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Economic contribution and social welfare of recreational charter boat fisheries in the northeast Atlantic: The cases of Galicia (Spain) and Madeira archipelago (Portugal)

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Recreational charter boat fisheries provide alternative economic development to traditional commercial fisheries, especially to coastal communities in warm seas. Charter boat fishing has been little studied in temperate regions, and the factors that trigger its development and social contribution to fishing communities are unknown. We performed an economic analysis of recreational charter boat fisheries in the Eastern North Atlantic to assess their contribution to social welfare. We selected two case studies located in Galicia (NW Spain) and Madeira archipelago (Portugal). The two cases differ in the socioecological attributes in which recreational charter boat fishing is developed (e.g., relevance of commercial fishing, tourism, or targeted species), that were included in the assessment. Up to 7 charter fishing companies were identified in Galicia (10 boats) and 14 in Madeira (18 boats), and information on the costs and benefits of the activity were collected by a questionnaire answered by company managers and skippers. Charter boats in Galicia are operating throughout the year, and anglers mostly engage in bottom fishing targeting demersal predators like ballan wrasse (*Labrus bergylta*) and European seabass (*Dicentrarchus labrax*) that they retain. Despite the strong seasonality of the fishery in Madeira, focused on summers, the fishing effort is higher than in Galicia. On average, charter boats go fishing for 39.3 ± 41.5 (SD) fishing journeys and take 2 500 anglers on board per year in Galicia, while in Madeira they fish 63.7 ± 32.7 journeys and take 3 200 anglers on board. Anglers target in Madeira pelagic top predators like blue marlin (*Makaira nigricans*), or some tuna species, e.g., bigeye (*Thunnus*

obesus), by trolling in a catch and release fishery. The economic balance of companies was more favorable in Madeira, with an average gross annual profit of € 28 883 ± 30 755, while economic yield in Galicia was € 4 444 ± 7 916. We also applied a travel cost method to assess the recreation demand of recreational fishing trips based on a questionnaire answered by 150 clients in Galicia and 55 in Madeira. We estimated the visitor surplus mean value to be € 1 385 per year in Galicia (95% confidence interval, $CI_{95\%}$= € 1 219 – € 1 550), and € 1 738 in Madeira ($CI_{95\%}$= € 1 433 – 2 043). The social annual recreation value of Galician fishery was worth € 3.4 Million, ranging between € 3.0 M and € 3.8 M, a value well below the annual economic impact generated by commercial fishing (€ 700 M). The recreation value of the charter boat fishery in Madeira, € 6.3 M, ranging between € 5.2 M and € 7.5 M, is comparable to the annual economic impact of commercial fishing, that contributes to the local economy with € 12 M.

KEYWORDS

travel cost method (TCM), marine recreational fisheries, economic contribution, big game fishing, blue economy

Introduction

Marine recreational fishing is defined as an activity aimed at the capture of aquatic resources for leisure and/or personal consumption (Pawson et al., 2008; ICES, 2013). Marine recreational fisheries are very important worldwide, with millions of practitioners and involving a considerable economic contribution to the global economy (Cisneros-Montemayor and Sumaila, 2010; FAO, 2012; Arlinghaus et al., 2014). In Europe there are about 9 million recreational fishers operating along the coastlines that each year generate around 6 € billion in direct expenditures (Hyder et al., 2018).

Fishing for commercial purposes is rarely considered as a traditional component of marine recreational fishing (FAO, 2012). However, recreational charter boat fishing (where clients pay for the transfer on board to a suitable fishing spot, among other potential services, like fishing guides), is a thriving business widely distributed in warm coastal waters worldwide (Ditton and Stoll, 2000; Ditton and Stoll, 2003; Shiffman and Hammerschlag, 2014). There are also some relevant charter boat fisheries in temperate waters, e.g., in Australia (Lynch et al., 2020) and North America (Steinback, 1999; Lew and Larson, 2015). In Europe, charter boat fishing is a relatively important economic activity in the Mediterranean (Öndes et al., 2020) and in the Atlantic archipelagos of Canary, Madeira, and Azores islands (León et al., 2003; Vieira and Antunes, 2017; Diogo et al., 2020; Martinez-Escauriaza et al., 2021). However, in the Atlantic continental coast of Southern Europe there are relatively few companies dedicated to charter boat fishing.

Since marine recreational fisheries can have a significant impact on European fish stocks (Radford et al., 2018), recreational charter boat fishing in Europe is under some management restrictions designed to ensure the sustainability of fish stocks (Council of the European Union, 2008), and to a control regime aimed to reduce conflicts arising from the concurrent use of the same fishing areas and fish stocks with commercial fishing vessels (Council of the European Union, 2009).

On the other hand, the Parliament of the European Union (EU) encourages further development of recreational charter boat fishing initiatives to improve local economic development, particularly in rural areas and in outer regions of the EU (European Parliament, 2018). To facilitate this process, it is necessary to understand the mechanisms that encourage the creation of charter boat fishing opportunities and their resilience over time. However, and despite its socioeconomic importance, to date, charter boat fishing has been little studied in Europe, and the factors that trigger its potential business development are unknown for the most part.

The basic characterization of this activity is essential to understand the public policies necessary to favor its sustainable development, including support for the development of ancillary services needed for implementing new charter operations (Williams et al., 2020). To obtain key information on this activity in Europe, especially in areas where its development is most necessary due to a high dependence on marine resources and the scarcity of economic alternatives, we selected two recreational charter boat fisheries located in rural

and outer European regions, namely in Galicia (Spain) and Madeira archipelago (Portugal) (Figure 1).

Galicia, located in the Atlantic coast of Spain, has a long and strong tradition in marine recreational fisheries, with 60 000 fishers and 4 000 boats engaged in this activity in coastal waters (Pita et al., 2018). The high primary productivity of its waters, enriched by a coastal upwelling (Bode et al., 2009), the great importance of its commercial fishing sector, with the largest European fleet and one of the largest in the world (STECF, 2017), and the concurrence of many other maritime activities, including maritime transport (Suárez de Vivero and Rodríguez Mateos, 2012), aquaculture (Pérez-Camacho et al., 1991) and growing tourism (Cortés-Jiménez, 2008), make up a very complex socio-ecological system. Many Galician coastal towns and villages are highly dependent on marine resources, especially commercial fisheries due to the lack of alternative jobs, this sector being of key relevance in terms of the Galician Gross Domestic Product (GDP) (Freire and García-Allut, 2000; Villasante et al., 2013; Villasante et al., 2016). Despite the multiple human impacts exerted on coastal ecosystems, there is potential for the development of sustainable charter boat fishing, which is currently little developed (Pita et al., 2017; Pita and Villasante, 2019).

The case of Madeira archipelago, in the Macaronesia region, is very different in terms of charter boat fishing, since it is one of the best-known places in the world to practice big game fishing (Martinez-Escauriaza et al., 2021). The Madeira archipelago consists of two main inhabited islands (Madeira, and Porto Santo), and two other uninhabited islands (Desertas and Selvagens islands), with some adjacent islets. The local population also shows a relevant participation in recreational angling (Martínez-Escauriaza et al., 2020). The main threat to the continuity of recreational charter boat fishing companies comes from the high tourist pressure that can reduce the benefits derived from the stay for visitors who value natural environments the most (Oliveira and Pereira, 2008; Almeida et al., 2014; Almeida, 2016), and the impacts of different fisheries along the wide distribution ranges of the targeted fish stocks, mostly large and vulnerable oceanic top predators (Martinez-Escauriaza et al., 2021).

In this study we characterized for the first time, and compared, the main attributes of recreational charter boat fisheries of Galicia and Madeira archipelago, including an estimation of their direct economic contribution by assessing the financial performance of the companies operating in the two studied regions. We also evaluated the recreation demand of both recreational charter fisheries by characterizing recreation fishing use as a benefit generating social welfare.

