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## The ectoparasites of brushtail possum *Trichosurus vulpecula* in New Zealand

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**Abstract** The ectoparasites of the brushtail possum *Trichosurus vulpecula* were examined at 15 original release sites in New Zealand. Three species of fur mite—*Atellana papilio* Domrow, 1958, *Petrogalochirus dycei* (Domrow, 1960), and *Murichirus anabiotus* Domrow, 1992—were present in all population samples from the North, South, Stewart, and Kawau Islands. *M. anabiotus* was absent from the Chatham Islands. *A. papilio* was isolated from 82 (98%) of the 84 digested pelts, *P. dycei* from 78 (93%) of 84, and *M. anabiotus* was found in 67 (93%) of the 72 pelts digested from populations where the mites were present. The follicle mite *Marsupipus trichosuri* Fain, 1968 was detected in two (7%) and one (3%) of pelts examined from Kawau Island and the Orongorongo Valley, respectively. *Trichosuroaelaps crassipes* Womersley, 1956 was present on 99% of possums and absent only from Kawau Island. Nymphs and larvae of the cattle tick *Haemaphysalis longicornis* were isolated from four (33%) of the 12 Northland pelts. The loss of ectoparasitic mites resulting from the transfer of possums from their native Australia to New Zealand has been minimal in mites with a direct life cycle. Acariasis of the rump and tail was attributed to *M. trichosuri*, and *A. papilio* is implicated in fur breakage.

**Keywords** possums; biological control; ectoparasites; acariasis; vectors; New Zealand; mites

### INTRODUCTION

The use of myxoma virus on rabbits in Australia and feline panleucopenia (cat flu) virus on Marion Island cats are rare examples of biocontrol success with pathogenic microendoparasites (Dobson 1988). Macroectoparasites such as fleas, mites and ticks, lice, and mosquitoes are well known as vectors in the transmission of pathogenic micro-organisms within vertebrate populations, but by themselves are rarely considered to be major controlling influences in wild populations. Odum (1959: 239) stated that “the negative effects [of parasitism] tend to be quantitatively small where the interacting populations have had a common evolutionary history in a relatively stable ecosystem” and “severe interaction is most frequently observed where the interaction [of host and parasite] is of recent origin.” Bull (1964) found that the endemic parasitic helminths of rabbits *Oryctolagus cuniculus* (L.) were rarely an important cause of host mortality in New Zealand, although coccidiosis could be pathogenic.

Since the possum *Trichosurus vulpecula* has become a pest of national importance in New Zealand (Jolly 1993; Heath et al. 1994), the search for long-term biological control strategies has been funded by the New Zealand Government.

This paper reports the results of a survey to establish which species of ectoparasites are present on possums in New Zealand. Secondary aims were to record the geographical distribution of the parasites, the numbers of parasites and their effects on the host, and to compare and contrast the New Zealand list with that of the host in its native Australia. The rationale for the survey is covered in Heath et al. (1994) and Stankiewicz et al. (1996). It is conceivable that all or some of the possum populations in New Zealand are without the full complement of parasites from their native Australia (Cowan 1990), as many New Zealand populations were founded on

few individuals, and all New Zealand possums are descended from 200–300 individuals. It is essential to know which parasites are present and therefore available as vectors of microbes or available for manipulation by modern molecular technology.

### Abbreviations

ACT, Australian Capital Territory; MONZ, Museum of New Zealand, P.O. Box 467, Wellington, New Zealand.

### Repositories

Voucher specimens of species collected in this survey are deposited at MONZ. The skin with fur breakage attributed to *A. papilio* and the free-living incidental mites are in the collection of JMC.

## METHODS

### Sample sites and pelt selection

Possums skins were collected from the 15 locations where possums were originally released in New Zealand (Stankiewicz et al. 1996): Northland, Kawau Island, Wanganui, Bridge Pa (Hawke's Bay), Shannon, Paraparaumu, Orongorongo Valley (Wellington), Nelson, Banks Peninsula, South Island West Coast, Pigeon Flat (Dunedin), Riverton, Stewart Island, and the main Chatham Island. Trapped possums were handled as described in Stankiewicz et al. (1996).

