The Scientific Committee under the NSW *Threatened Species Conservation Act 1995*: seven years of debate

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ABSTRACT

As specified by the NSW *Threatened Species Conservation Act 1995*, the Scientific Committee is responsible for listing threatened species, populations, ecological communities and key threatening processes in schedules of the Act, as well as for several review and advisory tasks. In this paper, I outline the composition, structure and functioning of the NSW Scientific Committee during its first seven years of operation (1996-2002), and then describe the Committee's approach in evaluating five nominations of different entities for listing. Each generated debate about different aspects of the listing process, the amount and quality of information required for the Scientific Committee to be able to make a determination, and about how criteria for listing different entities in the Act should be interpreted. From the debates, the Committee was able to develop robust and effective protocols for review of nominations and assessment of status. These protocols allowed the Scientific Committee to process some 600 nominations for listing and delisting of species, populations, communities and key threatening processes during its first seven years of operation, and should continue to assist the Committee to function in future.

Key words: Scientific Committee, threatened species, populations, ecological communities, threatening processes.

Introduction

Passage of the *Threatened Species Conservation Act* in New South Wales in 1995 provided for the establishment of a Scientific Committee to carry out and oversee a number of statutory obligations. Among these obligations were to maintain lists of threatened species, endangered populations and ecological communities in Schedules 1 and 2 of the Act, and to list key threatening processes in Schedule 3. Additional obligations were to review drafts of joint management agreements between the NSW Department of Environment and Conservation, or DEC (formerly NSW National Parks and Wildlife Service), and other public authorities for conservation of threatened taxa, populations or ecological communities, to provide comment on draft recovery and threat abatement plans and advice on the prioritization of plans, and to advise both the Director-General of DEC and the Minister for the Environment on biodiversity conservation in general. A Scientific Committee was established in 1996 and has functioned continuously to the present.

Effective operation of the Scientific Committee is important for several reasons. Firstly, the listing of threatened species, endangered populations and endangered ecological communities confers recognition of status and some protection of these entities from further threats. It also triggers a requirement by DEC to prepare a recovery plan within a specified time period. Listing of key threatening processes likewise confers recognition of important threats to biodiversity and leads to the preparation of threat abatement plans by DEC in consultation with other stakeholders. Secondly, critical input by the Scientific Committee into draft recovery plans, threat abatement plans, joint management agreements and other documents assists in ensuring that conservation management is underpinned by sound principles. Finally, because of the obligation to provide relevant advice to the Minister for the Environment and Director-General of DEC, the Scientific Committee is potentially able to flag emerging problems and issues of general conservation concern before they become serious. The Scientific Committee is independent of both the Minister and the Director-General and its decisions on listing are final; hence its roles in offering sound advice and commenting on policy, as well as maintaining lists of threatened entities and key threatening processes, are particularly important.

Because of the manifold functions of the Scientific Committee and the significance of its operations, it is of paramount importance that the Committee not only carries out its duties but is also seen to work effectively. A parliamentary review of the Threatened Species Conservation Act two years after its inception vindicated both the independence and work of the Scientific Committee (Anon 1997). However, criticisms have been levelled that the operations of the Scientific Committee are not accountable (Lim 1997), that they "stretch the capacity of science further than is widely recognised" (Cardew 1997), and that they do not consider land use planning (Jerogin 1997). Decisions of the Scientific

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Committee have also been reported negatively and sensationally in the press (e.g., "Urban bush seized"; Benson 1997), or challenged in the NSW Land and Environment Court (VAW (Kurri Kurri) Pty Ltd versus the Scientific Committee 2002-03) and NSW Court of Appeal (VAW (Kurri Kurri) Pty Ltd versus the Scientific Committee 2003). Although the criticisms have been addressed (Adam *et al.* 1997*a*, *b*; Smith 1997) and legal challenges dismissed, it is still crucial that the Scientific Committee is seen as impartial, objective and effective in carrying out its operations.

In this paper, I outline the functioning of the Scientific Committee in its first seven years of operation (1996-2002), when I had the privilege of being Chairperson. I shall briefly describe the composition of the Committee, how it carried out its tasks, and then focus on the approaches taken by the Committee in evaluating and finally listing several contentious species, populations, communities and key threatening processes in the schedules of the *Threatened Species Conservation Act*. While this account is largely historical, it has strong contemporary bearing because almost all of the entities listed from 1996-2002 remain in the schedules of the Act, and because debates on procedures and approaches led to a robust framework that should assist the operations of both the current and future committees.

Scientific Committee: composition

Section 129 of the *Threatened Species Conservation Act 1995*, as enacted in 1996, specified membership of the Scientific Committee as follows:

(1) The Scientific Committee is to consist of 10 members appointed by the Minister.

(2) Of the members of the Scientific Committee:

(a) two are to be scientists employed by the National Parks and Wildlife Service nominated by the Director-General,

(b) one is to be a scientist employed by a public authority, having expertise in one or more of the areas of study referred to in subsection (3), selected by the Minister,

(c) one is to be a scientist nominated by the Commonwealth Scientific and Industrial Research Organization,

(d) one is to be a scientist employed and nominated by the Australian Museum Trust,

(e) one is to be a scientist employed and nominated by the Royal Botanic Gardens and Domain Trust,

(f) one is to be a scientist nominated by the Ecological Society of Australia,

(g) one is to be a scientist nominated by the Entomological Society of Australia,

(h) one is to be a scientist who is employed by a tertiary educational institution and who is selected by the Minister,

(i) one is to be a scientist having expertise in agricultural science and natural resource management who is selected by the Minister.

