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THE TAXONOMY AND SYSTEMATICS OF A GROUP OF NEW ZEALAND LYCOSIDAE (ARANEAE) (WOLF SPIDERS).

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THE TAXONOMY AND SYSTEMATICS OF A GROUP OF NEW ZEALAND LYCOSIDAE (ARANEAE) (WOLF SPIDERS).

By C.J. Vink

The taxonomy and systematics of a group of spiders in the family Lycosidae, informally known as the "hilaris group", that are often numerically dominant ground dwelling predators in agroecosystems, has been studied. Ten species of New Zealand Lycosidae have been taxonomically revised. Eight of the species have been placed in the newly erected genus Zeacosa, which has been defined here. Four existing Zeacosa species have been redescribed and four new species of Zeacosa have been described. The new genus Austracosa has been defined and the new species Austracosa robusta has been described. The genus Allotrochosina has been redefined and the species Allotrochosina schauinslandi has been redescribed. Distributions of all ten species, plus a probable additional ninth species of Zeacosa, Z. subantarctica, have been mapped and their distribution discussed. A phylogeny for all ten species has been derived using parsimony analysis of morphological characters with very strong support for the monophyly of the genus Zeacosa. One tree topology was derived and discussed.

Keywords: Araneae, Lycosidae, New Zealand, Zeacosa, "hilaris group", spiders, taxonomy, phylogenetics.
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INTRODUCTION

What is a Lycosid?

Lycosidae, or wolf spiders, are found worldwide. Most lycosids do not build a web for prey capture. Approximately 2195 species and 103 genera (N.I. Platnick, pers. com.) have been described worldwide. The monophyly of the Lycosidae is supported by four characters: the characteristic eye arrangement; the absence of a retrolateral tibial apophysis in males; the egg sac carried on spinnerets of females; and young carried on the dorsal surface of the mother’s abdomen (Dondale, 1986; Griswold, 1993).

The detail of the arrangement of the eyes in three rows is unique (see figure 1). The anterior row consists of four small eyes; the eyes in the middle row (formed by the two posterior median eyes) and eyes in the posterior row (formed by the two posterior lateral eyes) are much larger. The posterior median eyes and the posterior lateral eyes have the strongest visual acuity (Rovner, 1993). The lateral and the posterior eyes have a layer of light-reflecting cells called the grate-shaped tapetum (Homann, 1971). Presence of grate-shaped tapetum is the classical synapomorphy for the super family Lycosoidea (Griswold, 1993). Both Pisauridae and Trechaleidae have eye arrangements that are similar to lycosids but the posterior median and the posterior lateral eyes are not as enlarged as those of the Lycosidae and the eye rows that they form are not as strongly recurved as those of the Lycosidae.

Unlike most closely related spider families, Lycosidae possess no retrolateral tibial apophysis (RTA). The loss of the RTA is believed to be a derived character state (Dondale, 1986). Males of some species in the subfamily Venoniinae possess a tibial apophysis that is small, weak and situated near the base of the tibia on the ventral surface (Lehtinen & Hippa, 1979; Hippa &
Lehtinen, 1983). The location and nature of this structure suggests it is not homologous with the RTA of related species (Dondale, 1986).

All species of the Lycosidae carry their spherical egg sacs on spinnerets. Trechaleids, the sister family, also carry egg sacs in this way but their egg sacs are hemispherical (Carico, 1993). Active transport of young (see figure 2) is made possible by special setae which the young cling to (Rovner et al., 1973). Trechaleids carry their young on the empty egg sac (Carico, 1993).

Lycosid Biology

Feeding
All lycosids are predators and their main prey are arthropods, mostly insects (Stratton, 1985; Nentwig, 1987). Knost and Rovner (1975) found that three lycosid species scavenged dead arthropods. Behavioural and morphological adaptations allow lycosids to handle prey much larger than themselves; e.g., scopula hairs on the legs help the spiders restrain larger prey, erectile spines provide protection from the prey, legs can extend rapidly to grasp prey and are strong to hold onto prey (Rovner, 1980). Lycosids can also capture prey less than 5% of their size (collembola, pers. obs.) Lycosids can survive longs periods of food shortage (Miyashita, 1968) by storing large amounts of fat (Humphreys, 1977), having highly distendable abdomens and low metabolic rates (Humphreys, 1978). Lycosids, like the majority of spiders, are generalist predators and will attack most arthropods that they encounter (Nentwig, 1986; Riechert & Harp, 1987). Generalism seems necessary to lycosids in terms of dietary requirements. Uetz et al. (1992) found that there was significantly lower survivorship of Hogna helluo (Walckenaer) and Lycosa sp. raised on monotypic prey (also see Miyashita, 1968; Van Dyke & Lowrie, 1975; Greenstone, 1979); although Holmberg and Turnbull (1982) found no evidence of any benefit from a generalist diet. Lycosids employ a sit-and-wait foraging behaviour (Kronk & Riechert, 1979; Riechert & Luczak 1982; Stratton, 1985). Sit-and-wait foraging, generalist predation and physiological
adaptations are believed to be adaptations lycosids have developed for periods of food shortage (Stratton, 1985; Riechert & Harp, 1987; Humphreys, 1988).

**Lycosid growth and life cycles**

Adult size in lycosids is extremely variable (Miyashita, 1968; Van Dyke & Lowrie, 1975; Workman, 1979; Uetz et al., 1992; pers. obs.). Growth rates are also variable (Miyashita, 1968; Van Dyke & Lowrie, 1975; Workman, 1979; Wise & Wagner, 1992; Uetz et al., 1992). Size at maturity and growth rates are dependant on food supply (Miyashita, 1968; Van Dyke & Lowrie, 1975; Workman, 1979; Wise & Wagner, 1992) and diet (Uetz et al., 1992). Kessler (1971 & 1973) found a positive correlation between number of eggs produced and amount of food consumed by *Pardosa* spp.

Lycosid life cycles can extend over one (e.g., Miyashita, 1969; Edgar, 1972), two (e.g., Hagstrum, 1970; Edgar, 1971; Workman, 1978) or three years (e.g., Humphreys, 1976; Workman, 1978; Workman, 1979). Within a species, lycosid life cycle length and synchrony may vary with altitude or latitude (e.g., Miyashita, 1969; Edgar, 1971; Workman, 1979). Timing of breeding within a species may also differ between populations (e.g., *Geolycosa patellonigra* Wallace breeds in spring or autumn or both seasons in Florida (McCrone, 1965)). New Zealand *Lycosa* spp. adults are in greatest numbers from late spring to late summer (Martin, 1983; pers. obs.) and females are usually seen with egg sacs in late spring/early summer and in late summer/early autumn (pers. obs.).

**Lycosids as predators in ecosystems**

Lycosids are found in many different habitats (McKay, 1985a; Stratton, 1985; Wise, 1993) Within a habitat, lycosids are numerically abundant predators (e.g., up to 22.4 *Pardosa lugubris* (Walckenaer)/m² (Edgar, 1971) and up to 76 *Trochosa terricola* Thorell/m² (Workman, 1978)). Lycosids have been reported to be numerically dominant predators in ecosystems (e.g., Kiritani et al., 1972;
Lycosid species are important predators in both natural and agricultural ecosystems. The majority of studies looking at the role that lycosids play in ecosystems have been in agroecosystems.

In an eastern Tennesse grassland Van Hook (1971) used radio-isotopes to study the effect of wolf spiders on its orthopteran prey population. One genus of wolf spiders, *Lycosa*, consumed 21% of total net secondary production in this grassland ecosystem. Dobel (1987, cited in Wise 1993) found that lycosids, especially *Pardosa littoralis* Banks, limited planthopper populations in intertidal salt marshes. Hurd and Eisenberg (1990) manipulated population densities of *Hogna rabida* (Walckenaer) in a fenced-off pasture in Maryland, USA. Ten individuals were added to each metre$^2$ enclosure but no measurable difference in prey densities was detected. *H. rabida* was already present in the field and is highly cannibalistic, which, combined with lycosid territoriality (Riechert, 1982) may explain why no measurable differences were found.

In cereal fields in eastern Switzerland, Nyffeler and Benz (1988) calculated that *Pardosa* spp. killed two aphids/m$^2$/week during winter (when the spiders are less active). Aphid densities are usually low during the winter; any predation during that time may impact on the aphid populations later on. Nyffeler and Breene (1990) found evidence of low daily food consumption by *Pardosa* spp. in an autumnal hay meadow in Central Europe. The effect of *Pardosa agrestis* (Westring), a species of Micryphantidae and a species of Linyphiidae on cereal aphid populations in the laboratory was investigated by Mansour and Heimbach (1993). They found the presence of *P. agrestis* and other spiders caused between 34 and 58% reduction in aphid population development. Laboratory studies on *Pardosa hortensis* (Thorell) showed that feeding and behaviours associated with feeding increased as prey numbers increased (Samu & Bíró, 1993); and that *P. hortensis* could control agricultural pests in a density sensitive way.
A large number of studies on lycosid predation in agroecosystems have been based on *Pardosa pseudoannulata* (Bösenberg & Strand) in rice fields. Kiritani *et al.* (1972) found that *P. pseudoannulata* is the dominant spider in rice fields and that these spiders depress populations of the major pests green rice leafhopper and brown plant hopper. Kiritani and Kakiya (1975) showed density dependant reproductive numerical response to prey numbers by *P. pseudoannulata*. They concluded that although *P. pseudoannulata* were very important in limiting the overall population density of green rice leafhopper they would not exert enough predation pressure to effectively control rice dwarf virus (a disease spread by green rice leafhoppers). A seven-year study in an insecticide-free rice field in Kochi, Japan revealed that *P. pseudoannulata* and an egg parasitoid, *Paracontroilia andoi*, affected a 50% reduction in the egg density of green rice leafhopper (Kiritani, 1977). Using cages including and excluding spiders, Kang and Kiritani (1978) demonstrated that *P. pseudoannulata* at a density of five individuals/m² reduced the overwintering populations of green rice leafhopper by half over the course of winter. (Miyai *et al.*, 1978) used a revised model by Sasaba *et al.* (1973) and empirical data and predicted that absence of lycosid spiders would result in a 4.3 fold increase of green rice planthopper numbers.

