Artificial upward trends in Greek marine landings: a case of presentist bias in European fisheries

Athanassios C. Tsikliras, Donna Dimarchopoulou, Androniki Pardalou

Laboratory of Ichthyology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki,
Greece

Corresponding author:

Athanassios C. Tsikliras

Laboratory of Ichthyology, School of Biology, University Campus, Aristotle University of
Thessaloniki, 541 24, Thessaloniki, Greece

Email: atsik@bio.auth.gr

24 **Abstract**

25 According to the official landings as reported by the international databases for Greece, the
 26 declining trend of the Greek marine fisheries landings that had been continuous since the mid
 27 1990s has been reversed during the last two years, with the total marine fisheries landings
 28 showing elevated catches after 2016. We claim that this upward trend is an artifact that is
 29 attributed to the combined reporting of the landings of additional fleets since 2016 that had
 30 been separately reported before and resulted in 20-30% inflation of the landings. In 2016, the
 31 Greek statistical authorities included the landings of 10 000 small-scale coastal vessels with
 32 engine horsepower lower than 20 HP together with the remaining coastal vessels, purse-
 33 seiners and trawlers whose landings formed the official reported Greek marine fisheries
 34 landings from 1970 to 2015. We acknowledge that this act of partial catch reconstruction
 35 improved the resolution of the landings and the officially reported values are now more
 36 realistic. However, the artificial, albeit inadvertent, inflation of the official Greek marine
 37 fisheries landings as they appear in international databases is a clear case of ‘presentist bias’
 38 and may distort stock assessments and ecosystem modeling. As the currently misleading data
 39 stand, they are cause for substantial misinterpretation and analytical errors that can influence
 40 fisheries policy and have serious implications for fisheries management. We suggest that
 41 researchers should refrain from using the combined time-series and that a correction should
 42 be applied to the original time series (1970-2015) to account for the entire small-scale coastal
 43 fleet.

44

45 **Keywords:** combined fleets, fisheries management, catch, catch-reconstruction,
 46 Mediterranean fisheries

47

48 1. Introduction

49 The recent reconstruction of global catches revealed that a large proportion of the total official
50 catch statistics still remains unreported and that unreported catch mainly refers to small-scale
51 artisanal and recreational fisheries, which are incompletely recorded or even omitted from
52 official catch statistics on a global scale [1]. The underreporting or misreporting of marine
53 catches and fishing effort may bias stock assessments and hamper fisheries management
54 because a large proportion of the total biomass removed by fishing is not accounted for [1, 2].
55 This, in turn, may influence national policies on fisheries [3].

56 In Greek waters, a fisheries data-poor area [4], the initial [5] and recent catch
57 reconstructions [6] revealed several discrepancies, inconsistencies and dataset discontinuities
58 prior to 1982 and an unreported catch that may exceed 30% of the officially reported landings.
59 However, despite those inconsistencies and biases that are confined to the earlier years of the
60 dataset (1970-1981) and several aggregations to higher taxonomic groups [7], the *modus*
61 *operandi* of the Greek statistical authorities remained the same between 1982 and 2015 [8, 9].
62 From 2016 onwards, the Greek statistical authorities reformed their reporting by changing the
63 number of species that are being recorded and by including the landings derived from small
64 scale coastal vessels with engine lower than 20 HP (around 10 000 vessels) to the landings of
65 the remaining coastal vessels, purse-seiners and trawlers whose landings had formed the
66 official reported Greek marine fisheries statistics from 1970 to 2015 [10] to the General
67 Fisheries Commission for the Mediterranean (GFCM) and Food and Agricultural Organization
68 (FAO) databases. This change that improved the reliability of reporting, is clearly stated in the
69 2016 Annual Bulletin [11], which is available online: “Until the reference year 2015, the survey
70 covered the professional motor-propelled fishing vessels of 20 HP and over. From the reference
71 year 2016 onwards, the survey covers all motor-propelled professional fishing vessels
72 irrespective of their horsepower”. This statement, however, does not appear in international

73 databases of GFCM and FAO and constitutes a clear case of ‘presentist bias’, a term that has
74 been recently proposed in fisheries science to describe the overestimation of the present
75 against the past [12]. It refers to an improvement in an official catch reporting system (such as
76 an inclusion of a previously unmonitored activity related to fleet, gear or region) that leads to
77 an increase in recent reported catches without the corresponding past (unmonitored) catches
78 being corrected for retroactively [3]. ‘Presentist bias’ is an inadvertent consequence of the
79 effort most countries make to improve their national data collection and reporting systems [3].

