

OPEN SESSION 1

Four important issues to consider when managing natural-resource based systems

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In this paper we consider four important issues that are often not well considered when managing natural-resource based systems. We describe some of the resulting consequences and suggest solutions for overcoming them. The four issues are:

- Natural resource based systems, whether they are used for production, conservation or both are complex and our knowledge of them is imperfect and always will be.
- The management problem needs to be clearly defined.
- An appropriate monitoring and evaluation program is essential.
- Management program need to be developed and implemented jointly with all key stakeholders.

The most serious consequence from not addressing these issues is poor management of our natural-resource based systems and the risk of losing or further decline in threatened species and communities, reduced production and threat to ecosystem services. The key to overcoming these adverse consequences is for planners and managers to be aware of and understand the issues and to have the skills to plan and manage natural-resource based systems based on best practice.

We illustrate the issues and consequences for not addressing them with appropriate examples.

Single-species and trophic-interactive models of animal population dynamics: does it matter when predicting extinction risk?

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Animal populations that persist through time are generally considered “regulated”, neither increasingly indefinitely nor going extinct. Early experiments that focussed on this phenomena, identified density-dependent variation in the instantaneous rate of change in population abundance (r , or its constituent demographic rates: fecundity and immigration, mortality and emigration) as the proximal cause of population regulation. This observation spawned a research industry based on identification of key demographic rates that varied in a density-dependent fashion, and extension of these data to single-species models. More recently, these models have been used to explore a wide range of wildlife management systems from pest control and harvesting, to conservation. However, while the application of single-species models to management questions continues to proliferate, initial academic interests in the mechanisms that produce density-dependence has been largely restricted to theoretical considerations; specifically how interaction between two or more species can lead to density-dependence (i.e. host-pathogen, plant-herbivore, predator-prey interactions). An obvious question that arises is whether abstracting the mechanism that produces density-dependence limits the usefulness of single-species models in addressing management questions? In this paper I explore this question by testing the influence that model type (single-species cf. trophic-interactive) has on projected extinction risk (measured as quasi-extinction probability), in a simple plant-herbivore system.

Fishery bycatch of Australian sea lions in commercial shark nets: action taken in 2010 to alleviate the problem

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Australian sea lions (ASL) are listed as Vulnerable under the EPBC Act. Over the last two decades, ASL populations in South Australia (SA) have shown little change while sympatric New Zealand fur seals increased. Lack of ASL recovery is likely related to interactions with gill-nets of the shark fishery. ASLs are bottom feeders and their distribution overlaps with bottom-set nets of the shark fishery.

Management of ASL is by State and Commonwealth environment departments, including Environment, Water, Heritage and the Arts (DEWHA). The shark fishery is managed by Australian Fisheries Management Authority (AFMA).

Options for spatial management of effort (area closures) in the shark gillnet fishery to mitigate ASL bycatch risk developed by Goldsworthy et al. (2010) utilised models combining ASL foraging effort, bycatch data and PVAs. The options were largely ignored by AFMA during development of a sea lion management plan aimed at limiting sea lion bycatch to satisfy Wildlife Trade Operation requirements under the EPBC Act. The management plan involves area closures around all 48 SA breeding sites out to 4-10 nautical miles (7.3-18.5 km), with largest closures around colonies perceived to have the greatest interaction risk. This should reduce incidence of bycatch mortality for many breeding sites.

Within and between sex range use overlaps in southern Kalahari leopards

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The range size of larger carnivores must provide them with sufficient prey to form viable populations. In arid and semi-arid, prey-poor environments this requires extensive ranges. Whereas the ranges of several adult female leopards in more mesic and prey-rich environments usually overlap with each other and those of one or more males, the ranges of the adult males are usually exclusive of others of their sex. Moreover, the ranges of adult females depend on their food resources, while those of adult males depend on the abundance and range sizes of the females, but are considerably larger than those of the females. In the semi-desert and prey-poor Kalahari ecosystem of southern Africa, the mean ranges of both sexes of leopard are considerably larger than in more mesic regions, and are the largest known in leopards in the world. These ranges are not used uniformly, nor are the long-term mean ranges used at all times of the year as certain portions of the ranges act as core areas of use. In the southern Kalahari ecosystem, male and female leopards show within and between sex overlaps in range use as is known from other arid and prey-poor regions. Based on GPS telemetry, an adjacent and overlapping adult male and female were as much as 47.6 apart at times, but were in the same location at a mean interval of 35 days on four successive occasions. This is within the mean oestrus cycle of 45 days in an adult female. The range overlaps within and between sexes and the increased rainfall from south-west to north-east create a viable population of leopards in the semi-arid Kgalagadi Transfrontier National Park of 37 991 km² which would have been impossible had the ranges not overlapped. The leopards are mainly solitary but not asocial and no indication of within and between sex aggression was found.

