



NEW ZEALAND THREAT CLASSIFICATION SERIES 32

# Conservation status of New Zealand indigenous terrestrial Gastropoda (slugs and snails), 2020

## Part 1. Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails)

G.M. Barker, F.J. Brook, K. Mahlfeld, K. Walker, D.J. Roscoe, R.A. Hitchmough, E. Edwards, J.R. Rolfe and P. Michel



Department of  
Conservation  
*Te Papa Atawhai*

Cover: *Athoracophorus rufovenosus*, Waipoua. Photo: Gary Barker.

*New Zealand Threat Classification Series* is a scientific monograph series presenting publications related to the New Zealand Threat Classification System (NZTCS). Most will be lists providing NZTCS status of members of a plant or animal group (e.g. algae, birds, spiders). There are currently 23 groups, each assessed once every 5 years. From time to time the manual that defines the categories, criteria and process for the NZTCS will be reviewed. Publications in this series are considered part of the formal international scientific literature.

This report is available from the departmental website in pdf form. Titles are listed in our catalogue on the website, refer [www.doc.govt.nz](http://www.doc.govt.nz) under *Publications*.

The NZTCS database can be accessed at [nztc.org.nz](http://nztc.org.nz). For all enquiries, email [threatstatus@doc.govt.nz](mailto:threatstatus@doc.govt.nz).

© Copyright June 2021, New Zealand Department of Conservation

ISSN 2324-1713 (web PDF)

ISBN 978-0-9951392-6-8 (web PDF)

This report was prepared for publication by Te Rōpū Ratonga Auaha, Te Papa Atawhai/Creative Services, Department of Conservation; editing and layout by Lynette Clelland. Publication was approved by the Director, Terrestrial Ecosystems Unit, Department of Conservation, Wellington, New Zealand

Published by Department of Conservation Te Papa Atawhai, PO Box 10420, Wellington 6143, New Zealand.



This work is licensed under the Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, distribute and adapt the work, as long as you attribute the work to the Crown and abide by the other licence terms. To view a copy of this licence, [www.creativecommons.org/licenses/by/4.0/](http://www.creativecommons.org/licenses/by/4.0/).

Please note that no departmental or governmental emblem, logo or Coat of Arms may be used in any way that infringes any provision of the Flags, Emblems, and Names Protection Act 1981. Use the wording 'Department of Conservation' in your attribution, not the Department of Conservation logo.

# CONTENTS

Abstract	1
<hr/>	
1. Summary	2
<hr/>	
1.1 Changes to conservation status assessments	4
1.2 Trend 2010 to 2020	5
1.3 Conservation status of taxa assessed for the first time	6
1.4 Data deficient taxa	7
1.5 Threatening processes	7
2. Conservation status of New Zealand indigenous Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails) (Gastropoda), 2020	9
<hr/>	
2.1 Assessments	10
2.2 NZTCS categories, criteria and qualifiers	12
3. References	14
<hr/>	



# Conservation status of New Zealand indigenous terrestrial Gastropoda (slugs and snails), 2020

## Part 1. Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails)

G.M. Barker<sup>1</sup>, F.J. Brook<sup>2</sup>, K. Mahlfeld<sup>3</sup>, K. Walker<sup>4</sup>, D.J. Roscoe<sup>5</sup>, R.A. Hitchmough<sup>6</sup>, E. Edwards<sup>6</sup>, J.R. Rolfe<sup>6</sup> and P. Michel<sup>6,7</sup>

<sup>1</sup> Manaaki Whenua Landcare Research, PO Box 69040, Lincoln 7640, New Zealand

<sup>2</sup> PO Box 1652, Nelson 7040, New Zealand

<sup>3</sup> 5 Imlay Crescent, Ngaio, Wellington 6035, New Zealand

<sup>4</sup> Biodiversity Group, Department of Conservation, Private Bag 5, Nelson 7042, New Zealand

<sup>5</sup> 2 Oakleigh Street, Maungaraki, Lower Hutt 5010, New Zealand

<sup>6</sup> Department of Conservation, Biodiversity Group, PO Box 10-420, Wellington 6143, New Zealand

<sup>7</sup> Email: threatstatus@doc.govt.nz

### Abstract

The conservation status of 65 New Zealand indigenous terrestrial Gastropoda taxa in the family Athoracophoridae and one taxon in the family Succineidae was assessed using the New Zealand Threat Classification System (NZTCS). A full list is presented, along with a statistical summary and brief notes on the most important changes. This list replaces all previous NZTCS assessments for terrestrial Gastropoda in the Athoracophoridae and Succineidae. Among Athoracophoridae, six species are Threatened, 28 are At Risk, and 20 are Not Threatened. Eleven species are Data Deficient – insufficient information is available to assess them. Only 23 of the 65 New Zealand Athoracophoridae species have been formally described and named. The Succineidae comprise a single species, assessed as Threatened – Nationally Critical.

Keywords: New Zealand Threat Classification System, NZTCS, conservation status, snail, leaf-veined slug, Athoracophoridae, Succineidae

© Copyright June 2021, Department of Conservation. This paper may be cited as:

Barker, G.M.; Brook, F.J.; Mahlfeld, K.; Walker, K.; Roscoe, D.J.; Hitchmough, R.A.; Edwards, E.; Rolfe, J.R.; Michel, P. 2021: Conservation status of New Zealand indigenous terrestrial Gastropoda (slugs and snails), 2020. Part 1. Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails). *New Zealand Threat Classification Series 32*. Department of Conservation, Wellington. 15 p.

# 1. Summary

New Zealand indigenous terrestrial Gastropoda, excluding *Powelliphanta*, were last assessed in 2010 (Mahlfeld et al. 2012). *Powelliphanta* were previously assessed in 2005 (Hitchmough et al. 2007) but were excluded from the 2010 assessment because of ongoing research into their taxonomy. A reassessment of terrestrial Gastropoda including *Powelliphanta* was initiated in 2014 and is continuing. Reports on the new assessments are to be published progressively in four parts. Part 1, this report, covers the Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails). Part 2 will cover Achatinellidae, Bothriembryontidae (pūpūharakeke/flux snails), Euconulidae, Helicarionidae, Pupinidae and Vertigindae. Part 3 will cover Rhytididae (carnivorous snails); Part 4 will cover Charopidae and Punctidae.

The Athoracophoridae and Succineidae comprise the Succineoidea clade within the Stylommatophora, the largest order of terrestrial gastropods. The most noticeable difference between the two families is that New Zealand's sole representative of the Succineidae, *Succinea archeyi*, is a snail (able to withdraw completely within the shell) whereas all members of the Athoracophoridae are slugs (shell reduced to internal granules). The New Zealand Athoracophoridae are commonly known as leaf-veined slugs for the 'leaf-vein' patterning on their dorsal surfaces. Conservation status assessments of 65 species of leaf-veined slug are reported in Section 2, below, along with an assessment of *Succinea archeyi*. The assessment data can be accessed online at <https://nzctcs.org.nz/reports/1099>.

*Pseudaneitea campbellensis* Burton, 1963, despite being a formally published name, is here treated as unresolved because the taxon was described from a single specimen which has proved to be an immature individual and thus not robustly distinguishable from the better known Campbell Island endemic *Pseudaneitea sorenseni* Powell, 1955. The status of *Pseudaneitea campbellensis* will not be resolved until mature specimens referable to the species, from Campbell Island, are examined.

