Redefining animal mortality accounting within indigenous paradigms and sustainability frameworks

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ABSTRACT

This paper explores how concepts of animal sustainability and institutional responsibility are reshaped through the documentation of animal mortality at Zoo Negara Malaysia. While global concern for animal welfare and conservation has intensified, scholarly attention has seldom examined how sustainability principles are operationalised within zoo management systems, especially through an indigenous and ecological lens. This study bridges that gap with a multidisciplinary analysis of Zoo Negara's historical mortality records, institutional documents, and conservation practices, critically engaging with indigenous critiques of Western conservation models (Todd, 2014, 2016, 2018, 2022) and ecological accounting paradigms. It unfolds along two interrelated trajectories: first, examining how Zoo Negara's practices around documenting and disclosing animal fatalities serve as instruments of transparency and ethical accountability; and second, critically analysing how current biological asset accounting standards both reveal and conceal the complex realities of zoo-based conservation and breeding efforts. Findings highlight persistent tensions in conventional accounting classifications, including challenges in selecting appropriate measurement units across diverse species, valuing animals amid fluctuating care costs, and accounting for reproductive outcomes. Framed through indigenous paradigms that challenge the commodification of animal life and emphasise relationality, alongside ecological models that foreground biophysical realities over financial abstractions, the study proposes alternative, holistic approaches to mortality accounting. These approaches prioritise relational accountability to animal kin while integrating sustainability metrics that respect ecological interconnectedness. In doing so, this research offers Zoo Negara and similar institutions pathways to reconceive how they account for life and death, honouring indigenous wisdom, ecological integrity, and ethical stewardship, within a redefined sustainability framework.

Keywords: accounting, animal, indigenous, mortality, sustainability, zoo

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1. Introduction

The growing imperative for sustainability reporting has transformed accountability practices across industries, extending into the complex realm of animal conservation and welfare (Adams, 2004; Druglitrø, 2022; Tavakolnia, 2023). Zoos, positioned at the intersection of public education, species preservation, and entertainment, present a critical case study for examining how institutional accounting practices conceptualise and manage animal life and death. However, the increasing financialisation of conservation, whereby living beings are commodified into tradable assets, has introduced profound ethical and ecological distortions into sustainability reporting (Brock, 2018; Kuokkanen 2024; Ogilvy et al., 2018). This study seeks to illuminate these tensions, particularly how conventional accounting frameworks reduce animal mortality to financial metrics while obscuring moral responsibilities, and explores alternative paradigms grounded in indigenous perspectives and ecological ethics.

Central to this investigation is the problematic framing of zoo animals as "biological assets" under accounting standards like MFRS 141, a practice that exemplifies the transformation of living beings into financialised commodities. By treating sentient creatures as depreciable inventory, such reporting mechanisms prioritise capital accumulation over ecological integrity (Zinkevičienė et al., 20192019), while systemic opacity around mortality data undermines public accountability (Clay & Visseren-Hamakers, 2022). These financialised approaches often justify ethically fraught decisions, such as selective breeding or culling, through species-level metrics that disregard individual welfare (Roth et al., 2016), revealing a fundamental misalignment between zoos' conservation rhetoric and their accounting practices. This study interrogates how financialisation reconfigures conservation ethics, asking: How might accounting for animal mortality transcend its current economistic limitations to embrace more holistic and equitable frameworks? In addressing this question, the research engages with indigenous critiques of Western conservation models (Todd, 2014, 2016, 2018, 2022), which reject commodification in favor of relational accountability to non-human kin. Todd's work on fish pluralities and fossilised kin demonstrates how indigenous legal orders conceptualise animals as agential beings embedded in reciprocal relationships, offering transformative alternatives to the extractive logics of financialised reporting. By bridging critiques of market-driven conservation with indigenous ontologies, this research aims to redefine how animal lives and deaths are acknowledged and valorised, fostering more ethical and sustainable conservation paradigms. Ultimately, it contributes to broader discussions on decolonising conservation practices and redefining humanity's ethical obligations towards more-than-human communities.

The study unfolds in four parts. It begins by examining the historical and contemporary connections between accounting standards, animal mortality rates, and claims of sustainability within zoos, revealing how the logic of financialisation distorts conservation priorities. The next section details the research methodology employed. Following that, empirical data on species-specific mortality patterns and institutional strategies at Zoo Negara (NZ) Malaysia. are analyzed to illustrate the operational realities affecting animal welfare and conservation outcomes. The subsequent section offers a theoretical reflection on indigenous relational ethics and the perspectives of Zoe Todd, emphasising how these frameworks challenge prevailing accounting norms. Finally, the study critically evaluates the implications of current standards like MFRS 141 for both ecological sustainability and animal welfare, proposing pathways for more relational and ethically grounded approaches. The concluding section outlines prospects for future research aimed at advancing these ideas within global and local contexts.

2. Sustainability, zoo accounting practice, mortality and indigenous perspectives

The intersection of accounting practices with animal welfare and sustainability has emerged as a significant area of scholarly inquiry in recent decades. As sustainability accounting has expanded beyond traditional financial metrics, researchers have increasingly examined how accounting frameworks conceptualise and measure ecological relationships (Gottlieb et al., 2022; Schaltegger, 2020; McLaren & Appleyard, 2020, 2022; Vinnari & Vinnari, 2022; Christensen & Lamberton, 2022, 2025; Tavakolnia, 2023; Vinnari et al., 2022). This growing body of literature reveals a fundamental tension between the financialisation of nature and the ethical considerations surrounding animal welfare.

