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Conservation status of New Zealand reptiles, 2009

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The threat status of New Zealand's reptiles was re-evaluated, using revised New Zealand Threat Classification System criteria. The resulting list included 109 known taxa and undescribed entities—an increase of 11 since the 2005 listing. Two species were listed as Extinct; 17 taxa were listed as Threatened, including six as Nationally Critical, three as Nationally Endangered, and eight as Nationally Vulnerable; 51 taxa were listed as At Risk, including 10 Naturally Uncommon, 11 Relict, 3 Recovering, and 27 Declining; eight taxa were listed as Data Deficient; five visiting marine species were listed as Vagrant, and two as Migrant; 23 taxa were considered Not Threatened; and there was one Introduced and Naturalised species. The six taxa assessed as being at greatest risk of extinction (Nationally Critical) were all South Island skinks. Five taxa had improved in threat status since 2005 as a result of conservation management action. Two taxa had worsened in threat status due to potential threats from rabbit-driven predator irruptions plus the new threat of dairy conversion destroying habitat. The threat status of a further 24 taxa changed as a result of improved knowledge or a change in the criteria and/or categories since 2005.

Keywords: *Caretta*; *Chelonia*; conservation status; *Dermochelys*; *Eretmochelys*; *Hoplodactylus*; *Lampropholis*; *Laticauda*; *Lepidochelys*; *Naultinus*; New Zealand; *Oligosoma*; *Pelamis*; reptiles; *Sphenodon*; threat classification

Introduction

A system for assessing the threat status of New Zealand's flora and fauna (the New Zealand Threat Classification System—NZTCS) was first published in 2002 (Molloy et al. 2002). Hitchmough (2002) applied that system across a range of New Zealand taxa, and presented a threat classification list. That list was updated in 2005 (Hitchmough et al. 2007), resulting in changes in the threat status of some taxa and the addition of others to the list.

NZTCS listing has no direct or automatic impact on the legal status or resourcing of work on threatened species. However, it provides vital information for processes such as applying legal protection to species via amendments to the Schedules to the New Zealand Wildlife Act (1955). The classification of taxa according to the risk of extinction they face allows work and resources to be directed to those species that need them most—although threat status is only one of several criteria used in this prioritisation (Joseph et al. 2008). The published lists also form a basis for national outcome monitoring to measure the impact the New Zealand Department of Conservation (DOC) and other agencies and community groups have through their management of natural heritage (Department of Conservation 2009). Changes in numbers of taxa in the various categories are reported

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nationally and internationally (e.g. Convention on Biodiversity) as an indicator of the success or failure of threatened species management.

In 2007, the NZTCS was reviewed, resulting in a new manual for classifying New Zealand's plant, animal and fungal taxa according to their threat of extinction (Townsend et al. 2008). The fundamental approach remained unchanged from Molloy et al. (2002), but changes were made to some of the categories and criteria, as well as to the recommended process. As part of the implementation of this revised system, we re-evaluated the threat status of New Zealand reptiles in 2009. This follows parallel evaluations of the vascular plant flora (de Lange et al. 2009) and the bird fauna (Miskelly et al. 2008). This paper reports the results of our assessments.

Methods

An up-to-date taxonomic list of New Zealand reptiles was compiled using: (1) the recent systematic revision of the New Zealand skinks by Chapple and colleagues (Chapple & Patterson 2007; Greaves et al. 2007, 2008; Bell & Patterson 2008; Chapple et al. 2008a, b, c, 2009; Hare et al. 2008; Liggins et al. 2008a, b; D Chapple pers. comm.; G Patterson pers. comm.); (2) unpublished results of R Hitchmough and the thesis of Nielsen (2008) for geckos; (3) the review of tuatara genetics and systematics by Hay et al. (2010) (which reduced tuatara to a single species); and (4) the list of marine reptiles published by Gill (1997), with the addition of one more recently described sea snake species with a specimen recorded from New Zealand (Heatwole et al. 2005). We used the suggested common names of Jewell (2008) for some recently discovered or recently distinguished species that did not already have appropriate and well-established common names, but we did not change well-established common names. We followed Chapple & Hitchmough (2009) in rejecting any of Jewell's suggested taxonomic changes that were at variance with strong genetic data.

The list under consideration included both endemic and non-endemic taxa; where a non-endemic taxon was listed, only the New Zealand population was assessed. Both taxonomically determinate and indeterminate taxa were assessed—taxonomically determinate taxa are those that are legitimately and effectively published according to the criteria of the International Code of Zoological Nomenclature (http://www.iczn.org/iczn/index.jsp) and generally accepted by relevant experts as distinct, while taxonomically indeterminate taxa are either legitimately and effectively published but not generally accepted as distinct, or are entities yet to be furnished with a formal name (Townsend et al. 2008). In this paper, we use 'taxa' collectively to cover both groups. Taxa are listed in Table 1.

We incorporated information from the public and a broader pool of experts not directly involved in the listing process. A call for submissions on the reptile threat status re-evaluation was made via the New Zealand Department of Conservation website (http://www.doc.govt.nz/getting-involved/consultations/closed/new-listing-of-threatened-status-of-new-zealand-reptiles-and-amphibians/) in November 2008 and through the Society for Research on Amphibians and Reptiles in New Zealand (SRARNZ). Submissions closed on 28 February 2009.

Reptile experts selected in consultation with SRARNZ were invited to be part of an expert panel to undertake the re-evaluation process. The role of the expert panel members (the authors of this paper) was to provide knowledge on their particular field of expertise at the threat classification list meeting, to answer queries on listing decisions reached, and to consult with peers to bring as much information as possible to the meeting (Townsend et al. 2008).

The panel met on 23–24 April 2009 and placed taxa into threat categories (Fig. 1) based on the criteria provided by Townsend et al. (2008). This process was guided by submissions received, panel knowledge, and reference to recent publications relating to taxonomic and population status. Where there was doubt over

Table 1 Threat rankings for reptiles. The following is a list of all reptile taxa we assessed according to Townsend et al. (2008). Taxa are grouped by threat category, then alphabetically by scientific name. For those non-endemic species that are threatened internationally, the IUCN category is listed alongside the NZTCS listing. See Townsend et al. (2008) for details of criteria and qualifiers, which are abbreviated as: CD, Conservation Dependent; De, Designated; DP, Data Poor; EF, Extreme Fluctuations; EW, Extinct in the Wild; IE, Island Endemic; Inc, Increasing; OL, One Location; PD, Partial Decline; RF, Recruitment Failure; RR, Range Restricted; SO, Secure Overseas; Sp, Sparse; St, Stable; TO, Threatened Overseas.

Threatened

Nationally Critical

Criteria for Nationally Critical: A, very small population (natural or unnatural); B, small population (natural or unnatural) with a high ongoing or predicted decline; C, population (irrespective of size or number of sub-populations) with a very high ongoing or predicted decline (>70%).

Scientific name	Family	Criteria (see summary above)	Qualifiers
Oligosoma aff. *longipes* 'Rangitata'	Scincidae	A (2)	DP, OL
Oligosoma aff. *inconspicuum* 'Te Kakahu'	Scincidae	A (3)	CD, DP, OL
Oligosoma grande (Gray, 1845)	Scincidae	C	CD, PD, Sp
Oligosoma otagense (McCann, 1955)	Scincidae	C	CD, PD, Sp
Oligosoma aff. *infrapunctatum* 'Chesterfield'	Scincidae	B (2/1)	DP, RR, Sp
Oligosoma taumakae Chapple & Patterson, 2007	Scincidae	A (2)	CD, OL

Nationally Endangered

Criteria for Nationally Endangered: B, small stable population (unnatural).

Scientific name	Family	Criteria (see summary above)	Qualifers
Hoplodactylus aff. *granulatus* 'Open Bay Islands'	Diplodactylidae	B (1/1)	CD, OL
Oligosoma judgei Patterson & Bell, 2009	Scincidae	B (2/1)	DP, RR, Sp
Oligosoma whitakeri (Hardy, 1977)	Scincidae	B (1/1)	CD, RR

Nationally Vulnerable

Criteria for Nationally Vulnerable: B, moderate, stable population (unnatural); C, moderate population, with population trend that is declining; D, moderate to large population and moderate to high ongoing or predicted decline.