Methods

Interviews with company owners and skippers

In January 2019 we interviewed owners and skippers of recreational fishing charter boat companies of Spain (Galicia) and Portugal (Madeira archipelago) to collect key economic, social, and ecological information. To identify the charter boat companies operating in the two areas we followed a snowball model (Goodman, 1961), starting with a small group of initial informants, and expanding through their contacts and social

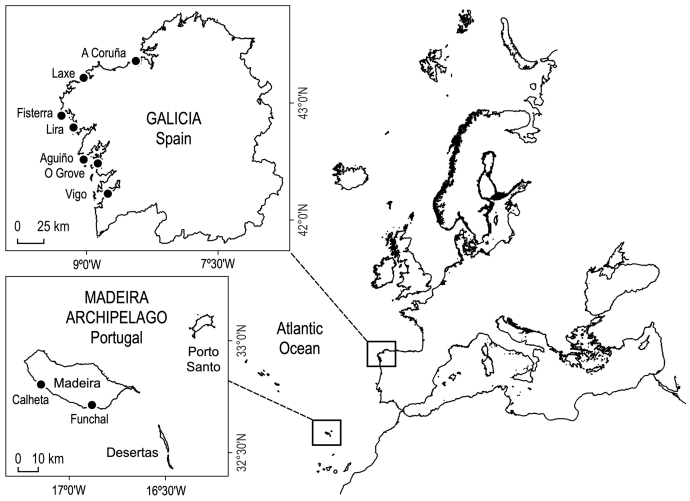

FIGURE 1
Map showing the location of Galicia (NW Spain) and Madeira archipelago (Portugal). We also show the marinas harboring recreational fishing charter boats.

networks. Although the supply of charter boat companies was simple to identify in Madeira, with the boats concentrated in a few marinas, in Galicia the offer was much more dispersed and less accessible to the uninitiated. For this reason, in our interviews we specifically asked respondents for the name and location of other companies, or contacts that could provide further references.

In-depth interviews were carried out to obtain information on the characteristics of the fishing boats (i.e., length, power, and onboard crew and clients), used fishing gears, seasonality, fishing effort (i.e., number of fishing journeys per year, number of hours per journey, and number of anglers per year), targeted species (including the ratio of retained and released fish), and on the economic performance of the companies, including costs and investments (i.e., in boat mooring, fuel and maintenance, fishing gears, food and drinks served onboard, insurances, licenses and taxes, staff salaries, publicity, and other), and also gross annual revenue. Company owners and boat skippers also reported the percentage of dedication of their boats to fishing in relation to other recreational activities with clients (e.g., tourist visits, wildlife watch, etc.) that was used to weigh the economic balance of the companies. To prevent recall bias in the responses, the company owners and skippers were asked to provide averages in their responses for the last three years.

Client survey

Between February 2019 and October 2020, we performed interviews with clients of recreational fishing charter boat companies in Galicia and Madeira by using a structured questionnaire (Appendix 1). In Galicia, due to the dispersion of the companies along the coast, we provided the owners and skippers of the companies with paper copies of the questionnaire so that they could deliver them to the anglers. To facilitate responses, we also enabled an online form with the same questionnaire so that it could be answered by mobile phone, or computer. In Madeira, the owners and skippers preferred that the surveys be carried out by the researchers involved in this study. Thus, researchers visited the ports on a temporary random basis, including working and non-working days, through the annual fishing cycle.

Our survey aimed at collecting information on 1) visiting profile and frequency (number of fishing journeys during the current trip, number of fishing journeys during the previous year in the same, and in other locations, group size, type of accommodation, and daily expenses including accommodation, fishing fee and travel allowances); 2) characteristics of the fishing experience influencing the trip decision, e.g., reasonable cost, fish abundance or diversity, presence of particular fish species, natural or cultural values of the area, uncrowded, or close to my home, among other set of response options (the respondents could write their own option if it was not available in the list); 3) travel distance from home and transport modality; 4) other recreational activities practiced during the trip (number of days during the current trip); and 5) socioeconomic and demographic characteristics (age, gender, civil status, education level, number of people living in the household, number of underage people living in the household, job, working hours per month, revenue per month, residence country, and if they belonged to any fishing association or club). We also included an open-ended question about the Willingness To Pay of a tax (WTP_t) to support the ecological sustainability of the local environment.

The margin of error of the client survey, with a 95% confidence ($ME_{95\%}$), was obtained by following the equation:

$$ME_{95\,\%} = 1.96 \times \frac{\sigma}{\sqrt{n}} \quad [1]$$

Where σ represented the population standard deviation, and n the sample size.

Travel cost calculation

We estimated recreation value with the Travel Cost Method (TCM) (Clawson, 1959), a widely used revealed preference method of non-market valuation. Recreation value was estimated based on anglers' WTP obtained in an on-site survey, from which we estimated the Consumer Surplus (CS), i.e., the excess of social value for consumers over the price actually paid.

The Combined Travel Cost (CTC) was calculated as the sum of the individual travel cost (tC), the Opportunity Cost of Time (OCT), and Other Costs (OC) like fishing fee, accommodation, and food. The information on OC was provided by the anglers in the questionnaires. We then calculated tC as the product between the travelled distance in kilometers, also reported by the anglers, and the cost per kilometer, separately for anglers that arrived at the boat by walking (set to 0), by car or motorbike, and by national, European, and international flights. We multiplied by 2 the travelled distance to account for forward and return travels. In the case of cars and motorbikes, we estimated the cost per kilometer by using the official fiscal value. The travel cost both for Spain and Portugal was 0.19 € per km (Agencia Tributaria, 2022). In the case of flights, we used the information provided by one of the most popular flight search engines in Europe (Kayak España, 2017). For both Spanish and Portuguese national flights, we used 0.08 € per km, and for European and international flights we used 0.05 €/km, as estimated for flight searches conducted for round flights departing from Madrid and Barcelona in economic class between 2016 and 2017. In the case of multi-mode trips (e.g., anglers who traveled by plane and then by car, or other vehicle), we only considered the distance traveled by plane.

We finally used the product between the round trip time and 1/3 of the wage rate to estimate the OCT (Martínez-Espiñeira

and Amoako-Tuffour, 2008; Roussel et al., 2016). The wage rate was approximated by the monthly income divided by the monthly hours of work (information that was provided in the questionnaires answered by the anglers). We calculated the trip time from the reported travel distance and assuming a driving average speed of 80 $km \cdot h^{-1}$ and a flying average speed of 600 $km \cdot h^{-1}$.

CS was derived from a recreation demand function obtained from the relationship between the number of fishing journeys undertaken to the site per year (outcome), and the price (the travel cost), among a set of other predictors, including the avidity for substitute sites, the number of days dedicated to practicing other leisure alternatives during the current fishing trip, group size, and visitors' socio-economic characteristics collected in the survey. We finally estimated the social annual value of fishing trips for the overall anglers' population to provide a first valuable reference.

Econometric models

In the econometric models (fitted separately for each geographic area), Y_i was the outcome representing the number of fishing journeys made by the respondent to the same destination during the past year (including the current trip) as a function of the Combined Travel Cost (CTC) and other independent predictors (see equation 2). Since the outcome is a nonnegative integer variable, linear models are unsuitable to estimate the recreation demand function (Shaw, 1988). We kept zero-truncation and potential overdispersion controlled by using more flexible negative binomial Generalized Additive Models (GAMs) (Hastie and Tibshirani, 1990). We used the maximum possible flexibility in the smoothed terms (i.e., the basis dimension) allowed by the available amount of data for each predictor, and cubic regression splines to avoid erratic behaviors of the fitted values at the extremes (Ferrini and Fezzi, 2012).

The demand function for the $_i$th visitor was:

$$Y_i = f[CTC_i, \quad p_i(N_i, \quad G_i, \quad A_i, \quad S_i)] \qquad [2]$$

Where $p_i(\cdot)$ represents the vector of other visitor-specific independent predictors. These predictors included N_i, which accounted for the number of days devoted to the practice of alternative leisure activities during the current fishing trip (following Roussel et al., 2016). G_i included group size, i.e., the number of people traveling with the angler, in the fitted GAMs (including non-angling travelers). A_i accounted for the willingness to choose alternative trips by including a factor variable (*avidity*) with 3 levels (*Low*, *Medium*, and *High*), based in the fishing days during the past year (that ranged between 0 and 80), and the country in which the fishing took place (national or foreign). Thus, *Low* included visitors that fished <40 days in their own country, *Medium* included visitors that fished ≥40 days in their own country, or <15 days in a foreign country, and *High* included visitors that fished ≥15 days in a foreign country. S_i represents a set of visitors' socio-economic and demographic characteristics, including age, gender, civil status, education level, number of people living in the household, number of underage people living in the household, job, working hours per month, revenue per month, residence country, and level of associativism (i.e., membership to fishing associations or clubs) to account for fishing avidity.

Unadjusted GAMs were fitted first (i.e., considering the effect of only one predictor), whereas a backward stepwise selection procedure was followed to fit adjusted models (i.e., from saturated models to final models, removing non-significant variables at each step). The best models were selected based on the Akaike's information criterion (Akaike, 1973), deviance explained, and appropriate residual structure. Models with highly dispersed and anomalous distribution of residuals were discarded. All calculations were performed with the statistical software R ver. 4.0.2 (R Core Team, 2019).

We used the parameters of the final models to calculate recreation benefit, or welfare in terms of the CS anglers derive from trips to Galicia and Madeira. We calculated the average individual CS for access by computing the area under the demand curve (Haab and McConnell, 1996) by adaptive quadrature methods and obtained confidence intervals following a Monte Carlo simulation to solve the numerical integrals. We then multiplied the results by the predicted number of persons by trip to obtain the predicted annual CS for the average visitor group.

