
The nationwide assessment of marine recreational fishing: A French example

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Abstract:

In 2006, IFREMER, with the help of the polling institute BVA, implemented a national pilot study of recreational fishing. Taking into account all the different fishing methods, from shellfish gathering to offshore angling, including spear-fishing, this study was designed to provide estimates of (i) the number of recreational fishers in France, (ii) recreational fishing effort; (iii) catches and landings; (iv) the economic impacts of recreational fishing, and to develop a classification of recreational fishers. A two-part method was adopted: a random-digit-dialing (RDD) survey combined with an on-site survey. The data collected from telephone and on-site surveys were compared and then used in combination to provide a reliable estimate of this growing activity in France. Recreational fishers are estimated at around 2.5 million, with the total catch estimated at 24,000 t of fish and 3100 t of shellfish. Fishing expenditure was estimated at between 1200 and 2000 million euros.

Highlights

► We assess recreational fishing effort in France. ► We extrapolate fishing catch and economic impact coming from this activity. ► We discuss methods enabling us to get these estimates. ► We discuss the weight of this activity in comparison with commercial fishing.

1) Introduction

Interest in marine recreational fishing has grown in the last three decades, as studies have shown that recreational fishing can be an important source of income for national economies (Haab et al. 2001). Its impact on marine biodiversity is increasingly being recognized as potentially non-negligible, as a large proportion of the catch results in the mortality of the fish caught (Coleman et al. 2004; Lewin et al. 2006). Further, conflicts have developed between recreational fishers and commercial fisheries over the allocation of access to fishing areas and fish stocks (Arlinghaus et al. 2005; Cooke and Cowx 2004; Kerbiriou et al. 2008). Policies aimed at controlling these impacts and reducing these conflicts require a sound information base, which is lacking for recreational activities in most countries around the world (Lee and Chang 2008). Recreational fishing is difficult to monitor due to the diversity of fishing practices involved, and to the fact that the population concerned is often highly mobile (Pollock et al. 1994), on international, national, regional, and local levels. Large-scale information systems for recreational fishing have been developed in several countries, notably the USA (NOAA 2006; Steinback and Gentner 2004), Australia (Henry and Lyle 2003; Gray 2008), New Zealand (Wheeler and Damania 2001), South Africa (Pradervand and Hiseman 2006), and Canada (Analyses économiques et statistiques Secteur des politiques 2005). In Europe, the UK, Ireland, and Norway (Toivonen et al. 2004) have also been conducting surveys for several years. However, it has recently been recognized that there is still a widespread lack of national data on this activity (International Council for the Exploration of the Sea 2009). The number of recreational fishers, their total catch, and their total expenditure are known only approximately, if at all, in most European countries. There does not even seem to be an agreed definition of "recreational fishing" at this stage (Pawson et al. 2008). The definition adopted here is the European Commission definition: "all fishing activities not conducted for commercial fishing purposes" (CEC 2001, p.1799; cited by Pawson 2008, p.340). To date, most studies have focused on particular species and areas, and on one type of fishing (Dintheer et al. 2007; Dubreuil 2005; Laspougeas 2007; Lloret et al. 2008; Maggi et al. 1998; Morales-Nin et al. 2005; Peronnet et al. 2003; Pitcher and Hollingworth 2002; Pradervand and Hiseman 2006; Rangel and Erzini 2007; Véron and Appéré 2004). However, there has been increasing social and political interest in this question (Arlinghaus et al. 2007; Drouot et al. 2003), and the need for more comprehensive monitoring systems on the national level has increasingly been recognized (Roth et al. 2001).

31 Recently, the European Commission encouraged its Member Countries to develop the monitoring of
32 recreational fishing of a limited number of species in the Data Collection Framework (DCF)
33 (International Council for the Exploration of the Sea 2010, 2011).

34
35 In France, recreational fishing is subject to only limited regulation; there is no licensing system or
36 registry of marine recreational fishers, and the activity has never been assessed on a national level
37 until the present study. Under the supervision of a national committee, a pilot study was carried out
38 between 2006 and 2009, with the aim of producing a first comprehensive assessment of marine
39 recreational fishing on a national level in France (not including overseas territories) (Berthou et al.
40 2008; Levrel et al. 2009; Herfaut et al. 2010). The approach drew on methods used in the USA, which
41 combine telephone and on-site surveys (Essig and Holliday 1991; Gentner and Lowther 2002), with
42 some adaptations. In particular, the French survey deliberately addressed the entire spectrum of
43 fishing activities, from shore-based shellfish gathering to boat-based angling, spear-fishing, and the
44 use of nets and traps. The aim of the survey was to provide a first estimate of the number of
45 recreational fishers in France, the number of fishing trips and size of catch, and the economic impact
46 of recreational fishing, and then to establish a typology of recreational fishing activities. This article
47 presents and discusses the methods used in this pilot survey and the main results obtained for France.

48

49 **2) Materials and methods**

50

51 The survey was designed and carried out under the supervision of a national steering committee
52 involving the national administration in charge of fisheries policy (DPMA), scientists working on this
53 topic, and a statistical institute in charge of data collection (BVA), as well as representatives of the
54 main recreational fishing associations and of the French commercial fishing organization. A dual
55 survey was adopted: a random digit dialing (RDD) telephone survey (phase 1) and an on-site survey
56 (phase 2) (Ditton and Hunt 2001; NOAA 2006; Pollock et al. 1994). A similar method had already been
57 used in the USA (Gentner and Lowther 2002), focusing on anglers. The approach was used here for
58 all categories of recreational fishing, including shore-based fish and shellfish gathering. Data collection
59 was carried out over a two-year period. The first phase of the survey was designed to produce an
60 initial estimate of the population of marine recreational fishers at the national level and a basis for the

61 sampling plan of the second phase, using direct interviews, which sought to obtain more precise trip-
62 level data on catch and expenditure. The study was conducted with French residents aged over 15, as
63 this is the population for which census-based socio-demographic indicators were available. A
64 representative random sample for the RDD survey was selected, which produced an initial estimate of
65 the population of recreational fishers and description of the diversity of their fishing practices. The
66 information collected via telephone surveys also provided a rough estimate of the number of trips, size
67 of catch, and expenditure by fishers, with fairly large levels of uncertainty, as answers were based on
68 recollections of past behavior in relatively short interviews. The on-site surveys were then set up to
69 capture the diversity of fishing practices described in the responses to the telephone survey, with the
70 aim of getting more precise numbers for size of catch and expenditures.

71

72 A) Data collection

73 a) *First stage of data collection: telephone survey of recreational fishers*

74

75 A total of 15,000 French households were contacted during the year 2006. The interviews were
76 carried out with the computer-assisted telephone interviewing system (CATI) used by BVA. The
77 interviews were conducted in five waves, in April 2006, June 2006, September 2006, November 2006,
78 and January 2007 (Table 1).

79

80 The questionnaire was in five sections (with a maximum of 89 questions), covering (1) marine fishing
81 activity over the previous three months (2006), (2) information about the most recent fishing trip (2006),
82 (3) overall fishing activity during the previous year (2005), (4) information on boats owned (2005), and
83 (6) fishers' perceptions of their activities and how these have changed over time, and their attitudes
84 and opinions about new regulations. It took between 10 and 20 minutes to go through the
85 questionnaire, depending on how many sections were completed by the respondent.