Scientific name	Family	Criteria (see summary above)	Qualifiers
Hoplodactylus aff. *granulatus* 'Cascades'	Diplodactylidae	B (2/1)	DP, Sp
Hoplodactylus aff. *granulatus* 'Roys Peak'	Diplodactylidae	B (2/1)	DP, RR, Sp
Hoplodactylus cryptozoicus Jewell & Leschen, 2004	Diplodactylidae	B (2/1)	DP, Sp
Hoplodactylus stephensi Robb, 1980	Diplodactylidae	B (1/1)	CD, RR

Table 1 (*Continued*)

Oligosoma aff. *infrapunctatum* 'Southern North Island'	Scincidae	C (2/1)	DP, Sp
Oligosoma aff. *lineoocellatum* 'central Canterbury'	Scincidae	C (2/1)	Sp
Oligosoma aff. *lineoocellatum* 'Mackenzie Basin'	Scincidae	D (2/1)	DP, RR
Oligosoma homalonotum (Boulenger, 1906)	Scincidae	B (1/1)	CD, RR

At Risk

Declining

Criteria for Declining: B, large population and low to moderate ongoing or predicted decline; C, very large population and low to high ongoing or predicted decline.

Scientific name	Family	Criteria (see summary above)	Qualifiers
Hoplodactylus aff. *maculatus* 'Canterbury'	Diplodactylidae	C (1/1)	PD
Hoplodactylus aff. *pacificus* 'Matapia Island'	Diplodactylidae	C (2/1)	PD
Hoplodactylus aff. *pacificus* 'North Cape'	Diplodactylidae	C (2/1)	PD
Hoplodactylus aff. *maculatus* 'Otago large'	Diplodactylidae	C (1/1)	PD
Hoplodactylus aff. *granulatus* 'southern forest'	Diplodactylidae	C (2/1)	DP, RR, Sp
Hoplodactylus rakiurae Thomas, 1981	Diplodactylidae	B (1/1)	CD
Naultinus 'North Cape'	Diplodactylidae	C (2/1)	
Naultinus e. elegans (Gray, 1842)	Diplodactylidae	C (2/1)	
Naultinus e. punctatus (Gray, 1842)	Diplodactylidae	C (2/1)	
Naultinus gemmeus (McCann, 1955)	Diplodactylidae	C (2/1)	Sp
Naultinus grayii Bell, 1843	Diplodactylidae	C (2/1)	
Naultinus manukanus (McCann, 1955)	Diplodactylidae	C (2/1)	PD
Naultinus rudis (Fischer, 1882)	Diplodactylidae	C (2/1)	DP
Naultinus stellatus Hutton, 1872	Diplodactylidae	C (2/1)	PD
Naultinus tuberculatus (McCann, 1955)	Diplodactylidae	C (2/1)	DP, De
Oligosoma aff. *chloronoton* 'West Otago'	Scincidae	B (1/1)	DP, Sp
Oligosoma aff. *inconspicuum* 'Burgan'	Scincidae	B (1/1)	DP, RR
Oligosoma aff. *lineoocellatum* 'South Marlborough'	Scincidae	B (1/1)	DP, Sp
Oligosoma aff. *longipes* 'southern'	Scincidae	C (1/1)	Sp
Oligosoma aff. *smithi* 'Three Kings, Te Paki, Western Northland'	Scincidae	B (2/1)	CD, PD, Sp
Oligosoma chloronoton (Hardy, 1977)	Scincidae	C (2/1)	PD
Oligosoma infrapunctatum (Boulenger, 1887)	Scincidae	B (2/1)	CD, PD, Sp
Oligosoma longipes Patterson, 1997	Scincidae	C (1/1)	DP, Sp
Oligosoma microlepis (Patterson & Daugherty, 1990)	Scincidae	B (2/1)	Sp
Oligosoma ornatum (Gray, 1843)	Scincidae	C (2/1)	CD, PD
Oligosoma striatum (Buller, 1871)	Scincidae	C (2/1)	DP, Sp
Oligosoma waimatense (McCann, 1955)	Scincidae	C (2/1)	Sp

Table 1 (*Continued*)

Recovering

Criteria for Recovering: A, moderate population; B, moderate to large population.

Scientific name	Family	Criteria (see summary above)	Qualifiers
Oligosoma alani (Robb, 1970)	Scincidae	A	CD, RR
Oligosoma macgregori (Robb, 1975)	Scincidae	B	CD, RR
Oligosoma townsi (Chapple et al. 2008)	Scincidae	B	CD, RR

Relict

Criteria for Relict: A, 5000–20,000 mature individuals and stable ($\pm$ 10%); B, $>$20,000 mature individuals and are stable or increasing at $>$10%.

Scientific name	Family	Criteria (see summary above)	Qualifiers
Hoplodactylus chrysosireticus Robb, 1980	Diplodactylidae	B	CD, PD, RR
Hoplodactylus duvaucelii (Duméril & Bibron, 1836)	Diplodactylidae	B	CD
Hoplodactylus nebulosus (McCann, 1955)	Diplodactylidae	B	CD, PD, RR
Hoplodactylus pacificus (Gray, 1842)	Diplodactylidae	B	CD, PD
Oligosoma aff. *infrapunctatum* 'crenulate'	Scincidae	B	CD, RR
Oligosoma acrinasum (Hardy, 1977),	Scincidae	B	CD, RR
Oligosoma lineoocellatum (Duméril & Duméril, 1851)	Scincidae	B	CD, PD
Oligosoma moco (Duméril & Bibron, 1839)	Scincidae	B	CD, PD
Oligosoma oliveri (McCann, 1955)	Scincidae	B	CD, RR
Oligosoma suteri (Boulenger, 1906)	Scincidae	B	CD, PD
Sphenodon punctatus (Gray, 1842)	Sphenodontidae	A	CD, RR

Naturally Uncommon

Scientific name	Family	Qualifiers
Hoplodactylus aff. *maculatus* 'Kaikouras'	Diplodactylidae	
Hoplodactylus aff. *pacificus* 'Mokohinau'	Diplodactylidae	CD, IE
Hoplodactylus aff. *maculatus* 'Mount Arthur'	Diplodactylidae	Sp
Hoplodactylus aff. *pacificus* 'Poor Knights'	Diplodactylidae	CD, IE
Hoplodactylus aff. *pacificus* 'Three Kings'	Diplodactylidae	CD, IE
Hoplodactylus kahutarae Whitaker, 1985	Diplodactylidae	DP, Sp
Oligosoma aff. *ornatum* 'Poor Knights'	Scincidae	CD, IE, OL
Oligosoma fallai (McCann, 1955)	Scincidae	CD, IE, RR
Oligosoma hardyi (Chapple et al. 2008)	Scincidae	CD, IE, RR
Oligosoma stenotis (Patterson & Daugherty, 1994)	Scincidae	

Table 1 (*Continued*)

Other Categories

Introduced and naturalised

Scientific name	Family	Qualifiers
Lampropholis delicata (de Vis, 1888)	Scincidae	SO

Migrant

Scientific name	Family	Qualifiers	IUCN status
Chelonia mydas (Linnaeus, 1758)	Cheloniidae	TO	Endangered A2bd ver 3.1
Dermochelys coriacea (Vandelli, 1761)	Dermochelyidae	TO	Critically Endangered A1abd ver 2.3

Vagrant

Scientific name	Family	Qualifiers	IUCN status
Caretta caretta (Linnaeus, 1758)	Cheloniidae	TO	Endangered A1abd ver 2.3 (needs updating)
Eretmochelys imbricata (Linnaeus, 1766)	Cheloniidae	TO	Critically Endangered A2bd ver 3.1
Laticauda colubrina (Schneider, 1799)	Laticaudidae	SO	
Laticauda saintgironsi Cogger & Heatwole, 2005	Laticaudidae	SO	
Lepidochelys olivacea (Eschscholtz, 1829)	Cheloniidae	TO	Vulnerable A2bd ver 3.1

Coloniser

No taxa listed in this category.

