Styx Mill Conservation Reserve: invertebrate assessment and implications for management

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SUMMARY

Insects –conservation perspective

- The boggy ditches and adjacent vegetation in the eastern part of the Styx Mill Conservation Reserve have exceptional diversity of shore flies (Ephydridae) with 15 species, which is around 20% of all known New Zealand species. The rediscovery of *Hydrellia acutipennis* (Harrison 1959) from only the second known site proves it is associated with more than salt marshes. This is a significant advance in our knowledge of this rarely collected fly. *H. acutipennis* was described from three specimens taken from Allans Beach, Otago Peninsula, from a salt marsh flat. Mathis (pers. comm.) did not find any specimens from Allans Beach in January 2004. The Styx Mill Conservation Reserve specimens are the first good quality males of the species for description coming from only the second site known for *H. acutipennis*. *Hydrellia* species are herbivores, but the host plant for *H. acutipennis* is unknown. The Reserve also has one or two new rather small species of *Hydrellia*. In addition, an *Ephydrella* species was initially ascribed to *E. thermarum*, but all previous specimens were associated with hot springs at four sites in the North Island in the Bay of Plenty and Taupo. Mathis has yet to fully recheck these specimens, especially the genitalia, to verify this identification.
- Conservation of the pointed winged *H. acutipennis* and retention of a spectrum of shore flies, Empididae e.g. *Isodrapetes* and muscid flies directly conflicts with the proposal based on botanical values to restore forest to the eastern grassland in the Reserve. Waterways are of minimal botanical value for native species. The apparent localized loss of *H. acutipennis*, which was only found in open sites, would be adversely affected by shading of the forestation proposal by botanists. Protection of our fauna under the Resource Management Act 1992 makes it important to check the even more limited areas of salt marsh in Pegasus Bay to resolve whether *H. acutipennis* is truly associated with waterway margins and perennial herbs. If it is not, then the Styx Mill Reserve habitat becomes even more important.

Entomology – undescribed species and guild diversity

- The recorded level of endemic species (found only in New Zealand) was about 80%, the same as for Travis Wetland, but the actual level is probably about or somewhat above 90%. An estimated 6-12 insects (2.2 – 4.2%). the salticid spider and some tetragnathid spider species may well be undescribed. Certainly undescribed insect species include *Molophilus* (2 species), *Hercostomus* species, *Isodrapetes* species and the small *Hydrellia* species. Several of the Muscidae species (genus *Millerina*) some of the midge species and perhaps up to three dark metallic species of Dolichopodidae are also likely to be undescribed. Most of these species were not present at Travis Wetland. Some, including the undescribed *Hercostomus* species, but not *Isodrapetes* or *Ceratomerus crassipennis* were found in the concurrent south west Christchurch water way survey, which I carried out.
- At least four insect species previously known from one to six sites in the South or Stewart Island, and known from fewer than 10 specimens, have been discovered in the Styx Mill Reserve and in the sand dunes at New Brighton. After the Scelioniidae from New Brighton were examined in Auckland, several unusual species from several very poorly known genera for New Zealand were identified. Already, samples from the braided Tasman River bed (another habitat so far not properly surveyed) are yielding further undescribed Diptera species. These valuable new finds for Canterbury illustrate the need to check the two remaining distinctive but inadequately documented habitats (nationally) in the Christchurch: Banks Peninsula and, if possible, Pegasus Bay. The relevant habitats are salt marshes and lagoons/estuaries (including their brackish shrublands, e.g., Lake Ellesmere and Brooklands Lagoon) that need at least scoping surveys of the Diptera to determine if they similarly have little known species.
- It is important that funding for scoping surveys such as this one is not too limited; because time and payment should be allowed to post some specimens to specialists to improve identifications especially if the work is to be published in scientic journals. Specialists need time and money especially for extensive or difficult identifications. Fuller access to specialists for this survey could have revealed further interesting species and habitat distributions.
- For the different guilds (e.g., predators, parasites) of invertebrates, the ratios in species diversity seem to be reasonably consistent between major land habitats.

Wetland flies

- Characteristic fly species for this wetland are the marsh fly, *Dilophus nigrostigma*, and two Dolichopodidae species (*Tetrachaetus bipunctatus, Sympycnus* sp.), which were more abundant away from the freshwater. I have found theflightless crane fly, *Gynoplistia pedestris,* prefers open swampy to muddy areas, but it was not common. It was only found in six or 31 broadly suitable sites in insect surveys of Travis Wetland, south west Christchurch waterways and Styx Mill. When Styx Mill is treated as one site then *G. pedestris* has been collected from 16 sites (Waipara coast to the Halswell River) (Macfarlane 2004). However, urbanization has almost certainly reduced and altered sites since the initial collections from the 1920s to 1950s. Therefore *G. pedestris* may merit 'vulnerable' conservation species status. Three (Travis wetland, Styx Mill reserve, south wets Christchurch waterways) of five insect community studies I have financed by the Christchurch City Council have provided useful information about the current distribution and status of this distinctive fly. The crane fly *Molophilus quadrifidus* preferred either wetland or ephemeral pools.
- Conservation of the pointed winged *Hydrellia acutipennis* and the retention of a spectrum of shore flies, Empididae, e.g., *Isodrapetes,* and muscid flies directly conflicts with the proposal based on botanical values to restore forest to the eastern grassland in the Styx Mill Reserve. The presence of undescribed Diptera species in the wetlands and along at least only partly shaded waterways, e.g., *Hercostomus,* are fully to possibly partly incompatible with shading of their wetland or waterways.

Waterway insects including clarification of habitat use for flies

- The survey identified *Scaptia ricardoae* (Tabanidae) as a first record for Christchurch waterways and confirmed that *Ceratomerus crassinervis* (Empididae) still exists in Christchurch and Canterbury. The diversity of species and genera for midges (Chironomidae), dance flies (Empididae) and Muscidae from freshwater streams and ponds was partly clarified compared with previous invertebrate surveys from within the Styx River Reserve, but was hampered by inadequate taxonomy of the adults. With perhaps 20 species of midges and Muscidae, it would not be a large task to photograph and provide a working key to distinguish

these waterway flies for any further survey of the upper reaches of the Styx River. This would, in future, allow much better monitoring of the full within waterway and waterway margin species. Formal descriptions of the species may well be achieved only many years from now due to grossly inadequate and insufficiently shrewdly funded support for taxonomic studies and better support for suitable retired enthuisiasts..

- The introduced *Hydrophorus praecox* (Dolichopididae) and two genera of biting midge were also identified from the Styx catchment for the first time. Most of the long legged flies (Dolichopodidae) and all of the Muscidae are associated with the muddy fringes of the ditches of the Styx River – see also Macfarlane (2004). The long legged fly *Hercostomus* sp. was characteristically associated with the Styx River and other higher flow waterways in south west Christchurch.
- In addition, night light trapping revealed there were 19 caddisfly (Trichoptera) species present in the area compared with 11 revealed from four sites in the 1980 survey by Robb. This included only the second location record in eastern Canterbury for *Triplectidina moselyi*. This less common, but quite widespread caddisfly *T. moselyi* was collected only in the vicinity of the peaty to marshy slow flowing south creek. The Styx Mill Reserve can probably be considered as the type locality for the widespread caddis fly *Hudsonema alienum*.
- No mayflies (Ephemeroptera) were found even in the two short and small stony creeks. This loss has occurred in the last 10 or so years. This highlights the need for a resurvey of Smacks Creek, which is becoming increasingly affected by urban development.
- This survey emphasizes the value of the "soupy" ditches with summer mud flats, which are now very inadequately represented in other Christchurch wetlands or waterways. From a field day I attended at Amberley beach and a Waimakariri overview report (Boffa Miskell 2004), it is apparent that coastal sites of slow flowing short waterways in Canterbury in the Waimakariri and Hurunui Districts are also still declining in perceived quality. So far, the possible considerable impact on invertebrate diversity has not been assessed. Thus I suggest these short waterways in the Styx Mill Reserve are particularly precious, and being in a reserve they could be managed. In addition, the Styx Mill Reserve is favourably sited for further studies by the few Canterbury entomologists compared with other more isolated coastal waterways in the South Island. The survey draws attention to three subtle classes of freshwater within the reserve.
- The Styx River, for Christchurch, is now the premier waterway for freshwater insects. However, there are two contrasting slow flowing creeks with soft bottoms but different shores – the southern creek was the sole collection site for the caddisfly *Triplectidina moselyi* whereas the central eastern ditch had by far the greatest populations of the large shore flies *Ephydrella* spp with wide ephemeral mud flats in summer. The smaller mud flats elsewhere had these species, but the stock yard ditch was the chief source of *Parahyadina*, *Hyadina irrorata* and the introduced *Eleliodes chloris*. These species were also present at the ford on the muddy margins of the north eastern creek. The north eastern creek and the headwaters of the central ditch had stony bottoms and the reconstructed central creek had no muddy fringing banks and so no *Parahyadina*, *Hyadina irrorata* or *Eleliodes chloris* even although it was within 25 m of the mud flats of the central ditch. Silting of the north east creek in the reserve makes the waterways of Smack creek all the more precious for lowland Canterbury. The upper Styx river invertebrate fauna has also become much more significant ecologically on a regional basis, because smaller lowland waterways have been subject to declining flows in rural Canterbury with more intense and extensive irrigation. This can be combined with increased pollution (dung, nitrogen) or bank disturbance with more dairy farming.
- Species identification in several fly families [e.g., the largely aquatic midges (Chironomidae) and biting midges (Ceratopogonidae) and terrestrial gall (Cecidomyiidae) and root midges (Sciaridae)] depends largely on features of the male genitalia. For both midges and root midges taxonomic information makes it theoretically possible to identify at least some species or genera provided reliable identified material is available. Conversely, generic identification is about the best that can be expected for families such as gall midges and biting midges, because a high proportion of the species remain undescribed. Therefore, it was really disappointing that more precise identification of the midges here and elsewhere in Christchurch has yet to be achieved with backing from national specialists, who are much closer to the single national collection where most types are held. Relating morpho-species of midges identified in this survey to described genera and species is of special interest for two main reasons. Midges are important as food for fish. The distribution of the morpho-species from this and a survey of the south west Christchurch waterways show a

few species are sensitive to water quality. Conversely, other Orthocladinae and *Chironomus* species tolerate poor water quality and maybe even ephemeral waterways. Surveys that have to deal with the immature stages can not distinguish Orthocladinae and other midge taxa species' diversity.

Insect species habitat use

- Green or wetter or long grassland supported considerable numbers of *Psilopa metallica*, a light brown geometrid moth, and the crickets *Bobilla* spp.
- The biological springs formed by the overflowing water troughs supported a range of the commoner shore flies (*Scatella* and *Ephydrella*) but only one species of Muscidae.
- This survey clarified the ecological role of the small native fly *Gaurax novaezelandiae*, which was associated with dung of both livestock and water birds in two separate short grass/forb areas. This bird dung also attracted a small range of blow and other fly species.

Conflicts and partial resolution in habitat management recommendations

- The invertebrate survey places considerably more value than botany on the boggy wetland (area N) and especially the ditch in Area D of McCombs (2003b). It reinforces the botanical assessment of the value of the introduced woodlands, but the grazed grasslands have potentially different needs compared with plant or some bird oriented conservation.
- It is suggested that forest restoration should consider the NE willow woodland for the formation of a kahikatea area, which is currently lacking in greater Christchurch, provided control of blackberry is achieved there first. Limited kahikatea might be planted along the river bank at the Redwood Springs flat if this does not compromise road safety in winter. These areas do not appear to compromise invertebrate values and, if possible, such plantings would add to the matai-dominated podocarp forest at Riccarton Bush and replanting of open wetlands at Travis Wetland.
- The advocated release of weka for 2006/2007 should not proceed in the naturalized area based on the value of the wetlands for rare flies – see integrated management goal below.

Wetlands, waterways and integrated management goals

- As an education and potential conservation resource Styx Mill Reserve has considerable potential value for wetland and waterways habitats. From a conservation perspective, the eastern half of the reserve provides an accessible spectrum of wetland and waterways, which apparently no longer exist in such an unmodified form in the headwaters of the four major rivers that are in the Christchurch district. The waterway conservation value is largely due to the subtle variations in the ecology of the smaller waterways. There is also a considerable range of soil habitats, which offer the potential for restoration of plants and wetland birds at least on the better soils and perhaps eventually also on the dry light grassland soils.
- The light dry soils are small islands of this reserve have three advantages compared to a major population than the 'savannah grasslands' in the McLeans Island/airport area. They are more accessible for Christchurch and southern Waimakariri residents they have a lower risk of fire and should have an even lower risk of ever being affected by *Hieraceum* infestation.
- Cattle pug the central wetland (area N) deeply and this may lower populations of larvae of the flightless coastal Canterbury crane fly *Gymnoplistia pedestris*. Therefore, sheep may be a more appropriate animal to graze the central wetlands.
- Conservation of the flightless Christchurch crane fly *Gymnoplistia pedestris*, and possibly other moss inhabiting beetles (not yet surveyed) and wetland insects, could conflict with any reserve-wide release of the buff weka. This probable conflict and the potential to restore less usual wetland birds (see comments in next two sections below) must be evaluated before any proposal to liberate weka on the main part of Styx Mill wetland is approved.
- Weka fluctuate in numbers and have considerably higher population densities than the other wetland bird species listed for restoration. Therefore, buff weka can be more destructive to the flightless crane fly.
- Planning for restoration of declining wetland bird populations must take account of potential conflicts in their ecology. Other wetland birds use similar nest sites, food sources and wekas have aggressive between species interactions. This includes the ability of wekas to destroy other bird eggs. The ability of weka to develop relatively high populations suggest that other less familiar wetland birds (bitterns, fernbirds, crakes) be accorded priority for release into the Styx Mill Reserve, when the predator proof fence has been developed and rodents eliminated. Other closely related weka are relatively available elsewhere in New Zealand compared with the less widespread and seen wetland specialist birds (bitterns, fernbirds, crakes). In addition, once weka have become established, then they would make establishment of fernbirds especially more difficult, partly because both species use similar nesting sites. Both weka and fern birds depend more on insects for food than bitterns so the more adaptable and inquisitive weka could well place some pressure on invertebrate food resources that fernbirds might use.
- I would recommend that sites other than the predator proof Styx Mill Reserve be considered for any release of "Canterbury" weka from Chatham Island, because of the ecological risks outlined above and the presence of other sites elsewhere. I would suggest other ecologically suitable and even larger open sites such as Godley Head, when it is developed as a mainland island, the farmland part of Travis Wetland or perhaps the rather small Redwood Springs area just to the east of the Styx Mill Reserve (not currently council land) be evaluated as more suitable alternatives for the release of the weka. The adjacent Redwood Springs, Wilson swamp near

the motorway just south of the Waimakariri River or even perhaps Travis Wetland would seem to be more suitable sites for weka, where the urban population has ready access to weka than the precious Styx Mill Reserve for which the addition of free ranging kiwi would also be greatly appreciated. Consequently, it is imperative that caution is applied in the reintroduction of the ground feeding weka, especially when we do not know the distribution and conservation status at least two fly species in the wetland let alone other wetland insect species of beetles and perhaps bugs.

Native forest and shrubland restoration

- Recommendations for restoration planting in the proposed natural area should aim to keep the full range of habitats and not over plant valued open wetland habitat with forest trees. Revegetation should also consider restoration of dry grasslands and some banks to diversify available native plants and flowering native plants, which would restore the ecological niche that hemlock was providing insects. Use of native spaniard plants *Aciphylla* spp., *Olearia* and autumn-flowering lacebark to add to midsummer flowering kanuka and cabbage trees on the less accessible steep banks could help rectify such a loss and aid conservation of native species under pressure from grazing loss on Banks Peninsula and other grasslands in the vicinity of Christchurch. Reserve plantings, including the recent planting adjacent to the reserve to the north east, are dominated by pollen-only producing plants (sedges, rushes, grasses, coprosma) with very few and poor nectar-producing species for the waterway Empididae and the largely undescribed array of New Zealand insect parasites. Therefore I recommend more attention be placed on redressing this balance in plantings of natives within the greater Christchurch area.
- From an invertebrate perspective, it is becoming vitally important that a reasonable assessment is made of the value of replanting forest for native species of the five major orders of insects. Initial results from other Christchurch (see this report –Table 3) and Coromandel studies show predatory spider hunters and apparently several insect species and genera are, at best, less common in replanted native bush not associated with bush remnants. Replanted forest, which does not have a remnant of bush for insect dispersal, should not be assumed to be recolonized readily by more than a minority of the more ecologically flexible (e.g., decomposers) native insect species or those with waterway corridors. With the enlargement of the Christchurch City to include Banks Peninsula a wider perspective of Canterbury bush reserves becomes possible. Thus the greater Christchurch area has considerable bush areas and a range of bush and other vegetation in over 8,000 ha in over 45 reserves dominated by native forest. Some of the entomology of the largest reserve (Hinewai) and Quail Island has already been relatively well documented (Ward *et al.*, 1999; Bowie *et al.*, 2004).
- Eventual supplementary planting to establish an alternative and available grey shrubland in the stonier eastern soils to include plant species under threat at McLeans Island area is recommended to ensure conservation of shrubby plants such as *Olearia odorata*. Development of further grey shrubland species under pressure in inland Canterbury such as various *Clematis* species and native brooms, *Carmichaelia* spp., would be desirable to extend the floral diversity and period of bloom for native insect species. In addition, such an area might provide a safe haven for rare native scarab beetles from the Mackenzie Country, which could be under pressure from the inexorable *Hieracium* invasion and depletion of the rarer host shrub species they favour, but which are unknown at present.

Weed control in wetlands and woodlands

- Control of the ingress of willow seedlings and growth of gorse in the central northern area swamps is the top priority as far as weed control to maintain habitat for the rarer insect species.
- Blackberry control in the central willow woodland and the restoration woodland by the ponds is also important before blackberry becomes an even larger a problem, as in other parts of the willow woodlands. The willow woodlands should be allowed to gradually regenerate into native-dominated species. Already, the eastern willow woodland was virtually inaccessible for study with pan, malaise and intercept traps, which are so vital in the assessment of forest insect diversity. Blackberry is a potent source of berries for black birds to disperse elsewhere in the reserve.

Insect community survey planning

- Further insect community surveys need to either be more focused on particular insect groups or habitats to allow modestly funded proposals to pay at realistic rates. Planning could benefit from seeking supplementary funding from other sources in advance, so that a more comprehensive survey can be achieved. The

availability of digital photography makes it possible to provide illustrations within a week of work for a considerable part of an invertebrate community. If this tool had been available when the series of five insect community studies I have completed within greater Christchurch then, for instance, it would have been much clearer how the Ichneumonidae and other small parasite species compare between the Styx Mill Reserve, Travis Wetland and the overall similar dry grassy habitats short mossy McLeans Island or long grassy sand dunes of New Brighton. This possibility needs to be considered for any future partial or more comprehensive invertebrate surveys.