3. A person appointed as a member of the Scientific Committee is to have expertise in one or more of the following areas of study:

(a) vertebrate biology,

(b) invertebrate biology,

(c) plant biology,

(d) terrestrial ecology,

(e) plant community ecology,

(f) limnology,

(g) marine ecology,

(h) genetics of small populations,

(i) population dynamics (including population viability analysis or evolutionary ecology).

Members of the original and subsequent Scientific Committees were selected following an extensive nomination process involving the various societies, organisations and authorities listed in section 129, thus ensuring that the Committee had broad expertise in biodiversity conservation and resource management. Lim (1997) commented that the Act did not require representation from local government, the union movement or the manufacturing and mining industries, but apparently confused the scientific role of the Committee with economic, cultural and social implications that arise when developments are proposed. Following amendments to the Threatened Species Conservation Act in 2002, membership of the Scientific Committee has now been expanded to 11.

Scientific Committee: structure and functioning

Any large, diverse body of people faced with a continuing and heavy workload needs an efficient administrative structure to function effectively, and the Scientific Committee is no exception. From its first meeting in May 1996, the Committee met for at least one full day a month and, by December 2002, had sat on 76 occasions. Much of the business of meetings was concerned with evaluating nominations for listing, delisting or changing the status of entities in the schedules of the *Threatened Species Conservation Act*; procedures for this have been described elsewhere (Dickman 1997). However, meetings also provided venues for discussing protocols, refining determinations, reviewing public submissions on preliminary determinations and other documents such as draft recovery plans, debating contentious issues, and developing proposals for listing within the Committee itself. All members were asked at the beginning of meetings to declare any pecuniary or non-pecuniary interests that may have affected their judgments on issues before the Committee, and to bring any issues of general interest to the table. In addition, all members of the Scientific Committee carried out substantial research between formal meetings, reviewing papers, seeking expert opinion and information on particular issues, preparing draft determinations and assessing comments received after advertising of preliminary determinations.

Under sections 22 and 24 of the *Threatened Species Conservation Act*, the Scientific Committee is required to notify the nominator, Minister for the Environment and Director-General of the NSW National Parks and Wildlife Service (DEC) when preliminary and final determinations are made. Notice of any decision must also be published in a statewide newspaper (the *Sydney Morning Herald* was selected), the *Government Gazette*, and any local newspapers that circulate in areas that may be affected by a determination. However, in response to early criticism that many potentially interested parties did not get to hear of the Scientific Committee's determinations until too late, letters of notification were also sent routinely to many government and non-government organisations, interested individuals, scientific advisory committees in Victoria and the Australian Capital Territory, the Commonwealth Threatened Species Scientific Committee, to all local councils that may be affected by a determination, and in some instances landholders, if they could be identified. Most members of the Scientific Committee, especially the Chair and Deputy Chair, were called upon at times to comment on determinations in print, radio or television interviews, or to present seminars on Committee functions to interested societies and organizations (e.g., Ecological Society of Australia, Royal Australian Planning Institute, Royal Zoological Society of New South Wales). As Chair, I estimate that these various activities occupied 2-2½ days a week on average; they could not have been less for the Committee's Deputy Chair during the period 1996-2002, Paul Adam.

While members of the Scientific Committee worked diligently to carry out their tasks, little could have been achieved without the dedicated, full-time support of Executive Officers, Kylie Mayne (1996) and Sue Chate (1997 to the present) and their assistants Jan Bloomfield and Kelly Taylor. In addition to organizing meetings and correspondence, liaising with nominators, submission writers, officers of DEC and other government departments, as well as the Committee itself, executive support has extended to fielding many inquiries from the public as well as to coping with the occasional abusive phone call. Most of the Committee's meetings have been held at the DEC Head Office in Hurstville, but others have been hosted by regional offices in Coffs Harbour, Dubbo and Queanbeyan. DEC has provided considerable further support to the Scientific Committee by providing funds for dedicated research assistants, access to legal advice on the prosecution of Committee duties, a workshop in Dubbo on potentially endangered ecological communities in the state's far west, and briefings on current and emerging issues. Integration of these people and tasks has been essential to the efficient functioning of the Scientific Committee since its inception.

Seven years of debate

Despite the considerable expertise within the Scientific Committee and much support to ensure its effective functioning, many issues that came before the Committee were contentious and resolved only after much debate. For example, the definitions of several important terms in the *Threatened Species Conservation Act*, such as 'vulnerable', 'endangered', 'population' and 'community' leave much scope for interpretation (Adam 2004), while concepts such as community extinction are difficult to delineate; is a community extinct when one species is lost, or should some (pre-defined) set of species disappear before extinction can be ascribed? For species or other entities that are cryptic, poorly-defined or known, what is the minimal kind or amount of information required to make a decision on status? What can be done when there is residual error or uncertainty about the information that is available (Akçakaya *et al.* 2000; Burgman 2004), and what role can the precautionary principle (Calver *et al.* 1999; Whelan *et al.* 2004) play in deliberations?

In general, the Scientific Committee used as much information as was available from different sources to inform its decision-making process. We sought expert opinion on virtually all nominations received. The primary, peer-reviewed literature was consulted frequently but, where appropriate, licence records, unpublished reports and other 'grey' literature documents were also used. Much use was made, in addition, of distributional data provided by DEC, State Forests of NSW, the Australian Museum, Royal Botanic Gardens and Herbarium and other authorities. Consultants were engaged to review certain taxonomic groups for which information was scattered, such as marine mammals, birds and reptiles, and ecological communities in western New South Wales. These resulted in detailed written reports, with recommendations or options for listing, and sometimes also in presentations to the Committee. With certain very contentious nominations, such as for the listing of the Dingo *Canis lupus dingo* and the Grey-headed Flying-fox *Pteropus poliocephalus* as threatened species, the Committee co-organised public fora (with the Royal Zoological Society of NSW and Australasian Bat Society) to gather all available information prior to making any decisions.

