

Eagle CSI: Investigating causes of death in Tasmania's threatened birds of prey





Tasmanian Wedge-tailed Eagle (*Aquila audax fleayi*)

- Endangered (Tas and EPBC)
- Population estimated at 1000-1500 individuals (2006)



White-bellied Sea-Eagle (*Haliaeetus leucogaster*)

- Vulnerable (Tas)
- Population estimated at <1000 individuals (2006)



Grey Goshawk (*Accipiter novaehollandiae*)

- Endangered (Tas)
- Population estimated at <110 breeding pairs (1999)

Threats include:

- Loss of nesting habitat
- Disturbance from land clearing
- Unnatural mortality (shooting, collisions, electrocutions, poisoning)

Partnership between TasNetworks and TMAG



In 2021 TasNetworks funded a part-time technical officer for 3 years; additional funding from Woolnorth Renewables from 2022

- To provide timely information on causes of death, to inform mitigation of hazards in high-risk areas
- To enable clearer insight into circumstances leading to death, and therefore develop strategies to avert those dangers
- To contribute to building a long-term dataset that will facilitate future research on the biology and health of Tasmania's birds of prey.



Background

- Deceased threatened raptors (mostly eagles) are sent to TMAG and stored frozen prior to necropsy.
- There was a backlog of several years of collection in the freezer when I started.
- Many of the birds are found by TasNetworks staff after power outages.
- Others come from windfarms or are found as roadkill. Some come from wildlife refuges (Bonorong, Raptor Refuge, Raptor Care NW) and vets following unsuccessful rehabilitation and euthanasia.



My role:

Measure, weigh, accession and photograph each specimen

Accession No.	B 9458
Tag No.	SAP15742 RN7646 C07994
Genus	<i>Aquila audax</i>
Common Name	WTE
Collector	Tus Networks
Date	1/9/2021
Locality	349 Narawa Rd, Wilmet
Preparation	neurology J.C
Date	11/11/2021
Total Length	980
Wing Span	2060
Wing chord	680
Tail	455
Weight	4500
Sex	subadult F
Remarks, samples	Doc mid-span electrocution feathers, liver, kidney, muscle, pancreas head, L foot, intestines
Primary Length	129.4
Forearm	254
Beak	51.4, 66.2
Tarsus	L 12.8 W 15.3 D 18.6
Toe	83
Hallux	L 50.3 W 10.5
Parasites	few feather lice
Stomach Contents	empty

TMAG data accession card



Standard photos (as per Pay et al. 2021)



My role:

2. Carry out necropsies to identify causes of death

External examination

Internal examination



545 nm forensic torch



Burnt feathers and skin photoluminesce under light of certain wavelengths. They absorb light in the 530-570 nm spectrum and emit light at a longer wavelength that can be detected when viewed through a red filter.

Case Report

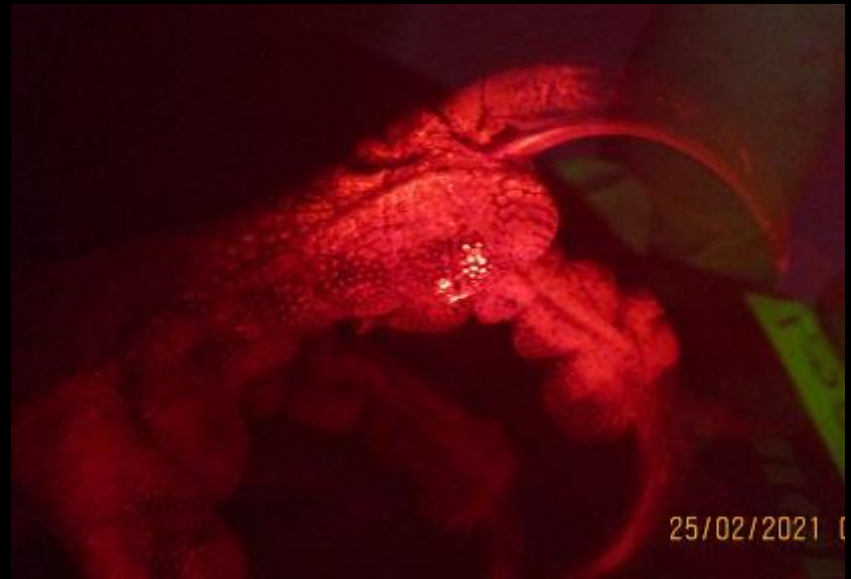
Using an alternate light source to detect electrically singed feathers and hair in a forensic setting



Tabitha C. Viner*, Rebecca A. Kagan, Jennifer L. Johnson¹









Metal detectors

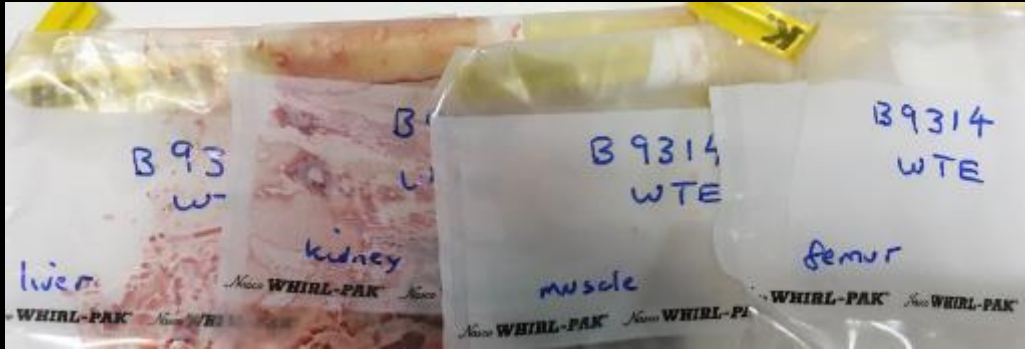
- Shotgun pellets
- Lead ammunition
- Ingested metal objects





My role:

3. Collect samples for further research or diagnostics



Liver, Kidney and Femur

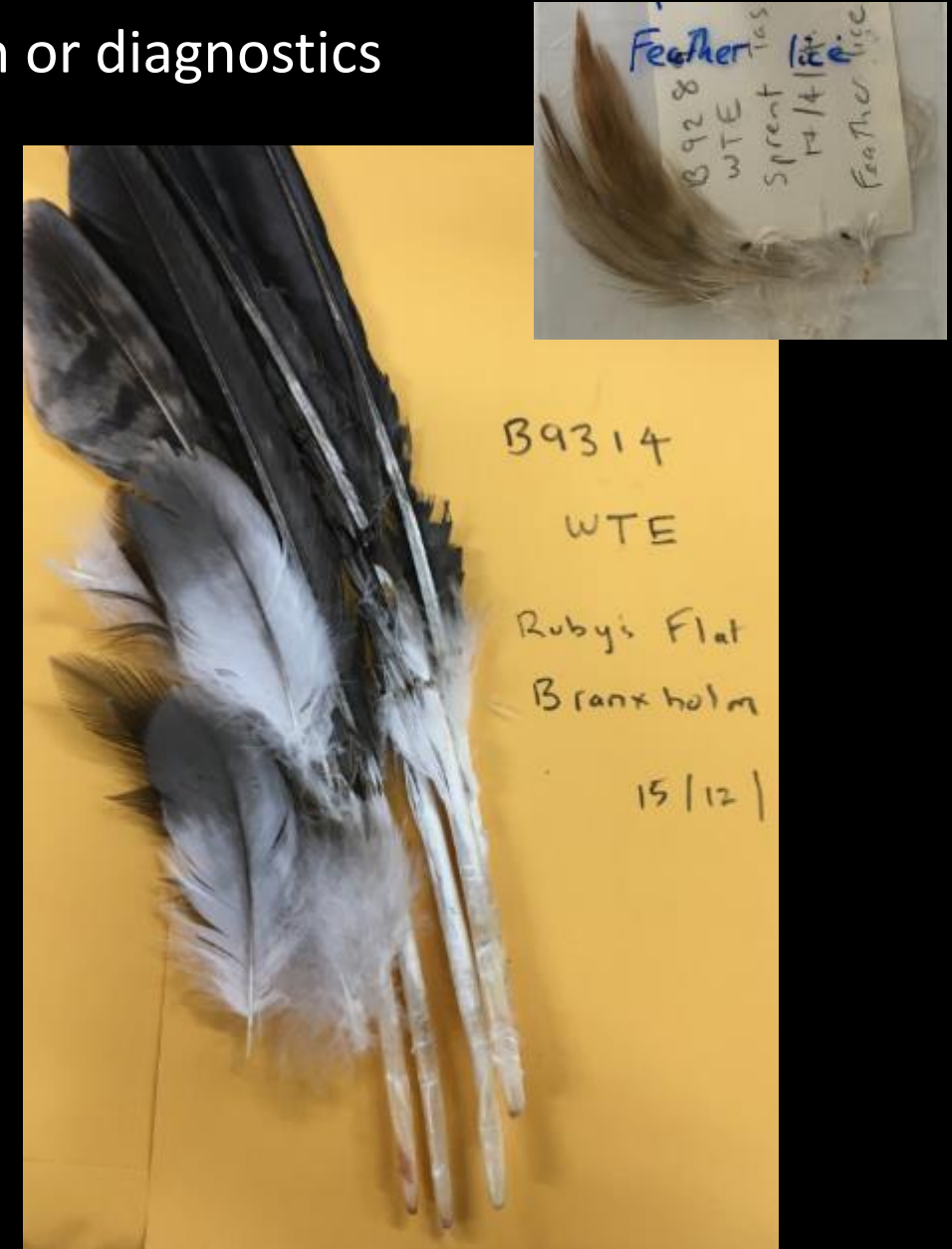
- for heavy metal and rodenticide analysis

