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The Role of Historical Research in Stream Rehabilitation: a Case Study from Central Victoria

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SUMMARY: In order to restore or rehabilitate a stream it is essential that something is known about the stream's pre-disturbance form, and that there is some understanding of the causal factors driving stream degradation. This type of information may be best derived from historical research. The significance of historical research for stream rehabilitation is illustrated in this paper using a case study from central Victoria. The Granite Creeks comprise several perennial and ephemeral streams flowing from the granitic Strathbogie Ranges across the Riverine Plain into the Goulburn River. Many of these creeks are now choked with sand and are significantly degraded, both in a physical and biological sense. An investigation of the history of the Granite Creeks since European settlement was conducted using historical maps and plans, land selection files and other archival records, as well as anecdotal evidence. These lines of evidence were used to identify original stream forms, the sequence of changes in stream form that have taken place over time and the factors driving those changes. This methodology is invaluable for stream rehabilitation because it provides a model for stream rehabilitation works, information about the factors that have led to degradation in the past, and identifies the issues that must be addressed if the rehabilitated stream is to be sustained into the future.

THE MAIN POINTS OF THIS PAPER:

- Historical information can generally be obtained without much difficulty. Sources include:
  - explorers' diaries
  - surveyors' notes
  - archival records (eg. Shire records, State government records)
  - railway and road bridge cross-sections
  - local interviews
- Historical information obtained in central Victoria has provided important information about pre-disturbance creek forms, the extent of degradation of the creeks and the activities/events contributing to that degradation
- Such information provides a sound basis upon which cost-effective stream rehabilitation and management strategies can be built
- Attempting stream rehabilitation without gathering the relevant historical information may ultimately lead to the failure of the project

INTRODUCTION

In recent years the focus of stream management has shifted from dealing with site specific problems to advocating stream rehabilitation as a panacea for many of the ills we attempt to manage. The very fact that this entire conference is focussed on stream rehabilitation demonstrates the increasing importance being placed on the need to rehabilitate our rivers and streams. Whilst we have now identified the need to rehabilitate we still lack knowledge about the process. The recent release of 'An Australian Stream Rehabilitation Manual' (Rutherfurd et al. 1998) has begun to address this knowledge gap.

'Rehabilitation' implies a return to some previous condition, yet all too often in Australia unsubstantiated anecdotal evidence, rather than sound historical research, is the only information used to determine what that previous condition was. Due to the relatively recent settlement of Australia, we are particularly well provided with the required sources of historical information but too few river managers appreciate their value.

Historical research can be an invaluable tool in devising a stream rehabilitation strategy because it provides information about a stream form to which we can aspire, and it can also tell us something about the factors driving stream degradation. Understanding why the creek has become degraded is just as important as knowing what to do to rehabilitate it, because unless we can manage the stream to mitigate the degradation processes all our efforts will be wasted (also see paper by Starr, this volume).

In this paper we describe the type of historical information that has been collated for three streams in central Victoria and we demonstrate how important it is for the development of an effective strategy for stream rehabilitation.

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STUDY AREA

The Granite Creeks Landcare Project involves six Landcare Groups that cover the western slopes of the Strathbogie Ranges in central Victoria (Figure 1). The Strathbogie Massif is comprised of granite (LCC 1984) and as is common in granitic catchments in Australia, sand slugs have developed in local watercourses since European settlement (Rutherfurd 1996). From the beginning of 1998 a research project has been underway, funded by the Cooperative Research Centre for Freshwater Ecology, to analyse the condition of the streams in the Granite Creeks Landcare Project area and to devise strategies for their rehabilitation.

Three creeks were chosen to be the focus of the biological and geomorphological investigation - Castle Creek, Creightons Creek and Pranjip-Nine Mile Creek (Figure 1).

Each of the three creeks rise on the Strathbogie Plateau and then flow in a north-westerly direction, eventually joining the Goulburn River just south of Shepparton. These creeks are relatively small, with catchment areas in the vicinity of 200 km^2. The creeks are fed by springs rising in the granite hills. Castle Creek and Pranjip-Nine Mile Creek tend to stop flowing over the summer months, whilst Creightons Creek is more persistent and will flow to the Pranjip-Nine Mile confluence in all but the driest summers (O'Connor 1991).

