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BIODIVERSITY OF NEW ZEALAND BEETLES (INSECTA, COLEOPTERA)

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Abstract

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Approximately 5235 species are described for New Zealand, including 354 introduced. They belong to 82 families in two suborders, Adephaga and Polyphaga. The New Zealand beetle fauna is distinguished by the absence of many major lineages, a high level of endemism, which in many groups is over 90% at the specific level and over 43% at the generic level (e.g., Staphylinidae), and the radiation of many groups of genera and species. The origins of New Zealand's beetle fauna are still poorly understood. They are likely to be varied, including Gondwanan elements and elements which arrived here by short and long-distance dispersal recently and in the remote past. The size of the New Zealand beetle fauna is consistent with species number/land area relationships in other areas around the world.

Introduction

The beetles are the largest order of organisms, with over 350 000 described species worldwide.

There are approximately 4881 described native and 354 introduced species of beetles in New Zealand (Appendix 1), representing c. 1094 genera in 82 families (Klimaszewski and Watt, in press). The total number of species is estimated at around 10 000 to 10 500 (Watt, 1976: Kuschel, 1990). In comparison, the vascular plant flora includes about 2500 species, and the terrestrial vertebrate fauna about 350 species (Watt, 1976). Watt (1976) estimated at 20 000 the number of described and undescribed species of terrestrial and freshwater Arthropoda probably occurring in New Zealand.

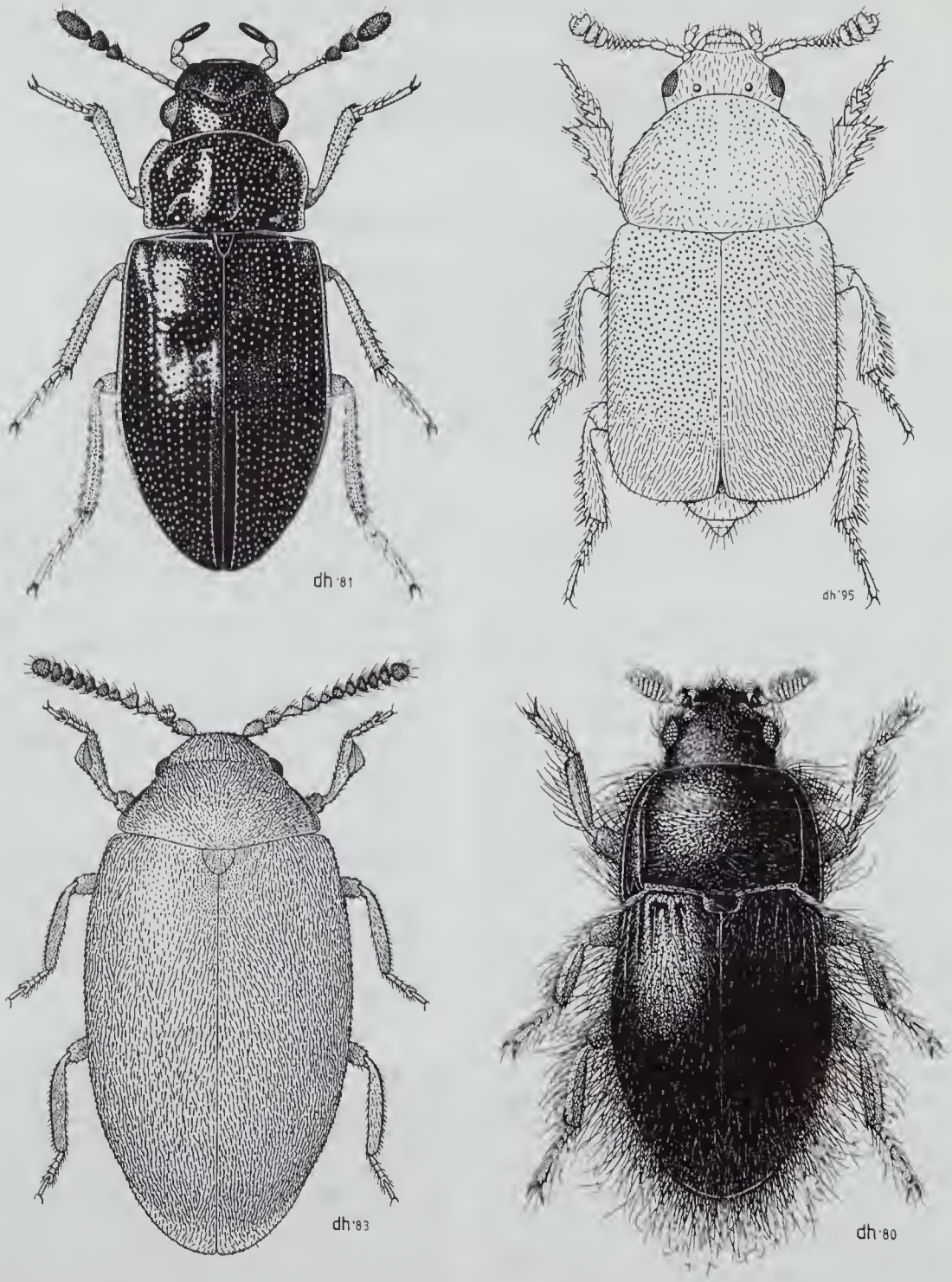
New Zealand beetles belong to two suborders, Adephaga and Polyphaga. Archostemata and Myxophaga, present in Australia, are absent from New Zealand. Four families (Archeocrypticidae, Gyrinidae, Lycidae, and Trogidae) are present only as introduced species. One, Chalcodryidae, is endemic. Eleven families are represented by more than 100 species: Curculionidae (1321), Staphylinidae including Pselaphinae (1021), Carabidae (445), Colydiidae (196), Cerambycidae (188), Scydmaenidae (165), Chrysomelidae (156), Scarabaeidae (144), Elateridae (135), Tenebrionidae (134), and Scirtidae (125). Some smaller families — Byrrhidae, Cleridae, Hydraenidae, Corticariidae (=Latridiidae), Leiodidae, Melandryidae, and Trogossitidae — are also well represented in New Zealand. The most comprehensive local survey of New Zealand beetles is that of Kuschel (1990), in the suburb of Lynfield, Auckland, in which 982 beetle species were recorded in a diverse vegetation including remnant forest, pastureland, and suburban garden.

