# The development of "The action plan for Australian reptiles"

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**ABSTRACT**

The Action Plan for Australian Reptiles has been prepared by Dr Hal Cogger and his associates at the Australian Museum under a consultancy to the Australian Nature Conservation Agency. The Plan, which is due for publication at the end of 1993, reviews the conservation status of Australian reptiles, identifies those taxa at greatest risk, and provides conservation profiles — species recovery outlines — for them. This article describes the methods used to develop the Plan, including the compilation and ranking of the list of threatened taxa. The Plan identifies the geographic regions most significant to conserving diversity in endangered and vulnerable Australian reptiles as well as the habitats with the greatest number of those taxa, and the commonest causes of their decline.



The Action Plan for Australian Reptiles (Cogger *et al.*, in press) is an initiative of the Endangered Species Program of the Australian Nature Conservation Agency (an Agency of the Federal Environment Portfolio known formerly as the Australian National Parks and Wildlife Service). In 1991 Hal Cogger (Deputy Director of the Australian Museum, Sydney) undertook a consultancy with ANCA to prepare an Action Plan for Australian Reptiles; other Australian Museum staff who assisted in the consultancy were Elizabeth Cameron, Ross Sadlier and Peter Eggler. The purpose of the consultancy was to review the conservation status of Australian reptiles, identify those taxa at greatest risk, and develop conservation profiles for them. It is intended that the Action Plan serve as a guideline for the Australian Nature Conservation Agency in developing Federal policies for threatened Australian reptiles, and when providing support for State and Territory Government programmes for reptile conservation.

The approach taken in the consultancy emphasized review of existing literature and databases, consultation with professional herpetologists and conservation managers, and objective methodology for assessing conservation status. An initial list was compiled of reptile taxa already identified as being "at risk". It included taxa on official lists of State and Federal Government conservation agencies (including the ANZECC list, 1991), on lists of non-government conservation organizations (e.g., World Conservation Monitoring Centre 1990; Klippel 1992) and those mentioned in the literature on threatened Australian reptiles (e.g., Czechura and Covacevich 1985; Ehmann and Cogger 1985; Hutchinson 1992; Kennedy 1990).

Nominations of species or populations of Australian reptiles at risk were then canvassed from professional herpetologists and members of natural history and conservation organizations. This was achieved by sending questionnaires with an explanatory letter to 42 organizations throughout Australia, and to each member of the Australian Society of Herpetologists. The questionnaire included the IUCN definitions of "endangered", "vulnerable" and "rare", and respondents were asked to assign the reptiles they regarded as being at risk, to one of those categories. The form further requested information on the geographic region covered by the response, possible reasons for the taxon's poor conservation status and localities where it occurred and/or should be conserved.

Similar information was sought from all State and Territory Government conservation agencies on the reptiles within their jurisdiction which they considered at risk. The agencies were also asked to identify conservation reserves and management policies and actions relevant to those taxa.

As a result of these surveys, the list of reptiles at risk was expanded to include more than 200 species, subspecies or geographically-isolated populations. Opinions on the conservation status of some reptiles differed widely and it was obvious that if a degree of consensus was to be reached at a national level, a taxon priority system needed to be applied.

A number of systems had been developed and applied in Australia and overseas (e.g., Ahern *et al.* 1985a, 1985b; Mace and Lande 1991; Millsap *et al.* 1990; Molloy and Davis 1992) but the Millsap methodology (which was developed for the vertebrate fauna of the state

of Florida) appeared the most appropriate because of its flexibility and the breadth of its scope. Amongst other advantages, it applies weighted values to such variables as phylogenetic uniqueness, previous rates of decline, and the extent to which threatening processes have been moderated. Perhaps most importantly, it takes appropriate account of the knowledge base for a taxon; lack of knowledge of a particular parameter is assigned a score commensurate with the significance of that parameter in identifying threatening processes. The essential feature of the Millsap *et al.* methodology is the recognition of three distinct but often related data sets, each of which consists of a suite of scored criteria. These data sets consist of:

(a) Biological variables which assess the state of a series of biological/ecological parameters for each taxon;

(b) Action variables which attempt to assess the state of the knowledge base required to effectively manage the taxon; and

(c) Supplemental variables which attempt to assess the genetic significance of the taxon and its harvest/protection status.

Table 1 lists the Millsap *et al.* data sets, modified by the consultants to apply to the Australian continental situation and further refined by participants at the specialist workshop (see below).

*Table 1.* Variables used to assess and rank Australian reptiles nominated for threatened status (based on Millsap *et al.* 1990. Variations in bold).

1. BIOLOGICAL VARIABLES, CATEGORIES WITHIN VARIABLES, AND SCORES USED IN RANKING TAXA.

| Biological variables and categories within variables | Assigned points |
|---|---|
| 1. Population size — the estimated number of adults throughout the range of taxon (i.e., worldwide). | |
| (a) 0–500 individuals | 10 |
| (b) 501–1 000 individuals, or population size is unknown but suspected to be small | 8 |
| (c) 1 001–3 000 individuals | 6 |
| **(d) Unknown population size** | **5** |
| (e) 3 001–10 000 individuals | 4 |
| (f) 10 001–50 000 individuals, or size is unknown but suspected to be large | 2 |
| (g) >50 000 individuals | 0 |
| 2. Population trend **in Australia** — overall trend in number of individuals throughout taxon's range over last **5** decades. If population trend is unknown, consider trends in the availability and condition of the taxon's habitat as indicative of population trend. | |
| (a) Population size known to be decreasing | 10 |
| (b) Trend unknown but population size suspected to be decreasing | 8 |
| (c) Population formerly experienced serious declines but is presently stable or increasing | 6 |
| **(d) Population trend unknown** | **5** |
| (e) Population size stable or suspected to be stable or increasing | 2 |
| (f) Population size known to be increasing | 0 |
| 3. Range size **in Australia** — the size of area over which the taxon is distributed during the season when distribution is most restricted (e.g., for a species that nests over 1 000 km$^2$ on the coast, use the breeding range). | |
| (a) <100 km$^2$ | 10 |
| (b) 101–1 000 km$^2$ | 9 |
| (c) 1 001–**80 000 km$^2$ (up to 1% area of Australia; approximately the area of Tasmania)** | 7 |
| (d) **80 001–1 000 000 km$^2$ (up to 12% area of Australia or about the size of South Australia)** | 4 |
| (e) **1 000 001–4 000 000 km$^2$ (about 50% of the area of Australia)** | 1 |
| (f) **>4 000 000 km$^2$** | 0 |
| 4. Distribution trend — % change (since European settlement) in area occupied by the taxon. (This is an estimate of change in the portion of the total range that is occupied or utilized; it may not equal the change in total range.) | |
| (a) Area occupied has declined by 90–100% | 10 |
| (b) Area occupied has declined by 75–89% | 8 |
| (c) Area occupied has declined by 25–74% | 5 |
| (d) Area occupied has declined by 1–24% | 2 |
| (e) Area occupied is stable or has increased | 0 |
| 5. **Geographic** population concentration — degree to which individuals within populations congregate or aggregate seasonally (e.g., at hibernacula, breeding sites, migration focal points) or daily (e.g., communal roosts) at specific locations. Implies a regular temporal compression of the distribution independent of factors considered in variables 3 and 4 above. | |
| (a) Majority concentrates at single location | 10 |
| (b) Concentrates at 1–25 locations | 6 |
| (c) Concentrates at >25 locations | 2 |
| (d) Does not concentrate | 0 |

