FISH and FISHERIES, 2005, **6**, 156–159

Ghoti

Ghoti papers

Ghoti aims to serve as a forum for stimulating and pertinent ideas. Ghoti publishes succinct commentary and opinion that addresses important areas in fish and fisheries science. Ghoti contributions will be innovative and have a perspective that may lead to fresh and productive insight of concepts, issues and research agendas. All Ghoti contributions will be selected by the editors and peer reviewed.

Etymology of Ghoti

George Bernard Shaw (1856-1950), polymath, playwright, Nobel prize winner, and the most prolific letter writer in history, was an advocate of English spelling reform. He was reportedly fond of pointing out its absurdities by proving that 'fish' could be spelt 'ghoti'. That is: 'gh' as in 'rough', 'o' as in 'women' and 'ti' as in palatial.

Good news, bad news: global fisheries discards are declining, but so are total catches

Dirk Zeller & Daniel Pauly

Fisheries Centre, University of British Columbia, Vancouver, Canada V6T 1Z4

Abstract

During fishing operations, fish are often caught that were not targeted. When the species in question are of low value, or protected, this 'by-catch' is often thrown overboard as 'discards', the retained part of the catch constituting the landings. The amounts of fish discarded are generally highly area- and gear-specific, but can be high; for example, discards in tropical shrimp trawl fisheries may be one order of magnitude higher than the retained catch. The latest analysis undertaken by the Food and Agriculture Organization of the United Nations suggests that global discards have declined in recent years, indicating that wastage is being reduced in global fisheries operations. By all accounts, reducing waste is a good thing, and hence good news. Nevertheless, if one considers this decline in discards in conjunction with the reported decline in global fisheries landings over the last decade, it becomes evident that total global fisheries catches (consisting of landings plus discards) might have declined at a substantially steeper rate than previously thought. This could be bad news, if it is indicative of declining total availability of fish. While acknowledging the high uncertainty in both discard and landings data at the global scale through time, the present observation may serve as an urgent reminder that global fisheries may be in more trouble than we thought previously.

Keywords fisheries catches, fisheries discards, fisheries landings, overfishing

Correspondence:
Dirk Zeller, Fisheries Centre, University of British Columbia, Vancouver, Canada V6T 1Z4
Tel.: 1-604-822-1950
Fax: 1-604-822-8934
E-mail: d.zeller@fisheries.ubc.ca

Received 18 Feb 2005
Accepted 17 Mar 2005

Introduction

The Food and Agriculture Organization of the United Nations (FAO) has recently released a draft report which estimated as 7.3 million tonnes (t) the amount of fish (usually dead or dying) discarded annually by marine fisheries throughout the world (Kelleher 2004; Fig. 1). This estimate is considerably lower than previous estimates of 27 million t (reported range 17.9–39.5 million t), pertaining to the late 1980s/early 1990s (Alverson *et al.* 1994), and subsequently adjusted figures of 20–22 million t presented in the mid-1990s (FAO 1996, 1999) (Reference and direct comparison to some of the earlier, higher estimates were made by the FAO press release titled 'New data show sizeable drop in numbers of wasted fish', dated 14 September 2004, archived at http://www.fao.org/newsroom/en/news/2004/50302/index.html). The trend implied by these numbers over the last 10–15 years is good news: we waste less fish now than we did one or two decades ago. The reduction of discards is attributed to more selective gears and fishing practices (which avoid catching as much by-catch as previously), to the decline of some particularly wasteful fisheries, and especially to higher retention, i.e., fish previously discarded are now retained, for example, as feed for aquaculture in Southeast Asia and Europe.

Here we consider the long-term trends in global fisheries landings and discards, and evaluate an alternative implication of the suggested decline in global discards in light of our understanding of global trends in fisheries landings.

Figure 1 L'Acqua (The Water, 1566) by Giuseppe Arcimboldo (Italy, 1527–1593), oil on wood. Humans have used aquatic resources for centuries, and L'Acqua symbolizes the connection between marine life and our use of these resources. At the same time it illustrates the biodiversity of life in the sea, something potentially at risk from unsustainable fishing practices. Courtesy of the Gemäldegallerie, Kunsthistorisches Museum Vienna, Austria.

Catch = landings + discards

Total catches (i.e., total extractions from the oceans) consist of landings and discards. Interestingly, this is something that seemed to not have been clearly spelled out with regards to the reported reduction of fishery discards. While declining discards are definitely good news with regard to wastage, they may in addition signal or amplify an underlying trend in total global catches. Given that global fishery landings are thought to have declined in the last decade (Watson and Pauly 2001), it seems only appropriate to combine the existing, albeit limited, estimates of patterns of discards with fisheries landings, and consider the implications of their sum.