*Reflectopallium papillata* Burton, 1962 is listed as taxonomically indeterminate because the nomenclature is confused. Burton (1982) synonymised the genus *Reflectopallium* Burton, 1963 with *Pseudaneitea* Cockerell, 1891 and in doing so realized *Papillata* Burton, 1962 became a secondary junior homonym of *Pseudaneitea papillata* (Hutton, 1879). For expediency, Burton (1982) treated the two species as synonyms even though they are distinct. Consequently, *Reflectopallium papillata* Burton, 1962 needs a replacement name. The situation is confused further because the genus *Pseudaneitea* was founded on the misidentification of the type species *Pseudaneitea papillata* (Hutton, 1879) (see Barker, 2018). *Reflectopallium papillata* Burton, 1962 is listed as taxonomically indeterminate pending resolution of this problem in a published revision of the family.

The names of 10 taxa in this report differ from those under which they were reported by Mahlfeld et al. (2012) (Table 1). These taxa are all presently undescribed and the changes are refinements to their 'tag' names to improve their meaning. Listing as 'Athoracophoridae sp.' indicates the species belongs to a new genus, presently undescribed.

Table 1. Name changes affecting New Zealand Athoracophoridae taxa between the publication of Mahlfeld et al. (2012) and this document.

NAME AND AUTHORITY IN MAHLFELD ET AL. (2012)	NAME AND AUTHORITY IN THIS REPORT
Athoracophoridae sp. "Mt Hikurangi"	Athoracophoridae sp. 1 (NMNZ M.274797) "Hikurangi"
<i>Athoracophorus</i> sp. 5 (NMNZ M.151431)	Athoracophoridae sp. 5 (NMNZ M.151431) "Fiordland"
<i>Athoracophorus</i> sp. 7 (NMNZ M.151433) "Warawara 2"	Athoracophoridae sp. 7 (NMNZ M.151433) "Warawara 2"
<i>Athoracophorus</i> sp. 8 (NMNZ M.151434)	<i>Athoracophorus</i> sp. 8 (NMNZ M.151434) "Arthur Range"
<i>Athoracophorus</i> sp. 9 (NMNZ M.151435)	Athoracophoridae sp. 9 (NMNZ M.151435) "Westland"
<i>Pseudaneitea</i> sp. 1 (NMNZ M.151420)	<i>Pseudaneitea</i> sp. 1 (NMNZ M.151420) "Burton Chathams"
<i>Pseudaneitea</i> sp. 4 (NMNZ M.151423)	<i>Pseudaneitea</i> sp. 4 (NMNZ M.151423) "Tobacco Bay"
<i>Pseudaneitea</i> sp. 5 (NMNZ M.151424)	<i>Pseudaneitea</i> sp. 5 (NMNZ M.151424) "Takitimu"
<i>Pseudaneitea</i> sp. 6 (NMNZ M.151425)	<i>Pseudaneitea</i> sp. 6 (NMNZ M.151425) "Hauruakopara"
<i>Pseudaneitea</i> sp. 7 (NMNZ M.151426)	<i>Pseudaneitea</i> sp. 7 (NMNZ M.151426) "Chathams"

Forty-five of the taxa in this report, all in the Athoracophoridae, have been assessed for the first time (Table 2). These additions reflect improved knowledge of New Zealand members of Athoracophoridae from an ongoing systematic revision of the family (Barker unpubl. data).

Table 2. Taxa assessed for the first time in this report.  
All newly added taxa belong to the family  
Athoracophoridae.

NAME AND AUTHORITY
Athoracophoridae sp. 6 (NMNZ M.151432) "Picton"
<i>Amphikonophora gigantea</i> (Suter, 1909)
<i>Amphikonophora</i> sp. 1 (NMNZ M.185963) "Darran Mts"
<i>Amphikonophora</i> sp. 2 (NMNZ M.185973) "Lewis Pass"
<i>Amphikonophora</i> sp. 3 (NMNZ M.302983) "Takitimu"
<i>Amphikonophora</i> sp. 4 (Otago Mus IV5299) "Almer Glacier"
<i>Amphikonophora</i> sp. 5 (NMNZ M.316325) "Takaka"
<i>Athoracophorus bitentaculatus</i> (Quoy & Gaimard, 1832)
<i>Athoracophorus maculosus</i> Burton, 1963
<i>Athoracophorus rufovenosus</i> Suter, 1908
<i>Athoracophorus</i> sp. (NHMUK 45.4.18.1)
<i>Athoracophorus</i> sp. 1 (NMNZ M.151427) "Wellington"
<i>Athoracophorus</i> sp. 2 (NMNZ M.151428) "Ranfurly Bay"
<i>Athoracophorus</i> sp. 10 (NMNZ M.151436) "Kaikoura"
<i>Athoracophorus suteri</i> Burton, 1963
<i>Pseudaneitea aspera</i> Burton, 1963
<i>Pseudaneitea delli</i> (Burton, 1963)
<i>Pseudaneitea dendyi</i> (Suter, 1897)
<i>Pseudaneitea leva</i> Burton, 1977
<i>Pseudaneitea maculata</i> Burton, 1963
<i>Pseudaneitea martensi</i> Suter, 1909
<i>Pseudaneitea papillata</i> (Hutton, 1879)
<i>Pseudaneitea powelli</i> Burton, 1963
<i>Pseudaneitea pseudophyllum</i> (Burton, 1963)
<i>Pseudaneitea schauinslandi</i> (Plate, 1897)
<i>Pseudaneitea simrothi</i> (Suter, 1896)
<i>Pseudaneitea</i> sp. 2 (NMNZ M.137906) "Kirkliston Range"
<i>Pseudaneitea</i> sp. 3 (NMNZ M.151422) "Barratt Te Anau"
<i>Pseudaneitea</i> sp. 8 (NMNZ M.151399) "Takaka"
<i>Pseudaneitea</i> sp. 9 (NMNZ M.183017) "Sawcut Gorge"
<i>Pseudaneitea</i> sp. 10 (NMNZ M.302945) "Seaward Kaikoura Range"
<i>Pseudaneitea</i> sp. 11 (NMNZ M.302967) "Sugarloaf"
<i>Pseudaneitea</i> sp. 12 (NMNZ M.185480) "Deans Bush"
<i>Pseudaneitea</i> sp. 13 (NMNZ M.185471) "Banks Peninsula"
<i>Pseudaneitea</i> sp. 14 (NMNZ M.185469) "Akaroa"
<i>Pseudaneitea</i> sp. 15 (NMNZ M.185210) "Jollies Pass"
<i>Pseudaneitea</i> sp. 16 (NHMUK 86.11.18.22)
<i>Pseudaneitea</i> sp. 18 (NMNZ M.185761) "St. Arnaud"
<i>Pseudaneitea</i> sp. 19 (NMNZ M.185846) "Richmond Range"
<i>Pseudaneitea</i> sp. 20 (NMNZ M.185010) "Port Pegasus, Hebe Island"
<i>Pseudaneitea</i> sp. 21 (NMNZ M.185870) "Pikikirunga"
<i>Pseudaneitea</i> sp. 22 (NMNZ M.185842) "Millar Mt Arthur"
<i>Pseudaneitea</i> sp. 23 (NMNZ M.308850) "Piano Flat"
<i>Pseudaneitea</i> sp. 24 (NHMUK 1896.1.22.33-4)
<i>Reflectopallium papillata</i> Burton, 1962