Finally, we used the expected number of anglers in Galicia and Madeira to obtain the overall social welfare for the two recreational charter boat fisheries. Since in our study we also assessed the economic performance of the charter boat companies operating in both recreational fisheries we did not consider their benefits as part of total social welfare. We computed the overall CS for the whole population of potential clients (P). Following Parsons (2003), the Population Surplus (PS) can be estimated as follows:

$$PS = CS \times P \qquad [3]$$

Results

Interviews with company owners and skippers

In Galicia we interviewed owners and skippers of 10 charter fishing boats belonging to 7 companies, which represents all the recreational fishing companies based in Galicia. In Madeira, we interviewed owners and skippers of 18 boats of a total of 20 currently operating in Madeira, belonging to the 14 companies, mainly based in Funchal and Calheta (Martinez-Escauriaza et al., 2021).

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The average length of Galician charter fishing boats was 8.63 ± 2.96 (SD) m, while the boats operating in Madeira were bigger (9.57 ± 2.46 m on average). Average engine power and crew size were also higher in Madeira (465.0 ± 298.43 HP, and 2.06 ± 0.24 crew members, respectively) than in Galicia (246.0 ± 214.53 HP, and 1.2 ± 0.42 crew members) (Table 1).

The most popular fishing gear of recreational fishing onboard Galician boats was bottom fishing (65.2% of total annual fishing time), followed by spinning (29.2%), jigging (3.2%), and trolling (2.3%). In Madeira, fishing charter boats mainly engaged in trolling (74.4%), and to a lesser extent in bottom fishing (16.9%), and jigging (5.2%) (Table 1).

Recreational fishing charter boat companies in Galicia maintained their activity throughout most of the year, while in Madeira the activity showed a very strong seasonality, since fishing charter boats mainly operated during the summer months (Figure 2).

In Galicia, charter boat companies performed an average of 39.30 ± 41.45 fishing journeys per year, while charter boats in Madeira sailed out 63.69 ± 32.71 journeys. Average duration of the fishing trips was also lower in Galicia (5.0 ± 2.21 hours) than in Madeira (5.89 ± 1.02 hours). On average, Galician charter boat companies reported 246.0 ± 444.73 clients per year. Portuguese skippers and owners did not report the number of clients per year. Instead, they reported the number of clients per trip (3.18 ± 0.75). Therefore, since the annual number of fishing journeys performed in Madeira by the 18 charter boats was 1 019 trips, the total number of clients per year was estimated at 3 242 anglers (2 460 in Galicia).

Main targeted species in Galicia were ballan wrasse (*Labrus bergylta*), black seabream (*Spondyliosoma cantharus*), European seabass (*Dicentrarchus labrax*), pouting (*Trisopterus luscus*), and white seabream (*Diplodus sargus*). Other relevant species reported were Atlantic horse mackerel (*Trachurus trachurus*), Atlantic mackerel (*Scomber scombrus*), blackspot seabream (*Pagellus bogaraveo*), comber (*Serranus cabrilla*), common two-banded seabream (*D. vulgaris*), European conger (*Conger conger*), John dory (*Zeus faber*), Mediterranean rainbow wrasse (*Coris julis*), and pollack (*Pollachius pollachius*). Company managers also mentioned some catches of blue shark (*Prionace glauca*), and squids *Loligo* spp.

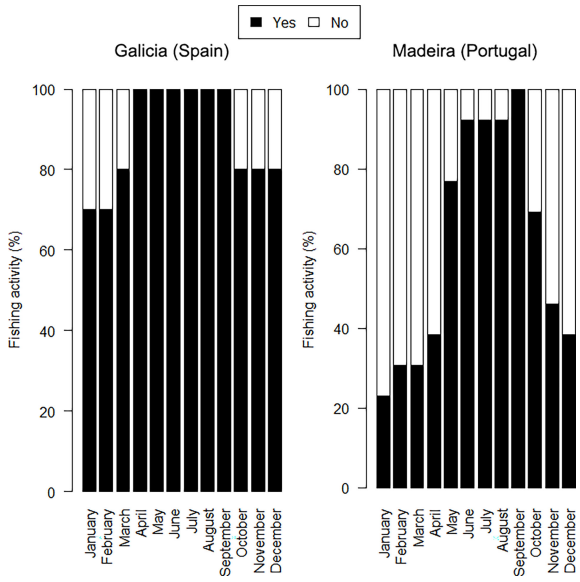

FIGURE 2
Annual cycle of activity of recreational fishing charter boat companies in Spain (Galicia) and Portugal (Madeira archipelago). The percentage of active boats in each month is shown.

In the archipelago of Madeira recreational anglers mainly targeted Atlantic white marlin (*Kajikia albida*), bigeye tuna (*Thunnus obesus*), blue marlin (*Makaira nigricans*), and wahoo (*Acanthocybium solandri*). Also, anglers onboard charter boats caught amberjacks (*Seriola* spp.), barred hogfish (*Bodianus scrofa*), barracudas (*Sphyraena* spp.), bluefish (*Pomatomus saltatrix*), dolphinfish (*Coryphaena* spp.), grey triggerfish (*Balistes capriscus*), island grouper (*Mycteroperca*

TABLE 1 Mean (and SD) characteristics of recreational fishing charter boats and percentage of annual fishing time using each gear in Spain (Galicia) and Portugal (Madeira archipelago).

Attributes		Spain (Galicia)	Portugal (Madeira)
Boat			
	Length (m)	8.63 ± 2.99	9.57 ± 2.46
	Power (HP)	246.0 ± 214.53	465.0 ± 298.43
	Crew (N)	1.20 ± 0.42	2.06 ± 0.24
Fishing gear			
	Bottom (%)	65.20 ± 44.43	16.94 ± 19.64
	Jigging (%)	3.20 ± 7.83	5.17 ± 11.45
	Spinning (%)	29.20 ± 46.64	0.0 ± 0.0
	Trawling (%)	2.30 ± 3.09	74.44 ± 24.25
	Other (%)	0.10 ± 0.32	3.44 ± 9.67

fusca), pink dentex (*Dentex gibbosus*), red scorpionfish (*Scorpaena scrofa*), skipjack tuna (*Katsuwonus pelamis*), white seabream, and zebra seabream (*D. cervinus*). Portuguese skippers and company owners also reported some catches on pelagic sharks. Notably, while almost all catches were released in Madeira, only 25.8% ± 22.8% of the catches were released in Galicia.

Economic performance of recreational fishing charter boat companies

Galician fishing charter boat companies spent on average € 9 799 ± 18 793 per year to carry out their activities, and in Madeira € 21 299 ± 5 216 (Figure 3). Although in general more costly in Madeira, the breakdown of the main company expenses was similar between the two regions. Expenses on publicity and mandatory operational licenses were the only costs that were higher in Galicia than in Madeira. The highest annual expenses and investments were made in the fishing boats, especially in fuel, but also in equipment and maintenance, and in moorings. Staff salaries were also a relevant cost for charter boat companies, followed by the purchase of fishing gears, different insurances, and food and beverages served on board (Table 2).

Average annual income was higher in Madeiran companies (€ 50 182 ± 35 971) than in Galician ones (€ 14 243 ± 26 709) (Figure 3). Therefore, and despite their higher costs, the economic balance of charter fishing companies was more favorable in Madeira, with an average gross annual profit of € 28 883 ± 30 755, while economic yield in Galicia was € 4 444 ± 7 916.

Client survey

We performed 150 interviews with clients of Galician recreational fishing charter boat companies and 55 interviews with clients of Madeiran companies. Most clients fishing in Galician companies were from Spain (94.7% of total), although some anglers also traveled from other European countries (France, Germany, the Netherlands, Russia, and Switzerland), and from the USA (Table 3). On the contrary, only 16.3% of total clients of Madeiran companies were from Portugal. In fact, the UK was the most relevant country of origin (38.2%), although many anglers also arrived from other European countries (Finland, France, Germany, Hungary, Italy, Latvia, Luxembourg, Russia, Spain, Sweden, and Switzerland), and from Canada, Costa Rica, and the USA (Table 3).

Almost half of the anglers in both destinations (43.9%, and 45.5% in Galicia and Madeira, respectively) were between 35 and 49 years old. Most anglers were men (85.4% in Galicia, and 89.1% in Madeira), married or living with a partner (58.3% in Galicia, and 79.6% in Madeira), and did not belong to any fishing association or club (80.3% in Galicia, and 70.2% in Madeira). Most anglers in Madeira finished university studies (85.7%), while in Galicia they mostly finished vocational training (36.9%), or university studies (36.2%) (Table 3).

