Background to key management actions

Undertake strategic revegetation works to improve connectivity

Clearing of native vegetation for agricultural expansion, urbanisation and industrial development has resulted in many deteriorated and fragmented habitats across the landscape. This has had a negative impact on the survival, diversity and abundance of native species and function of ecosystem services.

Revegetation programs should aim not only to increase the area of native habitat but also to re-link isolated, existing remnant vegetation vis connecting corridors. Linking existing patches of vegetation provides shelter for wildlife to move across the landscape. Corridors linking remnant vegetation can potentially also:

- expand the total size of the habitat patch
- increase foraging area
- expand territories of wildlife
- maintain seasonal movements

By connecting isolated patches of remnant vegetation landholders can also create a more permanent and long-term habitat for wildlife, and bring more native species to the farm.

Further reading

Munro, N.T., Lindenmayer, D.B. and Fischer, J. (2007). Faunal response to revegetation in agricultural areas of Australia: A review. *Ecological Management and Restoration.* 8: 199-207.

Office of Environment and Heritage (undated). *Conservation Management Notes; Wildlife on your property.* Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Conservation-management-notes/corridors-connectivity-conservation-management-notes-110657.pdf

Protect and recover riverine/riparian vegetation

Traditional agricultural practices have led to the degradation of many riverine (riparian) zones across Australia, particularly land clearing to support grazing and cropping enterprises, and allowing livestock to freely access aquatic systems for water. Some of the impacts include:

- loss in native vegetation condition
- decline in biodiversity
- weed infestation (due to disturbed soils)
- compacted soils (presence of hard hooved livestock e.g. cattle)
- erosion of stream banks and beds (sediment deposition further downstream)
- increase nutrient load runoff (leading to eutrophication)

Riparian vegetation plays a significant role in the biodiversity, health and function of an aquatic ecosystem (e.g. creek, river or swamp). Riparian vegetation contributes to:

- the function of riverine food webs
- thermal buffering
- the provision of shade (influencing in-stream primary production)
- nutrient and chemical interception, storage and release
- improved bank stability (reducing the risk of erosion)
- the provision of woody debris to the aquatic system as habitat and substrate for fish, invertebrates and algae
- the provision of habitat for native fauna

Landholders can conserve and restore riparian zones by:

- limiting livestock access to riparian zones via strategic grazing (i.e. short grazing periods and long rests between)
- establishing alternative watering points for livestock (e.g. dams or troughs)
- managing weeds (biological, physical or chemical management)
- planting native species endemic to the area
- enabling the recruitment of established native vegetation (fencing off recruitment sites)
- avoiding removal of large woody debris from waterways

Further reading

Roberts, S. (2008). *Riparian vegetation: benefits to landholders and ecosystems in the Goolwa to Wellington Local Action Planning region Eastern Mount Lofty Ranges, South Australia*. Available at: https://data.environment.sa.gov.au/Content/Publications/RiparianVegetationBenefitsLandholdersEcosystems-GoolwaWellingtonLAPRegionEasternMLRSA_2008.pdf

Pusey, B. J., and Arthington, A. H. (2003). Importance of the riparian zone to the conservation and management of freshwater fish: a review. *Marine and freshwater Research*, *54*(1), 1-16.

Palmer, M.A., Bernhardt, E.S., Allan, J. D., Lake, P.S., Alexander, G., Brooks, S., Carr, J., Clayton, S. Dahm, C.N., Follstad Shah, J., Galat, D. L. Loss, S. G., Goodwin, P., Hart, D.D., Hassett, B. Jenkinson, R., Kondolf, G.M., Lave, R., Meyer, J.L., O'Donnell, T.K., Pagano, L. and Sudduth, E. (2005). Standards for ecologically successful river restoration. *Journal of Applied Ecology.* 42: 208-217.

Protect and rehabilitate wetlands (including cessation of fire)

Many wetlands across Australia are degraded as a result of increased water regulation, expansion and intensification of agricultural production, urban development and industrial expansion. The drainage of wetlands has had a significant impact on the native species dependent on wetlands for breeding, shelter, nesting, rearing of young, social interactions and foraging grounds. Wetlands provide a number of ecosystem services and provide habitat for a range of plant and animal species. Wetlands also assist in reducing the impact of floods, absorbing pollutants and improving water quality. Some examples of wetlands include:

- swamps
- lakes
- billabongs
- claypans

Land managers can prevent and restore wetland areas by:

- fencing off sensitive areas, excluding or restricting the area and time in which livestock have access to wetlands
- establishing alternative watering points such as troughs or dams away from wetland areas
- establishing a buffer zone by revegetating an area between the wetland and grazing or cropping land with native species (this may need to be fenced to enable strategic grazing of livestock)

Further reading

Department of the Environment and Energy. (2016). *Wetlands and agriculture*. Available at: https://www.environment.gov.au/water/wetlands/publications/factsheet-wetlands-agriculture

Jansen, A. and Healey, M. (2003). Frog communities and wetland condition: relationships with grazing by domestic livestock along an Australian floodplain river. *Biological Conservation.* 109: 207-291

Use best practice water management (leave more flow in the river)

Urbanisation, industrialisation, mining and agricultural practices in Australia have altered many freshwater ecosystems due to the development of dams, reservoirs, levee's and channels. These developments and practices have resulted in the modification to natural flow regimes of many major rivers and streams, threatening the function and resilience of freshwater ecosystems. As Australia is subject to frequent and sometimes prolonged periods of drought it is essential that water is used efficiently to optimise the amount of environmental water available to aquatic species. Water flow in aquatic ecosystems affects biotic composition, distribution and diversity and has a major influence on the physical habitat of rivers and streams.

Efficiency measures are activities or projects that aim to change water use practices, ultimately saving water and increasing the amount of water available for the environment. In agricultural, industrial and urban settings, examples of projects targeting water efficiency in the Murray-Darling Basin include:

- Upgrading irrigation systems
- Lining water delivery channels
- Installation of water meters
- Productivity improvements in manufacturing or irrigated agriculture
- Managing urban water practices to reduce water use (water restrictions)

Further reading

Walker, K.F. (1985). A review of the ecological effects of river regulation in Australia. *Hydrobiologia.* 125: 111-129.

Kingsford, R.T (2001). Ecological impacts of dams, water diversions and river management on floodplain wetlands in Australia. *Austral Ecology.* 25: 109-127.