Muscle samples

- archived in our -80 freezer for genetics

Feathers

- archived dry



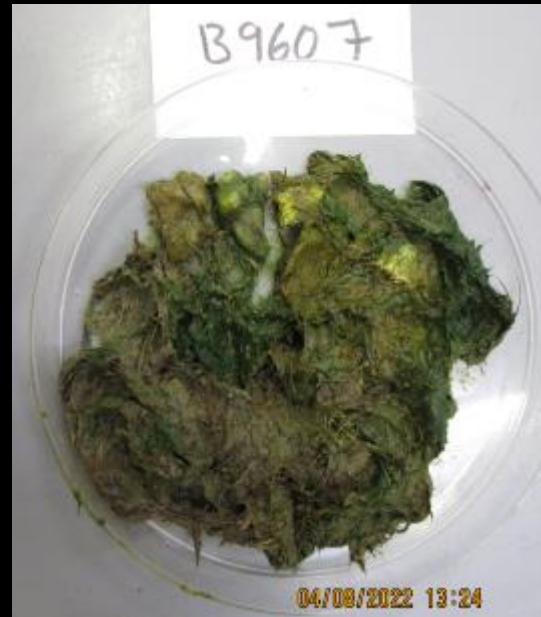
My role:

3. Collect samples for further research or diagnostics

Stomach and crop contents
106g grey fur, flesh, bones, mush in stomach; 151g fresh flesh in crop



Stomach and crop contents
49g bile stained mush, feathers and few bones in stomach. Crop empty



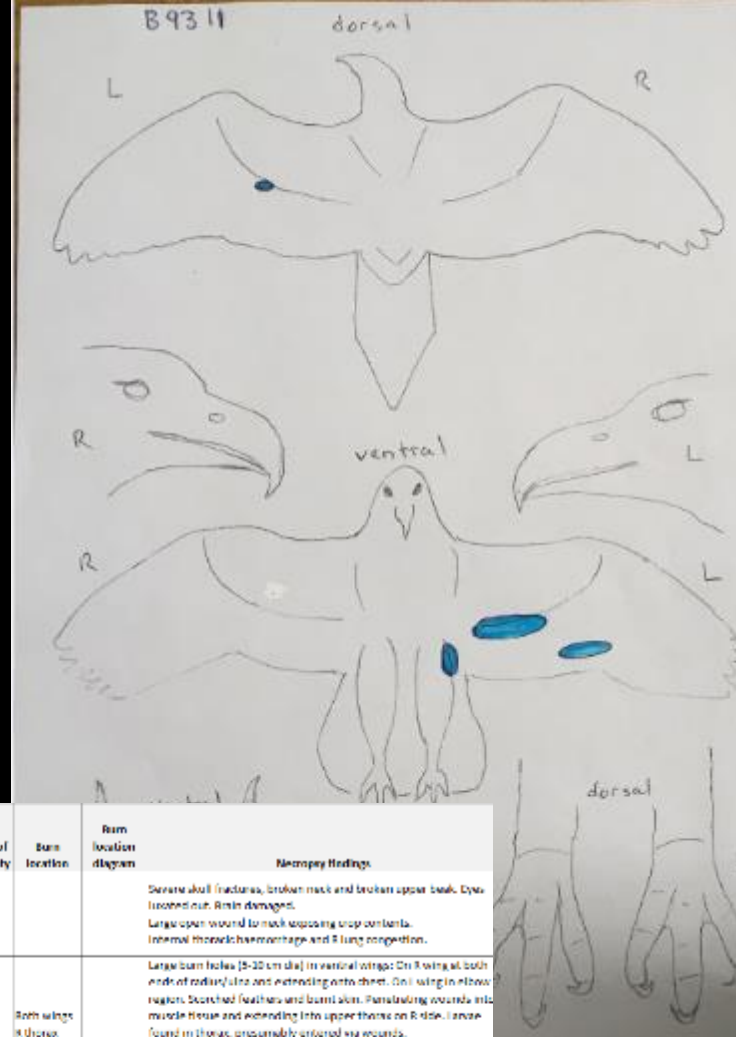
Stomach and crop contents
Bird skin, claw, bones, feathers in stomach and crop



4. Keep detailed records

- Report data to TasNetworks, windfarm managers and other stakeholders
- Record necropsy data, measurements and sample information in TMAG database (and Atlas of Living Australia)

IMAU R number	IMAU RNP	TraNetworks SAP ID	Incident Priority (Lowest/Urgent 3-digits/low)	Species	Date died/found	Death details	Date necropsied	Age	Age comments	Sex	Sex comments	Cause of death	Level of certainty	Burn location	Burn location diagram	Necropsy findings
89554	7257	n/a	2	WFE	19 Sep 20	Found dead on road at Laguna with damaged head.	18 Nov 20	Subadult	Plumage and size	M?	Morphometrics. No gonad development	Collision. Probably with vehicle, given location.	High			Severe skull fractures, broken neck and broken upper beak. Eye flushed out. Ribs damaged. Large open wound to neck exposing crop contents. Internal thoracic hemorrhage and R lung congestion.
89557	n/a	6257	2	WFE	14 Aug 20	Found dead under/over powerlines at Waco (Pik Main Rd) with burn holes. Aspen.	19 Nov 20	Subadult	Plumage and size	F?	Morphometrics. No gonad development	Electrocution	High	Both wings & thorax		Large burn holes (3-20 cm dia) in ventral wings. On R wing at end of radius/ulna and extending into chest. On L wing in the rump. Scattered feathers and burnt skin. Flamingo found in mud hole and extending into upper thorax on R side. Lander found in thorax, presumably entered via wounds. Cranial lung lobes congested but not much evidence of burn damage within thoracic cavity. No other obvious abnormalities.
89558	7267	12357	1	WFE	14 Nov 20	Found dead, directly under HY-UM Lines on Seaford Rd, Little Swanport. Taken to Craig Webb. It rained at Sandy Bay Hotel on 18/11/2020. No obvious fractures.	26 Nov 20	Subadult	Plumage and size	F?	Morphometrics. No gonad development	Electrocution likely, given severity of internal trauma with little external damage. RIT no obviously burnt feathers.	Med	R thigh & thorax		Tail tips ragged. Areas of skin building on R flank and R lower thigh. Severe subcutaneous bruising of R thorax over ribs and flank. Subcutaneous and muscular bruising R upper medial thigh. Possible burn?? trace of skin kept. Haemorrhage within thoracic cavity adjacent to ribs and around heart and lungs. Lungs congested, blood in bronchi, trachea and mouth. No food in stomach or crop. Digesta in intestines.
89559	5550	12138	2	WFE	12-Nov-20	Found on ground at Cattle Hill and farm unable to fly. Taken to Denbury for veterinary examination. 3- days showed calloused fracture of proximal R radius and ulna, probably 2- 3 weeks old. Repair not deemed possible so eagle was euthanased.	26-Nov-20	Subadult	Plumage and size	F?	Morphometrics. No gonad development	Collision with something possibly powerlines or wind turbine. Emphysema due to malunion of fractured R radius/ulna	Med			Healed, mark of most prominent on both wings. No abnormalities other than fractured R radius/ulna Stomach contents: fat, ribs (small mammal)

[illegible]

My role:

5. Prepare specimens from suitable material and contribute to exhibitions

Study skins



Skeletons and skulls



Skulls and heads



Those of you with an eagle eye might have noticed a new display up in the Earth and Life Gallery! You can see these two majestic birds from Tuesday Sunday, 10:00 am – 4:00 pm.

#tmag #newdisplay #tasmanianeagles #wedgetailedeagle
#whitebelliedseaeagle



Exhibitions

Nature in the News

Do you know which Tassie eagle wears shorts rather than pants? Visit TMAG to learn about raptor identification and then get out into the field this weekend for “Where? Where? Wedgie!” – Tasmania’s annual eagle survey. For more info: bit.ly/39QJslr

#tmag #naturetrackers



Forensic torch used at TMAG to identify burnt feathers in electrocuted eagles

Eagle CSI: Using forensics to examine the health of Tasmania's eagles

Wild raptors (birds of prey) face a range of dangers within their natural environments.

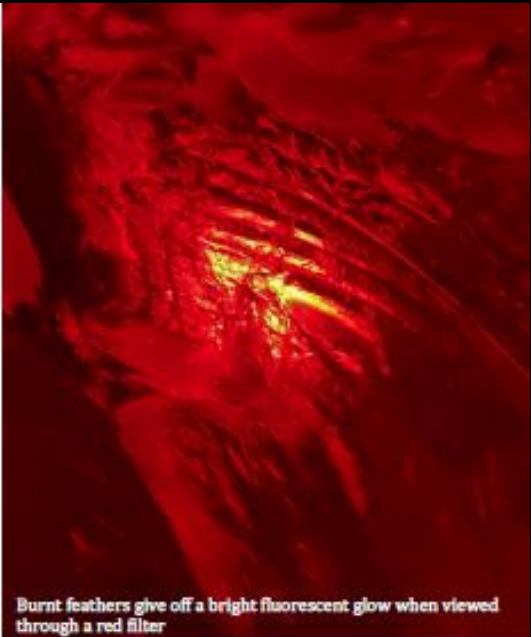
This includes threats caused by climate change (e.g. habitat loss or fragmentation), human disturbance, and cryptic processes such as disease or poisoning from rodenticides or other pollutants.

One particular problem is the threat posed by powerlines – which transmit electricity to homes and businesses throughout Tasmania – but also pose an electrocution risk to birds that accidentally contact them.

The Tasmanian Museum and Art Gallery is partnering with TasNetworks to determine the causes of death for eagles carcasses found near powerlines in Tasmania.

Electrocution results in burnt feathers which give off a fluorescent glow under a special forensic torch. This enables us to confirm which birds have been electrocuted, helping to guide TasNetworks in the deployment of eagle mitigation devices.

