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Changes in abundance and distribution of the rock wren (*Xenicus gilviventris*) in the South Island, New Zealand

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Abstract We collected and collated more than 2100 records of the rock wren *Xenicus gilviventris*, covering the period 1912-2005. These records allowed past and present distribution patterns to be mapped and compared. Areas from which birds have apparently disappeared were identified. The rock wren was common once on mountain ranges along or close to the Southern Alps, South Island, New Zealand, but has been recorded less frequently in many areas after 1980. More numerous records from some areas and during some decades could have resulted from differences in search effort and from inconsistency in record keeping. Nevertheless, there were consistent anecdotal accounts of decline, evidence of predation by stoats and mice, unsuccessful searches in previous strongholds and the recent extinction of 5 confamilial species which indicate that the rock wren should be regarded as a threatened species.

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INTRODUCTION

The rock wren (*Xenicus gilviventris*: Acanthisittidae) is a diminutive, ground-feeding subpasserine found presently only in mountains in or near the Southern Alps, South Island, New Zealand. It remains above tree line throughout its life, and at present is the only true alpine bird in New Zealand. It occupies a specialised niche in an environment characterized by harsh climatic conditions and rugged terrain.

The Acanthisittidae (New Zealand wrens) is an ancient lineage, part of the early radiation of songbirds that until 1000 years ago included at least 7 species in 5 genera. As a result of predation by introduced mammals, only the rock wren and the rifleman (*Acanthisitta chloris*) remain. There are 4 avian families endemic to New Zealand (Apterygidae, Acanthisittidae; Callaeatidae; Notiomystidae; Jones *et al*. 2007). Sibley & Alquist (1982) suggested from DNA-DNA hybridization studies of New Zealand wrens and other passerines, that the Acanthisittidae are suboscines (suborder Oligomyodi), and that they are sufficiently distant from other suboscine passerines to warrant recognition as a separate infraorder, the Acanthisittides.

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More recently, it has been suggested (Edwards & Boles 2002; Ericson *et al*. 2002; Barker *et al.* 2002) that these taxa are the sole survivors of the sister group to all other passerines. The New Zealand wrens therefore have no extant close relatives. Additionally, their separation at infraordinal level makes the group one of the most significant in the New Zealand avifauna as well as being one of the most genetically isolated bird assemblages in the world.

It is only with the recent phylogenetic work that the true significance of the Acanthisittidae has been recognised. That lack of appreciation has, along with the logistic difficulties of working in alpine areas, meant that there has been surprisingly little scientific study of the rock wren. Only a dozen or so authors have published research on the rifleman, the only other surviving New Zealand wren, and that has been on their general biology and behaviour; apart from the atlases produced by the Ornithological Society of New Zealand we .know of no investigation of trends in abundance or distribution. The literature on the rock wren is even more limited, being restricted to Riney's (1953) work on the Fiordland population and the feeding, habitat, and reproductive studies of Michelsen (1982), Heath (1986), and Michelsen-Heath (1989).

Several naturalists, including Rod Morris, Rhys Buckingham, David Massam, Hugh Wilson, and Peter Child, compiled valuable collections of field notes and sighting records (mostly during the 1970s and 1980s), which were used in this study. Recent work published internally by the Department of Conservation includes an account of a translocation to Anchor Island (Willans & Weston 2005; Weston 2006), and a study of trends in abundance and predator impacts (Willans 2007). Studies in the Henderson Basin, Kahurangi National Park by Rod Hay, Alison Ballance, and others, have been continued by Golden Bay members of the Nelson Region, Ornithological Society of New Zealand (Stocker *et al*. 2006).

Since the early 1990s, anecdotal reports have suggested that rock wren have declined in numbers in many areas and of their absence from areas where they once were common. Michelsen-Heath (1989) and Willans (2007) identified mice (*Mus musculus*) and stoats (*Mustela erminea*) as predators of rock wren eggs and young. Although the extent and effect of predation by introduced mammals on rock wren has not been investigated, it has been devastating for most endemic hole-nesters on the mainland of New Zealand (O'Donnell 1996). A recent study in the Murchison Mountains (Willans 2007) compared abundance of rock wren with that recorded during the intensive research by Michelsen-Heath (1989), and showed a 44% decline over 20 years.

