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DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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FORESTS DEPARTMENT

Manjimup Research Office,

To A.D.F.O. McCaw 10 June 1985

Western Australia

Fire Research

Reference-H.O.

Local

SUBJECT: "TRYPHOCARIA ACANTHOCERA IN KARRI REGENERATION"

Attached is a preliminary report on the incidence of the wood-borer Tryphocaria acanthocera or "Bulls-eye" borer in the karri regeneration stands.

The literature available regarding this parasite is extremely limited, and the only reference of value found so far is contained in an article by J. Clark in the West Australian Journal of Agriculture 1925.

Some of Clark's material is quoted.

R.V.

R. Voutier
A.F. (TECH)
RESEARCH DIVISION MANJIMUP

RV:LS
enc

Copy to: C.O.D. Havel - Como
Supt. McKinnell - Como
Supt. Christensen - Como
Dr Abbott - Como
A.D.F.O. Lowe - Como

1. TRYPHOCARIA ACANTHOCERA

1.1 The presence of this borer and its ability to cause severe structural damage to healthy trees has been recognized for many years, and as far back as 1925 its attack on Marri trees in Mundaring W.A. was studied and described by Clark. Also known as the Marri-borer it attacks a number of other eucalypts including karri: a fact not mentioned in the literature. Tryphocaria acanthocera is one of the longicorn beetles, and the female deposits her eggs in wounds or cracks in the bark. The eggs are greenish white, about six or seven millimetres long and extremely fragile. "They are coated with an adhesive substance that secures them in place and oviposition is thought to take place in November or December" (Clark).

On hatching the larva eats its way through the bark in an upwards spiral until large enough to enter the wood. By this time it is about three centimetres long and five to seven millimetres thick. Its life cycle is about two years, and during its larval state it mines extensively through the wood in an upwards direction. The pattern followed is to excavate areas of hardwood just below the sapwood. In karri regeneration the length of these damage areas ranges between one third and one half metres. The width can be up to ten centimetres and depth as much as one centimetre. The tree trunk swells directly above this activity, and the extent of the damage can often be traced with the fingers. At the apex of the excavation it begins boring upwards again in a rough spiral but remaining generally in the same wood layer. Occasionally a gallery is opened out through the bark and frass will be ejected for some time. This pattern is repeated three to five times and usually extends for a total vertical distance of one and a half to two metres up the tree. At the last and highest area of damage the larva eats through the sapwood and into the hard-wood. It then cuts a shallow but positive "ear" shaped groove in the wood. The function of the groove is to channel away from the mouth of the pupal cell, the kino, that eventually flows from the wound. Below the groove and centrally the larva cuts the deep down-curved pupal cell at such an angle that it remains in the hard-wood and does not enter the pith. On the single occasion a larva was observed at work it appeared that the cell is initially cut out to the same dimensions as a connecting gallery. The cell mouth is later widen-ed, and at the point where it begins to curve downward the outer end

of a tightly fitting plug is built. To begin with, the cell mouth is blocked for about one centimetre with loosely packed wood-chips. Working from inside the cell, the larva then builds against the chips a wall made of a grey cement-like excretion that sets into a hard air-tight shield about one millimetre thick. The remainder of the cell is then widened, and the chips and fibres cut from the walls are packed tightly against the shield all the way down the cell. Just enough room is left at the bottom for the larva to lie and await metamorphosis. Frass is not found in the cell, indicating that the wood is not ingested during this phase. After metamorphasis the beetle breaks out through the plug to continue the cycle.

In his paper Clark writes that "the cells are made in April and May with pupation taking place in October or November and the beetle exiting January and February". However, in the karri occurrence the evidence is for a slightly later date for cell construction. Here, no new cells have been found prior to mid July. Clark's given period for pupation is supported by this study with pupal cells opened in mid November showing the process well under way, with the stage reached where the antennae and fore-legs are free of the carcass. Live beetles have been taken from traps from mid January through February which is again supportive of Clark's comment. However, if oviposition occurs in November-December as Clark postulates then it would appear the beetle has a life span of approximately twelve months. Although this seems improbable at first glance it tends to be given substance by the data contained in section 11 of this report in which a larva was observed to proceed to beetle status in an eleven month period. This also supports the theory of a two year life cycle.

A further point of interest confirmed by this study and not noted in the literature is that the borer has the innate capacity to delay metamorphosis for as much as twelve months; presumably so that the beetle emerges when conditions are most suitable. Substantiation of this is provided by the removal of live beetles in February 1985 from cells known to have been made in June-July 1983. The process by which metamorphosis is delayed is beyond the scope of this study but an understanding of the reasons for it may well provide a means of controlling the borer population.

2. Distribution

2.1 The indications are that the borer will be found in varying degrees throughout the karri regeneration mosaic. Infestation has been confirmed in the following forest blocks and karri plots.

