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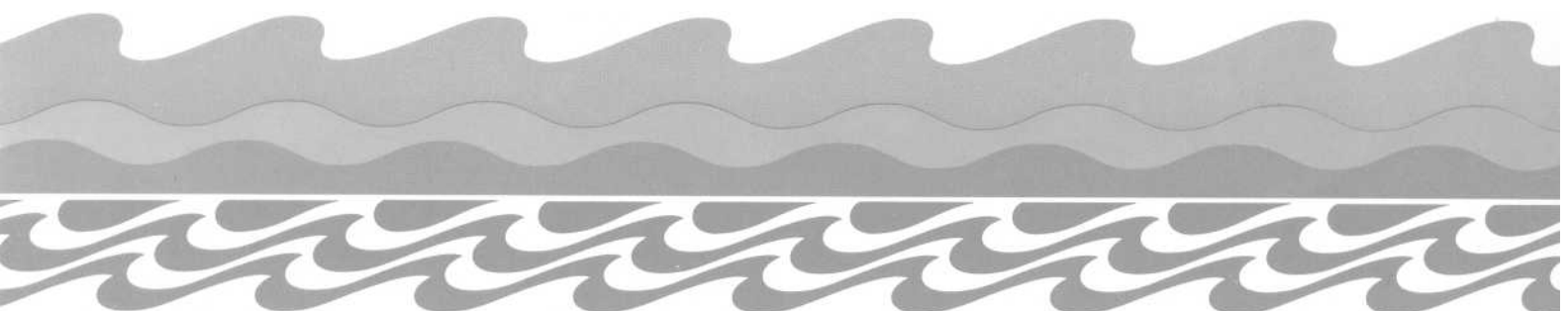
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### THE IMPORTANCE OF INVERTEBRATE BIODIVERSITY : AN OTAGO CONSERVANCY REVIEW

(Short Answers in Conservation Science)

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**THE IMPORTANCE OF INVERTEBRATE BIODIVERSITY  
AN OTAGO CONSERVANCY REVIEW**

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**INTRODUCTION**

Although this review focuses on the invertebrates of Otago, its main objective is to stress the important role invertebrates play in natural processes within all parts of New Zealand and the contribution that New Zealand invertebrates make to global diversity.

Invertebrates comprise the bulk of animal species diversity in all terrestrial habitats, including freshwater, within Otago Conservancy. Of the estimated 20 000 invertebrate species present in New Zealand, 60% or about 12 000 are found naturally in Otago Conservancy (Table 1). (These figures include only known species. Kuschel (1990) estimates our beetle fauna at 10 500 species and total insect fauna at 42 000 alone.) As less than 2% of these are introduced, the great majority are native species. Unlike the familiar birds we see, the familiar insects are generally native species such as the huhu beetle (*Prionoplus reticularis*) (the largest native beetle), porina moths (*Wiseana* spp.) and bluebottle fly (*Calliphora quadrimaculata*). Those exotic species we have are often confined to suburban or pastoral settings. Invertebrates including insects are New Zealand's major contribution to world biodiversity and are as important as the kiwi or tuatara. Every part of Otago Conservancy has a particular assemblage of native invertebrates, which are vital components of the functioning ecosystem of that place.

Overall the New Zealand invertebrate fauna is noted for its high rate of endemism (at least 90%) and is among the three highest in the world for a discrete area, the others being Madagascar and Hawaii (Dugdale, 1988). However, the number of species restricted to Otago could be expected to be much lower. I estimate 5-10% of the invertebrates of Otago are only found there. This reflects the variety of habitats available in Otago which in turn is determined by both the nature of and history of the basement rocks of Otago. The species richness of Otago invertebrates strongly reflects both the long and complex geological history of Otago and the existence of a very wide range of present day environments including the driest, among the wettest, highest, coldest and hottest parts of New Zealand. Otago landforms are composed of some of the oldest rocks in New Zealand and have the oldest preserved land surfaces.

