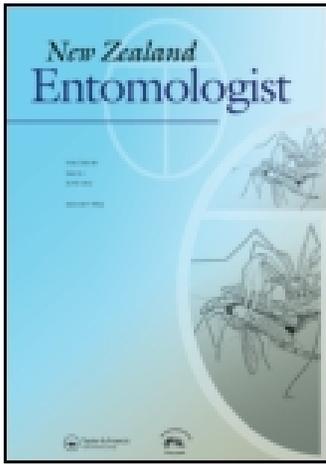


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The conservation status of New Zealand Coleoptera

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The conservation status of New Zealand Coleoptera

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Forty-five New Zealand beetles (Coleoptera) in 37 families are classified as THREATENED: 35 taxa in 10 families are NATIONALLY CRITICAL, seven taxa in five families are NATIONALLY ENDANGERED and three taxa in separate families are NATIONALLY VULNERABLE. A further 267 taxa in 31 families are AT RISK, consisting mostly (91%) of NATURALLY UNCOMMON taxa. Fifty-two taxa in 13 families are DATA DEFICIENT and four taxa in three families are EXTINCT. The largest proportions of THREATENED and AT RISK species comprise Carabidae (respectively 42.2% and 6.7%) and Tenebrionidae (respectively 29.3% and 22.2%). Many of the threatened Coleoptera are large and flightless which may contribute towards their decline.

Keywords: body size, Carabidae, flightlessness, Tenebrionidae, threatened species

Introduction

The four previous publications listing the threatened species of New Zealand (Molloy & Davis 1992; Molloy et al. 1994; Hitchmough 2002; Hitchmough et al. 2007) included from 20 to 28 THREATENED Coleoptera species and from three to 174 species that were potentially THREATENED. The numbers of THREATENED and potentially THREATENED taxa have increased over successive reviews (Table 1). THREATENED taxa accounted for 24%, 23%, 11% and 12% of all listed THREATENED terrestrial invertebrates in 1992, 1994, 2002 and 2007, respectively. The purposes of these lists and the methods used to rank taxa are summarised by Stringer and Hitchmough (2012). Here we present a reassessment of the threat classifications of New Zealand Coleoptera following a Department of Conservation (DOC) revision of the criteria used to rank threat status (Townsend et al. 2008).

Methods

Threat assessments were made by a panel of coleopteran experts (the authors of this paper) who met on 10–12 February 2010. The role of this panel and details of the method follow Stringer and Hitchmough (2012), including the opportunity for public to make submissions. No submissions on Coleoptera were received. We did not attempt to assess the status of the entire known Coleoptera fauna, but concentrated on those listed previously and those for which scarcity of material in collections suggested that they were likely to be uncommon.

Information to inform assessments included notes from previous listings, panel knowledge, and reference to recent publications not cited by McGuinness (2001), and the number of specimens housed in the New Zealand Arthropod Collection (NZAC) and Lincoln University Entomology Research Museum (LUNZ). Classification

Table 1. Numbers of species included in previous lists of THREATENED New Zealand Coleoptera from Molloy and Davis (1992), Molloy et al. (1994), Hitchmough (2002), Hitchmough et al. (2007).

Category	1992	1994	Category	2002	2007
Highest priority spp.	7	8	NATIONALLY CRITICAL	12	15
Second priority spp.	7	12	NATIONALLY ENDANGERED	8	12
Third priority spp.	6	6	NATIONALLY VULNERABLE	0	1
			SERIOUS DECLINE	1	1
			GRADUAL DECLINE	0	1
			SPARSE	24	34
			RANGE RESTRICTED	52	95
Threatened, but few data	3	76	DATA DEFICIENT	36	42
Extinct	5	7		1	4
Total	28	109		134	205

of Coleoptera follows Maddison (2010). Informal tag-names were replaced using option 1 as suggested by Leschen et al. (2009). Specimens were labelled with bar-codes and vouchered in the NZAC and LUNZ. These are listed in Supplementary Appendix 1 (Coleoptera) by their names followed by locality, collection and bar-code number.

