to produce an all-female brood, which again is contrary to my findings. The model thus fails to explain the female-biased population-level sex ratios as well as the occurrence of all-female broods over the whole range of colony sizes. Hence, in *Formica truncorum*, the female-biased population-level sex ratios, together with the colony-level sex ratio patterns, still support predictions based on worker control of sex allocation[2,7,8]. The effect of parasites/pathogens on sex allocation is, however, certainly a factor that needs to be addressed, especially as multiple mating may confer higher disease resistance[5].

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Man-made lakes and sea-level rise

SIR — Sahagian *et al.*[1] estimate the total man-made lake impoundment to date to be 1.9×10^{12} m^3. As such it is the single largest (and negative) contribution to the sea level, yet it is not large enough to offset the combined positive contributions from other anthropogenic sources such as groundwater withdrawal and deforestation. However, my earlier estimate[2], based on documented sources[3,4], puts the total water impoundment (by 1991) at as much as 10×10^{12} m^3. More than five times larger than that of Sahagian *et al.*[1], this estimate would easily swamp all the other positive contributions (as I explicitly stated[2]) and the sum thereof.

Just for the sake of argument, suppose that on average the reservoirs are only filled to three-quarters of their designed capacity, and that no new reservoirs were constructed after 1986 (which is not in fact the case, considering some gigantic water projects in developing countries such as China). Then, by proper scaling of my earlier estimate, the total water impoundment would be about enough to nullify the other anthropogenic sources, leaving a zero net contribution.

Thus, it is clear that man-made water impoundment is the single element that decides whether the total anthropogenic contribution to the global sea level is positive (as claimed in ref. 1), negative (as claimed in ref. 2), or close to nil (as in the above hypothetical example). To resolve this only requires some up-to-date compilation of basic data for the world's water projects, a task much more accessible than natural processes such as that of calculating water balance of mountain glaciers or polar ice sheets.

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SIR — Sahagian *et al.* attempt to estimate the share of observed sea-level rise that can be attributed to human activities rather than global warming (and consequent glacial melting and thermal expansion of sea water)[1]. Unfortunately, the authors significantly understate the amount of fresh water stored behind dams, an error that when corrected cancels or even reverses the claimed effect.

To estimate a net sea-level rise of 11.8 mm from non-climate-related sources during the twentieth century, Sahagian *et al.* summed total contributions from several anthropogenic sources (for example, depletion of 'fossil' aquifers, loss of soil moisture and deforestation). They then deducted the amount of water stored behind dams and thus removed from the sea-level equation during this period. They reported this storage to be 1.9×10^{12} m^3, the equivalent of a 5.2-mm drop in sea level.

The 1983 source[5] used by Sahagian *et al.*, however, actually listed 170 major dams with a combined reservoir capacity of 2.8×10^{12} m^3, 0.9×10^{12} m^3 greater than they used in their calculations. And by 1986, there were at least 36,065 additional reservoirs behind large dams that are 15 m tall or over (an additional 2,000 might have been unreported from the former Soviet Union)[6]. There are literally millions of smaller reservoirs, down to the size of farm ponds, all over the world.

Total reservoir storage has been variously estimated at 5.5×10^{12} m^3 (in 1983)[7] and more than 5.0×10^{12} m^3 (in the late 1980s)[8]. Even one source[1] cited in ref. 9 estimated that total reservoir volume (large and small) grew by 6.0×10^{12} m^3 between 1932 and 1982 and that total anthropogenic storage during the same time, including recharging of ground water and increased soil moisture due to irrigation projects, grew by 18.8×10^{12} m^3 — translating to a 5.2-cm sea-level decrease[10], ten times larger than the figure used in ref. 1. Thus, depending on the figures used, net sea-level rise from anthropogenic sources during this century ranges from almost nil (a mere 3.3 mm) to strongly negative (−35.0 mm).

Correcting the analysis in ref. 1 makes it clear that little, if any, of the global sea-level rise we observe can be assigned to the anthropogenic causes listed therein. Indeed anthropogenic storage of water behind dams, in aquifers and as soil moisture, could well have significantly limited the observed sea-level rise. There is no reason to think that the contributions of climate-related effects are smaller than previously supposed.

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SAHAGIAN *ET AL.* REPLY — Chao and Rodenburg both suggest that there is more water stored in artificial reservoirs than we accounted for in our paper[1], and that this would reduce the amount of net anthropogenic sea-level rise to date. We do not doubt that our list of artificial reservoirs was incomplete, as we did not include dams listed as under construction[5].

In assessing the consequences of this omission, there are two important issues to consider. The first is the difference between reservoir capacity and the actual amount of water stored in the reservoir. In our analysis we assumed that all of the dammed reservoirs have been continuously filled to capacity (and free of sediments). This is surely not the case. Chao's supposition of three-quarter capacity may be reasonable, but such data have not yet been compiled.

Second, the surge of large dam-building activities between 1954 and 1985 has essentially ceased, and other than the Three Gorges Dam in China, there seem to be no major future plans for large dams nor is there any reason to believe that the number or volume of small farm ponds, as suggested by Rodenburg, will increase.

Consequently, we conclude that while additional dammed reservoirs not included in our tally would reduce the calculated historical amount of anthropogenic sea-level rise, they do not affect the present rate of anthropogenic sea-level rise (to be extrapolated into the future). It is the present rate of sea level rise, and not the past amount, that will have the greatest impact on modern society. To assume that the continued construction of large dams will abate future anthropogenic contributions to sea-level rise is not, in our view, wise.

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