

2014

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Molfese, C., Beare, D., and Hall-Spencer, J. (2014) 'OPINION: Overfishing and the replacement of demersal finfish by shellfish: an example from the English Channel', *The Plymouth Student Scientist*, 7(2), p. 212-216.

<http://hdl.handle.net/10026.1/14077>

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The Plymouth Student Scientist  
University of Plymouth

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# **Overfishing and the replacement of demersal finfish by shellfish: an example from the English Channel**

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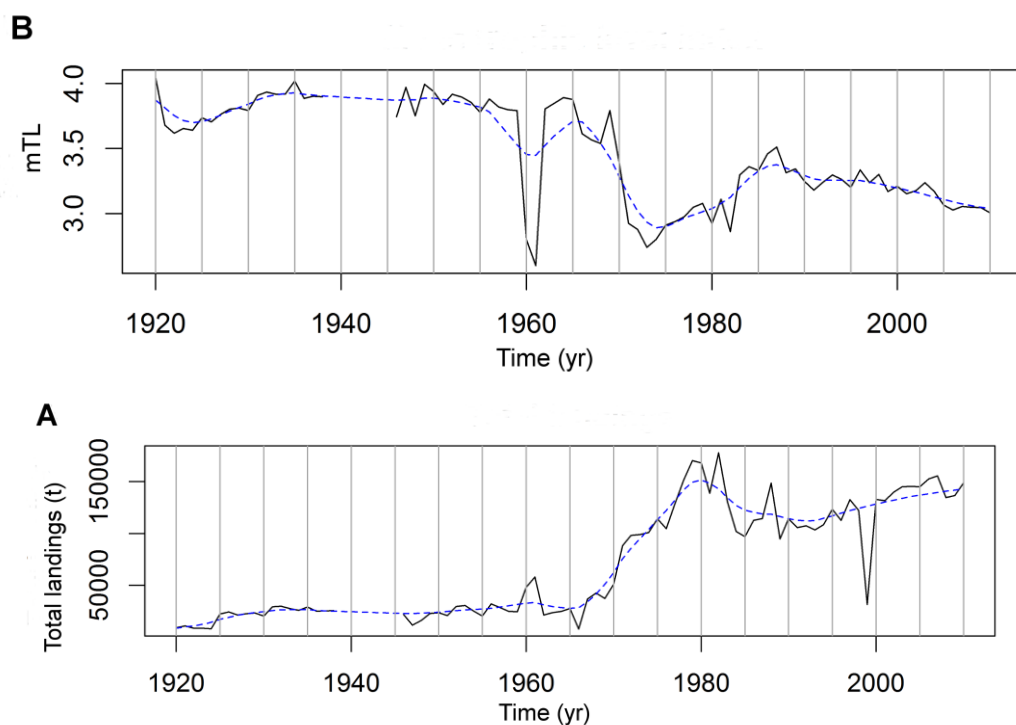
<sup>2</sup>*Worldfish, Batu Maung, Penang, Malaysia.*

The worldwide depletion and collapse of major fish stocks through intensive industrial fishing has raised many concerns about the sustainability of current fishing practices and the effectiveness of existing management measures (Christensen et al., 2003; Baum and Worm, 2009; O’Leary et al., 2011). Long-term data series such as fishery statistics have been analysed extensively in recent decades to assess changes in fish populations and ecological communities (Pauly et al., 2001; Pinnegar et al. 2002; Pauly and Chuenpagdee, 2003). Since Pauly et al.’s (1998) pioneering work, the phenomenon of “Fishing Down Marine Food Webs” has been investigated worldwide. The trend for fisheries shifting towards much smaller species found lower in the food chain as predatory species have been depleted has been demonstrated in many marine regions around the world through declines in the mean Trophic Level (mTL) of fisheries landings (Table 1). A study by the authors focused on the English Channel, a region with a long history of human exploitation where this assessment has never been performed before.

