

Our aim in this paper is to analyze through a choice experiment (CE) the preferences of the own fishers with respect to a proposed management program, trying to understand what factors are mostly valued by the own fishers. Understanding how management policies could be improved is rather relevant due to the failure of the existing ones. The CE methodology has been successfully used in different studies (Knowler et al. (2009), Agimass and Mekonnen (2011), Pulina and Meleddu (2012), among others). In particular, in this CE setting, we are also interested in studying the following hypotheses: 1) We test Ostrom´s theory with respect to the involvement of users in the management process, and whether this implies more effective results in terms of conservation when we face common pool resources. In order to test this hypothesis, our sampling methodology contains observations from a Marine Protected Area (MPA) as well as in other selected areas that act as control groups. 2) We test whether users are impatient in terms of time preferences following the study of Viscusi et al. (2008). The knowledge of the implicit discount factor is an important aspect that affects extraction patterns. As Gunatilake et al. (2008) highlight, higher discount factors come from individuals who are more aggressive in the extraction of resources. Therefore they have to receive higher compensations to improve their behavior in order to become more patient. In addition and to our knowledge, only three studies have analyzed this question: Curtis (2002), Akpalu (2008) Johnson and Saunders (2014). 3) We are also interested in analyzing whether there are strong social norms among users that contribute to a more sustainable behavior. With this purpose, we include in our survey different questions in order to understand the social norms that are present among fishers in

this sector. Specifically, we study the effect of conditional cooperation in this specific setting. Fehr and Fischbacher (2004) indicate that "this norm prescribes cooperation if the other group members also cooperate, whereas the defection of others is a legitimate excuse for individual defection. The norm is violated if an individual defects even though the other group members cooperated." As we have mentioned previously, it is crucial not only to consider economic incentives but also other aspects, such as social norms to understand the motives behind certain practices, including poaching. 4) To conclude, and due to the seriousness of the current situation with respect to the illegal shellfish activity, we analyze the influence of this problem when users have to choose a management plan.

The rest of the paper is organized as follows: the application of CE in fisheries is presented in Section 2. Section 3 presents the empirical models, and section 4 presents the research hypotheses. Survey and data description are contained in section 5. Section 6 presents the results, while the paper concludes with a final discussion in section 7.

2. The application of choice experiment (CE) in fisheries

As mentioned, in this study we employ the CE methodology; it is important to highlight that this is a fairly novel technique in the field of fisheries management. One of the first applications was conducted by Aas et al. (2000) who evaluate different management alternatives to the harvesting regulation in Norway. Wattage et al. (2005) highlight that as the management of fisheries is defined by multiple objectives, more efficient solutions can be found when knowing the preferences of the various stakeholders. Moreover, they indicate that CE methodology can offer useful information to the management process. In addition, Knowler et al. (2009) also employ the CE approach to evaluate several programs in India, and Wattage et al. (2011) to analyze the uncertainty about the value of the

reserved habitats to fishing industry in Ireland. However, in this latter case, the CE is applied to the residents of the Republic of Ireland and not only to the users. Agimass and Mekonnen (2011) evaluate through a CE the willingness to pay (WTP) for fisheries and watershed management in Ethiopia. Their results show that socioeconomic variables such as education, household income and family size are significant when determining the selection of a management plan. More recently, Pulina and Meleddu (2012) employ this methodology to evaluate the implementation of a MPA in Italy, concluding that these stakeholders prefer to improve sustainable yields, to reduce their internal conflicts and to increase the profits from the fishery. With respect to shellfisheries, studies such as Nunes et al. (2009) have analyzed the importance of conflicting objectives in the sector. Specifically, they study how carrying out the harvest of shellfish damages the feeding of birds. However, in the previous literature, we did not find any other study that analyzes preferences of the on-foot shellfisheries trying to understand their main concerns on their daily management activities. Therefore, this current application studies this sector paying special attention to time preferences, the effect of co-management through a MPA, the effect of social norms and the illegal poaching.

In our choice modeling experiment, we present a management plan with the objective to improve the abundance of the resource to catch, which requires an extraction ban. This conservation plan implies the acceptance of an agreement that will have duration of five years, where each year there would be a certain number of months where harvest activity will be prohibited. During these months of prohibition activity, shellfishers will be compensated with an economic subsidy of 1200€/month[1]. Moreover, the positive side effects of this prohibition will not be immediate; that is, there exists a period of time

[1] We include an economic subsidy with the aim to reduce protest responses.

(waiting time) until the biological improvement of stocks is obtained. In addition, we also include a limitation of the number of on-foot shellfish catchers[2]. Finally, it is indicated that in case when individuals accept to participate and they do not obey the rules, they will be sanctioned with the devolution of the economic subsidy received and 20% more in concept of fine. The name of these infringing individuals will also be published.

