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Letter to the Editor

Size still matters. A response to Svedäng (2013): *Size matters: Ne quid nimis*

In 2008 we published the paper "Size matters: how single species management can contribute to ecosystem-based fisheries management" (Froese et al., 2008). We showed that the impact of fishing on cohort biomass and age/size structure of a stock can be strongly reduced if an allowed catch is taken after the fish have reached an optimum length (L_{opt}) where somatic growth rate and cohort biomass are maximum.

As of September 2014, that paper had attracted 39 citations in the Web of Science and 57 citations in Google Scholar. Most of these citations confirm our conclusions, typically after evaluating exploitation scenarios with different lengths at first capture (e.g. Chavez et al., 2013; Brunel and Piet, 2013; Colloca et al., 2013; Vasilakopoulos et al., 2012). Thus, one can say that the conclusions of Froese et al. (2008) have been independently tested and found to be sound. Yet, one author, Svedäng (2013), takes issue with the L_{opt} concept, claiming that it is "aiming for a treasure at the end of the rainbow." More specifically, the author claims that Froese et al. (2008) had aimed to maximize catch per unit effort (CPUE) and in doing so had committed the error of confounding population biomass with biomass available for exploitation. This claim is not true.

Throughout the paper, Froese et al. (2008) clearly refer to the goal of optimizing cohort biomass under different fishing scenarios. They even discuss the difference between exploited and total biomass, stressing that exploited biomass "is proportional to the CPUE but cannot be used to measure the effect of various scenarios of fishing on the stock abundance. For such a purpose, we used a biomass per recruit equation related to the total stock (i.e., the recruited phase) [.]". Froese et al. (2008) did say that under an L_{opt} fishing scenario "[c]ohort and stock biomass is several-fold higher, thus increasing catch per unit effort and reducing cost of fishing." This was in the context of comparing the L_{opt} scenario with actual exploitation patterns, where fishing mortality for e.g. North Sea cod in 2002 stood at $F = 0.93$, i.e., nearly five times the maximum sustainable rate of $F_{msy} = 0.19$ (ICES, 2012). Cod was caught (and discarded) from one year onward (ICES, 2012), with an average length at first capture (L_c) probably below 30 cm compared to $L_{opt} = 86$ cm. Fig. 1 shows the exploitable biomass-per-recruit for such fishing mortality as a function of length at first capture. Even if the legal minimum landing length for North Sea cod $L_l = 35$ cm is taken as length at first capture, exploited biomass and thus CPUE are about two-fold higher when fishing starts at L_{opt}, even though the peak in exploitable biomass occurs below L_{opt}, at a length of first capture of about 80 cm. For comparison, Fig. 1 shows exploitable biomass for recent (2013) fishing of cod at $F = 0.40$, where exploitable biomass at L_{opt} is about 50% higher than if $L_c = L_l$. For a yet-to-be-achieved cod fishing scenario where $F = F_{msy} = 0.19$, exploitable biomass would be about the same with fishing starting at L_l or L_{opt}, with an intermediate peak that is only 19% higher, i.e., differences in CPUE as a function of L_c become less as fishing mortality approaches sustainable values. The same is true for yield-per-recruit (Fig. 2), which at $L_c = L_{opt}$ is slightly higher than at L_l and where the intermediate peak is only 14% higher than yield per recruit at L_{opt}. However, applying

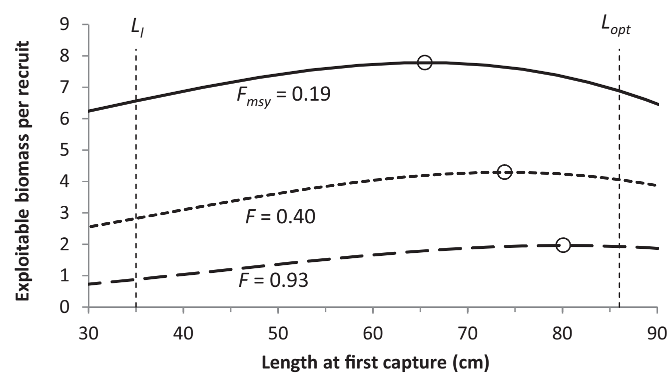

Fig. 1. Relative exploitable biomass per recruit as a function of length at first capture and fishing mortality F, with life history traits for North Sea cod. L_l marks minimum legal landing size, L_{opt} marks the length where cohort biomass is maximum. $F_{msy} = 0.19$ is the fishing mortality resulting in the maximum sustainable yield and $F = 0.40$ and $F = 0.93$ were cod fishing mortalities in 2002 and 2011, respectively (ICES, 2012). The circles indicate the peaks in exploitable biomass, where catch-per-unit-effort would be maximum.