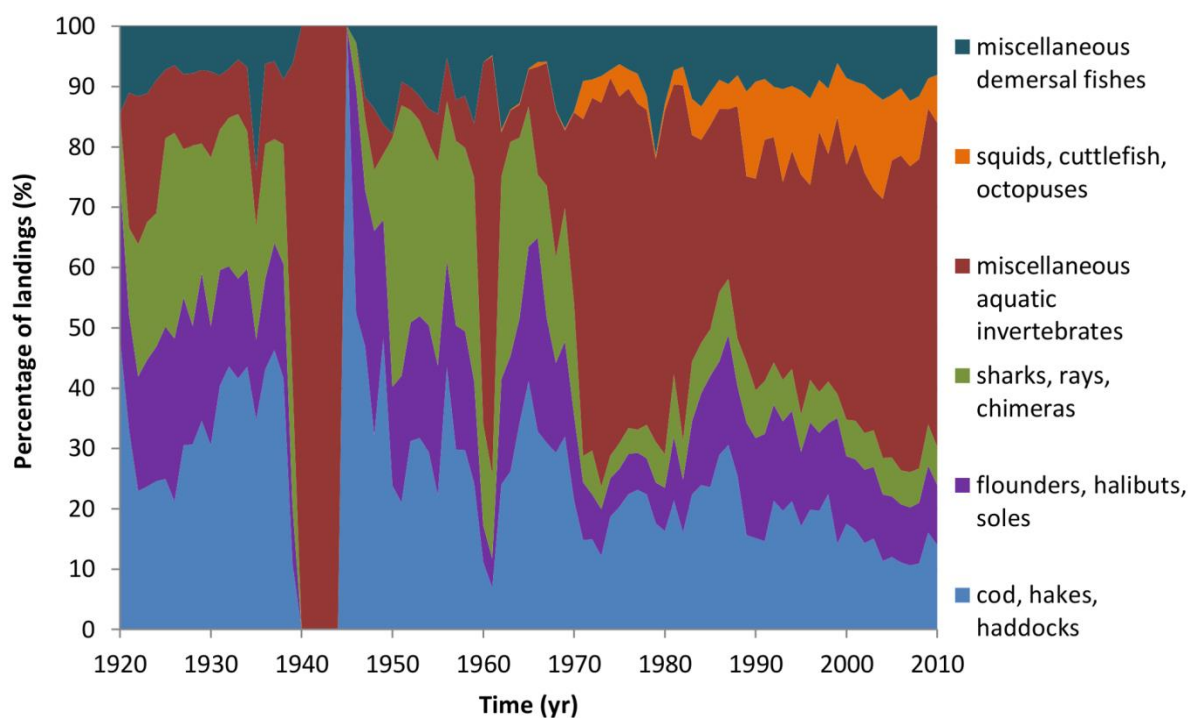
Over the whole time-series of fishery landings which comprises 90 years of data (1920-2010), the mTL has declined significantly from 4.0 units in 1920 to 3.0 in 2010, a 0.1 unit drop per decade, the fastest rate observed so far in Europe (Figure 1A). Meanwhile total landings have increased substantially since the 1920s thanks to an industrialization of fishing that allowed vessels to exploit deeper grounds further away from the coast with greater efficiency (Figure 1B).

**Table 1:** Instances of “Fishing Down Marine Food Web” across the globe, showing rates of decline in mean trophic level (mTL).

Country/Area	Period	mTL decline	Source
Cuba EEZ	1960-1995	0.10 decade <sup>-1</sup>	Baisre (2000)
Canada (West and East coast)	1950-1997 and 1873-1996	0.03-0.1 decade <sup>-1</sup>	Pauly et al. (2001)
Celtic Sea	1982-2000	0.04 year <sup>-1</sup> (ICES catch data) and 0.03 year <sup>-1</sup> (scientific survey)	Pinnegar et al. (2002)
Thailand	1965-1997	0.05-0.09 decade <sup>-1</sup>	Pauly and Chuenpagdee (2003)
Iceland	1918-1999	0.06 decade <sup>-1</sup>	Valtysson and Pauly (2003)
Chile	1979-1999	0.175 decade <sup>-1</sup>	Aranciba and Neira (2005)
Greece	1950-2001	0.02 decade <sup>-1</sup>	Stergiou (2005)
Indian States and Union Territories	1950-2000	0.058 decade <sup>-1</sup>	Bathal and Pauly (2008)
Argentinean-Uruguayan Common Fishing Zone (AUCFZ)	1989-2003	0.03 year <sup>-1</sup>	Jaureguizar and Milesi (2008)
Portugal	1970-2006	0.005 year <sup>-1</sup>	Baeta et al. (2009)
Brazil	1978-2000	0.16 decade <sup>-1</sup>	Freire and Pauly (2010)



**Figure 1:** ICES data for the English Channel for the period 1920-2010. Analysis excludes pelagic species. (A) Changes in the mTL over time, (B) Annual landings from the English Channel. The blue dashed line is a smoothing function, "supsmu" (Friedman, 1984) available as standard with the R software package (R Core Team, 2013).



**Figure 2: ICES data on changes in catch composition for the English Channel 1920-2010. Species grouped into ISSCAAP categories.**

These figures aren't all about what's in the sea. Market mechanisms create 'perverse incentives' which reinforce the shift to reduced biodiversity. By raising the value of species like scallops or crab it becomes profitable to keep degraded marine habitats as they are. Indeed, if we consider the footprint of beam trawlers and scallop dredges produced by Campbell et al. (2014), it seems obvious that it is only scavengers and tiddlers that survive the tremendous pressure exerted by heavy fishing gear on Britain's seabed. Besides, the UK is a net importer of fish: in 2010 most of the cod and haddock supply was freighted in from Iceland and Norway where fishing with trawls and dredges is banned in coastal waters due to the damage it does to fish spawning areas. We simply cannot catch enough of those species in UK waters to meet consumer demand.