86

87 TABLE 1

88

89 The sampling plan was constructed taking into account the location and socio-demographic
90 characteristics of the households to which the respondents belonged, based on census data for the

91 French metropolitan population aged 15+. The coastal zones were over-sampled based on knowledge
92 derived from previous studies, which showed a greater proportion of recreational fishers in coastal
93 resident populations, with higher numbers of fishing trip and catch levels than those of fishers from
94 inland regions (Morizur 2004). This made it possible to improve the cost-effectiveness of the survey
95 while keeping the sample representative. The selection bias introduced by this over-sampling was
96 adjusted for in the analysis of the information collected, by applying weighting correction factors to the
97 data relating to coastal residents (see below).

98

99 *b) Telephone survey data corrections and adjustments*

100

101 To ensure the sample was representative of the French population, taking into account the over-
102 sampling of coastal residents as well as deviations observed between the socio-demographic
103 characteristics of the sample and the overall population, a set of weighting factors was applied to the
104 sample data. The individual weights were calculated by iterative proportional fitting. This is a
105 procedure implemented by the French National Institute of Statistics and Economic Studies (INSEE),
106 the “Generalized Calibration Procedure” (Macro CALMAR) (Le Guennec and Sautory 2002). The
107 weights were based on the observed characteristics of the household in terms of gender by residence
108 zone (coastal or inland), age by residence zone (coastal or inland), socio-professional group by
109 residence zone (coastal or inland), size of household (coastal or inland), region,¹ and number of
110 interviews carried out during each of the five waves.

111 The range of final weights applied to individual observations varied between 0.25 and 2.94. Our
112 sampling frame seems to be reliably representative, as seen by comparing the characteristics of the
113 head of household in our sample (after adjustment) with those of heads of household in the French
114 population as a whole (Table 2).

115

116 TABLE 2

117

118 *c) Second data collection stage: on-site survey of fishing trips*

119

¹ As defined by the National Institute of Statistics and Economic Studies.

120 The second stage was an intercept survey of recreational fishers at fishing access sites. While the aim
121 of the telephone survey was to estimate the size of the population involved in different types of
122 recreational fishing and to make a preliminary assessment of totals of trip numbers, catch, and landing
123 by recreational fishers in France, it was anticipated that these metrics might be strongly affected by
124 the usual problems of recollection error and response bias described for telephone surveys (NOAA
125 2006). The on-site survey was thus used as a complement to the telephone survey, to obtain more
126 precise estimates of the key variables relating to catch and expenditure (Drouot et al. 2003; Pollock et
127 al. 1994). The sampling plan for the on-site surveys was developed based on the information collected
128 via the telephone survey about the location of interviewees' most recent fishing trip, taking into
129 account the different types of fishing identified in the first phase of the study.

130 The fishing sites where the surveys were to be conducted were identified by combining different
131 sources of information obtained through the local and national maritime administration, fishing clubs,
132 previous studies (Maggi et al. 1998; Drouot et al. 2003), and experts from IFREMER research
133 laboratories on the coast of France. 150 coastal sites were identified, with each representing a specific
134 type of fishing (Figure 1). The statistical unit for this part of the survey was the fishing trip. Three
135 criteria were used to stratify the sample: the maritime region (Atlantic coast, English Channel, and
136 Mediterranean Sea), the season, and the type of fishing. This led to the identification of 44 strata, of
137 which only 28 were considered for sampling, since fishing activity in the 16 others was considered too
138 limited to be surveyed. For instance, although spear-fishing can be done in the three maritime regions
139 of France all year round, spear-fishers in the Mediterranean were only interviewed during spring and
140 summer, which corresponded to the highest frequency of trips for this type of fishing, according to the
141 telephone survey.

142

143 FIGURE 1

144

145 The allocation of sampling effort across strata was based on the distribution of fishing trips per type of
146 fishing across regions and times of the year, as observed in the telephone survey. Some over-
147 sampling was applied to boat fishing and to the winter strata to ensure that a sufficient number of
148 observations would be collected for these categories of trip. By contrast, under-sampling of shellfish
149 gathering was applied, as this was a strongly represented type of fishing for which it was easier to

150 obtain a relatively large sample. As in the telephone survey, these selection biases were accounted for
151 in the analysis of the data collected by applying weighting factors. Angling competitions were excluded
152 from the sampling frame, as they were deemed to introduce bias that would be difficult to measure
153 and correct.

154 The sample plan of the on-site survey was not randomized, as no sampling frame was available for
155 the scale of fishing trips. Rather, it was developed as a quota-based approach, using the information
156 collected via the telephone survey to determine the number of observations of fishing trips required
157 per type of fishing (Table 3). This included the description of the most recent fishing trip, which
158 included the type of fishing and the maritime region in which the trip had taken place, and also the
159 number of fishing trips during the previous year along with their distribution across the seasons.

160

161 TABLE 3

162

163 Interviewers received initial training in administering the survey and the questionnaire, and were given
164 advice as to the sites to visit and the time of the day at which to visit them. Different types of fishing
165 called for different approaches. When possible, interviews took place on Friday or Saturday (though
166 some took place during the week, for instance at high spring tide dates or school holidays). For the
167 shellfish gathering interviews, agents had to go at low tide. For boat fishing, they visited harbors in late
168 morning and late afternoon, when most of the boats came back. For shore angling, interviewers went
169 to sites known to have a high concentration of fishers (surf-casting beaches, dikes and jetties, etc.).
170 Full questionnaires were administered to fishers only if they had been fishing for at least an hour for
171 shore angling, or 30 minutes for shellfish gathering.

172

173 A total of 1775 interviews were carried out between July 2007 and July 2008 (Table 3). Species were
174 identified by the interviewers, who were given training in species identification, but due to logistical
175 constraints and to avoid suspicion on the part of fishers, fish were not directly measured or
176 photographed. Interviewers had to estimate the weight and length of fish caught by visual observation.
177 The questionnaire for the on-site survey was based on the design used in the telephone survey, and
178 consisted of a maximum of 81 questions, focusing mainly on the current fishing trip of the fishers
179 interviewed.

180 Lastly, the data from the telephone survey were also sorted by fishing trip (Robson and Jones 1989).
 181 Each fisher received a weight proportional to the annual number of fishing trips taken.

182

183

184 B) Extrapolation methods

185 a) *Appraisal of the number of recreational fishers*

186 To estimate the number of recreational fishers in France, four steps were required. The calculation
 187 can be summarized in this formula:

188 (Number of recreational fishers in 2005 in our sample/ Number of people over 15 in our sample) x
 189 French population over 15 = Estimate of the number of recreational fishers
 190

191 b) *Calculation of size of catch*

192 The two surveys were combined to obtain a first estimate of total catch per species and per group of
 193 species. The telephone survey data were considered as equivalent to 3130 fishing trips, weighted to
 194 give a representative sample of the total number of fishing trips for the year 2005. Extrapolation from
 195 the number of fishing trips and the number of fish landed per trip was used to extrapolate the total
 196 catch per species and per type of fishing. The calculations are detailed below.