## 1.1 Changes to conservation status assessments

Table 3 compares the number of taxa in each category in this report with the 2010 assessment (Mahlfeld et al. 2012). Table 4 summarises the changes in conservation status that have occurred in this report. The status of five taxa changed after the information used to support the assessments of Mahlfeld et al. (2012) was reinterpreted. Athoracophoridae sp. 9 (NMNZ M.151435) “Westland” is now assessed as Not Threatened, as further field work has indicated a wider extent of occurrence and higher abundance than previously indicated. It was previously At Risk – Naturally Uncommon. *Pseudaneitea campbellensis* and *Pseudaneitea* sp. 5 (NMNZ M.151424) “Takitimu” are now assessed as Data Deficient. They were previously At Risk – Naturally Uncommon. *Pseudaneitea* sp. 6 (NMNZ M.151425) “Hauruakopara” is now Threatened – Nationally Vulnerable reflecting new information that indicates presence both in the southern part of Pitt Island and in adjacent Hauruakopara Island in the Chatham Islands group. It was previously At Risk – Relict. The relictual condition of the species’ geographic range has not been established. *Pseudaneitea* sp. 1 (NMNZ M.151420) “Burton Chathams” is now At Risk – Relict, reflecting the recognition of range contraction with apparent extinction from Chatham Island in the Chatham Islands group. It was previously At Risk – Naturally Uncommon. New distributional data for Athoracophoridae sp. 1 (NMNZ M.274797) “Hikurangi” has led to its assessment changing from Data Deficient to At Risk – Naturally Uncommon.

Table 3. Comparison of the number of taxa in each category in the 2010 assessment (Mahlfeld et al. 2012) with the 2020 assessment (this report).

CONSERVATION STATUS	2010	2020
Data Deficient	3	11
Threatened – Nationally Critical	1	4
Threatened – Nationally Endangered	1	0
Threatened – Nationally Vulnerable	0	3
At Risk – Declining	0	3
At Risk – Relict	1	3
At Risk – Naturally Uncommon	13	22
Not Threatened	2	20
<b>Total</b>	<b>21</b>	<b>66</b>

Table 4. Summary of status changes of New Zealand Athoracophoridae and Succineidae between 2010 (Mahlfeld et al. 2012) and 2020 (this document). Numbers in light-grey-shaded cells above the dark grey cells indicate improved status (e.g. 1 taxon of 13 assessed as Naturally Uncommon in 2010 has moved to Not Threatened in 2020); numbers in medium-grey-shaded cells below the dark grey cells indicate change to poorer status. Numbers in the dark grey cells have not changed status. Numbers without shading are either new to this report or are now considered to be Data Deficient.

		Conservation status 2020								
		Total 66	DD 11	NC 3	NE 0	NV 3	Dec 3	Rel 3	NU 22	NT 20
Conservation status 2010	Data Deficient (DD)	3	2						1	
	Threatened – Nationally Critical (NC)	1		1						
	Threatened – Nationally Endangered (NE)	1		1						
	Threatened – Nationally Vulnerable (NV)	0								
	At Risk – Declining (Dec)	0								
	At Risk – Relict (Rel)	1				1				
	At Risk – Naturally Uncommon (NU)	13	2					1	9	1
	Not Threatened (NT)	2							1	1
Not listed	45	7	2		2	3	2	11	18	



## 1.2 Trend 2010 to 2020

Of the 21 taxa that had previously been assessed (Mahlfeld et al. 2012), the conservation status of 13 remains unchanged.

The sole New Zealand member of family Succineidae, *Succinea archeyi* Powell, 1933, is endemic to northeastern North Island. It inhabits *Spinifex* sandfield and open shrubland on coastal dunefields, and has undergone a precipitous decline over the last c. 150 years, primarily as a result of the degradation and loss of native dune vegetation, but probably also as a consequence of predation by introduced species of small mammals, and by introduced species of the European land snail genus *Oxychilus* Fitzinger, 1833 (Brook 2000). The Nationally Critical (C, DPT, EF) conservation status of *S. archeyi* reported in this study has changed from the Nationally Endangered status reported by Mahlfeld et al. (2012). However, these assessments have been based on surveys carried out in 1994–98, which indicated that there were 15 extant populations of this species in Northland and eastern Coromandel Peninsula, nine of which occupied total areas of less than 0.05 ha each, and were at high risk of going extinct (Brook 1999, 2000). As far as we are aware, there have been no subsequent surveys to determine the fate of the various populations of *S. archeyi* (Fig. 1), and the conservation status of this species may have been underestimated.

The leaf-veined slug *Pseudaneitea ramsayi* Climo, 1973 is confined to a small area of Manawatāwhi/Great Island in the Manawatāwhi/Three Kings Island group, where it is recovering from previous loss and disturbance of its habitat (Brook 2002). The Nationally Critical (A(3) CD, IE, OL) conservation status reflects the very narrow range of the species and its ongoing conservation dependency, especially biosecurity to maintain the island's freedom from mammalian predators. However, the 2012 and 2020 assessments have been largely based on surveys undertaken in 1996 and 1999 (Brook 2002). As far as we are aware there have been no subsequent surveys to determine the distribution and population trends of *Pseudaneitea ramsayi*.

*Palliopodex verrucosus* (Simroth, 1889), *Pseudaneitea sorenseni* Powell, 1955 and *Pseudaneitea huttoni* (Suter, 1909), which are endemic to the Auckland Islands, Snares Islands/Tini Heke, and Campbell Island/Motu Ihupuku respectively, have a status of Naturally Uncommon, reflecting their subantarctic island group endemisms. Collection records and sightings have indicated that *P. verrucosus* has maintained a wide distribution and high abundance in the Auckland Islands (Barker 2012; G.M. Barker, unpubl. data), despite a period of significant habitat disturbance by human occupation and pastoral farming. *Pseudaneitea sorenseni* is less well represented in collections but specimen records indicate population stability subsequent to cessation of sheep farming on Campbell Island in 1931 (Barker 2012). Although the Snares Islands have been less frequently surveyed, collection records (Barker 2012) similarly indicate *Pseudaneitea huttoni* has maintained a stable population.

Three additional island taxa – *Pseudaneitea multistriata* Burton, 1963 of several islands in the Titi/Muttonbird Islands group; *Pseudaneitea* sp. 7 (NMNZ M.151426) “Chathams” of the Chatham Islands; and *Pseudaneitea pallida* Climo, 1973 of Manawatāwhi/Three Kings Islands – have similarly retained the status of Naturally Uncommon, reflecting their island endemism. However, as far as we are aware, there have been no recent surveys to assess trend in distribution and population size. *Pseudaneitea multistriata* is represented in collections only by a series of specimens collected during 1955 (Barker 2012). *Pseudaneitea pallida* was found to be common on several islands in the Manawatāwhi/Three Kings Island group during surveys in 1996 and 1999 (Brook 2002). *Pseudaneitea* sp. 7 (NMNZ M.151426) “Chathams” was found in 1976 and 2001 surveys (G.M. Barker unpubl. data) to be not uncommon on Chatham Island and Pitt Island (Rangiauria).

*Pseudaneitea* sp. 4 (NMNZ M.151423) “Tobacco Bay” and Athoracophoridae sp. 9 (NMNZ M.151435) “Westland” retain the status of Not Threatened. *Pseudaneitea* sp. 4 (NMNZ M.151423) “Tobacco Bay” of Stewart Island/Rakiura and Southland is common and locally abundant (Barker 2012; G.M. Barker unpubl. data). Survey work since the report of Mahlfeld et al. (2012) has indicated Athoracophoridae sp. 9 (NMNZ M.151435) “Westland” to be widely distributed



*Succinea archeyi*, Te Pahi. Photo: Euan Brook.

and generally abundant throughout Westland, including in lowland habitat greatly modified by agricultural activities (G.M. Barker unpubl. data).

