Black-eyed geckos *(Hoplodactylus kahutarae)* on Mt Arthur, Kahurangi National Park

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Abstract

The black-eyed gecko *(Hoplodactylus kahutarae* Whitaker 1984), of eastern Marlborough, is arguably NZ's only alpine lizard, inhabiting cliffs and bluffs between 1,250 and 2,200 m asl. In January 1998 a black-eyed gecko was discovered at Eyles Creek on Mt Arthur, Kahurangi National Park, 120 km north-west of its previously known range. A follow up survey in March revealed that population density at the locality is comparable to that at the highest density sites on the Seaward Kaikoura Range. Structurally the habitat on Mt Arthur (deeply creviced bluffs and cliffs) is very similar to that at previous sites but the lithology is markedly different (marble *cf.* greywacke) and represents a significant extension to the habitat definition.

Morphometric and genetic data from two specimens captured on Mt Arthur show minor differences from geckos from eastern Marlborough but the very small sample sizes limit interpretation. At this stage specific separation can not be justified.

The discovery of black-eyed geckos on Mt Arthur, and the different habitats they occupy, opens the possibility that they could occur on any South Island mountaintop. Distribution of potential habitat in north-west Nelson indicates they could occur throughout that region. There are no apparent threats to the gecko population. These factors combine to improve their conservation status but not sufficiently - at this stage - to warrant changing their DOC conservation priority ranking nor the IUCN *'Red List'* classification.

Recommendations include surveys on Mt Arthur for black-eyed geckos and 'forest geckos', the collection of more black-eyed gecko material for taxonomic and genetic research, and searches for black-eyed geckos in inland Marlborough and mid- to south Canterbury.

1. Background

The black-eyed gecko, *Hoplodactylus kahutarae* Whitaker 1984, is arguably New Zealand's only alpine lizard (Whitaker 1997). It is nocturnal and saxicolous, inhabiting alpine or subalpine bluffs and cliffs between 1,250 and 2,200 m asl in the mountains of eastern Marlborough.

The species is regarded as rare, perhaps because of the difficulties of working in the rugged and inhospitable terrain it inhabits rather than a true reflection of population density. In the 25 years since its discovery in 1970 - and despite a number of specific searches - fewer than 50 individuals have been seen. One of these geckos was in the Hodder Valley on the Inland Kaikoura Range (Clerke 1994) but the remainder were at four sites spread over 32 km of the Seaward Kaikoura Range between George Spur in the north and the Kahutara Saddle in the south (Sherley 1988,Whitaker 1991 and 1992). One of

the 5 sites listed by Whitaker (1992) was for a dead black-eyed gecko found washed down the Hapuku Rivers. This hardly constitutes a precise locality for the species and, as it could easily have come from the headwaters of the north branch Hapuku River where the species is known to occur, has been discounted here.

Black-eyed geckos have been ranked in Category B for conservation priority by the Department of Conservation because of their presumed rarity and restricted range (Molloy & Davis 1994). The lack of obvious threats to these populations and the huge area of potential habitat available led the IUCN to assign the species a *lower risk, near threatened* (LRnt) ranking in the *`Red List'* for threatened species, i.e. a species which is close to being given a *vulnerable* (VU) ranking (IUCN 1996).

In a concerted attempt to redress the paucity of ecological data on black-eyed geckos, and to investigate the ecophysiological mechanisms that enable a small nocturnal lizard to survive such a harsh alpine environment, the Society for Research on Amphibians and Reptiles in New Zealand undertook a major field research project at the type locality on the Kahutara Saddle in February 1997. This study is yet to be fully reported. During eight days in the field, 18 black-eyed geckos were caught and several others seen (increasing the number of known sightings by about 40% to around 70) but the habitat definition for the species remains essentially unchanged.

With this apparent rarity and restricted range it was therefore a considerable surprise when, in January 1998, a juvenile black-eyed gecko was discovered by chance on Mt Arthur in Kahurangi National Park (Shaw 1998). A subsequent survey confirmed the presence of a population at the site. This discovery is not only remarkable because it is 120 km north-west of the nearest known locality but because it is on completely different geomorphology and lithology.

The purpose of this report is to record the details surrounding the original capture, the follow-up survey, and investigations into the genetic status of the new population. It discusses the implications of this new population with respect to the conservation of black-eyed geckos and makes recommendations about the need for further surveys and research.

