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Workplace Attitudes and Responsibilities regarding Euthanasia Practices within Australasian Zoos and Aquariums

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Abstract

Euthanasia of a diverse range of species is carried out regularly in Australasian zoos, however little is known about zoo employee attitudes on the use of euthanasia within Australasian zoos, the types of euthanasia performed and the range of personnel involved. I carried out a survey of staff in zoos across Australia and New Zealand and used quantitative and qualitative methods to analyse the responses. Widely variable employee support was documented for both lethal and non-lethal animal management strategies, with polarizing attitudes expressed toward the use of euthanasia for “otherwise healthy” animals. Non-lethal methods (e.g. reproductive control) to avoid creation of surplus young were emphatically supported, and were preferred over lethal methods that focused on managing resultant individuals. The underlying justification for the use of euthanasia was critically important to attitudes held by employees, suggesting many zoo professionals will apply moral judgements at the individual animal-level, with euthanasia performed for geriatric animals shown to be a well-accepted and common practice. We documented a broad variety of personnel involved in the euthanasia decision-making process within zoos, and identified divergence in attitudes held across individual employees and major employee groups (i.e. ‘management’, ‘animal care’, and ‘veterinary services’). Variation in euthanasia use and attitudes was identified across different workplace settings, and geographic influences were revealed with a broadly heterogenous set of attitudes identified for Australasia. This work calls for more open and transparent considerations around animal euthanasia, with recognition of the cultural differences that may exist, and the risks that euthanasia practices create for the experiences of those caring for animals, to the animals themselves, and to the maintenance of zoos’ social licence.

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Table of Contents

Abstract	2
Acknowledgements	3
Introduction	7
Chapter 1: Literature review	11
1.1. Animal Euthanasia in Contemporary Society	11
1.1.1. Animal Killing Across Industries	11
1.1.2. Euthanasia Practices within Zoos and Aquariums	14
1.1.2.1. Uses of Euthanasia within Zoos	14
1.1.2.2. Controversial Zoo-based Euthanasia Practices	15
1.2. Contact with Animal Euthanasia	17
1.2.1. Personnel Involvement with Euthanasia in Modern Society	17
1.2.2. Occupational Stress and Mental Health Impact of Euthanasia Exposure	18
1.2.2.1. 'Closeness', Exposure Frequency, and Type of Work	19
1.2.2.2. Workplace Type	20
1.2.2.3. Personal and Demographic Factors	21
1.3. Attitudes toward Euthanasia and Lethal Control of Animals	21
1.3.1. Societal Beliefs on Death and Euthanasia.....	21
1.3.2. Zoo Community Attitudes toward the Use of Euthanasia within Zoos	22
Chapter 2: Methods	23
2.1. Participants	23
2.2. Study Design	24
2.3. Measures Used	27
2.4. Procedures	34
2.5. Data Analysis	34
2.5.1. Quantitative analyses	34
2.5.2. Qualitative analyses	35
Chapter 3: Results	35
3.1. Data Preparation	35
3.2. Participant and Workplace Characteristics	35
3.3. Use of Euthanasia Reported at Australasian Zoos	36
3.4. Zoo Employee Euthanasia Tasks	37
3.4.1. Personnel Responsible for Performing Euthanasia	37
3.4.2. Personnel Involved with Euthanasia Decisions and Authorisation	39
3.4.2.1. Overall	39

3.4.2.2. Workplace Differences	39
3.5. Zoo Employee Attitudes to Use of Euthanasia for “Surplus” and “Geriatric” Animals	44
3.6. Zoo Employee Attitudes to Lethal and Non-lethal Options for Population Management ...	44
3.7. Attitudinal Variation – Participants	47
3.7.1. Employment.....	47
3.7.2. Euthanasia Exposure and Animal Contact	47
3.7.3. Other Participant Demographics	47
3.8. Attitudinal Variation – Across Workplaces	49
3.8.1. Facility Type	49
3.8.2. Awareness and Known Use of Euthanasia at Workplace	49
3.8.3. Geographical Location	51
3.9. Thematic Analyses	51
3.9.1. Responsibilities of Non-Veterinary Staff during Euthanasia Events	51
<i>Theme: ‘For Certain Reasons and Certain Species’</i>	51
<i>Theme: ‘Approved Methods by Trained Staff’</i>	52
3.9.2. Employee Responsibilities during Euthanasia Decisions, Authorisation and End-of-Life Care	52
<i>Theme: ‘Keepers and their Animals Aging Under their Care’</i>	52
<i>Theme: ‘Variable Roles of Veterinary Staff’</i>	52
<i>Theme: ‘What is Authorisation?’</i>	53
Chapter 4: Discussion	53
4.1. The Use and Acceptability of Euthanasia within Australasian Zoos	53
4.2. Personnel Involvement and Attitudes	55
4.3. Decision-Making Responsibility	57
4.4. Outcomes for Industry	59
4.5. Limitations	61
Conclusion	61
References	63
Appendix A – Full Survey	71
Appendix B – Thematic Coding-Tree Excerpts.....	97

List of Figures:

Figure 1: Progression of Key Questions using “Branch Logic” within Qualtrics Survey Software – Personnel Involvement in Euthanasia Practice and Decision-Making	25
Figure 2: Progression of Key Questions using “Branch Logic” within Qualtrics Survey Software – Personal Attitudes to Euthanasia and Population Management	26
Table 1: Sample characteristics - Participant Sociodemographic and Employment Data	28
Table 2: Sample characteristics – Location and Workplace	29
Table 3: Sample characteristics – Comparison of Employment Field with Key Demographic Features across Australian and New Zealand Data	30
Table 4: Sample characteristics – Comparison of Key Workplace Features across Australian and New Zealand Data	31
Table 5: Sample characteristics – Participant Exposure to Euthanasia and Zoo Animal Contact	32
Table 6: Reported Use of Euthanasia Practices at Australasian Zoos	37
Table 7: Zoo Personnel Reported to Perform Animal Euthanasia	38
Figure 3. Employment Roles Reportedly Involved in Euthanasia Decision-Making and Authorisation	40
Figure 4. Personal Feelings of Involvement with Euthanasia Decision-Making	41
Table 8: Workplace Variation in Personnel Involved in Euthanasia-Decisions of “Geriatric” Animals	42
Table 9: Workplace Variation in Personnel Involved in Euthanasia-Decisions of “Surplus” Animals	43
Figure 5: Zoo Employee Attitudes Toward Euthanasia Under Two Contrasting Circumstances	45
Figure 6: Comparison of Employee Attitudes Toward Lethal and Non-lethal Population Management Strategies	46
Figure 7: Attitudes of Different Employment Fields Toward Euthanasia Under Two Contrasting Circumstances	48
Figure 8: Employee Attitudes Associated with Awareness of Euthanasia Use at Workplace	50

Introduction

Individual animals within zoos routinely reach ages that are older than their wild counterparts (Baker, 2000; Föllmi et al., 2007; Heintz et al., 2019) and more offspring may survive than would be expected under natural conditions (Lewandowski, 2003). This can cause challenges for zoos that have inherent space and resource constraints (Carter & Kagan, 2010). Compounding this, many zoo species often have typical lifespans far in excess of domestic species, potentially living for many decades. Due to these long lives, zoo animals will have been cared for by numerous different zoo keepers. They will have been exposed to many visitors and environmental stressors, and could have experienced life within multiple enclosures across different zoos.

Therefore, over the lifetime of a zoo animal, many aspects of their social environment, reproductive lives, psychological experiences and overall health will change. This can lead to animals that may experience difficulties within captive circumstances for reasons that appear variably during different stages of their life (Rebelo, 2019). These life-time experiences, and attention to the wellbeing of animals during each discrete phase of life (Campbell-Ward, 2023), is of high importance for protecting the overall welfare of zoo animals with these lengthy, and often complicated, courses of life.

When animals age, individuals are increasingly exposed to challenges to their health and welfare, and multiple health concerns and co-morbidities may be experienced simultaneously (Flacke et al., 2016; Rebelo, 2019). It is argued that without close attention, zoos may unintentionally expose long-lived zoo animals to unexpected welfare concerns (Föllmi et al., 2007), and that there can be a tendency for zoos to celebrate animal longevity at the risk of prolonging animal life beyond what may be considered appropriate for the animal itself (Jessup & Scott, 2011). With increasing age, obesity, neoplastic and reproductive pathologies may emerge, immune strength may diminish, and individuals may experience degenerative conditions such as osteoarthritis, dental disease, organ failure, or cognitive and sensory decline (Flacke et al., 2016; Moittie et al., 2020; Rebelo, 2019). Concurrently, an aging animal's ability to utilize environmental features of their enclosure may be impacted (Heintz et al., 2019) or engagement with enrichment devices may reduce (Baker, 2000). Animals may experience social challenges via shifting group dynamics and changes in behavioural patterns, as activity levels and preferences of aging individuals within populations change (Baker, 2000) and the strength of social connection between individuals may weaken (Thompson González et al., 2021). For many reasons, considerations around the end-of-life phase become substantial, and it may be unacceptable for the welfare of an individual animal to continue to live within its existing environmental or social circumstances.

These scenarios lead to many added responsibilities for the personnel caring for these animals (Campbell-Ward, 2023; Föllmi et al., 2007; Hepps Keeney & Harrison, 2022). Animal care staff may need to devote time to undertaking additional tasks within their working day, and senior employees may become responsible for difficult decisions regarding captive animal quality-of-life, longevity, collection planning, and euthanasia. Staff within animal care teams can become responsible for performing novel and sometimes physically or emotionally onerous tasks to ensure animals remain comfortable. For instance, providing pain medication and monitoring animals closely for signs of age-related decline each day (Rebelo, 2019) or altering physical environments and animal introduction practices to suit aging animals (Baker, 2000). This may be particularly challenging if multiple individuals within a cohort reach old age simultaneously, or when individuals are difficult to directly handle or observe up-close (pers. obs.). Moreover, veterinary staff may face diverse clinical and practical considerations associated with the technical challenges of euthanising non-domestic

species (Hepps Keeney & Harrison, 2022), surrounded by an increasing need for collaboration between teams to achieve the “best outcome” for aging animals (Moittie et al., 2020; Rebelo, 2019). Distinct and varying pressures might also be applied on decision-makers about appropriate housing for aging individuals, or populations, as management and animal care requirements shift. In many cases, euthanasia may be discussed. Within zoological settings, these discussions may comprise many personnel and become complex discussions across a range of stakeholders (Rebelo, 2019) which may vary with institutional structure and size (Campbell-Ward, 2023), and may involve organisational or political elements (Föllmi et al., 2007).

The use of assessment frameworks and tools that aid in the evaluation of aging animals are increasingly embedded within practices across different animal care settings. These tools can support the decision-making process around euthanasia, with examples present within companion animal care (Belshaw, 2018; Fulmer et al., 2022; McKenzie & Chen, 2022; Yeates & Main, 2009) through to laboratory animal management (Lambeth et al., 2013), equine medicine (Parker & Yeates, 2012) and zoos (Campbell-Ward, 2023; Föllmi et al., 2007). Despite the inherent conceptual challenges of terminology and variable interpretations embedded within approaches, application of such tools within zoological institutions is increasingly encouraged by global accreditation bodies (Campbell-Ward, 2023). Within Australasia these tools are often referred to as “quality of life assessments (QoL’s)”, or “aged animal assessments”, and have been promoted within zoological medicine and zoo animal wellbeing texts (Chapman et al., 2023; Vogelnest & Talbot, 2019).

In addition to euthanasia related to welfare reasons of ill-health, social dynamics, or age-related declines, decisions may be made to euthanise healthy animals for reasons that are associated with practical or financial restraints, or for other reasons unrelated to the individual animal themselves (Carter & Kagan, 2010; Persson et al., 2020; Reeve et al., 2005; Stevens et al., 2022). Within zoological settings, this can be associated with financial cost or resource challenges of captive population management, poor genetic suitability for cooperative breeding programs within the local geographical region, space limitations, or for a broader set of reasons associated with institutional specific goals (Carter & Kagan, 2010). The euthanasia of healthy animals is under broad active debate across the animal care profession (Hartnack et al., 2016a).

It is well known that zoological institutions contribute to contemporary conservation (Spooner et al., 2023) and that efforts to counteract extinction rates are beneficial to maintaining public confidence and ‘social licence to operate’ (Sayers, 2020). However, their effectivity is questioned (Lees & Wilcken, 2009) and it is argued that the global zoo profession is facing a genetic “sustainability crisis” (McCann & Powell, 2019; Powell, 2019). With this in mind, there are calls from within the zoological profession to review institution policies (Kaumanns et al., 2020) and to re-evaluate the use of planned euthanasia of healthy animals as part of integrated population management strategies (Powell, 2019; Wenker et al., 2012) to assist effectivity and operation of zoos. The rationale provided is to enhance genetic health, behavioural suitability, and overall longevity and reproductive effectivity of captive populations, given the known limitations that exist for small animal management within zoos (Powell & Ardaiole, 2016). Unsurprisingly, the use of routine planned euthanasia is a contested point of view, with many advocating for the value of alternatives (Asa et al., 2010; Browning, 2018; Carter & Kagan, 2010) and the societal benefits of guiding ethical paradigms that do not prioritise lethal management strategies (Asa, 2016). This euthanasia of “otherwise healthy” animals may be perceived to conflict with zoos’ mission to save wildlife (Powell & Ardaiole, 2016). This may cause heightened moral challenges for personnel working directly with animals (Herzog Jr et al., 1989; Powell & Ardaiole, 2016) and risks attracting concern from the general public

(McCulloch & Reiss, 2017) as well as published peer-reviewed literature (Browning, 2018; Mc Loughlin, 2023b).

While these debates continue to evolve, it is anticipated that curatorial, managerial, or other senior leaders will be responsible for fielding questions increasingly often regarding the role and practice of euthanasia within the modern zoo, either from the internal or external community. The wider public clearly takes an active interest and is concerned about the use of euthanasia within zoos (Levin, 2015). Most famously, there was international outcry associated with the euthanasia of a young male giraffe named “Marius” who was deemed genetically surplus at Copenhagen Zoo (McCulloch & Reiss, 2017). Ongoing coverage of this case, and others, is readily apparent through investigations of currently active social media and popular news coverage. Recently, a decade after the death of Marius, a documentary reflecting on the scenario has been released (Carey, 2024), re-emphasising public intrigue and attention toward the life and death of animals within zoos. The application of euthanasia to healthy animals is therefore an ethical challenge and topic of public concern that modern zoological facilities must continue to face (Levin, 2015).

Most directly, staff members may be personally responsible for potentially confronting decisions associated with breeding and population control. As per Asa et al. (2010), “the burden and responsibility of population control [is placed] directly onto the shoulders of animal managers and zoo administrators” (p. 469). In addition to conservation needs, the pressure to continue to breed animals, despite space and resource constraints, may be spurred on by visitors placing a high value on viewing young animals (Carter & Kagan, 2010; Lewandowski, 2003), which in-turn may improve visitation and profitability. This may be more important for establishments that rely financially on visitation rates and commercial products, and adds a further ethical layer for consideration.

Importantly, there are members of the zoo community who are directly responsible for recommending and performing the euthanasia of zoo animals (e.g. veterinary staff) (Hepps Keeney & Harrison, 2022; Wenker et al., 2012), which can have a profound impact on the professional and personal lives of these personnel. Baran et al (2012) frame euthanasia as a technical and emotional act that puts the employee “in direct contact with death” (p. 607). Across animal care, it is known that veterinarians may perform euthanasia even under circumstances with which they do not personally agree (Moses et al., 2018), and that personal attitudes, age, and gender may influence agreement with requests to euthanise an animal (Bennett & Rohlf, 2005; Hartnack et al., 2016a; Ogden et al., 2012). Moreover, the experiences and emotional responses of those who undertake the euthanasia of wildlife during professional work have been shown to be unanticipated and variable, with employees finding multiple diverse ways to justify or explain the act of killing (Von Dietze & Gardner, 2014). As such, assumptions cannot be made that every employee involved with euthanasia during their professional career undergo a comparable experience, assume parallel duties and responsibilities, or exhibit similar reactions to performing or observing euthanasia within their workplace. The pivotal role of curators, managers, and veterinary team members in appropriately integrating the use of animal euthanasia is critical to recognise, and their experiences during their working lives worthy of consideration.

The World Association of Zoos and Aquariums (WAZA) “Animal Welfare Strategy” encourages all member groups to establish written euthanasia policies (Mellor et al., 2015). The strategy specifies that institutional policies should illustrate the circumstances when euthanasia may be appropriate and should outline who is mandated to perform the euthanasia. The document also states that policies should clearly outline roles and responsibilities of staff during euthanasia events and that policies should indicate how euthanasia will be used, which presumably encompasses the methods and practices used. Similarly, the Zoo and Aquarium Association Australasia (ZAA) provides Animal

Euthanasia guidelines (ZAA, 2015) that indicate that the decision to euthanise an animal rests with the member zoo or aquarium, that each

institution has ethical obligations in the use of euthanasia at their facility, and may formulate their own policies based on the ZAA guidelines provided. These guidelines provide circumstances where euthanasia may be used; stipulating that euthanasia may be performed during “responsible application of veterinary medicine” or “scientific management of animal populations” (p. 1). The guidelines also recognise the possibility of culling animals for food, feral animals, confiscated animals, or euthanasia of wildlife undergoing rehabilitation. The use of institutional or independent Animal Ethics Committees during euthanasia decisions is encouraged. However, the guidelines themselves do not navigate what euthanasia practices are appropriate, or which personnel should be responsible for performing euthanasia, or directing euthanasia decisions. Overall, individual zoos are able to independently interpret “quality of life” and apply approaches and ultimately euthanasia based on their own operational needs and culture (Campbell-Ward, 2023).

It is clear that caring for captive aging animals and breeding populations is a significant issue for animal welfare and management within zoos, with end-of-life care, employee ‘burn out’, and euthanasia decisions posing active ethical and practical concerns across animal care settings (Scotney et al., 2015). The potential breadth of employee duties regarding euthanasia, collection planning and end-of-life care have been described in-part (Jessup & Scott, 2011; Krebs et al., 2018) and are often known to those working within animal care. However, little is formally known about the roles and responsibilities of zoo professionals within Australasia, and what may influence their personal experiences of euthanasia. These factors and the demographics that may influence zoo employee attitudes toward animal welfare and controversial zoo practices is important to understand to support development of policy and educational initiatives (Bacon, Bell, et al., 2023). Cultural influences are likely, and important to explore within different regions if the international zoo community is to be successful in wide reaching cooperative conservation strategies. As such, gaps in knowledge around international attitudes toward zoo animal welfare have recently been identified and emphasized for continued attention (Bacon, Bell, et al., 2023).

Moreover, while it is common knowledge that veterinarians are responsible for undertaking euthanasia within their line of work (Hepps Keeney & Harrison, 2022; Wenker et al., 2012), the involvement of veterinarians across different facility types is currently undocumented. This may be a concern particularly for smaller facilities, who may draw on contracted or casual veterinarians that may not be as closely embedded in the institution’s animal care (pers. obs.). Overall, current practices around the use of euthanasia within Australasia, and the process of how euthanasia is undertaken locally within Australasian zoological institutions is broadly unknown and has had minimal attention within published literature. This study aims to provide industry-specific insights into the process of euthanasia within Australasian zoos. The work assists in describing characteristics of employees that may influence moral beliefs and attitudes toward animal management practices, considerations that are important for enhancing moral comfort during employee lives, and understanding the underlying values systems that are active within the Australasian region. The project therefore contributes to the global emerging understanding of attitudes of zoo personnel toward topics of animal welfare relevance (Bacon et al., 2021a, 2021b; Powell & Ardaiolo, 2016; Powell et al., 2018).

Within this study, quantitative and qualitative methods are used in-conjunction to document the roles and responsibilities of zoo professionals engaged with animal euthanasia practices, decisions, and end-of-life care within Australia and New Zealand. It is explored whether organisational or workplace characteristics, and key personal demographics, alter the attitudes and responsibilities of

employed zoo professionals. It is also investigated whether ethically relevant animal-based features that reflect underlying euthanasia justification play a role in influencing employee attitudes (i.e. whether the animal is “geriatric” or “surplus/healthy”), and compares attitudes across lethal and non-lethal management options including, for example, contraception, separation of animals, and euthanasia of animals at different ages. The thesis is organised into four chapters, consisting of a literature review, and subsequent chapters dedicated to the methods, quantitative and qualitative results, and discussion.

Chapter 1. Literature Review

1.1. Animal Euthanasia in Contemporary Society

1.1.1. Animal Killing Across Industries

It is a routine part of modern life that animals are killed and euthanised by humans across many sectors of society, and for a multitude of underlying reasons (Fawcett, 2013; Ison, 2022). Even restricted to specific animal use settings, the numbers of animals euthanised annually is substantial and hard to comprehend. For instance, Rogelberg et al. (2007) reports 3 – 4 million companion animals euthanised annually within rescue shelters, for this industry alone. The practice of ending the life of an animal is common, and embedded within many societal activities and operations globally, including agriculture, science and technology, disease control and public health, as well as the keeping of pets, a wide range of recreational purposes, and societal pursuits such as conservation. Indeed, human society is intertwined with the killing of animals (Ison, 2022). While it is commonly considered that euthanasia is performed for reasons of best interest to the animal, the justified use of killing and causing the death of animals is complex, with extrinsic factors such as financial and practical considerations contributing to euthanasia decision-making, and in many cases these factors may provide key reasons a non-human animal is euthanised (Persson et al., 2020; Stevens et al., 2022).

The word “euthanasia” in itself is problematic and understood to be morally polysemous (Karumathil & Tripathi, 2022) with multiple interpretations and meanings, and associated conceptual confusion (Persson et al., 2020). That is, across both human medical and veterinary medical ethics, “euthanasia” may be used to describe killing undertaken across scenarios that vary in ways that are ethically relevant (Persson et al., 2020). The key feature that may vary is whether the euthanasia can be interpreted as being performed for the benefit of the individual animal to relieve suffering (or similar negative concept), or for reasons extrinsic to the individual; and whether or not consent has been provided. It appears that for veterinary purposes, we apply the word “euthanasia” liberally across more contrasting scenarios than is the case for human medicine (Fawcett, 2013; Persson et al., 2020). For instance, the killing of laboratory mice at the conclusion of scientific studies (Turner et al., 2020), or the killing of non-native wild animals (Tidemann et al., 2011) may each be referred to as euthanasia, despite often not being performed for the animal’s individual benefit. On the contrary, there are scenarios where the killing of an animal can be argued as being performed for the individual’s benefit – and therefore sits within a more narrow conception of the word euthanasia to relieve suffering – yet alternative terms such as “culling” appear to be favoured. For example, the culling of animals impacted by drought (Windsor, 2021), culling of wild animals impacted by disease (Wilson et al., 2015), or the slaughter of livestock when environmental farming conditions are impoverished (Yeates, 2022). In fact, it is argued that these subtle semantic differences may reflect that, on a deeper level, Western society has deemed these non-domesticated species as “not worthy” of death by euthanasia (Ison, 2022).

Therefore, it appears within veterinary or animal contexts a variety of terms are applied to the practice of humane animal killing, and are also applied variably across contexts. As such, discourse around animal death is complicated by different terminology interwoven and many associated moral dilemmas (Ison, 2022). To aid with this confusion, The Australian Veterinary Association (AVA) provides a simple delineation within its Euthanasia Policy (AVA, 2007) for attending veterinarians to consider that euthanasia occurs when pain/suffering or welfare impact is beyond resolution; whereas humane killing is for all other circumstances, including for those animals that have outlived their intended purpose within breeding, scientific research, the killing of unwanted pets, pest control, and slaughter of livestock at abattoirs. Similarly, (Yeates, 2010) provides an ethical framework for veterinarians to consider three justification classifications: “absolutely justified euthanasia”; “contextually-justified euthanasia”; and “killing that is not truly in an animal’s interests”, which is described as not meeting an appropriate euthanasia definition, but could still be a justified act for extrinsic reasons beyond the individual. For the purposes of this literature review, and in order not to limit the discussion to only scenarios where killing has been designated or described as euthanasia, I will initially discuss euthanasia and killing of animals and associated perceptions in a general sense, and will define terminology further where needed within following chapters.

Overarchingly, many features around the justification and use of killing practices and euthanasia varies between animal use industries. Within laboratory environments, euthanasia or humane killing of animals may be a necessary and expected outcome of research studies (LaFollette et al., 2020), whereas within animal shelter environments, pets may be euthanised because a home cannot be found (Rogelberg et al., 2007). Killing is of course required for the consumption of agricultural species, and death and euthanasia may be a routine inadvertent outcome of the use of equids and other animals engaged in high-speed racing or dangerous sports or recreations. This includes, for example, equestrian sports (Stein, 2020), greyhound racing (Palmer et al., 2021; Stevens et al., 2022), falconry (Ash, 2012), and pig-hunting (Orr et al., 2019). In many of these cases, although euthanasia may be performed to relieve suffering from injuries incurred, the dangerous circumstances were imposed due to their purpose as animals used for recreation, and so the killing is the consequence of a range of underlying animal use justifications.

Within companion animal care of domestic pets, animals are often euthanised for reasons of old age and debilitating health conditions, or due to injury or costly treatment that cannot be afforded by owners (Boller et al., 2020). In many cases during the veterinary care of animals, euthanasia may be considered aligned with the best interests of the animal, i.e. when suffering associated with continuing to live is high. However even within these cases there must be ethical attention given to the best *timepoint* for euthanasia to occur (Föllmi et al., 2007; Heintz et al., 2019; Knesl et al., 2017; Persson et al., 2020). The euthanasia of “otherwise healthy” pets also occurs during the provision of veterinary care to companion animals, commonly due to financial reasons, practical constraints, owner request, or a range of other circumstantial reasons. A subset of this type of euthanasia may be termed “convenience euthanasia” and creates elevated ethical challenges for those involved (Herzog Jr et al., 1989; Persson et al., 2020). An example of “convenience euthanasia” occurs when an owner may move house, is unable to take their pet, and elects to have the pet euthanised rather than rehomed with a new family. In some cases, behavioural abnormalities may be cited for the reason euthanasia is performed for an otherwise healthy pet, but precise explanations here can be hard to establish and in many cases this justification will not allay community concerns more broadly (Ison, 2022). The term “economic euthanasia” is gaining increased use to describe the specific scenario where lack of funds leads to a decision to euthanise a pet (Boller et al., 2020; Fawcett, 2013). Healthy domestic pets may also be killed if determined legally necessary for posing a danger or perceived nuisance to the community (Fawcett, 2013), their use in sport has discontinued (Stein,

2020; Stevens et al., 2022) or after retirement from farm work (Orr et al., 2019). There are also reports of individuals that do not suit preferred phenotypes being killed within pedigree dog breeding (Wanner, 2017). It is clear that even when restricted to species of domestic pet, there are many underlying justifications for animal killing.

