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Response to removing biases in forecasts of fishery status

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Previously in this journal, we demonstrated an empirical relationship between maximum sustainable yield (*MSY*) and historical maximum catch ($C_{\max}$) for fishery stocks off the Northeast U.S.—a relationship we then applied to estimate the potential catch losses from unsustainable fishing worldwide (Srinivasan et al. 2010). Two studies have since found similar relationships between *MSY* and maximum catch using larger regional datasets (Froese et al. 2012; Halpern et al. 2012). In a third paper in this issue of the *Journal of Bioeconomics*, Costello et al. (2013) update the MSY-$C_{\max}$ relationship in two ways. First, they correct for the "retransformation bias" (Duan 1983) omitted in our earlier analysis, and second, they reparametrize the model using data for 109 stocks from the RAM II global database of stock assessments (Ricard et al. 2011). Their updated model is arguably more representative of global fisheries than the one we used (Srinivasan et al. 2010), and when we apply it to re-estimate global

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catch losses to overfishing over 1950–2004, we find that our original conclusions are strengthened.

Using the updated model to recalculate *MSY* from $C_{\max}$ for stocks deemed overfished in our analysis (Srinivasan et al. 2010), we find that estimated global catch losses are significantly greater than the range we originally published. Total global losses over 1950–2004 may be 4.8 and 2.1 times as high as our previous central and upper bound estimates, respectively. For year 2000 alone, global losses are re-estimated at 36 million tonnes (66 % of actual recorded catch for that year), compared to 9.1 million tonnes (17 % of actual catch) in our previous work (50 % prediction interval: 3.6–19 million tonnes, 7–36 % of actual catch). Recalculating catch losses as a percentage of potential total catch for the year 2000, we find that these shares increased for five out of six continental regions and the high seas—from 7 to 41 % for South America, from 19 to 47 % for Europe, from 11 to 45 % for the high seas, from 23 to 42 % for North America, from 19 to 38 % for Africa, and from 14 to 19 % for Asia. For Oceania, the proportion of catch losses decreased slightly from 13 to 11 %.

Costello et al. (2013) note that since their regression and ours cross at an *MSY* of roughly 27,000 tonnes, our regression would have underestimated *MSY* for large fisheries, explaining why overall losses were significantly understated previously. Similarly, they argue that our analysis would have significantly overestimated *MSY* for small and mid-sized fisheries. The effect here was milder than they suggested; re-estimates with the new model show a slight reduction in losses for Oceania, as most of its 29 exclusive economic zones (EEZs) are island nations with relatively small fisheries. Indeed, we took several measures to avoid overestimating the losses, including capping the upper bound *MSY* estimate for a stock by its maximum recorded catch.

The reanalysis reported here does not change the general conclusions of Srinivasan et al. (2010), that overfishing is reducing the capacity of our oceans to produce seafood and threatening the nutrient health of many low-income food deficit nations. Instead it further highlights the seriousness of the problem and underscores the case for timely fishery reform.

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