Zoo accounting practices exemplify these tensions most acutely, with current literature highlighting important pathways for future research. For instance, emerging studies on shadow reporting suggest that alternative documentation methods can enhance transparency and more accurately reflect the values, ethics, and welfare commitments of conservation institutions (Abbott & Tan-Kantor, 2022; Fahmi et al., 2024). These methods seek to address key limitations in conventional accounting frameworks. At the same time, relational ethics provide a crucial theoretical foundation for rethinking how we account for human-animal interdependencies. Scholars argue that a more holistic approach is necessary, moving beyond narrow economic valuations to better recognise the complex ethical relationships and welfare considerations involved (Morton & Tsahuridu, 2023; Pujiningsih & Utami, 2024).

While each of these developments is important, the most critical and pressing area of research particularly within the scope of animal welfare and sustainability is accounting for animal mortality. This issue sits at the intersection of ethical responsibility, ecological integrity, and institutional accountability. Integrating nature's inherent population regulation mechanisms into reporting practices is essential, especially in light of human-driven disruptions to ecosystems (Clauss et al., 2025). As anthropogenic impacts such as deforestation, pollution, overfishing, and climate change continue to degrade habitats and deplete resources (Adla et al., 2022), they fundamentally alter animal population dynamics and mortality rates. Addressing how mortality is conceptualised and reported in accounting systems is therefore not only timely but essential. Together, these emerging tensions underscore the urgent need for accounting practices that are ethically grounded, ecologically informed, and institutionally transparent.

Building on these concerns, it is thus important to recognise how conventional zoo accounting frameworks have, in practice, treated animal mortality. Within financial statements, animals are often classified as depreciable assets a practice that reduces living beings to economic units. When it comes to accounting for mortality, particularly within the zoo sector, prevailing standards tend to frame it as a matter of asset depreciation rather than a moment of ethical reckoning (Abbott & Tan-Kantor, 2022). This framing creates what scholars refer to as "ethical blind spots" in institutional reporting (Clay & Visseren-Hamakers, 2022). Mortality events are reduced to statistical adjustments, while conservation outcomes are evaluated through species-level metrics that often obscure the lived experiences and welfare of individual animals (Roth et al., 2016; Druglitrø, 2022). Even progressive sustainability frameworks, such as the Taskforce on Nature-related Financial Disclosures (2023), while acknowledging biodiversity risks, continue to operate within a fundamentally financialised paradigm (cf. Linsley et al., 2023). This approach overlooks deeper ontological questions about human-animal relationships and ethical responsibilities.

In response to this financialised logic, emerging indigenous perspectives offer transformative alternatives that challenge the commodification of animal life. These approaches are grounded in relational accountability, ethical responsibility, and multispecies kinship, as exemplified by the work of Métis anthropologist Zoe Todd (2014, 2016, 2018, 2022). Todd's

ethnographic research with Inuit communities in Arctic Canada provides a radical counterpoint to dominant Western accounting paradigms. Her documentation of fish pluralities (Todd, 2014; 2016, 2018) illustrates how indigenous legal orders understand aquatic life as agential kin, not extractable resources emphasising reciprocity and responsibility over quantitative management. This worldview fundamentally disrupts the ontological assumptions underpinning conventional accounting systems. As Todd (2022) argues, financial reporting mechanisms often enact "epistemic violence" by rendering some lives calculable and others disposable. Her analysis of fossilised kin in Alberta's energy sector highlights patterns also present in zoo accounting, where living animals are reduced to financial assets and their deaths are processed as depreciation entries.

The implications of Todd's work for animal mortality accounting are both profound and timely. While conventional Western accounting frameworks emphasise standardised metrics and financial valuations (Schaltegger, 2020), indigenous perspectives offer alternative approaches rooted in relational ethics and ecological awareness. These alternatives may include narrative forms of documentation that honour individual animal lives, qualitative assessments of wellbeing, and explicit recognition of interspecies relationships (Clark, 2024; Woodhouse et al., 2021). Such perspectives challenge the reduction of mortality to numerical adjustment, instead advocating for accountability practices that engage with the ethical and emotional dimensions of animal loss. However, integrating these values into mainstream systems presents significant challenges. Current accounting standards continue to privilege quantifiable data (Mügge & Linsi, 2021), while zoo management structures often remain aligned with colonial conservation models that prioritise species survival and genetic viability over individual welfare (Mouledous, 2024.).

Nevertheless, the urgency of ecological crises, combined with growing recognition of indigenous knowledge systems, is creating new opportunities to rethink how animal mortality is accounted for. Emerging scholarship in ecological accounting and multispecies justice suggests that it is possible to incorporate indigenous principles without compromising reporting rigour. These approaches aim not only to enhance transparency and ethical integrity but also to transform the underlying values that inform institutional reporting. Ultimately, indigenous critiques call for more than incremental reform they demand a fundamental reimagining of how institutions acknowledge and take responsibility for animal life and death. This would require confronting the colonial legacies embedded in conservation accounting and embracing new forms of documentation that reflect relational accountability. As Todd's work simply reminds us, meaningful accountability begins with recognising what conventional frameworks have systematically erased: that animals are not expendable assets, but kin with whom we share moral and ecological obligations.

3. Research Method

This study employs a comprehensive mixed-methods approach to examine animal mortality accounting practices at the Zoo Negara of Malaysia. The primary data source comprises the zoo's annual reports from 2005 to 2021, which systematically document species inventories, mortality statistics, and reported causes of death.