Thus, for all taxa discussed above, there are few data from which to infer any trend in area of occupancy or population size over the decade 2010 to 2020. For the most part, it is likely that there has been no substantial decline since 2010. However, there is an urgent need to monitor *Succinea archeyi* because of its high threat status and likely ongoing decline in habitat conditions.

*Athoracophorus* sp. 3 (NMNZ M.151429) “Waiare” and *Athoracophorus* sp. 8 (NMNZ M.151434) “Arthur Range” remain Data Deficient, as there has been no additional information since the assessment of Mahlfeld et al. (2012). These taxa remain known from single localities (Barker 2011; G.M. Barker unpubl. data).

### 1.3 Conservation status of taxa assessed for the first time

Of the 45 Athoracophoridae assessed for the first time, 19 are considered threatened. Details of the assessments are given in Section 2 below. Most notable are *Pseudaneitea* sp. 8 (NMNZ M.151399) “Takaka” and *Pseudaneitea* sp. 15 (NMNZ M.185210) “Jollies Pass”. Both are assessed as Nationally Critical as they are presently known from single localities in habitat of small extent and highly vulnerable to further disturbances. *Pseudaneitea* sp. 8 (NMNZ M.151399) “Takaka” is known from only a single location in the Pikikirunga Range, in Abel Tasman NP in an area of montane beech/kamahi forest about 1 ha in extent. The species was first discovered in October 1998, when numerous slugs (estimated 300 individuals within a 10 m radius of an observation point) were observed descending *Griselinia* sp. poles in *Fuscospora* forest in the early morning with low misty cloud cover at canopy height after night rain. A further visit to the site in December 2010 under similar conditions confirmed persistence of the locally high population density. Repeated searches elsewhere in the Pikikirunga Range, in Abel Tasman NP generally and surrounding areas, have failed to detect additional populations, but detection of the highly cryptic slugs on the forest floor during the day is extremely difficult. Further surveys are warranted, focusing on searches at night or daybreak under moist weather conditions. *Pseudaneitea* sp. 15 (NMNZ M.185210) “Jollies Pass” is known only from a 1962 collection made in a remnant area of dryland shrubland and tussock. The site has been subject to ongoing livestock grazing and is highly vulnerable to fire.

*Pseudaneitea* sp. 11 (NMNZ M.302967) “Sugarloaf” and *Pseudaneitea* sp. 13 (NMNZ M.185471) “Banks Peninsula” are assessed as Nationally Endangered because of their small area of occupancy and sparse, fragmented populations confined to remnant patches of indigenous vegetation. Surveys in the last two decades indicate stable populations (G.M. Barker, unpubl. data), but habitat of both species is subject to ongoing disturbances for grazing and human recreational activities, and vulnerable to fire.

A similar situation prevails for *Pseudaneitea* sp. 2 (NMNZ M.137906) “Kirkliston Range”, *Pseudaneitea* sp. 12 (NMNZ M.185480) “Deans Bush” and *Pseudaneitea* sp. 14 (NMNZ M.185469) “Akaroa”, but because of evidence of ongoing decline in extent and condition of habitat these taxa have been assessed as At Risk – Declining. Surveys are needed to provide more definitive evidence of population trend.

*Pseudaneitea schauinslandi* (Plate, 1897) is known from approximately 15 localities from NE Nelson to Marlborough Sounds and Wellington coastal islands, including Stephens Island (Takapourewa), Rangitoto ki te Tonga/D’Urville Island, Maud Island and Mana Island. It is

assessed as At Risk – Relict. Collection records and sightings indicate the species is abundant on islands free of mammalian predators, such as Stephens Island (Takapourewa) and Maud Island, but sparse on the South Island mainland. The distribution is evidently relictual, and the species may have formerly occupied the southern North Island mainland in the vicinity of Wellington.

*Athoracophorus* sp. 2 (NMNZ M.151428) “Ranfurlly Bay” is similarly assessed as At Risk – Relict. The species is known only from lowland nīkau (*Rhopalostylis sapida*) forest in the vicinity of Whangaroa Harbour, eastern Northland, including Stephenson Island. The species is locally common. Surveys more broadly in eastern Northland have not detected it, despite the wide occurrence of nīkau forest, indicating a relictual distribution.

## 1.4 Data deficient taxa

The panel notes with concern that 11 of the 67 species listed in this report are Data Deficient, because lack of data prevents them from being assessed. The abundance of a species may be naturally low and sightings of them rare, or they may be cryptic in behaviour, making it difficult to detect them, estimate their numbers and determine population trends. It is likely that many of these species are, in fact, threatened due to low numbers, fragmented populations and/or restricted habitat. In addition to on-going research related to a systematic revision of Athoracophoridae, several surveys have specifically targeted data deficient species (e.g. Barker 2011, 2012, 2015) and in some cases have provided data allowing reassessment of conservation status. This type of survey work needs to continue.

## 1.5 Threatening processes

Despite lacking an external protective shell (or perhaps because of this shell loss) athoracophorids are behaviourally and anatomically well adapted to varied habitat and climatic conditions (well-tuned activity periods). They return to well-protected, moist daytime ‘roosts’; can go into an aestivatory resting state; ecophysiologicaly tolerate large fluctuations in body water content; uptake water through the foot during both active and rest periods; have a very long water-conserving ureter), and are represented across the full moisture gradient (central Otago, 340 mm annual rainfall, to montane 5000+ mm annual rainfall) and habitat disturbance and successional conditions. Five decades of research on the ecology and systematics (G.M. Barker unpubl. data) suggests the principal driver of decline in population abundance among New Zealand athoracophorid species is degradation of habitat. A number of Athoracophoridae occur in the most fragmented landscapes and disturbed habitats (occupying scattered flax (*Phormium* spp.) bushes and tussocks in deforested areas; small remnants of forest, shrubland and riparian areas; degraded river banks and wetlands dominated by introduced *Salix* spp.; urban gardens; etc.) and thus exhibit a high level of persistence in the face of great modification and loss of primary habitat. Such habitat degradation has undoubtedly reduced abundances in these species and ultimately may lead to local extinction in the absence of habitat restoration, although lack of quantitative data currently prevents robust assessment of population trends. For the most part, geographic ranges in New Zealand Athoracophoridae are evidently intact; only a few species exhibit ranges that may be regarded as relictual, as discussed above. Furthermore, not all athoracophorid species have suffered in equal measure from habitat modification. Indeed, semelparous r-strategist species such as *Athoracophorus bitentaculatus* may have become more abundant with forest fragmentation and disturbance since human settlement. While present throughout New Zealand indigenous forests and wetlands, *A. bitentaculatus* favours forest margins and secondary shrublands where it is a particularly common occupant of *Cordyline* and flax, and in leaf litter under broadleaf shrubs. The priority in conservation management of Athoracophoridae should be indigenous habitat preservation.

Specimen records and modelling from such data provide the principal baseline information from which to assess declines in species' area of occupancy and abundance, but deficiencies in sampling can lead to gross inaccuracies in both historical and current range estimations, and provide only very crude estimates of changes in athoracophorid abundances.