Mean household size was up to 3.04 ± 1.22 persons in the case of Galicia, and 2.16 ± 1.19 persons in the case of clients of Madeiran companies, while on average 0.79 ± 0.84 and 0.68 ± 0.87 were minors, respectively. Mean monthly income of visitors to Galicia was € 1 692 ± 492, while € 2 071 ± 646 in the case of the visitors to Madeira. Almost half of the anglers of the two countries were employees (48.6% in Galicia, and 50.0% in

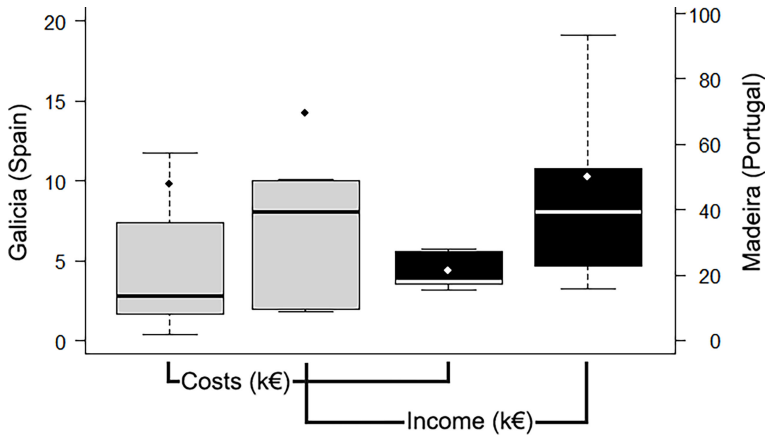

FIGURE 3
Annual expenses and income of companies engaged in commercial MRF in Spain (Galicia, in grey; left y-axis) and Portugal (Madeira archipelago, in black; right y-axis). The top and bottom sides of the boxes correspond to the first and third quartiles of the values, the vertical lines extend up to 1.5 times the interquartile range, the median is indicated with a horizontal line, and the mean with a black dot. Outliers are not shown for visualization purposes.

TABLE 2 Mean (and SD) annual expenses and investments (€) of recreational fishing charter boat companies operating in Spain (Galicia) and Portugal (Madeira archipelago).

Expenses	Spain (Galicia)	Portugal (Madeira)
Boat equipment and maintenance	539 ± 898	4 650 ± 5 111
Boat fuel	2 776 ± 6 492	5 194 ± 2 967
Boat mooring	517 ± 990	2 994 ± 2 320
Fishing gears	1 800 ± 1 568	708 ± 1 211
Food and beverages	92 ± 206	850 ± 961
Insurances	415 ± 429	1 396 ± 715
Licenses	280 ± 492	189 ± 6
Publicity	2 870 ± 8 717	965 ± 1 330
Salaries	4 947.53 ± 3 615.48	12 500.0 ± 0.0

Madeira), who on average worked 8.0 ± 1.26 hours per day in the case of Galicia, and 8.3 ± 0.44 hours per day in the case of Madeira. Self-employed and businessmen were the other occupations of fishers of working age, while the access of students and retirees was much lower (Table 3).

The natural value of the environment was the most valuable attribute of the fishing trip in the case of clients of Galician companies (45.0% of respondents), followed by the price (28.6%), and the presence of certain fish species (23.6%). Clients of Madeiran boats primarily valued the complete experience (36.5%), followed by the presence of certain fish species (23.1%) (Table 3).

Mean number of fishing journeys while on their current trip was 1.81 ± 2.71 days in Galicia, and 1.91 ± 1.69 days in Madeira. The previous year, these anglers fishing in Galicia spent another 0.84 ± 3.12 days in the same location, 1.11 ± 2.90 days in the case of Madeira. The anglers interviewed in Galicia spent another 3.39 ± 8.94 days in other fishing places, 7.38 ± 12.76 days in the case of clients of Madeiran companies. Moreover, the visitors also spent on average 0.52 ± 1.27 days in Galicia, and 2.73 ± 3.31 days in Madeira in alternative recreational activities (Table 3).

Mean group size was similar in both locations (2.69 ± 0.93 in Galicia, and 2.36 ± 1.09 in Madeira). Visitors to Galicia traveled on average 335.55 ± 566.19 km to arrive at the fishing location, while visitors to Madeira traveled 2 800 ± 1 880 km. According to the distances and the isolated nature of the Madeira archipelago, cars were the main transport in the case of Galicia (93.3% of total), while plane (87.3%) was the main transport used to arrive in Madeira. In the same way, most clients of Galician companies did not sleep away from home (59.3%), while up to 76.4% of anglers traveling to Madeira stayed in a hotel or in a vacation rental (Table 3).

All travel costs were higher in Madeira than in Galicia: mean individual travel cost (*t*C) was € 100.42 ± 140.38 in Galicia and € 282.63 ± 185.56 in Madeira; mean Opportunity Cost of Time (OCT) was € 21.39 ± 33.54 and € 36.20 ± 25.47, respectively; and mean daily costs (OC), that included fishing fees, accommodation, and food was € 127.97 ± 128.01 and € 156.18 ± 101.11, respectively. Consequently, mean individual CTC in Madeira, i.e., the sum of *t*C, OCT, and OC (€ 475.01 ± 247.66), almost doubled the CTC in Galicia (€ 249.77 ± 214.83). However, Willingness To Pay of an ecological tax (WTP_t) to support the local environment was a bit higher in the case of visitors to Galicia (€ 7.40 ± 12.72), than that of visitors of Madeira (€ 3.05 ± 6.88) (Table 3).

Association between fishing journeys, willingness to pay and other predictors

In the econometric models the outcome was the number of fishing journeys performed by the respondent angler to the same location during the past year (including the current trip). Although the main predictor was expected to be the CTC (as a proxy of the WTP), we included other independent variables, like the number of days practicing alternative leisure activities, the willingness to choose alternative trips, the group size, and socio-economic characteristics.

The CTC had a significative effect in the number of fishing journeys in Galicia and Madeira, both in the unadjusted ($p= 0.024$; $R^2 = 0.005$, and $p= 0.041$; $R^2 = 0.047$, respectively), and in the adjusted GAMs ($p= 0.024$; $R^2 = 0.005$, and $p= 0.025$; $R^2 = 0.230$, respectively) (Table 4). The CTC had a clearer negative effect on the number of fishing journeys in Galicia than in Madeira, where the demand function was not decreasing at the right tail of the CTC values (Figure 4).

The different relative importance given by the anglers to the journeys dedicated to alternative recreational activities could partly explain the differences in the demand functions of Galicia and Madeira, affecting the expected negative slope of the demand function in the case of Madeira. To assess this, we fitted GAMs that modeled the association between the journeys devoted to fishing and alternative activities on the full duration of the trips, i.e., including days not dedicated to angling (Table 4). We found that although fishing journeys always exceed those dedicated to other activities in Galicia, after 10

TABLE 3 Descriptive characteristics of the fishing activity valued by clients of recreational fishing charter boat companies in Spain (Galicia) and Portugal (Madeira archipelago).

Attributes		Spain (Galicia)	Portugal (Madeira)
Selected features		**% (N=140)**	**% (N=52)**
	Companionship	2.9	0.0
	Crew friendliness	3.6	7.7
	Cultural values of the area	15.0	0.0
	Fish abundance	18.6	0.0
	Fish diversity	20.0	0.0
	Low crowding	5.7	0.0
	Natural values of the area	45.0	7.7
	Presence of particular fish species	23.6	23.1
	Price	28.6	0.0
	Proximity	19.3	7.7
	Trophy fish	0.0	1.9
	Whole experience	4.3	36.5
Fishing journeys		Mean (N=150)	Mean (N=55)
		1.8 ± 2.7	1.9 ± 1.7
Past fishing journeys		Mean (N=150)	Mean (N=55)
		3.4 ± 9.0	7.38 ± 12.8
Past fishing journeys same place		Mean (N=150)	Mean (N=55)
		0.8 ± 3.1	1.1 ± 2.9
Activity journeys		Mean (N=150)	Mean (N=55)
		0.5 ± 1.3	2.7 ± 3.3
Travel distance (km)		Mean (N=150)	Mean (N=55)
		335.6 ± 566.2	2 800.2 ± 1 880.0
Transport		% (N=150)	% (N=55)
	Walking	0.0	3.6
	Motorbike	0.7	0.0
	Car	93.3	9.1
	National plane	2.0	3.6
	European plane	3.3	76.4
	International plane	0.7	7.3
Group size		Mean (N=150)	Mean (N=55)
		2.7 ± 0.9	2.4 ± 1.1
Accommodation		% (N=150)	% (N=55)
	Home	59.3	12.7
	Family/friend	2.0	10.9
	Car	1.3	0.0
	Motorhome	0.7	0.0
	Camping	1.3	0.0
	Vacation rental	12.7	14.5
	Hotel	22.7	61.8
Daily expenses (€)		Mean (N=150)	Mean (N=55)
		128.0 ± 128.0	156.2 ± 101.1
WTP_t (€)		Mean (N=93)	Mean (N=22)
		7.4 ± 12.7	3.1 ± 6.9
Age		% (N=148)	% (N=55)
	18-24	4.1	0.0