2. Field study

2.1 METHODS

General

Grid references, expressed in New Zealand Map Grid (NZMG), and altitude (m) are derived from the 1:50,000 topographical map series NZMS 260, sheet M27 Mount Arthur.

Morphometric measurements were made on live animals. Measurements of body length were made with a ruler to 1 mm; measurements of head dimensions were made with dial callipers to 0.1 mm; measurements of weight were made with a Pesola™ spring balance to 0.1 g.

19-21 January 1998

The January survey was set up to search the northern slopes of Mt Arthur for a number of rare plant and animal species known from sub-alpine karst habitats (Shaw 1998), including one of the taxa within the *Hoplodactylus maculatus* cryptic-species complex that is believed to be endemic to the area (Hitchmough 1997). The occurrence of black-eyed geckos in the area was not expected and thus the methods used are not the most appropriate for this nocturnal, saxicolous species.

Only daytime searching was undertaken. The search team was spread out at approximately 20 m intervals and moved slowly over the slopes searching potential lizard and invertebrate cover. This involved moving stones in argillite screes, lifting loose slabs of marble, examining rock crevices, and fossicking through the dry leaf bases of mountain flax *(Phormium cookianum),* tussocks *(Chionochloa* spp.), and astelias *(Astelia* spp.). Any stones that were turned were carefully returned to their original positions. The search also included looking for the sign of lizard occurrence such as droppings or fragments of sloughed skin. The positions of significant finds were plotted using a Trimble Scoutmaster™ GPS.

The total search area covered approximately 130 ha, straddling the watershed of the Arthur Range southwards from the Mt Arthur Hut (NZMG 24860 60010) to the headwaters of Horseshoe Basin (NZMG 24838 60988), and extending 150-250 m asl below it on both sides.

Seven people were involved in the January survey but only three (including TS) had previous experience of searching for geckos. Approximately 120 person hours of searching were achieved.

12-13 March 1998

The March survey was specifically to search for black-eyed geckos in the vicinity of the site where the specimen was found in January (NZMG 24856 60000).

Black-eyed geckos are strongly nocturnal, passing the day hidden deep in inaccessible crevices and emerging after dark to forage on rock faces and cliffs. The method used in March -'spot-lighting'- is the only one proven to be successful for locating the species elsewhere in its range (Whitaker 1991 and 1992).

Nocturnal geckos can be located by 'eye-shine' when torch-light is reflected from the tapetum lucidum in their eyes (Whitaker 1967 and 1994). Geckos' eyes are small and their pupils contract rapidly when light is shone on them, thus limiting the reflections. Best results are therefore obtained when the light source is close to the observer's line of sight and when light levels are

relatively low. This is most easily achieved by using a spotlight mounted on binoculars to give a coincident line of light and line of sight, and an electronic current regulator to enable the light levels to be adjusted according to the range being searched. Equipment of this kind is particularly effective for locating geckos occupying inaccessible habitats or those that are difficult to search, where population densities are very low, or where the species are cryptic. It has been used successfully for detecting black-eyed geckos over the range 10-100 m. Once a gecko has been located it is kept under observation while an assistant is directed to the site to identify or capture it.

During night searching the ambient air temperature (using a Ama-Digit AD 15TH™ electronic thermometer), wind speed and direction, and cloud cover were recorded at approximately hourly intervals (see Appendix 8.1).

A brief period of daytime searching (18:45 to 19:45 hr) was undertaken on out-cropping marble using the same search techniques as those in January (see above). The night searching with specialist equipment was from 20:37 to 00:20 hr.

Two people were involved in the March survey, only one of whom (TW) had previous experience with the search techniques and carried appropriate search equipment. The total search time was 2 person hours by day and effectively only 3.75 person hours at night.

2.2 RESULTS

Capture details

Two black-eyed geckos were captured during this study and three other geckos were seen that are presumed to be the same species.

At 11:10 hr on 21 January 1998 a sub-adult male black-eyed gecko was found beneath a loose marble slab in an area of exposed rockland in the headwaters of Eyles Creek (NZMG 24856 60000, elevation 1,320 m). This animal has been humanely killed as a voucher specimen and is now in the national herpetological collection at the Museum of New Zealand-Te Papa Tongarewa (specimen number NMNZ R2518).