1. Taxidermied wing from a Tasmanian wedge-tailed eagle (*Aquila audax fleayi*) showing burns caused by contact with an overhead powerline.
2. Two types of 'Bird Flapper', which are devices installed on powerlines throughout Tasmania to make them more visible to birds of prey, enabling birds to avoid dangerous collisions. Flappers are used alongside other electrocution mitigation strategies including the installation of safe perches on power poles and conductor covers over live wires.



Burnt feathers give off a bright fluorescent glow when viewed through a red filter

Exhibitions

taypani milaythina-tu: Return to Country

Opens 01-10-2022, closes 07-05-2023

Argyle Galleries 1-4



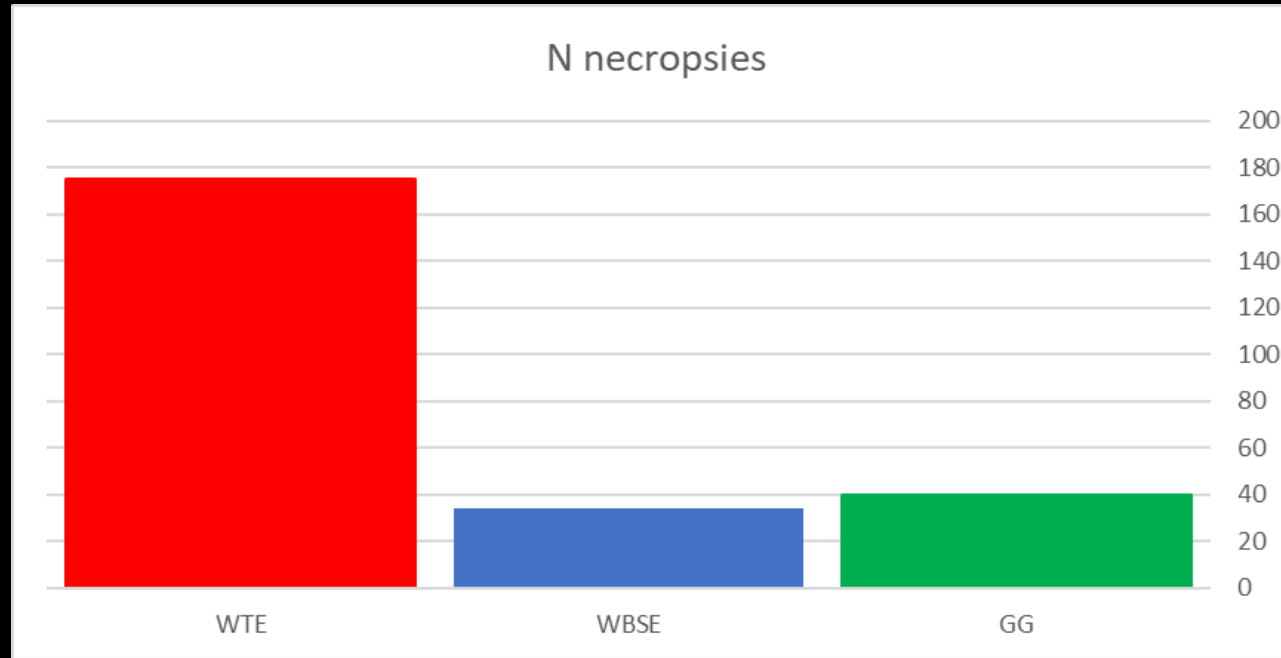
This ground-breaking exhibition presents creative work from 20 Tasmanian Aboriginal artists responding to relationships between community and Ancestral objects, particularly those held in institutions outside lutruwita/Tasmania.

Ancestral objects from collections around the world will return to lutruwita to be exhibited alongside these contemporary responses, some of which are by descendants of the original makers, representing generational reconnection across time and place.

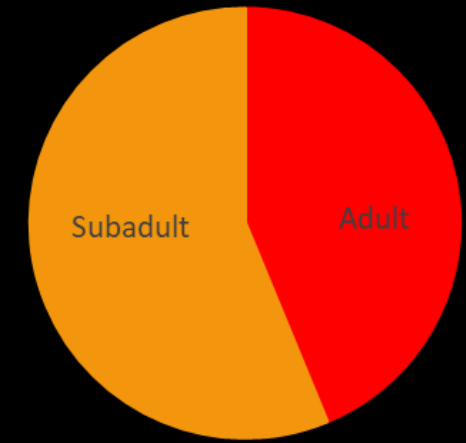


Necropsy program

To date, 252 raptors have been necropsied since Nov 2020, including a frozen backlog of 105 carcasses



Wedge-tailed eagles



Average 40 per year



Average 5 per year



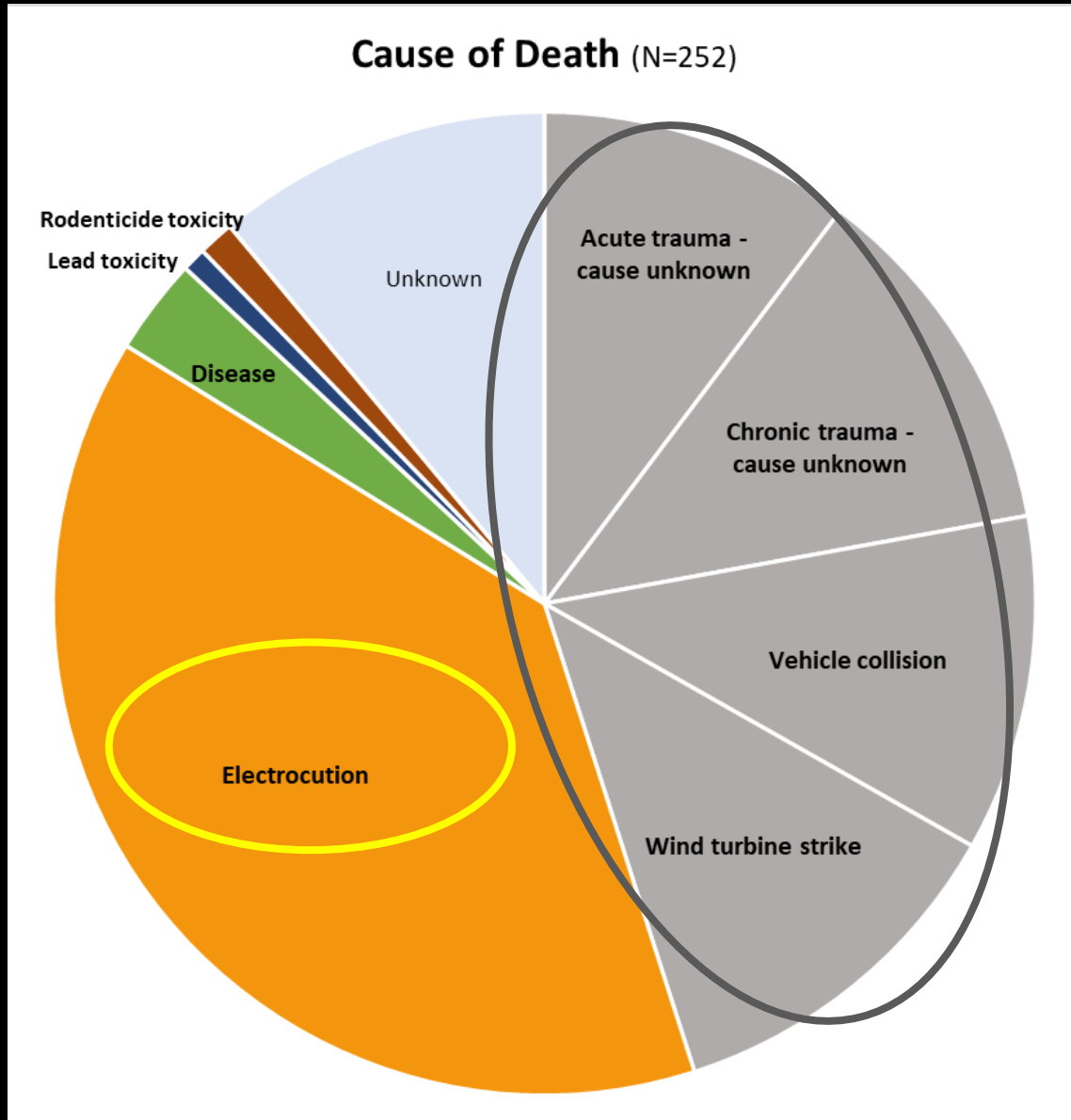
Average 8 per year

Primary Causes of Death:

Electrocution



Trauma

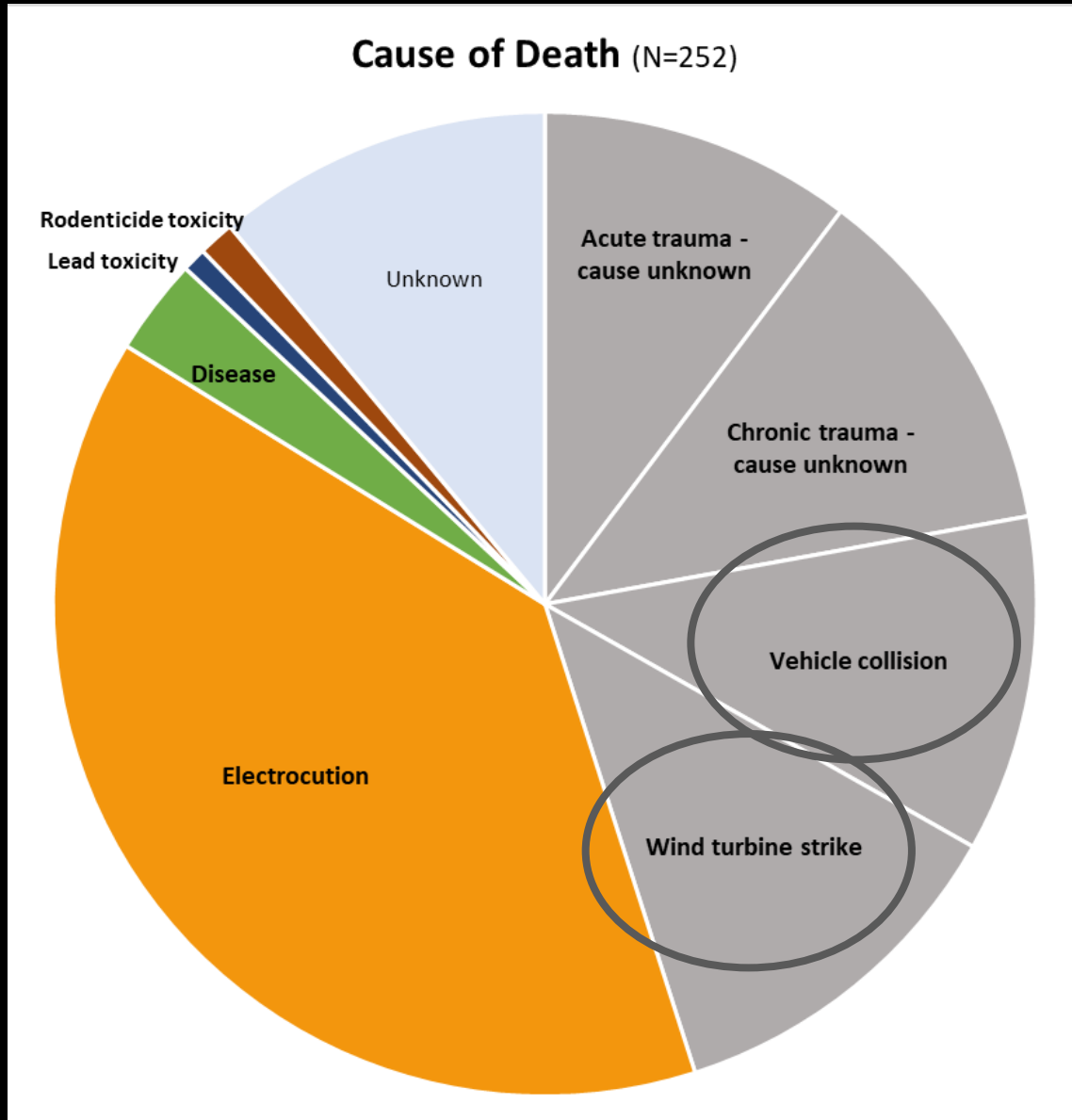


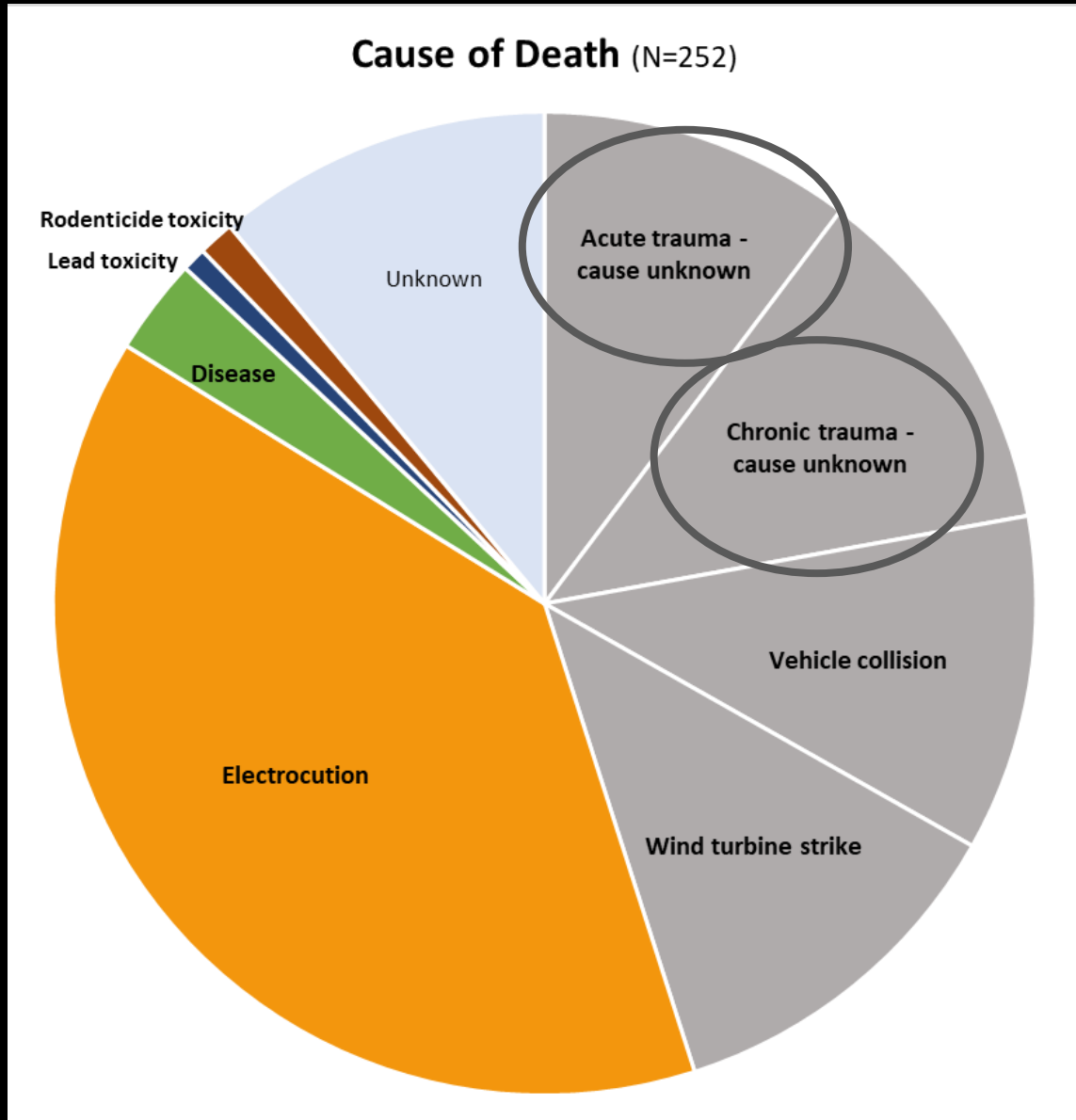
Primary Causes of Death:

Electrocution



Trauma





Primary Causes of Death:

Electrocution

Trauma

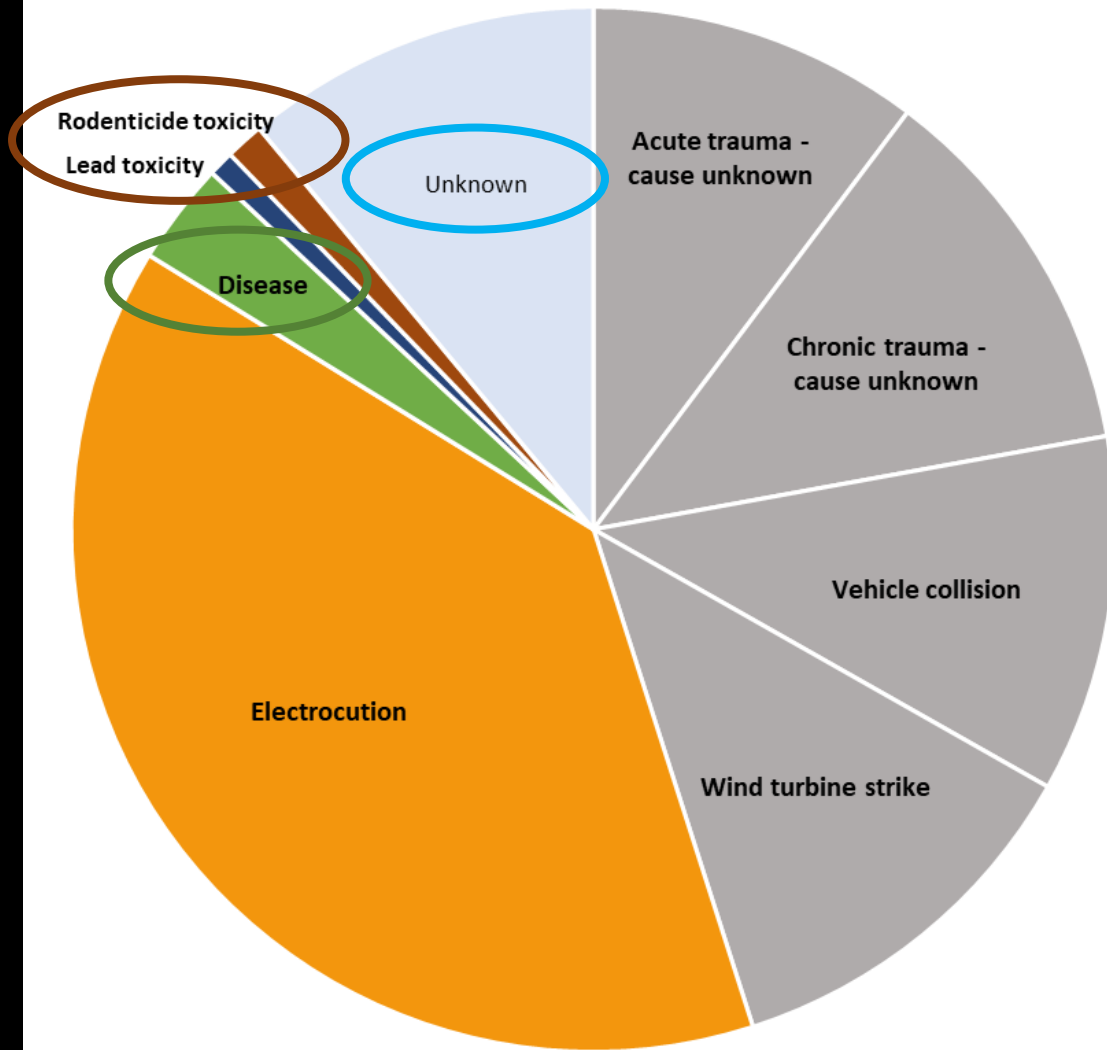
Wind turbines and vehicles

Injuries of uncertain origin

- Electrocution?
- Powerline collision?
- Vehicle collision?
- Fighting?
- Fences?



