

1 **Supporting information: Recreational sea fishing in Europe in a global context –**
2 **selection of data by country**

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79 **Running title:** Marine recreational fishing in Europe

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108 **Introduction**

109 This Supporting Information contains details of the underlying data provided for each country on
110 marine recreational fishing (MRF) participation, effort and expenditure, the reasoning for the
111 selection of data, and the assessment of the quality of the survey data. Where data were not available
112 for a country (hereafter termed “recipient country”), an extrapolation was conducted from a country
113 with data (hereafter termed “donor country”), and justification is provided for the extrapolation in
114 terms of the donor country selected and caveats surrounding the use of these data. MRF in Europe is
115 managed under the European Union (EU) Common Fisheries Policy (CFP) (Council Regulation
116 (EU) 2015/812) and reporting of MRF catches is required under the European Data Collection
117 Framework (DCF) (EU, 2001, 2008, 2010, 2016) and Control Regulations (Council Regulation (EC)
118 No 1224/2009; EU, 2010). The data used in this study represent the highest quality, latest, and most
119 relevant data selected by national experts that are responsible for development and delivery of EU
120 statutory data on MRF that are compiled annually by the ICES Working Group on Recreational
121 Fisheries Surveys (<http://www.ices.dk/community/groups/Pages/WGRFS.aspx>; ICES, 2010, 2011,
122 2012, 2013, 2014, 2015, 2017). A summary of the derivation of the semi-quantitative assessment of
123 bias for number of fishers, total fishing effort and expenditure on MRF in each country is provided
124 (Table S1).

125 **Albania, Bulgaria, Croatia, Cyprus, Malta, Montenegro & Romania**

126 There were no studies of MRF available in Albania, Bulgaria, Croatia, Cyprus, or Romania, so
127 extrapolation was needed for these countries (Table 2). The MRF target species and composition of
128 the sector were assumed to be most similar to Greece and Italy, therefore data from Greece was used
129 for the extrapolation of participation rates, and data from Italy was used for extrapolation of fishing
130 effort and expenditure (Table 2). The bias associated with these estimates was assumed to be the
131 same as for the donor country (Table S1). More information on the surveys in Greece and Italy is
132 provided in the relevant country-specific sections.

133 **Belgium**

134 **Recreational fishing sector**

135 The MRF sector in Belgium is relatively small compared to neighbouring countries, but catches of
136 some target species can be significant at a national level. MRF in Belgium includes: boat angling
137 (private and charter boats), beam trawling, bottom otter trawling, longline fishing, beach fishing with
138 static gear, shore angling, and wading with small towed nets in the surf zone. The use of trammel and
139 gillnets by recreational fishers is banned. The main MRF target species in Belgium are Atlantic cod
140 (*Gadus morhua*, Gadidae), European sea bass (*Dicentrarchus labrax*, Moronidae), whiting
141 (*Merlangius merlangus*, Gadidae), common dab (*Limanda limanda*, Pleuronectidae), common sole
142 (*Solea solea*, Soleidae) and Atlantic mackerel (*Scomber scombrus*, Scombridae) (van den Stein,
143 2010). No licence is required for MRF in Belgium.

144 **National Survey Data**

145 Few estimates of MRF catches in Belgium exist (ILVO, 2007; van den Stein, 2010; Lescauwae et
146 al., 2013). Most studies were based on small samples of few participants and it was not possible to
147 raise estimates to the whole population as the numbers of participants was not known. In 2006, a
148 pilot study was conducted to estimate MRF catches of Atlantic cod in Belgian waters. A
149 questionnaire was sent to 50 recreational fishers and 15 responses received, that led to an estimate of
150 MRF cod landings between 100 and 200 tonnes each year by about 2,000 fishers over 40,000 trips
151 (ILVO, 2007). Another study was done on MRF at events organised by the national angling
152 association, and 224 recreational fishers completed the survey (Persoon, 2015). Coastal and boat
153 fishers were targeted and asked about fishing locations, catches, releases and expenditures, and the
154 study revealed an estimated annual expenditure of €1,372 per fisher (Persoon, 2015).

155 Verleye et al. (2015) used an on-site survey to map the MRF sector in Belgium, that included
156 individual vessel characteristics, estimation of fishing effort, and identification of fishing locations at

157 sea. A total of 631 boats were identified that were mostly located in four coastal marinas, and effort
158 was estimated using on-site observations of numbers of boats. On-site observation showed that most
159 boats did not operate during high winds ($> 5.5 \text{ m.s}^{-1}$), resulting in 171 days with outgoing boats and
160 an average of 63 boats active each day. This gave a total of 10,735 boat days with on average 2.4
161 fishers aboard giving a total of 25,765 individual trips (Verleye et al., 2015). Some boats were
162 observed more than once, so the total number of fishers was 24,409 after correction for multiple trips
163 (T. Verleye, pers. comm.).

164 Data used in this study

165 Total number of fishers and fishing effort were taken from Verleye et al. (2015) (Table 2).
166 Participation and effort were likely to be a high underestimate, as only boat fishers were included
167 (Table S1). Expenditure by individual fishers was not collected using a probability-based sampling
168 scheme (Persoon, 2015), so was likely to be subject to large bias (ICES, 2010). Total expenditure
169 was calculated by multiplying average expenditure (Persoon, 2015) by the number of boat fishers
170 (Verleye et al. 2015), so was likely to be a small underestimate.

171 **Denmark**

172 Recreational fishing sector

173 MRF is a popular leisure activity in Denmark, with two main approaches: passive gear fishing using
174 stationary gear (e.g. gill and fyke nets); and angling (rod and line). Spear fishing is also practiced and
175 is becoming more popular. Passive gear fishing is done from small boats targeting European eel
176 (*Anguilla anguilla*, Anguillidae), European flounder (*Platichthys flesus*, Pleuronectidae), Atlantic
177 cod, and sea trout (*Salmo trutta*, Salmonidae) (Sparrevohn et al., 2010). Angling is done from the
178 shore and boats targeting sea trout, garfish (*Belone belone*, Belonidae), Atlantic cod, various flatfish,
179 and Atlantic salmon (*Salmo salar*, Salmonidae) (Rasmussen & Geertz-Hansen, 2001; Ministeriet for
180 Fødevarer Landbrug og Fiskeri, 2010). All anglers, including tourists, between 18 and 65 years and

181 passive gear fishers over 12 must purchase a license, with on average 33,433 passive gear and
182 195,361 angling licences sold annually (Danish Agrifish Agency, 2015).

183 National Survey Data

184 The numbers and effort of the Danish population participating in MRF both with and without a
185 licence was estimated using a national omnibus survey in 2009 and 2010 (Sparrevohn et al., 2010).
186 Catches of European eel, Atlantic cod and sea trout, were estimated every 2 years using a
187 combination of telephone and internet recall surveys. This targeted fishers with a licence, collecting
188 fishing effort in the last six months and numbers of fish kept and released for each species, and was
189 repeated every quarter for individual ICES management areas (Sparrevohn et al., 2010; Sparrevohn
190 & Storr-Paulsen, 2012; Olesen & Storr-Paulsen, 2015). The demographics of anglers have been
191 investigated (Bohn & Roth, 1997) and further surveys were done on demographics, economic
192 impact, willingness to pay, recreational fisher motivations, and recreational fishing tourism (see e.g.
193 Ministeriet for Fødevarer Landbrug og Fiskeri, 2010). The number of fishers was estimated to be
194 425,000 in 1997 (Bohn & Roth, 1997), 616,000 in 2009 (Ministeriet for Fødevarer Landbrug og
195 Fiskeri, 2010), and 442,000 in 2010 (Sparrevohn & Storr-Paulsen, 2012). The proportion of fishers
196 that fish in the sea was estimated to be 73% (Bohn & Roth, 1997). The numbers of licences
197 purchased each year between 2004 and 2015 was 154,520 year, 17,778 week, and 23,063 day
198 licences (Danish Agrifish Agency, 2015). This was much lower than estimates of numbers of fishers,
199 indicating that many people fish without licences both legally (e.g. under 18 or over 65 years old) or
200 illegally (23% angling and 28% passive fishing - Sparrevohn & Storr-Paulsen, 2012). The number of
201 trips by each fisher each year was 9.4 and 3.6 days for legal and illegal fishers, respectively
202 (Sparrevohn & Storr-Paulsen, 2012). The proportion of sea fishing trips was estimated to be between
203 54% (Bohn & Roth, 1997) and 56% (Ministeriet for Fødevarer Landbrug og Fiskeri, 2010). Hence,
204 the number of MRF trips each year was 2,369,771 based on 416,926 legal anglers fishing for 9.4
205 days and 112,074 illegal anglers fishing for 3.6 days, and 55% of trips took place in the sea.

