FLORA & FAUNA GUARANTEE

FLORA AND FAUNA GUARANTEE - SCIENTIFIC ADVISORY COMMITTEE

PRELIMINARY RECOMMENDATION ON A NOMINATION FOR LISTING

Poisoning of native wildlife by anticoagulant rodenticides
(Potentially Threatening Process)

DOCID107-417469679-742

Dates of Consideration: 21 January, 16 May, 30 June, 19 August 2022

Validity: The nomination is for a valid item.

Prescribed Information: The prescribed information was provided

Name of the Nominator is adequately provided

Name of the Item is adequately provided

In the opinion of the Scientific Advisory Committee (SAC) the Potentially Threatening Process (PTP) is adequately defined and described. The nominated process is defined as 'Poisoning of native wildlife by anticoagulant rodenticides'.

Eligibility for listing as a PTP under the Flora and Fauna Guarantee Act 1988

The SAC has assessed the eligibility of this nomination in accordance with Section 16C of the *Flora and Fauna Guarantee Act 1988* (FFG Act) and the criteria for determining eligibility for listing prescribed in the *Flora and Fauna Guarantee Regulations 2020* (FFG Regulations).

Process information

Globally, anticoagulant rodenticides (ARs) are used extensively in both agricultural and urban landscapes as a means of rodent pest control (Rattner et al. 2014). First generation ARs (FGARs) were originally produced in the 1940s-1960s and include compounds such as warfarin, pindone and coumatetralyl (Brakes & Smith 2005). While FGARs were initially effective, many rodent populations subsequently became resistant. This triggered the development of second generation ARs (SGARs) in the 1970s and 1980s, a group which includes chemicals such as brodifacoum, bromadiolone and difethialone (Hong et al. 2019; Memmott et al. 2017).

The primary function of ARs is to disrupt the vitamin K cycle in the liver, pancreas and kidneys. The resulting reduction in vitamin K hydroquinone inhibits normal blood clotting, causing internal and external bleeding, and usually death, for target rodent species (Valverde et al. 2020). The severity and speed of these effects appear to be influenced by both the concentration of poison in relation to body size (Eason & Spurr 1995) as well as some interspecific variation with regards to susceptibility (Martínez-Padilla et al. 2017). ARs are typically distributed passively via laced grain baits, with lag times between consumption and death varying between compounds. However, SGARs are consistently more potent, and have a longer biological half-life and in turn, a greater tendency to bioaccumulate by binding to the liver (Brakes & Smith 2005; Memmott et al. 2017).

Exposure (and subsequent mortality) of non-target wildlife species to ARs has been well-documented in all places where testing has been conducted. Predatory species that target rodents as prey (particularly raptors) are known to be susceptible to AR poisoning (Laakso et al. 2010). Poisoning may occur via primary (direct consumption), secondary (consumption of poisoned prey items) or even tertiary (consumption of a poisoned predator by another predator) pathways (Nakayama et al. 2019). Given many avian predators occupy large home-ranges that often include human dominated land-use types, there is a considerable risk of secondary poisoning of avian predators due to vertebrate pest control in these landscapes (Cooke et al. 2022; Lohr & Davis 2018).

The geographic area over which the threat of AR poisoning of wildlife occurs is widespread, and includes (but is not limited to):

- rural areas where grain crops are grown, and rodent control is standard practice
- other farming areas where pests such as rabbits may be subject to control
- urban, peri-urban areas and regional towns where ARs are used to control residential pests
- conservation reserves where rabbits and rodents may be managed using ARs

Decision by the Scientific Advisory Committee

The eligibility of the nominated PTP to be specified in the Processes List must be determined in accordance with the eligibility criteria prescribed for the purposes of Division 2 of Part 3 of the FFG Act. The relevant eligibility criteria are prescribed in Schedule 3 of the FFG Regulations, which provides that if a criterion is met, the PTP is eligible to be specified in the Processes List.

Criterion 1.1 *the potentially threatening process poses or has the potential to pose a significant threat to the survival of two or more taxa.*

Evidence:

AR residues are increasingly being detected in non-target animals globally. The impacts of ARs in Australia (and specifically Victoria) have not been as well documented as in other parts of the world. Emerging research has shown that poisoning from AR toxicity occurs across taxa (Lohr 2018; Letoof et al. 2020) with a high frequency of poisoning events resulting from exposure to second generation ARs. Cases of suspected AR poisoning in wildlife are commonly presented to vets, however resources for toxicology testing are not usually available, and poisoned animals are often euthanised due to the severity of symptoms (Grillo et al. 2016). Early spatial analysis shows that exposure to ARs increases with proximity to developed habitat (Lohr 2018) and that exposure to second generation ARs is widespread across both urban forest and agricultural landscapes (BirdLife 2022a unpublished; Cooke et al. 2022). A comprehensive Australian review by Lohr & Davis (2018) identified 37 native species (predominantly birds, but also one reptile and five mammals) which were reported to have experienced primary or secondary poisoning as a result of ARs, including some studies inferring population-level effects. Three of those species are listed as threatened under the FFG Act: Grey Goshawk, Barking Owl and Masked Owl. In Australia, ARs continue to be publicly available and extensively used for grain crop protection, residential pest control, and also for conservation applications such as island pest eradications.