The main abbreviations used are: THREATENED: NC = NATIONALLY CRITICAL; NE = NATIONALLY ENDANGERED; NV = NATIONALLY VULNERABLE. AT RISK: Dc = DECLINING; Rc = RECOVERING; RI = RELICT; NU = NATURALLY UNCOMMON. Other categories: DD = DATA DEFICIENT; NT = NOT THREATENED; I&N = INTRODUCED AND NATURALISED; Vg = VAGRANT; Ex = EXTINCT. Other terms used: New = taxa added in 2010; Sp = SPARSE; RR = RANGE RESTRICTED; SD = SERIOUS DECLINE; GD = GRADUAL DECLINE; Syn = synonym; Other = not present or established in New Zealand or recorded as present in error. For full definitions of abbreviations and terminology see Townsend et al. (2008).

Results

We classified 45 taxa as THREATENED, 267 taxa as AT RISK, 52 taxa as DATA DEFICIENT and four taxa are considered EXTINCT (see Supplementary Appendix 2 (Coleoptera)). A complete list of all taxa and their threat status can be found in Supplementary Appendix 1 (Coleoptera).

Almost half of the taxa listed as NATIONALLY CRITICAL are carabids (see Supplementary

Appendix 2 (Coleoptera)). These are comprised mostly of five *Holcaspis* taxa, four *Mecodema* species, and three *Zecillenus* species. Curculionidae and Rhipiphoridae each have four NATIONALLY CRITICAL species. Lucanidae includes three *Geodorcus* species and the Tenebrionidae has two species of *Pseudhelops*. Also included are an anthribid (*Cerius otagensis*), a cerambycid (*Xyloctes costatus*), a dermestid (*Trogoderma pictulum*), a dytiscid (*Rhantus schauinslandi*) and an erotylid (*Cryptodacne rangiauria*). Overall, 60% of these NATIONALLY CRITICAL taxa are known from ONE LOCATION and a further 20% are RANGE RESTRICTED. These include 26% that occur only on single islands or island groups (ISLAND ENDEMIC), six that are known from areas of less than 1 ha, and two (*Neanops pritchardi*, *Waiputrechus cavernicola*) that are found in single caves. There is low confidence in listings for 37% of the taxa because these are DATA POOR and 20% are SPARSE, including taxa that are either known from a single specimen (*W. cavernicola*, *Zecillenus embersoni*) or fewer than 10 specimens. Taxa known from very few specimens were only considered NATIONALLY CRITICAL if the panel was confident of their rarity because significant searches for them had been carried out.

Seven species are NATIONALLY ENDANGERED. Of these, three (*Geodorcus alsobius* (Lucanidae), *Prodontria lewisii* (Scarabaeidae), *Stephanorhynchus insolitus* (Curculionidae)) are only known from ONE LOCATION, while *Paralissotes oconnori*

(Lucanidae) is RANGE RESTRICTED. *Prodontria lewisii*, which occurs around Cromwell, has also been the subject of active conservation management for many years (Barratt 2007). Three species, *Mecodema atrox*, *M. pulchellum* (Carabidae) and *Paralissotes oconnori* (Lucanidae) are SPARSE. Very few collections were known of the primitive species *Horelophus walkeri* (Hydrophilidae; see Hansen 1991) ranging from Marlborough to Buller and the biology of the species is presented by Fikáček et al. (in press).

We classified three species, *Geodorcus capito* (Lucanidae), *Hadramphus spinipennis* (Curculionidae) and *Pseudhelops clandestinus* (Tenebrionidae), as NATIONALLY VULNERABLE. All are ISLAND ENDEMICS and their populations have declined in some of these localities, but they still occur on several islands. The numbers of *H. spinipennis* also fluctuate greatly over several years and patches of their host plant, *Aciphylla dieffenbachii*, can also become locally extinct (Schöps et al. 1999).

