Positive Listing Regulation Systems in the Wildlife Trade: Policy Recommendation

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Section I: Abstract

This paper is intended to thoroughly explain the mechanisms through which the wildlife trade threatens biodiversity, and how positive listing regulations alleviate these threats relative to negative listing regulations. **Negative listing regulation systems** only include regulations against, or limitations of, the trade of certain species. By contrast, **positive listing regulation systems** regulate the trade by only permitting the trade of certain species explicitly written into law. Ultimately, a legislative implementation of positive listing regulation systems in the United States of America is recommended.

Section II: Introduction

The overarching goal of this paper is to justify the implementation of positive listing regulation systems in the wildlife trade. Therefore, the ability of policy makers, advocates, lobbyists, stakeholders, and interest groups to deeply understand all the content in this paper is critical. As such, technical terms are bolded and defined according to the explanations of Bowman and Hacker (2022) in *Ecology* for bolded terms in sections II and III, and of Toland and co-authors (2020) for bolded terms in sections I and IV.

The **wildlife trade** (also referred to as ‘the trade’ throughout this paper) refers to the market where wild animals are sold to buyers. These transactions may involve whole industries/businesses or simply be between an individual consumer and seller. The sold animals are commonly used for purposes of entertainment (circuses, zoos, other exhibits), adoption (particularly in the exotic pet trade, which is a component of the larger wildlife trade), collection, competitions, medicine, resale (for the animal itself or for its fur, feathers, skin etc.) and more. The wildlife trade is considered global, meaning that there exists a worldwide market where these transactions occur. Removal of wild animals from their native habitats is inherent in wildlife trading practices.

The global wildlife trade is a strong example of how humans are exploiting wild animals, and consequently, the environment, resulting in major losses to **biodiversity**, the degree of variation in a biological system in a specified region and biological grouping. **Species**

biodiversity is a measurement which quantifies biodiversity in a specified region by **species richness** (number of different species) and **relative species abundances** (number of individuals belonging to a species divided by the total number of individuals from all species, where more equal abundances across species leads to higher biodiversity measurements). Species biodiversity can be measured for different biological groupings, such as for **communities** which are composed of species in a given region, and for **ecosystems** which consist of living and non-living components in a given region. Species biodiversity is the most common measure of biodiversity, so species biodiversity and biodiversity will be used interchangeably.

Morton et al. (2021) compare the species richness (part of species biodiversity) of birds, mammals, and reptiles versus the level of wildlife trade in different areas around the world. They consider the effects of wildlife trade on species richness for both national (within-country) and international (between-country) trading. Both within-and-between-country level of wildlife trading was found to be a significant contributor to declines in species richness, with average species declines of 76% from the national trade and 66% from the international trade.

Decreases in biodiversity have important ecological consequences for future generations of wildlife, and those that rely on them, such as humans. Fortunately, some governments have taken a new approach, the adoption of positive listing systems, in regulating the wildlife trade that has clear theoretical and practical mechanisms to minimize biodiversity loss through the trade. Positive listing regulation systems contrast the presently more utilized negative listing regulation systems. However, before getting into the importance of governments adopting positive listing systems, it is important to understand the mechanisms through which the wildlife trade is threatening biodiversity. Then, the frameworks and details of positive and negative listing systems are developed and analyzed, and a national implementation of a positive listing regulation system of the wildlife trade in the United States of America is ultimately suggested.

Section III: Mechanisms Behind Biodiversity Loss:

Section III (1): Mechanism #1 Biodiversity Loss Via Removal

Genetic Variation & Natural Selection Strength Determine Species Biodiversity

Genes are the biological components that code for the specific characteristics/traits (e.g. behavioral, functional, physical, etc.) of an organism. **Populations** refer to groups with members/individuals of the same species occupying a distinct area from other members of the same species. Two definitions that follow, for genetic variation and natural selection, are described from the perspective of a population, as they will be throughout the paper unless otherwise noted. However, they can also be described for different biological groups, such as cells, species, communities and ecosystems. **Genetic variation** refers to the presence of **alleles** (different variations of a gene) in a population. **Natural selection** (primarily referred to as selection in this paper) refers to the process where individuals with traits better suited to the environment are more likely to survive and reproduce in the population, passing along their "successful" alleles to offspring as they do so.

