INFORMATION BULLETIN

DROUGHT AND RIVER HEALTH

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INTRODUCTION

Drought is a natural feature of the Australian climate and has been critical in shaping our unique environment. Climate change models forecast that droughts will occur more frequently in south-eastern Australia. As a result, stream flows will be severely reduced, particularly in Victoria's western catchments. The recent severe dry period is providing an opportunity to see how river health may be affected under the forecast drier climate.

There have been few broad-scale investigations of the effects of drought on aquatic ecosystems conducted in the world. In this study, EPA used data collected since 1990 under its statewide biological monitoring program to look at how drought has affected river health and water quality in Victorian streams.

The diversity of fauna is an important part of river health – allowing ecosystems to adapt or recover from effects of drought and other impacts. Diversity is also important to the provision of services normally found in a healthy ecosystem, such as fish to catch and clean rivers to swim in. Despite this natural resilience, extended drought has the potential to dramatically affect the nature of the ecology of many of our streams and the uses we take for granted.

VICTORIA'S BIOLOGICAL MONITORING PROGRAM

EPA tests the number and type of different macroinvertebrates (insects, snails and worms) as an indication of river health. Samples are usually collected from two habitats in a stream – from shallow, fast-flowing water (riffles) and from slow-flowing edges and backwaters (edge habitat). Site locations for this program are selected at random and generally focus on medium to larger streams.

REDUCED FLOWS AND DRYING OUT OF STREAMS

In an obvious response to the drought, increased drying of streams and reduced flows were observed. Some streams were reduced to a series of disconnected pools. While the assessment of biological changes focused on data to 2004, in the 2006–07 assessment period about 25 to 30 per cent of the sites visited were dry, compared to less than five per cent in previous years. A dry site was one at which there was insufficient water to gather a sample. Considerably higher rates of dry sites were observed in some individual catchments, particularly in the west and north of the state. An even larger proportion of small headwater streams, which are typically not included in

A drying stream in the Moorabool catchment

A stonefly nymph found in riffles
(photo courtesy of John Gooderham and Ed Tsyrlin)

The dry bed of Natimuk Creek in the Wimmera catchment

the biological monitoring program, are likely to have been dry.

These data are 'spot' observations and the full extent of dry stream networks has not been measured, although some catchment management authorities are beginning to map this information. Nonetheless, these observations indicate an increasingly dry landscape.

CHANGES IN THE ECOLOGY OF STREAMS

In the assessment up to 2004, riffles that had sufficient water to be sampled maintained their ecological health. As riffles dry, some macroinvertebrates may become trapped and die (for example, some caddisflies and freshwater mussels). Others migrate deeper into the moist sediment or fly to remaining pools (for example, backswimmers).

There were significant decreases in the health of macroinvertebrate communities living in the edge habitat. In the edge and backwater habitat, under low or no-flow conditions, river health was reduced by increased algal and plant growth and by sedimentation. Sensitive species were replaced by more resilient species such as mosquito larva. These thrive in stagnant conditions and are tolerant of low levels of oxygen.

While it is unlikely that species have become extinct, full recovery of streams after drought to previous levels of biodiversity and other ecosystem services will take time and depend on factors such as proximity and maintenance of refuges[1]. A diverse and abundant macroinvertebrate community is a necessary component for the full recovery of fish stocks and other ecosystem values.

Preliminary analysis of data available for 2004 to 2006 indicates a significant decrease in the number of sites meeting biological objectives — 40 per cent, compared to 66 per cent for the period 1998 to 2004.

WATER QUALITY

The drought has affected water quality through changes in:

- dissolved oxygen (DO) — which most freshwater animals need to survive
- salinity — most animals can survive only in low salt conditions
- turbidity (lack of water clarity) — which affects habitat quality and the growth of plants.

DO concentrations varied more and were lower during the drought. This may have been due to increased plant or algal growth.

In some areas of the state, low flows led to considerable increases in salinity, particularly in the Wimmera and Goulburn catchments. This resulted in few species being able to survive in some streams. A related effect of low stream flows can be seen in our lakes drying and becoming more saline, leading to the death of large numbers of fish, including eels, in the State's western districts.

Turbidity was a lot lower and varied less during drought. This was most likely due to low flows allowing particles to settle on the stream bed and less rain washing soil into the stream.

SUMMARY AND FUTURE DIRECTIONS

Overall, this study showed that the ecological effects of drought depended strongly on the residual stream flow in the systems.

The edge habitat was the most affected. Where sufficient water remained in riffles, stream health was maintained, although some impacts were observed in the associated pools.

The observations based on data to 2004 may provide an indication of the changes that may occur under a drier climate, but it is likely that conditions in many upland streams had not reached a critical threshold at that time. More significant changes in stream health may be expected as a result of record low rainfalls in recent years and the increased proportion of streams that have dried or ceased to flow.

This study assessed monitoring data from better quality streams. Streams that are already degraded may be less resilient and less able to cope with the added strain of drought.

The standard biological monitoring method is designed to assess the general condition of streams, rather than the causes underlying any observed impacts. It is also strongly biased to sites where water remains. Areas for further work include:

- refinement of methods for assessing the impact of drought, particularly in detecting the early stages of drought impact and assessing the impact of stream drying
- understanding the level of resilience in river systems and rates of recovery where flows return
- determining the key features of pools and other refugia that need to be maintained to enable recovery.

FURTHER READING

Drought and river health in Victoria, EPA publication 1171, December 2007.

Scientific investigation into eel deaths in Western Victoria, EPA publication 1173, December 2007.

[1] A refuge is part of the stream (usually a pool) which persists and is of sufficient quality to allow species to survive.