<b>TABLE 1</b>		
<b>Invertebrate Class or Insect Order</b>	<b>Approximate Number of Species in Otago</b>	<b>% of New Zealand Fauna</b>
Spiders (Arachnida)	1000	34
Land snails (Mollusca)	300	40
Beetles (Coleoptem)	3100	62
Flies (Diptera)	1600	64
Wasps (Hymenoptera)	700	?
Moths (Lepidoptera)	1220	61
Caddis (Trichoptera)	110	52
Others	3970	?
<b>Total</b>	<b>12 000</b>	<b>60</b>

## **GEOLOGICAL BACKGROUND**

Geologically, Otago has been divided into the following:

- 1 The Haast schist core stretches from the eastern coast, where Pliocene volcanoes have erupted through the core, to the West Coast where it merges with the Fiordland granite complex. Low grade schist is mapped to the Waitaki River but in reality it is a transition area of semi-schist grading into the Canterbury greywacke. To the south it meets the ancient Southland greywackes on the Southland Syncline and in the Catlins.
- 2 North Otago limestone of Oligocene/Eocene age covering the schist basement with Eocene volcanoes along the coast.
- 3 Southland greywacke of Triassic/Jurassic age in the Catlins.
- 4 Some areas of Torlesse greywackes in North Otago, more typical of Canterbury.

Essentially then Otago consists of ancient metamorphosed schist worn down to a peneplain in the Cretaceous and Tertiary eras then uplifted quite recently (five million years ago), but with an older flora and fauna that through its present distributions has left a trace of former geography and tectonics.

Several stratigraphic features of the schist bedrock, and soils that have developed there, are unique to Otago, such as the exhumed tors, sarsen stones and saltpans. They are all striking features of the Otago landscape and their attendant specialised flora and fauna is also unique to Otago. The broad summits of the Central Otago mountains are particularly well vegetated, consisting of cushionfield-tundra, dwarf shrubland, rich snowbanks, fellfield, grasslands and many tarns, seepages and streams. Major features of the basin systems between the many mountain ranges are river terraces of semi-natural vegetation with short grasses and native cushion plants. Also present are areas of sandy soils containing a distinctive assemblage of plants and insects, and numerous wetlands including ephemeral wetlands. These wetlands characteristically have a range of spring annual plants present, together with a distinctive insect fauna.

## **SPECIAL FEATURES OF INVERTEBRATES**

- 1 Invertebrates are small and can utilise very small resource items. A large number of species can share the same habitat, some of which may have very large populations.
- 2 Most species have annual life cycles and depend on suitable breeding conditions being present every year at the appropriate time. For species with more than one generation a year these requirements are repeated through the year. Fewer species have generations longer than one year, even fewer both long and short.
- 3 Invertebrates in general have no long term resting stage so they cannot easily overcome even short periods of adversity.
- 4 Invertebrates have complex life cycles and each part of the life cycle has specific habitat requirements that must be met within the limits of mobility for the life stage of the species.

- 5 Most invertebrates have very limited means of dispersal and are therefore very slow at recolonisation of sites from where they have been lost.
- 6 Invertebrates are cold blooded and therefore dependent on external heat for normal activity. Therefore, warm surfaces such as bare ground, rock faces and tree trunks are important for their survival.

### **FEATURES OF NEGLECTED HABITATS**

Many habitats that are important for invertebrates for part or all of their life cycle are generally unrecognised and therefore often unprotected in the reserve system. Some important points are:

- 1 Minor features of a site may be a vital feature to some of the invertebrates of that site.
- 2 Neglected features such as dead wood (at all stages), bare ground, bare rock surfaces, tidal wood, dead algae and river shingle are very important for a great many invertebrate species at some stage of their life cycle.
- 3 Juxtaposition of habitats is a key factor in determining the suitability of sites for many invertebrates as each life cycle stage can require different conditions.
- 4 Ideal sites for invertebrates contain a variety of habitats with a gradual transition between them.
- 5 Most invertebrate species depend on common plants not rare plants.

