The Status of Marine Reptiles in New South Wales

A Report prepared for the New South Wales National Parks and Wildlife Service

by

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Executive Summary

Seventeen species of marine reptiles –turtles and snakes – have been recorded from the coast or coastal waters of New South Wales. Of these, four species are observed with sufficient regularity to be regarded as "regular" visitors, while one species can be regarded as a year-round "resident". In only four species have breeding events been recorded in NSW.

Only in these last four species – the Green Turtle (*Chelonia mydas*), the Loggerhead Turtle (*Caretta caretta*), the Luth or Leathery Turtle (*Dermochelys coriacea*) and the Yellow-bellied Sea Snake (*Pelamis platurus*) are the NSW populations likely to represent significant proportions of their eastern Australian stocks. However on the basis of existing records, only in *Dermochelys coriacea* and *Pelamis platurus* do the NSW populations appear to have the potential to contribute significantly to recruitment in their Australia-wide stocks. Indeed, there is circumstantial evidence that the stock of *Pelamis platurus* in oceanic waters off NSW is a major, permanently resident proportion of the Australian population.

The NSW records of all other species appear to represent vagrant individuals which stray southward with the assistance of the Eastern Australian Current, especially in warmer months. However this pattern may also reflect, in part, the seasonal activity patterns of human observers. Nesting turtles in far northern NSW nest synchronously with populations further north, and so probably represent simply outliers of the resident south-eastern Queensland stock.

Currently, three of the five turtle species recorded from NSW are on Schedule 2 of the Threatened Species Conservation Act,1995 (Green, Loggerhead and Leathery), while two (Hawksbill and Flatback) are unlisted. Given that the eastern stock of the Loggerhead Turtle (Caretta caretta) has declined dramatically in the past 20-30 years, it is recommended that this species be elevated to "endangered" status (Schedule 1), but that the other turtle species retain their current status. The status of the Green Turtle elsewhere in eastern Australia is currently being monitored and there are indications of an ongoing decline. If such a decline is confirmed and is shown to be ongoing, consideration should be given to elevating this species in NSW to Schedule 1.

No marine snakes are currently listed on either Schedule 1 or Schedule 2 of the Threatened Species Conservation Act, 1995. Given that most of the marine snakes recorded from NSW are seen infrequently and are clearly vagrant individuals which have strayed from their core tropical populations, and also that there is no evidence of any significant decline in those core populations, no change in their protected status in NSW is proposed.

In the case of the Yellow-bellied Sea Snake (*Pelamis platurus*), which is apparently abundant and probably a long-term resident in oceanic waters off the NSW coast, there is not only no evidence of any decline but also no evidence of any significant anthropogenic mortality in this species. Consequently no change in its current unlisted status is proposed.

Recommendations for further research on the Yellow-bellied Sea Snake (*Pelamis platurus*) and for the conduct of a survey of fishers, divers and regional coastal newspapers to enlarge the existing database of marine reptile records from NSW, are made.

1. Introduction

With the exception of a single marine lizard in the Galapagos Islands, the only living groups of reptiles adapted to a primarily marine existence are chelonians (the sea turtle families Cheloniidae and Dermochelyidae) and snakes of two related groups here treated arbitrarily as distinct families - the sea snakes, Hydrophiidae and sea kraits, Laticaudidae - although each is often included as a subfamily in the polyphyletic family Elapidae.

While other reptiles living in shore or estuarine environments may enter the sea briefly, there are very few (such as the estuarine crocodile, *Crocodylus porosus*) which have the physiological ability to excrete the extra salt load entailed in drinking or absorbing seawater for lengthy periods.

Australia is a major centre of diversity for both marine turtles and sea snakes, with significant regional endemism. While six of the world's seven species of marine turtles (Marquez, 1990) occur in Australian waters, our fauna includes the regionally endemic monotypic genus *Natator* (the flatback turtle, *Natator depressus*). Of 33 species of sea snakes recorded from Australian waters, 21 (63%) are regional endemics, and this latter group includes all but three of the seven species treated in this report as occurring in NSW.

Both sea turtles and marine snakes are essentially tropical in distribution. Sea turtles are tropicopolitan, whereas marine snakes are confined to the Pacific and Indian Oceans. Both groups occur in the coastal waters of New South Wales, but with the exception of Lord Howe Island and the far north coast of New South Wales, most species are vagrants which apparently utilise the warm waters of the Eastern Australian Current to disperse southward each summer. Whether such dispersal/movements are deliberate or merely random events is a matter of conjecture, although both are probably implicated in NSW records of taxa in both turtles and snakes.

However it is important to stress that excluding Lord Howe Island, and with the exception of two species, each of the remaining 12 species covered by this report occur in NSW at the extreme southern limits of their known distributions and outside the limits of their normal breeding ranges. Indeed, most of the infrequent reproductive events which occur in NSW waters are likely to result in near-zero recruitment to the future breeding stock of each species. Further, except for individuals occurring in far northern NSW waters, even when potentially-breeding adults survive the cooler temperate conditions they are unlikely to contribute in any significant way to future recruitment to, and the maintenance of current adult population levels of, their respective species.

A consequence of these high probabilities is that any assessment of the conservation status of NSW species and their populations, such as those involved in applying criteria adopted by IUCN, by the NSW Threatened Species Conservation Act, or by Millsap et al. (1990), based on applying those criteria to NSW populations alone, is likely to result in their spurious elevation to a higher threatened category than those much larger geographic components of their populations (outside NSW) which actually determine the survival prospects of each taxon in NSW. No conservation action within NSW, involving either legislation or population management, is likely to have any significant impact on the conservation status of the relevant species – globally, nationally or within NSW. That is, the conservation of most taxa occurring within NSW will continue to depend on the security of their populations outside the territorial boundaries of NSW, while contributing little to maintaining that extralimital security.

This conclusion does not imply that particular taxa should not be afforded protection under NSW legislation, but I would argue that this should only occur where taxa are clearly at risk because of the threatened status of their populations in those areas beyond NSW where significant reproduction and recruitment occur.

The frequency with which marine turtles and snakes are recorded from NSW waters are shown in figs. 1 and 2 below. The same records graphed by month of capture, when known,

(figs. 3 and 4 below) indicate clear seasonality of occurrence in NSW waters of those species which occur regularly. The patterns in individual species are discussed and shown below under each species.

In these latter two figures, all available *dated* records, independent of identity, have been utilised. Both of these figures show an increase in observations (non-vouchered records) occurrences since the 1970s. This pattern almost certainly reflects human social and demographic changes rather than bio-ecological changes in the relevant species, resulting from increased coastal development and year-round human activity along once sparsely used beaches, an increased community awareness of wildlife and conservation issues, and the development of observation-based wildlife databases such as the NPWS Wildlife Atlas of NSW. However some peaks may also represent exceptional seasons or changes in sea temperatures associated with movements in the Southern Ocillation Index.

While causes of variation are speculative, these graphs nevertheless suggest that geographically and temporally scattered records of marine reptiles from NSW are representative of a seasonally significant marine reptile biota within NSW waters.

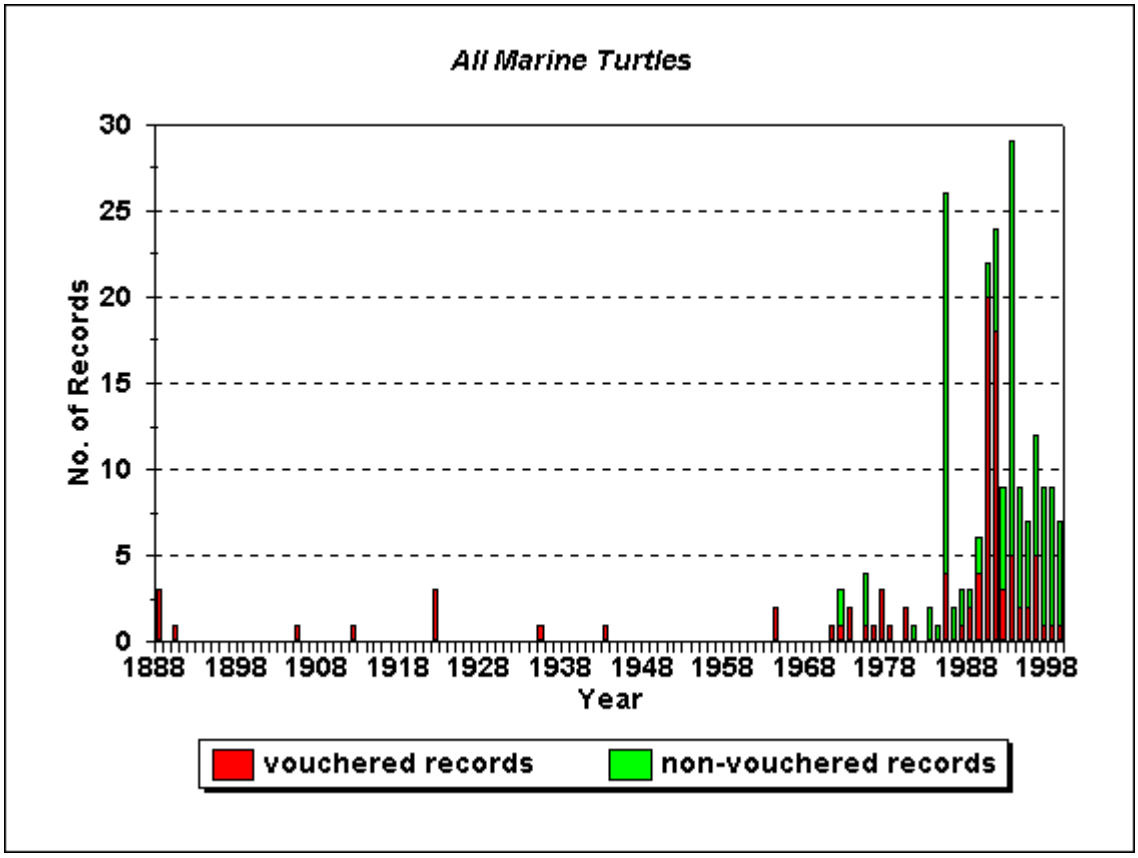

Figure 1: The frequency and chronology of recorded occurrences in NSW of all marine turtles in the period 1888-1998

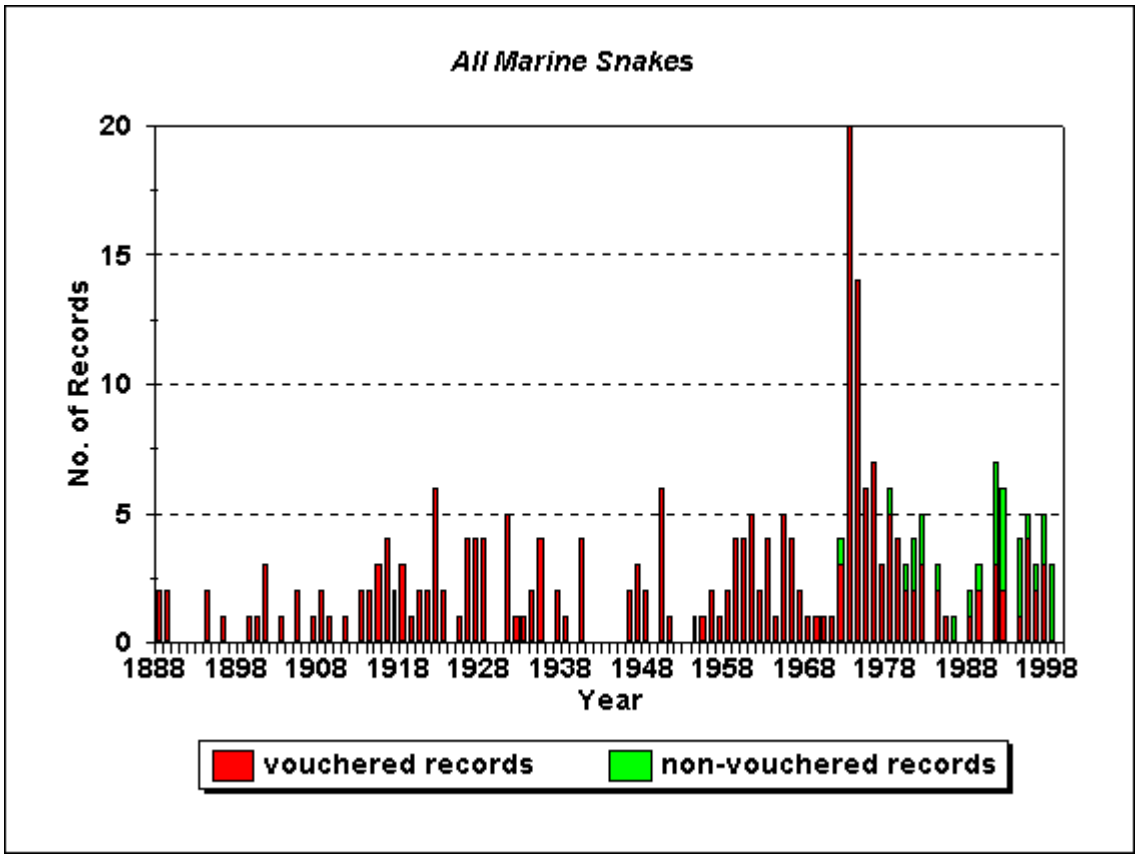

Figure 2: The frequency and chronology of recorded occurrences in NSW of all marine snakes in the period 1888-1998

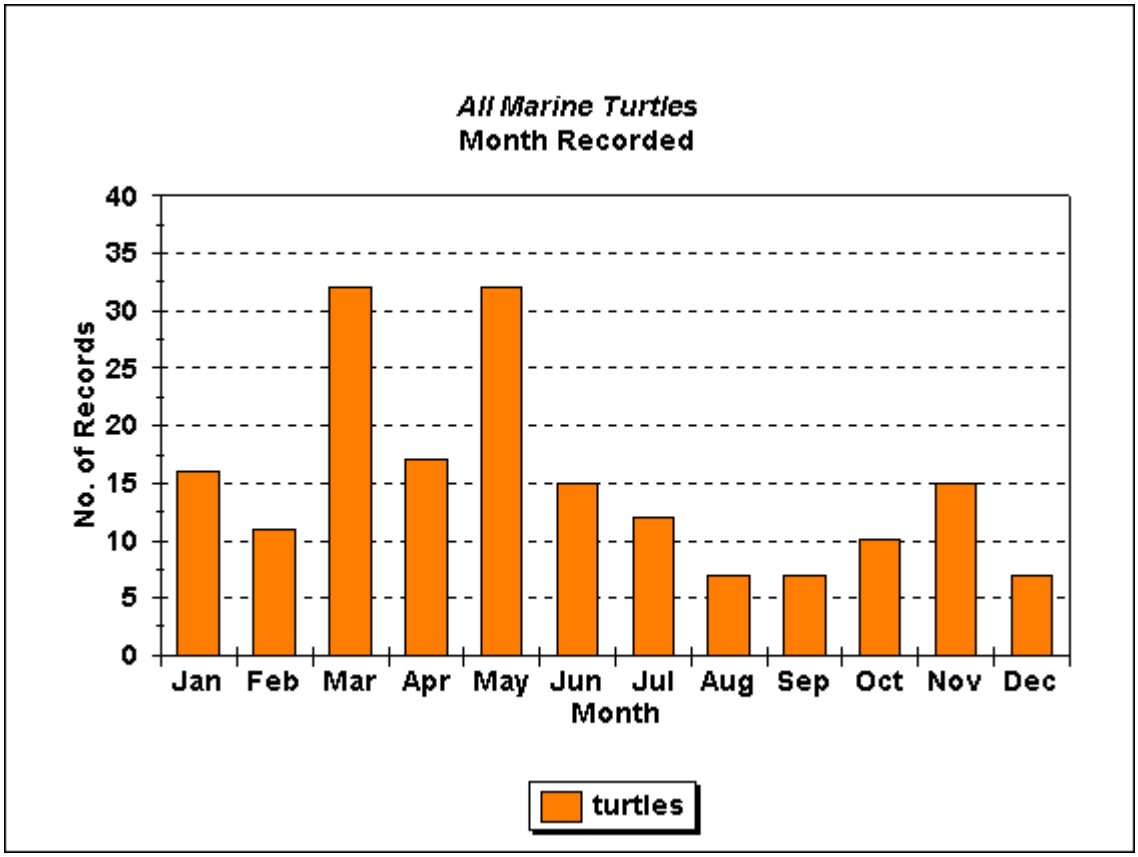

Figure 3: Recorded occurrences in NSW, by month of capture or record where known, of all marine turtles in the period 1888-1998

