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Proposal for a practical framework to determine financial compensations for damage to nature

A discussion note prepared for the BIOVAL project of EUFJE, IMPEL and ENPE

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PROPOSAL FOR A PRACTICAL FRAMEWORK TO DETERMINE FINANCIAL COMPENSATIONS FOR DAMAGE TO NATURE

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Abstract

In this updated discussion note we construct a methodology for determining financial compensations for irreversible damage to nature, specifically for vertebrate species in Flanders. The methodology is meant to offer judges and prosecutors in criminal, civil or administrative court cases a tool to order financial compensation when nature cannot be restored. Currently such compensations are not being ordered because the judiciary does not have the time, knowledge or experience to value environmental damage.

To determine the compensations we have set up a transdisciplinary valuation process including experts from academia, prosecutors, judges, lawyers and enforcers. We built on the criteria and methodologies that are already being applied throughout Europe and integrate the plural values of nature to align with the most recent scientific insight on how to value nature.

Our methodology consists of an additive formula including four criteria that are evaluated for the species that has been irreversibly damaged: extinction risk, ecological significance, cultural significance and contribution to welfare. The outcome is scaled to an acceptable monetary amount through a fifth criterion, which is the size or lifespan of the species. The formula is weighted, giving the most importance to extinction risk, and compensations are increasing exponentially as species are assessed at higher levels for the criteria. This resulted in compensations ranging from €83 to €50.000. The list of compensations included in this discussion note were obtained through assessing the five criteria in a Delphi expert workshop. While a previous version of this discussion note lowered some amounts for species with temporal or local killing permits, the amounts now are strictly indicative and leave any circumstantial adaptations to the judge.

With this novel way of calculating compensations for irreversible damage to nature, the different values of nature are reflected, leading to a more balanced outcome. The formula is a scientifically grounded, socially acceptable and transparent way of calculating the compensation for the damage to species. However, it is not a calculation of *the* value of a species and should therefore never be applied outside of the intended use.

The future of the methodology and list of compensations depends on its uptake in courts. If proven useful, the list should be updated regularly to reflect changes in levels of the criteria for the different species but also to increase the robustness of the indicators through incorporating new scientific insights. While this exercise started with 100 species assessed for the context of Flanders, the methodology allows for flexible addition of species and translation to other regions.

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1 INTRODUCTION

This project proposes a practical framework to determine financial compensations for ecological and societal losses resulting from damage inflicted on vertebrate animals. We focus on the Flemish region with the possibility of upscaling the outcomes to Belgium and the European Union.

We draw upon the principles of environmental liability and the polluter pays, meaning that damage to the environment, including animal species, must be remediated by the ones liable for it. In Flanders this principle is also used in the Nature Decree of 21 October 1997 ("Decreet betreffende het natuurbehoud en het natuurlijk milieu"), stating in article 14, §1 that any damage to wild native fauna or flora or migratory wild animal species should be remediated by the natural or legal person that inflicted the damage. However, remediation is not defined in this decree.

We refer to the definitions of damage and remediation in Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (ELD):

Damage is defined in the ELD as *any measurable adverse change in a natural resource or measurable impairment of a natural resource service which may occur directly or indirectly*.

In the same Directive it can be understood that *Remedying of environmental damage, in relation to water or protected species or natural habitats, is achieved through the restoration of the environment to its baseline condition by way of primary, complementary and compensatory remediation, where:*

- *'Primary' remediation is any remedial measure which returns the damaged natural resources and/or impaired services to, or towards, baseline condition;*
- *'Complementary' remediation is any remedial measure taken in relation to natural resources and/or services to compensate for the fact that primary remediation does not result in fully restoring the damaged natural resources and/or services;*
- *'Compensatory' remediation is any action taken to compensate for interim losses of natural resources and/or services that occur from the date of damage occurring until primary remediation has achieved its full effect;*

BIOVAL is distinct from and additional to the ELD. BIOVAL concerns remediation, not prevention of environmental damage to protected species (and in a later stage possibly habitats). Whereas the ELD is binding EU legislation based on the powers of administrative authorities, BIOVAL will be a non-binding tool to be applied mainly by the judiciary.

BIOVAL will not apply in ELD cases, but in all other cases of environmental damage which do not fall under ELD either because the damage was not caused within the framework of economic activities, because the damage does not meet the thresholds to qualify as "damage to protected species and natural habitats"[1] or because the species and habitats concerned are not protected at EU level.

1 Art. 2, 1°, a) ELD defines "damage to protected species and natural habitats" as "any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. The significance of such effects is to be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I"

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BIOVAL intends to offer judges and prosecutors in criminal, civil or administrative court cases a tool to order financial compensation for damage to nature only when remediation to the baseline condition is not possible. Of course remediation *in natura* must remain the principle, but this is not always practically possible. It is e.g. not possible to breed and reintroduce a Marsh Harrier which has been poisoned, because the bird cannot be bred in captivity and released into the wild. In such a case, the court could order a financial compensation to be paid by the perpetrator (covering ecological, societal, but also interim losses) which could then be reinvested through a government owned nature fund in the conservation of this bird.

Many EU Member States already have legislation which allows such or similar orders for financial compensation e.g. Croatia, Finland, Hungary, Spain, Slovakia. In Flanders, the court can order remediation to the baseline condition of environmental damage (Flanders e.g. art. 16.6.6, §1 Decree containing general provisions on environmental policy of 5 April 1995[2]) **in addition to the punishment**. The court can do this *on its own initiative,* at the request of the Public Prosecutor, of the competent authority or of the civil party. In EU Member States where this possibility does not exist, similar legislation could be created. The proposal for a new Ecocrime Directive explicitly adds as additional sanction or measure, without prejudice to the requirements of the ELD, the obligation for the offender to "reinstate the environment, provided the damage is reversible or, the obligation to compensate for the damage if the damage is irreversible or if the perpetrator is not in a capacity to carry out such a reinstatement"[3].

Currently such compensations are not being ordered because the judiciary does not have the time, knowledge or experience to value environmental damage. As a consequence, in many smaller cases of environmental damage, it is never restored and nature keeps declining by a "death by thousands cuts". BIOVAL intends to offer the judiciary a criteria-based list of financial compensations for species to order financial compensation (on top of the punishment in criminal cases), only in cases where remediation *in natura* is not possible or feasible.

As such, BIOVAL is complementary to the ELD and will contribute to reaching the goals of the EU Biodiversity Strategy 2020-2030 of improving enforcement and restoring nature.

The BIOVAL tool requires that a monetary amount can be calculated that reflects the value that was lost by the damage. When doing so, one must keep in mind two things:

First, nature's value has multiple dimensions, namely the intrinsic, instrumental and relational dimension as defined by Díaz et al. (2015) in the IPBES Central Framework:

- The intrinsic value is the value inherent to nature, independent of human experience and evaluation and thus beyond the scope of anthropocentric values and valuation approaches.
- Instrumental values are closely associated with the notion of nature's benefits as far as they allow people to achieve a good quality of life, be it through spiritual enlightenment, aesthetic pleasure or the production or consumption of a commodity. They can be linked to economic values.
- Relational values are imbedded in desirable (sought after) relationships, including those between people and nature (as in 'living in harmony with nature') or biophilia,

[2] "Decreet 5 april 1995 houdende algemene bepalingen inzake milieubeleid" (DABM).
[3] Proposal for a Directive of the European Parliament and of the Council on the protection of the environment through criminal law and replacing Directive 2008/99/EC, provisionally agreed text 16 November 2023.

regardless of whether those relationships imply trade-offs to obtain nature's benefits, and therefore they depart from an economic valuation framework.

Nature's value can therefore not be monetized and any attempt to do so will inherently fail to reflect all the dimensions properly.

Second, setting an amount for the financial compensation of nature must never be interpreted as commodifying nature or putting a price on nature whereby it could be used as a "license to thrash". It is imperative that besides remediation in natura or financial compensation, in case of a crime, a punishment (imprisonment, fine, forfeiture) is imposed which is effective, proportionate and dissuasive (art. 5 Ecocrime Directive[4]). Only by making this punishment severe enough and by sound enforcement of the law, nature will be protected adequately.

4 Directive 2008/99/EC of the European Parliament and the Council of 19 November 2008 on the protection of the environment through criminal law.

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2 METHODS

The project was done in six main phases and one preparatory phase where definitions were streamlined to facilitate the interdisciplinary exchanges. In the first phase of the investigation the existing methods and criteria for determining a financial compensation of damage to nature were screened and categorised. Subsequently these criteria were evaluated in the second phase to arrive at a set of possible criteria. These were then tested in the third phase on three selected species. In the fourth phase this discussion note was presented at a first expert's workshop on 29 April 2022 in Brussels organised by EUFJE, at the MIKT 5 meeting on 7 June 2022[5] and at a second expert's workshop on 28 November 2022. Subsequently the discussion note was adapted and updated with the emerging insights. In the fifth phase the agreed upon methodology was implemented on a list of species through an expert workshop. The sixth and final phase entailed the enforceability check and adjustment of the list of compensations. In the following section, each of these phases will be further explained.

Phase 0: Streamlining the definitions
Prior to the start of the actual investigation, a set of definitions was agreed upon to make sure this interdisciplinary research had a consensus on the interpretation of certain important terms such as damage, value, compensation and remediation. The result of this exercise is the list of definitions which can be consulted in the glossary in annex 6.

Phase 1: Screening of methods and criteria for determining financial compensations for damage to nature
During the first phase the already gathered information from the Bioval project's red kite exercise and general literature was screened for possible criteria and methods. This was supplemented with a short literature scan focusing on both environmental damage in general and species specific damage. The gathered criteria were listed and subsequently organized and categorized into 7 overarching categories. The extended list can be consulted in annex 6.2

Phase 2: Evaluation and selection of criteria
For each of the listed criteria the type of value of nature it covers and a preliminary estimate of the data availability was determined. The result was presented and discussed with representatives of the contractor. Next, a subset of the criteria was selected that was judged to cover all necessary categories and values of nature as well as to be achievable in terms of data availability. The selected criteria were subsequently discussed with two in-house experts at the INBO to confirm their relevance and potential data availability in Flanders, Belgium and the EU.

Phase 3: Testing the criteria in a possible method
In the third phase the selected criteria were tested on three different species: the red kite (*Milvus milvus*), Eurasian water shrew (*Neomys fodiens*) and red fox (*Vulpes vulpes*). A possible methodology was developed to integrate the selected criteria into a formula which results in a monetary amount. The results of this exercise were discussed with the representatives of the contractor.

5 Joint Meeting of the Bern Convention Network of Special Focal Points on Eradication of Illegal Killing, Trapping and Trade in Wild Birds and the CMS Intergovernmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean on 7 June 2022.

Phase 4: Discussing the criteria and methodology

The selected criteria and methodology were presented during expert workshops organized by the contractor. The first workshop took place in April 2022 and was attended by 26 people representing experts from academia, prosecutors (members of ENPE), judges (members of EUFJE), the European Commission and members from IMPEL. The criteria and methodology were discussed and key points of improvement identified. This yielded an improved methodology which was presented and discussed during a 2nd expert's workshop on 28 November 2022 attended by 39 people from the same audience. After this workshop, the formula was once again refined.

Phase 5: Implementing the formula

After agreement on the formula, in June 2023, an expert workshop was organized according to the Delphi principle to apply the formula to a selection of 100 species. The species were selected based on their appearance in court cases, expected future relevance and to have a diversity in species characteristics.

Phase 6: Enforceability check

As a final check the compensation list yielded from the Delphi expert workshop was presented to members of the Flemish Nature Inspection, part of the Agency of Nature and Forest. The Nature Inspection is responsible for enforcing the law concerning nature and checking the enforceability of new legislation, which made them the best placed to do a final enforceability check for these compensations in court procedures. This resulted in a final adaption of the compensation list.