Cause of Death (N=252)



Other Causes of Death:

- **Disease:**

- Chronic abscesses
- *Trichomonas gallinae*
- *Mycobacterium avium*
- Aspergillosis

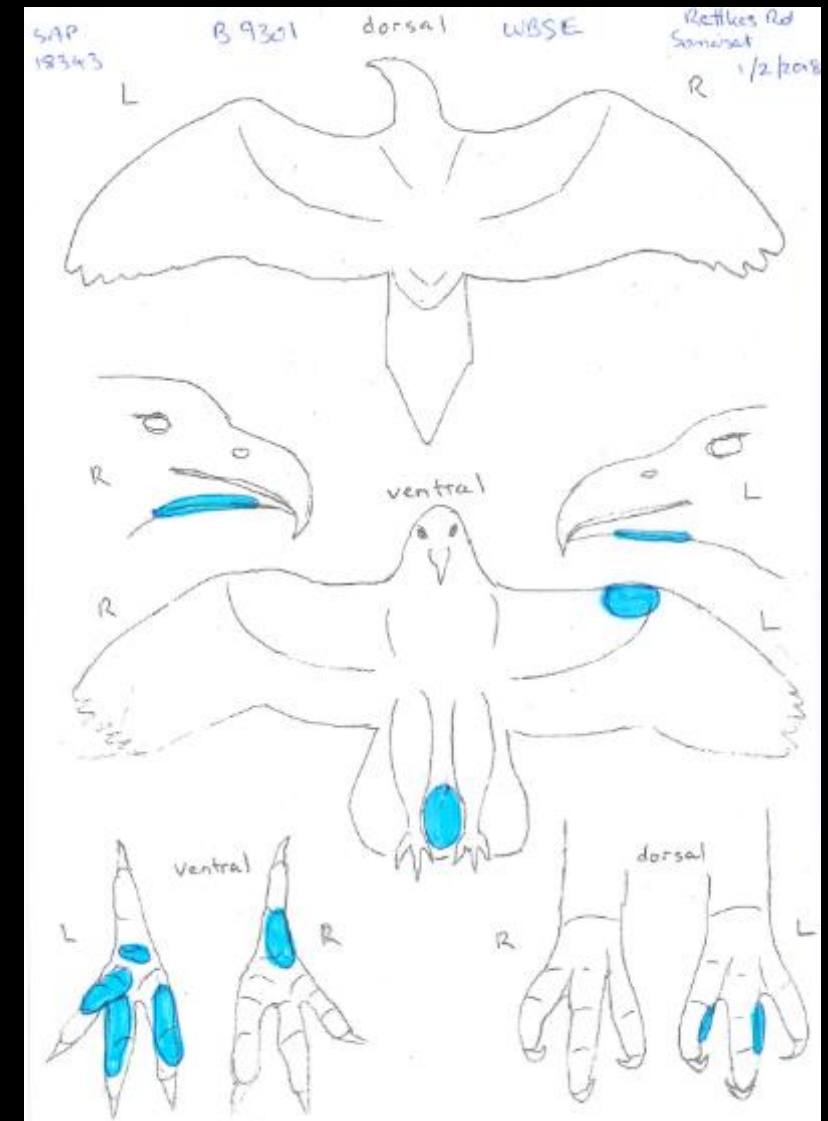
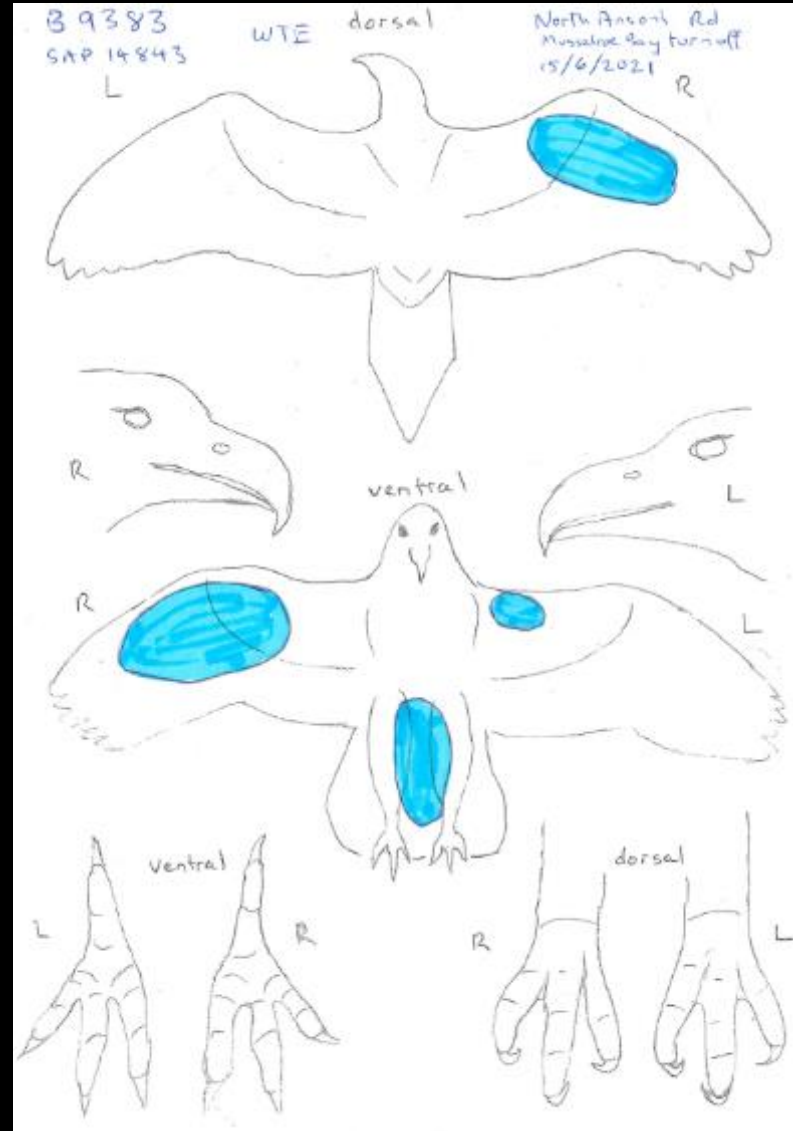
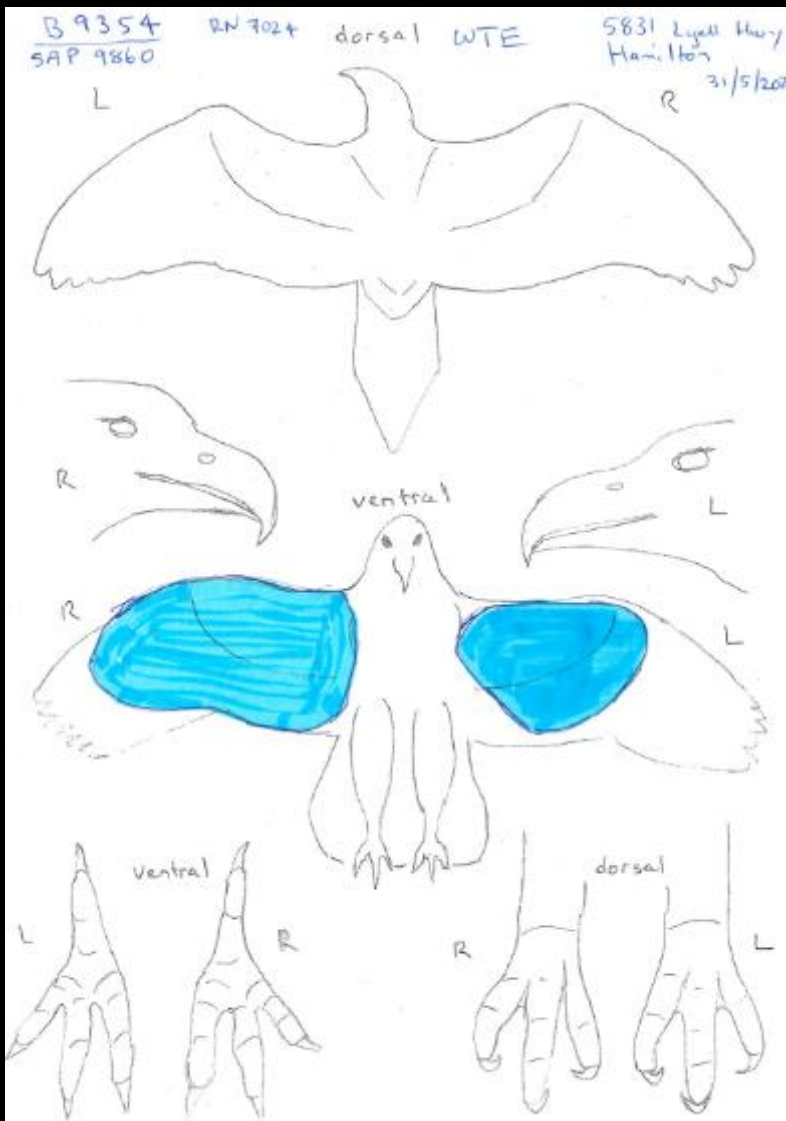
- **Unknown**

- Decomposed
- No obvious gross pathology
 - Neurological damage?