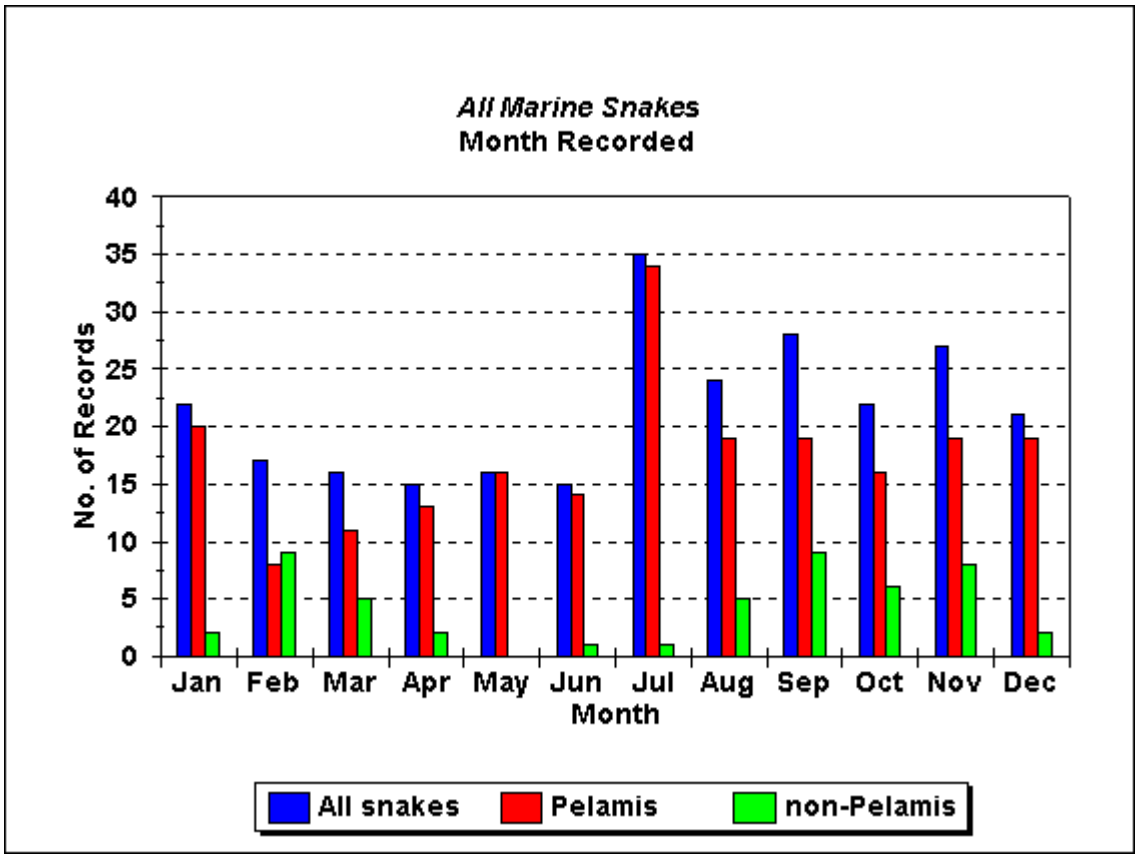

Figure 4: Recorded occurrences in NSW, by month of capture or record where known, of all marine snakes in the period 1888-1998

2. The conservation status of marine reptiles in NSW: assessment criteria and their significance

One of the major problems confronting conservation agencies in Australia is to assign a conservation status to any given taxon that accurately reflects the potential contribution that such status can make to the maintenance of viable populations of the taxon in its natural range. In other words, unless the absence of such status can be shown to place significant populations of the species (or the species itself) at risk of decline, then there is no *ecological* basis for assigning that status in the first place.

There may well be other more pressing reasons - usually sociological (such as animal welfare criteria) or political (such as public perception of conservation action) - for attempting to conserve individual organisms, but to claim that this is effective *conservation* of a particular species is intellectually dishonest.

Unfortunately conservation legislation often fails to distinguish between conservation and protection, with the result that there is a widespread misperception that the latter is a pre-requisite of the former. Often rarity in a particular circumscribed (usually politically defined) area is, of itself, considered to warrant protection.

I have belaboured these points because most marine reptiles recorded from most of NSW coastal waters are essentially seasonal waifs or vagrants, peripheral to their parent populations and in most cases unlikely to contribute significantly, if at all, to the future maintenance of the parental stocks. Consequently I would argue that each of the species recorded from NSW waters should be assessed not only on the basis of their rarity, range or numbers in NSW (e.g. see criteria in Lunney et al., 1996), but more especially on their potential to contribute to the maintenance of the viability of the taxon as a whole, and, to a lesser extent (unless the taxon is an Australian endemic), the Australian population(s) of that taxon.

The assessment methods adopted below (i.e. variations on the assessment and ranking methods of Millsap *et al*., 1990) have the advantage of taking both of these conditions into account.

But ultimately there are really only two broad bases for determining the need for targeted legislative protection for any given taxon: that which ensures the welfare of individual organisms and that which ensures the maintenance of viable and sustainable populations of the community or taxon. This report is concerned only with the latter.

3. Methodology

Information on the occurrence in NSW of species of marine reptiles was sought from a range of organisations and individuals. All museum (i.e. specimen-based) records held in Australian institutions were obtained and collated, together with relevant records from the Atlas of New South Wales Wildlife. Records in the latter are rarely specimen-based, and so their association with particular species cannot always be confirmed by reference to the observed specimen; in the absence of any indication that such records were erroneous (such as being well outside the documented range of the species concerned) such records have been accepted at face value but characterised by different symbols on the maps.

Museum records were obtained for the entire NSW coastline, and for 100 km north and south of the NSW border. Further, a literature search was conducted to locate published records of marine reptiles from NSW.

While there are several other potential sources of information on the occurrence of marine reptiles from NSW – most notably fishers, divers and dive operators, and local newspaper records – only rarely would such records be accurately attributable to particular species. With the exception of two highly distinctive species – the yellow-bellied sea snake (*Pelamis platurus*) and the leathery or luth turtle (*Dermochelys coriacea*), all other marine reptiles recorded from NSW are notoriously difficult to identify by the layman and, in the case of sea snakes, sometimes even when the specimen is in the hands of a specialist.

Such surveys, with their associated costs in money and time, were beyond the scope of the present consultancy. While they are included, as a low priority, in the Recommendations, they would need to be conducted by a marine reptile specialist if meaningful data for managing or conserving particular species were to be obtained.

In their assessment of the conservation status of Australian reptiles, Cogger *et al.* (1993) determined that no Australian marine snakes were at that time threatened, although they categorised three intertidal species from tropical Australia (none of which occurs in NSW) as “rare or insufficiently known”.

The status of each NSW species has been assessed below using two modifications of the scheme devised by Millsap *et al*. (1990). The first modification is that used by Cogger *et al.* (1993) in preparing the Action Plan for Australian Reptiles for the then Australian Nature Conservation Agency in the Commonwealth Department of Environment, Sport and

Territories. The second modification is that developed by Lunney *et al.* (1996) for the NSW National Parks and Wildlife Service. Differences between these two approaches largely reflect different scoring methods rather than fundamental differences in criteria (although Lunney *et al*.have most criteria confined to NSW populations), but they have both
been used here to enable comparisons to be made with the results of the two major applications, within Australia, of the Millsap *et al.* approach to ranking the conservation status of highly diverse taxa.

4. Data Sources

Data on the holdings of NSW (and adjacent parts of Victoria and Queensland) marine reptiles were obtained from all Australian museums, including the Australian National Wildlife Collection (CSIRO). These are identified in Appendix 1 (on the CD ROM which accompanies this Report) by the acronym preceding each record, each acronym being that used by the Australian Biological Resources Study in all volumes of the Zoological Catalogue of Australia. The sources of literature records are referenced, while those extracted from the Atlas of New South Wales Wildlife are cited under the acronym WANSW.

In addition, some records held by Taronga Zoological Park, including personal records maintained by Mr John West, were made available for this project.

5. Major threatening processes with the potential to impact significantly on marine reptiles

Whereas no studies have suggested that any species of sea snake is declining globally (although local and regional declines of harvested species have been documented), most marine turtles have seriously declined globally over the past 50 years (Magnuson *et al.*, 1990; Ross, 1982). While it was long thought that Australian sea turtle populations were relatively secure and immune to global trends, recent studies have disclosed a major decline, approaching 70-80%, in the eastern Australian populations of the loggerhead, *Caretta caretta*, and a lesser, but significant decline in green turtles, *Chelonia mydas* (Limpus *et al.,* 1994; Limpus, pers. com.)

A number of key threatening processes have been identified as having caused, or as having the potential to cause, significant declines in marine reptiles. However, oviparous species which must come ashore periodically to deposit their eggs are especially vulnerable to loss of adult females during the time spent at or near their nesting sites, and to loss of eggs, to a wide variety of terrestrial predators, including humans.

All marine turtles come ashore to lay their eggs in egg chambers dug individually by each female for each clutch. An adult female will usually come ashore several times in the course of a season to lay several clutches of eggs; clutch size varies in number from about 50-150, depending on species and on the age and size of individual females. Consequently each female turtle produces about 150-500 eggs in a season. Each female will typically produce eggs in two successive seasons before “resting” for 1-2 years before laying another series of clutches.

In marine snakes, only the sea kraits of the family Laticaudidae are oviparous, depositing their eggs in terrestrial sites; all other sea snakes (family Hydrophiidae) are viviparous, and reproduce entirely within their aquatic environment.

All sea kraits spend significant periods on land, not only to breed but to rest and digest their

food. Their eggs are virtually never seen in the wild, suggesting that they deposit them deep in crevices out of reach of most predators. The sea kraits often form large aggregations (up to 500 or more individuals), usually on uninhabited small rocky and sandy islets within, or surrounded by, large coral reef systems. Because both sexes spend time on land throughout the year, both sexes would seem to be subject to similar predation pressure, which appears to be low in terrestrial environments. Principal terrestrial predators throughout their range are birds of prey and pigs. They are rarely preyed on by humans in our region, although in some Asian countries (e.g. the Philippines, Japan's Ryukyu Archipelago) they are exploited for skins, meat and traditional medicine.

At sea, both marine turtles and marine snakes are at risk of entanglement in nets and trawls (Poiner and Harris, 1996; Robins and Mayer, 1993; Murphy and Hopkins-Murphy, 1989), although only in Australia's tropical fisheries are there some reliable data on either numbers taken or mortality rates. Recognition of the extent of this threat in some fisheries has led to the compulsory introduction of turtle exclusion devices (TEDs) in commercial trawls in North America and moves for their mandatory use in northern Australian trawl fisheries (Crouse *et al.*, 1992; Slater et al., 1998).

Juvenile turtles and both juvenile and (less frequently) adult marine snakes are taken by a wide range of sea birds and fishes (Heatwole, 1975). Adult turtles are subject to predation by some shark species.

Ward (1991), as an observer on prawn trawlers operating out of Darwin, has provided figures on the annual take of sea snakes by the northern trawl fishery. Most specimens were dead or dying when brought on board, and such data have been used in the past to justify a skin trade based on this by-catch, although currently such an industry is confined to Queensland and the Northern Territory. Proposals have been drafted (but are yet to be submitted to the Commonwealth Government) to approve the export of snake skins collected under these State by-catch fisheries.

Limpus (pers. com.) has shown that voluntary reporting by some trawl fishers, while indicating a relatively high by-catch of marine turtles in some eastern Queensland fisheries, also indicates a low mortality rate with most of the catch being taken alive and later released. However recent telemetric tagging of released individuals indicates that severe trauma leading to erratic behaviours probably results in a much higher post-release mortality than previously reported by fishers.

Limpus (in litt.) has also indicated that recent studies suggest that oceanic long-line tuna fishing is a significant cause of mortality in marine turtles, although currently unquantified because there are no regulatory bodies authorised to mandate the collection of information.

A major conservation issue arises in relation to the life history traits of marine turtles.The longevity of marine turtles (50+ years) and the non-annual periodicity of egg production means that there is often a considerable time lag (decades) between the onset of a threatening impact and measurable responses to that threat in a species' population size and other demographics. In such species, application of the precautionary principle is especially critical, otherwise declines may be difficult or impossible to reverse by the time they become obvious. For this reason sophisticated population modelling and simulation programs have been developed in an attempt to identify current trends and long-term impacts (Crouse *et al.,* 1987; Chaloupka and Limpus, 1997a, 1997b; Chaloupka, 1988; Heppell *et al*., 1996), together with methods for aging individuals of such long-lived species (Chaloupka and Musick, 1996; Zug, 1990).

In summary, the major threatening processes leading to significant mortality in marine turtles and marine snakes are:

(a) Mortality from direct exploitation or by-catch

- hunting of turtles for food throughout their ranges (in Australia, such hunting is legal only for indigenous peoples wishing to consume their traditional foods, though there is no requirement that traditional hunting methods be used).

- the taking of turtle eggs from natural nest sites for human consumption (the previous comments on indigenous Australians also apply)

- the taking of eggs and hatchling turtles by native and exotic animal predators such as seabirds, foxes, monitor lizards and pigs

- the by-catch of turtles in trawls, shark-nets, drift nets and on long lines and of marine snakes in in-shore trawling operations, both of which result in moderate (turtle) to high (sea snakes) mortality rates

- the taking of some species of turtles for their shells (for taxidermy, or for use of the carapace plates in the manufacture of curios); illegal throughout Australia and importation prohibited.

- the taking of snakes for their skins, to be used in the manufacture of leather, or for meat or traditional medicine; permitted under licence in Queensland and the Northern Territory.

(b) Mortality from ecosystem degradation

- Pollution (e.g. chemical, from agricultural runoff; physical, from siltation or repeated trawling) of key habitats, including feeding grounds

- Physical degradation of breeding sites (e.g. tourism, recreational vehicles, removal of benthic biota and topographic features by repeated trawling)

- Physical damage caused to individual animals through recreational small craft, outboard motors, etc and subsequent loss of habitat quality

All of these processes, other than those affecting terrestrial nesting sites, are likely to be impacting on marine reptiles in NSW waters, although there has been no quantified research on which to base estimates of their impacts.

However two other factors have the potential to impact on the future status of turtle populations in NSW (and other State) waters. First, global warming may well result in a southward shift in turtle populations seeking optimal feeding and breeding conditions. Whether NSW could offer such conditions under a higher oceanic thermal regime is conjectural, but it remains a distinct possibility that has implications for future monitoring and management programs.

A linked issue is that of incubation temperature-dependant sex determination in marine turtles. Currently, breeding events in northern NSW, at the cooler end of the range of cheloniid species, can result in cooler mean incubation temperatures and extended incubation periods, both with the potential to increase egg mortality and/or produce all-male hatchlings. Both current and future (under a global warming scenario) demographic implications are unknown.

6. Annotated List of Species of Marine Reptiles recorded from NSW

The following species have been accepted as occurring in the waters of NSW based on confirmed, specimen-based records in museum collections. Sea snakes, especially, are notoriously difficult to identify from sightings, and even specimens in hand generally require identification by a specialist. For this reason, except for sightings of the distinctive yellow-bellied sea snake (*Pelamis platurus*), records of marine snake taxa based solely on unconfirmed reports (i.e. those which are not confirmable from voucher specimens, or which lack even approximate locality data) are indicated below by an asterisk but are otherwise rejected as NSW fauna for the purposes of this report.

TURTLES

Family Cheloniidae (hard-backed sea turtles)

Green Turtle (***Chelonia mydas***)
Flatback Turtle (***Natator depressus***)
Loggerhead Turtle (***Caretta caretta***)
Hawksbill Turtle (***Eretmochelys imbricata***)

Family Dermochelyidae

Luth or Leathery Turtle (***Dermochelys coriacea***)

SNAKES

Family Hydrophiidae (viviparous sea snakes)

Acalyptophis peronii
Aipysurus duboisii
Aipysurus laevis
Astrotia stokesii
Disteira kingii
Disteira major
Emydocephalus annulatus
Hydrophis elegans
Hydrophis inornatus
***Hydrophis ornatus/ocellatus* complex**
Pelamis platurus

Family Laticaudidae (oviparous sea kraits)

Laticauda colubrina

7. Marine Turtles

Green Turtle (*Chelonia mydas*)

Current conservation status

Global	Endangered
National	Vulnerable
NSW	Vulnerable (Schedule 2)

Distribution

Global	Tropicopolitan, with waifs extending to higher latitudes
National	Tropical Australia, with breeding largely restricted to areas north of latitude 27ºS
NSW	Coastal waters in small numbers which attenuate rapidly southwards; rare breeding events in far northern NSW, mostly unsuccessful (fig.5). The frequency and chronology of dated records are shown in fig.6.

Field diagnostic characters: Four costal shields on each side of carapace; four or more postocular shields; enlarged scales on upper eyelid.

General remarks

The green turtle is one of the world's most abundant and widespread marine turtle species. It is the most highly prized species for human consumption, and in the past has been subjected to intense hunting pressure throughout its range, except in Australia where it was, and continues to be, hunted in relatively small numbers by aboriginal communities throughout northern Australia. A small green turtle fishery existed on the Great Barrier Reef for the first half of this century, but ended by about mid-century. Consequently it is considered to be endangered globally and has been so categorised by IUCN.

It breeds in vast numbers at some northern Australian rookeries (e.g. Raine Island, Crab Island), while lower nesting intensities occur on mainland and island beaches throughout its Australian range (Bustard, 1972; Limpus, 1980; Limpus and Reed, 1985). These large numbers of individuals, including nesting females, have led turtle biologists to conclude that the species is secure in Australia, probably moreso than in any other part of its range.

