Reply to Baird et al.: Mangroves and storm protection: Getting the numbers right

Baird et al. (1) appear to accept the principal conclusion of our paper (2), that mangroves reduced the number of deaths from the storm surge of the 1999 super cyclone in Orissa. They are unsure whether we controlled for distance to coast and topography, and they imply that we did not control for proximity to storm path. Table 1 (rows 4 and 5) and Table S8 in ref. 2 show that we controlled for these factors.

Regarding model selection, our stated objective was to test the hypothesis that 1999 mangrove width did not affect the death toll. Under well-known conditions (3)—in particular, absence of omitted variables bias—regressing deaths on 1999 mangrove width and village population (to control for lives at risk) provides a valid test of this hypothesis. Row 1 of Table 1 in ref. 2 shows results for this simple model. Omitted variables bias is a serious concern, however, and to reduce it we progressively added groups of related variables, including one for villages in former mangrove areas. The regression parameter on 1999 mangrove width remained highly significant and changed little as we added these controls (Table 1, rows 2–7 in ref. 2). Contrary to Baird et al.’s conclusion, mangroves thus reduced deaths not merely by “preventing occupation of the most dangerous areas” (1).

Baird et al. (1) err by interpreting the square of the correlation coefficient as the proportion of variation in deaths that mangroves explain. A correlation coefficient understates the relationship between two variables when one of the variables is discrete (4), which is the case with deaths. To investigate the relationship properly, one must use statistical methods that account for the discrete nature of the number of deaths, such as the count-data models that we used. Although these are not least-squares models, pseudo-$R^2$ measures with some of the properties of an ordinary $R^2$ can be calculated for them. The pseudo-$R^2$ for a poisson regression of deaths on 1999 mangrove width is 0.085, much larger than the squared correlation coefficient calculated by Baird et al.

Baird et al. (1) compound this error by equating the impact of mangroves to the proportion of variation in deaths that mangroves explain. The impact is instead related to the regression parameter on 1999 mangrove width. For villages within 10 km of the coast, our regression results imply that remaining mangroves reduced the average number of deaths by 69% (Table S9 in ref. 2). This is hardly “small,” as Baird et al. claim (1).

Baird et al. (1) exaggerate the cost of saving lives by retaining mangroves, claiming that we estimated an opportunity cost of $300,000 (US)/ha when in fact our estimate was 172,970 rupees/ha, or $4,022 (US)/ha (2). Although our results suggest that mangroves saved fewer lives than the government’s early warning, we would not discount the role of mangroves as an adjunct to early warning systems. Despite being warned, much of the population in Orissa did not evacuate because of limited storm-shelter capacity, concern that deserted houses would be looted, and underestimation of the storm’s intensity. Mangroves helped save the lives of these people who stayed put.

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The authors declare no conflict of interest.

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