Department of Agriculture. (2019). *Murray-Darling Basin policy; Efficiency measures*. Available at: http://www.agriculture.gov.au/water/mdb/policy/efficiency-measures

Reduce grazing pressure from domestic livestock

Native pastures provide a critical forage source for livestock during dry times, or when seasonal conditions are unfavourable for introduced pasture species such as perennial ryegrass (*Lolium perenne*). Overstocking/overgrazing is a major cause of native pasture degradation in Australia. To combat this, it is important that stocking rates match forage availability to manage grazing pressure effectively. It is also advisable to avoid continuous grazing in favour of pulse grazing, so that native pastures are rested.

Managing grazing pressure is vital for the sustainability and resilience of a given pasture. Some general principles that should be considered include the:

- ability of the plant species to withstand drought after defoliation
- risk of soil erosion comparative to groundcover
- opportunity for seedling recruitment and replenishment of the soil seed bank to occur
- increased likelihood of drought tolerance based on pasture species diversity
- impact of overgrazing on pasture species composition and their ability to recover
- benefits of periodic resting (rotational grazing, crash grazing)

Further reading

Department of Primary Industries (undated). *Managing Native Pastures*. Available at: https://www.dpi.nsw.gov.au/agriculture/pastures-and-rangelands/native-pastures/managing-native-pastures

Fence habitat to avoid trampling by livestock

Trampling can cause physical and ecological damage to sensitive areas that include wetlands, rocky outcrop, rivers and creeks, eroded areas, plant populations and rare and unusual ecosystems. Fencing can be used to prevent access of livestock to these areas, either permanently or intermittently. Fencing may be temporary (e.g. electric fencing) or permanent.

Further reading

Lunt, I.D., Eldridge, D.J., Morgan, J.W. and Witts, B. (2007). A framework to predict the effects of livestock grazing and grazing exclusion on conservation values in natural ecosystems in Australia. *Australian Journal of Botany.* 55: 401-415.

Create alternative watering points for livestock

Wetlands and waterways throughout Australia have been exposed to a number of management practices and alterations which in many cases have led to the deterioration of their ecological condition. Allowing livestock unrestricted access to wetlands and riparian zones of waterways has contributed to this deterioration. Some of the ongoing impacts are:

- Overgrazing of selected plant species
- Compaction of soil exacerbated by the hard hooves of domestic livestock (cattle, sheep, horses and goats)
- Weed infestation
- Poor germination of native species
- Increased risk of soil erosion due to lack of groundcover
- Poor water quality on and off-site (runoff)
- Increased salinity issues
- Unbalanced transfer of water through the catchment
- Sediment deposition further downstream can alter water courses and flow

Land managers can significantly reduce these impacts by:

- fencing off sensitive areas, excluding or restricting the area and time in which livestock have access to wetlands and riparian zones
- establishing a buffer zone by revegetating an area between the wetland and grazing or cropping land with native species (this may need to be fenced to prevent browsing by livestock)
- establishing alternative watering points such as troughs or dams away from wetland areas

Further reading

Amy, J. and Robertson, A.I. (2001). Relationships between livestock management and the ecological condition of riparian habitats along an Australian floodplain river. *Journal of Applied Ecology.* 38: 63-75.

Robertson, A.I. and Rowling, R.W. (2000). Effects of livestock on riparian zone vegetation in an Australian dryland river. *River Research and Applications.* 16: 527-541.

Morris, K. and Reich, P. (2013) Understanding the relationship between livestock grazing and wetland condition. Arthur Rylah Institute for Environmental Research Technical Report Series No. 252. Department of Environment and Primary Industry, Heidelberg, Victoria

Water and Rivers Commission. (2000). *Water notes; Livestock management: Watering points and pumps.* Available at: https://www.water.wa.gov.au/ data/assets/pdf_file/0019/3169/11438.pdf

Working with the community to control carp

Carp (*Cyprinus carpioare*) is an abundant invasive fish species, establishing populations in all states and territories of Australia over the past 100 years except the Northern Territory. Carp is highly adaptable and dominate native fish species. In the Murray-Darling Basin it is estimated that carp accounts for 80-90% of the fish biomass in the system. Carp has a significant impact on native fish habitat and out-compete native species for resources. The feeding habits of carp disturbs the muddy sediment of stream beds, increasing the turbidity of the system which reduces the depth at which sunlight can penetrate a waterbody, consequently reducing photosynthetic processes that occur and thus the primary production of the water body. Primary production in a waterbody is essential for food webs within the aquatic ecosystem.

FeralFishScan is a new website and App, freely available to the community. It allows members to record and map feral fish such as carp, sightings which allows authorities to identify feral fish hot-spots across our catchments. Further information can be accessed via: https://www.feralscan.org.au/feralfishscan/

Further reading

Vilizzi , L., Thwaites, L.A., Smith, B.B., Nicol, J.M. and Madden, C.P. (2014). Ecological effects of common carp (*Cyprinus carpio*) in a semi-arid floodplain wetland. *Marine and Freshwater Research*. 65: 802-817.

Fisheries Research and Development Corporation. (2017). *National Carp Control Plan*. Available at: https://www.carp.gov.au/

Invasive Animals Ltd. (2019). *FeralFishScan*. Available at: https://www.feralscan.org.au/feralfishscan/

Working with the community to control European fox

The European Red Fox is an introduced species which is found across 75% of Australia's mainland. Predation by foxes in Australia significantly contributes to native mammal extinctions. Foxes are a threat to various species of birds, mammals, reptiles and amphibians.

The environmental and agricultural costs associated with foxes are estimated to be up to $190 million per annum. Community involvement is necessary for the effective control of foxes in the Australian landscape. FoxScan is a website and App freely available to the public where they can record and map sightings, damage caused, and the control methods used. FoxScan provides information and resources which enables community members to better manage foxes and the problems they cause in their local area.

Landholders can also participate in baiting programs often coordinated with Local Councils as well as Local Land Services in NSW and NRM Regions in Queensland. Coordinated baiting programs are ideal as the aim is to reduce the impact of foxes over a large area and this is more effective when multiple landholders (neighbouring properties) are involved. The most common method of baiting is the use of 1080 which requires a minimum chemical use accreditation at AQF3 or the EPA accredited course delivered by Local Land Services.

Strategic fencing, shooting and trapping are other control methods used to control fox populations. The use of guard animals (Alpacas, Maremmas or Donkeys) and habitat manipulation through non-lethal strategies such as the destruction of dens and harbour (weed infestations, fallen timber and rubbish sites) can deter fox presence.