The selected timeframe represents a strategically significant period in the zoo's development. The baseline year, 2005, marked a pivotal moment of operational reform, characterised by improvements in day-to-day management and increased public engagement. According to the report A Journey Through Time, "Year 2005 has seen major improvements especially in the day-to-day running of the zoo... The zoo was constantly in the media and the public was more aware of the zoo with its monthly events such as Earth Day, Environmental

Day, Universal Children's Day and many others... The zoo also received its highest ever amount from sponsors in history which came to a total of over half a million Ringgit" (pp. 16–17).

Over the following two decades, the zoo transitioned toward more professionalised operations, adopted international animal welfare standards, and adapted to evolving public expectations around transparency and accountability. Technological advancements in animal record-keeping during this time further enhance the reliability of long-term analysis. This twenty-year span allows the study to identify both gradual trends and sudden changes in mortality patterns, offering insights relevant to contemporary zoo management and conservation policy.

To provide a well-rounded and critical assessment, the study draws on a range of additional information sources. These include monitoring reports from Malaysian conservation NGOs, veterinary and welfare audits, media investigations, and public complaints submitted to wildlife authorities. Comparing these independent perspectives with the zoo's official reports helps uncover differences in interpretation and reporting, and highlights areas where institutional narratives may diverge from external observations.

The study examines animal mortality from two complementary perspectives. First, it analyses key patterns such as changes in species populations, mortality rates across different animal groups, and recorded causes of death. Since the data is dynamic, the analysis primarily covers the years 2005 to 2021; however, some datasets for other observations may only contain data for eight or three years due to unavailability of information for certain periods. Additionally, the study includes an analysis of specific strategies and operational practices at Zoo Negara during relevant years, focusing on issues related to breeding, conservation, and biosecurity. Together, these approaches provide a comprehensive understanding of how the zoo monitors, manages, and communicates its animal conservation efforts, highlighting shifts and challenges faced in animal mortality.

4. Analyses

4.1 Animal Species

Based on the statistics from 2005 to 2021 provided by Zoo Negara, the zoo has a diverse range of animal species. Animals are categorised into several classes, including mammals, birds, reptiles, fish, amphibians, and invertebrates, each containing unique species and specimens.

Table 1: Species of Each Class of Animals

Species	Years																
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Mammals	95	96	94	93	90	80	77	73	71	72	68	67	67	67	66	68	64
Birds	134	128	127	127	126	119	88	87	81	81	77	77	71	75	72	70	75
Reptiles	59	60	62	58	57	50	52	52	49	47	42	42	41	42	42	37	43
Fish	114	140	177	182	181	237	230	237	225	237	211	256	0	0	1	1	3
Amphibians	0	0	18	22	22	20	22	21	12	8	0	0	0	0	10	10	12
Invertebrates	0	0	0	0	0	0	0	2	3	7	7	7	206	64	74	61	64

Sources: Zoo Negara Malaysia, Annual reports, 2005 – 2021

Table 2: Speciment of Each Class of Animals

Species	Years																
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Mammals	557	591	565	548	525	533	515	509	499	474	472	497	493	503	513	503	473
Birds	1323	1330	1342	1492	1532	1639	1567	1712	1849	1855	1814	673	637	708	581	516	531
Reptiles	314	280	292	247	236	263	301	325	289	224	180	167	169	165	194	236	250
Fish	0	0	87	106	114	138	147	110	32	21	0	0	0	0	9	6	5
Amphibians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	317	731	526
Invertebrates	1201	2247	3075	3044	3039	2828	3477	3936	3715	3716	4032	4017	3921	1609	1699	1663	1452

Sources: Zoo Negara Malaysia, Annual reports, 2005 – 2021

Tables 1 and 2 provide a detailed overview of the Zoo Negara's animal collections over a 17-year period, highlighting significant shifts in both species diversity and total specimen counts across all major animal classes.

Mammals show a steady decline in species from 95 in 2005 to 64 in 2021, which is mirrored by a reduction in the number of individual specimens from 557 to 473 over the same period. This parallel drop suggests a potential strategic streamlining of the mammalian collection, possibly in response to resource limitations, refined animal welfare goals, or an institutional shift toward more sustainable caretaking practices. Birds similarly experienced a reduction in both species and individual numbers. The species count fell from 134 in 2005 to 75 in 2021, while specimen numbers fluctuated significantly, rising to a peak of 1855 in 2014, then plummeting to 516 by 2020. This steep decline after 2014 may indicate a significant change in collection strategy, exhibit redesign, or policy decisions aimed at downsizing large populations in favor of quality care. Reptiles exhibited relatively modest changes in species count, ranging from 59 species in 2005 to 43 in 2021. Specimen numbers, however, saw more variation, rising from 314 in 2005 to a peak of 325 in 2012, before gradually declining to 250 in 2021. This reflects a relatively stable commitment to reptilian species, possibly due to consistent infrastructure or sustained educational and conservation interest. Fish displayed the most dramatic shifts. The number of fish species surged from 114 in 2005 to a high of 256 in 2016, followed by an abrupt drop to zero in 2017 and 2018, before returning minimally in subsequent years. Specimen data reflects a similar pattern: from no recorded specimens in the early years to 147 in 2011, dropping again to single digits by 2021. These changes likely signal infrastructural transitions, such as renovation or closure of aquatic exhibits, or shifts in exhibit prioritisation and reporting methodology. Amphibians were first recorded in 2007 with 18 species, fluctuating modestly to 12 species by 2021. Interestingly, although species counts remained low, specimen data reveals a dramatic late surge, from zero through 2016 to 317 in 2019, and then peaking at 731 in 2020. This pattern suggests a targeted acquisition or breeding effort, possibly reflecting a growing institutional focus on amphibian conservation. Invertebrates, entirely absent in both species and specimen counts before 2012, experienced an explosive entry into the zoo's records. Species numbers reached 206 by 2017 and remained consistently represented thereafter. Specimen counts, meanwhile, soared from 1201 in 2005 to a peak of 4032 in 2015, with numbers staying above 1400 through 2021. These trends point to a significant expansion in the zoo's attention to biodiversity beyond vertebrates, likely reflecting contemporary conservation frameworks that emphasise ecosystem interdependence.