Rock wren are usually found in alpine basins. This habitat, the bird's weak flight, persistent home ranges, and its ground-feeding habit promote a disjunct distribution and hence a potential vulnerability to local extinction. The rock wren is listed as 'Nationally Vulnerable' in the New Zealand Threat Classification (Hitchmough 2002). By collecting and collating as many distributional data as possible, we hoped to provide a more rigorous assessment of changes in the abundance and distribution of rock wren.

METHODS

Data sources

The analysis was based on records of rock wren in the Department of Conservation's Bioweb database. To these records were added others from the following sources: Bull *et al.* (1985: microfiche); Department of Conservation Banding Office records; South Island tramping and alpine clubs trip reports; New Zealand Alpine Club journal; Classified Summarised Notes featured in *Notornis*; Tenure Review reports from the Department of Conservation; and field notes and personal communications volunteered by private individuals. A significant number of records and important ecological information came from the field notes of Rod Morris, Hugh Wilson and the late Peter Child; the research findings of Michelsen-Heath; and the field notes of members of the Takahe Recovery Programme, Murchison Mountains, Fiordland National Park.

During early 2004, we interviewed Department of Conservation field staff at offices responsible for significant areas of alpine habitat, which were headquarters for major high-country tramping routes, or which were known to have (or to have had) programmes for recording information about rock wrens. Staff were asked about any apparent trends in the abundance of rock wrens, and whether they were still being seen in areas where they had been seen in the past. Additionally, all relevant log books and other archived field notes were searched for records of rock wrens or for pertinent ecological data. In many instances, we were referred to other reliable observers.

Database and mapping

All records were entered in a Microsoft® Excel file. Locations of sightings were entered as metric 7-figure grid references; dates were standardised in an 8-digit format to allow sorting of records. All ecological information associated with records was also recorded. At the end of the project, all additional records were included Bioweb database. New records will be added to the database.

All rock wren sightings were plotted on a map with 10 km × 10 km grid squares, similar to those used by the Ornithological Society of New Zealand's bird mapping schemes. Maps were produced with ESRI-ARC-GIS, using the spatial analyst extension.

Field investigations

Two sites in the Murchison Mountains, Fiordland National Park, were visited in Feb 2004 and the frequencies of sightings were compared to those accumulated by the Takahe Recovery Project team in 1982-1987 and M-H's unpublished data. Two areas (Homer Tunnel and Gertrude Valley, both in the Darren Mountains, Fiordland National Park, and the Lead Hills and Quartz and Douglas Ranges, Kahurangi National Park) where there had been consistent reports of declines in rock wren numbers were also searched, in Feb 2004 and Mar 2004, respectively. Some areas where rock wren had not been recorded during the previous 20 years were searched in Mar 2005.

RESULTS

In total, of 2167 rock wren records were examined, of which 615 were in the existing Bioweb database and the remaining 1552 records were accumulated during this study (Table 1).

Variation in abundance

The study by Willans (2007) has recently provided compelling evidence of a decline in abundance ove a 20-year period. However, changes in abundance could not be demonstrated so well from our study.

