THE FITZROY RIVER CATCHMENT: AN ASSESSMENT OF THE CONDITION OF THE RIVERINE SYSTEM

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Summary. A multidisciplinary ecological approach is being used to assess the *state of health* of streams within the Fitzroy catchment in Queensland. Initial biological results including diversity and abundance of invertebrates and native fish species indicate a fairly healthy state for most sites. Some other parameters are of concern. Suspended sediment, nitrogen and phosphorus concentrations are higher than environmental guideline values at downstream locations especially during higher stream flows. Blue-green types dominate algae at lower catchment sites in spring and summer under limited flow conditions. Low concentrations of pesticides, including the herbicide atrazine, are quite common in surface waters of the system particularly during flows and in summer. Further work will be needed to determine if these low concen-trations of agricultural chemicals have any short or long-term impacts on the biota of the streams.

INTRODUCTION

The Fitzroy catchment is one of the larger river systems of eastern Australia comprising almost 10% of the agriculturally productive land in Queensland. While seasonal variations and market forces will effect land use patterns, dominant land uses and their approximate percentages of the catchment include grazing (~ 90%) and cropping (~ 6%) (6). The major urban centre of Rockhampton is near the mouth of the Fitzroy River which discharges into the marine environment at the southern end of the Great Barrier Reef. Within the catchment, the numerous smaller towns and rural communities are directly dependent on surface water and groundwater resources. The streams of this sub-tropical, semi-arid region are somewhat ephemeral with summer rainfall dominant. Several large sub-catchments, including the Connors, Isaac, Nogoa, Mackenzie, Comet and Dawson contribute to flows in the Fitzroy River.

Resource uses within the Fitzroy catchment, the physical environment, flora and fauna have been recently discussed (3). Minimal historical data on water quality are available for the catchment, most studies being of limited scope and often site specific. With a growing awareness that all water users - urban, industrial and rural - have a role in catchment management, an assessment of the cur-rent *state of health* of the Fitzroy system is appropriate. For this, a multidisciplinary, ecological ap-proach is needed. A joint Queensland Department of Primary Industries, Central Queensland Uni-versity project team has been set up with funding support from the National Landcare Program for 1993-96. This paper reports initial results from the project in which flows, sediment loads, physical and chemical water quality characteristics as well as aquatic flora and fauna are being assessed.

MATERIALS AND METHODS

Sampling strategies

Streams at 11 sites representing the major sub-basins of the Fitzroy system were sampled three times (May/June 1994; October 1994 and May 1995) under base (background) flow conditions for the following parameters:

• physico-chemical:- flow, suspended particulate matter (SPM), turbidity (Secchi-disc), pH, dissolved oxygen (DO), temperature (T) and electrical conductivity (EC).

• chemical:- nitrogen (N), phosphorus (P) and pesticides including organochlorines, organo-phosphates and triazines (with detection limits of 0.1 µg/L).

• biological:- fish (species and abundances), phytoplankton (algae - types and abundances), macrophytes (aquatic vegetation), invertebrates (small aquatic animals) and zooplankton.

Six additional Dawson River sites were sampled every two months from August 1994 for physico-chemical and chemical parameters. Major flows in the sub-basins during 1994/95 were sampled for chemical parameters. Flow data were available for all sites from Water Resources gauging stations.

Sampling protocols

Strict sampling protocols and post-sampling preservation techniques (1) were used to ensure representative sampling and sample integrity. Physico-chemical parameters were measured *in situ* or on site, nutrient and pesticide samples were refrigerated and sent by air to the Resource Management Institute laboratory, Brisbane. Fish were captured, studied and released on site. Aquatic macrophytes were surveyed at each site. Phytoplankton (algal) and invertebrate samples were analysed by project participants at the Central Queensland University, Rockhampton. Zooplankton were evaluated at The Murray Darling Freshwater Research Centre, Albury. Results for chemical parameters were evaluated against Australian guidelines (1, 7) or overseas ones where Australian guidelines are not presently available.

RESULTS AND DISCUSSION

Rainfall and stream flow

Dry conditions prevailed throughout most of the Fitzroy system during 1994/95, with annual rainfall totals falling well below long-term means. The main rainfall event in 1994 occurred in March in the Dawson and Nogoa sub-basins. Again in 1995, significant rain fell in the upper Dawson and parts of the Mackenzie sub-basins during February and March. These were the only flows to move down the system past Rockhampton. Stream flows within the Fitzroy system were generally well below average during the sampling period.

Physico-chemical parameters

Results under base flow conditions for most measurements at most sites fell within environ-mental and drinking water guidelines (1, 7). For electrical conductivity (EC), one site at Rannes, on the Don River, was in the irrigation (high) range and exceeded the guidelines for aquatic ecosystem protection and raw water for drinking subject to coarse screening. This high conductivity may be the result of incursion of groundwater. No guidelines are presently available for suspended particulate matter (SPM) in Australian streams. Under moderate flow conditions (Table 1), Fitzroy waters grossly exceeded some overseas recommendations (2, 8). For the moderate flow in the lower Fitzroy in March 1994 (2.5 million megalitres), 3.4 million tonnes of soil were transported (5).