Data Deficient

Scientific name	Family	Qualifiers
Hoplodactylus aff. *granulatus* 'Cupola'	Diplodactylidae	
Hoplodactylus aff. *granulatus* 'Okarito'	Diplodactylidae	
Hoplodactylus aff. *stephensi* 'Coromandel'	Diplodactylidae	
Oligosoma 'Whirinaki'	Scincidae	
Oligosoma aff. *inconspicuum* 'Okuru'	Scincidae	
Oligosoma aff. *inconspicuum* 'Nevis'	Scincidae	
Oligosoma levidensum (Chapple et al. 2008)	Scincidae	
Oligosoma pikitanga Bell & Patterson, 2008	Scincidae	

Table 1 (*Continued*)

Extinct

Scientific name	Family	Qualifiers
Hoplodactylus delcourti Bauer & Russell, 1986	Diplodactylidae	
Oligosoma northlandi Worthy, 1991	Scincidae	

Not threatened

Scientific Name	Family	Qualifiers
Hoplodactylus aff. *maculatus* 'Central Otago'	Diplodactylidae	
Hoplodactylus aff. *maculatus* 'Cromwell'	Diplodactylidae	
Hoplodactylus aff. *maculatus* 'pygmy'	Diplodactylidae	
Hoplodactylus aff. *maculatus* 'Marlborough mini'	Diplodactylidae	
Hoplodactylus aff. *maculatus* 'Southern Alps'	Diplodactylidae	
Hoplodactylus aff. *chrysosireticus* 'southern mini'	Diplodactylidae	
Hoplodactylus aff. *granulatus* 'southern North Island'	Diplodactylidae	
Hoplodactylus granulatus (Gray, 1845)	Diplodactylidae	PD
Hoplodactylus maculatus (Gray, 1845)	Diplodactylidae	PD
Oligosoma aeneum (Girard, 1857)	Scincidae	PD
Oligosoma aff. *inconspicuum* 'Eyres'	Scincidae	RR
Oligosoma aff. *polychroma* Clade 2	Scincidae	
Oligosoma aff. *polychroma* Clade 3	Scincidae	
Oligosoma aff. *polychroma* Clade 4	Scincidae	
Oligosoma aff. *polychroma* Clade 5	Scincidae	
Oligosoma inconspicuum (Patterson & Daugherty, 1990)	Scincidae	PD
Oligosoma maccanni (Patterson & Daugherty, 1990)	Scincidae	
Oligosoma nigriplantare (Peters, 1873)	Scincidae	PD, IE, RR, CD
Oligosoma notosaurus (Patterson & Daugherty, 1990)	Scincidae	
Oligosoma polychroma (Patterson & Daugherty, 1990)	Scincidae	
Oligosoma smithi (Gray, 1845)	Scincidae	PD
Oligosoma zelandicum (Gray, 1843)	Scincidae	Sp
Pelamis platurus (Linnaeus, 1766)	Hydrophiidae	SO

the placement of a given taxon into a threat category, we referred our provisional assessments to other relevant experts after the workshop.

Reptile taxa were classified using both status and trend criteria. Status criteria (total number of mature individuals, total number of populations, number of mature individuals in the largest population, or area of occupancy of the total population) were generally considered first followed by an evaluation of the trend criteria (ongoing or predicted population trend measured either by population size or area of occupancy). A series of Qualifiers (e.g. Data Poor) was also available to enable additional information to be captured and considered for each taxon (Townsend et al. 2008; Table 1).

Statistical analysis

The limited nature of our data did not permit detailed statistical analysis. Instead, we used separate Pearson's chi-square tests to examine trends in the distributions of threat ranking categories (Threatened, At Risk and Not Threatened; lizard taxa only) in relation to

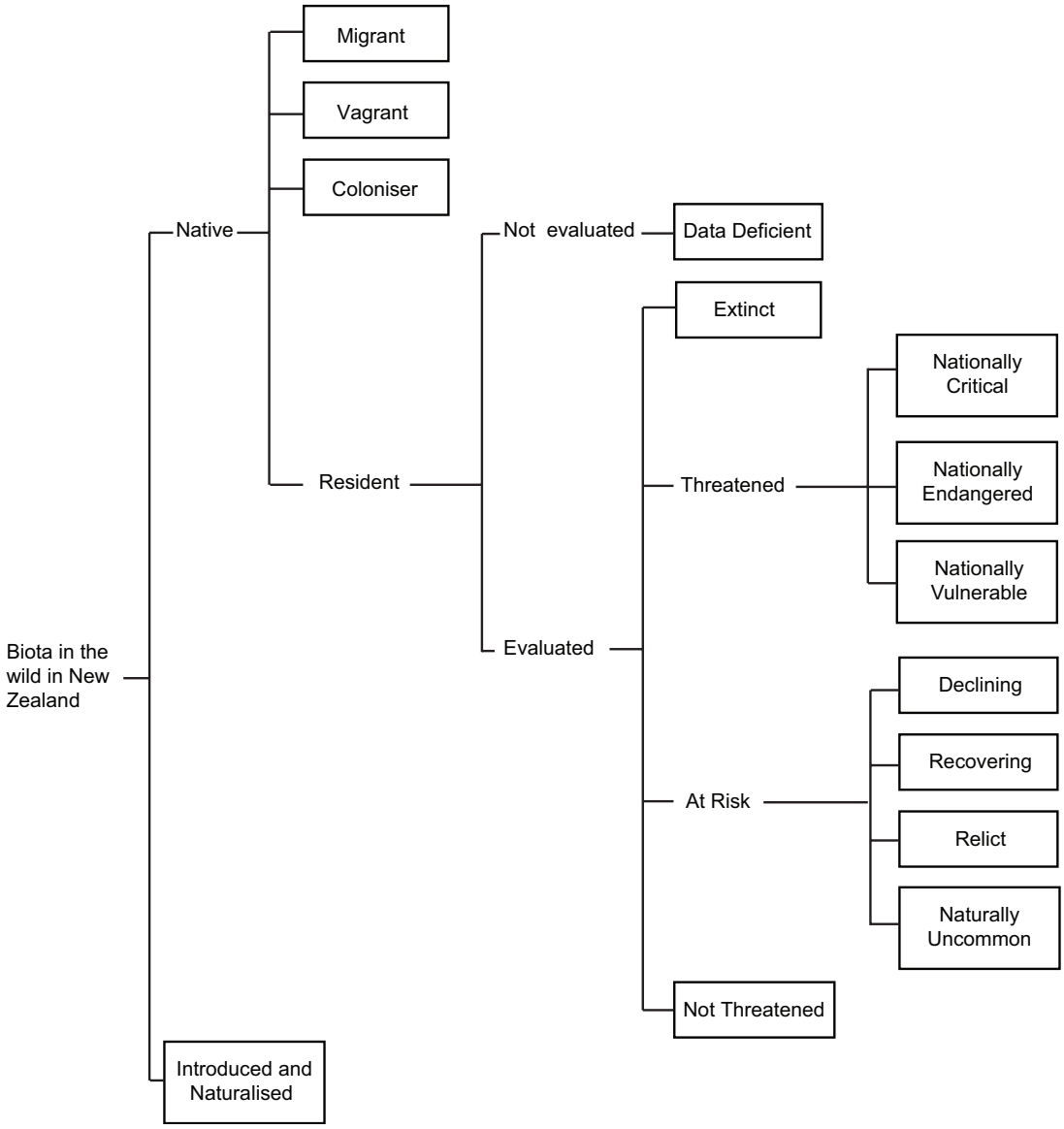

Fig. 1 The structure of the New Zealand Threat Classification System (reproduced from Townsend et al. [2008] with permission of the New Zealand Department of Conservation).

variables which have been hypothesized to influence risk of extinction, particularly from the impact of mammalian predators: (1) taxonomic group (geckos vs. skinks); (2) body size (adults typically <75 mm snout-vent length [SVL] vs. ≥ 75 mm SVL); (3) activity phase (diurnal vs. crepuscular/nocturnal); (4) habitat use (primarily terrestrial vs. primarily arboreal); (5) latitude (most populations north of Cook Strait vs. south of Cook Strait); and (6) representation on off-shore islands free or cleared of introduced mammalian predators (no secure island population vs. at least one secure island population). The term 'secure' is used here simply to denote species' presence on at least one island free of mammalian predators, irrespective of actual population size and trend. Taxa restricted to off-shore islands free of introduced mammals but clearly threatened by avian predators were not considered secure (e.g. *O. taumakae* is preyed on by [native] wēkā [*Gallirallus australis* F. Rallidae] that were introduced to the Open Bay Islands c. 100 years ago; Chapple & Patterson 2007). Species that fitted into more than one category (e.g. *H. rakiurae* is generally considered nocturnal

but frequently basks in the day-time) were constrained to the best-fitting category, using expert opinion where uncertainties arose. Species that did not fit into any category (e.g. *O. nigriplantare* is only found on the Chatham Islands and is therefore not found north or south of Cook Strait) were not included in the analysis. Data for taxa that were equally distributed across both islands ($n = 6$) were similarly omitted. All tests used a significance level of 0.05, and were conducted in Program R (R Development Core Team 2007). Yates' continuity correction and simulated P values ($N = 2000$ replications) were used where some of the threat ranking categories contained fewer than five counts (Sokal & Rohlf 1995; Venables & Ripley 2002). Taxa were also classified on the basis of the knowledge of the authors as exclusively or almost exclusively coastal/littoral, primarily or entirely montane to alpine, or lowland or generalist (often overlapping the coastal and montane zones), and the distribution of threat categories among these groups examined.

