Sustainably feeding captive raptors and reptiles:

Are there alternatives to culled male chicks?

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1. Introduction: What is the problem?

It is estimated that between 40 and 45 million newly hatched male chicks[1] are culled every year in the UK as they are of no value to the egg industry (Animal Welfare Committee [AWC], 2023). This is a significant welfare problem due to: 1) the number of individuals involved; 2) the exceedingly young age of the chicks at just a few hours old; 3) the absence of any agency, choice, exploration, water/food, and positive experiences in the chicks' short lives; and 4) the culmination of the aforementioned points preventing the fulfilment of "a life worth living"—a *minimum* goal of modern animal welfare (Mellor, 2016; Farm Animal Welfare Council, 2009, pp. 14-16). Additionally, an increasing number of animal welfare scientists view (especially premature) killing as a significant welfare issue due to the removal of future positive experiences and shape-of-life considerations (e.g., Browning & Veit, 2020; Jensen, 2017; Kasperbauer & Sandøe, 2015; Yeates, 2010).

Technology now exists to determine the sex of the chick embryo whilst still in the egg and prior to the capacity for pain emerging (AWC, 2023; pp. 14-19), meaning chick embryos can instead be killed with considerably lower ethical concerns and no welfare concerns. This has led some European countries, such as Germany, to ban the culling of male chicks (Niekerk & Workamp, 2022; p. 30). To maintain its reputation as a world leader in animal welfare, the UK needs to follow suit. However, in the UK, close to 100% of culled chicks are used as whole prey feed for captive[2] raptors, reptiles, and some mammals (AWC, 2023, pp. 24-25). This leads to the following question: What will captive raptors and reptiles be fed if the mass culling of male chicks is outlawed? This report will explore extant more sustainable[3] alternatives and suggest next steps. While some mammals are also fed chicks, the AWC (2019) identifies primarily raptors[4] but also carnivorous reptiles (snakes and large lizards) as the main recipients; thus, for the purpose of this report, these will be the nonhuman animals (hereafter, animals) focused on. Additionally, the feeding of live animals will not be discussed as this is illegal in the UK—bar exceptional conservation/training derogations (DEFRA, 2025a; p. 24).

2. Raptor and reptile behavioural/nutritional needs

There are no comprehensive and precise figures available; however, through a Freedom of Information request, 4252 raptors from 170 species across 95 UK dedicated bird of prey centres alone have been found (Tomlinson, 2018). Reptiles are increasing across UK zoos and as pets too, though not all will be carnivorous species (Tansley, 2025; Sparrow et al., 2024). UK Pet Food (2024) estimates 600,000 pet snakes alone in the UK—all of whom are carnivorous. Over the last 150 years, there has been a shift away from feeding raptors and carnivorous reptiles with processed meat or muscle meat and towards feeding these animals with whole prey (Chitty, 2009; Dierenfeld, 1997, p. 990)—most commonly culled male chicks from the egg industry or rodents bred specifically for this

[1] This figure concerns male chicks from chicken "layer" breeds exclusively. Additional to this figure, will be male newly hatched poults (turkey chicks), who are often surplus to breeding requirements (as well as female poults less frequently). According to the AWC (2023; p. 9), poults are typically macerated (versus gassed) and so not fed as whole prey to captive raptors and reptiles, while male ducklings from the much smaller duck egg industry are reared for meat.

[2] Captive raptors and reptiles is a catch-all term for those kept in zoos, in wildlife parks, as exotic pets, and/or in rescue centres, as well for those reintroduced to the wild.

[3] "More sustainable" is understood as posing fewer ethical, welfare, and environmental problems than the current form of reptile and raptor feed.

[4] Specifically, based on evidence provided by stakeholders, the AWC (2023; p. 24) states that 70% of culled male chicks in Great Britain go to two main wholesalers in England; of this proportion, 60% go to raptors, 30% to zoos (which can include raptors again), and 5% to pet reptiles (the report does not clarify how the final 5% are used). The other 30% are sold directly to regional customers (again, this will include some raptor keepers). There is a paucity of information/figures available regarding more precise destinations of culled male chicks, including how many are used for strictly conservation/rehabilitation purposes.

purpose (Nijboer, 2024a, 2024b). The use of whole prey as feed fulfils both highly motivated behaviours and nutritional needs, especially for raptors.