Genetic drift refers to the random change in the frequency of an allele in a population. It follows that **genetic drift strength** refers to the tendency of random changes in allele frequency. Selection, as explained, is nonrandom. So, selection strength can be measured relative to the strength of genetic drift. Specifically, **selection strength** experienced by a population for a given allele can be found by the **effective population size** (size of an ideal population that would experience the amount of genetic drift observed) multiplied by the **selection coefficient** (the fitness associated with the allele relative to other existing alleles for the gene in the population). An **ideal population** refers to a population that is not limited in its size by factors such as inbreeding, sex ratios, variance in the number of offspring produced between individuals of reproductive maturity, etc.

As environmental changes occur, genetic variation in the population and the selection strength experienced by the population are critical in preventing the **endangerment** (susceptibility to extinction of a biological grouping) and **extirpation** (population extinction) of wild populations. Specifically, a population with more genetic variation and under stronger selection is more likely to **persist** (survive). In a specified region, as more populations of a given species persist, the more likely the species as a whole will persist, increasing or maintaining biodiversity through species richness. In addition, as more species persist through sufficient genetic variation and selection strength of populations, the more likely that species abundances will be similar, increasing or maintaining biodiversity through relative species abundances.

HOW Genetic Variation & Selection Strength Determine Species Biodiversity

As previously stated, the likelihood of population persistence is positively correlated with genetic variation and natural selection strength. This is because when there is more genetic variation within a population, there is a greater chance that at least some individuals will possess alleles which encode for traits that are most suitable for survival and/or reproduction in the environment they face. Due to their higher resilience and/or mating success, these individuals pass on their alleles to offspring more frequently relative to less suited individuals. As a result, future generations become increasingly suited to the environment as these suited alleles increase in frequency in the population. This is the mechanism behind natural selection, where genetic variation is the raw material in which selection “acts” on. If selection strength is sufficiently high, then a greater frequency of members in the population will pass on these favored alleles to future generations, increasing or maintaining the likelihood of population persistence.

WHY Genetic Variation & Selection Strength are Critical during Environmental Change

Genetic variation and selection strength are especially important for population persistence in the face of environmental change since the most suited traits are likely to change along with the environment. Therefore, more genetic variation increases the probability that a favored allele for this new environment is supplied or exists so that selection, if strong enough, can act on it in a timely manner for the population to persist. It is therefore important that a balance of sufficient selection strength and genetic variation exists for a population so that selection maintains suited alleles at high frequencies while genetic variation increases the likelihood that an allele suited for a future stressor exists or is supplied.

Supplying Genetic Variation in a Population: Genetic Mutations, Meiosis & Migration

There are three ways in which genetic variation is supplied/maintained in a wild population. The first mechanism is by population members having **genetic mutations**, which are random alterations in genes that as a result of the changes can produce new alleles. Increased genetic variation through genetic mutations is primarily supplied by newborn individuals who have obtained these random changes during processes that give rise to their early forms (e.g.

DNA replication, which is the process where copies of **DNA**, biological units composing and containing genes, are made).

The second mechanism is through **meiosis**, which is the process that forms **sperm and egg cells** (cells that when combined as a result of conception between a biological male and female, give rise to offspring) in biological organisms. Meiosis can supply genetic variation in two ways. The first is through the random separation of paternal and maternal **complementary chromosomes** (stretches of DNA, commonly two, defined by their composition of a given set of genes) in meiosis. Through each random separation of complementary chromosomes that occurs in meiosis, the resulting sperm or egg cell contains maternal or paternal DNA, which differ if the individual undergoing meiosis has different alleles between complementary chromosomes. The unique assortments of chromosomes in sperm and egg cells can therefore supply genetic variation in the offspring they give rise to upon conception. The second way that meiosis can supply genetic variation is through **genetic recombination** (primarily referred to as recombination in this paper), which refers to the swapping of DNA segments between paternal and maternal complementary chromosomes in meiosis. Recombination can introduce new alleles in the population, therefore supplying genetic variation, if these combinations of DNA segments within the chromosomes incorporated in sperm or egg cells are unique (generate new alleles).