Results

List of taxa

A total of 109 reptile taxa were considered during the threat classification re-evaluation process: 43 geckos, 57 skinks, 1 tuatara, 3 sea snakes, and 5 turtles (see Table 1). All terrestrial reptile taxa are endemic to New Zealand at genus level or higher, with the exception of one introduced skink (*Lampropholis delicata*). Seventeen taxa/entities were added to the list since the preparation of the previous list in 2005 (Hitchmough et al. 2007) as a result of taxonomic revision, evidence that taxonomic revision is required, or new discoveries: *H.* aff. *maculatus* 'pygmy', *O. levidensum* (Chapple et al. 2008b), *O.* aff. *ornatum* 'Poor Knights', *O.* aff. *smithi* 'Three Kings, Te Paki, western Northland', *O. judgei* Patterson & Bell, 2009, *O.* aff. *longipes* 'Southern', *O.* aff. *inconspicuum* 'Burgan', *O.* aff. *inconspicuum* 'Nevis', *O.* aff. *inconspicuum* 'Okuru', *O.* aff. *inconspicuum* 'Eyres', *O.* aff. *infrapunctatum* 'Chesterfield', *O.* aff. *infrapunctatum* 'crenulate', *O.* aff. *polychroma* Clade 2, *O.* aff. *polychroma* Clade 3, *O.* aff. *polychroma* Clade 4, *O.* aff. *polychroma* Clade 5 and *Laticauda saintgironsi* Cogger & Heatwole, 2005 (Table 2).

Hoplodactylus aff. *maculatus* 'pygmy' was recognised as a distinct entity, but included some southern Marlborough and northern Canterbury populations formerly included in *H.* aff. *maculatus* 'Marlborough mini', as well as the Rangitata Valley population discovered by Jewell (2007). The large extinct species *O. northlandi* (known from a subfossil deposit in Northland; Worthy 1991) was included in the list for the first time, as a result of a change to the definition of the Extinct category, which now includes records back to 1000 years ago, rather than only since 1840 (Townsend et al. 2008; cf. Molloy et al. 2002). Nine entities recognised by Hitchmough (2002) and/or Hitchmough et al. (2007) as likely new endemic terrestrial species have subsequently been judged not taxonomically distinct and removed from the list considered here (see Table 2 for these deletions).

Submissions

We received seven submissions from within the New Zealand Department of Conservation, members of the public and non-government organisations within New Zealand. We received one each for *O.* aff. *inconspicuum* 'Nevis', *O.* aff. *inconspicuum* 'Eyres', and *O. judgei*; three for *Naultinus gemmeus*; and one combined submission for *O. grande* and *O. otagense*.

Extinct taxa

Two species were listed as Extinct—*O. northlandi* (known only from fossil bones) and *H. delcourti* (known only from one French museum specimen, linked to New Zealand only by its taxonomic position and agreement in appearance with Māori and early European settler reports).

Table 2 Taxonomic concordance. The following is a list of all reptile taxa that have changed their names since the last listing, been removed from the list because they are no longer considered taxonomically distinct, or been added to the list as new discoveries or newly recognised distinct entities (c.f. Hitchmough 2002; Hitchmough et al. 2007).

Species	Former name	Reason for change
New taxa		
Hoplodactylus aff. *maculatus* 'pygmy'		Southern populations newly recognised as distinct from *H.* aff. *maculatus* 'Marlborough mini' on the basis of discovery by T Jewell and genetic work of Nielsen (2008)
Laticauda saintgironsi Cogger & Heatwole, 2005		Newly described species
Oligosoma aff. *inconspicuum* 'Eyres'		Newly recognised as distinct on the basis of the work of Chapple et al. (pers. comm.)
Oligosoma aff. *inconspicuum* 'Okuru'		Newly recognised as distinct on the basis of a unique, morphologically distinctive museum specimen (G Patterson pers. comm.)
Oligosoma aff. *inconspicuum* 'Burgan'		Newly recognised as distinct on the basis of the work of Chapple et al. (pers. comm.)
Oligosoma aff. *inconspicuum* 'Nevis'		Newly recognised as distinct on the basis of the work of Chapple et al. (pers. comm.)
Oligosoma aff. *infrapunctatum* 'Chesterfield'		Newly confirmed as distinct on the basis of the work of Greaves et al. (2008)
Oligosoma aff. *infrapunctatum* 'crenulate'		Newly recognised as distinct on the basis of the work of Greaves et al. (2008)
Oligosoma aff. *longipes* 'Southern'		Newly recognised as distinct on the basis of the work of Chapple et al. (pers. comm.)
Oligosoma aff. *ornatum* 'Poor Knights'		Newly recognised as distinct on the basis of the work of Chapple et al. (pers. comm.)
Oligosoma aff. *polychroma* Clade 2		Newly recognised as distinct on the basis of the work of Liggins et al. (2008b)
Oligosoma aff. *polychroma* Clade 3		Newly recognised as distinct on the basis of the work of Liggins et al. (2008b)
Oligosoma aff. *polychroma* Clade 4		Newly recognised as distinct on the basis of the work of Liggins et al. (2008b)

Table 2 (*Continued*)

Species	Former name	Reason for change
Oligosoma aff. *polychroma* Clade 5		Newly recognised as distinct on the basis of the work of Liggins et al. (2008b)
Oligosoma aff. *smithi* 'Three Kings, Te Paki, western Northland'		Newly recognised as distinct on the basis of the work of Hare et al. (2008)
Oligosoma levidensum (Chapple et al. 2008)		Newly distinguished and described species
Oligosoma judgei Patterson & Bell, 2009		Newly discovered and described species
Name changes		
Hoplodactylus stephensi (Robb, 1980)	*Hoplodactylus stephensi* Cook Strait populations	Greater confidence in taxonomic distinctiveness of Coromandel population from genetic work of Nielsen (2008)
Hoplodactylus aff. *stephensi* 'Coromandel'	*Hoplodactylus stephensi* Coromandel populations	Greater confidence in taxonomic distinctiveness of Coromandel population from genetic work of Nielsen (2008)
Oligosoma aeneum (Girard, 1857)	*Cyclodina aenea*	Generic synonymy by Chapple et al. (2009)
Oligosoma alani (Robb, 1970)	*Cyclodina alani*	Generic synonymy by Chapple et al. (2009)
Oligosoma hardyi (Chapple et al. 2008)	*Cyclodina* 'Poor Knights'	Generic synonymy by Chapple et al. (2009)
Oligosoma macgregori (Robb, 1975)	*Cyclodina macgregori*	Generic synonymy by Chapple et al. (2009)
Oligosoma nigriplantare (Peters, 1873)	*Oligosoma n. nigriplantare*	Raised to full species by Chapple et al. (2009)
Oligosoma northlandi (Worthy, 1991)	*Cyclodina northlandi*	Generic synonymy by Chapple et al. (2009)
Oligosoma oliveri (McCann, 1955)	*Cyclodina oliveri* both Poor Knights and southern populations	Generic synonymy by Chapple et al. (2009)
Oligosoma ornatum (Gray, 1843)	*Cyclodina ornata*	Generic synonymy by Chapple et al. (2009)
Oligosoma pikitanga Bell & Patterson, 2008	*Oligosoma* 'Sinbad Valley'	Formally named
Oligosoma polychroma (Patterson & Daugherty, 1990)	*Oligosoma n. polychroma*	Raised to full species by Chapple et al. (2009)
Oligosoma taumakae Chapple & Patterson 2007	*Oligosoma* 'Open Bay Island skink'	Formally named
Oligosoma townsi (Chapple et al. 2008)	*Cyclodina* 'Mokohinau Island'	Generic synonymy by Chapple et al. (2009)