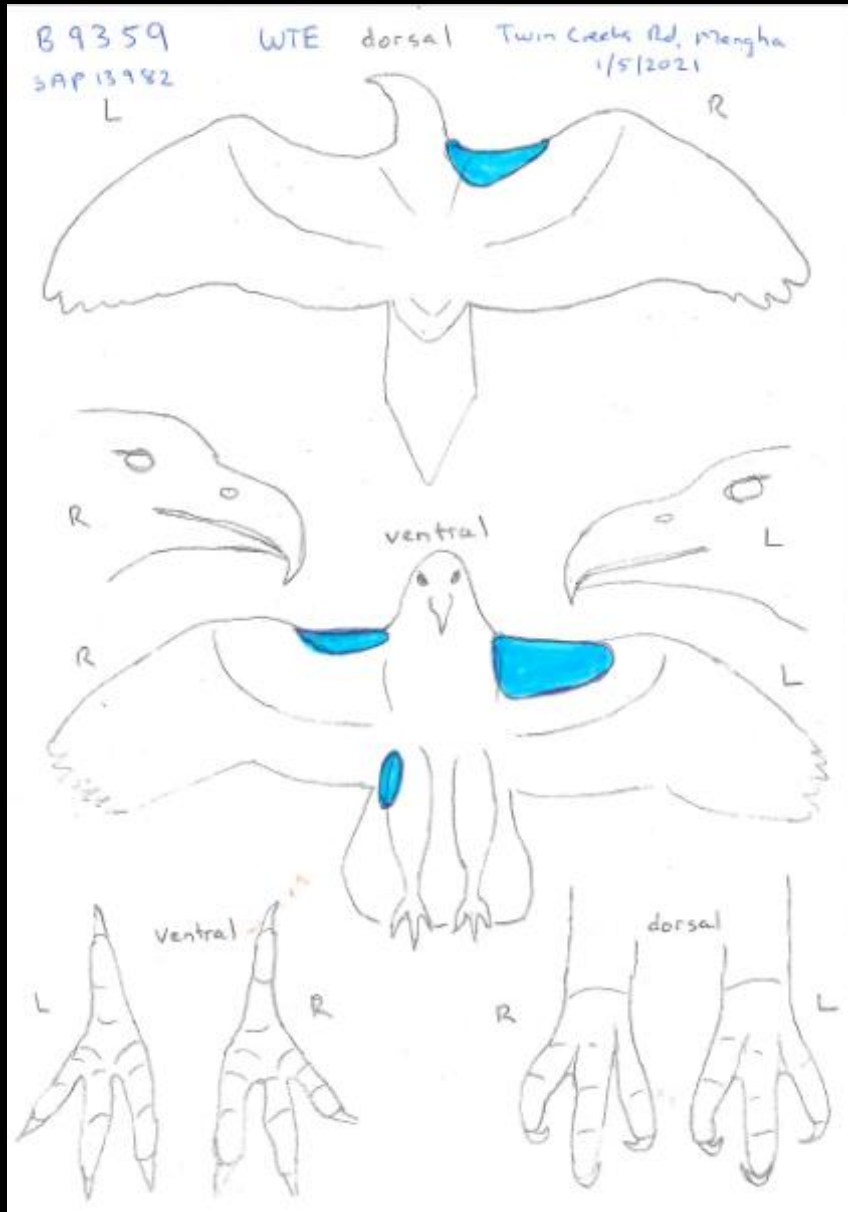
- **Toxicity:**

- Lead
- Rodenticides

Learnings to date: Burn Diagrams



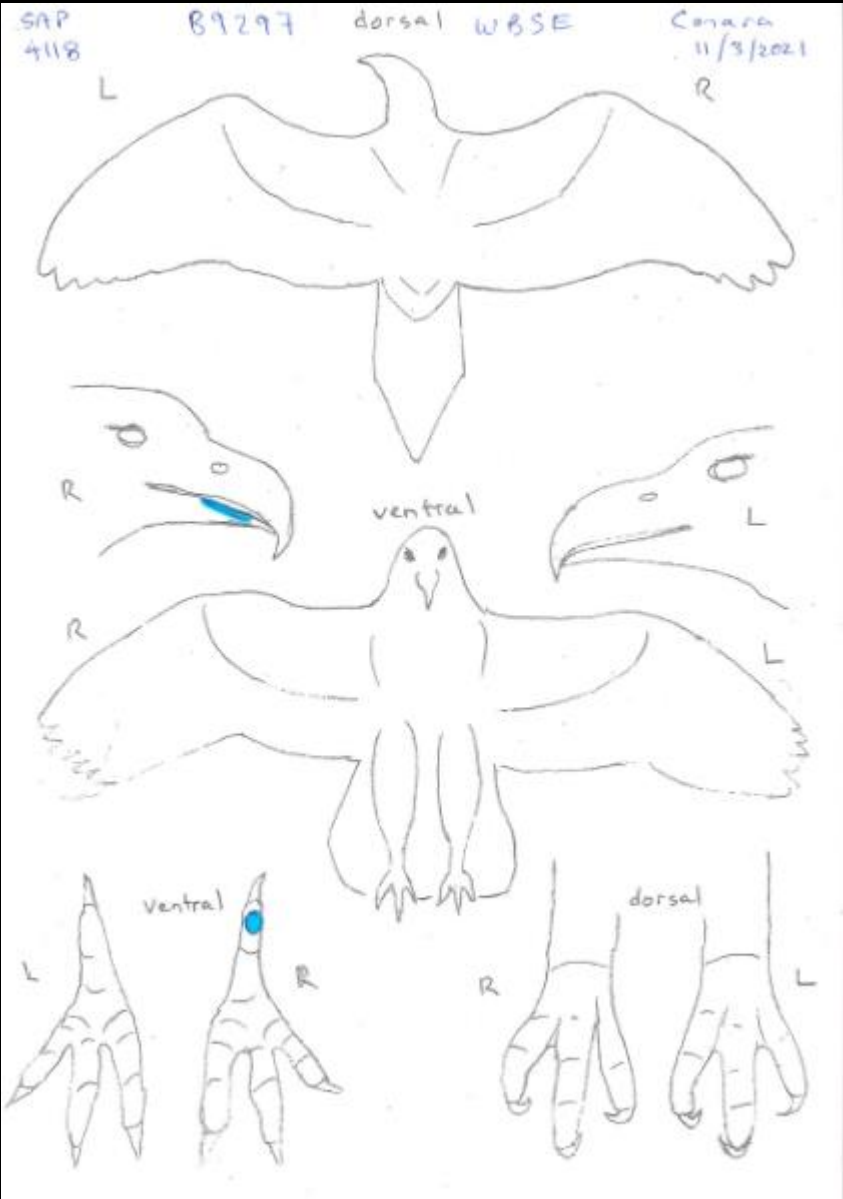
SAP9359 – wedge-tailed eagle – Mengha



Bird age	Male/ Female	Incident type2	Signs of mechanical injury?	Signs of feeding pre-incident?
Sub-adult	Male	Electrocution	No	No
Incident type? (mid-span or pole-top)	Perching or flying?	If flying, what was the likely direction of travel?		Other notes
Mid-span				



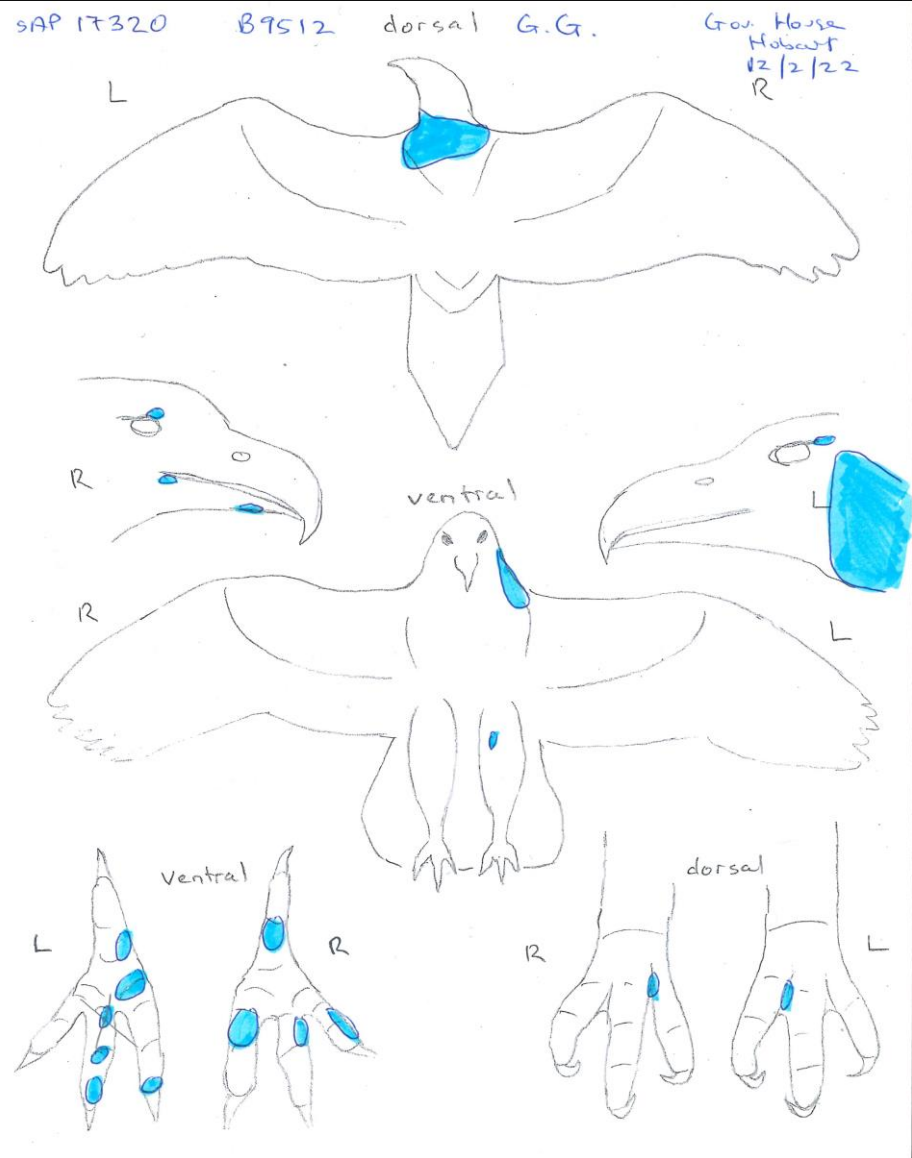
SAP4118 – White bellied sea eagle – Conara



