2 February 2022

Chemical Review
Australian Pesticides and Veterinary Medicines Authority (APVMA)
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Dear Chemical Review Team,

WILDLIFE HEALTH AUSTRALIA SUBMISSION: CHEMICAL REVIEW OF ANTICOAGULANT RODENTICIDES

Please find attached a submission regarding native wildlife and anticoagulant rodenticide products.

Wildlife Health Australia (WHA) welcomes the APVMA's reconsideration of anticoagulant rodenticide approvals and registrations. Non-target primary and secondary poisoning of native wildlife with anticoagulant rodenticides is a significant global concern. Exposure to anticoagulant rodenticides has been reported in a broad range of species and geographic areas of Australia, and toxicity has been confirmed in multiple events. Further research is needed to understand the impact of anticoagulant rodenticides on native wildlife populations.

WHA recommends increasing the oversight, regulation and stewardship of anticoagulant rodenticide usage in Australia, following the approaches of other countries such as the US Environmental Protection Agency and United Kingdom Health and Safety Executive. Funding to enable ongoing monitoring of native species exposure to anticoagulant rodenticides will be critical to understanding the impact, and assessing the effectiveness of any regulatory changes.

We hope that this submission is of assistance. Wildlife Health Australia would be happy to discuss it further should you require additional information or clarification.

Yours sincerely,

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In relation to the current APVMA reconsideration of anticoagulant rodenticides (AR) approvals and registrations, Wildlife Health Australia (WHA) holds concerns about the potential for unacceptable risks in relation to environmental safety, including primary and secondary poisoning of non-target wildlife. The reasons for these concerns are outlined below and supported by contemporary peer-reviewed literature and WHA-sourced Australian wildlife disease data.

1. Impact of anticoagulant rodenticides on Australian wildlife

Non-target poisoning of native wildlife with ARs is a significant global concern (reviewed by Nakayama et al 2018; Van den Brink et al 2018), particularly for some classes of animals such as birds of prey due to secondary poisoning via consumption of prey species (e.g. rodents; see Wiens et al 2019). In Australia, AR exposure in wildlife has not been broadly studied, but there is evidence that it is also a significant issue here (see McLeod & Saunders 2013; WHA 2021; Lohr and Davis 2018).

Lohr & Davis (2018) reviewed the impacts of AR on native Australian wildlife, and found that AR exposure and suspected poisoning have been reported in a broad range of species and geographic areas. ARs have also been implicated in a number of wild bird mortality events in Australia, including threatened species (Lohr & Davis 2018; Cox-Witton et al 2018). Lohr (2018) found detectable AR exposure in 72.6% (n = 73) of southern boobook owls (*Ninox boobook*) found dead or moribund in WA, mostly from urban or peri-urban areas, and exposure to two or more ARs in 38.4%. More recently, Pay et al (2021) found AR exposure in 74% (n = 50) of Tasmanian wedge-tailed eagles (*Aquila audax fleayi*).

Native mammals and reptiles are also susceptible to AR poisoning (Lohr & Davis 2018; McLeod & Saunders 2013; Lettoof et al 2020). Possums, for example, commonly present with suspected rodenticide poisoning to wildlife veterinary clinics in urban areas in South East Queensland (Grillo et al 2016). Cooke et al (2022) found AR exposure in 83% (n = 18) of Victorian powerful owls (*Ninox strenua*), whose diet consists primarily of possums, indicating a non-target, non-rodent exposure pathway. Lettoof et al (2020) demonstrated that 45% (n = 11) of tiger snakes (*Notechis scutatus occidentalis*), 60% (n = 10) of bobtail lizards (*Tiliqua rugosa*) and 91% (n = 11) of dugites (*Pseudonaja affinis*) around Perth, WA had AR residues, with the dugite being the only rodent predator.

Despite known knowledge gaps, the importance of both sub-lethal and long-term exposure of native wildlife to ARs also needs consideration (Van den Brink et al 2018). Exposure to sub-lethal doses of ARs has been proposed as a contributing factor to mortality due to other causes. Even if not acutely toxic ARs could potentially have sub-clinical health impacts on fitness, reproduction, and immune function (Rattner et al 2014). By reducing immune function, AR exposure could increase susceptibility to parasitism and other disease; impact on an animal's ability to move, fly or react and subsequently increase the likelihood of predation and collisions; and increase the chance of significant blood loss after minor injuries (summarised in Lohr 2018). There is a critical need in Australia and many other parts of the world to investigate bioaccumulation, transfer and impact of ARs in food webs, and not just in species that are the targets for poisoning or their predators (Cooke et al 2022). One major challenge is that the literature worldwide currently lacks validated thresholds for the differentiation of exposure from toxicity in free-ranging wildlife (Rached et al 2020), with extrapolation from

experimental species required (Van den Brink et al 2018). However, this lack of knowledge has not prevented significant regulatory reform around AR access and use in Europe, the United Kingdom, Canada and the United States of America.