While increased genetic variation through meiosis is supplied by the resulting offspring, the mechanism relies on reproducing population members having these unique combinations of DNA in the egg or sperm cells they make. In addition, the more pre-existing genetic variation within a population, the more unique combinations (of full chromosomes from random separation or of parts of chromosomes from recombination) are possible. Consequently, pre-existing genetic variation in a population amplifies the supply of genetic variation through both random separation and recombination in meiosis.

The third mechanism through which genetic variation is supplied/maintained in a population is **migration**, which is the movement of individual(s) from another population into the population of interest, where both populations belong to the same species. Increased genetic variation through migration is therefore supplied by the new population members, assuming they possess one or more unique alleles. These three mechanisms help maintain genetic variation that selection can act on within wild populations.

Determinants of Natural Selection Strength: Population Size and Mating Patterns

Natural selection is stronger in larger populations. This can be understood by an analogy of tossing a coin. Regardless of the probability of flipping heads, it is more likely that two heads are flipped in a row, and much less likely that 100 heads are flipped in a row. **Random allele fixation** refers to the situation of genetic drift where an allele reaches 100% frequency in a biological grouping by chance, which is analogous to only flipping heads in a row (whether 2x or 100x). So, in this same way, regardless of the probability of an individual possessing an unsuited allele (analogous to probability of flipping a single head), allele fixation in the population (analogous to only flipping heads in a row) is less likely in larger populations (analogous to more coin tosses/trials). This means that selection, which disfavors/selects *against* unsuited alleles, is a stronger/more effective force in larger populations since fixations of unfavored alleles are less likely to happen by chance. Put another way, a population with a greater probability of random allele fixation is experiencing stronger genetic drift, and as a result, reduced selection strength. Additionally, in large populations, there are enough individuals for rare and/or new alleles to be maintained at low frequencies (without requiring allele fixation), which helps maintain the supply of genetic variation for selection to act on, most notably during sudden environmental changes.

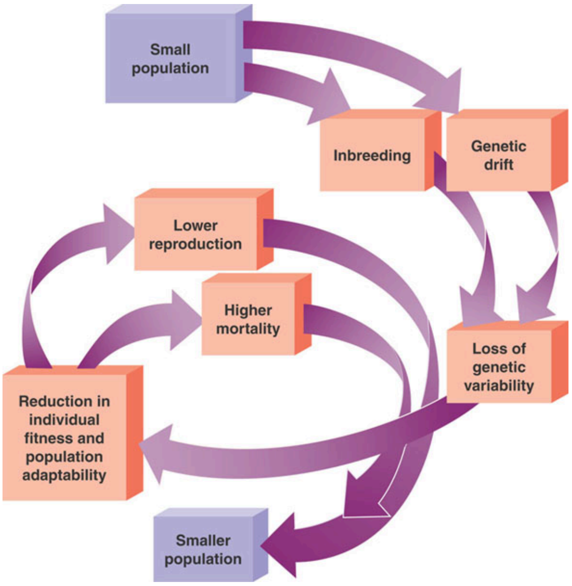
Natural selection is weaker in populations with more **inbreeding**, which refers to a form of non-random mating where individuals are more likely to mate with a genetically close relative than with a random individual. On average, the closer two relatives are (the more recently they shared a common ancestor), the more genetically similar the two individuals are. So, it's more likely that two related individuals carry the same unsuited allele, and if mated with one another, will pass this unsuited allele to offspring compared to two unrelated (or less closely related) individuals. In other words, if both mates possess the unsuited allele, there is a greater chance of it being incorporated in the egg and/or sperm cell that forms the offspring. Additionally, if the offspring inherit the same alleles from both parents, then subsequent random separation of complementary chromosomes and genetic recombination processes occurring in the offspring are less likely to generate unique chromosome assortments or DNA combinations and resulting unique alleles, respectively, such that genetic variation through meiosis is not supplied as adequately to the descendants of the offspring. Whether considering the level of genetic variation supplied by the offspring or the offspring's descendants (and generations that follow), it is clear that selection, which "acts" *against* this allele, is effectively weakened.