206 An economic evaluation of the recreational fishery emphasised the importance in Denmark (Roth et
207 al., 2001; Toivonen et al., 2004). A panel of 1,500 respondents was used to estimate the direct and
208 indirect economic impact of angling which was €389 million or €147 million excluding taxes and
209 imports, and supporting 2,473 Full Time Equivalent (FTEs) (Ministeriet for Fødevarer Landbrug og
210 Fiskeri, 2010). Danish recreational fishers spent on average €543 each year, with large variations
211 between fisher types and fishing locations. Sea fishers generally spent more than freshwater fishers,
212 especially those specialised in trolling for salmon (Ministeriet for Fødevarer Landbrug og Fiskeri,
213 2010).

214 Data used in this study

215 The number of fishers used was derived from the average of the two most recent surveys and was
216 529,000 (Ministeriet for Fødevarer Landbrug og Fiskeri, 2010; Sparrevohn & Storr-Paulsen, 2012).
217 The proportion of sea anglers was assumed to be 0.73 (Bohn & Roth, 1997) giving a total of 386,000
218 sea fishers in Denmark (Table 2). The number of fishing trips per angler was taken from the omnibus
219 survey as it separated legal and illegal fishers (Sparrevohn & Storr-Paulsen, 2012), giving on average
220 6.15 days per year and total effort of 2,369,771 days (Table 2). The economic impact of MRF cannot
221 be separated from freshwater fishing, so the average expenditure estimate of €543 each year
222 (Ministeriet for Fødevarer Landbrug og Fiskeri, 2010) was used (Table 2). Country level data was
223 high quality (negligible bias), but some avidity bias exists in the expenditure (small overestimate)
224 and uncertainties in proportion of sea fishers (Table S1).

225 **Estonia**

226 Recreational fishing sector

227 MRF in Estonia is comprised of three sectors: (1) licenced fishers mainly using passive gears with
228 mandatory logbooks (e.g. gill nets, longlines, crayfish traps); (2) licenced anglers and spear fishers
229 that purchase fishing rights; and (3) non-licenced fishery using one hand line or rod with a single

230 hook without a reel. The most popular species caught by MRF are European flounder, Eurasian
231 perch (*Perca fluviatilis*, Percidae) and northern pike (*Esox lucius*, Esocidae).

232 National Survey Data

233 The licenced recreational fisheries (e.g. gillnet, longline, salmon fishery in rivers etc.) have
234 mandatory logbooks for catches. There were 3,615 individual fishers that purchased a monthly gill
235 net licence and 13,934 monthly licences were issued in 2014, with on average 115 days fished each
236 year and 123 tonnes of catch reported. The number of fishers that purchased fishing rights was
237 46,346, and 8,563 people that bought a fishing licence. Some fishers bought both, so there were
238 51,092 recreational fishers paying for fishing in 2014. There were an additional 14,000 recreational
239 fishers that did not have to purchase fishing rights, including children under 16 years of age,
240 pensioners, people with disabilities, and fishers using a hand line or a single rod without a reel
241 (Rakko, 2014). Thus, there were approximately 65,000 recreational fishers or a 5% participation rate
242 in recreational fisheries. The length of the shoreline and regional distribution of the population meant
243 that around 30% of these fished in the sea resulting in a total number of 19,500 sea fishers. A recent
244 survey of recreational fishing estimated that the average annual expenditure per fisher was €275 in
245 2013 (Ender et al., 2013).

246 Data used in this study

247 The number of fishers used in this study was derived assuming that 30% of all recreational fishers or
248 19,500 individuals fished in the sea (Table 2), and average annual expenditure per fisher was €275
249 (Ender et al, 2013). The biases associated were a small underestimate for participation and a small
250 overestimate for expenditure (Table S1).The recreational sea fishing effort data was extrapolated
251 from Latvia (see Table 2 and country-specific section for details) as the target species and the
252 composition of the MRF sector are similar to Estonia and the bias associated with this estimate was
253 assumed to be the same as for the donor country (Table S1).

254 **Finland**

255 **Recreational fishing sector**

256 In 2012, there were 1.5 million recreational fishers in about 850,000 households in Finland,
257 representing a participation rate of 28%. The catch was 24,500 tonnes from both freshwater and
258 marine waters, with the majority in freshwater and only 300,000 marine fishers in the Baltic Sea. The
259 most important MRF species are Eurasian perch, northern pike, Baltic herring (*Clupea harengus*
260 *membras*, Clupeidae), roach (*Rutilus rutilus*, Cyprinidae) and pikeperch (*Sander lucioperca*,
261 Percidae). MRF is mostly done from small, private boats using gill nets, fish traps and trap nets
262 (<http://stat.luke.fi/en/recreational-fishing>). In 2012, the MRF catch from the Baltic Sea was 6,000
263 tonnes with a first sale value of €11 million (<http://stat.luke.fi/en/producer-prices-fish>). The most
264 economically important species were pikeperch, Eurasian perch, whitefish (*Coregonus lavaretus*,
265 Salmonidae), and northern pike (<http://stat.luke.fi/en/recreational-fishing>). No licence is needed for
266 angling (i.e. bait fishing, ice fishing and herring fishing with a rig), but a governmental management
267 fee must be paid by individuals aged between 18 and 64 years for all other types of fishing including
268 lure fishing.

269 **National Survey Data**

270 Biannual surveys are conducted to estimate participation, fishing effort and catches of the
271 recreational fishery in Finland (<http://stat.luke.fi/en/recreational-fishing>). In the national household
272 surveys, probability-based samples of 7,500 households are drawn from the Finnish population
273 register and the number of fishers, demographics, fishing activity by fishing area, and catches are
274 collected by the Natural Resources Institute Finland (www.luke.fi).

275 **Data used in this study**

276 The numbers of fishers and fishing effort derived from the latest household survey were used in this
277 study (Table 2). The biases associated with Finnish participation and fishing effort estimates were

278 assumed to be negligible (Table S1). There were no estimates of expenditure for MRF in Finland, as
279 the only study that exists includes both marine and freshwater fishing (Toivonen et al., 2004).
280 Therefore, the average expenditure per recreational fisher per year was extrapolated from Sweden
281 (see Table 2 and country-specific section for details). The bias associated with this estimate was
282 assumed to be the same as for the donor country (Table S1).

283 **France**

284 **Recreational fishing sector**

285 MRF in France is practiced with passive gears, rod and line, and spear guns from the shore and boats
286 (Herfaut et al., 2013; Levrel et al., 2013; Rocklin et al., 2014). Rod and line fishing with live bait or
287 lures and spear fishing are the main methods used from shore, with both angling and nets used from
288 boats (Herfaut et al., 2013; Levrel et al., 2013; Rocklin et al., 2014). In 2011, there were 1,319,000
289 fishers in France making around 9,000,000 fishing trips each year, with around 60% and 40% of the
290 effort in Atlantic and Mediterranean waters, respectively. There was an even split of effort between
291 shore and boat fishing, with about 60% of the trips resulting in any catch. Trips from the shore
292 represented 52% of all trips and on average 2.9 fish were caught per trip, whereas 48% were boat
293 fishing trips with 7 fish caught during an average trip duration of 3 hours (Levrel et al., 2013). The
294 main species caught are European sea bass, Atlantic mackerel, pollack (*Pollachius pollachius*,
295 Gadidae), whiting, pouting (*Trisopterus luscus*, Gadidae), cuttlefish (*Sepia officinalis*, Sepiidae), and
296 sea breams (*Spondylionoma cantharus* and *Sparus aurata*, both Sparidae). There is no licencing
297 system or registry of recreational sea fishers in France.