Further reading

Dickman, C.R. (1996). Impact of exotic generalist predators on the native fauna of Australia. *Wildlife Biology*. 2: 185-195.

Agriculture Victoria. (2017). *Red Fox*. Available at: http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-animals/a-z-of-pest-animals/red-fox

Department of Primary Industries. (*n.a.*). *Fox control*. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/foxes/fox-control

Invasive Animals Ltd. (2019). *Fox Scan*. Available at: https://www.feralscan.org.au/foxscan/default.aspx

Working with the community to control feral cat

Community involvement is critical for the management of feral cats in the Australian landscape as they present a significant challenge for the conservation of Australian fauna. A feral cat has the ability to survive in the wild without human reliance or contact. It is estimated that there are between 2 million and 6 million feral cats throughout Australia.

Feral cats are the leading cause of mammal extinctions in Australia, having approximately twice the impact of foxes. They have directly contributed to the extinction of 20 Australian mammals and are putting pressure on another 124 species which are at risk of extinction.

It is estimated that every year feral cats are responsible for killing:

- 316 million birds
- 596 million reptiles

Feral cats also spread diseases that can affect both humans and livestock.

Feral Cat Scan is a website and App, that can be used by members of the community to record sightings and impacts caused by feral cats in their local area. The site enables a detailed map to be produced depicting the feral cat problems in a local area; informs local authorities of current problems; and creates a local community action group. This information assists in the development of practical and humane solutions to manage feral cats and reduce their impacts on Australian fauna within the local area.

Further information can be accessed via: https://www.feralscan.org.au/feralcatscan/default.aspx

Further reading

Jones, E. and Coman, B.J.(1981). Ecology of the Feral Cat, *Felis catus* (L.), in South-Eastern Australia I. Diet. *Wildlife Research.* 8: 537-547.

Department of the Environment and Energy. (2017). *Tackling Feral Cats and their impacts – Frequently asked questions.* Available at: https://www.environment.gov.au/system/files/resources/bb591b82-1699-4660-8e75-6f5612b21d5f/files/factsheet-tackling-feral-cats-and-their-impacts-faqs.pdf

Australian wildlife Conservancy (undated). *Feral Cat and Fox Control*. Available at: https://www.australianwildlife.org/our-work/feral-cat-and-fox-control/

Working with the community to control wild pig

Feral pigs were introduced to Australia for domestic purposes (meat) and are classified as an invasive species. They have a severe impact on ecosystems and typically favour wetland, floodplain and watercourse environments. Feral pigs are identified as a pest species because they:

- prey on native animals such as frogs, reptiles, birds and small mammals
- eat native plants; overgrazing on specific plant communities
- increase the competition for resources (outcompete native fauna)
- trample areas damaging native vegetation and causing soil compaction
- dig for food causing soil erosion particularly in wetter environments (drainage lines, swamps, lagoons or after rain)
- wallow in dams, waterholes and other swampy areas contaminating water sources
- can destabilise stream banks by creating drainage channels in swamps
- spread diseases; they can carry endemic diseases such as leptospirosis, brucellosis and melioidosis
- spread weeds
- damage fences, eat and damage grain crops and pasture and can also prey on new-born lambs

Integrated management involves utilising a number of methods to effectively control the feral pig populations, these strategies may include:

- fencing off valuable environmental or agricultural areas- fences need to be continuously maintained to sustain their effectiveness
- aerial shooting- effective for the initial knockdown of numbers and in areas that are inaccessible from the ground.
- ground shooting- an opportunistic method used to follow-up and maintain numbers after the initial knockdown program has finished.
- trapping- used as an effective follow-up and maintenance technique after the initial knockdown program to prevent numbers from rapidly building up again.
- baiting- 1080 can be an effective method especially if green feed and other food sources are scarce. 1080 application requires a minimum chemical use accreditation at AQF3, or the EPA accredited course delivered by Local Land Services.

FeralPigScan is a website and App freely available to the community. It allows community members to record and map sightings, damage and control activities of feral pigs in their local area. This information can allow a coordinated large- scale approach to controlling feral pig populations effectively. Further information can be accessed via: https://www.feralscan.org.au/feralpigscan/

Further reading

Office of Environment and Heritage. (2019). *Predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*. Available at: https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2004-2007/Predation-habitat-degradation-disease-transmission-by-feral-pigs-key-threatening-process-listing

Department of Primary Industries. (*n.a.*) *Feral pig control*. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/feral-pigs/feral-pig-control

Working with the community to control rabbit

The European rabbit was first introduced to Australia as domestic livestock with European settlement. The accidental and intentional release of rabbits into the landscape has resulted in them inhabiting approximately 70% of mainland Australia, causing serious environmental degradation. Rabbit populations impact 75 commonwealth listed threatened plant species and five TECs. The presence of rabbits in the environment impacts the following:

- reduced regeneration of native plants due to overgrazing and ringbarking of saplings
- native fauna due to increased competition for resources
- soil erosion as a result of overgrazing and lack of groundcover
- damage to historic and cultural sites (undermining, soil erosion etc)
- spread parasites (ticks)
- native fauna populations as rabbits attract other pest animals such as feral cats, dogs and foxes which prey on rabbits and native animals

Due to the extensive area over which rabbits occur, coordinated community programs are a necessary approach to the effective management of the species. RabbitScan is a website and App freely available to community members to record and map rabbit activity, warrens, damage, and management activities within their local area. Further information can be accessed via: https://www.feralscan.org.au/rabbitscan/

Landholders can also implement management practices such as:

- warren-ripping
- trapping
- shooting
- poisoning, using Pindone or 1080 requires a minimum chemical use accreditation at AQF3, or (for example in NSW) the EPA-accredited course delivered by Local Land Services.
- erecting rabbit-proof fences to exclude them from sensitive areas (this method may have negative implications on the movement of native species across the landscape)

Department of Primary Industries. (*n.a.*). *Rabbit biology and distribution*. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-biology

Office of Environment and Heritage. (2018). *Rabbits*. Available at: https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/rabbits

Invasive Animals Ltd. (2019). *Rabbit Scan*. Available at: https://www.feralscan.org.au/rabbitscan/

Working with the community to control goat

Goats were introduced to Australia for their meat, hair and milk during European settlement and are now found across 28% of Australia with a population of at least 2.6 million. Feral goats have a major impact on native vegetation including herbs, shrubs and trees. Overgrazing and soil compaction prevents the regeneration of native plant species leaving the soil exposed and at risk of erosion. The lack of regeneration of native plant species also reduces habitat for native fauna. Feral goats can foul waterholes, introduce weeds to new environments by depositing seeds with their dung, and infect domestic sheep with diseases such as footrot.