Table 1. Suspended particulate matter for the Fitzroy monitoring sites (g/L).

Parameter	Base Flow	Low to Moderate Flow	Moderate Flow
Mean (g/L)	0.032	0.643	2.3 (5)
Range	0.007 - 0.119	0.20 - 2.18	
Standard deviation	0.020	0.420	
No. of samples	54	24	

Nutrients (nitrogen and phosphorus)

Table 2 presents summarised data for the total nitrogen (TN) and total phosphorus (TP) content of streams in the Fitzroy system for moderate flows and under base (background) flow conditions. Under base flow conditions, the *mean* TN and TP values were within the upper guideline limits although values for several individual sites were not. For moderate flows, both the *means* and values for *all* sites clearly exceeded the recommended levels. TN and TP concentrations were highest at downstream locations.

Table 2. TN and TP concentrations (mg/L) for samples from the Fitzroy monitoring sites.

	Total nitrogen[a]	Total phosphorus[a]
Flow conditions Mean	1.51	0.46
Range	(0.89 - 2.88)	(0.17 - 0.87)
Standard deviation	0.49	0.18
No. of samples	24	24
Base flow conditions Mean	0.58	0.08
Range	(0.17 - 1.84)	(0.03 - 0.33)
Standard deviation	0.31	0.07
No. of samples	28	28

[a]Environmental guideline upper limits for total nitrogen and total phosphorus in Australian streams are: TN, 0.1 - 0.75 mg/L; TP, 0.01 - 0.1 mg/L (1).

Pesticides

The herbicide atrazine was the most commonly detected and widely distributed pesticide. From March 1994 to July 1995, atrazine residues were detected in 57 of 133 (43%) of stream samples from 16 sites throughout the Fitzroy system. Concentrations were low and within guidelines (7). Residues of *cotton* chemicals, including endosulfan, prometryne and profenofos were commonly detected downstream from irrigated cotton areas at Theodore and Emerald during summer. Levels of endosulfan exceeded the suggested upper environmental limit of 0.01 ?g/L (1). To our knowledge, no fish kills attributable to these residues occurred in the Nogoa or Dawson Rivers.

Algae (phytoplankton)

Sporadic algal blooms have occurred throughout the Fitzroy system. In 1994, the low algal counts (generally less than 500 cells/ml) of winter changed to quite high counts by October (up to 5000 cells/ml), with blue-green (cyanobacteria) types dominating at downstream sites on the Mackenzie and Fitzroy Rivers. These counts were however well below that (15000 cells/ml), at which direct contact should be avoided (1). Common genera included *Anabaenopsis, Aphanizomenon, Cylindrospermopsis* and *Pseudanabaena*. A rapid succession from diatoms (August) to euglenoids and dinoflagellates (October) to a cyanobacterial (blue-green) bloom (December) was evident at the Moura Weir on the Dawson River. A better understanding of factors controlling blooms in the Fitzroy system is obviously needed.

Aquatic invertebrates

The major insect, mollusc and crustacean taxa recorded were the Coleoptera, Diptera, Ephemeroptera, Hemiptera, Odonata, Trichoptera, Bivalvia, Gastropoda, Decapoda and Isopoda. A broad representation of families within these taxa, without an excess of any one type indicated that the streams at the monitoring sites were relatively *healthy*. The presence of Trichoptera and Ephemeroptera in high numbers at many sites was promising as these organisms are often associated with good water quality.

Fish

A total of two exotic and 21 native species including several with culinary and game fishing value were recorded at the eleven sites. One species, *Hypseleotris galii* (firetail gudgeon) was present at all 11 sites. In general, species diversity decreased with increasing distance from the mouth of the Fitzroy River, possibly due to restricted instream habitats at upper catchment locations.

CONCLUSIONS

Biological measurements indicated a fairly *healthy* state at most of the river sites studied.

Significant flow events moved millions of tonnes of soil as suspended material past Rockhampton into the marine environment (5). Suspended solids are known to act as a major transport mechanism for phosphorus (4) and potentially pesticides. Lack of historical data makes difficult the task of evaluating the impact of land clearing and development that has taken place over the last fifty years. Determining the age of strata in offshore sediment profiles would assist in this evaluation.

Nutrient concentrations were higher than environmental guidelines at lower catchment sites and in areas of intensive agricultural activity such as the mid Dawson basin. For these sites, algal growth was probably not limited by the availability of nutrients but by other factors such as high turbidity (1).

Low concentrations of pesticides in surface waters of the catchment were reasonably common during and after flow events and in summer. These concentrations were mostly within current guidelines, where available, but the impact, if any, of the residues on riverine biota has not been determined.

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