Large-Scale Hydrological Changes in Tropical Asia: Prospects for Riverine Biodiversity

DAVID DUDGEON

Various anthropogenic activities threaten the biodiversity of rivers and their associated wetlands at global and regional (Asian) scales and may well impair or significantly reduce the ecosystem services those rivers and wetlands provide. These threats can be placed in four categories: flow alteration or regulation (including impoundment by dams, water extraction for irrigation, and so on); pollution; drainage-basin alteration (especially deforestation); and overharvesting (mainly of fishes).

Researchers, increasingly aware of the potential impact of hydrologic alterations on biodiversity, have begun to focus on the environmental and social consequences of large-scale hydroelectric development (Rosenberg et al. 1997). Their attempts to predict the consequences of flow alterations on biodiversity in Asia, however, are confounded by the trend in the region toward more, and bigger, dams, as exemplified by the Three Gorges Scheme in China (Dudgeon 1995a).

In 1950 Asia had 1541 large dams (more than 15 m high), accounting for 30% of the global total (van der Leezen et al. 1990); by 1982 that figure had grown to 22,701 (65% of the global total). Most—18,595, or 82%—were in China. India, ranked fifth in the world (and second in tropical Asia) in number of large dams, had a comparatively modest total of 1085. Absolute numbers of dams have changed over the last several years, of course, but Asia’s proportionate share of the global total of dams remains high.

The natural hydrologic cycle

Table 1 lists the major rivers of tropical Asia.1 Some of them—Chang Jiang, Mekong, Indus, Brahmaputra, Ganges, Irrawaddy, and Zhujiang, for example—are among the world’s greatest rivers, in terms of their discharge and length and thus in terms of the biodiversity they might support. Discharge seasonality influences the biota and land–water interactions of tropical Asian rivers (Dudgeon 1992, 1995a, 1995b, 1999, Dudgeon and Bretschko 1996). The dominant influence of monsoons gives rise to a characteristic pattern (Figure 1) whereby predictable periods of drought in the dry season alternate with periods of increased discharge, spates, and floodplain inundation in the wet season. For many animals, especially fishes, these changes result in alternating periods of resource scarcity (during the dry season) and resource glut (during the wet season). The monsoon drives flood pulses (sensu Junk et al. 1989)—the predictable advance and retraction of water over the floodplain—and the life histories of aquatic organisms are timed to take account of

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1Tropical Asia is used here to refer to that area experiencing a monsoon climate and broadly overlapping with the Oriental biogeographic region (i.e., the part of Asia to the south of a line extending from the Indus River in the west [longitude 70° E] along the Himalaya and ending at the mouth of the Chang Jiang [Yangtze] River in the east [longitude 150° E]). This area includes China south of latitude 30° N, Southeast Asia, the East Indies, and the Indian Subcontinent. A bias toward Southeast Asia and southern China (i.e., Asia east of longitude 93° E) reflects my familiarity with this area.

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David Dudgeon (e-mail: ddudgeon@hkucc.hku.hk) is a professor and head of the Department of Ecology & Biodiversity at The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China. © 2000 American Institute of Biological Sciences.