Athoracophorids are nocturnally active, primarily as a desiccation avoidance strategy. They are generally highly cryptic in leaf litter and hide by day in well-protected crevices in woody debris, under rocks and tree roots, in tree holes, under moss carpets, and in leaf axils of large monocots. Therefore, they can be expected to be most vulnerable to nocturnal/crepuscular predators. Invasive rats, hedgehogs and mice are known to prey on athoracophorids and their eggs and are potentially disruptive to athoracophorid population stability. Predation by these mammals is evidenced by records of slugs and their radulae teeth and jaws in stomach contents of animals and their scats (e.g. Brockie 1959, Best 1969, Miller & Miller 1995 and G.M. Barker, unpubl. observations), and from acceptance of slugs as prey in cage trials (G.M. Barker, unpubl. observations). Nonetheless, there is presently no definitive evidence of rats, hedgehogs and mice effecting decline in athoracophorid populations. The importance of feral pigs, possums and various introduced birds as predators of athoracophorids is presently unknown.

That collection records and sightings indicate some athoracophorid species may be more abundant on islands (where they may have more freedom from invasive and feral mammals, relative to the mainland), which suggests that predation and habitat disturbance by non-native mammals constitute threatening processes. Nonetheless, many mainland species have persisted and are rather common – even locally very abundant – despite a long co-occurrence with invasive mammalian predators and feral browsers. We know rodents and hedgehogs prey on leaf-veined slugs but caution against equating evidence of athoracophorids as prey items to evidence for the importance of introduced predators in population dynamics and decline. Because athoracophorids provide no after-life residues (such as empty shells) that may be readily observed in the field, it can also be extremely difficult to estimate rates of predation (i.e. proportion of the population lost to predation).

In a companion study to that of Barker (2016), estimates of athoracophorid abundance in paired forest blocks with (T) and without (NT) ship rat control have been made (G.M. Barker unpubl. data) as an initial attempt to estimate adverse effects of rodent predation. A stratified-sampling approach was used to count slugs in their daytime home sites in *Cordyline*, *Freyrcinetia*, *Astelia* and *R. sapida* in the two treatments (plants used for home sites varied with forest type; equal numbers of plants within plant species sampled in T and NT blocks). This work was undertaken during April-May (autumn) 2008 at Waitakere (kauri (*Agathis australis*) forest), Moehau (mixed broadleaf forest), Ruakuri (tawa (*Beilschmieda tawa*)-podocarp forest), Boundary Stream (beech (*Nothofagus*) forest) (sites and rodent management regimes described in Barker 2016). *Athoracophorus bitentaculatus* occurred at all sites, while *Athoracophorus rufovenosus* Suter, 1908 was also present at Waitakere and Moehau. Null model analysis Monte Carlo permutation using EcoSim 7.44 was applied to assess the significance of differences in athoracophorid abundance between paired T and NT blocks within locations, and T and NT blocks across all locations. Despite high numbers of slugs counted in the field (mean 152 per treatment block; range 138–325), no treatment effects were detected. Thus, at least for these *Athoracophorus* species, there is presently no evidence for reduced abundance in the presence of ship rats. Nonetheless, we cannot discount the possibility that apparent restriction of species such as *Athoracophoridae* sp. 1 (NMNZ M.274797) “Hikurangi” and *Pseudaneitea* sp. 8 (NMNZ M.151399) “Takaka” to montane areas is a relict zonation imposed by processes such as predation by rats.

Athoracophorids are eaten by native fauna, including tuatara (Walls 1981), several native birds such as kiwi (*Apteryx* spp.) and weka (*Gallirallus australis*) (e.g. Bramley 1994), and by various invertebrates such as centipedes, carabids and flatworms (G.M. Barker unpubl. data). Further, they are parasitised by native trematodes (G.M. Barker unpubl. data), nematodes (Morand & Barker 1994; Ivanova et al. 2013) and ereynetid mites (Fain & Barker 2003, 2004; G.M. Barker

unpubl. data). Athoracophorids are also preyed on by invasive flatworms (Barker 1989; Winsor et al. 2004) and parasitised by non-native trematodes (G.M. Barker unpubl. data), nematodes (e.g. Wilson et al. 2012; G.M. Barker unpubl. data), cestodes (G.M. Barker unpubl. data) and ereynetid mites (Barker & Ramsay 1978; Fain 2004; G.M. Barker unpubl. data), with records primarily from mainland habitats. The importance of non-native predation and parasitism sources of mortality is unknown, as is the potential interactions of native and non-native enemies and habitat disturbances on the population dynamics of athoracophorids.

Habitat disturbance effects of large mammal browsers on Athoracophoridae have not been adequately researched. Changes in understorey vegetation, trampling and removal of leaf litter, and disturbance of woody debris (Wardle et al. 2001), along with consequent changes in microclimate can be expected to have species-specific effects on athoracophorid ecology. Nonetheless, as noted above, Athoracophoridae remain common – even locally very abundant – despite a long co-occurrence with feral browsers and often substantial modifications of forest understorey and litter.

## 2. Conservation status of New Zealand indigenous Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails) (Gastropoda), 2020

Taxa are assessed according to the criteria of Townsend et al. (2008), and the results are presented in Table 5. The Data Deficient list precedes the other categories, which are ordered by degree of loss, with Nationally Critical at the top of the list and Not Threatened at the bottom. Although the true status of Data Deficient taxa will span the entire range of available categories, taxa are in that list mainly because they are very seldom seen, so most are likely to end up being considered threatened and some may already be extinct. The Data Deficient list is likely to include many of the most threatened species in New Zealand.

The full data for the assessments listed in Table 5 can be viewed and downloaded at <https://nztc.org.nz/reports/1099>.

The definitions of qualifiers and criteria for assessments are summarised in section 2.2. See Townsend et al. (2008) for details details (<https://www.doc.govt.nz/globalassets/documents/science-and-technical/sap244.pdf>).

Brief descriptions of the NZTCS categories and criteria are provided in section 2.2. See Townsend et al. (2008) for full definitions of categories, criteria and qualifiers, and explanation of the assessment process

## 2.1 Assessments

Table 5. Conservation status of New Zealand indigenous Athoracophoridae and Succineidae.