Very little work has been done on the role that New Zealand lycosids play in ecosystems. Martin (1983) found that, along with spiders in the family Linyphiidae, lycosids in the "hilaris species group" are the most numerous spider in pasture in Nelson. This has also been found in Canterbury pasture (A.R.G. McLachlan, pers. com.) and in carrot fields (W. Sivasubramaniam, pers. com.). More than 70% of spiders caught in the understorey of a Lincoln University pesticide-free apple orchard by A.M. Henwood were lycosids (pers. obs.). One of the major obstacles to investigation of the role that lycosids play in New Zealand ecosystems (both modified and natural) has been the lack of a sound taxonomic base. One of the original goals of this study was to provide descriptions of the lycosid species that are found in modified New Zealand habitats.
Lycosid behaviour

A substantial amount of research into lycosid behaviour has been done, especially in America, Europe and Asia (see Stratton, 1985 for a review). Lycosids are sit-and-wait predators (Kronk & Riechert, 1979) although they do show frequent changes in location (Ford, 1978). Rovner (1980) found that lycosids remained motionless until a prey item is seen or vibrations from prey movement are felt. Lycosids then employed a short distance pounce to capture large, dangerous prey and, after contacting the prey, repeated repositioning to avoid prey defences. Rovner (1980) suggested that the behaviour that lycosids use to attack and subdue prey is family specific. The courtship behaviours of lycosids involve chemical, acoustic and visual signals (Stratton & Uetz, 1981; Stratton, 1985; Rovner, 1993). The differences in courtship between lycosid species can be a useful tool in taxonomy. Observations of the courtship behaviours of Schizocosa spp. have revealed distinct species that are difficult to discern morphologically (Stratton, 1991). Differing courtship behaviour serves as an isolating mechanism between species (Stratton & Uetz, 1986). The only documented New Zealand lycosid behaviour is a description of prey capture, egg sac construction and transportation of the egg sac and young of the "striped wolf spider" (presumably Zeacosa hilaris (Koch)) and a brief description of the courtship behaviour of Allotrochosina schauinslandi (Simon) (Forster & Forster, 1973).

Lycosid Taxonomy and Systematics

Taxonomic methodology in spiders

In the Araneae variation in size, morphology and colouration is common between specimens of the same species. These variations result from different environmental influences and the ability of spiders to mature in any of several moults. It is possible to identify many spider species by their colour pattern and somatic features, however, often the only way to be sure which species a given specimen belongs to is to examine the adult genitalia;
the epigynum (female copulatory pores) and the male palp. Since the 17th century it has been known that spider species differ in their genitalia (Coddington & Levi, 1991). Clerck (1757, cited in Coddington & Levi, 1991) illustrated genitalia when he described Swedish spiders but many authors after him neglected to do so in their eagerness to name new spiders. By the 1940s clear illustrations of genitalia were included in almost all descriptive taxonomic spider works. Levi (1981) and Coyle (1985) found that, despite allometric growth and variable morphology, the dimensions of adult genitalia vary much less than do their colouration, body dimensions or proportions. Eberhard (1985) discusses the question of why genitalia reflect species specific differences; he argues that the mechanism is sexual selection on genitalic morphology by female choice during copulation.

**Systematic methodology in spiders**

Since Charles Darwin's "Origin of the Species" (Darwin, 1859) systematics has progressed from a catalogue of static diversity to a science that interprets species and their relationships in terms of a rigorously formulated evolutionary hypothesis (Mayr *et al*., 1953; Nelson & Platnick, 1981; Brooks & McLennan, 1991). Up until the early 1960s, the dominant way of constructing phylogenies was by evolutionary systematics. The basic hypothesis by which evolutionary systematic operates is the theory of evolution by natural selection. Rather than being based on a clearly defined methodology, evolutionary systematics is steeped in intuition (based on sound evolutionary reasoning) and, therefore, it does not lend itself to testing and falsification.

In the early 1960's numerical phenetics emerged (Sokal & Sneath, 1963). Numerical phenetic methodology produces relationships based on the overall similarities of species characters. These relationships are unlikely to reflect the true phylogeny of the taxa being analysed as this method does not account for homoplasious (convergent) characters.
Hennig (1966) devised a new system of constructing relationships called cladistics. This method bases relationships among taxa on the shared possession of derived characters (synapomorphies). There has been a close relationship between the development of cladistics and spider phylogeny in the last 20 years (e.g., Nelson & Platnick, 1981).

One of the major problems with inferring spider phylogeny is, as tersely put by Coddington and Levi (1991), "not so much a question of finding characters as it is of allocating homoplasy". The morphology of the male palp is commonly used in spider systematics; Coddington (1990) showed that it can be extremely difficult to establish homologies of the male palpal sclerites across a wide range of spider taxa.

**Lycosid phylogenies**

There has been little work done on constructing the phylogeny of the Lycosidae. Dondale (1986) divided the Lycosidae into five subfamilies and examined the relationships between them. Griswold (1993) used cladistic analysis to examine the relationships of Lycosoidea; his results supported the monophyly of the Lycosidae and placed the Trechaleidae as the sister family. Casanueva (1980) revised the taxonomy and performed a phenetic analysis of the Chilean lycosids. The Australian lycosid fauna is reasonably well known (McKay, 1973, 1974a, 1974b, 1974c, 1975a, 1975b, 1976a, 1976b, 1979a, 1979b, 1979c, 1979d, 1979e, 1985b) but no phylogeny has been derived.

**New Zealand Lycosids**

Forster (1975) states there are "two or three widespread endemic species of wolf spiders probably derived from the subalpine fauna" inhabiting New Zealand pasture land. Species diversity of endemic lowland tussock lycosids appears to be highest in the Otago region and includes New Zealand's sole burrowing species, *Pardosa bellica*osa* (Goyen) (Forster & Forster, 1973; Forster, 1975).
In subalpine and alpine herb fields lycosids are the dominant spider species, along with small linyphiids; there are also "many" species of lycosids found on scree slopes and rock faces (Forster, 1975). Alpine lycosids, and other spiders, that inhabit the scree slopes, are mainly dark coloured and unusually large in size (Forster, 1975; pers. obs.). Unlike many other spider families, the subalpine and alpine lycosids do not show a direct evolutionary relationship to the forest dwelling species (Forster, 1975). Lycosids form the most conspicuous part of the spider fauna of shingle riverbeds, which appear to be derived from high country scree spiders (Forster, 1975). Dark coloured lycosids inhabit New Zealand's shingly beaches and pale coloured lycosids are found on sandy beaches; "some of these spiders are directly related to riverbed species" (Forster, 1975).

Allotrochosina schauinslandi is found in forests throughout New Zealand (Forster, 1967; Forster & Forster, 1973; pers. obs.); Zeacosa westlandica n.sp. is also found in forests and forest margins but only in Westland and Fiordland. The low species diversity of lycosids found in forests is atypical of the New Zealand spider fauna, as the great majority of other New Zealand spider families are found in forests (Forster, 1975).

**Taxonomic history**

The first New Zealand lycosid to be described was *Lycosa nautica* (Walckenaer, 1837). Walckenaer's description is insufficient to identify this species, the type has been lost (Dalmas, 1917; Parrott, 1946) and Roewer (1954) lists this species as "nicht zu deuten!" in his catalogue. In the years between 1877 and 1925 23 New Zealand lycosid species were described. The last New Zealand lycosid to be described was *Lycosa subantarctica* Forster, which was described from a single female specimen in 1964 (Forster, 1964).

**Objectives**

As can be seen, a considerable amount of research has been carried out on the biology, ecology and behaviour of European, American and Asian
lycosids. Most of these studies would not have been possible without a sound taxonomic base. The lack of taxonomic knowledge of New Zealand Lycosidae makes it very difficult for investigations into their biology, behaviour and ecology to occur. The group of lycosids examined in this study were informally named the "hilaris group", which included an unknown number of species found in grasslands and open scrub. Lycosids in the "hilaris group" form a major component of the beneficial arthropods of agroecosystems and are often the numerically dominant ground living predators. A revision of the "hilaris group" would aid researchers in a wide range of fields related to sustainable agriculture as well as helping those investigating spider biology, behaviour and ecology by providing a sound taxonomic base to work from.

This study has three major objectives:

1) To provide a sound taxonomic base for future studies of the "hilaris group" of New Zealand lycosids.

2) To investigate the phylogeny of the "hilaris group" and discuss the relationships of the species.

3) To investigate and record the distributions and habitats of all the "hilaris group" species.
Figure 1. Dorsal view cephalothorax (40x) of *Zeacosa hilaris* showing the arrangement of eyes characteristic for the Lycosidae.

AME = anterior median eye(s); ALE = anterior lateral eye(s); PME = posterior median eye(s); PLE = posterior lateral eye(s).
Figure 2. Female *Zeacosa hilaris* with spiderlings clinging to her abdomen. Body length, 6.7mm. Photograph by J.W.M. Marris.
MATERIALS AND METHODS

Specimens were examined and illustrated using a Carl Zeiss DRC stereoscopic microscope with a Carl Zeiss camera lucida. Specimens were examined in 100% ethanol, which reduced convection currents and consequent movement of the specimens (Dondale & Redner, 1990). Specimens were stored in 70% ethanol. All measurements were in millimetres. Somatic morphology measurements (cephalothorax length and width, abdomen and leg segment lengths) were taken using a grid reticle in the dissecting microscope. The cephalothorax length was measured in lateral view and its width was taken at the widest point. The length of the abdomen was also measured in lateral view, and the width at the widest point. The measurements of the abdomen were approximated because abdomen size changed more easily in preserved specimens than more sclerotised parts (e.g., chelicerae). Total length was measured in lateral view and was also approximated because it involved the size of the abdomen and its relative position (the position of the abdomen in a preserved specimen may differ to the resting position of the abdomen in a live spider). Leg segment lengths were measured in lateral view without detaching legs from the animal and by positioning the segment perpendicular to the cephalothorax. The most accurate and consistent method to obtain measurements of leg segment lengths is to excise each leg and mount it on a slide (Hormiga, 1994). This method was not used as it involved partial destruction of specimens (some species were represented by one or a few specimens). For this reason, measurements of leg segments were approximate. All measurements are those from one male and one female specimen (with their collecting information given). Size range in each species was expressed by the minimum and maximum body lengths found in all specimens as variation in adult Lycosidae is well documented (e.g., Miyashita, 1968; van Dyke & Lowrie, 1975; Workman, 1979; Dondale & Redner, 1990; Uetz et al., 1992). Leg spination was examined but not included in the species descriptions as interspecific variation was not
discernable from intraspecific variation or intraspecimen variation (variation between opposite legs of the same specimen). The colour patterns described for each species were from the male and female from which measurements and genitalia illustrations were made.