Centuries of intensive fishing have upset the ecological balance of the seas around us by removing important components of the food web and by damaging marine habitats essential for the survival of certain species (Thurstan and Roberts, 2010; Thurstan et al., 2010). Our study documented a shift in the landings from the English Channel towards the cockroaches, rats and mice of the sea to the demise of signature species of the 20<sup>th</sup> century. As with monocultures on land, invertebrate fisheries are easy to manage and initially there's a good return, but the habitat becomes less stable too, more vulnerable to disease, parasites and climate change (Anderson et al., 2011; Howarth et al., 2013). That is why we recommend a network of recovery areas closed to fishing to allow the regeneration of marine life and increase the resilience of this highly impacted marine ecosystem.

Full details of the author's research project can be accessed at

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0101506>

## References

- Anderson SC, Flemming JM, Watson R, Lotze HK. (2011) Rapid Global Expansion of Invertebrate Fisheries: Trends, Drivers, and Ecosystem Effects. *PLoS ONE* 6(3): e14735.
- Baeta F, Costa MJ, Cabral H (2009) Changes in the trophic level of Portuguese landings and fish market price variation in the last decades. *Fisheries Research* 97: 216–222.
- Baisre JA (2000) Chronicles of Cuban marine fisheries (1935-1995). Trend analysis and fisheries potential. *FAO Fisheries Technical Paper*. 394, p26.
- Baum JK, Worm B (2009) Cascading top-down effects of changing oceanic predators abundances. *Journal of Animal Ecology*, 78: 699-714.
- Bhathal B, Pauly D (2008) 'Fishing down marine food webs' and spatial expansion of coastal fisheries in India, 1950–2000. *Fisheries Research* 91: 26–
- Campbell MS, Stehfest KM, Votier SC, Hall-Spencer JM (2014) Mapping fisheries for marine spatial planning: Gear-specific vessel monitoring system (VMS), marine conservation and offshore renewable energy. *Marine Policy* 45: 293-300.
- Christensen V, Guénette S, Heymans JJ, Walters CJ, Watson R et al. (2003) Hundred-year decline of North Atlantic predatory fishes. *Fish and Fisheries* 4:1–24.
- Freire KMF, Pauly D (2010) Fishing down Brazilian marine food webs, with emphasis on the east Brazil large marine ecosystem. *Fisheries Research* 105: 57–62.
- Friedman, J. H. (1984) A variable span scatterplot smoother. *Laboratory for Computational Statistics, Stanford University Technical Report No. 5*.
- Howarth LM, Roberts CM, Thurstan RH, Stewart BD (2013). The unintended consequences of simplifying the sea: making the case for complexity. *Fish and Fisheries* doi: 10.1111/faf.12041
- Jaureguizar AJ, Milessi AC (2008) Assessing the sources of the fishing down marine food web process in the Argentinean-Uruguayan Common Fishing Zone. *Scientia Marina* 72 (1): 25-36.
- O'Leary BC, Smart JCR, Neale FC, Hawkins JP, Newman S et al. (2011) Fisheries mismanagement. *Marine Pollution Bulletin* 62(12): 2642–2648.
- Pauly D, Christensen V, Dalsgaard J, Froese R, Torres F (1998) Fishing Down Marine Food Webs. *Science* 279: 860-86.
- Pauly D, Palomares ML, Froese R, Sa-a P, Vakily M et al. (2001) Fishing down Canadian aquatic food webs. *Can. J. Fish. Aquat. Sci.* 58: 51–62.
- Pauly D, Chuenpagdee R (2003) Development of fisheries in the Gulf of Thailand Large Marine Ecosystem: analysis of the unplanned experiment. In Hempel G, Sherman K, eds. *Large Marine Ecosystems of the World 12: Change and Sustainability*. 337 - 354.
- Pinnegar JK, Jennings S, O'brien CM, Polunin NVC (2002) Long-term changes in the trophic level of the Celtic Sea fish community and fish market price distribution. *Journal of Applied Ecology* 39: 377–390.
- R Core Team (2013). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>
- Stergiou KI (2005). Fisheries impact on trophic levels: long-term trends in Hellenic waters. pp. 326-329 in: Papathanassiou E. and Zanetos A. (eds.) *State of the Hellenic Marine Environment*, Hellenic Centre for Marine Research, Athens, Greece.
- Thurstan RH, Roberts CM (2010) Ecological Meltdown in the Firth of Clyde, Scotland: Two Centuries of Change in a Coastal Marine Ecosystem. *PLoS ONE* 5(7): e11767.
- Thurstan RH, Brockington S, Roberts CM (2010) The effects of 118 years of industrial fishing on UK bottom trawl fisheries. *Nature Communications* 1 doi: 10.1038/ncomms1013.

Valtýsson HP, Pauly D (2003) Fishing down the food web: an Icelandic case study. In: Competitiveness within the Global Fisheries, 13-24. Arancibia H, Neira S (2005) Long-term changes in the mean trophic level of Central Chile fishery landings. *Scientia Marina* 69 (2): 295-300.