OPEN SESSION 2

Use of habitat by koalas in tropical environments

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Maintaining thermal neutrality is an important biological adaptation among homeotherms, but the mechanisms used by koalas are not completely understood. Given the koala's wide latitudinal range and the accompanying extremes of temperature, ecological plasticity should be considerable. In the absence of den use, koalas must either possess extreme physiological flexibility, or exhibit behavioural adaptations that enable them to exist across a wide range of climatic niches. We studied the choice of roost site of koalas in a tropical habitat to investigate the capacity of these marsupials to adjust their behaviour. Using remote telemetry and automated data collection we examined the position and activity of the koala and the thermal regime of the canopy, and found that some koalas gained a significant thermal advantage by choosing non-food (shelter) trees for daytime roosting. Other koalas roosted in more exposed positions in food trees and these were more inactive during hotter seasons when water turnover was high, suggesting that this species may conserve water by reducing activity. These findings indicate that management of tropical habitat for koalas must consider the presence shelter trees as well as food trees.

Dispersing sub-adults koalas use of habitat

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Information about juvenile koala dispersal and habitat use should guide habitat preservation and corridor establishment for native animals. Maturing sub-adult koalas were radio tracked as they undertook dispersal or extended movements away from their natal areas before establishing a home range and breeding. Before being independent, juveniles remained in their mothers' territory, mirroring her ranging and movement behaviour and tree species use. After three to five months, the juveniles ventured beyond the mothers' range and used different tree species to their mother, before establishing their own home range. The direction and timing of dispersal varied among individuals and across gender. Females usually established a ranging area close to, or overlapping, the other's home range, while males established ranging areas further afield.

How do wildlife rehabilitators contribute to the management of Koalas in NSW?

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Highways and major roads have large signs stating: "For injured wildlife - call the following number". We looked beyond the road signs to examine koala rehabilitation in NSW. The records of wildlife rehabilitation groups were analysed from the point of view of wildlife managers. The questions we addressed were: where was rehabilitation occurring; what were the cause of injuries; what was the care success rate; and what lesson can we draw on how to best manage sick or injured koalas?

Among the lessons are the need for a more robust recording system and that there is an ethical component to wildlife rehabilitation, which contributes to its success, but also can generate conflict over such issues as euthanasia. With around 1,000 Koalas taken into care annually, most of which are euthanised because the injuries are too severe, the scale of the matter for this threatened species in NSW points to a need for continuing analysis of the

human dimensions of this often distressing wildlife management subject. The successful rehabilitation of native fauna potentially makes an important contribution to wildlife management in NSW from both a species perspective and the way that the wider community responds to wildlife and its particular needs.

From experimental field trials to full scale wildlife management: the use of gestagen implants for fertility control in koala populations impacting on their habitat in south-eastern Australia

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In south-eastern Australia, management of koala populations that have reached densities where they over-browse their food trees involves very substantial financial and logistical costs to state governments. These populations also cause significant ecological damage . Our experimental field trials on koalas, testing the longevity and safety of gestagen implants for reducing adult female fertility, have now been running for 7 years . At the commencement of this trial a mixed age group of adult females were treated with either 70 mg levonorgestrel or placebo (control) implants. To date (August 2010), none of the levonorgestrel treated animals have resumed breeding, and we have not found any significant health effects of the implants . Some animals, both treatment and controls, are now dying of old age. On the basis of our findings, levonorgestrel is now being used in State Government koala population management programs. Although reducing population density using in situ fertility control takes some time to achieve desired ecological outcomes (i.e. recovery of trees from browse damage), this approach is more humane, less stressful to the koalas and more cost effective than past management approaches that relied on translocation to relieve koala browse pressure in landscapes where habitat became fragmented rapidly after European settlement.

