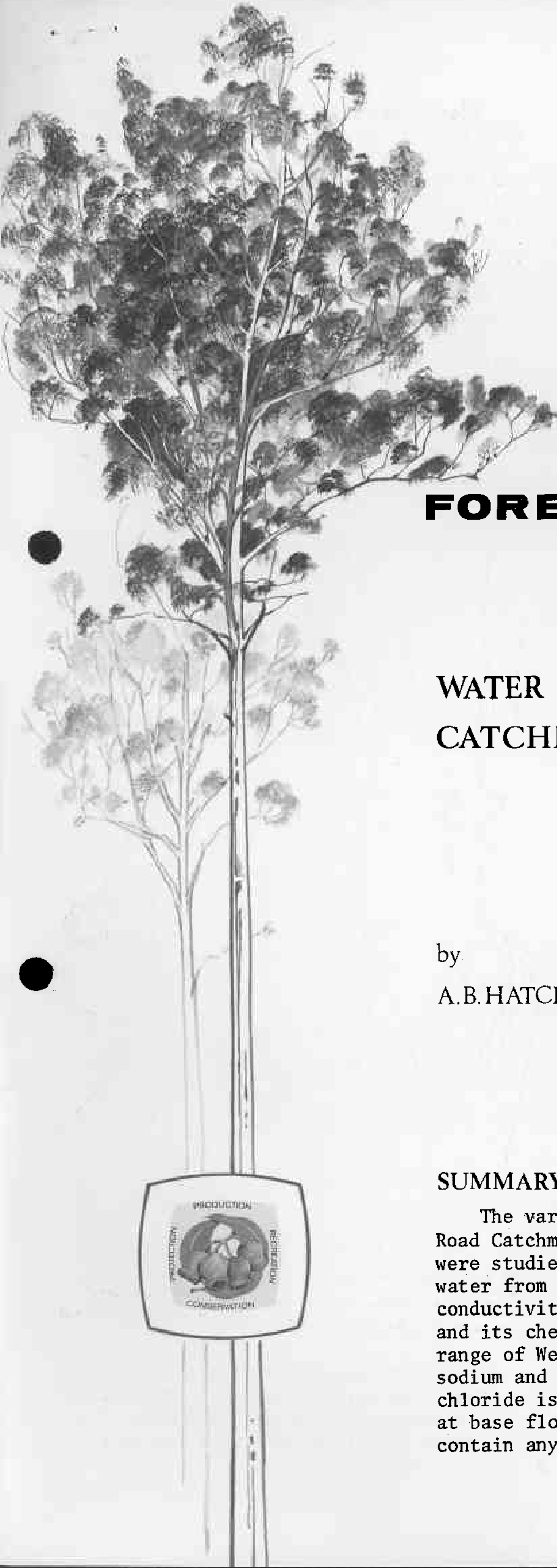

Research Paper 30
1977

FORESTS DEPARTMENT
OF WESTERN AUSTRALIA

WATER QUALITY IN ALLAN ROAD CATCHMENT, WESTERN AUSTRALIA

by
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SUMMARY

The variations in water quality within Allan Road Catchment, 16 km south east of Dwellingup, were studied from August 1973 to April 1974. The water from the Catchment has low electrical conductivity (EC) with a maximum of 735 $\mu S \cdot cm^{-1}$, and its chemical composition is similar to a wide range of Western Australian forest streams : sodium and magnesium are the major cations, and chloride is the dominant anion. The EC values at base flow suggest that the catchment does not contain any large subsoil reserves of salt.

INTRODUCTION

As part of a detailed study of the hydrology of the jarrah (Eucalyptus marginata Sm.) forest in Western Australia, a stream sampling programme was started in the catchments near Dwellingup in July 1973. The aims were:

1) to examine any variations in water quality within and between catchments;
2) to use the electrical conductivities (EC) of base flow to define areas containing subsoil reserves of salt.

The data reported in this paper relate to Allan Road Catchment, a small catchment within the forest zone of the Murray River drainage system (Figure 1).

Description

The Allan Road Catchment is located 16 km south east of Dwellingup and has an area of 2050 ha. The drainage pattern is oriented in a north westerly direction towards the Murray River and the stream has four main tributaries (Figure 2). The closest meteorological station is at Dwellingup where the average annual rainfall is 1288 mm, 84% of which falls during the six months April to September (Bureau of Meteorology, 1965).