Avian predators

The detection of rodenticides in raptors that prey specifically on species that are targeted for poisoning (e.g. rats, mice and rabbits) is unsurprising and has been reported in many predators globally (Cooke et al. 2022; Lohr 2018; López-Perea & Mateo 2018; Nakayama et al. 2019). Possums are also known to ingest ARs and can consume high quantities before being poisoned, posing considerable risk of secondary poisoning to raptors that may inadvertently consume poisoned possums (Grillo et al. 2016) There is compelling evidence that many so-called common bird species are experiencing significant declines in abundance and distribution, including declines in carnivorous birds across most Australian regions (BirdLife Australia 2015). Many avian predators have relatively low fecundity and populations occur at low densities. A number of avian predators are listed as threatened under the FFG Act (Table 1), and any additional threatening processes, such as poisoning with toxicants, could have significant ramifications for the viability of populations, especially in urbanizing landscapes. Even if not lethal or acutely toxic, toxicants could have potentially subclinical health impacts on fitness, reproduction, and immune function (Cooke et al. 2022; Rattner et al. 2014). In long-lived raptor populations, increases in adult mortality can disproportionally increase extinction risk. Australia's threatened and declining carnivorous bird populations, specifically raptors, cannot afford the added risk of mortality from ARs (McCarthy et al. 1999).

Peer-reviewed empirical studies provide evidence of the widespread and serious nature of the threat posed by ARs in Australia. Lohr (2018) analysed the livers of 73 dead or moribund Boobooks (*Ninox boobook*) collected in the vicinity of Perth. 73% of individuals were exposed to ARs, 51% had potentially dangerous levels of AR residues in their tissues, and multiple types of ARs were detected in 38% of individuals. The concentration of liver AR was correlated with the amount of urbanisation in the area surrounding where the individuals had been collected. Lohr (2018) also reported detection of ARs which cannot be purchased by the public, so were presumably linked to professional pest control use.

Cooke et al. (2022) investigated the death of eight Powerful Owls (*Ninox strenua*) around Melbourne in less than one year (2020/2021). The Powerful Owl is an FFG Act listed apex predator that consumes mainly arboreal marsupial prey. Eighteen deceased Powerful Owls were toxicologically screened and ARs were detected in 83%, with 61% of owls sampled having levels high enough that toxic effects were likely to have occurred. The most common SGAR detected was brodifacoum, which was present in every bird in which a rodenticide was detected. Powerful Owls do not scavenge but prey mostly upon arboreal marsupials, suggesting that brodifacoum is entering the Powerful Owl food web via accidental or deliberate poisoning of non-target species (possums). Birdlife Australia's recent research (2022a unpublished) focusing on NSW Powerful Owls has identified recent dietary shifts to include rodents and ground-mammals, with rodents forming up to 15% of owl diets in some areas. Preliminary results have found AR compounds present in 92% of tested Powerful Owl mortalities across the greater Sydney region, with SGARs being responsible for all fatal levels of ARs detected.

A study of Tasmanian Wedge-tailed Eagles (*Aquila audax fleayi*) highlights the comparable threat posed by ARs in agricultural landscapes for predatory birds (Pay et al. 2021). Of the 50 Wedge-tailed Eagle livers tested, ARs (mostly SGARs) were detected in 74% of individuals, with 22% of the livers containing likely lethal concentrations of SGARs. Once again, there was a correlation between liver AR concentrations and the amount of agricultural or urban landscape surrounding the collection area. Of particular concern, is the fact that the species is not particularly known for feeding on rodents, yet high levels of ARs were detected.

There are also concerns for other predatory and scavenging birds such as butcherbirds (*Cracticus* spp.), Laughing kookaburras (*Dacelo novaeguineae*), Australian magpies (*Gymnorhina tibicen*), currawongs (*Strepera* spp.) and ravens (*Corvus* spp.). The high prevalence of ARs detected in dead avian predators suggests there is considerable potential for toxicants to move through food webs due to accidental or deliberate poisoning of non-target species and is of significant conservation concern.

Table 1: FFG Act listed avian predators for which ARs have the potential to pose a significant threat to their survival, based on known diet and/or published evidence of poisoning.