298 **National Survey Data**

299 France has conducted three nationwide studies on MRF: a national MRF pilot study in 2006 (Herfaut
300 et al., 2012, 2013); a national study between 2009 and 2011 to assess sea bass catches on the Atlantic
301 coasts (Rocklin et al., 2014); and a national study from 2011 to 2013 estimating catches in both the

302 Atlantic and Mediterranean (Levrel et al., 2013). The pilot study produced a comprehensive
303 assessment of MRF by combining telephone and self-reporting surveys, and assessed a wide variety
304 of gears and methods (Herfaut et al., 2012, 2013). The study produced estimates of the numbers of
305 fishers, fishing effort, and catches (Herfaut et al., 2012, 2013). Catches of European sea bass on the
306 Atlantic coast were assessed using a large-scale telephone survey and fishing diary panel (Rocklin et
307 al., 2014). A total of 467 sea bass fishers completed an in-depth telephone interview, and 256 fishers
308 submitted catch diaries covering 1,190 fishing trips and 1,383 catches, along with information on
309 fishing methods (Rocklin et al., 2014). The second national study combined telephone and diary
310 surveys with 16,000 households selected using random digit dialling. A two-step interview process
311 was used: a short screening interview to collect demographic information and numbers of fishers in
312 the household; and a second longer interview including detailed questions for 792 fishers that were
313 identified during the screening interview. Catch diaries were kept by 364 fishers, 213 from the
314 telephone survey and 151 from an association of recreational fishers, providing catch information
315 from 2,836 trips (Levrel et al., 2013).

316 Data used in this study

317 The data used in this study was from the 2011-2013 telephone and diary survey after exclusion of
318 diarists recruited from the angling association (Levrel et al., 2013) as the earlier surveys had higher
319 levels of bias. The country level estimates used are shown in Table 2 and were of high quality with
320 negligible bias (Table S1). A relative effort split was assumed to partition the estimates in Atlantic
321 (60%) and Mediterranean (40%) waters (M. Bellanger, pers. comm.). The German expenditure data
322 was used for extrapolation as this was considered to be the most similar (see Table 2 and country-
323 specific section for details). The bias associated with this estimate was assumed to be the same as for
324 the donor country (Table S1).

325 **Germany**

326 **Recreational fishing sector**

327 There were 174,000 recreational sea fishers in Germany in 2013/2014, with the majority fishing in
328 the Baltic Sea (163,000) and 32,000 in the North Sea (H.V. Strehlow & M.S. Weltersbach,
329 unpublished data). In the North Sea, shore fishing is restricted to harbours and the north and east
330 Friesian Islands and boat fishing opportunities are limited. The Baltic Sea is popular for shore and
331 boat fishing and most German charter vessels operate in this area (Strehlow et al., 2012). Fishing
332 effort was almost 1.4 million days, with 90% of the effort exerted in the Baltic Sea (H.V. Strehlow &
333 M.S. Weltersbach, unpublished data). Fishing from the shore (surf angling and wading with rod and
334 line) and sea-based fishing methods (boat and charter vessel angling with rod and line) are equally
335 popular with the fishing effort being almost evenly split in the Baltic Sea (Strehlow et al., 2012).
336 Furthermore, 1,684 active, recreational fishers (1,020 in the Baltic Sea and 664 in the North Sea)
337 used passive gear in 2012 (H.V. Strehlow & M.S. Weltersbach, unpublished data). The main species
338 targeted are Atlantic cod, Atlantic herring (*Clupea harengus*, Clupeidae), Atlantic mackerel,
339 European flounder, European plaice (*Pleuronectes platessa*, Pleuronectidae), common dab, sea trout
340 and Atlantic salmon. Recreational fishing licences are obligatory in all federal states, apart from
341 Lower Saxony. In addition, to a valid fishing licence, the Baltic Sea states require a coastal fishing
342 permit (Mecklenburg-Western Pomerania) or a federal fishing licence (Schleswig-Holstein).

343 **National Survey Data**

344 Several surveys have been conducted estimating participation, catch, and effort in Germany (Grosch
345 et al., 1977; Möller & Tiffert, 1988; Hilge 1998; Wedekind et al., 2001; Wolter et al., 2003;
346 Arlinghaus, 2004; Dorow & Arlinghaus, 2011; Strehlow et al., 2012; Ensinger, 2015), but few
347 explicitly collected data for MRF. Möller & Tiffert (1988) counted the numbers of herring anglers,
348 sampled one charter vessel, and conducted interviews with beach anglers to estimate catch rates and

349 total catch of Atlantic herring and Atlantic cod, yearly expenditure for angling equipment, and total
350 yearly income per charter vessel in Kiel Bight (western Baltic Sea).

351 A nationwide telephone survey and diary study with 648 panellists was conducted in northern
352 Germany and produced estimates of the number, effort and catch of recreational fishers in
353 Mecklenburg-Western Pomerania (Dorow & Arlinghaus 2011). Recreational landings of Atlantic
354 cod in Mecklenburg-Western Pomerania exceeded 3,000 t in 2007 and were higher than the
355 commercial landings of cod in the same state (Dorow & Arlinghaus 2011).

356 A nationwide MRF study was done involving a mail-diary survey with 66,000 questionnaires sent to
357 angling clubs. A total of 2,313 responses were used to estimate numbers and effort of anglers, and
358 showed significant catches of Atlantic cod in the western Baltic Sea (Zimmermann et al., 2007). The
359 corresponding catch per unit effort was estimated using a multi-annual on-site access point intercept
360 survey and recreational length distributions were obtained onboard charter vessels (Strehlow et al.,
361 2012). The on-site survey has been done annually since 2005, with over 21,100 anglers interviewed
362 by 2015.

363 A national telephone-diary survey covering nine out of 16 federal states was done in 2014, with two
364 states far from the sea used as proxies for the seven states not covered by the survey. A random digit
365 dialling telephone survey resulted in a sample of 50,200 valid telephone numbers of private
366 households, 678 anglers were identified, and 348 panellists recruited. In addition, a non-
367 representative sample of coastal fishing permit holders resulted in 582 panellists. During the
368 screening survey respondents were asked to provide an estimate of the number of days fished and
369 expenditure each year (H.V. Strehlow & M.S. Weltersbach, unpublished data).

370 Data used in this study

371 The number of fishers, fishing effort and expenditure estimates (Table 2) used in this study were
372 derived from a recent national 1-year telephone-diary study from 2014-2015 (H.V. Strehlow & M.S.

373 Weltersbach, unpublished data) as the former mail-diary survey included both coverage and non-
374 response biases (Strehlow et al., 2012). Catch estimates for western Baltic Sea cod originated from
375 the on-site access point intercept survey as described in Strehlow et al. (2012). The estimates were
376 considered to contain only negligible bias (Table S1).

377 **Greece**

378 **Recreational fishing sector**

379 Greek marine fisheries exploit many different species using various gear types, and the reported
380 fisheries landings currently exclude recreational catches (Tsikliras et al., 2007). MRF is done for
381 leisure and consumption, and divided into boat and shore fishing, spear fishing, and shellfish
382 collection. The complexity of the coastline and the variety of different gear types used means that
383 surveying MRF in Greece is a significant challenge (Lloret & Font 2013; Moutopoulos et al., 2013).
384 Shore fishing is a common activity with estimates of catch representing on average 8% of total
385 removals between 1950 and 2010, with a range of 3 to 22% (Moutopoulos & Stergiou, 2012).
386 Between 11 and 48 demersal species are important MRF target species depending on the area, with
387 European sea bass and sea breams (Sparidae) accounting for around 40% of the total recreational
388 catch (Moutopoulos et al., 2013).