80 The objective of the present work was to point out the first case of ‘presentist bias’ in
81 European fisheries that emerged from including the landings of additional fleets to the official
82 fisheries statistics without accounting for the associated fishing effort increase, or without
83 correcting these data backwards (hindcasting) to generate a full historical time series. Such
84 incomplete time series have serious implications for future stock assessments and policy
85 development because they result in misinterpretation of fisheries trends, as well as on
86 ecosystem modeling and studies of climate impact on marine populations.

87

88 **2. Materials and methods**

89 The annual catches of the Greek marine fishing fleet, expressed as live weight equivalent of
90 landings, had been recorded for 66 species or groups of species (henceforth called taxa) since
91 1982 by the Greek statistical authorities (the current official name of the service is Hellenic
92 Statistical Authority, HELSTAT) and published in annual bulletins (www.statistics.gr/en/). The
93 HELSTAT dataset originally referred to the legal and reported offshore (trawlers and purse-
94 seiners) and coastal fisheries (netters, boat seiners and longliners with engine horsepower
95 greater than 20 HP) landings, excluding discarded, illegal and unreported catches, recreational
96 and sport fishing as well as the catch of small scale coastal vessels with engine horsepower
97 lower than 20 HP [5]. Although the latter was partly recorded by another national statistical

198 authority and was available only in Greek, it was not a part of the official Greek marine
199 fisheries landings up to 2015.

200 Up to 2015 the landings of four fleets (trawlers, purse seiners, boat seiners, small-scale
201 coastal vessels with engine horsepower > 20 HP) are reported annually and their landings were
202 acquired from the official HELLSTAT annual bulletins since 1982. From 2016, onwards the
203 landings of a fifth fleet (small-scale coastal vessels with engine horsepower < 20 HP) were
204 added in the official Greek marine landings dataset and these data were also acquired from
205 the official HELLSTAT annual bulletins. In this work, the years 2016 and 2017 were split into
206 landings of four and five fleets for presentation purposes.

207 GFCM records the annual landings of the Mediterranean and Black Sea fisheries stocks
208 since 1970 on a country, species and subdivision basis whereas the FAO dataset begins in 1950
209 and differs from that of GFCM in terms of spatial division and species aggregation. Both FAO
210 and GFCM catch statistics are available online and can be downloaded using the FishStat J
211 software [13]. The equivalent to the HELLSTAT dataset landings for Greece were downloaded
212 from both FAO and GFCM databases for the same period of time. It should be noted here that
213 the GFCM/FAO only include the landings of the HELLSTAT, without any information on fleets
214 and effort data [13].

215 The inclusion of all fleets in official Greek marine fisheries landings statistics is
216 essential and a main target of catch reconstructions [1, 3]. For this reason, a correction of
217 including the landings of a fifth fleet (small-scale coastal vessels with engine horsepower < 20
218 HP) was applied to the entire dataset (1982-2017) here, following the catch reconstruction
219 methodology [5, 6]. Finally, the catch per unit of effort (CPUE) was estimated as landings (in
220 metric tons) per vessel for the four and the five fleets aiming to reveal the impact of adding
221 the landings of an extra fleet of 10 000 small-scale coastal fishing vessels to the official marine
222 fisheries landings time series.

123 3. Results

124 The official Greek marine fisheries landings derived from the four fleets (trawlers, purse-
125 seiners, boat-seiners and small-scale coastal vessels with engine horsepower >20HP), as they
126 are reported by HELSTAT and adopted by GFCM and FAO datasets have been increasing up to
127 the mid 1990s and declining from their historical maximum in 1994 (165 000 t) to 2012 when
128 they stabilized around 60 000 t (blue line in Figure 1). The landings of the four fleets continue
129 to fluctuate around 60 000 t in 2016 and 2017 (dotted blue line in Figure 1).