In the early part of the study, from six locations, 10 transects each 2.5 cm long were made in the fur on each pelt and each transect was examined for arthropods under a dissecting microscope. Up to 60 pelts from some localities were examined by this method. It became clear that most pelts had the ectoparasite if that species was present in the population, so in later samples fewer pelts were examined, but in greater detail. Up to 12 pelts were slipped of their fur, which was digested in 2N NaOH solution as described by Clark (1993). Pelts were also selected for this digest if they appeared to be in any way unhealthy or modified by parasites. Both sexes and a range of ages were selected for the digest. We consider our samples to have been deliberately biased in favour of finding parasites. Ectoparasite counts were made with aliquots of one-tenth of the digested pelt until the rarest parasite was counted 20 times, to ensure statistical robustness (Sokal & Rohlf 1969). As opportunity permitted, observations were made on the method and location of feeding by mites.

## RESULTS

Transects in the fur were used to record the presence or absence of an ectoparasite from the population sampled, but have not been used to report other results. The fur transect data are available on request from JMC.

### Species and prevalence of parasites collected

Only a single specimen of the cat flea *Ctenocephalides felis felis* was recorded from the 38 pelts examined from Kawau Island.

### Fur-clasping mites (Astigmata:

#### Listrophoridae: Atopomelinae)

The three species of fur mite—*Atellana papilio* Domrow, 1958, *Petrogalochirus dycei* (Domrow, 1960), and *Murichirus anabiotus* Domrow, 1992—were present in all population samples from North, South, Stewart, Chatham and Kawau Islands, with the exception that *M. anabiotus* was absent from the Chatham Islands (Table 1).

*A. papilio* was isolated from 82 (98%) of the 84 digested pelts, and *P. dycei* from 78 (93%) of 84; *M. anabiotus* was found in 67 (93%) of the 72 pelts digested from populations where *M. anabiotus* was present.

### Follicle mite *Marsupipus trichosuri* Fain, 1968

This species was detected in two (7%) of the 38 pelts examined from Kawau Island and one (3%) of 39 pelts from the Orongorongo Valley sample.

### Possum laelaptid mite *Trichosurolaelaps crassipes* Womersley, 1956

This species was present in all population samples except that from Kawau Island. It was present in 83 (99%) of 84 digests.

### Cattle tick *Haemaphysalis longicornis* Neumann, 1901

This species was isolated from four (33%) of the 12 Northland pelts.

### Numbers of parasites

From nine populations, 84 pelts were digested. Aliquot counts were multiplied to give an estimate of the number of mites of each species on each pelt, and the mean and range are given in Table 1 for the four common species. Hundreds of *M. trichosuri* mites were isolated from the tails of infected possums from the two localities where this species occurs. Only one or two specimens of the cattle tick

(nymphs and larvae) were found on each of the four Northland pelts; some contained blood.

### Incidental mites collected

In the digested samples, oribatid mites were collected from Paraparaumu, Castlepoint, Shannon, Nelson, the Chatham Islands, and Stewart Island. Uropodid mites (Mesostigmata) were collected from the Shannon and Nelson pelts. Several species of free-living gamasid mite (Mesostigmata) were present in the fur digests from Nelson, Stewart Island, and Chatham Island. Two acarid mite species were collected from Pigeon Flat: three *Glycyphagus destructor* hypopodes, and a single specimen of a *Tyrophagus* species.

### DISCUSSION

The fur mites *A. papilio*, *P. dycei*, and *M. anabiotus* with the laelaptid *T. crassipes* are ubiquitous throughout the host's range in the three largest New Zealand islands. *T. crassipes* is absent from Kawau

Island and *M. anabiotus* is absent from Chatham Island. This survey revealed that high prevalence and loads of 1000 or more fur mites per host were common. These findings are congruent with Sweatman's (1962) data from Banks Peninsula, Tapanui forest, and the Mackenzie country, where all 59 possums collected were infested with both *A. papilio* and *T. crassipes*. All four common species complete their life history on the host (Clark 1995a, b) and are therefore expected to have transferred to New Zealand with the host (Dobson 1988).

Data from Australia are not comparable with the results of this survey of prevalence and numbers of mites (Viggers & Spratt 1995). Indications from anecdotal data are that the infestation rate and load are lower in Australia (Presidente et al. 1982; Presidente 1984).