Table 2 (*Continued*)

Species	Former name	Reason for change
Oligosoma whitakeri (Hardy, 1977)	*Cyclodina whitakeri*	Generic synonymy by Chapple et al. (2009)
Sphenodon punctatus (Gray, 1842)	*Sphenodon p. punctatus* + *Sphenodon punctatus* 'Cook Strait' + *Sphenodon guntheri*	Synonymised by Hay et al. (2010)
No longer recognised		
	Hoplodactylus 'Anatoki'	Now regarded as not distinct from *H.* 'Mt Arthur' (Nielsen 2008)
	Hoplodactylus 'Cascades' Esperance population	Now regarded as not distinct from *H.* 'Cascade'
	Oligosoma 'Big Bay'	Now regarded as not distinct from *O. inconspicuum* (D. Chapple, pers. comm.)
	Oligosoma 'Grey Valley'	Now regarded as not distinct from *O. polychroma* (Liggins et al. 2008b)
	Oligosoma 'Paparoas'	Now regarded as not distinct from *O. infrapunctatum* (Greaves et al. 2008)
	Oligosoma gracilicorpus	Synonymised with *O. homalonotum* by Chapple et al. (2009)
	Hoplodactylus 'Dansey's Pass'	Regarded as not distinct from *H.* aff. *maculatus* 'Otago large' (Nielsen 2008); last listed as a separate entity by Hitchmough (2002)
	Oligosoma 'Denniston'	Regarded as not distinct from *O. infrapunctatum* (Greaves et al. 2008); last listed as a separate entity by Hitchmough (2002)
	Oligosoma 'Garston skink'	Regarded as not distinct from (melanistic morph of) *O. maccanni*; last listed as a separate entity by Hitchmough (2002)

Threatened taxa

Six taxa were listed as Nationally Critical (Table 1)—*Oligosoma grande* (Gray, 1845), *O. otagense* (McCann, 1955), *O. taumakae* Chapple & Patterson, 2007, *O.* aff. *longipes* 'Rangitata', *O.* aff. *inconspicuum* 'Te Kakahu', and *O.* aff. *infrapunctatum* 'Chesterfield'. All six were skinks resident on the South Island or its surrounding islands.

Three taxa were listed as Nationally Endangered—*H.* 'Open Bay Islands', *O. judgei*, and *O. whitakeri* (Hardy, 1977).

Eight taxa were listed as Nationally Vulnerable—*H.* aff. *granulatus* 'Cascades', *H.* aff. *granulatus* 'Roys Peak', *H. cryptozoicus*, *H. stephensi* Robb, 1980, *O.* aff. *infrapunctatum* 'Southern North Island', *O.* aff. *lineoocellatum* 'Central Canterbury', *O.* aff. *lineoocellatum* 'Mackenzie Basin', and *O. homalonotum* (Boulenger, 1906).

At Risk taxa

While the three Threatened categories are clearly ranked according to degree of risk of

extinction, this does not apply to the At Risk categories. These represent different types of risk (decline, small population or area of occupancy, or dependence on management) rather than different degrees of risk, and the degree of risk can vary quite widely within each of these categories (R Hitchmough, P de Lange and C Miskelly, pers. comm.).

A total of 52 taxa were placed in the At Risk categories (Table 1). Most (27) of these were listed as Declining, which includes taxa that are still quite abundant and widespread, but will not remain so in the long term if current declines continue. Ten taxa were listed as Naturally Uncommon, meaning their distributions are naturally confined to specific substrates, habitats or geographic areas, or they occur within naturally small and widely scattered populations—this category included six species with distributions restricted to particular islands (e.g. the Poor Knights). Twelve taxa were listed as Relict, as they have suffered substantial reductions in range historically, but their populations have now stabilised in safe refuges such as pest-free offshore islands. Three species of large nocturnal skinks (formerly in the genus *Cyclodina*) were listed as Recovering, as a result of successful rodent eradications and/or island translocations.

Other categories

Eight taxa were considered to be Data Deficient, with insufficient information currently available to assess threat status (Table 1). Six of these were recently discovered, undescribed entities, and the others are the recently described species *O. levidensum* (Chapple et al. 2008) and *O. pikitanga* Bell & Patterson, 2008.

A further 23 taxa did not fit any of the above categories and were listed as Not Threatened (Table 1).

Non-resident natives

In contrast to the terrestrial reptiles, none of the marine reptiles known to frequent New Zealand waters are endemic or have been confirmed to breed in New Zealand. Most are seasonal migrants or vagrants. However, non-breeding individuals of *Chelonia mydas* are believed to be resident in waters around the Kermadec Islands year-round. Sea surface temperatures are sufficiently high for *Pelamis platurus* to also be resident year-round in the northernmost part of New Zealand's territorial waters (Graham et al. 1971). *Pelamis* is also likely (but not yet confirmed) to breed in New Zealand waters, as it gives birth in its normal habitat at sea rather than returning to land to do so (Vallarino & Weldon 1996). Because of this, *Pelamis* is listed as Not Threatened rather than Migrant or Vagrant. Of the other marine species, five are listed as Vagrant, and two as Migrant. For those non-endemic species that are threatened internationally, the IUCN category is listed alongside the NZTCS listing (Table 1).

Introduced and Naturalised

The only established Introduced and Naturalised species, the small Australian skink *Lampropholis delicata*, was an accidental introduction in freight (Gill & Whitaker 1996). It established in South Auckland in the 1960s and has spread rapidly since then.

Although there is considered to be a high risk that some exotic reptile species that are available through the pet trade in New Zealand could establish naturalised populations, none have yet done so. Individual red-eared slider turtles (*Trachemys scripta elegans*) are quite frequently found living in the wild, but these are all believed to be escaped or released individuals—successful breeding and recruitment has never been confirmed, so they do not fit the definition for Introduced and Naturalised used in this system (Townsend et al. 2008).

Changes in status since the last evaluation

Thirty-one taxa changed status since the 2005 evaluation by Hitchmough et al. (2007)

Table 3 Taxa that have changed status and reasons for the changes. NB Taxa that moved from Gradual decline to Declining as a result of the changed category names and criteria are not included, as these categories are considered equivalent. Similarly, the new categories Naturally Uncommon and Relict are considered equivalent to the former Range Restricted and Sparse categories.

Species	Status in 2005 (Hitchmough et al. 2007)	New status	Reason for change
Real change in status			
Hoplodactylus chrysosireticus	Gradual Decline	Relict	Increase on Mana Island and at managed mainland sites now considered to have more or less offset likely declines at unmanaged sites.
Hoplodactylus pacificus	Gradual Decline	Relict	Recovery of island populations now judged to at least balance declines of remaining small mainland populations.
Oligosoma alani	Range Restricted	Recovering	Confirmation of population increase in translocated populations.
Oligosoma aff. *lineoocellatum* 'Mackenzie Basin'	Gradual Decline	Nationally Vulnerable	Greater weighting given to potential threats from rabbit-driven predator irruptions plus new threat of dairy conversion destroying habitat.
Oligosoma longipes	Sparse	Declining	Greater weighting given to potential threats from rabbit-driven predator irruptions plus new threat of dairy conversion destroying habitat.
Oligosoma macgregori	Range Restricted	Recovering	Confirmation of population increase in translocated populations.
Oligosoma townsi	Range Restricted	Recovering	Confirmation of population increase in translocated populations.
Improved understanding			
Hoplodactylus aff. *granulatus* 'Cascades'	Data Deficient	Nationally Vulnerable	Additional records and new localities since last listing.
Hoplodactylus aff. *granulatus* 'Roys Peak'	Data Deficient	Nationally Vulnerable	Additional records and new localities since last listing.
Hoplodactylus cryptozoicus	Data Deficient	Nationally Vulnerable	Additional records and new localities since last listing.
Hoplodactylus aff. *granulatus* 'Open Bay Islands'	Nationally Critical	Nationally Endangered	Area of occupancy now better known—larger than previously estimated.
Hoplodactylus aff. *pacificus* 'North Cape'	Sparse	Declining	Likely severity of ongoing decline due to predation re-assessed.
Naultinus 'North Cape'	Sparse	Declining	Likely severity of ongoing decline due to predation re-assessed.
Naultinus manukanus	Sparse	Declining	Likely severity of ongoing decline due to predation re-assessed.
Naultinus tuberculatus	Sparse	Declining	Likely severity of ongoing decline due to predation re-assessed.
Oligosoma aff. *infrapunctatum* 'Southern North Island'	Nationally Endangered	Nationally Vulnerable	Discovery of additional populations.