A 'Threat abatement plan for competition and land degradation by unmanaged goats' has been developed providing a national framework that promotes the best use of available resources for feral goat management. Management of feral goats by landholders is most effective when neighbouring properties work collectively to manage the pests. Coordinated management programs can be established through community meetings, local Landcare groups or through Local Land Services (NSW) or Region NRM groups (QLD). FeralGoatScan is a website and App which enables community members to identify and map goat sightings/populations, damage and control methods used by others within their local area. This provides information and resources to community members allowing them to better manage feral goats and the problems they cause in their local area. Further information can be accessed via: https://www.feralscan.org.au/feralgoatscan/

Further reading

Parkes, J., Henzell, R. and Pickles, G. (1996). *Managing Vertebrate Pests: Feral Gouts*. Australian Government Publishing Service, Canberra.

Department of Sustainability, Environment, Water, Population and Communities. (2011). *The Feral Goat (Capra hircus)*. Available at: https://www.environment.gov.au/system/files/resources/0b78ac9f-c442-4fe1-9f96-8205f505a4c8/files/feral-goat.pdf

Invasive Animals Ltd. (2019). *Feral Goat Scan*. Available at: https://www.feralscan.org.au/feralgoatscan/

Working with the community to control wild dog

In NSW the term wild dog refers to dingoes, feral domestic dogs and hybrids of the two. Wild dogs are prevalent throughout Australia, within the eastern ranges, coastal hinterland and tablelands of NSW having the highest populations. Wild dogs pose a significant threat to livestock industries such as sheep, cattle, goats and poultry due to predation and spread of disease, costing the Australian economy $66 million per annum. The sheep industry has been greatly affected by the predation of wild dogs, although attacks on calves and older cattle are also common.

The predation on native species varies depending on the area however, wild dogs can have negative impacts on some threatened species. Koalas are vulnerable to wild dog attacks and this combined with habitat fragmentation is a

significant contributor to potential localised extinctions.

Wild dogs have extensive home ranges which overlap with other wild dogs to a degree and may range in size from 400 to 100,000 ha. In eastern NSW home ranges average about 4,000 ha and up to 90,000 ha in dry western regions. The large areas that wild dogs cover require coordinated community programs to achieve effective and continual management. Landholders can carry out trapping, shooting and baiting methods, these are most effective when implemented across neighbouring properties. Local Land Services can be contacted to arrange management programs and attain accreditation for the use of 1080 baits as a control method.

WildDogScan is website and App freely available to community members. It allows members to record and map wild dog sightings, problems and control methods used in their local area. WildDogScan can also be used to inform neighbours and local biosecurity authorities of wild dog activity and identify priority areas for control. Further information can be accessed via: https://www.feralscan.org.au/wilddogscan/

Further reading

Australian Wool Innovation Ltd. (2019). *Wild dogs, Foxes and Pigs*. Available at: https://www.wool.com/on-farm-research-and-development/sheep-health-welfare-and-productivity/pest-animals/wild-dogs-foxes-and-pigs/

Department of Primary Industries. (*n.a.*). *Wild dog control*. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/wild-dogs/wild-dog-control

Department of Primary Industries. (*n.a.*). *Wild dog biology and distribution*. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/wild-dogs/wild-dog-biology

Working with the community to control cane toad

Cane Toads were introduced to Australia in 1935 and released in Northern Queensland as a biological control measure for the cane beetle which was responsible for damaging sugarcane crops. It was later found that the toads were inefficient controllers of the beetle and their presence as a highly invasive pest species was soon realised. Cane toads have migrated rapidly from their point of introduction, heading west and south across the country. The International Union for the Conservation of Nature and the Global Invasive Species Programme have identified cane toads as one of the worlds 100 worst invasive species. Due to their poisonous glands, they present a significant threat to native and domestic animals (cats and dogs). Larger toads have been found to have a higher toxin level than smaller toads and are more lethal if consumed. Due to the difference in toxicity, native animals that prey on smaller amphibians have been unaffected when eating smaller toads and have learnt to avoid them. Consequently, native species that target larger prey are exposed to a lethal dose when feeding on older and larger toads.

Due to the abundance of toads in affected areas it is important that community programs to control cane toads are developed. Controlling cane toad numbers humanely in small areas such as along local creeks or ponds is possible. However, it is imperative that participants know how to accurately identify the species as to not confuse them with native frogs/toads. Control is achieved best at the egg or adult stage as these are more easily identifiable. There are a number of community-based programs running presently aimed at identifying, controlling and monitoring toad numbers. ToadScan is a community website and App that allows members to record and map sightings of cane toads, the problems they cause and control activities available in their local area. Further information can be accessed via: https://www.feralscan.org.au/toadscan/pagecontent.aspx?page=toad_impactanoverview.

Further reading

Shine, R. (2010). The Ecological Impact of Invasive Cane Toads (*Bufo Marinus*) in Australia. *The Quarterly Review of Biology*. 85: 253-291

Department of the Environment and Energy. (2010). *The cane toad (Bufo marinus) – fact sheet*. Available at: https://www.environment.gov.au/biodiversity/invasive-species/publications/factsheet-cane-toad-bufo-marinus

Invasive Animals Ltd. (2019). *Toad Scan*. Available at: https://www.feralscan.org.au/toadscan/pagecontent.aspx?page=toad_impactanoverview

Working with the community on Noisy Miner control

The Noisy Miner (*Manorina melanocephala*), is a native species of honeyeater that lives in large colonies and is found throughout eastern Australia ranging from far north Queensland to Tasmania. The species defends habitat aggressively, working cooperatively to attack, chase and expel other smaller, native bird species. Larger native species are not likely to be driven out of the area however they can still be harassed by the species. A study by Thomson et al. (2015) found that the richness and abundance of smaller native bird species where noisy miners were

present was 50% less than in those areas where the species was absent.