Factors responsible for the diversity and nature of the present-day New Zealand beetle fauna are:

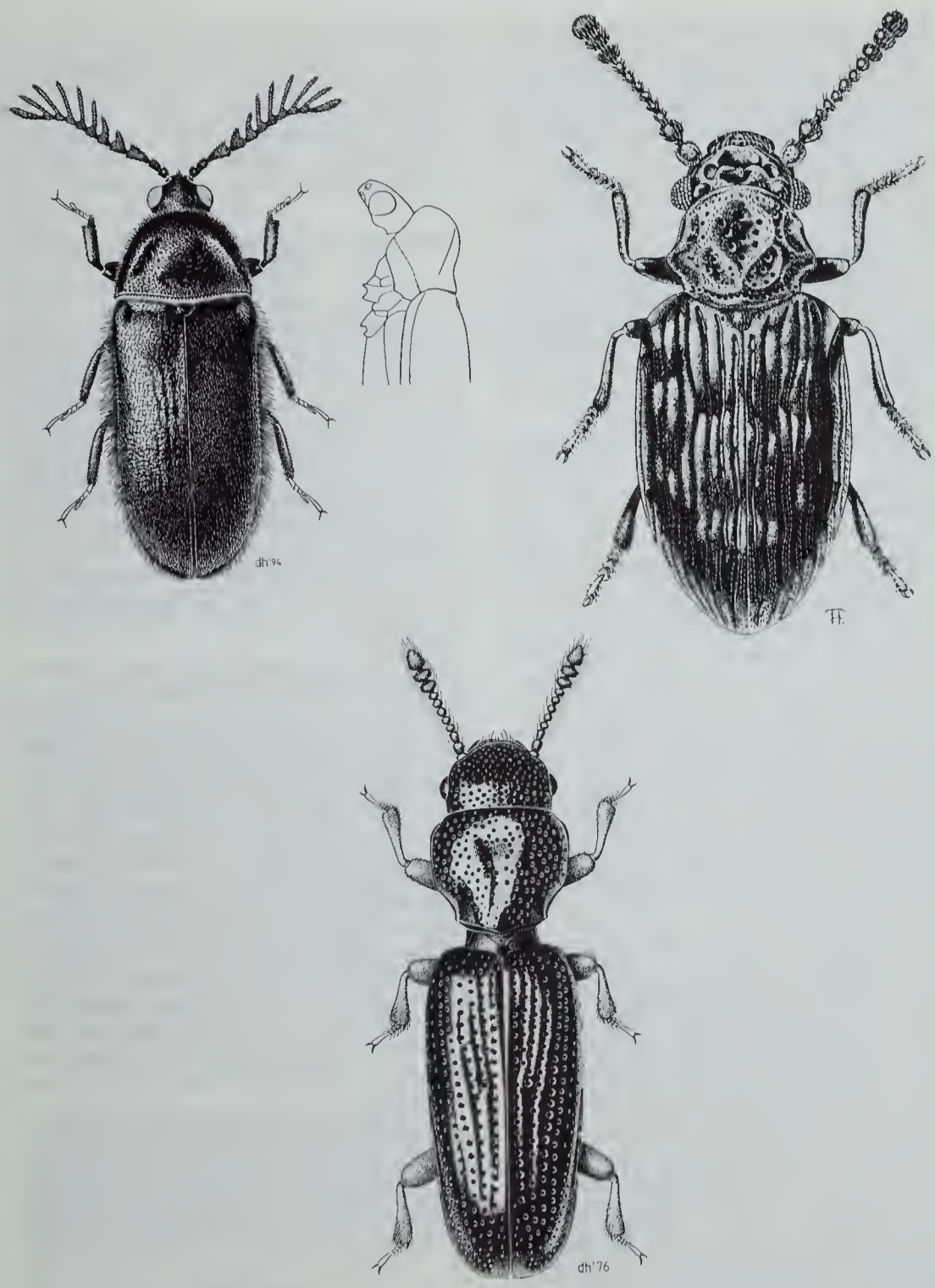
1. Gondwanan origin of some of our biota;
2. approximately 80 million years of geographic isolation of New Zealand, which has resulted in a high level of generic endemism and approximately 90% endemism at the specific level;
3. changing climate, changing shorelines (Oligocene bottleneck) (Cooper and Millner, 1993; Cooper and Cooper, 1995), orogenies, glaciation, and volcanic activity; and
4. absence of terrestrial mammals and other animals and plants which have dominated ecosystems elsewhere in the world.