Male palps were removed from specimens at the trochanter/femur joint and examined and drawn in their unexpanded state. The right palp was illustrated following the convention of R.R. Forster and colleagues in their descriptions of New Zealand spiders (e.g., Forster & Blest, 1979). Shading was only applied to diagnostic features. Male palps from preserved specimens of each species (except Zeacosa chathamica n.sp. where there were only two specimens) were expanded by placing them in a concentrated (approximately 35%) KOH solution for four hours, transferred to distilled water and returned to alcohol when expansion was obtained.

The external genitalia of females were illustrated. Female genitalia were removed using sharpened needles. Tissue was cleaned away using fine needles and the genitalia were then placed in trypsin (suggested by C.E. Griswold) to clean away remaining tissue. Specimens were then transferred to distilled water and then to 70% ethanol for examination under a dissecting microscope. The internal genitalia of Zeacosa hilaris and Zeacosa adumbrata (Urquhart) were examined. There were minor differences in the internal genitalia of the two species, however, the external genitalia of the females yielded enough differences to distinguish between species, so this procedure was not followed for all species.

For new species, illustrations, measurements and colour pattern descriptions were made from a designated holotype male and an allotype female. For existing species, illustrations, measurements and colour pattern descriptions were made from a representative male and female specimen (with collecting information shown). Measurements, illustrations and colour pattern description were not made from type specimens as they were faded and
brittle. The representative specimens chosen were from locations as close as possible to where the types had been collected. These specimens have been labelled accordingly to enable future workers to go back to the same specimens.

Lycosid specimens were examined from collections at Auckland Institute and Museum (AMNZ), British Museum of Natural History (BMNH), Canterbury Museum (CMNZ), Lincoln University Entomological Museum (LUNZ), Museum of New Zealand (MONZ), New Zealand Arthropod Collection (NZAC), Otago Museum (OMNZ). To supplement these collections, various localities were sampled for specimens on collecting trips. Locality information for each species was recorded on distribution maps as provided in the Fauna of New Zealand series.

Type specimens were examined from Muséum National d’Histoire Naturelle (MNHN) Paris, Otago Museum (OMNZ) and Senckenberg Museum (SMF). New Zealand collections were searched and enquiries were made at all major overseas collections for type specimens of New Zealand lycosids. Only 5 (of a possible 25) type specimens were located, the rest of the type specimens have apparently been either lost or destroyed.

The recent trend in revisions of spider taxa has been to include a systematic analysis of the group (e.g., Griswold, 1990; Hormiga, 1994). This practice is encouraged by the PEET (Partnerships for Enhancing Expertise in Taxonomy) report on taxonomy (National Science Foundation, 1994). As with most recent revisions, cladistic analysis was used to derive an estimate of phylogeny for the group of New Zealand lycosids studied. Cladistic analysis, using branch and bound, was performed using the computer package for phylogenetic analysis, PAUP 3.1.1 (Swofford, 1993). The data was bootstrapped using 1000 replications to assess the robustness of the most parsimonious trees. Allotrochosina schauinslandi was selected as an outgroup for the phylogenetic analysis. A. schauinslandi was chosen as it was clearly
different from the spiders in the "hilaris group" and was abundant throughout New Zealand.

Most characters used in the analysis were from male palpal morphology. Male genitalia are commonly used in spider phylogenetic analysis (e.g., Griswold, 1990, 1991b; Hormiga, 1994; Harvey, 1995; Hormiga et al., 1995). Characters were also taken from female genitalia morphology and somatic morphology. The following characters were used in a cladistic analysis:

**Character 1:** Length of median apophysis after the 90° bend. 0; there is no 90° bend in the median apophysis. 1; short - length after the 90° bend is less than length before the bend. 2; long - length after the 90° bend is equal to or greater than length before the bend.

**Character 2:** Thickness of median apophysis (mesal view). 0; thick - approximately as wide as when viewed ventrally. 1; thin - less than half as wide as when viewed ventrally.

**Character 3:** Direction of the tip of the median apophysis. 0; other - median apophysis without tip. 1; forward. 2; backward. 3; straight.

**Character 4:** Number of tooth like projections at end of median apophysis. 0; none. 1; one. 2; two.

**Character 5:** Apophysis with a 90° bend. 0; no. 1; yes.

**Character 6:** Apophysis length. 0; short - apophysis reduced. 1; long - in Zeacosa hilaris the apophysis goes across the basal part of the median apophysis and in Austracosa robusta n.sp. the apophysis is hidden by the tegulum.

**Character 7:** Number of bristles on the tip of the cymbium. 0; none. 1; between 2 and 6. 2; eight or more.

**Character 8:** Ratio of cymbium length to tibia length. 0; 1.1:1. 1; 1.4:1. 2; 1.5:1. 3; 1.6-1.9:1. 4; 2.3:1.

**Character 9:** Embolus length. 0; short - length less than half the width of the cymbium. 1; long - at least as long as half the width of the cymbium.

**Character 10:** Terminal apophysis functioning as conductor. 0; no. 1; yes.
Character 11: Grove in terminal apophysis in which embolus rests. 0; absent. 1; present.

Character 12: Shape of terminal apophysis tip (this was unknown for *Zeacosa chathamica* as there were not enough specimens to expand the palp). 0; none. 1; spatula shaped. 2; pointed.

Character 13: Overall palpal configuration. 0; *Allotrochosina schauinslandi* configuration. 1; *Austracosa robusta* configuration. 2; *Zeacosa* configuration.

Character 14: Subtegulum. 0; prominent - not obscured by tegulum. 1; obscured by tegulum.

Character 15: Posterior lip of epigynum. 0; absent. 1; present. 2; thickened.

Character 16: Distance between female genital openings (unknown for *Zeacosa chathamica*). 0; short - distance between openings less than width of opening. 1; long - distance between openings greater than or equal to the width of opening.

Character 17: Claw on tip of female palp (unknown for *Zeacosa chathamica*). 0; absent. 1; present.

Character 18: Teeth on female chelicerae (unknown for *Zeacosa chathamica*). 0; 3 promarginal, 2 retromarginal. 1; 3 promarginal, 3 retromarginal. 2; 3 promarginal (distal very reduced), 3 retromarginal. 3; 3 promarginal (distal very reduced), 3 retromarginal (proximal very reduced). 4; 3 promarginal (distal very reduced), 2 retromarginal.

Character 19: Sternum length to width ratio. 0; less that 1.25:1. 1; more than 1.25:1.

Character 20: Carapace length. 0; less than or equal to 4mm. 1; greater than 4mm.

Character 21: Carapace colour pattern. 0; not striped. 1; striped - with three longitudinal stripes.

Character 22: Habitat. 0; found in forest, forest margins and damp areas. 1; found in open scrub and grasslands. 2; found in riverbeds, shingle screes and beaches.

See table 1 for the data matrix of characters for phylogenetic analysis.
Table 1. Data matrix of characters.

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SYSTEMATICS

Family Lycosidae Thorell, 1869

Small to large, three-clawed, ground living, hunting spiders. Eyes 4.2.2.; posterior eyes much larger than anterior eyes and the row formed by the posterior eyes very strongly recurved. Trochanters notched. Colulus absent. Male palp without tibial apophysis. Leg IV longest. Female lycosids carry the spherical egg sac attached to the spinnerets and the young, after hatching, climb on the back of the female; they cling on to specialised hairs on the females abdomen (McKay, 1985a).

Subfamily Lycosinae Simon, 1898

Type genus: Lycosa Latreille, 1804.

The subfamily is defined by two male palpal characters (Dondale, 1986); median apophysis transverse, with ventrally directed spur and median apophysis with sinuous channel on dorsal surface.

Genus Zeacosa, n.gen.

Type species: Lycosa hilaris Koch, 1877

Diagnosis
Male: terminal apophysis and the earlike lobe of the tegulum form the conductor together. Terminal apophysis with a groove in which the embolus rests. Median apophysis with an approximately 90° bend in it giving it the shape of an inverted "L" (Figure 3). Cymbium with 2 - 6 stout bristles at tip. Female: with a sclerotised lip posterior to the paired openings of the epigynum (Figure 5). Palpal tarsi with claw.
Body length between 4.9 and 15.8 millimetres. Abdomen usually with a lighter coloured heart stripe (a dorsal longitudinal band extending from the anterior end of the abdomen along the midline to at least half way along the abdomen). Legs in order of length; 4, 1, 2, 3 (male and female).

Remarks
The earlike lobe of the tegulum forming part of the conductor shows Zeacosa to lie among the genera of the Trochosa group in the subfamily Lycosinae (sensu Dondale, 1986) (C.D. Dondale, pers. com.). The terminal apophysis forming part of the conductor with the earlike lobe is unique in the lycosines (C.D. Dondale, pers. com.), as is the groove in the terminal apophysis, in which the embolus rests. The median apophysis is the most useful tool in separating species in the genus. There is some slight intraspecific variation of the median apophysis of Zeacosa species, but the range of variation within species is much less than between species.