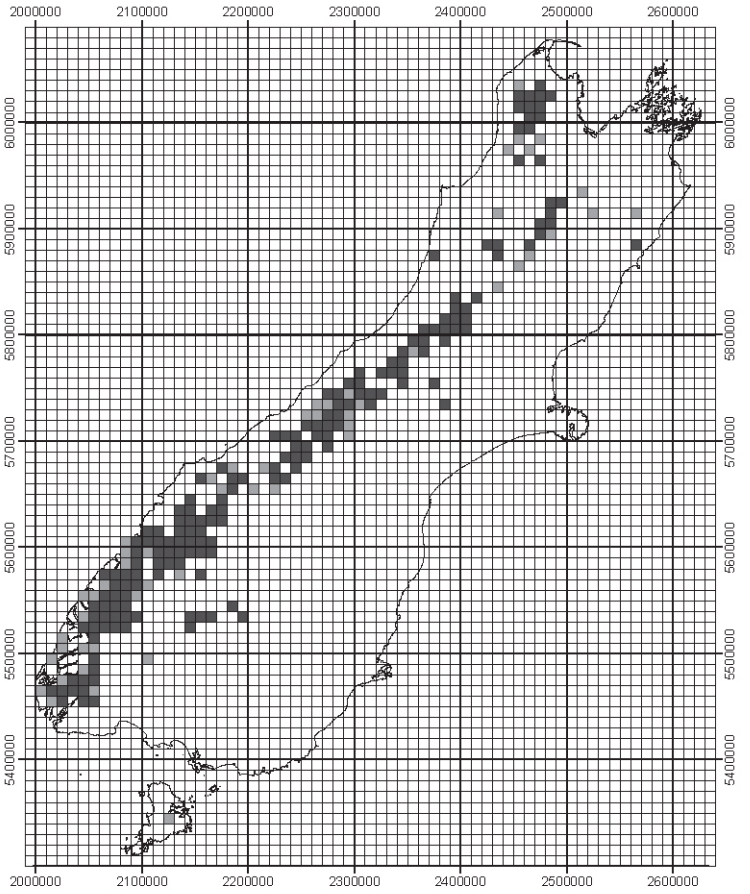

Fig. 1 The 10 km × 10 km New Zealand map grid squares from which rock wren (*Xenicus gilviventris*) have been recorded. The lighter squares are those from which no records were received since 1984.

For example, whereas Ballance (1989) reported at least 9 pairs of rock wrens and possibly up to 29 individual birds in Henderson Basin, Kahurangi National Park, the same area was been searched annually from 2000 (Stocker *et al*. 2006) and numbers were always less than those reported by Ballance: they also varied greatly between visits. No other investigation has included repeated searchs. Before 1986, 2.6% of all sightings where number of birds seen was recorded were for > 2 birds; after 1986, it was 3.4% but the difference was not significant. The inconsistent detectability of the species means that these values should be treated with caution.

Changes in abundance may be better measured by changes in the rate at which records were contributed. Our records include observations from 1 Apr 1912 to 7 Mar 2004, but only 4 rock wrens were recorded before 1946. For the 30 years after 1946, there were a further 280 records (12.9% of all records). In the next 20 years (1976-1995, inclusive), there were 1616 sightings (74.6% of all records). The remaining 267 records (12.3% of total) are from the 9 years between the beginning of 1996 and 2004. The peak recording period was 1986-1990 (inclusive), with 1116 rock wren records (51.5% of total) in only 5 years (Table 2).

Seasonal variation in recording rates is understandably marked, with most rock wren sightings (79%) being made in Nov-Feb. There were few sightings in winter and the 28 records in winter months (Jun, Jul, Aug) (Table 3) were made by only 20 observers.

Distribution - general

Records of rock wren of have not been distributed uniformly throughout the Southern Alps (Table 4). Most (76%) records were from Fiordland, Aspiring, and Aoraki/Mt Cook National Parks: 623 records were from the Murchison Mountains (Fiordland) where observers have been particularly active in association with research on the takahe (*Porphyrio hochstetteri*) and other species. Less than 2% of all records were from mountain areas away from the main dividing range of the Southern Alps (Paparoa National Park; Eyre, Kaikoura, and Takitimu Mountains). A single sighting of a rock wren on Mount Rakeahua, Stewart I, was reported by more

Table 1 Origin of records held in the rock wren (*Xenicus gilviventris*) database.

Source	Records
BIOWEB database	615
OSNZ atlas scheme	14
Notornis – Classified Summarised Notes	52
DoC Takahe Project team field notes	509
Peter Child notebooks	287
NZ Alpine Club and South Island tramping clubs	34
Michelsen-Heath (Mt Cook and Murchison Mountains)	153
Field reports - Rhys Buckingham (Kahurangi and Fiordland National Parks)	42
Banding records (other than by Michelsen-Heath)	12
Individual observers (*pers. comm.*)	30
Tenure Review and other DoC internal reports	10
Visits to DoC offices (field notes, unreported casual observations, etc.)	409
TOTAL	2167

Table 2 Changes in recording rates for rock wren (*Xenicus gilviventris*) 1912–2004.

Time interval	Records
Before 1900	0
1901-1915	1
1916-1920	0
1921-1925	1
1926-1930	0
1931-1935	0
1936-1940	1
1941-1945	1
1946-1950	24
1951-1955	31
1956-1960	46
1961-1965	27
1966-1970	36
1971-1975	116
1976-1980	281
1981-1985	219
1986-1990	761
1991-1995	355
1996-2000	137
2001-2004	130
TOTAL	2167

Table 3 Seasonal variation in the recording rates of rock wren (*Xenicus gilviventris*).

Month	Records	% total
Jan	523	24
Feb	426	20
Mar	222	10
Apr	128	6
May	31	1
Jun	3	<1
Jul	12	<1
Aug	12	<1
Sep	11	1
Oct	33	2
Nov	323	15
Dec	443	20
TOTAL	2167	100

than 1 person but must remain questionable as there are no other records of rock wren on the island.

