

Box 2.25 Fragmentation and Flow

For centuries, in all parts of the world, rivers and lakes have been modified to improve navigation, wetlands drained to make way for settlement, and dams and channels built to control the flow of water for human purposes. These changes have raised agricultural output by making more land and irrigation water available, easing transport, and providing flood control and hydropower.

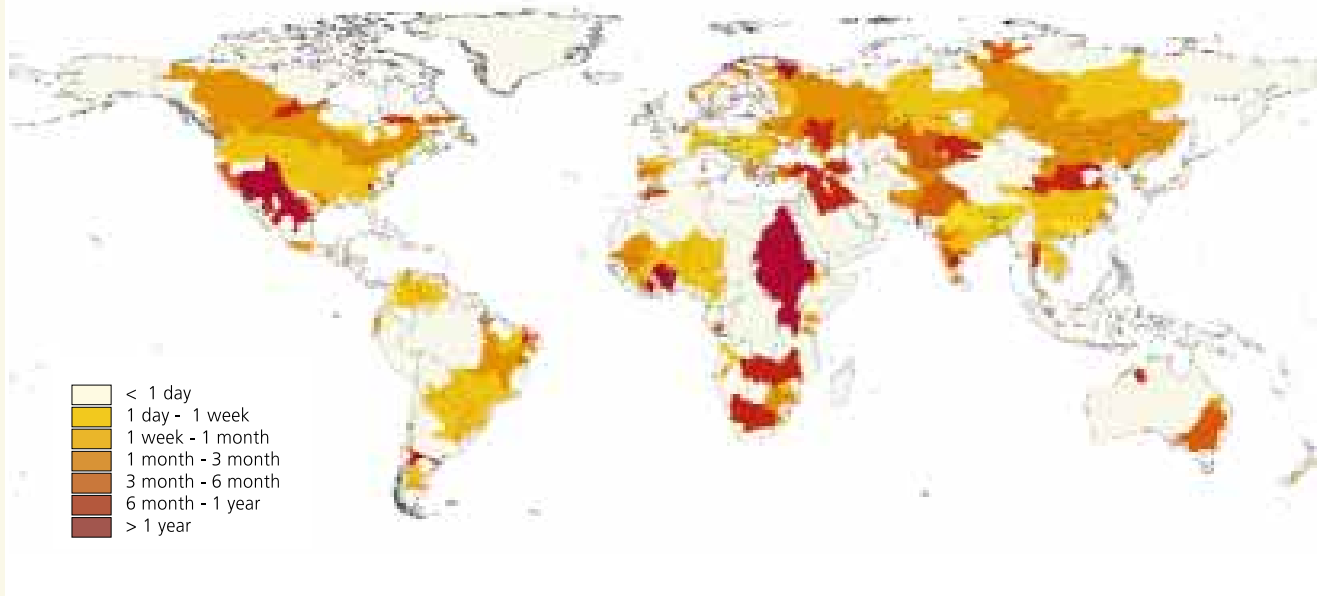
But human modifications have also had far-reaching effects on hydrological cycles and the species that depend on those cycles. Rivers have been disconnected from their floodplains and wetlands, and water velocity has been reduced as river systems are converted into chains of connected reservoirs. These changes have altered fish migrations, created access routes for nonnative species, and narrowed or transformed riparian habitats. The result has been species loss and an overall reduction in the level of ecosystem services freshwater environments are able to provide.

The construction of dams has had an impact on most of the world's major river systems. There are more than

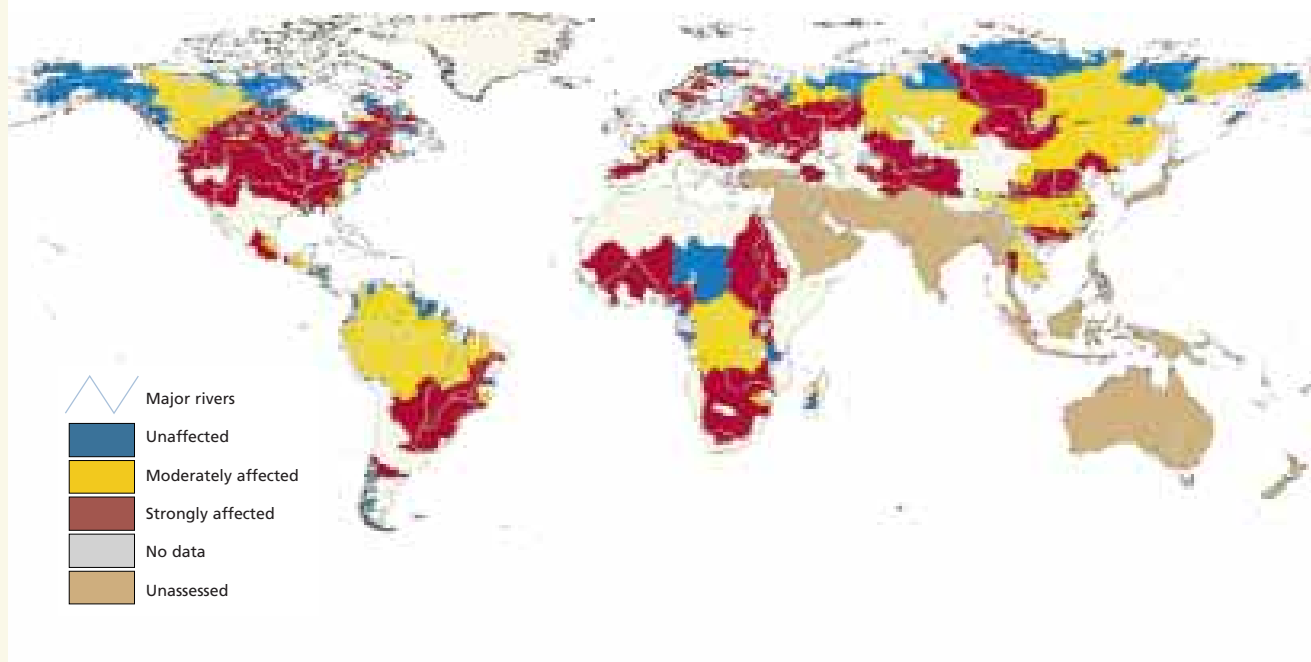
41,000 large dams in the world—a sevenfold increase in storage capacity since 1950 (ICOLD 1998, Vörösmarty et al 1997). The map at the top of the facing page shows the extent of fragmentation, or interruption of natural flow, caused by human intervention in 227 large river systems (Dynesius and Nilsson 1994; Nilson et al. 1999; Revenga et al. [PAGE] 2000). Almost all large river systems in temperate and arid regions are classified as highly or moderately affected, while all but a handful of the unaffected systems in which water still flows freely are located in Arctic or boreal regions. This trend will continue as new large dams are built throughout Asia, the Middle East, and Eastern Europe.