In regard to highly motivated behaviours, the use of whole prey mimics feeding behaviour in the wild more closely. For raptors, this includes use of beaks and talons to manipulate and skin the prey, rip off certain parts—and just generally spending more time occupied with their food (Forbes, 2020; Department of Environment & Water, n.d.). It also includes casting, whereby raptors regurgitate indigestible stomach contents in the form of pellets (Chitty, 2002; p. 181). As raptors are fed multiple times a day, this adds up to significant levels of stimulation. Carnivorous reptiles (particularly snakes), on the other hand, often consume their prey whole in the wild. Some species may injure/poison their prey first who wander off and die, leaving a tracking scent to follow. This solicits tongue-flicking behaviour—the tongue being where their scent receptors are (American Association of Zoo Keepers, n.d.). Snakes and some carnivorous lizards, in contrast to raptors, have a comparatively low metabolism meaning captive carnivorous reptiles may only be fed every one-to-two weeks (Nijboer, 2024b). Overall, feeding whole prey can aid a positive affective state and reduce behavioural abnormalities from emerging.

In regard to nutritional needs, the use of whole prey is thought to increase the chance of achieving a nutritionally adequate diet due to the balance of macro- and micronutrients therein, reflecting what is evolutionarily appropriate (Forbes, 2000). For instance, studies have analysed raptor pellets and found that casting (e.g., bones and other non-meat carcass parts) has been altered by going through a raptor's digestive system, suggesting the raptor may be partially digesting it and benefitting nutritionally from it (Forbes, 2000). Reliance on muscle meat or processed meat increases the risk of health problems for captive raptors and carnivorous reptiles. Examples of raptor nutrition-related problems are malnutrition, weakness, reproductive failure, seizures, and poor quality beak, talon, and feathers (Chitty, 2009; RSPCA, 2013). In carnivorous reptiles, examples include metabolic bone disease, anaemia, and obesity and related conditions (Whittington, 2011; Raiti, 2002, p. 241). As many keepers of raptors/reptiles will be invested in optimal reproduction and breeding, adequate nutrition is of particular concern as it can affect these capabilities (Clum et al., 1997; p. 271). Vitamins and minerals are particularly at risk of being deficient in captivity, rather than macronutrients such as lipids and proteins (Clum et al., 1997; pp. 268, 270).

3. Why are male newly hatched chicks favoured as the whole prey of choice?

Newly hatched chicks are often favoured due to a nutritional profile of high protein, low fat, good calcium (to phosphorus ratio), and multiple key vitamins (Forbes, 2024, 2000). The yolk sac—retained as an appendage to a chick's body for the first few days post-hatch—for instance, is high in vitamins such as vitamin A (Forbes, 2000; Chitty, 2009, Bird & Ho, 1976). Additionally, as there are only two main hatcheries in UK serving the commercial egg industry, the vitamin/mineral makeup of newly hatched chicks is likely consistent between chicks, despite historical findings to the contrary (Bird & Ho, 1976; p. 46). As the casting of culled chicks is much less tough than the casting of older or other species, culled newly hatched chicks are also considered a valuable whole prey item for ill or young raptors (Daut, 2016; RSPCA, 2013). Additionally, chicks boast widespread availability and very low cost (AWC, 2023; pp. 24-25)—at least hitherto. Sustainability has also been a factor and this dictates why *male* newly hatched chicks are favoured as they are an unwanted byproduct of the egg industry.

4. Drawbacks of using culled male chicks

The low cost and widespread availability of newly hatched chicks to date leads to an overreliance on this one nutritional source. For instance, whilst precise figures are not available, Forbes (2020) states that over 50% of UK raptor keepers feed exclusively culled chicks to their raptors. This is against optimal nutrition advice, which asserts a *range* of whole prey species should be fed. Thus, removal of this extremely cheap and widely available food source could potentially encourage and incentivise the improved welfare of captive raptors/reptiles whose caregivers over rely on culled chicks as a feed currently. Additionally, interspecies differences between raptors mean that, for instance, kestrels can thrive on a predominantly culled chick diet, but merlins cannot (Forbes, 2024, 2000).