The protective emotional function of designing a plausible justification to support killing appears to be high (Von Dietze & Gardner, 2014), with many pet owners providing detailed descriptions of euthanasia justifications that exist to their mind (pers. obs). Identifying practical considerations and justifications may be helpful also for veterinarians to persuade themselves that euthanasia is acceptable under the circumstances, if animals are not sick or suffering physically. For example, killing of livestock may be seen as justified for farming systems to allow for new healthy animal lives, or killing may be considered essential and justified to contain the spread of disease (Yeates, 2022). Equally, veterinarians have been shown to refuse to undertake euthanasia for young and healthy animals if suitable justifications cannot be found (Yeates & Main, 2011). Zoo employees have also been shown to want further information when providing judgements on the acceptability of euthanasia (Powell & Ardaiole, 2016); shown as especially important for veterinarians (Powell et al., 2018)

In contrast to the detailed attention afforded to individual animals described above, there may not be a specific owner or responsible party advocating for individual animal experiences within industrial or large scale operations. Instead, a very high number of animals may be killed simultaneously, or systematic killing may be initiated to continue over time. That is, a *group* or groups of animals are killed, irrespective of individual needs. Common examples include the killing of day old male chicks that do not have a purpose in continued poultry production (Leenstra et al., 2011), or the depopulation of farms in association with disease control measures and public health (Stikeleather et al., 2013). Culling of high numbers of animals within populations may also be integrated within conservation and ongoing wild animal management programs, for example the selective culling of predatory species to improve predator-prey dynamics within specific geographical regions or populations (Sanz-Aguilar et al., 2009), to support land management and ecological outcomes (Pople et al., 2023), or control of animals considered to be pests or otherwise harmful (Tidemann et al., 2011). Pet animals may also be killed at scale, for example the millions of animals within pounds and shelters that are not successfully rehomed each year (Ison, 2022). In the general impression of the author, “group killing” or killing of high numbers of animals systematically at a population-level, appears to attract high degrees of public scrutiny.

The requirement to kill high numbers of animals also poses unique practical challenges, that may lead to elevated welfare or animal cruelty concerns for the animals involved. For example, the use of hyperthermia as a mass depopulation strategy for pigs during the early months of the COVID-19 pandemic, undertaken due to supply chain disruptions and industry impacts (Baysinger et al., 2021), or the use of fire-fighting foam to cause poultry suffocation during avian influenza disease outbreaks (Whiting & Keaney, 2022). These activities received substantial reactions, and are argued as amounting to animal cruelty (Whiting & Keaney, 2022). When considering work at a landscape scale or in areas that pose geographical access difficulties (Strive & Cox, 2019), the performance of killing and euthanasia may involve practices that are considered particularly harmful or controversial. Clear examples include the use of traps and baits for free-roaming animals (Beausoleil et al., 2022; Littin et al., 2004; Morris & Weaver, 2003), or the release of lethal diseases (Cooke & Fenner, 2002; Strive & Cox, 2019). These practices may occur sporadically, or may become routine, ongoing conservation tools within certain geographic regions. For instance, biological control has been used within the Australian ecosystem to suppress the population of feral rabbits for over 70 years (Strive & Cox,

2019), and brushtail possums are trapped and killed routinely in New Zealand (Morris & Weaver, 2003). Elevated attention around such practices being inhumane and worthy of enhanced scrutiny may occur due to strong feelings of community value toward certain species, for instance, badgers that are culled in the UK for agricultural disease control reasons (Bennett & Willis, 2008). The challenges around killing large numbers of wild animals often leads to innovation and development of new strategies that create unusual ethical or potentially confronting strategies; for example mobile CO₂ chambers moved via trailer for feral pigs (Kinsey et al., 2016), traps disguised as rubbish bins to lure and kill corellas (Milienos, 2022), or delivering carbon monoxide into nestboxes (Tidemann et al., 2011). It is important to note that in certain cases approaches to killing may be preferred for animal welfare reasons, yet these activities may still attract public scrutiny related to the method of killing selected. For example, the killing and harvesting of kangaroos via firearms may be argued as preferential as part of management practices to provide support for individual animal welfare outcomes during periods of overabundance and/or climatic drought (Stephens, 2021), but may still attract public scrutiny.

Overall, the killing of animals can be observed readily across many animal care and use settings and societal pursuits. Public scrutiny is high and elevated for specific types of killing, and the terminology used to describe animal deaths is challenging to follow. As such, it is valuable to recognise the underlying reasons an industry uses euthanasia or killing may vary, and that euthanasia justifications may be important for the owners or employees involved.

1.1.2. Euthanasia Practices within Zoos and Aquariums

1.1.2.1. Uses of Euthanasia within Zoos

Within zoos and aquariums there are a multitude of reasons animals are euthanised associated with events that may present through the course of an animal's life. This may be directly connected to animal-based features of health and welfare, or related to external factors including social dynamics or environmental conditions. Within zoo contexts, it is common for animals to achieve longevity in excess of wild counterparts (Heintz et al., 2019), due to protection from environmental harms and predation, and high standards of husbandry and medical care. As such, managing the euthanasia of aging animals has become a notable aspect of contemporary zoo management and the daily lives of zoo keepers, with protection of animal welfare during the end-of-life period rising in priority (Campbell-Ward, 2023; Rebelo, 2019). Moreover, many species typically held in zoos may have naturally long lifespans, sometimes far in excess of domestic animals, which therefore extends and compounds the significance of the end-of life period within the zoo setting.

As per veterinary care of domestic species, elderly zoo animals may be euthanised to remove the pain and suffering an individual animal is experiencing as quality of life deteriorates (Campbell-Ward, 2023; Heintz et al., 2019; Krebs et al., 2018; Moittie et al., 2020; Rebelo, 2019). Regardless of species, euthanasia of an animal suffering an age-related disease requires professional competencies and decisions by human caretakers to approximate the timepoint when death is a more suitable outcome than continuing to live (Knesl et al., 2017). Euthanasia may even be seen as a moral obligation once this time point has been realised (Persson et al., 2020). It is identification of this justifiable time-point that makes the euthanasia of aging animals challenging, particularly long-lived aging zoo animals, and as a result scoring systems have been developed to support this process (Campbell-Ward, 2023; Föllmi et al., 2007; Simpson et al., 2024). Ultimately, euthanasia decision-making and the process of dying for a zoo animal may be protracted across many years, or even decades.

Zoo animals may also be euthanised for social reasons associated with group living in captivity, or behavioural concerns (Rebelo, 2019). For instance, group dynamics of social species may lead to an individual animal being harmed psychologically or physically by conspecifics, and patterns of aggression may deviate from what is observed for the species in the wild (Davis et al., 2009). Non-human primates are a common taxa held within zoos where intra-specific aggression may lead to injuries of varied severity, potentially leading to death (Davis et al., 2009; Inglett et al., 1989; Wiley et al., 2018). Animals that are not coping psychologically or behaviourally with captivity may also be euthanised to prevent continued suffering, if evidence of severe stereotypic or other behavioural signs are non-responsive to treatment attempts (Walraven et al., 2018).

Moreover, for captive zoo animals, environmental surroundings pose challenges for consistently achieving good welfare throughout animal lives. For example, environments may be static, poorly suited, or restricted in complexity, space affordances, or other environmental parameters. In particular, zoo animals may be housed beyond their natural geographic region and/or housed in outdoor areas exposed to local climatic and thermal environments. This may not lead to thermal comfort for all animals (Wark et al., 2020) and/or may not be compatible with naturally evolved thermoregulatory strategies (Langman et al., 1996). Although increasing efforts are made by the international zoo community to recognise this and create appropriate environmental variation (i.e. provide environments that are suited to individual needs that may change over time and/or between individuals), it remains true that zoo animals depend on the surroundings artificially provided to them (Wickins-Dražilová, 2006). Therefore, for zoo animals to experience high levels of welfare in captivity they must be physically and physiologically capable of utilizing these physical environments available to them, and opportunities for autonomously seeking environments that suit individual preferences or needs may be restricted. This becomes a particular concern with age, as thermoregulatory capacities, mobility, and other physiological needs weaken (Rebelo, 2019), and the existing environment may no longer meet their shifting needs (Baker, 2000). As such, if aging or disease impacts an animal's ability to use a given environment effectively, welfare impacts may result as the animal struggles to cope sufficiently. If a suitable alternative environment cannot be designed or identified, euthanasia may be selected as the most humane course of action.

1.1.2.2. Controversial Zoo-based Euthanasia Practices

To fulfill societal expectations, contemporary zoos exist with responsibilities to groups and populations of animals, and therefore must think and operate beyond protecting the welfare and interests of individual animals in isolation (DiVincenti Jr et al., 2023). This is because zoos have daily responsibilities to the captive care of social beings living in groups, to managing genetically and behaviourally sustainable and robust populations, and hold commitments to conservation and wild populations. Scenarios where conservation priorities and decisions made for population-level benefits conflict with individual animal interests poses notable contemporary challenges for zoos (Clay & Visseren-Hamakers, 2022; Keulartz, 2023; Levin, 2015).

It has been argued that due to a “genetic sustainability” crisis within zoos, there should be contemporary consideration afforded to increased use of euthanasia in response (Powell, 2019; Powell & Ardaiole, 2016; Wenker et al., 2012). In some cases, this may result in euthanasia decisions performed for reasons that conflict with the interests of individual animals. Terminology or phrasing that is used in association with this type of zoo-based killing is “population management euthanasia” or “PME” (Powell, 2019; Powell et al., 2018), “management euthanasia” (Browning, 2018; Walraven et al., 2018) or “culling” of surplus animals (Gunasekera, 2018; Lacy, 1991). Regardless of terminology, this type of killing (hereafter referred to as “PME”) can be considered a controversial practice, even with purported benefits to the management of zoo populations (Lewandowski, 2003;

Schmidt & Kappelhof, 2019). The killing of a young healthy giraffe, Marius, by Copenhagen zoo in 2014 is a famously publicized example of PME and has been extensively covered by world media, sparking a range of concerns from both the public and published discourse (Gunasekera, 2018; Levin, 2015; Mc Loughlin, 2023a). It is often reported that for certain species (e.g. gorilla and elephants) juveniles may be produced under zoological conditions that are considered excess to the basic needs of breeding programs (Lewandowski, 2003). However, euthanasia of healthy animals creates ethical and practical challenges for decision-makers within zoos, particularly for charismatic or well-known species (Powell et al., 2018; Wolfensohn, 2020), or individually well-loved animals (Lewandowski, 2003). Regardless of the known perception risks, there are contemporary arguments made that increasing breeding outputs is important and justified for zoo-based contributions to conservation and for individual animal fertility, and that the culling of resultant animals is not necessarily an issue for animal welfare unless inhumane methods are used (Penfold et al., 2014). As per domestic animal care, the euthanasia of these “otherwise healthy” animals is contentious and under active debate across the animal care profession (Hartnack et al., 2016a), and poses serious public credibility issues for zoos (Keulartz, 2023).

In addition to genetic oversupply reasons, there are a variety of other scenarios where euthanasia or animal death may be claimed justifiable for specific zoo-based purposes that consequently raise ethical questions for zoos. For instance, justifications for the use of “live” feeding of prey species to encourage natural hunting and prey acquisition behaviours, or the intentional breeding of genetically surplus juveniles to maintain parental instincts or fertility (Powell & Ardaiole, 2016) followed by killing of progeny (“breed and cull”) (Penfold et al., 2014; Wenker et al., 2012). This killing of offspring may occur either early in life during the neonatal period, or at the age of natural dispersal or weaning (Penfold et al., 2014). These approaches are selected to emulate the times when mortality is most likely to occur under natural conditions, and is argued to presumably cause less distress to the mother (Asa, 2016). In the opinions of some within the profession, and reported by (Asa, 2016) this may hold animal welfare benefits from animals experiencing a more behaviourally enriched life, able to engage in natural expression of breeding behaviours. With increasing attention afforded to the benefits of feeding carcasses for large captive carnivores (Finch et al., 2020; Stark, 2005), there is heightened possibility that some institutions may choose to breed and cull livestock species on-site for readily available food items. Interestingly, the supply of food items for carnivorous zoo animals, such as day-old chicks that are by-products of commercial poultry production, provides further examples of zoos’ many connections to animal death and killing (EAZA, 2007). For those personnel that place high value on the maintenance of natural behaviours as important to animal welfare outcomes, aligned with the “natural living” concept of animal welfare (Learmonth, 2019), or the ethical importance of respecting the *Telos* of different species (Rollin, 2007a), these above scenarios may feel justified. Similarly, those who prioritise responsibilities to conservation or population-level outcomes may also be comfortable with euthanasia that appears ethically challenging to those who place heightened focus on the individual (Powell & Ardaiole, 2016).

Regardless of the strength of justifications provided for euthanasia, zoos may be inherently exposed to a higher degree of public scrutiny, as euthanasia may be more controversial for species that hold “charismatic qualities” (Powell et al., 2018; Wolfensohn, 2020), or are endangered (Keulartz, 2023; Powell & Ardaiole, 2016). For example, the euthanasia of male elephants would likely attract more attention than the euthanasia of less well known or admired species, and risk damaging the public’s trust in zoos to a higher degree (Schmidt & Kappelhof, 2019). With a slight sex ratio skew toward male calves observed for Asian elephants breeding in European Zoos, there are challenges around breeding adequate numbers of females while simultaneously securing adequate space and housing for bulls (Lueders & Allen, 2020), but these practical justifications are unlikely to nullify public

concern for such a species. Zoos may also play a role in responding to confiscated illegally traded exotic wildlife, or response to injured wild animals, leading to euthanasia requirements for biosecurity, legal or animal welfare reasons that may attract public concern. For example, snakes are exotic reptiles to New Zealand and their entry is restricted to avoid economic and ecological risks (Chapple et al., 2016). If a snake is identified at the border or within New Zealand, they may be euthanised within zoos and attract public news coverage around their involvement (NZ Herald, 2024).

While it can be assumed that euthanasia occurs routinely based on the publication of regional euthanasia guidelines, media releases, and personal accounts, there is no existing published data on the extent of euthanasia use within Australasian zoos and aquariums. Due to the sensitive nature of some types of euthanasia, it is hard to produce a robust or clear understanding around whether animals are euthanised within Australasian zoos for reasons other than individual animal welfare. This body of work seeks to provide empirical information to support and trigger more nuanced conversations regarding the euthanasia process in zoos, and the potential impact on human caretakers.

1.2. Contact with Animal Euthanasia

1.2.1. Personnel Involvement with Euthanasia in Modern Society

Despite differences in the need or purpose for euthanasia/killing of animals, in all cases there are personnel required to contribute within their professional lives, throughout different phases of euthanasia decisions. Including undertaking and performing duties directly associated with the euthanasia task itself (Hepps Keeney & Harrison, 2022). Personnel that commonly work in association with euthanasia include veterinary personnel, animal technicians working within scientific research, slaughtermen and abattoir workers, animal shelter workers, and animal carers working in different settings including zoos and aquariums. Animal care roles that perform euthanasia have been demonstrated to incur moral injury at high rates within animal shelter work environments (Andrukonis & Protopopova, 2020).

Within zoo environments, duties indirectly associated with euthanasia may be diverse. Zoo keepers may be responsible for training animals to permit or cooperate with venepuncture, which is then used directly within the approach to euthanasia (i.e. to place an IV cannula for the sedative and/or euthanasia solution) (Mc Loughlin, 2023a). Cleaning enclosures after an animal's death (pers. obs.) and/or disposing of remains are additional tasks that must be undertaken (Gates et al., 2023) and may become the responsibility of zoo keepers or veterinary personnel. The coordination of scenarios that allow animals to "say goodbye" to their lost conspecifics may also become the responsibility of zoo-keepers. These unique duties associated with euthanasia can create morally complex experiences for these professionals to navigate, and lead to distress, compassion fatigue or experiences of grief (Bemister-Bourret & Tawfik, 2023; Brando et al., 2023)

Veterinarians play a key role during euthanasia and end-of-life care with specific professional and legal obligations, particularly in relation to protecting animals against suffering (Gates et al., 2023), and directly implementing euthanasia (Powell et al., 2018). Moreover, ethical competencies of veterinarians are considered relevant to provide professional judgements around the timing of euthanasia, and to competently perform euthanasia (Persson et al., 2020). In addition to guiding and undertaking the euthanasia itself, veterinarians are considered to be important for the mental experiences of caretakers and owners during euthanasia events (Yeates, 2022) and is a common feature of providing veterinary care within companion animal and equine medicine (Clough et al.,

2021). For instance, if struggling with euthanasia decision-making, owners will lean on their veterinarian for guidance when troubled (Knesl et al., 2017), with the frequent line: *“if it were your dog, what would you do?”* (pers. obs.). Veterinarians and veterinary personnel are also known to provide this support role during similar emotionally taxing times within zoo environments. For example, veterinarians may take the action of creating an environment for zoo keepers to have opportunities to say “goodbye” to animals, prior to euthanasia events (Bemister-Bourret & Tawfik, 2023). Veterinary personnel may also ensure time is prioritized to create mementos, such as footprints, for zoo workers to keep and cherish (pers. obs.)

In human medicine, death is characterised by involvement of many professional parties, including lawyers, doctors, priests, specialised palliative care teams, and usually occurs within medical institutions with extensive technological involvement (Karumathil & Tripathi, 2022). Such extensive processes around the act of dying in the modern day applies pressures and impacts on those professionals responsible for assisting (Cottrell & Duggleby, 2016), who each provide important support functions during the final stages of death. The conduct of physicians is known to be able to substantially influence emotional outcomes for dying patients (Kübler-Ross, 2015). Recognising the professional impact and difficulties inherent within euthanasia decisions and performance, there is evidence that veterinary medicine is also evolving toward similarly collaborative approaches; with examples of veterinary hospitals increasingly using discussion groups to support challenging veterinary treatment and euthanasia decisions (Ashall, 2023; Quain et al., 2022), and formalised hospice programs existing particularly within veterinary oncology practices (Jessup & Scott, 2011). As such, a range of personnel are likely to become involved in euthanasia tasks and euthanasia decisions within Australasian zoos aligned with general global directions (Braverman, 2020; Föllmi et al., 2007; Heintz et al., 2019; Powell & Ardaiole, 2016; Powell et al., 2018), and veterinarians are likely to play a role that is broader than simply the performance of euthanasia (Jessup & Scott, 2011; Rebelo, 2019; Wenker et al., 2012).

Our study provides the first set of empirical data regarding euthanasia involvement of zoo-based professionals within Australasian zoos and aquariums.

1.2.2. Occupational Stress and Mental Health Impact of Euthanasia Exposure

The risk of euthanasia related stress within professional settings is well recognised (Andrukonis et al., 2020; Herzog Jr et al., 1989; Reeve et al., 2005; Scotney et al., 2015). This may be the result of direct exposure to euthanasia (Witte et al., 2013), or associated with the moral complexity of recommending or deciding to perform euthanasia (Knesl et al., 2017; Yeates, 2010). As such, the contributions, experiences and attitudes of those relied upon for euthanasia practices is worthy of care, attention and on-going evaluation across all professional landscapes. A range of diagnosable mental health conditions and emotional challenges may be seen in animal workers associated with exposure to death and euthanasia, including compassion fatigue (Jacobs & Reese, 2021) which refers to a developed condition where assisting others leads to accrual of trauma (Levitt & Gezinski, 2020), as well as “burn-out” (Kogan et al., 2020; Levitt & Gezinski, 2020), Post-traumatic Stress Disorder, “moral injury” and “moral distress” (Andrukonis & Protopopova, 2020). This may be particularly pertinent for industries unable to avoid the use of euthanasia or killing, organisations under intense public scrutiny, or for those planning to up-scale the use of end-of-life practices. It is also relevant for industries that promote transparency of animal use activities (Mills et al., 2018), or those that use euthanasia despite the animal’s good health (Andrukonis et al., 2020), as these industries may in-principle be exposed to heightened social licence risks associated with killing practices, or organisational risks associated with staff wellbeing and satisfaction levels.

If personnel are exposed to experiences that conflict with an individual's moral code, moral stress and potentially moral injury can eventuate (Andrukonis et al., 2020). With society's ongoing intimate relationship with animals and high frequency of animal use across a broad range of contexts, it is pertinent to remain attentive to the mental experiences of those who perform vital and often complex duties associated with animal life and death (Levitt & Gezinski, 2020). These issues are real, and are particularly concerning given the high rate of suicide seen in veterinary professionals, without a clear understanding of why this occurs (Witte et al., 2013).

It is valuable to recognise that performing euthanasia can counterintuitively lead to positive feelings (Cooney & Kipperman, 2023), as it is a key way that veterinarians can exert their role to protect animals from suffering. It is likely that the degree and type of impacts will vary with professional training, employment position, and background, and it is relevant to employers to be aware that direct involvement with euthanasia influences mental health and satisfaction levels while at work (Scotney et al., 2015). Indeed, the cumulative impacts of the emotional high and low-points of zoo work has been highlighted recently, with out-of-hours concern about animals proven to be the highest reported stressor contributing to occupational stress within a survey of 311 employees across zoos in the UK, Northern Ireland and the USA (Brando et al., 2023). However, as reported by Andrukonis et al. (2020), it may not simply be the act of euthanasia, or higher exposure to euthanasia that leads to elevated emotional distress. A lack of sufficient justification for euthanasia appears relevant to the degree of stress experienced within a workplace, particularly for those responsible for euthanising animals that are otherwise healthy (Jacobs & Reese, 2021). Well-justified euthanasia decisions may in-fact provide a protective function for animal care workers (Jacobs & Reese, 2021). Conversely, the use of the word "euthanasia" for circumstances that are poorly justified may create a source of moral distress for veterinarians, as the true motivation for killing is hidden (Fawcett, 2013).

As presented by Scotney et al. (2015) a number of studies have described the occupational stress of animal caregivers, particularly within animal shelters, and identified that anecdotal evidence suggests similar compassion fatigue is likely for personnel caring for wildlife and captive zoo animals. A confronting set of experiences and personal accounts of factors contributing to compassion fatigue has been described recently from Toronto Zoo staff (Bemister-Bourret & Tawfik, 2023), which highlights the importance of close ongoing examination of non-typical employment fields to understand potential emotional experiences associated with exposure to euthanasia.

1.2.2.1. 'Closeness', Exposure Frequency, and Type of Work

Personal attachment to animals appears to be an important factor in either contributing to, or protecting from, compassion fatigue (Jacobs & Reese, 2021; Levitt & Gezinski, 2020). Interestingly, Andrukonis et al. (2020) found that those who had increased contact with animals (e.g. animal husbandry personnel) before animal euthanasia were more likely to experience work related burnout and traumatic stress, whereas Levitt and Gezinski (2020) described the alternative scenario where attachment to animals and affinity with animals may provide a protective function, when compared to those who do not have these personal drivers or sense of purpose within their work. Consistent with this finding, are descriptions by zoo personnel that moments of closeness with animals under their care aided their ability to manage feelings of sadness that occur (Bemister-Bourret & Tawfik, 2023).

The unique challenges of caring for animals and simultaneously being involved in bringing about or undertaking the euthanasia of the same animal poses challenging scenarios for those in animal care employment (Andrukonis et al., 2020). Relatively unique to those working with non-domestic species

within zoos, is the possibility of caring for an exceptionally long-lived animal over decades, and then participating directly in the animal's death. As such, Bemister-Bourret and Tawfik (2023) reports that strong attachment to animals within a zoo context provides necessary passion for staff to undertake their work, while also leading to emotional devastation when animals are lost. Workers within laboratory settings, domestic animal shelters, and production animal slaughterhouses may be disproportionately exposed to the death of high numbers of animals for factors extrinsic to the animal themselves, and therefore at a potentially elevated risk of moral harm (Herzog Jr et al., 1989). Indeed, Rogelberg et al. (2007) identified higher staff turn-over if they were more exposed to euthanasia occurring for reasons extrinsic to the animal (e.g. beyond behavioural abnormalities or health problems). Similarly, it is postulated that how necessary or well justified euthanasia is may influence the emotional impact on personnel, even if exposed at high frequencies when desensitization might be otherwise expected (LaFollette et al., 2020). Simultaneously, these personnel face public stigma for performing these activities and jobs, which have been formally described as "dirty work" (Ashforth & Kreiner, 2014) with unique employment challenges that can lead to shifts in workplace culture or ideological reframing providing "defence mechanisms" against perceptions (Ashforth & Kreiner, 1999). Ultimately a difficult set of emotional circumstances exist for animal carers during performance of euthanasia, resulting in the recognised difficulties of the "caring-killing paradox" (Reeve et al., 2005).

Within zoo-based euthanasia, the overall frequency of exposure may be lower (Powell & Ardiolo, 2016), but the type of interaction with animals may be closer, extend over a longer duration of time and include unique zoo-based elements; with compounding factors of societal attention toward charismatic animals becoming relevant. Strong existing relationships with animals may influence experiences and enter into objective or standardised decision-making, as seen for long-lived or well-known individuals (Lewandowski, 2003). Although frequency of exposure to euthanasia is considered to play a role in employee experiences, Andrukonis et al. (2020) compared three employment types (veterinarians, animal shelter employees, and university research personnel) known to vary in degree of animal caring duties. Here it was demonstrated that roles engaged in higher degrees of animal husbandry and animal contact were more impacted, and this factor mattered more than frequency of euthanasia exposure. Similarly, LaFollette et al. (2020) identified no association between frequency of performing euthanasia and levels of compassion fatigue in a large cross-sectional study of laboratory personnel within Canada and the United States. I hypothesise that working closely with animals within zoo environments is likely to be an important feature influencing employee attitudes associated with euthanasia of these animals.

1.2.2.2. Workplace Type

Overall, the degree of exposure and diversity of euthanasia scenarios an individual is exposed to is related to working environments (Persson et al., 2020). Those people working with non-domestic animal species are likely to have additional challenges associated with difficulty in achieving standardised humane practices and associated euthanasia complications (Hepps Keeney & Harrison, 2022), challenges with the disposal of bodies (pers. obs.), and challenges with accurate timing of euthanasia (Föllmi et al., 2007). Although LaFollette et al. (2020) found that species-type may not inherently be linked to levels of compassion fatigue and euthanasia stress observed in laboratory personnel working with a variety of animal taxa, from non-human primates to rodents or farm animals, the possibility remains that the unique challenges associated with the euthanasia of animals within zoos creates relevant additional difficulties. There is also suggestion that the type of euthanasia method (e.g. use of physical methods such as blunt force) may be more impactful to emotional experiences (LaFollette et al., 2020).