130
131 **Figure 1.** The official Greek marine fisheries landings without (blue line, four fleets) and with
132 (black line, five fleets) the small-scale coastal vessels with engine horsepower <20 HP for 2016
133 and 2017 (red line) and hindcasted for 1982-2015 based on the recent catch reconstruction of
134 Greek marine fisheries landings [5, 6]. The bars indicate the annual number of vessels from
135 which the landings are derived.

136 The inclusion of the landings of the around 10 000 vessels forming a fifth fleet (small-
137 scale coastal vessels with engine horsepower <20HP) in 2016, inflated the official Greek
138 marine fisheries landings in 2016 and 2017 by 28 and 23%, respectively (red line in Figure 1).
139 The hindcast of the five fleets follows the same fluctuation with that of the four fleets but the
140 magnitude is higher (black line in Figure 1). The landings in the FAO and GFCM datasets are
141 slightly different in the earlier years and identical in the latest years compared to the HELLSTAT
142 dataset but showing the exact same trend up to 2015 and follow the five fleet dataset from
143 2016 onwards.

144 The artificial inflation of including an extra fleet in the dataset also caused the abrupt
145 dropping of the overall CPUE to half of its previous values, from 10.5 t/vessel to around 5
146 t/vessel and resulted in a steeper decline of the CPUE of the Greek marine fisheries across the
147 study period (Figure 2).

148
149 **Figure 2.** The CPUE (tons of landings per vessel) based on the official Greek marine fisheries
150 landings. The blue trend line refers to the mixed dataset (four fleets for 1982-2015, five fleets

151 for 2016-2017) whereas the red dotted line refers to the corrected dataset (five fleets across
152 the study period, reconstructed landings for 1982-2015, original landings for 2016-2017).

153

154 **4. Discussion**

155 The official Greek marine fisheries landings have been extensively used to assess the status of
156 many stocks in the eastern Mediterranean Sea using catch-based methods [8, 10] and surplus
157 production models [14], in several ecosystem models in the area [15], in examining the effect
158 of sea warming [16] and climate variability [17] on marine populations and the effect of
159 fisheries on marine ecosystems [10].

160 The partial reconstruction by the inclusion of the landings of 10 000 small-scale coastal
161 vessels is certainly an improvement of the monitoring system and bridges the gap between
162 official statistics and the actual biomass of marine organisms removed by fishing. Therefore, it
163 is acknowledged as a very positive step but it is also the first documented case of presentist
164 bias in European fisheries. The transition from a recording system of four fleets to a recording
165 system of five fleets results in an artificial inflation of reported landings, which will certainly
166 affect the scientific output of various disciplines and distort fisheries management [3]. Firstly, a
167 real 20-30% increase in landings would suggest that the fisheries regulations and the general
168 management scheme in the Greek seas had been successful. However, all recent publications
169 and assessments [10, 14, 18, 19] highlight the bad status of the Greek stocks and the need for
170 less fishing, a condition that holds for most Mediterranean fisheries [10, 14]. This clearly
171 opposes the increased fishing pressure applied to pelagic and demersal stocks as a result of
172 “fishing in international waters” of the Greek fleet that practically allows them to operate all
173 year round [20]. It has been recently reported that all species targeted by the fishing fleets are
174 being overexploited in the Mediterranean Sea [21], with none of the Mediterranean stocks
175 being sustainably exploited [22], including 98% of unassessed demersal stocks [23]. Secondly,