The taxa we listed as AT RISK consist of six that are DECLINING, 18 that are RELICT and 244 that are NATURALLY UNCOMMON. No taxa were listed as RECOVERING. All DECLINING taxa are carabids, *Holcaspis falcis* is SPARSE whereas *M. howitti*, and *M. tenaki* are both RANGE RESTRICTED and SPARSE. Carabids (39%) and weevils (28%) comprise most of the RELICT taxa together with

single representatives of another six families. Ten taxa are either RANGE RESTRICTED or occur at ONE LOCATION, while seven are ISLAND ENDEMICS. One (*Megadromus omaramae* (Carabidae)) is DATA POOR and four (*Geodorcus auriculatus*, *Megadromus antarcticus crassalis*, *M. speciosus* and *M. compressus*) are SPARSE. *Amychus granulatus* (Curculionidae) is CONSERVATION DEPENDENT in that it survives only on islands in the Marlborough Sounds that are maintained rodent-free. The NATURALLY UNCOMMON taxa include 243 taxa in 31 families. Over half these taxa are in the families Carabidae (27%), Tenebrionidae (24%) and Curculionidae (10%) (see Supplementary Appendix 2 (Coleoptera)). Most (82%) of the NATURALLY UNCOMMON taxa are either RANGE RESTRICTED (65%) or found at only ONE LOCATION (17%), and both of these also include the 31% of taxa that are restricted to islands or island groups. In addition, 27% have the SPARSE qualifier and nearly 5% are DATA POOR.

Fifty-two taxa are DATA DEFICIENT. They are spread across 13 families, most frequently in Carabidae and Staphylinidae (both 24%), Scarabaeidae (15%) and Curculionidae (11%). Nineteen taxa (35%) are known from only ONE LOCATION whereas only two are found in the Chatham Islands, one is RANGE RESTRICTED, two are DATA POOR and three are SPARSE.

Table 2. Changes in the numbers of New Zealand Coleoptera in each threat category between 2007 (down) (Hitchmough et al. 2007) and 2010 (across).

2010	THREATENED			AT RISK			DD	I&N	NT	Ext	Syn (other)	Total
	NC	NE	NV	Dc	RI	NU						
New	15	1	1	1	6	128	17		12	1		182
NC	13			1			1					15
NE	3	2	1		5						1	12
NV			1									1
SD						1						1
GD				1								1
Sp		3		3	2	22			4		2	36
RR	4	1			4	77	5		3			94
DD						10	28		3		(1)	42
I&N								1				1
NT					1	5			51			57
Ext							1			3		4
Total	35	7	3	6	18	243	52	1	73	4	4	446

Note: See Methods for abbreviations.

Discussion

The present list adds 182 new taxa to the previous list of Hitchmough et al. (2007), with 170 valid species and 12 indeterminate taxa from 37 families (Table 2). The most frequent additions were carabids (37%), staphylinids (9%), curculionids (7%) and anthribids (7%) although taxa from 26 families previously not represented were added (see Supplementary Appendix 3 (Coleoptera)). In contrast, nine species that were previously listed by Hitchmough et al. (2007) are now considered NOT THREATENED. An indeterminate *Metablax* sp. (Elateridae) previously listed as DATA DEFICIENT by Hitchmough et al. (2007) has been removed from the list because the specimen could not be located and its identity is uncertain. *Navomorpha neglecta* (Cerambycidae) is a junior synonym of the *Coptomma neglecta* (Song & Wang 2003), and the latter name is listed. In addition, undescribed species, prior tag-names, and new and old indeterminate listings are included with voucher codes for 42 taxa.

Apart from the 15 species newly added to the NATIONALLY CRITICAL list, the classification of 11 species and two indeterminate taxa (*Holcaspis* n. sp. 1, *Megadromus* sp. 8) has remained unchanged, while the threat status of seven species has been upgraded to NATIONALLY CRITICAL. The latter comprise three species that were previously NATIONALLY ENDANGERED (*Mecodema costellum costellum* (Carabidae); *Anagotus stephenensis*, *Hadramphus tuberculatus* (Curculionidae)) and four that were previously RANGE RESTRICTED.