Noisy miners thrive in fragmented open structure woodland habitats, with a high edge:interior ratio. As they are a native species their management is only necessary under particular circumstances. However, revegetating habitat areas with shrubs and building up the understory of fragmented woodlands has been suggested to reduce the impact of noisy miners on smaller avian species. Providing educational community workshops on why and how noisy miners can be deterred is a necessary measure for the effective management of the species.

Further reading

Thomson, J. R., Maron, M., Grey, M. J., Catterall, C. P., Major, R. E., Oliver, D. L., ... and Robinson, D. (2015). Avifaunal disarray: quantifying models of the occurrence and ecological effects of a despotic bird species. *Diversity and Distributions*. 21: 451-464.

Department of the Environment and Energy. (2014). *Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (Manorina melanocephala)*. Available at: http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes/overabundant-noisy-miners

Aquatic weed control

Introduced aquatic plant species used in gardening and aquarium industries have become weeds in NSW waterways primarily a result of human activity. Aquatic weeds predominantly impact waterways on the east coast with many western flowing systems free of major weed infestation.

Recreational activities such as boating, and fishing contribute to the spread of aquatic weeds from an infested waterway to a weed-free waterway. For some aquatic weed species to establish in a new area it only requires a small fragment of the plant to be introduced into the new environment. Examples of how weed fragments may be introduced into a new environment include being:

- caught up in the propeller of a boat engine
- attached to the anchor
- attached to the boat and/or trailer
- caught up in fishing gear

Aquatic weeds can present a number of challenges in natural waterways including:

- altering dissolved oxygen levels and reducing water quality
- out-competing native aquatic plant species for resources
- replacing native aquatic plant species, reducing habitat for native animals
- restricting navigation and recreational activities on waterways
- posing hazards for livestock and recreational swimmers (drowning)
- toxicity to livestock

Community involvement is essential for the identification, management and monitoring of aquatic weeds. There is a NSW state-wide fund specifically targeting the management of aquatic weeds which: assists in delivering community education, awareness and extension programs; provides technical support to key stakeholders; and coordinates state strategies for high priority aquatic weeds. Members of the community can actively protect our waterways from the introduction and spread of aquatic weeds by:

- preventing ‘hitchhikers’, thoroughly inspecting and removing plant fragments from watercraft, trailers and equipment before leaving a site or entering a new site.
- not accessing infested waterbodies
- avoiding running boat motors through weeds beds
- preventing accidental pond escapees by screening outdoor ponds to prevent overflow during heavy rain.
- sourcing native aquatic plants for ponds
- not dumping pond plants in the green waste or local water ways (thoroughly dry specimens, disposing them in a sealed bag)

Further reading

Department of Primary Industries. (*n.a.*). *Water weeds in NSW*. Available at: https://www.dpi.nsw.gov.au/biosecurity/weeds/weed-categories/water-weeds/water-weeds

Retain/supplement in-stream habitat

The importance of large, woody, in-stream debris (large submerged or partly submerged logs) has not been well recognised in the past, with dead wood historically removed from streams to improve boat navigation, agricultural drainage and flood mitigation. The role of in-stream woody debris is now well recognised for the role it plays in the function and ecological health of rivers. In-stream woody habitat influences a number of processes including:

- flow hydraulics
- channel habitat units (pools, riffles and waterfalls)
- movement of sediment and organic matter
- primary production
- provision of habitat for invertebrate and fish species

River-health restoration projects now promote activities that increase in-stream woody habitats, encouraging natural geomorphic processes and an increase in diversity and abundance of aquatic organisms. Landholders can increase wood loads by re-establishing riparian vegetation, providing a natural source for in-stream woody habitats or by directly placing wood in the stream.

The Soil Conservation Service is a unit of Local Land Services and offer a range of river restoration services including in-stream woody habitat design, implementation and monitoring. The Soil Conservation Service can be contacted via: https://www.scs.nsw.gov.au/project-management/river-works.

Further reading

Erskine, W.D. and Webb, A.A. (2—3). Desnagging to resnagging: new directions in river rehabilitation in south-eastern Australia. *River Research and Applications.* 19: 233-249.

Kitchingman, A., Tonkin, Z., Ayres, R. M., Lyon, J., Stout, J. C., Rutherfurd, I. D. and Wilson, P. (2016). Predicting natural instream woody-habitat loads across large river networks. *Marine and Freshwater Research*. 67: 1844-1852.

Identify and impose non-fishing zones along major rivers/streams

Native fish species are susceptible to a range of anthropogenic threats both directly and to their habitats. Such threats include; habitat destruction through the removal of woody debris from rivers acting as nurseries and shelter; over-fishing, particularly of larger species e.g. Trout Cod (*Maccullochella macquariensis)*; and competition and predation as a result of introduced species. Fish populations of the Murray-Darling Basin are estimated to be at approximately 10% of their pre-European levels and of 44 native fish species found in the Basin, 24 are considered threatened at a regional, state or national level. Establishing non-fishing zones or sanctuary zones along major rivers would assist in habitat restoration and refuge for native species.

Further reading

Koehn, J. D., Lintermans, M., Lyon, J. P., Ingram, B. A., Gilligan, D. M., Todd, C. R., and Douglas, J. W. (2013). Recovery of the endangered trout cod, Maccullochella macquariensis: what have we achieved in more than 25 years?. *Marine and Freshwater Research*, *64*(9), 822-837.

Avoid use of sweep nets

The use of large nets in rivers and creeks can result in the capture of non-targeted by catch such as non-target fish species, freshwater turtles, diving birds, water rats and platypus. Abandoned fishing nets can also result in the entanglement and mortality of these species and other aquatic organisms. Discarded fishing nets also pose a risk to recreational swimmers and may cause damage to watercraft. Avoid their use, or if using them ensure the nets are removed afterwards. Remove old netting from rivers and streams if possible.

Further reading

Grant, T. R., Lowry, M. B., Pease, B., Walford, T. R. and Graham, K. (2004). Reducing the by-catch of platypuses (*Ornithorhynchus anatinus*) in commercial and recreational fishing gear in New South Wales. In *Proceedings of the Linnean Society of New South Wales* (Vol. 125, p. 259). Linnean Society of New South Wales.