To summarize, smaller populations have a higher probability of unsuited allele fixation since compared to in larger populations, a relatively smaller number of the same event (unsuited allele incorporation) would need to occur for the allele to fixate by chance. Also, there is likely less genetic variation in smaller populations, which have fewer individuals supplying it. Given that closely related individuals are more likely to have the same unsuited allele than two random individuals, inbreeding increases the probability that at least one unsuited allele is passed on to offspring. Inbreeding also decreases genetic variation through increasing the probability that the same allele from both parents is passed down to the offspring. In addition, inbreeding minimizes the mechanisms that supply or maintain genetic variation in future generations. Since selection acts on variation and *against* unsuited alleles, both small population sizes and inbreeding reduce the strength of selection in wild populations.

Cyclical, Amplifying & Expanding Effects: Inbreeding Depression & Extinction Vortices

So far, this paper has established that smaller population sizes and inbreeding reduce genetic variation and weaken selection. However, smaller population sizes also amplify inbreeding within wild populations. In a smaller population, there are fewer choices for mating such that for an individual, there is a greater concentration of closely related individuals in the population. This constraint on mating partners increases the probability that closely related individuals will mate, effectively increasing inbreeding. As previously described, Inbreeding further decreases genetic variation and selection strength, and increases the chance that unsuited alleles persist and/or fixate in the population. The increase in frequency of unsuited alleles decreases the overall fitness of the populations, putting them at greater risk of extirpation. This process encapsulates an **inbreeding depression**, which refers to when a population's fitness is declining as a consequence of inbreeding.

However, the effects usually do not stop there. The decreased population fitness leads to less individuals surviving and reproducing, and therefore, even smaller population sizes with less genetic variation. The smaller and less genetically diverse generations further the inbreeding depression since there are now even fewer mating choices, starting the whole cycle over and continually exaggerating its initial effects. This repeated and amplifying cycle is what is known as an **extinction vortex**, where the probability of extirpation continually grows from the effects of reduced population sizes and inbreeding depressions. Below is a helpful depiction of the processes leading to and maintaining extinction vortices (Hartwell, 2020).



As more populations enter extinction vortices, the effects can be seen in increasingly complex and larger groupings of living and non-living systems in a given region. In particular, extinctions at these different levels directly affect the larger grouping they belong to. For example, population extinctions result in increased extinction susceptibility of the species they belong to. Furthermore, a species extinction directly impacts the biodiversity, through a decrease in species richness, of the community it belongs to. In addition, there are indirect effects on the groupings that relied on the, now extinct, grouping. In sum, biodiversity of various biological grouping sizes and complexities can be drastically reduced from extinction vortices brought on by initial declines in genetic variation and selection strength of populations.

Refocusing: How the Wildlife Trade Fits into Mechanism #1

Wildlife trading practices decrease biodiversity in wild populations through the active removal of large numbers of individuals, directly reducing genetic variation and population sizes, leading to increased inbreeding, which further decreases genetic variation and selection strength, and therefore population persistence. As discussed, this declining population persistence widens the flood gates to the cyclical, amplifying, and expanding processes described.

McMillan co-authors (2021) provide an example wildlife trading, which they found to have decreased biodiversity through mechanism #1 (the active removal of individuals from wild populations, for purposes of trade). Specifically, they carry out a study that focuses on exotic animal/pet cafes in Asia, which allow humans to interact with wild species in a cafe-like setting. Of the 252 wild species in the recorded cafes, 117 were found to be threatened or declining and 111 are not under regulated trade. Additionally, the authors predict they found underestimates of the cafes' influence on wildlife since they only included cafes with an online presence that could be found by google search, and which therefore likely have less to hide and/or take more precaution when trading.

Shivaprakash et al. (2021) provide an example of wildlife trading, which they found to have decreased biodiversity, and through the cyclical, expanding, and amplifying consequences discussed, have increased disease transmission to human populations. Specifically, they found evidence that over 25% of traded animals possess 75% of recognized **zoonotic viruses**, which are viruses that can be passed from non-human animals to humans. Additionally, they found this percentage (75%) to be much higher than that of non-traded wild or domesticated animals. As populations of traded species experience fitness declines through the processes discussed, they often lose their niche or ability to capitalize it (for example by invasive species taking it over, see mechanism #2, or directly by population fitness declines). This results in these populations moving into areas inhabited by humans, where they have more access to resources, such as food, even when the food is less nutritious than their native food supply. There is strong evidence that this is the case for fruit bats, which harbor many zoonotic viruses (Egert-Berg et al. 2021). The worsened nutrition further worsens the fitnesses of the populations, putting them at greater risk of extirpation and also increasing the probability of them contracting infections as they are relatively less fit. On top of this, these populations are now closer to humans so the probability of disease transmission to humans is heightened.

