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The Biology of Proterodiplosis radialis Wyatt

(Cecidomyiidae : Diptera)

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## ABSTRACT

Aspects of the biology of Proterodiplosis radialis were investigated. Field studies in the S.W. Ruahine Range were supplemented with laboratory experimentation.

P.radialis is a root parasite of Metrosideros robusta A. Cunn. (MYRTACEAE), and forms galls on the tree's fine rootlets. The host's phenology and the developmental stages of P.radialis are described. The insect passes through three distinct larval instars and pupates within the gall. Adult emergence continues from mid-February to March. The adults represent a non-feeding, short-lived (2-4 days) reproductive stage in the life cycle. Dispersal appears to be heterogenous and of little direct consequence to the population. Other aspects of the dynamics of the population were investigated and the findings collated in a life table. Greatest mortality occurs while the insect is without the protection of the gall, i.e. the adults, eggs and first larval instar. The first larval instar is of long duration and predation by eurytopic soil fauna probably effects the most significant regulation of the insect's numbers. The pupa is parasitised by a small ceraphronid while within the gall.

P.radialis was found to be strongly host-specific. The subtleties of the intimate plant-insect association are discussed with reference to gall structure, metabolism and chemistry. The conclusion is drawn that P.radialis cannot be seriously implicated in the widespread debility of Metrosideros robusta.

## PREFACE

The thesis investigates various aspects of the biology of Proterodiplosis radialis - a root parasite of Metrosideros robusta. It is presented in three parts.

The first part describes the area in which the study was undertaken, the host tree, the phenology of the host and the developmental stages of P.radialis. The second part describes some aspects of the biology of P.radialis and factors influencing the dynamics of the insect's population. This section culminates in a life-table where the impact of the insect's biological character and external negating factors are assessed.

The third part attempts to describe the finer points of an intimate insect-plant association. The significance of the interaction to the biologies of the host and parasite is discussed.

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## INTRODUCTION

The Cecidomyiidae represent a large family of nematoceros Diptera. Although small in size the 5000 or so recorded species, with their novel habits, make this a conspicuous element in the world's insect fauna. They are most closely related to the fungivorous Mycetophilidae and a number of the more generalised cecids share this habit. Certain other cecids, notably Aphidoletes and Mycodipteris, are important as predators of other insects, especially Homoptera. However, the greater majority are phytophagous and may cause conspicuous, localised plant deformities, or galls, during their association with the plant. Many have become serious economic pests with some attaining international pest status. The Hessian fly (Meyetiola destructor), pear midge (Contarinia pyrivora) and clover midge (Dasineura leguminicola) are common pests throughout the world. Adult cecids are small two-winged flies ranging in size from 0.5-8.0 mm (Felt, 1925). They are readily dispersed (Johnson, 1969) and the phytophagous larvae are so well protected that control is often difficult.

The Cecidomyiidae, or gall midges, of economic importance in New Zealand have all been introduced. Our knowledge of endemic species is fragmentary. The Southern Hemisphere gall midge fauna appears to contain a considerable number of ancient, highly specialised, offshoots from the more primitive cosmopolitan genera, such as Lastremia, Porricendyla and Dasineura (Felt, 1925). Their character suggests a long period of zoological isolation. Lamb (1962) and Barnes (1937) have recorded a total of 40 species from New Zealand. The majority of these were captured as adults and tentatively identified with little knowledge of their biologies. Only the more common and economically significant species have so far been studied in detail.

Proterodiplosis radialis Wyatt was discovered during an investigation into the widespread mortality of northern rata (Metrosideros robusta A. Cunn.), a dominant indigenous forest species.

The midge proved not only to be a new species, but also a new genus of some economic interest (Wyatt, 1963). On the character of the male antennal structure, the midge was considered to be a primitive member of the tribe Cecidomyiidi trifila, other members of which show a range of feeding habits from predation to phlophagy. P.radicis, however, has the comparatively rare habit (Mani, 1964) of forming galls on the fine rootlets of the tree. The galls were found to occur on the roots of northern rata over a large area of the central North Island. However, it was considered improbable that they were an important factor in the mortality of the tree (Wyatt, 1963).

Northern rata is distributed throughout the North Island and the north of the South Island. Typically the seedling tree is an epiphyte, usually of rimu (Dacrydium cupressinum). Its descending ground roots coalesce and gradually overgrow the host tree. Over a number of years the host decays, leaving a massive, irregular, and to some extent, hollow tree. Its irregular epiphytic growth forms create conversion and seasoning difficulties for timber millers so the tree has no substantial market other than for local consumption as firewood. For these reasons rata is rarely felled and has become of some importance in watershed maintenance in milled lower montane forests (Masters et al., 1957).

This study was conducted in the Southern Ruahine Range. As early as 1951 heavy rata mortality was recorded in the Tamaki Valley (S.E. Ruahines, Fig. 1) and by 1952 canopy defoliation was conspicuous from the plains (Elder, 1958). Early in 1955 rata and kamahi (Weinmannia racemosa) mortality was reported from several areas almost simultaneously and an interdepartmental survey was instigated (Holloway et al., 1955). The survey revealed a number of injurious agents affecting rata. Individually these factors were capable of inflicting localised mortality; however, the widespread damage encountered was considered to be a complex ecological problem (Hoy et al., 1955). The present study investigates the role of P.radicis within this complex.