197

198
$$N + N' = T$$

199 N = Weighted number of fishing trips in the telephone survey (after data adjustment)

200 N' = Weighted number of fishing trips in the on-site survey (after data adjustment)

201 T = Total weighted number of fishing trips

202

203
$$\sum_{E,M} n_{E,M} + \sum_{E,M} n'_{E,M} = SP \quad \text{and} \quad TP = \frac{SP}{T}$$

204 $n_{E,M}$ = number of fishing trips with catch for the species E and the type of fishing M in the telephone
 205 survey

206 $n'_{E,M}$ = number of fishing trips with catch for the species E and the type of fishing M in the on-site
 207 survey

208 SP = total number of fishing trips with catch

209 TP = catch ratio per fishing trip

210

211 For the fishing trips with catch we calculated (with the information from both surveys):

212
$$PU_i = \frac{KG_i}{PR_i}$$

- 213 PR_i = number of fish per fishing trip i
 214 KG_i = total weight of catch per fishing trip i
 215 PU_i = average weight per fish per fishing trip i
 216 w_i = weighting factor for the fishing trip i
 217

$$218 \quad PU = \frac{\sum_i PU_i}{SP} \quad \text{and} \quad PR = \frac{\sum_i PR_i}{SP} \quad \text{and} \quad PT = PU \times PR$$

- 219 PU = average weight per fish
 220 PR = average number of fish per fishing trip with catch
 221 PT = total weight per fishing trip with catch
 222

- 223 The previous calculations were also done by species and by type of fishing, and were notated as PR_E ,
 224 PR_M , $PR_{E,M}$... These detailed calculations were done for each type of fishing, but only for species
 225 for which the number of observations was sufficiently high.
 226

- 227 We wanted to calculate the extrapolated number of fishing trips in 2005. This extrapolation was made
 228 from telephone survey data only, with the same extrapolation method as for the calculation of the
 229 number of recreational fishers in 2005.

$$230 \quad TOTAL_{MwithC} = TOTAL_M \times TP$$

- 231 $TOTAL_M$ = Extrapolated number of fishing trips of type of fishing M = Estimate of the total number of
 232 fishing trips for 2005
 233 $TOTAL_{MwithC}$ = Estimate of the total number of fishing trips with catch for 2005
 234

- 235 Finally, the total catch was estimated by type of fishing and/or by species:

$$236 \quad W_M = TOTAL_{MwithC} \times PI$$

- 237 W_M = estimation of the total catch for the type of fishing M in 2005
 238

- 239 Aggregation across the telephone and on-site survey data was based on the confidence interval,
 240 regarding each group of species: The higher the standard error of the estimate derived from the
 241 telephone survey by comparison with the estimate derived from the on-site survey, the lower the
 242 weight of the estimate derived from the telephone survey in the final estimate.
 243

- 244 c) *Calculation of expenditure*

245

246 The calculation of costs was based on responses to three groups of questions:

- 247 - the description of the most recent fishing trip, regarding both time budgets (preparation, travel,
- 248 fishing time) and expenses specific to each trip (travel costs, food costs, fees, gasoline for
- 249 boat trips, etc.), defined as operating costs
- 250 - the costs of equipment and clothing for the activity, defined as investment costs
- 251 - the costs related to depreciation and maintenance of boats, defined as costs for boats.

252 Extrapolations based on the sample data were carried out as follows:

- 253 - First, we estimated the total number of fishers and calculated total investment costs.
- 254 - Second, we estimated the total number of vessel owners and calculated the total costs for
- 255 boats, which were then weighted by the rate of use of boats for fishing that were declared by
- 256 respondents (fishing trips as a percentage of total trips made with the boat).
- 257 - Third, we estimated the average number of fishing trips per fisher and calculated the overall
- 258 budget-related operating costs.

259 Data from both telephone and on-site surveys were used: 67% from phone and 33% from on-site

260 surveys.

261 The economic results are obtained from a series of calculations based on five variables: number of

262 fishers (X_1), number of trips per fisher (X_2), total expense per trip (X_3), number of boats (X_4), average

263 expenditure per boat (X_5).

264 The total amount of expenditure is expressed as $D = X_1X_2X_3 + X_4X_5$ and the variance of D is

$$265 V(D) = V(X_1X_2X_3) + V(X_4X_5).^2$$

266

267 3) Results

268

269 In this section, we present the key results obtained for France.

270

271 A) Recreational fisher population

² We assume the independence of these five variables. This simplifying assumption is not too restrictive, since these estimates are based on entirely different calculation methods. Taking into account correlations between variables increases the calculations considerably; we can then show that these effects are second-order, using the same reasoning as in the formula above.

272

273 In 2005, the penetration rate (the number of fishers in the sample) was 11.1% in the coastal zone and
274 5.4% in the inland zone, representing 6.7% of the total interviewed households for 2005 (Table 4). The
275 number of recreational fishers aged 15+ in the sample was 1,016 (1.57 fishers per household).

276

277 TABLE 4

278

279 The total number of recreational fishers aged 15+ in France was estimated at 2.45 million (+/- 0.15
280 million) in 2005, corresponding to 5.1% of the population (Table 4).

281 Statistically significant differences in the socio-demographic profile were observed between
282 recreational fishers and the average characteristics of the French population. There was a greater
283 proportion of males (82%) and of individuals aged between 35 and 49. As expected, recreational
284 fishing was represented twice as much in coastal area households as in the rest of the country
285 (Table 5).

286

287 TABLE 5

288

289 B) Recreational fishing effort

290

291 The average number of trips per year per fisher was 13 in 2005. Half of them occurred during summer
292 (Figure 2), the period of better weather conditions and the school summer vacation, which is
293 associated with a large influx of visitors to the coastal areas of France.

294

295 FIGURE 2

296

297 In 2005, the average number of types of fishing was 1.4 per fisher. Recreational fishers mainly
298 practiced shellfish gathering (71%); 25% practiced angling from boats (Figure 3). Spear-fishing
299 represented only a very small proportion of marine recreational fishing. 14% of the interviewed fishers
300 owned a boat used for this activity. The total was estimated at 335,000 boats.

301

302

303 FIGURE 3

304

305 Two-thirds of the fishers interviewed caught at least one shellfish during the year, 55% at least one
306 fish, 51% at least one crustacean, and 12% at least one cephalopod. The main species caught were
307 sea bass, mackerel, pollack, black seabream, and sargo bream (Figure 4).

308

309 FIGURE 4

310

311 We detail total fish catch by type of fishing and by species, highlighting the confidence interval (Table
312 6).

313

314 TABLE 6

315

316 Average catch of fish per fisher was 10 kg per year¹ (Table 7). The most sought-after species were
317 sea bass (19% of fishers), mackerel (12%), and pollack (12%). The proportion of the three main
318 species in total catch decreased from 67% to 43% when the two surveys were combined, as the on-
319 site survey provided details of catch for species that had not been captured in the telephone survey.
320 Rarer and less targeted species were observed and counted on-site, whereas they were often
321 forgotten by fishers in the RDD declarations (Figure 4). This led to a final estimate of total catch of fish
322 (Table 7) that was higher in the combined survey results than in the telephone survey only.
323 Conversely, for other species groups (crustaceans, cephalopods, and shellfish), estimates of total
324 catch were lower in the combined survey results, as it appears that fishers over-estimated their catch
325 in weight of these species in the telephone survey. The differences between the two estimates
326 showed the advantage of combining the two survey approaches to get more accurate results
327 (Weithman and Haverland 1991).

328

329 TABLE 7

330

331 Final results estimated the fish catch at about 24,500 T, shellfish about 3150 T, crustaceans about
332 1600 T, and cephalopods about 495 T (Table 8). Fish catch was split into two categories. The first
333 included the five main species cited as target species, and represented approximately 15,500 T in
334 total. For these species, estimates obtained from the telephone survey and estimates obtained from
335 combining the telephone and on-site surveys were remarkably similar. It thus appears that for these
336 species at least, the information obtained via telephone surveys was fairly reliable. The second
337 category included all other fish species caught, for which the evaluation was less accurate and the
338 confidence interval too high to make sense at the species level.

339

340 TABLE 8

341

342 C) Estimates of expenditure

343

344 Estimates of total expenditure were made for the three categories of costs identified in the survey:

345

346 a) Operating costs including the costs of transport, food and lodging specific to each trip
347 (Figure 5a):

348 - The average car transport cost was 3.20 € per trip per person.