- Given the paucity of trained taxonomic entomologists, an alternative approach of joint niversity and appropriate consultant studies could be tried. Care on behalf of ratepayers needs to be taken in limiting the frequency of use of large orginasations with expensive consultancy sources.

INTRODUCTION

Botanical significance and history

For Christchurch, the 57 ha Styx Mill Conservation Reserve is the second largest area with a major portion of wetland. Botanically, the reserve has a high overall A ranking, because of its top ranking for unusualness and high diversity, representativeness and naturalness. Ten species of wetland rushes, sedges and sphagnum moss are regionally uncommon among the 30 species of indigenous and endemic plants there (McCombs 2002). McCombs (1993) tabulated the distribution of the 72 species into nine areas. Only sphagnum among several moss species in the woodlands is listed. Fagan & Meurk's (2004) maps recorded the distribution for four species of *Carex* sedge, the swamp tussock *Schoenus pauciflorus*, the rush *Juncus planifolius*, the mud starwort *Callitriche petriei* and the sphagnum moss *Sphagnum cristatum*. All seven species of trees and shrubs, the 12 species of grasses and four of eight rush species are introduced species. Native species include 15 of 56 forb/orchid species, all eight fern species, 20 of 26 rush and sedge species, two of 21 grass species (Fagan & Meurk 2004). A significant proportion of the native shrubs and trees are the result of restorative planting.

The reserve was remodeled in 1995 to include the current ponds on the central creek (Fagan & Meurk 2004) after the botanical values were summarized (McCombs 1993; Meurk *et al* 1993). Thus the stony floored central creek that combines the outflow from Styx and Cavendish Roads drains was only nine years old when the survey was done. Plantings of native trees (kanuka, cabbage tree), shrubs (*Coprosma* spp., matagouri) and flax from 1998 have increased the diversity of native plants on the areas of lower conservation value. They have provided a sorely missed sequence (mid spring to early summer) of quality nectar and pollen sources for insects. These plantings have also extended the area with moist litter for insects.

Since 1998, a considerable volunteer and financial input by the council has been devoted to the establishment and planting of native trees and shrubs in the central part of the Styx Mill Reserve (Fig. 1). This reserve has 10 of the 14 different types of vegetation that are represented on the Styx River catchment. The premier botanical areas are the wetland with the main marshy community of rushes and sedges. The willow woodlands have remnants of native vegetation. Planting on drier ground has established a vibrant flax shrub land, as well as useful kanuka and forest patches. The gravelly land also has some grey shrubland species with matagouri and *Coprosma*. The Styx River vegetation has been more intensively investigated at 15 sites (Miskell 1990) and changes in the vegetation evaluated on 11 sites after 4 years (McCombs 1997).
Meurk *et al.* (1993) surveyed 496 sites with native vegetation in the greater Christchurch area. They found flax or aquatic plants in the river, sedges, and rushes at 92-96 % of the non saline sites and ferns (*Blechnum, Polystichum* or bracken fern *Pteridium esculentum*) and perennial dicotyledon herbs at 72-76 % of the sites. There were only nine species of regenerating native shrubs and small trees in the willow woodlands or along untended river banks in 48 % of the sites. *Muehlenbeckia* creepers were present infrequently on the 25 sites with detailed plant survey records. Fagan & Meurk (2004) presented a plan for restoration of Styx Mill Reserve that allocates about half the current grassland to forest.

Figure 1 Styx Mill wetland reserve – sample sites

Christchurch - Banks Peninsula reference invertebrate surveys

Four reasonably thorough lowland insect community surveys in the Christchurch area and Banks Peninsula have focused on a wetland (Macfarlane *et al.* 1998) native forest (Ward *et al.* 1999), and mainly grassland (Macfarlane *et al.* 1998, Bowie *et al.* 2004). These studies and those of sand dunes (Macfarlane 2005) and Christchurch waterways (Macfarlane 2004) confirm that much of the potential insect and spider diversity can be quite rapidly collected, but NOT CURATED AND IDENTIFIED. The potential diversity expected can be estimated on the basis of native and introduced plant diversity, but the last third of the species tend to take much more time to collect. New Zealand has around 2,400 native vascular plant species and is estimated to have at least 20,000 insect species (Macfarlane *et al.* unpublished) and about 2,000 spider species. Therefore on average there are 7.5 to 10 insect species per native plant species and one spider species per plant species. However, at least 130 resident insect species were found on the New Brighton sand dunes (Macfarlane 2005). This unexpected diversity among introduced plant species provides a cautionary example about how even vegetation with no original native plants and only a limited array of restoration native species can retain a significant portion of the presumed initial native invertebrates. It also suggests that warm dry habitats can retain valuable invertebrate diversity even when the main introduced plant diversity is low (less than 12 species).

A series of invertebrate community studies have clarified not only the species diversity in some of the major reserves within Christchurch, but also differences in the spectrum of species resident in the markedly different habitats surveyed (Macfarlane *et al.*1998, 1999, Macfarlane 2004, 2005, Table 1).
An extensive three month survey of the invertebrates of Travis wetland recorded 467 insect species from the estimated 750-900 species (Macfarlane *et al.*1998) with *Hyadina irrorata* being identified since the report was written. This gave an unadjusted ratio of 7.5 resident insect species per native plant species. When the insect species supported by the introduced plant species had been discounted at 1.5 insect species per introduced plant species, the ratio is reduced to less than 6. An even more thorough invertebrate survey conducted for about a year was made of the 85 ha Quail Island reserve (Bowie *et al.* 2004). Emphasis was placed on pitfall trapping to gather beetles and in all 667 insect, 53 spider, 4 pseudoscorpion, 3 harvestmen and 5 millepede species were collected. This lowland Canterbury reserve is dominated by grassland, but has a forest remnant and at least an ephemeral

Table 1: Recorded invertebrate diversity in Christchurch

	Number of species					
Taxonomic group	Native bush	Wetland- swamp		Savannah like danthonia grassland	Sand dunes	Waterways (Fresh-saline)
		Travis	Styx			
Beetles, Coleoptera	95	70	25-7	42	16	14
Flies, Diptera	83	135	146-54	41	55-61	47-50
Moths, butterflies	243	59	12	61	10	1
Parasitic wasps, ants, bees	44	134	72-74	41	28	1
Bugs, scales, aphids, etc.	59	46	21	13	17	6
Caddisflies	-	1*	19	11 (water-race)	0	17
Other insects	30	32	14	21	14	13+
INSECTS	**495**	**459**	**309-21**	**229**	**140+**	**99-102**
Spiders	-	27	12+	22	10-15	1
Snails, slugs	2+	12		-	3	
Insect species to native plant ratio		7.5		10.0	Does not apply	

waterway that supported six species of Chironomidae, several *Scatella* species and four *Millerina* species. The even drier savannah grassland of McLeans Island had a stony based water race and small pool, which supported 11 caddisfly species. This danthonia and moss dominated grassland with 23 native vascular plant species was surveyed only from summer to autumn (Macfarlane *et al.*1999), but it had 8.8 insect species per native plant species after discounting insect diversity for the 18 introduced plant species. Thus, with about 30 of the original native plant species and 42 introduced plant species, the Styx Mill Reserve could be expected to provide a place to live for 360 to 650 insect species, if it has the national average diversity for insects to plant ratio.

McLeans Island had 7.2 herbivores to 1.5 parasites to 1 predatory species compared with a 5.4 to 2.5 to 1 ratio at Travis Wetland. On Quail Island, the ratio of species was 10.4 herbivores to litter feeders to 2.2 parasite to 1 insect predator. The combined spider, harvestmen, centipedes and pseudoscorpion ratio was 1.3 to 1 predatory insect species on Quail Island, but collection and identification of thrips was inadequate and parasite identification was limited beyond generic or subfamily level. The experience for Canterbury insect community studies so far indicates broad ratios do not vary that greatly between the different major guilds (e.g. herbivores, parasites). Thus it does seem that the wetland could be slightly inhibitory on overall insect diversity.

I present a summary of what is known of wetland invertebrates in Canterbury wetlands to round out the limited results for species identification of some groups, e.g., moths, from this habitat at Styx Mill. Other challenges had to be met as I applied a relatively novel sampling combination (dominated by pan trapping & light trapping) for New Zealand to assess habitat use by little known insect species in very localized areas within the reserve. It is likely that a considerable part of the results obtained with malaise trapping and sweeping from the rush and sedge wetlands from Travis Wetland also apply to the wetland parts of Styx Mill Reserve.

1.3 Wetland invertebrates

There is limited information on Canterbury insect communities in wetlands (Macfarlane *et al.*1998). At the Travis Wetland, insect species' loss has occurred with fragmentation of raupo, *Typha orientalis*, beds and depletion of manuka, *Leptospermum scoparium.* The initial investigation of the invertebrate fauna of Travis Wetland revealed a somewhat surprising measure of insect diversity (Table 1) considering the periodic flooding, acid peat soil and that at least 80% of the plant cover was of introduced species. It was encouraging that both there and at McLeans Island, where native plant species cover was also low, that around the national average of 85% of insect and spider species were species confined (endemic) to New Zealand. These studies also revealed that Travis Wetland had retained a few Christchurch or Canterbury species that depend on wetland (e.g., the wingless Christchurch crane fly *Gynoplistia pedestris*). However, other rarer regional plants such as *Celmisia*, manuka and sundews had lost some of their characteristic speciesThe species recorded at Travis wetland provide a reasonable initial guidance on the main insect species associated with rushes *Juncus* spp., sedges *Carex* spp. (especially tussock sedge, *C. secta*) and New Zealand flax, *Phormium tenax*. Consequently, less emphasis was given to determining these relationships in the survey of the Styx Mill Reserve. The survey of Travis Wetland probably produced an almost complete list of the predatory ground beetles, Carabidae, and pollinators resident there. There were 11 species at Travis wetland and 7 species from Quail Island, where pitfall trapping was much more intensively used in an effort to reveal beetle diversity (Bowie *et al.* 2004). Thus the diversity of the predatory beetles in lowland Christchurch area is relatively well documented (Macfarlane *et al*. 1998, 1999).. Therefore I focused on investigating larger, less well known aspects of the regional insect fauna.

Marsh vegetation has several common and characteristic herbivores. The orangy nymphs of the light green shield bug, *Rhopalimorpha obscura*, were confined to tussock sedge, *Carex secta*, at Travis Wetland and were not found from sweeping sedges in Styx Mill Reserve. The undescribed seed-feeding moth *Megacraspedus* sp. was collected from *C. secta* sedge in Travis Wetland, and at Aramoana and the Southland coast (Patrick 1994b, 1995). It can breed on other sedges.

Wiwi rush, *J. gregiflorus*, and soft rush supported the black-pointed winged moth, *Batrachedra tristictica*, which feeds on the seedheads. *B. arenosella* feeds on introduced rush species at least. The speckled brown rush mirid, *Chinamiris laticinctus*, may feed on rush pollen and green rush seeds because it was swept from rush flowerheads. The rush feeding lygaeid bug, *Brentiscerus putoni* (Myers 1926), was uncommon at Travis Wetland (Macfarlane *et al.* 1998). The beak-snouted plant hopper, *Paradorydium* species (Cicadellidae), was definitely associated with rushes and is reputed to feed on jointed rush, *Leptocarpus simplex*, and *Leptocarpus* spp. are commonly recorded from wetland rush and sedge habitats (Knight 1973). This reed apparently hosts the endemic armoured scale *Natalaspis leptocarpi* (Ben-Dov 1976, Dale & Maddison 1982). The introduced mealy bug *Trionymus diminutus* (Brittan 1938, Cox 1987) and the Lygaeidae bug *Remaudiereana nigriceps* (Myers 1926, Dale & Maddison 1982) are reputed to feed on rushes. The record of *R. obscura* feeding on rushes (Myers 1926) placed uncertainty on the correctness of the Lygaeidae host records. I doubt the validity of even the limited range of sedge species (Lariviere 1995) recorded as hosts.

The largish crane fly *Gynoplistria pedestris* with its wing stumps, was confined to peaty wetland, which was consistently damp in summer and waterlogged in winter. Large larvae of crane flies were dug up among the roots and peat in the swamp. These larvae lacked the spiracular disc of *Zealandotipula novarae*, but may not have

been *G. pedestris* either. The endemic Christchurch *G. pedestris* has been found at 15 sites from Waipara to Knights Stream in south west Christchurch. Loss of some of these populations seems likely for collection was from some sites over 40 years ago, and some sites may have been built over or modified with urban development. The northern records need confirmation. Drainage and rural development may have made these sites unsuitable. Travis Wetland and the discovery of *G. pedestris* in the Styx Mill Reserve rush-sedge wetlands mean the city has two relatively secure undisturbed sites for this species even though only a small part of both reserves is suitable for this crane fly. From the Styx Mill and the south west Christchurch surveys, *G. pedestris* clearly prefers open wetland and perhaps muddy stream banks. March flies (Bibionidae) are normally abundant in wetlands especially the largest species *Dilophus nigrostigma* (Macfarlane *et al.* 1998).

The Travis Wetland supported a surprising diversity of parasitic wasp species and some tachinids, e.g., *Heteria ?plebia,* which are clearly wetland species. There were 37 Ichneumonidae species, 18 Braconidae species and 18 Diapriidae species, with a ratio of 5.4 to 2.5 parasites to 1 predatory species. Spiders with 27-28 species are the main source of predatory biodiversity in the marsh vegetation and litter. Eight or nine of the 27 or 28 species are undescribed and 74 % are endemic to New Zealand. There were also 10 predatory Carabidae species (three introduced) and at least 11 species of rove beetles in the litter and among rotting logs. Common prey available among the litter and in the upper part of the swamp included 32 species of fungus wood, root gnats, crane and moth flies and more mobile prey including leafhoppers and andhoppers.

1.4 Woodland and shrubland invertebrates

In Christchurch in 1997, Landcare CRI and Lincoln University scientists lead by Vaughn Keesing and Richard Gordon sampled broadleaf remnants (Riccarton Bush, Dry Bush) and small planted patches of bush of over 80 years in age (Ashgrove), 35-40 years (Canterbury University) and the Christchurch City nursery in Gardiners Road (about 2 years old). Six sites with contrasting ages of planting were chosen, but all but Riccarton Bush were small (Dry Bush) to very small (0.1 to 02 ha) patches. Only Riccarton and Dry bush are original remnants. This meant that marginal habitat, especially the grassland around Dry Bush, allowed ready access of non bush species, which only have to move a few to 20 m to be within the sampled bush. The full invertebrate community was surveyed with canopy trapping with a malaise trap suspended at least 3 metres above the ground in the canopy. Further specimens such as *Trioza vitreoradiata* were beaten from three tree species (lemonwood, totara, ribbonwood). The initial results, recording a diversity of 90 species of beetle, have been presented without listing the taxa involved (Cone *et al.* 1998). Cabbage tree, *Cordyline australis,* and, to a lesser extent, manuka flowers are useful sites to monitor for certain flies, e.g., Tabanidae, *Odontomyia* spp, and various wetland beetle species. Riccarton Bush has also been sampled from the margin with a Malaise trap by Quinn, a Canterbury Museum volunteer without funding. The partially sorted collection is lodged in the Canterbury Museum. Surveys of Hinewai Reserve (Ward *et al.*1999) and Quail Island (Bowie *et al.* 2004) included sites adjacent to or within forests, but results from the different habitats were not distinguished. Thus our knowledge of the insects from lowland coastal native forest in Canterbury is frustratingly incomplete and relatively poorly documented compared with the collecting that has been done. This is extremely important given the extent of the area being recommended for restoration of native forest for Styx Mill Reserve (Fagan & Meurk 2004).

Willows (crack, *Salix fragilis*, weeping, *S. babylonica,* and grey or goat) are the main introduced naturalized tree species in the area. Their herbivore (gall making) insect and mite fauna has been studied in Christchurch on white, *S. alba,* and crack willow (Sandlant 1979). The polyphagous large and grey native case bearer moth, *Lithothula omnivora* feeds on willow foliage. Five generalist scale insect species including apple mussel scale, *Lepidosaphes ulmi* have been recorded from undetermined willow species in New Zealand (Dale & Maddison 1982). The two spotted ladybird, *Adalia bipunctata,* favours willows (Kuschel 1990), because some aphids, especially *Cavariella aegopodii* stay on willows from autumn to spring (Cottier 1953, Stufkens unpublished). *Ca. aegopodii* is one of the nine most abundant aphid species in the Canterbury Plains pastoral areas (Lowe 1966). Live branches of willow can harbour the generalist longhorn beetles, *Asteltholida lucida,* the lemon tree borer, *Oemena hirta,* and *Xyletoles griseus* (Dale & Maddison 1982, Kuschel 1990). Flowers of the pussy willow group (grey but not crack or weeping willow) are quite attractive to the bumble bee *Bombus terrestris* provided rain does not dilute the nectar (Macfarlane & Griffin unpublished). Most willow species are useful for pollen or nectar for the honey bee *Apis mellifera* (Matheson 1993).

Dead willow wood presumably harbours the weevils *Helmorius sharpi*, *Notacalles* spp. and *Paedoretus hispidus* (Kuschel 1990). On the ground, willows harbour other insects such as wood inhabiting crane flies

(Tipulidae), wood gnats, *Sylvicola* spp., ants, *Huberia striata* and *Prolasius advena* (Formicidae), and larve of the Tenebrionidae beetle *Zealandium zealandicum.* Some of these wood consumers provide food for two introduced ground beetle species, *Laemostenus complaneatus* and *Mecyclothorax rotundicollis,* as well as the native *Notogonum feredayi* and *N. metallicum* (Macfarlane *et al.* 1998). The fairly thin leaf litter may provide food for moth flies (Psychodidae), root gnats (Sciaridae), springtails (Entomobryidae) and some native snails found in this part of Travis Wetland. Fungi among the leaves support a rather restricted range of fungus gnat (Mycetophilidae) species and some rough mould beetles, *Pristoderus* spp., and perhaps some of the five unidentified rove beetle (Staphylinidae) species (Macfarlane *et al.*1998). This list of insects that derive food from four species of willow illustrates how even a genus with only two specialist herbivore species (galls) can provide food materials for a considerable range of insect species.

The insect fauna of flax, *Phormium tenax,* and the creeper *Muehlenbeckia australis* is well known mainly from studies beyond Canterbury (Dugdale 1975, Dale & Maddison 1982, Miller 1984, Kuschel 1990**,** Macfarlane *et al.*1998). However, inadequate records exist for insect diversity found associated with the litter and below it.

Species of ground dwelling insects, spiders, harvestmen, slaters, andhoppers and pseudoscorpions appear to be quite sensitive to variations in the amount of vegetation to shelter in, which can reduce desiccation (Martin 1983, Macfarlane *et al.* 1998, 1999; Wratten *et al.* 1998). Some ground beetle species respond to greater cover in a pastoral habitat within a year and spread up to 100 m from uncultivated strips (Wratten *et al.* 1998).