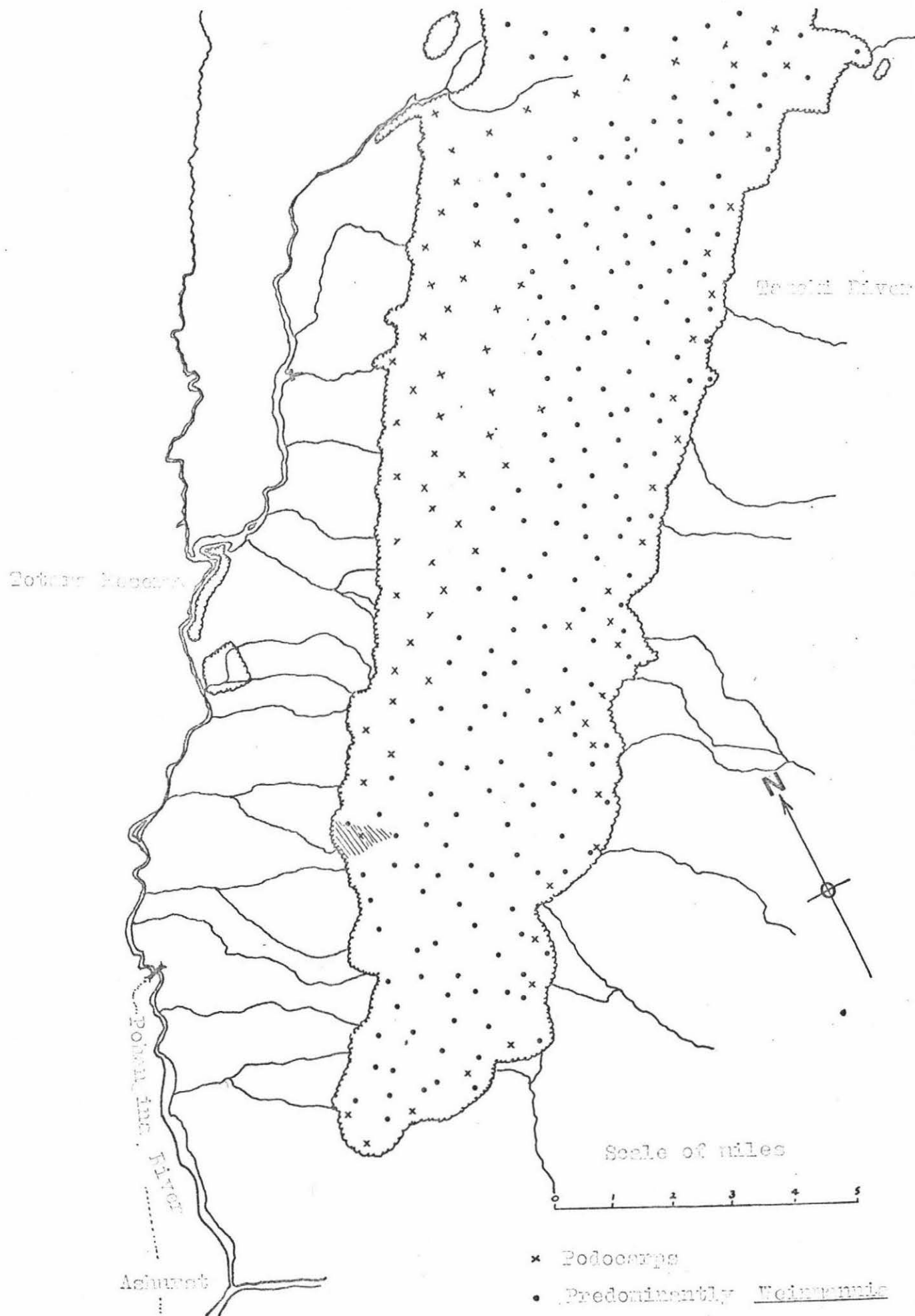


Fig. 1 The Rushing Range; // indicates the position of the study area. (after Elder 1965)

The study of gall midge biology is not easy. Owing to their small size and fragility they are difficult to detect and handle in the field and often there is a close resemblance between different genera (Felt, 1925). The absence of any data on P.radicis other than a taxonomic description, and the insect's intimate involvement with a host equally lacking in phenological description, left a wide field in which it was desirable to gain as much knowledge as possible in order to make valid conclusions about the effect of the parasite. Using a sequential sampling programme, it was possible to elucidate, simultaneously, the insect's life-cycle, various regulating factors, and some aspects of rata phenology. The life-cycle and ecological factors affecting it were summed in a life-table, and the field work was complemented by laboratory studies to assess the significance of the insect-plant association. The study was initiated in 1971 but the bulk of the field work took place between January 1972 and March 1973.

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