1.2.2.3. Personal and Demographic Factors

The extent that individuals working within the same environment are impacted by euthanasia varies (Levitt & Gezinski, 2020; Reeve et al., 2005) and is likely to be related to individual motivations or other psychological features (Persson et al., 2020). It has been argued that being female may incur higher rates of compassion fatigue amongst animal care workers, but with variable findings between studies (Jacobs & Reese, 2021). A gender difference associated with euthanasia concern has also been documented for Australian veterinary students, with male students rating it higher on their concern (Stafford et al., 2019). Within a zoo setting, male employees have been shown to be more supportive of euthanasia for population management within U.S. zoos (Powell & Ardaiole, 2016). While gender may play a role, it is unclear whether this is significant, and is complicated to study by a tendency for the animal care workforce to be female-dominated.

1.3. Attitudes toward Euthanasia and Lethal Control of Animals

1.3.1. Societal Beliefs on Death and Euthanasia

Belief systems around death and dying has a long history, and interconnects with political values and sociocultural factors (Cottrell & Duggleby, 2016). Views on intentionally causing death for reasons of euthanasia or suicide have culturally relevant variation, with societal acceptability, social norms and philosophical thought changing over time (Cottrell & Duggleby, 2016; Karumathil & Tripathi, 2022). Today, key issues continue to divide public opinion (Karumathil & Tripathi, 2022) and have resulted in variable legal permissions and attitudes associated with the use of human euthanasia globally (Cohen et al., 2006), and cultural nuances influence euthanasia decision-making (Karumathil & Tripathi, 2022).

Our relationship with prolonging life and avoiding death as a priority, and struggling to discuss issues of relevance to death has amplified during the mid-to-late 1900's, (Karumathil & Tripathi, 2022; Kübler-Ross, 2015), culminating into what has been referred to as a "death-denying" society, (Kübler-Ross, 2015) and appears to continue into the modern day. This extends to the ownership of pets, following the trend of societal value toward companion animals increasing (Rollin, 2007b), coupled with the increasing expected lifespan of pets (Jessup & Scott, 2011). Medical, technological and infection control improvements have resulted in increased time allowances for death preparations, and a move towards expectations that a good death is achieved if the death is "well-managed" (Cottrell & Duggleby, 2016).

Attitudes toward death are complex, and complicated as we struggle to conceive of our own death, and physicians (and veterinarians) must manage both the ethics of using "extraordinary measures" to prolong life (Knesl et al., 2017), as well as the unique medical, behavioural, and social challenges presented by the dying patient (Kübler-Ross, 2015). Our comfort levels around relying on the physician for making these decisions appears to vary with time and culture (Karumathil & Tripathi, 2022), with some cultural examples concluding that the physician should not make these decisions without collective input. As described by Cottrell and Duggleby (2016), current Western attitudes consider that death should be dignified and free from pain or distress, that it should occur at an appropriate time, in old age surrounded by family, and that the progression of dying follows a predictable course, and that advance directives are in place. Intriguingly, this is reminiscent of how we design the deaths of companion animals, and zoo animals (Jessup & Scott, 2011).

While the content of this work relates to the application of euthanasia to non-human animals, our collective societal attitudes toward euthanasia and death should be considered in-conjunction with

its use in humans, as sentiments and flows of philosophical thought are likely to occur between the two, and there could be important outcomes for consideration to employees engaged with performing both (Ogden et al., 2012). This potential for two-way influence between sentiments around “good deaths” and euthanasia of humans and animals has been highlighted recently (Ison, 2022; Selter et al., 2022). It is important to note that the practice of euthanasia with respect to animals and humans is inherently a different construct, as animals are unable to consent to their own death (Persson et al., 2020), even if we deem it the most morally correct course of action for an animal’s likely best interests.

As mentioned earlier, it is the author’s impression that inherent features of different types of killing are more likely to attract more emphatic public reaction; for instance, “group” killing of animals, practices that appear more violent to lay people, or practices that are in-fact more harmful in nature. Interestingly, high degrees of attention appear to exist around the death of young animals. Some examples include the social acceptability and concern about killing of kangaroo joeys during harvest (Karstaedt, 2012; Sharp, 2015; Stephens, 2021), the killing of surplus dairy calves that have limited agricultural value (Bolton & Von Keyserlingk, 2021), or the killing of male chicks (Leenstra et al., 2011). Moreover, it appears these concerns remain even if individuals would have been ultimately killed for human consumption at a latter timepoint, or diverted to other agricultural purposes. Degrees of concern around euthanasia also appears to vary between different species (Powell, 2016; Powell et al., 2018), with charismatic or large megafauna appearing to create heightened concern over more cryptic or ectothermic species.

1.3.2. Zoo Community Attitudes toward the Use of Euthanasia within Zoos

While there are reportedly justifications for increased use of PME, it is acknowledged that it is an emotionally difficult topic for acceptance and integration into zoo working environments (Powell & Ardaiole, 2016). Only three contemporary studies could be identified that deal with surveying zoo-based employee attitudes to zoo animal euthanasia (Powell, 2016; Powell & Ardaiole, 2016; Powell et al., 2018). These studies provided initial characterisation of attitudes within the US and Europe using either interview or survey techniques. No previous data could be found pertaining to Australasia.

Demographic and work-related features including gender, prior exposure to euthanasia and/or awareness of PME instances at their institution, and professional background were each hypothesised by Powell and Ardaiole (2016) to be likely to influence attitudes of animal care personnel to PME. These authors suspected that managers would be more aware of the difficulties embedded in long term captive population management, and therefore likely to be more accepting of PME. The study confirmed their suppositions, with breeding program leaders and institutional managers significantly more accepting of PME than zoo keepers, for a wide range of taxa (Powell & Ardaiole, 2016). Men were identified to be more generally supportive, as were personnel aware of PME occurring at their workplace (Powell & Ardaiole, 2016). Both of these findings extended to veterinarians that were surveyed within a follow-up study (Powell et al., 2018). Taxa-based differences were also shown to influence attitudes (Powell & Ardaiole, 2016; Powell et al., 2018). Interestingly, these studies conflated geriatric animal euthanasia with other forms of PME, as the definition for PME used within this research included “euthanasia of offspring, non-reproductive animals, post-reproductive animals, or geriatric animals, to manage the population of the species.” (p. 188) (Powell, 2016). As such, no zoo-based data could be identified within the published literature that deals specifically with attitudes toward euthanasia of geriatric animals.

It has recently been emphasised that cultural and ethical differences between geographical districts (e.g. Europe and China) may influence zoo staff attitudes toward the practice of euthanasia (Bacon, Bell, et al., 2023), and a Western “conflict” between animal welfare and conservation ethics is reported in the literature (Clay & Visseren-Hamakers, 2022; Gray, 2017; Paquet & Darimont, 2010). The approach of veterinarians toward companion animal euthanasia has also been suggested to have geographically relevant variation (Yeates & Main, 2011). Lastly, it has also been identified that, in addition to across cultures, there can be disparate beliefs and knowledge about zoo animal welfare issues within a single culture (Bacon, Bell, et al., 2023). As mentioned, the existing studies on employee attitudes to zoo-based euthanasia do not extend to the Australasian region. In addition these studies did not characterise the influence different workplace features or internal culture may have, although were predominantly focused on accredited facilities and so could be considered a portrayal of facilities that have higher existing focus on contemporary animal wellbeing.

The attention that killing in zoos attracts from the public cannot be understated, with philosophical debates triggered and perceived conflicts arising (Browning, 2018; Levin, 2015; Mc Loughlin, 2023a), compounded by rapidly rising expectations that zoos must provide high standard of care and respect to animals (Bacon et al., 2021b; Sayers, 2020; Wickins-Dražilová, 2006), while also maintaining focus on genetic sustainability (Powell, 2019). I hypothesise that substantial ideological division and disparities regarding appropriate euthanasia use exists within the international zoo community, and will be identifiable within the Australasian region. This is likely due to a broad range of contributing factors associated with ideological beliefs about the purpose of zoos, as well as cultural features, personal demographics and workplace features. As there are no existing Australasian reports on the opinions of zoo staff on the use of zoo-based euthanasia or controversial management practices, and there are knowledge gaps across multiple geographic regions (Bacon, Bell, et al., 2023), our work contributes important insights to characterising sentiments held within the international zoo community, holding benefit for both animal welfare and contemporary animal care workforces.

Chapter 2: Methods

2.1. Participants

Participants (n = 201) responded to an anonymous online survey that was open for completion by personnel currently or previously employed within any Zoo or Aquarium within Australia (n = 122) or New Zealand (n = 57), (n = 19 did not provide location data; n = 3 were from ZAA-member facilities within Oceania/SE Asia). Fig 1. and 2. represent progression of key questions. The survey was circulated via professional and personal networks using a “snowball” distribution and sampling technique (Dosek, 2021), with personnel encouraged to pass the survey to colleagues, and was circulated through the Zoo and Aquarium Association (ZAA) membership body. Multiple institutions undertook distribution within their employee networks. Self-selection into the study occurred at both an individual and institutional level. To the authors’ knowledge the survey link was placed onto two “closed” professional social media pages but was not distributed to the general public. The survey could be completed between the 18th of August and the 28th of October, 2019. As such, data is representative of circumstances and experiences prior to the commencement of the global COVID-19 pandemic. See Tables 1-5 for detailed sample characteristics.

Participant workplaces represented a diversity of institutions, varying in size and characteristics associated with governance, organisational structure, and funding structure (Table 2). The majority of participants worked within ZAA -accredited institutions (n > 175) with just four participants stating that they did not work within a ZAA -accredited institution; n = 22 did not provide an answer. Only three participants selected “prefer not to say” to their workplace funding structure. As such, data is

drawn predominantly from a subset of zoos that are affiliated with ZAA and have therefore undergone an accreditation process.

Most participants were in regular direct physical contact with animals (n=142) and many had been exposed frequently to animal euthanasia during their professional life (Table 5). Only 10 participants reported never having witnessed animal euthanasia. Participants predominantly identified as working within three primary Employment Fields: “Veterinary Services” (n=74), “Animal Keeping/Care/Training” (n=67) (hereby “Animal Care”) and “Management” (n=37) (Table 1). A minority of participants (n = 20) selected other fields (e.g. visitor experience, business, education, research etc.) and were treated collectively as “Other”. Only three participants selected “prefer not to say” to their employment field.

2.2. Study Design

The survey used a cross-sectional design constructed using Qualtrics Survey Software (<https://www.qualtrics.com>) and was partly individualised to each participant using branch-logic (Fig. 1 and 2.). The survey took approximately 20-40 minutes to complete depending on which branches were selected. The study utilised a mixed methods approach to data analyses. Participants were asked questions in a variety of quantitative formats (Multiple-Choice, Multiple-selection, Visual Analogue Scale or “VAS” scale, and Likert Scale) to describe and investigate associations between variables of interest. Participants were also able to provide written information throughout the survey; this qualitative data set was explored and analysed in conjunction with the quantitative results. Low risk human ethics was sought for the survey portion of this work via the Massey University Human Ethics Committee, with subsequent approval for additional adjunctive work conducted under application NOR 19/38.

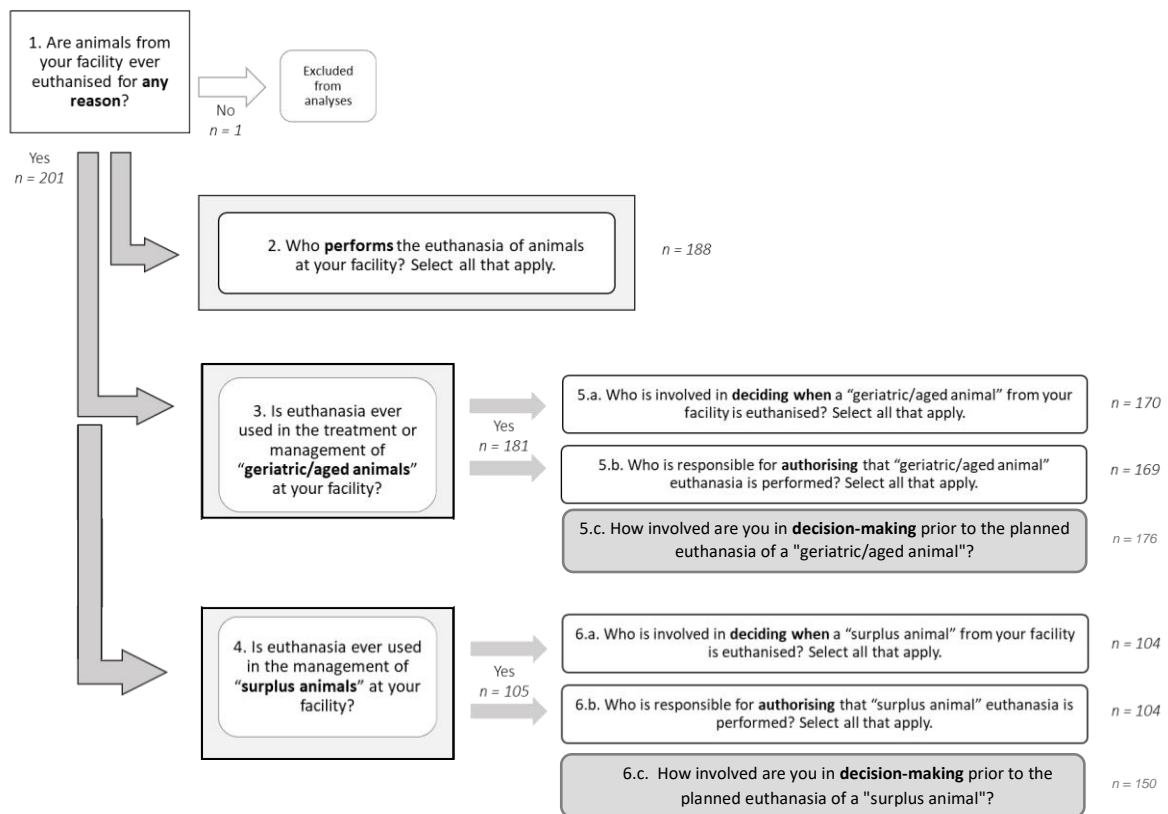


Figure 1. Progression of Key Questions using “Branch Logic” within Qualtrics Survey Software – Personnel Involvement in Euthanasia Practice and Decision-Making. *Note.* All participants who answered that euthanasia is performed at their workplace were asked Question 2. Participants were only displayed Questions 5 and 6 if they had answered “yes” within Questions 3 and 4, that euthanasia was used in the management of “geriatric” or “surplus” animals within their workplace, respectively. The questions of personal ‘involvement’ (Q.5.c. and 6.c.) were answerable via slider bar with a scale of ‘0 to 100’. The written anchors used for these scales varied from “heavily involved” to “not at all involved”.

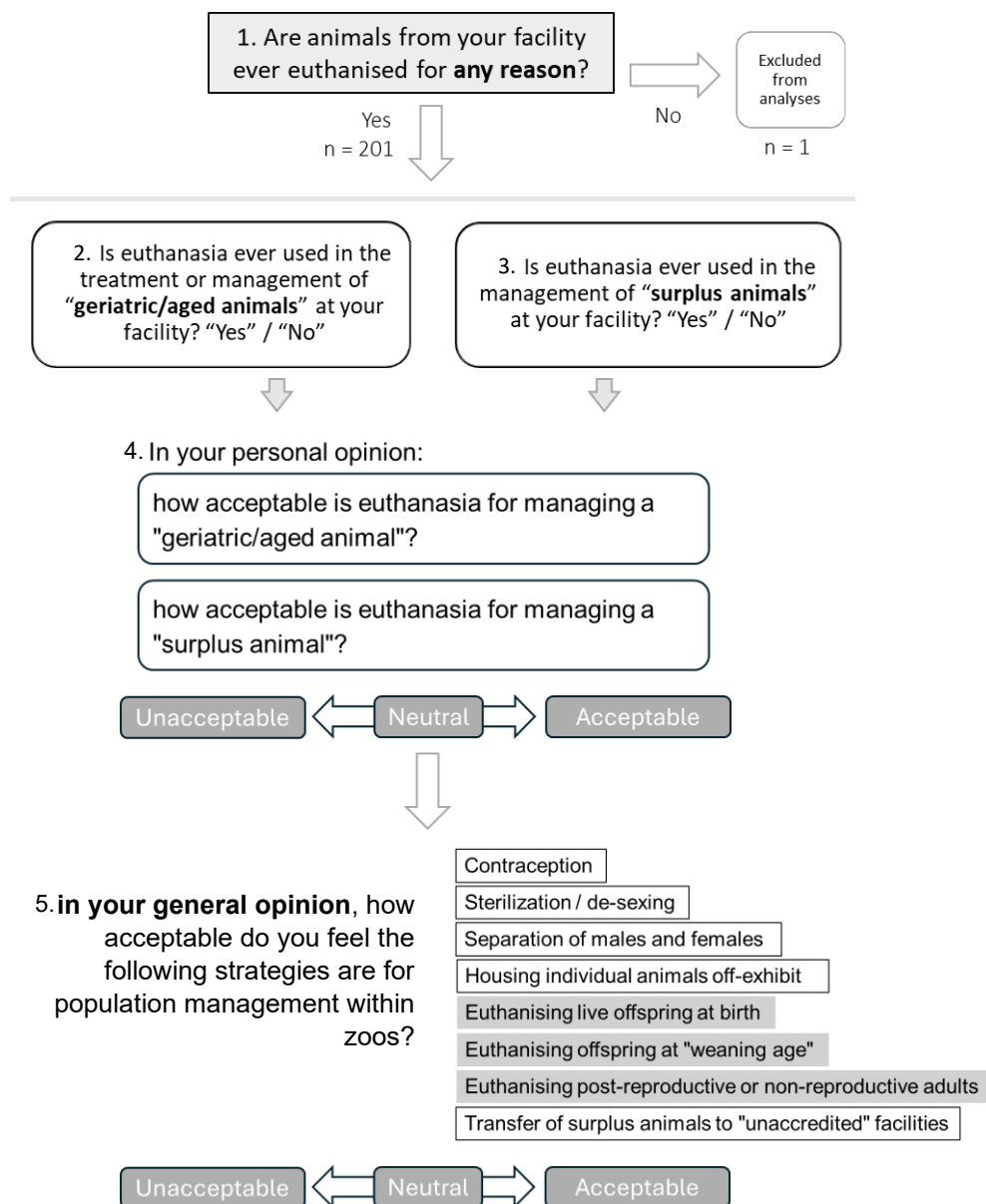


Figure 2. Progression of Key Questions using “Branch Logic” within Qualtrics Survey Software – Personal Attitudes to Euthanasia and Population Management. *Note.* All participants were asked for their personal opinions within Question 4 and 5, regardless of whether euthanasia was used in the management of “geriatric” or “surplus” animals within their workplace (question 2 and 3, respectively). The ‘personal opinion’ questions (Q.4. and 5.) were each answerable via slider bar with a scale of ‘0 to 100’. The written anchors used for these scales varied from “Unacceptable” to “Acceptable”. Participants who answered “no” to Question 1 were excluded from analyses, as the use of animal euthanasia at the participant’s workplace represented a key inclusion criteria.

2.3. Measures Used

Responders were asked a key question to confirm they met basic inclusion criteria for the study associated with use of animal euthanasia at the facility (Fig 1. Q1). Eligible participants were then able to answer five non-exclusive multiple-selection questions to indicate which personnel are involved in euthanasia tasks and decision-making relevant to their workplace (Fig 1. Q2-6). Further questions were then asked to explore personal attitudes toward euthanasia and population management (Fig. 2. Q4-5). These questions sat within a larger survey investigating current practices and personal attitudes; this is provided in Appendix A.

Participants were asked to answer all questions with their current or most recent workplace and employment in mind. Participants that alternate between multiple facilities were asked to focus on the workplace they are most familiar. Participants could select or describe their current/most recent employment role and, where appropriate, participants could indicate whether they would be considered "Senior Managers". This allowed designation of eight "Employment Role" descriptors (Table 1). Only one participant could not be allocated a descriptor.

To protect the anonymity of employers, participants were not asked to provide information about the physical size or number of animals held at their workplace. Instead, a general proxy measure of facility size has been inferred from estimations of staff numbers.

Participants had seven opportunities to provide open text comments throughout the survey in response to the prompt "do you have any comments you would like to add at this stage?" (n=106), and "do you have any further comments regarding any aspect of this study?" (n=33). In total, 112 people provided written data via these questions.

Table 1. Sample characteristics – Participant Sociodemographic and Employment Data (n = 201)

Gender	n	%	Employment Status	n	%
Female	112	55.7%	Current	183	91%
Male	62	30.8%	Previous	18	9 %
Prefer to not disclose/self-describe	7 / 1	4.0%			
Unspecified / incomplete	19	9.5%			
Age range (years)	n	%	Duration employed	n	%
<24	5	2.8%	<5 years	43	21.4%
25-34	53	30%	5-15 years	79	39.3%
35-44	70	39%	15-25 years	35	17.4
45-54	31	17%	25-35 years	19	9.5%
55-64	13	7.3%	>35 years	3	1.5%
>65	7	3.9%	Unspecified / incomplete	22	10.9%
Unspecified / incomplete	22	10.9%			
Employment Field	n	%	Employment Role	n	%
Animal Care	67	33.3%	Animal Keeper	18	9%
Veterinary Services	74	36.8%	Senior Animal Keeper	27	13.4%
Management	37	18.4%	Manager in Animal Keeping/Care	19	9.5%
Other	20	10%	Senior Management Personnel	37	18.4%
Prefer not to say	3	1.5%	Veterinarian	32	15.9%
			Senior Veterinarian	16	8%
			Veterinary nurse/technician	20	10%
			Role within Other Field	17	8.5%
			Unable to be allocated	15	7.5%

Table 2: Sample characteristics – Location and Workplace (n = 201)

Location	n	%	Zoo and Aquarium Association (ZAA) Membership	n	%
Australia	122	60.7%	Yes	175	87.1%
New Zealand	57	28.4%	No	4	2%
“Other”/Prefer not to say	5	2.5%	Don’t Know	4	2%
Unspecified / incomplete	17	8.5%	Prefer not to say	0	0%
			Unspecified / incomplete	18	9%
Funding Structure	n	%	Organisational Structure	n	%
Privately-run	59	29.4%	Jointly-operated	85	42.3%
Non-private	122	60.7%	Independently-operated	96	47.8%
Government/Local council	(98)	(54.1%)	Prefer not to say	4	2%
“Other” (e.g. Trust, NFP)	(24)	(13.3%)	Unspecified / incomplete	16	8%
Prefer not to say	3	1.5%			
Unspecified / incomplete	17	8.5%			
Indicators of Facility Size			Overseen by Board/Committee	n	%
<i>Staff Numbers</i>	n	%	Yes	119	59.2%
Low Numbers (Est. < 30)	27	13.4%	No	51	25.4%
Medium to High Numbers	117	58.2%	Don’t Know	13	6.5%
Very High Numbers (Est. >330)	32	15.9%	Prefer not to say	1	0.5%
Unspecified / incomplete	25	12.4%	Unspecified / incomplete	17	8.5%
<i>Department Numbers</i>	n	%			
Low	35	17.4%			
Moderate	76	37.8%			
High	72	35.8%			
Unspecified / incomplete	18	9.0%			

Table 3: Sample characteristics – Comparison of Employment Field with Key Demographic Features across Australian and New Zealand Data

	Age (Years)		Duration Employed (Years)		Gender		Location	
	Mean [min-max]	SD	Mean [min-max]	SD	Male n (%)	Female n (%)	Aus. n (%)	NZ n (%)
Employment Field								
Animal Care	35.5 [21-59]	8.01	13.3 [1.3-35]	7.85	18 (27)	40 (60)	37 (55)	24 (36)
Veterinary Services	40.8 [26-73]	10.1	10.9 [0.5-35]	8.28	17(23)	49 (66)	48 (65)	19 (26)
Management	47.5 [30-72]**	12.1	19.8 [4-42]**	11.4	22 (60)	12 (32)	23 (62)	11 (30)
Other	39.9 [25-58]	10.2	8.77 [1.75-22]	6.15	5 (25)	9 (45)	12 (60)	2 (10)
							χ^2 15.8	χ^2 3.95
							<i>P</i> .001	<i>P</i> .267

Note. % rounded to nearest whole number. Break-down details not reported for Primary Employment Roles to protect anonymity of participants.

Age, duration employed, and gender varied significantly across Employment Fields ** $P < .001$

Table 4: Sample characteristics - Comparison of Key Workplace Features across Australian and New Zealand Data

	Funding Structure			Staff Numbers			Organisational Structure		Overseen by Board	
	Private	Gov.	Other	Low	Mod. to High	Very High	Joint	Independent	Yes	No
Location	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Australia	47 (39)	57 (47)	16 (13)	15 (12)	72 (59)	30 (25)	64 (53)	57 (47)	81 (66)	37 (30)
New Zealand	11 (19)	38 (67)	8 (14)	10 (18)	44 (77)	1 (2)	19 (33)	35 (61)	36 (63)	12 (21)
			χ^2 7.31			χ^2 14.4		χ^2 4.7		χ^2 .663
			<i>P</i> .026			<i>P</i> <.001		<i>P</i> .03		<i>P</i> .416

Note. % rounded to nearest whole number. The characteristics of workplaces represented within Australia and New Zealand differed significantly; more private facilities, facilities with very large numbers of staff, and jointly-operated facilities were represented within Australia. There was no significant difference in the size of the facility when considering reported department numbers, and whether facilities were overseen by Boards.

Table 5: Participant Exposure to Euthanasia and Zoo Animal Contact.

A. Direct Exposure to Euthanasia of Zoo Animals

	Participants	
	n	%
Up to 30 times	177	55.7
None	(10)	(5.5)
Once or Twice	(10)	(5.5)
Up to 5 times	(18)	(9.8)
Up to 10 times	(27)	(14.8)
Approx. 20 or 30 times	(112)	(18.0)
More than 30 times	85	46.4
Unspecified / incomplete	18	9.0

B. Regular Direct Physical Contact with Zoo Animals

	Participants	
	n	%
No	17	9.2
Previously	25	13.6
Yes	142	77.2
Unspecified / incomplete	17	8.5

C. Exposure to Euthanasia and Regular Animal Contact with Zoo Animals across Employment Fields

	Direct Exposure to Euthanasia		Regular Direct Physical Contact		
	<30 times	>30 times	Yes	Previously	No
	n (%)	n (%)	n (%)	n (%)	n (%)
Employment Field					
Animal Care	45 (67)	17 (25)	54 (81)	5 (7.5)	3 (4.5)
Veterinary Services	19 (26)	50 (68)	60 (81)	8 (11)	1 (1.4)
Management	17 (46)	18 (49)	19 (51)	9 (24)	7 (19)
Other	15 (75)	0 (0)	8 (40)	2 (10)	5 (25)

2.4. Procedures

Prior to commencing the survey, participants were provided information overviewing the project goals, researchers, and a number of brief definitions for key terminology. Given the imprecise common usage and understanding of the term “euthanasia” it was elected to define it loosely as synonymous with any form of intentional killing. The concept of “planned euthanasia” was introduced and was described to be distinct from euthanasia elected for an animal that is in a sudden or severe state of distress, ill-health or injury (i.e. what may be termed “medical euthanasia”).