The epidemiology and pathology of chronic industrial fluoride toxicosis in macropods

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As wildlife increasingly inhabit industrial buffer zones due to reduction in alternative habitat, a novel form of human-wildlife conflict emerges. Australia has over 680 fluoride emitting industrial sources, ranging from brick works to aluminium smelters and coal-fired power generation plants. Particulate and gaseous fluoride emissions contaminate vegetation surrounding these industries, and long-term consumption by eastern grey kangaroos (*Macropus giganteus*) can result in skeletal and dental disease. It appears that macropods may be more sensitive to this condition than livestock. Previous studies have examined only culled kangaroos, which has not allowed for estimation of prevalence within populations, nor for the monitoring of individual fluoride exposure over time and how this correlates to progression of pathology and clinical signs of fluorosis. We aim to investigate this condition by monitoring populations of macropods that inhabit buffer zones surrounding fluoride-emitting industry. Management recommendations will ultimately be produced in an attempt to prevent disease in macropods due to industrial fluoride emissions.

Holiday haven or ecological trap? High adult mortality in urban kangaroos

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The town of Anglesea on the Surf Coast of Victoria is known for its urban population of eastern grey kangaroos (*Macropus giganteus*). Residents and tourists place a high value on kangaroo viewing, particularly at the golf course.

However, human-wildlife conflicts also arise, and the issue of greatest concern is road-kill. Since 2007 we have captured 193 adult kangaroos at the golf course and nearby school camp. We marked kangaroos with coloured combinations of reflective ear-tags, and collars bearing the name of each individual. We monitored the population in regular surveys of the golf course and camp, and relied primarily on citizen science reports of marked kangaroos in other parts of the town. By the end of 2009, 37% of the females were considered to be dead (21% known deaths, 16% missing < 6 months), as were 53% of the males (34% dead, 19% missing). When we were able to determine the circumstances of death, the overwhelming cause was road-kill. Adult females died close to their point of capture, whereas deaths of males were reported throughout the town. We conclude that road-kill is a major source of mortality in this population, with unknown consequences for other aspects of their ecology.

STUDENT SESSION 1

Is the current “Operation Nest Egg” (O.N.E.) practice maximising rowi (*Apteryx rowi*) recruitment, survival and fitness?

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The New Zealand Department of Conservation (DOC) employs a management practice for kiwi (*Apteryx* spp.) known as O.N.E (Operation Nest Egg), which involves removing eggs or chicks from the wild, hatching and rearing the young in captivity until they are large enough to no longer be at risk from stoats, and release back into the source population. DOC make recommendations for the use of behavioural studies in several areas of kiwi conservation. However a review of the literature and discussion with DOC kiwi managers suggests few behavioural studies have been undertaken. The aim of this research is to investigate the effects of O.N.E on kiwi behaviour in order to assess whether current O.N.E practices result in maximum possible recruitment, fitness and long term survival. The study involves analysis of historic information on the DOC database, alongside field studies of post-release behaviour, coupled with experimental manipulations of release group demographics. This presentation will focus on key hypotheses, and give details on the methodology being used for testing them. A more complete understanding of the behavioural effects of various release strategies will provide guidance for improving the effectiveness of future O.N.E reintroductions and kiwi conservation in general.

Population genetics as a tool for wildlife management: A case study on the platypus, *Ornithorhynchus anatinus*

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Genetics can provide an important tool for wildlife managers in its ability to assist in the classification of a ‘population’ for management purposes and in its ability to identify populations that are potentially at risk. Research on the platypus, *Ornithorhynchus anatinus*, will be presented to demonstrate how the identification of genetic similarities or differences between these populations can help address management concerns. Specific attention will be given to the large genetic differences discovered between Tasmanian and mainland platypuses and the unique findings of the isolated King Island population. Comparative population genetic analyses are able to expose populations suffering from low levels of genetic diversity as well as identify populations that are unique in terms of their genetic distinctiveness.

Estimating occupancy and abundance indices of Komodo dragons

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Monitoring population trends and distribution is crucial to both conservation and management of the endangered Komodo dragons (*Varanus komodoensis*). In Indonesia, where conservation resources and technical capacity are

often limited, it is necessary to implement monitoring methods that are cost-effective and technically appropriate whilst reasonably accurate and precise. We compared multiple methods using both indirect abundance estimates (eg. faecal counts), alongside direct methods (eg. site occupancy models, catch per unit effort and mark recapture based density estimates) of Komodo dragon monitored at 11 sites on 5 islands. There was a considerable difference in relationship between site occupancy parameters and abundance estimates of dragons among sites. Single season site occupancy model provided robust estimates relative to abundance parameters derived from Royle repeated count model. However, single season model parameter estimates were relatively uniform among sites compared to catch per unit effort and mark recapture based density estimates. Hence, whilst many monitoring methods are available for use on Komodo dragons, we suggest that mark recapture based method appear most useful because they are relatively precise and better estimate spatial variation in dragon abundance.