However Limpus and others (Karl *et al*., 1992; Bowen *et al*., 1992) have demonstrated, using molecular data, that while the Australian populations of this species represent a distinctive regional genetic pool with most breeding confined to members of this regional pool, Australian green turtles travel beyond Australian waters to feeding and maturing grounds in Indonesia and the Pacific (Allard *et al*.,1994; Meylan *et al*., 1990; Limpus *et al*., 1992). Consequently the Australian stock is subject to more intensive hunting pressure in these other areas, and recent downward trends in nesting rates have been recorded in monitoring programs for the Queensland stock (Limpus, pers. com.).

While not yet indicating a serious decline, the trends are worrying because although they may well represent normal cyclical events, they may also represent the early stages of a steep decline in this long-lived species.

Given that the species is probably relatively common in far northern NSW waters and at Lord Howe Island, and thus NSW stock may well be making a small but significant contribution to the core breeding stock in eastern and north-eastern Queensland, it is recommended below that the current conservation status of the Green Turtle in NSW be maintained. However given that current research in Queensland is indicating that core populations of this species are declining at a modest rate, any demonstrated increase in the rate of decline would justify elevation of this species in NSW to Schedule 1 (Endangered) status.

Analysis of status in NSW

Table 1: *Chelonia mydas* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	8	7	0	2	0	5	0	3.3	1.7	27	5	10	5	5	25	0	4	0	2	0	0	5	3	2

Table 2: *Chelonia mydas* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	7	0	5	4	3	3	5	c	VR	39

Recommended conservation status in NSW

While recent declines in the number of breeding females of this species have been recorded at a number of Queensland rookeries (Limpus, pers.com.), the extent and causes of such declines remain speculative. Processes commonly threatening nests, eggs and hatchlings (varanid lizards, foxes, pigs, human recreational use of nesting beaches) do not appear to have increased significantly during these declines, suggesting either that (a) adult green turtle mortality has increased significantly due to an increase in the intensity of inshore trawl fishing or offshore drift net and long line fishing or (b) an increase in the intensity of processes threatening adult , juvenile or hatchling turtles in decades past (including extra-territorial areas) is only now resulting in overall declines due to the long maturation period in marine turtles and its delayed demographic effects.

Pending further monitoring of green turtle breeding numbers at key Queensland rookeries, it is proposed that the status of the green turtle should continue to be “vulnerable” (Schedule 2) until current trends can be shown unequivocally to represent a significant decline in green turtle numbers in eastern Australia (current programs in the Northern Territory and Western Australia are unlikely to provide reliable trends for the remainder of the species’ Australian range).

However given the distinctive “delayed response” in animals with the life cycle and demographic characteristics of this and most other marine turtles (see discussion in Section 5 above), it could also validly be argued that application of the precautionary principle would

warrant immediate upgrading of this species to the "endangered" category (Schedule 1) to ensure that it receives maximum legislative protection in NSW . This is not proposed, although the Service might wish to seek further opinions.

Given that nesting of this species is uncommon on the coast of NSW, and that such breeding events are not only uncommon but infrequently result in the production of hatchlings which will be recruited into the core populations of the species, protection of adults rather than nests should be the principle objective of any conservation action in NSW. Unfortunately there are no data available on green turtle mortality in NSW waters, and thus no indication as to where to target conservation action. These circumstances would reinforce any proposal to elevate this species to endangered (Schedule 1) status.

Flatback Turtle (*Natator depressus*)

Current conservation status

Global	Vulnerable
National	Vulnerable
NSW	not threatened (unlisted)

Distribution

Global	Confined to tropical and warm temperate Australian seas and the adjacent territorial waters of southern Papua New Guinea and southern Irian Jaya.
National	Tropical Australian seas, with occasional waifs recorded from coastal NSW
NSW	Occasional records (only specimen-based record from Manly, Sydney in 1980); no resident/breeding population (fig 7). The frequency and chronology of dated records are shown in fig.8.

Field diagnostic characters: Four costal shields on each side of carapace; three postocular shields; scales on upper eyelid small, irregular, subequal.

General remarks

The monotypic genus *Natator* contains the single species *depressus* and is the only marine turtle endemic to the Australian region. Until 1988 it was treated as a congener of the green turtle, *Chelonia mydas* (Limpus *et al*., 1988). It is a common species which apparently spends its entire life cycle in Australian (and adjacent New Guinean) waters. It nests in very large numbers in some northern Australian rookeries, but also nests in smaller numbers on island and mainland beaches throughout its range (Bustard, 1972; Limpus et al., 1983; Limpus, 1971; Bustard and Limpus, 1969; Cogger and Lindner, 1969). Females lay about 50 eggs in a clutch, and lay several clutches in a season, but like other species the females do not produce eggs every year. Typically they lay eggs in two successive years then rest for a year

before again laying eggs. Like all marine turtles, they typically come ashore to nest at or just after dusk (depending on tides), but some diurnal nesting occurs.

Analysis of status in NSW

Table 3: *Natator depressus* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
2	8	7	0	6	0	5	0	3.3	1.7	33	5	10	5	5	25	0	4	3	0	0	0	5	4	2

Table 4: *Natator depressus* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	10	4	0	0	1	5	4	3	1	5	c	VR	37

Recommended conservation status in NSW

Given the rarity of records of this species from NSW, and the absence of any reliably identified nesting records, there is no evidence that the status of this endemic Australian species would be affected by any conservation action or inaction in NSW. For this reason it is recommended that the current conservation status of this species in NSW (protected but not threatened) remain unchanged. Clearly it is a rare vagrant to NSW waters, even though it is relatively abundant in the adjacent coastal waters of southern Queensland.

Loggerhead Turtle (*Caretta caretta*)

Current conservation status

Global Endangered

National Endangered

NSW Vulnerable (Schedule 2)

Distribution

Global Tropicopolitan, often straying into higher latitudes

National Tropical Australia, with breeding largely restricted to areas north of latitude 27ºS

NSW Coastal waters in moderate numbers in the far north, but which attenuate rapidly southwards; occasional breeding events in far northern NSW, mostly unsuccessful (fig.9). The frequency and chronology of dated records are shown in fig.10.

Field diagnostic characters: Five (rarely six) costal shields on each side of carapace; usually three enlarged inframarginal shields on the bridge, all without pores.

General remarks

The loggerhead turtle is a well-studied species which nests in large numbers at several rookeries, but throughout most of its range nests in relatively small numbers at usually isolated beaches. It is one of our largest marine turtles, attaining carapace lengths exceeding 150 cm. By comparison with other cheloniid turtles the head is large and distinctive.

Like other members of its family, each female lays several clutches in a season, typically on a two-years-on/one-year-off cycle. The eggs are large and a clutch normally consists of more than 100 eggs. Most aspects of its biology, ecology and distribution have been documented (Bustard, 1972; Limpus, 1973; Bustard et al., 1975; Gyuris and Limpus, 1988; Bjorndal et al., 1994; Limpus, 1994; Dodd, 1988; Bowen et al., 1994; Bustard and Limpus, 1971).

Analysis of status in NSW

Table 5: *Caretta caretta* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	10	7	0	6	0	5	0	3.3	1.7	33	5	10	5	5	25	0	4	0	2	0	0	5	3	2

Table 6: *Caretta caretta* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	13	4	0	7	0	5	4	5	1	5	c	E	48

Recommended conservation status in NSW

Until relatively recently the Australian populations of this species were thought to be relatively stable and secure. However it has been convincingly shown (Limpus and Reimer, 1992; Limpus et al., 1994; Limus, pers, com.) that the species in Queensland (its principal population based on nesting adults) has suffered a severe decline in recent years. Indeed, the population appears to be in real danger of extinction. Given that loggerhead turtles found in NSW represent those found at the southern limits of the eastern Queensland metapopulation, there is every reason to expect that the decline of the latter is reflected in NSW waters.

Like the green turtle discussed above, the life cycle of this species (longevity of 50+ years, time to sexual maturity of 15+ years, and non-annual periodicity of egg production) can result in a long lag time between the cause and effect of a decline in numbers. Thus, action must be taken immediately to reverse the major decline in Queensland loggerhead populations recorded by Limpus, even though there is a possibility that it may be too late to do so.

Consequently it is recommended that the loggerhead turtle in NSW be elevated to the highest possible conservation status, viz . Schedule 1 (Endangered).

Hawksbill Turtle (*Eretmochelys imbricata*)

Current conservation status

Global Endangered

National Vulnerable

NSW not threatened (unlisted)

Distribution

Global Tropicopolitan, with waifs extending to higher latitudes

National Tropical Australia, with breeding largely restricted to areas north of latitude 26ºS

NSW Coastal waters in small numbers which attenuate rapidly southwards; no breeding recorded in NSW; possibly one or more resident communities in far northern NSW (fig. 11). The frequency and chronology of dated records are shown in fig.12.

Field diagnostic characters: Four costal shields on each side of carapace; two pairs of prefrontals; tip of upper jaw projecting forwards and downwards to form a distinct projecting beak.

General remarks

The hawksbill turtle is found commonly throughout tropical Australia, yet relatively few major rookeries are known (Bustard, 1972; Limpus et al., 1983; Limpus et al., 1984; Limpus, 1992).

Widely scattered breeding, in relatively low numbers, characterises this species in Australia despite its wide range and relatively high abundance.

This species nests in the typical fashion of a cheloniid turtle, but lays small eggs in relatively small numbers (average clutch size about 50). It is believed to be a major predator on sponges (Meylan, 1988).

Analysis of status in NSW

Table 7: *Eretmochelys imbricata* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	8	7	0	2	0	5	0	3.3	1.7	27	5	10	5	5	25	0	4	0	2	0	0	5	3	2

Table 8: *Eretmochelys imbricata* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	7	0	5	4	2	1	5	c	VR	36

Recommended conservation status in NSW

NSW records of the hawksbill turtle represent records at the southern limits of the eastern Australian population which, according to Limpus (pers. com.) appears to be stable and secure. Further, because the hawksbill does not nest in NSW, conservation effort, if any, should be directed to maintaining the adult stock in coastal waters. While there are no data to indicate that, within NSW waters, this species is impacted on by any marine industry or activity, there appears to be no record maintained of any turtle by-catch in our northern trawl fisheries, a situation which needs to be redressed (see **Summary, Conclusions and Recommendations**, p.38).

However given that this species is considered to be secure and stable throughout its core breeding range, and that the contribution of the small number of adults recorded from NSW to the status of these core breeding populations is almost certainly insignificant, there is no basis for arguing any change in the current conservation status of this species in NSW.

Leathery or Luth Turtle (*Dermochelys coriacea*)

Current conservation status

Global	Endangered
National	Vulnerable
NSW	Vulnerable (Schedule 2)

Distribution

Global	Tropicopolitan, with adults frequently recorded from higher latitudes
National	Tropical and temperate Australia, with occasional individual nesting and no known nesting aggregations, suggesting that Australian stocks largely originate from outside our region.
NSW	Coastal waters in small numbers which attenuate southwards; few breeding records from NSW; possibly one or more resident communities in far northern NSW; observational evidence that the species deliberately travels south in summer to feed in NSW coastal waters (fig. 13). The frequency and chronology of dated records are shown in fig.14.

Field diagnostic characters: Both juveniles and adults characterised by a leathery skin (rather than enlarged horny shields) covering the carapace and by a series of five prominent, longitudinal ridges along the length of the carapace.

General remarks

This is the largest of all marine turtles, attaining a carapace length of nearly 2.5 m and a weight of nearly 900 kg. It lacks dorsal scutes and, with its strongly ridged carapace is the most distinctive of all marine turtles making its field identification easy and reliable.

It tends to be found more regularly in higher latitudes than cheloniid turtles, although it nests primarily in the tropics. Occasional nests are made in southern Queensland and far northern NSW, although there are few recorded successful hatchings of NSW nests. Knowledge of the biology and ecology of Australian populations is fairly fragmentary (Limpus and McLachlan, 1979).

Dermochelys feeds primarily on coelenterates and is seen from time to time in NSW coastal waters and estuaries feeding on swarms of jellyfish. Most records from NSW are based on individuals which have apparently drowned in fishing or shark nets and which are subsequently washed up on beaches.

Analysis of status in NSW

Table 9: *Dermochelys coriacea* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	8	4	0	2	0	5	1.6	3.3	1.7	25.6	5	10	5	5	25	5	4	0	2	0	0	5	2	1

Table 10: *Dermochelys coriacea* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	7	0	5	4	3	5	3	c	VR	39

Recommended conservation status in NSW

Given the propensity for this species to regularly enter temperate waters, presumably to visit major feeding grounds, it seems likely that significant numbers may visit NSW waters on a regular basis. However given that mortality is low (based on the small number of corpses washed up on NSW beaches) and that there is no evidence that Australian populations are currently in decline, it is recommended that the existing status of this species in NSW (Schedule 2, vulnerable) be maintained.

8. Marine Snakes

With the exception of the Sea Kraits (Laticaudidae) which spend much of their lives on land, knowledge of the biology and ecology of sea snakes (Hydrophiidae) is fragmentary. While considerable research has been conducted on sea snake venoms and their toxinology, on diving physiology, and on salt tolerance and secretion, most species are known from relatively few specimens and their biology extrapolated from general knowledge of the group. The behaviour of species found on coral reefs has received some attention, but behaviour and ecology of species found in deeper offshore or turbid inshore waters is poorly understood.

Similarly, knowledge of the taxonomy and systematic relationships of sea snakes has improved with the application of molecular methods, but remains contentious and lacks broad acceptance .

For the species occurring in NSW waters, current knowledge of their natural history and conservation status is summarised in a small number of key references. Rather than repeat each of these references under the individual accounts, they are listed here: Limpus. 1987; Heatwole, 1987; Cogger, 1975; Heatwole, 1999; Heatwole and Cogger, 1994; Heatwole and Cogger, 1993; Cogger, 1996; Smith, 1926).

Acalyptophis peronii

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Australian region, extending to New Guinea and far eastern parts of Indonesia, and east to New Caledonia.

National Estuaries and seas of Australia's tropical continental shelf

NSW Occasional records; no resident/breeding population (fig 15).

Field diagnostic characters: one of the most distinctive of all sea snakes in our region, with irregular and fragmented head scales, many of which have prominent ridges and low spines, especially prominent over the eyes.

General remarks

The body is strongly banded in juveniles and subadults, but the banding may become obscure or absent in older adults. Produces about 8-10 young. Little is known of its ecology, though it is most often seen in clear reef waters. A moderately common by-catch species in northern Australian trawl fisheries.

Analysis of status in NSW

Table 11: *Acalyptophis peronii* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	4	3	0	0	0	2	3	3

Table 12: *Acalyptophis peronii* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
N	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Aipysurus duboisii

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global North-west shelf through Arafura Sea to east coast of Australia, Coral Sea and New Caledonia.

National Tropical Australian seas, with occasional records of seasonal vagrants from coastal NSW and southern Western Australia.

NSW A single record made without voucher in 1991; no resident/breeding population (fig.16). The frequency and chronology of dated records are shown in fig.17.

Field diagnostic characters: Characterised by the combination of enlarged ventral scales (much wider than adjacent body scales), each with a small median notch on its free edge; 6 or more supralabial scales; nasal scales in contact; head shields entirely fragmented, the head being covered by small, irregular scales; fewer than 170 ventrals; 19 smooth mid-body scale rows.

General remarks

A common species throughout northern Australian waters, extending to the Coral Sea and New Caledonia, but rarely strays into higher latitudes. The species varies considerably in colour, from uniform brown or chocolate to forms with extensive cream spotting, large blotches, or all-cream lower surfaces and tail.

As indicated above, the occurrence of this species in NSW is based on a single, unvouchered record in the Atlas of New South Wales Wildlife made in 1991 at Ballina, NSW.

Analysis of status in NSW

Table 13: *Aipysurus duboisii* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	0	3	0	0	1	2	3	3

Table 14: *Aipysurus duboisii* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that there is currently only a single, unconfirmed (by voucher) record from NSW and that any individuals found in NSW waters are almost certainly seasonal vagrants, and that in addition there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change to the unlisted status of this species.

Aipysurus laevis

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global North-west shelf through Arafura Sea to east coast of Australia, Coral Sea and New Caledonia.

National Tropical Australian seas, with occasional records of seasonal vagrants from coastal NSW and southern Western Australia.

NSW Occasional records; no resident/breeding population (fig.18). The frequency and chronology of dated records are shown in fig.19.

Field diagnostic characters: Characterised by the combination of its large size (to 2 metres, average about 1.2 m), enlarged ventral scales (much wider than adjacent body scales), each with a small median notch on its free edge; 6 or more supralabial scales; nasal scales in contact; most head shields enlarged but fragmented; fewer than 170 ventrals; 21 or more smooth mid-body scale rows.

General remarks

One of the most abundant and best-studied of Australian marine snakes. The species varies considerably in colour, from uniform brown or olive to forms with extensive cream spotting or cream lower surfaces and tail.

It is a conspicuous and curious species which can occur in large aggregations on certain reefs, and which often actively approaches divers. Produces about 5-10 live young.

Analysis of status in NSW

Table 15: *Aipysurus laevis* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	5	4	0	2	3	1	0	0	1.7	16.7	5	10	10	10	35	0	0	0	2	0	1	2	4	3

Table 16: *Aipysurus laevis* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Astrotia stokesii

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Waters of Indo-Malaysia to Australia and New Guinea

National Estuaries and seas of Australia's tropical continental shelf

NSW Occasional records; no resident/breeding population (fig.20). The frequency and chronology of dated records are shown in fig.21.