*Table 1. — continued*

1. BIOLOGICAL VARIABLES, CATEGORIES WITHIN VARIABLES, AND SCORES USED IN RANKING TAXA *continued*

| Biological variables and categories within variables | Assigned points |
|---|---|
| 6. Reproductive potential for recovery — ability of the taxon to recover from serious declines in population size. | |
| A. Average number of eggs or live young produced/adult female/yr | |
| (a) <1 offspring/female/yr | 5 |
| (b) 1–9 offspring/female/yr | 3 |
| (c) 10–100 offspring/female/yr | 1 |
| (d) >100 offspring/female/yr | 0 |
| B. Minimum age at which females typically first reproduce. | |
| (a) >8 yr | 5 |
| (b) 4–8 yr | 3 |
| (c) 2–3 yr | 1 |
| (d) <2 yr | 0 |
| 7. Ecological specialization — degree to which the taxon is dependent upon certain environmental factors. | |
| A. Dietary specialization — choices below relate to the **extent to which local populations are likely to be able to respond to decreases in availability of preferred food type.** | |
| (a) Number of individuals declines; no substantial shift in diet | |
| **(i) Taxonomic specialist, i.e., eat only vertebrates of one family group (or lower) taxon OR only invertebrates of one order group (or lower) taxon** | **1.6** |
| **(ii) Food class specialist (e.g., eggs and larvae of ants and termites; plants)** | **1.7** |
| (b) Substantial shift in diet with little change in number of individuals | 0 |
| B. Reproductive specialization — choices below relate to the primary way in which local populations respond to decreases in availability of preferred breeding sites **(e.g., turtle's breeding beach)**. | |
| (a) Number of individuals or number of breeding attempts declines but no substantial shift to other breeding sites | 3.3 |
| (b) Substantial shift to alternate breeding sites with little change in number of individuals | 0 |
| C. Other specializations — ecological, behavioural **or morphological** specializations not covered in variables 7A or 7B (e.g., strict requirements for hibernacula, narrow ambient temperature limits, specific roosting structures **or large number of derived advanced characters (apomorphies)).** | |
| (a) Highly specialized | 3.3 |
| (b) Moderately specialized | 1.7 |
| (c) Not specialized | 0 |

2. ACTION VARIABLES, WITHIN VARIABLES, AND SCORES USED IN RANKING TAXA.

| Action variables and categories within variables | Assigned points |
|---|---|
| 1. Knowledge of distribution **in Australia** (survey score). | |
| (a) Distribution is extrapolated from a few locations or knowledge limited to general maps or **known only from single records, type, etc.** | 10 |
| (b) Broad r nge limits or habitat associations are known, but local occurrence cannot be predicted accurately | 5 |
| (c) Distribution is well known and occurrence can be accurately predicted throughout the range | 0 |
| 2. Knowledge of population trend **in Australia** (monitoring score). | |
| (a) Not currently monitored | 10 |
| (b) Monitored locally | 6 |
| (c) Statewide monitoring, but not with statistical sensitivity | 4 |
| (d) Statewide monitoring with statistical sensitivity, or nearly complete census | 0 |
| 3. Knowledge of **Australian** population limitations (research score). | |
| (a) Factors affecting population size and distribution are unknown or unsubstantiated | 10 |
| (b) Somefactors affecting population size and distribution are known, but 1 or more major factors are unknown | 5 |
| (c) All major factors affecting population size and distribution are known | 0 |
| 4. Ongoing management activities **in Australia** (management score). | |
| (a) None directed primarily at the taxon | 10 |
| (b) Management mostly related to enforcement of conservation laws | 5 |
| (c) Some direct management/**interventionist (i.e., manipulation of natural populations)** activities in addition to enforcement of conservation laws | 0 |

3. SUPPLEMENTAL VARIABLES AND CATEGORIES WITHIN VARIABLES

| Supplemental variables and categories within variables | Assigned points |
|---|---|
| 1. Sysematic significance of the taxon (select *all* categories that apply). | |
| (a) Monotypic family | 5 |
| (b) Monotypic genus | 4 |
| (c) Monotypic species **(no described subspecies)** | 3 |
| (d) **Disjunct subspecies** | 2 |
| (e) Intergrading subspecies or **taxonomic distinctiveness uncertain** | 1 |
| 2. % of taxon's total range that occurs **in Australia** (select category that best applies). | |
| (a) **Endemic to Australian island(s)** | 5 |