Abadía-Cardoso et al. (2017) demonstrate that due to the hunting of Northern elephant seals for the oil in their blubber in the 19th century, their populations have lost substantial amounts of genetic variation. As a consequence, they have undergone inbreeding depressions. These inbreeding depressions ultimately led to a reduction from thousands of Northern elephant seals to less than 25 inhabiting the Pacific Ocean by the 20th century.

Miller & Reading (2012) explain and provide evidence on how local extirpations of prairie dogs, which are popular in the exotic pet trade, led to black footed ferret extirpations within the same community. The authors also delve into the reductive effects of these prairie dog extirpations on species that use burrows or hunt prairie dogs. Given the complex web of interactions in biological systems, effects such as those presented in these examples are likely to continue and amplify.

Section III (2): Mechanism #2 Biodiversity Loss Via Introduction

Native species refer to species that occupy a given region without human introduction. **Invasive species** refer to species occupying a given region as a result of human introduction. Transport of wildlife, and subsequent introduction of invasive species in natural habitats (whether intentional or not), is another mechanism by which the wildlife trade reduces biodiversity, specifically native biodiversity. Species biodiversity measures species richness and abundance, as previously discussed. While the introduction of invasive species may initially increase species richness (assuming it does not immediately drive more than one native species to extinction), net reductions in biodiversity are likely to follow through the skewing of species abundances in the region. Specifically, introduced species often have not experienced the same selection pressures as native species, and so are able to occupy **species niches**, specific functional roles that species occupy in a given region and corresponding environment, in the new habitat at the cost of native species. Also, invasive species may carry diseases which kill and/or harm the previously unexposed native species. In either case, invasive species abundances may rise and native species abundances fall, ultimately reducing biodiversity through declines in relative species abundances. When this occurs, the previously discussed cyclical patterns with the first mechanism, which drive populations further into extinction vortices, can be observed for the native populations. As native species are driven to extinction from extirpations, biodiversity further declines through reduced species richness.

Refocusing: How the Wildlife Trade Fits into Mechanism #2

Wildlife trading reduces native biodiversity through the introduction of invasive species, which can harm native populations through occupying native niches, spreading disease, and more. The native animals are consequently subject to the same cyclical, amplifying, and expanding processes discussed in mechanism #1.

Hinsey and co-authors (2023) provide an example of wildlife trading, which they found to have decreased biodiversity through mechanism #2 (invasive species introduction through wildlife trading practices). Specifically, they found that of 294 global species extinctions analyzed, 230 were of ray-finned fishes. These 230 extinctions are primarily explained by introduced (invasive) commercial species preying on the now-extinct ray-finned fishes.

For an example of mechanism #2 and subsequent expanding effects, Gornall (2022) explains how the introduction of the invasive species Maori, brought by the Polynesians to New Zealand, ultimately led to the extinction of the New Zealand Moa. This extinction triggered the extinction of the Haast eagle, which was selectively preyed on the New Zealand Moa.

Section III (3): Summary of Mechanism #1 & Mechanism #2

In sum, mechanism #1 explains how the wildlife trade reduces biodiversity of traded species, and the effects that follow. In contrast, mechanism #2 explains how the wildlife trade reduces biodiversity of native species, and the effects that follow. The fates of the affected species, traded or native, are susceptible to the same cyclical and amplifying patterns of inbreeding, declining fitness, smaller populations, reduced genetic variation, and increased probability of extinction. The expanding effects of these biodiversity losses in different biological groupings also apply in both mechanisms. The difference between the mechanisms is the initial “shock”. For the first mechanism, this shock is the active removal of the affected (traded) species through the wildlife trade. For the second mechanism, this shock is the introduction of invasive species, through the trade, in regions that the affected (native) species occupy.