The ectoparasite fauna of possums in New Zealand and Australia is summarised in Table 2. The possum is a new host record for the cattle tick *H. longicornis*, although in Australia four species of *Haemaphysalis* and six species of *Ixodes* are recorded from *T. vulpecula*, as well as an (accidental)

**Table 1** Number and range of parasitic mites found on (n) possums from nine locations in New Zealand.

| Locality                                 | (n) | Mean number of mites<br>(range)        |                             |                                  |                                 |
|--|-----|--|-----------------------------|----------------------------------|---------------------------------|
|  |     | <i>Trichosurolaelaps<br/>crassipes</i> | <i>Atellana<br/>papilio</i> | <i>Petrogalochirus<br/>dycei</i> | <i>Murichirus<br/>anabiotus</i> |
| Northland                                | 12  | 70<br>(10–150)                         | 776<br>(10–1720)            | 178<br>(0–860)                   | 596<br>(0–4250)                 |
| Shannon                                  | 11  | 118<br>(10–400)                        | 704<br>(20–4020)            | 230<br>(70–490)                  | 507<br>(0–4960)                 |
| Castlepoint                              | 12  | 161<br>(0–480)                         | 1744<br>(400–5320)          | 1885<br>(23–5380)                | 1126<br>(10–3400)               |
| Nelson                                   | 2   | 310<br>(20–600)                        | 430<br>(200–660)            | 1820<br>(1040–2600)              | 7700<br>(800–14 600)            |
| West Coast                               | 5   | 223<br>(124–340)                       | 1350<br>(390–4180)          | 1435<br>(740–3500)               | 2950<br>(120–660)               |
| Pigeon Flat                              | 6   | 166<br>(7–456)                         | 716<br>(66–1705)            | 474<br>(95–1210)                 | 162<br>(3–615)                  |
| Riverton                                 | 12  | 205<br>(4–730)                         | 461<br>(0–1145)             | 526<br>(0–1365)                  | 1037<br>(0–8770)                |
| Stewart I.                               | 12  | 222<br>(10–480)                        | 1390<br>(190–3650)          | 1956<br>(10–7960)                | 8062<br>(40–28 480)             |
| Chatham I.                               | 12  | 187<br>(30–450)                        | 505<br>(0–3170)             | 1400<br>(70–3060)                | 0                               |
| No. of<br>possums<br>infested<br>(of 84) |     | 83                                     | 82                          | 78                               | 67                              |

argasid (Viggers & Spratt 1995). That *H. longicornis* has now been recorded from possums in New Zealand is not surprising as it uses a wide variety of mammal and bird hosts (Hoogstral et al. 1968).

*M. anabiotus* has not been reported from trichosurid possums in Australia, although Viggers (in Viggers & Spratt 1995) reported a species of *Murichirus* from *Trichosurus caninus*. *M. anabiotus* was recorded in New Zealand from the North Island (Domrow 1992; Clark 1993). This survey reports it as one of the most numerous mites on the host, and present in all populations except that on the Chatham Islands. It is surprising that such a large and distinctive mite was not reported by Sweatman (1962) or Bowie & Bennett (1983). On possums in New Zealand it is restricted to the ear bases, neck, and short shoulder fur on the host (Clark 1993), but can be found in low numbers on other parts of the pelt. It may have escaped notice in previous surveys. It is also possible that the mite spread into the New Zea-

land possum populations as late as the 1980s or 90s. There are good reasons, based on a consideration of the host and on mite phylogeny, for thinking that *T. vulpecula* is its main host. Most *Murichirus* species occur on murid rodents (Fain 1972; Fain & Lukoschus 1981), and all have a protruding shovel-like prodorsum which is remarkably similar to that of the listrophorid genera *Alabidocarpus* and *Labidocarpus* from bats. Lawrence (1962) suggested that this prodorsum is used to strip away fur scales and fatty tissue, especially on vibrissae. *M. anabiotus* may take such a diet of lipid and scale on the shoulder fur of possums. We consider the mite to be benign and more epizootic than parasitic, even if present in large numbers (>5000).

*P. dycei* also seems to fit the above description: a female was observed under the compound microscope scraping the fur surface with alternate chelicerae. The gut contents comprised a fine paste of indeterminate material.

This survey records *M. trichosuri* in two widely separated localities in New Zealand, although it was recorded previously only from the A.C.T. in Australia (Fain 1968; Domrow 1992; Viggers & Spratt 1995). It is parasitic only as a deutonymph (the only described stage), and produced alopecia and hyperkeratinisation in all the infections we found. The host's ears were not infested as can occur in Australia (Domrow in Fain 1968). The reason for this apparently restricted geographical distribution is unknown. The mite may be able to complete its life history without a parasitic phase (i.e. it may be a facultative parasite). The adults of other species of *Marsupiopus* are free-living in their host's dens (Lukoschus et al. 1979). *M. trichosuri* may be more widespread in New Zealand than our data shows, or it may survive only with possums in or near A.C.T. or populations in New Zealand derived from that gene pool. Further work on its life cycle, pathogenicity and distribution are needed for a better evaluation of its potential role in biocontrol of the host.