Retain native grassland and understorey shrubs

Remnants of natural native grasslands and grassy woodlands are some of the most threatened ecosystems in Australia. Native tussock grasslands once covered a large area of Australia and were dominated by native tussock-forming grasses combined with a mix of forbs and few shrubs. Dominant tussock species include:

- Bluegrass (*Dichanthium sericeum*)
- Kangaroo grass (*Themeda triandra*)
- Spear grass (*Austrostipa scabra*)
- Wallaby grass (*Rytidosperma spp*.)
- Plains grass (*Austrostipa aristiglumis*)
- Windmill grass (*Chloris truncata*)
- Mitchell grass (*Astrebla lappacea*)

Native grasslands are dynamic ecosystems and the mixture of species can vary over short distances and with seasonal changes. Native grasslands and shrubs provide nesting sites, foraging grounds and shelter for many birds, reptiles, carnivorous marsupials and insects.

Rainfall, temperature, soil composition and site history influence the variation of species within a native grassland. Many native grasslands have been subjected to overgrazing, soil compaction, fertiliser application and competition with introduced pasture species.

Landholders can preserve and restore native grasslands and shrubs by:

- excluding stock or minimising stock access especially during flowering and seed set
- encouraging regeneration of native, perennial grasses and forbs by managing weeds and implementing cool burns (low intensity and fast moving)
- restoring and re-connecting native grasslands by revegetating areas with native and endemic species
- retaining fallen timber as habitat for ground-dwelling species

Further reading

Department of Sustainability, Environment, Water, Population and Communities (2012). *Nationally Threatened Ecological Communities Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, and Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin.* Available at: http://www.environment.gov.au/system/files/resources/347c5d4e-cef8-411c-b53c-bed3ed1d3e1c/files/bio237-0512-natural-grasslands-guide.pdf

Local Land Services Central West (2016). *Recognising habitat features – A guide to identifying habitat on your property*. Available at:
https://centralwest.lls.nsw.gov.au/ data/assets/pdf_file/0010/737416/LLS_RecognisingHabitatFeatures_LR.pdf

Retain exfoliating and sub-surface rocks

Disturbance to rocky outcrops occurs via practices such as land clearing for development and agriculture, introduction of livestock to rocky outcrop habitats, significantly reduced fire regimes and the introduction of invasive flora and fauna. Conserving rocky outcrops and maintaining connection between them is important as they provide habitat for a broad range of endemic and highly specialised taxa, including plants, mammals and reptiles.

Further reading

Michael, D. R., Cunningham, R. B. and Lindenmayer, D. B. (2008). A forgotten habitat? Granite inselbergs conserve reptile diversity in fragmented agricultural landscapes. *Journal of Applied Ecology*. 45:1742-1752.

Michael, D. R., Lindenmayer, D. B. and Cunningham, R. B. (2010). Managing rock outcrops to improve biodiversity conservation in Australian agricultural landscapes. *Ecological Management and Restoration*. 11: 43-50.

Retain paddock trees and encourage natural regeneration beneath them

Retention of large paddock trees is important as they act as stepping stones for animals to move across fragmented landscapes. Large, older trees are also likely to have hollows which provides important habitat for more many species of vertebrate fauna. Due to land clearing and the extensive time in which it takes for sizeable hollows to form, their

abundance has declined and this impacts the survival of species that depend on hollows for breeding, nesting, rearing of young and shelter.

Clumps of trees assist in the movement of species across the landscape providing shelter, foraging grounds and allowing social interactions to occur. Remnant vegetation is critical for supporting native species, and maintaining the biodiversity, function and health of an ecosystem. Preserving patches of vegetation and implementing restoration projects can assist in the long-term movement of native species across the landscape.

Further reading

Bennett, A. F. (2016). Eucalypts, wildlife and nature conservation: from individual trees to landscape patterns. *Proceedings of the Royal Society of Victoria*. 128: 71-86.

Doerr, V.A.J., Doerr, E.D. and Davies, M.J. (2010). *Does structural connectivity facilitate dispersal of native species in Australia's fragmented terrestrial landscapes?* CEE review 08-007 (SR44). Collaboration for Environmental Evidence. Available at: https://www.environmentalevidence.org/wp-content/uploads/2014/07/SR44.pdf

Protect hollow-bearing trees

Land management practices have led to a decline in hollow-bearing trees across the landscape, with some hollow-bearing trees persisting as isolated mature individuals in paddocks or in small fragmented vegetation remnants.

It is important to retain hollow-bearing trees (including dead standing trees) as they take a long time to establish and they provide a critical habitat (shelter and nesting sites) for many terrestrial species. Many species of mammal, bird, reptile and frog depend on hollow-bearing trees for survival in NSW, and many of these are iconic or threatened.

The formation of hollows is more prevalent in tree species belonging to the Myrtaceous family, particularly Eucalypts. As there is a positive correlation between the age of a tree and the presence, abundance and size of the hollow, older and more mature trees have hollows with greater internal dimensions. Large, mature trees with larger hollows are rarely less than 220 years old. It is therefore vital that hollow bearing trees are retained due to the extensive period of time required for the formation of a hollow.

Further reading

Office of Environment and Heritage. (2019). *Loss of hollow-bearing trees – key threatening process listing*. Available at: https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2004-2007/Loss-of-Hollow-bearing-Trees-key-threatening-process-listing

Retain fallen logs

Many agricultural landscapes have been cleared of fallen timber to improve ease of access for machinery, increase the area available for productivity, and as a fire mitigation strategy. Large fallen logs provide habitat for a range of fauna including mammals, reptiles, amphibians and some bird species. Large logs that contain hollows are of particular importance as they provide cool shelter and a suitable environment for breeding, nesting and rearing young. Hollow logs can also provide protection for fauna in the event of a low intensity fire or sub-zero wind chill.

Farmers can retain large logs especially those with hollows in paddocks or relocate them to a wildlife refuge or corridor on their property. Areas fenced off or designated as wildlife corridors should retain large logs as habitat for native fauna. Travelling Stock Routes (TSRs) should also retain large logs for habitat.

MacNally, R., Parkinson, A., Horrocks, G. and Young, M. (2002). Current Loads of Coarse Woody Debris on South-eastern Australian Floodplains: Evaluation of Change and Implications for Restoration. *Restoration Ecology.*10:627-635.

Collins, L., Bradstock, R. A., Tasker, E. M., and Whelan, R. J. (2012). Impact of fire regimes, logging and topography on hollows in fallen logs in eucalypt forest of south eastern Australia. *Biological Conservation*. 149: 23-31.