*Table 1. — continued*

3. SUPPLEMENTAL VARIABLES AND CATEGORIES WITHIN VARIABLES — *continued*

| Supplemental variables and categories within variables | Assigned points |
|---|---|
| 2. % of taxon's total range that occurs **in Australia** (select category that best applies). — *continued* | |
| (b) **Endemic to Australia** | 4 |
| (c) **75–99% of total range in Australia** | 3 |
| (d) 50–74% of total range **in Australia** | 2 |
| (e) 25–49% of total range **in Australia** | 1 |
| (f) <25% of total range **in Australia** | 0 |
| 3. Trend in taxon's **Australian** population (select category that best applies). | |
| (a) **Australian** population known to be decreasing | 6 |
| (b) **Australian** population trend unknown or suspected to be declining | 5 |
| (c) **Australian** population stable or increasing overall but declining in some areas | 4 |
| (d) **Australian** population formerly experienced serious declines but is presently stable or increasing | 3 |
| (e) **Australian** population is stable or suspected to be stable or increasing | 2 |
| (f) **Australian** population is known to be increasing | 1 |
| 4. Period of occurrence **in Australia** (select category that best applies). | |
| (a) Permanent resident | 4 |
| (b) Resident during breeding season | 3 |
| (c) Resident during winter or non-breeding season | 2 |
| (d) Transient | 1 |
| 5. Harvest of the taxon **in Australia** (select category that best applies). | |
| (a) Harvested, with no legal protection | 4 |
| (b) No substantial harvest other than accidental take or harvest of nuisance animals; no legal protection | 3 |
| (c) Harvested, but harvest regulated **(includes taxa utilized by Aboriginal and Torres Strait Islander communities)** | 2 |
| (d) Harvest prohibited by regulation | 1 |

The consultants tested the Millsap *et al.* methodology by scoring 20 Australian reptiles (including some taxa which were not considered to be under any threat) for all three sets of variables. The scores for *biological variables* (the data set which identifies the conservation status of a taxon) ranked the trial subset of reptiles surprisingly close to the subjective opinions of a range of herpetologists. It was decided to subject the draft list of nominated reptile taxa to the Millsap *et al.* system, calling on the advice of a panel of herpetologists with specialist knowledge of the biology, ecology and systematics of Australian reptiles.

Consequently a workshop was held in December 1991 at the University of Sydney's Crommelin Biological Field Station at Pearl Beach. It was attended by sixteen herpetologists selected to include taxonomists, ecologists, and both professional and non-professional field herpetologists from most parts of Australia; museums, universities and conservation agencies were represented. In addition, Dr Arnold Kluge (University of Michigan) was currently visiting the Australian Museum and so was invited to participate. Dr Kluge's extensive knowledge of the Australian reptile fauna and his experience in cladistics provided valuable input to the workshop.

The round-table workshop facilitated discussion of underlying assumptions, resolution of conflicting opinions, and sharing of unpublished data and field experience which could not otherwise have been easily accessed. Some taxa on the draft list of reptiles "at risk" were removed on the recommendation of the participants and the remaining taxa were scored and ranked at the workshop, using the modified Millsap *et al.* criteria. Following the workshop, research data became available which led to minor changes in the scores (and hence ranking) of some taxa and the addition of several freshwater tortoises to the list, resulting in a final total of 204 threatened taxa (Table 2).

To set the lower limits for categories of "Endangered" and "Vulnerable" on this list, advice was again sought from workshop participants. Although the scores had a roughly normal distribution, eleven taxa separated out at the upper end of the scale (Fig. 1); personal knowledge of their population sizes and/or the processes threatening these taxa confirmed their status as "Endangered" according to the IUCN definitions (World Conservation Monitoring Centre 1990).

The selection of a cutoff point for the "Vulnerable" category was more subjective because there was no corresponding gap in scores. The line was drawn between taxa known to have very small populations and/or ranges (e.g., island species) and/or which occurred in habitats undergoing extensive

*Table 2.* Taxonomic list of Australia's threatened reptiles.

| Taxon | Status assigned in the action plan for Australian reptiles |
|---|---|
| **Family CROCODYLIDAE** | |
| *Crocodylus johnstoni* | Rare or insufficiently known |
| *Crocodylus porosus* | " " " " |
| **Family CHELONIIDAE** | |
| *Caretta caretta* | Vulnerable |
| *Chelonia mydas* | " |
| *Eretmochelys imbricata* | " |
| *Lepidochelys olivacea* | " |
| *Natator depressus* | " |
| **Family DERMOCHELYIDAE** | |
| *Dermochelys coriacea* | " |
| **Family CARETTOCHELYIDAE** | |
| *Carettochelys insculpta* | Rare or insufficiently known |
| **Family CHELIDAE** | |
| *Chelodina expansa* | " " " " |
| *Elseya sp. nov.* (Bellinger River, NSW) | " " " " |
| *Elseya* sp. nov. (Manning River, NSW) | " " " " |
| *Elseya sp. nov.* (Namoi River, NSW( | Vulnerable |
| *Emydura macquarii* | Rare or insufficiently known |
| *Emydura subglobosa* | " " " " |
| *Emydura signata* (Bellinger River, NSW) | Vulnerable |
| *Pseudemydura umbrina* | Endangered (critical) |
| *Rheodytes leukops* | Vulnerable |
| Gen. nov. sp. nov. (Mary River, Qld) | Endangered |
| **Family GEKKONIDAE** | |
| *Christinus guentheri* | Vulnerable |
| *Diplodactylus fulleri* | Rare or insufficiently known |
| *Diplodactylus kenneallyi* | " " " " |
| *Diplodactylus occultus* | " " " " |
| *Diplodactylus taenicauda* | " " " " |
| *Lepidodactylus listeri* | Vulnerable |
| *Lepidodactylus pumilus* | Rare or insufficiently known |
| *Nactus galgajuga* | " " " " |
| *Nephrurus deleani* | Vulnerable |
| *Oedura reticulata* | Rare or insufficiently known |
| *Phyllurus caudiannulatus* | " " " " |
| *Underwoodisaurus sphyrurus* | Vulnerable |
| **Family PYGOPODIDAE** | |
| *Aclys concinna major* | Rare or insufficiently known |
| *Aprasia aurita* | Endangered |
| *Aprasia haroldi* | Rare or insufficiently known |
| *Aprasia parapulchella* | " " " " |
| *Aprasia pseudopulchella* | Vulnerable |
| *Aprasia rostrata rostrata* | " |
| *Delma impar* | " |
| *Delma labialis* | " |
| *Delma mitella* | Rare or insufficiently known |
| *Delma torquata* | Vulnerable |
| *Ophidiocephalus taeniatus* | " |
| *Paradelma orientalis* | " |
| *Pletholax gracilis edelensis* | Rare or insufficiently known |
| **Family AGAMIDAE** | |
| *Cryptagama aurita* | " " " " |
| *Ctenophorus mckenziei* | " " " " |
| *Ctenophorus yinnietharra* | Vulnerable |
| *Diporiphora convergens* | Rare or insufficiently known |
| *Hypsilurus spinipes* | " " " " |
| *Tympanocryptis lineata inguicolla* | Vulnerable |
| *Tympanocryptis uniformis* | Rare or insufficiently known |