Section IV: Need for Positive Listing Systems:

Hughes (2017) discusses how collector demand has led to numerous extinctions of different species of geckos in the wild, especially those only known to scientists and collectors. Despite their extinctions in the wild, these unclassified species are still readily available to purchase “via the internet or reptile fairs”. It is without doubt that the effects of wildlife trading accumulate to have detrimental impacts on wildlife biodiversity worldwide, which current regulatory systems do not minimize.

In order to combat biodiversity loss from the wildlife trade, there need to be well-formulated changes in the current regulations on the trade, which is where positive listing systems provide a useful alternative. A strategic method for minimizing biodiversity loss from wildlife trade practices is the formation of positive listing regulation systems. Positive listing systems can be contrasted with negative listing systems, which will be discussed in detail first. Specifically, by understanding the issues that arise from negative lists, the need for regulations in a positive list format becomes much clearer.

As previously described, negative listing systems only include regulations against, or limitations of, the trade of certain species. There is an overwhelming number of issues that arise from negative listing systems. Five prominent concerns will be discussed here.

First, any species not classified or identified is by default allowed to be traded under negative listing regulations. This poses a problem when considering that there are relatively few species classified or protected by **CITES (Convention on International Trade in Endangered Species of Wild Fauna & Flora**, a global treaty to regulate the trade of certain species), especially the rarer species that are already more susceptible to trade for collection purposes. As a result, species may go extinct before even being identified. For example, only 2.8% of amphibian species recognized by the scientific community are listed in any of the CITES appendices. The trades for the rest, therefore, are not regulated at any level (Auliya et al., 2016, p. 2586). This first concern is therefore the legalization of trading unidentified species under negative listing regulations.

Secondly, negative lists focus on banning the trade of species that if allowed to be kept in homes, would cause harm primarily to human health and safety (Toland et al., 2020, p. 8). While humans are an important aspect to consider, these lists often fail to account for the less obvious consequences of certain species being traded by focusing more heavily on their effects on humans. Effects on humans tend to be the greater focus of research in part because they can be much easier to measure/detect. In addition, research tends to be biased towards the more "common" species that could cause potential harm to humans. For many traded species, "little is known about their biology, natural history, wild population status, invasive or potential risks that they pose to public health" and they are therefore not included in regulations "due to a lack of research-based information" (p. 25). This comes at the expense of the less well-researched species that may be endangered or on the brink of extinction. This second concern is the legalization of trading less extensively researched and/or well-understood species through negative listing regulations.

Thirdly, identification of illegally traded animals, and thus enforcement is made difficult due to the nature of negative listing regulations. According to Hughes (2017) the illegal side of the wildlife trade is the fourth largest illegal trade in the world and is "not buried in the 'dark web'" due to weak enforcement which enables traders to "operate in plain sight with little fear of reprisal" (paras. 20 & 21). Enforcement officers are usually trying to identify whether the animal in question belongs to a species that is legal to trade. Since there are many of these species under negative listing systems, many of which are not even identified and "allowed" by default, identification and ultimate enforcement are more difficult for officers. In other words, weak enforcement likely stems from the increased difficulty for these officers in identifying whether a species is one of the many "allowed" species versus one of the fewer "banned" species in negative lists. This third concern is the weakened enforcement on those illegally trading species due to the nature of negative listing regulation systems.

Fourthly, negative lists necessitate continual revisions to stay on track with new species entering the trade. On top of this being time-consuming, revisions require further research that relies on funding. In practice, up-to-date revisions of negative listing regulations are not carried out and therefore the regulatory systems are not successful in protecting species (Toland et al., 2020). This fourth concern is the unrealistically high attention demand for controlled wildlife trading under negative regulation listing systems.

Lastly, even when evidence calling for species protection is discovered, it may take years to gain legal protection for the species in the trade. This is a result of oppositions from individuals that are likely to arise despite the extent of evidence of the harm from a species trade, as well as the procedural, but dangerously long lag time to when protection gets written into law and enforced (Warwick & Steedman, 2021). Under negative listing systems, where species are by default legal to trade, this lag time risks the species going extinct or becoming further endangered before proper measures are taken. This fifth concern is the inefficiency of implementing trade bans, and therefore the delay in protecting endangered species, under negative regulation systems.