Waterway invertebrates and fish

Macfarlane (2004a) included a check list of known insect and other invertebrate species for Christchurch waterways, including 30 insect species from within the Styx River. His evaluation mapped and emphasized the significance of water flow and current strength in allocating biological zones to these waterways. This summary also commented on the significance of common insect species and groups that help distinguish these zones. The review by Taylor *et al.* (2000) did not deal with such basic stream ecology. The recorded diversity of insect species is about halved in the urban waterways of Christchurch (Robb 1980, Suren 1993, Taylor *et al.* 2000, Macfarlane 2004a) compared with the adjacent headwater creeks of the Styx and Halswell Rivers. Taylor *et al.* (2000) also analyzed available information from the 1979 and 1988 in-stream surveys of freshwater invertebrates for the whole 54.8 km length of the Styx River. They noted a decline in stream invertebrate species from 75 to 62 taxa. They re-evaluated the catchment using the more appropriate urban community index for slow flowing and muddy streams. They checked for changes in abundance of the 20 most frequently encountered invertebrates and among the main food for fish they noted an increase in numbers of the large midge *Chironomus zelandicus* and the caddisfly *Hudsonema amabilis*. Conversely, there was a sharp decline between 1979 and 1988 for the still-water inhabiting caddisfly *Triplectides obsoleta* and a modest decline for one of the commonest small caddisflies *Oxyethira albicep*. Taylor *et al.* (2000) also rated the catchment as fair for freshwater fish, with a diversity of 10 species, but with concern for the spawning for brown trout.

The same relatively novel stream-side sampling techniques were used by me for both the south west Christchurch waterways (Macfarlane 2004b) and the Styx Mill Reserve. In south west Christchurch, 26-29 species of Diptera were associated with the muddy fringes of these waterways. This included 21 species of fly among 36 freshwater insect species.

Waterway invertebrates and fish

A more extensive investigation is needed for different inland and further lowland Canterbury sites to determine variation and patterns of Diptera diversity in the muddy fringes and midge species' ecology. This should resolve whether other sites also have about 40-45% of the waterway insect fauna concentrated on the muddy shores, which are at best under sampled in the traditional within-stream fresh water surveys. Nationally, these stream-side surveys are needed because of the lack of modern revisions for the majority of waterway Diptera. The main revisions of midge (Chironomidae), biting midges (Ceratopogonidae), long legged flies (Dolichopodidae) dance flies (Empididae), shore flies (Ephydridae) and muscid (Muscidae) flies and crane flies (Tipulidae) were made between 1930 and 1959 mainly by overseas specialists so only one or two New Zealand insect collections were examined (Macfarlane & Andrew 2001). These families, with 1050 described species and 1450 known species, have so far little published information on the ecology, including favoured habitats, of most of even the described species. Consequently, the preferred habitat (wetland, muddy water fringe, freshwater) is almost unknown for these species except for a few of the crane flies and shore flies (Winterbourn *et al.* 2000, Macfarlane & Andrew 2001). Before this survey, it was difficult to know which species favour muddy waterway

banks and wetlands. In addition, deer flies (Tabanidae), *Odontomyia* spp. (Stratiomyidae), the non predatory native flower flies (Eristalinae), with a further 50 plus known species, and some of the Sphaeroceridae are known from overseas studies to inhabit freshwater or wetlands. Therefore there was a real challenge to extend the satisfying start to ecological understanding of Diptera made by the south west Christchurch waterways survey.

When the contract was offered it was not apparent that counting of species and the selection of so many sites would be required to tease out the habitat preferences of the insect species. Both less comment and little reliability about species use for the habitats could have been achieved about the various areas without counts for species and recording the incidence of collection. This was vital to determine species habitat use when there is almost nothing recorded on the ecology of nearly all species. The subsequent survey of south west Christchurch waterways (Macfarlane 2004b) examined contrasting sites in terms of several factors. There were shaded woodland and open sites and different types of waterways (ponds, ephemeral pools, gravelly low flow, medium flow and slow flow waterways). These comparisons demonstrated the value of counting species collected in pan traps. Pan traps are acknowledged as one of the top sampling means for forest sampling of active species(Kitching *et al* 2004). The south west Christchurch waterways survey and the subsequent study of the insect species active in the New Brighton sand dunes (Macfarlane 2005) highlighted the importance of open sunny sites for a range of at least eight predatory species of Muscidae and the smaller shore flies (Ephydridae).

The information vacuum is even more acute for the at least five and probably 10 - 15 species of undescribed flies as well as an apparently unrecorded Sphaeroceridae species for New Zealand. Without such a focus on detail, no initial indication on habitat use and favoured habitat conditions would have been derived from the survey. Hence, the recommendation of the need to retain open wetland could not have been made with any degree of conviction. Nor was the need for caution in allocating the north east area for forestation (Fagan & Meurk 2004) apparent when the main part of invertebrate survey was undertaken.

Threats to the terrestrial invertebrate fauna

Weed invasion threatens invertebrate habitat quality in the Styx Mill reserve in the medium to long term. McCombs (2003) provides a detailed plan for weed control. Willow, gorse and blackberry could overrun much of the valuable wetlands adversely affecting wetland native plants and invertebrates. These weeds can degrade plant host diversity and alter plant cover and shade sites to the detriment of invertebrates, which favour open habitats. Blackberry and gorse can inhibit or deny access for human recreation and management to parts or all of the wetlands and woodland. Further spread of blackberry will provide more food for blackbirds, which can then accelerate the spread of blackberry. Willow woodland with blackberry is difficult to convert into native forest. Gorse and broom support a few wood and twig boring insect species (Cameron *et al.* 1989). Broom has only about 3 insect species (all introduced) that feed on it consistently (Scheele & Syrett 1987, Syrett 1993). Gorse (Cameron *et al.* 1989) and *Hieracium* (Syrett & Smith 1998) are similarly depauperate of consistent sap and foliage feeders.

There are several long term threats to the invertebrates in the Styx Mill Reserve. The most valuable wetlands for native plants and invertebrates are under considerable threat from willow, blackberry and gorse incursion. McCombs (2003) provided a detailed plan for weed control. Such dominating and inhibiting weeds for access will degrade plant hosts for the invertebrates that favour open habitats. The quality of habitat for human recreation is also severely impairedbecause blackberry and gorse can deny access to parts or all of the wetlands and woodland. Further spread of blackberry will also provide more food for blackbirds, which will accelerate the spread of blackberry and make it more difficult to convert the willow woodland into native forest. The invasive scrub weeds gorse and broom support a few wood- and twig-boring insect species (Cameron *et al.* 1989). Broom has only about three insect species that feed on it consistently and these are introduced species (Scheele & Syrett 1987, Syrett 1993). Gorse (Cameron *et al.* 1989) and *Hieracium* (Syrett & Smith 1998) are similarly depauperate of consistent sap and foliage feeders.

Aquatic insect diversity is under long term threat with the continued urbanization of the upper reaches of the Styx River.

Survey objectives

To provide basic information on the invertebrate status of Styx Mill Conservation Reserve. Christchurch City Council parks managers wished to have basic information on:

- invertebrate species biodiversity of endemic species;
- rare and unclassified (undescribed) species and their locations and habitat sites;

- the relative importance of habitats within the reserve, so advice can be derived to manage the habitats to conserve key invertebrates;
- areas for protection from environmental change to protect existing invertebrate values.

METHODS

Site habitats and sampling procedure

The study focused on comparing representative vegetatited areas and the nearby waterways using 25 sample sites within the Styx Mill Reserve (Fig 1 on p 8 , Table 2) (19 sites are illustrated with 22 pictures on pages 16-20). Four sites were west of the central creek with its three constructed ponds in ungrazed grass (two sites) and grazed grass (two sites). Nine sites were beside (six sites) or within 10 metres of the central creek or ponds. Site three had two subsites; the upstream site was at the central creek and Styx River junction (see picture –light trap site) and the lower subsite was 10-12 metres downstream where a short spring with soupy mud was sampled with pan traps. Sites 12 and 20 were in dry gravelly sites with grassland (Table 2). Three sites were sampled in the north central wetland swamp and two for the eastern wetland, although site 17 was on the margin across the southern creek. Two sites were checked in the Redwood Springs flats with pan traps

Yellow pan trapping

Sampling used yellow pan traps much more than the survey of the Travis Wetland (Macfarlane *et al.* 1998), because I wanted to clarify habitat preferences of as many of the lesser known insect species as possible. Such novel assessment for many species was needed to make meaningful comments on the value of different habitats from an invertebrate conservation perspective. Specimens were counted to determine the degree of patchiness of the more abundant species and also to indicate which species were less common. Pan trapping usually continues to collect specimens after the traps are set up unlike sweep netting, which is another way to relate insects to particular vegetation or waterway margins. Pan traps can usually be set out in public areas because the low bowls are unobtrusive, as was proved in the New Brighton dunes (Macfarlane 2005). Pan traps are a favoured means of sampling species active in the vicinity of the ground in forests (Kitching *et al.* 2004) and were effective in discriminating some habitat differences in the New Brighton sand dunes (Macfarlane 2005). In this survey, 15 sites sampled were aimed at dual habitats, i.e., waterways (section 3 of Appendix 3) and the adjacent woodland, wetland or grassland. At these sites the pan traps were beside the waterway or within 2-3 metres of water.

The pan traps were generally left out for about one day and were usually undisturbed so similar sampling intensity was achieved for most of the sites. There were some important exceptions. First, the stockyard ditch was resampled in 2005 so two sites 55 metres apart at the head of the ditch and near the eastern fence were lumped together and the traps were left for about 1.5 days. This site was sampled again in 2005 in an attempt to collect more *Hydrellia acutipennis*. Collections at another four sites were considerably less intense because, at both the water trough and the exposed mown grass between the pools, cattle around the trough and peopleallowed the pan traps to be operation for only 20 and 45 minutes, respectively. Wind, a watery base and a sloping surface resulted in upset pan traps above the central creek ford and pukeko s disrupted pan traps in the Redwood Springs flats. All the pan traps at the muddy spring site at Redwood were upset as were some of the traps at the open "wallow", which came through under the fence. At site 8, some traps tipped up and the total catch was poor so the result was lumped together with the other ungrazed grassland sites. Also the site 1 collection was not counted fully so it was excluded from Appendix 3.

Sweep netting

Sweeping provided the specimens from hemlock, kanuka and yarrow flowers (sites 12, 13), dry ungrazed grass (sites 5 & 10), the northern bog (site 15) the short grazed grassland (site 11) between the upper two ponds on the central creek. At the Redwood Springs flats away from the river bank dock, butter cup and ungrazed grass were swept for insects. Even at these sites within the reserve water was only 5 to about 20 metres from the sample area so some vagrant aquatic and wetland insects were collected at these sites (Appendix 3).

Malaise trapping

Two malaise traps were operated at the same time at a wetland and woodland site. The first two sites (site 10- the eastern rush field & site 13- the southern willow) were sampled from February 21-28. This eastern rush field site was near the centre of the rush wetland in the south east part of Styx Mill Reserve well away from any trees, but close to a slow flowing waterway. The southern willow site was within about 5 metres of the peaty

waterway. There was little vegetation on the groundat the site, which was next to a wet, bare muddy area. Here there was little undergrowth and the canopy was fully closed cutting down the light intensity. Between March 3 and 13, the central planted "native" woodland (site11) with its well drained gravelly base was sampled.

Table 2 Stx Mill Reserve nvertebrate sampling:- method, vegetation and habitats sampled

Site No/ Area	Collectionsite	Sampling method	Adjacent vegetation	Nearby water or other habitat
		STREAM, CREEK,DITCH ANDPOOL HABITATS		
1 O*	Styx stream, western site	LT	Wetland, grasses	Stream
2	Water trough – manmade "spring"	PT	Short grazed grassland	Water trough
3 O	Central creek, Styx stream junction	LT, PT	Willow, mud slurry, sedge grass	Stream/mud
4 O	Lowest central pond -no 3	PT	Rushes, grass - limited duck weed	Pool
7 O	Middle creek ford	LT, SW	Flax, grass	Stony creek
8	Outlet below central pool -no 2 & adjacent short grass	LT, PT, ISS	Grass, willow, musk plant	Rock creek
13 N	Central wetland, north pool	LT, PT	Duck weed, rushes, willow	Natural pool
18 B	Peaty south creek, open	PT	Rushes, musk plant	Peaty creek
20 E	East creek ford	LT, PT	Muddy fringe, short grass, rushes	Stony creek
22 & 23 D	Mud ditch by stock yard, sites 50 m apart - 23 near east fence	PT, SW	Grass, willows	Soupy mud
		WOODLAND, SHRUBLAND		
6	Flax/cabbage trees by central ford	PT	Mainly flax and cabbage trees	Planted woods
12 R	Central planted woodland- by main top pond	PT, MT	Coprosmas, cabbage tree, elderberry, kanuka	Planted woods
16 N	North end, central woodland	PT, MT	Willows, rush, moss	Willow woods
17 K	Central woodland - south edge	LT, MT, PT	Willows, some ferns, peaty creek	Willow woods/creek
			WETLAND	
14 N	North central wetland margin	PT	Rush-sedge or grass	Beside north pool
15 N	North central wetland boggy area	PT	Rushes & swept sedges	None
19 C	East wetland with rushes-sedges	LT, MT, SW	Rushes, low fine leaved sedges	Soupy or stony ditch
		GRASSLAND - **GRAZED OR UNGRAZED**		
5 O	Long grass with sparse native tree planting	PT, SW	Kanuka flowers, brown top dominant long grass	Lower pool within 15 m
9	Short dry grass/forb area	PT, SW	Mowed & with waterfowl dung	Upper, middle pond
10	Long grass with planted shrubs	PT	Cocksfoot ungrazed grassland	Upper pool
11	Short dry grazed grassland	PT	Grazed grass with cattle dung	Between ponds
13 Q	Central ridge short grassland	SW	Yarrow flowers, grazed grass	Dry grassland
21 D	Stockyard field	SW	Grazed grass, plantain, red clover	
25	Redwood wet long grassland	PT, SW	Grass lax grazing with butter cup and dock patches	Pans beside river or muddy spring
		EDGE OFNORTH WILLOW WOODS		
24	N.E.woodland, East bank	SW	Hemlock	Weedy bank

Key: Sampling methods LT = light trap, MT = Malaise trap PT = pan trap ISS = in stream sample SW = sweepnet
*** - Area letter from McComb (2003b)**

Representative waterways, pools and adjacent woods, wetlands, grassland
Sample sites are arrowed or are circled

Site 1 Mini-wetland by Styx streamside – light trap site arrowed

Site 2 Water trough spring with yellow pan traps in front of it. View straight north to **site 1** near tall tree (circled)

Site 4 Lower central pool – pan traps at water's edge and in nearby long grass
(a) Pool side view (b) View towards lower pool and creek junction

Site 4 left hand side arrow.
Site 3 upper central arrow.

Site 3 Central creek junction with Styx River – light trap site. Pan traps subsite in side spring 10-12 m further downstream

Site 7 Central creek ford – light trap
View to west of proposed recreation area
Part in native forest an alternative end use.

Site 8 Central creek below middle pond–
pan traps site arrowed– north view

Site 17 South willow woodland – malaise trap and peaty south creek **(scan two prints)**

East view

low ground cover on wet soil –East north east view

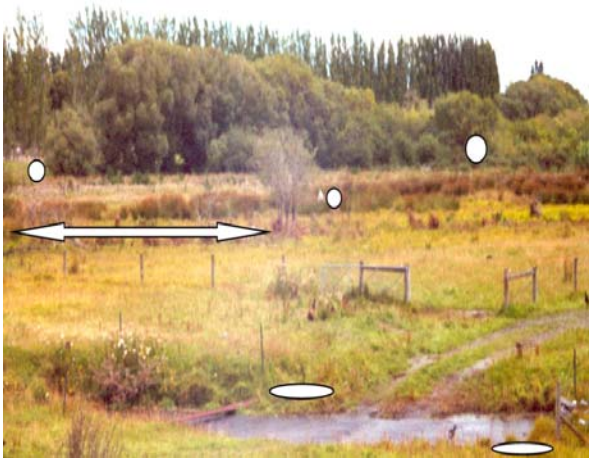
Site 14 Wetland central and north pool – north central wetland beyond

Sites 15 & 16 North central wetland –view to east Malaise trap site behind willows see arrow

Site 22 Mud ditch by stockyard and adjacent NE willow woodland

Site 21 Upper stockyard ditch - main site for *Hydrellia acutipennis*

Site 20 East creek ford with gravel bed and beyond **site 19** malaise trap (white triangle) among eastern rush-sedge wetland.
Ditch with mud flat arrowed.



Sites 17 18 Eastern west wetland margin, mud ditch with mud flats during dry periods. Prime shore fly habitat – similar habitat largely lost with pond development at Travis wetland

The woodlands

Site 12 Central planted native woodland (malaise site arrowed)
North view with upper pools in background

North east view near pool

Central woodland looking to the east from the southern bank (**site 17** circle among trees)

Grasslands

Site 9 Short grass with waterfowl dung
View to west –site 10 arrowed

Site 10 arrowed among long dry ungrazed grass.
View to north

Site 10 and 9 arrowed

Site 20 Red clover-grass field, swept – view almost to north, stockyard ditch (arrows **sites 21, 22)** beside north willow woods

Site 24 Redwood Springs flat. Long grass and forb flats –view to south south east Successful pan trap site in distance

It was within about 15 metres of the large upper pond of the central creek. The planted woodland was much denser in the lower 1.5 metres above the ground, and the ground was free draining and dry in summer. This site was also close to being a closed canopy. The second site sampled in March was an open site at the eastern edge of the northern part of the central willow woodland (site 14), which was about 30 metres south of the Styx River. Rain during sampling meant the grass/sedge/moss floor of the trap was covered with water when the insects were being collected, which reduced the effectiveness of collection when the water was lying on the ground. The traps collected specimens over 7-10 days per site.

Light trapping and seasonal duration of sampling

Light traps were operated beside eight waterway sites including the south central woodland and eastern wetland.

On a seasonal basis, sampling by yellow pans traps, sweep-netting, and light traps (three nights) extended from 18 December 2003 to 8 February, 2004. Sampling was resumed from January 21 to 28, 2005 at six sites (2, 6, 11D, 14, 19, 20). Effectively, only 4 of 15 pan traps placed at three sites in the Redwood Springs flat (east across the main north road) on 17 April 2005 remained operational. These pan traps were beside the side of the Styx Mill River in the vicinity of willows.