Local Land Services Central West. (2016). *Recognising habitat features – A guide to identifying habitat on your property*. Available at:
https://centralwest.lls.nsw.gov.au/ data/assets/pdf_file/0010/737416/LLS_RecognisingHabitatFeatures_LR.pdf

Retain stick and leaf litter

A number of species rely on fallen stick and leaf litter for a range of habitat functions. Plant debris creates food and shelter for insects which provide a food source for insect-eaters like antechinus, echidnas and some bird species. The decomposition of plant debris by organisms such as cockroaches, worms and termites deliver important nutrients to the soil and improves soil properties such as structure and water retention. Stick and leaf litter also provides materials for nest building species.

Landholders can preserve and restore stick and leaf litter habitats by:

- excluding stock or minimising stock access to selected habitat areas especially around known breeding sites for ground-dwelling species
- retaining plant debris (sticks, logs and leaf litter)
- avoiding collecting firewood
- managing hazard reduction burns carefully; cool burns (low intensity and fast moving)
- controlling predators (cats, foxes, pigs and wild dogs) to allow ground-dwelling species to return
- encouraging regeneration of native plant species
- revegetating around existing remnants and aim to re-connect existing remnants

Further reading

Local Land Services Central West. (2016). *Recognising habitat features – A guide to identifying habitat on your property*. Available at:
https://centralwest.lls.nsw.gov.au/_data/assets/pdf_file/0010/737416/LLS_RecognisingHabitatFeatures_LR.pdf

Maintain *Triodia* species (spinifex or porcupine grass)

The *Triodia* genera (commonly known as Spinifex or Porcupine grass) is a dominant component of Australian hummock grasslands which cover more than 18% of the mainland. *Triodia spp.* create an ecologically important grassland habitat for native species such as small mammals, reptiles and birds. Its spiky character provides a refuge from the predation of introduced species (e.g. cats and foxes). It also provide an effective groundcover in semi-arid areas, improving the structural stability of soil and reducing the risk of erosion due to the its extensive root system. *Triodia spp*. have good drought tolerance, persisting in harsh environments and providing refuge habitat during dry times.

Further reading

Department of Primary Industries and Regional Development, Western Australia. (2018). *Soft spinifexes*. Available at:
https://www.agric.wa.gov.au/rangelands/soft-spinifexes

Australian National Herbarium. (2016). *Triodia scariosa; Porcupine Grass*. Available at:
https://www.anbg.gov.au/gnp/interns-2015/triodia-scariosa.html

Protect known roost sites

Habitat loss due to urbanisation, agricultural and industry practices, changes to local climates and predation are threatening waterbird and flying-fox populations.

Flying-Foxes

On Australia's mainland there are four species of flying-foxes (Black flying-fox (*Pteropus alecto*), Grey-headed flying-fox (*P. poliocephalus*), Little Red Flying-fox (*P. scapulatus*) and Spectacled Flying-fox (*P. conspicillatus*)). The Grey-headed and Spectacled Flying-foxes are listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. Occupancy of roosting sites varies throughout the year with their movement patterns largely influenced by irregular and ephemeral resource availability. Individuals may travel up to 50 km to forage for fruit and nectar at night, congregating in roost sites during the day. Their numbers at roosting sites may vary from a couple or no flying-foxes to tens or hundreds of thousands depending on the availability of resources. Roosting sites are critical for social interaction and breeding of flying-foxes with conception, birth and lactation all occurring at a particular site.

Waterbirds

Waterbird populations, particularly migratory species, are declining. Increased human disturbance and changes in

land use such as agriculture practices, industrial expansion and urbanisation of coastal areas has resulted in the deterioration

of wetland habitats. Wetlands are important habitat sites for waterbirds and are used for feeding, nesting, breeding and moulting. Wetlands also provide protection from introduced predators such as cats and foxes which are also threatening the survival of waterbird species.

Any roost site within the cotton farm should be protected by creating a vegetated buffer around it, and by avoiding disruption (e.g. through constant movement of farm traffic).

Further reading

Currey, K., Kendal, D., Van Der Ree, R., and Lentini, P. (2018). Land manager perspectives on conflict mitigation strategies for urban flying-fox camps. *Diversity*, *10*: 39.

Department of Environment and Science, Queensland. (2012). *Shorebirds and other waterbirds, WetlandInfo*. Retrieved from https://wetlandinfo.des.qld.gov.au/wetlands/resources/education/water-birds.html

Protect raptor nest sites

Habitat loss, habitat alteration, fragmentation and direct intervention are major threats to raptor species, impacting the feeding, social interaction and breeding aspects of raptors.

Raptors are very selective when choosing a nesting site to build their large stick nests, which can be up to 2.0 metres across. An example is the White-bellied Sea Eagle, a migratory species that builds a large stick nest in a tall trees located in close proximity to a suitable feeding habitat (rivers, lakes and ocean).

It is important to protect and monitor these nesting sites as raptors will often return to the same nest over many breeding seasons. The assemblage of a stick nest is time consuming and requires specific conditions such as:

- location
- tree species, height and condition
- proximity to feeding areas
- adjoining vegetation for nest security, roosting ad perching of adult birds and fledglings
- adjoining vegetation for the collection of nesting materials

Further reading

Department of Environment and Conservation, NSW. (2004). *North East New South Wales – Raptor and Water Birds; nest trees*. Available at:
https://www.environment.nsw.gov.au/resources/nature/landholderNotes06RaptorsWaterBirds.pdf

Protect termite mounds

Termites may nest under the ground, in decaying logs, living trees or in above ground mounds. Termite mounds provide an important food resource and a place of refuge for small vertebrate species during bushfires or times of localised flood events. The internal temperature of termite mounds is cooler than the ambient temperature during the hottest part of the day and warmer during the coldest part of the day. The mounds therefore provide a thermal environment which modifies external extremes providing a suitable environment for diurnal animals to escape the heat of the day and nesting sites for birds and reptiles.

The extinct Paradise Parrot was an example of a species that was entirely dependent on termite mounds, excavating into them to build their nests. This species is now believed extinct as a result of widescale removal of termite mounds and introduction of foxes. Other species that routinely use termite mounds include Short-beaked Echidna and various reptiles and small mammal species. These mounds are an important structural and functional part of woodland systems and should be retained and protected where ever possible.

Further reading

Thompson, G. G., and Thompson, S. A. (2015). Termitaria are an important refuge for reptiles in the Pilbara of Western Australia. *Pacific Conservation Biology*. 21: 226-233.