On yet other occasions, members of the Scientific Committee undertook their own reviews or on-site investigations of nominated entities. When available information and raw data had been collated, it was sometimes subjected to primary analysis by the Committee itself (e.g., ordinations were run on quadrat-based floristic samples to delineate ecological communities). As far as possible, overall data sets were evaluated using robust, repeatable methods such as modified IUCN criteria (Keith 1998) or point-scoring approaches (Millsap *et al.* 1990; Lunney *et al.* 2000). When all available information had been collated and reviewed, the Committee's next task was to judge whether a nominated entity met the criteria specified by the *Threatened Species Conservation Act*.

In the section below, I describe five case studies of species, populations, ecological communities and key threatening processes that generated a lot of debate at meetings of the Scientific Committee, and outline the rationales that led to each being listed.

Endangered species

Under section 10 of the *Threatened Species Conservation Act*, "A species is eligible to be listed as an endangered species if, in the opinion of the Scientific Committee:

(a) it is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate, or

(b) its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction, or

(c) it might already be extinct, but is not presumed extinct."

***Nurus brevis* Motschulsky, 1865.** Nomination of this large carabid beetle was made on the grounds that the species appears to have a restricted distribution and is in very low numbers in New South Wales. Before proceeding to a determination, however, the Scientific Committee debated whether the beetle had been sufficiently sampled to be confident of its true status, whether it could be confused with other carabids (in particular, *Nurus atlas* had also been nominated at the same time for listing as a threatened species), whether it was known to have declined, or faced any current threats. Inquiries indicated that the beetle is a large (5 cm), highly distinctive predator with black and metallic green reflections that should allow ready detection in the field. It had been collected many times during the late nineteenth and early twentieth centuries, and recent records were scant despite targeted searches. As one monitored population had become extinct in the previous decade, only two further disjunct populations were known, loss of the species' apparently preferred rainforest habitat was continuing, and the species was at risk of collectors, *Nurus brevis* was considered to clearly satisfy criterion 10(b) above, and was listed as endangered on 16 March 2001 (Appendix 1).

Vulnerable species

Under section 14 of the *Threatened Species Conservation Act*, "A species is eligible to be listed as a vulnerable species if, in the opinion of the Scientific Committee, the species is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate".

***Cercartetus nanus* (Desmarest, 1818).** In contrast to *N. brevis*, the Eastern Pygmy-possum *Cercartetus nanus* is well-known and has a very broad distribution that encompasses the coast and tableland habitats of New South Wales, as well as several localities on the far western slopes of the Great Dividing Range. Despite the great extent of the species' occurrence, however, *C. nanus* is small, cryptic, and apparently occurs at a small number of localities where it appears to be genuinely rare. In a detailed review of the literature, Bowen and Goldingay (2000) found that *C. nanus* had been reported in only 26 of 72 surveys carried out in ostensibly suitable habitat, and that most surveys (77%) turned up fewer than 10 individuals. Over several meetings, the Scientific Committee discussed whether such a widely-distributed species could be considered threatened. Much debate focused on whether standard sampling methods could adequately reveal the presence of *C. nanus*, whether the species had declined or was continuing to decline, and whether it was subject to ongoing threats.

With respect to sampling, the Committee gave weight to evidence that such disparate sampling techniques as live-trapping, spotlighting, and detection of hairs from sampling tubes and predator scats returned similarly low rates of detection. Further evidence from experts also suggested that *C. nanus* would usually be captured in standard Elliott traps if they were present at a site and sampling effort was sufficiently intense (A. Tulloch, University of Sydney, pers. comm. 2001), and that even the most efficient means of detecting the species (nest boxes or traps set in food trees) frequently returned negative results. Given that relatively few *C. nanus* have been recorded in massive sampling efforts using a variety of techniques throughout the known distribution of the species (Bowen and Goldingay 2000), these considerations confirmed that *C. nanus* is sparse over most of its range. Because intense survey effort over the last 25-30 years has produced most records of the Eastern Pygmy-possum, it is not possible to assess trends in population size or distribution. However, continuing fragmentation and loss of habitat across much of the species' range, inappropriate fire regimes and probable impacts from introduced predators and the introduced plant disease *Phytophthora cinnamomi* (Garkaklis *et al.* 2004) provide no confidence that *C. nanus* is secure. With this body of evidence, the Scientific Committee considered that *C. nanus* met the criteria specified in section 14 of the *Threatened Species Conservation Act*, and it was listed as a vulnerable species on 8 June 2001 (Appendix 2).

Endangered populations

Under section 11 of the *Threatened Species Conservation Act*, "A population is eligible to be listed as an endangered population if, in the opinion of the Scientific Committee, its numbers have been reduced to such a critical level, or its habitat has been so drastically reduced, that it is in immediate danger of extinction and it is not a population of a species already listed in Schedule 1, and:

(a) it is disjunct and at or near the limit of its geographic range, or

(b) it is or is likely to be genetically distinct, or

(c) it is otherwise of significant conservation value."