Waterways

Variation in abundance, especially of the less well known taxa was investigated for five types of freshwater and the wetland. Numbers of species collected from two or more sites per habitat with pan traps were compared. Even single traps in grassland, cushion plant and among pine tree yielded distinct comparisons at McLeans Island (Macfarlane *et al* 1998). Light traps added to the information at sites near waterways for species diversity especially of caddisflies and readily also detected males of the common midge *Chironomus zealandica*. The running waterways were placed in five classes,1 to 5, with presumed reduced oxygen availability for categouries 4 and 5. **1** The deep, moderately flowing and partially shaded Styx River, which now has an almost entirely silted (grey) banks and bottom, was expected to have the best environmental quality. Ecologically, it resembles the Halswell River at Saby corner and at Leadleys Road in the south west Christchurch waterways survey (Macfarlane 2004b). **2** The stony, reasonably rapidly flowing central and eastern side creeks had clear water throughout most of the sampling. However, after some sustained rain, the eastern creek was milky with silt presumably from the Northwood subdivision. This silt contamination points to the need to allow for adequate areas with grass away from waterway banks when housing developments are being completed with their penchant for keeping piles of finely worked dirt piles often for months. Elsewhere in Canterbury and even in parts of Christchurch, these stony based waterways should have had mayfly nymphs present as at least a co-dominant part of the in stream invertebrate fauna. **3** The peaty bottomed (blackish), sluggishly flowing creeklets originating from the wetlands. **4** Ditches with muddy bottoms and vegetation to the banks. **5** Ditches with mud flats and the edges during the driest periods in summer**.**

Insect visitors of flowers

The value of flowering plantings of kanuka and flax was compared with hemlock and yarrow. Insects were also observed on flowers of lotus, white clover, thistles, mallow and catsear.

Fauna investigated and identification

Most insect taxa, apart from Lepidoptera, were collected. Notes were made of the presence of only a few readily identified moths and butterflies (Appendix 1). No attempt was made to identify aphids, thrips, spiders or Collembola beyond family level. Voucher insect and spider specimens have been labeled. Not fully identified species other than Lepidoptera have been lodged either in the Canterbury museum, New Zealand Arthropod (parasitic Hymenoptera) or Auckland Museum collection (some Hymenoptera). Further duplicate specimens especially of beetles may be lodged in the Lincoln university collection.

Recent reasonably thorough studies on insect communities in Canterbury dominated by bush (Ward *et al.* 1998) and dry introduced grassland (Bowie *et al.* 2004) and in central Otago *Olearia* shrubland (Derriak *et al.* 2000) had 20, 12 and 15 invertebrate specialist authors, respectively, to achieve reasonably comprehensive identification. Institution charges by the very limited numbers of professional insect taxonomists in New Zealand (usually only a one or two per main insect order) can readily lead to considerable charges for identification alone and sufficient time also must be allowed for the specialist to identify the taxa especially if extensive material if forwarded for identification.

I was responsible for sorting and the initial identification of the 1997 insect survey of Christchurch bush. The results for five sites are presented (Table 3). Consequently, I can now present the results obtained for Riccarton Bush and four small areas of planted native forest at Ashgrove, Ilam, School of Forestry, Canterbury University and 239 Gardiners Road (Christchurch City Council nursery) to supplement the results from the woodlands in Styx Mill Reverve. The Gardiners Road nursery site is around 1.5 km from Styx Mill Reserve and had been planted only 2-3 years before the survey was made (Carter pers. comm.).

RESULTS AND DISCUSSION

Over 9,100 specimens were collected, sorted, counted, labeled and in some cases pin mounted in the survey (Appendix 2). John Ward identified additional caddisflies and Peter Johns the crane flies. Even with incomplete separation into morphological species of the spiders, root midges and some other groups in excess of 800 insect tubes and 200 pinned specimens required mounting and labeling (Table 3). The species or taxa were then sorted according to 12 known or likely ecological roles:- running water, still water, mud shore, herbivores, forest and shrubland litter, grassland litter, pollinators, dung flies, carrion flies, parasites and predators.

The % frequency that each species was found at the sites and counts for species through to identified families have been segregated into four different sections: the five woodland sites, five waterway sites, four wetland sites and two grassland sites (Appendix 2). Totals of specimens are also given for many of the main fly families, which makes clear the degree of partial identification achieved. For the % frequency calculations of waterway insects, four sites were excluded because the sampling of pastures and flowers was only by sweep netting at least 5-20 metres from the nearest waterway. Sweeping from the kanuka and hemlock was also at about 0.5–1.5 m high above ground, unlike the pan traps that were within 25–40 mm of ground level.

Resultant invertebrate abundance and frequency of collection ddata were also compared between grazed and ungrazed grassland (Appendix 3). There was an extreme range from wet laxly grazed grassland, e.g., Redwood Spring flats (site 24), through long ungrazed damp to wet grassland (sites 4, 8) and dry long grass (site 10) to short dry grazed grassland (site 11, 13). Possible biological differences for total count or frequency data by habitat are marked in the appendix in bold. Known biological differences for species are marked with a hash mark (#). Some of these certain differences, such as the favourability of ungrazed grassland for a fuller spectrum of spiders and the value of long grass with decaying material to shelter European earwig, are already known. This agreement provides some confidence that the other trends noticed may be useful biological indications of habitat preferences.

A total of between 309-321 insect and at least 12 spider species were collected even with virtually all the moth specimens discarded (Table 1, Appendix 1). The total number of resident species could well be 800-1,000 given that, overall, the Diptera account for only about 20% of the insect species in New Zealand. The only clear vagrant species was the lesser bulb fly, *Eumerus strigatus* (Syrphidae), which affects garden bulbs. Thus a lower level of vagrants was collected than the 3 % at Travis Wetland (Macfarlane *et al.* 1998) simply by having the

collecting sites further into the reserve and not evaluating moth catches from light traps within 40 metres of the reserve's boundaries.

At least 47 of the identified taxa are adventive species. The total collected was probably 55-65 adventive species, when allowance is made for there being over five adventive aphid species, some gall midges and *Megaselia* species, one or two root gnat andweevil species and perhaps the odd chalcidoid parasite species. However, if the insect groups had been fully identified, then probably close to 350 species would have been identified. A few groups such as the springtails and the common moth flies (Psychodidae) include indigenous species. Therefore the proportion of endemic species collected would have been about 82-85% or virtually identical to that of Travis Wetland. However, I consider that the Styx Mill Reserve would have recorded a higher level of endemism if the moth species had been identified and more beetle species had been collected with pitfall traps and ground collecting, such as was done at Travis Wetland. The actual level of endemic resident species may well be between 88-95 %, when allowance is made for the considerable number of localized, uncommon to rare species, which remain uncollected. I see no reason why the species diversity at the Styx Mill Reserve should not be similar unless the wet ground zone of the woodlands restricts species diversity especially of parasites. Conversely, the Styx Mill Reverve clearly has at least 25 to perhaps 40 or 50 more insect species in the waterways than Travis Wetland.

An interesting incidental result of this survey, and the concurrent one of the south west Christchurch waterways, was the recording of four species, that have spread from the North Island to Canterbury since 1996 and 1997, when I carried out the surveys of Travis Wetland and McLeans Island. These species are the small Australian dung fly *Lasionemapoda hirsuta*, which has been in the northern part of the North Island since 1956 (Harrison 1959, Cumber and Harrison 1959). Both the herbovore *Nematus megaspilus* and the mud nesting wasp *Ancistrocerus gazelle*, which preys on caterpillars are relatively new arrivals. The lacewing for *Cryptoscaena australiensis* has been in the North Island for several decades.

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Table 3 Summary of specimens collected by habitats and guildsand species diversity by habitat in the Styx Mill Conservation Reserve

Parameter	Number of species						
	Woodland	**Waterway**	**Wetland**	**Grassland**	**TOTAL**	**Min**	**Max**
No of sites	4	10	7 : 4*	9 : 5*			
Freshwater insects	35	405	37	27	**504**	23	23
Water - still to slow flow	6	340	22		**389**	9	9
Mud & wetland	36	2248	294	13	**2591**	26	30
Terrestrial guilds							
Herbivores	282	-	472	2174	**2928**	75	90
Forest to grassland litter	246	-	278	93	**617**	43	50
Grassland litter	33	-	84	239	**356**	8	12
Pollinators	45	-	4	17	**66**	8	9
Dung	18	-	20	55	**93**	3	3
Carrion	2	-	0	12	**14**	4	4
Parasites	146	-	185	351	**682**	96	96
Predators	168	-	316	305	**788**	52	55
Unknowns	5	-	5		**10**	3	3
TOTAL	**1068**	**2796**	**1174**	**3148**	**9038**	**292**	**322**
No of separate taxa	**123**	**218**	**169**	**298**	**1116**		

Habitat preference based on average numbers per site and or frequency of occurrence in habitats was indicated for 21 herbivore species, 13 forest and litter inhabiting species or groups, 5 grass-litter dwelling species and 10 parasite species (Appendix 2 – the 7 summary pages). The distribution of various species within the reserve was also helpful in determining the habitat preferences of several little known species (Maps 1 & 2).

Unusual herbivores

The most prized find of the survey was of the small black shore fly *Hydrellia acutipennis*, which was collected most readily near the stock yards by the bend in the ditch as it comes out from the willow woodland and also by the east creek ford. However, the extensive sample gathered in 2005 from the original stock yard end of the ditch and a second set of pan traps 55 metres east of this by the fence failed to collect any more *H. acutipennis*. I wanted to photograph this very distinctive small black species with its small wings with a pointed tip. The small surface area of the wing suggests flight ability may not be good. This species was described in 1959 from the three specimens (two damaged) from a salt marsh site at Allan's Beach, Otago Peninsula. It was pleasing that Wayne Mathis (Smithsonian Institute, USA) could collect it using his "slow style" sweeping. During three visits to New Zealand, Wayne has sampled 750 sites from the three main islands for Ephydridae without recovering any specimens. The undescribed new *Hydrellia* species is also quite small with quite short wings, but the tip is not pointed.

Host plants have yet to be discovered for both *Hydrellia acutipennis* and the more abundant *Hydrellia* new species. All species of *Hydrellia* for which the biology is known are herbivores. Within the ditch and along its banks the only native plant that was apparent was *Azolla* weed floating on the ditch, which is known to host other *Hydrellia* species elsewhere in the world. Other sites where this weed was on ponds did not yield any *H. acutipennis* or, at best, a few specimens. On the wet banks at this site was the inconspicuous small wetland herb *Veronica serpyllifolia*, which is widespread in New Zealand. New Zealand has quite a diverse flora of Scrophulariaceae including similarly less woody and shorter species (e.g., *Parahebe*) from which *H. acutipennis* might have extended its plant host range. However, the lack of collection of this species elsewhere in New Zealand combined with the extensive distribution and abundance of *V. serpyllifolia* make this an unlikely candidate host. This is especially so given the focus that Mathis has for specialized shore fly collecting in habitats likely to have this herb. Incidentally, *V. serpyllifolia* is not listed as being present at the Styx Mill Reserve (Fagan & Meurk 2004). There was considerably less of this plant left after autumn grazing by cattle. Fagan & Meurk (2004) map *Carex flagelligera* and apparently *Scheonus pauciflorus* as the nearest uncommon plant species from the north-east willow woodland. It would is very desirable to find the plant hosts for *H. acutipennis* given the paucity of specimens of this species recorded so far.

At least two changes to the habitat in the north east willow woodland and the stock yard ditch between 2003/2004 and the summer of 2005 appear to have led to the loss of *H. acutipennis* at this site because, in resurveying for *Hydrellia acutipennis*, I could not recover this species. These changes include degradation of the ditch due to an increased water flow that is also evident from the deepening of the lower end of this ditch. The extra flow of water through the woodland may have killed off a plant host notably *Carex maorica*, which was recorded from only close to the surveyed ditch. Damming the creek with willow wood debris has increased the flow down the ditch and may also have made the ground too wet for any pupae that might exit sedge to survive. There has been some reduction in the herb diversity along its margin. The use of herbicide against blackberry along the fringe of the willow woodland may also have killed this rare sedge.

For the undescribed *Hydrellia* species, there are other ferns (probably water fern, *Histiopteris incisa*) apart from the less common *Blechnum minus* within the adjacent woodland. This more abundant native wetland fern may be the host for the undescribed *Hydrellia* species, because it was present at both ends of the 2005 ditch pan trap sample position. Unfortunately, area D of McCombs (2003b) was not sampled for plant species by McCombs (2003a). Area D should not be remodeled as a small open pool, as has been proposed, until at least the host and distribution status of *H. acutipennis* have been resolved.

THE HABITATS

An important reason why the less intensive survey of the Styx Mill Reserve recorded more Diptera than Travis Wetland was because of the range of running waterways combined with the presence of kanuka flowers from which to record some species. So far, neither *Hydrellia acutipennis* nor the apparently undescribed dance fly *Isodrapetes* sp. have been collected from other studies in Christchurch of wetlands and waterways. The undescribed species of *Hydrellia* may have been collected previously, but not have been recognized as an undescribed species. However, if present elsewhere, it was not as prominent in the samples because I would have remembered such a species with a small wing relative to the body size.

Waterways

The immature stages of about 32 species live within streams. Excluding caddifles, midges, with at least 5 species, comprised 72% of the specimens from running water.

Nineteen species of caddisfly were collected, including the rather rare micro-caddisfly *Paroxythera tillyardi*, which is often found near big lakes. It was commonest in light trapping close to the second pool outlet. This is its only site, apart from the Groynes, known from the east of the South Island. *Triplectidina moselyi* was recorded only on the third night of collecting from the peaty creek in the central willow woodland. It is usually found associated with reedy ponds and marshes and may exist in the Travis Wetland. A third species, *Helicopyshe albescens*, was one of three new site records for the Styx River. It has two known Christchurch sites (Waimairi Stream, and Coutts Island, Waimakariri), and several known Banks Peninsula sites including the type locality, Purau Stream. Two species recorded from the water race at McLeans Island were not recorded in this survey and no caddisflies were recorded from Travis Wetland. Nine species were recovered from the peaty creek and pools in the southern woodland with noticeably more of the larger caddisflies, including *Hydrobiosis* species. Twelve species were recorded from next to the stony creeks and drains. The long horned Leptoceridae were commoner in the vicinity of pools and the pond. Near Brooklands at Selkirk Road on the Styx River, 13 species have been recorded with repeated collecting. Two certain further species records from this collecting were *Costachorema xanthopterum* and *Hydrobiosis umbripennis* plus possibly *H. copris*, based on a female. This latter species is difficult to distinguish because its female is similiar to females of some other species in the genus. Robb (1989) recorded 11 species from the Styx Mill Reserve including two species not recovered in 2004. *Hudsonema aliena*, found in this survey, was present in the water race at McLeans Island as well as *Aoteapsyche catherinae*. A few of the small caddisflies, especially *Oxythera albiceps* were often collected in low numbers in pan traps by running water. This species was very abundant at sites with running water and stony-bottomed streams and much less common in the peaty creek area. No caddisfly species were found at Travis Wetland, where there were no stony creeks or major flowing streams. Nor has John Ward (pers. comm. 2004) found at least the most frequently recorded small species that extend well up into marginal and low flowing creeklets in Knights Stream (Macfarlane 2004b). This indicates these waterways may be contaminated by some toxic substance or at least that the waterways of Travis Wetland would benefit from a short selective survey to clarify the actual situation now that the level of waterways there has been raised.

No mayflies were taken in the light traps or found around stones in the central creek. However, Terry Hitchings (pers. comm.) has collected some from the central stream in 2002. Robb (1989) recorded *Deleatidium* species and *Coloburiscus humeralis* from Styx Mill Reserve. Since 1988, the creek and stream environment at the Styx Mill Reserve has apparently declined with the loss of mayfly species. From this it may be inferred that a toxin has be flushed down the drain from the Styx Mill new housing complex.

Males of the large common midge *Chironomus zealandicus* came very readily to lights from the major pools and are presumably an important source of invertebrate food for the water fowl in these ponds. Midge larvae were abundant under the rocks in the central stream between the top and middle pool. In the south west Christchurch waterways survey *Gressitius antarticus* (Macropelpini) and *Polypedium parvus* (Chironomini) were collected. The less easily identified Orthocladini species have been sent to Ian Boothroyd, Auckland, for identification. The objective to construct a key to distinguish some of the 12-15 midge species collected from the south west Christchurch waterways and the Styx Mill Reserve has yet to be achieved with no identifications received from Boothroyd after 2 years. A second retired specialist, who has also described New Zealand midge species, Don Forsyth,Wairakei , has yet to be contacted for taxonomic assistance because budgetary and his health reasons. In the 1990s Don was most helpful with Chatham Islands specimens. This would make further streamside surveys of the few premier headwater waterways on the northern margin of Christchurch such as Smacks Creek, quite readily achieved with an affordable survey. I am concerned that a very significant amount of the premier lowland headwaters, at least in central Canterbury, have been seriously degraded by the urban spread of Christchurch and the rearrangement of Rangiora waterways. Dairy farming is likely to have degraded lowland Canterbury waterways less severely, but over a considerably greater area. At least there are some records of invertebrates from the headwaters in the vicinity of Christchurch, but this does not apply for similar spring fed areas in the Waimakariri District. Certainly because of suburban development and waterway alterations, the original wetlands and creek sources of Rangiora have severely changed as this town was settled and has spread

out. All these changes to lowland Canterbury waterways make the subtly different waterways of Styx Mill Reserve even more precious from a Canterbury perspective than they were even 20-30 years ago.

The long legged fly *Hydrophorus praecox* was active on the fringes of the large upper pool, where water weed allowed it to skim along the water surface in search of prey and similarly it favoured loose waterweed on the fringes of the concrete food. In south west Christchurch, considerably higher numbers were found along the silt edge of a pool at Halswell Quarry (Macfarlane 2004b), so it favours silty edges of pools. The habitat for this species in Europe has not been verified by rearing larvae (Smith 1989), so this information provides a very useful clue about where to search for larvae.

In the waterways within the wetlands, 26-30 insect species were present at Styx Mill Reserve (Sections 2 and 3 - Appendix 3). These species have been deduced to live along the muddy shores based on both this survey and that of south west Christchurch (Macfarlane, in prep.). Thus it appears as if that shore line flies account for 45-48% of the species, that rely on the waterways. The figure may have been somewhat lower had the midges been identified to species.

Several species of long legged flies (Dolichopodidae) were generally abundant (Appendix 3) including what were apparently two new species of ?*Diaphorus* and the more generally widespread and better known *Tetrachaetus bipunctatus* and *Sympycnus* species. All these species seem to be associated with wetland or waterway margins with *Sympycnus* apparently preferring wetlands. Elsewhere at several Canterbury sites, I have collected *T. bipunctatus* alongside small roadside muddy ditches. The smaller new species of ?*Diaphorus* had browny legs and short tarsal bristles. The two species I have provisionally allocated to ?*Diaphorus* may actually be *Chrysotus* species but, if so, they do not fit the key for species in either genus (Parent 1932). This seems surprising given their relative commoness in the wetland/waterways margin habitat both at Styx Mill Reserve and the waterway margins of the Heathcote and Halswell Rivers (Macfarlane in prep.). I am certain that the *Hercostomus* species is undescribed because the male genitalia (cerci) are similarly spoon shaped like *H. philpotti* from the Chatham Islands. This undescribed mainland species has other distinguishing features on its head, which separate it from *H. philpotti*. It was only found along the margins of the main waterways (Map 1). The long legged fly *Tetrachaetus bipunctatus* clearly requires open areas since none was collected in the woodland sites.