At 22:19 hr on 12 March an adult male black-eyed gecko was captured as it foraged on a steep, shattered marble bluff approximately 60 m south of the site where the gecko was caught in January. It was detected by its eye reflections from approximately 60 m distance and made no attempt to move away when approached. At the time of capture the air temperature was 9.2 °C and intermittent mist was enveloping the site. This animal has been toe-clipped according to standard protocols, to collect tissue material for genetic analysis, and is now marked 4/0/4/0. It is currently being retained in captivity pending the final results of genetic testing and decisions on future research.

Between 23:15 and 22:30 hr on 12 March three different geckos were detected by their eye reflections as they foraged on a cliff face 40 m south of, but continuous with, the bluff where the black-eyed gecko was found an hour

earlier. These animals were about 4-6 m apart, approximately half way up a well-creviced, vertical cliff face that was about 15-18 m high. From their habitat, behaviour and especially from their eye reflections (large, bright, and red) they were almost certainly black-eyed geckos as well.

Habitat

The site where the black-eyed geckos were found - on a steep, south-facing slope, roughly mid-way between the ridge at 1,380 m and the bed of Eyles Creek at 1,280 m - is typical of the karst landscape on the Mt Arthur massif. Towards the ridge crest the exposed marble surface is more or less parallel with the slope, loose slabs and stones are numerous, and alpine vegetation is low and sparse. Lower on the slope, at around the elevation the geckos were found, the slope becomes more broken, with more prominent outcrops, small dolines, and larger patches of sub-alpine vegetation. Below this, and immediately above Eyles Creek, are still larger bluffs and cliffs.

Karst habitat of this nature occurs widely across the Mt Arthur massif from north of Mt Arthur to south of The Twins. Exposed marble rock surfaces and outcrops, semi-continuous with the outcrop where the black-eyed geckos were found, are particularly extensive on the eastern slopes in the vicinity of Winter Peak and in the headwaters of Horseshoe Basin

Population density

On the reasonable assumption that the three unidentified geckos observed on a cliff face in March were in fact black-eyed geckos, the five geckos found on Mt Arthur were distributed over approximately 100 m of more or less continuous habitat. The encounter rate - a crude measure of relative density - in January was one gecko in about three person hours of daylight searching. In March the encounter at night was four geckos in 3.75 person hours or roughly one per hour.

Behaviour

When the sub-adult black-eyed gecko was captured in January it was very aggressive and vocal. This aggression and readiness to call when handled was markedly greater than in other *Hoplodactylus* species. It did not diminish during the five-month period it was held in captivity despite relatively frequent handling.

In captivity, the sub-adult gecko spent considerable periods basking most sunny days. This basking was always close to cover but typically involved the exposure of more than half the animal's body to the sun.

Morphometrics

Morphometric data from the two black-eyed geckos collected on Mt Arthur are listed in Appendix 8.2. The gecko captured in January appears to be sub-adult male. The gecko captured in March is an adult male but at 75 mm SVL it is smaller than animals from the Seaward Kaikoura Range identified as adult males (79-86 mm, N=8).

Sympatric geckos

'Mt Arthur geckos' *(Hoplodactylus* n.sp. `Mount Arthur', *sensu* Hitchmough 1997) were found at six sites distributed throughout the study area (see Appendix 8.3). These sites ranged from 1,280 to 1,500 m in altitude and included two quite distinct habitats: 1) screes composed of small angular stones of argillite, and 2) exposed marble and marble-slab surfaces (karst) occurring as a mosaic with sub-alpine shrubland in which the dominant plants were tussock *(Chionochloa* spp.) and various species of *Dracophyllum, Coprosma, Hebe* and *Cassinia* shrubs to about a metre in height. The relative density of 'Mt Arthur geckos' was much higher in argillite screes (up to 5 at one site) than beneath marble slabs (where only single geckos were found).

3. Genetic study

3.1 METHODS

Tissue samples were collected from both the black-eyed geckos captured on Mt Arthur for genetic analysis to determine the relationship of the new population to those in the Seaward Kaikoura Range and to closely related species. The tests were conducted on the autotomised tail from the gecko captured in January and from two toes removed from the animal caught in March.

Tissue samples were frozen in domestic freezers (- -12 °C) as soon as possible after collection and sent to Wellington within a few days in a thermally buffered container. In Wellington they were stored in an ultrafreezer at -80°C until they were processed.

DNA extracted from the tissue samples was subjected to PCR (polymerase chain reaction) techniques to amplify-make multiple copies of-sections of the mitochondria) 16s ribosomal RNA and cytochrome-b genes. The DNA base sequence of both these genes was then determined for each animal using an automated DNA sequencing machine. About 860 bases (there was some variation between specimens) of 16s gene and 314 bases of cyt-b were sequenced.