In Australia, *T. vulpecula* is host to 10 species of chigger mite—nine Trombiculidae and one Leeuwenhoeekiidae (Presidente 1984; Domrow & Lester 1985; Viggers & Spratt 1995). None has been reported from New Zealand; perhaps with its dearth of native mammals and the demise of the ratite birds, this type of parasite cannot be sustained in noticeable numbers except on some reptiles (Goff et al. 1987). Four species of chigger are reported from *T. vulpecula* in Tasmania, indicating that climate is not the reason for the dearth of chigger mites in New Zealand.

**Table 2** Ectoparasites of the possum *Trichosurus vulpecula* in Australia and New Zealand.

|                                    | New Zealand<br>only | Australia<br>only | Both |
|------------------------------------|---------------------|-------------------|------|
| <b>ACARI</b>                       |                     |                   |      |
| S.O. Actinotrichida                |                     |                   |      |
| <i>Atellana papilio</i>            |                     |                   | *    |
| <i>Petrogalochirus dycei</i>       |                     |                   | *    |
| <i>Murichirus anabiotus</i>        | *                   |                   |      |
| <i>Marsupiopus trichosuri</i>      |                     |                   | *    |
| Chiggers (10 species)              |                     | *                 |      |
| S.O. Anactinotrichida              |                     |                   |      |
| Metastigmata                       |                     |                   |      |
| <i>Haemaphysalis</i> spp. (4 )     |                     | *                 |      |
| <i>Haemaphysalis longicornis</i>   | *                   |                   |      |
| <i>Ixodes</i> sp.                  |                     | *                 |      |
| Mesostigmata                       |                     |                   |      |
| <i>Trichosurolaelaps crassipes</i> |                     |                   | *    |
| <i>Haemaolaelaps sisypus</i>       |                     | *                 |      |
| <b>INSECTA</b>                     |                     |                   |      |
| <i>Siphonaptera</i>                |                     | *                 |      |
| (7 species in 2 families)          |                     |                   |      |
| Accidental ectoparasites           |                     |                   |      |
| <i>Ornithodoros macmillani</i>     |                     | *                 |      |
| <i>Listrophorus gibbus</i>         | *                   |                   |      |
| <i>Notoedres muris</i>             |                     | *                 |      |
| <i>Laelapsella humi</i>            |                     | *                 |      |
| <i>Ctenocephalides felis</i>       | *                   |                   |      |

Australian data from Viggers & Spratt (1995). New Zealand data from Sweatman (1962), Tenquist & Charleston (1981), and this survey.

We take the view that there is little scope to use chiggers against New Zealand possums because they are rather non-specific in their selection of a host (Domrow & Lester 1985), and the ratite *Apteryx australis* is a host to at least one species of *Guntheria* (Loomis & Goff 1983). Imported chiggers might, if they established, adversely impact on kiwi species, which are known to carry mammalian parasites (Clark & McKenzie 1982).

The fur mites and the laelapid found on possums in New Zealand appear to be relatively benign. *T. crassipes* has the potential, as a blood-feeder, to act as a pathogen vector (Clark 1995b), and we observed fur breakage on one pelt which we attribute to *A. papilio*. Sweatman (1971) considered that listrophorid mites damaged fur by clasping it tightly. Our observations on the highly chitinated gnathosomal anatomy of *A. papilio* revealed chelicerae positioned to feed from the fur surface. The gut of some specimens held numerous minute scales identical to those on the surface of the fur. We therefore consider it most likely that the fur breakage observed was the result of this mite ingesting the fur fibre's surface and thereby weakening its tensile strength.

The relatively benign nature of these fur mites does not mean that their potential role in a biological control strategy is unimportant. Barker (1994) pointed out that possums have no lice but do have fleas—seven species use *T. vulpecula* in Australia (Viggers & Spratt 1995). This concept of ectoparasite competitive exclusion is not new (Thompson 1938 and Hopkins 1949, both cited in Barker 1994), but there are few studies on possible mechanisms by which a group, such as mites, can exclude other groups such as lice. The role of nidicolous Mesostigmata in controlling flea larvae is documented in Mehl (1977) and Ryba et al. (1987), but we know less of the interactions between the other groups. With its absence of *T. crassipes* and presence of marsupial lice on the brushtailed rock wallaby (Palma 1996), Kawau Island may provide us with a natural laboratory where we can investigate the interactions between marsupial ectoparasites.

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