349 - The average boat transport cost was 1.64 € per trip per person.

350 - The average food cost was about 23 € per trip with expenses. This expense concerned 42.2%
351 of fishing trips. The average food cost was 9.72 € per trip per person.

352 - The average accommodation cost was about 339.74 € per stay. Dividing this by the number of
353 fishing trips made during the stay, the accommodation cost per trip per person is estimated at
354 28.74 €. This expense concerned 7.6% of fishing trips. The average accommodation cost was
355 2.19 € per trip per person.

356

357 b) Investment costs include the cost of practicing recreational fishing (bait, material, equipment,
358 clothes, magazines, etc.) (Figure 5a):

359 - Small equipment and bait cost was on average 23.12 € per trip with expenses. This expense
360 concerned 44% of fishing trips. The average cost was 10.22 € for the total number of trips.

- 361 - Fishing equipment (rods, reels, nets, etc.) and clothing costs were estimated at 4.39 € per trip
362 with expenses and concerned 79% of trips. The average cost was 3.48 € for the total number
363 of trips.
- 364 - Expenses for specialized magazines were estimated at 0.30 € and concerned 74% of the trips.
365 The average magazine cost was 0.22 € for the total number of trips.
- 366
- 367 c) Costs relative to the boat include the depreciation and use of boats (maintenance, insurance,
368 etc.) (Figure 5):
- 369 - The average boat purchase price was 24,931 €. 81% of the fishers had bought a boat. The
370 calculation of depreciation (basis over 30 years) gave an average of 545 € per year⁻¹.
- 371 - The average annual cost for the use of boats was divided into several categories: average
372 equipment expenditure= 521 €; maintenance=194 €; harbor dues= 381 €; insurance= 150 €;
373 registration rights tax= 10 €. The total cost for the use of each boat was estimated at 1256 €,
374 with 61% of the trips made in the boat being related to recreational fishing. The average cost
375 for the use of a boat for recreational fishing was thus estimated at 766 € per year⁻¹.
- 376

377 FIGURE 5

- 378
- 379 d) Total costs were calculated using the five variables listed in the methods section (Table 9).
- 380

381 TABLE 9

382

383 The extrapolation of annual expenditures generated by recreational fishing, based on a combination of
384 the data collected by telephone and the on-site surveys, was 1.256 billion euros, divided among
385 operating expenditures (524 M€), investment expenditures (435 M€), and expenditures on boats
386 (308 M€) (Figure 6). The standard deviation of expenditure is 221,359,471 €, representing a
387 coefficient of variation of 17.5% (222 M€/1267 M€). The total expenditure is estimated with a relative
388 error of $2 \times 17.5\% = 35\%$.

389

390 FIGURE 6

391

392 As in the case of catch figures, this estimate of expenditures was compared to an estimate based on
393 telephone survey data alone. After the two surveys were combined, the final estimate of expenditures
394 represented 61% of the estimate derived from the telephone survey database alone.

395

396 **4) Discussion**

397

398 Our results provide a benchmark from which it will be possible to monitor social, economic, and
399 ecological trends in recreational fishing in subsequent years. In particular, we have developed a set of
400 statistics that should make for more constructive discussion between commercial and recreational
401 fishers, and help to mediate conflicts over shared resources. Indeed, as emphasized by Arlinghaus
402 (2005) and Cooke and Cowx (2006), it is crucial to share the same indicators and framework for
403 discussing issues to do with recreational fishing if the level of negotiations is to be improved and
404 conflicts successfully mediated. It is also crucial to be able to identify potential sources of conflict and
405 possibly to manage and control them; without data and indicators, conflicts will increase.

406 The size of the recreational fishing catch is around 2% of the commercial catch in France and 11% of
407 the commercial fresh (not frozen) landing. Even if the total catch of recreational fishing is low
408 compared to commercial fishing, the catch of some targeted species can be considered high,
409 especially sea bass (around 100% of that of commercial landing), mackerel (19%), gilthead and black
410 seabream (44%), and pollack (92%). In addition, mackerel and pollack are subject to the European
411 Commission TAC (Total Allowable Catch): mackerel catch from recreational fishing represents one-
412 third of the permitted French quota for this species. For the moment catch by recreational fishers is not
413 counted in the quota.

414 However, these figures must be used with caution since data collection methods are quite dissimilar.

415

416 The estimate of transport expenses (by boat or car) is robust (using mileage and number of liters
417 consumed). The investment and boat costs are also accurately measured, but display high variability
418 in correlation with variability in types of boat. This diversity leads to less precision and greater
419 standard error. The food and lodging expenditures are more difficult to estimate. The variability of the
420 data is very great, and it is sometimes difficult to identify the part of these expenditures actually

421 imputable to recreational fishing (especially when it is included in a vacation). The estimates of total
422 expenditure must thus be viewed with caution. A methodological improvement might be to ask
423 recreational fishers what are their additional costs for food and lodging on these trips.

424

425 While statistical results are an interesting topic, the main part of the discussion concerns
426 methodological outputs.

427 Gathering national statistics on recreational fishing is becoming more and more mandatory, prompted
428 by the increase of this activity and its hypothetical impact.

429 However, as with all leisure and tourism activities, it is very hard to monitor recreational fishing
430 because the population of recreational fishers is mobile and highly heterogeneous. It is thus necessary
431 to test and improve new methodologies step by step, with a learning-by-doing approach. This French
432 pilot study was interesting to test, and identified the strengths and limits of a dual methodology using
433 telephone and on-site surveys.

434

435 The study has made it possible to define a benchmark that we will need for systematic follow-up of
436 recreational fishing. It has three dimensions:

- 437 - Species: this was developed using the data from the telephone survey, complemented by the
438 on-site survey. It can be improved further, and is linked with the French national Fisheries
439 Information System (website: www.ifremer.fr/sih).
- 440 - Types of fishing: this already seems quite complete, as nearly all recreational fishing practices
441 are indexed. It would be useful to connect this information with the "métier classification" used
442 for commercial fishers (Daurès et al. 2009).
- 443 - Recreational fishing sites: this was developed using several data sets in combination drawn
444 from other studies, administration, local knowledge, and so on. Now we need to build a more
445 precise site-period matrix on each seaboard, in order to establish a reference state from which
446 the sample plan can be developed.

447

448 The RDD survey seems to be a cost-effective method that gives a good estimate of the proportion of
449 the French population who practice recreational fishing as well as information about recreational fisher
450 profiles. This result is consistent with those of other publications (Gentner and Lowther 2002; NOAA

451 2006). The off-site survey also provides good coverage of night and private-access fishing that is
452 typically difficult to assess using on-site surveys. However, data about catch and expenditure are not
453 precise enough, due to what is known as recall bias (Essig and Holliday 1991; NOAA 2006; ICES
454 2010, 2011). It was hard for recreational fishers to recall the total weight of their catch during 2005. A
455 year later than the events is certainly too long a delay, and the unreliable memory of respondents
456 introduces bias, as noted by other publications. This is why on-site surveys were conducted, as they
457 were considered to be more reliable for estimating catch (especially in the case of shellfish and
458 crustaceans) as well as expenditures. However, on-site surveys are very expensive, and cross-
459 referencing the RDD and on-site data is far from easy.

460

461 The sharp differences between the results of the telephone survey and the combination of surveys are
462 essentially due to errors on declared weights by individuals interviewed by telephone. This bias has
463 already been noted in the literature and seems to pose a major challenge when two different sources
464 of data collected using different methods are to be compared (Tarrant et al. 1993; NOAA 2006; ICES
465 2010, 2011). This is especially true for shellfish and crustacean species: those interviewed seemed to
466 be unable to assess the weight of their catch precisely (overestimating it). In France, it is normal to
467 measure shellfish in liters, but in the telephone survey they were asked to use kilograms.