The above long legged flies were more frequently found along the main Styx River than the shore flies (Ephydridae), *Scatella* spp., *Ephydrella*, *Parahyadina* and *Hyadina irrorata*. These shore flies were associated more with the mud to silt fringes or mud flats of the small waterways in the Styx Mill Reserve. The main species or species groups (*Scatella*) are quite distinct – see photographs and Harrison (1959).

Associated with the innocuously normal ditch coming out from the willow woodlands by the stock yard were at least two very interesting small *Hydrellia* species with black palps. Consequently, Wayne Mathis spent 1.5 hours collecting shore flies along the 55 metres of this ditch. He recorded further species such as *Eleliodes chloris* (Appendix 1), which I had not collected in the pan traps. These shore flies and the larger Muscidae (*Millerina*) species require open sites and the Styx Mill survey confirmed the lack of *Millerina* in closed canopy areas such as the south willow woodland pan and light trapping.

Another interesting aspect was the presence of at least four species of dance fly adults (*Hilarempis* and *Hilara* spp.) foraging among the hemlock flowers beside the eastern creek. I suspect they could be preying on the small leaf mining Agromyzidae flies (*Liriomyza, Haplomyza, Cerodontha* spp.) and possibly the parasites that favour this flower. The flat flower platform is important in the conservation of energy because the insects visit each flower in the umbel, which characteristically has low nectar yields per flower. This is only the second site in lowland Canterbury where *Ceratomerus crassinervis* has been found and all but one of the specimens were males. It was associated with slow and low volumn flowing muddy waterways (Map 1).

Among the hower or flower flies both the introduced drone fly *Eristalis tenax* and the shiny blue-bodied native *Helophilus hochstetteri* were considerably commoner near the central ditch in the south east rush field. Their larvae are known as rattail maggots and are adapted to living in wet soil to watery sites.

The pale yellow leafhopper *Zygina zealandica* clearly does not favour the vegetation found at the edges of waterways.

The common red damselfly *Xanthocnemis zealandica* was abundant in December/January on the ponds. Quite often a large dragonfly probably a *Procordulia* species could be seen over or near the ponds. I was unable to catch any of them.

In the eastern Redwood Springs, there was one spring area with a muddy flat, which would appear to be ecologically similar to the mud flat ditch at the eastern end of the main Styx Mill Reserve. The creek from below

the culvert also appeared to be a potentially interesting short stretch of waterway with muddy banks and a good flow to check in summer.

Near the gate, in area N, a shallow side pool of the main Styx River, was seen to have over 30 mature inanga, confirming the reasonable quality of habitat for freshwater fish.

Wetlands

Since 1996, I have examined for the Christchurch city council about five non shady wetland or ditch sites at Travis wetland, 16 in the South west Christchurch waterways survey and about 15 sites in the Styx Mill reserve that were open to partly shaded and had consistently wet soil (thus fully shaded and dry grassland had no specimens). I have found *Gynoplistia pedestris* at only six of these sites with the best numbers in wetland and these wetland areas were quite restricted in size. Four of these sites were in the Styx Mill reserve (map 1). It is heartening that low numbers also exist along the margins of some waterways with a slow flow (upper Halswell river catchment) to still water (pond site, central Styx creek).

The waterways with their often rushy margins had the most specimens of the rush-feeding *Hydrellia enderbii*, which can be readily distinguished from other *Hydrellia* species in this habitat by the yellow palps and dark legs. The margins of the waterways in the wetlands also favoured the two hover flies *Eristalis tenax* and *Helophilus hochstetteri.* Another striking catch in the malaise trap, which had water on the floor during the trapping period, was 74 females of a small crane fly *Molophilus quadrifidus* (site 16, area N). This has unmarked wings unlike the larger aquatic *Paralimnophora skusei* (see photographs).

Plant hopper (Cicadellidae) samples from wetland rushes had a dark brown species (apparently Deltocephalinae) in common with grassland, that was found reasonably often in more than low numbers. The pale yellow *Zygina zealandica*, which apparently feeds on a range of perennial herbs, was also common in both habitats and at Travis wetland. The other eight species were only collected infrequently and in low numbers and included the vagrant (for native wetland vegetation) *Ribautiana tenerrima*, which feeds on black berry. Despite the disappointingly low catch greater species diversity from the wetland seems possible compared to the few species not found on shrubs in the Travis wetland survey (Macfarlane *et al.* 1998). In both wetlands the provisionally identified delphacid *?Sulax* sp. was locally quite readily collected and at Travis Wetland sweep netting showed an association with the glaucous sedge *Carex* sp. These almost straw-coloured bugs with a distinctive spur and only short outer wings were absent in the short dry grassland either at the Styx Mill Reserve (Appendix 2) or at McLean's Island. There was also a darker brown species with full length wings.

The Redwood Spring flats to the east of the Main North Road have high populations of pukeko and are dominated by long grass and creeping buttercup with some dock and other introduced forbs. There were few rushes, *Juncus* spp., or sedges, *Carex* spp., here that might support *Hydrellia acutipennis.*

Woodlands

Both the planted woodland and willow woodland in the Styx Mill Reserve supported at least the more adaptable woodland species (Appendix 1). Adults of at least 19 typical woodland species clearly sheltered the woods and did not move far from them and were often absent from the grassland sites (Appendix 2). Those that were also collected from wetland sites were less common there. The larvae of these species are believed to inhabit and feed among either the litter or its fungi, such as the soldier fly *Benhamyia* species, the Phoridae and three gropus of Mycetophilidae including *Anamalomyia guttata*) the long legged flies *Achalcus seperatus* and *Micropygus vagans* and three of the booklice species. However, some aquatic species shelter there too and these included 11 midges of three species (Chironomidae), one large caddisfly adult, two *Hydrophorus praecox* specimens. The presence of a modest range of caterpillars could be inferred, because there were eight specimens of at least three Tachinidae species and all the *Pales* spp. recovered in the survey.

The woodlands also provided the most assured catches of root gnats (Sciaridae). The malaise trap collected Ceratopogonidae most readily from the southern willow woodland. Far more specimens of the gall-making flies were collected from the wooded sites than other areas.

The 1997 survey of Christchurch native bush fragments on the flat sites presented initial identifications I obtained from over 10,000 specimens during three weeks of paid identification and spreadsheet compilation. This time did not allow for any keying of taxa; and the fly species were sent to Dr Richard Toft, Landcare CRI, Nelson. The small bush remnant at Dry Bush was also surveyed, but I have excluded those results, because that habitat is surrounded by grassland. There is an ephemeral creek through the middle of this tiny bush remnant and being in the upper third of the catchment it is much drier than the Christchurch flat bush fragments.

Interpretation of the results for the very small areas (0.1 to about 0.3 ha) of planted native bush is quite problematic. Among the herbivores some species such as the lemonwood Psyllidae *Trioza vitreoradiata* and, apparently, two of the Miridae species have colonized these small native bush patches. Conversely, the small, brown-spotted weevils, which presumably feed in the twigs of some trees, had barely spread to the medium aged areas on the Canterbury University campus and had not reached Gardiners Road trees. Rove beetles, which are often either predators or fungus feeders, were more common in native bush areas with bush remnants.

Among the Hymenoptera, chalcidoid and Diapriidae parasites, the predatory *Podagrites* sp (on flies), and the large orangey-brown predatory spider hunters *Sphictostethus* spp. were all less common in the restored (planted) native bush areas with no remnant bush attached to them. At the Styx Mill reserve the sole *Sphictostethus fugax* also came from the relatively long established south willow woodland, but the native planted woodland yielded good numbers of *Epipompilus insularis* instead, where prey clubionid spiders were readily collected (Appendix 2). Studies in the Coromandel Peninsula beach dunes, grassland, pine and native bush also found that *Sphictostethus* spp. were confined to mature forest (McLean *et al.* 1998). Among the flies, all the soldier fly species collected, especially *Zelandoberis violacea*, are characteristic forest inhabitants, but this group was represented in the Styx Mill woodland sampling only by a solitary *Benhamyia* sp. and specimen and very limited numbers of *Mycetophila* specimens. Older established forest also seemed to sustain considerably higher numbers of gall midges, *Allophylopsis* and *Fenwickia* spp., based on these surveys and other samples I have processed on behalf of the Canterbury Museum. Given the presence of *Asteia* in the 1997 survey and one collected at New Brighton (Macfarlane 2005), it is a pity the 1997 specimens could not have been identified.

Table 4 Christchurch invertebrates in remnant and planted native bush 1997, Landcare CRI/Lincoln University survey (Macfarlane initial identifications 10,552 specimens)

A = adventive species, V = vagrant to bush habitat (HE) = probable host lemonwood, ribbonwood, or totara
Ecological codes AQ = Aquatic CA = carrion or dung DE = decomposer FL = flower visitor FU = fungi
HE = herbivore OMS = Roots and organic matter, soil PA = parasitoid PO = Pollinator PR = predator as adult, l as larva, UK = unknown WO = wood. Lower case = less frequent role of these species a etc.,: comments appended for these species

Specimen totals # = Higher average no of specimens in remnant bush (Riccarton Bush, Dry Bush)
· = more specimens in Dry Bush – in some species from grassland or the ephemeral creek

Insect taxon	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens
HEMIPTERA 18 species							
Aleyrodidae, whiteflies							
undetermined species **?A b**	HE/?V	63	0	1	0	1	**65**
Aphididae							
Therioaphis trifolii A**c**	HE/?V	0	0	59	0	0	**59**
Other aphids ?A **d**	(HE)	2	1	129	1	23	**156**
Cicadellidae							
Brown/black species **e**	HE	0	?5	0	2	0	**7**
Ribautiana tenerrima	HE/?V	?2	0	0	0	7	**9**
Typhlocybinae species **g**	HE	41	48	9	5	7	**110**
Large brown leafhopper	(HE)	1	?2	0	7	0	**9-11**
Flatidae							
Siphanta acuta **h** generalist	(HE)	0	0	0	2	0	**2**
Lygaeidae							
Nysius huttoni wheat bug **i**	HE/V	1	0	0	0	1	**2**
Miridae							
Lygus undescribed sp. **j**	HE	1	8	0	1	0	**10**
Spotted species **k**	HE	2	11	0	2	0	**15**
Sejanus albisignatus **l**	(HE/pr)	0	8	6	0	0	**14**
Deraeocoris sp. (predator)	PR	0	0	1	0	0	**1**
Light green species **m**	(HE)	6	11	1	1	0	**19**
Pseudococcidae							
Eriococcus orariensis **n**	HE	0	0	18	0	0	**18**
Psyllidae							
Trioza vitreoradiata	(HE)	12	144	14	5	3	**197**
? *Psylla* sparse wing spots **q**	HE	1	206	34	3	0	**244**
?Psylla dense wing spots ? A **q**	HE	3	0	0	1	0	**4**

Species comments HEMIPTERA: b probable vagrant from garden plants **c** potted alfalfa aphid,vagrant unless kowhai is a host plant **d** totara a likely host **e** some grassland -sedge species include similar dark brown species **g** ome or most of the Typhlocybinae probably include the grass-herb feeding *Zygina zealandica*, **h** found in low numbers in gardens. **i** wheat bug favours crucifer & herb weeds, and open bare grassland areas, these bugs probably dispersed from these hosts, **j** an undescribed *Lygus* species at the time of the survey found on at least manuka and probably kanuka. **k** not a grassland or weed species in my experience. **l** known initially as a predator among apples, more recent unpublished work found it feeds on developing apples and this distorts apples, the quite regular presence in beating tray samples of nymphs suggests that the study species are genuine hosts, **m** this may be an undescribed species that seems to feed on ribbonwood, **n** this is apparently the large manuka scale, **q** one or both of these may include the gum and wattle psyllids from Australia

Table 4 Christchurch invertebrates in remnant and planted native bush (cont.)

	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens

Insect taxon							
COLEOPTERA 22 plus species							
Anthribidae fungus weevils							
Helmorius sharpi (mainly/only)	FU	0	1	7	0	1	**9**
Cryptophagidae/Lathridiidae							
Other species **aa**	FU	43	29	2	5	34	**146**
FUNGUS FEEDERS TOTAL		**43**	**30**	**9**	**5**	**35**	
Cerambycidae longhorns							
Zorion guttiferum	WO/FL	0	1	3	0	1	**5***
Other species (3-5 species)	?WO	1	0	0	0	0	**1#**
Curculionidae weevils							
Small brown species **b**	?WO	40	16	1	0	0	**57#***
Other species **c**	?WO	6	0	0	2	2	**10**
Melyridae							
Dasytes species	FV	1	0	2	1	0	**4***
Mordellidae pintailed beetles							
Species (predator/twig borer)	PR/WO	1	0	0	0	0	**1**
Scarabaeidae							
Odontria species	OMS	0	0	0	0	1	**1**
Scirtidae							
Several species	DE/AQ	0	2	0	0	3	**5**
Other beetles							
Several species	?WO	14	26	0	0	2	**42**
HERBIVORE -wood feeders	**TOTAL**	**63**	**45**	**4**	**3**	**11**	**115**
Carabidae ground beetles d	PRla						
1 species	PR/om	0	0	1	0	0	**1**
?Cleridae							
2 species	PRl	2	0	6	0	0	**6***
Coccinellidae ladybirds							
Coccinella unidecimpunctata A**e**	PRal	0	0	0	1	0	**1**
Rhyzobius forestieri A**f**	PRal	0	2	0	0	0	**2**
Other species	PRal	0	5	1	0	0	**5**
Staphylinidae	PRal						
Tachyporinae & other species **g**	PR/de	8	1	5	0	1	**15#**
Certain to likely predators	**TOTAL**	**10**	**8**	**12**	**1**	**1**	**49**

Species comments COLEOPTERA:

a these appear to include mainly *Cortincara hirtalis* and ? *Micrambria* species, **b** there could be two species, one with spotted outer wings, the other with evenly coloured wings, **c** about 4-6 species including a distinctive lumpy possibly litter feeding weevil, **d** mainly predators, **e** mainly an aphid feeder, **f** associated with manuka scale at Travis Wetland, **g** this includes a soft bodied species that may not be a staphylinid.

Species comments HYMENOPTERA erbivores and pollinators: a willow gall wasp, **b** twig nesters**,** general pollinator that carries pollen internally so it is not a very effective pollinator, **c** ground nesters prefer open sites with sunlight, pollinators of manuka, Compositae, hebes, etc., **d** ground nesters, semi-social, visit many species of small open native and some introduced flower species

Table 4 Christchurch invertebrates in remnant and planted native bush (cont.)

Insect taxon	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens	Hos com nam
HYMENOPTERA 30+ spp.								
Tenthredinidae -herbivores								
Pontania proxima A**a**	HE	0	0	0	0	1	**1**	Wil
Apidae social bees								
Apis mellifera A most general	PO	0	1	0	0	0	**1**	Hon
Bombus hortorum A	PO	2	0	0	0	0	**2**	Bun
B. terrestris A very general	PO	1	0	1	0	0	**2**	Bun
Colletidae								
Hylaeus sp. general **b**	PO	1	0	0	0	10	**11**	Nati
Leioproctus spp **c**	PO	0	0	1	0	0	**1**	Nati
Halictidae								
Lasioglossum sordidum **d**	PO	0	0	0	0	3	**3**	Nati
POLLINATORS TOTAL		**4**	**1**	**2**	**0**	**13**	**20**	
Aphelinidae (chalcidoid)								
Euxantanellus phillipinae A**e**	PA	1	3	0	5	1	**10**	Scal
Braconidae								
Aphidiinae species A**f**	PA	5	2	10	1	6	**24**	Aph
Other Braconidae	PA	13	19	9	8	10	**59**	Cut
?Rogas (red) -noctuid hosts	PA	0	0	0	0	2	**2**	
Chalcidoidea								
Various species	PA/he	23	24	18	4	9	**78#***	
?Charipidae (Cynipoidea)								
Species ?A **k**	?HE	1	0	0	0	0	**1**	
Diapriidae/Platygasteridae								
Several species **g**	PA	6	2	0	3	3	**20#**	Flie
Ichneumonidae h								
Various species	PA	42	6	2	2	10	**62#**	
Megaspilidae								
?Dendrocerus sp. A**i**	PA/V	0	2	1	0	1	**4**	Aph
Proctotrupidae								
1-2 species, beetle, moth hosts	PA	0	1	0	0	1	**2**	
PARASITES TOTAL		**91**	**55**	**40**	**23**	**43**	**253**	
Pompilidae (spider predators)								
Epipompilus insularis **j**	PR	1	0	1	0	0	**2**	Spio
Priocnemis nitidiventris grp **k**	PR	1	0	0	0	0	**1**	Spio
Sphictostethus species **l**	PR	16	0	0	0	0	**16#**	Spio
Sphecidae								
Podagritus/Rhopalum **m**	PR	13	0	0	0	0	**13#**	Sma
Spilomena (thrips) **n**	PR	1	2	2	0	1	**6**	Thri
Vespidae								
Vespula vulgaris A **o**	PR	2	2	0	0	3	**7**	Inse
PREDATORS TOTAL		**34**	**4**	**3**	**0**	**4**	**45#**	

Species comments HYMENOPTERA parasites and predators: e introduced parasite of scales, that has perhaps adapted to include some native hosts, **f** a weak association between aphid numbers in malaise samples and these aphid hyperparasites, **g** main hosts gall midges, and apparently litter inhabiting flies of caterpillars, so they are sensitive to the age of the bush, **h** species in this family seem to be quite sensitive to the development of mature bush, where flowers aid egg production, **i** no apparent relationship between more aphids and these parasites so they probably originate from grassland, **j** tree nests, hunts clubionid and other spiders, **k** ground nests may favour sand, mainly prey on hunting rather than web making spiders, **l** ground nests, hunts ground and foliage spiders, **m** ground nesters favour flies from blow fly to acalypterates or prey depending on species size, **n** adults nest in disused beetle holes, **o** November sample soon after nest establishment of this species in Canterbury, likely to be more prominent later in season up to March

Table 4 Christchurch invertebrates in remnant and planted native bush (cont.)