4.2 Animal death

All living organisms, including plants and animals, ultimately confront mortality. Figure 1 depicts the number of animal fatalities recorded at the Zoo Negara Malaysia over a fifteen-year period, from 2007 to 2021. Despite gaps in data, specifically the absence of mortality records for 2005–2006, 2008–2013, and 2017, the available figures suggest an upward trend in reported deaths. The number of recorded fatalities rose from 35 in 2007 to 158 in 2021, peaking at 160 in 2019. The most consistent sequence of data occurs from 2014 to 2016, revealing annual mortality figures of 110, 94, and 104, respectively. While there was a slight decline in 2015, the upward trajectory in 2016 may indicate increasing pressures on animal welfare systems within the institution.

Figure 1: Annual Mortality Trends

Year	No. of Deaths
2005	Not provided
2006	Not provided
2007	35
2008	Not provided
2009	Not provided
2010	Not provided
2011	Not provided
2012	Not provided
2013	Not provided
2014	110
2015	94
2016	104
2017	Not provided
2018	98
2019	160
2020	130
2021	158

Sources: Zoo Negara Malaysia, Annual reports, 2005 – 2021

These fluctuations align with broader debates on animal mortality in zoological settings (Tidière et al., 2023), which argue that such patterns are shaped by both biological and institutional factors. Moreover, when cross-referenced with species collection data, the mortality figures suggest potential correlations: the mortality rise from 2014 to 2016 coincided with notable reductions in fish populations, fluctuations in amphibian counts, and a significant increase in invertebrate specimens. These parallel shifts raise questions about how changes in collection management, such as species introductions, removals, or exhibit transitions, may have impacted welfare outcomes.

Figure 2: Causes of Animal Death

Causes of Death	2014	2015	2016
Neonatal Deaths	9%	3%	4.80%
Nutritional Problems (Bloat, Malnutrition, Foreign Body Obstruction)	16%	9%	13.50%
Diseases (Bacterial Infection, Viral Infection, Parasitism)	26%	41%	26.90%
Traumatic Injury	16%	15%	17.30%
Miscellaneous (Predator, Old age, No significant findings, Autolysed)	33%	32%	37.50%

Sources: Zoo Negara Malaysia, Annual reports, 2014 – 2016

Figure 2 provides further insight into the contributing factors behind animal deaths during the years 2014 to 2016, the only period for which detailed cause-of-death data is publicly available. Across these years, diseases consistently emerged as a major cause, ranging from 26% in 2014 to a high of 41% in 2015. This fluctuation may reflect varying effectiveness in disease prevention protocols and veterinary interventions. Nutritional issues followed a less consistent trajectory, declining from 16% in 2014 to 9% in 2015, then rising to 13.5% in 2016, potentially indicating shifts in dietary management or resource allocation.

Neonatal mortality showed marked improvement, decreasing from 9% in 2014 to between 3% and 4.8% in subsequent years. This may suggest advancements in breeding programs or neonatal care practices. In contrast, the percentage of deaths attributed to traumatic injuries remained relatively stable, at 15–17.3%, pointing to persistent issues in enclosure safety or inter-species conflicts.

A significant proportion of deaths, ranging from 33% to 37.5%, was categorised under "miscellaneous" causes, an overly broad classification that complicates efforts to identify and address specific welfare concerns. While this may reflect the complexity of diagnosing mortality in a diverse zoological population, it also highlights the need for more precise and standardised reporting.

4.3 Institutional Strategies and Operational Realities

Zoo Negara's animal management framework reveals a complex interplay between conservation objectives and practical constraints that characterise modern zoological operations. At the heart of this framework lies the institution's animal exchange program, which states in full:

> We acquire most of our animals through exchanges with zoos in countries like the Czech Republic, United Kingdom, Vietnam, Japan, and Singapore, as well as local zoos such as Taiping Zoo and Melaka Zoo. These exchanges are usually made to find suitable breeding partners or to introduce new animals to the public (Annual Report Zoo Negara 2018, para. 5)

Building upon this foundation, the zoo articulates its broader conservation mission:

> The department contributes ex-situ conservation by the captive breeding of wild animals, especially those whose numbers have declined significantly in the wild. In addition to this, we initiate animal exchange programs to other zoos globally in order to add new bloodlines to our

> collections. The ultimate aim is ex-situ conservation via reintroduction programs (Annual Report Zoo Negara 2018, para. 2)

However, these conservation aspirations must be understood within the context of persistent financial sustainability challenges that fundamentally shape operational decisions, as evidenced by the frank admission:

> Since the cost of animal feed is high, the Park and Gardens Department has taken an initiative to plant a number of trees and vegetables as a source of food for the zoo animals (Annual Report Zoo Negara 2008, p. 14, para 7)

This financial precarity reached critical levels during the unprecedented COVID-19 pandemic, when operational records reveal:

> During the pandemic, the zoo closed for 151 days from March to June and again from November to December. It reopened briefly from June to October when cases dropped nationwide. The public response was positive, and government bodies like the Fire Department and MPAJ helped sanitize the area. The police and army assisted in managing visitors on weekends and holidays. Generous donations from government bodies, NGOs, companies, and the public ensured the animals were well-fed and cared for during this time (Unknown)

In addition,

> Zoo Negara authorities have taken measures to ensure more than 300 animal species do not contract the Covid-19 (BERNAMA, 2020, para. 1.)