389 **National Survey Data**

390 There were no regular surveys of MRF in Greece, but historical removals have been reconstructed
391 (Moutopoulos et al., 2013) and some data has been collected from the sport fishing community
392 (Anagnopoulos et al., 1998) mainly related to tuna (Scombridae) (HCMR, 2004). All studies used
393 interviews with recreational and commercial fishing associations, coast guard, port offices, fisheries
394 administrations, and retail shops (Anagnopoulos et al., 1998; HCMR, 2004; Moutopoulos et al.,
395 2013). In addition, an independent estimate of the magnitude of MRF was provided by the National
396 Statistical Service of Greece (General Secretary of Fishery, pers. comm.).

397 The legal aspects, magnitude, and the socioeconomic role of MRF in Greece and Italy was reviewed
398 in a study by Anagnopoulos et al. (1998), but the results should be interpreted carefully due to issues
399 with the study design. Another study was carried out to assess the recreational tuna fishery that
400 focussed on the Aegean Sea (HCMR, 2004). Unreported shore-based MRF catches have also been
401 estimated regionally and by species for the period 1950-2010 (Moutopoulos et al., 2013), but are
402 likely to represent a large underestimate of the true values. The most recent estimate of numbers of
403 recreational sea fishers in Greece (2011-2012) was 300,000 boat, shore and spear fishers accounting
404 for 2.75% of the Greek population (General Secretary of Fishery, pers. comm.).

405 Data used in this study

406 An estimate of the participation in MRF was available for Greece, but there were no studies on
407 fishing effort or expenditure available, and therefore extrapolation was needed (Table 2). The MRF
408 target species and the composition of the sector were thought to be most similar to France and Italy,
409 therefore data from France and Italy was used for fishing effort and expenditure extrapolation,
410 respectively (see Table 2 and country-specific section for details). The biases associated with these
411 estimates were assumed to be the same as for the donor countries (Table S1). The bias associated
412 with the participation estimate was assumed to be a high underestimate (Table S1).

413 **Iceland**

414 Recreational fishing sector

415 The four main MRF target species in Iceland are Atlantic cod, Atlantic halibut (*Hippoglossus*
416 *hippoglossus*, Pleuronectidae), wolf fish (*Anarhichas spp.*, Anarhichadidae) and haddock
417 (*Melanogrammus aeglefinus*, Gadidae) (Solstrand, 2013). In Iceland, catch and release is forbidden
418 by law and all fish must be landed, except for Atlantic halibut, which must be returned alive if
419 viable. Tourists are required by law to use hook and line and cannot use other methods. Quotas are

420 issued to charter vessels, all catches must be reported, and additional quota can be purchased from
421 other vessels. No fishing licence is required for MRF in Iceland.

422 National Survey Data

423 MRF statistics and interviews with charter vessel skippers showed that there were 48 charter vessels
424 operating with an average catch of 48 to 61 kg per vessel per day, fishing for 80 days per year,
425 resulting in a total seasonal catch of 232 tonnes (Solstrand, 2015). There were few studies of MRF in
426 Iceland that collected data on all fishing sectors, and only the participation rate was available
427 (Toivonen, 2002).

428 Data used in this study

429 As only information on participation was available (Toivonen, 2002) extrapolation was needed for
430 fishing effort and expenditure. The MRF target species and the composition of the sector were
431 assumed to be most similar to Norway, therefore data from Norway was used for fishing effort, and
432 data from Denmark for expenditure (see Table 2 and country-specific sections for details). The
433 biases associated with these estimates were assumed to be the same as for the donor countries (Table
434 S1). The bias associated with the participation estimate was assumed to be negligible (Table S1).

435 Ireland

436 Recreational fishing sector

437 Ireland has an extensive coastline and its recreational fishery is almost exclusively confined to rod
438 and line fishing and limited spear fishing, but participation levels for the latter are unknown. MRF
439 comprised of shore, charter vessel and private boat fishing. Around 120 charter vessels operate
440 mainly on the north-west, west, and south coasts, with a capacity of between 6 and 8 fishers per
441 vessel. Two discrete categories exist: pelagic and demersal fishing; and shark fishing (< 5% of total
442 fishing days) (Wögerbauer et al., 2015).

443 The main species targeted by shore anglers are: European sea bass, Atlantic mackerel, Atlantic cod,
444 pollack, European flounder, whiting, common dab and lesser spotted dogfish (*Scyliorhinus canicula*,
445 Scyliorhinidae). Other elasmobranchs including tope (*Galeorhinus galeus*, Triakidae) and rays
446 (Batoidea) are targeted at specific locations. Shore angling is primarily a bait angling fishery
447 targeting all available species, but a sea bass fishery has emerged using artificial lures. Boat fishers
448 (charter and private boat fishers) target species including pollack, Atlantic cod, ling (*Molva molva*,
449 Lotidae), saithe (*Pollachius virens*, Gadidae), conger eel (*Conger conger*, Congridae), wrasse
450 (cuckoo - *Labrus mixtus* and ballan - *Labrus bergylta*, both Labridae), European sea bass, gurnards
451 (*Triglidae spp.*), blue shark (*Prionace glauca*, Carcharhinidae), spurdog (*Squalus acanthias*,
452 Squalidae), rays, and tope. High levels of catch and release are found for all species except gadoids
453 and mackerel. No MRF licence is required.

454 National Survey Data

455 A survey of the socioeconomic impacts of recreational fishing was done with 903 fishers interviewed
456 using face-to-face interviews (692) and online methods (211) (TDI, 2013). The interviews were
457 conducted at randomly selected marine and freshwater locations, and fishers who provided contact
458 details were asked to complete the online survey. The total economic contribution of recreational
459 fishing in Ireland was €755 million with an estimated 252,000 domestic and 154,000 tourist fishers
460 (TDI, 2013). Participation rates were estimated from 4,044 interviews and 7.6% of the population
461 aged over 15 years were recreational fishers, giving 273,600 domestic fishers of which 76,600 were
462 sea fishers. The ratio of shore-based sea fishers to boat fishers was estimated at approximately 3:1
463 giving 57,450 shore fishers and 19,150 boat fishers from current participation rates (Whelan &
464 Marsh, 1988). The average expenditure associated with Irish sea fishers was thought to be in the
465 region of €1,641 per angler per annum giving a total direct expenditure of about €126 million. Sea
466 fishers visiting from outside of the Republic of Ireland are thought to contribute a further €44 million
467 in direct expenditures.

468 Data used in this study

469 The data selected for this study were from the IFI omnibus study in 2015 (Table 2) and were
470 considered to contain negligible bias (Table S1).

471 **Italy**

472 Recreational fishing sector

473 Italy has between 600,000 and 1,000,000 marine recreational fishers, MRF effort was estimated to be
474 4.8 million days, and total expenditure was €240 million. Most fish from shore, but around one third
475 use either private or charter boats. The most commonly used gears are lines (rod and line 50%,
476 longline 18%) and pots (7%); with spear fishing accounting for about 12% of the total effort.
477 Commonly targeted species with significant catches include Sparidae (sea breams), tuna species,
478 European sea bass, common dolphin fish (*Coryphaena hippurus*, Coryphaenidae), little tunny
479 (*Euthynnus alletteratus*, Scombridae), cuttlefish (Sepiidae), squid (*Loligo vulgaris*, Loliginidae), and
480 sharks as bycatch in the tuna fishery (Cingolani et al., 2005; Pranovi et al., 2015). No licence is
481 required for MRF in Italy.

482 National Survey Data

483 Some data on MRF exist for Italy, but the few studies provided varying estimates due to different
484 sampling methods (Cautadella & Spagnolo, 2011). The main sources of data were interviews (AC
485 Nielsen, unpublished data), self-reporting during mandatory registration (MiPAAF, 2010), and
486 follow-up data collection (MiPAAF, 2012). Other partial or anecdotal information also existed, but
487 no reliable effort or catch data was available for the whole country.