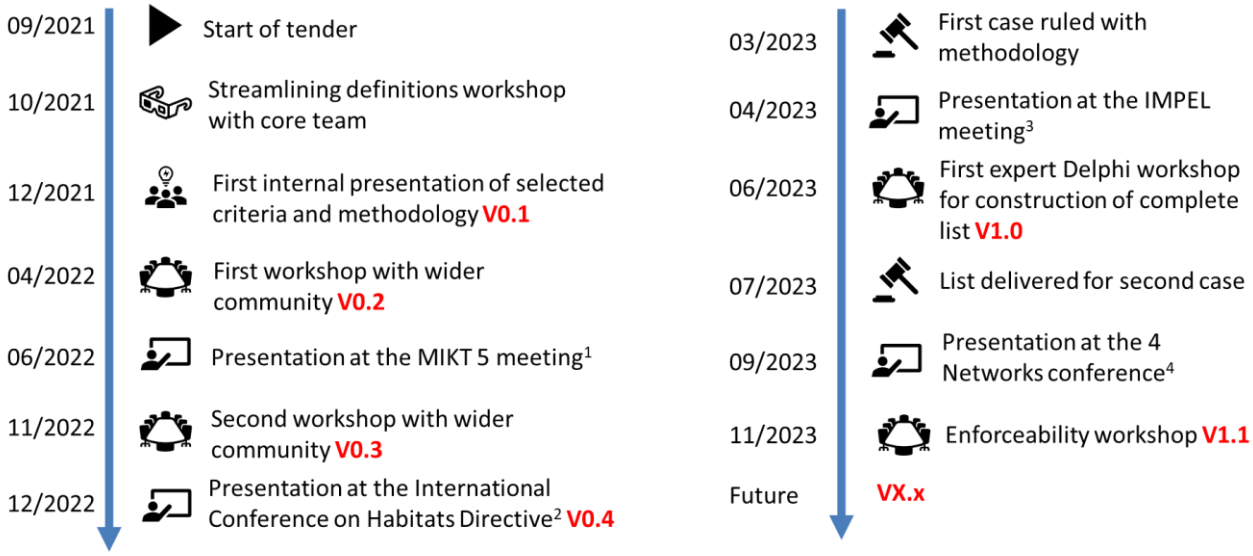

Figure 1: Timeline of the construction of the methodology and compensation list

1. https://www.cms.int/en/meeting/joint-meeting-bern-convention-sfps-and-cms-mikt-illegal-killing-taking-and-trade-wild-birds-
2. http://www.habitat-congress2022.brussels/
3. https://www.impel.eu/en/news/impel-nature-protection-expert-team-meeting-was-held-on-20-april-2023
4. https://www.envicrimenet.eu/the-4-networks-have-hailed-the-success-of-its-conference-held-between-the-28-29-september-in-rome/

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3 RESULTS AND DISCUSSION

3.1 RESULTS FROM THE BIOVAL SURVEY

An online survey conducted by EUFJE, ENPE and IMPEL in Spring 2020 and follow-up communication resulted in information on 23 of the 27 EU member states, with 10 having a list of monetary compensations per species or species group. Six of these countries also disclosed part of the criteria that were used to assign these compensation values but only one country (Finland) included the formula that was used.

Table 1: Overview of monetary compensation lists in use in the EU, source countries and criteria: BIOVAL survey, other data from own elaboration

Country	Year of establishment or last known update	Min value (€)	Max value (€)	Criteria	Formula
Countries with compensation lists and published methodology					
Finland	2002	17	9.755	Population size (P) Reproductive capacity (R) Extinction risk (S)	Compensation = (R x S / P)x €201,60
Countries with compensation lists with stated criteria					
Hungary	2001	13	2.605	Red List categories Likelihood of illegal killing, capture and/or trade Importance of Hungary to the species Population trend Relevance to actual conservation actions	
Latvia	2007	1.860	24.800	Level of danger Level of occurrence Level of significance	
Lithuania	2010	2.436	148.206	Protection status Rarity	
Slovakia	2013	20	3.000	Biological, ecological and cultural value that is determined taking into consideration their rareness, threat and performing of non-production functions.	

Spain - 15 regional lists	Variable	30	60.101	Extinction risk, Sensitivity to alteration of habitat Population size Market value Replacement cost Conservation status and protection status Species of special interest Scarcity Ecological function Subject to persecution or illegal trafficking	
Countries with compensation lists without stated criteria					
Bulgaria	2006	15	5.125		
Croatia	1996	66	13.276		
Estonia	2011	32	1.300		
Romania	2006	10	40.000		

3.2 ANALYSIS OF THE CRITERIA

In total we examined 6 different sources containing criteria for determining financial compensations for damage to nature:

1. Bioval survey: data available from the Bioval "Red kite" exercise and follow-up communications with respondents. The data contained **18** unique criteria that countries use or respondents would use to set the compensation amount.
2. Bern Convention: Convention on the conservation of European wildlife and natural habitats standing committee - Recommendation No. 177 (2015) of the Standing Committee, adopted on 4 December 2015, on the gravity factors and sentencing principles for the evaluation of offences against birds, and in particular the illegal killing, trapping and trade of wild birds. The recommendation contained **11** gravity factors that are recommended to take into account for the investigation, prosecution and conviction of offenders of wild bird crimes. It is important to note that these gravity factors concern punishment, not remediation.
3. ELD: Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage. This legislative document contains **3** criteria for determining the significance of any damage that has adverse effects on reaching or maintaining the favourable conservation status of habitats or species, namely the conservation status, the capacity for natural regeneration and the function for recreation.
4. Naves et al. (2020): C. Naves, D. de la Bodega, S. Cabezas-Díaz, N. López et al. Report on the economic valuation of protected animal species. LIFE Guardianes de la Naturaleza. SEO/BirdLife. Madrid, 2020. This scientific report was prepared for the purpose of establishing certain criteria and methods to enable an economic valuation to be made of protected wildlife species in Spain and other countries in the European Union. It proposes a methodology for the complete compensation cost using **4** criteria

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including MORA, The Environmental Liability Supply Model which is an environmental damage valuation tool providing replacement costs for all vertebrate species in Spain.

5. Finland Conservation act: Finland Nature conservation act, article 59 specifies that the Ministry of the Environment shall set standard monetary values for protected animals and plants. The Ministry used a methodology to calculate the complete remediation cost based on **3** criteria and one multiplier.
6. Perm Decree: Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region". This legislative document of the Russian Federation contains a methodology to calculate the compensation for damage caused by destruction or degradation of the habitat of animals and plants. This methodology uses **4** criteria.

The sources contained in total 43 criteria that partially overlapped, resulting in 30 unique criteria that could be categorised into 7 different categories as shown in the table below. In the next section these categories will be analysed for their strengths and weaknesses when used to calculate financial compensation for damage to nature.

Table 2: Categories of criteria for calculating compensations found in literature and practice

Category	Number of criteria	Number of unique criteria	Sources
Species rarity and conservation status	14	6	Bioval survey, Naves et al. 2020, Bern Convention, ELD, Perm Decree, Finland Conservation act
Conservation cost and effort	3	2	Bioval survey, Naves et al. 2020
Ecosystem functioning	8	6	Bioval Survey, Naves et al. 2020, Bern Convention, Perm Decree
Social value	4	4 (with high overlap)	Bioval survey, ELD
Market value	4	4	Bioval survey, Bern Convention
Scale	4	3	Bioval survey, Bern Convention, Perm Decree
Crime- related	6	5	Bioval survey, Bern Convention
Sum	43	30	

1. Species rarity and conservation status

Within this category two different but related aspects of a species population are captured. On the one hand, species have their natural distribution and abundance which is limited by their functional and habitat niche. This makes that some species are naturally more abundant than others, without this influencing the viability of the respective populations. This is for example the case for chaffinches and hawfinch, who are both non threatened species but because of their different natural distributions have different abundances. On the other hand there is the shrinking of a population because of external pressure which can drive a population into extinction, this can be a natural phenomenon but is shown to be often human-induced in recent decades. Where the first aspect can be called species rarity, the second can be called the risk of extinction. Other aspects included in this category are the regenerative capacity of a population and the legal protection status of a species. The criteria are mainly covering the intrinsic value of nature since the rarity of a species does not necessarily reflect its importance

in the stability of the ecosystem or the amount of services that are generated by the ecosystem for society. Nonetheless, for keystone species[6] these criteria would also cover relational and instrumental values since their survival is imperative for the functioning of the ecosystem which underpins human economies.

Strengths:

- Both from a moral and an ecological point of view it is intuitive that damaging a species of which only a few individuals exist will result in a higher loss than damaging a species that is very common.
- From an ecological point of view it is clear that damaging a species that has difficulties to reproduce is a higher threat to the population of the species than damaging a species that has no difficulties reproducing.
- From a legal point of view it is clear that damaging a species with a higher degree of protection is a worse crime than damaging a species that is not or less protected.
- There already exist aggregated indicators for this category that are reported both on a regional/national and European level, namely the Red List of Threatened Species and the Conservation Status of the Habitat and Birds Directive which are indicating the risk of extinction of the animals.

Weaknesses:

- All the criteria in this category are interlinked. To illustrate this: the risk of extinction, as defined by IUCN and used to set the Red List status, is based on population size and geographic range as well as changes thereof (IUCN, 2012). This relates closely to the conservation status of a species under the Habitat or Birds Directive, another measure for the risk of extinction, which is based on the current status and trend of the range, population and habitat of the species and its future prospects. Therefore, species rarity is explicitly taken into account for the risk of extinction. The same goes for the regenerative capacity of a species.
- The data on population size and trends is not available for all species and are for some species only gathered once every ten years. This is also prone to a sample selection bias.
- The population size is partly based on expert judgement as well as the assessment of the connectedness of a population to other nearby populations. Based on this judgement the outcome can differ substantially.
- Regional scarcity of a species can differ substantially between regions. Moreover, a completely different picture can emerge when looking at the global population. For example the Red Kite is very scarce in Flanders (1-6 breeding pairs) while the neighbouring population in the UK spectacularly recovered and the species is listed as “Green” on their Red List. Nonetheless because of a decline in the overall population, the species was listed as nearly threatened on a European scale.
- The legal protection of a species is apart from risk of extinction also based on other aspects like the species’ taxon and popularity (Mammides, 2019; Mammola et al., 2020).

6 Keystone species are species that play a crucial role in the functioning of an ecosystem.

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Recommendation:

Since all the criteria are interlinked, it is not advisable to use more than one of the criteria from this category in a formula as it would lead to double counting. Aggregated indicators are readily available in the Conservation status and the IUCN Red List, these provide an opportunity for indicating the risk of extinction of a species in an already accepted and institutionalised format. For the species of the Habitat and Birds directive the conservation status are available. For other species the regional Red List indicator can be used. If this is not available the European Red List can be used, taking into account that for regional populations there might be a large overestimation of the population size. If the species is on none of these lists, a local expert should be consulted. In Flanders this could be for example the Research Institute for Nature and Forest (INBO) or Natuurpunt.

2. Conservation cost and effort

These criteria include the funds that are invested in the conservation of the species as well as the costs for restoration of the damage to species. Even though the act of spending funds on the protection of species itself can be regarded as reflecting the intrinsic value of nature, using this as a criterion for compensation can be interpreted as mainly instrumental in the way it seeks to optimize the return of investment of nature conservation.

Strengths:

- The restoration cost is equivalent to remediation *in natura*. Therefore this should, from a legal point of view, in any case be incorporated in the calculation of the compensation. However, this is not relevant for our study as the BIOVAL-tool will only apply to the cases where remediation *in natura* cannot be achieved.
- The funds invested in the conservation are a reflection of the importance of that species to society.
- It is from a moral and practical point of view worse to damage a species for which a large amount of effort and thus means is put into its conservation than damaging a species for which little effort and means are spent to conservate.

Weaknesses:

- Restoration is not always possible. This can be the case when it concerns the last individuals of a species or when the species cannot be reproduced in captivity within a reasonable amount of time or with a reasonable amount of resources.
- The funds invested in a species are not necessarily correlated with the importance of said species in an ecosystem but rather are an aggregate of how threatened, iconic and ecologically significant the species is. Funds used for the protection of the species are for most species also difficult to untangle from funds for other species. Often funds go to the protection and restoration of umbrella species, which have large area requirements and thus share their habitat with a large amount of other species that benefit from the umbrella species' protection. The funds are allocated this way out of efficiency, rather than not valuing the species that will be 'secondary beneficiaries'.