Table 3 (*Continued*)

Species	Status in 2005 (Hitchmough et al. 2007)	New status	Reason for change
Oligosoma aff. *lineoocellatum* 'Central Canterbury'	Nationally Endangered	Nationally Vulnerable	Discovery of additional populations.
Oligosoma aff. *longipes* 'Rangitata'	Data Deficient	Nationally Critical	Further surveys have found no more populations (Lettink 2008, 2009)
Oligosoma homalonotum	Nationally Endangered	Nationally Vulnerable	Better knowledge of population size due to new survey and monitoring methods, indicating population is larger than previously thought.
Oligosoma inconspicuum	Gradual Decline	Not Threatened	Discovery of additional populations, and lumping of Big Bay skink (*O.* 'Big Bay') into this species.
Oligosoma lineoocellatum	Gradual Decline	Relict	Reassessment of status—bulk of population is on islands and some island populations increasing, offsetting declines of small remnant mainland populations.
Oligosoma microlepis	Serious Decline	Declining	Decline of small remnant populations on farmland has not progressed as rapidly as formerly feared. Continued presence on Motutaiko confirmed.
Oligosoma notosaurus	Sparse	Not Threatened	Better knowledge of abundance on Stewart Island/Rakiura.
Oligosoma striatum	Data Deficient	Declining	No trend data available over most of range. Reassessment of existing knowledge from Taranaki.
Oligosoma aff. *inconspicuum* 'Te Kakahu'	Data Deficient	Nationally Critical	Further surveys have found no more populations.
Oligosoma whitakeri	Nationally Vulnerable	Nationally Endangered	Very slow increase in one translocated population; other translocations not yet confirmed successful; mainland population in steep decline.
Pelamis platurus	Vagrant	Not Threatened	Reassessment of population size and likelihood of breeding in NZ waters.
Changed criteria/categories			
Hoplodactylus aff. *chrysosireticus* 'southern mini'	Range Restricted	Not Threatened	Change of category definition—area of occupancy is too large for the new Naturally Uncommon category.
Hoplodactylus stephensi	Range Restricted	Nationally Vulnerable	Result of changed definition of Nationally Vulnerable category.
Oligosoma nigriplantare	Range Restricted	Not Threatened	Result of changed definition of Naturally Uncommon (equivalent to former Range restricted) category.
Oligosoma zelandicum	Sparse	Not Threatened	Result of changed definition of Naturally Uncommon (equivalent to former Sparse) category.

(Table 3), not counting those that are in equivalent but renamed categories. Seven of these taxa have ongoing changes in numbers or distribution, which were judged to have progressed far enough since the last listing to carry them over the status and/or trend threshold into a different category. The other changes result primarily from improved knowledge, including discovery of new populations (20 taxa) or from changes to the criteria and categories in the NZTCS (four taxa).

Ecological and biological correlates of the distributions of threat ranking categories

Of the 89 lizard taxa considered in the analysis, approximately three-quarters were either Threatened ($n = 17$ taxa or 19.1% of the total number of taxa considered) or At Risk ($n = 50$ or 56.2%). Non-threatened taxa constituted the remaining quarter ($n = 22$ or 24.7% of taxa). Extinction risk was greater for larger taxa ($\chi^2 = 18.18$, df = 2, $P < 0.001$), and was greater for primarily ground-active taxa than for arboreal taxa ($\chi^2 = 8.03$, df = 2, $P < 0.05$) (Table 4). South Island taxa were over-represented in the Threatened and Non-threatened categories ($\chi^2 = 11.15$, df = 2, $P < 0.01$). Threatened taxa were under-represented on predator-free islands, but At Risk taxa were over-represented ($\chi^2 = 6.14$, df = 2, $P < 0.05$). Extinction risk was unaffected by activity phase ($\chi^2 = 0.62$, df = 2, $P = 0.73$) and did not differ between geckos and skinks ($\chi^2 = 2.29$, df = 2, $P = 0.32$). The distribution of taxa among categories by family is summarised in Table 5.

Discussion

The number of known taxa and new entities that are considered likely to justify taxonomic description has risen from 82 in 2002 to 98 in 2005 and 109 in 2009 (although the 2002 and 2005 lists did not include the one species that became extinct before 1840 and the one Introduced and Naturalised species). More than a third (45) of the 109 reptile taxa we evaluated remain taxonomically indeterminate at the time of writing. Taxonomic resolution is seen as vital for furthering conservation management (de Lange et al. 2009). Many described taxa are either recent new discoveries or recently identified as taxonomically distinct. Refinements and splits in the taxonomy of some species complexes previously thought to be common and widespread have resulted in more range-restricted taxa. There are, therefore, many taxa for which even basic information such as distribution, abundance, reproductive rate and age at maturity is very limited. Only *S. punctatus*, *O. grande* and *O. otagense* have reasonably robust population estimates across their known range, and even for *O. grande* and *O. otagense* information on the peripheral unmanaged populations is well out of date (N Whitmore and A Hutcheon pers. comm.). Trend information for most reptile taxa is particularly weak, except at the level of anecdotal observations of local population changes or extirpations. The NZTCS manual requires taxa to be listed in a category other than Data Deficient if at all possible. For many taxa, therefore, trends were crudely estimated from patterns of local disappearance, deduced from rates of habitat loss due to development, or inferred by reference to better-known species with similar ecology facing similar suites of threats.

The decision about whether to list taxa as Data Deficient or in a threatened category was very difficult in several instances. In particular, *O. pikitanga* has been shown to occupy only a small portion of the Sinbad Valley and to be at low population density in that area (H Edmonds unpubl. data). If that is the only population of this species, then it meets the criteria for Nationally Critical listing. However, there are many unsurveyed valleys in western Fiordland, so we decided that there was too great a likelihood that other populations would exist for a listing to be made on the basis of the Sinbad Valley information alone. The species was therefore listed as Data Deficient.

Table 4 Effects of taxonomic group, adult body size, activity phase, habitat use, latitude and island security on relative distributions of threat ranking categories for lizard taxa.

Variable	Categories	Number of Threatened taxa	Number of At Risk taxa	Number of Not threatened taxa	Subtotal	*P*
Taxonomic group	Geckos	5	25	9	39	NS
	Skinks	12	25	13	50	
Body size	Adults typically <75 mm SVL	3	19	18	40	***
	Adults typically ≥75 mm SVL	14	31	4	49	
Activity phase	Diurnal	11	27	12	50	NS
	Crepuscular/ nocturnal	6	23	10	39	
Habitat use	Primarily terrestrial	15	29	19	63	*
	Primarily arboreal	2	21	3	26	
Latitude	Mostly North of Cook Strait	3	26	3	32	**
	Mostly South of Cook Strait	14	22	14	50	
Island security	No predator-free island	12	18	10	40	*
	At least one predator-free island	5	32	12	49	

Notes: NS, not significant, $*P<0.05$, $**P<0.01$, $***P<0.001$. SVL, snout-vent length.

The submission on *O. grande* and *O. otagense* presented information demonstrating that these species have recovered dramatically in a managed area at Macraes Flat, which is increasingly the stronghold for these two species as other populations continue to decline.

Table 5 Number of taxa evaluated and assigned to threat categories, as defined by Townsend et al. (2008). Abbreviations: Ex, Extinct; NC, Nationally Critical; NE, Nationally Endangered; NV, Nationally Vulnerable; Dec, Declining; Rec, Recovering; Rel, Relict; NU, Naturally Uncommon; NT, Not threatened; Vg,Vagrant; Mg, Migrant; DD, Data Deficient; I&N, Introduced and Naturalised.