Among these crucial lifelines was the notable corporate sponsorship:

> HABIB has pledged RM50,000 up-front in funds as well as kick started a 'HABIB for Zoo Negara – Save our Animals' campaign. A portion of the proceeds from the gold wafer sale will be channelled to Zoo Negara (HABIB, 2020, para. 3)

These chronic financial constraints have precipitated several difficult management decisions regarding animal populations, including:

> Most of our single sex animals were sent out to other zoos on breeding loan. Owing to space constraint, we reduced some of our hoof stock. In 2008, our record stands at 93 species with a total of 548 individuals as compared to 94 species and 565 individuals in 2007 (Annual Report Zoo Negara 2008, p. 16, para 5-6)

A particularly illustrative example of these operational pressures emerges in the chimpanzee management strategy:

> We have five adult male Chimpanzees and one female. We plan to give the surplus three males out on breeding loan to suitable zoos in 2009 (2008, p. 17, para 5)

Compounding these challenge*s are* significant biosecurity threats that demand constant vigilance:

> Biosecurity threats from domestic cats, rats, civets, monitor lizards, pythons, macaques, and crows were addressed, with 366 animals captured and 35 animals microchipped for identification (Annual Report Zoo Negara, 2018)

This becomes even more troubling when juxtaposed with disturbing visitor accounts:

> When he visited the aquarium, the fish tanks were so dirty, he could barely see anything. He then visited the penguin area but was disappointed once again when he saw how terrible was the water condition the penguins lived in (Velusamy, 2021, 14-16, para. 4.)

More damning still is the comparative assessment by the visitor:

> I really don't want to compare but I've been to the zoos in Singapore, Taiwan and South Korea and ours seemed the most backwards (Velusamy, 2021, 17-19, para. 5.)

These troubling observations gain institutional validation when examining documented enclosure standard violations by another observant:

> He tried to contact Zoo Negara about the night dens in October 2018 and January 2020 and shared the photos but did not get a response on the matter. He then got a reply from Perhilitan in April this year after contacting a complaint bureau, in which Perhilitan acknowledged that 37 out of 38 of Zoo Negara's night dens for its large primates had failed to comply with the law (Tan Mei Zi, 2020)

This stands in paradoxical contrast to the zoo's professed habitat design philosophy:

> *Landscaping is one of the main reasons for tree and shrub planting in the zoo. Suitable plants will provide colours at locations that are dull."* (Annual Report Zoo Negara, 2007, p. 11, para 8, lines 1-3)

Concrete manifestations of this philosophy include carefully curated exhibits:

> The Shrub pseuderanthemum 'Jessica' with prominent red leaves has been planted in front of the Flamingo exhibit to give an interesting visual impact. This is off-set by a ground cover plant, Pandanus pygmaeus, with pointed yellow leaves edged with green lines (Annual Report Zoo Negara, 2008, p. 13, para 3)

Equally meticulous attention is devoted to aquatic environments:

> All tanks were landscaped according to their respective river zones to accommodate the kind of fish or the required habitat/niche of the zone. Tank landscape included the use of various materials such as sand, gravel, wood, plants, large stones etc, that are found in the natural habitat/niche of that river section (Annual Report Zoo Negara, 2008, p. 23, para 3-4)

More encouraging is the Milky Stork reintroduction program, which reports the following progress:

> Our first project for the release and introduction of Milky Storks (Mycteria cinerea) was at Kuala Selangor Nature Park, Selangor in conjunction with the Wildlife Department (PERHILITAN) and Malaysian Nature Society. Ten birds were released in the Nature Park about 15 years ago. To date, we still can see three of the Milky Storks flying together with the other water birds at Jeram and outside the Nature Park. Our partners planned to upgrade the Milky Stork shelters (cages) that are used to acclimatise the birds prior to their release. Once this is done, we will

> attempt for the second release of the Milky Storks in Kuala Selangor Nature Park (Annual Report Zoo Negara, 2007, p. 13, para 2-3)

Building on this, the institution's conservation efforts extend to specific species such as the Malayan tiger. The tiger initiative demonstrates both ambition and the challenge of sustaining funding. For instance, the zoo has secured formal support through a memorandum of understanding, as highlighted when:

> Kuala Lumpur City Hall (DBKL) today signed a memorandum of understanding with the Malaysian Zoological Society at Zoo Negara in a bid to save the Malayan tiger (BERNAMA, 2019, Free Malaysia Today, para. 1)

Despite this support, the operational costs remain significant. As reported:

> The zoology and veterinary director of the zoo said an adult tiger costs about RM120 per day or between RM3,000 and RM4,000 a month to maintain (BERNAMA, 2019, Free Malaysia Today, para. 8)

This comprehensive approach to tiger conservation includes both captive breeding and habitat protection:

> The Malayan Tiger Breeding Programme in collaboration with the Zoos that exhibit Malayan Tiger have been carried out since 2020. The aim of the programme is to ensure the continuity of this species in captivity as well as to support the Save the Malayan Tiger Campaign (Annual Report Zoo Negara, 2020)

Complementing this effort are innovative habitat solutions:

> There are also ingenious solutions proposed to deal with encroachment on wildlife habitats using tunnels and wildlife crossings. One place where this can be implemented is in Bukit Bauk, Terengganu, a natural habitat for wild Malayan tigers. All in all, the project is said to comprise 58 tunnels, 20 wildlife crossings and 128km of viaducts to help conserve as much forest and wildlife as possible (Annual Report Zoo Negara, 2020)