Participants were encouraged to answer survey questions with respect to the planned euthanasia of permanently captive zoo animals (c.f. animals undergoing rehabilitation, non-captive wildlife, or pests), and not in association with the death of animals occurring for disease control or human safety. “Zoo animal” was defined as a general umbrella term for any “captive” or “collection” animal kept within a zoo, aquarium or other facility that is open to the public. As clear and consistent definitions for the following terms could not be identified in the literature, it was specified that use of the terms “management euthanasia”, “population management euthanasia (PME)”, and “welfare euthanasia” was intentionally avoided within the survey.

Considering the variety of reasons captive animals may be killed, participants were specifically asked about the planned euthanasia of animals exhibiting either of two key features. That is, the euthanasia of “geriatric” animals and the euthanasia of “surplus” animals. These features, and the terminology used, were selected to reflect two mutually exclusive and contrasting practices that are mentioned by published literature as important to animal management within zoos. It was specified that, for the purposes of the survey, the term “geriatric” was considered analogous to “aged”, and that a “surplus” animal was considered and defined to be “any healthy offspring or adult animal that is deemed excess to requirements”. It was anticipated that the euthanasia of geriatric animals would reflect a standardly accepted practice, whereas the suggestion of euthanising otherwise healthy animals would act as an ethically contrasting practice. Participants were also asked about a range of lethal and non-lethal animal management practices that are known within the industry in association with managing population breeding and surplus animals.

Survey questions could be passed if needed. To minimise the number of accidentally missed questions, participants were displayed a confirmational alert if a question was left incomplete. Where relevant, participants could select “don’t know” or “prefer not to say” within certain questions.

2.5. Data Analysis

2.5.1. Quantitative analyses

SPSS and Jamovi statistics software were utilised for inferential and descriptive statistics, with some figures constructed using Microsoft Excel. Chi-squared tests were used to explore differences between key demographic and workplace characteristics, to investigate differences between personnel reportedly responsible for euthanasia-related tasks, and differences in reported euthanasia rates. One-way Welch’s ANOVAs with Games-Howell post hoc test, where needed, were utilised for ‘feelings of involvement’ and ‘acceptability’ comparisons across employment groups plus personnel and workplace characteristics of interest. A *P* value of less than .05 was used as an indicator of significance, with non-significant trends also examined, and tendencies of different employment roles considered during data analysis.

2.5.2. Qualitative analyses

NVivo was used to facilitate reflexive thematic analyses on all written data collected. An initial coding-tree was developed by the primary researcher during close reading of any text-based responses to questions 2-6, and the two open text comment sections that were shown after questions 2-6. The written data obtained throughout the remainder of the survey was then reviewed for additional detail relevant to employee roles and responsibilities. The material was read twice within a 7-day period, and on the second reading the material was read in the reverse order. The coding-tree was altered and expanded iteratively throughout this process.

The full set of written data was then re-read after two weeks, and the coding-tree was again altered as required whenever new detail was recognised. In order to minimise fatigue, close-reading of written data was performed in 20 minute blocks over a maximum session duration of 3 hours and was interspersed by 5-10 minute breaks.

The primary themes to be reported were established during the process of building and refining the coding-tree. These themes were then arranged into two overarching topics for reporting purposes: 1. "Responsibilities of Non-Veterinary Staff during Euthanasia Events" and 2. "Employee Responsibilities during Euthanasia Decisions, Authorisation, and End-of-Life Care". Key excerpts of the coding-tree can be viewed for illustrative purposes in Appendix B.

Chapter 3: Results

3.1. Data Preparation

To meet inclusion criteria, participants needed to answer that they had worked within the zoo and aquarium profession, and that animal euthanasia was performed at their workplace. Incomplete responses that had not answered key questions regarding employment and personal involvement were excluded (n = 18). A further 48 entries were registered by Qualtrics but had not answered any questions.

To aid descriptive analyses and examine overall trends of euthanasia acceptability, continuous data from VAS scales was converted into categorical data using the following criteria: "acceptable" = 75 and above; "somewhat acceptable" = 53 to 74; "neutral" = 48 to 52; "somewhat unacceptable" = 26 to 47; "unacceptable" = 25 and under. Five points around the mid-way point was used to represent "neutral" to cater for participants who may not have successfully clicked the mid-point exactly (e.g. if being completed on a smart device).

The following criteria was used to re-code numerical data into three discrete categories of workplace staff numbers: fewer than 30 staff = "low"; between 30 and 330 staff = "moderate to high"; greater than 330 staff = "very high". VAS scale estimates of staff numbers provided by some participants was integrated with written numerical estimates.

A category of "facility type" was derived including participants that had specifically selected they worked within privately funded institutions, and a separate category for all participants who opted to select an alternative financial structure (responses and descriptions ranged, but were frequently described as "government" based, "not-for-profits", or "trusts").

3.2. Participant and Workplace Characteristics

Characteristics of workplaces represented within Australia and New Zealand differed: privately funded facilities, facilities with "very high" numbers of staff, and joint-operated facilities were

represented significantly more often within the Australian data set (Table 4). Participants from both countries reported the use of euthanasia in the management of “geriatric” and “surplus” animals.

Overall, a greater proportion of participants identified as female than male (Table 1) and gender demographics were unequal between employment categories (Table 3). “Management” comprised a greater proportion of men (59%) while more females identified as working within “Animal Care” (60%) and “Veterinary Services” (66%). Age and duration of employment differed significantly across employment backgrounds and is presented further within Table 3.

Participants indicated high levels of awareness regarding who is responsible for euthanasia-related tasks at their workplace, with only one participant selecting that they did not know who performs animal euthanasia (1/188 = 0.5%). The vast majority of participants stated they know which personnel are involved in “geriatric” animal euthanasia decisions, with only three participants unaware (3/170 = 1.8%), while nine participants indicated they did not know who was responsible for authorisation of “geriatric” animal euthanasia (9/169 = 5.3%). Somewhat lower levels of awareness existed for the euthanasia of “surplus” animals; 11 participants selected they did not know who was involved in these decisions (11/103 = 10.7%), and 15 participants selected they did not know who was responsible for authorisation of this practice (15/103 = 14.6%). Overall, survey participants therefore represented high awareness of those involved with euthanasia related duties at their workplace.

3.3. Use of Euthanasia Reported at Australasian Zoos

Participants from both countries reported the use of planned euthanasia in the management of “geriatric” and “surplus” animals under at least some circumstances.

The use of euthanasia for “geriatric” animals was reported by employees at similarly high rates across Australia (91.8 %, 112/122) and New Zealand (91.2 %, 52/57) (Table 6). The use of euthanasia in the management of animals considered to be “surplus” was also reported by many participants (53%, 105/199), but at an obviously lower rate for both countries. The majority of participants from New Zealand (72%, 41/57) were aware of circumstances where “surplus” animals may be euthanised, in contrast to less than half of the Australian respondents (54/122 = 44%). This reflects a significant workplace-location effect, with New Zealand respondents more likely to report the use of planned euthanasia for “surplus” animals ($P < .001$).

Multiple workplace characteristics were associated with reported levels of euthanasia use (Table 6). More employees from privately-run workplaces reported that, to their knowledge, euthanasia was not used for surplus animals ($P < .001$), or geriatric animals ($P = .016$). Similarly, employees from workplaces with low numbers of staff were less likely to report euthanasia use for a geriatric animal ($P = .002$). This trend existed for surplus animals, but significance was not reached ($P = .141$).

Overarchingly, the use of euthanasia is commonplace, with all 201 survey respondents included having answered “yes” to whether animals are “ever euthanised for any reason” at their workplace¹ but the degree of reported use of planned euthanasia appears to vary with multiple workplace features.

¹ Answers from excluded submissions were reviewed. Only two stated that euthanasia does not occur at their workplace (from a total of 216 answered registered within Qualtrics). Both entries appeared to be erroneous, as few questions were answered coherently.

Table 6. Reported Use of Euthanasia Practices at Australasian Zoos

	Euthanasia of Geriatric Animals				Euthanasia of Surplus Animals			
	Yes		No		Yes		No	
	n	%	n	%	n	%	n	%
Location								
Australia	112	92	9	7.8	54	44	66	54
NZ	52	91	5	8.8	41	72	16	28
			χ^2	0.095			χ^2	11.3
			<i>P</i>	.758			<i>P</i>	<.001
Facility Type								
Privately-run	49	83	9	15.5	20	34	29	66
Other	116	95	6	5	77	63	43	36
			χ^2	5.78			χ^2	14.6
			<i>P</i>	.016			<i>P</i>	<.001
Staff Numbers								
Low	20	74	7	26	11	41	16	59
Mod to High	109	93	7	6	61	52	56	48
Very High	31	97	1	3.1	20	63	10	33
			χ^2	12.5			χ^2	3.91
			<i>P</i>	.002			<i>P</i>	.141
Total	181	90	19	9.5	105	52	94	47

3.4. Zoo Employee Euthanasia Tasks

3.4.1. Personnel Responsible for Performing Euthanasia

Veterinarians were reported to perform animal euthanasia by the vast majority of respondents (184/188 = 97.9%). However, only 60% of respondents reported that veterinarians are exclusively responsible for performing animal euthanasia at their place of work, with many participants stating that euthanasia is also performed by ‘veterinary support staff’ and ‘non-veterinary staff’ (Table 7). Overall, the combination of personnel reported to perform euthanasia varied notably between individual responses, with 14 different combinations reported in total. Despite this marked overall variability, no clear differences were found between the Australia and New Zealand datasets.

The majority of respondents reported that on-staff veterinarians are involved in performing euthanasia at their place of work (73.4%)², while a subset of these participants reported that their workplace utilizes both on-staff and external veterinarians (n=14). Approximately one quarter of respondents reported that their place of work relies wholly on veterinarians that are based off-site (i.e. external or contracted) (n=46/188). Three participants indicated that euthanasia is performed exclusively by non-veterinarians at their workplace.

² This figure of 73.4% was calculated by adding the number of participants who reported that “on-staff veterinarians” perform euthanasia (n=124) with the number of participants who reported that both “on-staff and external veterinarians” perform euthanasia (n=14) and divided out of the number of total responses (n=188).

Table 7. Zoo Personnel Reported to Perform Animal Euthanasia.

	n	%
Commonly Reported Combinations (>10% of responses)		
On-staff Vets Only	79	42.0
On-staff Vets + Veterinary Support Staff	28	14.9
External Vets Only	27	14.4
Uncommonly Reported Combinations (<10% of responses)		
External Vets + Non-Veterinary Staff	13	6.9
On-staff Vets + Veterinary Support Staff + Non-Veterinary Staff	11	5.9
Other Reported Combinations (<5% responses)		
On-staff Vets + Non-Veterinary Staff	6	3.2
Vets Only (Both On-staff and External)	6	3.2
External Vets + Veterinary Support Staff	4	2.1
Both External and On-staff Vets + Veterinary Support Staff	4	2.1
Both External and On-staff Vets + Veterinary Support Staff + Non-Veterinary Staff	2	1.1
Both External and On-staff Vets + Non-Veterinary Staff	2	1.1
External Vets + Veterinary Support Staff + Non-Veterinary Staff	2	1.1
Non-Veterinary Staff Only	2	1.1
Veterinary Support Staff Only	1	0.5
“Don’t Know”	1	0.5
Total Responses	188	100

3.4.2. Personnel Involved with Euthanasia Decisions and Authorisation

3.4.2.1. Overall

The combination of personnel reported to be involved with euthanasia decisions and authorisation was variable across individual responses and varied markedly with whether the animal was stated to be “surplus” or “geriatric” (Fig. 3.a. and 3.b.). Personal feelings of involvement with euthanasia decision-making were also noted to differ markedly between employment groups, particularly when considering those employees who are not routinely involved in animal work (i.e. the employment field of “other”) (Fig. 4.). Notable differences also exist when comparing fields of Management with Veterinary Services and Animal Care, with the latter groups feeling less involved for both “geriatric” and “surplus” euthanasia decision-making.

The employee groups that were most frequently reported as being involved in “geriatric” animal euthanasia decisions included Veterinarians (96.4%) and Senior Animal Keepers (91.6%), followed by non-senior Management Staff (74.9%) and non-senior Animal Keepers (74.9%). In contrast, the employee groups that were most frequently reported as involved in decisions about the euthanasia of “surplus” animals included Senior Animal Keepers (75%), Senior Management Staff (75%), non-senior Management Staff (72.8%) and Veterinarians (68.5%). The groups reported to be most frequently involved in the *authorisation* of “geriatric” animal euthanasia included Veterinarians (77.5%) and Senior Management Staff (63.1%), while the employee groups reported most frequently to be responsible for the authorisation of “surplus” animal euthanasia were Senior Management Staff (71.6%), Veterinarians (47.7%) and CEO’s or Facility Owners (46.6%).

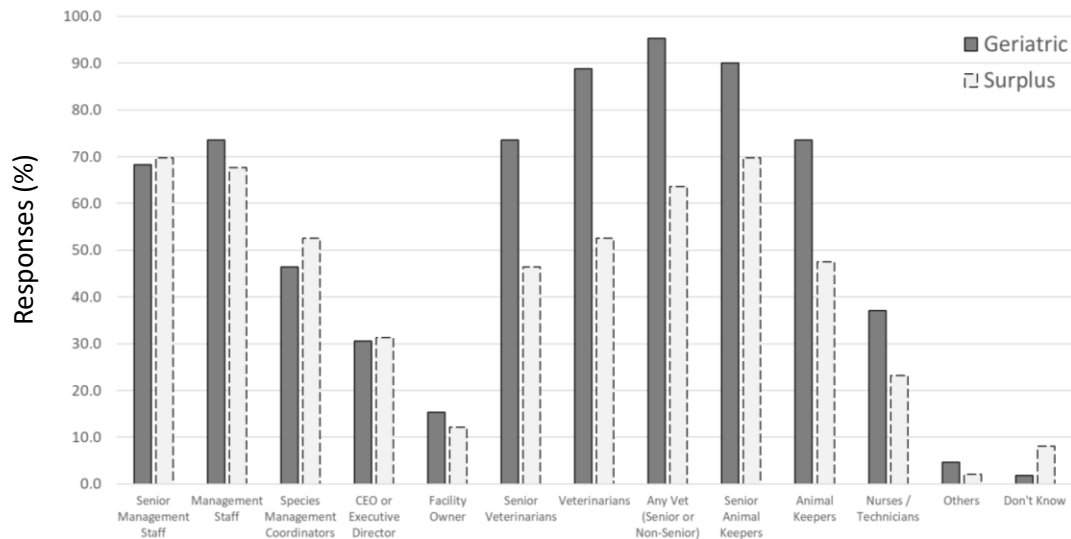
When considering other zoo-based roles that are generally considered to be in frequent close animal contact or euthanasia contact, veterinary nurses/technicians had particularly low rates of reported involvement in euthanasia decisions and authorisation for both “geriatric” and “surplus” animals (Fig. 3.a. and 3.b.), while keepers had low involvement in euthanasia authorisation (Fig. 3.b.).

3.4.2.2. Workplace Differences

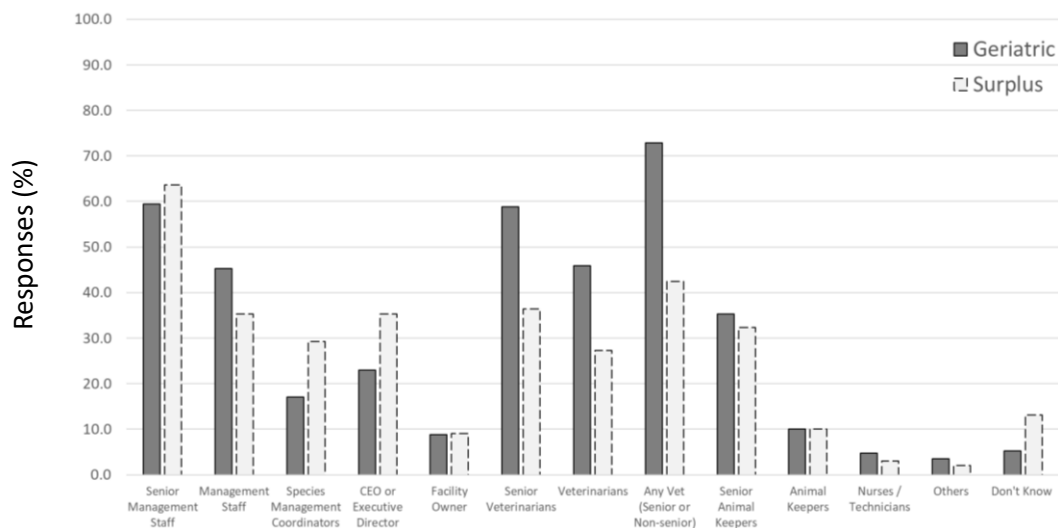
As per Tables 8. and 9, the personnel reportedly involved with euthanasia decisions varied across multiple workplace features, particularly with respect to facility size and type. Veterinarians were reportedly involved significantly less often at private facilities, regardless of whether the animal was stated to be “geriatric” or “surplus”. Notably, only 25% of participants from private facilities reported veterinarians as involved with “surplus” animal euthanasia decisions, in contrast to 79% of participants from “government” facilities and 92% from “other” facilities (Table 9). A similar pattern of difference was seen for the euthanasia of “geriatric” animals, although reported rates of veterinary involvement remained high across each type of facility overall (Table 8).

The reported involvement of veterinarians also varied significantly with facility size. Only 33% of participants from small facilities reported that veterinarians are involved with “surplus” animal euthanasia decisions (Table 9). Similarly, proportionately few participants from small facilities reported that veterinarians are involved in “geriatric” animal euthanasia decisions (17/20 = 85%), when compared to medium and large facilities (105/107 = 98%; 31/31 = 100%). Facility size was also associated with the reported involvement of most other employee types, with many of these differences were present across both “geriatric” and “surplus” decisions. Facility size did not, however, exert any influence on the involvement of species management coordinators (SMC’s) and animal keepers.

Interestingly, location appeared to exert minimal influence on the personnel involved with euthanasia decisions. Participants from New Zealand did, however, report a higher rate of involvement from animal keepers in “surplus” animal euthanasia decisions (92%) and a higher rate of involvement from CEO’s in “geriatric” animal euthanasia decisions (43%). While it is plausible that the difference noted for CEO’s may be the result of the higher number of private facilities represented within the Australian data set, the significance of this pattern is actually increased when private facilities are excluded (NZ: 21/42, 50.0% and Aus: 17/72, 23.6%) ($P = .004$).

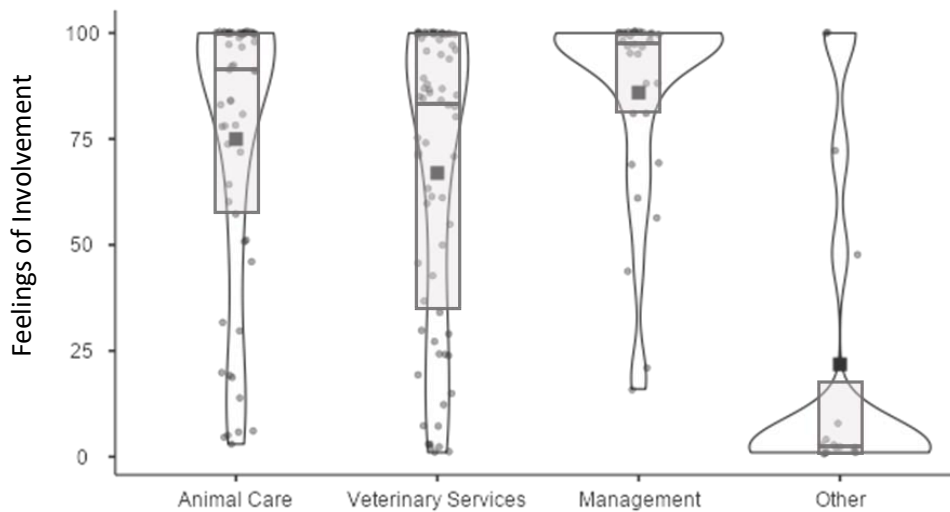


A. Reported Role Involvement with Euthanasia Decisions

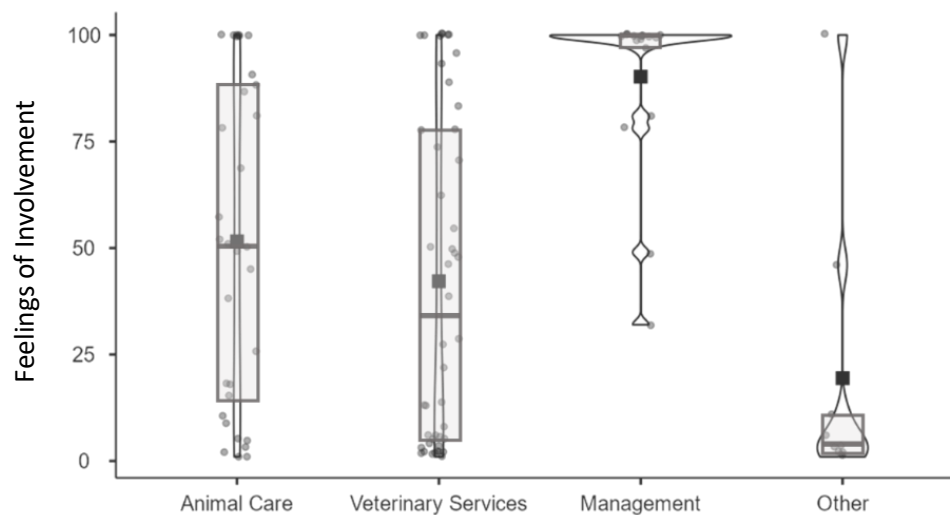


B. Reported Role Involvement with Euthanasia Authorisation

Figure 3. Employment roles reportedly involved in euthanasia decision-making and authorisation. *Note.* Involvement reported as a percentage of relevant responses for **A.** euthanasia decisions; and **B.** euthanasia authorisation prior to the planned euthanasia of “geriatric” (grey boxes) and “surplus” animals (dotted boxes).



A. Personal Involvement with Geriatric Animal Euthanasia Decision-making



B. Personal Involvement with Surplus Animal Euthanasia Decision-making

Figure 4. Personal feelings of involvement with euthanasia decision-making across employment fields. *Note.* Only participants who had previously stated that “geriatric” and “surplus” animals are euthanised at their workplace are included within 4.A. and 4.B., respectively. 0 = “Not at all Involved”; 100 = “Heavily Involved”. Mean = solid box; Median = solid line. Data shown respectively for **A.** euthanasia of “geriatric” animals. Animal Care staff (n=58), Veterinary Services (n=70), Management (n=32), and Other (n=16); and **B.** euthanasia of “surplus” animals. Animal Care staff (n=32), Veterinary Services (n=46), Management (n=17), and Other (n=9).

Table 8: Workplace Variation in Personnel Involved in Euthanasia-Decisions of “Geriatric” Animals. ** $P < .001$, * $P < .05$

	Veterinarians		Animal Keepers		Management		CEO		Facility Owner		CEO or Owner		Nurses/Techs		SMC		Don't Know	N/A	Total Possible
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	n	n
Location																			
Aus	105	95	105	95	99	89	28	25	21	19	69	62	38	34	47	42	2	9	111
NZ	51	100	49	96	46	90	22	43	4	8	27	53	24	47	28	55	1	5	51
	<i>P val.</i>		<i>.091</i>		<i>.686</i>		<i>.846</i>		<i>.022*</i>		<i>.070</i>		<i>.267</i>		<i>.119</i>		<i>.136</i>		
Facility Type																			
Private	44	90	46	94	44	90	12	25	20	41	26	53	14	29	13	27	1	9	49
Other	24	100	23	96	21	88	9	38	2	8	10	42	9	38	14	58	0	0	24
Government	89	99	87	97	81	90	29	32	3	3.3	30	33	38	42	51	57	2	6	90
	<i>P val.</i>		<i>.014*</i>		<i>.740</i>		<i>.937</i>		<i>.470</i>		<i><.001**</i>		<i>.077</i>		<i>.283</i>		<i>.002*</i>		
Facility Staff Numbers																			
Low	17	85	19	95	16	80	6	30	7	35	11	55	2	10	10	50	0	7	20
Mod-High	105	98	102	95	101	94	39	36	17	16	50	47	49	46	46	43	3	7	107
Very High	31	100	31	100	25	81	3	9.7	0	0	3	9.7	8	26	17	55	0	1	31
	<i>P val.</i>		<i>.005*</i>		<i>.466</i>		<i>.024*</i>		<i>.017*</i>		<i>.003*</i>		<i><.001**</i>		<i>.003*</i>		<i>.475</i>		
Organisational Structure																			
Joint	76	97	74	95	70	90	19	24	10	13	23	30	32	41	35	45	1	6	78
Independent	80	95	80	95	76	91	33	39	16	19	45	54	30	36	41	49	2	10	84
	<i>P val.</i>		<i>.459</i>		<i>.914</i>		<i>.876</i>		<i>.042*</i>		<i>.281</i>		<i>.002*</i>		<i>.487</i>		<i>.616</i>		

Table 9: Workplace Variation in Personnel Involved in Euthanasia-Decisions of “Surplus” Animals. ** $P < .001$, * $P < .05$

	Veterinarians		Animal Keepers		Management		CEO		Facility Owner		CEO or Owner		Nurses/Techs		SMC	Don't Know		N/A	Total Possible
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	n	n
Location																			
Australia	37	71	38	73	46	89	15	29	7	13.5	21	40	13	25	28	54	7	0	52
New Zealand	25	68	34	92	34	92	14	38	5	13.5	16	43	10	27	22	60	4	0	37
<i>P val.</i>		.717		.026*		.597		.372		.994		.787		.830		.599			
Facility Type																			
Private	5	25	15	75	17	85	5	25	9	45	12	60	1	5.0	5	25	2	0	20
Other	13	92	14	100	12	86	7	50	1	7.1	8	57	5	36	7	50	0	0	14
Government	45	79	44	77	53	93	18	32	2	3.5	18	32	17	30	39	68	9	0	57
<i>P val.</i>		<.001*		.127		.492		.292		<.001**		.038*		.055		.003*			
Facility Staff Numbers																			
Low	4	33	9	75	8	67	4	33	6	50	9	75	0	0	5	42	1	0	12
Mod-High	44	79	48	86	55	98	23	41	6	11	26	46	16	29	30	54	6	0	56
Very High	12	63	14	74	15	79	3	16	0	0	3	16	6	32	12	63	3	0	19
<i>P val.</i>		.007*		.412		.001**		.134		<.001**		.004*		.092		.501			
Organisational Structure																			
Joint	32	74	33	77	40	93	14	33	4	9.3	15	35	15	35	27	63	6	0	43
Independent	30	63	40	83	42	88	17	35	9	18.8	24	50	7	15	24	50	5	0	48
<i>P val.</i>		.223		.431		.378		.774		.199		.146		.024*		.220			

3.5. Zoo Employee Attitudes to Use of Euthanasia for “Surplus” and “Geriatric” Animals

The survey received 198 completed answers for whether euthanasia is “ever acceptable”, and 197 responses rated the acceptability of euthanasia for managing “geriatric” or “surplus” animals. Regardless of circumstance, participants held strong attitudes regarding euthanasia with few participants indicating a ‘neutral’ or near-neutral opinion on euthanasia acceptability (Fig. 5).