488 Data used in this study

489 The survey used in this study (MiPAAF, 2012; AC Nielsen, unpublished data) covered marine
490 recreational boat-fishing activities in Italy, but did not sample shore-based fisheries effectively and

491 underrepresented participants such as occasional fishers, children, and tourists. Thus, the bias in the
492 number of fishers, fishing effort and expenditure was considered a moderate underestimate (ISMERI,
493 2015) (Table S1).

494 **Latvia**

495 **Recreational fishing sector**

496 MRF in Latvia is carried out in the Baltic Sea (ICES subdivisions 26 and 28). Recreational fishing
497 comprises of two sectors: registered fishers fishing with passive gears for personal consumption that
498 cannot sell catch (e.g. gillnets, fyke nets, longlines); and active methods including angling (rod and
499 line fishing) and spear fishing. Passive gear fishers must report catches and these catches are
500 included in the national catch statistics. Angling is more common from the shore than from boats,
501 and ice fishing is done in the Gulf of Riga. European flounder, Eurasian perch, Atlantic cod, garfish,
502 Atlantic herring and round goby (*Neogobius melanostomus*, Gobiidae) are the main species targeted
503 by MRF. Recreational fishers between 16 and 65 years must have a licence, but do not need to report
504 catches (Latvijas Nacionālās, 2013) and are not allowed to sell their catch (Anonymous, 2007).

505 **National survey data**

506 There were no regular surveys of MRF in Latvia, with the only data collected from the logbooks of
507 passive gear fishers by the Ministry of Agriculture and Fisheries. In 2014, 887 passive gear fishers
508 were registered as consumption fishers, with 24,600 fishing trips reported and total landings of
509 approximately 104 tonnes. The main target species were European flounder (28 tonnes), Atlantic
510 herring (18 tonnes), vimba bream (*Vimba vimba*, Cyprinidae) (17 tonnes) and Eurasian perch (8
511 tonnes). Between 100,000 and 120,000 licences were purchased by anglers, with about 30% of the
512 2,200 interviewed anglers being involved in MRF (Birzaks, 2007; Korņilovs, 2013).

513 Data used in this study

514 The data used for Latvia related to the passive gear consumptive fishers (Table 2), and therefore
515 excluded around 40,000 anglers that fish in the Baltic Sea (Birzaks, 2007; Korņilovs, 2013). Thus,
516 the numbers, participation, and fishing effort were likely to significantly underestimate the actual
517 situation in Latvia, but the consumptive fishers were likely to fish more often than anglers, and so the
518 average effort per fisher was likely to be a significant overestimate (Table S1). No expenditure data
519 existed for Latvia, therefore Estonia was used for extrapolation (see Table 2 and country-specific
520 section for details) and the bias was assumed to be the same as for the donor country (Table S1).

521 **Lithuania**

522 Recreational fishing sector

523 MRF occurs mainly from the shore and in coastal waters in the Baltic Sea, and targets a range of
524 species including European plaice, Atlantic herring, Atlantic cod, turbot (*Scophthalmus maximus*,
525 *Scophthalmidae*) and salmonids (*Salmonidae*) (Lithuanian Fishing Services, 2016). Rod and line
526 fishing is the only permitted method, with trawls, nets, pots and traps banned.

527 National survey data

528 A recent study estimated Baltic cod catches using a recall-based interview survey, where a sample of
529 recreational vessels were interviewed and an on-board survey of smaller vessels was undertaken.
530 Small charter angling boats are licenced, so the numbers of trips and anglers were obtained from
531 census, direct interviews, and questionnaires. However, there was under-coverage of other sectors
532 (A. Svagzdys, pers. comm.).

533 Data used in this study

534 There was limited data available for Lithuania, so data for participation and effort was extrapolated
535 from Latvia and expenditures from Estonia (see Table 2 and country-specific sections for details).
536 The biases were assumed to be the same as for the donor countries (Table S1).

537 **Netherlands**

538 Recreational fishing sector

539 In 2013, 3.2% of the Dutch population participated in MRF with the majority taking between one
540 and five fishing trips each year. Most fishing was conducted with rod and line, and occurred from the
541 shore, charter vessels and private boats. The main species caught were flatfish (European plaice,
542 European flounder and common dab), Atlantic mackerel, Atlantic cod and European sea bass.
543 Average release rate was 30%, but varied between 10% (mackerel) and 60% (flounder). MRF occurs
544 also with gill nets, targeting mainly European sea bass, but catches are a very small fraction of the
545 total and a licence is required. No MRF licence is required for rod and line fishing in marine waters.

546 National Survey Data

547 The Dutch survey involved a two-phase design: a screening survey and a logbook survey (van der
548 Hammen et al., 2016). The screening survey was part of a marketing survey of households and
549 approximated the ratio of gender, age, completed education, and region of residents in the Dutch
550 population. The screening survey provided the number and demographics of recreational fishers in
551 the Netherlands and the logbook survey collected catches by individual fishers. These surveys were
552 carried out every two years. The screening survey was sent to around 50,000 households in 2011 to
553 collect data on participation in recreational fishing and gears used, and recruiting participants for a
554 logbook survey. Logbooks were completed between March 2012 and February 2013 with
555 participants selected from a representative probability-based sample of respondents. Monthly diaries
556 were completed by 1,800 participants for each fishing trip including: location, start and end times,

557 gear, species caught, and numbers retained or released. The combination of logbooks with regular
558 contacts with participants was used to minimise recall bias and encourage participation (van der
559 Hammen and de Graaf, 2013, 2015; van der Hammen et al., 2016).

560 Data used in this study

561 The data selected for this study were from the screening survey in December 2011 and the logbook
562 survey from March 2010 to February 2011 for expenditure and March 2012 to February 2013 for
563 fishing effort (Table 2) (van der Hammen and de Graaf 2015). The estimates for participation and
564 fishing effort were considered to contain negligible bias, whereas the expenditure estimate was
565 considered to be a moderate underestimation (Table S1) (van der Hammen et al., 2016).

566 Norway

567 Recreational fishing sector

568 MRF in Norway is a popular activity with around 33% of the population fishing on average 11.5
569 days each year (Table 2) (based on Vaage, 2015). Domestic recreational fishers can fish with rod and
570 line, jigging machines, traps, pots, gill nets, and longlines (Anonymous, 2006). The main target
571 species are Atlantic cod, ling, tusk (*Brosme brosme*, Lotidae), saithe, haddock and Atlantic mackerel
572 (ICES, 2010). Fishing tourism is important in Norway (Borch et al., 2011; Vølstad et al., 2011) with
573 foreign tourists allowed to use hand-held tackle and export 15 kg of marine fish or fish products and
574 one trophy fish. Atlantic cod and saithe dominate the tourist catch (Vølstad et al., 2011) and a large
575 proportion of fish are released (Ferter et al., 2013a, 2013b). Boat fishing is the predominant platform
576 used with 63% of over 750,000 private recreational boats used for recreational fishing (KNBF and
577 NORBOAT, 2012). Shore fishing is also popular due to the access to high quality shore fishing.
578 There are many charter fishing companies in Norway, but the magnitude of the activity is unknown.
579 Spearfishing and hand collecting using SCUBA is allowed for most species in Norway. No fishing
580 licence is required for MRF.

581 National Survey Data

582 Monitoring of recreational fishing started in the 1970s using a one-year recall survey (Vorkinn et al.,
583 1997) and six surveys partitioned recreational fishing into freshwater and marine, with the MRF
584 participation rate varying between 37 and 44% of the population. A large recall survey of MRF
585 activity integrated in an omnibus survey estimated that 43% of the Norwegian population fished and
586 48,000 tonnes fish were caught in marine waters (Hallenstvedt & Wulff, 2003). However, these
587 studies were likely to have significant recall bias, so the validity of estimates of participation and
588 catch is uncertain. Smaller in-depth studies that looked at aspects of MRF have been conducted. A
589 national probability-based survey was conducted to obtain harvest and effort estimates in tourist
590 MRF using weekly catch diaries recorded by a sample of angling tourism businesses (Vølstad et al.,
591 2011). Field-based sampling of effort and volunteer catch diaries and interviews were used to collect
592 catch per unit effort of MRF on European lobster (*Homarus gammarus*, Nephropidae) and showed
593 that MRF was responsible for 65% of the catches in southern Norway (Kleiven et al., 2012).