One notable addition to the NATIONALLY CRITICAL list is *Hadramphus tuberculatus* (= *Karocolens tuberculatus*), which had not been seen since 1922. It was rediscovered at Burkes Pass, Canterbury in 2005 (Young et al. 2008). It had previously been listed as extinct by the IUCN and had also been classified as EXTINCT at the annual DOC invertebrate meeting in 2005 where the threat status was re-assessed because frequent searches for it had been unsuccessful (IUCN 2010). The threat status of *Hadramphus tuberculatus* was subsequently changed to NATIONALLY ENDANGERED before Hitchmough et al. (2007) was published. Extensive searches in the surrounding areas have produced only one additional population close to the original locality; and because the habitat is vulnerable to grazing and fire (Chinn 2010), *H. tuberculatus* is also listed as NATIONALLY CRITICAL.

One NATIONALLY ENDANGERED species (*Horelophus walkeri* (Hydrophilidae)) is a new addition, and the status of two species (*Stephanorhynchus insolitus* (Curculionidae) and *Prodontria lewisii* (Scarabaeidae)), remains unchanged. The threat status of the remaining four NATIONALLY ENDANGERED species was upgraded from SPARSE (*Mecodema atrox*, *M. pulchellum* (Carabidae), *Paralissotes oconnori* (Lucanidae)) and RANGE RESTRICTED (*Geodorcus alsobius*). The change in status for these four is due to their large size (10–32 mm), flightlessness, potential to be preyed upon by rodents and restricted distributions. For example, *M. atrox* occurs on the Volcanic Plateau and eastern North Island where its lowland forest habitat is reduced (Seldon & Leschen 2011); *M. pulchellum* occurs on limestone mountains in the Nelson region but has not been found in recent searches; *P. oconnori* is restricted to Te Pahi, and *G. alsobius* occurs on Mt Moehau between 460–875 m (Holloway 2007; McGuinness 2001).

The three NATIONALLY VULNERABLE species comprise *Hadramphus spinipennis* (Curculionidae) which was previously listed as NATIONALLY VULNERABLE, *Pseudhelops clandestinus* (Tenebrionidae) which was previously listed as NATIONALLY ENDANGERED, and a previously unlisted species, *Geodorcus capito* (Lucanidae). The status of *P. clandestinus*, which occurs on the Antipodes Island and Bollons Island, was changed because the only potential threat is the presence of mice.

The majority (84%) of the changes in status for species in the AT RISK categories have occurred because the categories and criteria have been changed. However, there have also been fundamental changes in status for some of the present AT RISK taxa, such as those that were previously listed as THREATENED or DATA DEFICIENT.

The six taxa now classified as DECLINING are all large flightless carabids. *Mecodema manaia* from Whangarei Heads was previously not listed and *Mecodema tenaki* from the Cape Reinga-North Cape area was changed from NATIONALLY CRITICAL because it is now known to be more abundant than previously thought (Seldon & Leschen 2011). *Mecodema howitti* was previously listed as GRADUAL DECLINE. The remaining three species were previously listed as SPARSE and were reassessed as DECLINING. *Bullea antarctica* is restricted to the coastline in southern Westland,

Farewell Spit and Cape Reinga, though it was once widely distributed (Larochelle & Larivière 2001); *Holcaspis falcis* occurs in the MacKenzie Basin and *Mecodema chiltoni*, which occurs from central Otago to eastern Fiordland, is still in decline although it can be relatively common locally (Barratt 1993).