Participants were given the opportunity to select between three types of management plans containing the same attributes but presented at different levels. In each choice experiment task, participants were also given a third option to choose not to adopt either Management Plan A, Management Plan B nor Management Plan C.

To select the included characteristics we follow the description of current policies while revising the literature. Further, we have conducted a pre-test where a valuation of the different attributes proposed was included.

The selected attributes included into the contractual design to select by shellfish catchers were: *delay* that is number of months in which users do not perceive the improvement in the resource; *improvement;* this is the percentage of improvement in the resource abundance that will be achieved. With these characteristics we can calculate time preferences. The third characteristic is the *extraction ban* that indicates the number of months where fisheries will be closed, and therefore extraction will not be allowed. Finally, we include the attribute namely *coworkers*[3] indicating the number of catchers that

[2] Depending of the area of study, the number of on-foot shellfishers is different; therefore we chose levels that are realistic for all areas of study. We explain to participants that this is a hypothetical situation where we only try to understand their preferences.

[3] It is important to take into account the number of gatherer of shellfish is limited by the local government (Xunta de Galicia). Therefore, it is necessary to have a licence (PERMEX) to work. Each year, Xunta de Galicia evaluate whether the number of PERMEX can increase.

could be benefited by this measure. Table 1 contains a detailed description of the characteristics included in the choice experiment.

After defining the attributes and their levels, we proceed to design the combination of choices to be presented to respondents. We employed the JMP program from SAS; specifically, we include four attributes with three levels each. We specify a main effects model with one interaction effect (with the aim to obtain the discount factor). We obtain a choice of twelve cards with a 93.01% efficiency with respect to the optimal design. Finally we design twelve choices sets for each respondent. Table 2 contains an example of the choice sets included.

3. Empirical Models

Time preferences

We consider time preferences using the following general model:

$$U_i(C_0, C_1) = u_i(c_0) + \beta\delta u_i(c_1) \quad (1)$$

In this model we consider the standard exponential discounting model with $\beta = 1$. In this study we analyze time preferences following Viscusi et al. (2008), who use a CE to estimate discount rates for environmental quality through two attributes, the improvement in water quality, measured in percentage, while taking into account the delay in which these improvements take place. With this aim, we include in our design two specific attributes: the time of *delay* and the *improvement* in the resource. Through the cross-product of both characteristics we can estimate how participants value the improvement on

the quantity of resource available now and how these values vary according to the average waiting time. The theoretical framework followed by Viscusi et al. (2008) is as follows.

First, it is important to take into account that the costs of the program begin immediately while the benefits start after a period of 2 to 6 months[4]. That is, the time of closure needs to start at the beginning of the recovery plan while the improvement in the abundance of resource will happen then after some months, because shellfish has to grow. Therefore we evaluate the value in present euros of the level of improvement taking into account that this will be available at least in 2 months. To study the tradeoffs between the present value of costs and improvements, we consider the standard exponential discounting case with a constant annual discount factor δ as we mention below. Further, there is a time where users cannot work *(extraction ban)* of t months before the improvement begins. With an extraction ban of t months, the discount factor is δ^t. We suppose that the utility function is additively separable and linear in cost c and that the improvement in the level of abundance of resource is given by a. Thus, the present value of the 5-year imposition of costs beginning after 2 months is $c[1+\delta+\delta^2+\delta^3+\delta^4]$. In a similar way, the present value of the level of improvement in shellfish then of the time of closure is given by $a\delta^t[1+\delta+\delta^2+\delta^3+\delta^4]$. As the terms in brackets are identical, the person´s utility function reduces to ascertaining if the value of costs is greater than $a\delta^t$. The value of $\delta = 1/(1+r)$, where r is the rate of interest. Therefore, $1/(1+r)^t$ units of abundance of shellfish will result from improvements that begun immediately (in our case 2 months) and will be equivalent to a unit of abundance of shellfish improvement that begun after a period of t months. The cost of imposition will be worthwhile if the utility of the

[4] In our case and as point of difference with the study of Viscusi et al. (2008), benefits start at least after 2 months, because in fisheries it is not possible that benefits begin immediately.

improvement in shellfish abundance in month t is as least as great as $(1+r)^t$ multiplied by the utility of the annual cost. Therefore, through this application we aim to estimate the average tradeoff of users between the *delay* and the *improvement* on the level of abundance of shellfish.