Close to 99% of participants answered “yes” to whether euthanasia is “ever acceptable” within zoos (196/198), but employee support varied markedly with the reason for euthanasia (Fig. 5). Clear majority support existed for euthanasia in treating or managing a “geriatric” animal, with 93% of participants indicating the practice is “acceptable” to “somewhat acceptable” (184/197) (Fig. 5.a.). Just ten participants indicated that they consider this practice “somewhat unacceptable” to “unacceptable”. In contrast, attitudes toward the acceptability of euthanising a “surplus” animal were polarising: 52% of participants considered this practice “somewhat unacceptable” to “unacceptable” (102/197), while 37% of participants expressed that it was “somewhat acceptable” to “acceptable” (73/197) (Fig. 5.b.). A higher proportion of participants expressed a ‘neutral’ opinion toward using euthanasia for surplus animals (22/197; 11.5%) than for geriatric animals (3/197; 1.5%).

3.6. Zoo Employee Attitudes to Lethal and Non-lethal Options for Population Management

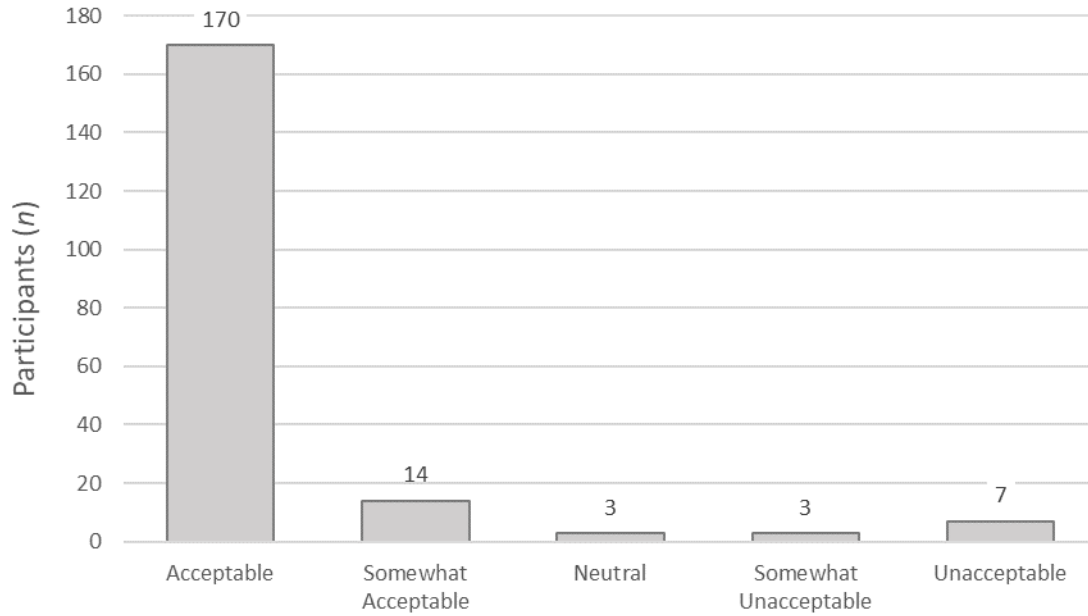
Employee attitudes toward the acceptability of potentially controversial captive management strategies were highly variable (Fig. 6). The acceptability of each population management strategy received between 189-193 responses respectively. Despite the variability, management strategies that utilize euthanasia (often referred to as Population Management Euthanasia, or “PME”) received significantly lower mean levels of acceptability, as did the transfer of animals to “unaccredited” facilities, in contrast to non-lethal reproductive management strategies.

Of all strategies, participants demonstrated very strong support for ‘contraception’ (90.3 ± 16.6 ; $n = 192$) (Fig 6. Column B.). ‘Sterilization’ (A) also received strong support (86.5 ± 20.5 ; $n = 192$). Other non-lethal options which involved separating animals (C + D) were also generally well supported. Employee support for these two strategies was more variable: (C) ‘separating males and females’ (80.7 ± 22.4 ; $n = 189$); (D) ‘housing individual animals off-exhibit’ (68.5 ± 31.4 ; $n = 191$).

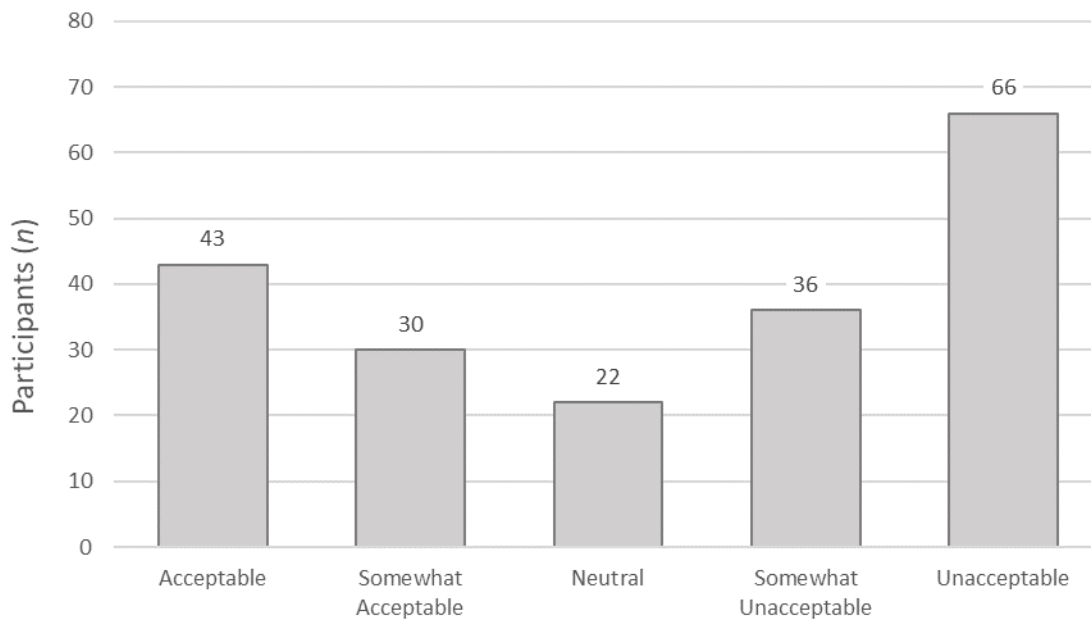
Employee acceptance of the three population management euthanasia strategies (PME) was low overall (E – G). Within this, support for euthanasia being undertaken at weaning age (F) received very low mean levels of support (29.4 ± 32.2 ; $n = 192$), and acceptability appeared lower than euthanising neonates at birth (37.1 ± 34.2 ; $n = 193$) (E) or non-reproductive animals in adulthood (36.9 ± 34.3 ; $n = 192$) (G). Level of acceptability toward euthanasia at birth appeared overall similar to the euthanasia of non/post reproductive adults.

Overarchingly, it was clear that substantial numbers of employees tend to prefer non-lethal options over PME. A notable exception existed: “transferring animals to ‘unaccredited’ facilities” (34.6 ± 31.6 ; $n = 190$) was considered substantially less acceptable than other non-lethal options, and was in-fact more similar in levels of acceptability to two of the PME strategies proposed (E + G).

Support for PME options were highly variable across participants, and more variable than for reproductive control.



A. Acceptability of Euthanasia for Treatment/Management of a Geriatric Animal



B. Acceptability of Euthanasia for Management of a Surplus Animal

Figure 5. Zoo employee attitudes toward euthanasia under two contrasting circumstances. *Note.* “Acceptable” = 75 and above; “somewhat acceptable” = 53 to 74; “neutral” = 48 to 52; “somewhat unacceptable” = 26 to 47; “unacceptable” = 25 and under. **A.** Acceptability of Euthanasia for Treatment/Management of a Geriatric Animal (n=197), and **B.** Acceptability of Euthanasia for Management of a Surplus Animal (n = 197).

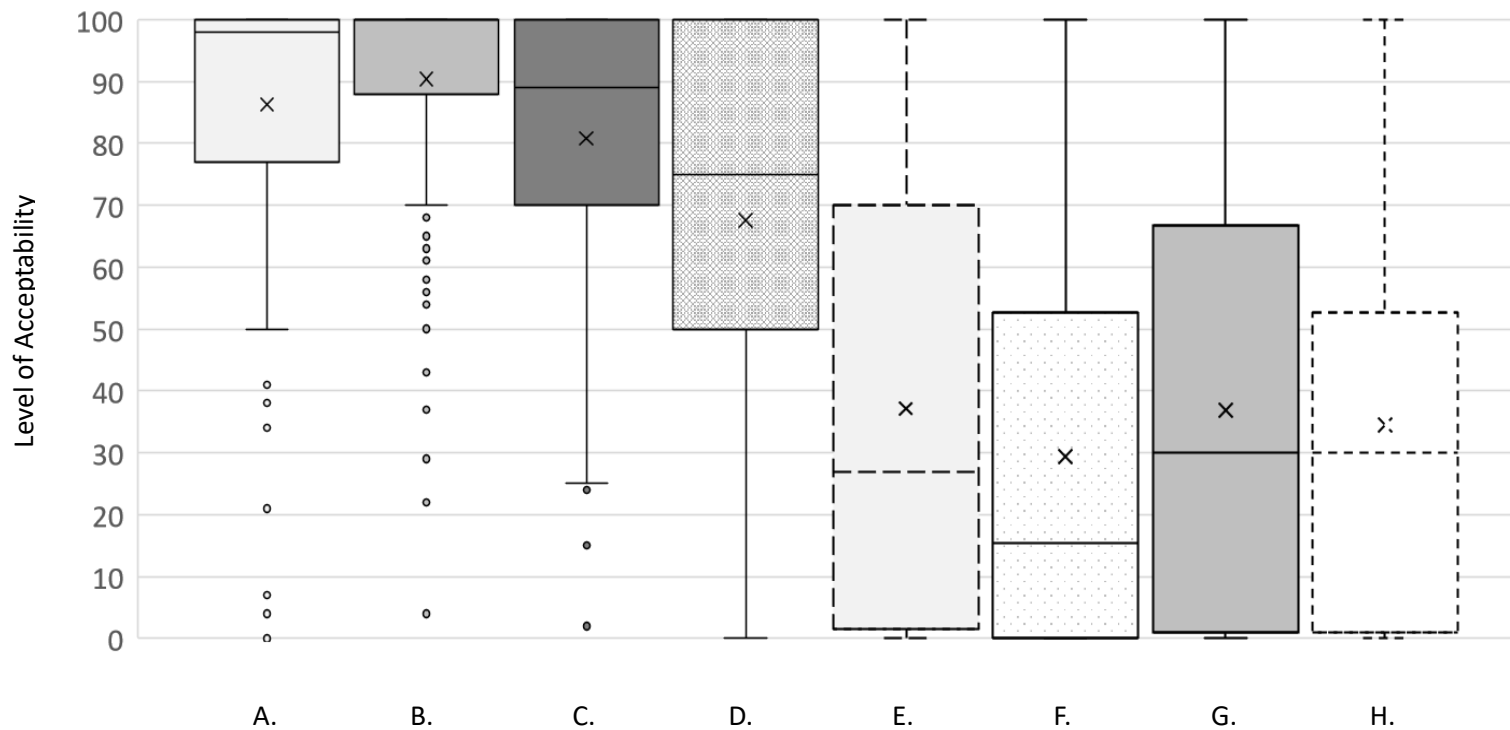


Figure 6. Comparison of employee attitudes toward lethal and non-lethal population management strategies. *Note.* **A.** sterilization/de-sexing, **B.** contraception, **C.** separation of males and females, **D.** housing individual animals off-exhibit, **E.** euthanising live offspring at birth, **F.** euthanising offspring at weaning age, **G.** euthanising post-reproductive or non-reproductive adults, and **H.** transferring “surplus” animals to ‘unaccredited’ facilities. 0 = “Unacceptable”, 50 = “Neutral”, 100 = “Acceptable”. Mean acceptability is represented by crosses and medians are represented by solid lines. N.b. non-lethal approaches include direct reproductive control (A and B); and physical separation as a means of reproductive control (C, D and H). Data within E, F, and G represent attitudes toward Population Management Euthanasia (PME) at different time points related to age of animal.

3.7. Attitudinal Variation - Participants

3.7.1. Employment

There were no detected differences of statistical significance in the attitudes of different employment backgrounds toward the acceptability of using euthanasia to manage geriatric animals (Fig. 7.a.). In contrast, attitudes toward the acceptability of euthanising a “surplus” animal varied significantly with Employment Field ($P = .044$). Employees within “Management” were more supportive of this practice than “Animal Care”, while “Veterinary Services” staff were positioned in-between these fields.

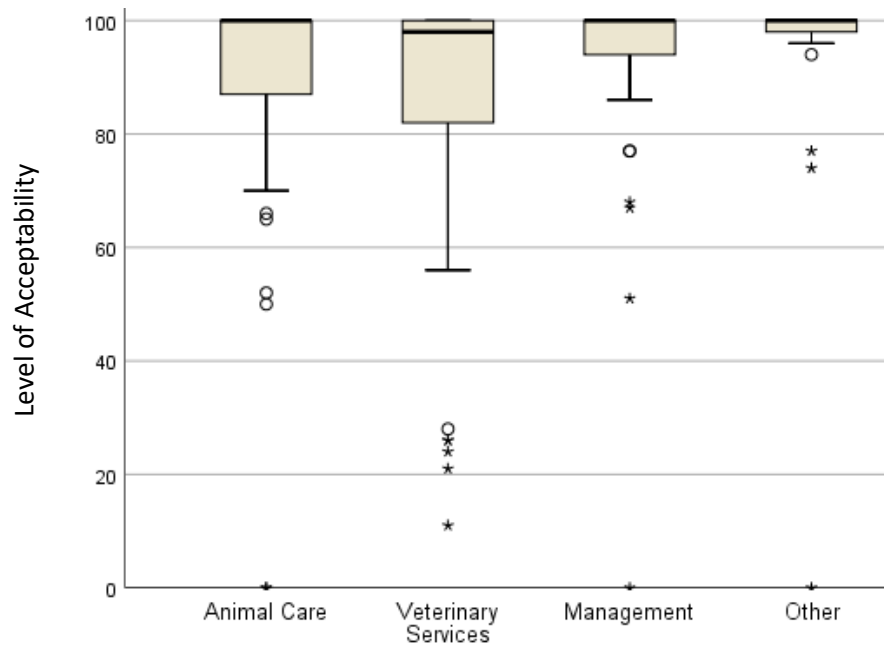
Differences between the four principal Employment Fields were not apparent for population management strategies, but Management roles tended to be more supportive for all cases of PME. It is important to note that within all Employment Fields and Roles there were individuals who expressed strong opinions both for and against each PME strategy. The only exception to this finding was the attitudes of veterinary nurses who were each disapproving of euthanasia at weaning age.

3.7.2. Euthanasia Exposure and Animal Contact

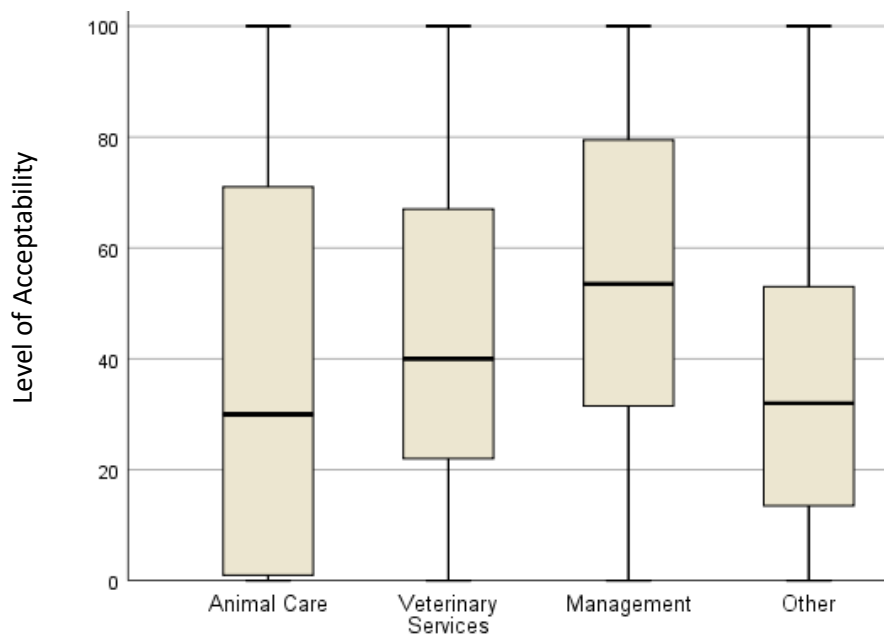
Participants who had been directly exposed to animal euthanasia fewer than 30 times were significantly less supportive of using euthanasia to manage a “surplus” animal (36.6 ± 30.4) than participants who had been exposed more frequently (57.1 ± 31.9) ($P < .001$). This finding existed for Animal Care ($P = .001$) and Veterinary Services staff ($P = .004$) but was weak when the analysis was restricted to employees within Management ($P = .393$). Conversely, attitudes toward the acceptability of euthanising a “geriatric” animal did not differ with level of euthanasia exposure. Participants who had been directly involved with animal euthanasia more than 30 times were significantly more accepting of each type of PME: ‘at birth’ ($P = .003$); ‘at weaning’ ($P = .009$); and ‘non-breeding adults’ ($P = < .001$). Regular direct contact with animals was not found to be associated with attitudes.

3.7.3. Other Participant Demographics

Female employees (41.4 ± 32.1) expressed somewhat lower feelings of acceptability than male employees (54.8 ± 32.4) toward the euthanasia of “surplus” animals ($P = .048$). Female participants were less accepting than male participants of all approaches to PME: euthanasia of “live offspring at birth” ($P = .026$), offspring at ‘weaning age’ ($P = .051$) and non-breeding adults ($P < .001$). No significant gender difference was detected for the euthanasia of “geriatric” animals.



A. Acceptability of Euthanasia for Geriatric Animals



B. Acceptability of Euthanasia for Surplus Animals

Figure 7. Attitudes of different employment fields toward euthanasia under two contrasting circumstances. *Note.* 0 = “Unacceptable”, 50 = “Neutral”, 100 = “Acceptable”. Median attitudes of acceptability is represented by solid lines for each Field of Employment. **A.** acceptability of euthanasia for “geriatric” animals; and **B.** acceptability of euthanasia for “surplus” animals. Animal Care staff (n=66), Veterinary Services (n=70), Management (n=32) and Other (n=16).

3.8. Attitudinal Variation – Across Workplaces

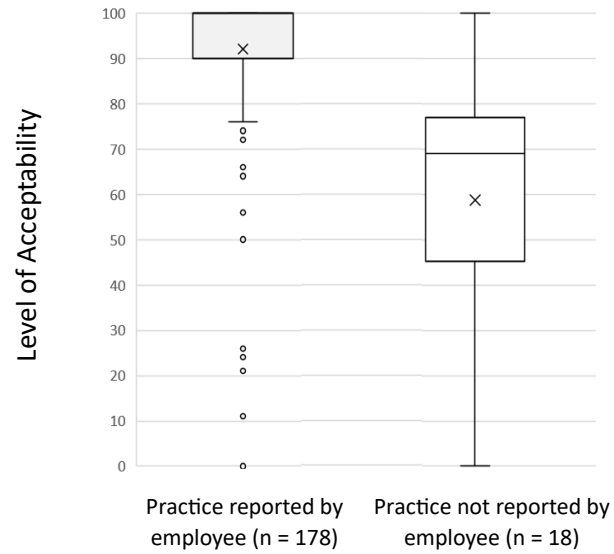
3.8.1 Facility Type

Participants from privately-run facilities expressed significantly lower support for the euthanasia of “surplus” animals ($P = .003$). Likewise, lower acceptance was shown toward all three descriptions of PME: ‘at birth’ ($P = .019$); ‘at weaning’ ($P < .001$); and ‘non-breeding adults’ ($P = .013$). Particularly low support was expressed for the euthanasia of offspring at ‘weaning age’ (15.6 ± 23.6 ; $n = 58$). In contrast, working within a privately-run facility did not influence acceptability toward direct reproductive control or other non-lethal strategies (including the acceptability of transferring to non-accredited facilities). Acceptability toward “geriatric” animal euthanasia did not vary with whether the workplace was privately-run, but acceptability was lower among participants from facilities with low numbers of staff (86 ± 21.47 ; $n = 26$) in comparison to facilities with very high staff numbers (96.4 ± 7.4 ; $n = 32$) ($P = .003$). Interestingly, facility size was not clearly associated with overall acceptability toward the euthanasia of “surplus” animals, or any of the descriptions of PME.

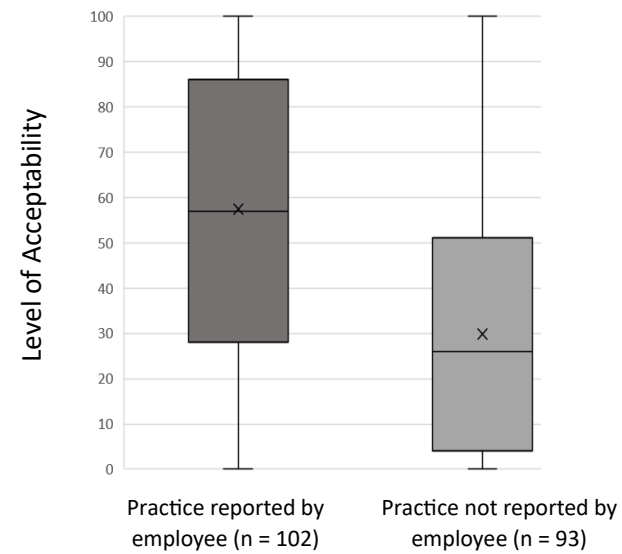
Employment within a jointly or independently-operated workplace was associated with variable attitudes toward all circumstances of euthanasia. Participants from jointly-operated workplaces were marginally more supportive of geriatric animal euthanasia: independent (87 ± 22.9 ; $n = 96$), joint (93 ± 14.1 ; $n = 84$) ($P = .033$). This trend also existed for the euthanasia of “surplus” animals, but significance was not reached due to high variability in both groups ($P = .079$).

3.8.2. Awareness and Known Use of Euthanasia at Workplace

Participants were significantly more supportive of euthanasia practices if they reported the respective practice at their workplace. That is, attitudes toward both “geriatric” and “surplus” animal euthanasia were more positive for participants who reported being aware of the practice occurring at their workplace ($P < .001$) (Fig. 8.). Similarly, participants who reported that euthanasia of surplus animals occurs at their facility were also more supportive of each type of PME: ‘at birth’ ($P = .002$); ‘at weaning’ ($P < .001$); and ‘non-breeding adults’ ($P < .001$). Interestingly, participants who reported that geriatric animals are not euthanised at their facility demonstrated particularly low levels of acceptability toward PME (mean acceptability = 11.8, 9.39, 19.0, respectively).



A. Euthanasia of Geriatric/Aged Animals at Workplace



B. Euthanasia of Surplus Animals at Workplace

Figure 8. Employee attitudes and awareness of euthanasia use at workplace. *Note.* 0 = “Unacceptable”, 50 = “Neutral”, 100 = “Acceptable”. Mean acceptability is represented by crosses and medians are represented by solid lines. **A.** euthanasia of “geriatric” animals at workplace, and **B.** euthanasia of “surplus” animals at workplace.

3.8.3 Geographical Location

Employees from New Zealand demonstrated lower mean acceptability toward the euthanasia of “geriatric” animals: NZ (84.9 ± 26.5 ; $n = 57$); Aus (92.9 ± 13.6 ; $n = 121$) ($P = .035$). No significant difference was identified across locations regarding the euthanasia of “surplus” animals, although the relationship was inverted with NZ more supportive of this practice: NZ (51.9 ± 32.0 ; $n = 56$); Aus (43.5 ± 33.3 ; $n = 122$). Likewise, attitudes toward PME were not detected to be different across countries, but on average acceptability from Australian participants was marginally lower in each case. Interestingly, Australian participants were notably more accepting of other non-lethal options including the suggestion of ‘housing individual animals off-exhibit’: Aus (73 ± 28.2 ; $n = 120$); NZ (58.1 ± 37.0 ; $n = 56$) ($P = .009$) and ‘separating males and females’: Aus (83.6 ± 20.7 ; $n = 119$); NZ (74.3 ± 25.1 ; $n = 55$) ($P = .019$).

3.9. Thematic Analyses

At multiple points through the survey participants had the opportunity to provide text-based responses. The detail below is reflective of the key themes that were generated regarding roles, responsibilities and duties undertaken by zoo-based personnel, in association with the process of euthanasia within Australasian zoos. The beneath reveals the breadth of experience and tasks that personnel may become responsible for when engaged in this highly unique and important aspect of their working lives. The dedication of personnel and variety of duties performed is clear, as well as the technical expertise and adaptability that is required when working with a variety of taxa, across different institutions and contexts. The findings support the quantitative results that euthanasia decision-making, and euthanasia duties, are not performed exclusively by veterinarians within modern zoos.