The 18 RELICT taxa include six previously unlisted species, one species that was previously listed as NOT THREATENED, two species that were previously SPARSE, four species that were previously RANGE RESTRICTED, and four that were previously NATIONALLY ENDANGERED. All taxa that were formerly NATIONALLY ENDANGERED were changed to RELICT after careful reassessment. For example, *Megadromus antarcticus crassalis* was reassessed after further successful searches in limestone areas of Geraldine and Albury. *Megadromus omaramae* occurs in a remnant of *Nothofagus* forest near Omarama (P. Johns, unpublished data) and *Loxomerus* sp. 1 is endemic to the Antipodes Islands but is no longer found on the main island (Marris 2000; see taxonomic status of this species in Johns 2010). *Amychus granulatus*, which in prehuman times occurred as far south as Canterbury, is now restricted to some of the islands in the Marlborough Sounds although it is possibly extinct at the type locality of North Brother Island (Marris & Johnson 2010). *Mimopeus parallelus* is now restricted to areas alongside tributaries in the Lower Clarence Valley (McGuinness 2001; Watt 1988).

Most of the NATURALLY UNCOMMON taxa (52%) were either previously not listed or are taxa that were in the previous categories of RANGE RESTRICTED (32%) or SPARSE (9%). Taxa in the latter two categories were approximately equivalent to the present NATURALLY UNCOMMON category. In addition, 10 (4%) taxa that were previously DATA DEFICIENT and five (2%) that were previously NOT THREATENED (Hitchmough et al. 2007) were moved to NATURALLY UNCOMMON after reassessment and one carabid, *Mecodema costellum obesum*, was also added which had previously been listed as SERIOUS DECLINE. This carabid occurs in scattered locations on valley floors in limestone areas in the St Arnaud region where its numbers have been apparently stable since 1970.

Many of the DATA DEFICIENT taxa (54%) were either previously classified as DATA DEFICIENT or

previously unlisted (33%). Five taxa previously listed as RANGE RESTRICTED were changed although no further data was available, *Menimus sinuatus* (Tenebrionidae) was changed from NATIONALLY CRITICAL because it has not been searched for sufficiently to justify that classification and *Megacolabus sculpturatus* (Curculionidae) was formerly listed as EXTINCT. The latter, known only from the type specimen, is more appropriately classified as DATA DEFICIENT.

Three of the taxa listed as EXTINCT were also previously listed in this category. No further specimens have been found despite extensive searching. These taxa are: *Mecodema punctellum*, which was found on Stephen's Island and has not been seen since 1931; *Thotmus halli* (Curculionidae), which is only known from the type specimen collected from Pitt Island (see image at Leschen et al. 2011); and *Mecodema costellum* "spelles" from two caves in North West Nelson. Only separated body parts have been found from several specimens of the latter (Townsend 1990). We now add a fourth EXTINCT species, the ulodid *Waitomophylax worthyi*, which was found in a cave near Te Kuiti.

Large size and flightlessness were amongst the physical attributes that McGuinness (2001: 10) reported to "bias invertebrates against survival in our current environment" because these relate to the ease with which introduced mammalian predators can catch them. This is well exemplified with Coleoptera. A greater proportion of Coleoptera that are both THREATENED and in the AT RISK categories of DECLINING and RELICT are larger than those that are NATURALLY UNCOMMON or DATA DEFICIENT (Table 3). Large carabids, however, show a reverse of this trend as those with body lengths of 20 mm or greater comprise 15% of THREATENED taxa, 14% of DECLINING and RELICT taxa and 16% of DATA DEFICIENT taxa whereas they comprise 42% of NATURALLY UNCOMMON taxa on the mainland.

Our data also indicate that a higher proportion of taxa in the THREATENED and combined AT RISK categories of DECLINING and RELICT may be flightless compared with taxa that are NATURALLY UNCOMMON or that are DATA DEFICIENT (Table 4). Carabidae, which account for 9.6% of the total described native Coleoptera fauna (Maddison 2010), have a disproportionately large influence on the incidences of flightlessness because they

Table 3. Relationship between maximum body length and threat listing for New Zealand endemic Coleoptera. Data is the percentage of taxa found in each size class. The number of species with body length measurements (N), the percentage this represents for each category (% assessed), and the percentage of Carabidae.