Field diagnostic characters: characterised by the combination of: small but paired ventral scales forming a distinct ventral keel; regular, enlarged head shields; a distinct mental groove; triangular mental shield.

General remarks

Astrotia stokesii is one of the largest of Australian marine snakes, attaining a length of nearly two metres with considerable girth and weight. Juveniles are strongly banded, but the bands become more obscure with age. 2-6 young in a litter.

Analysis of status in NSW

Table 17: *Astrotia stokesii* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	5	4	0	2	3	1	0	0	1.7	16.7	5	10	10	10	35	0	4	3	0	0	1	2	3	3

Table 18: *Astrotia stokesii* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Disteira kingii

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Confined to the Australian region

National Estuaries and seas of Australia's tropical continental shelf

NSW Occasional records; no resident/breeding population (fig.22) The frequency and chronology of dated records are shown in fig.23.

Field diagnostic characters: characterised by the combination of: small undivided ventral scales (scarcely larger than adjacent body scales); regular, enlarged head shields; a distinct mental groove; triangular mental shield; jet black head and throat.

General remarks

A long snake (to about 1.5 metres), very slender, strongly-banded. Rarely taken in trawl by-catches.

Analysis of status in NSW

Table 19: *Disteira kingii* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
2	2	4	0	2	3	1	1.7	0	3.3	19	10	10	10	10	40	0	0	3	0	0	0	2	4	3

Table 20: *Disteira kingii* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Disteira major

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Essentially Australia region, including New Guinea, but extending eastward into the Coral Sea and to the New Caledonian region; possibly also Fiji

National Tropical seas and larger estuaries

NSW Occasional records; no resident/breeding population (fig.24). The frequency and chronology of dated records are shown in fig.25.

Field diagnostic characters: Characterised by the combination of: length to about 1.2 metres; small undivided ventral scales (scarcely larger than adjacent body scales); regular, enlarged head shields; a distinct mental groove; triangular mental shield; head usually grey, but throat whitish.

General remarks

A moderately-built snake with conspicuous banding which becomes more obscure with age. Frequently encountered by divers on coral reefs and relatively common in trawl by-catch of northern Australian fisheries.

Analysis of status in NSW

Table 21: *Disteira major* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	5	4	0	2	3	1	0	0	1.7	16.7	10	10	10	10	40	0	0	3	0	0	1	2	4	3

Table 22: *Disteira major* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Emydocephalus annulatus

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global North-west shelf through Arafura Sea to east coast of Australia, Coral Sea and New Caledonia.

National Tropical Australian seas, with occasional records of vagrant individuals from coastal NSW

NSW Occasional records; no resident/breeding population (fig.26). The frequency and chronology of dated records are shown in fig.27.

Field diagnostic characters: . Characterised by having only three upper labial scales and, in many mature males, a distinctive spine on the snout (rostral scale).

General remarks

A small (to 1 metre), distinctive snake which varies greatly in colour and pattern, from uniform black or dark brown to strongly or obscurely banded or spotted forms. Litters of 2-4 large living young. Feeds exclusively on fish eggs, with consequence that dentition and venom glands have become vestigial.

Analysis of status in NSW

Table 23: *Emydocephalus annulatus* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	4	0	2	3	1	3.3	0	3.3	18.6	5	10	10	10	35	0	0	3	0	0	1	2	4	3

Table 24: *Emydocephalus annulatus* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	5	5	c	N	32

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Hydrophis elegans

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global	Confined to the Australian region, including the Coral Sea
National	Estuaries and seas of Australia's tropical continental shelf
NSW	Occasional records; no resident/breeding population (fig.28). The frequency and chronology of dated records are shown in fig.29.

Field diagnostic characters: Characterised by the combination of: small undivided ventral scales (scarcely larger than adjacent body scales); regular, enlarged head shields; a distinct mental groove; triangular mental shield; anterior chin shields large and mostly bordering the mental groove; at least some indication of spots or blotches in the pale interspaces between the larger dark bands or saddles.

General remarks

This is one of the most common and abundant species of Australian sea snakes, being a major component of trawl fishery by-catches throughout northern Australia, and on parts of the Great Barrier Reef. It is comparatively slender, and grows to about 2 metres in total length. It has one of the largest litter sizes among sea snakes, with litters of 20+ being common.

Analysis of status in NSW

Table 25: *Hydrophis elegans* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	5	4	0	2	1	1	0	0	1.7	14.7	5	10	10	10	35	0	0	3	0	0	1	2	4	3

Table 26: *Hydrophis elegans* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	4	3	2	2	1	5	c	N	30

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Hydrophis inornatus

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Status and distribution uncertain; confined to the Philippines by Mittleman (1947) although Smith (1926) regarded it as a good species extending from the southern coast of China through the Philippines and Indonesia to Australian waters (see Cogger, 1975).

National A few records from tropical Australian seas, with occasional records of southern vagrants from coastal NSW and southern WA

NSW Scattered and occasional records; no resident/breeding population (fig.30). The frequency and chronology of dated records are shown in fig.31.

Field diagnostic characters: . Similar in most respects to *Hydrophis ornatus/ocellatus*, it is reported to be almost invariably unbanded in adults, with a uniform bluish-grey dorsum and whitish venter.

General remarks

Because there are so few confirmed and reliably identified record of this taxon from Australia and NSW, the biology and ecology of this species is largely unknown. Shuntov (1972) records "*inornatus*" as constituting 6% of all sea snakes trawled in the Arafura sea.

Analysis of status in NSW

Table 27: *Hydrophis inornatus* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	0	3	0	0	0	2	3	3

Table 28: *Hydrophis inornatus* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
N	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that records of this species in NSW waters are rare, intermittent, and almost certainly represent seasonal vagrants, and consequently there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Hydrophis ornatus/ocellatus

Current conservation status

Global	not threatened
National	not threatened (unlisted)
NSW	not threatened (unlisted)

Distribution

Global	One of the most widely-distributed of sea snakes, extending from the Persian Gulf through Asia and the Indo-Malaysian Archipelago to New Guinea and Australia
National	Tropical Australian seas, with occasional records of southern vagrants from coastal NSW and southern WA
NSW	Scattered and occasional records; no resident/breeding population (fig.32). The frequency and chronology of dated records are shown in fig.33.

Field diagnostic characters: The Australian "species" is characterised by the combination of: small undivided ventral scales (scarcely larger than adjacent body scales); regular, enlarged head shields; a distinct mental groove; triangular mental shield; anterior chin shields large and mostly bordering the mental groove; no indication of spots or blotches in the pale interspaces between the larger dark bands or saddles, although in *ocellatus* the bands tend to form distinctive circular or ocellate markings on the flanks.

General remarks

Smith (1926) regarded *ocellatus* as an Australian subspecies of the widespread *Hydrophis ornatus*, but essentially sympatric through at least part of its Australian range with the nominal subspecies. However it seems likely that Australian specimens assigned to both subspecies belong to a single, endemic taxon to which the name *ocellatus* would apply. The matter is not resolved here, and so it is listed above under both names.

The Australian representatives range from strongly banded to unbanded forms, though typically the banding is more conspicuous anteriorly (see Cogger, 1975: p.119).

Analysis of status in NSW

Table 29: *Hydrophis ornatus/ocellatus* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	5	4	0	2	3	1	0	0	1.7	16.7	10	10	10	10	40	0	0	0	2	0	0	2	3	3

Table30: *Hydrophis ornatus/ocellatus* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
N	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Given that individuals found in NSW waters are uncommon and almost certainly seasonal vagrants, and that there is no evidence of a species-wide or State-wide decline in numbers, it is recommended that there be no change in the unlisted status of this species.

Yellow-bellied Sea Snake (*Pelamis platurus*)

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Tropical and warm temperate regions from eastern coast of Africa through Indian and Pacific Oceans to west coast of Central and northern South America

National Tropical and warm temperate areas, extending in summer to higher latitudes

NSW Common in NSW coastal waters, where it reproduces during winter (fig.34). The frequency and chronology of dated records are shown in fig.35.

Field diagnostic characters: The colour pattern of this species – black upper half of body and yellow or pale brown lower half of the body, the two contrasting colours sharply delineated on the flanks – distinguishes it from other Australian sea snakes.

General remarks

A surface-dwelling pelagic species found in the open ocean as well as in large estuaries and coral lagoons throughout its range.

The species occurs year-round in NSW coastal waters. It is highly venomous, with the potential to kill adult humans. However it is rarely encountered in the wild because it normally dives if approached closely by boat. Further, because specimens are rarely seen by bathers or fishers in inshore or estuarine waters (except under the circumstances indicated below) it is presumed that the species normally occurs in deeper waters offshore where its pelagic habit and feeding strategies can be optimally exploited.

Pelamis platurus typically feeds on small surface fishes, especially juveniles, which are attracted to slicks of floating vegetation and other debris. Often the fish will utilise the snake itself for shelter. When feeding, *Pelamis* uses a distinctive backward-swimming movement which brings its head level with a fish (which it then grasps in it jaws) which has been sheltering beside the snake's floating body.

Another distinctive behavioural feature of *Pelamis* is its method of shedding its skin. Other snakes, both terrestrial and marine, utilise rough, hard objects in their immediate environment on which they rub their snouts (to commence ecdysis) and subsequently their bodies (to complete ecdysis), stripping away the sloughed skin. Being a floating, pelagic species without a range of fixed, hard objects to rub against, *Pelamis* ties its body literally in knots, which pass down the length of the body; thus the body is rubbed against itself until the slough is loosened and removed.

There are few records of specimens of this species taken from populations at sea. Rather, NSW records are based almost entirely on beached specimens (living and dead). Such specimens are almost invariably associated with heavy seas resulting from extremely violent coastal storms, occurring at any time of year, and are usually washed up on exposed beaches in an exhausted condition and with a low probability of survival.

Because of its pelagic habit and wide tropical/warm temperate distribution from east Africa across the Indian and Pacific Oceans to the western Americas, it was long assumed that the species lacked barriers to gene flow and was therefore genetically and morphologically homogeneous throughout its range. However specimens from eastern Australia (mostly from NSW) recorded by Cogger (1975) are significantly larger than specimens from populations on the other side of the Pacific (Kropach, 1975), suggesting that there are indeed barriers leading to distinct regional populations. Pending studies of allozymes or DNA from representative populations throughout the range of the species, as a precautionary measure the Australian east coast population should be tentatively treated as a metapopulation worthy of conservation in its own right.

Further, Cogger (1975) commented on the fact that specimens were not only recorded from NSW more frequently in winter, but that it is during this period that gravid females are found, This is a reversal of what would be expected in other hydrophiid sea snakes in NSW waters, suggesting that it represents a major difference in reproductive biology and seasonality.

This pattern of major winter occurrence is reflected in the current survey, and it is for this reason that *Pelamis platurus* is shown separately in fig.4.

Analysis of status in NSW

Table 31: *Pelamis platurus* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	1	0	2	3	3	0	0	3.3	14.3	5	10	10	10	35	0	4	0	2	0	0	2	3	1

Table 32: *Pelamis platurus* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables													Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Recommended conservation status in NSW

Unfortunately there are no data available that would assist in determining whether populations of this species, either in NSW or elsewhere in Australia, have declined or are under threat. However because there is no known by-catch of *Pelamis* in any Australian fishery (in contrast to the high by-catch of other marine snake species in Australia's northern fisheries), and no known new or intensified existing anthropogenic threatening process affecting this species, there would seem to be no scientific basis for seeking any change in the present conservation status (unlisted on any schedule) of this species.

However it is important to stress that NSW may possess a significant component of the breeding stock of Australian populations of *Pelamis platurus*, and so conservation of the NSW stock may be of considerable significance nationally, and possibly internationally. Unfortunately research on these populations would be logistically difficult and therefore expensive.

Laticauda colubrina

Current conservation status

Global not threatened

National not threatened (unlisted)

NSW not threatened (unlisted)

Distribution

Global Bay of Bengal to southern China, Ryukyu Archipelago, south through the Philippine Islands and the Indo-Malaysian Archipelago to New Guinea and the islands of the western Pacific, south of the equator.

National The only records from Australia are extremely old and/or of generalised or doubtful provenance. The British Museum (The Natural History Museum) has a specimen from "New Holland" (1858)

while Smith (1926) records specimens in his own collection from "Queensland" and "New South Wales". The absence of more recent records of this species and its congener, *L. laticaudata*, from Australian waters is surprising given the hyperabundance of both species on the southern Papuan coast, the Solomon Islands, Vanuata and New Caledonia, all of which share many marine snake species with tropical Australia. Records from New Zealand and Tasmania suggest that vagrants reach higher southern latitudes via currents lying well east of Australia's eastern continental shelf, so that there is no opportunity for straying individuals to reach the northern parts of the Eastern Australian Current.

Further, there are no records of this species breeding in Australian territorial waters.

NSW The only provenanced, vouchered record from NSW is an old, undated specimen from "Sydney" in the Australian Museum; there are no specimens/records of this species from NSW in any other Australian institution. The Australian Museum specimen and the Smith (1926) specimen referred to above only from "New South Wales" appear to be the only basis for recording this species from the State. Given that the species is extremely abundant throughout its range and does not appear to have suffered other than local declines due to local fisheries, it can be regarded as a non-threatened, extremely rare vagrant to NSW waters (fig.36).

Field diagnostic characters: Broad belly scales (at least five times wider than adjacent body scales; nasal scales separated by internasals; six or more supralabials.

General remarks

As indicated in Section 5 above, *Laticauda colubrina* spends extended periods on land where it shelters in rock crevices or caves, or among dense living vegetation or deep litter, often in 'dens' containing a few to more than 100 individuals of both sexes. This terrestrial phase is believed to constitute a resting/digesting period, when the snakes digest the eels on which they feed almost exclusively, or during the cooler months of the year in some parts of its range. Gravid females lay their eggs on land. The period spent on land by any individual snake varies coniderably, and while individuals may leave the colony for the sea (or return from the sea to the colony) at any time, most movements from land to sea occur at or just after dusk and from the sea to land just before dawn.

Each female produces 4-8 eggs, which hatch in about 6-8 weeks at 30ºC. As previously indicated, eggs are virtually never found in the wild (despite some thousands of observations of adult snakes in a wide variety of terrestrial sites) indicating that they are most probably laid deep in narrow rocky or earth crevices. All current knowledge of clutch size and incubation periods is derived from eggs laid in captivity by fresh-caught specimens or from the dissection of gravid preserved specimens.

The venom of this species is highly toxic to humans and large females produce relatively large amounts of venom. Fortunately the species is not aggressive and virtually never bites humans in the wild, whether handled in the sea or on land, and even when treated roughly.

This species has been studied extensively. Some key references for the species in our region are: Saint Girons, 1964; Tamiya, 1975; Tamiya and Maeda, 1977; Tamiya *et al*., 1983.

Analysis of status in NSW

Table 33: *Laticauda colubrina* - Millsap analysis (modification vide Cogger et al, 1993)

Biological Variables										Biological	Action Variables				Action	Supplemental Variables								
1	2	3	4	5	6A	6B	7A	7B	7C	Score	1	2	3	4	Score	1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
0	2	4	0	2	3	1	1.6	0	3.3	16.9	10	10	10	10	40	0	0	3	0	0	0	2	1	3

Table 34: *Laticauda colubrina* - Millsap analysis (modification vide Lunney et al., 1996)

Biological Variables														Biological
1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	Score
N	4	4	4	0	1	1	3	2	2	5	5	c	N	31

Recommended conservation status in NSW:

Given that there are no reliable records of this species from NSW waters during the past 80 years, it should be treated either as of doubtful occurrence in NSW, or as an extremely rare vagrant to NSW of a widespread and abundant non-endemic species, and so should remain unlisted on any Schedule of the Threatened Species Conservation Act.

9. Conservation Ranking of Marine Reptiles in NSW

As previously indicated, two methods were used to rank the 17 taxa covered by this report, viz. two modifications of a quantitative method first proposed by Millsap *et al.* (1990) to assess and rank the conservation status of vertebrates in Florida. This method was first adopted and modified for Australian conditions (i.e. a continental fauna) by Cogger *et al.* (1993) in preparing the Action Plan for Australian Reptiles. Subsequently Lunney *et al.* (1996) proposed a further modification of the method to rank terrestrial vertebrate species in NSW.

The method has been shown to be surprisingly robust in ranking the conservation status and needs of a wide range of taxa. However its principal limitation is the latitude taken by some assessors in subjectively assigning scores where objective data are lacking and so there is a temptation to extrapolate from knowledge of related taxa - i.e. the criteria used in the *Millsap et al*. methodology must be rigorously applied. However a consequent problem arises when dealing with poorly-known taxa, because lack of knowledge of particular criteria can result in a set of similar (i.e. undifferentiated) scores.

However subjective differences between observers rarely account for more than minor differences in scores. Consequently minor differences in scores between two or more taxa (e.g scores of 27, 28 and 29) may not be statistically significant unless the knowledge base for each taxon is similar. Discussion of these and other issues of statistical rigour and limitations may be found in Millsap *et al.* (1990), Cogger *et al.* (1993) and Lunney *et al.* (!996).