		Threatened				At Risk				Others				
Family	Total	Ex	NC	NE	NV	Dec	Rec	Rel	NU	NT	Vg	Mg	DD	I&N
Cheloniidae	4										3	1		
Dermochelyidae	1											1		
Sphenodontidae	1							1						
Diplodactylidae	43	1		1	4	15		4	6	9			3	
Scincidae	57	1	6	2	4	12	3	6	4	13			5	1
Hydrophiidae	2										2			
Laticaudidae	1									1				
TOTAL	109	2	6	3	8	27	3	11	10	23	5	2	8	1

Table 6 Broad ecological zones inhabited by terrestrial New Zealand reptile taxa in each threat category.

Coastal	Lowland/generalist	Montane/alpine
Nationally Critical		
Oligosoma aff. *inconspicuum* 'Te Kakahu'	*Oligosoma* aff. *infrapunctatum* 'Chesterfield'	*Oligosoma* aff. *longipes* 'Rangitata'
	Oligosoma taumakae	*Oligosoma grande*
		Oligosoma otagense
Nationally Endangered		
	Hoplodactylus aff. *granulatus* 'Open Bay Islands'	*Oligosoma judgei*
	Oligosoma whitakeri	
Nationally Vulnerable		
	Hoplodactylus stephensi	*Hoplodactylus* aff. *granulatus* 'Cascades'
	Oligosoma aff. *infrapunctatum* 'Southern North Island'	*Hoplodactylus* aff. *granulatus* 'Roys Peak'
	Oligosoma aff. *lineoocellatum* 'Central Canterbury'	*Hoplodactylus cryptozoicus*
	Oligosoma homalonotum	*Oligosoma* aff. *lineoocellatum* 'Mackenzie Basin'
Declining		
Oligosoma aff. *smithi* 'Three Kings, Te Paki, Western Northland'	*Hoplodactylus* aff. *maculatus* 'Canterbury'	*Hoplodactylus rakiurae*
	Hoplodactylus aff. *pacificus* 'Matapia Island'	*Oligosoma* aff. *chloronoton* 'West Otago'
	Hoplodactylus aff. *pacificus* 'North Cape'	*Oligosoma* aff. *inconspicuum* 'Burgan'
	Hoplodactylus aff. *maculatus* 'Otago large'	*Oligosoma* aff. *longipes* 'Southern'
	Hoplodactylus aff. *granulatus* 'Southern forest'	*Oligosoma longipes*
	Naultinus 'North Cape'	*Oligosoma microlepis*
	Naultinus e. elegans	*Oligosoma waimatense*
	Naultinus e. punctatus	
	Naultinus gemmeus	
	Naultinus grayii	
	Naultinus manukanus	
	Naultinus rudis	
	Naultinus stellatus	
	Naultinus tuberculatus	
	Oligosoma aff. *lineoocellatum* 'South Marlborough'	
	Oligosoma chloronoton	
	Oligosoma infrapunctatum	
	Oligosoma ornatum	
	Oligosoma striatum	

Table 6 (*Continued*)

Coastal	Lowland/generalist	Montane/alpine
Recovering		
	Oligosoma alani	
	Oligosoma macgregori	
	Oligosoma townsi	
Relict		
Oligosoma acrinasum	*Hoplodactylus chrysosireticus*	
Oligosoma suteri	*Hoplodactylus duvaucelii*	
	Hoplodactylus nebulosus	
	Hoplodactylus pacificus	
	Oligosoma lineoocellatum	
	Oligosoma moco	
	Oligosoma oliveri	
	Sphenodon punctatus	
	Oligosoma aff. *infrapunctatum* 'crenulate'	
Naturally Uncommon		
	Hoplodactylus aff. *pacificus* 'Mokohinau'	*Hoplodactylus* aff. *maculatus* 'Kaikouras'
	Hoplodactylus aff. *pacificus* 'Poor Knights'	*Hoplodactylus* aff. *maculatus* 'Mount Arthur'
	Hoplodactylus aff. *pacificus* 'Three Kings'	*Hoplodactylus kahutarae*
	Oligosoma aff. *ornatum* 'Poor Knights'	
	Oligosoma fallai	
	Oligosoma hardyi	
Data Deficient		
	Hoplodactylus 'Okarito forest gecko'	*Hoplodactylus* aff. *granulatus* 'Cupola'
	Hoplodactylus aff. *stephensi* 'Coromandel'	*Oligosoma* aff. *inconspicuum* 'Nevis'
	Oligosoma 'Whirinaki'	*Oligosoma pikitanga*
	Oligosoma aff. *inconspicuum* 'Okuru'	
	Oligosoma levidensum	
Not Threatened		
Oligosoma smithi	*Hoplodactylus* aff. *maculatus* 'Marlborough mini'	*Hoplodactylus* aff. *maculatus* 'Central Otago'
	Hoplodactylus aff. *granulatus* 'southern North Island'	*Hoplodactylus* aff. *maculatus* 'Cromwell'
	Hoplodactylus granulatus	*Hoplodactylus* aff. *maculatus* 'pygmy'
	Hoplodactylus maculatus	*Hoplodactylus* aff. *maculatus* 'Southern Alps'
	Oligosoma aeneum	*Hoplodactylus* aff. *chrysosireticus* 'southern mini'

Table 6 (*Continued*)

Coastal	Lowland/generalist	Montane/alpine
	Oligosoma aff. *polychroma* Clade 2	*Oligosoma* aff. *inconspicuum* 'Eyres'
	Oligosoma aff. *polychroma* Clade 3	*Oligosoma notosaurus*
	Oligosoma aff. *polychroma* Clade 4	
	Oligosoma aff. *polychroma* Clade 5	
	Oligosoma inconspicuum	
	Oligosoma maccanni	
	Oligosoma nigriplantare	
	Oligosoma polychroma	
	Oligosoma zelandicum	

Despite this, we were of the opinion that the Macraes Flat recovery did not yet fit the definition that 'the population is increasing (>10%) and is predicted to continue to increase over the next ... three generations' (Townsend et al. 2008, p. 27): we considered that it had not yet progressed far enough to offset the declines in other parts of the species' ranges. Therefore, these species both remain Nationally Critical.

The public submissions on *N. gemmeus* provided information for only the Otago Peninsula population, arguing that it should be regarded as taxonomically distinct. We did not agree, instead regarding the species as including populations from Banks Peninsula southwards (Gill & Whitaker 1996). While we shared the submitters' concerns about declines, there are numerous, widespread records from Canterbury as well as some from western Otago, so Otago Peninsula represents only a small proportion of this species' range and population. For this reason, it did not fit the criteria for any Threatened category, but was listed as At Risk—Declining.

There is some risk of circular logic in our analysis of relationships between threat category and biological variables (Table 4). Ecological and taxonomic similarity to better known species was used to infer likely rates of decline, and therefore place some taxa into threat categories. However, we consider it very unlikely that the strong relationships detected between extinction risk and large body size, terrestrial activity and residence in the South Island are artefacts. Although no statistical difference between the status of skinks or geckos was detected, skinks were heavily overrepresented in the most threatened categories (all six Nationally Critical taxa and two of the three Nationally Endangered taxa). In addition, all three Recovering taxa were skinks that had been severely threatened before management intervention began (Towns 1992, 1999).

The strong and significant geographical bias (of the 17 Threatened lizard taxa, 14 are from south of Cook Strait, including all six Nationally Critical species) has several possible explanations:

- the greater number of pest-free islands near the North Island than the South Island, providing secure refugia for North Island taxa;
- a longer history of active management of threatened lizards on northern offshore islands;
- the generally lower topography of the North Island, meaning that almost the full range of mainland habitats is replicated on off-shore islands, whereas the alpine habitats common in the South Island and occupied by several species of lizards are present on few islands;
- cooler temperatures resulting in lower intrinsic rates of population increase in the south, because of lower reproductive rates and slower maturity.

In contrast, all three recovering species are from the North Island, reflecting the existence of a dedicated recovery group and recovery plans (Towns 1992, 1999) since 1992. This is also the likely explanation for the statistical over-representation of At Risk taxa on islands (including Recovering and also secondarily island endemic Relict and primarily island endemic Naturally Uncommon taxa), and under-representation of Threatened taxa on islands.