Thus, taking into account time preferences and the characteristics of the management plans, the utility function can be expressed as:

$$U_{ij} = \alpha delay_{ij} + \phi improvement_{ij} + \gamma extraction\ ban_{ij} + \mu coworkers_{ij} + \varphi delay * improvement_{ij} + \varepsilon_{ij} \quad (2)$$

where i denotes the respondent and j denotes any of the alternatives proposed (management plans). To obtain the discount factor, we apply the following formulation:

$$\delta = \left(1 + \frac{\varphi delay * improvement}{\phi improvement}\right)^{1/n} \quad (3)$$

Finally, with the goal to test the robustness of results and analyze the formulated research hypotheses, we extend equation (2) as follows:

$$\begin{aligned} U_{ij} = {} & \alpha delay_{ij} + \phi improvement_{ij} + \gamma extraction\ ban_{ij} + \mu coworkers_{ij} + \varphi delay * improvement_{ij} + \\ & \gamma coworkers * employment_{ij} + \eta coworkers * altruism_{ij} + \lambda coworkers * young_{ij} + \nu coworkers * MPA_{ij} + \\ & \pi coworkers * not conditional cooperator_{ij} + \varpi coworkers * organized_{ij} + \theta coworkers * disputes_{ij} + \\ & \vartheta delay * MPA_{ij} + \rho delay * income_{ij} + \sigma delay * young_{ij} + \varsigma delay * not\ frown\ upon by society_{ij} + \\ & \tau extraction\ ban * social\ norm\ compliance_{ij} + \upsilon extraction\ ban * no\exp erience_{ij} + \\ & \omega extraction\ ban * tradition_{ij} + \xi extraction\ ban * leader_{ij} + \varepsilon_{ij} \end{aligned} \quad (4)$$

As an empirical strategy, a baseline model such as the conditional logit model (CL) is estimated, assuming the independence of the irrelevant alternatives (IIA) property[5]. After estimating the baseline conditional logit model (CL), we extend the empirical section by estimating a Random Effects model (RE) (considering that we have several observations per respondents) and a Multilevel Mixed Effects (MME) (taking into account the place of residence of respondents). Based on this estimation strategy, initially we are assuming that individuals' preferences are homogenous, while in fact it is more logical to expect that their preferences are heterogeneous. We estimate these extended models with the aim to test our research hypotheses and to analyze the effect of others important variables.

4. Research Hypotheses

-Marine Protected Areas: the effectiveness of co-management

In Galicia the main problems facing by shellfisheries are over-harvesting and illegal poaching. It appears that that the "tragedy of the commons" proposed by Hardin (1968) still takes place. Nevertheless, and as we have mentioned, Ostrom (1999) and Dietz et al. (2003) conclude that a relative autonomy where all parties are involved can help. In our area of study, Freire and García-Allut (2000) have analyzed the state of artisanal coastal fisheries finding symptoms of a general state of overexploitation as a consequence of the mismatch between management and the biological and socioeconomic context. Furthermore, they highlight the need of a new management policy which recognizes territorial users´ rights and the fishers' knowledge as well as the use of MPA and minimum

[5] To test whether the CLogit model is appropriate, we employ the Hausman and McFadden test (1984), obtaining a statistic of 24.275 following a Chi-squared of 5 degrees of freedom with a p-value of 0.001. Therefore, the IIA restriction could not be rejected, and the CL model could be a valid model for our data. However, and in order to account for heterogeneity of preferences we estimate the proposed models (RE; MME).

sizes as key regulation tools. More specifically, Arlinghaus and Mehner (2005) evaluate the preferences of recreational anglers, finding that angler should be considered in designing and implementing management programs to facilitate their knowledge about the outcomes and risk of policy options. Frangoudes et al. (2008) analyze the process of transformation of on-foot shellfish in Galicia, standing out the empowerment of women as a mean to improve the social assessment of this activity. In this way, Stewart et al. (2013) analyze the stakeholders' perspectives of the stalked barnacles in a national park of Portugal, concluding that the majority of stakeholders believe that the resource was overharvested and that their needs should be considered as part of the legislation process. More recently, Perez de Oliveira (2013) study the case of one area of Galicia (Lira) where after years of overfishing, illegal fisheries and the consequences of the Prestige oil spill, an organization of fishermen has been the pioneers in creating a marine reserve. They find that the enrollment of fishers in this process have promoted best understanding of norms and improved the compliance. In addition, their study concludes that the effectiveness of marine reserve was very high during first years but that recently have been undermined due to the reduction of financial state support.

Therefore, we study the implications of being a member of a MPA in terms of sustainable extraction behavior. Specifically, we are interested in testing whether people belonging to a MPA act in a more sustainable way than the rest of users. To assess this, we analyze the utility changes with respect to two of the attributes that conform the choice experiment for MPA members.