The genetic data were compared with DNA data from tissue obtained from two black-eyed geckos captured in the Seaward Kaikoura Range in 1991. Additional material (toes) collected from black-eyed geckos in the Seward Kaikoura Range in 1997 is available but has not yet been processed. They were also compared with DNA sequences from all named species of New Zealand geckos, plus some related New Caledonian and Australian species.

3.2 RESULTS

Both allozyme and DNA data from tissue obtained from two black-eyed geckos captured in the Seaward Kaikoura Range in 1991 show black-eyed geckos to be much more closely related to 'forest geckos' *(Hoplodactylus granulatus*

sensu lato) than to any other species. The forest gecko *Hoplodactylus granulatus* Gray 1845 is now recognised as comprising a cryptic species complex of several allopatric taxa (Daugherty *et al.* 1994, Hitchmough 1997). The DNA data from the first Mt Arthur specimen (the only one analysed so far) show the same very close relationship with 'forest geckos'.

A table of percentage similarity for 16s and cyt-b sequences from the Mt Arthur black-eyed gecko (512), those from the Seaward Kaikoura Range (376, 377), and `forest geckos' from Maud Island (340, 341) and Hokitika, Westland (505), shows that all 4 populations are roughly equidistant (see Appendix 8.4). The closest crude similarity in 16s sequences (apart from between the two black-eyed geckos from the Seaward Kaikoura Range) is between the Mt Arthur black-eyed gecko and the Hokitika'forest gecko'. The cyt-b (the slightly faster-evolving gene) sequences of the Mt Arthur specimen are slightly more similar to those of Seaward Kaikoura black-eyed geckos and the Maud Island 'forest geckos' than to the Hokitika `forest gecko'. These minor differences in patterns of similarity simply reflect random differences among the populations in the mutation rates of these two genes.

4. Discussion

4.1 TAXONOMIC STATUS

Morphometrics

Most measurements, body proportions and scalation details of the two black-eyed geckos from Mt Arthur lie within the range observed in eastern Marlborough (Sherley 1988, Whitaker 1984, 1991 and 1992, pers. obs.). Where morphometric differences occur they are minor and their significance can not be determined due to the very small sample sizes.

The adult black-eyed gecko from Mt Arthur shows every characteristic of being mature but is 5% shorter than the smallest of 8 adult males from eastern Marlborough (75 mm SVL cf. 79 mm SVL).

Mean head ratios (expressed as a percentage of the SVL) of Mt Arthur black-eyed geckos lie within the range observed in eastern Marlborough for snout-eye, eye diameter and eye-ear, but the ear diameter (2.1-3.1%, N=2) is smaller (♀ 3.8-5.0%, N=2; ♂ 3.0-4.8%, N=2).

The number of rows of preanal pores on the Mt Arthur black-eyed geckos is lower than on males from eastern Marlborough (4, N=2 cf. mean 5.8,5-6, N=9), as is the width of the patch of preanal and femoral pores (expressed as number of pores wide, 1 1-12, N=2 cf. mean 19.7, 16-24, N=3).

Genetics

The results so far indicate that black-eyed geckos are evolutionarily a very recent offshoot from *Hoplodactylus granulatus* -in genetic terms they are just two more populations of 'forest gecko'. This is an extremely unusual situation, particularly given the great morphological difference between the two species. Black-eyed geckos appear to have arisen from within `forest geckos' and the two can not be regarded as sister species. This means that morphologically 'forest geckos' have remained relatively unchanged at the same time as black-eyed geckos have changed dramatically-that the genetic sequence of 'forest geckos' has evolved much more slowly than that of black-eyed geckos.

The divergence of the black-eyed gecko populations on Mt Arthur from those in eastern Marlborough must have occurred very soon after the separation of the ancestral black-eyed geckos from the 'forest geckos'. Furthermore, the very distinctive morphology of black-eyed geckos must have arisen extremely quickly, sometime between the divergence of black-eyed geckos and 'forest geckos' and the divergence of the Mt Arthur and eastern Marlborough populations of black-eyed geckos. Presumably this morphological change coincided with a move into subalpine habitat.

Taxonomic status

The differences in morphometrics and genetics indicate that the Mt Arthur population of black-eyed geckos is genetically isolated and distinct from those in eastern Marlborough. At this stage the differences are not clear enough to warrant taxonomic distinction. Further consideration of the taxonomic status will have to await additional material from the Arthur Range and from other localities, preferably between or beyond the known sites.