Minimise use of synthetic chemicals

Pesticides include a number of chemicals designed to control insects or herbicides to control weeds. Non-chemical solutions should always be considered by landholders as the preferred option to pesticide use, although this is often not possible for large operations. Where pesticides are used to control unwanted species, they should be avoided near riparian zones which are important for the healthy function of aquatic ecosystems providing habitat for native wildlife. Aquatic ecosystems are very sensitive to pesticide pollution which can harm non-target, native plant species, invertebrates, amphibians and fish. Contaminated water bodies also present a significant health risk to people who may use bore water for domestic purposes or if contaminants flow on to pollute reservoirs. Pesticides can move into a waterbody due to runoff, spray drift, accidental spills and by the improper disposal of chemical drums.

The application of pesticides on windy days should be avoided as spray drift can occur. Spray drift is the airborne movement of chemicals in the form of droplets, particles (fine dust) or vapour away from the target area. Spray drift can harm non-target organisms and ecosystems such as waterbodies and riparian zones as well as potentially having an impact on human health. To prevent contaminating non-target areas, application instructions printed on the label of any given pesticide should be followed.

Further reading

Devine, G.J and Furlong, M.J. (2007). Insecticide use: Contexts and ecological consequence. *Agriculture and Human Values*. 24: 281-306.

Department of Primary Industries. (2016). *Legal responsibilities in applying pesticides*. Available at: https://www.dpi.nsw.gov.au/ data/assets/pdf_file/0009/186390/legal-responsibilities-in-applying-pesticides-F.pdf

Environment Protection Authority, South Australia. (2017). *Safe and Effective Herbicide Use: A handbook for near-water applications.*

Responsible use of baits to control rodents, foxes and wild dogs

Production losses from vertebrate pests (rabbits, foxes, wild dogs and feral pigs) in Australia and cost of control to reduce these impacts is estimated at more than $500 million per annum. It is, therefore, necessary that baiting programs are continued throughout Australia. To ensure this, the application of baits must be carried out in accordance with label specifications and best practice. Pindone and 1080 are the two major types of baits used in Australia for the control of rodents, rabbits and wild dogs. These products are restricted pesticides due to the risk they pose to the environment, wildlife and domestic animals and users must be trained in the correct use of 1080 and Pindone. 1080 application requires a minimum chemical use accreditation at AQF3, or in NSW the EPA accredited course delivered by Local Land Services.

McIlroy, J. (1992). The effect on Australian animals of 1080-poisoning campaigns. *Proc. Vertebr. Pest Conf.* 15:356-359.

Department of Agriculture and Food. (2016). *1080 – Characteristics and use*. Available at: https://www.agric.wa.gov.au/sites/gateway/files/1080%20characteristics%20of%20use%20PDF.pdf

Environment Protection Authority. (2019). *Guidance for using 1080*. Available at: https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders/guidance-for-using-1080

Avoid fencing that restricts movement of native species

Fences serve a number of benefits in rural areas. They identify legal boundaries, restrict stock movement and create landholder access routes within properties. However, inappropriately designed fences can have negative implications on the movement, feeding, breeding and social patterns of large native fauna such as Kangaroos and Emus. The mortality of kangaroos and emus as a result of entanglement in fence wires (particularly barbed wire fences) and their exclusion from food and water sources present a serious animal welfare issue. Barbed wire fences pose a greater risk to wildlife entanglement when they are:

- Newly constructed
- Constructed on ridgelines
- Constructed along crossings or near surrounding waterways and dams
- Higher than the surrounding vegetation
- Poorly visible
- Have barbs on the top wire

Younger and older animals have a greater risk of injury/mortality.

There are options to traditional fencing techniques that landholders can implement to reduce the mortality of large native animals and allow for greater connectivity and movement of these species across the landscape. Such techniques include:

- Replacing the top strand of barbed wire with plain or white plastic coated (borderline) wire.
- Covering the top strand of barb in poly-pipe along areas where there is high movement of native animals e.g. near dams, ridgelines, waterways.
- Increase the visibility of the top two strands by attaching reflective materials such as metal tags or old compact discs (CDs).
- Allow enough space underneath the lowest wire to enable movement of large native animals. 50 cm is the recommended height.

Further reading

Bradby, K., Fitzsimons, J. A., Del Marco, A., Driscoll, D. A., Ritchie, E. G., Lau, J., ... & Hobbs, R. J. (2014). Ecological connectivity or Barrier Fence? Critical choices on the agricultural margins of Western Australia. *Ecological Management & Restoration*, *15*(3), 180-190.

Land for Wildlife Queensland. (2011). *Wildlife Friendly Fencing and Netting*. Available at: https://www.lfwseq.org.au/wp-content/uploads/2016/11/LFW-Note-2016_G4.pdf

Defensive driving to reduce loss of wildlife on country roads

Roadkill contributes to the death of approximately 4 million Australian mammals every year and orders of magnitude more birds, reptiles and frogs. Kangaroos and wallabies are at most risk as they are predominantly active at dawn and dusk and feed along roadsides which often have flushes of fresh grass as a result of water run-off from roads.

Drivers can reduce their chance of colliding with wildlife on Australian roads by:

- Identifying roadkill hotspots along their regular route. This allows drivers to pre-empt the increase likelihood of wildlife on particular stretch of road
- Be aware of wildlife during dusk and dawn, as these are active time periods for many animals and slow down to avoid collision
- Slow down to increase your reaction time when road visibility is poor e.g. in fog or rain
- If safe and possible to do so, remove dead wildlife from the road to reduce the attraction of scavengers such as quolls and birds of prey
- Drive to suit the conditions in order to avoid a potential collision with an animal, honk your horn to scare the animal off the road
- Slow down when coming to a crest in the road and along roads that have steep banks, ditches or other barriers (bridge) which can trap wildlife on the road

Australians have become desensitised to roadkill despite the level suffering of many animals each night. A respect for native wildlife and a slowing down by 10 km/h in high-risk areas and at high-risk times of the day/night (i.e. defensive driving) would significantly reduce the number of collisions with native wildlife.

Further reading

Lunney, D. (2013). Wildlife roadkill: illuminating and overcoming a blind spot in public perception. *Pacific Conservation Biology*. 19: 233-249

Englefield, B., Starling, M., & McGreevy, P. (2018). A review of roadkill rescue: who cares for the mental, physical and financial welfare of Australian wildlife carers?. *Wildlife Research*, *45*(2), 103-118.