Specifically, we analyze the effect in the *delay* and *coworkers* attributes. We expect that the *delay* increases the utility of users because this limitation will imply that the shellfish resource can grow.

$$H_0 : \vartheta delay * MPA \leq 0$$
$$H_1 : \vartheta delay * MPA > 0 \qquad (5)$$

On the contrary, we expect that the attribute *coworkers* carries a negative sign, implying that the entrance of more fishermen, and therefore the possibility of over-exploitation is negatively valued.

$$H_0 : \nu coworkers * MPA \geq 0$$
$$H_1 : \nu coworkers * MPA < 0 \qquad (6)$$

-Time preferences

Knowledge of on-foot shellfisher´s discount factor is very important and can facilitate the development of effective shellfisheries policies. Curtis (2002) states that in the case of fisheries, the analysis of attitudes of fishermen's attitudes and compliance with regulations are critical to the success of policy initiatives, but when little is known about their personal discount rate, conservation policies may be ineffective. Johnson and Saunders (2014) hypothesize that individuals with higher discount factors and less present bias with regards to financial decisions would also be more inclined towards resource conservation. On the contrary, individuals with lower discount factors and more present bias would be more inclined towards unsustainable levels of resource exploitation.

In addition, factors that make more likely species extinction are many, some of them, a higher price of the resource, a low exploitation cost, a low rate of growth, a higher discount rate, the open access to the resource and great volatility in the growth rate. In this study we pay attention to the discount rate, specifically, we analyze the discount factor among on-foot shellfishers. In this sense, higher discount factors are linked to higher extraction rates (Akpalu, 2008). To our knowledge only three studies have analyzed this question: Curtis (2002), Akpalu (2008) and Johnson and Saunders (2014).

Specifically, we aim to evaluate the effect of the time of delay with respect to the level of improvement that may be obtained. As Curtis (2002) states, personal discount rates vary with the time delay of the reward or penalty, while in addition not all individuals discount all future values at the same rate.

-Social norms

Social norms are defined by Ostrom (2000) as "shared understandings about actions that are obligatory, permitted, or forbidden." In the present application, we are interested in social norms related to their level of compliance. In the questionnaire, we include some issues to research this aspect. In this sense, we asked about the level of compliance among their coworkers, among neighbors of other areas and their own level of compliance. We expect that given the fact that the norm was to obey the law, the obligation to respect it does not imply a negative effect on the utility level because this is saw as a part of their obligations.

$$H_0 : \tau extraction\, ban * social\, norm\, compliance \leq 0$$
$$H_1 : \tau extraction\, ban * social\, norm\, compliance > 0 \qquad (7)$$

Another indicator to study the fact of conditional cooperation is also included. This concept was studied with respect to human behavior that face public goods is the conditional cooperation; Frey and Meier (2004) highlight that people are more willing to contribute when others contribute. Specifically, they find that higher contribution rates are observed when information is provided that many others contribute. In the same line, Pretty (2003) indicates that knowing that people have the confidence to invest in collective activities, also it increases the probability of others to do so. Therefore, when we talk about conditional cooperation we are considering the effect of social trust, defined as the trust in others. With our data we detect that most participants are not conditional cooperators. Therefore, we aim to test what are the implications of this fact for the attribute *coworkers.* Initially, we think that users would not see the entrance of new coworkers as positive because this reduces their individual earnings.

$$\begin{aligned} H_0 &: \pi cowokers * not\, conditional\, cooperator \geq 0 \\ H_1 &: \pi cowokers * not\, conditional\, cooperator < 0 \end{aligned} \tag{8}$$

In addition to this hypothesis of social norms, we also aim to study the effect of other variables related to the concept of altruism. Altruism is defined by Batson and Powell (2003) as a motivation to increase another person's welfare. To analyze the impact of this preference, we study the cross product of this with respect to the *coworkers* attribute. We expect that the coefficient of this indicator will be positive, because altruistic people will see the entrance of new colleagues as positive and their utility levels will increase.

$$\begin{aligned} H_0 &: \eta coworkers * altruism \leq 0 \\ H_1 &: \eta coworkers * altruism > 0 \end{aligned} \tag{9}$$

Finally, we look at the effect of culture. In this sense we are interested in analyzing where the most costly characteristic (extraction band) is better seen when the family is related to the same job and therefore it knows the importance of these fishing bans. .

$$H_0 : \omega extraction\, ban * tradition \leq 0$$
$$H_1 : \omega extraction\, ban * tradition > 0 \qquad (10)$$

-Illegal activity

To conclude the hypotheses of study, we also included one related to the effect of the main problem of this economic activity, the illegal fishing. We expect that those individuals who think that poaching is *not frown up by society* will see the *delay* as something negative given that when the society does not give importance to the illegal activity this will mean that where on-foot shellfishers´ are waiting for the improvement, poachers can be spoiling the resource without the people take care about this.

$$H_0 : \varsigma delay * not\ \ frown\, upon\, by\, society \geq 0$$
$$H_1 : \varsigma delay * not\ \ frown\, upon\, by\, society < 0 \qquad (11)$$

5. Survey and data description

This study centers the attention in the shellfish industry of one community in the North East of Spain, Galicia. This activity is conducted in an artisanal way and has a great social importance, because it is an important source of income for more than 3,900 persons, in large part, women (more than 88% in year 2012). At the same time, it is a source of independency for these women (IGE, 2013). According to data published by Xunta de Galicia (2013) the main species collected in this sector are two types of clams (*Tapes decussatus* and *Venerupis pullastra*) and cockle (*Cerastoderma edule*). Specifically, in

year 2012 the total economic value of these species amounted more than 33€ million and 3,813 tons auctioned (www.pescadegalicia.com).