4.2 DISTRIBUTION

National distribution

The new locality for black-eyed geckos on Mt Arthur brings the number of known localities for the species to 6 and extends the range of the species 120 km to the north-west. However, what is more remarkable than the actual distance is that the new site in the mountains of north-west Nelson lies west of the Alpine Fault and is geographically isolated from the axial mountains of the Southern Alps by lowlands such as the Nelson Depression, the Grey-Inangahua Depression, and the major valley systems of the Buller and Murchison area. If the presumption that black-eyed geckos are confined to alpine or subalpine habitats is correct, the populations in north-west Nelson would have been isolated from those of the main ranges by lowland forests for around 9,000 years. At the height of last of the Pleistocene ice-ages, approximately 18,000 yBP, the treeline was around 800 m lower than now (McGlone 1988). It is likely that subalpine or alpine habitats connected north-west Nelson to the rest of the Alps between 9,000-70,000 yBP.

The apparent confinement of black-eyed geckos to the Seaward and Inland Kaikoura Ranges has always seemed unreasonable and probably an artefact of search effort (targeted searches for black-eyed geckos have only been carried out at very few sites, mostly in the Seaward Kaikoura Range, and although many people visit the South Island mountains, very few of them are out at night, fewer still are on cliffs at night, and none but dedicated herpetologists are on alpine cliffs at night with appropriate equipment!). Habitat identical to and continuous with that in the Kaikoura ranges extends southwards along the eastern side of the Alps at least as far as south Canterbury, and it was over this area that it was thought the geckos would most probably occur. In the Seaward and Inland Kaikoura Ranges black-eyed geckos are syntopic with a rare, saxicolous species of alpine giant weta (the bluff weta, *Deinacrida* n.sp. `Maungakoura'). The recent discovery of this weta on Mt Somers, mid-Canterbury, opened the possibility that black-eyed geckos may occur there too but a preliminary search proved unsuccessful (Whitaker 1995).

The occurrence of black-eyed geckos in north-west Nelson therefore not only considerably strengthens the likelihood that the species will occur elsewhere along the Southern Alps, but raises the possibility they could be present on any mountain tops in the South Island. It must also significantly increase the likelihood they occur on the mountain ranges between these two populations (e.g. St Arnaud Range, Raglan Range, and probably the Richmond Range).

Discovery of the black-eyed gecko in January was extremely fortuitous. Of the 70 or so sightings to date only 5 have been by day, and only two of those have been chance encounters (the others were geckos located with torches as they hid deep in crevices on bluffs where black-eyed geckos were known to occur). This illustrates clearly just how easily the occurrence of black-eyed geckos on Mt Arthur could have escaped detection and how likely it is that other populations remain undiscovered.

Local distribution

Large areas of karst landscape occur all over the Mt Arthur massif and offer identical habitat to that at the new locality in Eyles Creek. Mt Arthur Group marble, the geological formation in which Mt Arthur lies, extends more or less continuously from Mt Owen in the south along the Arthur and Pikikiruna Ranges to Pohara, and north-westwards to the Wakamarama Range in Golden Bay (Grindley 1978). This must mean that mountain tops over this entire area are potential habitat for black-eyed geckos.

Within the north-west Nelson mountains there are areas of argillite and greywacke where the bluffs and outcrops are very similar in structure to those of the Kaikoura Ranges. These areas are also likely to be inhabited by black-eyed geckos.

4.3 HABITAT

Lithology

All previous records of black-eyed geckos have been from deeply creviced bluffs and outcrops of indurated sandstones and siltstones ('greywacke') (Whitaker 1991 & 1992). The new locality in Eyles Creek represents a significant departure from this habitat definition in that it is on 'Arthur marble', an Upper Ordovician marble that varies from pale calcite to dark-grey silicaceous graphitic marble (Grindley 1978). In extending the lithology on which the species occurs to marble the new record opens the possibility the species could occur on any out-cropping rock that weathers to form deep crevices for shelter.

Structure

Despite the markedly different lithology, the habitat at the new locality for black-eyed geckos on Mt Arthur is structurally very similar to that occupied in the Kaikoura Ranges (Whitaker 1984, 1991 and 1992), namely cliffs and bluffs that are weathered and fractured to form deep, stable crevices and fissures.