3.9.1. Responsibilities of Non-Veterinary Staff during Euthanasia Events

Theme: *‘For Certain Reasons and Certain Species’*

The two most common reasons conveyed for non-veterinary zoo staff performing euthanasia were for animals that are to be used as prey food for other animals, and for pest management within the zoo. The euthanasia of animals for use as prey was described to be a “daily activity” for some keepers, with “feeder rodents” including rats and mice the most commonly provided example. Other animals euthanised by non-veterinary staff for feeding purposes included domestic farm animals (e.g. chickens, piglets, goats), other domestic birds, invertebrates, native rodents, agouti, and other surplus animals that were unspecified. Species euthanised as part of pest management included pigeons, rodents, rabbits, mustelids, and cats. Numerous other participants specified that non-veterinary staff would euthanise domestic livestock that were surplus, sick, or injured.

Multiple descriptions were offered regarding the responsibility of non-veterinary staff in the euthanasia of collection animals that are traditionally considered to be lower order taxa, particularly fish, invertebrates and reptiles (e.g. frogs, lizards, snakes and crocodilians).

Non-veterinary staff were also explained to be relied upon on for the euthanasia of collection mammals and birds in situations that were particularly context dependent. For instance, non-veterinary staff may be responsible for the euthanasia of collection animals via gunshot (e.g. “large ungulates”) in select cases when “it is considered appropriate...and fits within [the] euthanasia policy”. Or, there may be instances where there is an urgent need for euthanasia and a veterinarian cannot be present within an “appropriate time”. Another participant described that this may happen particularly on weekends for animals that are “too injured to treat”.

Theme: *'Approved Methods by Trained Staff'*

Methods used by non-veterinary staff were frequently specified and included cervical dislocation, cranial impact (e.g. captive-bolt gun), carbon dioxide chambers, chemical overdose (e.g. barbiturates, Aqu-i-S) and the use of firearms. The use of traps may also be involved.

Many participants did not specify the exact techniques used but focused on emphasising that staff use "methods [and] practices [that are] approved". Similarly, others emphasised that euthanasia is only undertaken by "trained staff". Multiple participants specified that this staff training and approval process is the responsibility of veterinary staff or veterinarians.

3.9.2. Employee Responsibilities during Euthanasia Decisions, Authorisation and End-of-Life Care

Theme: *'Keepers and their Animals Aging Under their Care'*

Keepers are described as being involved in numerous aspects of animal euthanasia and decision-making, with many participants describing keepers as being heavily involved in the euthanasia discussions for the animals that are aging under their care. In particular, participants describe keepers as important in decision-making and the process of assessing quality of life because they are responsible for the "daily tracking" and assessment of animals; they "know their animal's personality"; and are able to detect what may not be "normal" for that animal. Keepers are also described as important during end-of-life care regarding the development and provision of husbandry changes to maintain quality of life of an aging animal (e.g. "cutting food smaller") or administration of medications. Keepers may also be directly involved in the handling and restraint of an animal that is under their care in order for the euthanasia to be ultimately carried out. Furthermore, in some cases, keepers may be personally responsible for the decision-making and also for performing the euthanasia (e.g. surplus domestic stock or critically injured animals when veterinarians are unavailable). It is relevant to note that a number of keepers specified that while they would be involved in the euthanasia decisions for animals directly under their care, they may not be involved for animals from other areas of their workplace.

Theme: *'Variable Roles of Veterinary Staff'*

Some participants described the veterinary team as the key decision-makers regarding euthanasia, while other participants explained that euthanasia decisions might be made by other team members in-conjunction with the veterinary team, or with the input of veterinary advice. Multiple participants expressed appreciation for being able to have veterinary advice to assist with euthanasia decision-making and in assessing the quality of life of animals under their care. Veterinarians were also described as important during end-of-life care regarding the provision of analgesic medication and assisting with animal welfare assessments. In many cases - although not all - veterinarians were described as responsible for performing euthanasia.

The level of involvement of veterinarians with euthanasia appears to be variable, with participants describing that veterinarians may provide leading advice for euthanasia being performed for geriatric or medical reasons, but that they may have little to no involvement with surplus animals being euthanised. Regarding the euthanasia of 'surplus' animals, multiple veterinarians explained that they believe other veterinarians at their workplace are involved with the processes and decision-making, but that they are personally not involved or aware of the process. Others reflected that the veterinary department was not involved (e.g. "the decision to euthanise surplus animals seems to all be the decision of the curatorial managers and divisional supervisors, not the vets"). Quite a number of different veterinary staff also described similar experiences, whereby they have endured situations where they were unaware of the decision-making process but would have

‘surplus’ animals “presented” to them or “dropped-off” for euthanasia without explanation.

Multiple veterinarians commented that they felt their professional input was ignored or undermined during euthanasia decision-making and – specifically - that they felt pressure to find “medical grounds” to euthanise an animal that was actually healthy.

Another key feature of veterinary involvement is the process of performing post-mortems of euthanised animals, and providing reports that then assist other team members with understanding why euthanasia was appropriate (e.g. “full review of post mortem results has always proven that the decision to humanely euthanise due to age-related conditions has been the right decision for the animal.”)

Theme: *‘What is Authorisation?’*

Similar to veterinary roles, the involvement of managers and curatorial staff appears variable. For instance, one participant specified that they were technically responsible for authorising euthanasia, however in all situations so far, they have followed the broader team’s decision.

Chapter 4: Discussion

4.1 The Use and Acceptability of Euthanasia within Australasian Zoos

The animal care setting of zoos provides a unique and revealing environment to explore attitudes and beliefs toward death and dying in contemporary society, as modern zoos have key responsibilities toward efforts that save animals (Bacon et al., 2021b; Penfold et al., 2014; Spooner et al., 2023), while simultaneously managing circumstances of animal death. A complicated set of pressures is created for those responsible for organisational and animal care decisions; magnified as zoos are vulnerable to intense community spotlight and scrutiny (McCulloch & Reiss, 2017). Zoos must balance responsibilities to individual animals and population-level outcomes (Clay & Visseren-Hamakers, 2022; DiVincenti Jr et al., 2023) resulting in philosophical conflicts that may emerge for employees (Powell, 2016). The operation of zoos must inevitably involve large numbers of diverse personnel working together (Föllmi et al., 2007), who may each hold different duties and perspectives associated with animal euthanasia.

Our study revealed that neutral or near-neutral attitudes toward animal euthanasia is uncommon, and that euthanasia is used commonly across ethically contrasting scenarios within Australasia. Overall, animal euthanasia was shown to be performed at high rates across the Australasian zoo profession, with over 90% of respondents from both surveyed countries reporting its use at their workplace. Euthanasia was performed for reasons that align with “best interest” to the animal (e.g. old age), as well as for reasons that are not clearly in the individual’s best interest (i.e. not related to health reasons). This latter group, documented as euthanasia performed for healthy animals that are “surplus”, may be considered to be at-odds with societal comfort around the use of animal killing, and may not sufficiently meet contemporary conceptions of animal euthanasia that highlight a “good death” performed in the animals own interests as the central focus (Cottrell & Duggleby, 2016; Fawcett, 2013; Persson et al., 2020; Yeates, 2010). Accordingly, we demonstrated a high number of zoo-based personnel are uncomfortable with the euthanasia of healthy animals.

The use of euthanasia for surplus animals was identified to occur across both countries, with somewhat higher use of the practice within New Zealand. The overall rates reported within this study are effectively identical to a similar study in the US, where 53% of zoo keepers were aware of PME at their institution (Powell, 2016). The location-based difference may partly be the result of higher

acceptability toward the practice seen within the NZ dataset, with other factors also expected to have contributed. The variation may reflect familiarity with terminology across the two countries, or due to variation in workplace demographics. For example, more jointly-operated zoos were represented in the Australian data-set, which may afford increased opportunities for sharing (i.e. transfer) of animals between zoos. This is a highly relevant consideration, given that cooperative management of zoo-based populations is essential (Che-Castaldo et al., 2021; Lees & Wilcken, 2009). This finding may demonstrate that connectivity between zoos, and presumably more cohesive policies and institutional approaches, leads to reduced requirements for population management euthanasia. This is consistent with existing reported benefits of cohesive management plans to minimise surplus animals (Carter & Kagan, 2010; Che-Castaldo et al., 2021). It is important to note that, due to both Australia and New Zealand's geographic isolation and strong biosecurity practices (Chapple et al., 2016), there are unavoidable realities that limit ease of integration with international efforts. It is likely this challenge is felt most strongly within New Zealand, as there are comparatively few institutions managing typical zoo species. Interestingly, euthanasia of geriatric animals was seen as somewhat less acceptable within the NZ dataset, in comparison to Australia. A concerning, but possible, interpretation is that there are pressures to avoid euthanising aging animals due to logistic difficulties with identifying and sourcing replacement animals stemming from this geographical isolation. While this possibility is worthy of consideration, other influencing factors are likely. For example, associated with the uneven balance of facility types, with the two regions characterised by facilities that differed in size, funding structure, and organisational structure. This may call for additional research to understand further details about attitudes toward euthanasia of aging zoo animals within New Zealand.

It is possible that the variation in reporting rates reflects true geographical variation but additional studies are required to reveal deeper explanations for the difference, and relevant cultural considerations and influences. As highlighted by (Bacon et al., 2021a), geographical and cultural differences must be considered to sufficiently understand perspectives of the international zoo community toward animal welfare within zoos. The importance of understanding cultural variations within the Australasian region is particularly important as often Australia and NZ are treated as a single operating entity and are represented by combined professional bodies within the zoo industry (e.g. ZAA; and the Australasian Society of Zoo Keeping), and more broadly within the animal care profession (e.g. Australian and New Zealand College of Veterinary Scientists; and the Australian and New Zealand Laboratory Animals Association).

Overall, the acceptability of euthanasia performed for healthy surplus animals was proven to be polarised within Australasia. As anticipated, this type of euthanasia was met with consistently lower levels of acceptability overall in comparison to euthanasia of geriatric animals, and those most likely to support this practice held positions in management, following trends seen regarding heightened management support for the practice within zoos in the USA (Powell & Ardaiolo, 2016). These disparities identified affirm that the use of controversial euthanasia practices within Australasia should be viewed as an organisational risk requiring close attention. Increasing integration of the practice represents hazards for the development of moral distress within the Australasian zoo industry, particularly if the practice is embraced for population-level reasons without adequate consideration of the likely perspectives of those directly caring for these animals, and those responsible for performing euthanasia.

In contrast, the euthanasia of animals performed due to old age was shown to be undertaken at a very high prevalence reported by over 90% of participants within both countries, and appears to be a well-accepted and embedded practice within the Australasian zoo profession. Acceptance was high

across all employment sectors. This can be presumed to be because this fits well within a modern-day conception of a “good death”, undertaken based on our perspectives and beliefs around the animal’s best interest (Cottrell & Duggleby, 2016). All employment fields rated euthanasia performed for geriatric reasons as highly acceptable. Interestingly, a number of personnel within “veterinary services” held an unexpected perspective expressing low acceptability toward geriatric animal euthanasia. This is an important finding as it is contrary to what might be assumed. It is recommended that further examination is afforded to understanding the perspectives of veterinary professionals regarding the euthanasia of aging zoo animals, as these personnel are regularly exposed to the process of euthanasia (Powell et al., 2018), they are in close frequent contact with animal death, and play key roles related to euthanasia within zoo-based workforces. It is expected that this was the result of reporting attitudes of veterinary nurses, junior, and senior veterinarians collectively, who may each hold differing views.

Examined at a closer scale, there appeared to be an association between the use of euthanasia and workplace features of size and type. Private facilities appeared significantly less like to perform euthanasia, particularly for surplus animals. Facilities with low numbers of staff also appeared to perform euthanasia less often. This represents previously unrecognised workplace-associated influences that may add to disparate belief systems and awareness of the use of euthanasia in zoos. A potential reason for this may be that private facilities are more dependent on commercial gain via visitation, and therefore more conscious of social licence impacts. This is speculative, however, and there are likely other equally impactful contributing factors, such as resourcing and access to veterinary services that may be more likely to detect the need for euthanasia (and able to more readily perform euthanasia), as well as possibly lower rates of animal movement and transfer within these facilities. To the author’s knowledge, no data exists on the influences that facility type and workplace characteristics may have on employee euthanasia attitudes, as existing studies within the USA focused on employee characteristics and personal demographics (Powell & Ardiolo, 2016). This study therefore provides an important reminder that workplace features and internal institutional culture may drive employee attitudes and exposure to euthanasia, in addition to personal belief systems and broader cultural influences. This study provides preliminary insights that the Australasian zoo profession holds variable views toward euthanasia acceptability, particularly for more controversial justifications. However, I did not investigate religious or cultural backgrounds of the individuals in this study, beyond their working environment. Further study of these factors may be required to understand the divergent opinions identified within this study.

4.2 Personnel Involvement and Attitudes

Our results proved conclusively that high numbers of different personnel are involved with the practice of euthanasia within Australasian zoos, with variable degrees of involvement across employment groups for each phase of decision-making, authorisation, and performing euthanasia. Given the range of employees directly and indirectly involved with the euthanasia of animals within zoos, it is likely that the topic has wide-reaching impact within workplaces. Indeed, a recent survey of zoo professionals revealed a number of participants worried about animals afterhours, often citing concerns about illness and death, despite only a small subset of participants within the study being veterinarians themselves (3.2%; 10/311) (Brando et al., 2023). As such, attitudes and beliefs of a breadth of employees should be considered carefully in order to approach and cohesively reach conclusions during the process of death and dying of a zoo animal.

When considering participant characteristics, employment field was demonstrated as important to euthanasia acceptability, particularly for more controversial practices. For example, management personnel were significantly more supportive of euthanasia use for “surplus” animals. This is

consistent with general expectations based on previous studies (Powell, 2016), as these personnel are likely to hold responsibilities and knowledge around population planning decisions, either directly or indirectly, and are less likely to work closely with animals on a daily basis. This is consistent with appeals to increase the practice within zoos for population-level outcomes, present within published discourse written from a population management frame of reference (Lewandowski, 2003; Powell & Ardaiole, 2016). Conversely, animal care personnel were demonstrated to be apprehensive about this practice. This is similarly unsurprising, as it is likely these participants have close connections to animals on an individual level, having potentially formed close bonds, and are generally likely to see animals as moral entities, rather than as units within a population. This mindset appears consistent with perspectives conveyed in the literature that oppose uptake of management euthanasia (Browning, 2018). Bacon, Bell, et al. (2023) notes that while considerable attention has been afforded to visitor perceptions within human-animal interaction literature, less effort has been afforded to characterise and describe employee beliefs held within zoos, and so our work provides helpful new insights to an understudied topic of relevance to zoo operation. Our findings hold specific relevance for reducing psychosocial hazards for personnel within the workplace responsible for performing euthanasia, as moral distress may occur if asked to perform euthanasia for unsubstantiated reasons. Within our results, we demonstrated many different personnel may be responsible for performing euthanasia, with many of these same individuals also apprehensive about euthanasia use. These individuals are likely to be exposed to the highest risks of moral distress developing associated with euthanasia use within zoos.

Participants identifying as female reported reduced acceptability toward the more controversial forms of euthanasia (i.e. surplus animal euthanasia) within our results than male participants. This adds to existing literature that a relationship may exist between gender and beliefs around euthanasia acceptability for both animal euthanasia (Hartnack et al., 2016b; Herzog Jr et al., 1989; Powell & Ardaiole, 2016; Powell et al., 2018) and human euthanasia (Ward, 1980). Our dataset had an inherent confounder however, as more managers identified as men than women. Managers, in turn, demonstrated higher acceptability toward euthanasia. This scenario of gender imbalance between zoo-based employment type and acceptability of euthanasia precisely mirrors results from similar work within the USA (Powell & Ardaiole, 2016). Despite the confounder, gender may hold relevance when building a picture of attitudinal variation toward euthanasia within the workplace, particularly if there is an over-representation or under-representation of particular genders within employment groups. Future studies are encouraged to also consider the influence of age, as either directly relevant or as a confounder within results, given this personal demographic also appears relevant to attitudes toward euthanasia (Hartnack et al., 2016a; Ward, 1980) but was not specifically analysed within our study. Direct animal contact was not found to influence outcomes, contrary to expectations. It is possible that use of this parameter was limited by use of a vague term (“regular”) in the question with only three answers possible, resulting in the vast majority of personnel answering positively that they have been in direct contact with animals either currently or previously. Future studies should use an approach that is more sensitive to variable degrees of animal contact. It is also possible that direct animal contact is less relevant for employees within zoo settings who may be separated from animals by physical barriers, and given it is generally recognised that strong emotional responses can be elicited by zoo animals simply due to being viewed as charismatic (Levin, 2015; Wolfensohn, 2020).

To date, the studies that exist around beliefs of zoo keeping staff toward euthanasia and welfare topics have a tendency to focus on zoo keeping staff (Bacon, Bell, et al., 2023), or managers and veterinarians (Powell & Ardaiole, 2016; Powell et al., 2018). Less appears to have been written around employees that work within zoos but don't specifically work with animals as part of their

routine working life. This appears to be true for many recent studies specifically looking at euthanasia stress, however (Brando et al., 2023) did investigate broad groups in association with animal welfare feelings generally. Our work provides a small data-set and some preliminary insights for these personnel who don't work with animals. This group indicated low levels of involvement in decision-making, and were generally very accepting of geriatric animal euthanasia, while being less likely to support euthanasia of healthy surplus animals. Given a high number of employees within contemporary zoos do not work directly with animals, but still hold perspectives that will influence zoo-based decisions, we argue that the perspectives of this group of stakeholders may be an important group to consider in further studies. They may provide an 'internal control', as per our study, and may provide insights for how the general public or lay person that does not work with animals may view controversial zoo-based activities. Potential consequences of not considering the full zoo-based workforce may include disconnected sentiments and difficulty with achieving consensus around policies and procedures, or lead to psychosocial hazards within the workplace due to conflicting views. Aspects of this have been conveyed by (Bemister-Bourret & Tawfik, 2023), that describe employees feeling dismay that management decisions were made that influenced the practice of euthanasia, without apparent full consideration of these impacts.

We showed that for both types of euthanasia personnel were more comfortable with the practice if they were aware of it occurring at their workplace. This is consistent with previous U.S. findings (Powell, 2016; Powell et al., 2018), and European interview findings that zoo keepers were more accepting of PME if they were more aware of euthanasia incidence at their workplace (Powell, 2016). Our results are internally consistent, with frequency of direct exposure to euthanasia identified as significantly relevant to employee attitudes toward the use of euthanasia for surplus animals. Interestingly, this pattern was not found for geriatric animal euthanasia, which suggests that frequency of euthanasia exposure becomes less relevant when considering less controversial or well established euthanasia practices. It is also plausible that personnel directly exposed to more controversial euthanasia may develop justifications within their belief systems progressively overtime, to rationalise that the individual-level or population-level benefits of euthanasia justifies the inherent harm caused by killing. General desensitization or habituation to the use of euthanasia is also likely to contribute to a degree, as per findings from a sample of veterinary students that suggested repeated exposure to euthanasia may lead to desensitization over time (Witte et al., 2013). Overall, increased awareness coupled with the practical benefits and drawbacks and complications of euthanasia is likely to influence belief systems and perspectives in uniquely different ways across employment fields, with multiple factors likely culminating to produce overall personal attitudes toward death and dying, with employment background a key driver.

4.3 Decision-Making Responsibility

While it is generally well known that veterinarians perform animal euthanasia (Powell et al., 2018) there are many industries where non-veterinarians become involved in killing animals for different reasons. Here, we present evidence that indicates a high degree of involvement by non-veterinarians within the Australasian zoo profession, in both the performance of euthanasia, and particularly the associated decision-making. A range of different personnel are responsible and involved with authorisation and decision-making steps associated with euthanasia, and this varied due to the underlying reasons the euthanasia is performed. Personnel involved in decision-making appeared more varied with the use of euthanasia for surplus animals, whereas decisions and authorisation of animals for geriatric reasons appeared to still be predominantly a veterinary-led decision.

As reported by Brando et al. (2023), there is strong desire for discussion to occur associated with the loss of an animal within zoo environments, and the euthanasia of animals within zoos is also known

to involve group conversations (Campbell-Ward, 2023; Föllmi et al., 2007). Combined with our findings that a broad cross section of participants are involved with the authorisation process, beyond veterinarians, our findings sit in contrast to descriptions of veterinarians as the key or primary euthanasia decision-maker within zoos (Wenker et al., 2012). The overall collaborative decision-making approach within zoos appears to follow phenomena seen in companion animal medicine, with the cooperative use of standardised templates between veterinarian and owner to describe features of wellbeing and welfare seen within domestic animal care (Belshaw, 2018). Aspects of collective decision-making is also observed within some cultures associated with euthanasia and assisted dying for humans, where decisions shift from the individual to the family (Karumathil & Tripathi, 2022). Of course, the comparison is only partially analogous, given animals can never be directly involved in communicating decision-making preferences themselves. Interestingly, conclusions by Karumathil and Tripathi (2022) suggest that a fear of a “slippery slope” in the USA associated with the use of euthanasia and assisted dying for humans has resulted in the increasing use of evidence-based decision-making processes. This has a striking resemblance to what is observed with increasing prevalence associated with end-of-life care of animals. We therefore suggest that euthanasia decision-making around zoo animals is following broader societal trends associated with companion animal death, and has some parallels with human medicine.

While our study demonstrated that veterinarians are not the only professionals involved in euthanasia decisions or even performing euthanasia, there are a range of relevant professional skills veterinarians hold that are important to recognise and remember. For example, providing interpersonal support that aids the grieving process and the importance of crafting euthanasia conversations appropriately is of known benefit to others during animal euthanasia events (Bemister-Bourret & Tawfik, 2023; Shaw & Lagoni, 2007), and it is recognised that veterinarians have ethical and professional responsibilities to animal owners, which they ordinarily execute as a secondary or additional priority to the direct welfare of their animal patients (Yeates, 2010; Yeates, 2009). It has also been proven that veterinarians provide moral judgements around the ethical use of euthanasia on a case by case basis (Yeates & Main, 2011), and should be seen as essential to implementing ethical matrixes and similar structured decision-making tools within formalised euthanasia processes, that otherwise may risk oversimplifying complex cases (Yeates, 2010). Veterinarians are also appropriately placed to comment on physiological suffering and the effectiveness of pharmaceutical mitigations within pain-management regimes and other drug-based approaches used within quality-of-life management, and have been shown to often approach ethical dilemmas by balancing the needs of the animal while remaining empathetic to caretakers (Knesl et al., 2017). For these reasons it is important that veterinarians remain to be seen as a key part of euthanasia decision-making and overall process. It is important to note that veterinary nurses are also known to play an important role in supporting human caretakers and validating grief experiences during euthanasia (Yeates, 2022).

It is increasingly understood that euthanasia and the overarching topic of animal welfare would benefit from receiving increased attention within formal veterinary education and professional training (Cooney et al., 2021; Knesl et al., 2017; Littlewood et al., 2021; Littlewood & Beausoleil, 2021; Littlewood et al., 2018), and the results of our study emphasise the value of this. The leadership throughout all phases of euthanasia provided by veterinarians is critical to animal welfare and employee wellbeing outcomes, and as such it is vital that veterinary curricula recognise and appropriately equip veterinary personnel to maximise effectivity in guiding complex euthanasia conversations, undertaking well considered and competently delivered approaches to euthanasia. This is likely to lead to broadly felt reductions in euthanasia stress within animal care workforces, and is likely to hold substantial and meaningful benefits for veterinary mental health.

4.4 Outcomes for Industry

Given the complexity of societal attitudes toward death and dying, it is likely that the topic of death creates heightened tensions within the complexity of the zoo environment, both for management decisions, and for those working directly with animals. Indeed, the frustration and sadness that can be experienced by zoo personnel associated with death of animals under their care is clear. The possibility of rifts occurring between staff is real (Bemister-Bourret & Tawfik, 2023), and a perceived conflict between conservation behaviours and animal welfare outcomes is noted, and may have a geographical relationship varying between regions (Bacon, Bell, et al., 2023). Regardless of the true extent of population sustainability issues within zoos, it appears likely that individual animal and population-level priorities are likely to play out contentiously amongst zoo employees (Clay & Visseren-Hamakers, 2022) given that time and effort must be devoted by zoos to use and advance cooperative management and small population management strategies to be successful conservation entities (Lees & Wilcken, 2009).

Understanding the potential rifts that exist already, and are at risk of widening over time is vital for zoos to provide a healthy environment for both animals and staff. Animal welfare outcomes are known to be enhanced by strong “stockpersonship”, which is influenced by the attitudes, wellbeing, and personalities of animal carers (Bacon, Bell, et al., 2023). Within zoos, this concept of stockpersonship can be extended to the zoo keeper (Bacon, Vigors, et al., 2023). For an organisation to create a working environment that fosters best outcomes, they must therefore consider the existing beliefs and consequent experiences of different stakeholders in association with euthanasia use.

Recently, Bacon, Bell, et al. (2023) drew attention to cultural and social norms as a key driver of zoo staff beliefs, rather than individual demographics. Our study illustrates beliefs held within Australasia, showing clearly polarising division in opinion within a single geographical region despite cohesive cultural features (e.g. English speaking). As such, our study appears to reflect a range of probable individual or workplace factors which may each have their own set of values, in addition to a degree of difference between geographical regions. This variation and heterogeneity in beliefs within subgroups of the same culture has also been described within attitudes toward human euthanasia (Karumathil & Tripathi, 2022). This suggests that factors in addition to culture do influence beliefs, with social norms of different workplaces appearing relevant. We argue that employee attitudes principally originate from an employee’s employment experiences and exposure to animal euthanasia, rather than other demographic features (e.g. gender). However, this may also play a role. A notable limitation within this conclusion is that our study did not ask if employees originated from outside of Australasia. This is a relevant question to understand cultural origins of apparently disparate opinions, as it is common for zoo staff to move between zoos across the globe. Regardless, our study demonstrated that Australasia contains a wide range of opinions which are relevant to understand and consider, to minimize ideological and ethical conflicts within a zoo workforce.

Overarchingly, the study has demonstrated that the euthanasia of healthy animals within zoos is a divisive topic, with polarised and variable perspectives demonstrated for all measures of lethal management strategies and surplus animal euthanasia. The study assists in filling gaps identified by (Bacon, Bell, et al., 2023) by characterising attitudes of zoo staff for topics of relevance to zoo animal welfare across the international zoo community. Attitudes toward death are never straightforward (Karumathil & Tripathi, 2022), and this study demonstrated clearly that underlying justifications matter to beliefs and employee attitudes associated with the euthanasia of animals, and the resulting feelings of those directly responsible for key phases within the euthanasia process. Steps to

reduce moral distress are critical, including the need for clear communication around euthanasia justifications to personnel involved in animal euthanasia.