Recommendation:

This category of indicators was deemed unfeasible to reflect the value of species for the calculator of monetary compensation. The funds invested in restoration or conservation are an imperfect measure, conflating different values and target species. Remediation to the baseline condition should always be demanded. When remediation to the baseline condition is not possible, criteria of this category are unsuitable to demonstrate the value of nature as the restoration cost is not a reflection of the value of a species.

3. Ecosystem functioning

This category includes criteria on the characteristics of the individual specimen that was damaged (age, sex, role in the population) as well as on the overall role the species has in the ecosystem. These criteria cover the intrinsic value of nature but could cover the relational and instrumental values of nature as well, when implied that those species that help the ecosystem function in a way that suits society more, have a higher value.

Strengths:

- As the aim is to calculate the compensation for damage to nature, it seems imperative to incorporate an indicator on the importance of the specimen or species within the population or ecosystem.
- Nature conservation can be done more efficiently if those species that are highly relevant for the functioning of the ecosystem are valued more.

Weaknesses:

- Apart for some keystone species, the role of an organism in the ecosystem is generally not well known.
- It can be argued that every species has its role and is therefore important. In general, it is the diversity of species that is linked to the performance of an ecosystem, and not just one species.
- The role one individual plays within an ecosystem is, in most cases, negligible. Only damaging larger parts of the population would significantly alter the functioning of the ecosystem.
- Depending on what ecosystem (functions) are expected from an area, the ecological importance of an animal can be different. For example the reintroduction of a wolf can be seen as highly beneficial from the point of view of nature conservation, but not as much from the point of view of recreation, living or livestock grazing.

Recommendation:

There should be an acknowledgement that some species can be replaced or disappear without compromising the ecosystem while others cannot. Therefore, it is advisable to incorporate a criterion on being a keystone species[7] or not and to regard the functional specialization. It should be noted that this is not always generally known and a local expert could be necessary to assess the case. As this is an important topic of research, this knowledge gap might decrease in the coming years.

[7] Other types of important species are also recognized such as dominant species, structural species, ecosystem engineers and foundation species (Ellison and Degrassi, 2017)

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4. Social value

This category includes criteria on the significance a species has within a culture or for recreation. It is directed towards the relational value of nature.

Strengths:

- It is important to acknowledge that nature means more to people and cultures than just the sum of chemical, physical and biological interactions that result in services for society (Pascual et al., 2023). This value should also be reflected in the compensation.
- Protecting emblematic species often has positive spill-over effects on the conservation of other species because they mostly are umbrella species.

Weaknesses:

- These are subjective criteria as a species or even a specimen can have a high importance for someone while it is seen as a nuisance by others. This also means that it can be very case specific.

Recommendation:

As the societal loss is also a loss in value, it is recommended to adjust the compensation for this. The compensation for this social loss can also be non-monetary. One could argue that when talking about caring for nature, compensation would be to transfer this attitude of caring for nature. In this sense, the offender could be mandated to follow nature education classes, to understand the value of nature and ultimately value nature too. But since this would be part of the punishment, this non-financial compensation falls out of the scope of BIOVAL.

5. Market value

Within the category of market value are criteria that reflect the amount of money one could get for killing and/or selling (parts of) an individual of a species, whether this is illegal or not. This covers relational values and instrumental values.

Strengths:

- The market value can be used to capture a part of the Total Economic Value of a species, which reflects some ecosystem services that are generated by the species.
- The market value, or more broadly, the economic gains one could have from harming a specimen will be an important driver for the illegal act. This means that a higher market value should be countered by more severe ruling (financial compensation and punishment together).

Weaknesses:

- The market value is already an aggregate of different values that are impossible to disentangle.
- The economic loss a natural or legal person would suffer from the illegal act of damaging a species, is not within the scope of this project. The victim should in that case claim damages.

Recommendation:

In our study the animal is assumed to belong to no one. Therefore the market value cannot be claimed by a victim. Indeed it does reflect to a certain extent a monetary value that societies attribute to a species but the way this is formed is unclear and impossible to untangle. Therefore we suggest not to use market value as a criterion as it would inherently be confounded with possible other criteria. The total amount that the offender should pay (i.e. the financial compensation plus the punishment), should however be much higher than the market value of the said specimen for the protection to be effective. Moreover, this needs to be adjusted taking into account the chance of actually being caught and sentenced for the crime.

6. Scale

Within this category there are criteria on the number of individuals that were damaged, the area affected and the duration of the effects. They do not cover any specific value of nature but are important indicators for the amount of damage that has been done and should be compensated.

Strengths:

- Can be quantified.
- It is intuitive that the larger the number of individuals affected, the larger the compensation has to be.
- Populations have a minimal viable population, if this threshold is crossed, the whole population collapses, meaning that by damaging only a few individuals, one could be guilty of damaging the whole population. This has to be taken into account in the compensation.

Weaknesses:

- The relationship between the population size and the functioning of an ecosystem is often not known.
- The threshold after which a population becomes unviable is often not known.

Recommendation:

These criteria can either be used as multipliers or as thresholds. Populations with a low number of individuals will be proportionally more affected by the loss of individuals. This can be used proportionally together with the first category. The effects of the scale, size and duration has to be evaluated by a local expert.

7. Crime-related criteria

This category contains a variety of criteria that indicate a person's malintent, recidivism and means of committing the offence.

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Recommendation:

We argue that these should not be taken into account for assessing remediation. These are related to the person of the offender and are to be taken into account for determining the punishment (fine, imprisonment, forfeiture, other).

General observations on the criteria

Most criteria are not easy to quantify. Only the red list and conservation status of species are readily available but even they are scale dependent, partly based on expert judgement and often not available on a regional scale and only updated every 6 or more years.

Ecosystem functioning and social value seem to be important categories to take into account when calculating the compensation. However, they are often case specific and therefore hard to generalize. Moreover, they are not readily quantifiable.

Nature underpins our economies and welfare. Damage to species that are more important for supporting human economies and welfare will result in a higher loss of value and should therefore be compensated with a higher financial compensation. This is however, surprisingly, absent from the criteria found in the quick literature scan.

3.3 ANALYSIS OF THE METHODS

In total 2 methods or formulas could be found in literature to assess the amount of compensation that has to be paid for damage to an individual of an animal species and one general formula for damage to the environment, including protected species and habitats. These will shortly be illustrated and discussed in the following section after which some recommendations will be given on implementing a new methodology.

Finland Nature Conservation act

The Finnish method was extensively discussed within the BIOVAL project. It is the only known methodology for calculating the compensation to be paid for an individual that is put into practice in Europe. The formula is as follows:

$$Y = (R * C / P) * 200 \text{ euros}$$

Where

- R = **reproductive capacity** (estimate simplified by using the mean weight (g) (log10) of species)
- C = **conservation status** (Red list category)
- P = **population size**
- **Multiplier** (200 euro) based on the real costs of conservation of white-tailed sea eagle (7.400 euro / adult individual in 1994)

Strengths:

- It is a fairly simple equation which can easily be calculated for the most important species.
- This method can be applied in every region or member state with a Red List and standard wildlife monitoring schemes.

Weaknesses:

- There is a high correlation between the conservation status, the population size and the reproductive capacity of a species.
- The method to calculate the reproductive capacity is only partly accurate and fails to take into account local conditions. A species might have a very high reproductive capacity in suitable conditions but a very low in practice because of a degraded habitat or a small population size.
- The multiplier is outdated and randomly chosen. It cannot be transferred to another region or country where the white-tailed sea eagle is not present.
- This formula only takes into account criteria from the category "Species rarity and conservation status". Thereby it misses certain important aspects of ecological damage and the social value of nature.

The methodology of Naves et al.

This formula was proposed by SEO/BirdLife in a report that was prepared within the LIFE Guardians of Nature project. This method has not yet been put into practice as to the best of our knowledge but is expected to be implemented mainly in Spain and Portugal within the coming years. The formula is as follows:

$$\beta \text{ (Valuation of the specimen)} = (C \times L \times E \times B) + M$$

Where

- C = The **baseline cost**, linked to the detection of damage to wild fauna: € 300
- L = The weighting coefficient for the damage to the fauna in accordance with the **legal situation of the species** (based on the NHBA in Spain or on the national classifications of other EU Member States, supplemented, nuanced or replaced, depending on the circumstances in each State, by the IUCN categories), which is applied to the baseline cost:
    - Critical situation: 70 times the baseline cost (e.g. €300 x 70).
    - In danger of extinction: 60 times the baseline cost.
    - Vulnerable situation: 40 times the baseline cost.
    - Near threatened: 20 times the baseline cost.
    - Least concern: 6.5 times the baseline cost.
    - Deficient data: 5 times the baseline cost.
- E = Weighting for **endemism**[8]:
    - x 1 no endemism
    - x 2 endemism
- B = Weighting for **biological determinants** of the species:
    - x 1.1 for immature specimens or eggs
    - x 1.5 for mature specimens
- M = Inclusion of the **cost of remediation** of the damage done to the specimen, in which case the order of magnitude established by MORA shall be used as reference. MORA is an environmental damage valuation tool that provides the costs of primary, compensatory and complementary remediation. It was designed to calculate the compensation that would be needed for a project before the damage was done. For species it uses a replacement cost technique.
- Maximum weighting for **other determinants** (where applicable): M x 2.

8 Endemism is the state of a species being native to a single defined geographic location. Therefore, if the species dies out in that location, it goes extinct in the wild.

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Strengths:

- The equation covers multiple important aspects of ecological damage (endemism, maturity) and legal aspects (baseline cost, protection status).
- The equation requires little expert knowledge once all data is available and is transferable to other regions.

Weaknesses:

- The formula is meant to calculate the value of a species but it is mixing the restoration cost (MORA, replacement cost) with indicators for the value of nature (endemism, biological determinants, legal situation) and crime-related criteria (baseline cost, other determinants). These are three very different things and we argue that only the indicators for the value of nature should be regarded, while the crime-related aspects should be reflected in the fine.
- The formula combines primary remediation (primary remediation based on MORA which is a replacement cost calculation) with other criteria to calculate the value of the species. In that sense the multiplicative part of the equation can be interpreted as the compensatory and complementary remediation. However, it is unclear if this is indeed the reasoning behind the formula and if so, the explanation is lacking why these criteria were chosen.
- The amounts coming out of the formula are very high. For example, killing one Red Kite would amount to €32.370,09. While this is indeed disincentivizing and would undoubtedly be supported by many environmentalists, it should be evaluated whether this is socially acceptable and therefore enforceable.
- The weighting coefficients for the legal status have a weak basis. The coefficients are based on the average rate of reduction in the observed population for a certain IUCN Red List category. For a species in a critical situation this rate of reduction is 70% or more over 10 years. However, when killing one animal there will not be a 70% extra reduction in the population, rather 1/30 = 3,33% extra reduction (population dynamics not taken into account).
- The other weighting coefficients are randomly chosen.
- The formula requires extensive resources to transfer to another region where other animal rescue centres and experts should be surveyed for new species.
- The formula only uses criteria from the categories “Species rarity and conservation status” and “conservation effort”. Thereby it misses certain important aspects of ecological damage and the social value of nature.

<u>The Russian methodology</u>

The Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region" contains both a methodology to calculate compensation for environmental damage, as well as a price list for damage to species. It is apparently retracted but no information could be found on replacing legislation. The formula for the environmental damage is as follows:

$$Y = C_i \times S \times D \times \text{minimum wage} \times K$$

Where

- Y is the **amount of compensation** for damage caused by destruction or degradation (damage) of the habitat of animals and plants (in Rubles)
- C_i - the **cost of an area unit** (1 hectare, 1 sq. M) of the initial habitat of flora and fauna before the start of economic impact (in units of multiples of the minimum wage) is established by habitat category in accordance with Appendix 1 to the Methodology

- S - the **area** of the habitat site subjected to anthropogenic (economic) impact (in hectares or square meters)
- D - coefficient of the **degree of anthropogenic degradation** (damage) of the original habitat
- **Minimum wage** - the statutory minimum wage as of the date of drawing up a protocol on violation of environmental legislation
- K is the coefficient of the **ecological significance** of the territory

In addition to this amount, a tax-based amount has to be paid for the damage to individual species listed in the Red Data Book of the Perm Region. The amount is calculated as follows:

$$Y = \text{Minimum wage} \times f(\text{Species group, rarity})$$

Meaning that the minimum wage is multiplied by a coefficient that is determined by both the **species group** and the **rarity of the species** within the species group. How the coefficient was calculated is unfortunately unknown.