176 the official landings are being used in stock assessments and are particularly important in
 177 catch-based method for estimating stock status [24] and surplus production models for
 178 estimating fisheries reference points [25]. An artificial change of the catch in the last 2-3 years
 179 of the time-series will affect the reference points and the output of the stock status [26] and
 180 will influence national policy discussions on fisheries and fisheries management decisions [3].
 181 Thirdly, the inclusion of the landings of a coastal fishing fleet disproportionately affects the
 182 landings composition in favour of species caught by netters and long-liners. This in turn
 183 distorts the input to ecosystem models and to methods that rely on landings and are used to
 184 determine the effect of fishing (such as mean weighted trophic level of the catch: [27]) and
 185 climate (such as the mean temperature of the catch: [28]) on marine populations and
 186 ecosystems. The total Greek marine fisheries landings can be rather easily updated to include
 187 the landings of the fifth fleet back to 1982 (black line in Figure 1) because the data are
 188 available in the recent catch reconstruction [5, 6]. However, the landings of individual taxa,
 189 which are used in stock assessments and ecosystem models, are harder to obtain. In any case,
 190 reforming of a landings time-series by including an additional fleet of 10 000 coastal vessels
 191 requires that all users, especially international ones that use the GFCM/FAO datasets, should
 192 be clearly informed and given the opportunity to convert the two time series so they have the
 193 same fleets throughout the dataset. We by no means imply that HELLSTAT and GFCM/FAO
 194 should be blamed for doing something wrong or are deliberately misreporting catch statistics
 195 but this artificial inflation is an issue they, especially GFCM/FAO, should address.

196 In conclusion, we acknowledge that this act of partial reconstruction improved the
 197 resolution of the landings and is more realistic and close to the actual biomass removed from
 198 the sea, but the inflation of landings in international datasets has serious implications for stock
 199 assessments, ecosystem models and climate impact studies. We propose correction of the
 200 original time series (from at least 1982 to 2015) to account for the entire small-scale coastal

201 fleet based on the recent reconstruction of marine fisheries landings of Greece [5, 6], which
 202 already exists. GFCM/FAO should be urgently informed to correct the international records.
 203 Finally, we suggest users to refrain from mixing the two datasets because they will get
 204 unrealistic, even erroneous, results.

205

206 **5. References**

- 207 [1] Pauly D, Zeller D (2016) Catch reconstructions reveal that global marine fisheries catches
 208 are higher than reported and declining. *Nat. Comm.* 7: 10244
- 209 [2] Keramidas I, Dimarchopoulou D, Pardalou A, Tsikliras AC (2018) Estimating recreational
 210 fishing fleet using satellite data in the Aegean and Ionian Seas (Mediterranean Sea). *Fish*
 211 *Res* 208: 1-6
- 212 [3] Zeller D, Pauly D (2018) The 'presentist bias' in time-series data: implications for fisheries
 213 science and policy. *Mar Pol* 90: 14-19
- 214 [4] Dimarchopoulou D, Stergiou KI, Tsikliras AC (2017) Gap analysis on the biology of
 215 Mediterranean marine fishes. *PLoS ONE* 12: e0175949.
- 216 [5] Tsikliras AC, Moutopoulos DK, Stergiou KI (2007) Reconstruction of Greek marine fisheries
 217 landings: national versus FAO statistics. *Fisher Centre Res Rep* 15 (2): 121-137
- 218 [6] Moutopoulos DK, Tsikliras AC, Stergiou KI (2016) Greece (excluding Crete), in: Pauly, D.,
 219 Zeller, D. (Eds), *Global Atlas of Marine Fisheries: a critical appraisal of catches and*
 220 *ecosystem impacts*. Island University Press, Washington DC, p. 278
- 221 [7] Moutopoulos DK, Koutsikopoulos C (2014) Fishing strange data in national fisheries
 222 statistics of Greece. *Mar Pol* 48: 114-122
- 223 [8] Tsikliras AC, Tsiros V-Z, Stergiou KI (2013a) Assessing the state of Greek marine fisheries
 224 resources. *Fisher Manag Ecol* 20: 34-41.
- 225 [9] Stergiou KI, Somarakis S, Triantafyllou G, Tsiaras KP, Giannoulaki M, Petihakis G, Machias A,

226 Tsikliras AC (2016) Trends in productivity and biomass yields in the Mediterranean Sea
227 large marine ecosystem during climate change. *Env. Dev.* 17 (Suppl. 1): 57-74

228 [10] Tsikliras AC, Dinouli A, Tsiros V-Z, Tsalkou E (2015) The Mediterranean and Black Sea
229 fisheries at risk from overexploitation. *PLoS ONE* 10: e0121188.

230 [11] HellStat (2017) Sea Fishery Survey 2016. Hellenic Statistical Authority, Greece.