The genus is known only from New Zealand (including the Chatham Islands and the Auckland Islands). Roewer records Zeacosa hilaris as present in Tasmania, but this record can not been confirmed. The illustration of the palp of Trochosa oraria (Koch) in McKay (1979e) appears to conform to the Zeacosa palpal configuration, but specimens of T. oraria and other Australian species placed in the genus Trochosa would need to be examined before a decision could be made about their possible inclusion in Zeacosa. It is probable, based on biogeographical relationships of other spider taxa, that other species of Zeacosa will be located in the Australian fauna.

Etymology
The generic name is a combination of New Zealand, where the genus is found, and -cosa, to signify it is a genus in the Lycosidae. The name is feminine in gender.
Key to the species of Zeacosa

1. Cephalothorax brownish with three longitudinal yellowish stripes.
   Found in grasslands, open scrub or forest ........................................ 2
   Cephalothorax not as above ............................................................ 5

2. Middle longitudinal stripe bright yellow and slightly wider than the width of PLE at the anterior end, tapering to a point at the posterior end. Carapace high (height greater than 0.4 times carapace length). Median apophysis without a right angle bend and spanner shaped (figure 25). Epigynum shape distinct (figure 26). Found only in Westland and Fiordland in forest and forest margins .................... Zeacosa westlandica n.sp.
   Middle longitudinal stripe yellow or yellow-brown and not shaped as above. Carapace not high (height less than 0.4 times carapace length). Median apophysis with a right angle bend giving it the shape of an inverted "L". Epigynum with paired anterior openings ............ 3

3. Male palp with a strong hooked apophysis (figures 3 & 4). Female epigynum with a pair of indentations posterior to the genital openings (figure 5). Varying colour pattern. Found in grasslands and open scrub throughout New Zealand. This is the lycosid species most often found in modified habitats .................... Zeacosa hilaris (Koch)
   Male palp with a much reduced apophysis and the tip of the median apophysis pointing posteriorly. Female epigynum without a pair of indentations posterior to the genital openings .................. 4

4. Middle longitudinal stripe a squarish patch between the PLE and the fovea, and a thin line posterior from the fovea. Median apophysis tip with two toothlike projections (figure 17). Females unknown. Bodylength less than 5.7mm. Found only on the Chatham Islands .... Zeacosa chathamica n.sp.
Middle longitudinal stripe not as above, usually a band tapering slightly toward the posterior end. Median apophysis tip with one toothlike projection (figure 7). Epigynum with the paired genital openings separated by at least the width of an opening. Found throughout New Zealand and not known from the Chatham Islands .................  Zeacosa adumbrata (Urquhart)

5. Cephalothorax brown to black with white pubescence. Abdomen dark grey. Median apophysis an anterior pointing tip and with one toothlike projection at the tip (figure 10). Epigynum with a thickened posterior lip and genital openings separated by the width of an opening (figure 11). Body length 5.6 - 12.2mm .................. Zeacosa canescens (Goyen) Cephalothorax and abdomen light yellow with grey to black markings. Usually found on beaches and in sand dunes (sometimes darker grey specimens are found in riverbeds). Median apophysis with two toothlike projections at the tip (figure 19). Epigynum with a thickened posterior lip and genital openings adjacent (figure 20). Body length 5.2 - 8.4mm .................. Zeacosa litoralis n.sp. Cephalothorax orange-brown to red-orange-brown. Abdomen black-brown or dark grey. Median apophysis with one toothlike projection at the tip. Posterior lip of epigynum not thickened. Body length 6.8 - 15.8mm .................. 6

6. Length of median apophysis distal to the right angle bend longer than length proximal to the bend and with a shallow wave shape after the right angle bend (figure 13). Epigynum with a slightly raised area posterior to the genital openings (figure 14) .... Zeacosa goyeni (Roewer) Length of the median apophysis distal to the right angle bend much shorter than length proximal to the bend and the tip pointing posteriorly (figure 22). Genital openings of epigynum obscured by two sclerotised projections pointing posteriorly ............ Zeacosa riparicola n.sp.
Figure 3. Palp (cymbium and tibia) of male *Zeacosa hilaris*, showing diagnostic palpal sclerites (135x).
Zeacosa hilaris (Koch, 1877)

Lycosa hilaris Koch, 1877

Lycosa umbrata Koch, 1877  New synonymy.

Pardosa vicaria Koch, 1877  New synonymy.

Lycosa virgata Goyen, 1886  nec Karsch, 1880  New synonymy.

Lycosa algida Simon, 1905  New synonymy.

Lycosa virgatella Roewer, 1951  replacement name for Lycosa virgata Goyen.

Schizocosa umbrata (Koch). - Roewer 1954

Pardosa virgatella (Roewer). - Roewer 1954

Figures 4 and 5

MALE

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The chelicerae have 3 (distal extremely reduced) promarginal and 3 retromarginal teeth. The male palp is shown in figure 4. The median apophysis has a right angle bend and the distal portion is straight. The apophysis is long, toothlike and curving towards the tip of the cymbium.
**FEMALE**

*Measurements* (in mm)

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The chelicerae has 3 (distal very reduced) promarginal and 3 retromarginal teeth. The epigynum is shown in figure 5, it has a sclerotised, posterior lip. The two genital openings are wide and close together. Paired indentations can also be seen posterior to the main anterior openings (probably where the long, toothlike apophysis is inserted). There is some variation in the appearance of the epigyna but this is usually a result of the degree to which the abdomen is distended.

**Size Range:**

Male body length: 4.9 - 10.8mm  
Female body length: 5.8 - 10.6mm  

**Colour:** The cephalothorax is brown with a longitudinal yellow-brown stripe extending from, and the same width as, the eye-group, tapering to the posterior of the carapace. There are also two longitudinal yellow-brown stripes near the edge of the carapace. The sternum is orange-brown. The abdominal colour patterns are extremely variable. The most common colour
pattern is a dark brown abdomen with a light yellow-brown heart stripe extending at least half way along the abdomen. The leg coxae, trochanters and femora are yellow-brown; the rest of the legs are orange-brown. The legs are striped with darker lateral bands.

Type material: *Lycosa hilaris* Koch; the species was described by Koch from a specimen from the "Bradley Sammlung" labelled "Von Neu-Seeland". Type not located. *Lycosa virgata* Goyen, lectotype male, here designated, labelled as *Lycosa variegata*, Id. by Goyen (a handwritten label is also present with the correct spelling), no collecting information, Goyen Collection, OMNZ (examined); paralectotype female, here designated, labelled as *Lycosa variegata*, Id. by Goyen (a handwritten label is also present with the correct spelling), no collecting information, Goyen Collection, OMNZ (examined). *Lycosa algida* Simon, holotype female, labelled Chatham Inseln, ex coll. Schauinsland, Roewer Arachnological Collection, SMF (examined).


Despite the type of *Lycosa hilaris* not being found, the illustration of the male palp (Koch, 1877) shows the structures of the median apophysis, apophysis and tegulum clearly enough for specimens to be identified from it. The types of *Lycosa umbrata* and *Pardosa vicaria* were also not found, however, Koch's illustrations of the epigyna (Koch, 1877) are clearly the same as the epigynum of *Z. hilaris*. The labels of the lectotype and paralectotype of *Lycosa virgata* were typewritten and misspelt *Lycosa variegata*. These labels were inserted by C.L. Wilton and based on Goyen's (1886) description (R.R. Forster, pers. com.).

The large variation in colour pattern is likely to mean that most of the previously described New Zealand Lycosidae are synonyms of *Zeacosa hilaris*. 
Most of the published descriptions are of variations of colour patterns and these descriptions fall within the range found in *Zeacosa hilaris*; without the type specimens, or better descriptions, it is not possible to synonymise them reliably.

*Zeacosa hilaris* is found throughout New Zealand, including Stewart Island, the Chatham Islands and many other offshore islands. Because it commonly found in pasture it is possible that it was spread around with stock feed by humans and its current distribution may not be a natural one. It generally inhabits grasslands and open scrub from sea level to sub-alpine areas. The distribution of *Z. hilaris* is shown on figure 6. *Z. hilaris* is the species most commonly found in human modified open habitats such as gardens, pasture and orchards.

North Island male specimens of *Z. hilaris* have a slightly longer apophysis (pers. obs.), however, I believe this feature is not enough to warrant separate species status as this feature is very slight when compared to differences between other *Zeacosa* species.

Adults of *Z. hilaris* can be found from early spring to late autumn. Females can be seen with egg sacs from mid spring to early autumn. The egg sac of *Z. hilaris* has a pinkish tinge and is carried behind the spinnerets.
Figure 4. Ventral view of male palp of *Zeacosa hilaris* (110x).
Figure 5. Ventral view of epigynum of *Zeacosa hilaris* (135x).
Figure 6. Distribution of collection localities, *Zeacosa hilaris.*
Zeacosa adumbrata (Urquhart, 1886)

Lycosa adumbrata Urquhart, 1886
Pardosa adumbrata Bryant, 1933

Figures 7 and 8

MALE

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The chelicerae have 3 promarginal and 3 retromarginal teeth. The male palp is shown in figure 7. The median apophysis has a right angle bend and the distal portion is straight with a toothlike projection at the tip.

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The chelicerae have 3 (distal very reduced) promarginal and 3 retromarginal teeth. The epigynum is shown in figure 8. The paired genital openings are more than the width of one of the openings apart. There is a pronounced posterior lip to the epigynum.

Size Range:

Male body length: 5.6 - 8.2mm
Female body length: 4.9 - 9.3mm

Colour: The cephalothorax is orange-brown with three yellow-brown longitudinal stripes; two stripes run adjacent to the edge of the cephalothorax, the other stripe runs from the ALE to the posterior. The sternum is brown. The abdomen is grey-brown with a yellow heart stripe to half way along the dorsal midline. The female has black markings surrounding the heart stripe and black markings on the posterior midline. The leg coxae, trochanters and femora are yellow-brown; the rest of the legs are orange-brown. The legs are striped with darker bands.

Types: The species was described by Urquhart from a single female specimen he collected at Te Karaka, Auckland (not seen).