Strengths:

- The ecological significance is taken into account, however, how this is calculated is not known.
- It takes into account the scale of the offense (area and severity of the degradation).
- By taking the minimal wage as a baseline, the formula is indexed automatically, overcoming the need for temporal revisions.

Weaknesses:

- The restoration cost is included (C_i) which seems to indicate that the rest of the formula are the compensatory and complementary remediation but this is not specified.
- Both the species as the environmental compensation include the minimum wage as a reference point, this is not less random than any other fixed amount.
- The methodology to account for the value of a species is not disclosed.
- By compensating for both the habitat destruction and the species destruction you are partially double counting.
- The social value of species or habitat is not accounted for.

General comments on the used methodologies

- None of the methodologies is exhaustive.
- All the methodologies suffer from non- or pseudoscientific coefficients or baseline costs. Even though this is inevitable as real scientific indicators are lacking, disclosure of how the amounts were set remains necessary.
- None of the methodologies consider the social value of nature nor use any real assessment of the ecological importance of a species for the functioning of the ecosystem or the importance of a species for human welfare.
- All the methodologies use *multiplications* which make it necessary to use a baseline cost. Moreover, it impedes using incomparable criteria like for example the ecological significance and the social value, since it confounds them. Namely if one of these criteria is estimated as very low, the other criterion has to be very high to compensate for this and when one criterion is zero, the outcome is zero, irrespective of the other criteria.

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3.4 RECOMMENDATIONS ON USING THE CRITERIA AND DEVELOPING A METHODOLOGY

Based on the strengths and weaknesses of both the abovementioned criteria and methodologies we have the following recommendations:

1. Use one criterion per category to avoid double counting as in the Finnish method.
2. Use criteria from the categories "Species rarity and conservation status", "Ecosystem functioning" and "Social value" to cover all values of nature (as opposed to the Finnish method) and acknowledge that a financial compensation for damage to nature should take into account the ecological functioning of the ecosystem and the importance for human welfare (as opposed to all the current methodologies).
3. Keep the crime-related criteria out of the compensation but address them in the punishment.
4. Do not include restoration costs if it is for damage that cannot feasibly be remediated and make a clear distinction between which part of the formula reflects the primary remediation and which part of the formula reflects other types of compensation.
5. Use the market value as a minimal value the punishment (fine and forfeiture) plus the compensation should amount up to.
6. The scale should be adapted to the local context. This can mean that the compensation to be paid is not just multiplied by the number of individuals damaged, but is scaled up to the whole population if the damage has made it unviable.
7. Use of *addition* rather than multiplication of criteria to avoid having to set a baseline cost and to make the formula modular.

3.5 SELECTING CRITERIA TO CALCULATE THE COMPENSATION FOR KILLING ONE INDIVIDUAL OF A SPECIES

The building blocks of the formula are the criteria that were selected based on our own recommendations derived from the literature review, the multiple values of nature that should be covered by the compensation and expert discussions. The selected criteria are presented below.

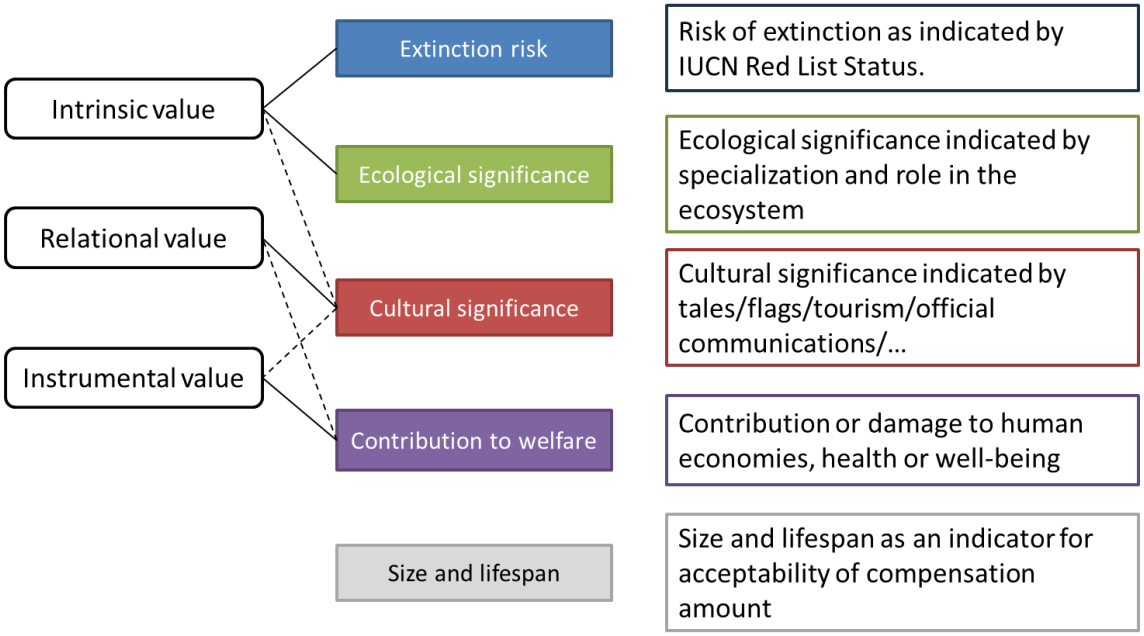

Figure 2: Selected criteria and their respective values of nature covered, used to calculate the compensation for the BIOVAL methodology

All of the criteria except for cultural significance are evaluated on the species level without distinguishing the characteristics of the individual(s) in question. Each of these criteria will be subdivided in discrete levels which will reflect the extent to which a species or individual of a species can be regarded to fulfil the criteria. All the criteria will be discussed in more detail in this section.

Building block 1: Extinction risk

This criterion was chosen to reflect the extent to which the species in question is at risk of extinction and therefore, to which extent the harming of a specimen of the species is contributing to this process. This is important from an ecological perspective and is reflecting the intrinsic value of the species. One could also argue from an economic perspective that the marginal value of each specimen increases with the species being more in threat of extinction. Both more rare species (Angulo & Courchamp, 2009; Booth et al., 2011) and more endangered species (Eagle & Betters, 1998; Richardson & Loomis, 2009; Subroy et al., 2019) have been shown to be valued more by people, this justifies the increasing compensation amount for more endangered species.

In choosing the right indicator for the risk of extinction for a species in our formula, two possibilities exist in Europe: the IUCN Red List and the Conservation status as defined by the Habitat or Birds Directive. Even though both aim to capture the risk of extinction, the outcomes of the two lists differs (Moser et al., 2016), as do their respective advantages. The IUCN Red List has the advantage of continual updates, streamlined statuses for all animals, high number of animals evaluated, and a geographical extent going from local over European to Global. Whereas the Conservation status has the advantage of being embedded in the EU legislation, having a regular update schedule of 6 years, and including all protected species. The scale and way of reporting the conservation status however differs between species groups. For species from the Habitat directive there exist four different types of conservation statuses derived from this reporting in Flanders:

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1) European level conservation status, divided by bio-region
2) National level conservation status, divided by bio-region (Belgium Atlantic/Continental)
3) Regional conservation status (Flanders)
4) Local conservation status of the population in designated protection areas

The last two are the most representative when taking into account damage to a species since this damage will affect the local population. The local and regional level statuses are aggregated by bio-region per country for the national and European reporting. For the species of the Birds Directive only a conservation status is derived for the Flemish level. There are no conservation statuses derived on a national or European level, only the population size and trends are reported. For the conservation status they refer to the IUCN European Red List. In light of the uniformity of the Red List, we chose to use this as a criterion for our methodology. The most local status should be used, as damage to a population will be also local. If not locally available, the regional or, if also not available, the global status should be used.

Some species might not be protected under the Birds or Habitat Directive, nor on any local red list but still be protected under CITES. These species are generally evaluated on the global IUCN Red List as the decision making on the CITES appendix is being informed by IUCN[9].

The IUCN Red List has 7 possible statuses for evaluated species for which there is adequate data. This can be reduced to 5 levels when we assume that species that were locally Extinct or Extinct in the wild but reappear, will be automatically Critically Endangered:

1. Least concern (LC)
2. Near Threatened (NT)
3. Vulnerable (VU)
4. Endangered (EN)
5. Critically Endangered, Extinct and Extinct in the Wild (CR)

Least Concern is equal to the baseline compensation for extinction risk while Critically Endangered is the most severe status and will require the full compensation. This means there are four levels that add an extra compensation for the extinction risk in the formula.

[9] https://www.iucn.org/theme/species/our-work/sustainable-use-and-trade/iucntraffic-analyses-cites-proposals

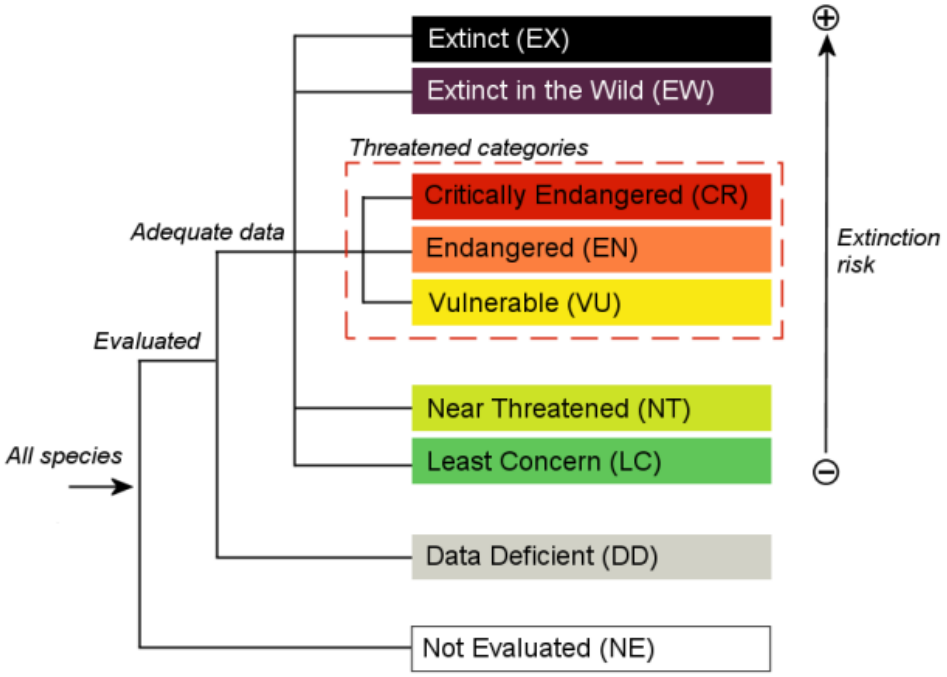

Figure 3: Classification of species according to the IUCN Red List (Source: IUCN)

Building block 2: Cultural significance

This criterion was selected to indicate the value a species has for the local culture. This reflects the relational value of a species. It has always been true that nature means more to people and cultures than just the sum of chemical, physical and biological interactions that result in services for society (Pascual et al., 2023). It is part and parcel of humans and their cultures (Chan et al., 2016), even though it is difficult, if not impossible to quantify and compare to other values and therefore often omitted in decision making (Gregory et al., 2023). For the cultural significance we choose to look at the immaterial contributions and non-extractive practices as the material contributions and extractive use of species will be addressed in the criterion "contribution to welfare".

Even though it is acknowledged that not all animals have the same cultural value, no classification of animals according to their cultural value exists, as to the knowledge of the authors. There is only the distinction of cultural keystone species that have a significantly higher value (Cristancho & Vining, 2004; Garibaldi & Turner, 2004), however, these notions include the consumptive aspects of animals, which we do not regard within this criterion. Therefore the choice was made to regard all species as having a cultural value for their mere presence in our lives, which would be through the channel of "interaction" and "living within" as used by Methorst et al. (2020), and some having a high cultural value. To translate this concept into a verifiable criterion, five different indicators of this higher cultural value were identified:

1. It is present in tales, folklore or literature of cultural importance
2. It is present in flags, emblems or names of local organizations
3. It has a dedicated species protection plan or other policy documents especially addressing it based on a cultural argumentation.