Body length (mm)	THREATENED	DECLINING + RELICT	NATURALLY UNCOMMON (mainland)	DATA DEFICIENT
30+ mm	15.9	30.4	3.4	2.4
20–29 mm	25.0	34.8	15.8	16.7
10–29 mm	31.8	21.7	26.7	16.7
<10 mm	36.4	21.7	63.7	71.4
N	44	23	146	42
% assessed	97.8	95.8	85.4	76.4
% Carabidae	40.9	56.5	39.0	28.6

Table 4. Relationship between flightlessness and threat listing for New Zealand endemic beetles. Data is the percentage of taxa found in each size class.

	THREATENED	DECLINING + RELICT	NATURALLY UNCOMMON (mainland)	DATA DEFICIENT
% flightless	66.7	62.5	50.0	36.4
% Carabidae	42.2	50.0	33.9	23.6

comprised 42% of THREATENED taxa that are flightless as well as 50% of DECLINING and RELICT taxa, 34% of NATURALLY UNCOMMON taxa on the mainland and 24% of DATA DEFICIENT taxa that are also flightless.

Other suggested causes of local extinction or reduction in abundance of beetles are the introduction of herbivores that eat host plants (Kuschel & Worthy 1996) and the low fecundity and long lifespans of some large species (Leschen & Rhode 2002). Common causes that result in invertebrates becoming threatened are dependency on a threatened host or habitat and habitat reduction or modification (McGuinness 2001). Habitat reduction is so widespread that we have not attempted to quantify its importance in terms of the threat status of Coleoptera. This is partly because it is now impossible to determine the historical distributions of many species because most of the reductions in habitat occurred either before Europeans arrived in New Zealand or during their early years of settlement (Pawson & Brooking 2002) and beetles rarely leave evidence of former occupancy, apart from fossils (Leschen & Rhode 2002; Marra 2008). The six DECLINING species, however, show clear evidence of their distributional ranges having been reduced substantially. Examples of Coleoptera that live in restricted habitats are included in the NATURALLY UNCOMMON category. These include the five

species of *Kettlotrechus* and three species of *Kupe-trechus* (Carabidae: Trechini) that live in caves, or *Kuschelydrus phreaticus* (Dytiscidae) that lives in aquifers and *Hygranillus kuscheli* (Carabidae) that lives in subterranean gravels. Finally, there are two listed Coleoptera that have unusual habits: the NATURALLY UNCOMMON *Holloceratognathus passaliformis* (Lucanidae) is associated with the ant *Prolasius advenus* whereas the NATIONALLY CRITICAL *Rhipistena* species (Rhipiphoridae) and the NATURALLY UNCOMMON *Ascetoderes paynteri* (Bothrideridae) are, or are likely to be, ectoparasitoids of cerambycid larvae (Eggleton & Belshaw 1992; Holloway 2007; Klimaszewski & Watt 1997).

We are at a critical point of taxonomic knowledge, and we are lucky to have resources, such as BUGZ (<http://www.bugz.org.nz/WebForms/about.aspx>) and other initiatives, to facilitate the study of New Zealand organisms. However, one impediment to understanding the natural history of Coleoptera and their importance in New Zealand ecosystems is the general lack of critical systematic studies that provide the basis for ecology and comparative biology (but see recent examples, Brown et al. 2012; Seldon et al. 2012). Though species lists and national databases are needed for documenting and accessing distribution and occurrence of species, such lists provide

no taxonomic assessments of described species or available names, new species, or keys for identification. There is, fortunately, a rather active set of researchers as well as amateur coleopterists who have helped enormously to progress our understanding of the carabid fauna (e.g., Larochelle & Larivière 2007; Townsend 2010) that contains the highest number of threatened species. But there is a complete absence of New Zealand-employed systematists in various other groups, such as weevils and tenebrionids, which account for many of the remaining threatened species. We hope that this publication will not only help to define conservation priorities, but will also be used to set priorities for taxonomic research in New Zealand Coleoptera systematics.

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