North Head population of the Long-nosed Bandicoot, *Perameles nasuta* Geoffroy, 1804. The Long-nosed Bandicoot is relatively common in forest habitats in eastern Australia and, as a species, is not considered to be at risk in New South Wales. However, the species has disappeared from much of its former range in the suburban and more developed areas of Sydney, and the population at North Head is probably the largest one remaining in the region. The population is confined to modified and less-disturbed habitats on the North Head peninsula and conforms to the requirement for a population to be "a group of organisms, all of the same

species, occupying a particular area" (section 4, *Threatened Species Conservation Act*). In addition, the population can be considered of significant conservation value in that it is disjunct, has been much-studied (e.g., Scott 1995; Scott *et al.* 1999; Ravallion 2000; Chambers and Dickman 2002; Banks 2004), and is accorded considerable value by the local community (Reizes 1997). But, could the population be considered in *immediate* danger of extinction?

Previous research at North Head had suggested that about 100 *P. nasuta* may be present, but the number of individuals effectively contributing to subsequent generations was expected to be only 10-11% of the census population (Frankham 1995). Such a small population is likely to be at risk of chance disturbances, demographic stochasticity and genetic introgression. The population was known to suffer sporadic mortality due to the depredations of red foxes, stray (and probably) domestic cats and dogs, and continuous mortality due to collisions with cars. Future loss of habitat was expected due to proposed developments at North Head. Further research on a restricted suburban population of the Eastern Barred Bandicoot *P. gunnii* in Victoria had confirmed that a comparably small population of *Perameles* could decline precipitously within just 25 years (Lacy and Clark 1990; Minta *et al.* 1990). In light of all these observations, the Scientific Committee interpreted "immediate danger of extinction" to be in the order of 10-25 years for *P. nasuta*, and considered that the North Head population satisfied the criteria for listing. The final determination was gazetted on 28 February 1997 (Appendix 3). Recent simulation modelling by Banks (2004) has specified a range of extinction probabilities for the North Head bandicoots between 2010 and 2050, thus providing independent confirmation of the Committee's conclusions.

Endangered ecological communities

Under section 12 of the *Threatened Species Conservation Act*, "An ecological community is eligible to be listed as an endangered ecological community if, in the opinion of the Scientific Committee:

(a) it is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate, or

(b) it might already be extinct."

Under section 4 of the Act, an ecological community is defined as "an assemblage of species occupying a particular area."

Hygrocybeae community of Lane Cove Bushland Park. At the time of the nomination of this community, more than 20 species of fungi in the family Hygrophoraceae were known to occur in a small riparian area of the Lane Cove Bushland Park in north Sydney. Although the area occupied was prescribed and the species richness of Hygrocybeae apparently very high, the Scientific Committee debated several issues. Firstly, as few people are likely to be able to reliably recognize and identify Hygrophoraceae, it was not clear if the community might occur more extensively at other locations but had simply gone unnoticed. Secondly, the community at Lane Cove has been studied over many years (Young 1999; R. and E. Kearney, Sydney Fungal Studies Group, pers. comm. 2000) so that even species with ephemeral fruiting bodies had probably been detected. If dedicated, long-term surveys at other sites had not been carried out, could disjunct fragments of the community have been overlooked? Finally, what threats might extirpate a fungal community in a protected bushland park?

Several respondents suggested that sufficient surveys had been carried out in potentially suitable habitat to detect extensions of the community, if they occurred, both in the vicinity of the Lane Cove Bushland Park and in other parts of the Sydney Basin. Many species of Hygrocybeae are distinctive and strikingly colourful, suggesting further that surveys carried out at appropriate times should detect them. Despite reasonably extensive surveys having been made, the Committee also gave weight to the fact that the Lane Cove Bushland Park is the holotype site for six species and subspecies of Hygrophoraceae (Young 1999), with four of these not known to occur anywhere else. As several of the species have been recorded from tiny areas of only 1-2 m^2 in the Lane Cove Bushland Park, they are likely to be uniquely susceptible to trampling, dumping of rubbish and invasion by introduced weeds. The community as a whole is surrounded by housing and other developments, and is thus also susceptible to urban run-off, flash flooding and potentially toxic industrial pollutants (R. and E. Kearney, pers. comm. 2000). Although the Scientific Committee debated whether the loss of one or more species could compromise the community to the extent of rendering it extinct, the uniqueness of the assemblage and the array of potential threats to its survival left no doubt that it fulfilled the criteria of section 12 of the Act, and it was listed as an endangered ecological community on 3 March 2000 (Appendix 4). Subsequent research on this community has elevated the number of Hygrocybeae species known to occur, and further confirmed the significance of the Lane Cove site (Kearney and Kearney 2000; Young *et al.* 2001).

Key threatening processes

Under section 15 of the *Threatened Species Conservation Act*, "A threatening process is eligible to be listed as a key threatening process if, in the opinion of the Scientific Committee, it:

(a) adversely affects 2 or more threatened species, populations or ecological communities, or

(b) could cause species, populations or ecological communities that are not threatened to become threatened."

Anthropogenic climate change. During the 1980s and 1990s evidence accumulated that human activity was changing the world's climate at a rate considerably faster than had occurred previously. At the same time, developments in predictive modelling were beginning to confirm that the fine-scale distributions of many species of plants and animals are determined by climate, and that many would be at risk if either average climatic conditions or the frequency of extreme events such as floods and fires were to change (Busby 1988). "Greenhouse" warming, for example, could be expected to reduce the extent of cool

refugia occupied by high-altitude mammalian specialists such as Leadbeater's Possum *Gymnobelideus leadbeateri* in Victoria, or the Mountain Pygmy-possum *Burramys parvus* and Broad-toothed Rat *Mastacomys fuscus* in New South Wales (Lindenmayer *et al*. 1991; Mansergh and Broome 1994; Green and Osborne 2003). High altitude plant communities would be similarly reduced in extent (Hughes and Westoby 1994). For many taxa, the adverse effects of climate change could be averted only if there were suitable areas for them to migrate to.