The altitude at which the black-eyed geckos were found on MtArthur (1,310 m) is within, but close to, the lower limit for the species in the Kaikoura ranges (1,250-2,200 m) (Whitaker 1991 & 1992). The highest peaks in northwest Nelson, The Twins (1,807 m) and Mt Owen (1,875 m), are well within the upper altitudinal limit for the species.

Nothing found on Mt Arthur indicates that the structural definition of the habitat should be extended from the present "creviced subalpine and alpine cliffs and bluffs". In January about 120 hours of searching for lizards was undertaken in a variety of habitats on the northern slopes of Mt Arthur, including subalpine tussock grassland and shrubland, marble rocklands, and marble and argillite screes (Shaw 1998). No evidence of black-eyed geckos was found in these habitats but other geckos and skinks were found.

Sympatric species

At sites below 1,700 m in the Seaward Kaikoura Range black-eyed geckos occur sympatrically with two species in the *Hoplodactylus maculatus* cryptic-species complex. *Hoplodactylus* 'Marlborough mini' *(sensu* Hitchmough 1997), the most numerous species, usually occurs in screes and other habitats. It is occasionally present on bluffs inhabited by black-eyed geckos. *Hoplodactylus* 'Southern Alps' *(sensu* Hitchmough 1997) is less common at sites >1,200 m but is sometimes present on outcrops and bluffs (although it has yet to be found with black-eyed geckos).

Only one species of *Hoplodactylus* has been recorded sympatrically with black-eyed geckos on Mt Arthur. 'Mt Arthur' geckos are widespread on the northern slopes of the mountain, where they are most numerous in argillite screes, probably because of the extra protection this habitat offers (Shaw 1998). They also occur on karst surfaces but have not been found syntopically on bluffs

with black-eyed geckos (the closest site was approximately 300 m away). A 'forest gecko' was found beneath a stone on an outcrop in beech forest clearing at 1,120 m on the `Tablelands', 7 km NW of Mt Arthur (Shaw 1997). This indicates 'forest geckos' are probably also present in montane beech forest or subalpine shrublands on Mt Arthur, maybe to the same elevation as black-eyed geckos. Other lizard species known from the Mt Arthur massif are the diurnal Nelson green gecko *(Naultinus stellatus)* (Hutton 1872) and small skinks *(Oligosoma* sp.) (Shaw 1998).

These observations suggest that on Mt Arthur, as in the Kaikoura Ranges, black-eyed geckos are able to exclude other *Hoplodactylus* species from their preferred creviced-cliff habitat.

4.4 POPULATION DENSITY

No quantitative data exist for the absolute population density of black-eyed geckos anywhere. Encounter rates provide a rough indication of relative density but data from Mt Arthur are very limited (3.75 hours). Nonetheless, and despite the cool conditions (6.9-9.6°C), the overall encounter rate on 12-13 March of approximately one gecko per hour is as good as, or better than, the highest rates on warm nights at the best studied site in the Seaward Kaikoura Range, the Kahutara Saddle. This must be treated with caution but it does suggest population densities are comparable.

4.5 CONSERVATION STATUS

Threats

There are no immediate or obvious threats to the black-eyed gecko population on Mt Arthur. Several species of browsing mammals (red deer *Cervus elaphus,* fallow deer *Dama dama,* goats *Capra hircus,* hares *Lepus europeus* and possums *Trichosurus vulpecula)* are present on the Mt Arthur massif, and in the past sheep were depastured in the area over the summer months. These species have been present for a long time with apparently no ill effect to the geckos. Any increase in the population density of goats would be of concern as they are animals that happily live and forage on steep rocky bluffs.

The species and status of mammalian predators (e.g. rodents, mustelids, feral cats) on the Mt Arthur massif is unknown and requires investigation. At the very least mice *(Mus musculus),* ship rats *(Rattus rattus),* stoats *(Mustela erminea),* and feral cats *(Felis catus)* are likely to be present. There is no evidence that the predator guild or density has changed in the recent past, or is changing now, so the threat(s) from introduced predators are unknown. Purely as an aside, it is worth noting that during the night search on 12-13 March four sightings were made of moreporks *(Ninox novaesellandiae)* foraging on bluffs in the subalpine zone between 1,300 and 1,500 m, including those on which the black-eyed geckos were seen. These birds had presumably come up from daytime roosts within the forest hundreds of metres below. Moreporks are known to be significant predators on geckos (Anon 1996).