231 [12] Pauly D, Zeller D (2017) The best catch data that can possibly be? Rejoinder to Ye et al.
232 “FAO's statistic data and sustainability of fisheries and aquaculture”. *Mar Pol* 81: 406-410

233 [13] FAO (2018) Fishery Information, Data and Statistics Unit GFCM capture production 1970–
234 2016. FISHSTAT J-Universal software for fishery statistical time series.

235 [14] Froese R, Winker H, Coro G, Demirel N, Tsikliras AC, Dimarchopoulou D, Scarcella G, Quaas
236 M, Matz-Lück N (2018) Status and rebuilding of European fisheries. *Mar Pol* 93: 159-170

237 [15] Dimarchopoulou D, Tsagarakis K, Keramidas I, Tsikliras AC (2019) Fishing effort reductions
238 benefit marine ecosystems in a semi-protected area (Pagasitikos Gulf, Greece). *Front Mar*
239 *Sci*, submitted

240 [16] Tsikliras AC, Stergiou KI (2014) Mean temperature of the catch increases quickly in the
241 Mediterranean Sea. *Mar Ecol Progr Ser* 515: 281-284

242 [17] Tsikliras AC, Licandro P, Pardalou A, McQuinn IH, Gröger JP, Alheit J (2019) Synchronization
243 of Mediterranean pelagic fish populations with the North Atlantic climate variability.
244 *Deep-Sea Res II* 159: 143-151

245 [18] Colloca F, Cardinale M, Maynou F, Giannoulaki M, Scarcella G, Jenko K, Bellido JM,
246 Fiorentino F (2013) Rebuilding Mediterranean fisheries: a new paradigm for ecological
247 sustainability. *Fish Fish* 14:89–109

248 [19] Vasilakopoulos P, Maravelias CD, Tserpes G (2014) The alarming decline of mediterranean
249 fish stocks. *Curr Biol* 24: 1643–1648.

250 [20] Tsikliras AC (2014) Fisheries mismanagement in the Mediterranean: a Greek tragedy. *Fish*

251 Aquac J 5: 1000e113

252 [21] Cardinale M, Osio GC, Scarcella G (2017) Mediterranean Sea: A Failure of the European

253 Fisheries Management System. *Front Mar Sci* 4: 72.

254 [22] Fernandes PG, Ralph GM, Nieto A, García Criado M, Vasilakopoulos P, Maravelias CD, Cook

255 RM, Pollom RA, Kovačić M, Pollard D, Farrell ED, Florin A-B, Polidoro BA, Lawson JM,

256 Lorange P, Uiblein F, Craig M, Allen DJ, Fowler SL, Walls RHL, Comeros-Raynal MT, Harvey

257 MS, Dureuil M, Biscoito M, Pollock C, McCully Phillips SR, Ellis JR, Papaconstantinou C,

258 Soldo A, Keskin Ç, Knudsen SW, Gil de Sola L, Serena F, Collette BB, Nedreaas K, Stump E,

259 Russell BC, Garcia S, Afonso P, Jung ABJ, Alvarez H, Delgado J, Dulvy NK, Carpenter KE

260 (2017) Coherent assessments of Europe's marine fishes show regional divergence and

261 megafauna loss. *Nat Ecol Evol* 1:0170.

262 [23] Osio GC, Orio A, Millar CP (2015) Assessing the vulnerability of Mediterranean demersal

263 stocks and predicting exploitation status of un-assessed stocks. *Fish Res* 171:110–121

264 [24] Froese R, Kesner-Reyes K (2002) Impact of Fishing on the Abundance of Marine Species.

265 *ICES CM* 12/L: 1-15.

266 [25] Tsikliras AC, Froese R (2019) Maximum Sustainable Yield, p. 108-115. In: Fath B (Ed)

267 *Encyclopedia of Ecology, Second Edition, Volume 1*. Elsevier, Oxford

268 [26] Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2017) Estimating fisheries reference

269 points from catch and resilience. *Fish Fish* 18: 506-526

270 [27] Pauly D, Christensen V, Dalsgaard J, Froese R, Torres F Jr (1998) Fishing down marine food

271 webs. *Science* 279: 860–863

272 [28] Cheung WWL, Watson R, Pauly D (2013) Signature of ocean warming in global fisheries

273 catch. *Nature* 497:365–368