Origin of New Zealand beetles

The New Zealand region and its ancestral biota originated in the fragmentation of part of an ancient supercontinent, Gondwana (Cooper and Millner, 1993; Cooper and Cooper, 1995). In the late Cretaceous c. 80–85 mya (million years ago), the New Zealand region had separated from the remainder of Gondwana through active sea-floor spreading and broadening of the Tasman Sea. The New Zealand region with its biota thus has been geographically isolated for approximately the last 80 mya, and during this period has undergone an active tectonic and



Figures 1–4. 1, *Horelophus walkeri* Orchymont, beetle of the endemic subfamily Horelophinae (Hydrophilidae); 2, *Microsilpha litorea* Broun, endemic species of Microsilphinae (Staphylinidae); 3, *Amplectopus pallicornis* Broun (Scirtidae); 4, *Parnida agrestis* Broun, endemic species (Dryopidae).



Figures 5–7. 5, *Bronnia thoracica* Sharp, only New Zealand member of Chelonariidae; 6, *Nothoderodontus gourlayi* Crowson (Derodontidae); 7, *Saphophagus minutus* Sharp (Jacobsoniidae).

volcanic history. These events have had profound effects on the composition and distribution of plants and animals, including beetles, and influenced their evolution. Certainly some of the contemporary New Zealand beetles have evolved from ancient Gondwanan forms. The modern beetle fauna consists of ancient, variously changed lineages, elements introduced by dispersal over short and long distance (e.g., groups dispersed passively over water as a result of the strong westerly winds and currents around the 40th parallel), and species intentionally and accidentally introduced. The fauna was greatly influenced in the last 1000 years by people who brought devastation to native forest and introduced harmful exotic animals — possum, rats, goats, deer and others (Ramsay, 1978).