It has earlier been suggested that black-eyed geckos may be secondarily confined to an alpine rocky environment by pressure from introduced mammalian predators (Sherley 1989, Whitaker 1991). The genetic data tend to suggest this is not the case and that the species is the alpine equivalent of the 'forest gecko'. If that is a fair interpretation, and the geckos occupy bluffs and outcrops for ecophysiological reasons, rather than as a refuge, it seems likely they are relatively secure from predators. Experimental work was undertaken in February 1997 to address the specific question - how do small nocturnal geckos cope with such a harsh alpine environment and does the selection of saxicolous habit on cliffs convey a thermal advantage that makes it possible? This study is yet to be reported.

Because of its proximity to the Nelson conurbation, and its ease of access, the Mt Arthur massif receives a high number of recreational visitors, including day-trippers. These people by and large avoid going on to the rocky bluffs, tending instead to follow the marked route to the summit or, in winter, to play in the snow close to the MtArthur Hut. The rapidly increasing interest in technical rock climbing means the vertical rockfaces on Mt Arthur may become a target for followers of the sport in the future. Apart from these recreational activities the area is protected from development because it lies within the Kahurangi National Park.

Nonetheless, there is a small risk that some of the people visiting the area may be 'fossickers' who would turn stones out of curiosity or actively search out unusual animals and plants. At the very worst, such activity is likely to have relatively little impact on the black-eyed gecko population due to the geckos nocturnal habits and inaccessible day time retreats deep within rock crevices.

With the exception of the human impacts from recreational users the potential threats to the black-eyed geckos on Mt Arthur are probably little different to those in the Kaikoura Ranges.

Conservation status

The new record for Mt Arthur has greatly increased the range over which black-eyed geckos are known to occur and has broadened their habitat definition by including a markedly different rock type. By implication this opens the possibility they could occur anywhere on South Island mountain tops. In theory, this must improve their conservation status, though the Mt Arthur population will require some separate conservation consideration as representing the western limit of distribution.

The population density of black-eyed geckos on Mt Arthur appears to be high in comparison to other sites, their habitat appears to be extensive and secure, and there are no obvious or apparent threats to their well-being. In theory, this must also improve their conservation status.

The genetic and morphometric studies have shown differences, albeit very minor at this stage, between the Mt Arthur black-eyed geckos and those from the populations in the east. If further work shows they should be regarded as separate species, the conservation status of each must be increased accord-

ingly. If not, it may still be that differences are sufficient for the Mt Arthur animals to warrant special consideration as a distinctive population.

The data on which this discussion is based are minimal-one site, two confirmed black-eyed geckos-so a precautionary approach dictates that for now both the IUCN classification and DOC conservation priority (Molloy & Davis 1994) remain unchanged. Further survey, and taxonomic and genetic work could easily change this and result in a down-grading or up-grading of either (or both) rankings.

5. Recommendations

The following recommended actions would contribute to a better understanding of the conservation status of black-eyed geckos:

1. In the coming summer (December 1998-February 1999) a dedicated search is made for black-eyed geckos at several sites within the karst habitat on the Mt Arthur massif. This search should use appropriate equipment and techniques, and should include personnel experienced in searching for black-eyed geckos.

   Reasons: To better assess the local distribution and population size, to obtain quantitative data on habitat, to obtain more morphometric data, and to collect additional specimens for taxonomic study.

2. Concurrent with or about the same time searches for geckos should be made in rocky environments and forests at lower elevations in the vicinity of Mt Arthur.

   Reasons: To test the possibility that black-eyed geckos may occur at lower elevation rocky sites or in completely different habitats (see Whitaker 1991 & 1992) and to collect `forest geckos' from a locality as close to a population of black-eyed geckos as possible to further test the genetic relationship of the species.

3. As and when the opportunity permits, but preferably within the next two years, dedicated searches for black-eyed geckos should be made in mountain habitats at localities between the eastern and western populations. Recommended sites are judges Creek in the upper Wairau River (significant because bluff wetas occur there), the St Arnaud Range (the Rainbow Skifield road provides ready access), and the Richmond Range (because it is also isolated from the axial ranges).

   Reasons: To confirm the presumed distribution of the species across the northern South Island and to collect additional material to test the taxonomic status of the eastern and western populations.

4. Within the next 2-3 years a dedicated search for black-eyed geckos should be made at a location on the Southern Alps in mid- to south Canterbury where there are extensive subalpine bluffs of similar structure to those in the Seaward Kaikoura Range. Recommended sites would be in the Pukaki or Ohau area.