Note that in the following application of these methods to marine reptiles in NSW involve some taxa with extensive knowledge bases (marine turtles) and other with very poor knowledge bases (most marine snakes). Further, the Cogger et al. methodology has been modified to the extent that the geographic criteria have been applied only to those components of the populations occurring within NSW,

The following tables summarise the rankings obtained by these two methods for the 17 taxa covered by this report.

Table 35 - Summary of Millsap scores and rankings (method of Cogger et al., 1993)

Biological Scores	Rank	Taxon
33	1	Caretta caretta
33	1	Natator depressus
27	3	Chelonia mydas
27	3	Eretmochelys imbricata
25.6	5	Dermochelys coriacea
19	6	Disteira kingii
18.6	7	Emydocephalus annulatus
16.9	7	Laticauda colubrina
16.7	9	Hydrophis ornatus/ocellatus
16.7	9	Disteira major
16.7	9	Astrotia stokesii
16.7	9	Aipysurus laevis
14.7	13	Hydrophis elegans
14.3	14	Pelamis platurus
13.7	15	Acalyptophis peronii
13.7	15	Aipysurus duboisii
13.7	15	Hydrophis inornatus

Table 36 - Summary of Millsap scores and rankings (method of Lunney et al., 1996)

Biological Scores	Rank	Taxon
48	**1**	Caretta caretta
39	**2**	Chelonia mydas
39	**2**	Dermochelys coriacea
37	**4**	Natator depressus
36	**5**	Eretmochelys imbricata
32	**6**	Emydocephalus annulatus
31	**7**	Laticauda colubrina
30	**8**	Hydrophis elegans
28	**9**	Pelamis platurus
28	**9**	Hydrophis ornatus/ocellatus
28	**9**	Disteira major
28	**9**	Acalyptophis peronii
28	**9**	Astrotia stokesii
28	**9**	Disteira kingii
28	**9**	Aipysurus laevis
28	**9**	Aipysurus duboisii
28	**9**	Hydrophis inornatus

It will be noted that the rank order of these 15 taxa differs somewhat in each analysis, and the reasons for such differences are readily explained by the different criteria used in each analysis. However the top ranking taxa are consistently ranked in both systems.

In both analyses, the turtles *Caretta caretta* and *Natator depressus* score highest. With "Lunney" scores of 50 and 46 respectively, both fall within the range of scores recorded for "threatened" (currently Schedule 1, "endangered"). Similarly, with "Cogger" scores of 33 each they lie within the overlapping score range between "vulnerable" and "endangered" in the Reptile Action Plan.

It should be noted that the "Cogger" scores for these two taxa are significantly higher than their scores in the Reptile Action Plan. The explanation for these differences is that (1) since 1992, research on both taxa has shown that their populations are declining, especially those of *Caretta caretta* which Limpus (pers.com.) estimates to be as high as 80%, and (2) by assessing the taxa primarily within NSW, the more limited geographic criteria lift their scores.

The somewhat lower scores of the remaining three turtle taxa (*Chelonia mydas, Eretmochelys imbricata and Dermochelys coriacea*) in both analyses are consistent with their existing listing on Schedule 2 (Vulnerable), and it is not recommended that their present status be changed.

None of the marine snakes attains a score or rank which would justify its elevation to threatened status, and for these and other reasons outlined under each species none is recommended for a change in its current status under the Threatened Species Conservation Act.

However, it is possible that NSW possesses as a resident stock a significant proportion of an eastern Australian metapopulation of the yellow-bellied sea snake (*Pelamis platurus*). There is an urgent need to support a study which characterises the genetic uniqueness (if any) of the NSW stock of this species. Only the results of such a study would be likely to justify elevation of this taxon to threatened status in NSW, especially as no regional threatening processes are known to be impacting on this species.

10. Summary, Conclusions and Recommendations

In the Action Plan for Australian Reptiles (Cogger *et al.*, 1993), it was pointed out that the globally threatened status of most marine turtles warranted special consideration of their national or regional conservation status.

Most terrestrial reptiles at risk in Australia are endemic to Australia, and so their conservation and ultimate survival depends entirely upon actions taken within Australia. Marine reptiles, on the other hand, despite sometimes having regionally-distinctive populations, tend to score down on endemicity criteria, while their effective conservation usually requires concerted international action.

Marine turtle species, more than marine snakes, are under severe threat throughout their range. Principal threatening processes are (a) rapidly declining recruitment due to loss of nesting sites; (b) heavy predation on eggs (by both humans and other predators) and heavy predation on reproductively active females due to their capture at or near nesting sites (for human consumption) and (c) loss to modern intensive fishing practices, including oceanic drift nets and long-line tuna fisheries, and from inshore prawn and mollusc trawling fisheries in tropical waters (including Australia).

Australia has long been regarded as a safe haven for marine turtles, possessing the most secure populations in the world. However a number of recent studies have shown that Australian marine turtle species and populations are in decline – some seriously so. The species most at risk is the loggerhead turtle (*Caretta caretta*) which appears to have suffered a decline approaching 80% in the past two decades. This species is at the southern limit of its residential range in far northern NSW, and only occasionally nests on NSW beaches.

Opportunistic observations by NPWS staff in northeastern NSW (L. Tarvey, pers. com.) confirm other observations that such nestings probably occur in most years, with a low proportion surviving to hatching. Nests are preyed on by foxes (and more rarely humans), and, if eggs are laid relatively late in the season, egg development may be slowed and ultimately terminated by low winter temperatures. Similar comments apply to occasional nestings of green turtles (*Chelonia mydas*) and leathery turtles (*Dermochelys coriacea*) on northern beaches in NSW, and so their few nests are subject to heavy predation pressure and high egg mortality due to marginal incubation temperatures.

The leathery turtle ranges into more temperate (cooler) waters than most other marine turtles, and NSW waters appear to be utilised extensively for foraging, although only a small number of individuals are observed. Shark meshing and fish and prawn trawling results in the drowning of some individuals, but the impacts of this threatening process are unknown within NSW. The ingestion of plastic bags has been implicated in the mortality of this species elsewhere, but again there are no data on this impact in NSW. In the absence of any evidence that this species is declining in NSW, or that impacts which could be ameliorated in NSW are subjecting the species to significant pressure, it seems appropriate to maintain its current Schedule 2 (Vulnerable) listing.

The two remaining turtle species recorded to date from NSW, the *flatback (Natator depressus*) and hawksbill (*Eretmochelys imbricata*), are known from only scattered records made decades apart. Both species are classified internationally and nationally under the present IUCN category “Vulnerable”. However, in the absence of any evidence that NSW individuals are contributing significantly to the maintenance of their core populations further north, or that that NSW individuals are being subject to any known major threatening processes,

None of the marine snakes recorded from NSW are known to be under threat or declining in numbers. With the exception of the Yellow-bellied sea snake (*Pelamis platurus*), all other species recorded from NSW occur irregularly and are recorded infrequently as vagrants which have apparently swum or drifted south from their core populations in the tropics, probably assisted by the summer-dominant East Australian Current.

Pelamis platurus is clearly abundant in NSW coastal waters, although it is rarely seen except when washed up dead or exhausted on coastal beaches after offshore storms. It is found in every month of the year, with the greatest frequency of records in winter, when females are gravid. While a pelagic species, it seems likely that the species is either resident in NSW waters or that ocean currents concentrate it in this area , especially in winter.

Recommendations

1. that the current conservation status of the Green Turtle *Chelonia mydas* in NSW be maintained;

2. as eastern populations of this species are declining at a modest rate, the Service should regularly monitor research on this species and respond to any demonstrated increase in the rate of decline of this species in eastern Queensland by elevating this species in NSW to Schedule 1 (Endangered) status;

3. that following the well-documented major recent decline in the eastern Australian stocks of the Loggerhead Turtle (*Caretta caretta*), this species be elevated from its current listing on Schedule 2 (Vulnerable) to Schedule 1 (Endangered);

4. that in the light of the present survey, which indicates (a) that the Hawksbill Turtle (*Eretmochelys imbricata*) and Flatback Turtle (*Natator depressus*) are rare visitors to NSW, and (b) that within NSW they do not breed and there is no indication that they are

subject to any known significant or ameliorable threatening processes, they should retain their current status in NSW (protected but not threatened);

5. that in the absence of (a) any data suggesting that their populations in NSW or their core populations outside NSW are in decline, and (b) any data suggesting that they are subject to any significant threatening processes in NSW, all marine snakes should retain their current status in NSW (protected but not threatened);

6. that the Service explore opportunities for supporting research on the occurrence, biology, ecology and status of Yellow-bellied Sea Snake (*Pelamis platurus*) populations occupying NSW coastal and oceanic waters, in order to determine whether these populations represent significant or core stock critical to the maintenance of Australian and western Pacific population;

7. that the Service explore opportunities to conduct a survey of professional and amateur fishers and divers (including dive shops and dive schools) in order to try to assess the extent to which existing records (largely based on strandings, nestings and washed-up corpses) can be correlated with observations and by-catches made at sea; and

8. that the Service explore opportunities to survey relevant regional newspaper records of marine reptiles in order to increase the existing limited database of marine reptile records in NSW.

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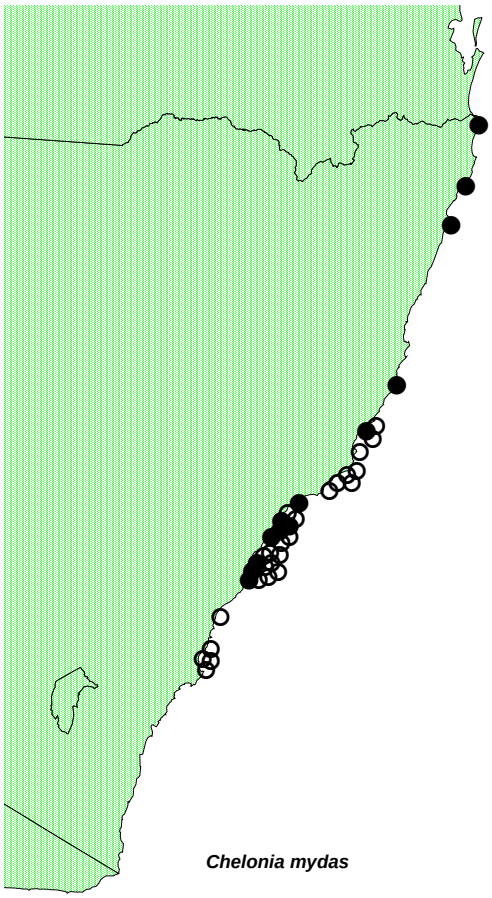

Figure 5: Distribution of provenanced records of *Chelonia mydas* from NSW waters.

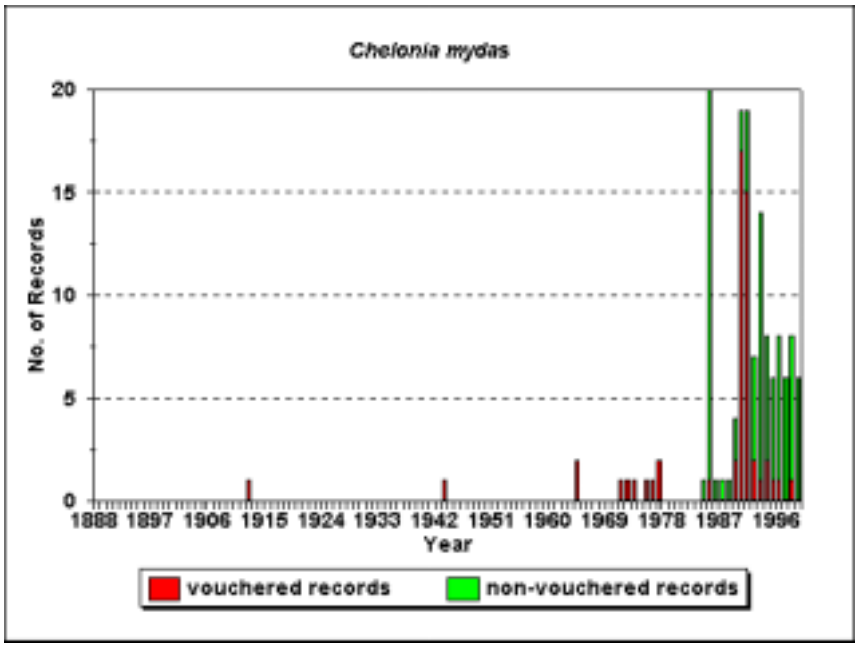

Figure 6: Chronological distribution of NSW records of *Chelonia mydas*.

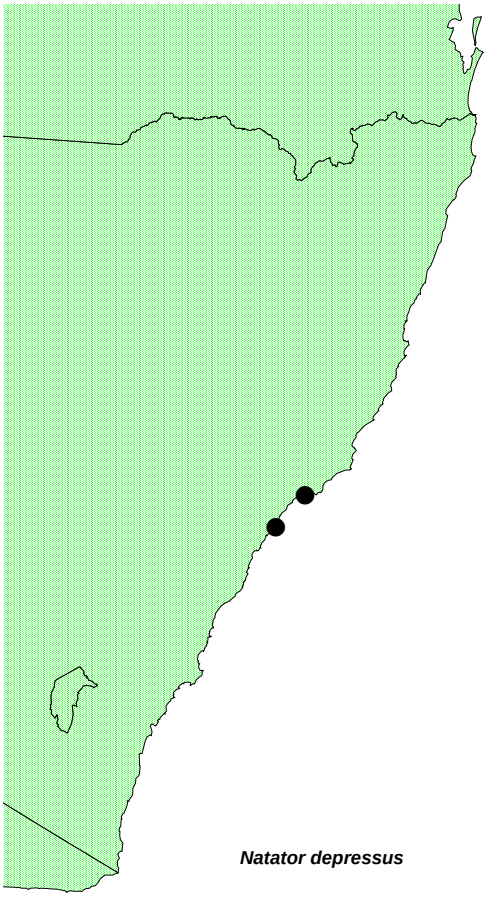

Figure 7: Distribution of provenanced records of *Natator depressus* from NSW waters.

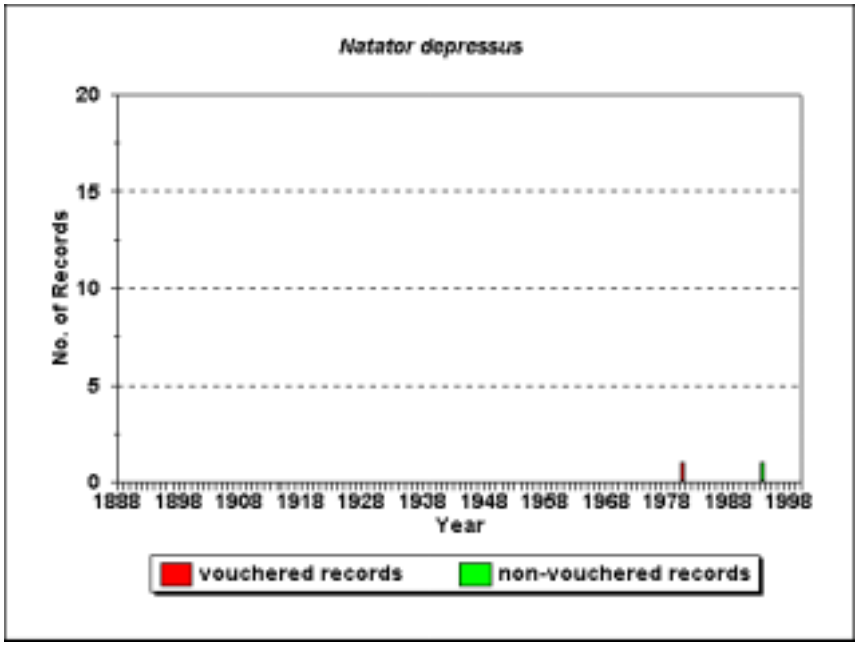

Figure 8: Chronological distribution of NSW records of *Natator depressus*.

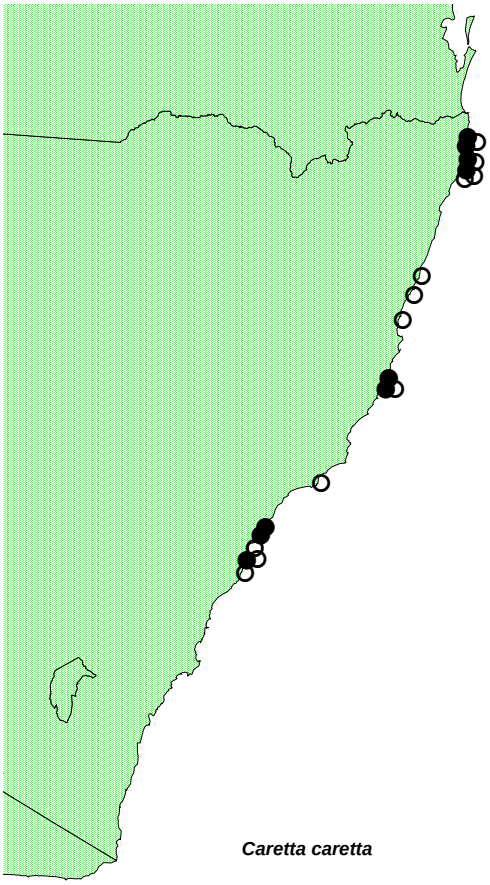

Figure 9: Distribution of provenanced records of *Caretta caretta* from NSW waters.