| Taxon | Status assigned in the action plan for Australian reptiles |
|---|---|
| **Family VARANIDAE** | |
| *Varanus glauerti* (Kakadu) | Rare or insufficiently known |
| *Varanus primordius* | " " " " |
| *Varanus rosenbergi* (SE Australia popn) | " " " " |
| *Varanus semiremex* | " " " " |
| *Varanus teriae* | " " " " |
| **Family SCINCIDAE** | |
| *Anomalopus gowi* | " " " " |
| *Anomalopus mackayi* | Vulnerable |
| *Anomalopus pluto* | Rare or insufficiently known |
| *Bartleia jigurru* | " " " " |
| *Calyptotis temporalis* | " " " " |
| *Calyptotis thorntonensis* | " " " " |
| *Carlia coensis* | " " " " |
| *Carlia rimula* | " " " " |
| *Carlia scirtetis* | " " " " |
| Coeranoscincus reticulatus | Vulnerable |
| *Cryptoblepharus fuhni* | Rare or insufficiently known |
| *Ctenotus alleni* | " " " " |
| *Ctenotus angusticeps* | " " " " |
| *Ctenotus aphrodite* | " " " " |
| *Ctenotus arnhemensis* | " " " " |
| *Ctenotus astarte* | " " " " |
| *Ctenotus capricorni* | " " " " |
| *Ctenotus delli* | " " " " |
| *Ctenotus ehmanni* | " " " " |
| *Ctenotus eurydice* | " " " " |
| *Ctenotus hypatia* | " " " " |
| *Ctenotus lancelini* | Endangered |
| *Ctenotus monticola* | Rare or insufficiently known |
| *Ctenotus nigrilineatus* | " " " " |
| *Ctenotus nullum* | " " " " |
| *Ctenotus quinkan* | " " " " |
| *Ctenotus rawlinsoni* | " " " " |
| *Ctenotus schevilli* | " " " " |
| *Ctenotus septenarius* | " " " " |
| *Ctenotus serotinus* | " " " " |
| *Ctenotus tanamiensis* | " " " " |
| *Ctenotus terrareginae* | " " " " |
| *Ctenotus xenopleura* | " " " " |
| *Ctenotus yampiensis* | " " " " |
| *Ctenotus zastictus* | Vulnerable |
| *Ctenotus zebrilla* | Rare or insufficiently known |
| *Cyclodomorphus* sp. (Samphire, SA) | " " " " |
| *Egernia arnhemensis* | " " " " |
| *Egernia coventryi* | " " " " |
| *Egernia douglasi* | " " " " |
| *Egernia kintorei* | Vulnerable |
| *Egernia pulchra longicauda* | " |
| *Egernia rugosa* | Rare or insufficiently known |
| *Egernia saxatilis saxatilis* | " " " " |
| *Egernia* sp. aff. *saxatilis* (Kaputar Ranges, NSW) | " " " " |
| *Egernia slateri* | " " " " |
| *Egernia stokesii aethiops* | Vulnerable |
| *Egernia stokesii badia* | Endangered |
| *Egernia stokesii stokesii* | Vulnerable |
| *Emoia atrocostata australis* | Rare or insufficiently known |
| *Eroticoscincus graciloides* | " " " " |
| *Eulamprus amplus* | " " " " |
| *Eulamprus kosciuskoi* | " " " " |
| *Eulamprus leuraensis* | Endangered |
| *Eulamprus luteilateralis* | Rare or insufficiently known |
| *Eulamprus murrayi* | " " " " |
| *Eulamprus tigrinus* | " " " " |
| *Eulamprus tympanum* ssp. nov. | Endangered |
| *Glaphyromorphus fuscicaudis* | Rare or insufficiently known |

*Table 2. — continued.*

| Taxon | Status assigned in the action plan for Australian reptiles |
|---|---|
| Family SCINCIDAE — *continued* | |
| *Glaphyromorphus mjobergi* | Rare or insufficiently known |
| *Lampropholis caligula* | " " " " |
| *Lampropholis* sp. aff. *challengeri* | " " " " |
| *Lampropholis colossus* | " " " " |
| *Lampropholis mirabilis* | " " " " |
| *Lampropholis robertsi* | " " " " |
| *Lerista allanae* | Endangered |
| *Lerista allochira* | Rare or insufficiently known |
| *Lerista ameles* | " " " " |
| *Lerista apoda* | " " " " |
| *Lerista axillaris* | " " " " |
| *Lerista carpentariae* | " " " " |
| *Lerista christinae* | " " " " |
| *Lerista cinerea* | " " " " |
| *Lerista haroldi* | " " " " |
| *Lerista humphriesi* | " " " " |
| *Lerista ingrami* | " " " " |
| *Lerista kalumburu* | " " " " |
| *Lerista lineata* | " " " " |
| *Lerista macropisthopus galea* | " " " " |
| *Lerista maculosa* | " " " " |
| *Lerista puncticauda* | " " " " |
| *Lerista quadrivincula* | " " " " |
| *Lerista robusta* | " " " " |
| *Lerista separanda* | " " " " |
| *Lerista speciosa* | " " " " |
| *Lerista stictopleura* | " " " " |
| *Lerista storri* | " " " " |
| *Lerista stylis* | " " " " |
| *Lerista viduata* | " " " " |
| *Lerista vittata* | Vulnerable |
| *Lerista walkeri* | Rare or insufficiently known |
| *Lerista wilkinsi* | " " " " |
| *Lerista yuna* | " " " " |
| *Lygisaurus rococo* | " " " " |
| *Lygisaurus tanneri* | " " " " |
| *Menetia concinna* | " " " " |
| *Menetia koshlandae* | " " " " |
| *Menetia sadlieri* | " " " " |
| *Nannoscincus maccoyi* | " " " " |
| *Niveoscincus palfreymani* | Vulnerable |
| *Notoscincus butleri* | Rare or insufficiently known |
| *Ophioscincus cooloolensis* | " " " " |
| *Ophioscincus truncatus* | " " " " |
| *Pseudemoia baudini* | " " " " |
| *Pseudemoia lichenigera* | Vulnerable |
| *Pseudemoia rawlinsoni* | Rare or insufficiently known |
| *Tiliqua adelaidensis* | Endangered |
| Family TYPHLOPIDAE | |
| *Ramphotyphlops broomi* | Rare or insufficiently known |
| *Ramphotyphlops exocoeti* | Vulnerable |
| *Ramphotyphlops howi* | Rare or insufficiently known |