(Continued)

TABLE 3 Continued

Attributes		Spain (Galicia)	Portugal (Madeira)
Selected features		**% (N=140)**	**% (N=52)**
	25-34	25.0	7.3
	35-49	43.9	45.5
	50-64	23.0	34.5
	>65	4.1	12.7
Gender		% (N=144)	% (N=55)
	Men	85.4	89.1
	Women	14.6	10.9
Civil status		% (N=148)	% (N=54)
	Single	34.0	13.0
	Married or living with a partner	58.3	79.6
	Divorced or separated	7.6	7.4
Education		% (N=141)	% (N=49)
	Primary	6.4	4.1
	Secondary	20.6	4.1
	Vocational training	36.9	6.1
	University	36.2	85.7
Household members		Mean (N=150)	Mean (N=55)
		3.0 ± 1.2	2.2 ± 1.2
Underage		Mean (N=150)	Mean (N=55)
		0.8 ± 0.9	0.7 ± 0.9
Occupation		% (N=146)	% (N=48)
	Student	4.8	0.0
	Employee	48.6	50.0
	Public employee	0.7	6.3
	Self-employed	23.3	10.4
	Businessman	13.7	18.8
	Retired	8.9	14.6
Working hours per day		Mean (N=150)	Mean (N=55)
		8.0 ± 1.3	8.3 ± 0.4
Monthly family income (€)		Mean (N=150)	Mean (N=55)
		1 692.0 ± 491.6	2 070.9 ± 645.7
Association		% (N=142)	% (N=47)
	No	80.3	70.2
	Yes	19.7	29.8
Country		% (N=149)	% (N=55)
	Canada	0.0	1.8
	Costa Rica	0.0	1.8
	Finland	0.0	7.3
	France	0.7	10.9
	Germany	2.0	3.6
	Hungary	0.0	1.8
	Italy	0.0	3.6
	Latvia	0.0	1.8
	Luxembourg	0.0	1.8
	Netherlands	0.7	0.0
	Portugal	0.0	16.4

(Continued)

TABLE 3 Continued

Attributes		Spain (Galicia)	Portugal (Madeira)
Selected features		**% (N=140)**	**% (N=52)**
	Russia	0.7	1.8
	Spain	94.6	1.8
	Sweden	0.0	1.8
	Switzerland	0.7	1.8
	UK	0.0	38.2
	USA	0.7	3.6

We also show the mean (and SD) number of fishing journeys performed during the current recreational trip, the mean number of fishing journeys performed during the past year, the mean number of fishing journeys performed during the past year in the same location, the mean number of journeys devoted to alternative recreational activities during the current recreational trip, the mean distance traveled from home, the main transport used, the mean total group size, the type of accommodation during the stay, the mean daily expenses, and mean Willingness To Pay of an ecological tax (WTP_t) to support the local environment. In addition, we show basic demographics.

days of vacation the time dedicated to alternatives to angling was greatly reduced. On the contrary, in Madeira, after 8 days of vacation, alternative recreational activities became more important than fishing (Figure 5). These results suggest that trips to Madeira have a higher multi-purpose character than in the Galician case, which could have affected the expected negative relationship between the CTC and the fishing days estimated by the demand function in Madeira, especially in the case of higher travel costs (as shown in the Figure 4).

In the case of Galicia, an increase in the number of minors living in the visitor household ($p= 0.002$; $R^2 = 0.030$), and membership to a fishing association or club ($p< 0.001$; $R^2 = 0.050$) had a positive effect on the number of fishing journeys predicted in the unadjusted models. In the adjusted model only the number of underage members of the family was retained ($p< 0.001$) (Table 4).

In Madeira, the bigger the visitor group size ($p= 0.034$; $R^2 = 0.026$) the lower the number of fishing journeys predicted in the unadjusted model, while membership of a fishing association or club ($p= 0.001$; $R^2 = 0.186$) had a positive effect. Only membership of a fishing association or club ($p= 0.004$) was retained in the adjusted model (Table 4).

Consumers' surplus

We estimated the individual CS mean value (as a reliable proxy for individual value) to be € 1 385 per year in Galicia (95% confidence interval, $CI_{95\%}$= € 1 219 – € 1 550), and € 1 738 in Madeira ($CI_{95\%}$= € 1 433 – € 2 043) (Figure 6).

The yearly mean CS per visit in Galicia could then be set to € 3 729, ranging from € 3 103 to € 4 404, since the observed size of the average group was 2.69 people ($CI_{95\%}$= 2.55 people – 2.84 people). In Madeira, the average fishing group was 2.36 people ($CI_{95\%}$= 2.07 – 2.65), for what the yearly mean CS per visit was € 4 108, ranging from € 2 973 to € 5 420.

To estimate the yearly social welfare of the recreational charter fishery in Galicia, i.e., the Population Surplus (PS), we

TABLE 4 Outputs of the GAMs fitted on the number of angling days and number of vacation days (including non-angling days, devoted to alternative recreational activities).

Country	Outcome	Predictor	P value	Deviance explained (%)	AIC
Spain	Angling days	CTC (WTP)	0.0242	3.5	636
	Angling days	Underage	0.0020	11.0	460
	Angling days	Association: No *vs.* Yes	<0.0001	13.3	624
	Angling days	CTC (WTP)	0.0051	21.6	453
		Underage	0.0004		
	Vacation days	Angling days*Non-angling days	<0.0001	98.8	392
Portugal	Angling days	CTC (WTP)	0.0408	10.6	245
	Angling days	Group size	0.0344	9.7	245
	Angling days	Association: No *vs.* Yes	<0.0001	32.8	232
	Angling days	CTC (WTP)	0.0245	42.1	229
		Association: No *vs.* Yes	0.0040		
	Vacation days	Angling days*Non-angling days	<0.0001	98.9	192

We show the p-values for the different significant predictors of unadjusted (i.e., considering the effect of only one predictor) and of final adjusted models (i.e., including more than one predictor), and the values of deviance explained, and Akaike's information criterion (AIC) (*stands for interaction term; CTC stands for Combined Travel Cost; WTP stands for Willingness To Pay; and "association" indicate anglers' membership to a recreational fishing association).

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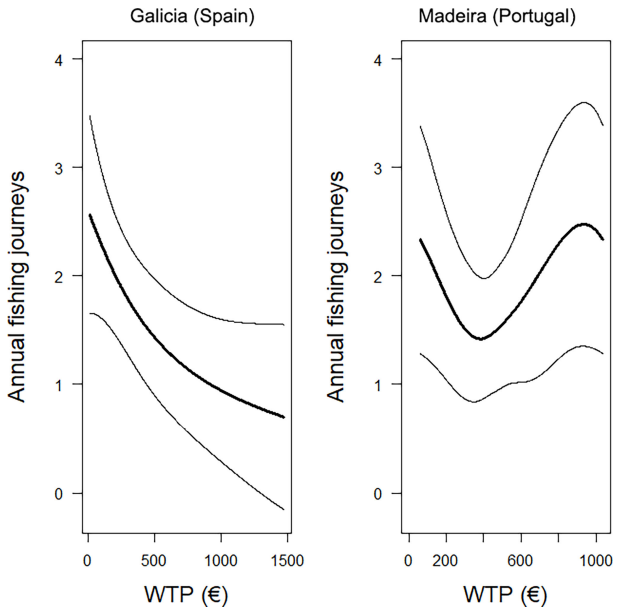

FIGURE 4
Partial effect of the WTP (as a function of the travel cost) on the number of fishing journeys to Spain (Galicia) and Portugal (Madeira). It is shown the prediction (dark lines), and their 95% confidence interval (thin lines) estimated by the adjusted GAMs.

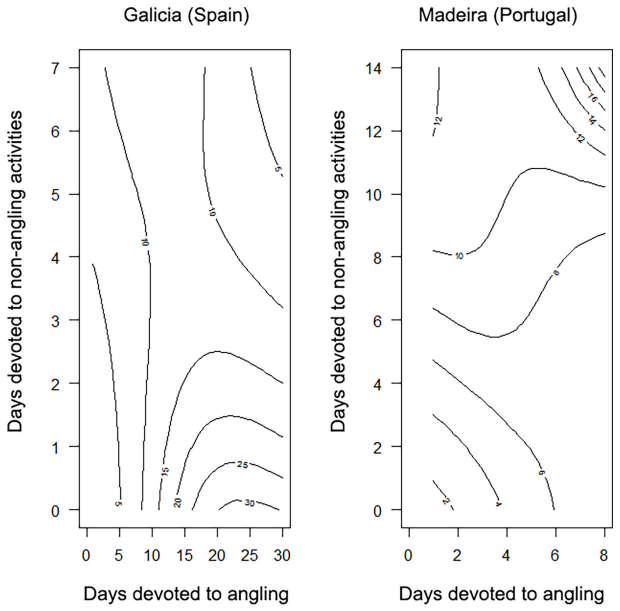

FIGURE 5
Partial effect of the interaction between the days devoted to angling and the days devoted to other recreational activities on the total days of the vacation in Spain (Galicia) and Portugal (Madeira). It shows the predictions of the total vacation duration estimated by a GAM.