Regional summary

Kahurangi National Park Rock wren have been recorded in widely distributed places in the national park and have been studied in Henderson Basin since the mid-1980s (Ballance 1989; Stocker *et al*. 2007). Numbers of birds observed in Henderson Basin have varied considerably during this period. In the Douglas Range, Buckingham (2004) found only 1 bird in Mar 2004 when searching 19 sites where birds had been recorded within the last 20 years. Rock wrens have been recorded recently from Mt Arthur and at Mt Perry which are well outside the core range.

Nelson Lakes National Park Fourteen sightings of rock wren have been recorded from the park over the period of this study. These have been clustered in 2 areas: the head of the D'Urville River and east branch of the Matakitaki River, including Lake Ella and the Waiau Pass; the eastern flanks of the Travers Range, including Mt Travers, Cupola Basin, and the head of Hopeless Creek. Elsewhere, there are single records from the east branch of the Sabine River below Mount Franklin, the Robert Ridge, and 2 separate sites on the St Arnaud Range. Given the frequent visits to alpine regions in this national park, it is surprising that these outlying records have not been repeated. Earlier records are even more scant and there is nothing that suggests a change in range.

Kaikoura Mountains Four sightings were made during 1970-80. None has been recorded since.

Paparoa National Park There was a sighting of a rock wren on the Croesus Track in 1991. A recent search of this area (Tilson 2005) failed to find any rock wrens. There have been no others despite increasing public use of the park.

Lewis Pass There have been scattered records from the Lewis Pass and Victoria Range. Few sightings have been repeated at any of these locations. Three of the locations were searched recently (Tilson 2005), but no rock wrens were found.

Arthurs Pass National Park Department of Conservation staff reported no change in distribution and no apparent cause for concern, although this is based on anecdotal observations rather than systematic work or recorded observations.

Mt Cook National Park Alpine Guides Ltd reported that numbers appeared to have been stable in many areas whereas Department of Conservation staff believed that numbers had declined in the preceding years.

Mt Aspiring National Park – Glenorchy – Queenstown Rock wrens have been reported to be in lower numbers in some areas that are visited regularly. In Feb 2004 no birds were seen in areas of the Serpentine Range where they had been abundant before (Michelsen-Heath, *pers. obs*). Few records had been received in previous 20 years from the

Table 4 Geographical distribution of rock wren (*Xenicus gilviventris*) records.

Region of South I	Records
Kahurangi National Park	125
Nelson Lakes National Park	33
Kaikoura Mts (Seaward and Inland)	4
Victoria Forest Park	5
Paparoa National Park	1
Arthur's Pass National Park	145
N Canterbury high country + Canterbury /Westland divide	29
Westland and Westland/Tai Poutini National Park	99
Aoraki/ Mt Cook National Park	185
Landsborough/Hunter/Hopkins/Makarora	42
Mt Aspiring National Park	220
Eyre Mts	27
Murchison Mts	632
Takitimu Mts	1
Fiordland National Park (excluding Murchison Mts)	611
Rakiura National Park	1
Other	17
TOTAL	2167

Young and Wilkin Valley areas which Peter Child (*pers. comm*.) had described as a stronghold for the species in the 1970s. This may, however, result from a lack of observers rather than of birds.

Eyre Mountains In 2006, Jono More (*pers. comm*.) found 60 rock wren at 29 locations in the Eyre Mountains, at 1150-1500m a.s.l.

Takitimu Mountains Rock wrens have never been recorded in these mountains although there are areas of apparently suitable habitat. Their apparent absence may be a function of the distance from the main divide or just a lack of observer effort.

Fiordland National Park Rock wren have generally been reported to be in good numbers in most areas but around Homer Tunnel there were consistent reports of difficulty locating birds. In Feb 2004 M-H found only 2 birds on the Nature Trail after a 1.5-h search, whereas before 1995 > 4-6 birds could be located within a few minutes. Climbers and an eco-tour operator (Mark Hanger, *pers. comm*.) also reported fewer sightings and longer searches to locate birds in 2002-2004. In both the 2004/5 and 2005/6 summers, however, at least 3 birds were located easily after short searches (Chris Gaskin, *pers. comm.*).

Borland area and ranges to the south and east Rock wrens have never been recorded in these areas although there are areas of apparently suitable habitat.