The importance of cooperative management across zoos to slow the decline of species is clear (Che-Castaldo et al., 2021), and the results of this work emphasise the importance of shared approaches to animal respect and euthanasia policies across the industry to facilitate enhanced cooperative management. Rather than ongoing debates that risk organisational stability or professional division, an enhanced approach would be to first understand likely euthanasia attitudes through the lens of the relevant culture (Karumathil & Tripathi, 2022). Preferences for bringing a good, well-managed, death to life within the zoo is clear, supported by the known use of extensive quality-of-life assessment approaches within zoo settings (Campbell-Ward, 2023), and reaffirmed by our findings that personnel prefer euthanasia that is undertaken in the animal's own interest. Approaches that integrate collaborative discussions, that minimise complications for the individual, and are clearly undertaken in the best interests of the individual, are likely to be well received within Australasian zoo workplaces.

As recently highlighted by Brando et al. (2023), the compounding impact of euthanasia exposure overtime on zoo employees is likely, and opportunities to continue to re-think, consult broadly, and review elements of end-of-life care and euthanasia will continue to be valuable for contemporary zoos and their workforce into the future. We argue that clearly identifying and communicating the justification behind use of euthanasia is critical, particularly for those involved directly with performing euthanasia. Justifications built purely on logistic or population-level rationales are unlikely to be enough to overcome the prevailing discourse around what constitutes a good death in Western cultures, with risks that the public may view this as "playing god" (Lueders & Allen, 2020), and employees may become disenfranchised or be exposed to heightened psychosocial hazards. For internal stakeholders, there is a prominent view in support of geriatric euthanasia, and therefore it can be assumed that this rationale will usually be considered sufficient for euthanasia justifications, presuming it is established and conveyed truthfully. As emphasized previously by Jessup and Scott (2011), public-facing communication (e.g. when celebrating animal birthdays) could take the opportunity to build community awareness that aging animals receive increased end-of-life care, to aid visitor understanding ahead of time that animals may require euthanasia at a future time. Overall, as highlighted by Hepps Keeney and Harrison (2022) increasing communications around euthanasia internally within institutions, combined with public-facing communications, if executed appropriately, may provide a protective function for those involved in euthanasia.

On an individual employee level, prior exposure to euthanasia, and the timepoint that euthanasia occurs will matter to moral judgements around euthanasia within the professional sphere of zoos and aquariums. Given the polarised views that exist, zoos should continue to explore non-lethal management strategies for use around 'surplus' animals, particularly within Australasia. As per Carter and Kagan (2010) this may include greater commitment and care toward 'off-display' areas, research toward non-lethal reproductive control and management approaches, and potentially regional 'retirement facilities' if appropriate. While lifetime reproductive planning may be important to maintain the reproductive success of captive populations (Powell & Ardaiole, 2016), it is recommended that this is integrated alongside lifetime welfare plans, including a register of cumulative welfare impacts, in addition to close consideration of the belief systems active within the local zoological region or institution.

4.5 Limitations

Our study provides a large cohort study within the zoo and aquarium profession to contribute to existing knowledge of occupational stress of performing euthanasia, reviewed previously by Scotney et al. (2015), and the developing understanding of perspectives held within the international zoo community (Bacon et al., 2021a). Our study provides a larger sample size in comparison to studies that have focused on small sample groups of <100 personnel (Scotney et al., 2015). However, given the sample size within each specific employment group was smaller (70 or less) and contained a range of different employment roles, interpretations of this work should be mindful that the findings are principally a reflection of those specific personnel who completed the survey, and may not translate to all working environments within Australasia. Due to anonymity and privacy considerations we were unable to verify how many personnel may have come from the same facilities, and therefore certain facilities (particularly those with high staff numbers) may have weighted the results to those viewpoints. The mixed methods approach of corroborating quantitative results with qualitative insights, combined with the general impression that the sample demographics represented a large number of different workplaces and personnel, should have partially off-set this risk of bias. As mentioned previously, we did not investigate specific cultural or religious features, plus there were confounders between key demographic features such as gender and employment that limited ability to definitively draw connections. Terminology variation is also considered to be a significant inbuilt challenge to this work, as well as similar studies, given that key relevant terminology is used inconsistently across institutions, as well as within published work. For example, similar employment roles may have different job titles across institutions, and the core concepts of an animal being “surplus” or “geriatric” is open to multiple different intuitive interpretations and reactions that may have occurred despite providing definitions within the survey. As per other studies that have investigated occupational stress of euthanasia, our study is limited by a survey design undertaken at a specific point in time, and future studies could consider longitudinal work focused toward individuals to help understand changes and responses associated with exposure to euthanasia and cumulative workplace experiences (Levitt & Gezinski, 2020; Scotney et al., 2015).

Conclusion

It has been previously shown that within a single culture there can be disparate beliefs and knowledge about zoo animal welfare issues, in addition to across cultures (Bacon, Bell, et al., 2023). Our study revealed that there is euthanasia attitudinal variation within the Australasian region and a single homogenous view does not exist for the use of euthanasia, particularly for animals that are otherwise healthy. Our study is aligned with previous findings for animal care personnel within USA (Powell & Ardaiole, 2016) that showed features including gender, prior knowledge of euthanasia occurring at the workplace, and employment backgrounds influenced attitudes. Within our study we demonstrated clearly that underlying justification for euthanasia matters to the attitudes held by zoo-based professionals, and that there is high acceptability toward euthanasia performed for reasons of old age. The overall practice of euthanasia and associated decision-making was shown to be variable across the profession, with no single standard of approach, with some key roles feeling uninvolved in the decision-making process. Our study highlighted that organisational elements are important to consider when building an understanding of euthanasia attitudes and experiences within a workplace. It was documented that euthanasia duties involve many personnel, and that veterinarians are not the sole employees tasked with performing euthanasia and guiding euthanasia decisions. Given the rapidly evolving set of societal pressures, zoo environments are

encouraged to closely consider the attitudes and experiences of those involved in animal euthanasia and animal care and take proactive steps to minimize psychosocial hazards and risks of moral distress developing within the workplace.

References

- Andrukonis, A., Hall, N. J., & Protopopova, A. (2020). The Impact of Caring and Killing on Physiological and Psychometric Measures of Stress in Animal Shelter Employees: A Pilot Study. *International Journal of Environmental Research and Public Health*, *17*(24), 9196. <https://www.mdpi.com/1660-4601/17/24/9196>
- Andrukonis, A., & Protopopova, A. (2020). Occupational health of animal shelter employees by live release rate, shelter type, and euthanasia-related decision. *Anthrozoös*, *33*(1), 119-131.
- Asa, C. (2016). Weighing the options for limiting surplus animals. *Zoo Biology*, *35*(3), 183-186.
- Asa, C. S., Porton, I. J., Baker, A., & Plotka, E. (2010). Contraception as a management tool for controlling surplus animals. *Wild mammals in captivity: principles and techniques for zoo management*, 469-482.
- Ash, L. (2012). Causes of mortality in falconry raptors. *The Journal of Washington Falconry*, 19-46.
- Ashall, V. (2023). Reducing Moral Stress in Veterinary Teams? Evaluating the Use of Ethical Discussion Groups in Charity Veterinary Hospitals. *Animals*, *13*(10), 1662.
- Ashforth, B. E., & Kreiner, G. E. (1999). "How can you do it?": Dirty work and the challenge of constructing a positive identity. *Academy of management Review*, *24*(3), 413-434.
- Ashforth, B. E., & Kreiner, G. E. (2014). Dirty work and dirtier work: Differences in countering physical, social, and moral stigma. *Management and organization review*, *10*(1), 81-108.
- Bacon, H., Bell, C., Dwyer, C. M., Waran, N., Qing, Y., Xia, L., & Shaw, D. J. (2023). Exploration of cultural norms and behavioural beliefs about zoo animal behaviour, welfare, ethics and husbandry practices in a sample of the international zoo community. *Zoo Biology*, *42*(3), 416-428.
- Bacon, H., Vigers, B., Shaw, D. J., Waran, N., Dwyer, C. M., & Bell, C. (2021a). Is animal welfare an internationally understood concept in the zoo world? Thematic analysis of two regional groups of zoo staff. *Animals*, *11*(7), 2059.
- Bacon, H., Vigers, B., Shaw, D. J., Waran, N., Dwyer, C. M., & Bell, C. (2021b). The modern zoo: Demographics and perceptions of two international groups of zoo staff. *Journal of Zoological and Botanical Gardens*, *2*(4), 636-649.
- Bacon, H., Vigers, B., Shaw, D. J., Waran, N., Dwyer, C. M., & Bell, C. (2023). Zookeepers—The most important animal in the zoo? *Journal of Applied Animal Welfare Science*, *26*(4), 634-646.
- Baker, K. C. (2000). Advanced age influences chimpanzee behavior in small social groups. *Zoo Biology: Published in affiliation with the American Zoo and Aquarium Association*, *19*(2), 111-119.
- Baysinger, A., Senn, M., Gebhardt, J., Rademacher, C., & Paris-Garcia, M. (2021). A case study of ventilation shutdown with the addition of high temperature and humidity for depopulation of pigs. *Journal of the American Veterinary Medical Association*, *259*(4), 415-424.
- Beausoleil, N. J., Baker, S. E., & Sharp, T. (2022). Scientific assessment of the welfare of trapped mammals—key considerations for the use of the Sharp and Saunders humaneness assessment model. *Animals*, *12*(3), 402.
- Belshaw, Z. (2018). Quality of life assessment in companion animals: What, why, who, when and how. *Companion Animal*, *23*(5), 264-268.
- Bemister-Bourret, K., & Tawfik, M. (2023). Record, Recall, Reflect: A Qualitative Examination of Compassion Fatigue in Toronto Zoo Staff. *Journal of Zoological and Botanical Gardens*, *4*(2), 413-426.
- Bennett, P., & Rohlf, V. (2005). Perpetration-induced traumatic stress in persons who euthanize nonhuman animals in surgeries, animal shelters, and laboratories. *Society & Animals*, *13*(3), 201-220.
- Bennett, R. M., & Willis, K. G. (2008). Public values for badgers, bovine TB reduction and management strategies. *Journal of Environmental Planning and Management*, *51*(4), 511-523.
- Boller, M., Nemanic, T. S., Anthonisz, J. D., Awad, M., Selinger, J., Boller, E. M., & Stevenson, M. A. (2020). The effect of pet insurance on presurgical euthanasia of dogs with gastric dilatation-

- volvulus: a novel approach to quantifying economic euthanasia in veterinary emergency medicine. *Frontiers in Veterinary Science*, 7, 590615.
- Bolton, S. E., & Von Keyserlingk, M. A. (2021). The dispensable surplus dairy calf: Is this issue a “wicked problem” and where do we go from here? *Frontiers in Veterinary Science*, 8, 660934.
- Brando, S., Rachinas-Lopes, P., Goulart, V. D. L. R., & Hart, L. A. (2023). Understanding job satisfaction and occupational stressors of distinctive roles in zoos and aquariums. *Animals*, 13(12), 2018.
- Braverman, I. (2020). *Zoo veterinarians: Governing care on a diseased planet*. Routledge.
- Browning, H. (2018). No room at the zoo: Management euthanasia and animal welfare. *Journal of Agricultural and Environmental Ethics*, 31(4), 483-498.
- Campbell-Ward, M. (2023). Quality-of-Life Assessments in Zoo Animals: Not Just for the Aged and Charismatic. *Animals*, 13(21), 3394.
- Carey, M. (2024, March 16). *Why Did A Zoo Kill Marius, A Healthy Young Giraffe? CPH:DOX World Premiere Doc Asks Profound Questions Springing From International Incident*. Deadline. <https://deadline.com/2024/03/marius-the-giraffe-documentary-life-and-other-problems-cphdox-premiere-1235859783/>
- Carter, S., & Kagan, R. (2010). Management of “surplus” animals. *Kleinman, D. et al.(2010)*, 263-266.
- Chapman, S., Chapman, J., & Chatterton, J. (2023). Euthanasia of Geriatric Zoo Animals: Decision-Making and Procedure. In *Optimal Wellbeing of Ageing Wild Animals in Human Care* (pp. 169-185). Springer.
- Chapple, D., Knegtmans, J., Kikillus, H., & Van Winkel, D. (2016). Biosecurity of exotic reptiles and amphibians in New Zealand: building upon Tony Whitaker's legacy. *Journal of the Royal Society of New Zealand*, 46(1), 66-84.
- Che-Castaldo, J., Gray, S. M., Rodriguez-Clark, K. M., Schad Eebes, K., & Faust, L. J. (2021). Expected demographic and genetic declines not found in most zoo and aquarium populations. *Frontiers in Ecology and the Environment*, 19(8), 435-442.
- Clay, A. S., & Visseren-Hamakers, I. J. (2022). Individuals matter: Dilemmas and solutions in conservation and animal welfare practices in zoos. *Animals*, 12(3), 398.
- Clough, H., Roshier, M., England, G., Burford, J., & Freeman, S. (2021). Cross-sectional study of UK horse owner's purchase and euthanasia decision-making for their horse. *Veterinary Record*, 188(6), e56.
- Cohen, J., Marcoux, I., Bilsen, J., Deboosere, P., Van der Wal, G., & Deliëns, L. (2006). European public acceptance of euthanasia: socio-demographic and cultural factors associated with the acceptance of euthanasia in 33 European countries. *Social science & medicine*, 63(3), 743-756.
- Cooke, B. D., & Fenner, F. (2002). Rabbit haemorrhagic disease and the biological control of wild rabbits, *Oryctolagus cuniculus*, in Australia and New Zealand. *Wildlife Research*, 29(6), 689-706.
- Cooney, K., Dickinson, G. E., & Hoffmann, H. (2021). Euthanasia education in veterinary schools in the United States. *Journal of Veterinary Medical Education*, 48(6), 706-709.
- Cooney, K., & Kipperman, B. (2023). Ethical and practical considerations associated with companion animal euthanasia. *Animals*, 13(3), 430.
- Cottrell, L., & Duggleby, W. (2016). The “good death”: An integrative literature review. *Palliative & supportive care*, 14(6), 686-712.
- Davis, N., Schaffner, C. M., & Wehnelt, S. (2009). Patterns of injury in zoo-housed spider monkeys: A problem with males? *Applied Animal Behaviour Science*, 116(2-4), 250-259.
- DiVincenti Jr, L., McDowell, A., & Herrelko, E. S. (2023). Integrating individual animal and population welfare in zoos and aquariums. *Animals*, 13(10), 1577.
- Dosek, T. (2021). Snowball sampling and Facebook: How social media can help access hard-to-reach populations. *PS: Political Science & Politics*, 54(4), 651-655.
- Fawcett, A. (2013). Euthanasia and morally justifiable killing in a veterinary clinical context. *Animal death*, 205-220.

- Finch, K., Williams, L., & Holmes, L. (2020). Using longitudinal data to evaluate the behavioural impact of a switch to carcass feeding on an Asiatic lion (*Panthera leo persica*). *Journal of Zoo and Aquarium Research*, 8(4), 283-287.
- Flacke, G., Tkalcic, S., Steck, B., Warren, K., & Martin, G. (2016). A Retrospective Analysis of Mortality in Captive Pygmy Hippopotamus (*Choeropsis liberiensis*) From 1912 to 2014. *Zoo Biology*, 35(6), 556-569. <https://doi.org/10.1002/zoo.21336>
- Föllmi, J., Steiger, A., Walzer, C., Robert, N., Geissbühler, U., Doherr, M., & Wenker, C. (2007). A scoring system to evaluate physical condition and quality of life in geriatric zoo mammals. *Animal Welfare*, 16(3), 309-318.
- Fulmer, A. E., Laven, L. J., & Hill, K. E. (2022). Quality of life measurement in dogs and cats: A scoping review of generic tools. *Animals*, 12(3), 400.
- Gates, M., Kells, N., Kongara, K., & Littlewood, K. (2023). Euthanasia of dogs and cats by veterinarians in New Zealand: Protocols, procedures and experiences. *New Zealand Veterinary Journal*, 71(4), 172-185.
- Gunasekera, C. A. (2018). the Ethics of Killing “surplus” zoo Animals. *Journal of Animal Ethics*, 8(1), 93-102.
- Hartnack, S., Springer, S., Pittavino, M., & Grimm, H. (2016a). Attitudes of Austrian veterinarians towards euthanasia in small animal practice: impacts of age and gender on views on euthanasia. *BMC Veterinary Research*, 12(1), 26. <https://doi.org/10.1186/s12917-016-0649-0>
- Hartnack, S., Springer, S., Pittavino, M., & Grimm, H. (2016b). Attitudes of Austrian veterinarians towards euthanasia in small animal practice: impacts of age and gender on views on euthanasia. *BMC veterinary research*, 12, 1-14.
- Heintz, M. R., Fuller, G. A., Woodhouse, S. J., Murray, A., & Allard, S. M. (2019). Case Studies of the Impacts of Cataract Surgery on Crested Penguin Welfare. *Journal of Applied Animal Welfare Science*, 22(4), 329-341. <https://doi.org/10.1080/10888705.2018.1519436>
- Hepps Keeney, C., & Harrison, T. M. (2022). Euthanasia complications in non-domestic species. *Journal of Zoological and Botanical Gardens*, 3(4), 616-623.
- Herzog Jr, H. A., Vore, T. L., & New Jr, J. C. (1989). Conversations with veterinary students: Attitudes, ethics, and animals. *Anthrozoös*, 2(3), 181-188.
- Inglett, B. J., French, J. A., Simmons, L. G., & Vires, K. W. (1989). Dynamics of intrafamily aggression and social reintegration in lion tamarins. *Zoo Biology*, 8(1), 67-78.
- Ison, J. (2022). Over the Rainbow Bridge: Animals and Euthanasia. In Fleming, D. J., & Carter, D. J. *Voluntary Assisted Dying: Law? Health? Justice?* (p. 113-136). ANU Press.
- Jacobs, J., & Reese, L. A. (2021). Compassion fatigue among animal shelter volunteers: Examining personal and organizational risk factors. *Anthrozoös*, 34(6), 803-821.
- Jessup, D. A., & Scott, C. A. (2011). Hospice in a zoologic medicine setting. *Journal of zoo and wildlife medicine*, 42(2), 197-204.
- Karstaedt, T. (2012). Kangaroos and the law. *Brief*, 39(9), 14-17.
- Karumathil, A. A., & Tripathi, R. (2022). Culture and attitudes towards euthanasia: An integrative review. *OMEGA-journal of Death and Dying*, 86(2), 688-720.
- Kaumanns, W., Begum, N., & Hofer, H. (2020). Animals are designed for breeding: Captive population management needs a new perspective. *Journal of Zoo and Aquarium Research*, 8(2), 76-85.
- Keulartz, J. (2023). Towards a futureproof zoo. *Animals*, 13(6), 998.
- Kinsey, J. C., Foster, J. A., & Reitz, R. L. (2016). Development of a self-contained carbon dioxide euthanasia trailer for large-scale euthanasia of feral swine. *Wildlife Society Bulletin*, 40(2), 316-320.
- Knesl, O., Hart, B. L., Fine, A. H., Cooper, L., Patterson-Kane, E., Houlihan, K. E., & Anthony, R. (2017). Veterinarians and humane endings: when is it the right time to euthanize a companion animal? *Frontiers in Veterinary Science*, 4, 45.
- Kogan, L. R., Wallace, J. E., Schoenfeld-Tacher, R., Hellyer, P. W., & Richards, M. (2020). Veterinary technicians and occupational burnout. *Frontiers in Veterinary Science*, 7, 328.

- Krebs, B. L., Marrin, D., Phelps, A., Krol, L., & Watters, J. V. (2018). Managing aged animals in zoos to promote positive welfare: A review and future directions. *Animals*, 8(7), 116.
- Kübler-Ross, E. (2015). Attitudes toward death and dying. In *Disaster Prevention* (pp. 63-79). Routledge.
- Lacy, R. C. (1991). Zoos and the surplus problem: an alternative solution. *Zoo Biology*, 10(4), 293-297.
- LaFollette, M. R., Riley, M. C., Cloutier, S., Brady, C. M., O'Haire, M. E., & Gaskill, B. N. (2020). Laboratory animal welfare meets human welfare: A cross-sectional study of professional quality of life, including compassion fatigue in laboratory animal personnel. *Frontiers in Veterinary Science*, 7, 514747.
- Lambeth, S., Schapiro, S., Bernacky, B., & Wilkerson, G. (2013). Establishing 'quality of life' parameters using behavioural guidelines for humane euthanasia of captive non-human primates. *Animal Welfare*, 22(4), 429-435.
- Langman, V., Rowe, M., Forthman, D., Whitton, B., Langman, N., Roberts, T., Huston, K., Boling, C., & Maloney, D. (1996). Thermal assessment of zoological exhibits I: Sea lion enclosure at the Audubon Zoo. *Zoo Biology: Published in affiliation with the American Zoo and Aquarium Association*, 15(4), 403-411.
- Learmonth, M. J. (2019). Dilemmas for natural living concepts of zoo animal welfare. *Animals*, 9(6), 318.
- Leenstra, F., Munnichs, G., Beekman, V., Van den Heuvel-Vromans, E., Aramyan, L., & Woelders, H. (2011). Killing day-old chicks? Public opinion regarding potential alternatives. *Animal Welfare*, 20(1), 37-45.
- Lees, C., & Wilcken, J. (2009). Sustaining the Ark: the challenges faced by zoos in maintaining viable populations. *International zoo yearbook*, 43(1), 6-18.
- Levin, A. (2015). Zoo animals as specimens, zoo animals as friends: the life and death of Marius the giraffe. *Environmental Philosophy*, 12(1), 21-44.
- Levitt, A. L., & Gezinski, L. B. (2020). Compassion fatigue and resiliency factors in animal shelter workers. *society & animals*, 28(5-6), 633-650.
- Lewandowski, A. H. (2003). Surplus animals: the price of success. *Journal American Veterinary Medical Association*, 223(7), 981-984.
- Littin, K., Mellor, D., Warburton, B., & Eason, C. (2004). Animal welfare and ethical issues relevant to the humane control of vertebrate pests. *New Zealand Veterinary Journal*, 52(1), 1-10.
- Littlewood, K., Beausoleil, N., Stafford, K., Stephens, C., Collins, T., Quain, A., Hazel, S., Lloyd, J. F., Mallia, C., & Richards, L. (2021). How decision-making about euthanasia for animals is taught to Australasian veterinary students. *Australian veterinary journal*, 99(8), 334-343.
- Littlewood, K. E., & Beausoleil, N. J. (2021). Two domains to five: advancing veterinary duty of care to fulfil public expectations of animal welfare expertise. *Animals*, 11(12), 3504.
- Littlewood, K. E., Beausoleil, N. J., Stafford, K. J., Stephens, C., Collins, T., Fawcett, A., Hazel, S., Lloyd, J. K., Mallia, C., & Richards, L. (2018). Exploring how end-of-life management is taught to Australasian veterinary students. Part 1: technical euthanasia. *Veterinary Record*, 183(22), 691-691.
- Lueders, I., & Allen, W. T. (2020). Managed wildlife breeding-an undervalued conservation tool? *Theriogenology*, 150, 48-54.
- Mc Loughlin, E. (2023a). Care and its discontents: Commodification, coercive cooperation, and resistance in Copenhagen Zoo. *Environment and Planning E: Nature and Space*, 6(3), 1923-1939.
- Mc Loughlin, E. (2023b). Dissecting the ethics of choreographed encounters with animal death in the zoo: A posthumanist lens on dark pedagogy. *Environmental Education Research*, 1-15.
- McCann, C., & Powell, D. M. (2019). Is there any more room on the Ark? An analysis of space allocation in four mammalian taxa. *Zoo Biology*, 38(1), 36-44.

- McCulloch, S. P., & Reiss, M. J. (2017). *Killing zoo animals surplus to requirements*. https://www.researchgate.net/profile/Steven-Mcculloch/publication/305490573_Killing_zoo_animals_surplus_to_requirements/links/598b2013a6fdcc7cf92746e6/Killing-zoo-animals-surplus-to-requirements.pdf
- McKenzie, B. A., & Chen, F. L. (2022). Assessment and management of declining physical function in aging dogs. *Topics in companion animal medicine*, *51*, 100732.
- Mellor, D. J., Hunt, S., & Gusset, M. (2015). Caring for wildlife: the world zoo and aquarium animal welfare strategy. *WAZA Executive Office: Gland, Switzerland*, 1-87.
- Mills, K. E., Han, Z., Robbins, J., & Weary, D. M. (2018). Institutional transparency improves public perception of lab animal technicians and support for animal research. *PloS one*, *13*(2), e0193262.
- Milienos, A. (2022, March 29). *Bizarre wheelie bins of death used to kill 'nuisance' native cockatoos are branded cruel - but many residents are happy to be rid of the destructive birds*. Daily Mail Australia. <https://www.dailymail.co.uk/news/article-10662201/Rockingham-Council-kills-1-000-corella-cockatoos-bizarre-wheelie-bins-death.html>
- Moittie, S., Dobbs, P., Waive, K., Ashfield, S., & Baiker, K. (2020). Management of a geriatric alpaca with multiple neoplasms in a zoological setting. *Veterinary Record Case Reports*, *8*(2), e001065.
- Morris, M. C., & Weaver, S. A. (2003). Minimizing harm in possum control operations and experiments in New Zealand. *Journal of Agricultural and Environmental Ethics*, *16*, 367-385.
- Moses, L., Malowney, M. J., & Wesley Boyd, J. (2018). Ethical conflict and moral distress in veterinary practice: A survey of North American veterinarians. *Journal of veterinary internal medicine*, *32*(6), 2115-2122.
- NZ Herald (2024, Dec 19). *How many snakes and exotic reptiles have entered New Zealand?* <https://www.nzherald.co.nz/business/how-many-snakes-and-exotic-reptiles-have-entered-new-zealand/ASJGSHH64ZH4DJKN6326NWEHSY/>
- Ogden, U., Kinnison, T., & May, S. (2012). Attitudes to animal euthanasia do not correlate with acceptance of human euthanasia or suicide. *Veterinary Record*, *171*(7), 174-174.
- Orr, B., Malik, R., Norris, J., & Westman, M. (2019). The welfare of pig-hunting dogs in Australia. *Animals*, *9*(10), 853.
- Palmer, A., Rogers, C., Stafford, K., Gal, A., & Bolwell, C. (2021). A retrospective descriptive analysis of race-day injuries of greyhounds in New Zealand. *Australian veterinary journal*, *99*(6), 255-262.
- Parker, R., & Yeates, J. (2012). Assessment of quality of life in equine patients. *Equine Veterinary Journal*, *44*(2), 244-249.
- Penfold, L. M., Powell, D., Traylor-Holzer, K., & Asa, C. S. (2014). "Use it or lose it": characterization, implications, and mitigation of female infertility in captive wildlife. *Zoo Biology*, *33*(1), 20-28.
- Persson, K., Selter, F., Neitzke, G., & Kunzmann, P. (2020). Philosophy of a "good death" in small animals and consequences for euthanasia in animal law and veterinary practice. *Animals*, *10*(1), 124.
- Pople, A., Amos, M., & Brennan, M. (2023). Population dynamics of chital deer (*Axis axis*) in northern Queensland: effects of drought and culling. *Wildlife Research*, *50*(9), 728-745.
- Powell, D. (2016). Humane euthanasia of animals for population management: perspectives from a sample of European zoo keepers.
- Powell, D. M. (2019). Collection planning for the next 100 years: What will we commit to save in zoos and aquariums? *Zoo Biology*, *38*(2), 139-148.
- Powell, D. M., & Ardaiolo, M. (2016). Survey of US zoo and aquarium animal care staff attitudes regarding humane euthanasia for population management. *Zoo Biology*, *35*(3), 187-200.
- Powell, D. M., Lan, J., & Eng, C. (2018). Survey of US-based zoo veterinarians' attitudes on population management euthanasia. *Zoo Biology*, *37*(6), 478-487.