Warwick and Steedman (2021) summarize many of the common failures of negative-listing systems in protecting biodiversity by mentioning its "[...] administrative inefficiencies, [...] incomplete reporting compliance" as well as the "misinformation circulated by traders and hobbyists that grossly understates known [...] complexities of animals [...] (p. 55).

As previously described, positive listing systems regulate the wildlife trade by only permitting the trade of certain species explicitly written into law. This means that all other species not listed are by default, illegal to trade. Positive listing regulatory practices are said to employ a "precautionary approach [...] to guide decision-making in the event of scientific uncertainty [...] until all elements [of the species trade in question] are proven safe" (Toland et al., p. 20). Under this system, a lack of evidence showing the negative effects from trading a species is not enough to allow the trade of such species, as it would be under negative listing regulations. Positive listing regulation systems require diligent and evidence-based evaluations in order to deem a species as safe and sustainable to be traded with regard to humans, the environment, and all affected species.

Section V: Comparative Wildlife Trade Regulations

The current worldwide status of wildlife trade regulations includes some new adoptions of positive listing systems but is still “overwhelmingly dominated by negative list-based regulations" (Toland et al., 2020 p. 21). In the United States, the trade is mostly legislated at state and local government levels, which is prone to difficulties in enforcement arising from different regulations between states. For example, the trade of sugar gliders is legal with little to no restrictions in some states, legal with permits in others, and illegal in others. The details of the regulations further vary between states. This has caused a great deal of confusion for travelling citizens and enforcement officers, such that the legality of the trade is considered ambiguous with “gray areas” in some states (Gale, 2025). Although this legislation varies throughout the country, it is still most often in a negative-list format.

By contrast, parts of Europe and Canada have implemented positive listing regulations. While these systems are still relatively new, the European country Belgium, which has adopted such regulations, has shown success in regulating the trade with this approach. Their concise list of permitted animals has been successful in controlling the online exotic pet trade. Citizens have been quickly alerting authorities of online advertisements showcasing species not explicitly allowed in the country’s positive list (Toland et al., p. 25). In discussing the importance of execution and status of international laws in conservation, such as CITES, Trouwborst et al. (2017) articulate that “To be effective, [...] legal instruments must include clear and adequate commitments” (p. 784). Belgium’s adoption of a positive listing system, their clarity in the list of animals permitted in the trade, and their legitimacy in enforcement, serves as a model for other countries to successfully employ positive listing regulation systems.

Section VI: Conclusion:

It is evident that biodiversity is being harmed through wildlife trading practices. Wildlife trading reduces the genetic variation within wild populations by the removal of individuals, all of which add to the genetic variation present in the population. Reducing genetic variation, and therefore a population’s ability to cope with the changing environment through selection, is the prominent mechanism by which the trade drives populations towards endangerment or extinction. Introduction of invasive species to areas with native species can also elicit these effects on native species. In many cases, the smaller and less genetically diverse population, with fewer mating choices, results in an inbreeding depression, and sends populations into an extinction vortex as the cycle repeats and intensifies. This eventually affects larger-scale levels of organization, such as species, communities, ecosystems etc. The cyclical, amplifying, and expanding nature of these effects poses an immense threat to long term biodiversity.

The incentives to engage in the wildlife trade vary, but all have major impacts on biodiversity. The lack of proper regulations and enforcement on the wildlife trade results in uneducated and unregulated purchases of these wild animals. These issues call for a new regulatory approach for the wildlife trade.

The wildlife trade's contribution to biodiversity loss is clear but can be minimized through the adoption of positive listing systems. These systems, permitting the trade of only species specifically deemed as safe to be traded, are based on substantial research and evidence, and allow for improved regulatory and enforcement measures. Additionally, they alleviate many of the current issues arising from negative listing systems, such as lack of research and identifications of certain species, insufficient enforcement, and the inefficiently slow process of creating and enforcing legislation when a species is threatened through the trade's practices. In order for successful implementation of positive listing regulations, there needs to be clarity in the lists of permitted species, as well as credibility in the enforcement mechanisms.

With the exception of a few countries that have recently implemented positive listing regulation systems, wildlife trade regulations use negative listing, as is the case in the United States. Given the information and discussions provided in this paper, the U.S. Congress should implement federal positive listing regulations for the wildlife trade.

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