Bird age	Male/ Female	Incident type2	Signs of mechanical injury?	Signs of feeding pre-incident?
Adult	Female	Electrocution	No	No
Incident type? (mid-span or pole-top)	Perching or flying?	If flying, what was the likely direction of travel?		Other notes
Pole-top				



SAP17320 – Grey Goshawk – Queens Domain

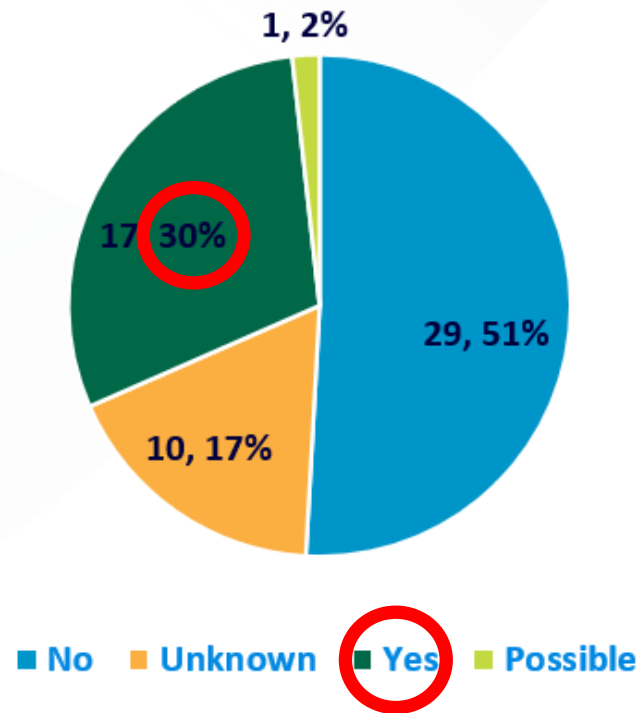


Bird age	Male/ Female	Incident type2	Signs of mechanical injury?	Signs of feeding pre-incident?
Adult	Female	Electrocution	Possibly	No
Incident type? (mid-span or pole-top)	Perching or flying?	If flying, what was the likely direction of travel?		Other notes
Pole-top				



WTE Interactions with powerlines

**TMAG analysis - signs of bird feeding
immediately prior to network interaction –
reportable incidents only (%)**



- Evidence of feeding on roadkill
- Moving roadkill off the road to an area away from powerlines



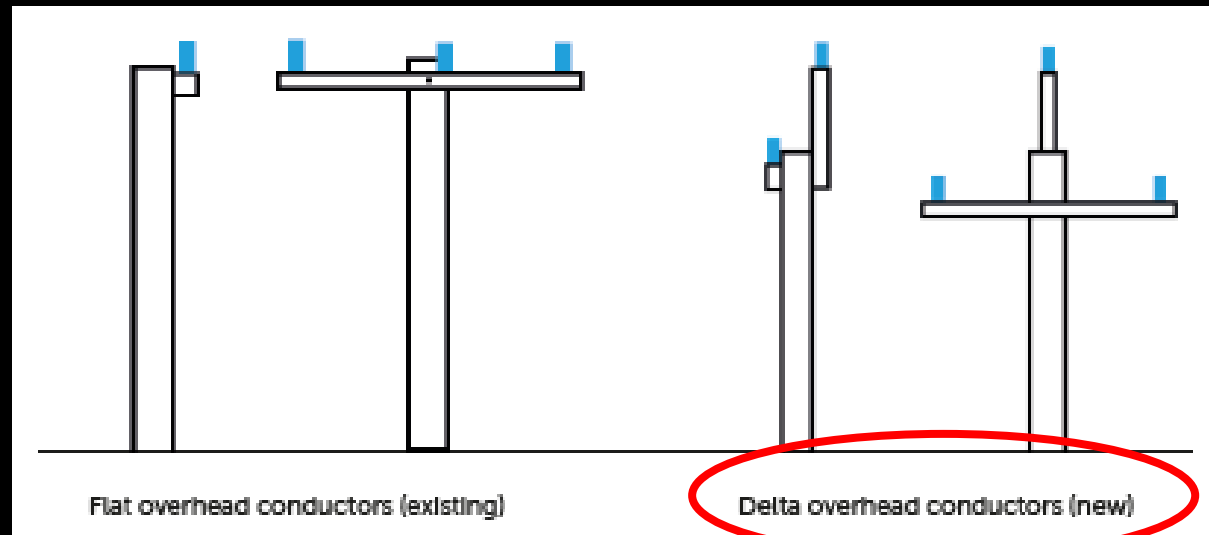
Mitigation



EAGLE SAFETY ZONE
Report birds of prey injured or killed near powerlines
132 004

A flapping good idea
We love Tassie's big birds. That's why we're putting flappers like these on our powerlines – to keep threatened birds like the Tasmanian wedge-tailed eagle out of harm's way.
Keep an eagle eye out for our TasNetworks team installing flappers, safe perching platforms and extra safety insulation to powerlines and conductors around the state.
If you find a bird of prey injured or killed near our powerlines, please call us on 132 004

 TasNetworks | Powering a Bright Future



Mitigation



Musselroe Wind Farm to deploy bird protecting radar in Australian first trial

[Michael Mazengarb](#) 19 December 2019



Photo Credit: Robin Radar Systems

Assessment of effectiveness of the IdentiFlight® avian detection system

Wild Cattle Hill Wind Farm

Prepared in satisfaction of EPBC Approval 2009/4838
Conditions 6A - 6C

February 2022



Toxicology – initial results

Eleven samples tested for a suite of heavy metals, including lead (mg/kg wet weight)

Species	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE
B_Number	9571	9574	9579	9581	9589	9606	9608	9614	9615	9616	9633
Age	Adult	Subadult	Adult	Adult	Adult	Adult	Adult	Subadult	Adult	Subadult	Subadult
Sex	M	M	F	F	F	M	F	M	F	M	M
Location	Buckland	Meadowbank	Orford	Evandale	Cattle Hill	Ulverstone	Fingal	Carlton River	Cattle Hill	Cattle Hill	Spreyton
CauseOfDeath	Trauma?	Electrocution	Toxicity?	Electrocution	Collision - turbine	Trauma, likely HBC	Electrocution	Electrocution	Collision - turbine	Collision - turbine	Toxicity?
Liver_Hg	0.02	0.03	0.03	<0.02	<0.02	0.04	0.03	<0.02	0.03	<0.02	0.03
Femur_Hg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Liver_Al	0.3	4.7	0.6	0.5	0.5	0.8	0.4	<0.3	1.3	<0.5	<0.5
Femur_Al	4.3	<2.5	<1.0	3.8							
Liver_As	<0.6	<0.6	<0.6	<0.6							
Femur_As	<1.6	<1.6	<1.6	<1.6							
Liver_Cd	<0.3	<0.3	<0.3	0.3							
Femur_Cd	<0.8	<0.8	<0.8	<0.8							
Liver_Cr	<0.3	<0.3	<0.3	<0.3							
Femur_Cr	<2.0	<2.0	<2.0	<2.0							
Liver_Cu	12.1	8.7	6.2	6.9							
Femur_Cu	<0.8	<0.8	<0.8	<0.8							
Liver_Fe	367	284	316	283							
Femur_Fe	14.3	18.2	7.2	12.5							
Liver_Mn	3.6	2.1	2.6	3.5							
Femur_Mn	2.9	4.5	2.2	1.9	3.7	3.7	3.3	2.9	3.0	3.7	2.3
Liver_Pb	<0.3	0.7	<0.3	<0.3	1.7	0.4	0.3	<0.3	1.6	0.4	<0.3
Femur_Pb	3.3	3.7	1.4	4.6	15.1	9.1	9.1	3.3	10.4	10.7	<0.8
Liver_Zn	43.8	17	18	20.7	17.3	34.1	14.6	20.6	25.6	26.6	29.8
Femur_Zn	184	177	166	195	208	188	203	170	179	194	139

Environmental Toxicology

High Frequency of Lead Exposure in the Population of an Endangered Australian Top Predator, the Tasmanian Wedge-Tailed Eagle (*Aquila audax fleayi*)

James M. Pay,^{a,*} Todd E. Katzner,^b Clare E. Hawkins,^a Amelia J. Koch,^{a,c} Jason M. Wiersma,^c William E. Brown,^d Nick J. Mooney,^e and Elissa Z. Cameron^{a,f}

Toxicology – initial results

Eleven samples tested for a suite of heavy metals, including lead (mg/kg wet weight)

Species	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE
B_Number	9571	9574	9579	9581	9589	9606	9608	9614	9615	9616	9633
Age	Adult	Subadult	Adult	Adult	Adult	Adult	Adult	Subadult	Adult	Subadult	Subadult
Sex	M	M	F	F	F	M	F	M	F	M	M
Location	Buckland	Meadowbank	Orford	Evandale	Cattle Hill	Ulverstone	Fingal	Carlton River	Cattle Hill	Cattle Hill	Spreyton
CauseOfDeath	Trauma?	Electrocution	Toxicity?	Electrocution	Collision - turbine	Trauma, likely HBC	Electrocution	Electrocution	Collision - turbine	Collision - turbine	Toxicity?