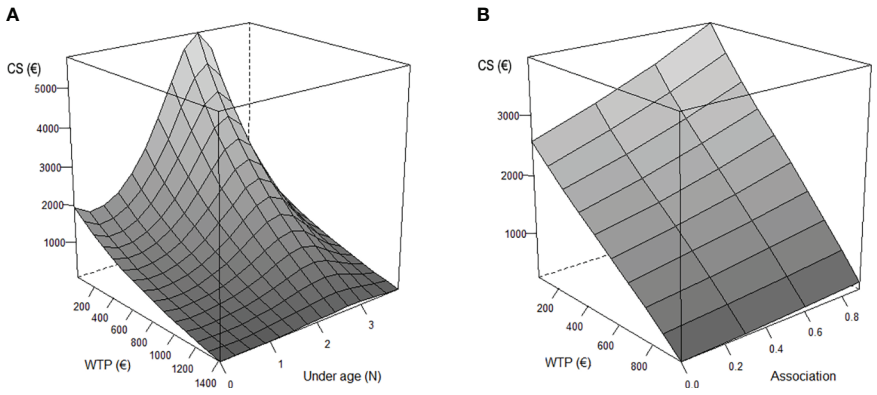

FIGURE 6
Consumer surplus (CS) per person and year estimated from fishing charter boat trips to Spain (Galicia; **A**) and Portugal (Madeira archipelago; **B**) by bidimensional GAMs. The covariate Willingness To Pay (WTP) was a function of the full individual travel cost. In the case of Galicia, the other covariate was the number of underage people in the household, while in Madeira we used a dummy numeric variable to include the membership (1) or not (0) to a recreational fishing association (see in Table 4 the outputs of the GAMs fitted on the fishing journeys).

used equation [3]. Since Spanish managers and boat skippers reported the number of clients per year in each of the charter boats, we obtained an estimate of total clients per year in Galicia (P = 2 460 anglers). This figure was then multiplied by the mean CS, to obtain a yearly recreation social welfare of € 3.41 Million in Galicia, ranging between € 3.0 M and € 3.81 M.

In Madeira we estimated that the 18 charter boats had 3 242 clients per year. However, the total number of fishing boats in Madeira was 20 (Martinez-Escauriaza et al., 2021). Therefore, we assumed that the two charter boats that were not included in our survey carried out the same average number of clients per trip that the assessed 18 boats (3.18 ± 0.75), so the total number of clients per year in Madeira was estimated at 3 648 anglers. Applying the equation [3], the yearly social welfare of the recreational charter fishery of Madeira was € 6.34 M, ranging between € 5.23 M and € 7.45 M.

Discussion

In our study we showed that the direct contribution to local economies derived from the operation of the recreational fishing charter boat companies is important, especially in Madeira. We believe that our results provide a first useful baseline, e.g., for the formulation of public policies aimed at increasing the resilience of coastal populations highly dependent on marine resources in remote and rural areas, as demanded by the EU Parliament (European Parliament, 2018). Managed in a sustainable way, we demonstrated that recreational charter boat fisheries can provide viable economic alternatives to commercial fishing, being possible to further increase its development in the European continental coasts.

As a general reference, commercial fishing generates some € 700 M annually in Galicia, which represents just over 1% of GDP (Surís-Regueiro and Santiago, 2014), while in Madeira, commercial fishing accounts for 0.7% of the GDP, which is about € 12 M annually (Vallerani et al., 2017). Gross output, representing the annual revenue from charter boats, estimated by extrapolating the mean annual turnover by company to the total number of companies, was of € 99 700 in Galicia and € 702 550 in Madeira. The relatively low figure that we obtained in Galicia, compared to gross outputs exceeding one million euros in similar charter boat fisheries (in terms of covered area, ambient conditions, visitation, and targeted species) of Southern England (Williams et al., 2020), indicates that it is possible to increase the economic contribution of this sector, helped by the low seasonality of the fishery. The similarity between the social welfare we derived from the charter boat fisheries in Galicia and Madeira (€ 3 M, and € 6 M, respectively) also points in this direction.

In our client survey we sampled up to 6.1% of the anglers fishing from charter boat companies operating each year in Galicia. Therefore, applying the equation [1] our survey had a potential margin of error of 7.8%. The margin of error was 13.1% in the case of the Madeiran survey (we interviewed 1.5% of charter boat anglers). Although our sampling error was moderate, we cannot rule out problems of representativeness of our sample with respect to the total population of anglers, that may ultimately affect the estimates of aggregated social welfare of the two recreational fisheries. It is possible, for example, that we have interviewed avid anglers more frequently (i.e., those who use the services of the companies the most), and that their answers differ in some way from those of other groups of anglers. On the other hand, we expect that the broad temporal and spatial coverage of our sampling has contributed to moderating

this bias. Moreover, some sample biases (i.e., recall, non-response, and declaration) inherent to recreation data and on-site surveys could also affect our estimates (see Pollock et al., 1994) for an overview of bias affecting recreational fishing surveys). Also, the relatively low values of explained deviation in the GAMs could indicate that part of the variability has not been fully explained by the predictors evaluated. Furthermore, in our client survey we did not obtain disaggregated information on the expenses of the anglers. Although fishing fees are relatively small compared with the full cost of the trip, these should have been excluded from the calculation of CS. Therefore, the obtained welfare measures should be seen as a reasonable estimate for the full benefit derived by anglers.

We have not found significant differences according to the gender of the anglers in the models we used to estimate recreation value with the TCM. However, it would be possible to increase the social benefits provided by recreational fishing charter boat companies by reducing the important gender gap in this activity (Pita et al., 2020a). Companies exploring this possibility should highlight the social aspect of the activity, little valued by the anglers in our survey, which included mostly men. Increased female participation in angling would be especially feasible in Madeira, due to the multi-purpose nature of the trip (in fact, anglers visiting Madeira valued above all the overall experience of their trip), its longer duration, and the larger size of the visiting group. The development of marketing strategies that promote trips combining angling experiences and other family leisure activities could be good to increase trips to Madeira.

The contribution of companies to nature conservation could strategically increase the value and participation of anglers, especially in the case of Galician companies, since this was one of the best valued attributes in our survey, as well as in other recreational fisheries in the Northeast Atlantic (González et al., 2021). Indeed, the anglers in Galician companies showed higher WTP_t to help conservation measures. Furthermore, the carbon footprint of the trips made to Galicia was lower than that of those made to Madeira, both because of the shorter distance traveled by the anglers and because of the use of less polluting means of transport, mainly private cars, instead of airplanes. The development of green strategies by charter boat companies and/or public institutions, which include the ecological restoration of the impacts produced during angling, could be well received by clients.

Another strategy that could increase numbers and length of anglers' trips to Galicia could be developed around promoting accommodation in the towns near the base port of the boat, since many of the clients spent the night back in their homes. For this, the support of public and private institutions is necessary to improve the infrastructure of basic tourist services in some of the areas of Galicia, with important deficiencies derived mainly from the high seasonality of tourism to Galicia, mainly focused on the summer (Garín-Muñoz, 2009). The high importance of the cost of the trip for the clients of the Galician charter boat companies suggests that economically adjusted packages would need to be offered.

The high dependence of the Madeiran charter boat fishery on big game fishing is a potential weakness in the face of the effects of environmental changes on the abundance and catchability of these species, e.g., because of the impact of climate change that could alter distribution ranges and/or affect the environmental conditions that anglers need to fish (Martinez-Escauriaza et al., 2021). In fact, the presence of "billfish" and other big predators was highly valued by the interviewed anglers in Madeira, which was found to be a key component of satisfaction, closely linked to loyalty to the fishing site in another recreational fishery in Macaronesia (González et al., 2021). Therefore, basing this fishery on catch and release seems a correct strategy in the long term. However, concerns about the impacts of both commercial and recreational fisheries on main targeted stocks (Restrepo et al., 2003; Maguire et al., 2006; Ehrhardt and Fitchett, 2016), make it necessary to assess the impacts of this charter boat fishery, specifically on post-release mortality. Increasing the percentage of released fish in the case of Galicia should be contemplated, especially if there is an increase in recreational fishing mortality, due to the current high human pressures on Galician marine ecosystems and fish stocks (Pita and Freire, 2014; Pita et al., 2020b), and the concerning state of conservation of some stocks of the most targeted species, such as European seabass (Council of the European Union, 2018).