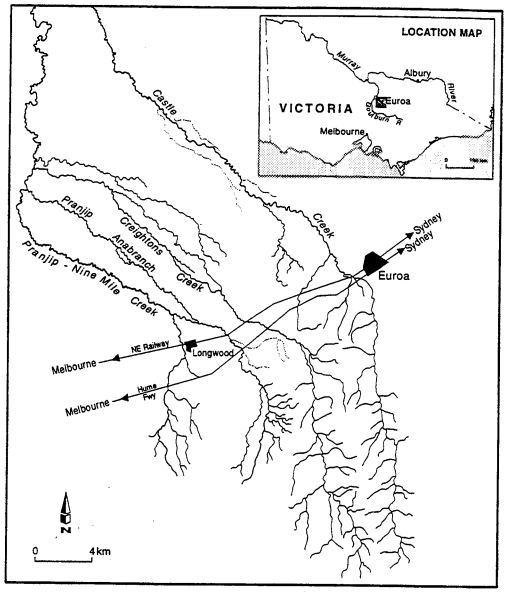

Figure 1: Map of the study area.

Each of Castle, Creightons and Pranjip-Nine Mile Creek rise at elevations in excess of 500 m AHD. The long profiles of the creeks are quite similar, dropping steeply from 500 m to 200-250 m over less than 10 km, resulting in gradients of 0.05 up to 0.2. Once the creeks leave the foothills and enter the Riverine Plain their grade is greatly reduced (0.002-0.004).

The main land use in the study area is grazing of cattle and sheep (Thompson & Associates 1992, Martin 1994, LCC 1983 & 1984). Some cropping occurs on better agricultural land on the Riverine Plain, whilst other agricultural activities include horse studs, vineyards and apiculture (Thompson & Associates 1992, Martin 1994).

In a survey of the environmental condition of Victorian streams, Mitchell (1990) classified the upper reaches of Creightons Creek as very poor and the middle reaches as poor. The upper reaches of Castle Creek were classed as being in a poor condition and the middle reaches in a moderate condition.

A more comprehensive survey of stream conditions in the area was carried out in 1992. In this survey substantial lengths of stream in the upper sections of Pranjip, Nine Mile, Creightons and Castle Creek, were classified as unstable or showing severe instability, and some old incision was also noted. Conversely the lower sections of these creeks were found to be subject to sedimentation, though some old incision and current instability was noted (Thompson & Associates 1992).

METHODOLOGY

The procedure for carrying out historical research involves locating and collating as much historical information about a given stream as is possible. Physical descriptions of the stream and its environs provide the most useful information. The sources of this information will vary from region to region and particularly across State boundaries. The sources of information described here are most relevant to Victorian creeks and rivers, but similar types of information will be available in one form or another in most States.

The diaries of some of the first explorers and squatters to pass through an area can be very useful sources of information. For example, Major Thomas Mitchell traversed the study area in October 1836 (Mitchell 1839), followed shortly afterwards by Alexander Mollison, an overlander (Randell 1980). Each kept a diary and described the study area. Whilst relevant diaries and documentation may not be available at everyone's local library, it is often possible to organise interlibrary loans.

The notes of the first surveyors to survey an area can also be quite informative and may be located in the State government department responsible for land. Any records kept by the relevant State government department on the condition of land bought or leased in an area can also be very useful. In Victoria, the public can access Land Selection Files, which contain all the correspondence related to the selection, lease and sale of most land parcels in Victoria. In some instances the files contain references to the state of nearby drainage lines and so can prove valuable in the reconstruction of the condition of waterways. Paintings and drawings of the area of interest can sometimes be found at local galleries, or via picture collections in State Libraries. Local histories and local interviews can also provide useful information, both in relation to historical and more recent events.

Information about streams during this century may be obtained from a number of sources including the local shire office (eg. complaints about flooding or channel instability, notes about damage to bridges, etc.), the state department responsible for river and or land management and even the local transport authorities (eg. repeat cross-sections might be available for road and rail bridges). By comparing physical descriptions of a stream over time, it may be possible to track stream degradation and link it to particular catchment activities.

There are several potential problems associated with the application of the methodology described above. The first problem relates to obtaining relevant information. Whilst a great deal of information is contained in the sources described above it is possible that some areas are not particularly well provided for and thus collating sufficient information may be not be possible. The second and potentially most serious problem relates to the use of anecdotal evidence. Anecdotal evidence can often prove to be unreliable and it is critical that such information be cross-checked against other evidence. In some instances insufficient evidence is available to allow a piece of anecdotal evidence to be verified, in such cases the relevant evidence should be discarded and not allowed to influence stream management decisions.

All of the sources described above were used to derive historical information relevant to Castle, Creightons and Pranjip-Nine Mile Creek. That information is summarised below and forms the basis for a discussion of the present state and potential rehabilitation of these creeks.