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4. It is explicitly mentioned in communications by (non)governmental organizations or the recreation/tourist sector.
5. It attracts spectators locally and/or from further away

Indicator 1 and 2 correspond to indicators of being a keystone species according to (Garibaldi & Turner, 2004): "role in narratives, ceremonies, or symbolism" and "persistence and memory of use in relationship to cultural change", as do indicator 3, 4 and 5: "level of unique position in culture". When going outside of the Belgian context, we could also add being worshipped by the local society or having dedicated rituals for it.

It is important to note that this very simplified interpretation of cultural value (either a cultural value or a high cultural value) is disregarding negative connotations of certain species or a general lack of cultural value that could be argued for some unknown species. However, in the light of the use of this formula, it is very probable that any species for which a court case is made, will have a cultural value as a person or the state deemed the animal important enough to defend in court.

Also note that this criterion can be specific for the specimen in question or for the whole species. To clarify this, imagine a specific specimen of the species that has a distinct look, behaviour or other characteristic that makes it special, attracting more interest than the average specimen of the species, as for example is the case for the white Bengalese Tiger. This adds a level of cultural value for that specimen even though another specimen, less noteworthy, of the same species would not require this additional level of compensation.

Building block 3: Ecological significance

This indicator reflects the importance of a species for the good state of the ecosystem. Damaging this species could therefore lead to deterioration of the said ecosystem. The ecological significance reflects the intrinsic value of the species as its value for the ecosystem is independent from human judgement.

Different species perform different functions in the ecosystem and therefore can all be regarded as being important. However, some types of species are regarded to have a disproportionate effect on the ecosystem, the most well-known types being keystone species and ecosystem engineers, but also foundation, structural, dominant and core species exist (Ellison & Degrassi, 2017). However, some species perform the same function in an ecosystem, meaning that the loss of one of those species could go unnoticed, whilst the loss of other species would mean the loss of the ecosystem as a whole (Hooper et al., 2005). In the context of compensation for damage to species, the loss of species whose function cannot be replaced, will result in a higher damage to the ecosystem (Loiseau et al., 2020) and thus should be compensated more. Two different approaches could be taken. The first builds on concept of guild as "a group of species that exploit the same class of environmental resources in a similar way" (Root, 1967). If a species is the only one in its guild within a particular ecosystem, it is clear that it is more important than if it were one of many in its guild. However, relying on this classification would require the ability to assign each animal to a guild, which has not been done for Belgium. Another possibility is through assessing the specialization of species. This includes habitat (foraging and nesting) and functional specialization. Morelli et al. (2019) designed a specialization metric for birds which provides a great starting point, however, the same endeavour has not been undertaken for other species.

Combining the three concepts (keystone species, number of species in the same guild, and specialization) we designed a classification for ecological significance with three levels:

1. Species whose functions in the ecosystem are easily substituted by other species (these species are often generalists or have multiple species in their guild)
2. Species whose functions in the ecosystem are harder to substitute by other animals (these species are often specialists or are the only species in their guild)
3. Keystone species of the ecosystem

Apart from the species-specific ecological significance, criteria were also reported for individual importance, both within the survey as in currently used criteria. A female would for example require more compensation and a juvenile would require more or less (conflicting argumentations are used) as the former has the role of breeder and the latter has a higher potential of procreation or, on the other hand, has a chance to die before coming to a reproductive age. Even though we acknowledge the impact of individuals on the ecology of an ecosystem (Allgeier et al., 2020) the choice was made within our methodology to disregard this for the practical reason that in that case each individual victim within the court case would have to be investigated which is a costly and time consuming activity, increasing the cost of conviction.

Species that are subject to illegal trade and thus confiscated outside their natural range, should be assessed according to their ecological significance at the place where they were illegally caught. It is in that case also advisable that the financial compensation, at least partially, goes to a nature fund which favours the ecosystem in question.

Building block 4: Contribution to welfare

This criterion reflects the degree to which a species is directly or indirectly contributing to human economies and welfare. This is mainly an instrumental value. Species contribute to human welfare through a number of processes: their presence can contribute to mental wellbeing, tourism for the species generates income, they can protect valuable natural assets like forestry plantations or crops, they can provide nature-based solutions which would otherwise demand costly technical solutions or they can also produce tradeable goods which generate wealth. Nonetheless, there are also a number of species that can pose a threat for human welfare such as poisonous animals and animals that do extensive damage to natural assets such as agricultural land or forestry plantations.

The specific contribution of one species, let alone one individual of a species, to human welfare is notoriously hard to calculate due to the complexity of ecological systems and the multifaceted way in which species contribute to welfare (IPBES, 2022). Moreover, apart from contributions of wildlife to welfare, negative impacts are also often reported, more so for mammals and reptiles which can negatively affect human health or damage agricultural crops (Methorst et al., 2020). While methodologies exist to calculate the total economic value of a species (see for example Richards & Loomis (2009)) in practice they are costly, time consuming and still prone to double-counting and omitting contributions or negative effects, necessitating an intensive and participatory approach (Gomez et al., 2022). Therefore, we propose a simplified indication of contribution to welfare (d_{CW}) with three levels:

0. This species has a negative contribution to human through direct damage to people, damage to infrastructure or costs for the economy
1. This species has a positive contribution to human welfare either directly through producing goods and services that can be quantified and traded, or indirectly through supporting the ecosystems on which our welfare depends

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2. This species has a high contribution to human welfare because it enhances the delivery of certain ecosystem services that are especially important for human welfare

Some species can be responsible for extensive damage to welfare. Most species, as is the case for ecological significance, have however a contribution to human welfare through indirect processes such as supporting the normal functioning of the ecosystems from which we derive our welfare. Species that are highly contributing to human welfare can also be identified such as beavers which help restore water cycles or squirrels who are crucial to rejuvenation of oak forests but also some iconic species that attract a high number of tourists which fuel the local economy.

We argue that a species that has a negative contribution to human welfare should not be compensated on this specific criterium. Species that belong to the first and second level, do require adequate compensation for their contribution to human welfare.

Building block 5: Size and Lifespan

This building block was introduced later on in the development process as a way to scale the formula (see next section). The criterion was chosen to acknowledge the fact that the loss of individuals within a small population is more damaging, regardless of the conservation status.

The criterion chosen to reflect the population size, regardless of its conservation status is the size and lifespan of the species. Larger and long-living species have on average larger area requirements and therefore a smaller and less dense population, regardless of the external pressures. This approach minimizes the overlap with the risk of extinction criterion. No uniform classification exists for all species. For example Devos et al. (2016) make the arbitrary distinction between short-living and long-living birds in Flanders at 3 years. We chose to categorize the size and longevity of species into three categories:

- Small or short-living species
- Medium-sized or medium long-living species
- Large or long-living species

Where the size and longevity are compared to other animals within their realm and original geographic location (a chaffinch caught in Flanders with all birds in Flanders, a mammal caught in Spain and discovered in Flanders with mammals in Spain etc.).

3.6 FROM CRITERIA TO A FORMULA

The overall goal of this study was to create a formula for the financial compensation for the damage to a species, based on a selection of scientifically sound criteria, which would result in an acceptable amount. In the previous section the criteria were selected, in this section the formula will be constructed.

As a first step, the choice was made to have an **additive formula** that is scaled based on stakeholder preferences rather than a multiplicative formula. This has two reasons. First, the different criteria are independent of each other, meaning that if one criterion is very low, this does not disproportionately affect the total compensation. Second, the different criteria can be assigned different weights to reflect their importance.

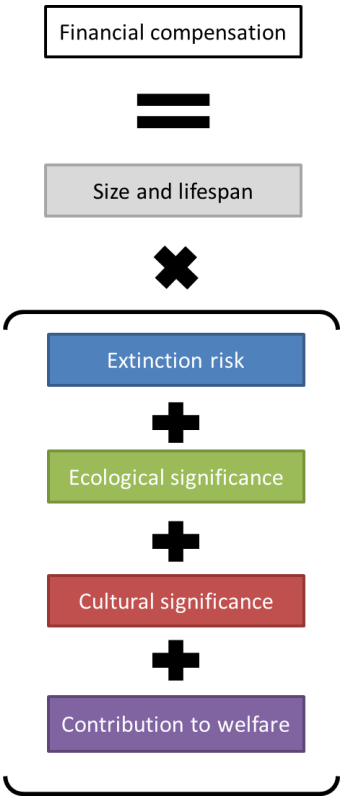

Figure 4: Visual representation of the formula for calculating the financial compensation

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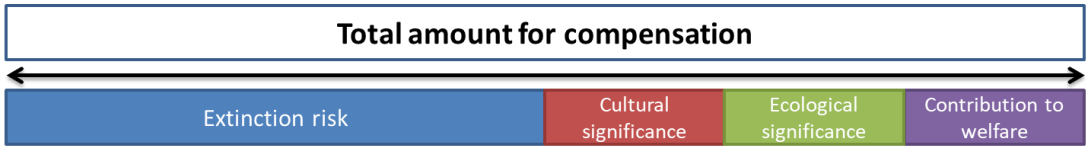
The second step was **assigning different weights to the criteria**. Which weights to assign to the different criteria is nonetheless a difficult exercise. While all values of nature are acknowledged, some were deemed more important than others during the workshops. The intrinsic value clearly gets more weight in the formula. It is both represented by the risk of extinction and the ecological significance of the species. The risk of extinction was even awarded triple the weight of the other criteria, making up half of the possible compensation. This bias was already apparent from the analysis of currently used and proposed criteria and is also reflected by the general understanding that legal protection of nature is predominantly based on the intrinsic value of nature (predominantly discourses on rights of nature) or the instrumental value (predominantly environmental legislation regarding resource use and distribution) (IPBES, 2022a). Another reason this was identified as the most important criterion was its perceived objectivity. Cultural significance was seen as a difficult concept to make tangible or translate into clear indicators, which seems to resonate with broader discussions on compensation for environmental destruction (Gregory et al., 2023). Ecological significance and contribution to welfare, as they are also scored through expert opinion, were also perceived to be less objective, or in any case easier to contest in court. The fact that the IUCN Red List status also relies in part on expert judgements (McBride et al., 2012) and is prone to other biases (Martín-López et al., 2011) is obscured, giving it a semblance of pure objectivity. In the first expert workshop, the risk of extinction was identified as one of the most important criteria, which should therefore get the largest weight. A proposed adaptation was agreed upon in the second expert workshop.

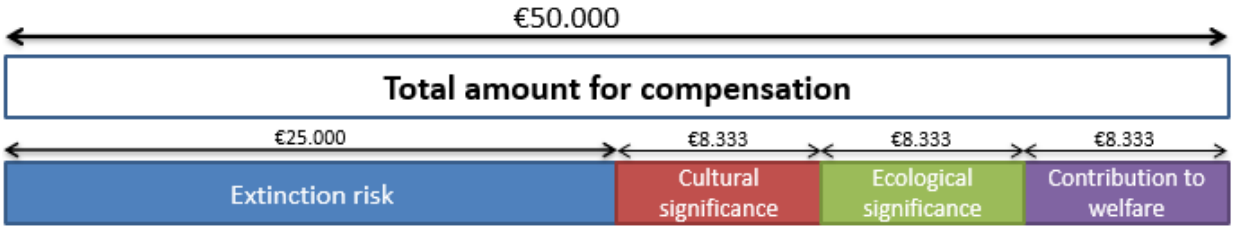


The criteria are scaled to an acceptable maximum amount, negotiated in the stakeholder workshops. To construct the additive formula, a maximal acceptable compensation is needed, which can then be distributed according to the weights of the different criteria. This is analogous to setting a baseline in a multiplicative formula, such as in the Spanish and Finnish method. There is no scientific agreement nor evidence of what this maximal amount should be. Indeed, what is acceptable and what not, has clearly not much to do with ecology but rather is a societal choice. With our methodology the maximum amount was set at €50.000 which would only apply for a large, keystone species on the verge of extinction and which simultaneously is an iconic species and has a high contribution to welfare. This amount is only surpassed by the Lithuanian and four Spanish regional lists. In Lithuania an amount of €148.206,24 is demanded for killing a brown bear or European bison if it was done in a protected area. Should it not have been in a protected area the amount would be a third, namely €49.402,08. In Spain the compensation lists of Comunidad de Andalucía, Cantabria, Castilla-La Mancha and Extremadura claim compensations of €60.000 to €90.152 for species such as the brown bear, lynx, eagles and the black stork. It should be noted that none of these species have a breeding population in Belgium, where the formula was piloted.