468 The difference between the reported weights of fish is due to the fact that the diversity of fish species
469 is lower in the phone responses than in the on-site survey. Reports of non-targeted fish species were
470 absent. By telephone, anglers only reported the most common species and larger fish actually caught
471 and not discarded. This bias has also been reported in previous publications (Essig and Holliday
472 1991).

473 However, by cross-referencing the data from both surveys, we get a much better estimate of the total
474 catch for the main species. One limitation of this method is that the data from both surveys are not
475 numerous enough to provide a precise estimate of the catch of the less targeted species. The number
476 of observations of those rare species is too low to allow for extrapolation.

477

478 Additional biases in both telephone and on-site surveys can be noted:

479 The telephone survey reached occasional fishers more easily than the on-site survey, because they
480 come to fish less frequently. In this population, probably less used to assessing the volume and weight

481 of their catch, we observe a substantial difference between phone responses and observation by on-
482 site survey.

483 The telephone survey also samples households, hence individuals, whereas the on-site survey
484 samples fishing trips. In order to combine the two databases we have used one statistical unit, the
485 individual trip.

486 Another bias of the telephone survey that is difficult to correct is that a (low) percentage of households
487 has no home telephone. These may represent special categories (those with only a cell phone, those
488 who move a lot, those without access to a telephone, etc.) that are undercounted.

489 But the on-site survey also displays bias: both the avid fishers and the very occasional fishers are
490 undercounted. This bias is now acknowledged and calls for collecting more specific information
491 regarding non-response bias (Dauk and Schwarz 2001; ICES 2010, 2011). The first group prefers
492 sites that are not accessible or not known to other fishers or interviewers. The second group is not
493 often present, so their proportion in the on-site sample is lower.

494

495 **5) Conclusion**

496

497 This study provides a first comprehensive view of recreational fishing in France, covering all types of
498 fishing. The most common type is definitely shellfish gathering. However, the volume involved is small,
499 as most fishers make only one or two fishing trips a year. Shellfish gathering is an occasional and low-
500 intensity activity; by contrast, angling on shore and from boats accounts for 24,500 tonnes of fish
501 annually.

502

503 This new information has substantial importance for improving the governance of marine social-
504 ecological systems. It is now more and more mandatory to produce national statistics on recreational
505 fishing, due to the increase in this activity and its presumed impact. It is a genuinely new research
506 topic, and it is thus necessary to test and improve new methodologies step by step, using a learning-
507 by-doing approach. This pilot study in France was interesting to test, and has identified the strengths
508 and limits of a methodology using both telephone and on-site surveys. We have noted that on-site
509 surveys have some drawbacks. They are difficult to implement and very expensive, and do not
510 eliminate all the biases of telephone surveys. Also, combining the telephone and on-site data is far

511 from easy; it is thus important to go on to test alternative monitoring systems, such as the use of a
512 voluntary recreational fishers logbook.

513

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517

518

519

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	Survey date	Number of households interviewed	Period of reference for Part A
	Test stage		
Wave 1	April 2006	2061	January, February, and March 2006
	Study stage		
Wave 2	June 2006	3003	April and May 2006
Wave 3	September 2006	5012	June, July, and August 2006
Wave 4	November 2006	3003	September and October 2006
Wave 5	January 2007	2006	November and December 2006
Total		15,085	1 year = 2006

Table 1: Distribution of the five waves of the telephone survey in France (overseas territories excluded)

	INSEE French household data	Interviewed households (15,085)		INSEE French household data	Interviewed households (15,085)
Sex			Age		
Men	74%	74%	15-24 years old	4%	4%
Women	26%	27%	25-34 years old	16%	17%
			35-49 years old	30%	30%
			50-64 years old	23%	23%
			65 and over	27%	26%
Region			Occupation		
North	6%	6%	Farmer	12%	12%
East Paris basin	8%	8%	Artisan, shopkeeper, professional	15%	15%
West Paris basin	9%	10%	Profession and intermediate occupations	14%	14%
West	13%	13%	Employee	12%	12%
Southwest	11%	11%	Laborer	19%	20%
Mediterranean region	13%	12%	Retired or otherwise inactive	39%	38%
Central East	12%	12%			
East	9%	8%			
Paris region	19%	19%			

Table 2: Characteristics of the heads of household in our sample after adjustment compared to those of heads of household in the French population as a whole

	Number of interviews	Quotas	Result
<u>English Channel</u>			
Shellfish gathering	177	150	118%
Offshore by boat	169	180	94%
Onshore angling	183	190	96%
Total English Channel	529	520	102%
<u>Atlantic</u>			
Shellfish gathering	304	180	168%
Offshore by boat	245	220	111%
Onshore angling	252	180	140%
Total Atlantic	801	580	138%
<u>Mediterranean Sea</u>			
Shellfish gathering	20	20	100%
Offshore by boat	140	140	100%
Onshore angling	197	200	98%
Spear-fishing from shore	45	30	150%
Spear-fishing by boat	63	30	210%
Total Mediterranean Sea	445	400	111%
Total	1775	1500	118%

Table 3: Sampling plan of the on-site survey

Number of recreational fishers over 15 interviewed circa 2005	1 016
Mean number of fishers by household	1.57
Total number of recreational fishers represented in our sample	1 599
Number of people over 15 in our sample	31 377
Penetration rate based on individuals over 15 (1599 / 31377)	5.1%

Table 4: Number of recreational fishers in 2005, results of the extrapolation

	French population over 15	Recreational fishers (after adjustment)
Sex		
Men	48%	82%*
Women	52%	18%*
Age		
15-24	16%	4%*
25-34	17%	21%*
35-49	27%	38%*
50-64	20%	25%*
65 and over	20%	12%*
Profession		
Farmer	2%	1%
Craft worker, Shopkeeper	17%	18%*
Executive	14%	21%*
Employee	10%	13%*
Laborer	23%	21%*
Retired or otherwise inactive	34%	26%*

Table 5: Comparison between the characteristics of the French population over 15 and the characteristics of the recreational fishers in the sample, after adjustment

*= significant difference at 5% (chi-square test)

Species name (common)	Spear-fishing from shore	Spear-fishing from boat	Angling from shore	Shellfish gathering	Angling from boat	Total weight	Confidence interval
Abalone	-	-	-	18	-	18	86
Anchovy	-	-	20	-	0	20	57
Atlantic horse mackerel	-	-	1	-	22	23	54
Black seabream	86	0	588	118	1 273	2 065	962
Bogue	-	-	8	-	2	10	38
Bonito	-	-	7	-	75	81	261
Brown comber	-	-	17	-	51	68	171
Brown trout	-	-	-	30	-	30	302
Carp	-	-	104	21	-	125	410
Clam	-	-	50	564	1	614	368
Cockle	0	-	7	480	-	486	333
Cod	-	-	71	-	308	379	574
Common dab	-	-	0	-	138	139	309
Common prawn	-	-	61	71	0	132	120
Common seabream	-	-	-	-	31	31	154
Conger	-	6	296	17	454	773	806
Crab (edible + spider)	-	42	66	1002	197	1 207	972
Cuttlefish	-	7	1	1	99	107	4
Derbio	-	-	2	-	-	2	12
Donax	-	-	-	16	-	16	345
Eel	-	-	969	13	-	981	1 075
Flounder	-	-	1	17	0	18	171
Garfish	-	-	25	-	153	177	246
Gilthead	-	-	23	41	73	137	184
Goby	-	-	7	1	55	63	140
Gray triggerfish	-	-	0	-	7	7	26
Great Atlantic scallop	19	27	-	8	-	54	174
Greater sand eel	-	-	-	1	0	1	3
Grey mullet	5	5	125	48	44	227	264
Grouper	-	-	814	-	-	814	1 036
Hake	-	-	-	-	97	97	250
Hermit crab	-	-	-	1	-	1	2
Lesser grey mullet	75	1	17	-	95	188	448
Limpet	-	-	-	28	-	28	47
Lobster	10	-	-	-	1	11	51
Mackerel	0	165	193	103	3 174	3 635	1 575
Meagre	-	-	2	16	576	594	860
Moray	-	-	26	-	0	26	76
Mussel	3	-	33	419	-	455	308
Norway lobster	-	-	-	2	-	2	17
Oblade	-	-	35	-	8	43	79
Octopus	5	0	1	74	10	160	991
Oyster	-	-	-	1 201	0	1 201	1 052
Plaice	-	62	48	42	71	223	483
Pollack	-	2	366	0	3 161	3 529	2 515
Pout	-	-	85	-	99	184	-
Queen scallop	-	-	-	3	-	3	14
Rainbow wrasse	26	-	29	0	55	110	178
Ray	-	-	1	-	19	19	138