Conclusions

The social and economic importance of charter fisheries, both in Galicia and Madeira, demonstrated in our study, should be duly recognized by public European administrations and economic, coastal and resource management at different levels. The development of programs and agreements with private companies to provide the basic services necessary to promote sustainable angling tourism is key to meet public directives aiming to foster economic and social development in rural areas and in outer regions of the EU (European Parliament, 2018). For instance, while Funchal, the capital of Madeira, offers different recreational alternatives to visitors, in Calheta (the other port in the islands harboring recreational charter boats) visitors' main attraction is the marina with recreational fishing operators, fueling the arrival of tourists to this island and improving the local economy.

It would also be necessary to review the current EU fishing regulations, which contemplates the allocation of quotas to recreational fishing in a very limited way, leaving to the power of the member states the possibility of allocating part of the assigned quota to the recreational sector, including recreational charter boat operators. Current EU legislation only requires

countries to provide data on the catches obtained in recreational fisheries (e.g., European Commission, 2016), but does not explicitly recognize the right of access by citizens or recreational charter boats.

This acknowledgment of fishing opportunities, in similar terms to that of commercial fishing fleets, should not necessarily drive an increase in total fishing mortality. In this sense, the further development of catch and release in charter boat fishing (Holland et al., 1998) could favor the socioeconomic development of this activity and avoid conflicts over access to resources with commercial fisheries. This is particularly important for regions, such as Galicia, highly dependent on fishing, and in general to avoid undesired local shortages of fishery products and the provision of other ecosystem services (see, e.g., Brown, 2016; Voyer et al., 2017).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics Statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

All co-authors contributed to the elaboration of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2022.939533/full#supplementary-material

References

Agencia Tributaria (2022) *Asignaciones para gastos de locomoción*. Available at: https://sede.agenciatributaria.gob.es/Sede/manuales/ejercicio-2018/modelo-100/7-cumplimentacion-irpf/7_2-rendimientos-trabajo-personal/7_2_1-rendimientos-integros/7_2_1_2-dietas-gastos-viaje/asignaciones-gastos-locomocion.html (Accessed May 22, 2022).

Akaike, H. (1973). Information theory and an extension of the maximum likelihood principle. In *Second International Symposium of Information Theory* B. N. Petrov and F. Csaki ed. (Tsahkadsor, Armenia, USSR: Akademiai Kiado), 267–81.

Almeida, A. (2016). Modelling tourism demand in Madeira since 1946: and historical overview based on a time series approach. *J. Spat. Organ. Dyn.* 4, 145–156. doi: 10.1016/j.scitotenv.2016.03.035

Almeida, A., Correia, A., and Pimpão, A. (2014). Segmentation by benefits sought: the case of rural tourism in Madeira. *Curr. Issues Tour.* 17, 813–831. doi: 10.1080/13683500.2013.768605

Arlinghaus, R., Tillner, R., and Bork, M. (2014). Explaining participation rates in recreational fishing across industrialised countries. *Fish. Manage. Ecol.* 22, 45–55. doi: 10.1111/fme.12075

Bode, A., Alvarez-Ossorio, M. T., Cabanas, J. M., Miranda, A., and Varela, M. (2009). Recent trends in plankton and upwelling intensity off Galicia (NW Spain). *Prog. Oceanogr.* 83, 342–350. doi: 10.1016/j.pocean.2009.07.025

Brown, C. J. (2016). Social, economic and environmental effects of closing commercial fisheries to enhance recreational fishing. *Mar. Policy* 73, 204–209. doi: 10.1016/j.marpol.2016.08.010

Cisneros-Montemayor, A. M., and Sumaila, U. R. (2010). A global estimate of benefits from ecosystem-based marine recreation: potential impacts and implications for management. *J. Bioeconomics.* 12, 245–268. doi: 10.1007/s10818-010-9092-7

Clawson, M. (1959). Methods of measuring the demand for and value of outdoor recreation. *Res. Future* 10.

Cortés-Jiménez, I. (2008). Which type of tourism matters to the regional economic growth? the cases of Spain and Italy. *Int. J. Tour. Res.* 10, 127–139. doi: 10.1002/jtr.646

Council of the European Union (2008). *Council regulation (EC) no 199/2008 of 25 February 2008 concerning the establishment of a community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy* (Brussels, Belgium: Official Journal of the European Union).

Council of the European Union (2009). *Council regulation (EC) no 1224/2009 establishing a community control system for ensuring compliance with the rules of the common fisheries policy* (Brussels, Belgium: Official Journal of the European Union).

Council of the European Union (2018). *Council regulation (EU) 2018/1308 of 28 September 2018 amending regulation (EU) 2018/120 as regards fishing opportunities for European seabass* (Brussels, Belgium: Official Journal of the European Union).

Diogo, H., Veiga, P., Pita, C., Sousa, A., Lima, D., Pereira, J. G., et al. (2020). Marine recreational fishing in Portugal: Current knowledge, challenges, and future perspectives. *Rev. Fish. Sci. Aquac.* 28, 536–60. doi: 10.1080/23308249.2020.1777083

Ditton, R. B., and Stoll, J. R. (2000). A socio-economic review of recreational billfish fisheries. In *Proceedings of the 51 st Gulf and Caribbean Fisheries Institute* L. R. Creswell ed. (US Virgin Islands: St. Croix), 666–81.

Ditton, R. B., and Stoll, J. R. (2003). Social and economic perspective on recreational billfish fisheries. *Mar. Freshw. Res.* 54, 545–554. doi: 10.1071/MF01279

Ehrhardt, N., and Fitchett, M. (2016). *Status of billfish resources and billfish fisheries in the western central Atlantic* (Bridgetown, Barbados: Food and Agriculture Organization of the United Nations).

European Commission (2016). "Commission implementing decision (EU) 2016/1251 of 12 July 2016 adopting a multiannual union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019," (Brussels, Belgium: Official Journal of the European Union).

European Parliament (2018). *European Parliament resolution of 12 June 2018 on the state of play of recreational fisheries in the European union* (Brussels, Belgium: Official Journal of the European Union).

FAO (2012). *Recreational fisheries* (Rome: FAO).

Ferrini, S., and Fezzi, C. (2012). Generalized additive models for nonmarket valuation *via* revealed or stated preference methods. *Land. Econ.* 88, 782–802. doi: 10.3368/le.88.4.782

Freire, J., and García-Allut, A. (2000). Socioeconomic and biological causes of management failures in European artisanal fisheries: the case of Galicia (NW Spain). *Mar. Policy* 24, 375–384. doi: 10.1016/S0308-597X(00)00013-0

Garín-Muñoz, T. (2009). Tourism in Galicia: domestic and foreign demand. *Tour. Econ.* 15, 753–769. doi: 10.5367/000000009789955107

González, L., Leon, C. J., Gonzalez Hernandez, M. M., and De Leon, J. (2021). The structural relationships of destination image, satisfaction, expenditure and loyalty in the context of fishing tourism. *Scand. J. Hosp. Tour.* 21, 422–441. doi: 10.1080/15022250.2021.1884596

Goodman, L. A. (1961). Snowball sampling. *Ann. Math. Stat.* 32, 148–170. doi: 10.1214/aoms/1177705148

Haab, T. C., and McConnell, K. E. (1996). Count data models and the problem of zeros in recreation demand analysis. *Am. J. Agric. Econ.* 78, 89–102. doi: 10.2307/1243781

Hastie, T., and Tibshirani, R. J. (1990). *Generalized additive models* (London: Chapman and Hall).

Holland, S. M., Ditton, R. B., and Graefe, A. R. (1998). An ecotourism perspective on billfish fisheries. *J. Sustain. Tour.* 6, 97–116. doi: 10.1080/09669589808667305

Hyder, K., Weltersbach, M. S., Armstrong, M., Ferter, K., Townhill, B., Ahvonen, A., et al. (2018). Recreational sea fishing in Europe in a global context–participation rates, fishing effort, expenditure, and implications for monitoring and assessment. *Fish. Fish.* 19, 225–243. doi: 10.1111/faf.12251

ICES (2013). *Report of the ICES working group on recreational fisheries surveys (WGRFS)* (Esporles, Spain: ICES).

Kayak España (2017) *Las rutas más caras según el precio por km*. Available at: https://www.kayak.es/news/vuelos-precio-por-km/#:~:text=VuelosenEuropa,esde0%2C03€ (Accessed April 24, 2022).