### **SPECIAL FEATURES OF NEW ZEALAND INVERTEBRATE FAUNA**

The New Zealand invertebrate fauna is markedly different from that of other areas on earth and this gives New Zealand a special role and mandate in global biodiversity conservation work. Some special features are as follow:

- 1 High rate of endemism as species level; > 90% for most groups.
- 2 Several endemic families of invertebrate (Mystacinobiidae - batflies, Mnesarchaeidae - moths, Synthetonychidae - harvestmen).
- 3 The most popular host plants are those that are cold adapted, ie, southern, alpine or both, or are genera that are found from coastal to alpine habitats, eg, *Hebe/Leonohebe*, *Olearia*, *Muehlenbeckia*, *Nothofagus*, *Celmisia*.
- 4 Richer alpine fauna (60 % of species) than lowlands although lowlands cover 60 % of country (perhaps a result of human introductions or habitat modification).
- 5 Beetle, moths, flies and true bugs dominate in terms of species numbers.
- 6 Hibernation non-existent - just slow their life cycles down as food resource/temperature decreases.
- 7 An especially rich land snail fauna (mostly in leaf litter), moth fauna and aquatic insect fauna.

- 8 A disproportionate number of heavy bodied insects (weta, giant weevils, hepialid moths, etc) that are often flightless in normally flighted groups.

### **SITE MANAGEMENT**

A site managed effectively for native invertebrates is usually a site managed well for native vegetation, other fauna and natural processes because invertebrates are effectively the lowest common denominator in communities. Some general points are as follow:

- 1 The larger and more ecologically diverse a site the better.
- 2 Habitat continuity and structural variation of the vegetation are important.
- 3 A site should be managed for its strengths not maximum diversity.
- 4 Promotion of all stages of vegetation succession enhances a site for invertebrates, therefore rotational management is important.
- 5 "Creative" management such as tree planting and pond digging should not be undertaken without careful thought on what is being destroyed in the process.

### **THE IMPORTANCE OF INVERTEBRATES**

In Otago, as elsewhere in New Zealand, invertebrates are found from the coast to the nival (above summer snowline) zone on the highest mountains. They are not only characteristic of all the plant communities present, but by their differential grazing of various plants strongly determine the plant species mix. Their seed and seedling eating habits are important in maintaining the integrity of communities by eliminating intruders which would usually arrive in very small numbers compared to the large number of seeds/seedlings produced by the resident plants. In this way, intact native communities can resist invasive weeds, unless the process is disrupted by man in the form of tracking, burning, stock grazing, etc. Table 2 summarises the importance of invertebrates to sustaining plant communities.

Invertebrates are important in the soil for aeration, decomposition of dead plant material to create an organic layer and consequent release of nutrients which are then available for living plants, and assisting with formation of soil structure. In the absence of leaf litter feeders our grasslands, shrublands and forests would be rapidly choked up with litter and die within months. Insects, together with some micro-organisms such as fungi, are the only terrestrial organisms able to break down cellulose, the basic material of plants. Higher animals would also disappear quickly in the absence of these recycling invertebrates and the world would quickly return to that of a billion years ago when only bacteria and algae existed. Aquatic invertebrates, apart from being prey for native fish, are important in the flow of energy in water systems. They utilise the flow of micro-organisms together with feeding on mosses, dead vegetation and the periphyton layer on rocks, while other species are predatory.

Adult invertebrates, particularly flying insects, serve a very important role in the pollination of plants, while their larvae often form complex relationships with their host plant or animal, feeding on them in such a way that both benefit. New Zealand has a rich invertebrate fauna of leaf-litter and this is reflected in Otago also, from high-alpine grassland through forests to coastal wetlands and dunes. Characteristic groups of this niche are minute snails, small beetles, moth larvae, spiders and mites, amphipods, millipedes and earthworms.

Present-day invertebrate distributions (biogeography) are important as they can tell us much about past geological events. Most invertebrates are effectively immobile (eg, because they are flightless in the female or tied to very specific ecological factors). Since the many different groups (snails, peripatus, insects, etc) have a long history in New Zealand (> 300 million years) and have evolved essentially on the rocks we now find them on, they provide a living record of past tectonic and climatic changes. This is in stark contrast to the inert and scanty fossil record.