- Quain, A., Mullan, S., & Ward, M. P. (2022). "There was a sense that our load had been lightened": evaluating outcomes of virtual ethics rounds for veterinary team members. *Frontiers in Veterinary Science*, 9, 922049.
- Rebelo, É. M. P. (2019). Quality of life and management of geriatric zoo mammals.
- Reeve, C. L., Rogelberg, S. G., Spitzmüller, C., & DiGiacomo, N. (2005). The caring-killing paradox: Euthanasia-related strain among animal-shelter workers 1. *Journal of Applied Social Psychology*, 35(1), 119-143.
- Rogelberg, S. G., Reeve, C. L., Spitzmüller, C., DiGiacomo, N., Clark, O. L., Teeter, L., Walker, A. G., Starling, P. G., & Carter, N. T. (2007). Impact of euthanasia rates, euthanasia practices, and human resource practices on employee turnover in animal shelters. *Journal of the American Veterinary Medical Association*, 230(5), 713-719.
- Rollin, B. E. (2007a). Cultural variation, animal welfare and telos. *Animal Welfare*, 16(S1), 129-133.
- Rollin, B. E. (2007b). Ethical issues in geriatric feline medicine. *Journal of feline medicine and surgery*, 9(4), 326-334.
- Sanz-Aguilar, A., Martínez-Abraín, A., Tavecchia, G., Mínguez, E., & Oro, D. (2009). Evidence-based culling of a facultative predator: efficacy and efficiency components. *Biological Conservation*, 142(2), 424-431.
- Sayers, J. (2020). The influence of animal welfare accreditation programmes on zoo visitor perceptions of the welfare of zoo animals. *Journal of Zoo and Aquarium Research*, 8(3), 188-193.
- Schmidt, H., & Kappelhof, J. (2019). Review of the management of the Asian elephant *Elephas maximus* EEP: Current challenges and future solutions. *International zoo yearbook*, 53(1), 31-44.
- Scotney, R. L., McLaughlin, D., & Keates, H. L. (2015). A systematic review of the effects of euthanasia and occupational stress in personnel working with animals in animal shelters, veterinary clinics, and biomedical research facilities. *Journal of the American Veterinary Medical Association*, 247(10), 1121-1130.
- Selter, F., Persson, K., Risse, J., Kunzmann, P., & Neitzke, G. (2022). Dying like a dog: the convergence of concepts of a good death in human and veterinary medicine. *Medicine, health care and philosophy*, 25(1), 73-86.
- Sharp, T. (2015). *Commercial kangaroo harvesting: the animal welfare implications for dependent young* UNSW Sydney].
- Shaw, J. R., & Lagoni, L. (2007). End-of-life communication in veterinary medicine: delivering bad news and euthanasia decision making. *Veterinary clinics: small animal practice*, 37(1), 95-108.
- Simpson, L., Grove, J., Bronson, E., & Herrelko, E. S. (2024). Quality of life assessment: The value of longitudinal data in making the end-of-life care decision for a macaque (*Macaca Silenus/Macaca Nemestrina*). *Journal of Applied Animal Welfare Science*, 27(2), 316-329.
- Spooner, S. L., Walker, S. L., Dowell, S., & Moss, A. (2023). The value of zoos for species and society: The need for a new model. *Biological Conservation*, 279, 109925.
- Stafford, K., Collins, T., Degeling, C., Freire, R., Hazel, S., Johnson, J., Lloyd, J., Phillips, C., Fisher, A., & Tzioumis, V. (2019). Veterinary students' opinions on their required competence in dealing with welfare and ethics issues pertaining to wildlife. *Journal of zoo and wildlife medicine*, 50(3), 659-664.
- Stark, B. (2005). The use of carcass feeding to enhance animal welfare. *Proceedings of the Seventh International Conference On Environmental Enrichment*, 198-204.
- Stein, V. (2020). Injury Rehabilitation Ethics in Equestrian and Equine Athletes within the Racing Industry. <https://digitalcommons.sacredheart.edu/cgi/viewcontent.cgi?article=1556&context=acadfest>
- Stephens, T. (2021). Kangaroo management and animal welfare. *Ecological Management & Restoration*, 22, 71-74.

- Stevens, E. G., Baker, T., & Lewis, N. (2022). Dealing with sentient surplus: A moral economy of greyhound rehoming. *Environment and Planning E: Nature and Space*, 5(4), 2033-2051.
- Stikeleather, L., Morrow, W., Meyer, R., Baird, C., & Halbert, B. (2013). Evaluation of CO2 application requirements for on-farm mass depopulation of swine in a disease emergency. *Agriculture*, 3(4), 599-612.
- Strive, T., & Cox, T. E. (2019). Lethal biological control of rabbits—the most powerful tools for landscape-scale mitigation of rabbit impacts in Australia. *Australian Zoologist*, 40(1), 118-128.
- Thompson González, N., Machanda, Z., Oтали, E., Muller, M. N., Enigk, D. K., Wrangham, R., & Emery Thompson, M. (2021). Age-related change in adult chimpanzee social network integration. *Evolution, Medicine, and Public Health*, 9(1), 448-459.
- Tidemann, C. R., Grarock, K., & King, D. H. (2011). Euthanasia of pest sturnids in nestboxes. *Corella*, 35, 49-51.
- Turner, P. V., Hickman, D. L., Van Luijk, J., Ritskes-Hoitinga, M., Sargeant, J. M., Kurosawa, T. M., Agui, T., Baumans, V., Choi, W. S., & Choi, Y.-K. (2020). Welfare impact of carbon dioxide euthanasia on laboratory mice and rats: a systematic review. *Frontiers in Veterinary Science*, 7, 411.
- Vogelnest, L., & Talbot, J. J. (2019). Quality-of-life assessment and end-of-life planning for geriatric zoo animals. In *Fowler's Zoo and Wild Animal Medicine Current Therapy, Volume 9* (pp. 83-91). Elsevier.
- Von Dietze, E., & Gardner, D. (2014). Euthanizing wildlife: experiences and coping strategies among people who conduct euthanasia. *Pacific Conservation Biology*, 20(1), 28-36.
- Walraven, E., Andrew, P., Boyle, N., & Duffy, S. (2018). Euthanasia and small-population management: development of transparent processes, good governance and a practical application. *International zoo yearbook*, 52(1), 258-266.
- Wanner, C. H. (2017). 'For the good of the breed': care, ethics, and responsibility in pedigree dog breeding.
- Ward, R. A. (1980). Age and acceptance of euthanasia. *Journal of Gerontology*, 35(3), 421-431.
- Wark, J. D., Wierzal, N. K., & Cronin, K. A. (2020). Mapping shade availability and use in zoo environments: A tool for evaluating thermal comfort. *Animals*, 10(7), 1189.
- Wenker, C., Hoby, S., & Lawrenz, A. (2012). Breed and cull: let's talk about a taboo. Proceedings AAZV conference,
- Whiting, T. L., & Keaney, M. A. (2022). Animal protection and mass depopulation. *The Canadian Veterinary Journal*, 63(8), 859.
- Wickins-Dražilová, D. (2006). Zoo animal welfare. *Journal of Agricultural and Environmental Ethics*, 19, 27-36.
- Wiley, J. N., Leeds, A., Carpenter, K. D., & Kendall, C. J. (2018). Patterns of wounding in hamadryas baboons (*Papio hamadryas*) in North American zoos. *Zoo Biology*, 37(2), 74-79.
- Wilson, D. P., Craig, A. P., Hanger, J., & Timms, P. (2015). The paradox of euthanizing koalas (*Phascolarctos cinereus*) to save populations from elimination. *Journal of Wildlife Diseases*, 51(4), 833-842.
- Windsor, P. A. (2021). Progress with livestock welfare in extensive production systems: lessons from Australia. *Frontiers in Veterinary Science*, 8, 674482.
- Witte, T. K., Correia, C. J., & Angarano, D. (2013). Experience with euthanasia is associated with fearlessness about death in veterinary students. *Suicide and Life-Threatening Behavior*, 43(2), 125-138.
- Wolfensohn, S. (2020). Too cute to kill? The need for objective measurements of quality of life. *Animals*, 10(6), 1054.
- Yeates, J. (2010). Ethical aspects of euthanasia of owned animals. *In Practice*, 32(2), 70-73.
- Yeates, J., & Main, D. (2009). Assessment of companion animal quality of life in veterinary practice and research. *Journal of Small Animal Practice*, 50(6), 274-281.

- Yeates, J., & Main, D. (2011). Veterinary opinions on refusing euthanasia: justifications and philosophical frameworks. *Veterinary Record*, 168(10), 263-263.
- Yeates, J. W. (2009). Response and responsibility: An analysis of veterinary ethical conflicts. *The Veterinary Journal*, 182(1), 3-6.
- Yeates, J. W. (2022). Death. *Ethics in Veterinary Practice: Balancing Conflicting Interests*, 444-459.
- ZAA (2015) Zoo and Aquarium Association Australasia (ZAA) Guidelines – Animal Euthanasia (2015). https://zooaquarium.org.au/common/Uploaded%20files/Portal/Policies/1b_2_G_Euthanasia.pdf

Appendix A – Full Survey

End of Life Decision-Making at the Zoo: Practices and Perspectives within Australasia

Thank you for participating in this survey, which will take approximately 20-30 minutes to complete and is open to present and past employees of any zoo, aquarium or other captive animal facility that is open to the public within Australia or New Zealand. Locum, resident and contracting/consulting staff are also invited to participate.

When completing this survey, unless the question states otherwise:

- Please answer with regard to the **facility where you primarily work**, or worked. If you alternate between facilities, please choose the place you are usually based or most familiar with.
- Please answer with regard to **planned euthanasia** only. This may include the euthanasia of geriatric animals, or surplus animals including offspring, non-reproductive or post-reproductive adults.
- Please answer with regard to **captive/collection animals** only. That is, not wild animals that are receiving temporary care.
- **Do not** answer with regard to euthanasia that is used when an animal is in a sudden or severe state of distress, ill-health or injury. Also do not consider euthanasia performed for human safety reasons, pest control, or infectious disease control.

When completing this survey, please answer questions using the following definitions:

- **"Euthanasia"** is considered as an umbrella term that includes "humane euthanasia", "culling", and "killing".
- **"Zoo Animal"** is considered as an umbrella term that includes any captive/collection animal that is kept in a zoo, aquarium or other facility that is open to the public.
- **"Geriatric"** is considered to be synonymous with "aged", but is considered here to be different from "surplus" animals.
- **"Surplus"** is considered as any healthy offspring or adult animal that is deemed excess to requirements. In this survey, "geriatric" animals are not considered within "surplus" animals.

The terms "management euthanasia", "Population Management Euthanasia (PME)", and "welfare euthanasia" are intentionally avoided.

Are you a **current** or **previous** employee of a zoo, aquarium or captive animal facility?

- Current employee
- Previous employee
- Previously an employee, and now in a volunteer role only
- Other (please specify) _____

If “previous”, please indicate when you were last employed within the zoo and aquarium sector?

You have selected that you are no longer an employee of a zoo, aquarium or captive animal facility. Was your departure in any way related to the topic of euthanasia of animals?

- Yes
- No

You have selected that your departure was in some way related to the topic of euthanasia of animals. Do you have any comments you would like to share regarding this?

For the purposes of this survey, please answer questions with relation to the primary facility and role within which you use to work.

Please select the option that **best** describes your current (or most recent) primary field of work:

- Animal Keeping/Care/Training
- Veterinary Services
- Management
- Grounds-keeping, Facilities or Maintenance
- Visitor Experience or Tourism
- Business, Finance, HR or Administration
- Education
- Marketing, Media or Communications
- Conservation, Science or Research
- Health and Safety
- Other (please specify) _____
- Prefer not to say

To your knowledge, are animals from your facility ever euthanised for **any reason**?

- Yes
- No

You have selected that no animals from your facility are ever euthanised for any reason. Is this correct?

- Yes. **If not, please press the back button and return to the previous page.**

You have selected that no animals from your facility are ever euthanised for any reason. Could you please explain why you think this is?

To your knowledge, are formalised **quality of life assessments** undertaken for "geriatric/aged animals" at your facility?

- Yes
- Occasionally
- No
- Don't know

To your knowledge, are **regular veterinary assessments** undertaken for "geriatric/aged animals" at your facility?

- Yes
- Occasionally
- No
- Don't know

To your knowledge, how often are "**geriatric/aged animals**" managed by transfer to another facility?

- Often
- In some cases
- In rare cases
- Never
- Don't know

To your knowledge, how often are "**surplus animals**" managed by transfer to another facility?

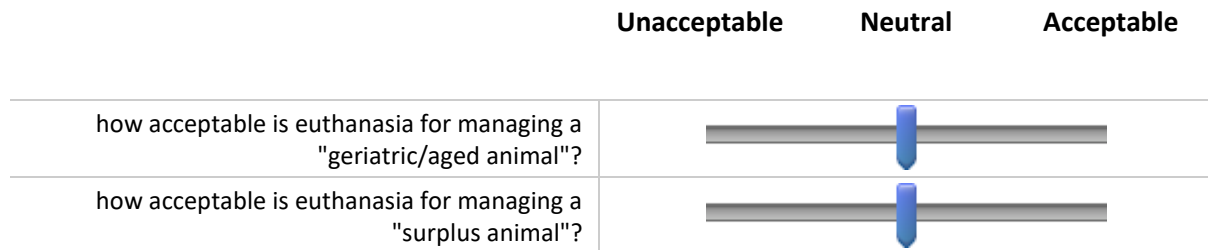
- Often
- In some cases
- In rare cases
- Never
- Don't know

In your personal opinion, is euthanasia ever an acceptable practice?

- Yes
- No
- Prefer not to say

Please **click along the line** to indicate

In your personal opinion:



Having trouble completing this question on your smart phone?

Try rotating into "landscape" mode.

While there are many relevant differences across species, **in your general opinion**, how acceptable do you feel the following strategies are for population management within zoos?

Please **click along each line** to indicate.

Unacceptable Neutral Acceptable

Sterilization / de-sexing ()	
Contraception ()	
Separation of males and females ()	
Housing individual animals off-exhibit ()	
Euthanising live offspring at birth ()	
Euthanising offspring at "weaning age" ()	
Euthanising post-reproductive or non-reproductive adults ()	
Transfer of surplus animals to "unaccredited" facilities ()	

Do you have any comments you would like to add at this stage?

Please **click along each bar** to indicate how involved your facility is with the following:

	Not at all involved	Heavily involved	Don't know
" ex-situ wildlife conservation " via captive breeding programs at your facility			
" in-situ wildlife conservation " (e.g. field-based conservation programs, habitat restoration or protection, financial support of local or international wildlife protection programs etc.)			
" community conservation " initiatives and campaigns			

Does your workplace sit within a larger group of facilities that are jointly operated?


- Yes
- No
- Prefer not to say

Do you know details about the total number of staff that are employed at the facility you are physically based?

- Yes. If so, please indicate an approximate number _____
- No
- Prefer not to say


Considering the facility you are physically based, please **estimate** the total number of staff that are employed by using the information below as a guide:

Very few (around 10 or less) **A lot** (around 350 or more)

Click along the bar to make an estimate: (1)	
--	--

Considering the facility you are physically based, please **estimate** the total number of different staff departments or divisions by using the information below as a guide:

Very few (single department) **A lot** (around 15 or more departments) Prefer not to say

Click along the bar to make an estimate: (1)	
--	--

Is your facility a Zoo and Aquarium Association (ZAA) member?

- Yes
- No
- Don't know
- Prefer not to say

Is your facility overseen by a Board (or equivalent committee of non-employees)?

- Yes
- No
- Don't know
- Prefer not to say

Please select which of the following applies to your facility?

- Privately owned/operated
- Local council or Government operated
- Other (please specify) _____
- Prefer not to say

Is your facility principally a museum?

- Yes
- No
- Prefer not to say

Is your facility in Australia or New Zealand?

- Australia
- New Zealand
- Other (please specify) _____
- Prefer not to say


Are you in **regular** direct physical contact with any zoo animal?

- No
- Not currently, but have been in a previous role
- Yes

Please approximate how many occasions you have **directly** observed, assisted or performed the euthanasia of a zoo animal over the course of your career?

- None
- once or twice
- up to 5 times
- up to 10 times
- approx. 20 or 30 times
- More than 30 times

In your general opinion, please indicate what you feel the **priority should be** when making euthanasia decisions about animals within zoos?

	The individual animal	Neutral	The species
Please click along the line ()			

Do you have any comments you would like to add at this stage?

Please indicate how long you have spent within the zoo and aquarium sector: _____

Please indicate your age: _____

Please indicate your gender:

- Female
- Male
- Prefer to self-describe _____
- Prefer not to say

With respect to your primary field of work that you selected earlier, would you be considered a manager?

- Yes
- No
- Prefer not to say

Earlier, you selected that you work within Veterinary Services, please select which role **best** describes you:

- Veterinarian
- Senior or Head Veterinarian
- Veterinary Nurse or Technician
- Head Veterinary Nurse or Technician
- Hospital Director, Practice Manager, or equivalent
- Other (please specify) _____
- Prefer not to say

Earlier, you selected that you work within Animal Keeping/Care/Training, please select which role **best** describes you:

- Junior Animal Keeper or Aquarist
- Animal Keeper or Aquarist
- Senior Animal Keeper or Aquarist
- Predominantly Animal Trainer role
- Nutrition or Food Preparation role only
- Manager within Animal Keeping/Care
- Other (please specify) _____
- Prefer not to say

Earlier, you selected that you work within Management. Please select which of the following roles **best** describes you, or please indicate as required:

- CEO, Executive Director, or equivalent role
- Facility Owner
- Manager within Animal Keeping/Care
- Manager within Science, Conservation or Research
- Veterinary Services or Hospital Manager
- Other (please indicate field) _____
- Prefer not to say

Please select which of the following **best** describes your role:

- Senior Management
- Middle Management
- Other (please specify) _____
- Prefer not to say

You have selected that you are a Veterinary Services Manager, Hospital Director or Practice Manager, please select which of the following apply to your career background:

- Veterinarian
- Veterinary technician or nurse
- Other (please specify) _____

Please select any **secondary fields** that apply to your current role, or within which you have previously spent more than three months working. Select all that apply.

- Animal Keeping/Care/Training
- Veterinary Services
- Management
- Grounds-keeping, Facilities or Maintenance
- Business, Finance, HR or Administration
- Visitor Experience or Tourism
- Education
- Marketing, Media or Communications
- Conservation, Science or Research
- Health and Safety
- Other (please specify) _____


To your knowledge, is euthanasia ever used in the treatment or management of "**geriatric/aged animals**" at your facility?

- Yes
- No
- Prefer not to say

To your knowledge, is euthanasia ever used in the management of **"surplus animals"** at your facility?

- Yes
- No
- Prefer not to say


In general, how involved do you feel when animals are euthanised at your facility?

	Not at all involved	Heavily involved
Click a point along the bar:		

Having trouble completing this question on your smart phone?

Try rotating into "landscape" mode.

How involved are you when **"geriatric/aged"** animals are euthanised?

	Not at all involved	Heavily involved
Click a point along the bar:		

How involved are you when **"surplus animals"** are euthanised?

Not at all involved	Heavily involved
------------------------	---------------------

Click a point along the bar:



Thinking for a moment about medical euthanasia, how involved are you when any zoo animals are euthanised for **medical** reasons?

**Not at all
involved**

**Heavily
involved**

Click a point along the bar:



How involved are you in **decision-making** prior to the planned euthanasia of a "geriatric/aged animal"?

**Not at all
involved**

**Heavily
involved**

Click a point along the bar:



How involved are you in **decision-making** prior to the planned euthanasia of a "surplus animal"?

**Not at all
involved**

**Heavily
involved**

Click a point along the bar:



Do you have any comments you would like to add at this stage?

What types of animals have been euthanised during a period when you were working with them?
Select all that apply.

- Invertebrates
- Mammals
- Reptiles
- Fish
- Birds
- Amphibians
- None

What types of animals have you euthanised, or been involved with when they were euthanised?
Select all that apply.

- Invertebrates
- Mammals
- Reptiles
- Fish
- Birds
- Amphibians
- None

You have selected mammals, please select all of the following groups that apply. The list is not intended to be exhaustive.

- Marsupials or Monotremes
- Bats
- Great Apes
- Other Non-Human Primates
- Elephants
- Hippopotamus
- Rhinoceros or Tapir
- Giraffe
- Other Ungulates

- Pinnipeds
- Cetaceans or Sirenians
- Mice or Rats
- Other Rodents
- Canids (excl. domestic dogs)
- Hyena
- Big Cats
- Other Felids (excl. domestic cats)
- Mustelids
- Red Panda
- Bears
- Other Carnivores
- If none of the above apply, please specify below:** _____

Can you please briefly indicate the type(s) of invertebrates and/or fish? Please indicate whether they were kept as display animals, or as animals to be fed as prey/food items.

Can you please briefly indicate the type(s) of reptiles and/or amphibians?

Can you please briefly indicate the type(s) of birds?


Considering these mice or rats, were they euthanised for the purpose of feeding them to other animals as food/prey items?

- Yes
- In some cases
- No


Does one (or more) written documents exist that guide the use of euthanasia at your facility?

- Yes
- No
- Don't know

If yes, how familiar would you consider yourself with those written documents?

	Unfamiliar	Very familiar
Click a point along the bar:		

Prior to the euthanasia of a "geriatric/aged animal", is a meeting or similar formalised discussion held across departments?

	Never	Always	Prefer not to say
Click a point along the bar:			

Prior to the euthanasia of a "surplus animal", is a meeting or similar formalised discussion held across departments?

Never **Always** Prefer not to say



Click a point along the bar:	
------------------------------	--

Do you have any comments you wish to add at this stage?

Please **click along the line** to indicate


In your personal opinion, how frequently at your facility:

Infrequently **Frequently** Prefer not to say

is the euthanasia of "geriatric/aged animals" undertaken too soon?	
is the euthanasia of "geriatric/aged animals" undertaken too late?	

In your personal opinion, is "surplus animal" euthanasia undertaken at your facility:

Not frequently enough **Neutral** **Too frequently** Prefer not to say

Please click along the line to indicate	
---	--

Please **click along each line** to indicate how much you agree or disagree with the following statements as they apply to your facility:

	Disagree	Neutral	Agree	Prefer not to say
There are clear policies around the use of euthanasia				
I am comfortable that all relevant staff are informed prior to the euthanasia of an animal				
There are suitable avenues for communication and discussion about euthanasia				
I feel comfortable bringing up concerns relating to euthanasia of an animal				

Please **click along each line** to indicate how much you agree or disagree with the following statements as they apply to your facility:

	Disagree	Neutral	Agree	Prefer not to say
I feel comfortable bringing up concerns relating to the quality of life of an animal				
I am satisfied that the euthanasia of geriatric/aged animals is undertaken when appropriate				
I am comfortable with the frequency that surplus animals are euthanized				
I am satisfied with the decision-making practices currently used to decide when an animal should be euthanized				

Do you have any comments you would like to add at this stage?

Who performs the euthanasia of animals at your facility? Select all that apply.

- External / contracted veterinarians
- On-staff veterinarians (including vet students under guidance)
- Other on-staff veterinary personnel (e.g. nurses, technicians)
- Non-veterinary staff
- Don't know

You specified that non-veterinary staff may perform euthanasia, can you please briefly describe situations where this occurs? *(Remembering that this survey excludes emergency responses undertaken for human safety)*

Who is involved in deciding when a "geriatric/aged animal" from your facility is euthanised ? Select all that apply.

- Animal Keepers/Aquarists
- Senior Animal Keepers/Aquarists
- Veterinarians
- Senior Veterinarians
- Other Veterinary Personnel (e.g. nurses, technicians)
- Management Staff
- Senior Management Staff
- Facility Owner
- CEO or Executive Director
- Species Management Coordinator
- Other (please specify) _____
- Don't know

Who is involved in deciding when a "surplus animal" from your facility is euthanised? Select all that apply.

- Animal Keepers/Aquarists
- Senior Animal Keepers/Aquarists
- Veterinarians
- Senior Veterinarians
- Other Veterinary Personnel (e.g. nurses, technicians)
- Management Staff
- Senior Management Staff
- Facility Owner
- CEO or Executive Director
- Species Management Coordinator
- Other (please specify) _____
- Don't know

Who is responsible for authorising that "geriatric/aged animal" euthanasia is performed? Select all that apply.

- Animal Keepers/Aquarists
- Senior Animal Keepers/Aquarists
- Veterinarians
- Senior Veterinarians
- Other Veterinary Personnel (e.g. nurses, technicians)
- Management Staff
- Senior Management Staff
- Facility Owner
- CEO or Executive Director
- Species Management Coordinator
- Other (please specify) _____
- Don't know

Who is responsible for authorising that "surplus animal" euthanasia is performed? Select all that apply.

- Animal Keepers/Aquarists
- Senior Animal Keepers/Aquarists
- Veterinarians
- Senior Veterinarians

- Other Veterinary Personnel (e.g. nurses, technicians)
- Management Staff
- Senior Management Staff
- Facility Owner
- CEO or Executive Director
- Species Management Coordinator
- Other (please specify) _____
- Don't know

Do you have any comments you wish to add at this stage?

Could you please describe briefly why you feel zoos and aquariums are important?

Do you have any further comments regarding any aspect of this study?

Appendix B – Thematic Coding-Tree Excerpts