594 Data used in this study

595 The data used for Norwegian participation and fishing effort in this study (Table 2) were derived
596 from Statistics Norway as this was the longest time-series, had the largest sample size, and
597 represented the most recent estimate (Vaage, 2015). The survey covers the population between the
598 ages of 16 and 79 years (in 2014 a population of 3,894,435), which means that the population under
599 16 years and above 79 years are excluded from the estimate (total population of 1,213,535). Thirty-
600 three percent of the sample population said that they fished in the sea in 2014. The mean number of
601 annual MRF trips per year was 11.5 trips per year per fisher. The estimates of participation and effort
602 were assumed to be moderate and small underestimates, respectively (Table S1). No national
603 estimates of expenditure by marine recreational fishers exist, so expenditure data from Denmark was
604 used (see Table 2 and country-specific section for details) and the bias was assumed to be the same
605 as for the donor country (Table S1).

606 **Poland**

607 **Recreational fishing sector**

608 MRF includes two main fishing methods: angling and spear fishing, that are conducted from shore
609 and boats in the Baltic Sea. An increase in shore angling has been observed over the last decade,
610 mainly targeting European flounder, common bream (*Abramis brama*, Cyprinidae), sea trout, garfish,
611 Atlantic herring and European eel. Trolling for Atlantic salmon from boats has also increased in
612 popularity in the last five years. Angling in brackish estuaries and lagoons targets mostly freshwater
613 species including Eurasian perch, pikeperch, roach and common bream. No data were available on
614 the numbers, effort, or catches by spear fishers. The number of fishing licences issued by the
615 Regional Maritime Fisheries Inspectorates has increased to almost 37,000 licences in 2014.

616 **National Survey Data**

617 Boat MRF in Poland was monitored using effort information (numbers of trips and fishers per trip)
618 collected by the Harbour Master Offices. Each fishing trip, registered as individual record by a local
619 Maritime Office, included vessel name, the date and hour of departure and return, as well as the
620 number of fishers onboard. Data were available from 1999 onwards, indicating very rapid
621 development of sea fishing in Poland as the number of fishing days had increased in recent years.
622 Catch composition and biological information were collected during onboard sampling by observers
623 selected at random from the charter vessel registry focusing on the recreational cod fishery (Radtke
624 and Dąbrowski, 2007, 2010). Catches were raised by quarter and ICES subdivision using the number
625 of MRF trips and the catch estimates from sampled vessels, and these estimates were summed to
626 produce total annual boat angling catches of cod for Poland.

627 In 2014, 11,217 boat angling trips were recorded and the total boat angling effort was 142,598
628 fishing days, although this may represent multiple trips by the same angler as angler details were not
629 recorded (Radtke & Dąbrowski, 2015). Eleven observer trips were conducted on charter vessels in

630 2014 to determine species captured, numbers of harvested and released fish, and biological
631 information (weight, length, sex, maturity and age) in the recreational cod fishery. The vessel
632 selection excluded very small boats potentially leading to bias (underestimation) in the total catch
633 estimates and uncertainty in the biological information. The survey did not cover shore fishing, but
634 this was thought to represent only a small proportion of the total cod catch.

635 Data used in this study

636 The recreational fishing effort from boats in Poland (Radtke & Dąbrowski, 2015) was the only
637 information available (Table 2). These data were of good quality, but the total sea angling effort was
638 likely to be a moderate underestimation as shore based MRF was not covered by the survey (Table
639 S1). Data on participation and expenditure were not available (Table S1). Germany was deemed the
640 most reasonable donor country for extrapolation of participation as the platforms, target species, and
641 angling seasons were similar. Expenditure data was extrapolated from Estonia (see Table 2 and
642 country-specific sections for details). The bias associated with these estimates was assumed to be the
643 same as for the donor countries.

644 **Portugal**

645 Recreational fishing sector

646 MRF is a very popular leisure activity in Portugal. No recent estimates were available, but the
647 number of fishers was likely to be between 170,000 and 200,000 in recent years based on the number
648 of licences issued (DGRM, 2015b; Regional Fisheries Department of Azores, unpublished data). The
649 most common fishing mode is shore angling, followed by demersal boat fishing, and spear fishing. In
650 some regions such as southern Portugal, Azores, and Madeira, the charter boat angling segment is
651 economically important. MRF is restricted to: hook and line for shore and boat angling; spear
652 fishing; and specific handheld instruments for shellfish and bait collection. Recreational fishers
653 capture many fish species, with targeted and captured species varying by fishing mode and region.

654 On the mainland, important target species are sea breams (Sparidae; particularly of the genus
655 *Diplodus* spp.), and European and spotted sea bass (*Dicentrarchus punctatus*, Moronidae). Intertidal
656 collectors target common octopus (*Octopus vulgaris*, Octopodidae), velvet swimming crab (*Necora*
657 *puber*, Macropipidae), bivalves (*Ruditapes* spp., Veneridae and *Donax* spp., Donacidae), and stalked
658 barnacles (*Pollicipes pollicipes*, Pollicipedidae) (Cruz et al., 2015). In the Azores, important targeted
659 species are sea breams, parrotfish (*Sparisoma cretense*, Labridae), wrasse (e.g. ballan wrasse),
660 grouper (e.g. *Serranus atricauda*, Serranidae), jacks (e.g. *Seriola* spp., Carangidae), and mackerel
661 (e.g. *Scombrus colias*, Scombridae). Intertidal collectors target mainly limpets (*Patella* spp.,
662 Patellidae), common octopus, and crabs (e.g. *Pachygrapsus marmoratus*, Grapsidae) (Diogo &
663 Pereira, 2013a, 2013b, 2014). Captured fish are mainly for human consumption, with catch-and-
664 release uncommon. Restrictions to control catch and effort in MRF have been in place on the
665 mainland since 2006 and in the Azores since 2008. These include fishing licences, bag limits,
666 minimum landing sizes, and closed areas and periods (Veiga et al., 2013; Diogo & Pereira, 2014). In
667 Madeira, spear fishing is the only regulated activity and subject to fishing licences.

668 National Survey Data

669 Despite European requirements for catch reporting (EU 2008, 2010, 2016), there is no systematic
670 monitoring of MRF in Portugal. The first national survey of MRF started in 2015 and targeted all
671 fishers to collect demographics, participation, effort, expenditure, catch, and attitudes towards
672 current regulations, but results are not available yet (DGRM, 2015a). Participation in the survey was
673 voluntary, with licenced fishers invited to participate via text messages to improve response rates.

674 The information on MRF came from several surveys covering specific fishing modes and regions of
675 Portugal and the Azores. In 2001, a roving creel survey in northern Portugal (ca.120 km of coastline)
676 was conducted to obtain socioeconomic (expenditure, demographics) and fishing activity related
677 information (e.g. catch, effort, target species) of shore anglers (Rangel & Erzini, 2007). Interviews

678 had a high response rate (90%) and 2,081 were completed. The most targeted species were European
679 sea bass and sea breams (Sparidae), with estimated shore angling catches of 7 and 2 tonnes,
680 respectively. Information was obtained on recreational boat and shore angling activity in the Tagus
681 estuary and Lisbon area (Vale, 2003; Lopes, 2004). A survey was conducted to describe the
682 recreational boat fishing activity in northern Portugal (Lima, 2006). Most boat fishing took place in
683 summer months with 27 fishing trips each year. Boat owners spent €2,727 annually, more than half
684 of which was related to boat maintenance (€1,415). In southern Portugal, several studies have also
685 been conducted (Castro, 2004; Veiga et al., 2010, 2013; Costa, 2012). Mean daily estimated densities
686 of anglers and shellfish collectors on the south-west coast were 2 and 9.4 persons per kilometre of
687 coastline, respectively, and yielded 4.3 tonnes biomass per kilometre (Castro, 2004). Veiga et al.
688 (2010) conducted a large-scale aerial-roving creel survey to estimate socioeconomics, effort, and
689 catch by shore anglers. There were 166,430 fishing trips per year, yielding a total of 147 tonnes
690 biomass. Each angler conducted on average 65 fishing trips and spent €865 each year. White sea
691 bream (*Diplodus sargus*, Sparidae) was the most targeted and captured species, with 82 tonnes
692 retained. The only spear fishing data for the mainland was from a nationwide online pilot survey
693 (Assis et al., 2012).