   Reasons: To confirm the likely presence of the species along the axial mountains of the South Island. For this it is important that a 'quantum leap' is made rather than checking sites in southern Marlborough/north Canterbury.

5. Before the coming summer a press release should solicit reports of geckos from rocky alpine or subalpine habitats in the mountains of the Nelson region.

   Reasons. To obtain important leads on the potential whereabouts of black-eyed geckos and thus save valuable field time for the search team. In many other lizard surveys significant information has been obtained from the public and already public contributions have proved valuable in this district. Stich publicity could also result in significant information on other lizard species and in other habitats.

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8. Appendices

8.1 PREVAILING WEATHER DURING SEARCH FOR BLACK-EYED GECKOS, EYLES CREEK, MT ARTHUR, KAHURANGI NATIONAL PARK, 12-13 MARCH 1998

Time (hr)	Temperature (°C)	wind (speed/direction)	Cloud' (oktas)
20:37	8.8	calm	4
21:40	9.2	calm	4
23:10	9.6	light NE	0
00:20	6.9	moderate E	0

a at various times throughout the search there was intermittent cloud at ground level that curtailed or prevented searching for short periods

8.2 CAPTURE DETAILS AND MORPHOMETRIC DATA FOR BLACK-EYED GECKOS CAPTURED AT EYLES CREEK, MT ARTHUR, KAHURANGI NATIONAL PARK, 1998

Animal number (toe clip):	0/0/0/0	4/0/4/0
Collector:	Tim Shaw	Tony Whitaker
Date of capture:	21 January 1998	12 March 1998
Site:	Headwaters of Eyles Creek	Headwaters of Eyles Creek
Grid reference (NZMG):	24856 60000	24856 60000
Altitude (m):	1,320	1,310
Sex:	♀?	♀
Snout-vent length (mm):	57	75
Tail length (mm):	12	74
Regeneration length (mm):	5	unbroken
Weight (g):	2.9	11.0
Snout-eye (mm):	6.5	8.1
Eye diameter (mm):	3.0	3.7
Eye-ear (mm):	5.1	6.8
Ear diameter (mm):	1.2	2.3
Supralabials (L/R):	10/10	12/13
Infralabials (L/R):	9/10	11/10
Lamellae (L/R, 4th toe, hind foot, proximal + distal):	11+8/11+7	14+8/13+8
Femoral/preanal pores:	4 rows deep on mid-line, 11 pores wide	4 rows deep on mid-line, 12 pores wide
Enlarged cloacal scales:	none	2, upper largest
Rostral/nostril:	-	in contact
Nasals:	·	4
Internasals:	·	1
Mental:	deeply grooved, two post-mentals	deeply grooved, several small post-mentals
Apical plates:	none	very slightly developed on thumbs only
Data collection:	Bernard Goetz	Tony Whitaker

8.3 LOCALITY, HABITAT AND RELATIVE DENSITY DATA FOR `MT ARTHUR GECKOS' (*HOPLODACTYLUS* AFF. *MACULATUS*) FOUND ON MT ARTHUR, KAHURANGI NATIONAL PARK, JANUARY AND MARCH 1998

Grid ref.	Alt. (m)	No. of geckos	Search time (h)	Habitat
24848 59999- 24850 600002	1,480	>5	1.5	Marble slab, subalpine shrubland
24850 299998	1,500	5	4.1	Argillite scree
24854 600008	1,340	2	0.6	Argillite scree
24856 600005	1,360	1	-	Marble slab, subalpine shrubland
24857 600003	1,350	1	2	Marble slab, subalpine shurbland
24858 600006	1,280	1	-	Marble slab, subalpine shrubland

8.4 CRUDE % SIMILARITY BETWEEN DNA SEQUENCES

Values are for of black-eyed geckos from Mt Arthur (specimen # 512) and the Seaward Kaikoura Range (# 376- 377) (shaded), and `forest geckos' from Hokitika (# 505) and Maud Island (# 340) (unshaded) (a second Maud Island'forest gecko', # 341, had identical sequences to # 340 so is not shown).Values above the diagonal are for the 16s gene, those below the diagonal for the cytochrome b gene.

	512	376	377	505	340
512		97	97	98	97
376	96		99	97	97
377	96	100		97	97
505	95	95	95		97
340	96	95	95	96	