**TABLE 2 : IMPORTANCE OF INVERTEBRATES  
IN COMMUNITIES**

- differential feeding by insect larvae determines structure and composition of plant communities (grasshoppers, beetle and moth larvae)
- pollination by adult insects enables plant communities to reproduce (flies, moths, wasps, beetles, thrips, etc)
- leaf-litter and soil invertebrates break down and release nutrients which are then once again available for plants - the organic layer is vital for soil structure for plants (earthworms, beetles, moth larvae, snails, fly larvae)
- soil invertebrates help with soil aeration and mixing of nutrients between soil layers (earthworms, fly larvae, nematodes)
- polyphagous larvae in relatively intact habitats eliminate incoming seeds of weed species, retaining the integrity of communities (beetle and moth larvae)
- important part of food chains in both freshwater and terrestrial habitats - eating and being eaten (spiders, predacious insects, snails and peripatus, etc)

### **IMPORTANCE OF SEMI-NATURAL AREAS**

The largest and most diverse populations of native invertebrates are generally those found in relatively undisturbed natural plant communities. This is true for Otago, where an intensive insect survey of the Waipori Ecological District found over 540 native species in 13 orders (Patrick et al., 1993) mostly in near intact tall-tussockland. Therefore, there is a temptation in conservation to only protect the most natural vegetative communities and ignore those that are a mix of native and exotic plant species. Often the exotic plant species dominate in these semi-natural communities, while the native plants (although relatively diverse) are unimportant in terms of ground cover by being confined to the margins of rock outcrops, fencelines or roadsides and low fertility sites.

Research in Otago, particularly Central Otago has shown that these semi-natural sites are extremely important for the conservation of the characteristic invertebrates of an area, whether it be a river terrace herbfield, a saline area or a shrubland. The native invertebrates have persisted in these areas much better than the native flora, although lichens and mosses have also remained an important component. Often the fauna has switched host plant to a related exotic species or adapted in some other intriguing way to the induced habitat.

In semi-natural grassland, shrubland, saltpan, wetland and for country around Alexandra 218 native moth species were recorded over 12 months in a five hectare area, far more than would be expected from an equivalent area of forested scenic reserve. The vascular flora was also diverse although mostly superseded in abundance by the exotic grasses and herbs. A total of 251 vascular plants were found with 142 being native species, again a higher native total than most other equivalent protected areas.

Semi-natural areas are important for invertebrate conservation and present challenges in their management new to protected area management. While less than 5 % of our native insect species have adapted to purely exotic plant communities (Kuschel, 1990), it appears that close to 100% can persist in these semi-natural areas, especially while they are extensive. As they become developed further by ploughing, etc, and consequently fragmented, invertebrate species drop-off will be inevitable. So protection of these invertebrate conservation values require large areas so as to encompass all the available residual native plants and to provide an adequate buffer to adjacent land management changes.

The department's purchase of Flat Top Hill (820 ha) near Alexandra was mooted for these reasons and its predominance of the diminutive exotic shrub *Thymus vulgaris* is significant. This shrub supports many native invertebrates on its foliage, its litter or root system including a flightless and local chafer beetle *Prodontria modesta* (Brent Emerson *pers. comm.*) and some moth species including *Tingena melanamma*.

## KEY OTAGO INVERTEBRATES

The following annotated list discusses the distribution, status and threats of a representative sample of the different groups of invertebrates in Otago.

### 1 Mollusca

One species (actually a subspecies) of giant land snail is found in south-west Otago - *Powelliphanta spedeni spedeni*. It is smaller than most of the genus and occurs at the upper edge of beech forest and into the tussock zone on Mt Benger, Umbrella Range, Mid Dome, Eyre Mountains, Nokomai Range and Mataura Range (type locality). It is only locally common.

### 2 Arachnida

The poisonous endemic katipo spider *Latrodectus katipo* has its southern-most occurrence in New Zealand just north of Otago Peninsula. It is not common in Otago dunes and may be under threat from exotic spider species.

Trapdoor spiders (*Cantuaria* spp.) are characteristic of relatively undisturbed grasslands/river terraces in Otago. Sites in North Otago appear the most intact but habitat modification continues to eliminate them. Densities as high as 68 kilograms of spider per hectare have been recorded so the presence of these spiders, which are top predators, is indicative of a healthy food chain.