694 Several studies were available on the impact of MRF on the Azores. A small study was carried out to
695 assess the spear fishing activity of São Miguel Island (Diogo & Pereira, 2013a). On-site surveys
696 were conducted on Pico and Faial to collect socioeconomic and fishery related information on the
697 main methods of recreational fishing (Diogo & Pereira 2013b, 2014). Catch composition varied by
698 fishing mode, as well as fishing pressure and expenditures. For Madeira, the only data available was
699 from a small survey on the Big Game fishery (Graça, 2009).

700 Data used in this study

701 No country level estimates on MRF participation, effort, or expenditure were available. Thus, the
702 data used in this study was based on the available information, both from fishing licence statistics
703 and the regional studies. The number of fishers was estimated from the number of fishing licences
704 and was reliable as compliance with fishing licences in Portugal was high (Veiga et al., 2010; Costa,
705 2012). For Portugal and the Azores, the number of fishers was estimated directly from the average
706 annual number of licences between 2012 and 2014 (Portugal: 166,041; Azores: 4,413) (DGRM,
707 2015b; Regional Fisheries Department of Azores, unpublished data). For Madeira, the number of
708 fishers (4,413) was estimated assuming the same participation as on the Azores (1.68%). Non-
709 licenced fishers (e.g. hand collectors and fishers under the age of 16) were excluded, but non-resident
710 fishers were included in number of licences, so was assumed to be a small underestimate (Table S1).
711 The effort and expenditure estimates for Portugal were based on the data available from the regional
712 surveys currently available (Lima, 2006; Veiga et al., 2010; Assis et al., 2012; Diogo & Pereira
713 2013a, 2013b). A nationwide study was used for effort and expenditure, and the expenditure was
714 corrected to constant 2015 prices using Harmonised Consumer Price Index for Portugal (Eurostat,
715 2016). The main potential source of bias came from the weighted averages used to estimate effort
716 and expenditure that were based on specific areas and fishing modes (which may not be
717 representative for the entire country). The estimates of effort and expenditure were assumed to be a
718 small overestimate and a small underestimate, respectively (Table S1)

719 **Slovenia**

720 MRF is carried out from the shore and boats in Slovenia, with sea breams being the main target from
721 the shore, and picarels (*Spicara spp.*, Sparidae), sea breams, European sea bass and squid from boats
722 (Gaudin & De Young, 2007). No licence is required for shore fishing (Gaudin & De Young, 2007),
723 but an annual licence is required, and gear restrictions and daily bag limits are in place for boat
724 fishing (Ministry of Agriculture, Fisheries and Food, 2016). There were no studies of MRF in

725 Slovenia, so extrapolation was needed. Target species and composition were thought to be most
726 similar to Italy, therefore data from Italy was used for extrapolations of participation, effort, and
727 expenditures (see Table 2 and country-specific sections for details). The biases were assumed to be
728 the same as for the donor country (Table S1).

729 **Spain**

730 **Recreational fishing sector**

731 MRF management is conducted by the Spanish Autonomous Regions for inshore areas and the
732 Ministry of Fisheries for offshore areas. The fisheries differ considerably between the Atlantic and
733 the Mediterranean, with shore, boat (mainly road and line), and spear fishing occurring. The main
734 target species in the Atlantic are albacore (*Thunnus alalunga*, Scombridae), ballan wrasse, conger
735 eel, horse mackerel (*Trachurus trachurus*, Carangidae), Atlantic mackerel, common octopus,
736 European sea bass, sea breams, and squid; while amberjack (Carangidae), European sea bass and
737 diverse species of Scianenidae, Sparidae, and Serranidae are the main targets in the Mediterranean.
738 An MRF licence is mandatory and is issued by the administrations of the Autonomous Regions.

739 **National Survey Data**

740 There were few studies on MRF in Spain, but some information has been gathered in the Basque
741 Country and Galicia (Pita & Freire, 2011, 2014; Veiga et al., 2013; Zarauz et al., 2013; Pita &
742 Fernández-Márquez, 2014; Ruiz et al., 2014). Estimates of spear fishing expenditure (Pita &
743 Fernández-Márquez, 2014) and effort and catches (Pita & Freire, 2011, 2014) were made for Galicia.
744 In the Basque Country, shore, boat, and spear fishers were interviewed, and catch and effort of
745 recreational fishers were estimated (Ruiz et al., 2014). The performance of e-mail, phone, and off-
746 site mail surveys was compared and effort was calculated independently for shore fishing, boat
747 fishing, and spear fishing (Zarauz et al., 2013, 2015). Mean expenditure for the Basque recreational
748 boat fishing sector was available from 555 interviews (Zarauz et al., 2013).

749 For the Mediterranean, several studies on the impact of recreational fishing from boats were
750 conducted. Questionnaires were done by direct poll (Tragsatec, 2004) or received by mail from a
751 randomly selected subset of licence holders. These studies provided catch composition, catch rates
752 and economic impact of the boat fishery. Detailed studies have been done in smaller geographical
753 areas (Morales-Nin et al., 2005, 2015; Font & Lloret 2011; Lloret & Font 2013).

754 Data used in this study

755 For the Atlantic coast, the number of fishers was calculated using the number of licences when
756 available (Galicia, Basque Country and Canary Islands). The participation rate in these regions was
757 extrapolated to the regions where the number of licences was not available (Asturias and Cantabria).
758 Fishers without licences and fishers under the age of 16 were not considered, which may result in a
759 small underestimation of the actual number. Effort estimates were calculated independently for shore
760 fishing, boat fishing, and spear fishing using the data collected in the Basque Country (Ruiz et al.,
761 2014), and then weighted by the total number of fishers using each fishing method. Mean effort was
762 30 days per fisher per year. Mean expenditure estimates were available for Basque boat fishing
763 (Zarauz et al., 2013) and for spear fishing in Galicia (Pita & Fernández-Márquez, 2014), and
764 expenditure data for shore fishers was estimated from spend on baits by boat fishers. These estimates
765 were extrapolated to the whole Atlantic coast (Table 2) which was reasonable because fisheries in
766 the Cantabrian Sea are very similar. Fisheries in the Canary Islands are different, so the estimation
767 may be biased (Table S1). The population of Spain fishing in the north and south was estimated from
768 the relative numbers of days fished and participation rates calculated (Table 2).

769 For the Mediterranean, the numbers of fishers were obtained from the number of licences (Franquesa
770 et al., 2004). The number of boat fishing licences was estimated to be around 93,168 for the Spanish
771 Mediterranean and an average boat angler fished 33 days each year (Tragsatec, 2004). The
772 expenditure of boat fishers was available (Gordoa et al., 2004; Tragsatec, 2004), but because the

773 expenditure of other fishing methods was unknown, the estimates of expenditure for the Atlantic
774 were used to estimate the total expenditure in the Mediterranean and the bias was assumed to be the
775 same as for the Atlantic (Table S1). Estimates for participation and fishing effort in the
776 Mediterranean were a moderate underestimate due to the non-coverage of some sectors (Table S1).