Insect taxon	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens	Hos use
DIPTERA								
Agromyzidae								
Cerodontha australis	HE/V	7	0	2	?0	?0	**9**	gras
Cecidomyiidae								
Various species	HE/PR	431	241	21	22	60	**847**	Mos
Pallotropidae								
Maorin 3-4 spp.	?pR/wo	63	25	8	6	7	**196#**	Fore
Trypetidae								
Tephritis spp.	HE	13	3	3	0	12	**31**	See
HERBIVORES								
Dolichopodidae TOTAL		**83**	**27**	**30**	**1**	**21**		
Parentia spp.	PRa	7	21	8	1	11	**48**	Gra
Sympycnus campbelli	PRa	8	0	0	0	0	**8**	Wet
Sympycnus sp.	PRa	5	0	0	0	0	**5**	Wet
Other species **e**	PRa	63	6	22	0	10	**150#**	Wat
Empididae TOTAL		**35**	**13**	**13**	**1**	**25**		
Empidinae species	PRa	25	9	13	1	25	**206***	Wat
Pseudoscelolabes fulvescens	PRa	0	3	0	0	0	**13***	
Tachydrominae	PRa	8	0	0	0	0	**8#**	
Hemerobiinae species	PRa	2	1	0	0	0	**4**	
Syrphidae		**11**	**9**	**1**	**1**	**6**	**41**	
Native Syrphinae species	PR/PO	8	8	1	0	6	**29**	Aph
Melangyna novaezelandiae	PR/PO	3	1	0	1	0	**11#**	poll
Therevidae								
Ectinorhynchus spp.	PRl	2	0	0	0	0	**4#**	Soil
Muscidae								
Various species **q**	DE/UK	12	6	5	0	16	**39**	wat
PREDATOR TOTAL		**132**	**46**	**48**	**2**	**42**	**251**	
Pipunculidae		0	0	0	1	0		
Pipunculus deani	PA	0	0	0	1	0	**1***	Lea
Tachinidae								
Undet. species	PA	3	2	0	0	2	**7***	Cat
PARASITE TOTAL		**6**	**2**	**0**	**1**	**2**	**106**	
Calliphoridae blow flies		**10**	**0**	**1**	**3**	**1**	**26**	
Xenocalliphora hortona	CA/po	1	0	1	3	0	**5**	Gra
Calliphora stygia (A)	CA/po	1	0	0	0	0	**1**	For
C. vicina (A)	CA/po	2	0	0	0	0	**2#**	Car
C. quadrimaculata	CA/po	6	0	0	0	1	**7#**	

Species comments DIPTERA: a species are typical flies of woodlands, biology unknown in New Zealand, possibly predators (Evenhius 1989), **e** several rather smaller species not readily identifiable but mainly distinct from the species in Travis Wetland so are presumably bush species **q** includes some *Spilogona dolosa* and probably *S aucklandica* **v** beating tray, sweep net samples contain 3 three species in 2 genera

Table 4 Christchurch invertebrates in remnant and planted native bush (cont.)

Insect taxon	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens
DIPTERA			**MAINLY DECOMPOSERS AND OTHERS**				
Acalypterates		**110**	**17**	**37**	**13**	**72**	**259**
Asteiidae							
Asteia two species	De/fu	24	1	1	0	1	**27#**
Chloropidae							
Gaurax spp.	?Ca/du	17	3	4	4	9	**37***
Other species		3	2	1	0	2	**8**
Drosophilidae							
Scaptomyza fuscitarsis	?DE	1	0	0	0	0	**1***
Ephydridae							
Psilopa metallica	?DE	3	0	0	0	0	**3**
Heleomyzidae							
Allophylopsis ?distincta **o**	?DE/fu	12	0	0	0	0	**12#**
Fenwickia sp. **o**	?DE	0	1	0	0	0	**1***
Lauxaniidae							
"Leptocera' 2-3 spp.	CA	nc	1	1	0	nc	**2**
Sapromyziidae							
Large yellow species **o**	?DE	20	4	8	0	26	**58***
Various species, 2-3 spp.	?DE	8	1	5	3	3	**20**
Families unidentified							
Banded wing 2 spp. **o**	?DE	25		16	0	0	**41**
Other species **p**	DE/he	7	8	1	6	31	**53**
Lonchopteridae							
Lonchoptera dubia A	DE/V	0	2	3	0	0	**5**
Nematocera & others							
Anisopodidae							
Sylvicola species **k**	DE	4	0	0	0	1	**5**
Mycetophilidae		**125**	**32**	**17**	**3**	**97**	
Anomalomyia guttata	DE/FU	8	20	7	1	37	**73**
Other species	DE/FU	117	12	10	0	60	**199#**
Phoridae							
Megaselia species	DE/fu	64	1	29	6	224	**324**
Psychodidae, moth flies							
Various species	DE/aq	150	13	14	2	52	**231#**
Scaptosidae							
Scatopse ?notata	DE	4	0	0	0	0	**4**
Sciariidae							
Various species	DE/he	259	32	53	42	61	**447***
Stratiomyiidae TOTAL		**147**	**41**	**189**	**29**	**55**	
Zelandoberis or *Austroberis*	?DE	63	21	134	16	20	**254#**
Zelandoberis violacea	?DE	15	2	2	5	0	**22***
Neactina spp.s	?DE	66	14	53	8	32	**125**
Benhamyia whitei	?DE	1	1	0	0	3	**4**
Benhamyia sp.	?DE/he	2	3	0	0	0	**3**
Tabanidae							
Species	DE/aq	0	0	0	0	5	**5**

Species comments DIPTERA: k attracted to human dung among other substances, **o** among the larger and more distinct Acalypterate fly species, not found in swamp or grassland studies so probably bush species, **p** includes some Chloropidae, probably *Gaurax* species, but excludes common grassland species implying the trap was set well enough into the bush

Table 4 Christchurch invertebrates in remnant and planted native bush (cont.)

Insect taxon	Ecological code	Riccarton Bush	Ashgrove	Ilam House	SOF, Univ. of Canty	Gardiners Road	Total of specimens
DIPTERA (cont.)							
Tipulidae crane flies							
?Leptotarsus huttoni	?he	Nc	nc	Nc	nc	Nc	**49**
Spotted and banded wing spp.	?DE	Nc	nc	Nc	nc	Nc	**13**
Various, 3 + species	?DE	Nc	nc	Nc	nc	Nc	**46**
OTHER INSECTS							
Sminthuridae	HE	0	0	1	0	0	**1**
Micromus tasmaniae	PR	5	4	33(4 L)	0	1	**43**
Orthodera novae-zealandiae	PR	0	0	0	0	1	**1**
Chelipoda (pseudoscorpion)	PR	2	0	0	0	0	**2#**
PREDATORS TOTAL		**7**	**4**	**33**	**0**	**2**	**44**
Psocoptera (3-5 spp)	DE	35	39	8	20	23	**118**
Termitidae (termites)	WO	0	2	0	1	0	**3**
Weta	DE	1	0	0	0	0	**1**
Collembola -Arthropleona	DE	5	8	25	2	11	**11**
Philaeothripidae (thrips)	HE/DE	0	1	0	1	0	**2**
Terrebrantia (thrips)	HE/DE	0	0	1	0	0	**1***
Trichoptera Leptoceridae	AQ	0	1	0	0	0	**1**
OTHER INSECTS TOTAL		**46**	**55**	**68**	**24**	**35**	**282**

w modest biodiversity apparent for this family with over 550 species
NC = not counted at each site

Considerable numbers of freshwater and mud-inhabiting flies were collected from the south willow woodland site because the pan traps were within 5 metres of the peaty creek. The Malaise trap in the closed canopy with a muddy floor with sparse low vegetation was within 10 metres of the same waterway. These sites were generally somewhat isolated from the main area of rushes, so it was not surprising that very few *Hydrellia enderbii* were collected from the four sites sampled. The woodlands also lacked wetland ferns except for a few nearby *Blechnum* and hard fens in the southern willow woodland, which could account for the absence of the new *Hydrellia* species.

The parasite collections were quite informative with a quite rich lot of Ichneumonidae from the older established woodland. However, the chalcidoid fauna was depleted and species diversity in Braconidae was limited. Conversely, the drier planted woodland and the flowers on the dry bank of the north east willow woodland supported a relatively favourable diversity of *Pales* spp. flies, but the planted woodland had very little other parasite activity.

Pasture, grassland and grazing

Low numbers of grass grub adults (*Costelytra zealandica*) were collected in the pan traps, but the survey period was well past its main flight period. A solitary specimen of *Odontria* was collected among the planted shrubland along with two specimens of a click beetle species. The cluster fly *Pollenia pseudorudis*, which is a parasite of earthworms, was found on yarrow in the dry pasture. The wheat bug *Nysius huttoni* was also common among the dry grass and ground here.

The herbivore guild was dominated by the grass-feeding *Hydriellia tritici* and *Cerodontha australis* and lesser numbers of the open ground dwelling wheat bug *Nysius huttoni*. Grazing did not adversely affect their numbers. The shore fly *Psilopa metallica* was prominent especially in wetter long grassland.

Other characteristic species included about six plant hopper species including *Zygina zealandica*. It was frustrating to devote over a day trying to apply the pretty well illustrated website key for Cicindellidae of Lariviere and Fletcher to the species in this study without resolving the genera involved. I spent a further few days carefully combining the information on the web, Knight's (1973) revision and Evans sub-family key(Evans 1966) to produce a new key to species with some less subtle features, which I could understand. The specimens are apparently mainly or almost entirely Deltocephalinae species. This reserve is more species rich than the other grasslands I have studied around Christchurch. Comparison with virtually the only reliably identified species in the Lincoln University collection needed more time to resolve with the descriptions from Knight (!973) what species from the Styx Mill Reserve were not represented in the collection. The illustrations' emphasis on genitalia and lack of other illustrations in Knight's revision of this family make identification without reference specimens difficult. Descrimination of Deltocephalinae species is also hampered by variation in colour within species and darkened wing patterns make venation difficult to see. These factors make this a difficult group to get to know adequately even though an interesting story remains to be unraveled about their parasites. In three other studies of dry grassland the following species have been identified. At McLeans Island only three species (*Arawa ?salubris, Horauta inconstans* , ? *Nesoclutha obscura*) were identified (Macfarlane *et al*. 1999). From Quail Island, two different species (*Eucunthella insularis, Arahura*) and an undetermined Deltocephalinae species were collected. The New Brighton sand dunes clearly had one dominant species that could be an *Arawa* species, which hosted a scantily known Dryinidae parasite, a family first recorded from New Zealand in 1955. The much less common pale species in the dunes with a distinctly pointed snout was clearly *Euacanthella palustris* but it was not found at other Canterbury sites. A small dark, short ?Deltocephalinae was present in both the New Brighton dunes and the grassland at Styx Mill Reserve.

Caterpillars were more readily collected in the ungrazed grassland. The small delicate gall midges and perhaps also the root gnats seemed to be favoured by ungrazed grassland. It is also apparent that long and or ungrazed grassland favours the flightless *Eutricimbra* species (Appendix 3), which may actually be an undescribed species rather than *E. ?deansi*. A similar if not the same species was collected in the survey of the New Brighton sand dunes especially in the denser, more sheltered hind dunes (Macfarlane 2005). The food source for these virtually unknown flies remains unknown but they may be either litter dwellers that feed on fungi or a grass herbivore, because other Chloropidae species are herbivores. They were not collected from the short dry grassland of McLeans Island (Macfarlane *et al* 1999) or from lucerne (Macfarlane 1970).

For the litter guild, the 20 taxa (several undistinguished species) from ungrazed grassland averaged 5.3 times more specimens than from grazed grassland. The difference could have been even greater because the

sweep netting of long grass would have been less effective in collecting ground dwelling and hoppers (*Makawe hurleyi*) and species favouring the ground surface such as the Lathridiidae. The study on Quail Island (Bowie *et al* 2004) revealed a quite diverse fauna of Lathridiidae.Both the dark and light brown groups of fungus feeding Lathridiidae, the *Megaselia* group of flies and the introduced little yellow grassland fly *Lonchoptera furcata* clearly favoured the long or ungrazed grassland (Appendix 3). Other typical woodland fungus-consuming Mycetophilidae (mainly *Anomalomyia guttata* and *Mycetophila* species) and *Macrocera* had drifted from their habitat and were collected.

Somewhat surprisingly, parasite taxa diversity was greater in the grazed grassland, but the tiny flightless ?Scelionidae seemed to prefer longer ungrazed grass. The main spider species, rove beetle and damsel bug were favoured by ungrazed grassland; 20 predatory taxa were collected from ungrazed grassland compared with nine taxa of predators from the grazed grassland.

Carrion and dung

The January 2005 sampling of the low grassland/plantain area contaminated with water fowl dung and the short, dry, grazed pasture with dry cattle dung about 40 metres away provided an interesting insight into the flexibility of some native New Zealand flies. Two species of blow flies were active around the fresh bird dung, but were not trapped in the dry grazed grassland. Conversely, the South American dung fly, *Oxysarcophaga varia*, and the small native New Zealand Chloropidae, *Gaurax novaezelandiae*, were quite common in the pan trap samples at this site.

At McLeans Island I had recorded a *Gaurax* species associated with insect carrion but the current survey suggests this species might also breed in cattle dung. The Australian *Lasionemapoda hirsuta* is a small dark-topped fly with mainly reddy-brown sides and legs. This is a new record for the Christchurch area. It was also detected in the south west Christchurch waterways survey (Macfarlane 2004a), but not on Quail island. Introduced blow flies *Calliphora* spp. and the dung fly *Hybopygia varia* were common only locally.

THE GUILDS

Parasites

Identification of New Zealand parasitic wasps lags well behind that of the other main insect orders. Consequently it is not even possible really estimate how many species of Hymenoptera there are in New Zealand (Berry in press).

Initially, a key was prepared for some of the larger species, e.g., Ichneumonidae, of Travis Wetland. Comparison with these numbered species was imprecise, because retrieving the specimens from within the Canterbury museum would have bee combersome and revising the key simply took to long to achieve. As it was over three days were spent on illustrating and distinguishing the species and compiling the results in the spreadsheet and then writing this part of the text. For the illustrations notes on species were taken on the obvious features from each site as they were photographed, each species was arranged so the most similar species were together and notes were retrieved about the aerolet to make the distinguishing notes for the photographs more powerful and several duplicate photographs could then be eliminated and some provisional allowance made for differences in the sexes.

The woodlands yielded both the most specimens and the best species diversity. The south willow woodland yielded 10 species with what are apparently ?*Degathina* species and Ichneumonidae species 28 (of the Travis wetland study) dominant in terms of biomass. Four different species were collected from the planted native woodland and only two from the temporarily flooded willow woodland fragment at site 16 in the northern wetland marsh. The photographs towards the end of the report illustrate what were clearly five species with a fully black thorax, but a largely to partly reddish abdomen with variations in the shape and size of the aerolet cell. Two species had legs with yellow bases. Three species have the front of the thorax black, but the hind part is red-brown to plum red. Four species have mainly red brown bodies, but here only two had yellow on the thorax compared to eight species at Travis wetland. There were four mainly black to dark species compared to considerably more at Travis wetland. The grasslands yielded relatively few Ichneumonidae specimens, but a malaise trap was not used in this habitat. Never the less species diversity in dry grassland at McLeans island was not great (Table 1).

For Braconidae, the southern willow woodland yielded the largest species apparently of *Rogas* species. The survey seemed to include two species as can be seen in the photographs. There was variation in the amount of dark pattern at the side of the thorax and on the "cheek" behind the eye varied from a faint mark to a distinct dark spot as well a differences in the colour of the stigma on the wing. Numerically *Chorebus ? rodericki* was the

dominant species in the grassland and wetland sites. Species found in the forest were not collected from the wetland or grassland.

An interesting and diverse array of small and tiny parasites were collected as well, but I had some difficulty distinguishing Diapriidae from Platygasteridae, because both families can have so little venation and a shaded line was eventually interpreted perhaps incorrectly as not being an inner basal wing vein. I could not attempt to more than sort the chalcoid specimens more or less into families and for the major families I relied on tarsal segments to distinguish Peteromalidae from Eulophidae. Some Eulophidae may actually be of one or two other families. No attempt at the slow and rather imprecise identification of the chalcoid families to species diversity, but males with branched antenna were generally attributed to Eulophidae. Hence it is not possible to compare the herbivore to litter consuming insect ratio with that of the parasites and predators, which has been possible with previous surveys.

Several of these micro-hymenoptera families had species with no wings or with only wing stumps (brachypterous). For convenience all the small species with no wing stumps were categourised as "Beiinae-Scelionidae". Other distinct tiny species with stump veins included both Encytidae and a small species with a spine on the hind thorax attributed provisionally to Scelionidae. At least three species of Scelionidae, including a small species with a stump of a wing and a short spine at the hind edge of the thorax, were collected. This incompletely winged species was also present in the ungrazed New Brighton sand dunes, which had an interesting array of species including some poorly collected taxa (Early pers. comm.).

What was apparent was that the generally wet sites collected only modest numbers of parasitic Hymenoptera. There were 15 times more specimens in the rush and sedge fields than the waterways and also about six times more specimens than in the woodland per site. The temporary pool of water for the malaise trap in the northern bog also yielded few Ichneumonidae compared to the comparative ratios between Ichneumonidae caught in the southern woodland malaise trap and the pan traps. Thus wet soil and water lying on the ground surface does not seem to favour the parasitic wasp species of micro Hymenoptera. The pan traps collected the small micro Hymenoptera (Diapriidae, Chalcidoidea, Figitidae) more readily than the Malaise traps, but conversely the malaise traps were excellent for collecting the Tachinidae. Generally the wetter the floor of the Malaise trap the lesser the number of species collected with the water covered trap in the area N wetland collecting the least with 23 species, the willow woodland at least 57 species, the firm rush wetland 59 species and the planted woodland 43 species.

The collections from flowers provided valued evidence of the presence of *Pales* species (caterpillar parasites - Tachinidae), and confirmed that the earthworm parasite *Pollenia pseudorudis* is now widespread within Christchurch.

Spiders and other predators

Three quarters of the spider specimens have been fully to provisionally identified. At least 10 species from seven families still require some specialist assistance for identification based on the photographs. When the wolf spiders were excluded it took well over a day to sort these species into probable species, record them, photograph them, adjust the photographs and enter the results and do the relevant basic calculations in the spreadsheet. Sixty six % appeared to be wolf with perhaps a few nursery web spiders *Dolomedes minor*. However, the common wolf spider clearly prefers open grassland or wetland to the shading within forests, while the large light brown nursery web spider was mainly collected in long grassland, but on the basis of their cage like webbing was observed to commonly inhabit wetland areas too. An orangy speckled species attributed to Clubionidae was relatively common in both forested sites and long ungrazed grassland, and could prefer to keep away from the cold wetland sites. A further at least 17 species were collected and distinguished based on colour pattern, size of mature spiders and eye pattern and of these 10 of these species are illustrated in the photographs. One species of the larger species with yellowy seemed as if it might prefer wetlands. A small brown species with yellowy legs might prefer grassland and was not found at the woodland sites. Both the cob web spider *Eriophora pustulosa* and the brown native harvestman *Nuncia* species were present in low numbers and were not readily collected from even ungrazed grassland. Other spider species were not collected in enough numbers or frequently enough from any habitat to distinguish any habitat preference. No crab spiders were collected but beating of shrubs and trees would probably have yielded several species based on the surveys of Travis wetland and McLeans Island.