NAME AND AUTHORITY	FAMILY	CRITERIA	QUALIFIERS	CHANGE REASON
<b>DATA DEFICIENT (11)</b>				
<i>Taxonomically unresolved (11)</i>				
<i>Amphikonophora</i> sp. 4 (Otago Mus IV5299) "Almer Glacier"	Athoracophoridae		OL	New listing
<i>Amphikonophora</i> sp. 5 (NMNZ M.316325) "Takaka"	Athoracophoridae		DPT, OL	New listing
Athoracophoridae sp. 6 (NMNZ M.151432) "Picton"	Athoracophoridae			New listing
<i>Athoracophorus</i> sp. 3 (NMNZ M.151429) "Waiare"	Athoracophoridae		OL	No change
<i>Athoracophorus</i> sp. 8 (NMNZ M.151434) "Arthur Range"	Athoracophoridae		OL	No change
<i>Athoracophorus</i> sp. 10 (NMNZ M.151436) "Kaikoura"	Athoracophoridae		DPS, DPT, OL	New listing
<i>Pseudaneitea campbellensis</i> Burton, 1963	Athoracophoridae		IE, OL	Greater uncertainty
<i>Pseudaneitea</i> sp. 18 (NMNZ M.185761) "St. Arnaud"	Athoracophoridae			New listing
<i>Pseudaneitea</i> sp. 20 (NMNZ M.185010) "Port Pegasus, Hebe Island"	Athoracophoridae		OL	New listing
<i>Pseudaneitea</i> sp. 23 (NMNZ M.308850) "Piano Flat"	Athoracophoridae		DPT, OL	New listing
<i>Pseudaneitea</i> sp. 5 (NMNZ M.151424) "Takitimu"	Athoracophoridae		RR	Greater uncertainty
<b>THREATENED (7)</b>				
<b>NATIONALLY CRITICAL (4)</b>				
<i>Taxonomically determinate (2)</i>				
<i>Pseudaneitea ramsayi</i> Climo, 1973	Athoracophoridae	A(3)	CD, IE, OL	No change
<i>Succinea archeyi</i> Powell, 1933	Succineidae	C(3)	DPT, EF	No change
<i>Taxonomically unresolved (2)</i>				
<i>Pseudaneitea</i> sp. 8 (NMNZ M.151399) "Takaka"	Athoracophoridae	A(3)	OL	New listing
<i>Pseudaneitea</i> sp. 15 (NMNZ M.185210) "Jollies Pass"	Athoracophoridae	A(3)	OL	New listing
<b>NATIONALLY VULNERABLE (3)</b>				
<i>Taxonomically unresolved (3)</i>				
<i>Pseudaneitea</i> sp. 6 (NMNZ M.151425) "Hauruakopara"	Athoracophoridae	B(3)	DPT, RR	Reinterpretation of data
<i>Pseudaneitea</i> sp. 11 (NMNZ M.302967) "Sugarloaf"	Athoracophoridae	B(3)	RR, Sp	New listing
<i>Pseudaneitea</i> sp. 13 (NMNZ M.185471) "Banks Peninsula"	Athoracophoridae	C(3)		New listing
<b>AT RISK (28)</b>				
<b>DECLINING (3)</b>				
<i>Taxonomically unresolved (3)</i>				
<i>Pseudaneitea</i> sp. 2 (NMNZ M.137906) "Kirkliston Range"	Athoracophoridae	C(2)	DPS, DPT, Sp	New listing
<i>Pseudaneitea</i> sp. 12 (NMNZ M.185480) "Deans Bush"	Athoracophoridae	C(2)	DPT, RR, Sp	New listing
<i>Pseudaneitea</i> sp. 14 (NMNZ M.185469) "Akaroa"	Athoracophoridae	B(2)	CD, DPT, RR, Sp	New listing
<b>RELICT (3)</b>				
<i>Taxonomically determinate (1)</i>				
<i>Pseudaneitea schauinslandi</i> (Plate, 1897)	Athoracophoridae	B	CD, DPT	New listing
<i>Taxonomically unresolved (2)</i>				
<i>Athoracophorus</i> sp. 2 (NMNZ M.151428) "Ranfurly Bay"	Athoracophoridae	B		New listing
<i>Pseudaneitea</i> sp. 1 (NMNZ M.151420) "Burton Chatham's"	Athoracophoridae	B	IE, RR	Reinterpretation of data
<b>NATURALLY UNCOMMON (22)</b>				
<i>Taxonomically determinate (11)</i>				
<i>Athoracophorus suteri</i> Burton, 1963	Athoracophoridae			New listing

Continued on next page

Table 5 continued

NAME AND AUTHORITY	FAMILY	CRITERIA	QUALIFIERS	CHANGE REASON
<i>Palliopodex verrucosus</i> (Simroth, 1889)	Athoracophoridae		IE	No change
<i>Pseudaneitea delli</i> (Burton, 1963)	Athoracophoridae		CD, RR	New listing
<i>Pseudaneitea huttoni</i> (Suter, 1909)	Athoracophoridae		IE, OL	No change
<i>Pseudaneitea maculata</i> Burton, 1963	Athoracophoridae		DPS, DPT, RR, Sp	New listing
<i>Pseudaneitea martensi</i> Suter, 1909	Athoracophoridae		IE, RR	New listing
<i>Pseudaneitea multistriata</i> Burton, 1963	Athoracophoridae		RR	No change
<i>Pseudaneitea pallida</i> Climo, 1973	Athoracophoridae		IE, RR	No change
<i>Pseudaneitea pseudophyllum</i> (Burton, 1963)	Athoracophoridae		DPS, Sp	New listing
<i>Pseudaneitea simrothi</i> (Suter, 1896)	Athoracophoridae		RR	New listing
<i>Pseudaneitea sorenseni</i> Powell, 1955	Athoracophoridae		IE, OL	No change
<b>Taxonomically unresolved (11)</b>				
<i>Amphikonophora</i> sp. 2 (NMNZ M.185973) "Lewis Pass"	Athoracophoridae		DPT, Sp	New listing
Athoracophoridae sp. 1 (NMNZ M.274797) "Hikurangi"	Athoracophoridae		DPS, DPT	More knowledge
Athoracophoridae sp. 5 (NMNZ M.151431) "Fiordland"	Athoracophoridae		RR	No change
Athoracophoridae sp. 7 (NMNZ M.151433) "Warawara 2"	Athoracophoridae		RR, Sp	No change
<i>Athoracophorus</i> sp. 11 (NMNZ M.158288) "Warawara 1"	Athoracophoridae		DPS, RR, Sp	No change
<i>Athoracophorus</i> sp. 4 (NMNZ M.151430) "northern NZ"	Athoracophoridae		RR	No change
<i>Pseudaneitea</i> sp. 7 (NMNZ M.151426) "Chathams"	Athoracophoridae		IE	Reinterpretation of data
<i>Pseudaneitea</i> sp. 9 (NMNZ M.183017) "Sawcut Gorge"	Athoracophoridae		DPT, Sp	New listing
<i>Pseudaneitea</i> sp. 10 (NMNZ M.302945) "Seaward Kaikoura Range"	Athoracophoridae		RR, DPT	New listing
<i>Pseudaneitea</i> sp. 19 (NMNZ M.185846) "Richmond Range"	Athoracophoridae		DPT, RR, Sp	New listing
<i>Pseudaneitea</i> sp. 21 (NMNZ M.185870) "Pikikirunga"	Athoracophoridae		DPT, RR, Sp	New listing
NAME AND AUTHORITY	FAMILY	CRITERIA	QUALIFIERS	CHANGE REASON
<b>NOT THREATENED (20)</b>				
<b>Taxonomically determinate (9)</b>				
<i>Amphikonophora gigantea</i> (Suter, 1909)	Athoracophoridae			New listing
<i>Athoracophorus bitentaculatus</i> (Quoy & Gaimard, 1832)	Athoracophoridae			New listing
<i>Athoracophorus maculosus</i> Burton, 1963	Athoracophoridae		DPS, DPT	New listing
<i>Athoracophorus rufovenosus</i> Suter, 1908	Athoracophoridae			New listing
<i>Pseudaneitea aspera</i> Burton, 1963	Athoracophoridae			New listing
<i>Pseudaneitea dendyi</i> (Suter, 1897)	Athoracophoridae			New listing
<i>Pseudaneitea leva</i> Burton, 1977	Athoracophoridae			New listing
<i>Pseudaneitea papillata</i> (Hutton, 1879)	Athoracophoridae			New listing
<i>Pseudaneitea powelli</i> Burton, 1963	Athoracophoridae			New listing
<b>Taxonomically unresolved (11)</b>				
<i>Amphikonophora</i> sp. 1 (NMNZ M.185963) "Darran Mts"	Athoracophoridae			New listing
<i>Amphikonophora</i> sp. 3 (NMNZ M.302983) "Takitimu"	Athoracophoridae			New listing
Athoracophoridae sp. 9 (NMNZ M.151435) "Westland"	Athoracophoridae			No change
<i>Athoracophorus</i> sp. (NHMUK 45.4.18.1)	Athoracophoridae			New listing
<i>Athoracophorus</i> sp. 1 (NMNZ M.151427) "Wellington"	Athoracophoridae			New listing
<i>Pseudaneitea</i> sp. 3 (NMNZ M.151422) "Barratt Te Anau"	Athoracophoridae			New listing
<i>Pseudaneitea</i> sp. 4 (NMNZ M.151423) "Tobacco Bay"	Athoracophoridae			No change
<i>Pseudaneitea</i> sp. 16 (NHMUK 86.11.18.22)	Athoracophoridae		Sp	New listing
<i>Pseudaneitea</i> sp. 22 (NMNZ M.185842) "Millar Mt Arthur"	Athoracophoridae		DPS, DPT	New listing
<i>Pseudaneitea</i> sp. 24 (NHMUK 1896.1.22.33-4)	Athoracophoridae			New listing
<i>Reflectopallium papillata</i> Burton, 1962	Athoracophoridae			New listing