CSIRO PUBLISHING

Wildlife Research, 2018, **45**, 287–306
<https://doi.org/10.1071/WR17180>

Heads in the sand: public health and ecological risks of lead-based bullets for wildlife shooting in Australia

Jordan O. Hampton^{A,B,G}, Mark Laidlaw^C, Eric Buenz^D and Jon M. Arnemo^{E,F}

Liver_Fe	367	284	316	283							
Femur_Fe	14.3	18.2	7.2	12.5							
Liver_Mn	3.6	2.1	2.6	3.5							
Femur_Mn	2.9	4.5	2.2	1.9							
Liver_Pb	<0.3	0.7	<0.3	<0.3							
Femur_Pb	3.3	3.7	1.4	4.6	15.1	9.1	9.1	3.3	10.4	10.7	<0.8
Liver_Zn	43.8	17	18	20.7	17.3	34.1	14.6	20.6	25.6	26.6	29.8
Femur_Zn	184	177	166	195	208	188	203	170	179	194	139



Toxicology – initial results

Eleven samples tested for a suite of heavy metals, including lead (mg/kg wet weight)

Species	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE
B_Number	9571	9574	9579	9581	9589	9606	9608	9614	9615	9616	9633
Age	Adult	Subadult	Adult	Adult	Adult	Adult	Adult	Subadult	Adult	Subadult	Subadult
Sex	M	M	F	F	F	M	F	M	F	M	M
Location	Buckland	Meadowbank	Orford								Spreyton
CauseOfDeath	Trauma?	Electrocution	Toxicity?								Toxicity?
Liver_Hg	0.03	0.03	0.03								0.03
Femur_Hg	<0.03	<0.03	<0.03								<0.02
Liver_Al	0.4	0.4	0.4								<0.5
Femur_Al	4.2	4.2	4.2								<4.0
Liver_As	<0.6	<0.6	<0.6								<0.6
Femur_As	<1.6	<1.6	<1.6								<1.6
Liver_Cd	<0.3	<0.3	<0.3								<0.3
Femur_Cd	<0.8	<0.8	<0.8								<0.8
Liver_Cr	<0.3	<0.3	<0.3								<0.3
Femur_Cr	<3.0	<3.0	<3.0								<3.0
Liver_Cu	38.2	38.2	38.2								38.2
Femur_Cu	<0.8	<0.8	<0.8								<0.8
Liver_Fe	74.2	74.2	74.2								74.2
Femur_Fe	5.7	5.7	5.7								5.7
Liver_Mn	2.7	2.7	2.7								2.7
Femur_Mn	2.3	2.3	2.3								2.3
Liver_Pb	<0.3	<0.3	<0.3								<0.3
Femur_Pb	<0.8	<0.8	<0.8								<0.8
Liver_Zn	43.8	17	18	20.7	17.3	34.1	14.6	20.6	25.6	26.6	29.8
Femur_Zn	184	177	166	195	208	188	203	170	179	194	139

Toxicology – initial results

Eleven samples tested for a suite of Rodenticides (mg/kg wet weight)

Species	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE
B_Number	9571	9574	9579	9581	9589	9606	9608	9614	9615	9616	9633
Age	Adult	Subadult	Adult	Adult	Adult	Adult	Adult	Subadult	Adult	Subadult	Subadult
Sex	M	M	F	F	F	M	F	M	F	M	M
Location	Buckland	Meadowbank	Orford	Evandale	Cattle Hill	Ulverstone	Fingal	Carlton River	Cattle Hill	Cattle Hill	Spreyton
CauseOfDeath	Trauma?	Electrocution	Toxicity?	Electrocution	Collision - turbine	Trauma, likely HBC	Electrocution	Electrocution	Collision - turbine	Collision - turbine	Toxicity?
Brodifacoum	<0.01	0.02	<0.01	0.02	<0.01	0.04	<0.01	0.02	<0.01	<0.01	<0.01
Bromadiolone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Coumatetralyl	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Difenacoum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Difethialone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flocoumafen						<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pindone						<0.02	<0.02	<0.02	<0.02	<0.02	0.75
Warfarin						<0.01	<0.01	<0.01	<0.01	<0.01	<0.01



Rodenticides work by disrupting the normal blood clotting process so that affected individuals suffer from uncontrolled bleeding



Toxicology – initial results

Eleven samples tested for a suite of Rodenticides (mg/kg wet weight)

Species	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE	WTE
B_Number	9571	9574	9579	9581	9589	9606	9608	9614	9615	9616	9633
Age	Adult	Subadult	Adult	Adult	Adult	Adult	Adult	Subadult	Adult	Subadult	Subadult
Sex	M	M	F	F	F	M	F	M	F	M	M
Location	Buckland	Meadowbank	Orford	Evandale	Cattle Hill	Ulverstone	Fingal	Carlton River	Cattle Hill	Cattle Hill	Spreyton
CauseOfDeath	Trauma?	Electrocution	Toxicity?	Electrocution	Collision - turbine	Trauma, likely HBC	Electrocution	Electrocution	Collision - turbine	Collision - turbine	Toxicity?
Brodifacoum	<0.01	0.02	<0.01	0.02	<0.01	0.04	<0.01	0.02	<0.01	<0.01	<0.01
Bromadiolone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Coumatetralyl	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Difenacoum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Difethialone	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flocoumafen	<0.01	<0.01	0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pindone	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.75
Warfarin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Second generation rodenticides are far more dangerous to wildlife than their predecessors because they break down more slowly and are toxic in smaller amounts



Toxicology – subsequent data

Rodenticides

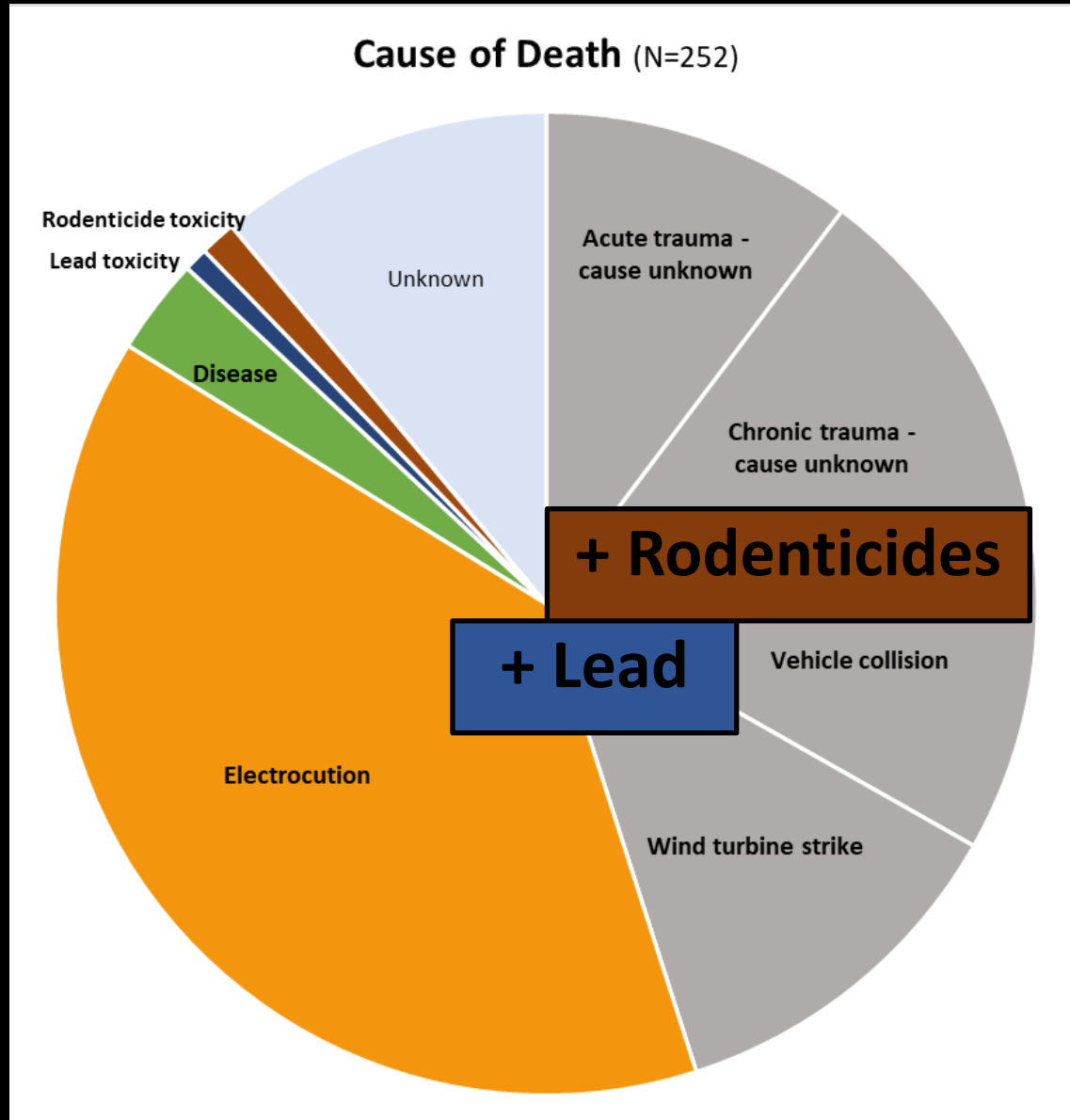
First Generation	Second Generation
Warfarin	Brodifacoum
Coumatetralyl	Bromadiolone
	Difenacoum
	Difethialone
	Flocoumafen

Mitre 10 and Woolworths



Bunnings





Haemorrhage

Weakness

Anaemia

Incoordination

Toxicology – subsequent data

Rodenticides

First Generation

Warfarin

Coumatetralyl



Second Generation

Brodifacoum

Bromadiolone

Difenacoum

Difethialone

Flocoumafen

Mitre 10 and Woolworths



Bunnings





NATURE
TRACKERS

Final Plug:



12-14 & 26-
28 MAY 2023

OUR PROJECTS

Where? Where? Wedgie!

Get your family and friends outdoors this May, to help track Tasmanian wedge-tailed eagle numbers, together with Tasmania's other birds of prey, white cockatoos and corellas.



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QUESTIONS?