### 3 Peripatus

Peripatus species are found in lowland forest in eastern Otago, montane rocky areas of Central Otago and in western Otago beech forests. Most species are undescribed including two new species recently recognised from Dunedin forests. Both these species are apparently confined to the Dunedin area.

### 4 Insecta

#### a Orthoptera (wetas, grasshoppers, etc)

A great many wets species are present in Otago with the majority being still undescribed. Different cave wets species occur from coastal cliffs through the for areas of Central Otago to the nival zone on the western mountains. Ground and tree wetas are also found from lowland



to upland areas with the tree wetas (*Hemideina maori*) reaching enormous size and often abandoning trees for a life under slabs of rock on the summits of the highest mountains in Central Otago. This species also occurs at low altitude on islands in Lake Wanaka in a forest environment, so it may have been more widespread prior to the introduction of exotic mammalian predators. Giant wetas (*Deinacrida* spp.) are present in Otago Conservancy but all three species are local in their occurrence. Table 3 lists five distinctive wets species special to Otago.

**TABLE 3 : SPECIAL OTAGO WETAS**

Species	Description	Distribution in Otago
<i>Hemideina maori</i>	large weta	Mouwaho, Moutapu - Lake Wanaka islands
<i>Hemideina maori</i>	large weta (larger than normal)	Rock and Pillar, Dunstan, Pisa, Ids, Lammermoor Ranges
<i>Deinacrida connectens</i>	scree weta	Kakanui Mountains, Ids, St Mary Ranges
* <i>Deinacrida</i> new species	giant weta	Matukituki Valley, Rob Roy Valley
* <i>Deinacrida</i> new species	giant weta	Rees Saddle
* <i>Hemiandrus</i> new species	ground weta	Cromwell Chafer Nature Reserve

\* Confined to Otago

One nationally uncommon grasshopper (*Sigaus minutus*) is present between Galloway and Alexandra in Central Otago. Elsewhere it only occurs in the Mackenzie Country.

#### **b Coleoptera (beetles)**

Beetles are the dominant order of insects in terms of the number of species both worldwide and in New Zealand. They occur almost everywhere as herbivores, predators or decomposers. Many are of a large size and therefore are not only obvious to the eye but are vulnerable to predation. Table 4 lists some of the distinctive Otago beetles, particularly the flightless chafers of the genus *Prodontria* which are characterised by having, in most cases, small natural distributions.

**TABLE 4 : SPECIAL OTAGO BEETLES**

Species	Description	Distribution in Otago
<i>Mecodema chiltoni</i>	large carabid	montane to alpine areas east and south of Wakatipu
<i>Scythrodes squalidus</i>	large chafer	central and western mountains
<i>Prodontria lewisi</i>	sand chafer	Cromwell dunes
<i>P. capito</i>	black chafer	Central Otago
<i>P. modesta</i>	black chafer	Alexandra/Manorburn areas
<i>P. bicolorata</i>	brown chafer	Alexandra area
<i>P. pinguis</i>	furry chafer	Hector Mountains
<i>P. praelatella</i>	sand chafer	Tautuku and Cannibal Bay dunes
<i>Prodontria</i> n. sp.	chafer	Danseys Pass
<i>Prodontria</i> n. sp.	chafer	Roaring Meg
<i>Prodonuia</i> n. sp.	chafer	Crown/Pisa Ranges
<i>Rhyncodes ursus</i>	elephant weevil	southern and western beech forests
<i>Lyperobius hudsoni</i>	giant weevil	Central Otago ranges
<i>L. cupiendus</i>	giant weevil	Central Otago ranges
<i>L. spedeni</i>	giant weevil	central and western alpine areas
<i>Lyperobius</i> n. sp. (2)	giant weevils	North Otago mountains

The giant weevils (several of the largest are still undescribed) are slow moving animals. Both larvae and adults feed on members of the carrot family, mainly of the genera *Aciphylla* and *Anisotome*.