Here, we used five available estimates of global discards presented over the last two-and-a-half decades as data anchor points in time. For the late 1970s we used the intermediate value (4.0 million t) of the range of 3.0–5.0 million t given by Anonymous (1982), recognizing that this estimate pertained to shrimp fisheries only, and thus represents a minimal, conservative estimate. For the early 1980s, we used Saila's (1983) conservative estimate of discards, approximately 6.72 million t (range: 3.0–11.0 million t being our conservative estimation from source data), based on discards from shrimp and selected non-shrimp fish groups for major countries. For the late 1980s, we relied on Alverson *et al.* (1994), who, based on the 1988–1990 averaged FAO landings, estimated global discards at approximately 27.0 million t (range: 17.9–39.5 million t), or approximately 35% of global landings (Alverson and Hughes 1996). For 1995, we utilized Alverson (2005) of 10.0–20.0 million t (intermediate value: 15.0 million t), who used FAO data from the early 1990s. Finally, for 2000, we used the most recent study by Kelleher

(2004), suggesting global discards of approximately 7.3 million t (range: 6.8–8.0 million t) based on 10-year averages. We consider that at least the first two anchor point estimates used here are likely under-representations, as they often excluded gear types or fishing areas for which little or no hard data existed at the time. However, caution needs to be applied even to the latest estimate (Kelleher 2004), as several major fishing countries (e.g., EU countries, India, New Zealand, Korea, Russian Federation) were under-represented in the discard database (FAO 2004).

Reconstructed estimates of annual global discards for the time periods between these anchor points were obtained by interpolating the ratio of discard anchor points (mean as well as range estimates) to reported landings. Such interpolated reconstruction of times series data with limited and uncertain 'hard' data requires bold assumptions, justified by the incorrect alternative of 'zero' discards, the ultimate default interpretation for 'no data' in global and regional statistics (Pauly 1998).

Findings and conclusions

Combining these reconstructed estimates of discards with the fisheries landings as reported by FAO on behalf of member countries, allows an estimation of total global fisheries catches to be considered. Figure 2 shows global marine fishery landings from 1975 to 2001 corrected for over-reporting by China (Watson and Pauly 2001), with the reconstructed mean, minimum and maximum discard estimates added. Such an explicit consideration of discards suggests that global total fisheries catches may have declined throughout the 1990s by approximately 2.3 million t per year (using the 'mean' discard values in Fig. 2), over six times faster than the decline of 0.39 million t per year estimated earlier for landings alone (Watson and Pauly 2001). Even considering the minimum range estimates in Fig. 2 (lower dotted line) would suggest a decline of approximately 1.6 million t per year, or four times faster than the decline for landings alone. Thus, even utilizing the rather conservative lower range estimate (17.9 million t) of Alverson *et al.* (1994), which is lower than the subsequently adjusted figure of 20–22 million t (FAO 1996, 1999), suggests a stronger decline in total catches than landings alone.

Figure 2 also suggests that increased retention (e.g., for reduction into fishmeal), even if indeed accounting for part or much of the decline in discards, has not halted or reversed the observed decline in landings. Furthermore, the majority of reduction fisheries catches are derived from gears which likely have low, if any, discards. However, the issue of reduced discarding being partially accounted for by increased retention, and the implications of such a trend for target and non-target stocks, the ecosystems, and human health (e.g., Hites *et al.* 2004) have not been assessed, and are beyond the scope of this paper.

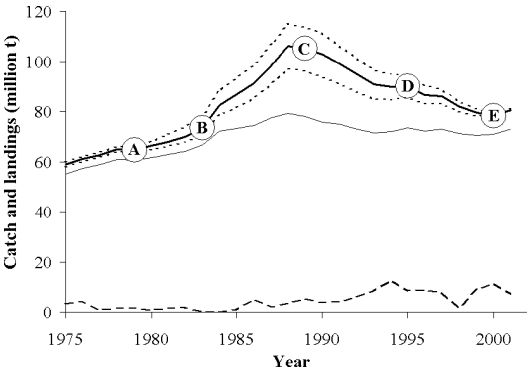

Figure 2 Landing and discarding trends in global marine fisheries. The graph shows fisheries landings for 1975 to 2001 (thin black line), as reported by FAO, but excluding catches over-reported by China (Watson and Pauly 2001), the highly variable Peruvian anchoveta (*Engraulis ringens*, dashed line) and discards. These landings have been declining by about 0.4 million t per year since the late 1980s (Watson and Pauly 2001). Total catches (thick black line), i.e., catches = reported landings + estimated mean discards, suggest a much stronger decline of about 2.3 million t per year. The same summation using minimum and maximum range estimates for discards are also shown (dotted lines). Fisheries discards are interpolated between five point estimates: A 1979 (Anonymous 1982); B 1983 (Saila 1983); C 1989 (Alverson *et al.* 1994); D 1995 (Alverson 2005) and E 2000 (Kelleher 2004).