León, C. J., Araña, J. E., and Melián, A. (2003). Tourist use and preservation benefits from big-game fishing in the canary islands. *Tour. Econ.* 9, 53–65. doi: 10.5367/000000003101298268

Lew, D. K., and Larson, D. M. (2015). Stated preferences for size and bag limits of Alaska charter boat anglers. *Mar. Policy* 61, 66–76. doi: 10.1016/j.marpol.2015.07.007

Lynch, T. P., Smallwood, C., Williams, J., Ochwada-Doyle, F., and Devine, C. (2020). *A cross continental scale comparison of Australian offshore charter boat recreational fisheries research and its applications to marine park and fisheries management*. Report to the National Environmental Science Program, Marine Biodiversity Hub. Hobart, Tasmania, Australia: CSIRO.

Maguire, J.-J., Sissenwine, M., Csirke, J., Garcia, S., and Grainger, R. (2006). *The state of world highly migratory, straddling and other high seas fishery resources and associated species* (Rome: Food and Agriculture Organization of the United Nations).

Martínez-Escauriaza, R., Hermida, M., Villasante, S., Gouveia, L., and Pita, P. (2020). Importance of recreational shore angling in the archipelago of Madeira, Portugal (northeast Atlantic). *Sci. Mar.* 84, 331–341. doi: 10.3989/scimar.05046.30A

Martinez-Escauriaza, R., Pita, P., de Gouveia, M. L., Gouveia, N. M., Teixeira, E., de Freitas, M., et al. (2021). Analysis of big game fishing catches of blue marlin (Makaira nigricans) in the Madeira archipelago (Eastern Atlantic) and factors that affect its presence. *Sustainability* 13:8975. doi: 10.3390/su13168975

Martínez-Espiñeira, R., and Amoako-Tuffour, J. (2008). Recreation demand analysis under truncation, overdispersion, and endogenous stratification: An application to gros morne national park. *J. Environ. Manage.* 88, 1320–1332. doi: 10.1016/j.jenvman.2007.07.006

Oliveira, P., and Pereira, P. T. (2008). Who values what in a tourism destination? the case of Madeira island. *Tour. Econ.* 14, 155–168. doi: 10.5367/000000008783554758

Öndes, F., Ünal, V., Öndes, H., and Gordoa, A. (2020). Charter fishing in the Aegean Sea (Turkey), eastern Mediterranean: The missing point of fisheries management. *Fish. Res.* 224, 105457. doi: 10.1016/j.fishres.2019.105457

Parsons, G. R. (2003). "The travel cost model BT - a primer on nonmarket valuation," Eds. P. A. Champ, K. J. Boyle and T. C. Brown (Dordrecht: Springer Netherlands), 269–329. doi: 10.1007/978-94-007-0826-6_9

Pawson, M. G., Glenn, H., and Padda, G. (2008). The definition of marine recreational fishing in Europe. *Mar. Policy* 32, 339–350. doi: 10.1016/j.marpol.2007.07.001

Pérez-Camacho, A., González, R., and Fuentes, J. (1991). Mussel culture in Galicia (NW Spain). *Aquaculture* 94, 263–278. doi: 10.1016/0044-8486(91)90122-N

Pita, P., Alos, J., Antelo, M., Artetxe, I., Biton-Porsmoguer, S., Carreño, A., et al. (2020a). Assessing knowledge gaps and management needs to cope with barriers for environmental, economic and social sustainability of marine recreational fisheries: the case of Spain. *Front. Mar. Sci.* 7. doi: 10.3389/fmars.2020.00023Assessing

Pita, P., Antelo, M., Hyder, K., Vingada, J., and Villasante, S. (2020b). The use of recreational fishers' ecological knowledge to assess the conservation status of marine ecosystems. *Front. Mar. Sci.* 7, 242. doi: 10.3389/fmars.2020.00242

Pita, P., Artetxe, I., Diogo, H., Gomes, P., Gordoa, A., Hyder, K., et al. (2017). Research and management priorities for Atlantic marine recreational fisheries in southern Europe. *Mar. Policy* 86, 1–8. doi: 10.1016/j.marpol.2017.08.030

Pita, P., and Freire, J. (2014). The use of spearfishing competition data in fisheries management: evidence for a hidden near collapse of a coastal fish community of Galicia (NE Atlantic ocean). *Fish. Manage. Ecol.* 21, 454–469. doi: 10.1111/fme.12095

Pita, P., Hyder, K., Gomes, P., Pita, C., Rangel, M., Veiga, P., et al. (2018). Economic, social and ecological attributes of marine recreational fisheries in Galicia, Spain. *Fish. Res.* 208, 58–69. doi: 10.1016/j.fishres.2018.07.014

Pita, P., and Villasante, S. (2019). The building of a management system for marine recreational fisheries in Galicia (NW Spain). *Ocean. Coast. Manage.* 169, 191–200. doi: 10.1016/j.ocecoaman.2018.12.027

Pollock, K. H., Jones, C. M., and Brown, T. L. (1994). *Angler survey methods and their application in fisheries management* (Bethesda, Maryland: American Fisheries Society Special Publication), 25.

Radford, Z., Hyder, K., Zarauz, L., Mugerza, E., Ferter, K., Prellezo, R., et al. (2018). The impact of marine recreational fishing on key fish stocks in European waters. *PloS One* 13, e0201666. doi: 10.1371/journal.pone.0201666

R Core Team (2019). *R: A language and environment for statistical computing*. Vienna, Austria.

Restrepo, V., Prince, E. D., Scott, G. P., and Uozumi, Y. (2003). ICCAT stock assessments of Atlantic billfish. *Mar. Freshw. Res.* 54, 361–367. doi: 10.1071/MF02057

Roussel, S., Salles, J.-M., and Tardieu, L. (2016). Recreation demand analysis of sensitive natural areas from an on-site survey. *Rev. dEconomie. Reg. Urbaine.* 2, 355–384. doi: 10.3917/reru.162.0355

Shaw, D. (1988). On-site samples' regression: Problems of non-negative integers, truncation, and endogenous stratification. *J. Econom.* 37, 211–223. doi: 10.1016/0304-4076(88)90003-6

Shiffman, D. S., and Hammerschlag, N. (2014). An assessment of the scale, practices, and conservation implications of florida's charter boat–based recreational shark fishery. *Fisheries* 39, 395–407. doi: 10.1080/03632415.2014.941439

STECF (2017). *The 2017 annual economic report on the EU fishing fleet (STECF-17-12)* (Luxembourg: Publications Office of the European Union). doi: 10.2760/36154

Steinback, S. R. (1999). Regional economic impact assessments of recreational fisheries: an application of the IMPLAN modeling system to marine party and charter boat fishing in Maine. *North Am. J. Fish. Manage.* 19, 724–736. doi: 10.1577/1548-8675(1999)019<0724:REIAOR>2.0.CO;2

Suárez de Vivero, J. L., and Rodríguez Mateos, J. C. (2012). The Spanish approach to marine spatial planning. marine strategy framework directive vs. EU integrated maritime policy. *Mar. Policy* 36, 18–27. doi: 10.1016/j.marpol.2011.03.002

Surís-Regueiro, J. C., and Santiago, J. L. (2014). Characterization of fisheries dependence in Galicia (Spain). *Mar. Policy* 47, 99–109. doi: 10.1016/j.marpol.2014.02.006

Vallerani, M., Martí, C.-P., and Ojamaa, P. (2017). *Fisheries in Madeira* (Brussels: European Parliament).

Vieira, J. C., and Antunes, M. C. (2017). Touristic big-game fishing in saint Michael island (Azores) evaluating anglers' profiles, perceptions about the destination and business revenues. *Tour. Econ.* 23, 1362–1368. doi: 10.1177/1354816616686414

Villasante, S., Pierce, G., Pita, C., Guimeráns, C., Garcia Rodrigues, J., Antelo, M., et al. (2016). Fishers' perceptions about the EU discards policy and its economic impact on small-scale fisheries in Galicia (North West Spain). *Ecol. Econ.* 130, 130–138. doi: 10.1016/j.ecolecon.2016.05.008

Villasante, S., Rodríguez-González, D., Antelo, M., Rivero-Rodríguez, S., and Lebrancón-Nieto, J. (2013). Why are prices in wild catch and aquaculture industries so different? *Ambio* 42, 937–950. doi: 10.1007/s13280-013-0449-8

Voyer, M., Barclay, K., McIlgorm, A., and Mazur, N. (2017). Connections or conflict? a social and economic analysis of the interconnections between the professional fishing industry, recreational fishing and marine tourism in coastal communities in NSW, Australia. *Mar. Policy* 76, 114–121. doi: 10.1016/j.marpol.2016.11.029

Williams, C., Davies, W., Clark, R. E., Muench, A., and Hyder, K. (2020). The economic contribution of sea angling from charter boats: A case study from the south coast of England. *Mar. Policy* 119, 104066. doi: 10.1016/j.marpol.2020.104066