A face to face survey was conducted in Galicia, specifically during 2013 and winter of 2014. Specifically, we obtain data from the different coastal provinces and one MPA. A sample of 146 shellfishers has been interviewed. It is important to highlight that in last years, two Marine Protected Areas (MPA) have been created in Galicia with the goal to fight against overexploitation issues. Initially, we have tried to include both areas as part of our study, although finally we have included only one of them due to impossibility to obtain collaboration from the second area. Specifically, the MPA that we included is located in the Northwest of Galicia (Spain), in Cedeira. It was created in 2009. The goal of this MPA (Xunta de Galicia, 2009) is to maintain the biodiversity as well as preservation of clean seas in which the exploitation of fishery resources is sustainable. Furthermore, this management tool allows in an indirect way bring new socioeconomic opportunities for fishermen and also to the fishing communities through tourism and marine culture; influencing the economy of fishing communities. All these facts are possible through the recovery of population of exploited resources.

Our survey solicited information about their beginnings at work, questions about their working habits, their opinions about the currently legislation and perceived problems. Finally, socio-demographic characteristics were elicited in the last part of the survey. With the data collected, we observe that more than 93% of respondents were women. This is a common aspect in this sector as we have mentioned above. In addition, the average age of our sample is about 50 years. On average, the number of individuals who live in the same household is around 3.67 persons. With respect to the level of studies we found that

84.62% of the respondents have a basic level of studies. Attending to the income question, we found that about 73.24% of participants obtain less than 1000€ monthly for their activity, while 25.35% earn an income between 1001- 1800€[6]. Furthermore, 22% of respondents are members of labor unions. About 25% of the participants have less than 5 years of experience in their job and around 69.9% thinks that there is a coworker that acts as a leader in the group.

To test the research hypotheses we have constructed the following indicators. First, and with the goal to reflect the *social norm of compliance*, we present in the survey a percentage scale from 10% to 100%. We detect that in all questions the participants choose higher percentages of compliance. To form this social norm we also create a dummy variable that identifies those respondents that selected the value of 80% or higher values. Therefore we could study the implication of those individuals who follow the rules and think that coworkers and neighbors follow a norm of compliance with rules (36.36% of respondents) with respect again to the most costly attribute *extraction ban*. To construct the indicator of *not conditional cooperation*, we have included one question on the interview. We indicate that their coworkers are complying with rules about a 50%, therefore we asked about what would be their behavior in this context. In addition, we specify three possible answers: increase their level of compliance, decrease their level of compliance and do not take into account the behavior of coworkers. Surprisingly we detect that around 74% participants act independently of the behavior of coworkers. To measure the altruistic behavior, we include a variable that identifies those respondents who agree with the idea of allowing the entrance of more people to work with them (65.68% of respondents). We also analyze the impact of tradition and culture. To achieve this we include an indicator that

[6] It is important to consider that they work about 15 days per month.

reflects those people who work as on-foot shellfisher by familiar tradition (37.76% of participants). We study this characteristic with respect to the attribute *extraction ban*. Finally, with regards to the hypothesis of illegal activity we aim to show the importance of this aspect, Table 3 shows some important data. In this sense, the own users believe that the current rate of unemployment is the main cause of this illegal activity. Attending to the solutions proposed, controls to sewage and controls in the inputs of the hotels are the most valued solutions. In addition, it is important to highlight that more than 82% of participants state that illegal poaching is one of the conflicts in their areas, and around 93% of respondents have in mind that this illegal activity is spoiling the resource. With respect to their opinion whether this activity is frown up by society; around 65.7% think that currently this is not the case. We test the effect of this issue with respect to the *delay* attribute.

6. Results

In Table 5, we can observe that the first three columns present the results of the baseline CLogit, the three following columns contain the results of the baseline RE, while the last three present the results of the MME. As we can observe, all attributes are statistically significant. The *improvement* attribute carries a positive coefficient, increasing the utility obtained. The possibility of entrance of new people *(coworkers)* is also perceived as positive. On the contrary, the coefficient associated with the *delay* and *extraction ban* have a negative sign, indicating a reduction in utility. One interesting result is that, although we indicated that there will be an economic subsidy during the time of closure this does not make that users change their opinion about this characteristic resulting in a positive

coefficient. We associate this issue thinking that on-foot shellfishers hope to obtain more income harvesting than only earning the payment. Another explanation that has been mentioned by users during the collection of surveys was that they do not trust in free aid. With regards to the cross product of the *delay* and the *improvement* attributes, (*delay*improvement*) we can observe that it produces an increase in the utility level; however this increase is less than the produced by the *improvement* attribute alone, as expected.