Apart from the separation of the marine and terrestrial components of the fauna, there are no absolute distinctions in habitat zone among reptile species—many species are generalists with broad ranges from the coast to the mountains. However, it is possible to identify an exclusively or almost exclusively coastal/littoral set of species, a set that is primarily or entirely montane to alpine, and a lowland or generalist group (Table 6). There is no obvious pattern of risk of extinction associated with these zones.

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References

Bell TP, Patterson GB 2008. A rare alpine skink *Oligosoma pikitanga* n. sp. (Reptilia: Scincidae) from Llawrenny Peaks, Fiordland, New Zealand. Zootaxa 1882: 57–68.

Chapple DG, Patterson GB 2007. A new skink species (*Oligosoma taumakae* sp. nov.; Reptilia: Scincidae) from the Open Bay Islands, New Zealand. New Zealand Journal of Zoology 34: 347–357.

Chapple DG, Daugherty CH, Ritchie PA 2008a. Comparative phylogeography reveals pre-decline population structure of New Zealand *Cyclodina* (Reptilia: Scincidae) species. Biological Journal of the Linnean Society 95: 388–408.

Chapple DG, Patterson GB, Bell T, Daugherty CH 2008b. Taxonomic revision of the New Zealand Copper Skink (*Cyclodina aenea*; Squamata: Scincidae) species complex, with description of two new species. Journal of Herpetology 42: 437–452.

Chapple DG, Patterson GB, Gleeson DM, Daugherty CH, Ritchie PA 2008c. Taxonomic revision of the marbled skink (*Cyclodina oliveri*, Reptilia: Scincidae) species complex, with a description of a new species. New Zealand Journal of Zoology 35: 129–146.

Chapple DG, Hitchmough RA 2009. Taxonomic instability of reptiles and frogs in New Zealand: information to aid the use of Jewell (2008) for species identification. New Zealand Journal of Zoology 36: 60–67.

Chapple DG, Ritchie PA, Daugherty CH 2009. Origin, diversification, and systematics of the New Zealand skink fauna (Reptilia: Scincidae). Molecular Phylogenetics and Evolution 52: 470–487.

de Lange PJ, Norton DA, Courtney SP, Heenan PB, Barkla JW, Cameron EK, Hitchmough RA, Townsend AJ 2009. Threatened and uncommon plants of New Zealand (2008 revision). New Zealand Journal of Botany 47: 61–96.

Department of Conservation 2009. Department of Conservation Statement of Intent 2009–2012. Wellington, New Zealand, Department of Conservation. 38 p.

Gill B, Whitaker T 1996. New Zealand frogs and reptiles. Auckland, New Zealand, David Bateman Ltd.

Gill BJ 1997. Records of turtles and sea snakes in New Zealand, 1837–1996. New Zealand Journal of Marine and Freshwater Research 31: 477–486.

Graham JB, Rubinoff I, Hecht MK 1971. Temperature physiology of the sea snake *Pelamis platurus*: an index of its colonization potential in the Atlantic Ocean. Proceedings of the National Academy of Sciences USA 68 (6): 1360–1363.

Greaves SNJ, Chapple DG, Daugherty CH, Gleeson DM, Ritchie PA 2008. Genetic divergences predate Pleistocene glacial cycles in the New Zealand speckled skink, *Oligosoma infrapunctatum*. Journal of Biogeography 35: 853–864.

Greaves SNJ, Chapple DG, Gleeson DM, Daugherty CH, Ritchie PA 2007. Phylogeography of the spotted skink (*Oligosoma lineoocellatum*) and green skink (*O. chloronoton*) species complex (Lacertilia: Scincidae) in New Zealand

reveals pre-Pleistocene divergence. Molecular Phylogenetics and Evolution 45: 729–739.

Hare KM, Daugherty CH, Chapple DG 2008. Comparative phylogeography of three skink species (*Oligosoma moco*, *O. smithi*, *O. suteri*; Reptilia: Scincidae) in northeastern New Zealand. Molecular Phylogenetics and Evolution 46: 303–315.

Hay JM, Sarre SD, Lambert DM, Allendorf FW, Daugherty CH 2010. Genetic diversity and taxonomy: a reassessment of species designation in tuatara (*Sphenodon*: Reptilia). Conservation Genetics 11 (3): 1063–1081.

Heatwole H, Busack S, Cogger H. 2005. Geographic variation in sea kraits of the *Laticauda colubrina* complex (Serpentes: Elapidae: Hydrophiinae: Laticaudini). Herpetological Monographs 19: 1–136.

Hitchmough R (comp.) 2002. New Zealand Threat Classification System lists—2002. Threatened Species Occasional Publication 23. Wellington, New Zealand, Department of Conservation. 210 p.

Hitchmough R, Bull L, Cromarty P (comps) 2007. New Zealand Threat Classification System lists—2005. Wellington, New Zealand, Department of Conservation. 194 p.

Jewell T 2007. Rangitata pygmy gecko discovered on Mt Harper. Forest & Bird 326: 4.

Jewell T 2008. A photographic guide to reptiles and amphibians of New Zealand (Photographs by R. Morris). Auckland, New Zealand, New Holland Publishers Ltd.

Joseph LN, Maloney RF, Possingham HP 2008. Optimal allocation of resources among threatened species: a project prioritisation protocol. Conservation Biology 23: 328–338.

Lettink M 2008. Lizard survey of the Lake Heron basin and upper Rangitata River catchment, Raukapaka Area. Unpublished Report, Raukapuka Area Office, Department of Conservation, Geraldine, New Zealand. 25 p. + maps.

Lettink M 2009. Lizard survey and monitoring in O Tu Wharekai Wetland Management Area, Raukapuka Area: 2009. Unpublished Report, Raukapuka Area Office, Department of Conservation, Geraldine, New Zealand.

Liggins L, Chapple DG, Daugherty CH, Ritchie PA 2008a. Origin and post-colonization evolution of the Chatham Islands skink (*Oligosoma nigriplantare nigriplantare*). Molecular Ecology 17: 3290–3305.

Liggins L, Chapple DG, Daugherty CH, Ritchie PA 2008b. A SINE of restricted gene flow across the Alpine Fault: phylogeography of the New Zealand common skink (*Oligosoma nigriplantare polychroma*). Molecular Ecology 17: 3668–3683.

Miskelly CM, Dowding JE, Elliot GP, Hitchmough RA, Powlesland RG, Robertson HA, Sagar PM, Scofield RP, Taylor GA 2008. Conservation status of New Zealand birds, 2008. Notornis 55: 117–135.

Molloy J, Bell B, Clout M, de Lange P, Gibbs G, Given D, Norton DA, Smith N, Stephens T 2002. Classifying species according to threat of extinction—a system for New Zealand. Threatened Species Occasional Publication 22. Wellington, New Zealand, Department of Conservation. 26 p.

Nielsen SV 2008. Molecular Systematics of the Geckos of New Zealand. Unpublished MSc thesis, Villanova University, Philadelphia, USA.

R Development Core Team 2007. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-003. http://www.R-project.org (accessed 20 March 2010)

Sokal RR, Rohlf FJ 1995. Biometrics. 3rd ed. New York, USA, W.H. Freeman.

Towns DR 1992. Recovery plan for Whitaker's skink and robust skink. Threatened Species Recovery Plan 3. Wellington, New Zealand, Department of Conservation. 48 p.

Towns DR 1999. *Cyclodina* spp. skink recovery plan 1999–2004. Threatened Species Recovery Plan 27. Wellington, New Zealand, Department of Conservation. 69 p.

Townsend AJ, de Lange PJ, Miskelly CM, Molloy J, Norton DA 2008. New Zealand Threat Classification System Manual. Wellington, New Zealand, Department of Conservation. 35 p.

Vallarino O, Weldon PJ 1996. Reproduction in the yellow-bellied sea snake (*Pelamis platurus*) from Panama: field and laboratory observations. Zoo Biology 15 (3): 309–314.

Venables WN, Ripley BD 2002. Modern applied statistics with S. 4th ed. New York, USA, Springer-Verlag.

Worthy TH 1991. Fossil skink bones from Northland, New Zealand, and description of a new species of *Cyclodina*, Scincidae. Journal of the Royal Society of New Zealand 21: 329–348.