The type was housed in the Canterbury Museum (Parrott, 1946) (with the other remaining Urquhart types) but could not be found. A series of specimens identified by R.R. Forster as *Paralycosa adumbrata* in the Otago Museum collection allowed for a positive identification. This is based on the assumption that Forster compared the identified females with the type. Urquhart’s (1886) and Bryant’s (1933) descriptions of the type are not sufficient by themselves for positive identification.

*Zeacosa adumbrata* is found throughout New Zealand in higher altitude grasslands and open scrub, which usually have a period of snow cover in winter. The distribution of *Z. adumbrata* is shown on figure 9. This species is very similar in appearance to *Zeacosa hilaris* but individuals can be easily differentiated by their genitalia.
Figure 7. Ventral view of male palp of *Zeacosa adumbrata* (100x).
Figure 8. Ventral view of epigynum of Zeacosa adumbrata (170x).
OFFSHORE ISLANDS

Kermadecs
Three Kings
Chathams
Snares
Bounty
Antipodes
Aucklands
Campbell

Figure 9. Distribution of collection localities, Zeacosa adumbrata.
Zeacosa canescens (Goyen, 1886)

Lycosa canescens Goyen, 1886

Pardosa canescens (Goyen). - Hogg 1911.

Figures 10 and 11

MALE

Measurements (in mm)

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<thead>
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The chelicerae have 3 (proximal very reduced) promarginal and 3 retromarginal teeth. The male palp is shown in figure 10. The median apophysis has a right angle bend and the distal portion is bent upwards with a toothlike projection at the tip.

FEMALE

Measurements (in mm)

<table>
<thead>
<tr>
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<th>Carapace</th>
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<td>height (mm)</td>
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The chelicerae have 3 (proximal very reduced) promarginal and 3 retromarginal teeth. The male palp is shown in figure 10. The median apophysis has a right angle bend and the distal portion is bent upwards with a toothlike projection at the tip.

Goyen described *Lycosa canescens* from specimens he collected from riverbeds in Otago (Goyen, 1886). The male and female identified by Hogg (1911) as *Pardosa canescens* (BMNH, examined) are a different (as yet undescribed) species of *Zeacosa*. It is possible that *Pardosa aerescens* (Goyen), *Geolycosa arenivaga* (Dalmas) *Artoriella maura* (Urquhart) and *Hogna urquharti* (Simon) are synonyms of *Zeacosa canescens*, however, the existing descriptions (Goyen, 1886; Urquhart, 1890, 1891; Simon, 1898; Dalmas, 1917) are not adequate to confirm this. The labels of the lectotype and paralectotype of *Lycosa canescens* were typewritten. These labels were inserted by C.L. Wilton and based on Goyen’s (1886) description (R.R. Forster, pers. com.).

*Zeacosa canescens* is found in riverbeds throughout New Zealand. Goyen (1886) collected this species in Otago and "never found this spider but in river-beds". *Z. canescens* can also be found on sand near lake edges and beaches. The distribution of *Z. canescens* is shown on figure 12. In life it is well camouflaged against the grey rocks and sand and is difficult to see when not moving. This species can be seen during the daytime running between the rocks in riverbeds catching prey.
Figure 10. Ventral view of male palp of Zeacosa canescens (105x).
Figure 11. Ventral view of epigynum of Zeeosa canescens (150x).
Figure 12. Distribution of collection localities, *Zeacosa canescens*. 
**Zeacosa goyeni** (Roewer, 1954)

*Lycosa uliginosa* Goyen, 1887 *nec* Westring, 1862.

*Lycosa goyeni* Roewer, 1951 replacement name for *Lycosa uliginosa* Goyen.

*Pardosa goyeni* (Roewer). - Roewer 1954

*Pardosa goyeni* (Roewer). - Forster and Forster, 1973

Figures 13 and 14

**MALE**

*Measurements* (in mm)

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The chelicerae have 3 (distal very reduced) promarginal and 3 retromarginal teeth. The male palp is shown in figure 13. The median apophysis has a right angle bend and the distal portion curves down and then up, with a toothlike projection at the tip.
FEMALE

Measurements (in mm)

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The chelicerae have 3 (distal very reduced) promarginal and 3 retromarginal teeth. The epigynum is shown in figure 14. The two genital openings are wide and positioned close together. The area posterior to the openings is slightly raised.

Size Range:
Male body length: 7.4 - 11.7mm
Female body length: 8.8 - 15.8mm

Colour: The cephalothorax is orange-brown with some blackish markings extending from the fovea to the carapace margins. The sternum is orange-brown. The abdomen is dark grey with two light yellow blotches towards the posterior and numerous small light yellow blotches. The ventral surface of the abdomen is yellow-brown. The male has a yellow-orange heart stripe on the abdomen. In the female the heart stripe is much duller. The leg coxae, trochanters and femora are yellow-brown; the rest of the legs are orange-brown. The legs are faintly striped with darker bands.

*Lycosa uliginosa* was described by Goyen from specimens he collected on the shores of Lake Wanaka. The type specimen has not been located. Forster (1967) states that most of Goyen's material has been lost, so it is likely that this type has been lost. Despite the type not being found, the description (Goyen, 1887) is sufficient for specimens to be identified from it. It is possible that *Hogna senica* (Koch) is synonymous with *Zeacosa goyeni*, however, the illustration of the female genitalia and the description (Koch, 1877) are not sufficiently clear to confirm this.

*Zeacosa goyeni* is found in riverbeds throughout New Zealand. It is well camouflaged against the surrounding rocks and gravel. The distribution of *Z. goyeni* is shown on figure 15. Females are found in September to early December in scooped-out depressions under stones in riverbeds with their egg sacs (Forster & Forster, 1973; pers. obs.). *Zeacosa goyeni* is a nocturnal hunter (Forster & Forster, 1973; pers. obs.)
Figure 13. Ventral view of male palp of *Zeacosa goyeni* (80x).
Figure 14. Ventral view of epigynum of *Zeacosa goyeni* (145x).
Figure 15. Distribution of collection localities, Zeacosa goyeni.
**Zeacosa subantarctica** (Forster, 1964)

*Lycosa subantarctica* Forster, (1964)

This species was described from a female collected on Auckland Island. Besides the holotype (not found), three other specimens have been collected, all females (Auckland Island, 1944, E.G. Turbott (not seen); Ocean Island, 1944, E.G. Turbott (not seen); Tussocky Ridge, 450 feet, Disappointment Island, 11.xii.1976, J.A. Bartle (seen)). Forster (1964) states that this species "belongs to a group that is common in lowland country throughout New Zealand" and is "quite distinct from other New Zealand forms examined". The colour pattern and female genitalia look similar to *Zeacosa hilaris* and *Z. adumbrata*. I believe this species is definitely a member of *Zeacosa* but it's relationship to the other species can not be inferred without seeing a male specimen. The distribution of *Z. subantarctica* is shown on figure 16.
Figure 16. Distribution of collection localities, *Zeacosa subantarctica*.
Zeacosa chathamica n.sp.

Figure 17

MALE

Measurements (in mm)

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<th>Leg 4</th>
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<tr>
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<td></td>
<td></td>
<td>0.9</td>
<td>0.6</td>
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</table>

The chelicerae have 3 promarginal and 3 retromarginal teeth. The male palp is shown in figure 17. The median apophysis has a right angle bend and the distal portion is bent downwards with two toothlike projections at the tip.

Size Range:
Male body length: 5.5 - 5.7mm

Colour: The cephalothorax is orange-brown with two faint yellow-brown longitudinal stripes running adjacent to the cephalothorax margins. There is also a yellow-brown squarish patch covered with white pubescence behind the PLE. The patch is the same width as the PLE and ends at the posterior of the head region at which point it continues posteriorly to the fovea as a thin stripe. The sternum is orange-brown. The abdomen is brown with a yellow-
brown heart stripe. The ventral surface of the abdomen is yellow-brown. The leg coxae, trochanters and femora are yellow-brown; the rest of the legs are orange-brown. The legs are striped with darker bands.


Although *Allocosa retiruga* (Simon), *Alopecosa ralphi* (Simon) and *Dingosa turbida* (Simon) were described by Simon (Simon, 1905) from specimens collected from the Chatham Islands by Schauinsland, the descriptions are of specimens 7, 8 and 10 millimetres in body length (respectively), which makes them too large to be *Zeacosa chathamica*. Simon's descriptions of the other features are also insufficient to determine if they are the same species as *Zeacosa chathamica*. All of the Schauinsland collection, which was housed in the Lübeck Museum, is presumed lost as a result of damage sustained during World War Two (M. Grasshoff, pers. com.) The type of *Lycosa algida* (Simon) was also collected from the Chatham Islands by Schauinsland and is part of the Roewer Collection, (SMF).

*Zeacosa chathamica* has only been found on Pitt Island and Mangere Island, despite extensive invertebrate collecting on Chatham Island (e.g., Emberson et al., 1993). *Z. chathamica* has been collected from open scrub and grassland habitat. The distribution of *Z. chathamica* is shown on figure 18.

*Etymology* The specific epithet refers to the Chatham Islands of New Zealand where this species is found.
Figure 17. Ventral view of male palp of *Zeacosa chathamica* (120x).
Figure 18. Distribution of collection localities, Zeacosa chathamica.
Zeacosa litoralis n.sp.

Figures 19 and 20

MALE

Measurements (in mm)

<table>
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The chelicerae have 3 (distal reduced) promarginal and 3 (proximal reduced) retromarginal teeth. The male palp is shown in figure 19. The median apophysis has a right angle bend and the distal portion is straight with two toothlike projections at the tip.

FEMALE

Measurements (in mm)

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<th>Carapace</th>
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<td>height</td>
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The chelicerae have 3 (distal reduced) promarginal and 3 (proximal reduced) retromarginal teeth. The male palp is shown in figure 19. The median apophysis has a right angle bend and the distal portion is straight with two toothlike projections at the tip.
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The chelicerae have 3 promarginal and 3 retromarginal teeth (proximal reduced). The epigynum is shown in figure 20. The paired genital openings are adjacent and there is a pronounced thickened posterior lip to the epigynum.