Support of the hypothesis that many of our beetles are of ancient origin comes from the high endemism, over 90% at the specific level, with several endemic subfamilies and tribes and many endemic genera (Watt, 1982). Several usually small families are represented in New Zealand by diverse endemic forms (e.g., Byrrhidae, Colydiidae, Hydraenidae, Melandryidae, Ptiliidae, Scirtidae and Scydmaenidae). Native species are those primarily associated with the lowland forest which has prevailed throughout most of New Zealand's geological history, the alpine habitats, the tussock grasslands, and the subantarctic islands (Kuschel, 1990). Introduced species are mostly associated with anthropogenic habitats (Kuschel, 1990). Many groups' distribution patterns are suggestive of a Gondwanan or pre-Gondwanan origin: for instance, the remnant relict genera of tenebrionoid Pilipalpinae persisting in Madagascar, New Zealand, southern South America, and Australia. The Nosodendridae occur in New Zealand, Australia, southern Africa, Madagascar, and the Holarctic region. The staphylinid *Stylogymnusa subantarctica* Hammond is known only from the Auckland Islands, with its closest relatives exclusively Holarctic. The New Zealand jacobsoniid beetle *Saphophagus minutus* Sharp was considered by Crowson (1959) as a relict coeval with the tuatara. The Chaetosomatidae are known only from New Zealand and Madagascar, and the Phycosecidae only from New Zealand and Australia. The small family Cavognathidae, with species occurring in birds' nests, are also known only from New Zealand and Australia. The New Zealand Nemonychidae are closest to species from Chile. Omaliine staphylinids of the genus *Metacorneolabium* (22 species) are distributed in New Zealand, Australia, and South America. Some southern temperate Staphylinoidea from families Hydraenidae, Ptiliidae, Agyrtidae, Leiodidae, Pselaphidae, and Staphylinidae show 'transaustral disjunctions' (occur on two or more widely separated southern land areas) — New Zealand, Australia, South Africa, and/or South America.

Comparison of Staphylinidae in New Zealand and other areas

The family Staphylinidae in New Zealand includes approximately 936 native and 85 adventive species (Klimaszewski et al., 1996. A comparison of the estimated numbers of species of rove beetles in New Zealand, the Hawaiian Islands, Florida, the British Isles, Central Europe, Fennoscandia, Australia, and North America north of Mexico is presented in Table 1. Species numbers are the result of many factors besides land area, including latitude, climate, topography (resulting in habitat diversity), and the geological and biological history of an area (including the impact of Pleistocene glaciations and the degree and duration of isolation from other areas).

New Zealand's staphylinid fauna is comparable in size, in relation to land area, to the faunas of a diversity of areas. This is quite striking in view of New Zealand's much longer isolation from other lands (compared to the other areas in Table 1) and its perhaps consequent lack of several major lineages of Staphylinidae. The tremendous topographic, climatic, and vegetational diversity of New Zealand is likely to have enhanced speciation. There could also be a connection between the absence of several lineages and the extensive New Zealand radiations in *Microsilpha*, *Sagola*, **Euplectopsis*, *Eupines*, *Sepedophilus*, *Oligota*, **Paratorchus*, *Hyperomma*, *Othius*, and '*Quedius*' [*endemic genera]. Far more knowledge of the ecological roles of staphylinid groups both in New Zealand and elsewhere is needed however, to test such an hypothesis.

The origins of New Zealand's staphylinid fauna are still poorly understood. They are probably varied, since the fauna includes over 20 genera or higher groups shared only with other southern temperate regions (Newton, 1985), as well as numerous more widespread lineages (e.g., *Sepedophilus*, *Gyrophaena*, *Oligota*, *Myllaena*, *Polylobus*, *Bledius*, *Carpelimus*, *Oxytelus*, Lathrobiina sensu lato, *Othius*, Quediina, *Cafius*, and *Philonthus*). Phylogenetic studies of all lineages within and outside New Zealand are

Table 1. Comparison of land areas and estimated numbers of species of Staphylinidae (including Pselaphinae, Scaphidiinae, Dasycerinae, and other groups) for several parts of the world (Klimaszewski, 1996).

Zoogeographical area	Land area (km^2)	Estimated species	Source of estimate
USA.: Hawaiian Islands	16 700	100	Nishida (1994)
USA.: Florida	140 800	498	Peck and Thomas, unpublished checklist
New Zealand	**268 800**	**936**	Newton and Thayer (1995), unpublished checklist; Chandler (1991), (Pselaphinae)
British Isles	315 000	1046	Pope (1977)
Central Europe (Austria, Czech Republic, Germany, Poland, Slovakia)	882 250	1949	Lucht (1987); Lohse and Lucht (1989)
Fennoscandia (Finland, Norway, Sweden)	1 073 500	1222	Silfverberg (1992)
Australia	7 692 300	2441	Newton & Thayer (1995), unpublished checklist; Chandler, in litt. (Pselaphinae)
North Ameriea (N of Mexico)	19 115 250	3974	Arnett (1985); Chandler (1994), (Pselaphinae)

needed in order to understand the history of the New Zealand staphylinid fauna.

Estimated number of species for Australia and New Zealand includes known deseribed and undescribed speeies, but excludes adventive species. Adventive speeies are also excluded from the Hawaiian Islands number, but not from the other geographic areas, where the number of adventive species is not known, but probably very low. Known but undescribed speeies are also included for Florida, but not for the remaining areas, where the number is not known, but probably low.