## 2.2 NZTCS categories, criteria and qualifiers

### Categories and criteria

#### Data Deficient

Taxa that are suspected to be threatened, or in some instances, possibly extinct but are not definitely known to belong to any particular category due to a lack of current information about their distribution and abundance. It is hoped that listing such taxa will stimulate research to find out the true category (for a fuller definition see Townsend et al. 2008).

#### Threatened

Taxa that meet the criteria specified by Townsend et al. (2008) for the categories Nationally Critical, Nationally Endangered and Nationally Vulnerable.

##### *Threatened – Nationally Critical*

Criteria for Nationally Critical:

##### **A – very small population (natural or unnatural)**

- A(1) <250 mature individuals
- A(2) ≤2 subpopulations, ≤200 mature individuals in the larger subpopulation
- A(3) Total area of occupancy ≤1 ha (0.01 km<sup>2</sup>)

##### **B – small population (natural or unnatural) with a high ongoing or predicted decline**

- B(1) 250–1000 mature individuals, predicted decline 50–70%
- B(2) ≤5 subpopulations, ≤300 mature individuals in the largest subpopulation, predicted decline 50–70%
- B(3) Total area of occupancy ≤10 ha (0.1 km<sup>2</sup>), predicted decline 50–70%

##### **C – population (irrespective of size or number of subpopulations) with a very high ongoing or predicted decline (>70%)**

- C Predicted decline >70%

##### *Threatened – Nationally Endangered*

Criteria for Nationally Endangered:

##### **A – small population (natural or unnatural) that has a low to high ongoing or predicted decline**

- A(1) 250–1000 mature individuals, predicted decline 10–50%
- A(2) ≤5 subpopulations, ≤300 mature individuals in the largest subpopulation, predicted decline 10–50%
- A(3) Total area of occupancy ≤10 ha (0.1 km<sup>2</sup>), predicted decline 10–50%

##### **B – small stable population (unnatural)**

- B(1) 250–1000 mature individuals, stable population
- B(2) ≤5 subpopulations, ≤300 mature individuals in the largest subpopulation, stable population
- B(3) Total area of occupancy ≤10 ha (0.1 km<sup>2</sup>), stable population

##### **C – moderate population and high ongoing or predicted decline**

- C(1) 1000–5000 mature individuals, predicted decline 50–70%
- C(2) ≤15 subpopulations, ≤500 mature individuals in the largest subpopulation, predicted decline 50–70%
- C(3) Total area of occupancy ≤100 ha (1 km<sup>2</sup>), predicted decline 50–70%



## ***Threatened – Nationally Vulnerable***

Criteria for Nationally Vulnerable:

### **A – small, increasing population (unnatural)**

- A(1) 250–1000 mature individuals, predicted increase >10%
- A(2) ≤5 subpopulations, ≤300 mature individuals in the largest subpopulation, predicted increase >10%
- A(3) Total area of occupancy ≤10 ha (0.1 km<sup>2</sup>), predicted increase >10%

### **B – moderate, stable population (unnatural)**

- B(1) 1000–5000 mature individuals, stable population
- B(2) ≤15 subpopulations, ≤500 mature individuals in the largest subpopulation, stable population
- B(3) Total area of occupancy ≤100 ha (1 km<sup>2</sup>), stable population

### **C – moderate population, with population trend that is declining**

- C(1) 1000–5000 mature individuals, predicted decline 10–50%
- C(2) ≤15 subpopulations, ≤500 mature individuals in the largest subpopulation, predicted decline 10–50%
- C(3) Total area of occupancy ≤100 ha (1 km<sup>2</sup>), predicted decline 10–50%

### **D – moderate to large population and moderate to high ongoing or predicted decline**

- D(1) 5000–20000 mature individuals, predicted decline 30–70%
- D(2) ≤15 subpopulations, ≤1000 mature individuals in the largest subpopulation, predicted decline 30–70%
- D(3) Total area of occupancy ≤1000 ha (10 km<sup>2</sup>), predicted decline 30–70%

### **E – large population and high ongoing or predicted decline**

- E(1) 20000–100000 mature individuals, predicted decline 50–70%
- E(2) Total area of occupancy ≤10000 ha (100 km<sup>2</sup>), predicted decline 50–70%

## **At Risk**

Taxa that meet the criteria specified by Townsend et al. (2008) for Declining, Recovering, Relict and Naturally Uncommon.

### ***At Risk – Declining***

Criteria for Declining:

#### **A – moderate to large population and low ongoing or predicted decline**

- A(1) 5000–20000 mature individuals, predicted decline 10–30%
- A(2) Total area of occupancy ≤1000 ha (10 km<sup>2</sup>), predicted decline 10–30%

#### **B – large population and low to moderate ongoing or predicted decline**

- B(1) 20000–100000 mature individuals, predicted decline 10–50%
- B(2) Total area of occupancy ≤10000 ha (100 km<sup>2</sup>), predicted decline 10–50%

#### **C – very large population and low to high ongoing or predicted decline**

- C(1) >100000 mature individuals, predicted decline 10–70%
- C(2) Total area of occupancy >10000 ha (100 km<sup>2</sup>), predicted decline 10–70%

### ***At Risk – Relict***

Taxa that have undergone a documented decline within the last 1000 years, and now occupy <10% of their former range and meet one of the following criteria:

- A 5000–20000 mature individuals; population stable (±10%)
- B >20000 mature individuals; population stable or increasing at >10%

The range of a relictual taxon takes into account the area currently occupied as a ratio of its former extent. Relict can also include taxa that exist as reintroduced and self-sustaining populations within or outside their former known range (for more details see Townsend et al. (2008)).

### ***At Risk – Naturally Uncommon***

Taxa whose distribution is confined to a specific geographical area or which occur within naturally small and widely scattered populations, where this distribution is not the result of human disturbance.

### **Not Threatened**

Resident native taxa that have large, stable populations.

