Effect of Land Development on Stream Bottom Faunas

K. Radway Allen

Fisheries Laboratory, Marine Department.

The most striking feature of land development in New Zealand has been the removal of the original forest cover from a large proportion of the land, and its replacement by pasture. Although no historical data are available, study of present conditions indicates that this change had comparatively little effect on the bottom fauna of streams. Where clearance has decreased the stability of the bed the average level of abundance has been probably reduced by more frequent and severe flooding. In small streams, on the other hand, clearance has increased the illumination of the stream bed and enabled the attached algae and the fauna feeding on them to increase also. Qualitatively, there appears to have been little change in the fauna, although a few groups such as the stone flies (Plecoptera) and caddisflies of the family Leptoceridae may have decreased.

The less conspicuous changes in land use in recent years which result from more intensive and efficient agriculture are, by contrast, having a pronounced effect upon the bottom fauna, particularly of the fairly rapid, stony, streams which are characteristic of much of New Zealand. The changes arise primarily from the increased supply of nutrients in the water; this increases the quantity of attached algae growing on the stream bed, and changes their nature; the changes in physical environment and food supply so produced cause qualitative changes in the nature of the bottom fauna.

These changes have been followed historically in the Horokiwi Stream near Wellington during the last 20 years, and, by comparison of present conditions, in a number of other streams. The main features are:—

a. *Chemical:*

Little change in the principal nutrients and bases but silicates are reduced from 12-15 p.p.m. to 2-5 p.p.m. apparently due to utilization by the increased diatom flora without any addition to the supply.

b. *Algae:*

The original thin brownish film of diatoms and blue greens (e.g. *Symploca*) is first invaded by isolated tufts of *Rhizoclonium* and *Cladophora* and then replaced by an increasingly heavy mat of diatoms (e.g. *Navicula* and *Melosira*) and filamentous forms (e.g. *Stigeoclonium, Oedogonium,* and *Ulothrix*).

c. *Bottom fauna:*

Fig. 1 summarises the changes which have occurred in the Horokiwi. The animals adapted to living on exposed surfaces and browsing on the diatom film (e.g. ephemerids and sericostomatid caddis) are replaced by ones which burrow into or creep over the algal felt (e.g. parnid beetle larvae, the snail *Potamopyrgus antipodum zealandiae*, and the ostracod *Candonocypris assimilis*). Similar changes seem to have occurred in the other streams surveyed, the fauna being generally completely changed where the algal felt has become heavy and completely covers the stream bed.

The additional nutrients causing the changes are derived either from increased fertility of part of the catchment or from some localised source. In grassland increased fertility, e.g. due to top dressing, has generally little effect except when developed on the upper part of the catchment, and even then only when the stream rises in a swampy basin. Well-developed river flats on the lower part of the course seem to make little contribution to the fertility of the stream. It seems possible that arable land may make a greater contribution even when in the lower part of the catchment. Localised sources which may modify the stream have been found to include such diverse items as flocks of geese and domestic septic tanks.

In the Wellington area a large number of streams have been found to be modified,

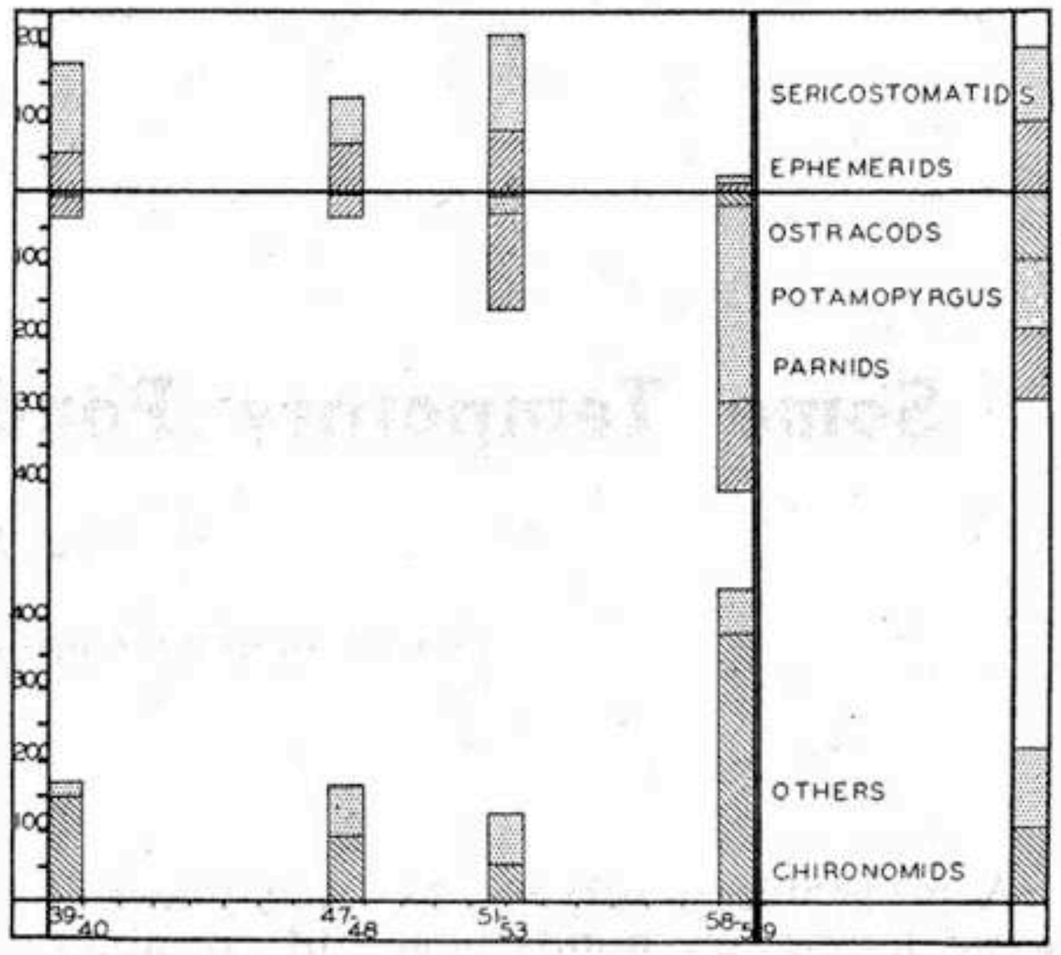

FIGURE 1.—*The average numbers per square foot of each of the principal groups in four series of bottom-fauna collections taken in the Horokiwi stream during the last twenty years.*

particularly in the Horokiwi, Ohariu, and Porirua systems. Modification has also been found in a tributary of the Waipoua River in the Wairarapa and in the Waikaka system in South Otago. In all cases the streams affected rise in relatively low hills in pasture or arable land. It is unlikely that large rivers rising in high or bush-covered country will be affected.