Dams slow the rate of natural flow, thereby increasing sedimentation and lowering levels of dissolved oxygen. The most affected river systems, in which length of water retention has risen by more than a year, include the Colorado River and Rio Grande in North America, the Nile and Volta Rivers in Africa, and the Rio Negro in Argentina.

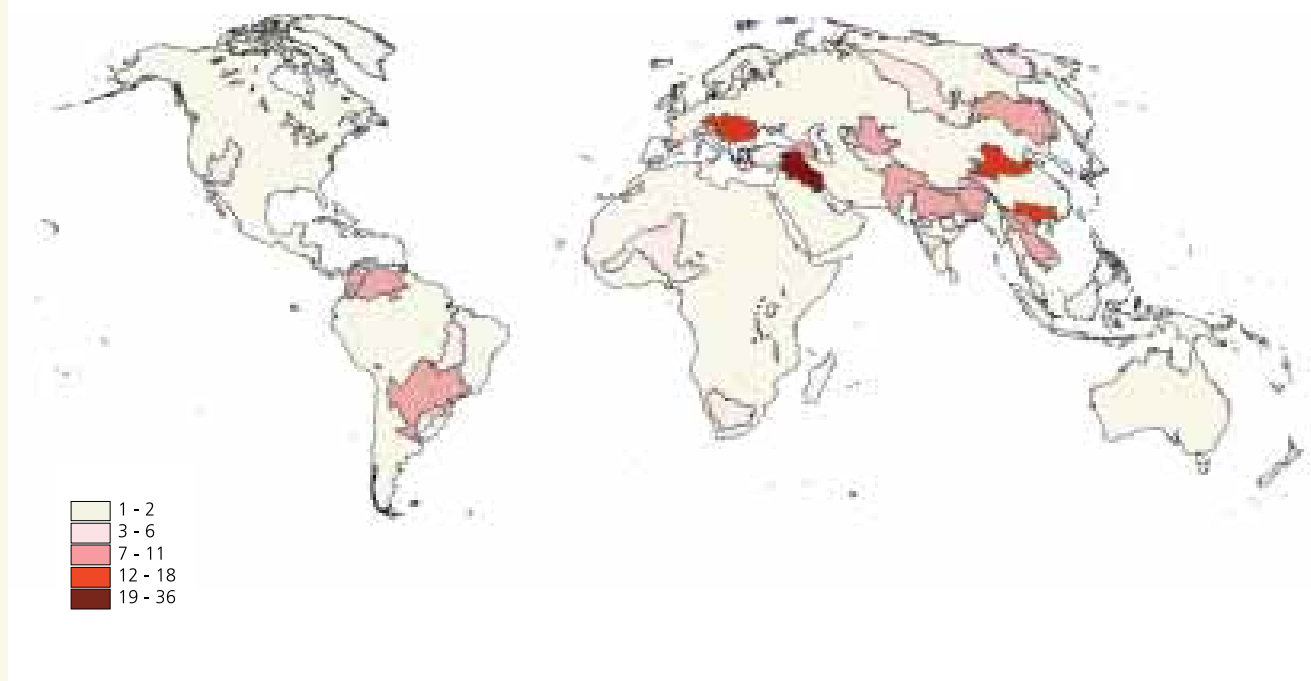
Aging of Continental Runoff in Major Reservoir Systems



River Channel Fragmentation and Flow Regulation



New Dams under Construction by Basin, 1998



Sources: Revenga et al. [PAGE] 2000. The continental runoff map on the preceding page is from Vörösmarty et al. (1997.) The fragmentation map above is based on Revenga et al. (1998), Dynesius and Nilsson (1994), and Nilsson et al. (1999). The map showing dams under construction are based on data from IJHD(1998)