Red gurnard	-	-	-	-	17	17	74
Red mullet	-	-	-	1	1	1	54
Sand steenbras	-	-	0	-	37	37	75
Sardine	-	-	169	-	2	170	1
Saupe	3	-	30	-	0	33	624
Scorpion fish	19	-	47	-	56	122	55
Sea bass	115	24	1 775	690	3 009	5 612	1 964
Sea urchin	0	0	0	116	-	116	183
Sebaste	-	-	-	-	1	1	50
Sergeant major	9	-	-	-	4	13	31
Shark	-	-	14	0	33	48	199
Smelt	-	-	26	2	0	29	45
Sole	0	70	150	1	236	457	138
Solen	-	-	5	49	-	54	76
Sprat	-	-	25	-	-	25	610
Squid	-	0	43	-	185	228	482
Surmullet	0	1	7	-	12	19	91
Tuna	-	-	-	5	53	57	45
Turbot	-	-	-	-	22	22	94
Velvet crab	-	-	82	139	9	230	281
Whelk	-	1	-	50	-	51	73
Winkle	-	-	15	76	-	91	74
Whiting	-	-	10	-	57	67	189
White bream	30	53	401	-	256	840	168
Warty venus	-	-	-	77	1	77	261
Worm	-	-	-	11	0	11	80
Weever	-	-	0	0	342	342	69

Table 6: Weight of species catch in tonnes and by type of fishing (highlighted species are those for which the confidence interval is lower than the estimate and the estimate can thus be considered sound)

	Initial estimate	Final estimate
	Telephone data	Telephone + on-site data
Fish		
Overall catch (tonnes)	14,500 T (+/- 5000)	24,500 T (+/- 4600)
Average weight per year per fisher (>15 years old)	6.1 kg +/- 2.1	10.0 kg +/- 1.9
Sea bass (<i>Dicentrarchus labrax</i>)	5000 T (+/- 1200)	5600 T (+/- 1600)
Mackerel (<i>Scomber scombrus</i>)	3300 T (+/- 100)	3600 T (+/- 1600)
Gilthead (<i>Spratus aurata</i>)	1600 T (+/- 500)	2000 T (+/- 960)
Pollack (<i>Pollachius pollachius</i>)	nc*	3500 T (+/- 2500)
Shellfish		
Overall catch (tonnes)	13,500 T (+/- 2500)	3150 T (+/- 1 200)
Average weight per year per fisher (>15 years old)	3.5 kg +/- 1.3	1.3 kg +/- 0.5
Mussels (Mytilidae)	4300 T (+/- 1200)	460 T (+/- 300)
Oysters (Ostreidae)	3000 T (+/- 900)	1200 T (+/- 1000)
Common cockles (Cardiidae)	2500 T (+/- 800)	490 T (+/- 300)
Carpet shells (Veneridae)	2300 T (+/- 700)	600 T (+/- 400)
Crustaceans		
Overall catch (tonnes)	6700 T (+/- 2600)	1600 T (+/- 900)
Average weight per year per fisher (>15 years old)	2.8 kg +/- 1.1	0.7 kg +/- 0.4
Cephalopods		
Overall catch (tonnes)	1600 T (+/- 500)	495 T (+/- 600)
Average weight per year per fisher (>15 years old)	0.7 kg +/- 0.2	0.2 kg +/- 0.3

Table 7: Catch estimates: comparison of the results from the telephone survey and the results from the combination of the two surveys. The confidence intervals for the estimates are indicated in parentheses.

nc*= not enough data to calculate the total catch

	Angling from shore	Angling from boat	Shellfish gathering	Spear- fishing from boat	Spear- fishing from shore	Total
Fish						
Tonnes	7460	14,453	1386	406	621	24,325
ME*	+/- 2481	+/- 3653	+/- 800	+/- 646	+/- 667	+/- 4583
CV**	0.33	0.25	0.58	1.59	1.07	0.19
Shellfish						
Tonnes	109	2	2990	28	22	3152
ME	+/- 143	+/- 19	+/- 1216	+/- 91	+/- 141	+/- 1235
CV	1.31	9.01	0.41	3.20	6.37	0.39
Crustaceans						
Tonnes	209	206	1146	42	10	1613
ME	+/- 335	+/- 280	+/- 686	+/- 232	+/- 50	+/- 847
CV	1.60	1.36	0.60	5.53	4.87	0.53
Cephalopods						
Tonnes	44	294	74	7	75	495
ME*	+/- 197	+/- 473	+/- 199	+/- 27	+/- 162	+/- 574
CV**	4.42	1.61	2.69	3.79	2.16	1.16
Invertebrates						
Tonnes	-	0	11	-	-	11
ME	-	+/- 3	+/- 69	-	-	+/- 69
CV	-	30.72	6.28	-	-	6.23
Sea urchins						
Tonnes	0	-	116	0	0	116
ME	+/- 1	-	+/- 182	+/- 2	+/- 16	+/- 183
CV	33.36	-	1.58	41.86	44.16	1.58
Total						
Tonnes	7824	14,956	5723	483	728	29,714
ME	+/- 2 515	+/- 3694	+/- 1633	+/- 693	+/- 703	+/- 4859
CV	0.32	0.25	0.29	1.43	0.97	0.16

Table 8: Final catch estimates (telephone + on-site data) per type of fishing

* ME = Margin of error and **CV = Coefficient of variation

Code	Variable	Mean	CV*
X1	Number of fishers	2,450,000	3.1%
X2	Number of trips per fisher	12.77	9.6%
X3	Total expense per trip (mean of operating cost per trip + mean of investment cost per trip)	30.67	9.3%
X4	Number of boats	234,954	1.0%
X5	Average expenditure per boat	1311	34.3%

Table 9: Variable assessment for the calculation of total expenditure:

*Coefficient of variation

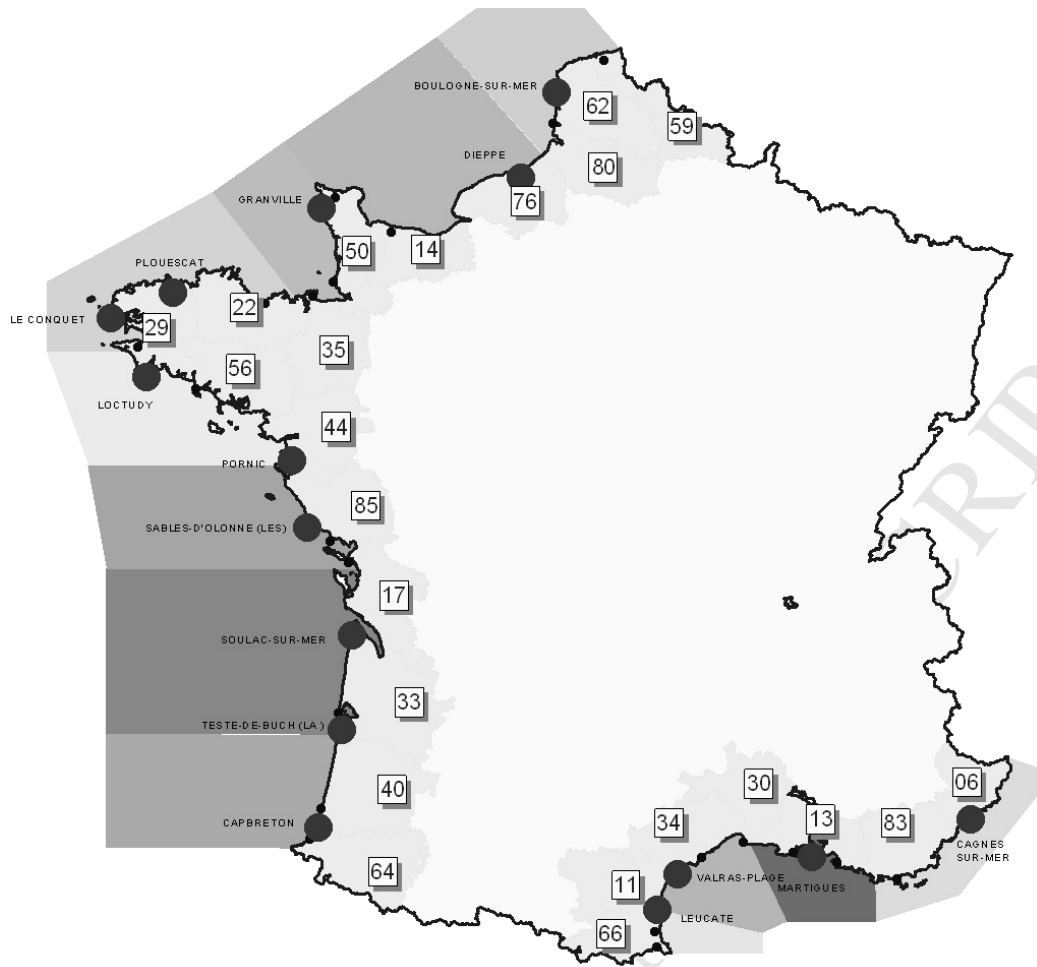


Figure 1: The 12 coastal areas in which the 150 interview sites were identified.

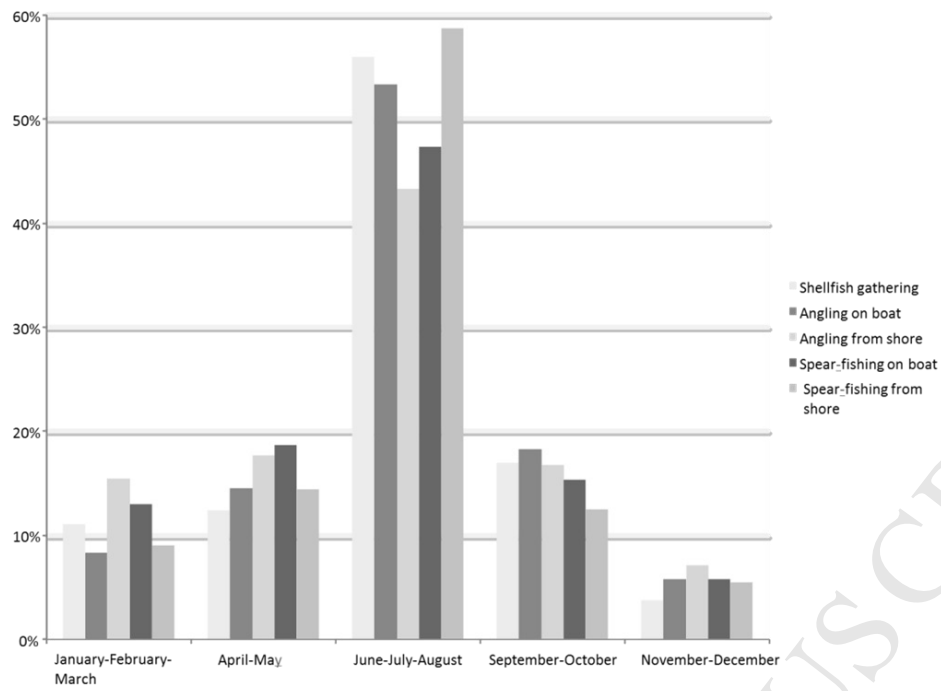


Figure 2: Distribution of fishing trips during 2005 (telephone survey data)

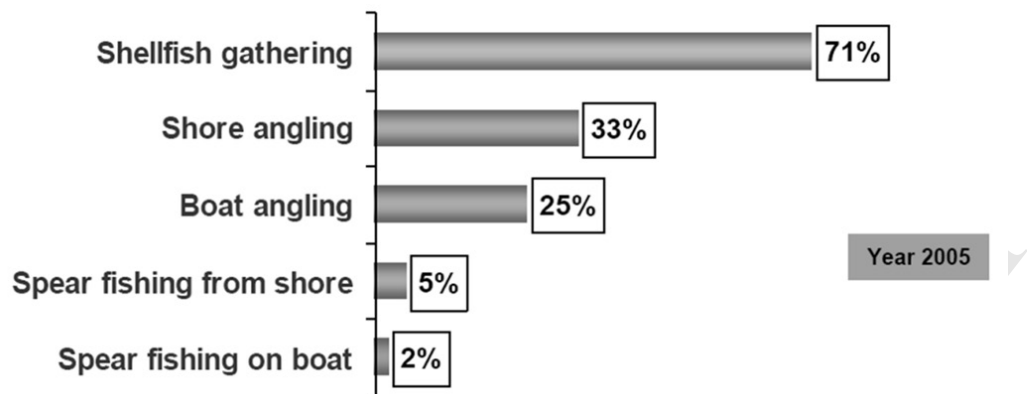


Figure 3: Distribution of types of fishing for fishers with at least one fishing trip in 2005 (telephone survey data).