A relatively new addition to the Canterbury spectrum of predatory insects is the small grey lace wing *Crytoscenea australis,* which was detected on Quail Island and in the south west Christchurch waterways survey in low numbers. However, it was not found in this survey

Flower visitors and pollination

Currently, both kanuka and hemlock provide valuable nectar and pollen resources for adult insects with 11 species found associated with the very limited kanuka and 26 insect species with the more extensive hemlock and several records from yarrow. The survey provided useful records of flower visitation for flies in New Zealand, a subject that has been hampered by the difficulty of obtaining species identifications (e.g., Primack 1978) and a lack of expertise and interest. Kanuka and manuka are known to be an important nectar source for the major porina parasite *Protohystricia alcis* (Primack 1978). The flies from hemlock provided useful guidance on the significance of this nectar source for *Pales* species, information that was not apparent from more limited hemlock at Travis Wetland. These are useful flower visitation records for one of the more distinct tachinid genera in New Zealand. Unfortunately, the flowers of the cabbage trees had set berries by the time the survey commenced but, from my experience elsewhere in Canterbury they are valuable sources of nectar and pollen for flower-visiting insects including Tabanidae, native bees and other flies, whereas matagouri provides an even earlier source especially of nectar. Two tenure surveys, which I made in 2002 in inland South Canterbury near Omarama have confirmed the value of native Spaniard *Aciphylla* flowers as food sources for flies as well as bees. These plants are a vital resource for some of the rare weevil species in New Zealand.

Among the native bees, *Leioproctus fulvescens* apparently had low populations because none was seen on the catsear flowers and no nests among the silt were apparent during the study. Flax flowers were being visited by the small relatively hairless *Hyleaus* species; all other native bees nest in the ground. Lotus, thistle, mallow and catsear flowers primarily supported introduced insect species including honey and bumble bees but were also visited by the native bees. Prominent introduced species included three species of social bees such as *Bombus terrestris* on a range of weed flowers including mallow, blue borage, clover, bull and Californian thistles and lotus.

Other flower visiting records are listed in Appendix 1 especially for various Agromyzidae, Tachinidae and Empididae.

Ground and litter dwellers

By contrast, the litter and wood decomposing invertebrate fauna of the tree and shrubland patches was much richer in smaller beetles species and fungus gnats. Fungus gnats were most numerous and diverse in the willow woodland and flax shrubland. The species diversity was at least a good as at Travis Wetland, but the population was considerably lower due to fewer *Anomalomyia guttata* being present.

CONCLUSIONS AND RECOMMENDATIONS

4.1 Diversity, species rarity and habitat management for rare species

The diversity and unusualness of insects from the wetlands and waterways showed these parts of Styx Mill Reserve to be much more significant than was apparent from botanical surveys.

If a predator free fence allows the release of such potentially exciting bird life as kiwi, and they it forages in open tussock as I have seen on Stewart Island. It is vital that the wetlands and their associated steady but small and slow flowing drains and creeklets are retained in as close to their current form as possible for the small spectrum of dance flies (*Hilarempsis, Ceratomerus*), the flightless Christchurch swamp crane fly *Gynoplistia pedestris* and the acute tipped shore fly *Hydrellia acutipennis*. These dance flies were not present at Travis Wetland and *Ceratomerus cassinervis* appeared to have more tenuous prospects for habitat retention in south west Christchurch waterways than in the Styx Mill Reserve.

The management needs of the pointed winged shore fly *Hydrellia acutipennis* can be indicated only in a preliminary way until it is known if the host plants are sedges, rushes, some wetland plant or the floating fern *Azolla* and whether the original record from the Otago Peninsula salt marsh is the typical habitat for its host plant or plant species. The numbers collected from Styx Mill Reserve were greater than form Otago, which suggests the host is a wetland or ditch fringe plant species that was not found in south west Christchurch or during extensive specialist collecting by Mathis in three visits to New Zealand. When the ecology of this species, and

hopefully its host, becomes known then its management needs will become much clearer. In the meantime, retaining the habitat how it is, or close to it, should be the best way of retaining this species in the reserve.

The conservation status of *Gynoplistia pedestris* should, if possible, be resolved to determine if it is a vulnerable or just regionally localized species of central lowland Canterbury wetlands as discussed in Macfarlane (2004b). The Canterbury Conservancy of the Department of Conservation really needs a summary of its known sites and recent recoveries from my Christchurch City Council sponsored studies. Other records, including the early historical collections such as on the coast towards Waipara, need to be re-evaluated. If the species is deemed to be vulnerable, then the Canterbury Conservancy should endeavour to ensure a follow-up study is done on the CURRENT distribution of this species.

Chemical control of gorse and blackberry in Block N is imperative especially if grazing is terminated on the completion of the predator proof fence. It would be desirable if even better control of the seedling willows and gorse were achieved in the swamp section such as area N of McCombs (2003b). Cattle pugging would seem to be deep enough to probably squash the larvae of this large crane fly despite their probably rubbery nature. Conversely, no grazing, which would soon see these areas covered with willow and gorse and become fully shaded is an even worse option for this species because I have collected it only from open wetland sites.

4.2 General principles in Restoration planting –general animal principles

Botanically focused recommendations for more native forest generally assume animals can readily recolonise restored forest. It is by no means assured that more than a modest fraction of insect species diversity, especially specialist herbivores, can colonize isolated patches of replanted native vegetation. Recolonisation by sedentary bush birds and many insect species to a restored site can be difficult to achieve. Even more mobile birds such as the bell bird, which can fly quite large distances, require a large enough area of forest to live in and enough flowers, fruit and insects to feed on. Two factors make native forest at Styx Mill difficult for colonisation, because there has been no native forest for many years and the area has become thoroughly isolated from native bush remnants. For less mobile and wingless insect species such recoloisation can be expected to be a challenge to virtually impossible. Even the costly restoration planting may be difficult. This was evident in the Styx Mill Reserve due to both the need for weed control and losses of planted specimens on lighter ground by the main ponds when periodic dry periods occurred. **However, figuratively speaking, with enough effort and on the correct ground the desired "cathedral" structure of a re-created forest can be reasonably assured within one or two generations. The same can not be assured for the multitude of forest dwelling invertebrates that use the ground, forest floor, flowers and canopy and which have, in human terms a considerable array of "trades", which were grouped together in this report as guilds. Thus, by the time such forest matures to botanical glory along with some of the icon bird species the "cathedral" may in reality be at best less than half full with the original congregation of more humble inhabitants. Hence it is important to remember that extending existing forest is likely to produce more assured results for the presently only partly known and poorly documented forest invertebrate congregation in Canterbury and even in New Zealand.**

Reserve plantings, including the recent planting adjacent to the reserve to the north east, are dominated by pollen-only producing plants (sedges, rushes, grasses, coprosma) with very few and poor nectar-producing species for the waterway Empididae and the largely undescribed array of New Zealand insect parasites. Therefore I recommend more attention be placed on redressing this balance in plantings of natives within the greater Christchurch area.

4.3 Native forest regeneration, Redwood Springs flats and some resolution of botany/insect recommendations conflict

Currently, greater Christchurch lacks available and especially mature areas of kahikatea (white pine) and it seems an opportunity exists to restore these icon trees to the district. This vegetation is no longer apparent in the district, and it would seem that Wilson Swamp north east of Belfast is about the only other wetland site where these trees might be planted, which is also a site readily accessed by both Canterbury residents and tourists. If possible, such plantings would add to the matai-dominated podocarp forest at Riccarton Bush and replanting of open wetlands at Travis Wetland.

I suggest that forest restoration should consider the north east willow woodland for the formation of a kahikatea area provided control of blackberry is achieved there first. With the raised water table this area needs to be resurveyed to determine if the less common native plants have survived there. Limited kahikatea might be planted along the river bank at the Redwood Springs flat. The flats of this modest area of land have a high water table and a lack of wetland vegetation that in the main reserve is supporting valued insect species. It is conceivable that a cluster of kahikatea might be planted close to the river and far enough from the road to avoid encouraging frost to persist on the busy road during winter. These areas do not appear to compromise invertebrate values.

Figure 2 North east willow woodland – pond fringe habitat and damming

Ponded area above and to west of North east woodlands
View to SE towards stockyards

North east woodland with mounded fern areas from Northwood bank

Northern fringe of North east woodland with two dam sites
Lower original dam site caused by track construction

Casual upper and later dam site

If botanical perspectives and the aesthetic appearance of the park and reserve hold sway and more forest is desired, then I would suggest there are other less vital parts of land to replant than the eastern wetland and stockyard area. For instance, the lower part of the large field west of the central creek, which included site 2 with the water trough has discontinuous rushes and a high enough water table to provide more reliable native tree growth compared with part of the ridge, where planted native woodland just to the east of the two large upper ponds on the central creek has died.

The Redwood Springs flats had no special insects from the limited surveying achieved. However, the record for the undescribed *Hercostomus* species provided useful confirmation of this fly's association with slow to moderate flowing waterways.

For wetland birds, the Redwood area, including the hill sides, would seem to be barely large enough to keep a sustained population of weka. Hopefully some other larger area can be found in the district for these birds.

4.4 Shrubland restoration and diversification of insect habitat

Pasture area D east of the stockyard and the pasture areas G and H along with the western stock corridor have medium light to very gravelly dry soils currently in pasture. Ultimately, some of this area might be planted in dry (grey) shrubland species (*Olearia, Charmichaelia, Clematis*), which to the west of the airport are showing signs of being obliterated by repeated grazing and periodic fires. This would also provide a much more accessible representative lowland grey shrub area for urban people and tourists to visit than either McLeans Island or the less modified Kaitorete Spit. It is a challenging habitat for such restorative re-vegetation, but it may avoid the risk of *Hieraceum* invasion because it is so isolated from other grey shrubland-savannah grasslands. If this could be achieved then, subsequently, some of the key moth species might be restored to the shrub hosts.

4.5 Wetland bird restoration

Planning for restoration of declining wetland bird populations must take account of their ecology. If need be, alternative mainland island sites should be sought for the buff weka preferably within the greater Christchurch district , but which are of less value to missing wetland birds. Other closely related weka are relatively available elsewhere in New Zealand compared with the less widespread and seen wetland specialist birds (bitterns, fernbirds, crakes). Weka also fluctuate in numbers and reach populations of 5 to 10 times the density of fernbirds so they are potentially more destructive to the flightless crane fly. In addition, weka attack eggs of other birds so, once they have become established, they would make establishment of fernbirds especially more difficult, partly because the species use similar nesting sites. Both weka and fernbirds depend more on insects for food than bitterns so the more adaptable and inquisitive weka could well place some pressure on invertebrate food resources that fernbirds might use. Therefore I would advocate that if bird-based conservation is really determined to reintroduce the Canterbury "variety" of weka to Christchurch, which is known on Chatham Islands to sustain some hunting pressure in similar wetland vegetation, then either a suitable sized area of Redwood Springs be purchased with this purpose partly in view or release of the weka should be considered for Travis Wetlands, where farmland can provide suitable habitat for feeding. In my opinion, I would far rather see rarer less seen wetland birds notably fernbirds and bitterns in the predator proof area. Consequently, it is imperative that caution is applied in the reintroduction of the ground feeding weka, especially when we do not know the distribution and conservation status at least two fly species in the wetland let alone other wetland insect species of beetles and perhaps bugs. If need be, alternative mainland island sites should be sought for the weka.

4.6 Coastal Canterbury insect community studies – status and way forward

The Greenspace Unit has shown commendable foresight in meeting resource management requirements in funding research that I have led over the last eight years. If other large urban areas had shown similar application, then it would be possible to make much more assured comparison for habitats about the heritage value of the reserves within Christchurch. This initially challenging work on the better and larger ecological areas in Christchurch has succeeded beyond my expectations. A reasonable insight has been provided of the heritage value, invertebrate species diversity and retention. Despite some limitations in identification of the insects, useful insights have been commented on in variation between the reserves.

The Department of Conservation has been provided with valuable information on lesser known insect species from both coastal wetlands and sand dunes from this local body funding. Nationally, the lack of attention to investigating wetlands, the fringe of waterways and sand dunes makes it desirable for the Christchurch city council funded reports to be published in a scientific journal. For Canterbury, there are still a few smaller and less botanically complex key habitats, e.g., salt marshes, coastal salt pans that remain unstudied. It is also very satisfying to demonstrate the high levels of native species, that reside even in adventive (introduced) plant dominated communities and to gain some insight into the level of undescribed species in these different habitats.

It would be very useful if a Canterbury or Lincoln University student could tackle a simple survey to compare willow woodland and planted native woodland insect diversity. This should allow the cost effectiveness of getting studies done this way to be clear for regional funders. It would also put in context the effectiveness of using higher cost institutions to obtain information that allows for truly balance ecological recommendations. There is a modest amount of material from this survey that could be used to start this process.

I recommend that greater use is made of a digital camera. The availability of digital photography makes it possible to provide illustrations within a week of work for a considerable part of an invertebrate community. A considerably better correlation of partly identified species could have been achieved if this tool had been available when I completed the previous five insect community studies within greater Christchurch. Thus for instance, it

would have been much clearer how the planthoppers (Cicadellidae), Ichneumonidae and other small parasite species compare between the Styx Mill reserve, Travis wetland and the overall dry and grassy mossy enriched habitats at McLeans Island or the long grassy hind sand dunes of New Brighton. This possibility needs to be considered for any future partial or more comprehensive invertebrate surveys. This approach would in the future, allow much better monitoring of the full within-waterway margin species too. Formal descriptions of these species may well be achieved only many years from now due to lack of funding for insect systemic work.

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APPENDIX 1 INVERTEBRATES RECORDED FROM STYX MILL RESERVE

(277 plus insect species, 38 introduced or indigenous species)

LEGENDS, CODES A = Introduced and indigenous species; the others are endemic species (only found in New Zealand)
W = wingless **For a smaller order %** given of total New Zealand species
MT = malaise trap PT = pan trap SW = sweep netting

Shared with Canterbury studies:- **1** = Travis Wetland, east Christchurch (pasture-regenerating forest) (Macfarlane *et al* 1997) **2** = McLeans Island danthonia grassland **3** = Canterbury mainly lowland pasture (Bowie *et a.l* 2004) **4 =**lucerne (Macfarlane 1970) Number in (e.g. 2,3) = common genus identification

INVERTEBRATE TAXA Canterbury reports Habitat, abundance

COLEOPTERA Beetles 25-27 species

Anthribidae fungus weevils
Euicides suturalis A 1 Cock foot grass feeder
Species 1 undetermined
Species 2 undetermined
Brentidae
Exapion ulicis A 1,2,4 Gorse seed weevil uncommon
Carabidae ground beetles
Undetermined species
Cerambycidae longhorn beetles
?*Hybolesius* species ?2
?Cleridae
Undetermined species
Coccinellidae ladybird beetles Immatures, adults aphid, scale predators
Coccinella. undecimpuncata A* 1-4 aphid, bug predator, uncommon elevenspotted lady bird
? *Rhyzobius* sp. black
Curculionidae weevils
Undetermined 1-2 species ?A Some of the weevils may include the introduced Argentine stem weevil
Elateridae click beetles Mainly omnivorous root feeders can be predatory
Conoderus exsul A* 2,3 PT Flax/cabbage tree planting, central ford common (Pasture roots) pasture wireworm
Species 2 PT Flax/cabbage tree planting, central ford
Helodidae
Undetermined species
Lathridiidae mildew beetles Fungal feeders
Cortinicara hirtalis A 1,2
Melanophthalma gibbosa 1-4 Prefers damp wetter grass
Undetermined species dark spots on wings
Melyridae
Dasytes sp. 1
Scarabaeidae grassgrub, dung, manuka beetles Major soil root and organic matter feeders
*Costelytra zelandica** 1-4 Among grassland mainly, adults uncommon past seasonal peak
Odontria sp.* 1,3 (2,4) PT planted woodland, uncommon
Staphylinidae rove beetles Often predators but some fungi feeders
Species 1-3 ?(1-4) Main species long, dark brown
Species 4 ?(1-4)
Undetermined family
2 -3 species

COLLEMBOLA Springtails 3 species

Entomobryidae
?*Entomobrya* sp. W ?(1,2,4) A grey springtail
Hypogastridae
Hypogastrura rossi W 1-4 black stubby spring tail
Sminthuridae Herbivore
Bourletiella sp. A W 1-3(4) Introduced grassland, uncommon

DERMAPTERA Earwigs

Forficulidae

Forficula auricularia A* 1-4 Planted woodland, flax, uncommon, European earwig

DIPTERA SUBORDER NEMATOCERA 45-51 species

Bibionidae marsh flies

Dilophus nigrostigma 1 Abundant in wetland parts of the reserve especially in early summer

Cecidomyiidae gall midges Herbivores or predators can be rather host specific

Lestromerinae (1) Wood gnats, litter feeders

Cecidomyiinae ?A (1-2) Gall midges, mainly herbivores, several species, which probably include some adventives

Ceratopogonidae (2-4) **biting midges Larvae aquatic or in damp areas**

Dasyhelea species 1

Dasyhelea species 2

Palpomyia species 1

Palpomyia species 2 1 The genus recorded as ?*Forcipomya* sp at Travis wetland are probably *Palpomyia*

Chironomidae midges Larvae aquatic

Chironomuszealandicus ?5-6 LT MT PT common to lights besides pools

Corynoneura scutellata A PT beside slow running water

Orthocladinae 5+ species MT,PT woodland and waterways mainly

Gressitius antarcticus MT,PT South willow woodland creek

Tanypodinae

Culicidae mosquitoes

? *Culex pervigilans* 1

Ditomyidae

Australosymmerus sp. (1) MT Willow woodland, uncommon

Dixiidae

Paradoxa neozelandica Styx stream and south creek, uncommon

Keroplatidae fungus gnats Includes predatory glow worms

Macrocera sp. (1,2,4) Grassland ungrazed, uncommon

Ceratolion sp. Wetland

?*Pyratula* sp Grass and woodland

Undetermined 2 species wetland

Mycetophilidae fungus gnats Mainly feed among rotting material

*Anomalomyia guttata** 1,2,4 Mainly in woodland

Mycetophila (1,2,4)

Other species (2,4) Wetland and woodland

Psychodidae moth flies Feed among decaying vegetation in wetter sites

Psychoda ?alternata/pseudoalternata A (2,4)

Psychoda penicillata 1

Psychoda 2-3 other species

Scaptomyzidae

Coboldia fuscipes A Woodland

Sciaridae root gnats Root, organic matter,fungus feeders

Undetermined 3 plus species (2-4)

Tipulidae Crane flies, daddy long legs. Feed among roots, decaying vegetation

Erioptera inconstans 1 PT Muddy ditch by stockyard

Gynoplistia pedestris 1 MT Both wetland sites in open, beside slow flowing peaty creek, locally quite Common

Leptotarsus dichroilthorax

Leptotarsus near *vulpinus*

Leptotarus ?obscuripennis

Limonia species (1)

Limnophora sp.