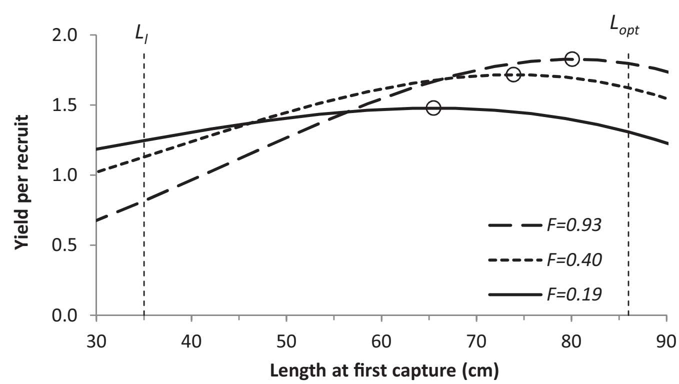

Fig. 2. Relative yield per recruit as a function of length at first capture and fishing mortality F, with life history traits for North Sea cod. L_l marks the minimum legal landing size, L_{opt} marks the length where cohort biomass is maximum. $F_{msy} = 0.19$ is the fishing mortality resulting in the maximum sustainable yield and $F = 0.93$ and $F = 0.40$ were cod fishing mortalities in 2002 and 2011, respectively. The circles indicate the peaks in yield-per-recruit.

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the equations by Froese et al. (2008) shows that in all three scenarios cohort and stock biomass-per-recruit under L_{opt} would be more than twice as large as from fishing starting at L_l.

In summary, we refute the criticism of Svedäng (2013). The explicit goal of Froese et al. (2008) was to demonstrate the importance of size at first capture in optimizing stock biomass and age structure. The respective equations, graphs and conclusions as presented in Froese et al. (2008) are correct. Froese et al. (2008) did not evaluate exploitable biomass or CPUE. Nevertheless, as shown in Fig. 1, their statement that CPUE would be higher under the L_{opt} scenario compared to actual fishing scenarios was correct. We want to use this opportunity to repeat the textbook knowledge (Beverton and Holt, 1957, Walters and Martell, 2004) that fisheries management must address fishing mortality as well as size at first capture in order to achieve profitable fisheries with low impact on the marine environment.

References

Beverton, R.J.H., Holt, S.J., 1957. On the Dynamics of Exploited Fish Populations. Fishery Investigations, Series II, 19. Her Majesty's Stationery Office, London, 533 pp.

Brunel, T., Piet, G.J., 2013. Is age structure a relevant criterion for the health of fish stocks? ICES J. Mar. Sci. 70, 270–283.

Chavez, E.A., Escobar-Toledo, F.D., Ortega-Garcia, S., 2013. Optimum harvesting scenarios for the management of the bigeye tuna *Thunnus obesus* at the Eastern Pacific Ocean. Rev. Biol. Mar. Oceanogr. 48, 235–243.

Colloca, F., Cardinale, M., Maynou, F., et al., 2013. Rebuilding Mediterranean fisheries: a new paradigm for ecological sustainability. Fish Fish. 14, 89–109.

Froese, R., Stern-Pirlot, A., Winker, H., Gascuel, D., 2008. Size matters: how single-species management can contribute to ecosystem-based fisheries management. Fish. Res. 92, 231–241.

ICES, 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–03 May 2012. ICES CM 2012/ACOM: 13.

Svedäng, H., 2013. Comments to Froese et al. (2008): Size matters: Ne quid nimis. Fish. Res., http://dx.doi.org/10.1016/j.fishres.2013.08.010.

Vasilakopoulos, P., O'Neill, F.G., Marshall, C.T., 2012. Differential impacts of exploitation rate and juvenile exploitation on NE Atlantic fish stock dynamics over the past half century. Fish. Res. 134, 21–28.

Walters, C.J., Martell, S.J.D., 2004. Fisheries Ecology and Management. Princeton University Press, Princeton.

Rainer Froese [a,*]
Henning Winker [b]
Didier Gascuel [c]

[a] *GEOMAR, Düsternbrooker Weg 20, 24105 Kiel, Germany*

[b] *South African National Biodiversity Institute, Kirstenbosch Research Centre, Claremont 773, South Africa*

[c] *Agrocampus Ouest, UMR985 Ecologie et Santé des Ecosystèmes, 65 rue de Saint Brieuc, CS 84215, 35042 Rennes Cedex, France*

* Corresponding author. Tel.: +49 431 600 4579; fax: +49 341 600 1699.
E-mail address: rfroese@geomar.de (R. Froese)

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