**Size Range:**
Male body length: 5.2 - 8.3mm
Female body length: 5.9 - 8.4mm

**Colour:** The cephalothorax is light yellow with two blackish longitudinal stripes adjacent to the edge of the cephalothorax. The sternum is light yellow with grey blotches. The abdomen has a light yellow heart stripe that extends to the posterior end. The remaining dorsal surface is mottled black on a light yellow background. The ventral abdominal surface is dirty cream coloured. The leg coxae, trochanters and femora are cream; the rest of the legs are light yellow. The legs are very faintly striped with darker bands.

Etymology
The specific epithet refers to the sea shore habitat where this species is found in (litoralis, Latin, belonging to the sea shore).

*Zeacosa litoralis* is found throughout New Zealand on sand dunes and beaches. The distribution of *Z. litoralis* is shown on figure 21. The colour and pattern of *Z. litoralis* make it well camouflaged and difficult to see against the sand. Its coloration varies and darker grey forms are found on riverbed sands; these darker forms have no other apparent differences to the lighter forms. Specimens found during the daytime are usually juvenile and most of the adult specimens have been caught in pitfall traps, so it is possible that juveniles are predominantly diurnal, while adults are nocturnal.
Figure 19. Ventral view of male palp of Zeacosa litoralis (110x).
Figure 20. Ventral view of epigynum of *Zeacosa litoralis* (160x).
OFFSHORE ISLANDS

Kermadecs
Three Kings
Chathams
Snares
Bounty
Antipodes
Aucklands
Campbell

Figure 21. Distribution of collection localities, *Zeacosa litoralis*. 
Zeacosa riparicola n.sp.

Figures 22 and 23

MALE

Measurements (in mm)

<table>
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The chelicerae have 2 promarginal and 3 retromarginal teeth. The male palp is shown in figure 22. The median apophysis has a right angle bend and the distal portion is short and bent slightly downwards.

FEMALE

Measurements (in mm)

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</table>
The chelicerae have 3 promarginal (distal very reduced) and 3 retromarginal teeth (proximal very reduced). The epigynum is shown in figure 23. The paired genital openings are obscured from the ventral view by two posterior projecting sclerotised rims. There is a posterior lip to the epigyna.

**Size Range:**
Male body length: 6.8 - 10.0mm
Female body length: 8.0 - 11.6mm

**Colour:** The cephalothorax is red-orange-brown. The sternum is orange-brown. The abdomen is black-brown with a faint heart stripe. The ventral abdominal surface is yellow-brown. The female has cream coloured patches around the epigyna. The legs are yellow-brown with very faint darker striping.

Etymology
The specific epithet refers to the stream bank habitat this species is found in (riparius, Latin, belonging to a stream bank; colere, Latin, to inhabit).

Zeacosa riparicola has only been found in Canterbury and Fiordland. It inhabits riverbeds and lives among the rocks and stones. The distribution of Z. riparicola is shown on figure 24.
Figure 22. Ventral view of male palp of *Zeacosa riparicola* (130x).
Figure 23. Ventral view of epigynum of *Zeacosa riparicola* (155x).
Figure 24. Distribution of collection localities, Zeacosa riparicola.
Zeacosa westlandica n.sp.

Figures 25 and 26

MALE

*Measurements* (in mm)

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Sternum length 1.5

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The chelicerae have 3 promarginal (distal reduced) and 3 retromarginal teeth.

The male palp is shown in figure 25. The median apophysis has a spanner-shaped end.

FEMALE

*Measurements* (in mm)

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Sternum length 1.7

The chelicerae have 3 promarginal (distal reduced) and 3 retromarginal teeth.

The male palp is shown in figure 25. The median apophysis has a spanner-shaped end.
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<td>Leg 3</td>
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The chelicerae have 3 promarginal (distal reduced) and 3 retromarginal teeth. The epigynum is shown in figure 26. The epigynum has a squarish posterior indent divided by a sclerotised structure that tapers posteriorly. The epigynum has a slight posterior lip.

**Size Range:**
Male body length: 4.4 - 6.1mm
Female body length: 6.0 - 8.1mm

**Colour:** The cephalothorax is brown with faint yellow-brown longitudinal stripes near the margins. There is also a wide yellow longitudinal stripe with white pubescence that begins half way between the PME and the PLE; this stripe is slightly wider that the width of the PLE at its anterior end and tapers almost to a point at the posterior end of the cephalothorax. The sternum is orange-brown. The abdomen is dark brown with a light yellow heart stripe. The legs are yellow-brown with orange-brown stripes; some specimens have an olive tinge on the femora.


*Etymology*

The specific epithet refers to the Westland region of New Zealand where this species is found.

*Zeacosa westlandica* has only been found in Westland and Fiordland. It inhabits forest and damp forest margins, but a specimen was also collected in a riverbed near forest. The distribution of *Z. westlandica* is shown on figure 27.
Figure 25. Ventral view of male palp of *Zeacosa westlandica* (115x).
Figure 26. Ventral view of epigynum of *Zeacosa westlandica* (145x).
OFFSHORE ISLANDS

Kermadecs  □
Three Kings  □
Chathams  □
Snares  □
Bounty  □
Antipodes  □
Aucklands  □
Campbell  □

Figure 27. Distribution of collection localities, *Zeacosa westlandica*. 
Subfamily **VENONIINAE** Lehtinen and Hippa, 1979.

Type genus: *Venonia* Thorell, 1894.

The subfamily is defined by male palpal characters (Dondale, 1986); median enlarged and oriented longitudinally on genital bulb, terminal apophysis small, situated distally on bulb and functioning as a conductor and embolus small, situated distally.

**Genus Austracosa, n.gen.**

Type species: *Austracosa robusta* n.sp.

*Diagnosis*

Male: large median apophysis with a shiny round end. The bases of the embolus, terminal apophysis and median apophysis originate in a deep cavity at the tip of the tegulum. The cymbium is more than twice the length of the palpal tibia. Cymbium with eight or more stoat bristles at tip. Female: The epigynum is very dark and the two genital openings face away from each other. The palpal tarsi are more than twice the length of the palpal tibiae. Palpal tarsi with claw. Legs in order of length; 4, 1, 2, 3 (male and female).

*Remarks*

*Austracosa* is a monotypic genus at present. The embolus and terminal apophysis are both small and are crowded together at the tip of the genital bulb and the median apophysis is enlarged; these characters place this genus in the subfamily Venoniinae (Dondale, 1986; C.D. Dondale, pers. com.). *Austracosa* lacks the usual venoniine character of the terminal apophysis acting as a conductor but this can be overlooked in the placement of this genus as the conductor does vary in shapes and situations (C.D. Dondale, pers. com.). The subtegulum is only a little elongated along the prolateral
margin, a character which is also found in some African venoniine genera, e.g., *Proevippa* (C.D. Dondale, pers. com.).

At present this genus is only known from the South Island of New Zealand in open scrub and grasslands but it is possible that other New Zealand species exist and, based on biogeographical relationships of other spider taxa (Forster, 1975), species might be located in Australia.

*Etymology*

The generic name is a combination of *australis*, Latin, southern and *cosa*, to signify it is a genus in the Lycosidae. The name is feminine in gender.
Austracosa robusta n.sp.

Figures 28 and 29

MALE

Measurements (in mm)

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</tr>
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The chelicerae have 3 promarginal and 3 retromarginal teeth. The male palp is shown in figure 28. The median apophysis is thick, slightly downward angled and with a rounded tip.

FEMALE

Measurements (in mm)

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<tr>
<td>Sternum</td>
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<td>width 1.4</td>
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</table>
The chelicerae have 3 promarginal and 3 retromarginal teeth. The epigynum is shown in figure 29. The epigynum is very dark and the two genital openings face away from each other.

Size Range:
Male body length: 8.9 - 9.6mm
Female body length: 9.5 - 11.5mm

Colour: The cephalothorax is orange-brown. The sternum is orange-brown. The abdomen is blackish with a cream heart stripe. The ventral abdominal surface is dirty cream. The female has four cream coloured patches around the heart stripe. The legs are orange-brown with faint, darker stripes.


Etymology
The specific epithet refers to the robust and stout appearance of this species (robustus, Latin, strong and robust).

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*Austracosa robusta* has only been found in Canterbury and Central Otago. It inhabits open scrub and grasslands. The distribution of *A. robusta* is shown on figure 30.
Figure 28. Ventral view of male palp of *Austracosa robusta* (85x).
Figure 29. Ventral view of epigynum of *Austracosa robusta* (145x).
OFFSHORE ISLANDS

Kermadecs
Three Kings
Chathams
Snares
Bounty
Antipodes
Aucklands
Campbell

Figure 30. Distribution of collection localities, Austracosa robusta.
Genus *Allotrochosina* Roewer, 1954

Type species: *Lycosa maunganuiensis* Berland (= *Lycosa schauinslandi* Simon) by monotypy.

**Diagnosis**
Male: The pommel-shaped median apophysis (when viewed ventrally), the absence of bristles at the cymbium tip and palpal tibia length being nearly equal to the length of the cymbium distinguishes this genus from all other New Zealand lycosids. Legs in order of length; 1, 4, 2, 3.
Female: The genital openings extend posteriorly from the epigynal area. The papal tibiae and tarsi are of almost equal length and there are no palpal claws. Legs in order of length; 4, 1, 2, 3.

**Remarks**
*Allotrochosina* is a monotypic genus at present and no other species have been seen in extensive collections of New Zealand lycosids examined. The reduced embolus and terminal apophysis, both crowded together at the tip of the genital bulb, place this genus in the subfamily Venoniinae (Dondale, 1986; C.D. Dondale, pers. com.). *Allotrochosina* lacks the usual venoniine characters of "terminal apophysis acting as conductor" and "median apophysis enlarged", however, these two characters may have been lost secondarily or may be irrelevant to the subfamily classification (C.D. Dondale, pers. com.). The elongated subtégulum along the prolateral margin of the tegulum is shared with *Pirata, Trabea, Trabeops* and *Proevippa*.