An overreliance on feeding culled young animals means key nutrition found in mature dead animals will be missing. For instance, even in six-week old chicks, manganese, copper, iron, and vitamin E may be missing or at inadequate levels (Bird & Ho, 1976; Clum et al., 1997). This is especially important when feeding growing raptors or at times of reproduction. Simultaneously, there may be an oversupply of macro nutrients such as lipids in culled chicks. This stems mainly from high cholesterol in the yolk sac, with studies finding elevated cholesterol in raptors who were fed solely newly hatched chicks (Legler et al., 2017). This leads some to suggest that the yolk sac should be removed prior to feeding—despite this also removing the main source of nutrients (Forbes, 2024, 2011). In terms of disease risks, feeding avian whole prey brings greater disease risks than feeding mammalian whole prey as pathogens less commonly cross classes of animals (Forbes, 2020). Additionally, some raptor species, such as hawks, are messy eaters, meaning infections can arise from carcass material becoming stuck under talons (Chitty, 2009; p. 47).

Aside from nutrition/health-based reasons, there are logistical drawbacks. Perhaps related to emergent bans on culling male chicks in the egg industry, there is evidence of shortages of newly hatched chicks (e.g., Feathers and Fur, 2025). Finally, there is the heavy ethical load of feeding newly hatched chicks—at all, let alone those with entirely absent welfare from a hatchery. The practice also appears to be against public preferences. For instance, in a representative survey, Bryant Research (2023) found 82% feel uncomfortable to some degree with the practice, with 77% supporting the adoption of in-ovo sexing technology instead. Similarly, the Vegetarian Society (Barclay, n.d.) polled the public and found 76% would support a ban on male chick culling, even if it meant paying 1p extra per egg. Forbes (2000, p. 14) also mentions how zoos often switch to muscle meat for food displays involving raptors as there would be disquiet from the public regarding use of whole prey.

5. More sustainable alternatives to culled newly hatched male chicks as feed

To prevent chicks' poor welfare, short lives, and deaths from simply being placed onto other animals (e.g., see AWC, 2023, pp. 29-30; Niekerk & Workamp, 2022, pp. 56, 70-71), the best current alternative is the use of whole-as-possible animal by-products (ABPs) from slaughterhouses. ABPs include casting (skin, blood, feathers, hair, wool, fur, bone, viscera, sinews, nails, specific body parts) in addition to meat unwanted by humans (Knight, 2023). This could be retained as whole as possible, and also, chopped into parts of a suitable size for the species concerned to prevent bone obstructions (Nijboer, 2024a). This could make available a wider array of whole prey sources, and therefore a wider array of nutrients and forms of stimulation/enrichment for the raptors and reptiles, than is currently the case. Crucially, unprocessed (not heat-treated) and as whole-as-possible ABPs should still be recognised as food, and thus accepted, by raptors and carnivorous reptiles. Raptors especially are opportunistic feeders, which includes feeding on carrion even of much larger species than they would normally hunt (Forbes, 2000, p. 3; Department for Environment and Water, n.d., p. 4). This also applies to at least some carnivorous reptile species (Cairncross et al., 2024). As the ABPs

stem from farmed animals kept under controlled conditions, the nutritional supply should also be consistent. For extra peace of mind, commercial formulated feed and supplements[5] specific to particular raptor and carnivorous reptile species should be used in tandem with ABPs.

Category 2 and 3 ABPs include all ABPs except those suspected of potentially transmissible disease or toxicity (DEFRA, 2018). The use of Category 2 and Category 3 ABPs to feed raptors and carnivorous reptiles, regardless of whether this is in a zoo or private capacity, is fully legal (DEFRA, 2014). Indeed, there is already some infrastructure in place for this; for instance, caretakers wishing to use ABPs as animal feed need to register as a "final user" (DEFRA, 2014).

Use of ABPs would retain the circular, low-impact approach. It would also prevent the continuation of male chick culling, purely for the purposes of feeding captive raptors and carnivorous reptiles. Use of ABPs has the additional advantage of reducing the "small body problem" insofar as all animals ending up at the slaughterhouse are going to be considerably larger than newly hatched chicks, meaning fewer individuals are harmed for the same amount of nutrition gained (Bryant Research, 2024)[6]. Importantly, hatcheries, captive animal stakeholders, raptor/reptile nutritionists, and public health officials should also collaborate and investigate the feasibility of utilising the killed male embryos and shells—in as an unprocessed form as possible—as a nutritious and stimulating feed that would also mimic wild diets (see Appendix I for an in-depth proposal of this plan).