Common Name	Scientific Name	Reference for confirmed poisoning	FFG Act Category of Threat
Grey Goshawk	*Accipiter novaehollandiae*	Mooney (2017)	Endangered
Grey Falcon	*Falco hypoleucos*		Vulnerable
Black Falcon	*Falco subniger*		Critically Endangered
Little Eagle	*Hieraaetus morphnoides*		Vulnerable
Square-tailed Kite	*Lophoictinia isura*		Vulnerable
Barking Owl	*Ninox connivens*	Thomas and Kutt (1997)	Critically Endangered
Powerful Owl	*Ninox strenua*	Cooke et al. (2022)	Vulnerable
Masked Owl	*Tyto novaehollandiae*	Thomas and Kutt (1997)	Critically Endangered
Sooty Owl	*Tyto tenebricosa*		Endangered

<u>Reptiles</u>

Snakes and varanids which prey on rodents may also be poisoned by ARs, including several FFG Act listed species (Table 2). New research has documented instances of Australian wildlife such as King's Skinks visiting bait stands or scavenging poisoned rodents, resulting in the death of the King's Skink, likely because of poisoning (Bettink 2015). Letoof et al. (2020) detected ARs in 91% of Dugites tested, 60% of Shingleback Lizards and 45% of Tiger Snakes, suggesting more widespread AR contamination across the food web. While the tolerance levels to ARs in these reptiles appears high, the ability for them to consume such large quantities of ARs before lethal effects occur creates danger of ARs poisoning other wildlife that may prey upon these reptiles (BirdLife Australia 2022b unpublished; Bettink 2015; Letoof et al. 2020).

Table 2: FFG Act listed reptiles for which ARs have the potential to pose a significant threat to their survival, based on known diet.

Common Name	Scientific Name	FFG Act Category of Threat
Common Death Adder	*Acanthophis antarcticus*	Critically Endangered
Bardick	*Echiopsis curta*	Endangered
Rosenberg's Goanna	*Varanus rosenbergi*	Critically Endangered

Lace Monitor	*Varanus varius*	Endangered
Carpet Python	*Morelia spilota metcalfei*	Endangered
Diamond Python	*Morelia spilota spilota*	Critically Endangered

Given the widespread use of ARs in agricultural, residential, and conservation applications in Australia (Lohr & Davis 2018), along with the comprehensive documentation of cases of primary, secondary, and tertiary AR poisoning of predator species globally (Laakso et al. 2010; Nakayama et al. 2019), there is strong evidence to suggest that ARs pose a current and future threat to the survival of multiple wildlife species in Victoria. Current regulations regarding AR usage means that the vast majority is unmonitored, and the real consequences to Australian wildlife are likely to be significantly underestimated (BirdLife Australia 2022b unpublished).

Documentation

The published information provided to and sourced by the SAC has been assessed. To the best of their knowledge, the SAC believes that the data presented are not the subject of scientific dispute and the inferences drawn are reasonable and well supported.

Preliminary Recommendation of the Scientific Advisory Committee

As outlined above, the nominated PTP satisfies at least one criterion of the set of criteria prepared and maintained under Division 2 of Part 3 of the FFG Act and stated in Schedule 3 of the FFG Regulations.

The SAC concludes that on the evidence available, the nominated PTP is eligible for listing because Criterion 1.1 of the FFG Regulations has been satisfied.

The Scientific Advisory Committee therefore makes a preliminary recommendation that the nominated PTP 'Poisoning of native wildlife by anticoagulant rodenticides' be supported for listing under the *Flora and Fauna Guarantee Act 1988.*

Endorsement by the Convenor of the Scientific Advisory Committee **Date**

Michelle Casanova

Dr. Michelle T. Casanova **5 September 2022**
Convenor

References

Bettink, K. (2015). Control and Eradication of Black Rats (*Rattus rattus*) on Penguin Island, Western Australia, December 2012–December 2014 Perth, Western Australia. In: Department of Parks and Wildlife (2015) Natural history and management of the Shoalwater Islands and Marine Park: proceedings of a seminar, 22 July 2015, Point Peron Camp School, Department of Parks and Wildlife, Perth.

BirdLife Australia (2015). The State of Australia's birds: 2015 Headline trends for terrestrial birds. BirdLife Australia, Carlton. https://birdlife.org.au/documents/SOAB-2015.pdf

BirdLife Australia (2022a unpublished). Widespread poisoning of urban Powerful Owls across New South Wales by anticoagulant rodenticides. Report prepared by Annalise Naimo and various contributors on behalf of BirdLife Australia. Research undertaken through the BirdLife Australia Powerful Owl Project.

BirdLife Australia (2022b unpublished). BirdLife Australia submission to the Australian Pesticide and Vet Medicine Authority (APVMA) Consultation on reconsideration of anticoagulant rodenticide (AR) products.