Northcliffe	Meribup Plot	Treen Brook
Collins	Mooralup Plot	Big Brook
Graphite	Dingup Plot	Channybearup
Boranup	Poole	Dombakup
Gray	Gordon	Boorara

3. Site Quality

3.1 The proposition has been suggested that Tryphocaria acanthocera is oriented toward the off-site situation. In other words its main attack is directed to the poorer quality, less vigorous stands. An assessment will be necessary to confirm this one way or the the other, but visual appraisement has shown that top quality sites tend to be more heavily infested than others.

Areas of young karri established on re-claimed grassland are also found to be under attack and the same situation is often found in young stands abutting grass-land. The possibility of correlation between these parameters is worth testing also.

4. Wood Moisture Content

4.1 The larvae of Tryphocaria acanthocera are well adapted to varying wood moisture-content levels and have been observed to remain active for months in log sections removed from the tree. The point at which moisture-content becomes too low to sustain life is not known but it must be quite minimal.

5. External Symptoms

5.1 Trees under attack by the borer for any length of time "bleed" profusely from the frass ejection vents. The kino runs down the trunk leaving a distinctive orange-red stain which is easily detectable even at distance.

6. Frass Ejection

6.1 The ejection vents are about five or six millimetres in diameter and attention is directed to them by frass clinging to the bark or heaped on the ground at the tree base. Clean dry frass ejected from the vents indicates the borer is active and near-by, whereas a vent choked with kino-soaked frass signals that the gallery has been extended some distance.

7. Pupal Cells

7.1 These are easily seen as the ear-shaped groove exposed by a slit cut through the bark and described in 1.1. Cells are found from one to fifteen metres up the trunk of young karri trees and in mature trees are seen with binoculars far above this level. The cells are located quite randomly on the tree trunk with no apparent preference for any particular aspect or direction. Occupancy is confirmed by the presence of the plug.

8. Trunk Deformities

8.1 Small sections of a tree trunk in which there are several active larvae can be so severely internally mined that they are snapped off by wind. Decay is almost always present in the walls of old galleries and radiates outwards into the wood. It seems probable that wood-rotting fungi is admitted to the tree via the galleries.

9. Predators

9.1 Birds and Braconid wasps are both described by Clark as predators of Tryphocaria acanthocera larvae, but only the Black Cockatoo (Calyptorhynchus spp.) is identified. This bird causes severe damage to young trees in the Eastern States by tearing away the wood in search of the larvae. No evidence whatsoever of this has been found in the young karri stands. Larval skins are occasionally found in the galleries indicating wasp attack. But this is quite rare and it seems unlikely that predators have much impact on the borer whilst in the larval state. Some predation by birds may occur once beetle status is reached but no evidence is available on this point.

10. Preferred Tree Size

10.1 The borer appears to attack healthy and vigorous trees of all sizes above a cross-sectional diameter of 75-80 mm. Below this diameter the incidence of larval mining is uncommon and suppressed trees are seldom attacked at all.

11. Detailed Observation

11.1 Figure 1. illustrates the monitored progress of a Tryphocaria acanthocera larva as it mined through a small karri tree in the "Cemetary" plot at Manjimup. The larval activity culminated in the construction of a pupal cell 1.7 metres above ground. Four vents for the ejection of frass were opened through the trunk as the galleries were extended upwards. No indication was found of where the juvenile larva first entered the trunk.

Observations began on 3 August 1983 when frass was seen being ejected from Vent 2, located 34 cm above Vent 1 and about 120° to the left. Frass was collected from Vent 2 until 14 September 1983 for a total yield of 12.1 grams O.D.W. in the 39 day period. Collection of frass was discontinued when the collecting device was vandalised, but ejection continued until 9 October 1983. No further signs of activity were noted until early May 1984 when frass was noted issuing from Vent 3, located 71 cm above Vent 2 and 80° to the left around the trunk. Vent 3 is estimated to have been opened in mid April 1984. Activity from Vent 3 ceased after a few days. On 11 June 1984 Vent 4 was found 17 cm above Vent 3 and 160° to the right. Frass ejection continued for several days and then ceased. When next the tree was examined on 23 July 1983 a pupal cell with the plug in place was noted 35 cm above Vent 4 and 30° left. It is a reasonable assumption therefore that in a period of roughly forty five days the larva had not only bored upwards a distance of 35 cm but had also constructed the pupal cell. The overall rate of excavation must therefore be considerable. A trap placed over the cell-mouth yielded an adult beetle in January 1985.

12. Conclusions

12.1 The study has clearly shown that the borer has the capacity to inflict severe structural damage to young vigorous karri regeneration.