Even though any type of formula has a maximum, the BIOVAL methodology makes this very explicit. While unavoidable, this seems to send the message that the value of nature is limited, and is limited to €50.000. This is of course not the case as animals can be argued to have unlimited value from an intrinsic (Bradley, 2001), relational (Guernsey et al., 2021) and instrumental (Smith, 2022) point of view. Countering this apparent limiting of the value of

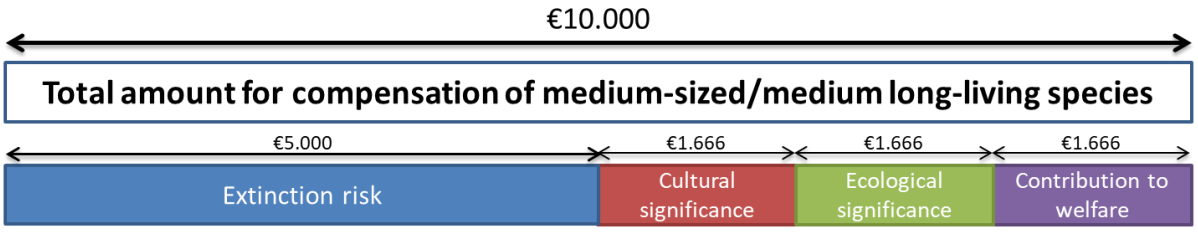
nature, it is important to note that the amount is a compensation that is issued by court. While the compensation needs to reflect the damage done, as otherwise the damage cannot be repaired and nature will keep degrading, it also serves a social purpose. As described by the UK government for the Criminal Injuries Compensations (2023):

"We recognise that no amount of compensation can ever make up for the harm and suffering caused to victims by violent crime. Injury awards are intended to be an acknowledgement of harm and an important gesture of public sympathy."



We therefore need to balance calculating the incalculable and the necessary, which we believe to have achieve through extensive iterations. **The scaling of the formula** is achieved through the fifth criterion, the size and lifespan. The maximum amount of compensation clearly has the most impact on the actual compensations that would be demanded in court. As was already indicated, how high this amount is, is a question of acceptability. For a keystone species on the verge of extinction and which simultaneously is an iconic species and generates wealth through tourism, €50.000 is regarded as an acceptable amount in the Belgian context. For an unremarkable, common species with no exceptional significance for society or the ecosystem, a compensation in the thousands of euros could be regarded as an excessively high amount. This might especially be the case when these amounts are compared to compensations paid for damage to humans (like the amounts in the *Indicatieve tabel*[10]), where moral damage for the loss of a child is compensated with the same amount. It should also be noted that amounts as high as €3.600.000 are used to value human life in the cost-benefit analyses of the Brussels ring road[11].

The total possible amount for compensation was scaled by the size and lifespan of a species through dividing the amount by 5 for medium sized or long-living species:



And by 50 for small or short-living species:

[10] A list of fixed compensations drawn up by the National Association of Judges of First Instance and the Royal Association of Justices of the Peace. https://www.schadeweb.be/sites/default/files/indicatieve-tabel-2020-tableau-indicatif-2020.pdf
[11] https://www.tmleuven.be/nl/project/MKBA-R0-Noord#!#collapseOne

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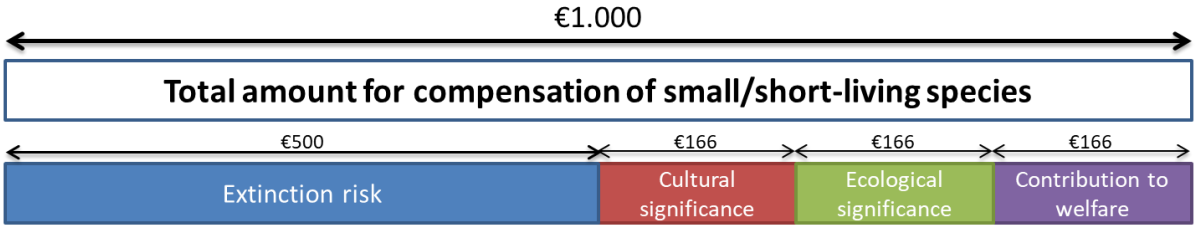
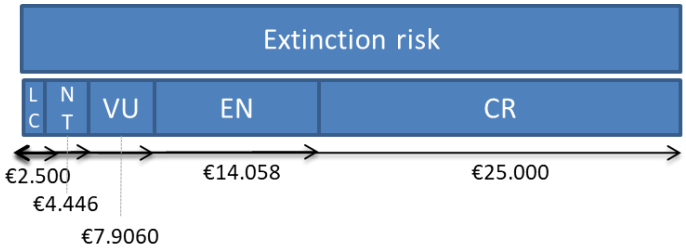


Within the criteria the consecutive levels require exponentially more compensation. Where an animal that only has the first level within a criterion (e.g. least concern for conservation status or normal ecological significance), it will require only 10% of the possible compensation for that criterion. This adaptation builds on the assumption that each consecutive level contains less species and the importance of species on higher levels grows exponentially. For

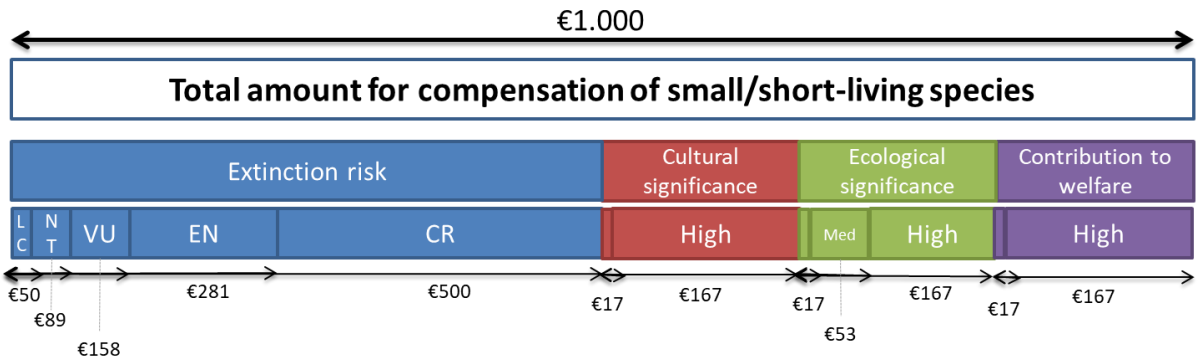


keystone species (both ecological and cultural) this assumption is within the definition of the concept. Also the IUCN Red List status has progressively less species per category in Europe (European Environment Agency, 2017), however, a real exponential trend is not present. In our own data of the 100 species, the distribution is indeed also indicating progressively lower amounts of species on higher levels. However, a real exponential trend is absent. In revisions of the formula, this can be addressed to better reflect real species distributions, should the criteria be applied to more representative and larger samples of species.

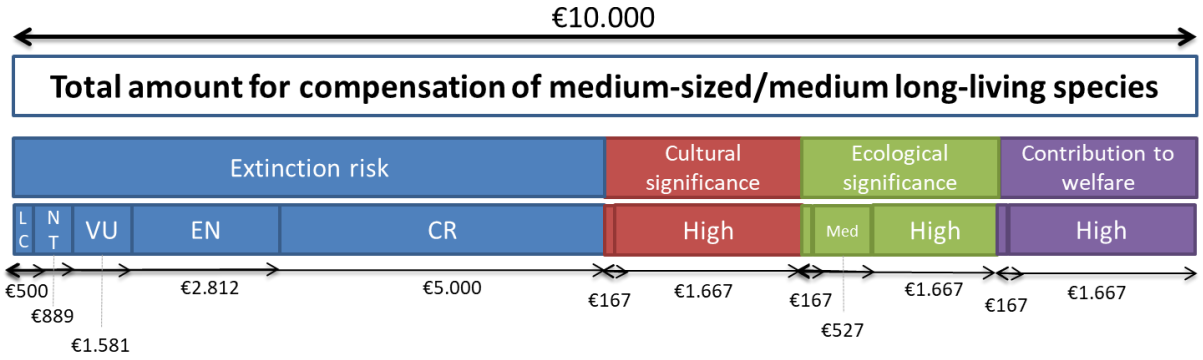
Please note that the numbers displayed here and further down are rounded to whole numbers. For that reason the sum of all the levels does not seem to reach 25.000. However, behind the visual is a calculation sheet where the rounding is only performed in the last step, omitting this problem.

The formula with different weights and categories, scaled to acceptable amounts

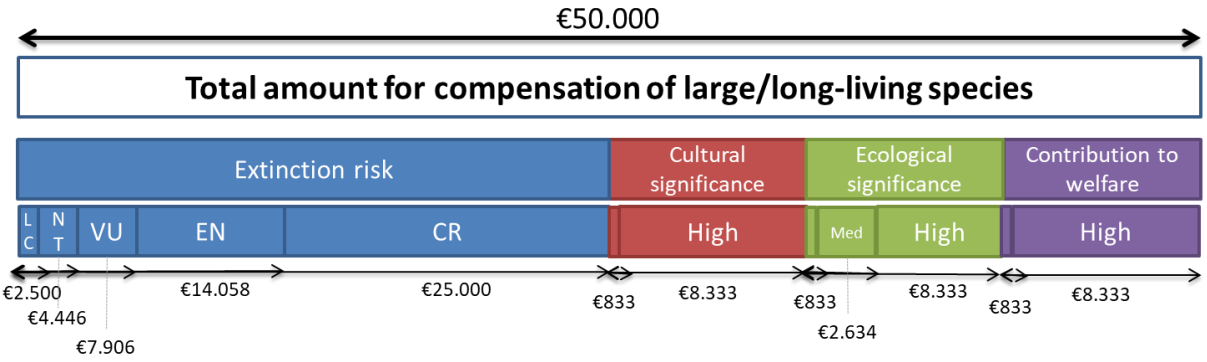
Integrating all of the above elements, the formula yields for the small or short-living species the lowest possible compensation of €83 and the highest €1.000, with the most common species requiring €100.



For middle sized or medium long living species this is between €833 and €10.000 with the most common species requiring €1000.



Large or long-living species require a compensation between €4.166 and €50.000. In this category it is more probable that the species are scoring high on multiple criteria as these are often the ecosystem engineers and culturally significant species.



This can be represented in a mathematical function as follows:

$$C = \frac{1405{,}85 * e^{0{,}58\boldsymbol{ER}} + 83{,}33 * e^{2{,}30\boldsymbol{CS}} + 263{,}52 * e^{1{,}15\boldsymbol{ES}} + 83{,}33 * e^{2{,}30\boldsymbol{CtW}}}{S}$$

With

C = Financial compensation
ER = Level of extinction risk (1, 2, 3, 4 or 5)
CS = Level of cultural significance (1 or 2)
ES = Level of ecological significance (1, 2 or 3)
CtW= Level of contribution to welfare (0, 1 or 2)
S = Level of Size or Lifespan (1, 5 or 50)

Additional considerations for the formula

To cope with the imperative to deter the crime, we suggest a minimal value for the sum of the punishment and the compensation. Namely the (illegal) market value or the monetary gains the offender has from the crime.

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Next, we also propose that if the scale of the offence is of that magnitude that the remaining local population becomes unviable, the compensation should be for the whole local population. An expert can be consulted for these cases.

Should species be assessed that are subject to illegal trade and were thus confiscated outside their natural range, we propose they should be assessed according to their ecological significance at the place where they were illegally caught. It is in that case also advisable that the financial compensation, at least partially, goes to a nature fund which favours the ecosystem in question. A list of Environmental Law Enforcers to contact in these cases could be beneficial and thus made available in the frame of the BIOVAL project.