| Taxon | Status assigned in the action plan for Australian reptiles |
|---|---|
| Family TYPHLOPIDAE — *continued* | |
| *Ramphotyphlops margaretae* | Rare or insufficiently known |
| *Ramphotyphlops micromma* | " " " " |
| *Ramphotyphlops tovelli* | " " " " |
| *Ramphotyphlops troglodytes* | " " " " |
| *Ramphotyphlops yampiensis* | " " " " |
| *Ramphotyphlops yirrikalae* | " " " " |
| Family BOIDAE | |
| *Aspidites ramsayi* (southwestern WA) | Endangered |
| *Chondropython viridis* | Rare or insufficiently known |
| *Liasis albertisii* | " " " " |
| *Liasis olivaceus barroni* | " " " " |
| *Morelia carinata* | " " " " |
| *Morelia oenpelliensis* | " " " " |
| *Morelia spilota imbricata* | Vulnerable |
| *Morelia spilota spilota* | " " " " |
| Family COLUBRIDAE | |
| *Cerberus rynchops* | " " " " |
| *Myron richardsonii* | " " " " |
| *Stegonotus parvus* | " " " " |
| Family ELAPIDAE | |
| *Acanthophis antarcticus* | " " " " |
| *Austrelaps labialis* Adelaide (SA) | Vulnerable |
| *Denisonia maculata* | " |
| *Echiopsis atriceps* | " |
| *Echiopsis curta* (population east of Adelaide) | " |
| *Elapognathus minor* | " |
| *Furina barnardi* | Rare or insufficiently known |
| *Furina dunmalli* | Vulnerable |
| *Hoplocephalus bungaroides* | " |
| *Hoplocephalus stephensii* | Rare or insufficiently known |
| *Notechis ater ater* (Flinders Ranges, SA) | Vulnerable |
| *Pseudonaja affinis exilis* | Rare or insufficiently known |
| *Pseudonaja affinis tanneri* | " " " " |
| *Rhinoplocephalus* sp. (Eyre Peninsula, SA taxonomic status uncertain) | " " " " |
| *Simoselaps calonotus* | Endangered |
| *Simoselaps minimus* | Rare or insufficiently known |
| *Simoselaps warro* | " " " " |
| *Vermicella annulata* | " " " " |
| Family HYDROPHIIDAE | |
| *Aipysurus pooleorum* | " " " " |
| *Hydrelaps darwiniensis* | " " " " |
| *Parahydrophis mertoni* | " " " " |

destruction, and taxa which were not common nor generally well known but occurred in habitats not known to be undergoing extensive destruction. All remaining taxa were included in the Rare or Insufficiently Known category. The ranked list of Endangered and Vulnerable reptile taxa appears as Table 3.

The families of terrestrial and freshwater reptiles with the highest proportion of species in the Endangered and Vulnerable categories are the freshwater tortoises, Chelidae (26% of species) and endemic legless lizards, Pygopodidae (24%). These figures are based on the total number of species listed for these families in Cogger (1992) with the addition of three undescribed taxa of chelids identified in the Action Plan for Australian Reptiles.

Further subjectivity was introduced in the treatment of the marine turtles which occur in Australian waters. While all six species were nominated for threatened status, none scored as high as the lowest ranked Vulnerable terrestrial

*Table 3.* The list of Australia's endangered and vulnerable reptiles, ranked by scores based on the methodology of Millsap *et al.* 1990.

**ENDANGERED (CRITICAL)**

*Pseudemydura umbrina* Family CHELIDAE
Western Swamp Tortoise

**ENDANGERED**

*Tiliqua adelaidensis* Family SCINCIDAE
Pygmy Bluetongue

Gen. nov. sp. nov. (Mary River, QLD) Family CHELIDAE
Mary River Tortoise

*Ctenotus lancelini* Family SCINCIDAE
Lancelin Island Skink

*Aprasia aurita* Family PYGOPODIDAE
Mallee Worm-lizard

*Eulamprus leuraensis* Family SCINCIDAE
Blue Mountains Water Skink

*Eulamprus tympanum* ssp. nov. (basalt plains, Vic)
Family SCINCIDAE
Dreeite Water Skink

