Anthropogenic influences on Hong Kong streams

Dudgeon, David, Department of Ecology and Biodiversity, The University of Hong Kong, Hong Kong

Received 16 October 1995; accepted 20 November 1995

Abstract: The Hong Kong countryside has experienced centuries of intense human impact, and none of the native climax forest remains. Anthropogenic influences upon Hong Kong freshwaters reflect, on the one hand, pollution and degradation of rivers and wetlands as a consequence of urbanization of rural lowlands. On the other hand, the need to preserve pristine catchments for the supply of water for human consumption has ensured the protection of upland streams which are typically unpolluted. Hong Kong has no natural lakes, limited ground-water reserves, and marked seasonal and inter-year rainfall variation. Most upland streams are impounded, and water is transferred from them into reservoirs by underground tunnels. Hong Kong’s 17 reservoirs collect insufficient water from local catchments to meet the territory’s needs. To satisfy the shortfall, large amounts of water (1.1 billion m$^3$ in 1994) are piped each year from the Dongjiang (a tributary of the Zhujiang or Pearl River) in Guangdong Province (southern China) into reservoirs in Hong Kong where it mixes with water from local streams. The natural seasonality of flow in Hong Kong streams is heightened by aggressive water extraction during the dry season. No consideration is given to maintenance of the minimum in-stream flows necessary to conserve ecosystem integrity below extraction points and, in extreme cases, surface flow ceases during the dry season. Water extraction also causes dry-season increases in pollution load as flows are reduced and the ability of streams to dilute pollution is diminished. The cumulative impact of such modifications is severe, and lowland freshwaters now support a depauperate flora and fauna of adaptable generalists, including a significant proportion of exotic or alien species.

1. Introduction

As part of higher landscape units, freshwater bodies in Hong Kong and elsewhere are particularly vulnerable to disturbance or damage by man. Perturbations within the drainage basin will affect in-stream communities through wash-off or run-off processes and, because of the downhill flow of water in streams, changes in headstream areas alter downstream reaches. The movement and effects of pollutants provide an all-too familiar manifestation of transport processes and linkages within drainage basins. Man’s modification of stream valleys can also affect the lotic fauna by influencing the terrestrial adult stages of amphibiotic insects and amphibians. Indiscriminate use of insecticides, or clearance of riparian vegetation leading to destruction of mating and resting sites, will reduce breeding success and recruitment.

Widespread channelization, damming and water extraction from Hong Kong streams alter flow patterns and discharge regimes, with concomitant effects on seston transport, sediment movements and river-bed characteristics (Dudgeon 1992a, b). Dams also impede the breeding migrations of certain decapod crustaceans (miten crabs, Eriocheir spp., for example) and fishes. In addition, the introduction of exotic plants and animals has disrupted the integrity of Hong Kong’s natural stream communities, and this effect has been exacerbated by the tendency for invasions of alien species to be more successful in perturbed or polluted environments (Dudgeon 1992a; Dudgeon and Corlett 1994).

These three categories of anthropogenic impacts – pollution, flow regulation, and exotic invaders – will be discussed herein with reference to Hong Kong, and placed in the context of long-term human modification of the environment as well as the strong seasonality of local freshwaters. Emphasis will be placed on streams, since Hong Kong has no natural lakes.
2. Environmental history

While Hong Kong (Figure 1) has considerable areas of countryside—an impressive 40% has been set aside as country parks—the contemporary terrestrial and freshwater communities are the product of centuries of intense human impact and thus cannot be considered pristine or natural (Dudgeon and Corlett 1994). The climax vegetation of Hong Kong—broad-leaved forest—was established at the end of the last glacial episode, 10–12,000 years ago. Although the climate has continued to fluctuate since then, the major environmental changes that have occurred have been entirely the result of human impact. The climax vegetation has been cleared during centuries of human impact, and none of the original forest remains (Dudgeon and Corlett 1994). There is archaeological evidence for the presence of humans in Hong Kong for at least 6,000 years, but records of well-established settlements are not found until the 14th century, when incense wood was exported. This does not mean, necessarily, that there was not extensive agricultural settlement in Hong Kong by this period or even considerably earlier—just that there is little evidence for (or against) this.

Much human colonization of the region probably took place during the 15th and early 16th centuries by Cantonese from northern Guangdong Province (in China) who inhabited valley bottoms and lowlands. The Hakka, a second ethnic Chinese group from further north, moved in from the late 17th century and cleared and cultivated hillsides and other marginal land leased from the Cantonese. The ecological impact of the Hakka immigration cannot be assessed accurately in the absence of information on the 17th-century flora and fauna, but the establishment of numerous Hakka villages in areas which were apparently only sparsely inhabited before must have been of major significance. It therefore seems most likely that the late 17th and early 18th centuries saw the final transformation of what was once a forested landscape with some cleared areas into the barren hills reported by European visitors during the 19th century (Dudgeon and Corlett, 1994 give further details).

From the 1840s onwards, many European visitors described the landscape of the new colony on Hong Kong Island. Adjectives such as “barren”, “bare”, “bleak” and “sterile” occur in all these accounts. The hills were covered in coarse grass, with a few scat-