Generally, the landscape of the Catchment is stable, but small areas of erosional and quasi-stable surfaces occur along the lower reaches of the stream. Consequently, the majority of the soils within the Catchment are Darling Range laterites, but restricted areas of younger soils derived from the underlying country rock occur on the erosional surface (Figure 3) (Clifton, 1966).

The Catchment is entirely within State Forest and the vegetation is predominantly a jarrah-marri (Eucalyptus calophylla R.Br.) pole stand with small pockets of blackbutt (Eucalyptus patens Benth.) along the streams. The codominant height of the stand is 27.4 to 30.5 m, (Figure 4), and the canopy cover varies between 40 and 60%. Jarrah dieback disease (Phytophthora cinnamomi Rands) is present in 11% (223 ha) (Figure 5) of the area, and is largely confined to the major drainage lines.

METHOD

Weekly stream sampling started on 8 August 1973 and continued until 30 April 1974. Eleven sites were sampled: seven along the main stream and one from each of the tributaries.

Electrical conductivity (EC) values were determined on each sample, and for four key samples (1,3,5 and 9) cation and anion analyses were carried out. The analytical methods used were those described by Hatch (1976).

An important measure of water quality is the total dissolved solids (TDS) present in the water, and this parameter is closely related to the EC of the water (Hart, 1974; Hatch, 1976; Richards, 1969). In this paper EC values have been used as an expression of water quality.

RESULTS

The seasonal trend in EC for four of the main stream samples (1,4,7 and 10)

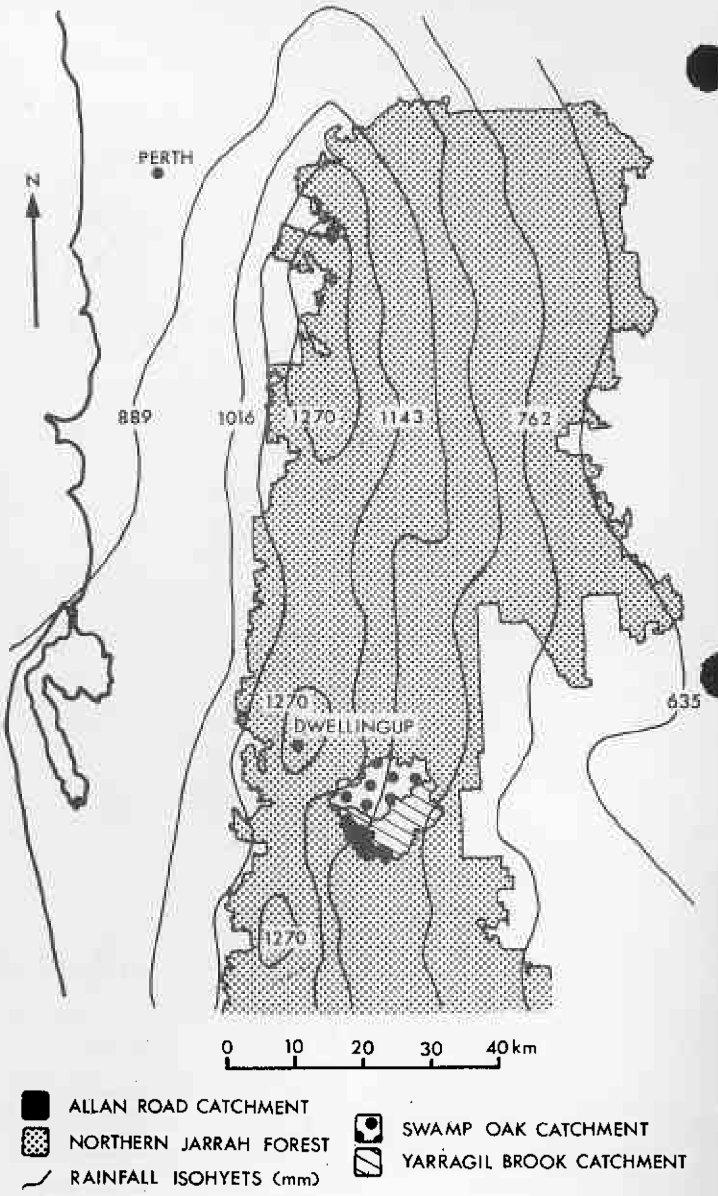

FIGURE 1: Locality plan of Allan Road, Yarragil Brook, and Swamp Oak Catchments showing the northern jarrah forest and rainfall isohyets