In view of these and other studies (e.g., Brereton *et al*. 1995), the Committee ultimately had little doubt that anthropogenic climate change met the criteria for listing as a key threatening process. While reviewing the evidence, however, the Committee debated the further issue of whether a listing of this process in schedule 3 of the Act would have any practical effect. Further, as listing of a key threatening process triggers preparation of a threat abatement plan, the Committee considered whether the listing of anthropogenic climate change might wastefully consume precious management resources. Climate change is occurring due to increased levels of CO_2 and other "greenhouse" gases in the atmosphere that are produced from the burning of fossil fuels, and to decreased plant biomass that could otherwise sequestrate much of the excess carbon. Clearly, it would be impossible for the NSW Government to halt the use of fossil fuel and, even if this could be done, it would have no effect on CO_2 production elsewhere in Australia and other parts of the world. Would the listing of anthropogenic climate change therefore be futile or even counter-productive?

Although little can be done to stem the production of greenhouse gases, the Committee took the view that adverse climatic effects on biota could be reduced if suitable habitats were available for species to migrate to. As the protected area network is currently too patchy to permit movement across the broader landscape (Pouliquen-Young 1999), the Committee considered that listing anthropogenic climate change would stimulate modelling of species movements in the future, and provide impetus to redesign the reserve network to accommodate them. After reviewing the evidence, the Committee was convinced that anthropogenic climate change met the criteria specified under section 15 of the *Threatened Species Conservation Act*, and it was listed as a key threatening process on 17 November 2000. The practicability of conservation planning for this process was noted in point 6 of the Committee's final determination (Appendix 5).

Discussion

Compilations of threatened taxa are of value for identifying taxonomic groups, biological attributes, geographical areas or other traits that may predispose species to endangerment, and provide trip wires for management intervention. Although the value of listing threatened species and other entities has been debated recently (Possingham *et al.* 2002; Brook *et al.* 2003; Lamoreux *et al.* 2003), lists underpin much conservation effort at state, national and international levels and help to direct the allocation of scarce resources (Burgess 2001; IUCN 2003). It is therefore imperative that the listing process is transparent, rigorous and effective.

The case studies provide an indication of the range of issues debated by the Scientific Committee in reviewing nominations. Other examples have been noted elsewhere (e.g., Dickman and Fleming 2002; Adam 2004). Additional issues that were canvassed by the Committee include how to delineate the geographical boundary of a population or community of mobile organisms; how to delineate the species composition of communities when not all organisms within a defined area could be distinguished or even sampled (e.g., many invertebrates, micro-organisms, fungal spores and plant seeds in the soil); how to deal with the problem of variation in species composition over time; whether communities could be considered endangered if they had been fragmented and degraded by invasion of introduced species but still occupied large areas; whether depauperate remnants of regrowth vegetation should still be considered part of communities; and whether certain taxa should be legally considered as 'fish' (e.g., dragonflies) or 'marine vegetation' (e.g., saltmarsh plants) because part of their life cycles take place in water, and hence be more appropriate for listing under the *Fisheries Management Act 1994*. There were, of course, many other issues of arcane, legal, philosophical or fundamental biological nature that enlivened debates of the Scientific Committee. However, the bottom line in all discussions was to ensure that decisions accorded with criteria set out in the *Threatened Species Conservation Act 1995* and were underpinned by sound science.

Despite the heavy workload, occasional invective and harangues from sections of the wider community, the Scientific Committee was able to maintain a clear focus during its first seven years of operation and handled some 600 nominations for listing or delisting of threatened species, populations, ecological communities and key threatening processes. Remarkably, virtually all decisions about listing were unanimous during this period. Among other factors, I suspect that this was due to the opportunities that were available for extensive debate. For example, except in the case of provisional listings that needed to be made quickly, members of the Committee had time to voice concerns about a nomination or the wording of a determination, to seek further information or expert opinion on specific issues, and to achieve broad consensus before a vote was taken. In addition, unanimity was assisted by adherence to scientific principles, and a common commitment to biodiversity conservation among members of the Scientific Committee. I hope the experiences gained and practices pioneered by the inaugural committee will be of use to members of both the present and future Scientific Committees.

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APPENDIX 1

Appendix 1.

Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the beetle *Nurus brevis* Motschulsky, 1865 as an ENDANGERED SPECIES on Part 1 of Schedule 1 of the Act. Listing of endangered species is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Nurus brevis* (Coleoptera: Carabidae) is a large (up to 5cm in length), predatory ground beetle. It is flightless, heavily built and black with metallic green reflections.
2. *Nurus brevis* appears to have been confined to heavily timbered areas east of the Great Dividing Range on the north coast of NSW, including the "Big Scrub". Prior to the clearing of the "Big Scrub" rainforest, *Nurus brevis* is thought to have been relatively common. There are many collection records of *Nurus brevis* from the 19th and early 20th centuries.
3. The biology of *Nurus brevis* has not yet been studied in detail, but it is known that the beetles live in burrows and that the females nurture the young at the bottom of the burrow.
4. *Nurus brevis* had not been collected for many years and was thought to be extinct until 1972, when *Nurus brevis* was re-discovered by G. Monteith at Rotary Park, Lismore. However, by the early 1990s this population had declined and latest data indicate that *Nurus brevis* is extinct in Rotary Park (G. Williams, G. Carruthers, pers. comms). This population formed the basis of a nomination of Rotary Park to the Register of the National Estate (Carruthers, 1993, Greenslade, 1994). There are now only two known populations of *Nurus brevis*, both of which are near Mallanganee and are very isolated (G. Monteith, C. Reid pers. comms).
5. The survival of this species is currently threatened by an extremely restricted distribution, clearing of rainforest remnants, removal of fallen timber and ground cover, and beetle collecting activities.
6. In view of 1, 2, 3, 4 and 5 above, the Scientific Committee is of the opinion that the numbers of *Nurus brevis* Motschulsky, 1865 have been reduced to such a critical level and its habitats have been so drastically reduced, that it is in immediate danger of extinction.