Possible contraction of rock wren range

The distribution of rock wren as revealed from the database is presented in Fig. 1. Grid squares from which all rock wren records were made before 1984 are in lighter shading. Grid references, observers, and dates for these records are given in Table 5.

DISCUSSION

It is difficult to quantify changes in rock wren abundance because of the low and variable detections rates even when they are present. For example, although rock wren have been recorded from many locations along the Douglas Range in Kahurangi National Park, no tramping party has ever recorded them from >2 of these locations on any single trip. Most colour-banded rock wren in Henderson Basin (Kahurangi National Park) escaped detection on many visits before being re-sighted (Stocker *et al*. 2006).

At Henderson Basin has there been an attempt to develop a repeatable measure of rock wren abundance. The results, although variable over a 20-year period, suggest a 50% decline. The study by Willans (2007) compared 2 intensive studies, 20 years apart, and concluded that there had been a decline of 44%. An alternative measure of any such decline might be possible through changes in the frequency of occurrence, although this would be difficult given the poor probability of detection.

A contraction in the distribution of rock wrens may be inferred from the data we collected, and from the number and distribution of squares where rock wren were not encountered during the 20 years leading up to the study. These squares, which comprise 24% of the total coverage, may reflect less extensive field work, or a real contraction in range. As 67% of all records in the database were contributed during those 20 years, implying more rather than less observer effort, a contraction is more likely. Six sites that only had old records were re-checked and rock wrens were recorded from only 1 of the locations (Tilson 2005).

Patterns of visitor use in the South Island high country have changed and this may have affected the frequency and distribution of rock wren reports. John Cocks (Federated Mountain Clubs,

Table 5 Records of rock wren(*Xenicus gilviventris*) sightings from 10 km grid squares from which no further records have been made since 1984.

10 km square	Map reference	Location	Observer	Year
2450-6030	M26 556348	Gouland Downs		1972
2380-5800	K33 894073	Crow Valley	R. Jackson	1957
2450-5980	M27 516805	Mount Brilliant	Bob Cresswell	1981
2440-5970	L28 498784	Mayrick Ridge	Bob Cresswell	1981
2460-5970	M28 650770	Luna Lake	Neil Simpson	1980
2510-5930	N29 135-314	Silverstream	Bill Warner	1970
2520-5910	N30 267178	Saxton Saddle	A. Carpenter	1979
2560-5910	O29 663145	Inland Kaikoura Range	*Notornis 5(7)*: 233	1991
2430-5910	L30 334113	Victoria Range	Mike Harding	1972
2480-5890	M30 802989	L Thompson	B. Postill	1979
2460-5870	M31 663796	Above Ada Pass	Neill Simpson	1980
2460-5870	M31 653799	trib. of Maruia	Bob Cresswell	1979
2450-5860	M31 565649	Technical/Norma	Elliott & Walker	1979
2400-5800	M31 867696	Edwards Valley	J.R. Jackson	1966
2430-5840	L32 349433	Tutaekuri Valley	B. Munden	1955
2180-5650	F38 678451	Summit Mt Aeolus	Peter Child	1970
2290-5740	I35 966411	Summit of Aylmer	Mal Clarbrough	1977
2290-5740	I35 971485	Whymper hut	J. Nankervis	1978
2260-5730	H36 688376	Cook River	J.R. Jackson	1977
2270-5730	H36 715336	above La Perouse Glacier	J.R. Jackson	1953
2270-5730	H36 717355	lower Balfour Glacier	Alan Cragg	1980
2270-5730	H36 717382	Craig's Peak (north face)	J.R. Jackson	1962
2300-5730	I36 032357	Rutherford Stream	Philip Temple	1977
2250-5720	H36 564219	Conical Hill/Douglas	Alan Cragg	1980
2260-5720	H36 619202	Douglas River	Alan Cragg	1980
2260-5720	H36 668222	Splinter Pk (west side)	Sue Michelsen-Heath	1979
2290-5720	I36 929284	Murchison River	Mal Clarbrough	1979
2260-5710	H36 633129	Landsborough (near Rubicon)	Sue Michelsen-Heath	1979
2290-5710	I36 932119	Fraser Stream	Rhys Buckingham	1982
2290-5700	I36 932087	Fraser Stream	Rhys Buckingham	1982
2150-5670	E38 567713	Lake McArthur	T. Riney	1953
2180-5670	F38 831784	Haast-Jacksons Bay	DG	1972
2210-5670	G38 129732	Head of South Fish River	P. Child	1974
2160-5660	E38 649643	Head of Fraser	Lynnette Hartley	1982
2170-5650	F38 795515	Top of peak 7140	Philip Temple	1980
2210-5650	G38 108532	Makarora Valley	*Notornis 1(7)*: 79 G.C. Hole	1941
2220-5650	G38 238-534	Hunter tops	Ian Sargerson	1979
2130-5630	E39 382-301	Forgotten River headwaters	Clelland &Burke	1972
2080-5600	D40 911-029	Transit River	Aspinall	1975
2080-5590	C40 849-958	Cameron Mts (S. of Rugged Mt)	R Buckingham	1975
2080-5580	C41 884-849	Head of Dark River	R Buckingham	1975
2120-5570	D41 293-740	mid Greenstone River	A. Austin	1982
2130-5570	E41 366-768	5510-Home Hill	R Buckingham	1982
2060-5560	C41 672-612	Leslie clearing	Lysaght	1970
2100-5560	D41 018-649	Billy Burn	Feasey	1970
2040-5550	B42 471-550	Irene River	Knight	1972
2050-5550	C42 572-550	Lake Shirley	Given	1969
2040-5530	B42 410-347	Lyall Bay	Hitchings	1958
2020-5510	B43 275-155	Dagg Sound	P. Dorizac	1960
2060-5510	C42 636-185	Te Au-Robin Saddle	P.J. Forsyth	1982
2020-5500	B43 213-034	Lake Beattie	MacRae	1965
2050-5500	B43 511-005	Seaforth River	John Burton	1975
2010-5480	B44 185-837	Mount Clark, Resolution Island	Sutherland	1955
2100-5490	D44 086-960	Takitimu Mtns	*Notornis 7*: 3	1955
2040-5480	B44 489-811	Heath Mts, below Seaforth	R. Buckingham	1975
2020-5470	B44 271-735	Oho Creek	Lloyd & Morrison	1983
2120-5340	D48 223-498	Mt Rakeahua	*Notornis 5 (6)*: 196	1936