2. Data on non-target poisoning of wildlife

Wildlife Health Australia (WHA) receives wildlife health data from government and non-government sources through Australia's general wildlife disease surveillance system, including submissions by state and territory WHA coordinators, zoo veterinarians, sentinel clinic veterinarians, university researchers, wildlife rehabilitators and members of the public. Data are reported into the national electronic Wildlife Health Information System (eWHIS) database. WHA provides annual reports of confirmed and suspected poisoning events in wildlife to the APVMA's Adverse Experience Reporting (AER) Program, including poisoning events associated with ARs in native wildlife. Data on AR poisoning events in wildlife collected in the eWHIS database, and additional data provided by WHA surveillance partners, has been summarised below in **Sections 2.1** to **2.3** respectively, and the data has been provided to the APVMA confidentially (**Appendices A and B**).

The summarised data includes disease events where poisoning has been confirmed or remains high on the list of possible causes. There are additional events reported to WHA but not included here, where poisoning is a possible cause and has not been ruled out, but there are other causes considered more likely. The data is not in any way comprehensive, or spatially or temporally representative, and reported cases will clearly represent a very small proportion of the overall cases occurring in native wildlife in Australia. Some of the data presented here may also be presented in published papers or reports[1].

2.1 eWHIS data summary – AR toxicity

The national electronic Wildlife Health Information System (eWHIS) database administered by WHA contains 77 records (covering 667 individual animals) of suspect or confirmed anticoagulant rodenticide toxicity, recorded between 2003 – 2021 from 62 different post codes across all states/territories except the ACT and NT [2]. This dataset is collected from a network of strategically selected surveillance partners at government agencies, wildlife hospitals and universities, and geared towards detection of new and unusual wildlife health issues. It is therefore not comprehensive, or temporally or spatially representative of anticoagulant rodenticide toxicity in wildlife, but provides a snapshot of cases that have presented to veterinary care or were reported for investigation. Additional data from our surveillance partners is also summarised below in **Section 2.2**.

Events were recorded in 29 different species (**Table 1**), including mammals, birds and amphibians. Most of these events (53%; 41/77) involved animals found dead, with another 23% (18/77) of events presenting with anaemia (low red blood cell count), and 13% (10/77) presenting with

[1] This includes WHA's annual reports to the APVMA's Adverse Experience Reporting (AER) Program.

[2] In addition to the cases described here, the eWHIS dataset contains details of brodifacoum mortalities in wild birds following the rabbit and rodent baiting program on Macquarie Island in 2010-11. Whilst identified and accepted as a risk during design of the pest eradication program, active mitigation efforts such as carcass collection and disposal significantly reduced impacts on avian predators/scavengers. These cases are not included in the data in this submission. Further information including the details of the impacts a can be found in a public Tasmanian government report available via the following link: https://parks.tas.gov.au/Documents/Evaluation_Report_Macquarie_Island_Pest_Eradication_Project.pdf

weakness/depression. The remainder of cases presented for other causes, including ill-thrift/weight loss, nervous system signs, respiratory signs, or trauma. The number of animals affected per event ranged from 1 to 150.

Of these 77 events, 35 included toxicology testing for anticoagulant rodenticides. These chemicals were primarily detected in liver or gut contents. Brodifacoum was the most common (found in 94% of events; n = 33), at liver concentrations varying from 0.01 to 2.95 mg/kg. There were also liver detections of bromadiolone (n = 6; up to 4.74 mg/kg), difethialone (n = 6; up to 0.69 mg/kg), difenacoum (n = 4; up to 0.029 mg/kg), pindone (n = 3; up to 0.0058 mg/kg) and coumatetralyl (n = 1; 0.0016 mg/kg). Flocoumafen was included in many testing panels but was not detected. As tissue concentrations of ARs associated with toxic effects are unknown in most wildlife species (Rached et al 2020), the concentrations are reported in **Appendix A** [confidential] but the significance of the levels detected is not discussed further.

In the remaining 42 events where toxicology testing was not conducted, the diagnosis of anticoagulant rodenticide toxicity was suspected following veterinary examination and treatment, based on one or more of these categories:

- clinical presentation (e.g. pale mucous membranes, unusual or excessive bruising or external haemorrhage)
- in-clinic diagnostic testing or necropsy (e.g. red blood cell count to determine anaemia, abnormal blood clotting time, significant haemorrhage into body cavities noted on necropsy, coloured bait seen in gastrointestinal tract or faeces)
- circumstantial evidence (e.g. animal seen eating bait, or history of recent local baiting)
- response to specific treatment (i.e. Vitamin K, the antidote for anticoagulant rodenticides).