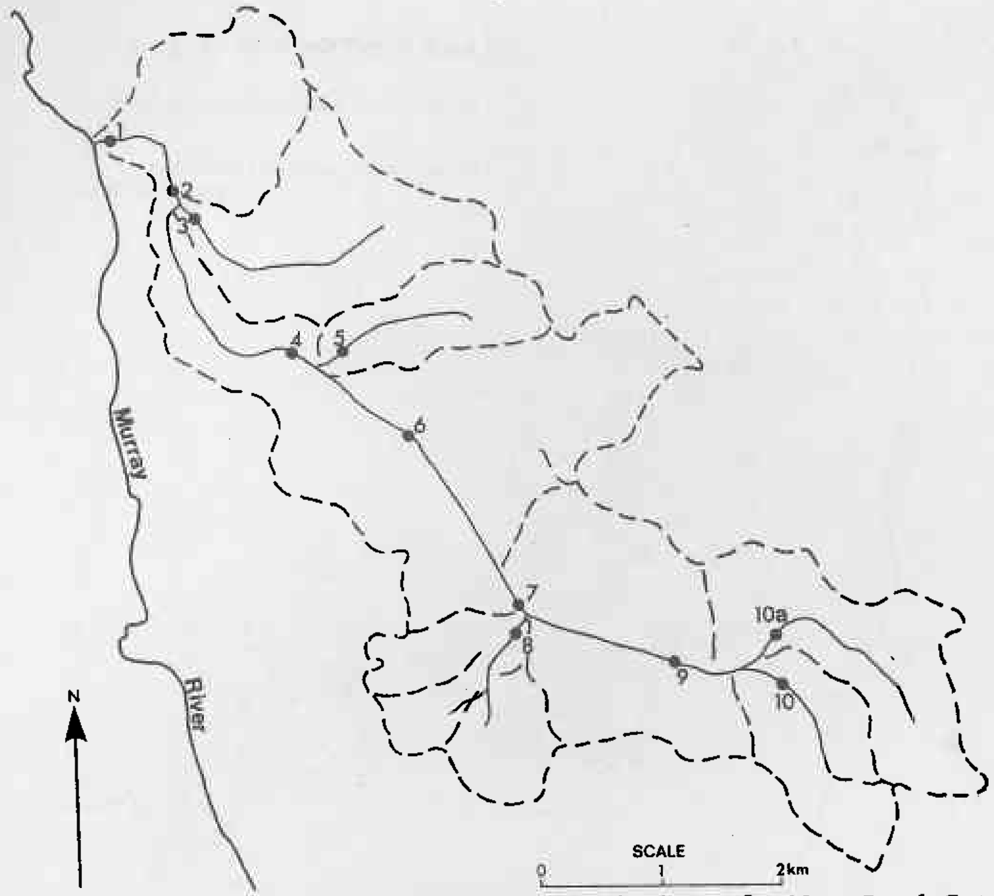

FIGURE 2: Catchment and microcatchment boundaries of Allan Road Catchment

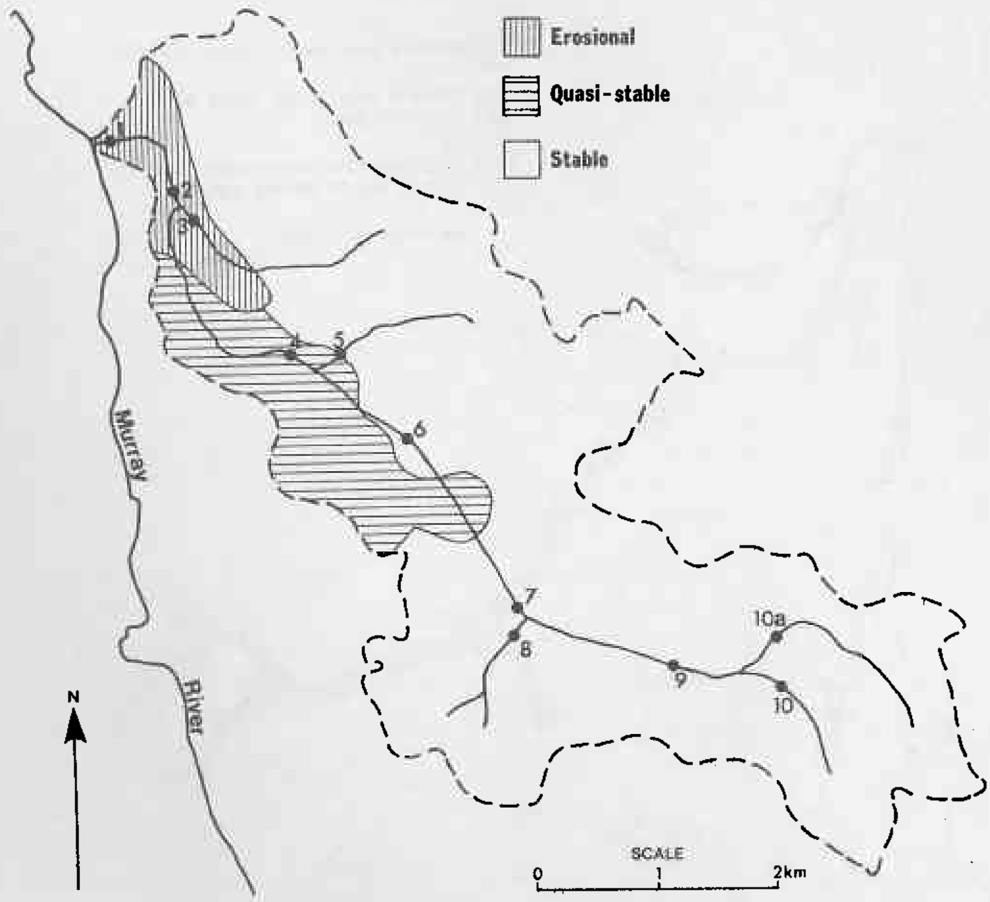

FIGURE 3: Geomorphological surfaces

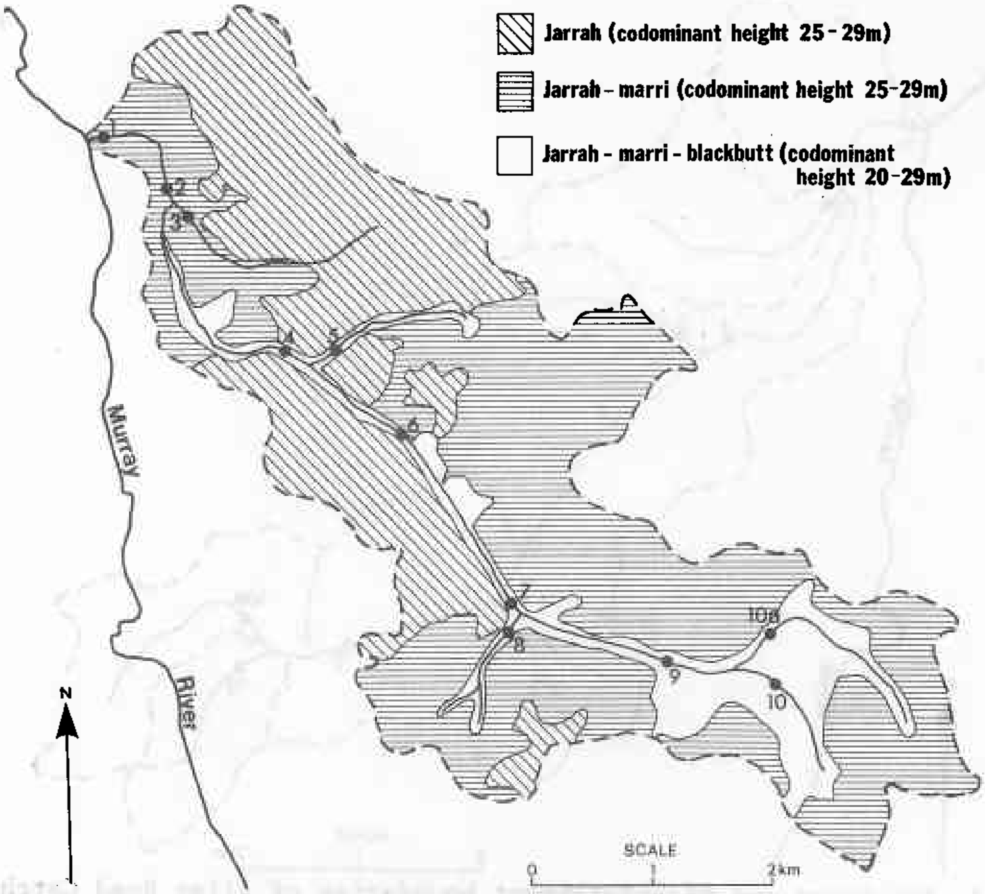

FIGURE 4: Major forest types

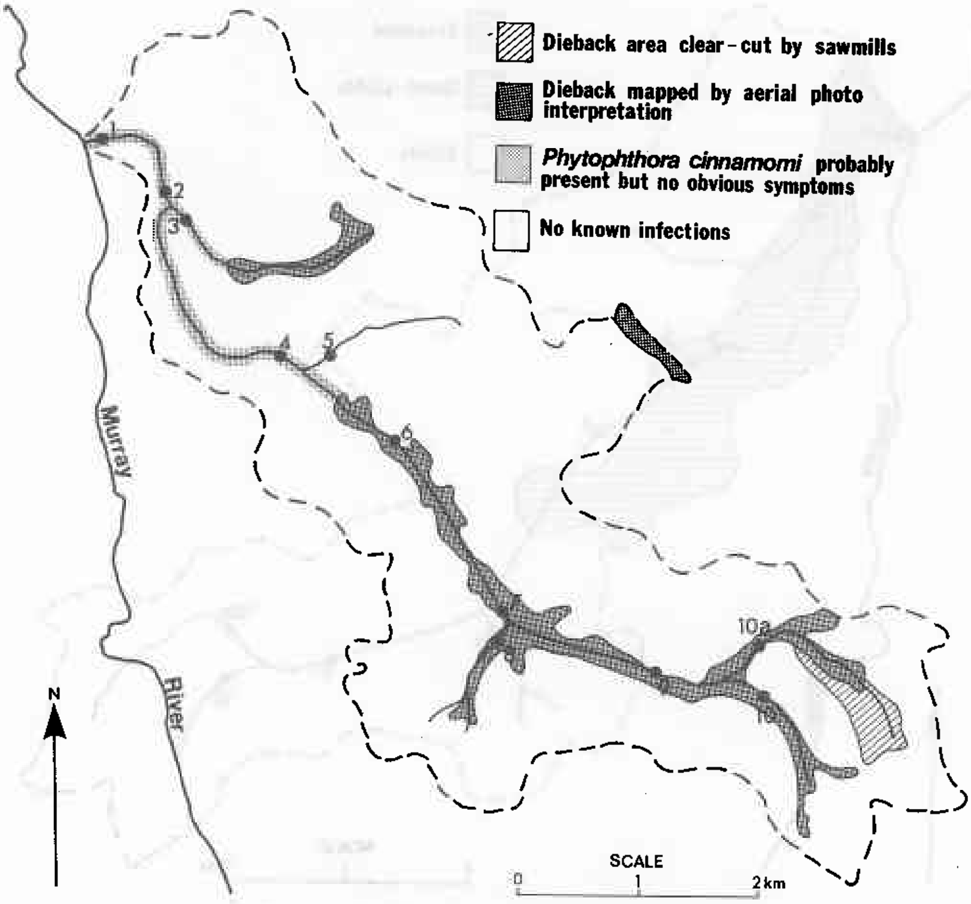

FIGURE 5: Incidence of jarrah dieback disease

is shown in Figure 6, and the corresponding values for the tributaries are plotted in Figure 7. This trend is similar to the trend for all Western Australian forest streams; EC values were lowest in winter (July to August), and highest either immediately before the stream dried up or during late summer or early autumn (February to April) for streams which flowed all year round (Hatch, 1976) (Table 1).

Ground water salinity is not an important factor in this catchment because all EC values at base flow were less than 750 µS·cm^{-1} (500 mg·l^{-1} TDS) which is considered as non-saline groundwater (Richards, 1969).

TABLE 1
Maximum and minimum EC

	EC µS·cm^{-1}	Sample no.	Date of sampling
Max.	735	7	17 April 1974
Min.	179	10	3 August 1973 22 August 1973