pers. comm.) reported changes in attitudes and aspirations amongst climbers. Different climbing styles are now evident: the "pioneer", exploratory approach to climbing in remote areas may be less fashionable, and young adults are apparently less interested in climbing and tramping than in other

sports. Some areas and routes are now less popular, and new tracks have been established in new areas. Ecotourism now competes with climbing as a major use of the back-country. Tramping in turn competes with kayaking, white-water rafting, and other adventure sports.

The number of rock wren sightings in Aoraki/Mount Cook National Park has declined markedly since the 1980s and early 1990s, but this may reflect changing park management styles rather than declining rock wren numbers. The lower number and different distribution and foci of observers in rock wren habitat during the 20 years to 2005 was matched by a change in the culture of staff employed in national parks. For example, in the 1970s and 1980s at Mount Cook National Park, many staff were engaged in outdoor education programmes throughout the summer. Also, during that period, more staff were involved in regular hut and track maintenance programmes and they regularly moved about the park on foot.

Since the mid-1990s, different priorities have led to these activities being reduced and fewer Department of Conservation staff familiar with field conditions and rock wren habitat have spent much time on programmes that provide adequate opportunities to search for and observe rock wrens. Activities such as completion of faunal and botanical surveys have been reduced both in frequency and effort.

The rate of recording may also have been affected by the status of recording systems (regional and national databases) and whether people in appropriate situations were encouraged to contribute. There has been no nationally co-ordinated recording scheme since the mid-1990s apart from the Ornithological Society of New Zealand's atlas scheme: results from that were not available for inclusion in this study.

Despite these factors, there were twice as many records for the period 1986-2004, inclusive, than for the preceding 20 years. However, recording rates for the 2 periods are similar if the more than 600 records from the targeted work in the Murchison Mountains are excluded. The apparent contraction in range we discovered should be a spur to efforts to ascertain the real present status and trajectory of the rock wren populations. The only contribution so far is that of Tilson (2005), who visited 6 sites where rock wren had not been recorded for more than 20 years and was able to find the species in only one.

The evidence presented here is obviously less than conclusive, but it is likely that rock wren are now absent from parts of their former range. Given the confirmed evidence of eggs, nestlings, and adult rock wrens being preyed on by mice and stoats (Michelsen-Heath 1989), the extinction of 5 confamilial species from predation and the history of other endemic species declining as a result of predation at the nest (O'Donnell 1996), it is reasonable to assume that the rock wren is similarly endangered.

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