Of note, however, is the high demand for ABPs in modern times—for energy, cat/dog food, medical products, chemicals, and more (Knight, 2023). With widespread calls for reductions in human animal product consumption for environmental, animal welfare, and public health reasons, the overall pool of ABPs may or may not reduce overtime as well. Such is the demand of ABPs, that even a reliable supply for cat/dog food (a practice firmly embedded in the industry) has been called into question (Carroll, 2022). For these reasons, ABPs should be a stop-gap solution whilst research into further alternatives is expedited[7]. This could include additional investment not only into cultivated meat, but conceivably even into cultivated casting. Currently, the focus is on solving barriers in 3D printing of cultivated meat (Ching et al., 2022, p. 7); however, once these are solved, there would be space for new challenges to be taken on, such as 3D casting and "whole prey" printing.

In terms of feeding rodents and other small animals (e.g., quail, guinea pigs) as an alternative to culled chicks, stakeholders should ensure they are first making use of surplus non-GM small animals (especially rodents) from science who will otherwise be killed and wasted—numbering around 1.8 million animals currently (Taylor & Alvarez, 2020; p. 204). It is difficult to find information regarding

[5]There is concurrent hesitancy and promotion of supplements for raptors and carnivorous reptiles—even by the same authors. For instance, Chitty (2002; p. 182) mentions how supplements may be counterproductive, whilst Forbes (2011; p. 6) highlights the dearth of evidence regarding their efficacy and the danger of overdosing on some minerals. Yet, the same authors proceed to recommend their use for certain high-stress times of life and highlight evidence for their efficacy in treating deficiencies (e.g., Chitty, 2009; p. 43). Supplements are also recommended in cases where only one type of whole prey is fed. Ultimately, the emphasis is on: 1) not relying solely on supplements, but to use them as a back-up, and 2) utilising commercial formulations to prevent errors with significant consequences (Forbes, 2000; pp. 18-19; Chitty, 2009; p. 44).

[6] Knight (2023; p. 16) highlights relative inefficiencies of feeding other animals ABPs on a kg for kg basis (versus human-grade meat), suggesting it would be more efficient to use human-grade meat. However, this *only* becomes relevant in the event that the human demand for meat becomes non-existent i.e., as long as humans are the primary driver for farmed animal meat and continue to eschew certain parts of the animal (an average of 31% of a carcass; p. 15), ABPs will continue to be generated and remain the less impactful option in terms of welfare and the environment.

[7] Whilst evidence is emerging regarding the potential adequacy of nutritionally sound vegan diets for domesticated obligate carnivores such as cats (e.g., see UK Pet Food, 2023), there are additional challenges with obligate carnivores in zoos, such as raptors. For instance, many species, unlike the cat, cannot digest plant material at all (Houston & Duke, 2007), and there are hundreds of different species to consider versus one for the domesticated cat. Nevertheless, research could seek to innovate in this area if hopeful avenues to pursue further are found.

what happens to these animals once killed; science labs should be contacted to investigate the feasibility of this. Outside of this, if rodents and other small animals are bred specifically as feed, many comparable welfare concerns (to those that exist for newly hatched chicks) remain. This includes living in poor conditions, being killed at just a few hours old or an otherwise very young age, and absent positive welfare (Simcikas, 2019; Jones et al., n.d.). There is also the higher price tag for zoos and guardians, even before additional welfare improvements are either voluntarily incorporated, or legislatively required, for breeding 'feeder' rodents.

However, *if* government could impose additional regulations and safeguards on rodent breeding, and/or *if* zoos could commit to breeding their own rodents on site and enabling some level of positive welfare to accrue (including a longer life), this in my view would still be preferable to the culling of male chicks from a welfare perspective. One industry should not hold another industry back from welfare improvements in their own domain that they are accountable for. This is not applied elsewhere; for instance, there are not curtailments on the 3Rs (replace, reduce, reuse) regarding animals used in science just because some industries/stakeholders (including zoos) may make use of surplus mice. Additionally, this disentangling of industries is more aligned with freedom of choice from a consumer perspective; some may wish to consume eggs but not support/visit zoos, or vice versa.