Infestation is widely spread throughout the resource, and with the parasites suspected prediliction for the quality tree the situation is potentially serious. Inside the tree the larva is remarkably well protected from the few known predators and these appear to make little impact on the inroads made by the borer. There is some evidence that larval metamorphosis is aborted by fungal attack inside the pupal cell, but the incidence does not appear to be high. Extremely vigorous trees will sometimes completely occlude the pupal cell area to the extent that the beetle cannot exit. However this is the exception rather than the norm and in any case the structural damage is permanent. At the moment no obvious means of controlling the borer presents itself but it is hoped that the data obtained in this study will aid future researchers. The problem should be taken seriously for the reason that although Tryphocaria acanthocera has always been around, its presence in large section trees has not been seen as a matter for concern. However the days of "large-section" timber production are numbered in the karri resource and "small-section" cutting will soon be the "modus operandi". In this situation larval mining becomes much more apparent, at once degrades the wood, is aesthetically displeasing, and of necessity must structurally weaken the product.

R.V

R. Voutier
A.F. (TECH)
MANJIMUP RESEARCH DIVISION

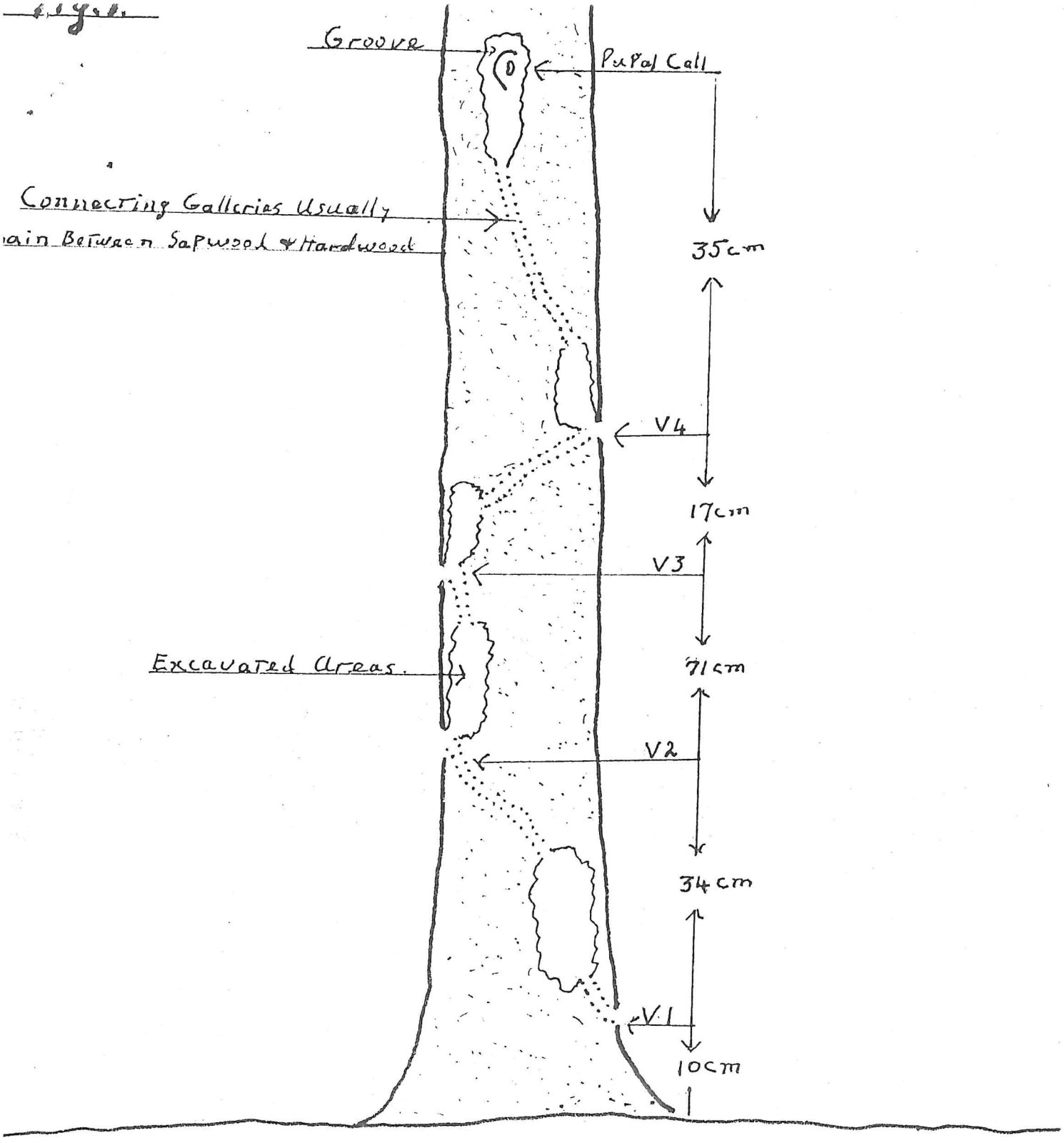

Figure 1. Internal damage caused by the larva of the Tryphocaria acanthocera (Macleay) to the trunk of a small karri (Eucalyptus diversicolor) over a measured period of 11 months.