### c Hemiptera (bugs including cicadas)

A distinctive group within this large family are the cicadas. The characteristic song of the male is heard in both forest and grassland habitats, where the subterranean larvae feed on root sap. About 14 species in three genera are present in Otago with the eight black cicada species of the genus *Maoricicada* being perhaps the most interesting. They frequent open riverbeds, alpine shrublands, snowbanks and high- alpine fellfield. At most only two species occur at any one site and each is easily separated by its song.

### d Plecoptera (stoneflies)

Stoneflies are generally crawling insects (although they have wings) whose larvae mostly live in cold flowing fresh waters. In Otago they are found from lowland forest and wetlands to the high-alpine zone in seepages and torrents. Between six to 10 species can be found in stretches of water that have retained some natural cover such as forested gullies, *Carex* or *Juncus* dominated wetlands or copper tussock (*Chionochloa rubra cuprea*) catchments. Quite small streams or wetlands can support important species such as a quarter hectare wetland near Alexandra that has its own endemic species *Zelandobius auratus*. Flightless, both brachypterous (short-winged) and apterous (no wings) forms are found at higher altitude together with overall larger species such as *Holcoperla magna* from the western mountains. Of the 46 species known from Otago, 13 are confined to Otago such as *Zelandobius mariae*, *Z. auratus* and *Z. alatus* while some others have a southern distribution (Table 5). Typically, the presence of stonefly larvae in a water body is indicative of good water quality and other aspects such as natural-like riparian vegetation.

TABLE 5 : SPECIAL OTAGO STONEFLIES

Species	Distribution
<i>Halticoperla tara</i>	Western Otago (Coronet Peak, etc)
* <i>Holcoperla magna</i>	The Remarkables, Mt Aspiring National Park
* <i>Apteryoperla illiesi</i>	Western Otago
<i>Spaniocercoides howesi</i>	Western Otago, Hawkdun Range
<i>Spaniocerca zwicki</i>	Southern South Island
* <i>Zelandoperla pennulata</i>	Central Otago mountains
* <i>Zelandoperla</i> n.sp.	Central Otago mountains
<i>Zelandobius foxi</i>	Alpine Central Otago and southern South Island
<i>Zelandobius uniramus</i>	Southern South Island
* <i>Zelandobius childi</i>	Rock and Pillar and Old Man Ranges
* <i>Zelandobius montanus</i>	Mt Aspiring National Park
* <i>Zelandobius auratus</i>	Conroys Road, Alexandra
<i>Zelandobius kuscheli</i>	Southern South Island
* <i>Zelandobius inversus</i>	Pisa Range
* <i>Zelandobius mariae</i>	Pisa Range
* <i>Zelandobius alatus</i>	Rock and Pillar and Old Man Ranges
* <i>Zelandobius</i> n.sp. 1	North Dunstan Mountains
* <i>Zelandobius</i> n.sp. 2	Pigroot area
* <i>Zelandobius</i> n.sp. 3	Matukituki Valley
<i>Vesicaperla substirpes</i>	Old Man Range (terrestrial)
* Endemic to Otago	

## e Trichoptera (caddis)

Caddis are aquatic insects in the larval and pupal stages while the adults are similar in appearance and habit to moths being readily attracted to light. About 110 species of caddis in 13 families are present in Otago from the sheltered coastal habitat of the marine caddis in Otago Harbour through to the high-alpine seepage habitat of *Tiphobiosis childi* on the central and western mountains. Caddis, apart from being the major food source of native and exotic fish species, are important in the energy flow in aquatic systems. The larvae live within specially constructed cases, silk-lined dens or are freelifing predators. The filter feeders trap food from the flowing water and make it available to other organisms rather than allowing it all to be lost out to sea. The presence of a good caddis diversity is often indicative of good water quality and substantial riparian vegetation. The latter increases habitat diversity by producing shaded and unshaded portions of the stream apart from contributing dead vegetation for larvae to feed on. Forested streams and streams flowing through tussock/shrubland are ideal habitat for a range of caddis groups. Ten species are endemic to Otago, such as *Pycnocentria* n. sp. confined to the Lammermoor and Pisa Ranges (Table 6). Another six species have a southern New Zealand distribution. Typically the alpine forms are flightless, possessing only short wings but compensated by strong legs for running (eg, *Philorheithrus* n. sp. from Rock and Pillar/Lammermoor/ Rough Ridge Ranges and short-winged forms of *T. childi* from the Pisa Range), although a brachypterous new *Oeconesus* species has been found in East Otago tributaries at only 500 m.