5.1. Feasibility tests

Some feasibility enquiries have already been conducted as will now be summarised (for further details see Mace, 2025a). For instance, initial contact with senior management staff at BIAZA (British and Irish Association of Zoos & Aquaria) has been positive. They stated:

> "*BIAZA has concerns over unintended negative welfare outcomes for the wide range of animals and birds within their zoos who would be impacted, some of high conservation importance. We are therefore open to a mini trial of using whole-as-possible ABPs amongst some of our members. Primary issues for BIAZA are welfare, nutritional quality and comparability, biosecurity, affordability, and logistical feasibility.*"
> – senior management staff at BIAZA.

Successful contact has also been initiated with the British Pest Control Association (BPCA), who are keen to implement the idea from a sustainability perspective, and are keen to liaise with BIAZA to achieve this. Use of culled 'pest' animals will be most viable from 2029 after extensive regulatory restrictions and bans on lead ammunition come into force in the UK (DEFRA, 2025b). Initial conversations with an NC3Rs (the National Centre for the Replacement, Refinement, & Reduction of Animals in Research) managerial staff member suggest it may be possible to re-direct non-GMO surplus small animals from science as whole raptor feed, should an appropriate framework be put in place. Additionally, successful contact has been made with an ABP processing company, which has supported the potential of whole-as-possible ABPs to be re-directed to captive raptors as whole feed.

Finally, a leading zoo avian vet, Dr Neil Forbes, has expressed support for the statement:

> *Quality assurance tests should commence regarding the most common animals (or parts thereof) that may be available as alternative whole feed for birds of prey to culled chicks. This will refine our understanding of the nutritional profile of alternative whole feeds and safeguard raptor health and welfare*.
>
> – supported by Dr Neil Forbes, BVetMed DECZM FRCVS, RCVS Recognised Specialist Zoo Animal and Wildlife Medicine (avian), European Veterinary Specialist Zoological Medicine (avian), Cert C&G Zoo Inspection.

Additionally, again, initial conversations with some senior staff at BIAZA suggest they would be able to liaise with (or signpost others to) their own zoo nutritionists who could further advise on and safeguard animal health/nutrition in potential transitions to whole-as-possible ABP replacement feed. This would build on health/welfare aspects already focused on in the present report.

6. What are other countries with bans on chick culling doing?

According to Niekerk and Workamp (2022), countries who have introduced legislation that bans the systematic culling of newly hatched male chicks from the egg industry include: Germany (first country, 2022, incubation day 13); France (2022, incubation day 15, animal feed exemptions); Italy (target of 2026); and Austria (2022, incubation day 14, animal feed exemptions). Luxembourg has since followed suit (European Parliamentary Research Service, 2022). None of these countries have simultaneously legislated against the import of culled newly hatched male chicks, around the displacement killing of alternative animals, nor around the use of the killed male embryos as nutritious and stimulating feed for captive raptors and reptiles. As a result, there is evidence of an increase in imported female chicks whose brothers will still have been culled—just in another country where the practice remains legal. These imported female chicks produce 30% of the eggs in Germany, for instance (Niekerk & Workamp, 2022; p. 58). Figures do not yet seem available regarding increases in animal 'feeder' production (such as rodents), and welfare inquiries into this. The UK could be a leader in accounting for such secondary effects of a ban on chick culling.

7. Summary of proposed alternatives and areas requiring further inquiry

The UK should lead the way with the most comprehensive legislative ban seen to date on the culling of newly hatched male chicks. The legislation (and/or accompanying legislation) should:

- Ban the culling of newly hatched male chicks, poults, ducklings, and young of any laying species (echoing the AWC, 2023; p. 29).
- Ban the import of culled newly hatched male chicks, poults, ducklings, and young of any laying species (echoing the AWC, 2023; p. 29).
- Ban the import of female chicks or eggs from countries without bans on male chick culling (echoing the AWC, 2023; p. 29).
- As a replacement to the use of culled male chicks as animal feed, wherever possible, promote/incentivise the use of unprocessed slaughterhouse and hatchery ABPs alongside carcasses from 'pest' control and surplus non-GMO small animals from science. This will disincentivise displacement killing and optimise sustainability by first using animal carcasses already generated—subject to logistical preparations and a mini trail with stakeholders. This can include the killed male chick embryos where in-ovo sexing technology is used (see Appendix I).
- Promote use of in-ovo sexing technology as the primary means of achieving the ban on male chick culling—versus rearing of male "layer" breeds or switching to dual purpose breeds (Mace, 2025b).
- Liaise with BIAZA nutritionists to help offer reassurances in regard to animal health. Consider implementation of quality assurance tests of the most commonly available whole-as-possible ABPs to help provide confidence in nutritional provisions.
- Implementation of both a logistics plan and a mini trial, involving at least one representative of each stakeholder type. Overarching institutions—including, for instance, BIAZA, BPCA, and the NC3Rs—will participate wherever possible.