With the objective to test the robustness of results, and obtain more information about on-foot shellfishers preferences, we also estimate an extended RE and MME. Table 6 shows both results. First, in order to test the correct empirical specification used, we have tested the presence of multicollinearity through the Variance Inflation Factor (VIF) indicator with a mean of 3.97, denoting no serious correlation problems. All attributes are statistically significant and carry the expected signs. Specifically, we obtain the following results:

With respect to the *coworkers* attribute, young shellfishers see the entrance of new colleagues *(coworkers*young)* as an element that decreases their utility levels with respect to the average. This can be a consequence that young users are thinking in improving their current income and the possibility of entrance of new member will decrease their benefits. As regards of the *delay* characteristic, those individuals who earn lower incomes undergo a positive impact in utility compared with the mean with the attribute *delay (delay*income).*This is a logical result because the delay may imply more abundance of

resource and therefore the possibility of improving income. Moreover, young participants also value positively the delay attribute (*delay*young*). These results may be logical, given that younger fishermen tend to be more conservationists. Furthermore, attending to the *extraction ban* attribute, users with less than 5 years of experience in their jobs perceive the extraction ban as a positive issue (*extraction ban* no experience*). This may be explained due to the fact that new users know to be more aware with respect the resource compared with the average. Finally, those users who think that there is a leader among their working group, value the extraction ban as something positive *(extraction ban*leader).*

-Hypotheses Results:

1) Marine Protected Areas

With respect to the formulated hypothesis, we find that members of a MPA have more economic awareness on average, given that they reduce their utility levels as a consequence of the introduction of *coworkers (coworkers*MPA);* and on the contrary, they value positively the *delay* on extraction to allow recovery of stocks *(delay*MPA).*

2) Time preferences

Attending to the time preferences, we find that the coefficient associated with this cross product *(delay*improvement)* is lower than the obtained for the *improvement only*. This means than when users take into account the *improvement* together with the *delay*, this affects positively the utility level, although much less. We associate this result to the fact that users know that the *delay* is inevitable and therefore they value positively the

improvement but less when they take into account the waiting time while the resource is growing.

Thus, in Table 7 we can observe the variations of the obtained discount factors, depending of the estimated model. The displayed discount factors are around 1.02-1.09 depending of the estimated model. Therefore, we observe as own users are quite impatient whether we take into account that these values are for an average period of 3 months. It is important to consider that as we have mentioned before, users value negatively the extraction ban although this is compensated with an economic subsidy. Thus, we associate this impatience with the age of respondents and with the current situation of poaching and over-extraction. We may recall that the average age of this sample is around 50 years therefore we believe that a large part of the sample may be considering the retirement and therefore they are thinking in present terms and not about the future. The actual economic crisis has also reduced their income in a considerable way (according to comments that users made when we conducted the surveys), and thus they seek to increase it as soon as possible. Finally, taking into account the current situation of over-extraction may be logical to find higher discount factors. When we compare our results with the results obtained in previous studies, we find that Curtis (2002) obtained through a CE a mean discount factor of 0.70 over an eight year horizon for fishers in Irish Sea; Akapalu (2008) found that fishing boat skippers in Ghana show a mean discount factor of 0.43. Johnson and Saunders (2014) found that discount factors vary from ≤ 0.40 to ≥ 1.0.

3) Social norms

With respect to the third hypotheses, the social norm of compliance with rules, we can observe that this implies that the *extraction ban* increases utility, this may be a consequence *that fishermen a following the norm, do not suffer losses in terms of utility*

*with these restrictions extraction ban*social norm compliance).* Attending to the altruism indicator, we observe that the expected results is confirmed, so that more altruist individuals perceive the entrance of new colleagues as something positive *(coworkers*altruism).* Furthermore, those who are not influenced by the behavior of *coworkers* (*coworkers*not conditional cooperator*) see this attribute as negative and those who become shellfishers as a familiar tradition *(extraction ban*tradition)* perceive the *extraction ban* as negative, in spite of the fact that they may well know the importance of fishing bans to recover over-exploited results.

4) Illegal activity

Finally and with respect to the hypothesis of illegal poaching, we can conclude that the fact that users perceive that this illegal activity is not a problem implies that users value more negatively the time of delay. This may be a consequence of respondents seeing the *delay* as something ineffective because while they are waiting for the improvement of the resource, others may be spoiling it.

7. Conclusions

In this study, we model shellfishers' preferences for management plans through a CE, considering specifically the role of economic incentives as well as the role of social norms. We find important conclusions that policy makers may take into account when designing effective conservation recovery programs. . Specifically, we observe that on-foot shellfishers value positively the *improvement* of resource and the possibility of entrance of new *coworkers*. On the contrary, shellfisher value negatively the *delay* and the *extraction ban* although this last characteristic was compensated with an economic subsidy.