This lack of toxicology testing is standard practice in veterinary clinics due to difficulties in antemortem toxicological analysis (i.e. blood is a less sensitive matrix for analysis (Rached et al 2020) and liver biopsy is expensive and invasive, in addition to risking haemorrhage in an animal with compromised clotting ability) and the high cost of this analysis. In addition, it has been shown that the severity of clinical signs and the extent of abnormal blood clotting are not necessarily correlated to measured internal AR concentration in all species (Rached et al 2020).

Supportive in-clinic diagnostic testing and/or response to specific treatment are usually used to confirm clinical suspicion, in combination with circumstantial evidence. This is especially the case in wildlife where funds are often unavailable for testing, combined with a lack of knowledge for wildlife species of the significance of levels detected. Toxicological testing is most commonly undertaken in a research context or if a malicious poisoning event is being investigated.

Table 1: Species (n = 29) from 77 suspect or confirmed anticoagulant rodenticide toxicity events between 2003 and 2021 in the national electronic Wildlife Health Information System database (eWHIS) administered by Wildlife Health Australia (data described above in Section 2.1).

Group and species
Birds - Non-raptors
Cracticus tibicen / Australian Magpie
Corvus coronoides / Australian Raven
Grallina cyanoleuca / Australian Magpie-Lark
Eolophus roseicapilla / Galah
Larinae / Gulls
Cacatua sanguinea / Little Corella
Eudynamys scolopacea / Common Koel
Corvus mellori / Little Raven
Manorina melanocephala / Noisy Miner
Pitta versicolor / Noisy Pitta
Sturnus vulgaris / Starling #
Podargus strigoides / Tawny Frogmouth
Threskiornis molucca / Sacred Ibis
Corvus orru / Torresian Crow
Birds - Raptors
Falco cenchroides / Australian Kestrel
Ninox connivens / Barking Owl
Tyto alba / Barn Owl
Haliastur sphenurus / Whistling Kite
Ninox strenua / Powerful Owl
Ninox novaeseelandiae / Southern Boobook
Mammals
Trichosurus vulpecula / Common Brushtail Possum
Pseudochirus peregrinus / Common Ringtail Possum
Pseudocheirus occidentalis / Western Ringtail Possum †
Macropus giganteus / Eastern Grey Kangaroo
Antechinus flavipes / Yellow-footed Antechinus
Amphibians
Litoria peronii / Peron's Tree Frog

Non-native bird species included as these are non-target species and could be sentinels for native species
† Critically endangered (EPBC Act 1999)

2.2 Surveillance partner data summary

WHA administers the national Wildlife Disease Surveillance programs that include 10 zoo based wildlife clinics, 10 'sentinel' veterinary clinics and 7 universities that report wildlife cases into the eWHIS database. In December 2021, WHA requested submission of any data relating to anticoagulant rodenticide toxicity, which was not already entered into the eWHIS database (see the eWHIS database summary above in **Section 2.1**), from this network of surveillance partners. We received additional data from five clinics following this request. These datasets cover different timeframes (e.g. two are from 2019 onwards only) and one of the datasets only includes cases in brushtail possums as this was searched manually. The data received was reconciled with the eWHIS database to remove duplicates.[3]

The dataset contains 299 records of suspect anticoagulant rodenticide toxicity, recorded between 1998 – 2021 from 118 different post codes in NSW, QLD and WA (**Appendix B**; confidential). This geographic representation does not indicate a lack of cases elsewhere but reflects both the distribution of the WHA surveillance network, the heterogenous nature of clinic size and caseload, and the ease of historic data extraction by the clinics.

The dataset has 23 different species represented and includes mammals (83%), birds (12%) and reptiles (5%) (**Table 2**). Of the cases recorded, the majority (75%) died or were euthanised and 24% were released to care or the wild following specific treatment for anticoagulant rodenticide toxicity (1% of cases had an unknown outcome).

All cases were diagnosed as suspect anticoagulant rodenticide toxicity based on clinical presentation, in-clinic diagnostics, circumstantial evidence and/or response to specific treatment. Toxicology testing was not undertaken in any of the reported cases (standard practice in wildlife clinics). Supportive in-clinic diagnostic testing and/or response to treatment are usually used to confirm clinical suspicion, in combination with circumstantial evidence, for the reasons outlined above in **Section 2.1** (p.4).