RESULTS OF HISTORICAL RESEARCH

Past and Present Stream Condition

At the time European settlement commenced in the study area (1839) the creeks appear to have had two distinct forms. In the upper catchment the creeks tended to flow over 'swampy flats' interspersed with waterfalls. Sometimes flow over the swampy flats would be concentrated in a small, shallow channel, and in other places there was no distinct channel, just a number of small, temporary streams that meandered across the flat. No physical descriptions of the flats could be found so it can only be surmised, based on the 'swamp' description used by the surveyors and remnant flats, that the flats were well vegetated with rushes, tree ferns and possibly some large trees. Lower down the catchment, as the stream moved out of the foothills and the valley gradient decreased, permanent channels formed. Little information is available about these middle reaches of the creeks, but it would appear that they consisted of pool-run sequences, and the bed of the creek may have been sandy. The lower reaches of Castle, Creightons and Pranjip-Nine Mile Creek comprised multiple channels, with deep pool-run sequences, founded on clay beds (Figure 2).

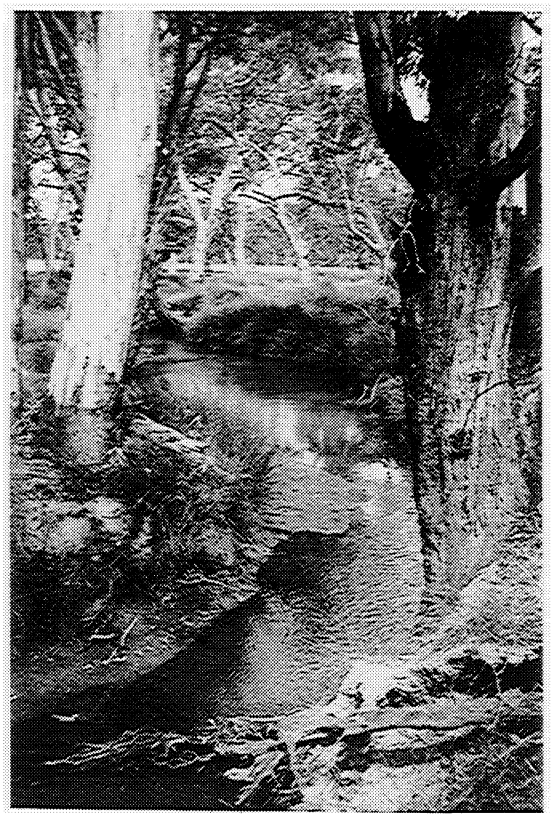

Figure 2: A typical pool-run sequence on the lower reaches of Creightons Creek.

Castle, Creightons and Pranjip-Nine Mile Creek appear quite different today. Whilst the 'swampy flats' and even the original small channels are still visible in some parts of the upper catchment, today the creeks generally flow through incised channels. The level of incision varies from less than 0.5 m in some reaches to in excess of 10 m in other reaches. Channel widening has accompanied incision and in some areas the channel is in excess of 30 m wide (Figure 3). Some of the ephemeral drainage lines have gullied.

The middle reaches have been impacted, initially by aggradation, due to material being released from upstream, and later by incision, as the deposited material was remobilised and moved further downstream. Today the channels may be of a similar size to their pre-settlement form, but all the pools have been filled with sand, and a flat, sand-bed channel remains.

On the Riverine Plain two types of channel are apparent. The lowest sections of the creeks remain relatively unimpacted by European settlement, with deep clay-bottom pools and runs (see Figure 2). However, upstream the clay pool-run sequences have been completely submerged by the sand slugs that have moved out of the hills. The channels that remain are shallow, rectangular in cross-section and flat, with little or no variation in bed form (Figure 4).

Figure 3: A deeply incised reach in the upper catchment of Creightons Creek.

Figure 4: A section of Castle Creek submerged by a sand slug.

Causes of Incision and Instability

In less than two hundred years substantial changes have taken place along Castle, Creightons and Pranjip-Nine Mile Creek. To prevent these changes re-occurring once rehabilitation has taken place we need to understand what has driven them. The following account has been assembled from the collated historical information.