Molophilus ? multicinctus Small species, clear wings Both sites with muddy ditch and backwater present.

Molophilus quadrifidus PT North end willow clump and Styx Mill

Paralimnophora skusei 1 PT Spotted wings, medium sized species

Zelandochina cubitalis

Zelandochina unicornis
Zelandotipula sp. Willow woodlands a slender orangy-brown 3 spots on wings and end veins largely

SUBORDER BRACHYCERA 100-102 species

Acroceridae
Ogocodes sp. Rush wetland, rare
Agromyzidae* leafminer flies **Leaf mining herbivores**
Cerodontha australis A 1-4 PT Grassland, (*Poa*, ryegrass, barley grass, cocksfoot leaf miner, Spencer 1976)
Haplomyza chenopodii A SW On hemlock flowers, host chickweed, fathen
Liriomyza clianthi SW On hemlock flowers, host native broom and kaka beak
Liriomyza hebae SW Host a few *Hebe* species
Liriomyza urticae PT host stinging nettle
Liriomyza vicina SW On hemlock flowers, host not known
Phytomyza platanginis PT host plantain
Phytomyza syngenesiae 2,4 PT host daisy, sow thistle, thistle, dandelion, ? also catsear
Anthomyiidae
Anthomyia punctipennis A 1,4 Slightly more common in wetter semi-shaded sites especially compared with short dry grass. Recorded previously as *Delia* (1) or *Hylemya platura* (4)
Asilidae* robber flies **Predators of soil larvae, medium and larger flying insects**
Saropogon sp* (2-4) SW Grassland by yards, uncommon (larvae general soil predator, adult flying insects)
Calliphoridae* blow flies **Breed mainly in carrion, but adults use dung, flowers for food**
Calliphora stygia A PT Flax planting, uncommon (carrion)
Calliphora vicina A 1-4 (carrion, all year, especially spring)
Lucilia sericata A 1-4 SW Yarrow flowers, uncommon (carrion, commonest mid summer)
Pollenia pseudorudis A SW Yarrow flowers, localised in grassland (European earth worm parasite)
Xenocalliphora hortona 1-4 PT, SW (carrion, commonest early summer, pastures)
Chloropidae* frit, stem flies **Includes pasture pests in Northern Hemisphere**
Gaurax excepta? PT among rushes, uncommon black antenna, dark femur and darker band on hind femur do not match description for *G. excepta*, but 5 distinct black stripes on notum
Gaurax flavoapicalis A 2-4 SW Hemlock flowers, associated with cattle and bird dung – apparently previously misidentified as *G. flavoapicalis*
Gaurax mesopleuralis MT wetland only uncommon
Tricimbra ?*deansi* (wingless) PT Mainly in long ungrazed grassland
Dolichopodidae* long legged flies Adults predators of smaller soft bodied prey – 12 species
Achalcus separatus Woodland mainly
Chrysotus near *bellax* (1,2)
Chrysotus ?uniseriatus PT locally abundant
?*Diaphorus* ?new sp. 1 PT MT Larger black, black legs, long tibial setae
?*Diaphorus* ?new sp. 2 PT Smaller brownish species, almost brown legs, short tarsal setae
Hercostomus new sp. PT By river and flowing water,
Hydrophorus praecox A LT,PT,SW Most common on water above waterweed on sides of pond, central creek.
Microphagus vegans
Ostenia robusta PT Grassland, uncommon
Parentia griseocollis
Parentia mobile 1-4 PT localised, seldom abundant
Sympycnus sp. (1) PT quite common in places
*Tetrachaetus bipunctatus** (1-4) PT, SW Ditch edges and wetter grassland, abundant widespread, characteristic species
Drosophilidae
Drosophila sp.
Scaptomyza fuscitarsis SW Hemlock flowers and ungrazed grassland mostly
Empididae
Ceratomerus crassinervis PT mainly found by stockyard ditch
Chelifera new sp. PT Associated with sites with small running water
Hilara species 1 (1) PT Smallish, tawny legs, male genitalia point upwards & forward
Hilara species 2 LT Smallish, dark legs & proboscis, male -blade genitalia; only collected by Styx river
Hilarempsis species 1 (1) SW Hemlock flowers
Hilarempsis species 2
Hilarempsis species 3

Isodrapetes new sp. PT Associated with eastern wetland in open sites and similar to *I. hydina*
Oropezella sp.
Ephydridae*
Eleliodes chloris A SW tockyard ditch, quite common. This is among the southern records for this species in New Zealand
Ephydrella aquaria 1 PT, SW Commonest in soupy ditches in eastern part of reserve
Ephydrella ? *thermarum*/new sp. SW Central creek
Hyadina irrorata PT SW Mainly in stockyard ditch
Hydrellia acutipennis PT, SW stockyard ditch mainly to eastern pool, localised, quite common
Hydrellia new sp. PT, SW stockyard ditch mainly to eastern pool, localised, quite common
Hydrellia enderbii PT, SW Common in wetland sites, hosts rushes
Hydrellia tritici A 1-3 PT, SW Grassland leaf miner, quite common to common in drier grasslands, uncommon in wetland
Hydrellia velutinifrons PT, SW tockyard ditch quite widespread and common
Parahyadina sp. PT, SW Eastern creek & stockyard ditch, less common
Psilopa metallica 1,4 PT, SW Abundant in wetter and long grassland
Scatella nubeculosa PT, SW Quite common in ditch and creek margins and muddy slurries
Scatella 2-3 spp PT, SW (abundant in places)
Lonchopteridae*
Lonchoptera bifurcata A 1 PT, SW beyond grassland, uncommon
Muscidae house, stable, testse flies Scavenging to blood sucking flies
Limnohelina sp. (1) PT central creek and Redwood flats river bank
Millerina aucklandica 1-3(4) Ungrazed rush,sedge, grass associate
M. dolosa 1(4) Grassland, uncommon
M. ?melas
Millerina 4 other spp
Pallopteridae*
Maorina palpalis PT Flax planting near central ford, uncommon
Phoridae (2,4) **hump backed flies Mainly feed on smaller carrion and rotting vegetation**
Megaselia
Other Phoridae
Sarcophagidae* flesh flies Dung feeders
Oxysarcophaga varia A 2,3 Grassland uncommon (Fresh cattle dung, pastures) Striped dung fly
Sciomyzidae
Neolimnia sigma MT South peaty creek, aquatic snail predator, uncommon
Sepsidae
Lasionemopoda hirsuta A Dung. New record for Canterbury
Sphaeroceridae Feed on decaying material
Phithitia ?lobocerus **PT** Quite common, keys to this species, but also two undescribed species
Phithitia thomasi/*notthomasi* 2, Grassland mainly, breeds in decaying material
Pullimosina heteroneura Open wetland/waterway
Limnosinae species 1 PT locally common, with enlarged lower tongue, which is also black
Limnosinae species 2 PT uncommon, possibly 2 species
Stratiomyidae soldier flies
Australoberis sp. LT Uncommon by river and bog (site 1).
Benhamyia sp.
Odontomyia sp. SW
Odontomyia sp. 2. SW
Zelandoberis sp. PT Uncommon, middle creek below upper pool outlet (site 6)
Syrphidae* hover flies Aphid predators, decomposers or herbivores, adults pollinators
Eristalis tenax A Drone fly
Eumerus strigatus A 1
Helophilus hochstetteri MT, SW Most abundant by slow flowing peaty ditch, kanuka, yarrow flowers
Melangyna novaezealandiae 2, MT, SW Tall grass, wetland, less common (aphid predator) Large hover fly
Melanostoma fasciatum 2,3 MT,SW, PT Grassland, main predatory syrphid, most abundant in wet grassland
Small hover fly (aphid predator)
Tabanidae*
Scaptia ricardoae SW Kanuka flowers, males only

Tachinidae* **Mainly caterpillar parasites**
Pales ?nyctemeriana 2,4 PT east stream Grassland & towards rush/sedge wetland, ? sod webworm parasites
Pales brown leg, face, scutellum PT, SW stockyard, east creek, middle creek sites also on kanuka flowers
Pales medium sp. MT native planted woodland
Pales small all black sp. SW from NE bank, hemlock flowers
Pales small brown face & palps SW from NE bank, hemlock flowers
Pales small dark face & palps SW from NE bank, hemlock flowers
Pales brown scutellum
Protohytricia alcis 2,4 SW kanuka flowers, grassland, porina parasite
Tachinidae species 1 SW yarrow flowers, uncommon
Tachinidae species 2 PT by stockyard willow woodland
Voriini ? *Caligera* sp. (1) Associated with wetland, woodlands probably same as Travis wetland
Therevidae* stilleto flies **Larvae light soil predators, adults non predatory**
Anabarhynchus sp. ?2,4,6 PT Grassland by lowest central pond, uncommon
Undetermined acalypterate species

HEMIPTERA Bugs aphids, scales, mealybugs 50 plus species

Aphididae Aphids
Undetermined 3+species A Note 9 adventive species were recorded from Travis Wetland.
Aphrophoridae* spittle bugs
Carystoterpa trimaculata Native spittle bug associated with trees and shrubs
Philaneus spumarius A 1-3 On a range of plants, quite common meadow spittle bug
Cicadellidae leafhoppers **Often rather host specific herbivores**
?Euacanthella palustris
Ribautiana tenerrima A Associated with blackberry
Zygina zealandica A* 1-3 Associated with perennial herbs, locally common
Undetermined 14 spp.
Delphacidae **Seem to be rather host specific herbivores**
? *Sulux* sp. 1,3 Associated with wetland/rushes and sedges
Undetermined sp
Pseudococcidae **Mealybugs** **Mainly above ground herbivores**
? *Balanococcus* sp.
Psyllidae
Undetermined 3 species

SUBORDER HETEROPTERA

Lygaeidae **Can be flower and seed feeders**
Nysius huttoni 1-3 Dry open grassland, quite common Wheat bug
Rhypodes anceps
Rhypodes sp.
Miridae
Sidnia kinbergi IRedwood Springs flat, swept from dock or buttercup dominated vegetation
? Lygus sp. Associated with kanuka
Undetermined 3 species
Nabidae
Nabis sp.
Pentatomatidae stink and shield bugs
Dictyotus caenosus Inhabits rush lands
Reduviidae
Undetermined species
Saldulidae
Saldula sp. (1)

HYMENOPTERA Wasps, bees, ants, sawflies 106 species

Aphelinidae
Undetermined 2 species
Apidae social bees* **Major pollinators of introduced and some native plants**
Apis mellifera A 1-3 Flax flowers mainly, locally common honey bee
Bombus terrestris A 1-3 Lotus, kanuka, mallow, blackberry flowers common earth bumble bee
Braconidae **Parasitic on many insect groups**

Aphaereta aotea Long marginal cell, reddy legs, stouter Blow fly parasites
'*Apanteles*' 6 species Caterpiller parasites
Aphidius sp. A Aphid parasites
Chorebus ?rodericki Long marginal cell, black species
? *Chorebus sp*
Rogas sp
Alysiinae other species
Undetermined 7 spp.
Colletidae
Hylaeus relegatus
Hylaeus sp. Flax flowers (seen only)
*Leioproctus fulvescens** 1-2 Catsear, yarrow flowers, localised, uncommon
Leioproctus spp. Kanuka flowers
Cynipidae
Phanacis hypochaeridis A 2,3 Gall of catsear stems, common
Cynipoidea
?*Charips* sp
Undetermined sp.
Diapriidae mainly parasites of flies
Hemilocryptus spinosa
Spilomicrus evenly black
Spilomicrus thorax brown Female with semi-short wing
Spilomicrus undetermined 7 sp
Undetermined genus
Elasmidae
Elasmus sp
Encyrtidae
Undetermined sp.
Eulophidae
Pedobius sp.
Undetermined 11 spp.
Eumenidae
Ancistrocerus gazella A Caterpiller predator, immigrant to Canterbury since Travis Wetland survey
Figitidae
Anacharis zelandica 1 Parasite of brown lacewings
Formicidae aAnts Omnivores-predators
Monomorium antarcticus 2,3 Very localised omnivore, southern ant
Halictidae* native ground nesting subsocial bees
*Lasioglossum sordidum** 2,4 Kanuka flowers, locally common
Ichneumonidae parasitic wasps of many insect orders (host unknown unless stated)
Xanthocryptus novozealandicus
Degathia species
?Degathina sp
Undetermined 22 species
Megaspilidae*
Dendrocerus species A 2,3 Quite common (hyperparasite, hosts Aphidiinae)
Mymaridae
Undetermined sp
Pompilidae predatory spider hunters
Epipompilus insularus MT planted native woodland
Priocnemis small black sp.
Spictostethus fugax MT Willow woodland
Platygasteridae
Undetermined 6 spp
Pteromalidae
Undetermined 3 spp.
Scelionidae
Black, no wings ?Baeiinae

Dark, winged species
Black, wing small stump Hind part of thorax also with short spine/horn
Sphecidae mainly ground nesting, insect-spider predators
Undetermined spp.
Tenthredinidae* Sawflies, larvae rather sluglike rather host specific herbivores
Pontania proxima A* Crack willow galls in leaves, willow sawfly, abundant
Nematus megaspilus A A yellow gall sawfly, immigrant to Canterbury since Travis Wetland survey
Trichogrammatidae
Undetermined spp.
Vespidae yellow jacket wasps
Vespula vulgaris A

LEPIDOPTERA Moths and butterflies 12 plus species

Crambidae grass moths Main species pasture-soil pests
Orocrambus flexuosellus 1-7 Grassland, abundant (grasses native and adventive)
Geometridae looper caterpillars herbivores
Undetermined species
Hepialidae* porina moth Very large non sugar feeding moths
Wiseana umbriculata 1-3 Tall grass site 1, uncommon late flying porina
Lycaenidae blue and copper butterflies
Zizina labradus 1-3 Grassland quite common (clover, haresfoot trefoil hosts) little blue butterfly
Noctuidae cutworm moths
Agrotis ipsilon A 1,2 Grassland, (polyphagous on leaves & lower stems) greasy cutworm
Persectania aversa 1-3 Long grass area, locally common (grasses, pastoral herbs) streaked armyworm
Nymphalidae
*Bassaris itea** 2,3 **V** uncommon,diurnal (stinging nettle) yellow admiral butterfly
Pieridae
Pieris rapae A 1, 4 white butterfly
Psychidae*
Undetermined sp. On totara foliage
Tineidae (1,2)
Undetermined sp.
Monopis ethelella A 2 litter-dead grass association, grassland & dead wool
Tortricidae (1-4) **Common pest species generalised herbovires**
Undetermined spp.

NEUROPTERA 2 species (14.2 % of 14 NZ species)

Hemerobiidae* brown lacewings Aphid, soft body insect predators
Micromus tasmaniae A 1-3 MT, PT, SW in the vicinity of grassland, uncommon
Coniopteridae
Cryptoscaena australiensis A MT South peaty creek, uncommon, predator of freshwater sponges

ODONATA Damsel and dragonflies

Coenagrionidae

Xanthocnemis zealandica 1,2,4 PT common red damselfly

Corduliidae

?Procordulia sp. Eluded collection, which prevented certain identification of three possible species

ORTHOPTERA Grasshoppers, wetas, crickets, katydids

Gryllidae crickets
Bobilla 1-2 spp. 1 SW,PT Grasses, commonest in drier semi-open grassland . In Travis report recorded as *Pteronemobius* species

PSOCOPTERA Booklice 5 species

Caeciliusidae
?Caecilius flavus Yellow species with pale clear wing
Ectopsocidae
Ectopsocus briggsi A Smaller species with spots along margin of wing

Philotarsidae
Zelandopsocus sp. 1 Medium sized black species with haired wings and complex dark pattern to wing
Other families no hairs on veins, 2 tarsal segments
Species 1 larger, brown species, clear wing
Species 2 larger species, dark marking along much of wing veins

TRICHOPTERA Caddisflies 19 species (6.8 % of 234 N.Z. species) *= Recorded by Robb 1989

Conoescidae
*Pycnocentrodes aureolus** 2 LT Styx stream, stony creeks & drains, peaty creek (once) in woodland. Aquatic
*P. evecta** 2 LT Styx stream & central creek ford, peaty creek (once) in woodland. Aquatic
Helocopsychidae
Helicopsyche albescens LT Central creek pond outlet Aquatic
Hydrobiosidae
*Hydrobiosis parumbripennis** 2 LT Styx stream, stony creek fords, drain & peaty creek in woodland Aquatic
*Neurochorema confusum** LT Styx stream & central creek & stony drain Aquatic
Psilochorema bidens 2 LT Styx stream & stony creeks & drain Aquatic
P. tautora LT Styx stream Aquatic
Hydropsychidae
*Aoteapsyche colonica** 2 LT Styx stream & stony creeks. Aquatic
Hydroptilidae
*Oxyethira albipes** 2 LT PT Styx stream, stony creek fords & drains, peaty creek in woodland. Aquatic
Paroxyethira hendersoni LT Styx stream & stony creeks & drains, peaty creek (once) in woodland. Aquatic
Paroxyethira tillyardi LT Styx stream & stony creek & drains Aquatic
Leptoceridae Long horned caddisflies
*Hudsonema amabie** 2 LT Styx stream, central creek ford, peaty creek (once) in woodland Aquatic
Oecitus unicolor 2 LT Styx stream, central creek & east drain, peaty creek (once) in woodland Aquatic
Triplectides cephalotes 2 LT Styx stream, central creek ford, peaty creek in woodland Aquatic
*Triplectides obsoletus** LT Styx River Aquatic
Oeconesidae
*Oeconesus maori** LT Styx River Aquatic
Polycentropodidae
*Polyplectropus puerilis** 2 LT StyxRiver, peaty creek (once) in woodland Aquatic
Olinga feredayi 2 LT Central creek pond outlet. Aquatic
Psychomyiidae
Triplectidina moselyi LT Localised, peaty creek, central woodland, less common Aquatic

ARACHNIDA Spiders

Araneidae orb weaver spiders, webs vertical or nearly so
Eriophora pustulosa A
Clubionidae two clawed hunting spiders
Undetermined species MT planted native woodland, main species in this habitat
Lycosidae wolf or ground spiders
?Allotrochosina schauinslandi MT Planted native woodland, brown wolf spider
Anopterosis hilaris 4,?6 Mainly in grassy sites banded brown wolf spider
Linyphiidae sheet web spiders, webs may be horizontal

Pisauridae nursery web spiders
Dolomedes minor 4-6 Among wetland and shrubs nursery web spider
Salticidae jumping spiders, hunters
2 undescribed species * Small dark grey species
Tetragnathidae
Tetragnatha sp. MT Native planted woodland, larger mainly dark brown species
?*Nanoneta* sp. MT Native planted woodland, smaller pale brown species
Theridiidae cobweb or comb footed spiders
Achaearanea veruculata 4 Likes settled sites, prey flies, ants, walking prey, New Zealand cobweb spider
Theridion sp. MT Native planted woodland