Brakes, C.R. & Smith, R.H. (2005). Exposure of non-target small mammals to rodenticides: short-term effects, recovery and implications for secondary poisoning. Journal of Applied Ecology 42, 118–128

Cooke, R., Whiteley, P., Jin, Y., Death, C., Weston, M. A., Carter, N., & White, J. G. (2022). Widespread exposure of powerful owls to second-generation anticoagulant rodenticides in Australia spans an urban to agricultural and forest landscape. Science of the Total Environment, 1;819:153024

Eason, C.T. & Spurr, E.B. (1995). Review of the toxicity and impacts of brodifacoum on non-target wildlife in New Zealand. New Zealand Journal of Zoology 22, 371–379.

Grillo, T., Cox-Witton, K., Gilchrist, S. & Ban, S. (2016). Suspected rodenticide poisoning in possums. Animal Heath Surveillance Quarterly 21, 8.

Hong, S. Y., Morrissey, C., Lin, H. S., Lin, K. S., Lin, W. L., Yao, C. T., Lin, T. E., Chan, F. T., & Sun, Y. H. (2019). Frequent detection of anticoagulant rodenticides in raptors sampled in Taiwan reflects government rodent control policy. Science of the Total Environment, 691, 1051-1058.

Laakso, S., Suomalainen, K. & Koivisto, S. (2010). Literature Review on Residues of Anticoagulant Rodenticides in Non-Target Animals. Nordic Council of Ministers, Copenhagen.

Lettoof, D., Lohr, M., Busetti, F., Bateman, P., & Davis, R. (2020). Toxic time bombs: Frequent detection of anticoagulant rodenticides in urban reptiles at multiple trophic levels. Science of the Total Environment, 724, 138218.

Lohr, M.T. (2018). Anticoagulant rodenticide exposure in an Australian predatory bird increases with proximity to developed habitat. Science of the Total Environment 643, 134–144.

Lohr, M.T. & Davis, R.A. (2018). Anticoagulant rodenticide use, non-target impacts and regulation: a case study from Australia. Science of the Total Environment 634, 1372–1384.

López-Perea, J.J. & Mateo, R. (2018). Secondary exposure to anticoagulant rodenticides and effects on predators. In: van den Brink, N.W., Elliott, J.E., Shore, R.F., Rattner, B.A. (Eds.), Anticoagulant Rodenticides and Wildlife, Emerging Topics in Ecotoxicology. Springer International Publishing, Cham, pp. 159–193.

Martínez-Padilla, J., López-Idiáquez, D., López-Perea, J.J., Mateo, R., Paz, A. & Viñuela, J. (2017). A negative association between bromadiolone exposure and nestling body condition in common kestrels: management implications for vole outbreaks. Pest Management Science 73, 364–370.

McCarthy, M.A., Webster, A., Loyn, R.H. & Lowe, K.W. (1999). Uncertainty in assessing the viability of the Powerful Owl *Ninox strenua* in Victoria, Australia. Pacific Conservation Biology 5(2), 144-154.

Memmott, K., Murray, M. & Rutberg, A. (2017). Use of anticoagulant rodenticides by pest management professionals in Massachusetts, USA. Ecotoxicology 26, 90–96.

Mooney, N. (2017). Risks of anticoagulant rodenticides to Tasmanian raptors. Tasmanian Bird Report, 38, 17-25.

Nakayama, S.M.M., Morita, A., Ikenaka, Y., Mizukawa, H. & Ishizuka, M. (2019). A review: poisoning by anticoagulant rodenticides in non-target animals globally. The Journal of Veterinary Medical Science 81(2), 298-313.

Pay, J.M., Katzner, T.E., Hawkins, C.E., Barmuta, L.A., Brown, W.E., Wiersma, J.M., Koch, A.J., Mooney, N.J. & Cameron, E.Z. (2021). Endangered Australian top predator is frequently exposed to anticoagulant rodenticides. Sci. Total Environ. 788, 147673.

Rattner, B.A., Lazarus, R.S., Elliott, J.E., Shore, R.F. & van den Brink, N. (2014). Adverse outcome pathway and risks of anticoagulant rodenticides to predatory wildlife. Environ. Sci. Technol. 48 (15), 8433–8445.

Thomas, M., & Kutt, A. (1997). Owl populations and habitat: factors that could impact populations of native owls in the sugarcane growing areas in Queensland. Australian Centre for Tropical Freshwater Research. James Cook University of North Queensland, Townsville.

Valverde, I., Espín, S., Gómez-Ramírez, P., Navas, I., Sánchez-Virosta, P., Torres-Chaparro, M.Y., Jiménez, P., María-Mojica, P. & García-Fernández, A.J. (2020). Temporal persistence of bromadiolone in decomposing bodies of Common kestrel (*Falco tinnunculus*). Toxics 8, 98.