3.7 FROM FORMULA TO COMPENSATION LIST

Once the criteria and methodology were accepted, the formula was applied to a list of 100 species. The species list was provided by the BIOVAL project team and was based on (1) the most occurring species in environmental crime cases in the court of East Flanders, Belgium; (2) potentially emerging cases. Birds were the largest species group (n=80), followed by 10 mammals, 8 reptiles and two amphibians. The formula was applied in a Delphi study[12] with five experts from the fields of population ecology, ornithology, species policy and ecological economics. The experts were given a scoring manual to provide guidance on the interpretation of the different criteria and were asked to fill in the criteria independently at home. The scorers did not see the resulting compensations during the scoring to maintain objectivity of each individual score. During a workshop the deviating scores were discussed until consensus was reached for each score. As a final step the compensations were sorted from highest to lowest to check for consistency.

In a previous version of this discussion note, the list of compensations was consecutively workshopped with members of the Nature Inspection team of the Agency of Nature and Forest of the Flemish Region of Belgium, responsible for the enforcement of nature regulations and checking the enforceability of new regulations. During this workshop compensation amounts were highlighted as difficult to enforce. All of these were species that were huntable or where permits for local control are often granted. It specifically concerns those species who are mentioned in the Hunting Decree (Jachtdecreet - 24/07/1991) to be huntable to avoid damage to crops (article 4) or that can be killed if damage has occurred and cannot be solved through hunting (article 22). It also includes species mentioned in the annex 3 of the Species Act (Besluit van de Vlaamse Regering met betrekking tot soortenbescherming en soortenbeheer – 15/05/2009). The killing of the latter requires a special permit. While these permits might make the indicative amounts more difficult to enforce, we no longer provide a priori corrections, as the aim is to provide an indicative list, which the judge can correct in function of the context of the case. The compensations reflect the ecological damage, which does not depend on the circumstantial decision to allow hunting or population control measures for certain species at certain locations during certain periods.

The final list can be found in Annex 6.3.

[12] A Delphi study is a research method that involves collecting and synthesizing opinions from a panel of experts through a series of structured surveys or questionnaires, aiming to achieve consensus or convergence on a specific topic. The process typically includes multiple rounds of feedback, fostering an iterative and anonymous exchange of expert insights.

3.8 DISCUSSION ON OUR METHODOLOGY

In this section the formula is discussed, based on the insights from the workshops and literature.

3.8.1 Process

The application-oriented development process is at least as important as the produced list and formula, as it defines the legitimacy, acceptability and thus applicability of the indicative list. From the onset, the development of the methodology has been in close cooperation with the end-users and other stakeholders of the compensation list. Not only were there two in-depth workshops, the methodology was also presented at multiple international events within the environmental legal community. This process was set up in Belgium but the workshops to construct the formula, including the selection and weighting of the different criteria and the scaling to an acceptable amount, included an international European audience. Therefore the methodology can be regarded as accepted within the European Union. The scoring of the individual species is however something that reflects local values and thus requires local experts.

3.8.2 Contribution to advancing the state of the art

With our formula we believe we do advance the state of the art in calculating the compensation for species by selecting a number of independent, scientifically grounded criteria, reflecting the plural values of nature and scaling the formula to a socially acceptable amount, in the range of other methodologies and lists through stakeholder workshops. The compensation list is constructed through a Delphi study, limiting the personal or professional bias and ensuring scientific robustness. Both the criteria and the methodology itself are transparent and easily replicable in other regions and countries where a regional Red List is available and species experts willing to devote their time.

The formula is a scientifically grounded, socially acceptable and transparent way of calculating the compensation for the damage to species. However, it is not a calculation of *the* value of a species. Moreover, the robustness of the indicators is a clear possible (and arguably necessary) point of future improvement. The most impactful and therefore priority improvement should be the size and lifespan of the species. Metrics could be devised to make this quantifiable, rather than based on expert opinion. Also the ecological significance could be further quantified, based on certain vital ecosystem processes and exploration of substitutability of species. However, care should be taken not to oversimplify the ecosystems in an attempt to make this criterion more robust

3.8.3 Beyond the technical: operating space of the formula

A tool is only as good as its application. Therefore some clear guidelines should be set for the use of the BIOVAL methodology. First of all it is important to note the geographical scope of the list. It was designed in Belgium, the country with the highest median wealth in the world (Credit Suisse Research Institute, 2023), but also the European country with the worse state of conservation of its habitats (European Environment Agency, 2020) and a lack of most large wild fauna. This implies that, when changing the geographical scope of the formula to one where the socio-economic and ecological context is different, the amounts should be adapted. A straightforward way to do this is to scale the formula to a new socially acceptable amount using a stakeholder workshop. Other methods could include scaling the formula based on the

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difference in average income of the regions. Local experts will always be necessary to adapt the scores as animals with high cultural value in Belgium are not necessarily as important in other parts of Europe.

A second important consideration is the destination of the compensation. In Flanders the compensation would go to the Fund for the Prevention and Remediation of Environment and Nature (MINA fonds). This fund is used to sponsor projects for nature restoration, but also a high number of other, environment related projects such as a circular economy, air pollution, participation projects etc. (Departement Omgeving, 2023). While the need for all these projects is not contested, the use of funds specifically issued as a compensation for damage to a specific species, should arguably be for the perceivable benefit of such species.

Thirdly, the list will require updates. Not only are its criteria bound to be outdated after a while, also the methodology will be able to rely on new social and scientific insights. We propose an annual update of the Risk of extinction criterion as this will most likely be the most rapidly changing. Other criteria can be updated in longer cycles. A revision of the methodology will probably be most frequent in the early years of adoption, as case law makes clear what the barriers are for uptake or what gets contested most in court and on what grounds. An update every two years seems plausible.

Our endeavour started with 100 species. This is just a fraction of the hundreds of vertebrate animals. As this compensation list is a practical instrument first, the lack of exhaustiveness is not a problem as long as there is a formalized mechanism to add species to the list on demand. We propose a flexible mechanism whereby species can be rapidly assessed by the competent authority (the nature agency or research institute) for ad-hoc cases. Annually, with the update of the list, these species can then be validated and officially added to the list. The work does not necessarily stop with the vertebrate species of course. The methodology could also be applied to construct a list for invertebrates or even plants, should this be deemed necessary.

4 CONCLUSION

Scientifically, the BIOVAL methodology builds on different criteria and categories already in use in legal practice and existing formulas. This was combined with recent insights from the global IPBES assessment on diverse values and valuation of nature and the applied papers that derive from this assessment. The BIOVAL formula and methodology can thus be seen as the state of the art in calculating compensations for damage to nature. The methodology provides practice-relevant and robust valuations, on the condition that these are updated regularly and applied within a relevant context. Court rulings and applications to come will moreover help opening up the much needed scientific and public debate on the subject.

In practice, the resulting indicative values list provides a straightforward and transparent instrument for court rulings. Moreover, the methodology can be reproduced or adapted to add species to the list, to develop nation- or region-specific lists, or to update the indicative amounts following changes in species status. No valuation will ever be eternal or generally applicable, but the BIOVAL methodology and indicative list provides robust, transparent and acceptable indicative compensation values, which can result in supporting restoration and protection of nature.

The actual impact of this development work depends on the uptake in courts, on the scientific follow-up for updating values, species and regions as well as on the continued development and improvement of the formula as new data and insights become accessible.

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6 ANNEX

6.1 BIOVAL GLOSSARY

Hereafter, we define the most important terms that will be used in the discussion note for BIOVAL. This is to establish a common legal, environmental and economic vocabulary. It is important to note that these definitions are for the purpose of the project only and do not necessarily correspond exactly to definitions that can be found in other literature or practice.

- **Damage**: Adverse effects on nature or the environment. Also defined by EU Directive 2004/35/EG: any measurable adverse change in a natural resource or measurable impairment of a natural resource service which may occur directly or indirectly
- **Remediation**: the restoration of the condition that would have existed had the environmental damage not occurred.
- **Compensation**: The financial compensation for the environmental damage. This can be calculated by the Value-to-value or Value-to-cost remedial measure
- **Fine**: Form of punishment, adding suffering because of a crime
- **Different types of values**:
    - **Value** has several meanings: (1) ethical/moral value (e.g. every human being has rights), (2) value as 'importance' of something to someone (e.g. how important is my house, our landscape, this laptop), (3) value as the result of a measurement (e.g. 20°C).
    - **Social value** as the 'importance' of something is also linked to the ethical-moral cultural basis and often translates into a measurement.
    - **The value of nature** consists of different, overlapping dimensions, which are not necessarily 'exchangeable' with each other.
- **Intrinsic dimension of the value of nature**
    - *The value that nature has in itself, without requiring human utility, benefit or judgement.*
    - Recognising this value is an ethical and moral choice and as such cannot be quantified or determined.
    - **Ecological value** is often determined by measuring or estimating biodiversity, rarity or ecosystem functions. These can be seen as an appreciation of 'nature in itself'.
- **Instrumental dimension**
    - *The importance of nature for individual or societal well-being*
    - **Economic value** in the broad sense: total economic value, includes use and non-use values for current and future generations.
    - **Ecosystem services**, include supporting, providing, regulating and cultural goods and services that nature produces for people.
    - **Nature contributions**, include material, immaterial and insurable contributions of nature to human quality of life.
- **Relation dimension of the value of nature**
    - *The value of nature-human relationships in itself*
    - Attitudes to life or world views such as "life of nature", "with nature", "as nature",...

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- Biocentrism, ecocentrism, anthropocentrism,...
- Man as owner, user, steward, part of nature. This translates into use of natural resources, but also animal rights, animal welfare, protected species and areas, nature conservation efforts, etc.

- **Values and trade-offs**
  - **Values co-exist** in individuals and communities. For example, people find a nature area important for nature itself (intrinsic), because they enjoy it on a walk (instrumental) and because they have worked on it (relational).
  - **Values are 'incommensurable'** - not exchangeable or comparable. The loss of intrinsic value (e.g. a species disappears from a nature area) cannot be replaced by an increase in instrumental value (e.g. more walkers are admitted). Intrinsic and relational values are the most vulnerable and are preserved in cultural (traditions) or legal (protection) ways.
  - **Choices are 'trade-offs'** when one and the other cannot be preserved or obtained. Making social trade-offs is a political decision-making process in which various values 'count' to a greater or lesser extent: see valuation
- **Valuation:**
  - *Valuation is the intentional determination, via a described procedure, protocol or (combination of) method(s), of the importance of an object to an individual or community.*
  - Various methods are available for capturing diverse values, from a wide range of disciplines and traditions. No single method can, by itself, capture the entire diversity of values.
    - Nature-based valuations measure natural structures or processes
    - Behavioural-based valuations derive values from what people do with nature (e.g. observations of recreational behaviour, market-based methods)
    - Statement-based valuations derive values from what people say or score about the importance of nature (e.g. statements, questionnaires and scoring methods)
    - Integrative valuations combine results of one or more of the above methods into a synthetic result for decision making (e.g. cost-benefit analyses, nature accounting, biological valuation map)
  - In these categories we find monetary as well as non-monetary methods, techniques from sociology, economy, anthropology, biology and ecology, accounting, as well as protocols in local traditions and cultures that determine the importance of nature in function of collective decisions.
  - Each of these methods has strengths and weaknesses. Applying one method will *de facto* mask some values and over-emphasise others. Often mixed methods from the above groups are needed for a reliable, fair and realistic valuation.