In examining animal welfare, the veterinary efforts demonstrate significant commitment:

> In 2020, the veterinary team treated 183 animals for various conditions. Twenty-four animals were anesthetized and nine surgeries performed, including mass removal from a Monocellate Cobra and partial coccygeal amputation of a Malayan Tiger (Annual Report Zoo Negara, 2020)

Yet these medical interventions stand in contrast to concerning reports about enclosure standards:

> Perhilitan concluded that the zoo's dens for its large primates were only 1.86 metres in length and width and 3.35 metres in height, which violated guidelines stating that enclosures must be at least four metres in length and three metres in width and height for each animal. They then conducted repair works to open up three individual dens in May to become a single enclosure of 6.4 metres in length, 1.83 metres in width, and 3.35 metres in height (Tan Mei Zi, 2020)

Beyond physical care, educational and environmental initiatives reveal a multifaceted approach to conservation:

> Monthly seminars for staff, were conducted with the primary aim to improve knowledge about zoo management. The seminars were open to the public with a view to boost knowledge on wildlife, plant conservation and other related environmental issues. Topics covered were 'The Importance of Plants in Life', 'Introduction to GPS', 'The Effect of Ecological Changes on Fish Population', 'Cleaner Air for Healthier Zoo', 'Electrical Safety', 'Amphibian Workshop', 'Photography Workshop', 'Influenza HUNT', 'Animal Rights, an Islamic Perspective', 'MAZPA Keeper Field Training Course' and 'Customer Satisfaction & Hospitality'. We would like to thank the speakers who gave their time for our seminars and workshops (Annual Report Zoo Negara, 2009, p. 20, para 6-7)

This educational mission extends to habitat improvement projects:

> The celebration of Earth Day was carried out through a one-day event known as 'TV3 Goes Green with Zoo Negara.' It was held on 24th April 2005 as a joint event between Sistem Televisyen Malaysia Bhd (TV3) and Zoo Negara. One of the major activities organized was 'The Planting of 100 Trees.' The trees were planted by VIPs from TV3, the Forest Research Institute of Malaysia (FRIM), Walls, and TV3 personalities. The young wood trees were planted in various sites around the Zoo as an effort to promote a greener Earth. Most of the trees were planted outside the perimeter of the Mammal Kingdom, Savannah Walk, Bear Complex, and Tiger Section. There were altogether six different types of local hardwood trees donated by FRIM. Among the trees planted were: Pteleocarpa lamponga, Pometia pinnata, Syzygium grande, Sterculia sp. And Syzygium campanulatum (Annual Report Zoo Negara, 2005, p. 14)

Furthermore, beautification efforts demonstrate ecological considerations:

> There were several beautification projects that had taken place around the Zoo which involved replanting. Most of the areas had been replanted with cover crops; Ophiopogon jaburan, or small flowered-plants; Lantana camara, or flowered shrubs; Sanchezia nobilis, Turnera troniflora, Iresine sp., Canna sp., to add more colour. Besides the facelift, replanting also resulted in other advantages. The Malvaviscus arboreus mexicans for instance produced flower that was favored by small wild birds, and flower from Quisqualis indica produced a strong lovely scent at night (Annual Report Zoo Negara, 2005, p. 15)

In terms of institutional governance, the zoo's formal accreditation demonstrates commitment to professional standards:

> The ISO 9001:2000 certification was awarded Zoo Negara in July 2007 by IQ Net and SIRIN QAS International Sdn. Bhd. for the two field of activities; (1) 'Provision of recreational and conservation education, research and training facilitations relating to animals and plants', and (2) 'Provision of healthcare services to zoo animals'. We are proud to note in this report that these two activities are very comprehensive and only few zoos in the world had achieved this certification, if any. Zoo Negara has also proudly achieved the SEAZA Ethics and Animal Welfare Accreditation during the SEAZA Conference in September 2007. The recognition encourages all members of SEAZA to develop and maintain high standards of animal displays and animal welfare in their collections (Annual Report Zoo Negara, 2007, p. 6, para 2-3)

Nevertheless, implementation challenges persist, particularly regarding infrastructure:

> The elephant show was cancelled in compliance with SEAZA's ethics and welfare certification. The staff in-charge still continues to train the elephants in order to control them for medical examination and for maintenance work in their enclosure. The animals still follow verbal instruction but extra precaution is needed when working with the bull elephant. Plans to construct a larger enclosure to house the bull are still pending due to insufficient funds (Report Zoo Negara, 2008, p. 18, para 9)

Overall, the quotations presented above provide the necessary foundation for deeper critical analysis of contemporary zoological management practices, particularly regarding the tensions between conservation ideals and operational realities in resource-constrained environments. This comprehensive examination of Zoo Negara's operations reveals an institution navigating complex conservation challenges while balancing multiple priorities and constraints, which contribute to the observed mortality.

5.0 Theoretical Reflection: indigenous relational ethics and Todd's perspective

The collection patterns discussed in Section 4.1, particularly the decline in mammal and bird species at Zoo Negara Malaysia between 2005 and 2021, present a complex picture when viewed through Zoe Todd's critiques of colonial natural history practices. While the reduction from 95 to 64 mammal species and 134 to 75 bird species might superficially suggest a move away from treating animals as commodities, Todd (2022) would argue that such numerical changes alone do not necessarily indicate a transformation in underlying institutional paradigms. The dramatic decrease in bird specimens from 1,855 to 516 could be interpreted as reflecting growing unease with mass confinement, yet Todd's work reminds us that true change requires dismantling the very frameworks that enable animal objectification. The increased attention to amphibians and invertebrates, while potentially expanding biodiversity representation, still operates within a system that Todd critiques for its persistent categorisation of life forms according to institutional priorities rather than indigenous understandings of kinship.