*Lerista allanae* Family SCINCIDAE
Allan's Lerista

*Aspidites ramsayi* (south-western WA)
Family BOIDAE
Woma

*Egernia stokesii badia* Family SCINCIDAE
Western Spiny-tailed Skink

*Simoselaps calonotus* Family ELAPIDAE
Black-striped Snake

**VULNERABLE**

*Aprasia rostrata rostrata Family* PYGOPODIDAE
Hermite Island Worm-lizard

*Ramphotyphlops exocoeti* Family TYPHLOPIDAE
Christmas Island Blind Snake

*Pseudemoia lichenigera* Family SCINCIDAE
Lord Howe Island Skink

*Lepidodactylus listeri* Family GEKKONIDAE
Christmas Island Gecko

*Anomalopus mackayi* Family SCINCIDAE
Long-legged Worm-skink

*Notechis ater ater* (Flinders Ranges, SA)
Family ELAPIDAE
Krefft's Tiger Snake

*Hoplocephalus bungaroides* Family ELAPIDAE
Broad-headed Snake

*Elseya* sp. nov. (Namoi River, NSW)
Family CHELIDAE
Namoi River Elseya

*Emydura signata* (Bellinger River, NSW)
Family CHELIDAE
Bellinger River Emydura

Austrelaps labialis (Adelaide, SA) Family ELAPIDAE
Pygmy Copperhead

*Delma impar* Family PYGOPODIDAE
Striped Legless Lizard

*Delma torquata* Family PYGOPODIDAE
Collared Delma

*Lerista vittata* Family SCINCIDAE
Mount Cooper Striped Lerista

*Coeranoscincus reticulatus* Family SCINCIDAE
Three-toed Snake-tooth Skink

VULNERABLE — *continued*

*Denisonia maculata* Family ELAPIDAE
Ornamental Snake

*Furina dunmalli* Family ELAPIDAE
Dunmall's Snake

*Christinus guentheri* Family GEKKONIDAE
Lord Howe Island Gecko

*Ctenophorus yinnietharra* Family AGAMIDAE
Yinnietharra Rock Dragon

*Niveoscincus palfreymani* Family SCINCIDAE
Pedra Branca Skink

*Delma labialis* Family PYGOPODIDAE
Striped-tailed Delma

Aprasia pseudopulchella Family PYGOPODIDAE
Flinders Ranges Worm-lizard

Morelia spilota imbricata Family BOIDAE
Western Australian Carpet Python

Echiopsis atriceps Family ELAPIDAE
Lake Cronin Snake

Echiopsis curta Family ELAPIDAE
(population east of Adelaide)
Bardick

*Rheodytes leukops* Family CHELIDAE
Fitzroy Tortoise

*Nephrurus deleani* Family GEKKONIDAE
Pernatty Knob-tail

*Underwoodisaurus sphyrurus* Family GEKKONIDAE
Border Thick-tailed Gecko

*Tympanocryptis lineata pinguicolla* Family AGAMIDAE
South-eastern Lined Earless Dragon

Elapognathus minor Family ELAPIDAE
Short-nosed Snake

Ctenotus zastictus Family SCINCIDAE
Hamelin Ctenotus

Egernia kintorei Family SCINCIDAE
Great Desert Skink

*Egernia pulchra longicauda* Family SCINCIDAE
Jurien Bay Rock-skink

*Egernia stokesii aethiops* Family SCINCIDAE
Baudin Island Spiny-tailed Skink

*Egernia stokesii stokesii* Family SCINCIDAE
Houtman Abrolhos Spiny-tailed Skink

*Ophidiocephalus taeniatus* Family PYGOPODIDAE
Bronzeback Snake-lizard

*Paradelma orientalis* Family PYGOPODIDAE
Brigalow Scaly-foot

**MARINE TURTLES**

*Caretta caretta* Family CHELONIIDAE
Loggerhead Turtle

Chelonia mydas Family CHELONIIDAE
Green Turtle

*Eretmochelys imbricata* Family CHELONIIDAE
Hawksbill Turtle

*Lepidochelys olivacea* Family CHELONIIDAE
Olive Ridley

*Dermochelys coriacea* Family DERMOCHELYIDAE
Leatherback Turtle

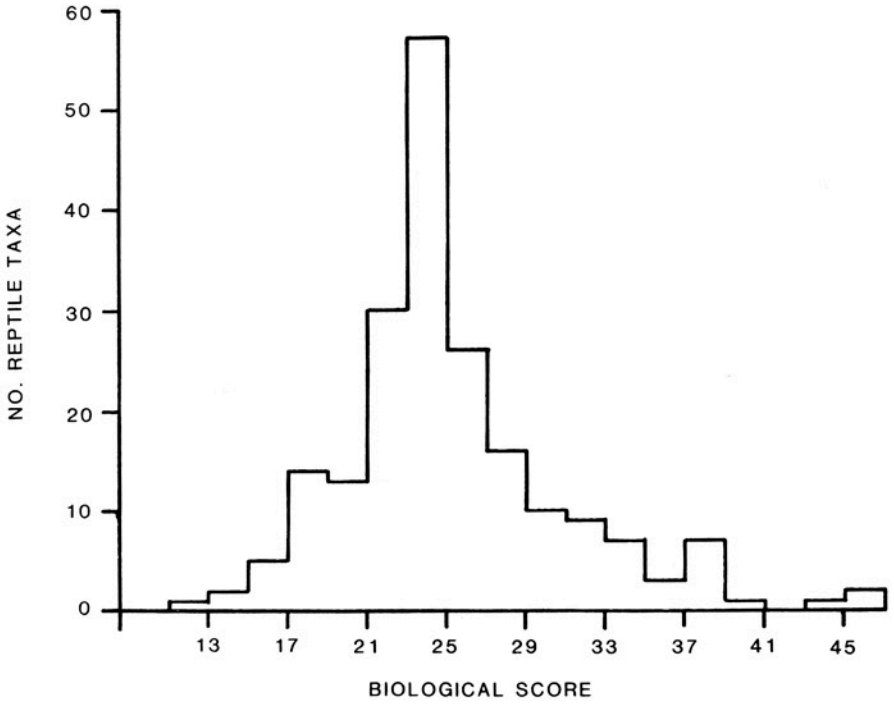


*Fig. 1.* Distribution of total scores for biological variables assigned to the 204 Australian reptiles identified as threatened in the Action Plan for Australian Reptiles. The biological variables are listed in Table 1 and are adapted from the taxon priority system of Millsap *et al.* (1990).

or freshwater reptile. This was in part due to the low endemism of the marine turtles compared with the high endemism of the terrestrial reptiles, in part to the large geographic distribution of most marine turtles compared with the usually limited range of other threatened species, and in part to the great pressures being placed on many terrestrial and freshwater habitats.

Nonetheless all species of sea turtles (except *Natator depressus*) are declining globally, and the Australian populations of several species are in serious decline at least regionally, so the consultants believe that a special case can be made for all species except *Natator* to be given Vulnerable status. This view is supported by most Australian marine turtle experts who have prepared a series of draft recommendations for marine turtle conservation (Australian Nature Conservation Agency and Queensland Department of Environment and Heritage, in press). However some herpetologists working with threatened endemic terrestrial and freshwater reptiles have expressed concern that such listing may result in the diversion of too great a proportion of scarce conservation resources towards a group of wide-ranging circumtropical species.

When the threatened reptile taxa had been ranked and categorised, dossiers were compiled for each of the 11 Endangered and 42 Vulnerable taxa. Data on their holdings of reptiles in these two categories were supplied by the Collection Managers of all Australian natural history museums. Information volunteered in the nomination process and provided by State and Territory Government conservation agencies were added to the dossiers and a literature search was undertaken. Further information was sought from researchers (including the workshop participants) familiar with the listed taxa.