- Continue to try and secure contact with a hatchery and a slaughterhouse.
- Enhance rodent, rabbit, quail, and other 'feeder' animal welfare provisions in anticipation of increased farming and use (echoing the AWC, 2023; p. 30).

Longer term, alongside more general research into raptor and carnivorous reptile nutrition, the UK government and businesses should invest in research supporting even more sustainable and independent opportunities for raptor and reptile nutrition (echoing the AWC, 2023; p. 31). This should include moving beyond cultivated meat, with innovative research into developing cultivated casting.

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Appendix I

Proposition

Use of pre-sentient killed embryonated male eggs—whilst preserving the integrity of the egg—as whole animal feed for birds of prey and other exotic animals in captivity.

Suggested killing method: Freezing whole pre-sentient male embryonated eggs post in-ovo sex identification (gassing as a back-up method of killing).

NB: This is proposed alongside use of whole-as-possible animal by-products (ABPs) from slaughterhouses, research labs, and culls of 'pest' animals, as outlined earlier in this report.

Relevant legislation/guidance

For brevity, equivalent legislation in devolved nations will not be covered here.

Direct relevance

- Retained EU Regulation (EC) No 1069/2009 (provides the framework)
- Retained Commission Regulation (EU) No 142/2011 (covers the detail)
- Animal By-Products (Enforcement) (England) Regulations 2013 (covers the implementation)
- Official Guidance by DEFRA and APHA explaining how to follow the aforementioned legislative requirements:
    - Transporting ABPs
        - "*use vehicles and containers that are covered and leak-proof*".
        - "*clean, disinfect, and dry vehicles and containers before and after every use*".
    - Using ABPs to feed carnivores
        - "*You can feed category 2 and 3 animal by-products (ABPs) to … zoo animals … reptiles and birds of prey, either in zoos or if they're pets*".
        - Pet owners can feed category 3 raw ABPs at home to their pets in England and Wales, but not Scotland.
    - ABP categories
        - Category 2 ("*unhatched poultry that has died in its shell*") or Category 3 ("*eggs, egg by-products, hatchery by-products and eggshells*").
        - Likely classified as Category 3 (low risk) as "*unhatched poultry that has died in its shell*" (Category 2) refers to those dying of natural or accidental causes.

Indirect relevance

- Animal Welfare Act (2006) (AWA)
    - "*Nothing in this Act applies to an animal while it is in its foetal or embryonic form*" (s. 1.2).
- WATOK (2015), via PATOK (2009, Annex I), only lists maceration as a means of killing embryonated eggs.
- Code of Practice for the Welfare of Laying Hens and Pullets
    - "*Surplus chicks and in-shell embryos, including in hatchery waste, must be culled humanely by a trained and competent person and in accordance with the specific welfare at the time of killing legislation*" (point 111, p. 27).
- Guidance on the operation of the Animals (Scientific Procedures) Act 1986 (ASPA)

- "*Embryonic and fetal forms of mammals, birds and reptiles are protected animals once they have reached the last third of their gestation or incubation period*" (s. 1.4.2).

Comment: Whilst the AWA does not apply to embryonated eggs, the only method of killing them that is explicitly mentioned in PATOK and the accompanying Code of Practice is maceration. There could be a risk of a legal grey area forming here. It may be the case that maceration is listed as the most obvious and easy means of killing embryonated eggs, aligned with current industry operations, and especially for late-stage embryonated eggs. The legislation and Code are not thorough in listing all methods not acceptable, leaving ambiguity. There is good reason to think that *pre-sentient* embryonated eggs prior to the last third stage (so up to embryonic day 14) would not be covered by legislation, meaning death by freezing could be permitted. This is, for instance, permitted under ASPA and global best practice guidelines for euthanasia of early stage embryonated eggs (e.g., AVMA, s. 5.3, p. 82).