Another feature of the caddis is a number of dark coloured diurnal species; *Zelolessica cheira* of pools, the larger *Z. meizon* of torrents, *Olinga fumosa* endemic to greater Dunedin, *Olinga* n. sp. of alpine west Otago, *Beraeoptera roria*, *Periwinkla childi* of the Central Otago alpine zone snowmelt areas, *T. childi* and *Tiphobiosis* n. sp. of waterfalls.

**TABLE 6 : SPECIAL OTAGO CADDIS**

Species	Distribution
* <i>Costachorema hebdomon</i>	High-alpine Otago
* <i>Helicopsyche howesi</i>	Eastern Otago
<i>Hydriobiosella tonela</i>	Swampy Summit and Western Otago
* <i>Hydrobiosis</i> n.sp.	Old Man, Pisa Ranges
* <i>Olinga fumosa</i>	Dunedin hills
* <i>Olinga</i> n. sp.	East Lake Hawea (alpine)
* <i>Neurochorema pilosum</i>	East Otago
* <i>Oeconesus</i> n. sp.	East Otago
* <i>Pseudoeconesus</i> n.sp.	Dunedin area, Otago Peninsula
<i>Periwinkla childi</i>	Central Otago mountains
* <i>Pycnocentria</i> n.sp.	Lammermoor and Pisa Ranges
<i>Philanisus plebeius</i>	Otago Harbour (marine)
* <i>Philorheithrus</i> n.sp.	Rock and Pillar, Lammermoor, Rough Ridge, Taieri Gorge
<i>Psilochorema acheir</i>	Southern and eastern South Island
<i>Tiphobiosis childi</i>	Alpine Central Otago
<i>Tiphobiosis fulva</i>	Humboldt Mountains
<i>Tiphobiosis</i> n.sp.	Waterfalls - Otago-wide
<i>Zelolessica meizon</i>	Montaine to alpine torrents
<i>Zelandopsyche ingens</i>	Western Otago (large species)
<i>Triplectides obsoleta</i>	Southern New Zealand
* Endemic to Otago	

## **f      vidoptera (moths and butterflies)**

Moths and butterfly species abound from coastal rocks, dunes and saltmarshes to the high mountains where several species even breed above the summer snowline.

The forest moths of Otago are generally nocturnal, drab and widespread species whereas the open country species of wetlands, grasslands and rock outcrops are diurnal, brightly-coloured and mostly restricted to southern New Zealand, particularly Otago. The open country species are most numerous on the Central and western Otago mountains but are conspicuous also in the limestone areas of North Otago and the montane areas of Central and eastern Otago.

Some groups of moths and butterflies that are characteristic of Otago and have their centre of diversity in Otago are:

### **i      Family Hepialidae (swift moths)**

About three-quarters of New Zealand species are found in Otago, including 10 of the genus *Aoraia* which are large (6-10 cm wingspan), hairy species of both grassland and forest. Other monotypic genera (*Heloxycanus*, *Cladoxycanus*) are typical of wetlands, snowbanks or alpine grasslands. Southern New Zealand, particularly Otago is the centre of diversity for this family. Larvae are subterranean. Several native species of the genus *Wiseana* have adapted to man-made pasture where their larvae are the notorious porina grass grubs.

### **ii     Family Arctiidae (tiger moths)**

All the New Zealand endemic species occur together in only one place; the Queenstown area of Otago. They consist of the magpie moth (*Nyctemera annulata*) and three species of tiger moth (*Metacrias*). Tiger moths are brightly coloured moths in the male with flightless short-winged females. The larvae are the conspicuous woolly bear caterpillars, often seen by day moving quickly over tracks or alpine vegetation.