Two of the central data sources relied upon in this paper, Alverson *et al.* (1994) and Kelleher (2004), use two different approaches to obtain their global estimates. Alverson *et al.* (1994) took a species-based approach, using reported discard ratios by fisheries in conjunction with reported landings by species, thus potentially biasing the differences between different gear types or geographical regions. Kelleher (2004), in contract, used a fisheries-by-fisheries approach, separating fisheries by area, fishing gear and target species. Both approaches clearly had a different emphasis, and are therefore

subject to different biases. However, we disagree with the notion that the resultant global estimates are not broadly comparable (Kelleher 2004). For one, they attempted to estimate the same thing. Thus, both the fisheries/gear-based approach of Kelleher (2004) as well as the taxa based approach of Alverson *et al.* (1994) should, within the limits of the underlying discard data, yield final results that can be broadly compared, as was performed here, and also in FAO (2004). However, an independent, quantitative evaluation of the uncertainties of both approaches and results is needed, yet is beyond the point we like to draw attention to herein. Nevertheless, we hope the present discussion may serve as impetus for such an independent evaluation and rigorous analysis, as well as result in increased emphasis being placed on complete data recording of total catches, not only landings for fisheries. In the same vein, while discarding has received needed attention, the potentially large, maybe even larger (Pauly *et al.* 2002; Clover 2004), share of unaccounted catches, being the Illegal, Unregulated and Unreported (IUU) catches, remains essentially unassessed at a global scale (but see Anonymous 2004).

To conclude, while the reduction of wastage implied by a decline in discards is good news, and to be applauded and encouraged, it appears to imply that, on the global scale, total fisheries catches are declining faster than previously thought. And that is bad news, especially if it is indicative of declining total availability of fish, such as those suggested for the North Atlantic based on biomass estimation (Christensen *et al.* 2003). Furthermore, if a lowering of discards (because of improved fishing practices, reduction of wasteful fisheries, or increased retention) occurred under sustainable global stock conditions and fishing practices, would one not expect stabilization or increases in landings, particularly in light of current excess fishing capacity? However, neither can be observed at present. Thus, the trends in Fig. 2, though they do not yet account for IUU catches, give us increased reasons to be concerned about the future of marine fisheries exemplified in Fig. 1.

Acknowledgments

We thank S. Martell and two anonymous referees for helpful criticism and comments on the manuscript, and acknowledge the Pew Charitable Trusts, Philadelphia for funding the *Sea Around Us* Project.

References

Alverson, D.L. (2005) Session IIA: Managing the catch of non-target species. In: *Improving Fishery Management: Melding Science and Governance. Summary Proceedings from a Symposium held at the University of Washington, November 15–16, 2004* (eds W.S. Wooster and J.M. Quinn). The School of Marine Affairs, University of Washington, Seattle, pp, 13–19.

Alverson, D.L. and Hughes, S.E. (1996) Bycatch: from emotions to effective natural resources management. *Review of Fish Biology and Fisheries* **6**, 443–462.

Alverson, D.L., Freeberg, M.H., Pope, J.G. and Murawski, S.A. (1994) *A Global Assessment of Fisheries By-catch and Discards*. FAO Fisheries Technical Papers T339, Rome, 233 pp.

Anonymous (1982) *Fish By-Catch-Bonus from the Sea*, Report of a technical consultation on shrimp by-catch utilization held in Georgetown, Guyana, 27–30 October 1981. International Development Research Centre and FAO, Ottawa, 163 pp.

Anonymous (2004) *Fish Piracy: Combating Illegal, Unreported and Unregulated Fishing*. Organization for Economic Co-operation and Development (OECD), Paris, 406 pp.

Christensen, V., Guénette, S., Heymans, J.J., Walters, C.J., Watson, R., Zeller, D. and Pauly, D. (2003) Hundred-year decline of North Atlantic predatory fishes. *Fish and Fisheries* **4**, 1–24.

Clover, C. (2004) *The End of the Line: How Overfishing is Changing the World and What We Eat*. Random House, London, 320 pp.

FAO (1996) *Technical consultation on reduction of wastage in fisheries*, Tokyo, 28 October – 1 November 1996. *FAO Fisheries Report* No. 547, Rome, 27 pp.

FAO (1999) *The State of World Fisheries and Aquaculture (SOFIA) 1998*. Food and Agriculture Organization, Rome, Italy.

FAO (2004) *The State of World Fisheries and Aquaculture (SOFIA) 2004*. Food and Agriculture Organization, Rome, Italy.

Hites, R.A., Foran, J.A., Carpenter, D.O., Coreen Hamilton, M., Knuth, B.A. and Schwager, S.J. (2004) Global assessment of organic contaminants in farmed salmon. *Science* **303**, 226–229.

Kelleher, K. (2004) *Discards in the world's marine fisheries. An update*. *FAO Fisheries Technical Paper* No. 470 (draft), Rome, 131 pp.

Pauly, D. (1998) Rationale for reconstructing catch time series. *EC Fisheries Cooperation Bulletin* **11**, 4–10.

Pauly, D., Christensen, V., Guénette, S. et al. (2002) Towards sustainability in world fisheries. *Nature* **418**, 689–695.

Saila, S.B. (1983) *Importance and assessment of discards in commercial fisheries*. FAO-FIRM-C765, *FAO Fisheries Circular*, Rome, 67 pp.

Watson, R. and Pauly, D. (2001) Systematic distortions in world fisheries catch trends. *Nature* **414**, 534–536.