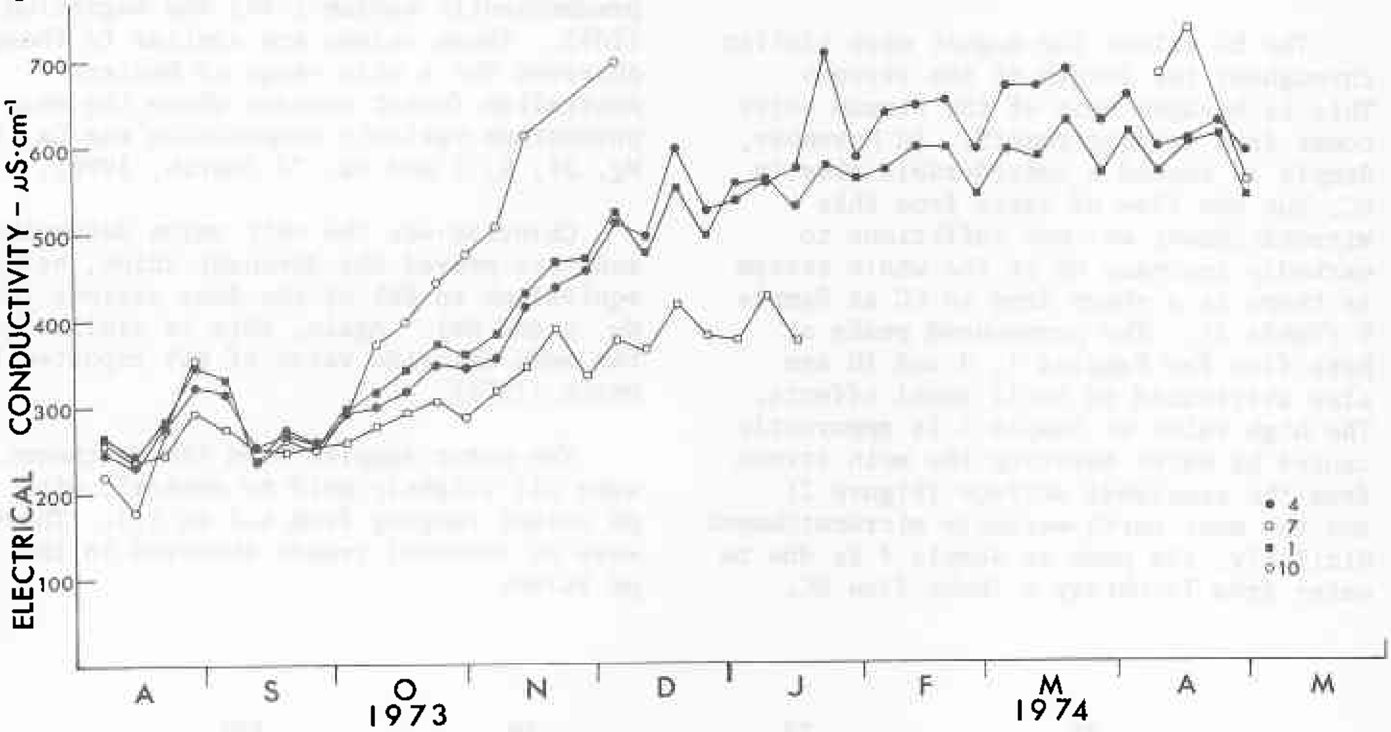

FIGURE 6: Seasonal variation in EC for main stream sampling points

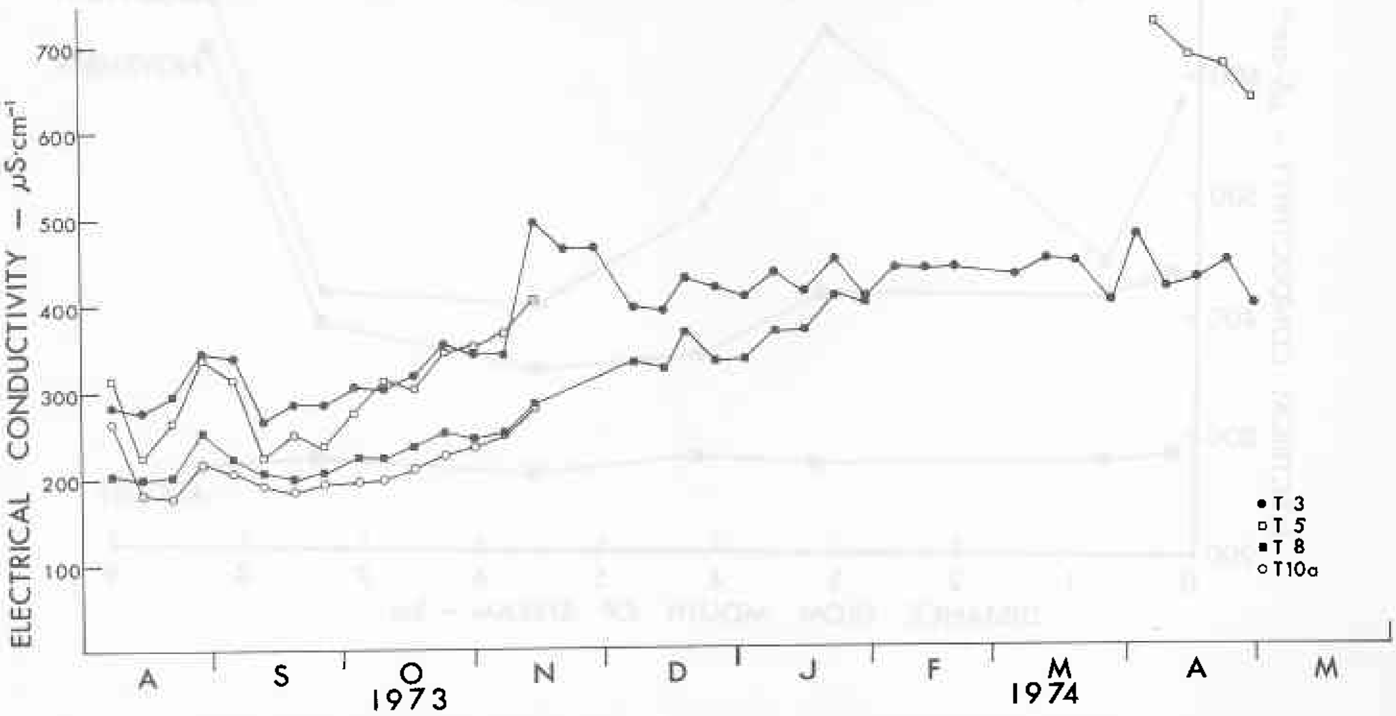

FIGURE 7: Seasonal variation in EC for tributary sampling points

To examine the effects of the different tributaries, the EC values for sampling points on the main stream were plotted against the distance from the mouth of the stream. Three sets of data were compared: the mean values for late winter (August), the mean values for late spring (November), and the base flow value. For the ephemeral streams, base flow values were calculated as the mean EC of the last two samples, and for the permanent streams the mean February values were regarded as the base flow EC (Figure 8).

The EC values for August were similar throughout the length of the streams. This is because most of the stream water comes from surface runoff. In November, Sample 10 showed a considerable rise in EC, but the flow of water from this microcatchment was not sufficient to markedly increase EC in the whole stream as there is a sharp drop in EC at Sample 9 (Table 3). The pronounced peaks at base flow for Samples 1, 4 and 10 are also attributed to small local effects. The high value at Sample 1 is apparently caused by water entering the main stream from the erosional surface (Figure 2) and the most north-westerly microcatchment. Similarly, the peak at Sample 4 is due to water from Tributary 5 (base flow EC, 667 $\mu S \cdot cm^{-1}$) and the high value for Sample 10 was already evident in the November samples.

Statistical analysis of the EC data for all sample points for these three periods indicates that the differences in EC between streams and sampling periods are highly significant (Table 2). The variations in cation composition for samples 1, 3, 5 and 9 for the three periods are shown in Table 3. All four samples are very similar in cationic composition: predominantly sodium (74%) and magnesium (20%). These values are similar to those observed for a wide range of Western Australian forest streams where the mean percentage cationic composition was Ca, 6; Mg, 21; K, 1 and Na, 72 (Hatch, 1976).

Chloride was the only anion determined and this proved the dominant anion, being equivalent to 88% of the four cations (Ca, Mg, K and Na). Again, this is similar to the mean chloride value of 86% reported by Hatch (1976).

The water samples from the Catchment were all slightly acid to neutral, with pH values ranging from 6.2 to 7.1. There were no seasonal trends observed in the pH values.