### **Qualifiers**

See Townsend et al. (2008) for details of criteria and qualifiers, which are abbreviated as follows:

CD	Conservation Dependent
DPS	Data Poor: Size
DPT	Data Poor: Trend
EF	Extreme Fluctuations
IE	Island Endemic
OL	One Location
PE	Possibly Extinct
RR	Range Restricted
Sp	Sparse

## 3. References

- Barker, G.M. 1989: Flatworm predators of terrestrial molluscs in New Zealand, and a brief review of previous records. *The New Zealand Entomologist* 12: 75–79. <https://doi.org/10.1080/00779962.1989.9722571>.
- Barker, G.M. 2011: Revising the Threat Classification status of Data Deficient slugs (Athoracophoridae) 1. Slugs of Northland. Landcare Research Contract Report LC277, prepared for Department of Conservation.
- Barker, G.M. 2012: Revising the Threat Classification status of Data Deficient slugs (Athoracophoridae) 2. Slugs of Southland (including southern islands). Landcare Research Contract Report LC1085, prepared for Department of Conservation.
- Barker, G.M. 2015: Revising the Threat Classification status of Data Deficient slugs (Athoracophoridae): 3. Status of Athoracophorid ‘Mt Hikurangi’ (NMNZ M.274797), Athoracophorid ‘Takaka’ and *Athoracophorus* sp. 7 (NMNZ M.1514333), and their parasitic ereynetid mites. Landcare Research Contract Report LC1853, prepared for Department of Conservation.
- Barker, G.M. 2016: Land snail communities respond to control of invasive rats in New Zealand forest systems. *New Zealand Journal of Ecology* 40(3): 310–320.
- Barker, G. M. 2018: Nomenclatural and type catalogue of Athoracophoridae (Mollusca: Eupulmonata: Succineoidea): a synopsis of the first 185 years of biodiscovery in the South West Pacific region. *Zootaxa* 4434(2): 201–249.
- Barker, G.M.; Ramsay, G.W. 1978: The slug mite *Riccardoella limacum* (Acari: Ereynetidae) in New Zealand. *The New Zealand Entomologist* 6: 441–443. <https://www.tandfonline.com/doi/abs/10.1080/00779962.1978.9722316>
- Best, L.W. 1969: Food of the roof rat (*Rattus rattus rattus* L.) in two forest areas of New Zealand. *New Zealand Journal of Science* 12: 258–267.
- Bramley, G.N. 1994: The autecology and conservation of the North Island weka (*Gallirallus australis greyi*). Unpublished MSc Thesis, Massey University.
- Brook, F.J. 1999: Distribution and conservation status of the dune snail *Succinea archeyi* Powell (Stylommatophora Succineidae) in northern New Zealand. *Science for Conservation* 129, Department of Conservation, Wellington.

- Brook, F.J. 2000: Holocene distribution, ecology and local extinction of the endemic New Zealand dune snail *Succinea archeyi* Powell (Stylommatophora: Succineidae). *Journal of the Royal Society of New Zealand* 30(3): 209–225. [DOI:10.1080/03014223.2000.9517618](https://doi.org/10.1080/03014223.2000.9517618)
- Brook, F.J. 2002: Changes in the landsnail fauna of Great Island, Three Kings Islands, northern New Zealand. *Journal of the Royal Society of New Zealand* 32: 61–88. doi:10.1080/03014223.2002.9517684
- Brockie, R.E. 1959: Observations on the food of the hedgehog (*Erinaceus europaeus* L.) in New Zealand. *New Zealand Journal of Science* 2(1): 121–136.
- Burton, D.W. 1982: The status of the genus *Reflectopallium* Burton (Gastropoda: Athoracophoridae). *Journal of the Royal Society of New Zealand* 12(1): 59–64. <https://doi.org/10.1080/03036758.1982.10427167>
- Fain, A. 2004: Mites (Acari) parasitic and predaceous on terrestrial gastropods. Pp. 505–524 in Barker, G.M. (Ed.): Natural enemies of terrestrial molluscs. Wallingford, CAB International.
- Fain, A.; Barker, G.M. 2003: A new genus and species of mite of the family Ereyneidae (Acari Prostigmata) from the pallial cavity of a New Zealand terrestrial gastropod (Athoracophoridae). *Bulletin de la Societe Royale Belge d'Entomologie* 139: 233–238.
- Fain, A.; Barker, G.M. 2004: A new species of the genus *Riccardoella* Berlese, 1923 (Acari: Ereyneidae) occurring as a parasite in the pallial cavity of Athoracophoridae (Gastropoda) in New Zealand. *Bulletin de la Societe Royale Belge d'Entomologie* 140: 43–48.
- Hitchmough, R.; Bull, L.; Cromarty, P. 2007: New Zealand Threat Classification System Lists 2005. Department of Conservation, Wellington. 194 p.
- Ivanova, E.S.; Spiridonov, S.E.; Clark, W.C.; Tourna, M.; Wilson, M.J.; Barker, G.M. 2013: Description and systematic affinity of *Alaninema ngata* n. sp. (Alaninematidae: Panagrolaimorpha) parasitizing leaf-veined slugs (Athoracophoridae: Pulmonata) in New Zealand. *Nematology* 15: 859–870. <https://doi.org/10.1163/15685411-00002724>
- Mahlfeld, K.; Brook, F.J.; Roscoe, D.J.; Hitchmough, R.A., Stringer, I.A.N. 2012: The conservation status of New Zealand terrestrial Gastropoda excluding *Powelliphanta*. *New Zealand Entomologist* 35(2): 103–109. <https://doi.org/10.1080/00779962.2012.686313>.
- Miller, C.J.; Miller, T.K. 1995: Population dynamics and diet of rodents on Rangitoto Island, New Zealand, including the effect of a 1080 poison operation. *New Zealand Journal of Ecology* 19(1): 19–27.
- Morand, S.; Barker, G.M. 1994: *Hugotdiplogaster neozelandia* n. gen., n. sp. (Nematoda: Diplogasteridae), a parasite of the New Zealand endemic slug, *Athoracophorus bitentaculatus* (Quoy and Gaimard, 1832) (Gastropoda: Athoracophoridae). *New Zealand Journal of Zoology* 22: 109–113. <https://doi.org/10.1080/03014223.1995.9518027>
- Townsend, A.J.; de Lange, P.J.; Duffy, C.A.J.; Miskelly, C.M.; Molloy, J.; Norton, D.A. 2008: New Zealand threat classification system manual. Department of Conservation Wellington, New Zealand. 35 p.
- Walls, G.Y. 1981: Feeding ecology of the tuatara (*Sphenodon punctatus*) on Stephens Island, Cook Strait. *New Zealand Journal of Ecology* 4: 89–97.
- Wardle, D.A.; Yeates, G.W.; Barker, G.M.; Bonner, K.I.; Ghani, A. 2001: Introduced browsing mammals in New Zealand natural forests: aboveground and belowground consequences. *Ecological Monographs* 71: 587–614. [https://doi.org/10.1890/0012-9615\(2001\)071\[0587:IBMINZ\]2.0.CO;2](https://doi.org/10.1890/0012-9615(2001)071[0587:IBMINZ]2.0.CO;2)
- Wilson, M.J.; Burch, G.; Tourna, M.; Barker, G.M. 2012: The potential of a New Zealand strain of *Phasmarhabditis hermaphrodita* for biological control of slugs. *New Zealand Plant Protection* 65: 161–165. <https://doi.org/10.30843/nzpp.2012.65.5388>
- Winsor, L.; Johns, P.M.; Barker, G.M. 2004: Terrestrial planarians (Platyhelminthes: Tricladida: Terricola) predaceous on terrestrial gastropods. Pp. 227–278 in Barker, G.M. (Ed.): Natural enemies of terrestrial molluscs. Wallingford, CAB International. <https://www.cabi.org/cabebooks/ebook/20043115144>