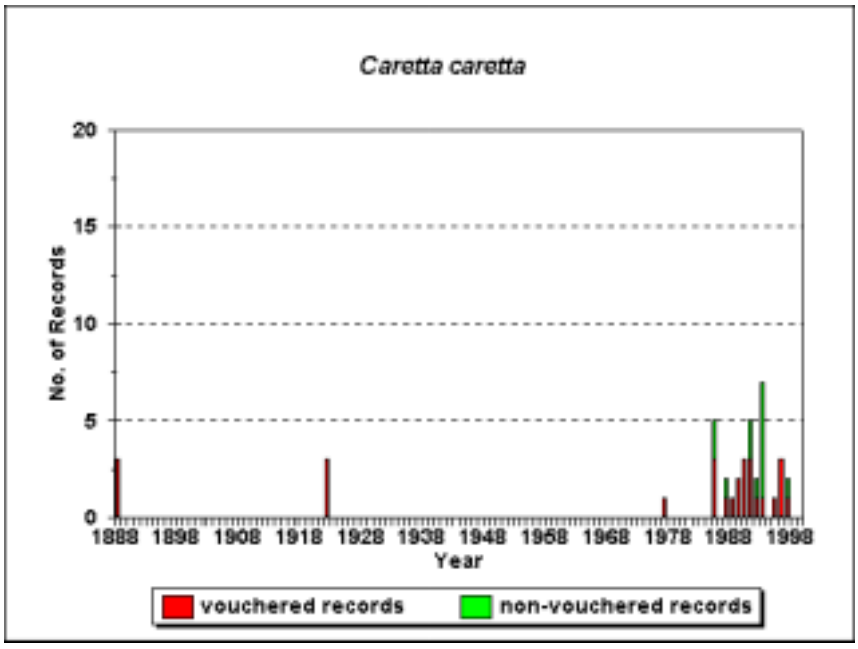

Figure 10: Chronological distribution of NSW records of *Caretta caretta*.

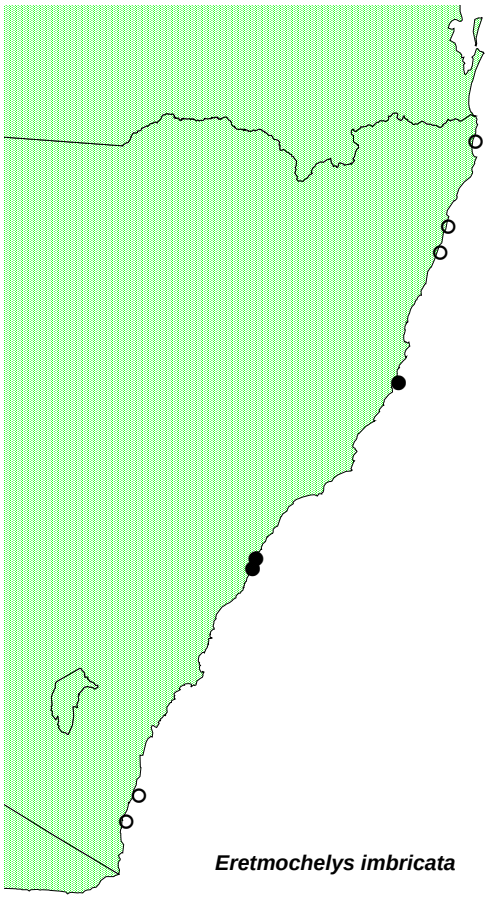

Figure 11: Distribution of provenanced records of *Eretmochelys imbricata* from NSW waters.

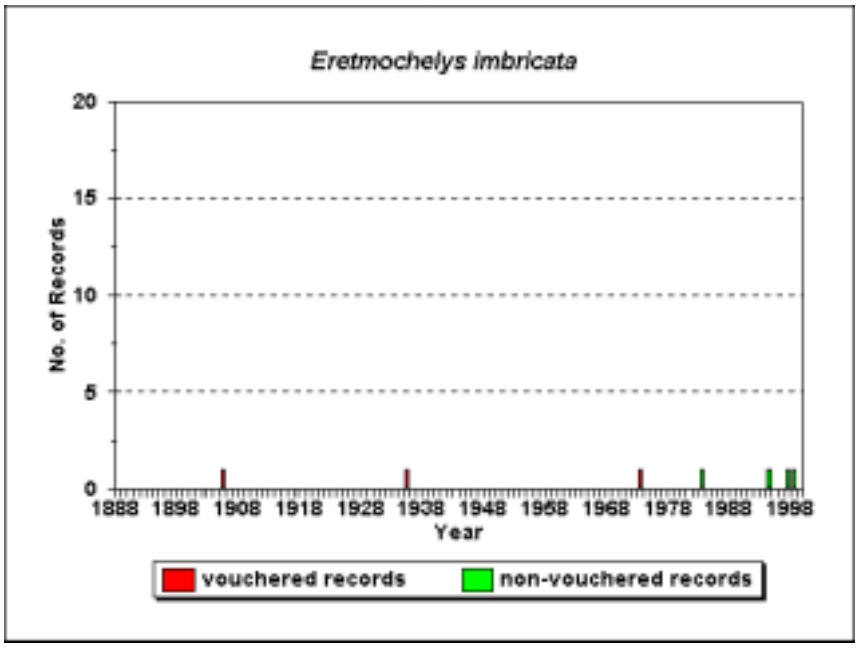

Figure 12: Chronological distribution of NSW records of *Eretmochelys imbricata*.

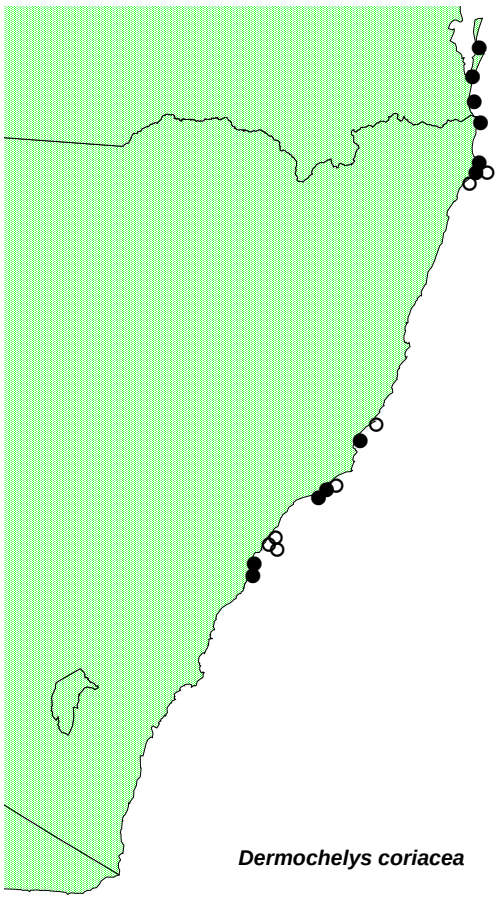

Figure 13: Distribution of provenanced records of *Dermochelys coriacea* from NSW waters.

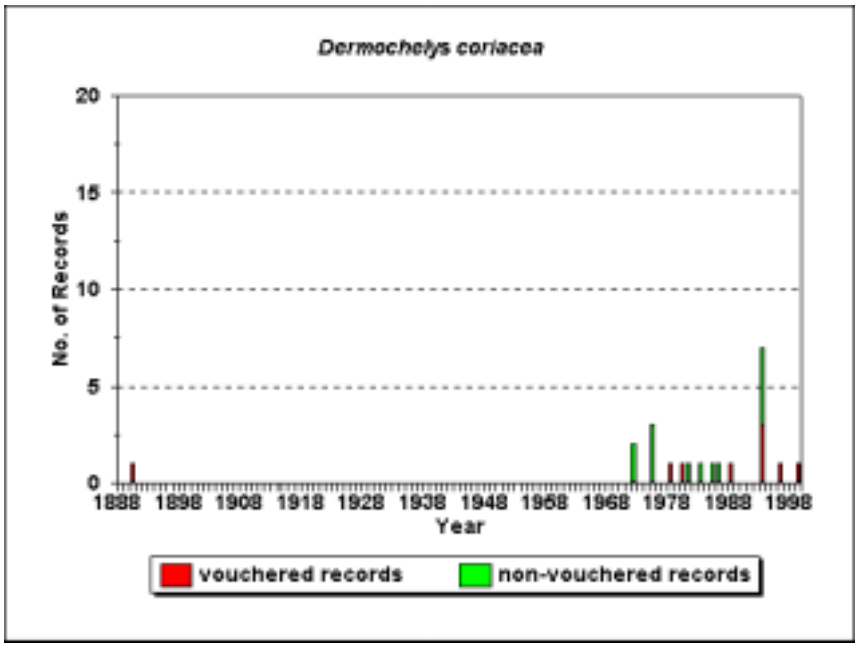

Figure 14: Chronological distribution of NSW records of *Dermochelys coriacea*.

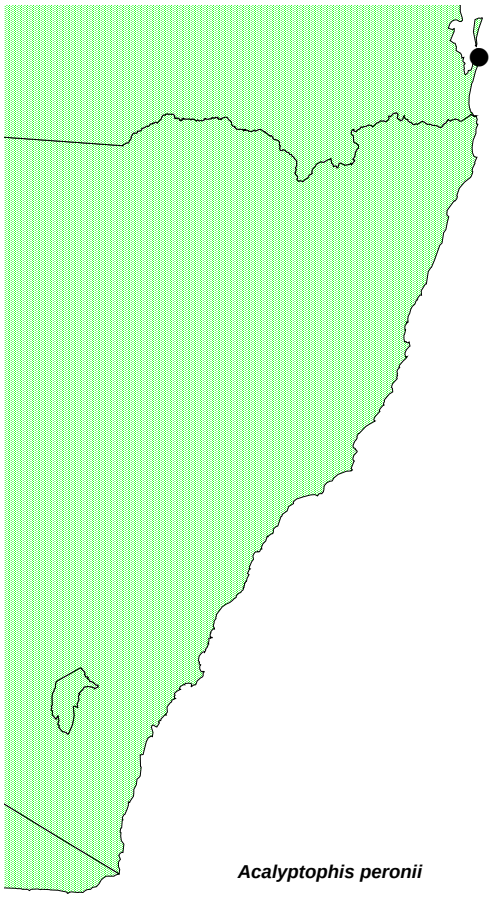

Figure 15: Distribution of provenanced records of *Acalyptophis peronii* from NSW waters. The single record of *Acalyptophis peronii* from NSW is undated.

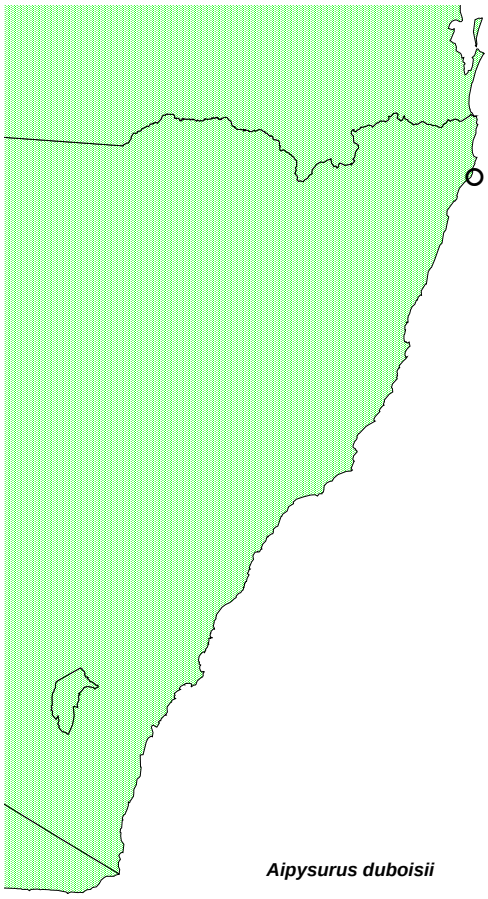

Figure 16: Distribution of provenanced records of *Aipysurus duboisii* from NSW waters.

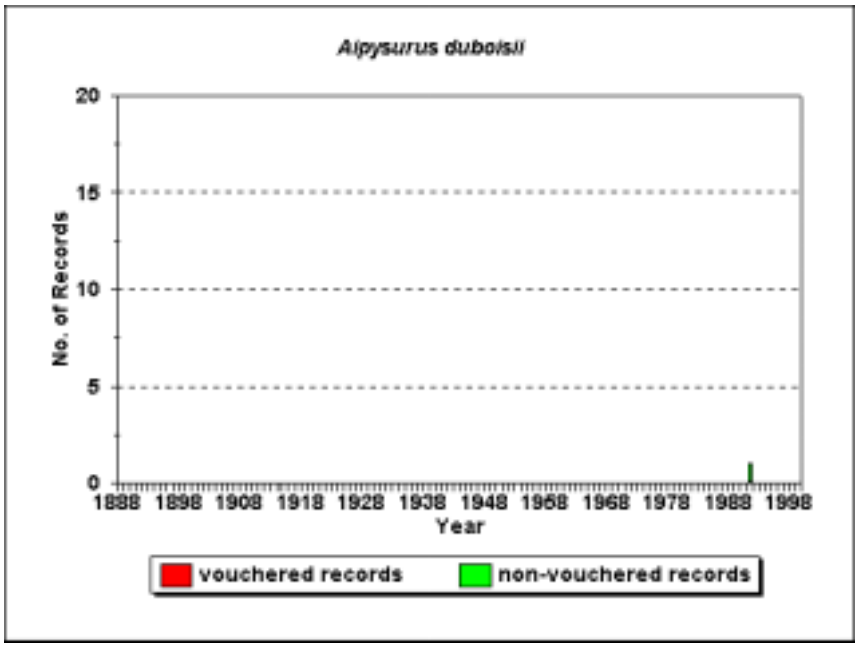

Figure 17: Chronological distribution of NSW records of *Aipysurus duboisii*.

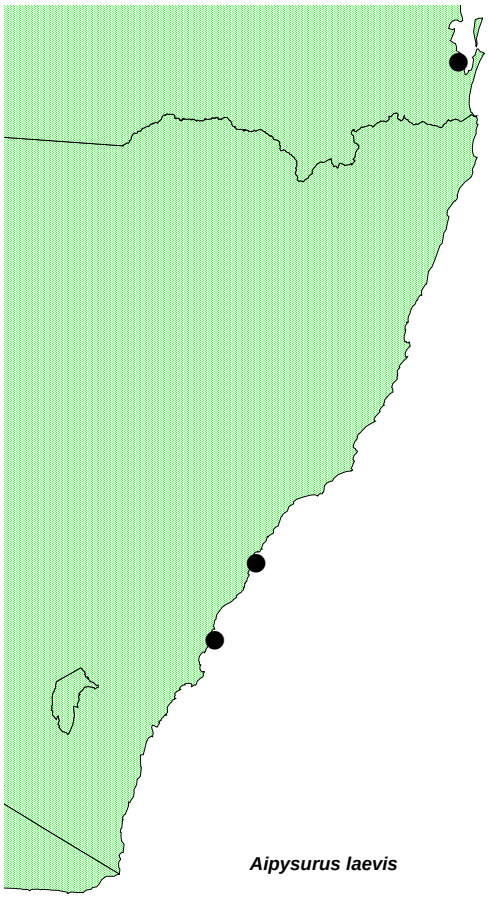

Figure 18: Distribution of provenanced records of *Aipysurus laevis* from NSW waters.

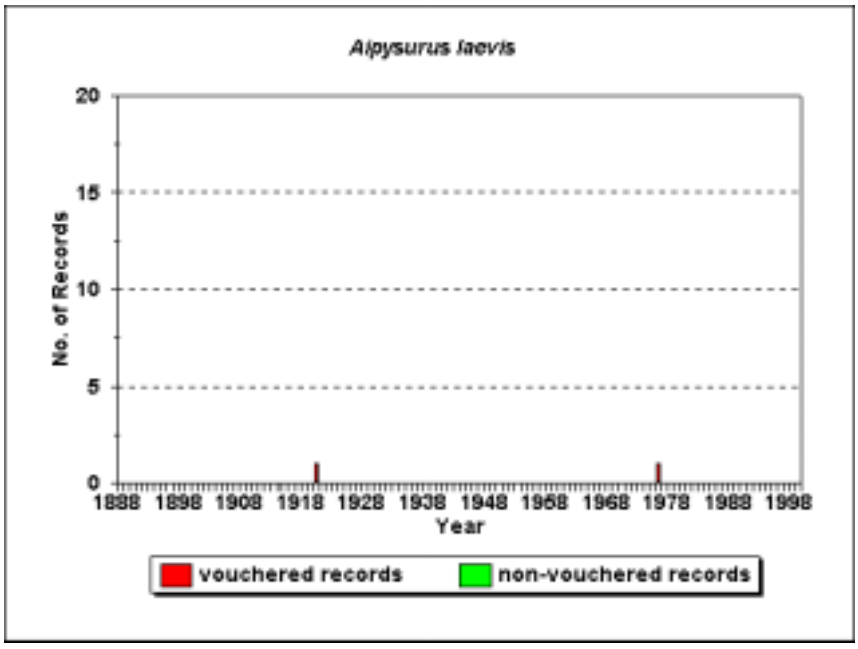

Figure 19: Chronological distribution of NSW records of *Aipysurus laevis*.