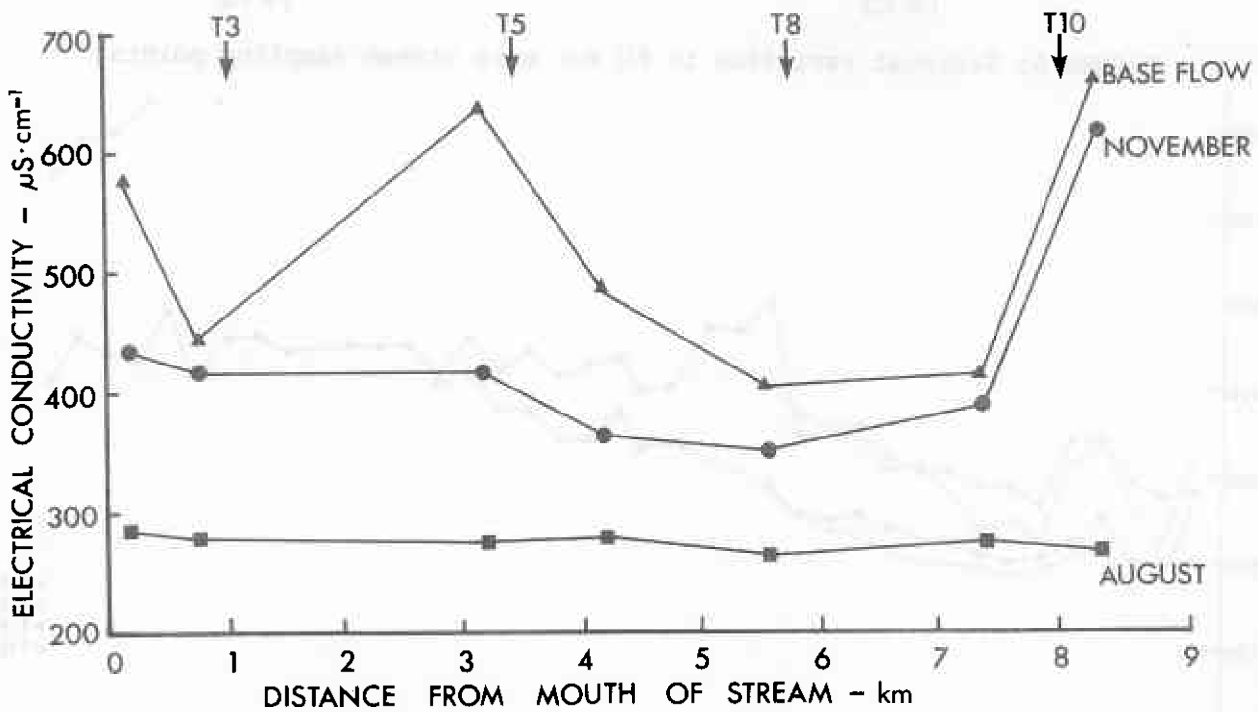

FIGURE 8: Relationship between EC and sample point location

TABLE 2
Variation in EC
Analysis of variance

S	df	SS	MS	VR
Sample points	10	163235.52	16323.55	3.44**
Sampling periods (a)	2	276677.52	138338.76	29.18***
Error	20	94832.48	4741.62	
Total	32	534745.52		

(a) August, November, and base flow

TABLE 3
Seasonal variation in cation composition

Sample no.	Month	EC $\mu S \cdot cm^{-1}$	Ca	Mg	K	Na
				%		
1	Aug	283	4	17.5	1.5	77
	Nov	436	4.5	18.8	1	75.7
	Feb or bf	575	5.8	23	1	70.2
	Means		4.7	19.9	1.2	74.2
3	Aug	301	5.5	20.5	1	73
	Nov	440	4.8	18.8	1.2	75.2
	Feb or bf	438	5.2	22.8	1	71
	Means		5.2	20.7	1.1	73.0
5	Aug	285	5.5	21.5	2	71
	Nov	386	4.5	20	2	73.5
	Feb or bf	667	6.5	25	2	66.5
	Means		5.5	22.2	2.0	70.3
9	Aug	268	3.5	17.2	1.8	77.5
	Nov	380	3	16	2	79
	Feb or bf	406	4	20	1.5	74.5
	Means		3.5	17.7	1.8	77.0

bf = base flow

DISCUSSION AND CONCLUSIONS

The Allan Road Catchment drains a small forested area which apparently does not contain large subsoil reserves of salt within the drainage area. This suggestion is supported by the EC values at base flow which indicated a mean maximum of 667 $\mu S \cdot cm^{-1}$. This is in contrast to the two neighbouring catchments of Swamp Oak Brook and Yarragil Brook (Figure 1) where some microcatchments showed base flow EC values of 2972 and 1857 $\mu S \cdot cm^{-1}$ respectively.

The water from Allan Road Catchment is a good quality water: TDS (calculated from EC data) is less than 500 $mg \cdot l^{-1}$ (World Health Organisation, 1971).

Jarrah dieback disease (affecting 11% of the area) does not appear to have had a deleterious effect on the water quality of the Catchment.

The data indicate that this detailed sampling technique is needed to detect minor variations that can occur within a catchment.

ACKNOWLEDGEMENTS

Acknowledgement are due to the staff of the Dwellingup Research Station for their assistance in the collection of the samples.

Thanks are also due to Mrs. C.Y. Goodlet, who was associated with the laboratory analysis of the samples.

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