STREAM SALINITY IN A COASTAL CATCHMENT, BEGA, NSW: A CONCEPTUAL MODEL

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INTRODUCTION

There is little documented evidence to date of the extent and level of near-coastal stream salinity in NSW, let alone a conceptual model that describes the contributing factors and control mechanisms on its development. Such a conceptual model of Near-Coastal Stream Salinity has been developed by using a case study of catchments in the Bega Valley, South Coast, NSW. The landscape and biophysical components and processes that cause stream salinity have been identified using the relative significance of likely sources of salt—basement rocks and rainfall accession—and by determining the significance of hydrological changes to the geomorphology of valley fills and river styles brought about by land use change.

METHODS

A case study was developed of stream salinity levels for the Wolumla and Candelo catchments in the Bega Valley, NSW, with data collection also in Tantawangalo and Sandy Creeks and the Bemboka and Bega Rivers. The catchments are biophysically representative of the near-coastal environments of southeastern NSW. Comprehensive baseline sampling and analysis was carried out for stream water EC, pH and cation concentrations of Na, K, Ca and Mg at 23 sites from May 1994 to May 1995 during drought conditions.

RESULTS

This research investigated the principal sources of salt, which were found to be basement rocks and rainfall. Rainfall accession was determined from seven sites across the catchments in a transect perpendicular to the coast. Accession was highest closest to the ocean, and the greatest contributions were from single events (probably relating to storm source), rather than constant low level inputs. Sodium dominated the cations found in rainwater. The geochemistry of underlying basement rocks had the greatest influence on the level of stream salinity and the types of salts (Table 1).

Geochemical data (Beams 1975, Lesh 1975) showed basement rock types contributed markedly different levels of Na, and ratios of Na to Ca, and these inputs coincided strongly with stream outputs. The geochemistry of the underlying rocks has a profound effect on the storage and release of salts. The effect is twofold. Not only are the basement rocks underlying a catchment a source of Na, they can also buffer the release of Na by their Ca, K and Mg content. The ratios of Na to Ca + Mg and Na to K can be used to predict salinity levels. The catchments containing basement rock types high in K, Ca and Mg have buffering processes that allow the leaching of Na from soils and sedimentary fills preferentially, preventing the build-up of NaCl and subsequent problems of salinity in streams. These salts are stored in specific parts of the landscape, which are governed by the physical structure of the landscape such as the soils, and sedimentary deposits, including valley fill sequences, swamps and chains of ponds. These stores, in soils and sediments are protected by specific vegetation which stabilises them. A further factor relating to the release of salts is the leaching process itself. Soils high in Na from either rainfall accession or underlying basement rocks, that have their hydrology changed anthropogenically, are prone to leaching and subsequent development of sodicity. Sodicity markedly affects erosive potential and the subsequent release of salts.

Under the influence of land use changes in the past 200 years, the catchment vegetation has been changed. There are two parts to these changes. The first is the clearing of slopes and crests causing an increase in discharge, resulting in some incision. However the much more important change causing the release of salt has been the destabilisation of the vegetation on the swamps and valley fills—the melaleuca communities. Thus the components of the Coastal Stream Salinity Model are the sources of salt, the landscape stores of salt, and the salt release mechanisms (Figure 1).

DISCUSSION

Stream geomorphology and sediment stores in valley fills and swamps were found to play the greatest role in defining the development of saline stream conditions. Valley in-fill sedimentary sequences have been eroded to expose windows into saline ground water. Certain sequences of river geomorphology have been shown to develop more or less severe salinity, with the risk being reduced in the presence of a forested upland headwater catchment, and increased by particular underlying basement rocks. The process is driven by the changes in land use since European settlement, so management aims would need to include land use practices that increase rainfall interception, infiltration and decrease runoff to prevent further incision of drainage channels. Particularly important is the protection and preservation of swamps and valley fills and an awareness that swamp and infill clearing precipitates the development of erosion and thereby stream salinity.