The bulk of the Action Plan for Australian Reptiles is a series of "species recovery outlines" for all Endangered and Vulnerable terrestrial and freshwater reptiles. These were compiled from the dossiers and the personal knowledge of the consultants. The recovery outlines follow the format for the Action Plan for Australian Birds (Garnett 1992) and information is listed under twenty headings. The first four headings identify the species and any infraspecific taxa. The other headings cover:

species survival status;
former distribution;
current distribution;
habitat;
reasons for decline;
conservation reserves in which species occurs;

other conservation reserves where species might be expected to occur;
other public lands on which species occurs;
other land on which species occurs;
adequacy of knowledge base, crucial information that is lacking;
recovery plan objectives;
management actions already initiated;
management actions required;
organizations responsible for conservation of species and individuals involved;
other organizations and individuals involved;
budget for recovery plan;
remarks and references

In addition to a general description of habitat, and a discussion of real and speculated reasons for decline (referred to as "threatening processes") in each taxon, categories of habitat and reasons for decline were standardized to facilitate comparison between taxa and to provide guidance in determining priorities for management actions. Habitats were defined in terms of vegetation structure, following the classification in the AUSLIG (1990) Atlas of Vegetation with some additional descriptors used for aquatic and rocky habitats (see Table 4). Categories of threatening processes (Table 5) were based on those used in the Action Plan for Australian Birds (Garnett 1992) with additional descriptors which were not always mutually exclusive (e.g., habitat clearance and habitat fragmentation).

Individual Species Recovery Outlines were circulated for review to herpetologists and wildlife management officers in conservation agencies and their comments were incorporated in the modified Outlines. The final draft of the complete document of the Action Plan for Australian Reptiles was circulated for comment to all the Australian conservation agencies represented on the Australian and New Zealand Environment and Conservation Council (ANZECC).

*Table 4.* Habitats of Australia's endangered and vulnerable reptiles (excluding marine turtles).

| Habitat | No. of species using habitat |
|---|---|
| Closed forest | 5 |
| Low closed forest | 1 |
| Tall open forest | 3 |
| Open forest | 6 |
| Woodland | 9 |
| Open woodland | 10 |
| Low woodland | 2 |
| Low open woodland | 2 |
| Tall shrubland | 6 |
| Tall open shrubland | 3 |
| Heathland | 8 |
| Low shrubland | 2 |
| Hummock grassland | 2 |
| Tussock grassland | 9 |
| Littoral complex | 1 |
| Swamps | 3 |
| Rivers | 4 |
| Riparian habitats | 3 |
| Rocky isolates | 12 |

*Table 5.* Processes threatening Australia's endangered and vulnerable reptiles (excluding marine turtles).

Most of these threats are speculative; few have been confirmed by research. Individual recovery outlines in Cogger *et al.* (in press) should be consulted for further explanation of the processes which are believed to be responsible for declines.

| Threatening Process | No. of species threatened |
|---|---|
| Habitat clearance | 30 |
| Overgrazing by stock | 21 |
| Cropping | 21 |
| Predation | 14 |
| Urban development | 14 |
| Pasture improvement | 12 |
| Fire regime | 11 |
| Soil degradation | 9 |
| Visitor disturbance | 8 |
| Soil and/or water pollution | 7 |
| Mining | 6 |
| Native forest logging | 6 |
| Rabbit grazing | 6 |
| Climatic variation | 5 |
| Habitat fragmentation | 5 |
| Weed invasion | 5 |
| Habitat drainage | 4 |
| Rock removal | 4 |
| Irrigation | 3 |
| Captive trade | 2 |
| Loss of litter | 2 |
| Competition from native species | 2 |
| Loss of food source | 2 |
| Fishing | 1 |
| Water supply augmentation scheme | 1 |
| Displaced by introduced species | 1 |
| Dam construction | 1 |
| Hunted for food | 1 |
| Competition from introduced species | 1 |
| Plantations | 1 |
| Poisoned by introduced species | 1 |

A small database file was created for the museum data on locality (including latitudes and longitudes), date of collection and numbers of specimens held. From this file distribution maps were generated for each taxon and these were plotted over a base map supplied by ERIN which showed the distribution in Australia of reserves larger than 1 000 $km^2$. The proximity of specimen records to a reserve was considered indicative of the probability of that taxon occurring within the reserve. Of course, where the preferred habitats of a species do not occur in a reserve, the probability of the reptile's occurrence in that reserve is substantially reduced. The

primary purpose of the map overlay was to indicate to land managers those reserves which should be given priority in surveys of threatened species. In some cases it highlighted the scarcity or absence of large reserves within the range of a species.

Recovery Outlines were not compiled for marine turtles because their conservation requires a different, international approach (see above) but brief "Species Profiles" were included as an appendix and specimen records were plotted on a map of the Australian coastline. In addition to the first five headings used in Species Recovery Outlines for terrestrial and freshwater reptiles, the marine turtle Profiles included the following information:

worldwide distribution;
Australian distribution;
conservation status under State and Commonwealth legislation;
organizations responsible for conservation of species and individuals involved;
other organizations and individuals involved;
remarks;
references

As this was a *national* Action Plan, it was considered essential to identify those regions of Australia and its Territories which are most critical to the conservation of the greatest number and diversity of Endangered and Vulnerable terrestrial and freshwater reptile taxa. This was achieved through the application of components of the WORLDMAP software package to the database file of museum specimens. The WORLDMAP programme is currently being developed by Dr Paul Williams and his colleagues at the Natural History Museum in London (Vane-Wright *et al.* 1991; Williams *et al.* 1993); a copy was kindly lent to the consultants to trial in the Australian Action Plan for Australian Reptiles.

The WORLDMAP authors, recognizing that phylogenies based on cladistic methods provide an effective measure of phylogenetic uniqueness, developed this software package to measure various components of biodiversity and, through a series of algorithms, use a set of criteria to identify geographic areas (on a variety of scales) of high value for the conservation of biodiversity and hence of potential value as reserves. Amongst other characteristics, the analyses identify areas with the highest species richness, endemism and taxonomic dispersion.

The WORLDMAP analyses of the distribution of Australian Endangered and Vulnerable terrestrial reptile taxa highlighted 10 areas of high biodiversity — three each in Western Australia and Queensland, one each in New South Wales, Victoria and South Australia, and one encompassing the Indian Ocean Territory of Christmas Island. The states with the highest number of severely threatened reptiles are Western Australia (15 Endangered or Vulnerable taxa) and Queensland (12 Endangered or Vulnerable taxa).