Section 4.2's mortality data reveals deeper tensions in the zoo's operations that resonate with Todd's analysis of institutional care. The rising animal deaths from 35 in 2007 to 158 in 2021, peaking at 160 in 2019, demonstrate what Todd (2018) identifies as the fundamental contradictions of captive care systems. While these numbers might reflect resource limitations rather than outright neglect, Todd's perspective would emphasise how such mortality patterns expose the inherent violence of confinement systems, regardless of caretaker intentions. The fluctuating causes of death, including disease outbreaks and injuries, exemplify what Todd describes as the inevitable consequences of removing animals from their ecological and cultural contexts. These gaps in care and record-keeping do not merely represent operational challenges, but rather reveal what Todd sees as the epistemological limitations of institutional approaches to animal welfare that fail to centre indigenous relational ethics.

The habitat management practices detailed in Section 4.3 offer further opportunities for Todd-informed analysis. While the zoo's landscaping efforts, including the planting of vibrantly coloured shrubs and creation of naturalistic enclosures, demonstrate aesthetic consideration, Todd would question whether such measures truly honour the animals as relational beings rather than display objects. The breeding programs for species like the Malayan tiger, though framed as conservation efforts, exemplify what Todd (2017) critiques as the reproductive commodification of animals within institutional settings. The zoo's environmental initiatives, such as tree planting and educational seminars, are admirable in their

own right. Nevertheless, according to Todd, these efforts would need to be fundamentally rethought to transcend Western conservation paradigms and incorporate indigenous concepts of interspecies kinship. The persistent infrastructural limitations and space constraints mentioned in 4.3 serve as tangible manifestations of what Todd identifies as the inherent contradictions of attempting ethical animal management within unchanged institutional structures.

Throughout these sections, Zoo Negara Malaysia's practices demonstrate an institution grappling with evolving ethical expectations amid constraints imposed by colonial frameworks. Todd's work helps us recognise that genuine transformation requires more than incremental adjustments to collection sizes, mortality rates, or habitat designs. It demands a fundamental rethinking of the zoo's relationship to animals, not as specimens, displays, or conservation units, but as sovereign beings enmeshed in complex webs of ecological and cultural relations. The tensions visible in the data - between conservation and commodification, care and confinement, education and exhibition - all point to what Todd (2018) would identify as the need for deeper institutional reckoning with colonial legacies and more meaningful engagement with indigenous paradigms of relationality.

6.0 MFRS 141 Biological Assets and Implications to Accounting Research

Malaysian Financial Reporting Standards (MFRS 141) sets out guidelines for agricultural activities, mainly focusing on the management and valuation of living assets used in the production of agricultural goods. This standard emphasises activities such as farming, planting, livestock management, and harvesting crops or animals. However, animals at a zoo are generally not classified under MFRS 141 as part of agricultural activities, because they are primarily maintained for conservation, education, research, and entertainment purposes, not for sale or traditional agricultural output (PricewaterhouseCoopers, 2009). As such, the accounting treatment of zoo animals falls outside MFRS 141's scope and is governed by other principles that consider the unique objectives for which the animals are kept. Interestingly, under MFRS 41, animals bred for sale or used in the production of agricultural output could potentially be classified as biological assets, but this classification does not align with zoo management's primary objectives, which complicates the accounting framework's applicability and exposes limitations in capturing relational and cultural values.

Adding to this complexity, Malaysian Public Sector Accounting Standard 27 (MPSAS 27 (2015), paragraph 9, explicitly states that biological assets employed for purposes such as research, education, entertainment, or other non-agricultural activities are excluded from the standard's prescribed accounting procedures (MPSAS, 2017). Instead, these assets should be accounted for under standards like MPSAS 12 on inventories or MPSAS 17 related to property, plant, and equipment, provided they satisfy asset recognition criteria. Nonetheless, the year-to-year fluctuations in the animal population, resulting from deaths, highlight a potential "going concern" risk that challenges the stability and sustainability of zoo inventory management. While the zoo recognises its animals as inventory that serves a non-resale purpose, their economic contributions through visitor fees and educational outreach complicate their classification, raising questions about how such assets should be recognised and valued in financial statements. The facts and figures presented in Tables 1 and 2, alongside Figures 1 and 2, underscore the obligation for the zoo to publish its animal inventory, despite its non-categorisation as a biological asset, following the stipulations of MPSAS 27, which mandate disclosure of such information to reflect the zoo's operational realities.

Building upon this, the discussion extends to the broader influence of accounting's conceptual framework in shaping how assets are perceived and measured. The classification and measurement of zoo animals, ranging from mammals and birds to reptiles, fish, and

invertebrates, are inherently influenced by their physical attributes, such as weight and length, which serve as proxies for valuation. This aligns with the findings in recent accounting research that highlight how measurement choices, seemingly technical, are deeply ideological and reflect underlying institutional priorities (Alsaid & Ambilichu, 2021; Casas-Arce et al., 2022; O'Dwyer et al., 2024.). As Swaisgood and Shepherdson (2005) and Ward et al. (1998) observe, choosing the measurement units, such as weight for mammals and birds, or length for fish and reptiles, can inadvertently reinforce a reductionist view of animals as standardised objects, rather than recognising their relational and ecological complexity. This approach echoes Todd's critique (Todd, 2014), which warns against the epistemic dominance of quantitative measures that abstract away the cultural, spiritual, and relational dimensions of non-human life. When laboratory or accounting metrics focus heavily on physical dimensions, they risk reducing animals to mere data points, neglecting the relationality and kinship that are central to many indigenous worldviews, which Todd emphasises as vital for authentic environmental stewardship (Todd, 2016).