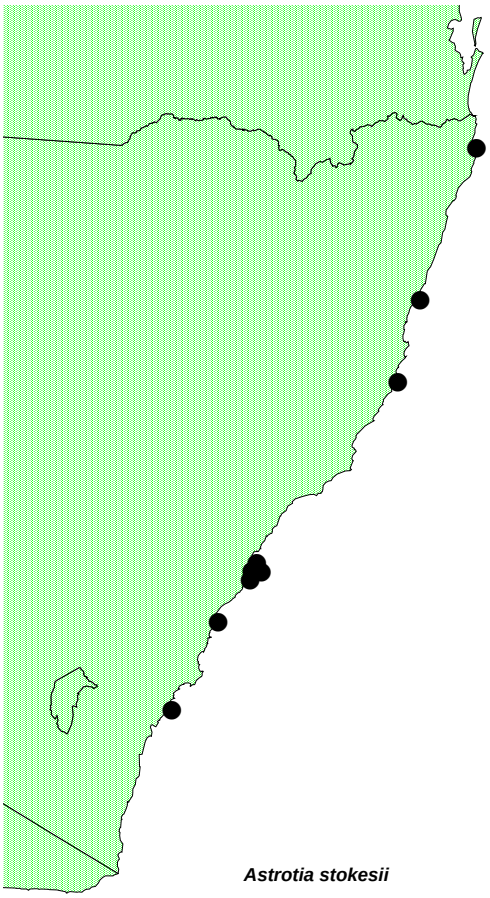

Figure 20: Distribution of provenanced records of *Astrotia stokesii* from NSW waters.

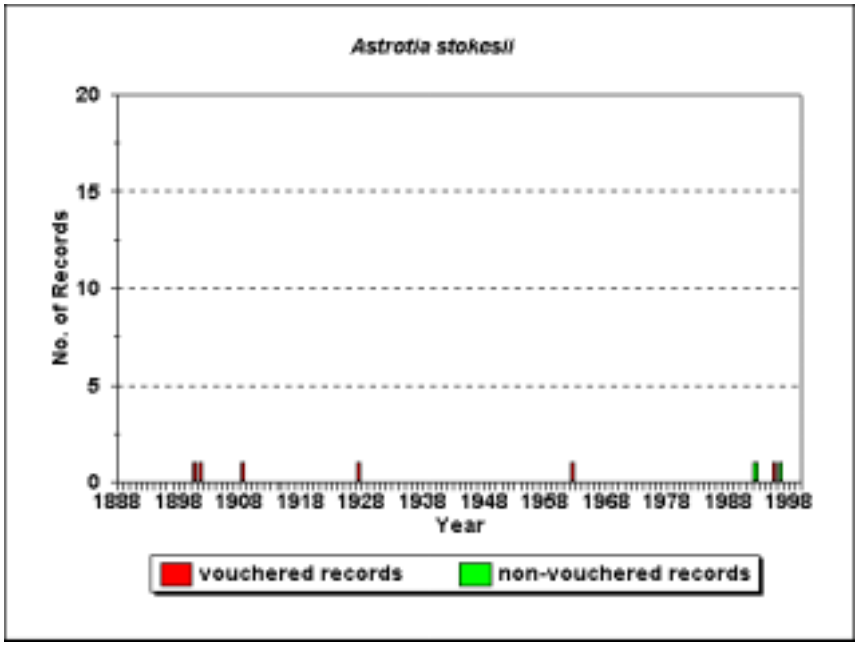

Figure 21: Chronological distribution of NSW records of *Astrotia stokesii*.

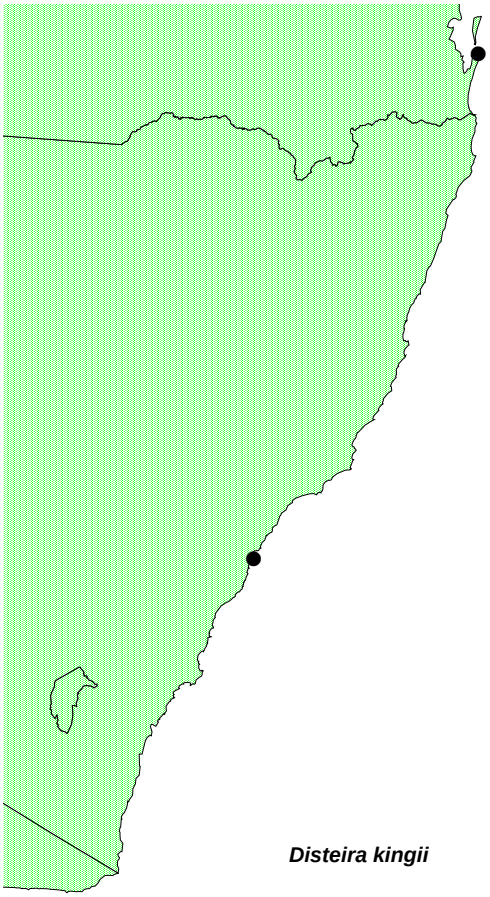

Figure 22: Distribution of provenanced records of *Disteira kingii* from NSW waters.

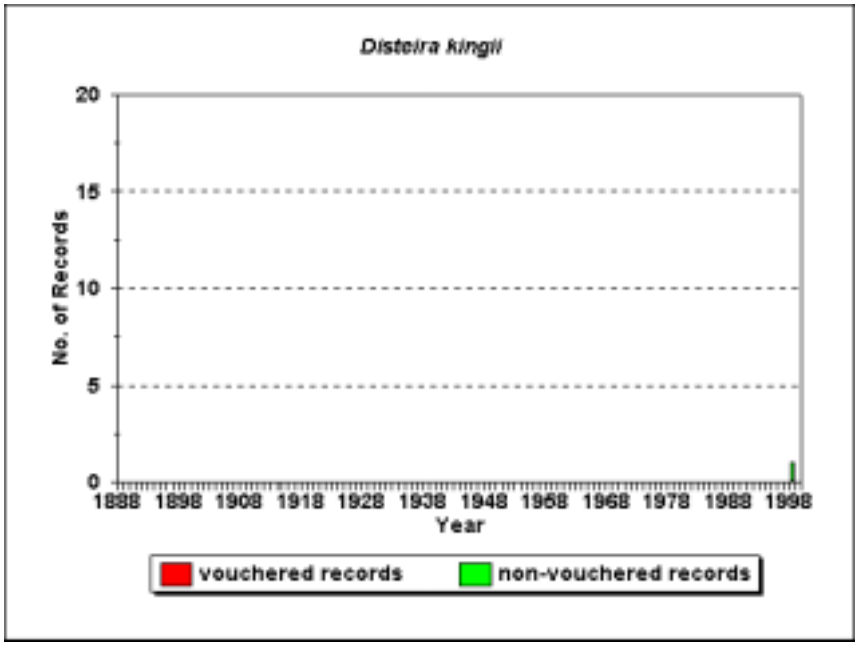

Figure 23: Chronological distribution of NSW records of *Disteira kingii*.

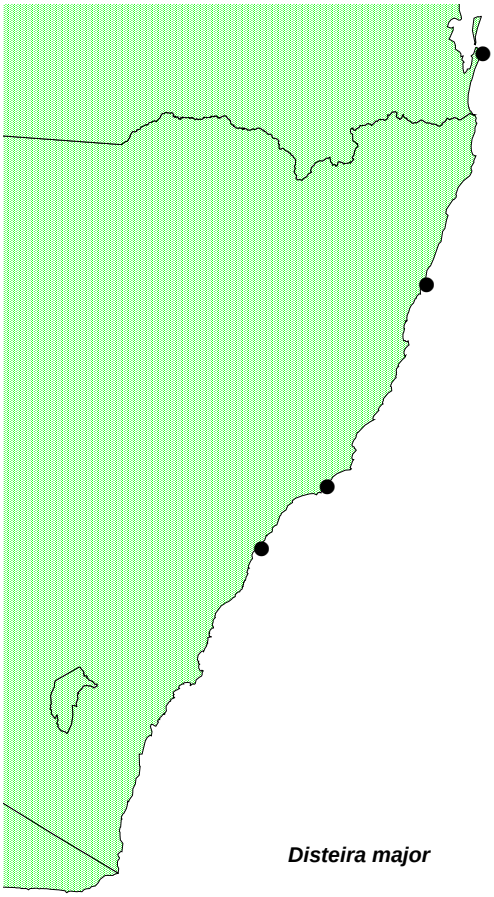

Figure 24: Distribution of provenanced records of *Disteira major* from NSW waters.

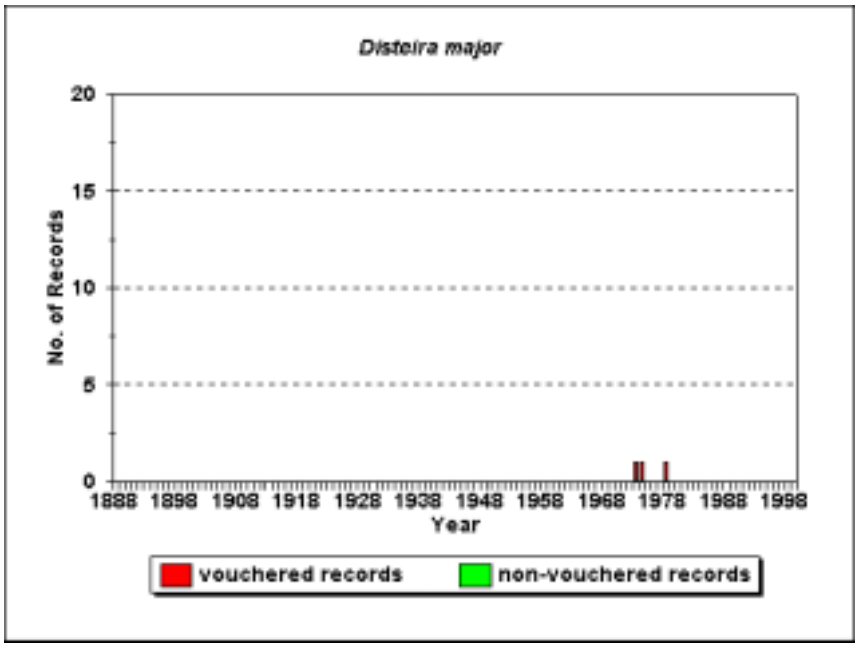

Figure 25: Chronological distribution of NSW records of *Disteira major*.

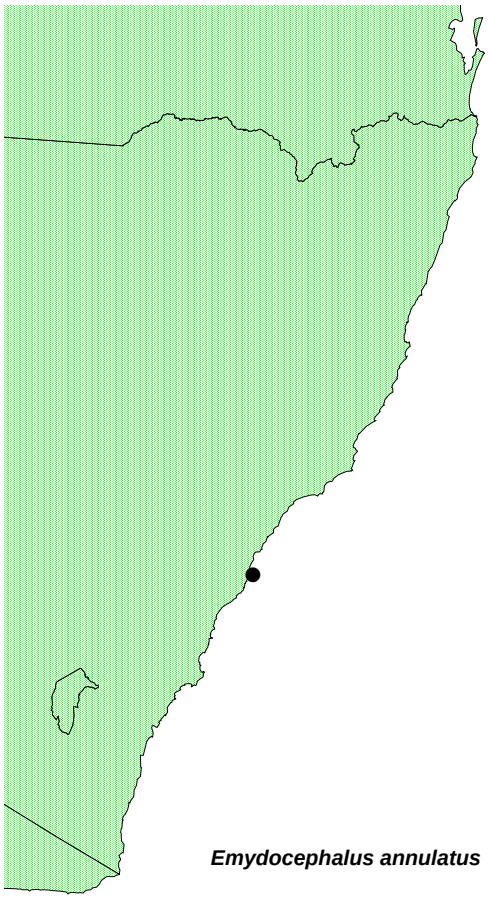

Figure 26: Distribution of provenanced records of *Emydocephalus annulatus* from NSW waters.

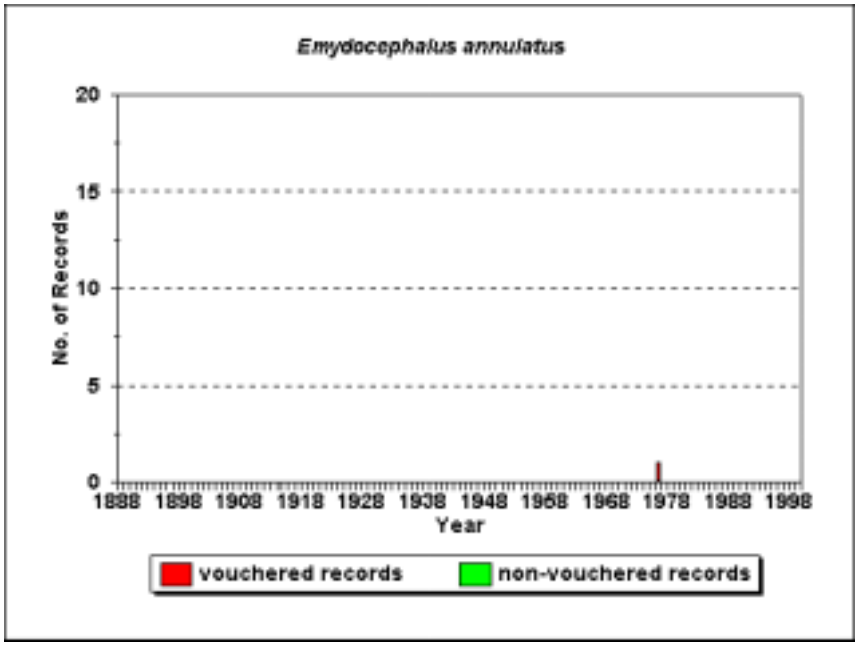

Figure 27: Chronological distribution of NSW records of *Emydocephalus annulatus*.

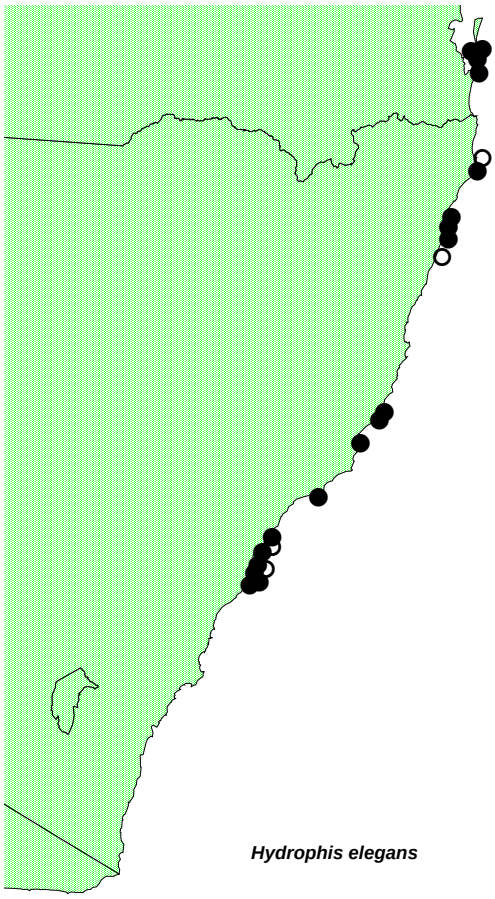

Figure 28: Distribution of provenanced records of *Hydrophis elegans* from NSW waters.

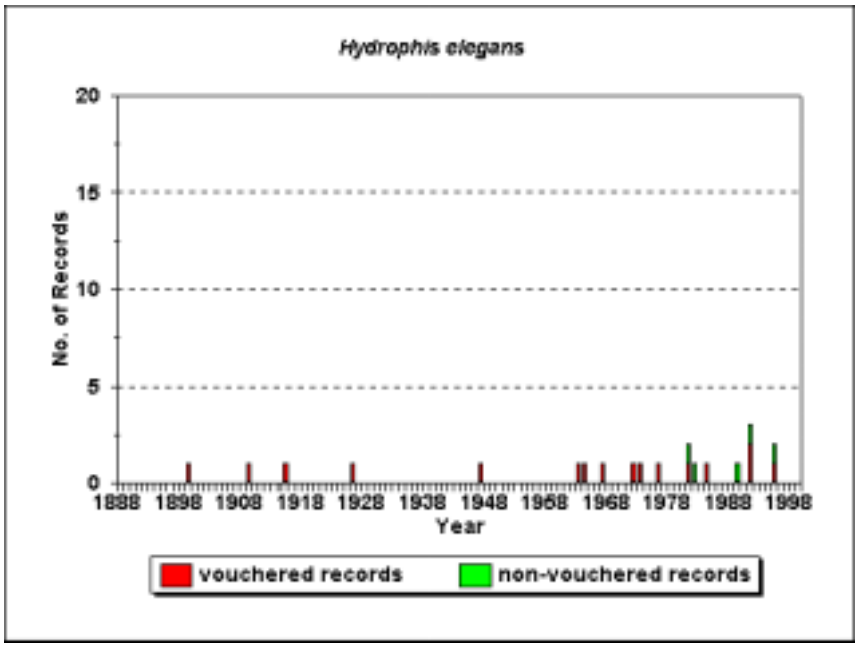

Figure 29: Chronological distribution of NSW records of *Hydrophis elegans*.