Another important aspect that should be taken into account in the design of new effective policies is t the effectiveness of MPA as a tool to preserve the resource. In this sense, users involved in a MPA have a more conservative behavior in terms of extraction preferences, understanding the effect of the *delay* attribute. Therefore the involvement of users in the management process may be an effective solution in terms of sustainability, changing the way of thinking of users. In addition, and with respect to the social norms, in a small society where the fulfillment of the norm is the general rules, the establishment of restrictions are accepted without producing a decrease in the utility. Furthermore, when users perceive that the illegal activity is not a problem or is indifferent for the society, users value negatively the time of *delay*. Attending to time preferences, we observe that in our sample of on-foot shellfishers in Galicia the discount factor for a delay of 3 months varies between 1.02-1.09. These results indicate that current users are quite impatient and therefore they are aggressive in their extraction levels today. Therefore, policymakers should be taking into account the effectiveness of MPA, the impatience of users and the role that social norms play in on-foot shellfishers´ preferences when they design management policies.

Table 1 Attributes description and levels

Attributes	Description	Levels		
Delay	Number of waiting months until the improvement is noticeable	2	4	6
Improvement	Percentage of improvement in the resource abundance	10%	15%	25%
Extraction ban	Number of months with extraction ban	6	12	18
Coworkers	Number of shellfisher catchers that could benefit from the conservation program	20	40	60

Table 2 Example of choice set card presented

	Management Plan A	**Management Plan B**	**Management Plan C**	**Does not endorse any management plan**
Delay	6	2	4	
Improvement	10%	15%	25%	
Extraction ban	18	6	12	
Coworkers	40	20	60	
Which Management Plan do you select?				

Table 3 Causes and solutions for the illegal activity according to the own users.

Cause	**%**	**Solution**	**%**
Poor surveillance	41.07	More surveillance	54.55
Little knowledge of the harm done	27.17	Higher penalties	56.25
Possibility of obtaining higher income not reportable	68.25	Controls to hotels	54.96
Low penalty	50.00	Jail sentence	17.07
Marginalized groups	52.88	Works for the community	49.57
It is not frown up by society	30.00	More employment	51.40
Unemployment	61.90	Controls on sewage	62.50
Others	25.00	Others	21.92

Table 4 Description of the variables

Variable	Description	Mean	Std.Dev.
Choice	Dependent variable	0.250	0.433
	Characteristics of Management Plans		
Delay	Attribute delay (measured in months)	8.625	6.47
Improvement	Attribute improvement (measured in %)	0.115	0.082
Delay*improvement	Cross product of the attribute of delay and improvement	1.312	1.145
Extraction ban	Attribute closed season	2.875	2.157
Coworkers	Attribute coworkers	27.914	21.112
	User´s characteristics		
Young	1, if the respondents age is less than 50 years; 0 otherwise	0.455	0.498
Income	1, if the the salary of the respondent is less than 1000€ monthly; 0 otherwise	0.727	0.445
No Experience	1; if respondents have less of 5 years of experience in this job; 0 otherwise	0.245	0.43
Tradition	1, if respondents are shellfisher as a family tradition; 0 otherwise	0.378	0.485
MPA	1 for respondents that are members of a Marine Protected Area; 0 otherwise	0.161	0.367
Organized	1, if respondents affirm that work in an organized way; 0 otherwise	0.734	0.442
	User´s opinions		
Employment	1, if respondents think that more employ will be a solution against the illegal poaching; 0 otherwise	0.385	0.487
Altruism	Indicator of altruism: 1 whether respondents think that they would be better if they were less working on the beach; 0 otherwise	0.657	0.475
Not conditional cooperator	1, if respondents comment that their behavior not change knowing the behavior of the rest of the group; 0 otherwise	0.734	0.442
Disputes	1, if respondents think that one of the major disputes that exists currently in their area is the illegal poaching; 0 otherwise	0.818	0.386
Social norm compliance	Social norm of compliance with law. This variable reflects that respondents answered that level of compliance with law are higher that the 80% for themselves of for the coworkers.	0.364	0.481
Leader	1, if respondents think that there is a leader among the group; 0 otherwise	0.699	0.459
Not frown upon by society	1, if respondents think that the illegal poaching is not frown up or indifferent for society; 0 otherwise	0.308	0.462
	Cross products		
Coworkers*employment	Cross product of coworkers*employment	10.737	18.866
Coworkers*altruism	Cross product of coworkers*altruism	18.336	21.646
Coworkers*young	Cross product of coworkers*young	12.701	19.897
Coworkers*MPA	Cross product of closed coworkers*MPA	4.49	13.3
Coworkers*not conditional cooperator	Cross product of coworkers*not conditional cooperator	20.484	21.896
Coworkers*organized	Cross product of coworkers*organized	20.495	21.893
Coworkers*disputes	Cross product of coworkers*disputes	22.838	21.922
Delay*MPA	Cross product of delay*MPA	1.387	4.096
Delay*income	Cross product of delay*income	6.273	6.723
Delay*young	Cross product of delay*young	3.926	6.124