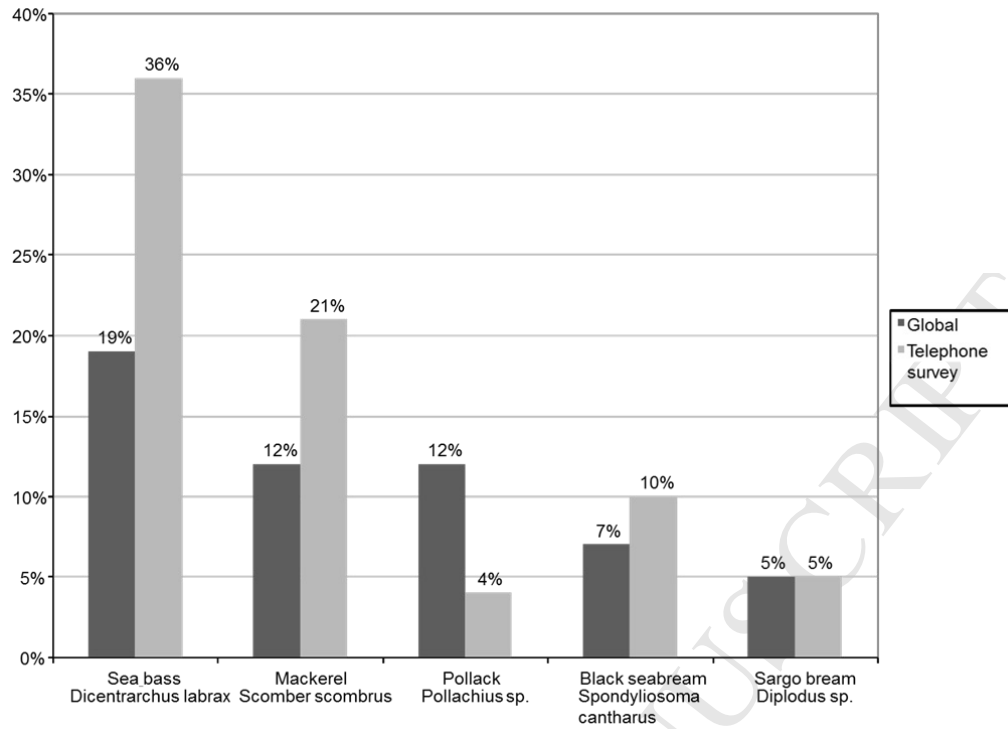
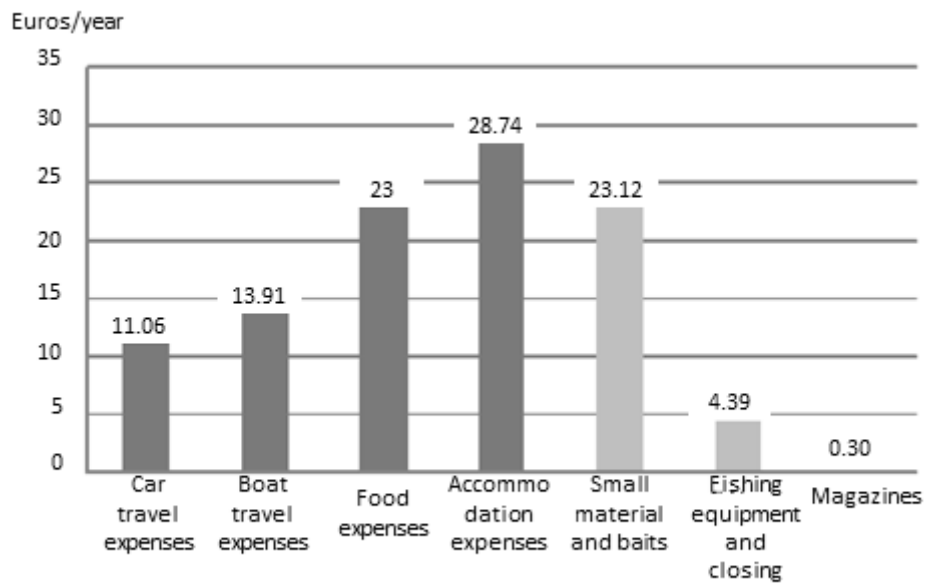
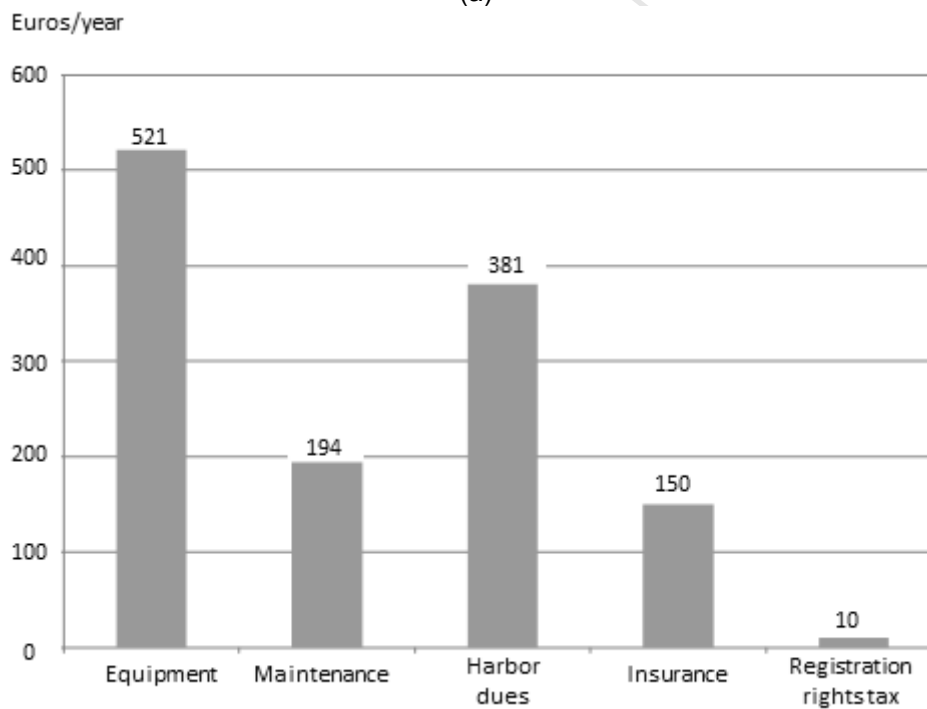


Figure 4: Proportion of the main species: global estimate (telephone + on-site survey) and telephone survey estimate.



(a)



(b)

Figure 5: Average costs: (a) operating and investment costs per fishing trip with expenses and (b) costs related to ownership and use of boat for recreational fishing per year

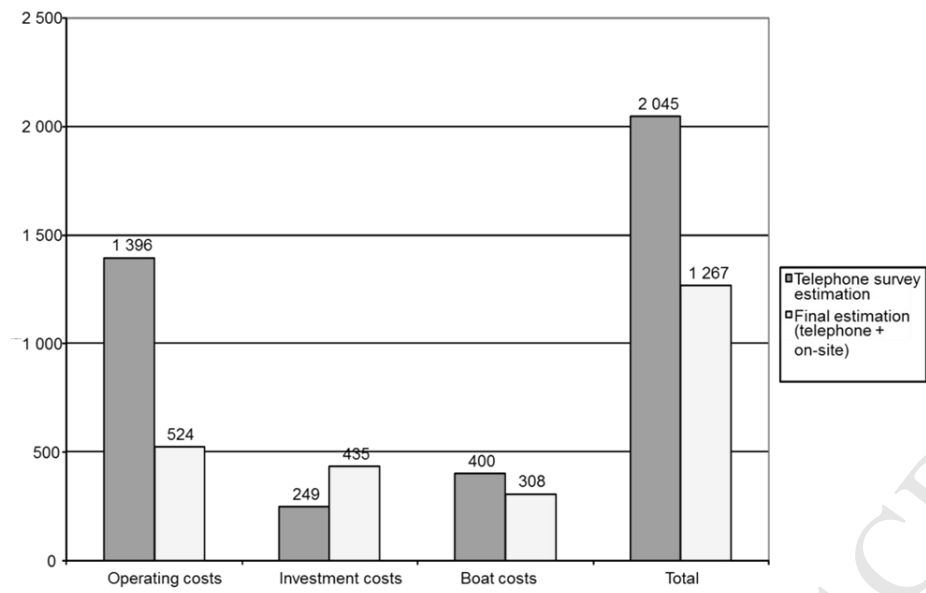


Figure 6: Total expenditure estimates for 2005, comparison of telephone survey estimates and overall estimates