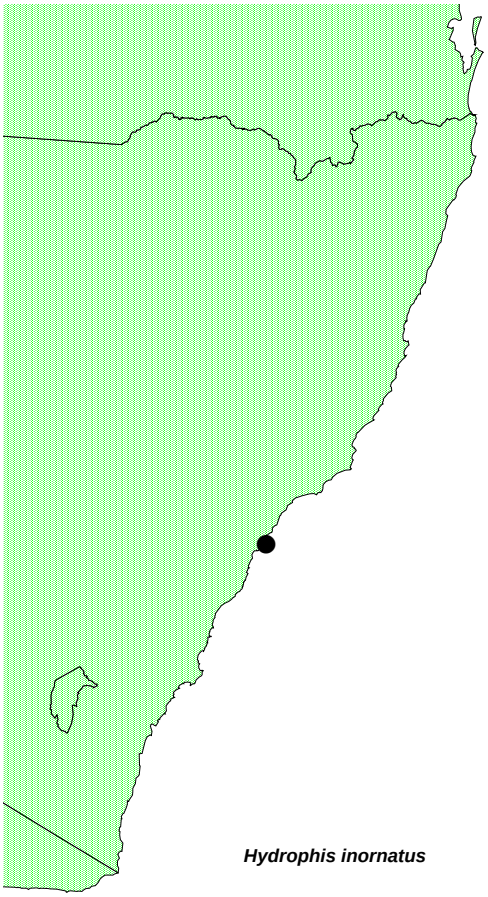

Figure 30: Distribution of provenanced records of *Hydrophis inornatus* from NSW waters.

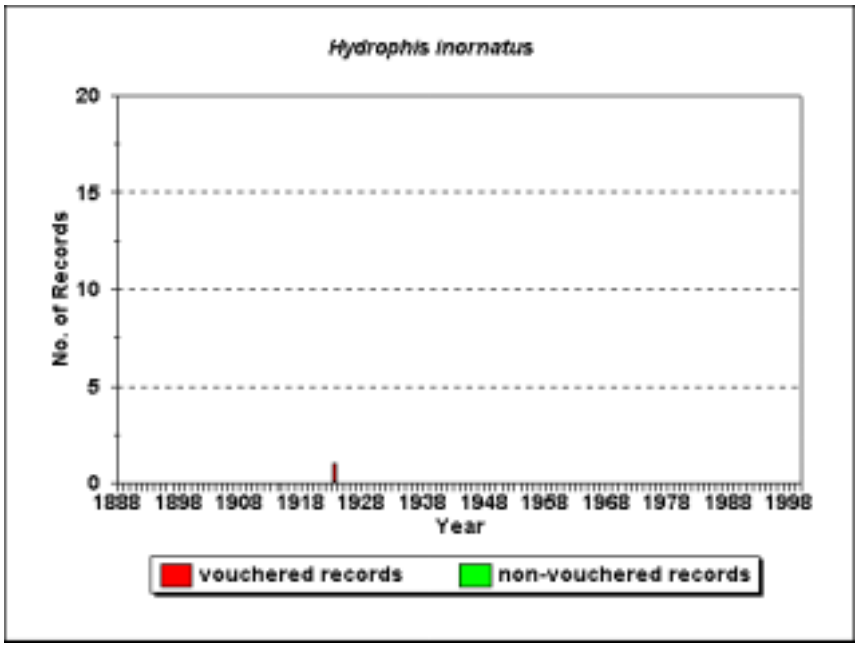

Figure 31: Chronological distribution of NSW records of *Hydrophis inornatus*.

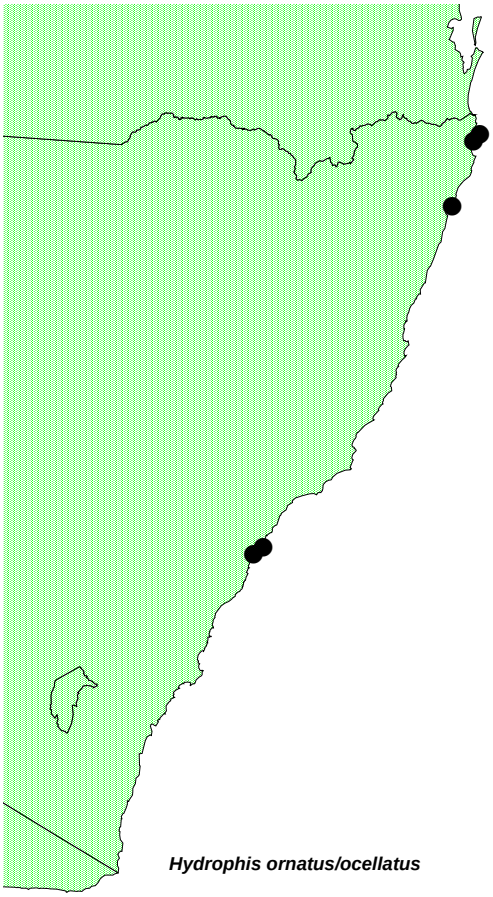

Figure 32: Distribution of provenanced records of *Hydrophis ornatus/ocellatus* from NSW waters.

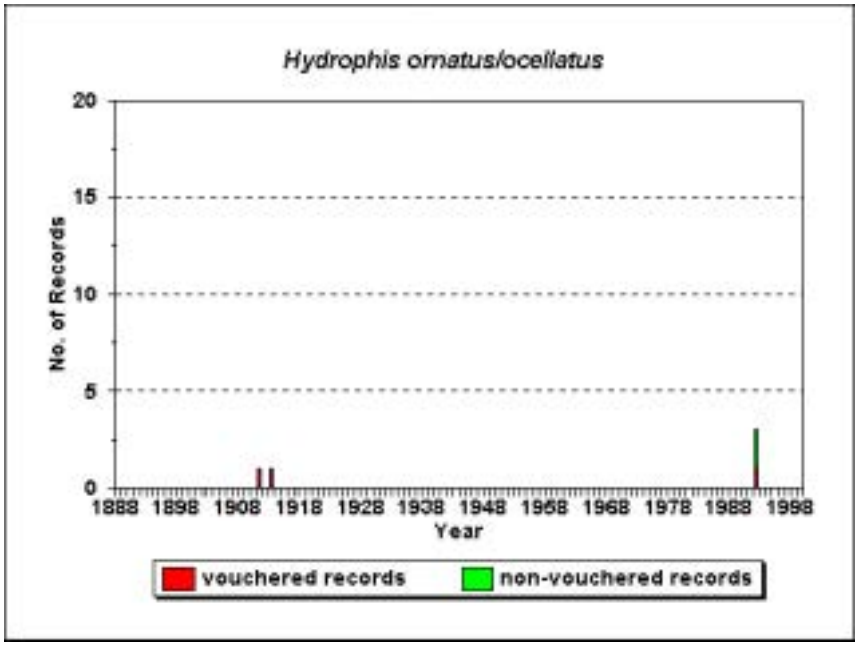

Figure 33: Chronological distribution of NSW records of *Hydrophis ornatus/ocellatus*.

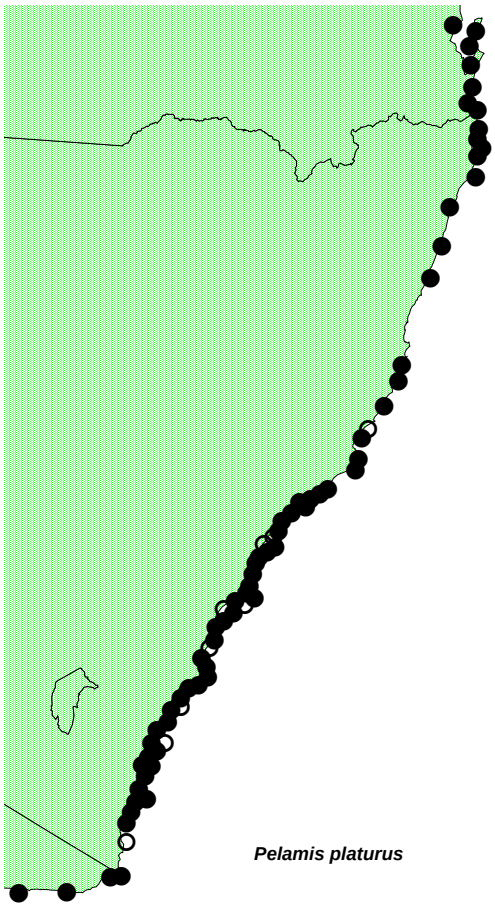

Figure 34: Distribution of provenanced records of *Pelamis platurus* from NSW waters.

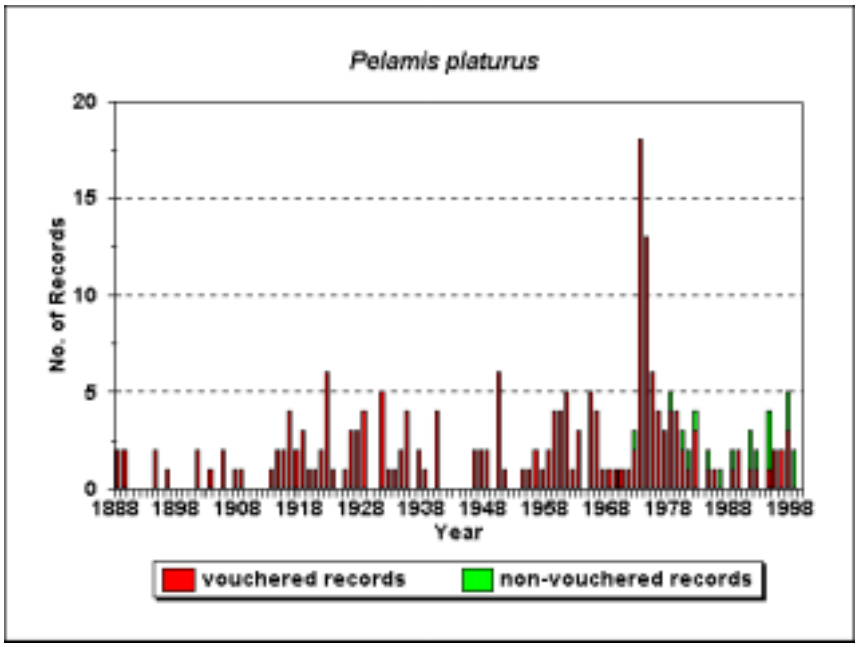

Figure 35: Chronological distribution of NSW records of *Pelamis platurus*.

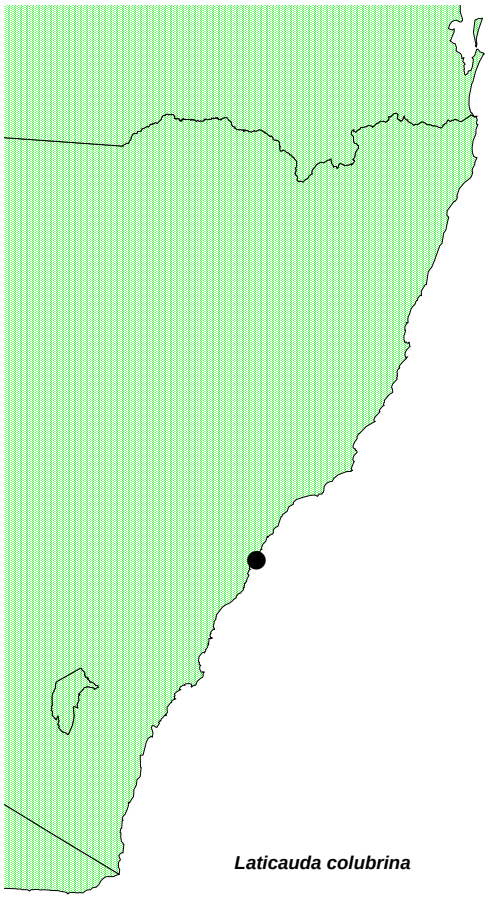

Figure 36: Distribution of provenanced records of *Laticauda colubrina* from NSW waters. The single record from NSW is undated.

Appendices

Appendix A: Full Millsap scores and rankings using modified version of Cogger et al. (1993)

Biological Scores	Rank	Taxon	Biological Variables										Biological Score	Action Variables				Action Score	Supplemental Variables								
			1	2	3	4	5	6A	6B	7A	7B	7C		1	2	3	4		1(a)	1(b)	1(c)	1(d)	1(e)	2	3	4	5
33	1	Caretta caretta	0	10	7	0	6	0	5	0	3.3	1.7	33	5	10	5	5	25	0	4	0	2	0	0	5	3	2
33	1	Natator depressus	2	8	7	0	6	0	5	0	3.3	1.7	33	5	10	5	5	25	0	4	3	0	0	0	5	4	2
27	3	Chelonia mydas	0	8	7	0	2	0	5	0	3.3	1.7	27	5	10	5	5	25	0	4	0	2	0	0	5	3	2
27	3	Eretmochelys imbricata	0	8	7	0	2	0	5	0	3.3	1.7	27	5	10	5	5	25	0	4	0	2	0	0	5	3	2
25.6	5	Dermochelys coriacea	0	8	4	0	2	0	5	1.6	3.3	1.7	25.6	5	10	5	5	25	5	4	0	2	0	0	5	2	1
19	6	Disteira kingii	2	2	4	0	2	3	1	1.7	0	3.3	19	10	10	10	10	40	0	0	3	0	0	0	2	4	3
18.6	7	Emydocephalus annulatus	0	2	4	0	2	3	1	3.3	0	3.3	18.6	5	10	10	10	35	0	0	3	0	0	1	2	4	3
16.9	7	Laticauda colubrina	0	2	4	0	2	3	1	1.6	0	3.3	16.9	10	10	10	10	40	0	0	3	0	0	0	2	1	3
16.7	9	Hydrophis ornatus/ocellatus	0	5	4	0	2	3	1	0	0	1.7	16.7	10	10	10	10	40	0	0	0	2	0	0	2	3	3
16.7	9	Disteira major	0	5	4	0	2	3	1	0	0	1.7	16.7	10	10	10	10	40	0	0	3	0	0	1	2	4	3
16.7	9	Astrotia stokesii	0	5	4	0	2	3	1	0	0	1.7	16.7	5	10	10	10	35	0	4	3	0	0	1	2	3	3
16.7	9	Aipysurus laevis	0	5	4	0	2	3	1	0	0	1.7	16.7	5	10	10	10	35	0	0	0	2	0	1	2	4	3
14.7	13	Hydrophis elegans	0	5	4	0	2	1	1	0	0	1.7	14.7	5	10	10	10	35	0	0	3	0	0	1	2	4	3
14.3	14	Pelamis platurus	0	2	1	0	2	3	3	0	0	3.3	14.3	5	10	10	10	35	0	4	0	2	0	0	2	3	1
13.7	15	Acalyptophis peronii	0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	4	3	0	0	0	2	3	3
13.7	15	Aipysurus duboisii	0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	0	3	0	0	1	2	3	3
13.7	15	Hydrophis inornatus	0	2	4	0	2	3	1	0	0	1.7	13.7	5	10	10	10	35	0	0	3	0	0	0	2	3	3

Appendix B - Full Millsap scores and rankings using modified version of Lunney et al. (1996)

Biological Scores	Rank	Taxon	Biological Variables														Biological Score
			1	2	3	4	5	6	7A	7B	8A	8B	9A	9B	10	11	
48	**1**	Caretta caretta	Y	4	13	4	0	7	0	5	4	5	1	5	c	E	48
39	**2**	Chelonia mydas	Y	4	4	4	0	7	0	5	4	3	3	5	c	VR	39
39	**2**	Dermochelys coriacea	Y	4	4	4	0	7	0	5	4	3	5	3	c	VR	39
37	**4**	Natator depressus	Y	4	10	4	0	0	1	5	4	3	1	5	c	VR	37
36	**5**	Eretmochelys imbricata	Y	4	4	4	0	7	0	5	4	2	1	5	c	VR	36
32	**6**	Emydocephalus annulatus	Y	4	4	4	0	1	2	3	2	2	5	5	c	N	32
31	**7**	Laticauda colubrina	N	4	4	4	0	1	1	3	2	2	5	5	c	N	31
30	**8**	Hydrophis elegans	Y	4	4	4	0	1	4	3	2	2	1	5	c	N	30
28	**9**	Pelamis platurus	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Hydrophis ornatus/ocellatus	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Disteira major	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Acalyptophis peronii	N	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Astrotia stokesii	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Disteira kingii	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Aipysurus laevis	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Aipysurus duboisii	Y	4	4	4	0	1	2	3	2	2	1	5	c	N	28
28	**9**	Hydrophis inornatus	N	4	4	4	0	1	2	3	2	2	1	5	c	N	28

Assumptions and Qualifications:

1. Known populations trend elsewhere in Australia assumed to apply to NSW
2. Level of habitat specialisation that of species, except where permanent (I.e.resident) populations exist in NSW