The first disturbances imposed on creeks in the study area coincided with the overlanding expeditions that travelled south from the settled districts in the 1830s. Large herds of sheep and cattle, and fires in the area combined to reduce the level of vegetative cover (Randell 1980, Walker 1838); other impacts such as damage to creek beds and banks by hoofed feet can only be surmised. Between the arrival of the overlanders and the 1870s the main activity in the catchments was light grazing, which was carried out by the local squatters who leased large areas of the catchments (Billis and Kenyon 1974). However, the 1870s heralded the arrival of 'progress' in the Granite Creeks area, and the following decades saw major changes. Land selection commenced in the Granite Creeks catchments in the 1870s, dramatically impacting on the area through tree clearing and an increase in grazing pressure (Land Selection Files). The North-Eastern Railway arrived in the early 1870s, creating a barrier to flow across the Riverine Plain, and providing a means of transporting produce, including firewood, to Melbourne, thus making the region attractive for farming and woodcutting. Consequently, by the turn of the century two of the most significant changes to be imposed on the Granite Creeks, ie. clearing and the construction of the North-Eastern Railway, were already in place. Whilst some erosion had been noted by this early stage (Land Selection Files), no other signs of degradation were yet widely reported.

In contrast to the 1800s, degradation was clearly evident throughout the 1900s. The following description of the response of a creek to European settlement comes from a detailed analysis of the history of Creightons Creek, and what has occurred in this catchment may well be an analogue for the other creeks flowing off the Strathbogie Ranges.

In the period since settlement the upper section of Creightons Creek (ie. above the Hume Highway) has incised extensively, and gullying has also occurred. The incision and gullying have been the result of a sequence of erosion heads moving along the creek and appear to be related to a number of activities that have taken place in the Creightons Creek catchment, including clearing, cultivation, channelisation, channel dredging and clearing, bushfires and droughts. As a result of the extensive erosion of drainage lines in the upper catchment large quantities sediment have been released into the creek and this has seriously impacted on the lower section of Creightons Creek.

Below the Hume Highway aggradation has been a significant problem which eventually led to the diversion of low flows from Creightons Creek to Branjee Creek (an anabranch) at Nelsons Swamp.

Whilst the abandonment of a section of channel in such a manner is probably not unusual for a stream on the Riverine Plain, it is likely that the process was greatly accelerated by the excessive release of sediment induced by activities associated with European settlement. In recent years erosion heads have continued to move through Creightons Creek and, based on the available evidence, it seems most probable that these heads are related primarily to stock accessing the drainage lines and channel clearing, dredging and the initiation of meander cutoffs.

IMPLICATIONS AND CONCLUSIONS

The most obvious benefit of the historical research carried out on Castle, Creightons and Pranjip-Nine Mile Creek is that the original forms at the time of European settlement have been identified. This work suggests that rehabilitating the middle and lower reaches of these creeks may involve re-establishing pool-run sequences. The severity of incision in the upper reaches of the creeks, as well as land use and infrastructure constraints (eg. road bridges) indicates that rehabilitation strategies for these reaches will need to focus on improved management of the riparian zone, which will assist rehabilitation by improving the riverine environment and stabilising eroding sections that are still liberating sediment.

The review of historical information also revealed that in recent times channel degradation may have been driven by activities such as channelisation (particularly along tracks and drains), possibly bushfires and droughts, channel dredging, clearing and straightening, and agriculture, primarily in relation to clearing and allowing stock access to streams. So it would appear that today the greatest threat to channel stability may well be poor management of stock in drainage lines, and thus fencing out of stock from the drainage lines, particularly above the Hume Highway will be a key step in the rehabilitation of these creeks. Other action may involve educating land-holders about the detrimental impact of channel dredging and the removal of vegetation on the creeks. Very little can be done to stop bushfires, droughts and floods (which drive the erosion heads at a greatly accelerated rate). Increasing vegetative cover throughout the catchment and improving its management will help to minimise the impacts of these phenomena.

The impact of incision in the upper catchment on the lower reaches of the creeks indicates that rehabilitation strategies must focus, at least initially, on the upper catchment. Similarly stream rehabilitation strategies should not be carried out on isolated stream sections because each section will be strongly influenced by what is happening both upstream and downstream, and as such these rehabilitation works may be prone to failure.

The benefits of using historical research as input to the stream rehabilitation process are clearly demonstrated by the example presented in this paper. The historical research conducted for the Granite Creeks Project revealed which sections of stream were suitable for rehabilitation and which sections required improved management. The information also identified what types of strategies were needed to ensure the long-term success of stream rehabilitation works carried out on these creeks, as well as priority action areas.

At locations where sufficient information is available and anecdotal evidence has been cross-checked to ensure its veracity, important historical information can be collated. Such information is not only beneficial, it is vital and stream rehabilitation projects that proceed without historical information are, figuratively speaking, ‘flying blind’.

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Department of Natural Resources and Environment, Victoria Files

Goulburn-Murray Water (former Rural Water Commission) Files

Land Selection Files (Public Records Office of Victoria, Victorian Public Records Series)

Public Transport Corporation Bridge Files

Strathbogie Shire Council Bridge Plans

VicRoads Bridge Plans