Furthermore, assessing the value of such inventories involves complicated calculations, often entailing expenses related to food, housing, veterinary care, and other resources. Scholars like Hosey et al. (2013) and Woods et al. (2018) highlight that these costs are dynamic, varying over time and across species, making valuation an inherently complex process that is sensitive to fluctuating biological and ecological conditions. Todd's perspective suggests that this technical challenge reveals deeper epistemic limitations: that the very act of quantifying and monetising living beings imposes a Western logic of control that conflicts with indigenous principles of relationality. For instance, weight or size fluctuations due to reproduction or aging might complicate inventory valuation, thus requiring continuous monitoring that could be seen as an attempt to impose a masterful order over living systems, a process that Todd critiques as perpetuating colonial residues of domination (Todd, 2022).

Ultimately, the prevailing accounting standards and practices, while serving to organise and quantify biological assets within a financial framework, persistently fall short of capturing the relational, cultural, and ecological complexities intrinsic to living beings. As the case of Malaysian zoo animals demonstrates, reliance on physical measures, financial valuation, and standardised classifications often results in the reduction of animals to mere data points or commodities, neglecting their roles as kin and ecological actors. Such practices reinforce colonial epistemologies of mastery and control that Todd (2014, 2022) critically challenges, arguing that true stewardship requires recognising animals as active agents embedded within reciprocal relationships. Moving forward, there is an urgent need to redefine animal mortality accounting by integrating indigenous paradigms of relational accountability and ecological sustainability. This involves shifting from a narrow focus on economic and quantitative metrics toward approaches that honour animals' intrinsic worth and interconnectedness. Embracing indigenous epistemologies and ecological ethics can foster more holistic, equitable, and sustainable frameworks, ones that validate the moral and relational dimensions of animal lives and deaths, ultimately transforming accounting practices from systems of domination to sites of relational responsibility.

7. Conclusion

Quantifying and documenting financial and operational aspects in a zoo with diverse inventory categories involve considerable complexity, owing to the distinctive attributes and inherent limitations associated with each classification. From an accounting standpoint, standards such as MFRS 141 and MPSAS 27 provide frameworks for valuation, yet their applicability to living organisms, particularly within a cultural context that recognises relational and spiritual

dimensions, remains limited (Nardi & da Silva, 2023; Ore, 2011; Rozentale & Ore, 2013). For instance, assessing animals by physical measures such as weight or length may overlook the deeper relational values as emphasised by Zoë Todd (Todd, 2014), who critiques how Western epistemologies tend to reduce non-human life to quantifiable objects. When animals are acquired through purchase, their valuation is based on historical cost, an approach that records assets at their original purchase price, as supported by Radu et al. (2015). Conversely, animals or plants obtained through donations, adoptions, or gifts, such as a newborn panda from China (New Straits Times, 2018), are valued at fair value, in accordance with MPSAS 12, which underscores that non-exchange transactions should be recognised at their fair market value at the time of acquisition. This process exemplifies how accounting frameworks attempt to embed living beings within a transactional and economic logic, often disregarding their cultural, ecological, and relational significance, which Todd (2016) articulates as a form of epistemic violence rooted in colonial residues of dominance.

Classifying animals as inventory rather than assets highlights a fundamental tension; animals lack potential for future monetary gains but serve social, educational, and conservation purposes. Given that Zoo Negara operates as a non-profit institution reliant on government grants, donations, and public support, resource management becomes critical. The high costs of maintaining large populations, over 4,000 fish and 600 birds, underscore the importance of sustainable funding not just for routine care but also for infrastructural improvements like cage removals, enclosure modifications, and landscaping enhancements (Cipreste et al., 2010; Mallinger et al., 2023). These operational needs illustrate a broader critique, aligned with Todd's perspective, that dominant economic valuation systems tend to commodify animals, marginalising their ecological and cultural roles. They risk reducing animals to mere assets, neglecting their relational and spiritual contexts, and thus perpetuating a form of epistemic alienation from non-human kinship.

Furthermore, as Zoo Negara's focus gravitates toward social and educational outreach, its reporting framework emphasises non-financial metrics, such as transparency around mortality rates and causes of death, all of which resonate with Todd's advocacy for relational accountability (Todd, 2022). Transparently reporting animal fatalities and providing candid explanations uphold the principles of reliability, relevance, and sincerity, resisting the colonial silencing of uncomfortable truths. Such practices reflect an emerging shift toward accountability grounded in relational and ethical considerations, recognising animals as kin and acknowledging the moral obligation to respect their lives beyond mere statistical metrics.

This study's scope, primarily cantered on Zoo Negara, nevertheless poses limitations to its broader applicability. While offering valuable insights into the intersections of accounting, ecology, and indigenous relationality, the findings may not fully reflect the diversity of practices across other Malaysian zoos such as Taiping, Melaka, or Johor, or the Department of Wildlife and National Parks. Future research exploring these institutions would facilitate a more comprehensive understanding of how environmental variables, cultural epistemologies, and accounting practices influence population dynamics, mortality, and resource allocation. Moreover, integrating indigenous perspectives, as highlighted by Todd and numerous scholars in environmental and social accounting, offers pathways to redefining conservation not solely through economic metrics but as relational and moral commitments rooted in kinship and eco-spiritual principles. Such a shift would not only redefine how animal life and death are recorded but also transform conservation into a moral and relational practice aligned with sustainability and indigenous wisdom.

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