Table1: Stream Salinity trends for particular rock types

Catchments Basement rock types [a]		**1. Kameruka** Granodiorite	**2. Yurammie** Adamelite	**3. Candelo** Tonalite	**4. Bemboka** Granodiorite
Creeks	Site ref.	Stream water salinity levels as EC (μS/cm)			
W	1	1,351			
O	2	1,184			
L	3	1,520			
L	4	972			
U	5	1,076			
M	6	1,849			
L	7	729			
A	8	1,143			
	9	712			
	10	1,785			
	11		641		
	12		778		
	13		274		
	14		459		
C	1		734		
A	2			366	
N	3			296	
D	4			357	
E	5			386	
L					
O					
RE	1				173
GI	2				426
ON	3				197
Al	4				Mixed Geol. - 234
Approx. Area		88 km^2	67 km^2	102 km^2	
Average EC (**μS/cm**)		**1232**	**577**	**351**	**257**
EC Min. – Max.		712 - 1849	274 - 778	296 - 386	173 - 426
Range in EC		1137	504	90	253

a. Sources: Lewis *et al.* (1994).

Land management can only be effective if the components and processes that make up a system are understood by the owners or managers making the decisions. The components and processes have been identified by this research and can be incorporated into the development of a Rapid Appraisal Technique (RAT)(Hook 1992) for potentially saline streams to enhance the understanding of the landscape and thereby, land management effectiveness. The RAT is based on landscape indicators assembled either in a Geographic Information System or by using hard copy base maps. Basement rock types, geomorphology, and a snapshot stream salinity survey are the key components of the RAT.

CONCLUSIONS

The Model and RAT can be used to develop valid strategies for the prevention and management of stream salinity, and the baseline stream salinity data for Wolumla and Candelo catchments can be used to assess the outcomes of catchment management changes.

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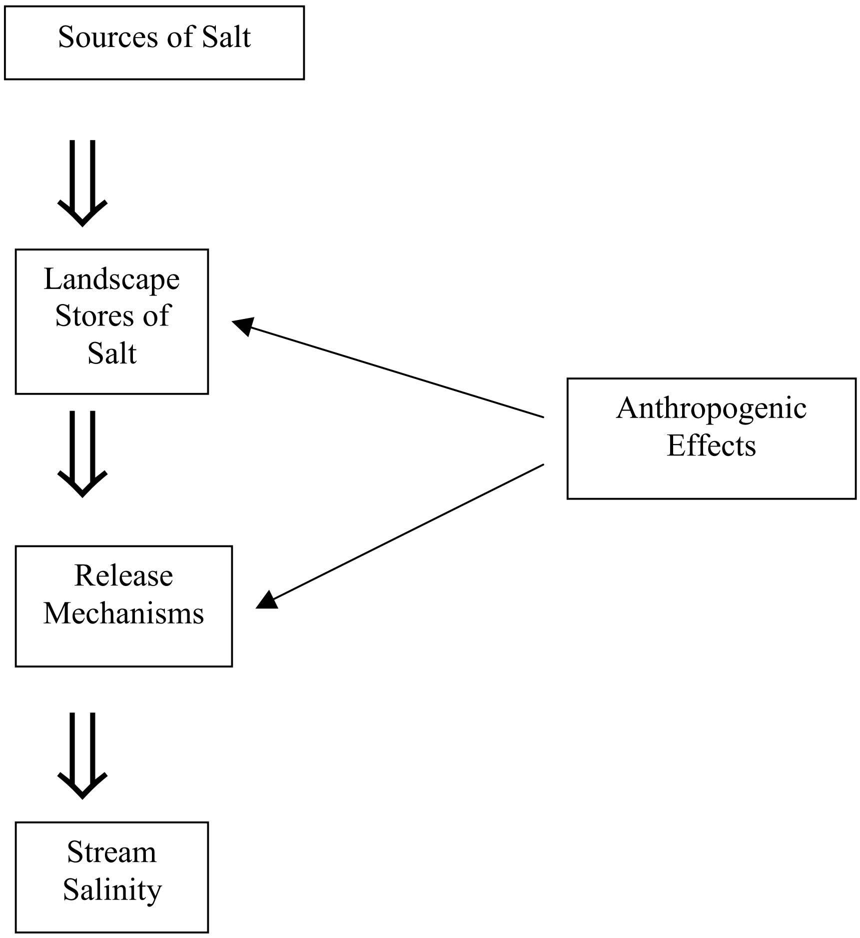

Figure 2: The four components of the Coastal Stream Salinity Model