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Appendix 1 Inventory of New Zealand beetles. Classification adopted from Lawrence and Newton (1995). Suborders and families with over hundred species are in bold.

Taxon	Approximate number of recorded native species	Approximate number of introduced and adventive species
Suborder ADEPHAGA		
Superfamily CARABOIDEA		
1. Rhysodidae	6	0
2. **Carabidae** (including Cicindelinae)	**426**	**19**
3. Dytiscidae	12	1
4. Gyrinidae	1	1
Suborder POLYPHAGA		
Series STAPHYLINIFORMIA		
Superfamily HYDROPHILOIDEA		
5. Hydrophilidae	70	5
6. Histeridae	22	6
Superfamily STAPHYLINOIDEA		
7. Hydraenidae	32	0
8. Ptiliidae	48	8–9
9. Agyrtidae	2	0
10. Leiodidae	112	1
11. **Scydmaenidae**	**201**	1
12. **Staphylinidae**	**936**	**85**
Series SCIRTIFORMIA		
Superfamily SCIRTOIDEA		
13. **Scirtidae**	**125**	0
14. Eucinetidae	1	0
15. Clambidae	8	2

Appendix 1 Continued.

Taxon	Approximate number of recorded native species	Approximate number of introduced and adventive species
Series SCARABAEIFORMIA		
Superfamily SCARABAEOIDEA		
16. Lucanidae	24	4
17. Trogidae	0	1
18. **Scarabaeidae**	**132**	**12**
Series ELATERIFORMIA		
Superfamily BUPRESTOIDEA		
19. Buprestidae	3	1
Superfamily BYRRHOIDEA		
20. Byrrhidae	79	0
21. Dryopidae	4	0
22. Elmidae	16	0
23. Limnichidae	7	1
24. Heteroceridae	1	0
25. Ptilodactylidae	6–8	0
26. Chelonariidae	1	0
Superfamily ELATEROIDEA		
27. Eucnemidae	22	0
28. **Elateridae**	**132**	**3**
29. Lycidae	0	1
30. Cantharidae	40	1
Series BOSTRICHIFORMIA		
Superfamily DERODONTOIDEA		
31. Derodontidae	1	0
Superfamily BOSTRICHOIDEA		
32. Jacobsoniidae	3	0
33. Nosodendridae	2	0
34. Dermestidae	11	6
35. Bostrichidae (incl. Lyctinae)	1	7
36. Anobiidae (incl. Ptininae)	28	11
Series CUCUJIFORMIA		
Superfamily CLEROIDEA		
37. Trogossitidae	24	1
38. Chaetosomatidae	4	0
39. Cleridae	37	2
40. Phycosecidae	1	0
41. Dasytidae	33	0
Superfamily CUCUJOIDEA		
42. Nitidulidae	21	11
43. Monotomidae	1	5
44. Phloeostichidae	2	0
45. Silvanidae	7	5
46. Cucujidae	1	0
47. Laemophloidae	3	3
48. Phalacridae	3	1
49. Cavognathidae	5	0
50. Cryptophagidae	23	12
51. Languridae	8	0
52. Erotylidae	9	0
53. Bothrideridae	6	1

Appendix 1 Continued.

Taxon	Approximate number of recorded native species	Approximate number of introduced and adventive species
54. Cerylonidae	5	0
55. Endomychidae	6	1
56. Coccinellidae	22	18
57. Corylophidae	19	2
58. Corticariidae (=Lathridiidae)	53	11
Superfamily TENEBRIONOIDEA		
59. Mycetophagidae	12	1
60. Archeocrypticidae	0	1
61. Ciidae	20	0
62. Melandryidae	38	0
63. Mordellidae	6	1
64. Rhipiphoridae	5	0
65. **Colydiidae**	**196**	0
66. Ulodidae	20	0
67. Chalcodryidae	5	0
68. **Tenebrionidae**	**149**	**10**
69. Prostomidae	1	0
70. Oedemeridae	18	3
71. Pyrochroidae	7	0
72. Salpingidae	22	0
73. Anthicidae	17	9
74. Aderidae	15	0
75. Scraptidae	4	0
Superfamily CHRYSOMELOIDEA		
76. **Cerambycidae**	**180**	**8**
77. **Chrysomelidae**	**134**	**19**
Superfamily CURCULIONOIDEA		
78. Nemonychidae	4	0
79. Anthribidae	58	3
80. Belidae	11	0
81. Brentidae	3	1
82. **Curculionidae**	**1496**	**46**