### **ii     Family Geometridae (looper moths)**

Several genera in this large family are features of the Otago fauna. Firstly the genus *Dichromodes* whose cryptic larvae feed on various lichens on tors. Nine species occur in Otago, of which five are found nowhere else. The attractively marked adults are fast fliers by day over rock outcrops.

The genera *Notoreas*, *Dasyuris*, *Paranotoreas*, *Aponotoreas* and *Arctesthes* contain altogether about 60 species in Otago. A few of these are lowland species such as the undescribed *Notoreas* at Shag River mouth, but the majority are colourful day-flying moths of alpine regions. The larvae are both grass or herb feeders, but are very selective on their choice of a foodplant, often being confined to a single species or group of closely related species. Otago mountains are the centre of diversity for all these genera with many species being also confined to Otago.

Additionally, two once widespread but now threatened New Zealand geometrid moths, *Asaphodes stinaria* and *Xanthorhoe bulbulata* appear to have their last strongholds in Otago - both in the greater Queenstown area. Table 5 lists some key Otago moths, all of which have an essentially Otago-only distribution.

A feature of the Otago moth fauna is the occurrence of usually alpine taxa at strategic coastal localities such as Nugget and Shag Points and also Otago Peninsula, where they are joined by native plants and other insects with alpine affinities.

Another feature is that the moth fauna is highly seasonal with different species emerging at distinct times, right through the year including winter. Some species emerge only in the upland areas when there is often scattered snow about in May and June. These species are characterised by diurnal males and flightless females. Otago is the New Zealand centre of diversity for this distinctive, late autumn-early winter emerging moth fauna.

**TABLE 7 : SPECIAL OTAGO MOTHS**

<b>Species</b>	<b>Distribution</b>
<i>Aoraia orientalis</i>	Rock and Pillar/Lammermoor/Rough Ridge Ranges
<i>Aoraia macropis</i>	Old Man Range, Mt Benger
<i>Arctesthes siris</i>	Central Otago mountains
<i>Notoreas</i> n. sp. 1	Shag River mouth cliffs
<i>Notoreas</i> n. sp. 2	snowbanks on Garvie Mountains and Lammermoor Range
<i>Notoreas</i> n. sp. 3	North Otago mountains
<i>Notoreas chioneres</i>	Central Otago mountains
<i>Notoreas ortholeuca</i>	Central and Western Otago mountains
<i>Paranotoreas fulva</i>	Central Otago saltpans
<i>Dichromodes simulans</i>	Alexandra/Manorburn area tors
<i>Dichromodes ida</i>	eastern and Central Otago tors
<i>Dichromodes</i> n. sp.	Central Otago mountains tors
<i>Orocrambus geminus</i>	eastern/Central Otago mountains
<i>Scoparia tuicana</i>	Dunedin hills, Maungatua, Catlins uplands
<i>Loxostege</i> n. sp.	Central Otago saltpans
<i>Scoriodyta suttonensis</i>	Central Otago tors
<i>Kiwaia glaucoterma</i>	Cannibal Bay and Chrystalls Beaches
<i>Meterana</i> n. sp. aff. <i>pictula</i>	Tautuku Bay dunes

## RESEARCH

While at a faunistic level we have a good idea of the species present, ongoing survey work in Otago continues to find new species and extend known distributions within certain limits.

For most species basic biological and ecological work has not been done, let alone detailed genetical studies. For many species, even the host plant has not been elucidated. Much work on Otago invertebrates is yet to be attempted and only the Cromwell Chafer Beetle has its population regularly monitored.

The Otago Conservancy strongly supports biosystematic research of invertebrate groups represented in Otago, and the important ongoing curation of collections that serve that end. Both aspects of this work are currently undertaken principally by Landcare Research, Mt Albert, Auckland, although Victoria University and the Otago Museum also have an important role. The Otago Conservancy will continue to facilitate this work by providing specimens via ongoing survey, collection permits, logistic support where possible and letters of support for their relevant FORST applications.

We will also support ecological work on Otago invertebrates by the above institutions and Otago University, Zoology Department, but stress that this work must be underpinned by basic biosystematic data.

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