As an example of this diagnostic process, the data from one high caseload wildlife clinic was explored in more detail. This dataset consisted of 90 cases in 12 wildlife species between 2013 and 2021, and included mammals, reptiles and birds. Most cases (76%; 69/90) were in common brushtail possums (*Trichosurus vulpecula*). From the veterinary history provided, WHA veterinarians classified each case as having evidence supportive of anticoagulant rodenticide toxicity in four different categories:

1. clinical presentation (e.g. pale mucous membranes, unusual or excessive bruising or external haemorrhage, coloured bait seen in faeces)
2. in-clinic diagnostics or necropsy (e.g. red blood cell count to determine anaemia, abnormal blood clotting time, significant haemorrhage into body cavities noted on necropsy, coloured bait seen in gastrointestinal tract on necropsy)
3. circumstantial evidence (e.g. animal seen eating bait, or history of recent local baiting) and/or
4. response to specific treatment (i.e. Vitamin K, the antidote for anticoagulant rodenticides).

In summary, two thirds (66%; 59/90) of the cases from this veterinary clinic had evidence supporting anticoagulant rodenticide toxicity from two or more of the above four categories i.e. a very high index of suspicion despite a lack of confirmatory toxicological testing.

[3] This data has not been included in WHA's annual reports to the APVMA's Adverse Experience Reporting (AER) Program.

Table 2: Species (n = 23) from 299 suspect anticoagulant rodenticide cases in wildlife from five Wildlife Health Australia (WHA) sentinel clinics between 1998 – 2021 (data described above in Section 2.2).

Group and species	Cases
Birds - Non-raptors	**31**
Columba livia / Rock (Feral) Pigeon #	3
Dacelo novaeguineae / Laughing Kookaburra	1
Threskiornis molucca / Sacred Ibis	3
Cacatuidae / Cockatoo	5
Cacatua sanguinea / Little Corella	15
Podargus strigoides / Tawny Frogmouth	2
Trichoglossus / Lorikeet	1
Strepera graculina / Pied Currawong	1
Birds - Raptors	**6**
Ninox novaeseelandiae / Southern Boobook	5
Tyto alba / Barn Owl	1
Mammals - Marsupials	**240**
Isoodon macrourus / Northern Brown Bandicoot	2
Isoodon obesulus / Southern Brown Bandicoot †	3
Petaurus breviceps / Sugar Glider	1
Petaurus norfolcensis norfolcensis / Squirrel Glider	2
Pseudocheirus peregrinus / Ringtail Possum	13
Trichosurus caninus / Mountain Brushtail Possum	20
Trichosurus vulpecula / Brushtail Possum	199
Mammals – Native rodents	**8**
Hydromys chrysogaster / Water Rat	1
Rattus fuscipes / Bush Rat	5
Rattus lutreolus / Australian Swamp Rat	2
Reptiles - Lizards	**1**
Tiliqua rugosa / Shingleback (Bobtail)	1
Reptiles - Snakes	**13**
Morelia spilota variegata / Carpet Python	12
Pseudonaja textillis / Eastern Brown Snake	1
TOTAL	**299**

Non-native bird species included as these are non-target species and could be sentinels for native species
† Endangered (EPBC Act 1999)

2.3 Summary and implications of WHA data

The data summarised above in Sections 2.1 and 2.2 demonstrates exposure and/or toxicity due to first and second generation ARs (FGARs and SGARs) in Australian wildlife and supports our recommendations below. Historically, the species most at risk have often been assumed to be predatory birds/raptors, whereas this data indicates a broad list of exposed non-target wildlife species from multiple taxa at risk of primary or secondary AR toxicity in Australia. While the cases presented are not representative of cases nationally, they are evident across a broad geographic range. In line with recent publications (e.g. Lohr and Davis 2018; Lettoof et al 2020; Cooke et al 2022), the data presented above and in **Appendices A and B** demonstrates that impacted non-target species are not solely those that consume rodents, and therefore points to widespread environmental exposure and a broader infiltration of ARs into the foodweb of Australian wildlife.

The magnitude of the problem is not known and warrants further investigation to determine the level to which non-target species are affected by primary and secondary AR exposure and toxicity, and the impact of ARs on native animal populations. We note that in many cases confirmatory testing in wildlife is not conducted, often due to the prohibitive cost of toxicology screening, the lack of clear toxicological thresholds, or difficulties in antemortem toxicological analysis, but also in cases where a very high index of suspicion by a veterinarian is considered sufficient. For these reasons, testing is generally only undertaken in a research context or if a malicious poisoning event is being investigated. The high proportion of uncomfirmed cases in this data demonstrates that in order to properly understand the impact of ARs, including any variation in impact due to regulatory change, funding needs to be directed to a dedicated, standarised monitoring program.