How does this align with current industry operations?

ABPs are legislatively required to be transported in a frozen state. They are also recommended (or legislatively required, depending on the case) to be *stored* in a frozen state. Thus, death by freezing—*acceptable from a welfare perspective due to the pre-sentient stage of the embryonated eggs*—appears the most feasible option from a logistical perspective. Equipment may need updating to transport frozen eggs en masse. To meet the aforementioned legislative requirements, they need to be transported in a covered and leak-proof manner. This could be achieved, for instance, by silicon clip-on covers for the trolleys of eggs in addition to leak-proof covers surrounding the entire trolleys. As is also currently practiced, all equipment needs to be disinfected after each use.

There is anecdotal evidence that non-embryonated eggs can be frozen with minimal cracking/leakage. Embryonated eggs comprise less liquid, suggesting even lower levels of shell cracking and leakage compared to non-embryonated eggs. Staged freezing could aid with this too to prevent shocks. The eggs can be coated in an edible wax to reduce risk of micro-cracking/leakage yet further. This points to the ability to retain use of the killed pre-sentient male embryonated eggs as whole animal feed for exotics. Zoos can transfer small batches from their walk-in freezers into leak-proof Tupperware boxes and feed them to their exotics within 24 hours of thawing.

Nutrition for birds of prey and other exotics

At embryonic day 13, the yolk sac is present and larger than after hatching, meaning much of the nutritional benefits from newly hatched chicks for captive raptors remains present. Casting is also available such as via the shell, blood, bone, beak, nails, and even some feather development. Developmental images can be seen here and here. Size-wise, two or three of these eggs may be required to match a newly-hatched chick.

Main challenges/reservations

- Risk of legal grey area over freezing/gassing pre-sentient embryonated eggs? Confirmation required.
- Discomfort with lack of immediacy of freezing/gassing versus maceration.
- Need for stakeholders to update some equipment/processes.

Comment: Whilst killing (freezing or gassing) pre-sentient embryonated eggs on mass still produces some ethical discomfort, welfare implications are practically nil. Thus, this is a significantly preferable option to killing of newly hatched chicks or other neonates to replace newly hatched chicks. Research pertaining to embryonic day 13 as the earliest possible stage for the emergence of the capacity to suffer is strong (see Mace & Knight, 2025; the AWC's report (p. 28); or here). Choosing technologies that allow in-ovo sex identification prior to day 13 would not only be optimal, as also recommended by the AWC (p. 28), **but also essential**, if freezing the embryonated eggs in a definitively pre-sentient stage. Samples can be tested to provide extra assurance over death at pre-sentient stages of development. This is also a stop-gap solution and research should help innovate in the area of feeding raptors and other exotics (e.g., advancing cultivated meat further into 3D structures and with casting). Just as government would assist with the implementation of in-ovo sexing technology, so it could aid with any updating of equipment and processes required for stakeholders for implementing this proposal.

Next steps

- Consult APHA (confirm legality), hatcheries, zoos.
- Refine plan and develop costing plan.
- Advocate use of pre-sentient killed embryonated male chicks as whole exotic animal feed to be included in any legislation banning killing of male chicks (as an incentive for hatcheries to take this route as it will require a little adaptation).
- Key hatcheries: Moy Park, Avara.
- Exemplar wholesalers: Ridgeway Frozen, Kiezebrink, Raptor & Reptile Food, Exotic-Pets.

Back-up plans:

- If preferred, pre-sentient embryonated eggs can also be killed via exposure to pure CO_2 for 30 minutes. This is a permitted method for newly hatched chicks, so there should be no qualms about applying this method to pre-sentient embryonated eggs. Samples can be tested to confirm death at pre-sentient stages. Gassing entire embryonated eggs may pose fewer welfare problems at later stages of embryonic development (relative to freezing). Further investigation required.
- A lighter level of maceration could be considered as an alternative form of killing? But the product would be of lower value to zoos.
- If for any reason this proposition cannot proceed, carnivorous exotic captive animals can still be fed with whole-as-possible ABPs from slaughterhouses. Thus, rejection of this proposition should not be a reason for delays over banning of the culling of male chicks.