The Action Plan for Australian Reptiles concludes with a list of herpetological authorities consulted and a complete score-sheet for the 204 taxa which compose the list of Endangered, Vulnerable and Rare or Insufficiently Known Australian reptiles. The Action Plan is intended to be a reference document for all those concerned with the conservation of Australia's rich diversity of reptiles in Australia, but it should be recognized that the conservation status of individual taxa is dynamic; their true status may change dramatically as their environment changes and the status assigned to them by conservationists may be altered as a result of further research and surveys.

The Action Plan for Australian Reptiles has benefited from the contributions of many individuals and agencies; they are individually acknowledged in Cogger *et al.* (in press). The constructive comments of two reviewers of this article are acknowledged with thanks.

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# BOOK REVIEWS

**"Reptiles and Amphibians of Australia: The bible of Australian herpetology"**
**Dr Harold Cogger**
**Reed International Books, Chatswood, Australia**

Unlike most herpetologists I know, I was born without a reptile in my hand. I am also of the sex that is generally discouraged from having an interest in things "creepy crawly". As a result I became interested in reptiles at an age when most herpetologists already know their subjects intimately.

My first introduction to Dr Harold Cogger and his works came with my first serious scientific discussion of reptiles. I was handed a copy of the 1975 edition of *Reptiles and Amphibians of Australia*, with the caution that there was a much expanded, new edition available. I soon obtained the "new" edition of this bible of Australian herpetology. Since then I have obtained two more editions for my own use and, in addition, provided copies as gifts for overseas colleagues and recommended it as a reference to untold numbers of others interested in herpetology. The work of no other author contained in my library has been so well thumbed or widely recommended.

Dr Cogger's works are so much an integral part of Australian herpetology that it is easy to overlook their true value. This book is the essential reference in the field. No other herpetologist has provided the background information for so many studies and associated identification of Australian herps. It is impossible to be interested in reptiles and amphibians and not know of this great man and his work. This is probably why the latest edition of *Reptiles and Amphibians of Australia* (1992) has arrived in the bookshops without the fanfare it deserves. As with previous editions it provides an up-to-date reference of all described species of Australian herpetofauna, complete with a "thumb-nail sketch" of each, a distribution map and excellent photographs of many of the species. It goes without saying that everybody who is remotely interested in the field needs access to a copy of this amazingly informative work.

Shelley Burgin

**Smuggling of Australia's wildlife:**
**The dirt, unsubstantiated allegations and distortions of the truth**
**Raymond Hoser**
**Apollo Books, Sydney.**

To have written this largely unsubstantiated tome, Raymond Hoser must be either very stupid or alternatively he has little respect for his own welfare, that is even if few of his allegations are true. He alleges that by May, 1981 after five years of collecting information and tracking down the principals involved in smuggling Australian wildlife, he knew who was responsible. After months of his phone being tapped, ". . . the smugglers . . . struck back" (pp. 2). He goes on to tell us that these "smugglers" consisted of ". . . five employees of three Government Departments". Since that time he claims to have been ". . . subject to harassment by Government officials in three States and by various Government Departments" (pp. 3).

If we believe his "facts" (virtually all unsubstantiated), he is lucky to be alive: he alleges that "many others have been beaten or harassed into silence . . ." (pp. 2), at least six have been mutilated and used for lobster pot bait near Sydney Heads and others have been put through a mincing machine in Brisbane. He further alleges that accidents have been faked, for example Joseph Mattinson had a tractor rolled on him and in another incident two brothers were found in a car in the bottom of a dam. After printing so many allegations against people capable of such crimes how is it that he is still walking the streets of Sydney in good health.

One of the major short-comings of this book, and there are many, is that the "correlation of facts" are largely unsubstantiated. The source of over 30 per cent of the material listed in the lengthy bibliography comes from a variety of articles in periodicals and newspapers, while in excess of 20 per cent of the references are anonymous. Despite the large number of court cases reported, few of the original Australian cases are referenced. In fact, throughout the book original material is rarely sourced. The exceptions are the case of Malcolm Ackroyd (Ackroyd vs N.P.W.S.: NSW Government 1982a) and the subsequent case in the High Court (1986), the official paperwork in the form of The Victorian Ombudsman (Geschke 1990) is also provided for the case of Bruce Jacobs. Other than that the Fitzgerald Report (1989) and several court cases involving the author and N.P.W.S. spanning the years 1982–1985 (NSW Government 1982b, 1982c, 1984, 1984–85) are referenced, although they are not discussed in the text. The contents of other references seem to have little or no relevance to the text, for example Burgin (1984), Schultze-Westrum (1971) and a series of articles and letters on the Wells and Wellington (1983) review of the Australian Reptilia which have nothing to do with smuggling or keeping of wildlife (e.g., Tyler 1985; Grigg and Shine 1985). I have also been told of several passages where quotes from people have been taken out of context, although I have not verified these personally. One such example is the apparently damming quotes from Mr Ronald Strahan's evidence to the 1976 House of Representatives Inquiry into Smuggling.

The book is also confusing in the sense that it leaps from one case to another with admitted "no attempt at chronology". Names and situations appear and reappear throughout the book. Whether accidental or not, this is a very clever trick, because if you are not concentrating intensely you get the distinct impression that there are far more cases discussed than are actually addressed. Even so, no fewer than 10 employees of the New South Wales National Parks and Wildlife Service are named for their alleged corrupt activities, while others are implicated. In addition, New South Wales' public servants from a variety of other areas including Customs, Telecom and the police, together with various airline staff, are accused of being corrupt. However, from reading the book one could get the impression that wildlife trafficking (and associated corruption) is worse in South Australia and Queensland, than in New South Wales.

The figures are unbelievable, even more so when the names are reviewed. As a scientist working with reptiles and having also for some years been associated with the National Parks and Wildlife Service in various advisory roles, I find the majority of the accusations ridiculous beyond belief.

I also question the logic of labouring cases which are in excess of 20 years old. Attitudes to the conservation, export and import of wildlife have changed dramatically, even in the last decade. People like Sir Edward Halstrom (Director of Toronga Park Zoo in the 1960s) was, at least in part, interested in acclimatization of animals and probably had little interest in the conservation of Australian wildlife in the context of the 1990s.

The most frightening thing about this book is that virtually none of the accusations against named individuals are substantiated. For the first time in my life I am left wondering about the democratic society that I have valued. The fact that the foreword and preface are written by people of high standing in the community, is even more damming.

I personally find this book disturbing in the extreme.

Shelley Burgin

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