This genus is found throughout New Zealand in forest and damper parts of open scrub and grasslands. It is probable, based on biogeographical relationships of other spider taxa (Forster, 1975), that other species may be located in the Australian fauna.
Allotrochosina schauinslandi (Simon, 1899)

Lycosa schauinslandi Simon, 1899
Lycosa maunganuiensis Berland, 1925
Alopecosa schauinslandi (Simon). - Roewer, 1954
Allotrochosina mananganuiensis (Berland). - Roewer, 1954 specific name misspelt
Allotrochosa schauinslandi (Simon). - Forster, 1967 generic name misspelt
Allotrochosina schauinslandi (Simon). - Forster and Forster, 1973
Trochosa maunganuiensis (Berland). - McKay, 1979e

Figures 31 and 32

MALE

Measurements (in mm)

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The chelicerae have 3 promarginal and 2 retromarginal teeth. The male palp is shown in figure 31. The pommel-shaped median apophysis, the absence of bristles at the cymbium tip and palpal tibia length being nearly equal to the
length of the cymbium distinguishes this species from all other New Zealand lycosids. In the Lycosidae leg 4 is normally the longest leg, however, in male *A. schauinslandi* leg 1 is the longest.

**FEMALE**

*Measurements (in mm)*

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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg 1</td>
<td>3.0</td>
<td>1.5</td>
<td>2.7</td>
<td>2.7</td>
<td>11.2</td>
</tr>
<tr>
<td>Leg 2</td>
<td>2.7</td>
<td>1.4</td>
<td>2.3</td>
<td>2.4</td>
<td>10.0</td>
</tr>
<tr>
<td>Leg 3</td>
<td>2.5</td>
<td>1.2</td>
<td>2.0</td>
<td>2.4</td>
<td>9.2</td>
</tr>
<tr>
<td>Leg 4</td>
<td>3.3</td>
<td>1.4</td>
<td>3.1</td>
<td>3.8</td>
<td>13.0</td>
</tr>
<tr>
<td>Palp</td>
<td>1.5</td>
<td>0.8</td>
<td>1.1</td>
<td>1.0</td>
<td>4.4</td>
</tr>
</tbody>
</table>

The chelicerae have 3 promarginal and 2 retromarginal teeth. The epigynum is shown in figure 32. The genital openings extend posteriorly from the epigynal area.

*Size Range:*

Male body length: 7.0 - 7.5mm
Female body length: 6.7 - 8.8mm

*Colour:* The cephalothorax is orange-brown with darker bands extending from the fovea to just before the darker edges of the carapace. There are four darker longitudinal bands on the head area of the carapace. The sternum is orange-brown. The abdomen is yellow-brown with four blotchy, blackish bands on the anterior dorsal surface. the posterior dorsal surface is mostly
covered in blackish stripes producing a faint chevron pattern. The ventral surface is yellow-brown with three blotchy blackish longitudinal stripes. The legs are orange-brown with faint darker lateral stripes.

*Type material:* *Lycosa schauinslandi* Simon, syntype male and female, labelled N. Zeal. French Pass (Sch.[Schauinsland]), MNHN (examined). *Lycosa maunganuiensis* Berland, cotype female, labelled Chatham Islands: Maunganui, G. Archey, 15.xii.1923, MNHN (examined).


*Allotrochosina schauinslandi* is found in forests and in damper parts of grasslands and open scrub. It is dependant on high humidity and dies in a short time when kept in a dry container (Forster & Forster, 1973). It is a nocturnal hunter and in the daytime it hides under logs or among leaf litter (Forster & Forster, 1973; pers. obs.). The courtship behaviour of *Allotrochosina schauinslandi* is briefly outlined in Forster and Forster (1973). Females produce a bluish egg sac, which is smaller than egg sacs produced by comparable sized *Zeacosa* species. The female carries the egg sac under the abdomen rather than behind.

The distribution of *A. schauinslandi* can be seen on figure 33.
Figure 31. Ventral view of male palp of *Allotrochosina schauinslandi* (160x).
Figure 32. Ventral view of epigynum of *Allotrochosina schauinslandi* (160x).
Figure 33. Distribution of collection localities, *Allotrochosina schauinslandi*. 
Morphological characters from *Zeacosa* spp. (see table 1) were analysed by parsimony analysis using the computer program PAUP 3.1.1 (Swofford, 1993). *Zeacosa chathamica* had missing entries as it is known only from two males.

The data was analysed with all characters unordered and equally weighted and produced 29 most parsimonious trees with a treelength of 58 steps, a consistency index (excluding uninformative characters) of 0.60 and a retention index of 0.54 (see figure 34). The consistency index (CI) and retention index (RI) are measures of homoplasy. CI is defined as the number of character state changes in a data set divided by the number of character state changes required for the same data given the tree in question (Kluge & Farris, 1969). The RI takes into account the number of taxa that have each state as well the number of states for each character (Farris, 1989). In a second analysis, characters 1, 2, 4, 5, 7, 9, 10, 11, 13, 14, 15, 17, 18 and 21 were treated as ordered and the analysis was run again. One most parsimonious tree was obtained (figure 35) with a treelength of 60 steps, a CI of 0.61 and a RI of 0.57. This tree had the same topography as one of the 29 most parsimonious unordered trees.

*Z. chathamica* was removed from an analysis to check whether its missing entries influenced tree topology. The removal of *Z. chathamica* resulted in seven most parsimonious trees (treelength 56, CI 0.63, RI 0.53) with little structure in common between the trees. The removal of the five characters with states unknown for *Z. chathamica* also resulted seven most parsimonious trees (treelength 41, CI 0.62, RI 0.62) with little structure in common between the trees. In both cases *Z. westlandica* remained as the most basal *Zeacosa*. Large numbers of missing entries can result in large numbers of equally parsimonious solutions, some of which may not be supported by the actual
available data in the matrix (Platnick et al., 1991). This occurs because the program algorithm places a state in the unknown state position for the parsimony analysis. Taxa with many missing entries tend to occupy basal positions on the tree (Swofford, 1993).

Bootstrap analysis was performed on the data matrix and the bootstrap values can be seen on figure 35. A bootstrap analysis generates a representation of the sampling error that would be obtained by repeated sampling of characters (Sanderson, 1995). In a phylogenetic analysis the characters cannot be repeatedly sampled but are resampled with replacement from the original data set (Felsenstein, 1985). There was good support from the data for the monophyly of Zeacosa. There was also some support for Z. westlandica as the sister taxon to the remaining Zeacosa species and for Z. goyeni and Z. riparicola as sister taxa.

A twofold increase in weighting of genitalic characters relative to non-genitalic characters was tried. A. robusta and Z. westlandica still retained the same position on the resulting trees. Trees produced by weighting are not shown as the basic tree structure was the same as unweighted and not enough is known about the characters to attempt to assign weighting to them with confidence.

Austracosa robusta was originally thought to belong to the "hilaris group". The analysis showed it was outside the monophyletic Zeacosa. Subsequently C.D. Dondale (pers. com.) examined A. robusta and identified it as a member of the Venoniinae based on male palpal morphology. Allotrochosina schauinslandi to Zeacosa spp. and Austracosa robusta another outgroup taxa needed to be included in the analysis. The monophyly of the genus Zeacosa is supported by the following synapomorphies: presence of teeth on the tip of median apophysis, 2-6 bristles on tip of cymbium, concealed subtegulum, epigyna with posterior lip, embolus long, terminal apophysis acting as a conductor,
terminal apophysis with groove in which the embolus rests in, three longitudinal stripes on carapace.

The bootstrap results indicate that most branches within the Zeacosa clade are not particularly robust. More characters are required to achieve more robust branches for the phylogenetic relationships among these taxa. The Lycosidae is a morphologically conservative family and a large suite of morphological characters would be difficult to obtain. Characters could be obtained by examining the internal genitalia of females and examining the spinnerets and other structures with an electron microscope (e.g., Hormiga, 1994; Harvey, 1995). Lycosids have complex sexual behaviour (see Stratton, 1985) which could yield many useable characters. Of the species examined here only Z. hilaris and Allotrochosina schauinslandi have been investigated with respect to their sexual behaviour (Forster & Forster, 1973). Another source of characters would be genetic information, a recent addition to spider systematics (e.g., Huber et al., 1993).
Figure 34. Strict consensus of 29 unordered trees.
Figure 35. Ordered tree showing character state changes and bootstrap values (in italics).
GENERAL DISCUSSION

Summary of results
Ten species of New Zealand Lycosidae have been taxonomically revised. Eight of the species have been placed in the newly erected genus *Zeacosa*, which has been defined here. Four existing *Zeacosa* species have been redescribed and four new species of *Zeacosa* have been described. The new genus *Austracosa* has been defined and the new species *Austracosa robusta* has been described. The genus *Allotrochosina* has been redefined and the species *Allotrochosina schauinslandi* has been redescribed. Distributions for all ten species plus *Z. subantarctica* have been plotted and their distribution is discussed below. A phylogeny for all ten species has been derived, using parsimony analysis, with very strong support for the monophyly of the genus *Zeacosa*. One tree topology was derived and discussed.

Species distribution
The distribution of New Zealand Lycosidae can be seen on figures 6, 9, 12, 15, 16, 18, 21, 24, 27, 30 and 33. *Allotrochosina schauinslandi* and *Zeacosa hilaris* are found throughout New Zealand and on the Chatham Islands. *Z. hilaris* has been collected from remote areas of Fiordland open scrub and grasslands, which suggests that natural dispersal abilities may be significant enough to explain their current distribution. *Z. hilaris* is also likely to have benefited from the increased areas of suitable grassland habitat produced by human deforestation, which may have lead to an increase in total population and range of this species. It is possible that *Z. hilaris* has been dispersed to novel areas by hay and straw bales for stock feed as *Z. hilaris* does get caught up in the bailing process (pers. obs.). There is intraspecific variation of abdominal and carapace colour pattern throughout the range of *Z. hilaris*.