Interpreting and applying home range data: A Case study with black rhinoceros

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Home range ecology features prominently in the management of many species. Wildlife managers sometimes use home range size as a proxy for habitat condition and to determine overall carrying capacity. Hluhluwe-iMfolozi Park (HiP), South Africa, is a strategic donor population for black rhinoceros meta-population management. Some report a 67% increase in range size from 7.55 km² to 23.02 km² as evidence for declines in habitat quality, which they attribute to over-population and use as evidence for increased harvesting. We present home range estimates for the largest cohort of black rhinoceros (n=22) to date fitted with VHF radio-transmitters in HiP. Rhino were regularly located in a random stratified fashion to estimate seasonal [mean wet season: male, 8.16 km² ± 2.37 SE; female, 6.24 km² ± 1.79 SE/ mean dry season: male, 4.20 km² ± 0.63 SE; female, 9.07 km² ± 0.99 SE] and annual home range sizes [male, 8.22 km² ± 0.80 SE; female, 9.35 km² ± 1.25 SE]. Both annual and seasonal home range estimates are over 60% smaller than recent values and similar to estimates to published in the 1960's from the same reserve. The reasons why other contemporary estimates differ so much from ours is a useful reminder of how not to conduct and construct home range studies. Our results also indicate that home range sizes have not changed. Further, we discuss these results in the context of the researcher-management relationship and how over-interpreting poor quality data can mislead the management of a critically endangered species.

The effectiveness of pond draining and its role in the adaptive management of a green and golden bell frog (*Litoria aurea*) population.

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The once common green and golden bell frog (*Litoria aurea*) began to experience large-scale population declines in NSW during the 1970s, and predation of eggs and tadpoles by the introduced mosquito fish (*Gambusia holbrooki*) has been implicated as one of the key causal factors of these ongoing declines. Each year a number of ponds at Sydney Olympic Park are drained prior to the breeding season of *L.aurea* to temporarily remove this invasive fish species. In this study, the relative abundances of tadpoles, metamorphs, juveniles and adult *L.aurea* at ponds which had been recently drained were compared with those of ponds which were not drained, over the past seven years. The results of this research have allowed the effectiveness of draining as a tool to increase breeding success to be evaluated. This process of measuring the outcome of previously implemented actions is a vital part of adaptive management, as it provides a basis for planning the future allocation of resources in a way that will result in the best possible outcome in terms of the conservation of a species.

Some of the data included in the analyses were collected under contract to the Sydney Olympic Park Authority (SOPA). We have the permission of SOPA to analyse and report this data. Contractors were Ecology Partners Pty Ltd for 2006-07 (project managers: Hamer, A. and Organ, A.), and Australian Museum Business Services Consulting for 2003-05 (project managers: Burns, E., McElroy, C., Ryan, B. and Tipping, J.).

Demographic changes of a woylie (*Bettongia penicillata*) population with increasing density in a fenced reserve

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The woylie (*Bettongia penicillata*) has suffered severe decline across populations since 2001. A population at Karakamia Sanctuary in southwest Western Australia has not declined and the density has been increasing since its establishment in 1994. This population exists within a 275 ha fenced reserve which is owned and operated by the Australian Wildlife Conservancy (AWC). To provide information on the impact of high population density, this study investigated changes in demographic parameters between 1995 and 2010. Trapping data was collected each year as part of the fauna monitoring conducted by AWC. We analysed changes in body condition, sex ratio and fecundity as density increased between these years. Home range estimates were also calculated using radio telemetry to provide another estimate of the impact of high density. Preliminary results show as much as a threefold increase in home range size compared with other estimates for the species. This is presumably related to a decrease in resource availability for individuals at high population density. Additional results relating to body condition, sex ratio and fecundity will also be discussed. These results have implications for the persistence of this important population and for the use of fenced reserves for conservation.