Delay*not frown upon by society	Cross product of delay*not frown upon by society	5.669	6.654
Extraction ban *Social norm compliance	Cross product of extraction ban *social norm compliance	1.045	1.899
Extraction ban *no experience	Cross product of extraction ban *no experience	0.704	1.633
Extraction ban *tradition	Cross product of extraction ban *tradition	1.086	1.923
Extraction ban *leader	Cross product of extraction ban*leader	2.009	2.234

Table 5 Results from the CLogit, RE and MME models

	CLogit			Random Effects			Multilevel Mixed Effects		
Variable	**Coef.**	**Std. Err.**	**P>|z|**	**Coef.**	**Std. Err.**	**P>|z|**	**Coef.**	**Std. Err.**	**P>|z|**
Delay	-1.123	0.149	0.000	-0.096	0.013	0.000	-0.096	0.013	0.000
Improvement	5.989	0.788	0.000	6.137	0.799	0.000	6.137	0.799	0.000
Delay*improvement	0.163	0.077	0.034	0.169	0.078	0.031	0.169	0.078	0.031
Extraction ban	-0.217	0.020	0.000	-0.223	0.021	0.000	-0.223	0.021	0.000
Coworkers	0.050	0.002	0.000	0.051	0.002	0.000	0.051	0.002	0.000
Constant				-2.206	0.078	0.000	-2.206	0.078	0.000
$\log \sigma 2\_u$					-15.536	19.453			
σ_u					0.000	0.004			
ρ					0.000	0.000			
							Random parameters		
Residence							0.000	0.031	
Log likelihood	-2945.69			-3220.847			-3220.847		
N	6864			6864			6864		
$Wald\,\chi^2$				1034.63			1034.63		
$LR\chi^2$	1247.540								
$P > \chi^2$	0.000			0.000			0.000		
$Pseudo R^2$	0.175								

Table 6 Results from the extended RE and MME model.

	Random Effects			Multilevel Mixed Effects		
Variable	**Coef.**	**Std.Err.**	**P>|z|**	**Coef.**	**Std.Err.**	**P>|z|**
Delay	-0.140	0.017	0.000	-0.023	0.002	0.000
Improvement	6.192	0.805	0.000	1.014	0.132	0.000
Delay*improvement	0.181	0.079	0.022	0.036	0.013	0.004
Extraction ban	-0.267	0.029	0.000	-0.048	0.004	0.000
Coworkers	0.058	0.004	0.000	0.010	0.001	0.000
Coworkers*employment	0.002	0.002	0.306	0.000	0.000	0.188
Coworkers*altruism	0.003	0.002	0.050	0.001	0.000	0.022
Coworkers*young	-0.009	0.003	0.007	-0.002	0.001	0.002
Coworkers*MPA	-0.023	0.004	0.000	-0.004	0.001	0.000
Coworkers*not conditional cooperator	-0.005	0.002	0.013	-0.001	0.000	0.002
Coworkers*organized	0.002	0.002	0.365	0.000	0.000	0.151
Coworkers*disputes	0.001	0.002	0.684	0.000	0.000	0.784
Delay*MPA	0.093	0.016	0.000	0.013	0.002	0.000
Delay*income	0.032	0.008	0.000	0.005	0.001	0.000
Delay*young	0.022	0.012	0.076	0.003	0.002	0.077
Delay*not frown upon by society	-0.014	0.006	0.031	-0.002	0.001	0.041
Extraction ban*social norm compliance	0.034	0.019	0.075	0.006	0.003	0.053
Extraction ban *no experience	0.066	0.021	0.001	0.012	0.003	0.000
Extraction ban *tradition	-0.065	0.019	0.001	-0.010	0.003	0.001
Extraction ban *leader	0.044	0.020	0.028	0.008	0.003	0.009
Constant	-2.206	0.078	0.000	0.098	0.010	0.000
$\log\sigma 2\_u$	-15.798	21.945				
σ_u	0.000	0.004				
ρ	0.000	0.000				
				Random Parameters		
Residence						
Sd con				0.015	0.008	
Sd residual				0.388	0.003	
Log likelihood	-3169.581			-3351.020		
N	6864			6864		
$Wald\,\chi^2$	1085.360			1712.550		
$P > \chi^2$	0.000			0.000		

Table 5 Estimated discount factors

Baseline models			
	Average (3 months)	**95% Confidence Intervals**	
Clogit	1.086	1.084	1.087
RE	1.088	1.087	1.089
MME	1.088	1.087	1.089
Extended models			
	Average (3 months)	**95% Confidence Intervals**	
RE	1.094	1.092	1.095
MME	1.020	1.020	1.021

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