3. Recommendations

The following recommendations could be considered to reduce the exposure of Australian native wildlife to ARs:

- Increase the oversight and regulation of AR usage in Australia, including the removal of SGARs from retail outlets.
- Adopt the approaches of other countries or regions, such as the US Environmental Protection Agency, the United Kingdom Health and Safety Executive, the European Chemicals Agency, and the Government of British Columbia including, for example, the restriction of use of
    - First generation AR products by consumers to tamper proof bait stations, and
    - Second generation AR products to certified professionals only.
- Implement a stewardship program (e.g. the UK's Rodenticide Stewardship Regime coordinated by the 'Campaign for Responsible Rodenticide Use'/CRRU) including:
    - a code of best practice developed in consultation with stakeholders and experts
    - a training and certification scheme for users
    - SGARs used only as part of an Integrated Pest Management (IPM) program
    - appropriate record keeping for the sale, use and disposal of SGARs
    - appropriate monitoring and reporting of toxicity in non-target species.
- Ensure labelling of AR products and associated compliance activities are adequate to minimise poisoning of non-target wildlife.

- Consider evidence of rodenticide efficacy at reduced AR bait concentrations (e.g. Frankova et al 2019).
- Increase awareness of members of the public on humane and effective alternatives to ARs. Examples of existing resources: Healthy Wildlife Healthy Lives, BirdLife Australia.
- Comprehensively monitor native species exposure to ARs to help understand the impact on non-target species and also to assess the effectiveness of any regulatory changes. Examples of overseas monitoring schemes include: UK Predatory Bird Monitoring Scheme, European Raptor Biomonitoring Facility, LIFE APEX Project (Movalli et al, 2019).

4. Appendices (confidential)

Appendix A – National electronic Wildlife Health Information System (eWHIS) anticoagulant rodenticide data (confidential)

Appendix B – Additonal Wildlife Health Austlralia surveillance partner anticoagulant rodenticide data (confidential)

5. References

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ABOUT WILDLIFE HEALTH AUSTRALIA

Wildlife Health Australia (WHA) is the coordinating body for wildlife health in Australia and operates nationally. The head office is located in Sydney, NSW.

WHA activities focus on the increasing risk of emergency and emerging diseases that can spill over from wild animals and impact on Australia's trade, human health, biodiversity and tourism. We provide a framework that allows Australia to better identify, assess, articulate and manage these risks. We provide the framework for Australia's general wildlife health surveillance system.

Our mission is to develop strong partnerships in order to better manage the adverse effects of wildlife diseases on Australia's animal health industries, human health, biodiversity, trade and tourism.

WHA directly supports the Animal Health Committee (AHC), Environment and Invasives Committee (EIC), Animal Health Australia, the Animal Health Policy Branch and the Office of the Chief Veterinary Officer (OCVO) and Chief Environmental Biosecurity Officer (CEBO) within the Australian Government Department of Agriculture, Water and the Environment (DAWE) and Australian governments in their efforts to better prepare and protect Australia against the adverse effects of wildlife diseases. It

provides priorities in wildlife disease work, administers Australia's general wildlife disease surveillance system as well as facilitating and coordinating targeted projects.

Wildlife health intelligence collected through the National Wildlife Health Information System (eWHIS: www.wildlifehealthaustralia.com.au) administered by WHA is provided to members of AHC and the Australian Government DAWE, and Department of Health, on issues of potential national interest, potential emerging issues and significant disease outbreaks in wildlife. The information is provided in line with the agreed policy for data security. WHA supports the National Animal Health Information System (NAHIS) by provision of quarterly reporting and Australia's Chief Veterinary Officer by hosting the World Organisation for Animal Health (OIE) Focal Point for Wildlife. WHA also provides Australia's representative to the International Union for the Conservation of Nature Species Survival Commission Wildlife Health Specialist Group (IUCN SSC WHSG).

WHA is administered under good corporate governance principles. An elected management committee, including DAWE and AHC representatives, provides strategic direction and advice to a small team, which oversees the running of WHA. It is important to note that WHA involves almost every agency or organisation (both government and NGO) that has a stake or interest in animal and wildlife health issues in Australia. There are over 40 member organisations and more than 750 wildlife health professionals and others from around Australia and the rest of the world who have an interest in diseases with feral animals or wildlife as part of their ecology that may impact on Australia's trade, human health and biodiversity.

More information on WHA is available at: www.wildlifehealthaustralia.com.au.