Dr Chris Dickman
Chairperson
Scientific Committee

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Gazetted: 16/03/01

APPENDIX 2

Appendix 2.

Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Eastern Pygmy-possum *Cercartetus nanus* (Desmarest, 1818) as a VULNERABLE SPECIES on Schedule 2 of that Act. Listing of vulnerable species is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The Eastern Pygmy-possum *Cercartetus nanus* (Desmarest, 1818) is a small arboreal marsupial that is distributed in the south-eastern corner of mainland Australia and in Tasmania. In New South Wales the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevation only. Pygmy-possums are agile climbers that feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit.
2. Although the Eastern Pygmy-possum is broadly distributed, recent studies have shown that within this range the species appears to be patchily distributed and its overall abundance is low.
3. Despite a large number of intensive trapping programs undertaken in the eastern forests and woodlands of New South Wales in recent years, only a small number of captures (154) have resulted from a total trapping effort of 315,000 Elliott trap-nights and 57,000 pitfall trap-nights (Bowen and Goldingay 2000).
4. Other detection techniques such as spotlighting, predator scat analysis, hair tubes and trapping in trees have produced similar low rates of detection. Capture rates are highest for installed nest-boxes and traps set in flowering banksias. This may reflect a habitat preference or a more successful trapping method.
5. From these and more recent studies (A. Tulloch, pers. comm.), there were only six localities where more than 10 observations of Pygmy-possums have been made. These were the Pilliga area, New England Tablelands, Barren Grounds Nature Reserve-Budderoo National Park, Royal and Heathcote National Parks, Kioloa State Forest and the Eden area.
6. The factors threatening the survival of the Eastern Pygmy-possum include isolated sub-populations with little opportunity for dispersal which increases the risk of local extinction, clearing that results in habitat loss and fragmentation, inappropriate fire regimes that remove nectar-producing understorey plants, the loss of nest sites due to past intensive forestry and firewood collection, and predation by foxes and cats.
7. In view of 2, 3, 4, 5 and 6 above, the Scientific Committee is of the opinion that the Eastern Pygmy-possum *Cercartetus nanus* is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate, and is therefore eligible for listing as a vulnerable species.

Associate Professor Paul Adam
Deputy Chairperson
Scientific Committee

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Gazetted: 08/06/01

APPENDIX 3

Appendix 3.

Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the North Head population of the Long-nosed Bandicoot, *Perameles nasuta*, Geoffrey 1804, as an Endangered Population on Part 2 of Schedule 1 of the Act. The distribution of the population is defined on the map which forms part of this Final Determination.

Any submissions received following advertisement of the Preliminary Determination have been considered by the Scientific Committee.

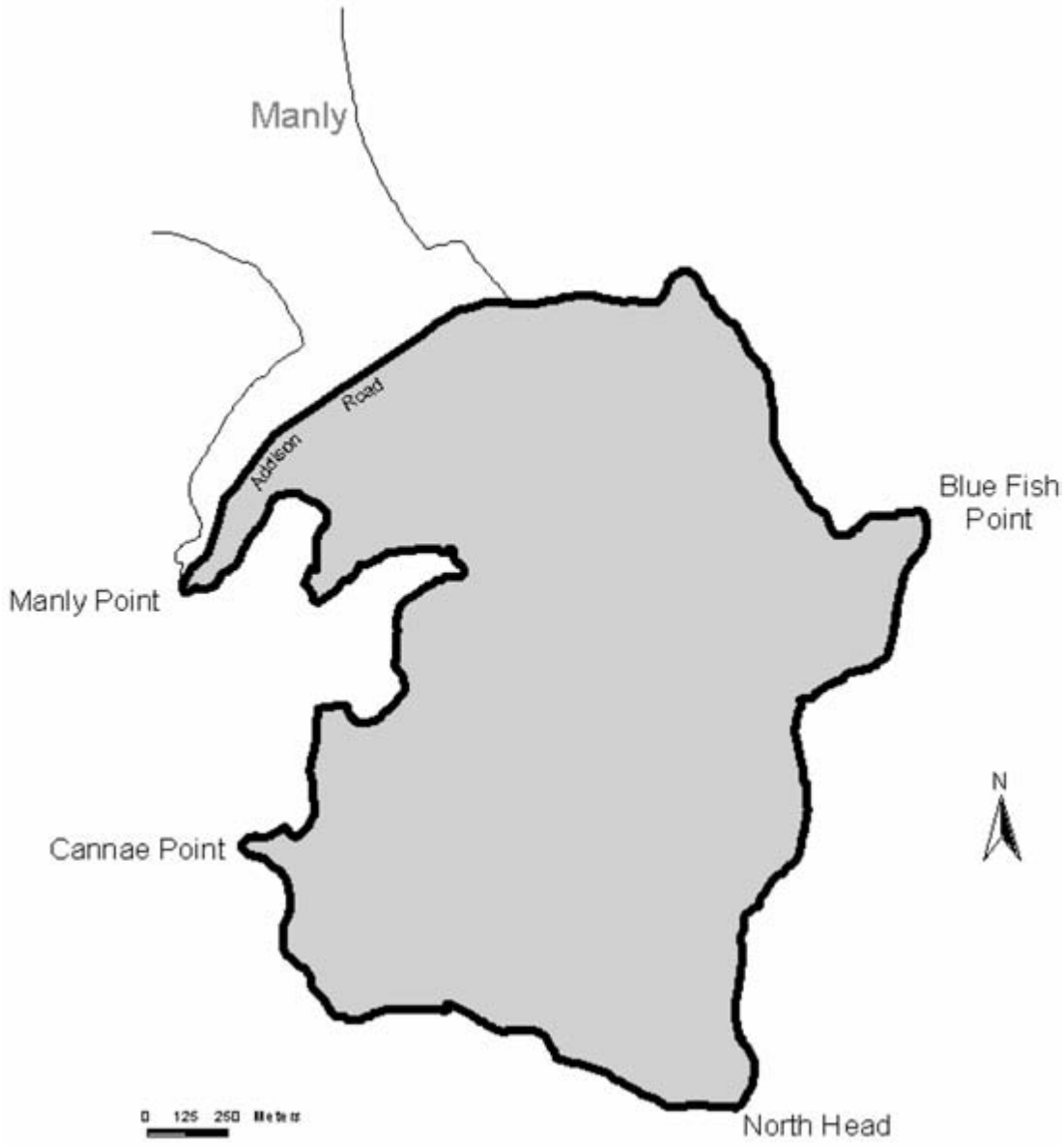
Listing of Endangered Populations is allowed for by Section 11 of the Act.