777 **Sweden**

778 **Recreational fishing sector**

779 Sweden has a long coastline on the North Sea in the west and Baltic Sea in the east. A range of
780 fishing methods and opportunities exist, including passive and active gear, shore and boat (private
781 and charter) fishing. Recreational fishing is a popular activity in Sweden, with over 1.7 million
782 recreational fishers (both marine and freshwater) (Svergies Officiella Statistik, 2013) making it one
783 of the most common recreational pursuits. Recreational fishing includes all fishing activities by those
784 without a commercial fishing licence, both using passive gears such as gill nets and fyke nets, and
785 active methods like angling. Few surveys have been carried out evaluating recreational catches, so
786 there was limited knowledge of catches, but some local scale information exist. The main marine
787 species targeted are Atlantic cod, Atlantic mackerel, flatfish species, Atlantic herring, sea trout,
788 crabs, and European lobster (Karlsson et al., 2014). A fishing license is not generally needed in
789 Sweden, but there are some exceptions (e.g. coastal trolling and net fishing).

790 **National Survey Data**

791 The Swedish national survey of recreational fishing was done in 2013. A postal questionnaire was
792 sent to 10,000 randomly selected permanent residents in Sweden (Svergies Officiella Statistik,
793 2013). Around 1.7 million Swedes aged 16 to 80 went fishing and there were approximately 565,634
794 individuals fishing for 4.5 million days in the sea (assuming the number of days fished in the sea is
795 proportional to the number of days fished in total). Recreational cod catches in Swedish coastal
796 waters were estimated at 689 tonnes and there were 8,000 tonnes of all marine species retained.

797 Data used in this study

798 The data used in this study were derived from the survey of recreational fishing in Sweden in 2013
799 (Svergies Officiella Statistik, 2013) as this was the most recent, highest quality, and comprehensive
800 dataset available. The average expenditure per fisher was converted to euro using an exchange rate of
801 0.11. The survey did not distinguish between freshwater and marine fishers, so the numbers and
802 expenditure of marine fishers were derived assuming the same ratio as the numbers of days fished
803 (Table 2). The statistics did not include MRF carried out by tourists and so the number of fishers and
804 fishing effort were likely to be moderate underestimates. The expenditure was likely to be higher for
805 marine fishers than for the general fishing population due to higher costs (e.g. boat ownership), so
806 represented a moderate underestimate of the true expenditures (Table S1).

807 **UK**

808 Recreational fishing sector

809 MRF in the UK is diverse, with most effort by fishers on the shore and boats (private and charter
810 vessels) (Armstrong et al., 2013). There were 1,080,000 recreational sea fishers in Great Britain, with
811 2.2% of all adults going sea fishing (Armstrong et al., 2013) and an additional 64,800 in Northern
812 Ireland (McMinn, 2013). Annual expenditure was £1.23 billion in England (Armstrong et al., 2013),
813 £140.9 million in Scotland (Radford & Riddington 2009), £87.1 million in Wales (Monkman et al.,
814 2015) and a further £54.6 million in Northern Ireland (McMinn, 2013). Sea angling also had
815 important social and well-being benefits including relaxation, physical exercise, and a route for
816 socialising. In England, around 3.8 million sea fishing days were recorded, with shore angling most
817 common, followed by private or rented boats, and charter vessels were the least common. Average
818 catches per trip were highest in England on charter vessels, followed by private boats, and lowest
819 from shore. The most common species caught were Atlantic mackerel, whiting, European sea bass,

820 Atlantic cod, and elasmobranchs. Shore and boat anglers released around 75% and 50% of fish,
821 respectively (Armstrong et al., 2013). No MRF licence is required in the UK.

822 National Survey Data

823 Several different surveys of recreational fishing participation, activity, catch, expenditure, and social
824 benefits have been done that cover different regions of the UK (Drew, 2004; Simpson & Mawle,
825 2005, 2010; Richardson et al., 2006; Radford & Riddington 2009; Brown et al., 2010, 2012; Brown,
826 2012; Armstrong et al., 2013; McMinn 2013; Monkman 2013; Monkman et al., 2015). The most
827 recent and comprehensive survey collected data on activity and catch from shore, private boats and
828 charter vessels using a variety of different survey methods (Armstrong et al., 2013). This comprised
829 of six surveys that included interviewing of over 12,000 households, contributions from 11,000
830 anglers, and visiting of over 2,000 stretches of coastline (Armstrong et al., 2013). Retained catches
831 for European sea bass and Atlantic cod were estimated to be around 30-40% of the reported English
832 commercial fishery landings (Armstrong et al., 2013). In Northern Ireland, questions were added to
833 an economics landscape study to assess participation and an online survey was used to look at areas
834 visited, species targeted, catch rates, and attitudes of sea fishers, but no estimates of catches were
835 made (McMinn, 2013).

836 Data used in this study

837 The data used in this study were derived from recent surveys of MRF in England (Armstrong et al.,
838 2013), Northern Ireland (McMinn, 2013), Scotland (Radford & Riddington, 2009), and Wales
839 (Monkman et al., 2015). MRF was mainly angling (rod and line), so the number of fishers were
840 derived from the Great Britain national survey (Armstrong et al., 2013) and the estimates for
841 Northern Ireland (McMinn, 2013), giving a total of 1,149,988 sea fishers (Table 2). Fishing effort
842 estimates were derived from the national surveys in England, Wales, and Scotland (Radford &
843 Riddington, 2009; Armstrong et al., 2013; Monkman et al., 2015) and angling effort in Northern

844 Ireland was calculated from the numbers of anglers (McMinn, 2013) multiplied by the average effort
845 per angler for England. This gave a total MRF effort of 7.1 million days (Table 2). Finally,
846 expenditure was summed from the estimates for the individual countries (Radford & Riddington,
847 2009; Armstrong et al., 2013; McMinn, 2013; Monkman et al., 2015) and the average expenditure
848 per fisher calculated before conversion to euro using an exchange rate of 1.25 euro to 1 GBP (Table
849 2). These figures were assumed to be representative of the UK and represent only negligible biased
850 estimates (Table S1).

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1195

1 **Table S1: Semi-quantitative assessment of bias associated with the assessment. A scoring system of + and - was used to represent over- and under-**
2 **estimates, respectively, and the number of each sign represents the magnitude of the bias (--- = high underestimate, -- = moderate underestimate, - =**
3 **small underestimate, +/- negligible bias, + small overestimate, ++ = moderate overestimate, +++ = high overestimate). Where extrapolation is used the**
4 **magnitude of the bias is assumed to be the same as in the donor country (indicated in brackets).**

Country	Recreational Sea Fishing Information		
	Number of fishers	Total effort (days)	Expenditure (€)
Albania	--- (Greece)	-- (Italy)	-- (Italy)
Belgium	---	---	-
Bulgaria	--- (Greece)	-- (Italy)	-- (Italy)
Croatia	--- (Greece)	-- (Italy)	-- (Italy)
Cyprus	--- (Greece)	-- (Italy)	-- (Italy)
Denmark	+/-	+/-	+
Estonia	-	+++ (Latvia)	+
Finland	+/-	+/-	-- (Sweden)
France	+/-	+/-	+/- (Germany)
Germany	+/-	+/-	+/-
Greece	---	+/- (France)	-- (Italy)
Iceland	+/-	- (Norway)	+ (Denmark)
Ireland	+/-	+/-	+/-
Italy	--	--	--
Latvia	---	+++	+ (Estonia)
Lithuania	--- (Latvia)	+++ (Latvia)	+ (Estonia)
Malta	--- (Greece)	-- (Italy)	-- (Italy)
Montenegro	--- (Greece)	-- (Italy)	-- (Italy)
Netherlands	+/-	+/-	--
Norway	--	-	+ (Denmark)
Poland	+/- (Germany)	--	+ (Estonia)
Portugal	-	+	-
Romania	--- (Greece)	-- (Italy)	-- (Italy)
Slovenia	-- (Italy)	-- (Italy)	-- (Italy)
Spain (AT)	-	-	-
Spain (MED)	--	--	- (Spain (AT))
Sweden	--	--	--
UK	+/-	+/-	+/-

5