*Z. adumbrata* and *Z. goyeni* are found throughout New Zealand and are limited to subalpine grasslands and open scrub, and large riverbeds. *Z. canescens* and *Z. litoralis* are also found throughout New Zealand in riverbeds and sand dunes, although *Z. litoralis* may also be found on dunes and
beaches of the Chatham Islands as this habitat is unlikely to have been searched for this species. The distribution of *Z. canescens* and *Z. litoralis* appears to be more limited than other lycosid species, which may be a result of their cryptic nature rather than their actual distribution. *A. robusta* and *Z. riparicola* both appear to have a distribution limited to south of 43° latitude. These species may be cold adapted like many other New Zealand spider species (Forster, 1975). *Z. chathamica* is found on the Chatham Islands and *Z. westlandica* is found in Westland and Fiordland. The Southern Alps have isolated Westland and Fiordland from the rest of the South Island for at least five million years (H. Cutten, pers. com.) and the Chatham Islands have been isolated for at least several million years (Emerson, 1995). It would be reasonable to expect that these long periods are long enough for speciation to have occurred (see Platnick, 1976; Griswold, 1991a). *Z. subantarctica*, found on the Auckland Islands, is also likely to have been isolated for a long period of time but it’s relationship to the rest of the New Zealand fauna cannot be determined on until male specimens are found.

**Other New Zealand lycosid species**

In the later stages of this study several potential *Zeacosa* specimens were found that did not fit the descriptions of the eight *Zeacosa* species recognised here. Due to time limits and small sample sizes I decided it was best to limit this study to the *Zeacosa* species that were more commonly found, plus the outgroup species for the phylogenetic analysis. There may be about three more *Zeacosa* species. Two of these species are found in South Island riverbed habitats and have a palpal configuration similar to *Z. riparicola*. The other possible species has been found on beaches in the South Island, which includes the specimens collected from a mud bank in Picton Harbour that Hogg incorrectly identified as *Pardosa canescens* (Hogg, 1911). *Pardosa bellica* (Goyen) is likely to be a *Zeacosa* (R.R. Forster, pers. com.) and it may well be synonymous with one of the *Zeacosa* species described here. Unfortunately, Goyen’s description (Goyen, 1887) is not clear enough to identify this species,
but does state that *P. bellicosa* builds a silk lined burrow 5 - 7.5cm deep; this behaviour may enable live specimens to be identified at a later date.

Two other non-*Zeacosa* lycosid species have been collected from the northern part of the North Island. One of these species has a similar palpal configuration to *Austracosa robusta*. A single male specimen of the Australian and South West Pacific species *Allocosa palabunda* (Koch) has been collected from the Kermadec Islands.

Table 2 lists the species of Lycosidae described from New Zealand including those treated in this study. It is likely that the status of many of the species will remain unknown as their descriptions are poor and the types have been lost. The species are in the genera as per Roewer (1942, 1954), Brignoli (1983) and Platnick (1989, 1993).

**Future work on New Zealand Lycosidae**

Before this work can be published the remaining possible *Zeacosa* species will need to be examined. The other possible *Austracosa* species and the non-*Zeacosa* Northland species need to be described. Specimens of Australian Lycosidae, that have been placed in the genus *Trochosa*, should also be examined to assess their relationship to *Zeacosa*.

The confidence in the phylogeny of the *Zeacosa* can only be increased if information for more characters and character types is collected. Such data may come from scanning electron microscopy of the spinnerets and other morphological features, from behavioural information and from genetic data.

**Conclusions**

The new genus *Zeacosa* as described contains eight species and there is strong evidence for the monophyly of this genus. A phylogeny of the species in *Zeacosa* has been constructed. The new genus *Austracosa* contains one species at present with the possibility of another undescribed species. The genus
Allotrochosina is monotypic and its single species is widespread throughout New Zealand. The exact relationship between Austracosa and Allotrochosina is remains unknown. The relationship between the three New Zealand genera in this study and Australian and other foreign Lycosidae needs future investigation. It is now possible to identify the most commonly found New Zealand Lycosidae to species, which was not previously the case. It is hoped that this revision and phylogenetic analysis will lead to the complete revision of all New Zealand Lycosidae and will also assist further behavioural and ecological studies into this family.
Table 2. New Zealand Lycosidae species - an annotated checklist.

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Allocosa palabunda</em> (Koch, 1877)</td>
<td>Probably restricted to the Kermadec Islands, within the New Zealand region.</td>
</tr>
<tr>
<td><em>Allocosa retiruga</em> (Simon, 1905)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Allotrochosina schauinslandi</em> (Simon, 1899)</td>
<td>Redescribed above.</td>
</tr>
<tr>
<td><em>Alopecosa schauinslandi</em> (Simon, 1899)</td>
<td>Here transferred to <em>Allotrochosina</em>.</td>
</tr>
<tr>
<td><em>Alopecosa ralphii</em> (Simon, 1905)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Anoteropsis flavescens</em> Koch, 1878</td>
<td>Type not found, possibly a <em>Zeacosa</em> species. Forster (Forster &amp; Blest, 1979) states that this species is &quot;one of a group that inhabit the riverbeds of the South Island&quot;. The genus is currently placed in the Pisauridae (Platnick, 1993).</td>
</tr>
<tr>
<td><em>Arctosa tremula</em> (Simon, 1899)</td>
<td>Type not found. <em>Incertae sedis</em>.</td>
</tr>
<tr>
<td><em>Artoriella maura</em> (Urquhart, 1891)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa canescens</em>.</td>
</tr>
<tr>
<td><em>Austracosa robusta</em></td>
<td>Here described.</td>
</tr>
<tr>
<td><em>Dingosa turbida</em> (Simon, 1905)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Geolycosa albovestita</em> (Dalmas, 1917)</td>
<td>Type not found. <em>Incertae sedis</em>.</td>
</tr>
<tr>
<td><em>Geolycosa arenivaga</em> (Dalmas, 1917)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa canescens</em>.</td>
</tr>
<tr>
<td><em>Hogna senica</em> (Koch, 1877)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa goyeni</em>.</td>
</tr>
<tr>
<td><em>Hogna urquharti</em> (Simon, 1905)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa canescens</em>.</td>
</tr>
</tbody>
</table>
Table 2 continued.

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lycosa algida</em> Simon 1905</td>
<td>Here synonymised with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Lycosa hilaris</em> Koch, 1877</td>
<td>Here transferred to <em>Zeacosa</em>.</td>
</tr>
<tr>
<td><em>Lycosa nautica</em> Walckenaer, 1837</td>
<td>Type lost. <em>Nomen dubium</em>.</td>
</tr>
<tr>
<td><em>Lycosa subantarctica</em> Forster, 1964</td>
<td>Here transferred to <em>Zeacosa</em>.</td>
</tr>
<tr>
<td><em>Pardosa adumbrata</em> (Urquhart, 1886)</td>
<td>Here transferred to <em>Zeacosa</em>.</td>
</tr>
<tr>
<td><em>Pardosa aerescens</em> (Goyen, 1886)</td>
<td>Type not found, possibly synonymous with <em>Zeacosa canescens</em>.</td>
</tr>
<tr>
<td><em>Pardosa bellica</em> (Goyen, 1887)</td>
<td>Type not found, probably a <em>Zeacosa</em> species.</td>
</tr>
<tr>
<td><em>Pardosa canescens</em> (Goyen, 1886)</td>
<td>Here transferred to <em>Zeacosa</em>.</td>
</tr>
<tr>
<td><em>Pardosa goyeni</em> (Roewer, 1951)</td>
<td>Here transferred to <em>Zeacosa</em>.</td>
</tr>
<tr>
<td><em>Pardosa taylori</em> (Goyen, 1886)</td>
<td>Type not found, probably a <em>Zeacosa</em> species.</td>
</tr>
<tr>
<td><em>Pardosa vicaria</em> Koch, 1877</td>
<td>Here synonymised with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Pardosa virgatella</em> (Roewer, 1951)</td>
<td>Here synonymised with <em>Zeacosa hilaris</em>.</td>
</tr>
<tr>
<td><em>Pirata piratica</em> (Clerck, 1757)</td>
<td>Simon recorded this European species from French Pass in the Marlborough Sounds. This species is very similar in appearance to <em>Allotrochosina schauinslandi</em>, with which he may have confused it. If <em>P. piratica</em> was present in New Zealand it has not been found since.</td>
</tr>
</tbody>
</table>
Table 2 continued.

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizocosa umbrata (Koch, 1877)</td>
<td>Here synonymised with Zeacosa hilaris.</td>
</tr>
<tr>
<td>Trochosa mananganuiensis (Berland, 1925)</td>
<td>Here synonymised with Allotrochosina schauinslandi.</td>
</tr>
<tr>
<td>Zeacosa chathamica</td>
<td>Here described.</td>
</tr>
<tr>
<td>Zeacosa litoralis</td>
<td>Here described.</td>
</tr>
<tr>
<td>Zeacosa riparicola</td>
<td>Here described.</td>
</tr>
<tr>
<td>Zeacosa westlandica</td>
<td>Here described.</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

So, you have finally read through my thesis (or perhaps, like me, you thought you would have a peek at the acknowledgements). All the preceding pages would not have made some sort of sense, been finished in time or even existed without the following people.

Many thanks to Adrian Paterson for his friendship, advice, phylogenetic expertise and encouragement. I doubt I would have finished in time without his help; I look forward to reading the book he gave me that was not to be read "until thesis complete".

I thank Rowan Emberson for his supervision, willingness to answer any questions I had and for the suggestion of the name *Zeacosa*.

I thank Ray Forster for his advice and instruction in spider taxonomy and I thank Ray and Lyn for their encouragement and for all their work on New Zealand spiders. Thanks Charles Dondale for his invaluable advice on the subfamilial placement of New Zealand lycosids and for valuable comments on specimens I sent him.

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Thanks to all the staff and students of the Entomology & Animal Ecology Department for their good humour, friendship and for occasionally not ignoring my do not disturb sign.
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