The Scientific Committee has found that:

1. *Perameles nasuta* is not listed on Part 1 of Schedule 1 of the Act and thus populations of *P. nasuta* are eligible for consideration for inclusion on Part 2 of Schedule 1 of the Act.
2. *P. nasuta* has been reliably reported as occurring on North Head, within the area defined on the accompanying map.
3. The population of *P. nasuta* at North Head is estimated to be about one hundred animals, with fluctuations around this number over time.
4. The Scientific Committee is of the opinion that the effective population size is much less than the census population, and that, on the basis of the scientific literature the best available estimate of the effective population size would be approximately 10-11% of the census population.
5. There is evidence that one cause of mortality of *P. nasuta* at North Head is as a result of attacks by introduced predators (foxes, dogs, cats). Road kills have also been reported.
6. *P. nasuta* was once widespread in the Sydney region but many formerly recorded populations have become extinct. The North Head population is now isolated and disjunct. The nearest surviving population to that at North Head known to the Committee is in Pittwater Local Government Area.
7. Population genetic theory would suggest that a population as small as that of the North Head *P. nasuta* population would suffer effects of inbreeding depression and loss of genetic variation, affecting population viability.
8. In addition to genetic consequences of small population size, a small population occupying a limited, discrete area is at risk from stochastic disturbance events.
9. In light of the above, and taking into account discussion in relevant international scientific literature, the Scientific Committee is of the opinion that the North Head population of *P. nasuta* is in immediate danger of extinction.
10. While the North Head population of *P. nasuta* is disjunct it is not situated at or near the limit of the geographic range of the species.
11. The Committee is not aware of any genetic studies of the North Head *P. nasuta* population. However, the effects of fragmentation and isolation may result in local populations possessing distinct genetic features. There is thus a likelihood that the population may be genetically distinct.
12. The Scientific Committee is of the opinion that the North Head *P. nasuta* population is of significant conservation value on the grounds that it is:
    - a disjunct population
    - one of the few surviving populations within the Sydney region
    - a population which has been the subject of a number of scientific studies, and is thus an important reference population
    - accorded considerable value by the local community, and thus serves to promote conservation more generally.
13. As a consequence of points 1, 9, 11 and 12 above the Scientific Committee is of the opinion that the criteria specified in Section 11 of the Act are met and that the North Head Population of *P. nasuta* should be listed as an Endangered Population on Part 2 of Schedule 1 of the Threatened Species Conservation Act.

Dr Chris Dickman
Chairperson
Scientific Committee
Gazetted: 28/2/97

APPENDIX 3



Map accompanying the Final Determination for the North Head population of the Long-nosed bandicoot

APPENDIX 4

Appendix 4.

Final Determination

The Scientific Committee established by the Threatened Species Conservation Act, has made a Final Determination to list the Hygrocybeae Community of Lane Cove Bushland Park as an ENDANGERED ECOLOGICAL COMMUNITY under Part 3 of Schedule 1 of the Act. Listing is provided for under Part 2 of the Act.

The Scientific Committee has found that:

1. The Hygrocybeae Community of Lane Cove Bushland Park is an assemblage of more than 20 species of fungi in the family Hygrophoraceae (Fungi, Basidiomycota, Agaricales, Hygrophoraceae).
2. The Community is restricted to a core zone along the Gore Creek catchment in the Lane Cove Local Government Area in Sydney. The majority of species occur in the warm temperate gallery rainforest centred on the banks of the north-eastern arm of Gore Creek and its tributaries in Lane Cove Bushland Park. This core zone also extends to the wet sclerophyll catchment, north of the tributary junction with Gore Creek. A minority of the species in the assemblage is found in a buffer zone of dry sclerophyll between the perimeter of Lane Cove Bushland Park and outer edges of the gallery canopy and along Gore Creek in Osborne Park.
3. The following species have been recorded in the community:

Camarophyllopsis kearneyi	*Hygrocybe anomala* var. *ianthinomarginata*
Hygrocybe astatogala	*Hygrocybe aurantiopallens*
Hygrocybe aurantipes	*Hygrocybe austropratensis*
Hygrocybe cantharellus	*Hygrocybe cheelii*
Hygrocybe chromolimonea	*Hygrocybe erythrocala*
Hygrocybe graminicolor	*Hygrocybe helicoides*
Hygrocybe involutus	*Hygrocybe irrigata*
Hygrocybe kula	*Hygrocybe lanecovensis*
Hygrocybe lewellinae	*Hygrocybe mavis*
Hygrocybe miniata	*Hygrocybe reesiae*
Hygrocybe sanguinocrenulata	*Hygrocybe stevensoniae*
Hygrocybe taekeri	*Hygrocybe virginea*

   Other species in the Community have been collected but remain undescribed and unclassified, and other Hygrocybeae may be present.
4. Lane Cove Bushland Park is the holotype site for *Hygrocybe aurantipes*, *Hygrocybe austropratensis, Hygrocybe lanecovensis, Hygrocybe anomala* var. *ianthinomarginata, Camarophyllopsis kearneyi* and *Hygrocybe reesiae*. [Young, A.M., 1999, The Hygrocybeae (Fungi, Basidiomycota, Agaricales, Hygrophoraceae) of the Lane Cove Bushland Park, New South Wales. *Austrobaileya* **5**: 535 - 564].
5. The assemblage is not known to occur outside the Lane Cove Local Government Area. Furthermore, the number of species of *Hygrocybe* is very high compared with other known sites in Australia and overseas. Species will not have above-ground fruiting bodies at all times of the year. There may be differences depending on seasonal conditions and other factors.
6. Within Lane Cove Bushland Park, different species of Hygrocybeae have been reported from one to several specific locations. More species occur at the southern than at the northern end of the Park. The ecological requirements of most species are poorly known, but are likely to be associated with a dense tree canopy and sandstone rocks.
7. The Community is threatened by water-borne pollutants. Industrial pollutants occur particularly in the upper reaches of Gore Creek catchment and domestic contaminants arise from residential properties on the perimeter of Lane Cove Bushland Park. The Community is also at risk from encroachment by exotic weeds, dumping of rubbish and garden refuse, excess pedestrian traffic in areas sensitive to erosion, and inappropriate bush regeneration measures that disturb the forest canopy and native understorey plants.
8. In view of the small area occupied by the Community and the threats to its integrity identified in 7 above, the Scientific Committee is of the opinion that the community is likely to become extinct in New South Wales unless the circumstances threatening its survival cease to operate.

Dr Chris Dickman
Chairperson
Scientific Committee
Gazetted: 3/3/00

APPENDIX 5

Appendix 5.

Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Anthropogenic Climate Change as a KEY THREATENING PROCESS on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The distribution of most species, populations and communities is determined, at least at some spatial scale, by climate.
2. Climate change has occurred throughout geological history and has been a major driving force for evolution.
3. There is evidence that modification of the environment by humans may result in future climate change. Such anthropogenic change to climate may occur at a faster rate than has previously occurred naturally. Climate change may involve both changes in average conditions and changes to the frequency of occurrence of extreme events.
4. Response of organisms to future climate change (however caused) is likely to differ from that in the past because it will occur in a highly modified landscape in which the distribution of natural communities is highly modified. This may limit the ability of organisms to survive climate change through dispersal (Brasher & Pittock 1998; Australian Greenhouse Office 1998). Species at risk include those with long generations, poor mobility, narrow ranges, specific host relationships, isolate and specialised species and those with large home ranges (Hughes & Westoby 1994). Pest species may also be advantaged by climate change.
5. Modelling of the distribution of species under realistic climate change scenarios suggests that many species would be adversely affected unless populations were able to move across the landscape (for example, Brereton, Bennett and Mansergh 1995). Examples of species which would be at risk in New South Wales include:

Mammals	
Burramys parvus	Mountain Pygmy-possum
Potorous longipes	Long-footed Potoroo
Mastacomys fuscus	Broad-toothed Rat
Pseudomys fumeus	Smoky Mouse
Birds	
Leipoa ocellata	Malleefowl
Pedionomus torquatus	Plains-wanderer
Tyto tenebricosa	Sooty Owl
Calyptorhynchus banksii graptogyne	Red-tailed Black-cockatoo
Polytelis anthopeplus	Regent Parrot
Petroica rodinogaster	Pink Robin
Pachycephala rufogularis	Red-lored Whistler
Reptiles	
Delma impar	Striped Legless Lizard
Amphibians	
Litoria spenceri	Spotted Frog
Litoria raniformis	Southern Bell Frog
Pseudophryne pengilleyi	Northern Corroboree Frog
Pseudophryne corroboree	Southern Corroboree Frog
Flora	
Communities likely to become threatened include alpine vegetation communities (Busby 1988, Hughes & Westoby 1994).	

APPENDIX 5

6. The present protected area network was not designed specifically to accommodate climate change, and the present biodiversity values of the protected area system may not all survive under different climatic conditions (see Pouliquen-Young, O. 1999). Conservation planning at the landscape scale could provide opportunities for species to respond to future climate change and the Threat Abatement Plan could address modifications to the present protected area network to account for climate change.
7. Fire is an integral part of the dynamics of many Australian ecosystems. Studies suggest that the risk of fire may increase in some areas as the climate changes and decrease in others with consequent changes to the species composition and structure of ecological communities (Brasher & Pittock 1998; NSW Scientific Committee 2000).
8. In view of the above, the Scientific Committee is of the opinion that Anthropogenic Climate Change adversely affects two or more threatened species or could cause species, populations or ecological communities that are not threatened to become threatened.

Dr Chris Dickman
Chairperson
Scientific Committee

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Gazetted: 17/11/00