6.2 LONGLIST OF IDENTIFIED CRITERIA

Criterium type	Criterium/gravity factor	Source
species rarity and conservation status	Population size in the region (in relation to number of dead specimens)	BIOVAL online survey of EUFJE, IMPEL and ENPE members Spring 2020 (hereafter: BIOVAL survey)
	Population size	Finland Nature conservation act, art. 59
	Endemism	C. Naves, D. de la Bodega, S. Cabezas-Díaz, N. López et al. Report on the economic valuation of protected animal species. LIFE Guardianes de la Naturaleza. SEO/BirdLife. Madrid, 2020
	Rarity of species	BIOVAL survey
	Rarity of species	Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region"
	Conservation status	BIOVAL survey
	Conservation status of species	Bern Convention 2015
	Conservation status	Finland Nature conservation act, art. 59
	Legal situation of the species	C. Naves, D. de la Bodega, S. Cabezas-Díaz, N. López et al. Report on the economic valuation of protected animal species. LIFE Guardianes de la Naturaleza. SEO/BirdLife. Madrid, 2020
	Conservation status	Directive 2004/35/CE of the European Parliament
	Capacity for natural regeneration	Directive 2004/35/CE of the European Parliament
	Reproduction capacity	BIOVAL survey
	Reproductive capacity	Finland Nature conservation act, art. 59
	Legal obligation to protect under international legislation	Bern Convention 2015
Conservation effort	Cost of restoration measure	BIOVAL survey
	Cost of remediation	C. Naves, D. de la Bodega, S. Cabezas-Díaz, N. López et al. Report on the economic valuation of protected animal species. LIFE Guardianes de la Naturaleza. SEO/BirdLife. Madrid, 2020
	Funds invested in conservation of species	BIOVAL survey
Ecosystem functioning	Age (juvenile/adult)	BIOVAL survey
	Determinants of the species (mature/juvenile)	C. Naves, D. de la Bodega, S. Cabezas-Díaz, N. López et al. Report on the economic valuation of protected animal species. LIFE Guardianes de la Naturaleza. SEO/BirdLife. Madrid, 2020
	Role in population (female/breeder)	BIOVAL survey

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	Consequences of the harm caused	BIOVAL survey
	Impact risk for ecosystem	Bern Convention 2015
	Species group (birds, ferns,…)	Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region"
	Ecological significance	Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region"
	Place in ecosystem	BIOVAL survey
Societal value	Esthetic value	BIOVAL survey
	Threathened societal value	BIOVAL survey
	cultural value or importance	BIOVAL survey
	Function for recreation	Directive 2004/35/CE of the European Parliament
Market value	Market value	BIOVAL survey
	illegal trade as a motive	BIOVAL survey
	Illegal gain/quantum	Bern Convention 2015
	Commercial motivation	Bern Convention 2015
Scale	Number of individuals	BIOVAL survey
	Scale of offending (number of specimens involved)	Bern Convention 2015
	Scope and duration of environmental damage	BIOVAL survey
	Area affected	Decree of the Governor of the Perm region of October 1, 2003 N 187 "On compensation for harm caused to objects of flora and fauna of the Perm region"
Crime- related	Intentionality	Bern Convention 2015
	Indiscriminate method used in committing offence	Bern Convention 2015
	Prevalence of offence and need for deterrence	Bern Convention 2015
	Professional duty on defendant to avoid committing offence	Bern Convention 2015
	Intent and recklessness by defendant	Bern Convention 2015
	History/recidivism	BIOVAL survey

6.3 LIST OF FINANCIAL COMPENSATIONS

Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
Wolf (Canis lupus)	42.500,00	Large/long-living	Critically endangered	High	Keystone species	Normal	
Eurasian spoonbill (Platalea leucorodia)	29.301,90	Large/long-living	Critically endangered	Normal	Medium/specialist	Normal	
Eurasian curlew (Numenius arquata)	25.860,43	Large/long-living	Endangered	High	Medium/specialist	Normal	
White stork (Ciconia ciconia)	24.058,53	Large/long-living	Endangered	High	Normal/generalist	Normal	
Snowy owl (Bubo scandiacus)	20.000,00	Large/long-living	Least concern	High	Keystone species	Normal	
Eurasian goshawk (Accipiter gentilis)	16.247,60	Large/long-living	Near threatened	High	Medium/specialist	Normal	
Common raven (Corvus corax)	14.301,90	Large/long-living	Least concern	High	Medium/specialist	Normal	
Common crane (Grus grus)	12.500,00	Large/long-living	Least concern	High	Normal/generalist	Normal	
Ring-necked pheasant (Phasianus colchicus)	12.500,00	Large/long-living	Least concern	Normal	Normal/generalist	High	Hunted species
Fire salamander (Salamandra salamandra)	12.207,59	Large/long-living	Vulnerable	Normal	Medium/specialist	Normal	
Spur-thighed tortoise (Testudo graeca)	10.405,69	Large/long-living	Vulnerable	Normal	Normal/generalist	Normal	
European beaver (Castor fiber)	8.500,00	Medium sized/medium long-living	Critically endangered	High	Keystone species	Normal	
European otter (Lutra lutra)	8.500,00	Medium sized/medium long-living	Critically endangered	High	Keystone species	Normal	
European pond	6.945,70	Large/long-living	Near threatened	Normal	Normal/generalist	Normal	

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Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
turtle (Emys orbicularis)							
Red kite (Milvus milvus)	6.945,70	Large/long-living	Near threatened	Normal	Normal/generalist	Normal	
Great cormorant (Phalacrocorax carbo)	5.968,56	Large/long-living	Least concern	Normal	Medium/specialist	Negative	
Pine marten (Martes martes)	5.860,38	Medium sized/medium long-living	Critically endangered	Normal	Medium/specialist	Normal	
Wildcat (Felis silvestris)	5.860,38	Medium sized/medium long-living	Critically endangered	Normal	Medium/specialist	Normal	
Common snipe (Gallinago gallinago)	5.500,00	Medium sized/medium long-living	Critically endangered	Normal	Normal/generalist	Normal	
Peregrine falcon (Falco peregrinus)	5.172,09	Medium sized/medium long-living	Endangered	High	Medium/specialist	Normal	
Black kite (Milvus migrans)	5.000,00	Large/long-living	Least concern	Normal	Normal/generalist	Normal	
Common buzzard (Buteo buteo)	5.000,00	Large/long-living	Least concern	Normal	Normal/generalist	Normal	
Great egret (Ardea alba)	5.000,00	Large/long-living	Least concern	Normal	Normal/generalist	Normal	
Grey heron (Ardea cinerea)	5.000,00	Large/long-living	Least concern	Normal	Normal/generalist	Normal	
Hermann's tortoise (Testudo hermanni)	5.000,00	Large/long-living	Least concern	Normal	Normal/generalist	Normal	
Hare (Lepus europaeus)	4.389,14	Medium sized/medium long-living	Near threatened	High	Normal/generalist	High	
Canada goose (Branta canadensis)	4.166,67	Large/long-living	Least concern	Normal	Normal/generalist	Negative	Hunted species

Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
Eurasian jay (Garrulus glandarius)	4.000,00	Medium sized/medium long-living	Least concern	High	Keystone species	Normal	
Badger (Meles meles)	3.941,52	Medium sized/medium long-living	Vulnerable	High	Medium/specialist	Normal	
Adder (Vipera berus)	3.672,09	Medium sized/medium long-living	Endangered	Normal	Medium/specialist	Normal	
Grass snake (Natrix helvetica)	3.672,09	Medium sized/medium long-living	Endangered	Normal	Medium/specialist	Normal	
Western marsh harrier (Circus aeruginosus)	3.672,09	Medium sized/medium long-living	Endangered	Normal	Medium/specialist	Normal	
Grey partridge (Perdrix perdix)	3.581,14	Medium sized/medium long-living	Vulnerable	Normal	Normal/generalist	High	Hunted species BUT vulnerable
Barn owl (Tyto alba)	2.860,38	Medium sized/medium long-living	Least concern	High	Medium/specialist	Normal	
Eurasian kestrel (Falco tinnunculus)	2.860,38	Medium sized/medium long-living	Least concern	High	Medium/specialist	Normal	
Rook (Corvus frugilegus)	2.860,38	Medium sized/medium long-living	Least concern	High	Medium/specialist	Normal	
Tawny owl (Strix aluco)	2.860,38	Medium sized/medium long-living	Least concern	High	Medium/specialist	Normal	
Fox (Vulpes vulpes)	2.693,71	Medium sized/medium long-living	Least concern	High	Medium/specialist	Negative	Hunted species
Hooded crow	2.500,00	Medium	Least concern	High	Normal/generalist	Normal	

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Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
(Corvus cornix)		sized/medium long-living					
Carrion crow (Corvus corone)	2.500,00	Medium sized/medium long-living	Least concern	High	Normal/generalist	Normal	Controlled species
Eurasian jackdaw (Corvus monedula)	2.500,00	Medium sized/medium long-living	Least concern	High	Normal/generalist	Normal	Controlled species
Eurasian magpie (Pica pica)	2.500,00	Medium sized/medium long-living	Least concern	High	Normal/generalist	Normal	Controlled species
Crested newt (Triturus cristatus)	2.441,52	Medium sized/medium long-living	Vulnerable	Normal	Medium/specialist	Normal	
Polecat (Mustela putorius)	2.441,52	Medium sized/medium long-living	Vulnerable	Normal	Medium/specialist	Normal	
Eurasian woodcock (Scolopax rusticola)	1.389,14	Medium sized/medium long-living	Near threatened	Normal	Normal/generalist	Normal	
Little owl (Athene noctua)	1.360,38	Medium sized/medium long-living	Least concern	Normal	Medium/specialist	Normal	
Long-eared owl (Asio otus)	1.360,38	Medium sized/medium long-living	Least concern	Normal	Medium/specialist	Normal	
Eurasian sparrowhawk (Accipiter nisus)	1.360,38	Medium sized/medium long-living	Least concern	Normal	Medium/specialist	Normal	
Stock dove (Columba oenas)	1.000,00	Medium sized/medium long-living	Least concern	Normal	Normal/generalist	Normal	
Beech marten (Martes foina)	833,33	Medium sized/medium long-	Least concern	Normal	Normal/generalist	Negative	

Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
		living					
Common wood-pigeon (Columba palumbus)	833,33	Medium sized/medium long-living	Least concern	Normal	Normal/generalist	Negative	Hunted species
European turtle-dove (Streptopelia turtur)	736,04	Small/short-living	Critically endangered	High	Medium/specialist	Normal	
Corn bunting (Emberiza calandra)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
Crested lark (Galerida cristata)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
European serin (Serinus serinus)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
Fieldfare (Turdus pilaris)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
Lesser redpoll (Acanthis cabaret)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
Ortolan bunting (Emberiza hortulana)	550,00	Small/short-living	Critically endangered	Normal	Normal/generalist	Normal	
Barn swallow (Hirundo rustica)	544,15	Small/short-living	Vulnerable	High	Medium/specialist	High	
Eurasian skylark (Alauda arvensis)	358,11	Small/short-living	Vulnerable	High	Normal/generalist	Normal	
Northern lapwing (Vanellus vanellus)	331,17	Small/short-living	Endangered	Normal	Normal/generalist	Normal	Hunted species BUT Endangered
Tree sparrow (Passer montanus)	331,17	Small/short-living	Endangered	Normal	Normal/generalist	Normal	
Common chaffinch (Fringilla coelebs)	250,00	Small/short-living	Least concern	High	Normal/generalist	Normal	
European goldfinch (Carduelis carduelis)	250,00	Small/short-living	Least concern	High	Normal/generalist	Normal	
European robin (Erithacus rubecula)	250,00	Small/short-living	Least concern	High	Normal/generalist	Normal	

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Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
Spotless starling (Sturnus unicolor)	250,00	Small/short-living	Least concern	High	Normal/generalist	Normal	
European starling (Sturnis vulgaris)	250,00	Small/short-living	Least concern	High	Normal/generalist	Normal	
Red crossbill (Loxia curvirostra)	244,15	Small/short-living	Vulnerable	Normal	Medium/specialist	Normal	
Bearded reedling (Panurus biarmicus)	208,11	Small/short-living	Vulnerable	Normal	Normal/generalist	Normal	
Eurasian linnet (Linaria cannabina)	208,11	Small/short-living	Vulnerable	Normal	Normal/generalist	Normal	
House sparrow (Passer domesticus)	208,11	Small/short-living	Vulnerable	Normal	Normal/generalist	Normal	
Redwing (Turdus iliacus)	208,11	Small/short-living	Vulnerable	Normal	Normal/generalist	Normal	
Sand martin (Riparia riparia)	174,95	Small/short-living	Near threatened	Normal	Medium/specialist	Normal	
Coal tit (Parus ater)	138,91	Small/short-living	Near threatened	Normal	Normal/generalist	Normal	
Reed bunting (Emberiza schoeniclus)	138,91	Small/short-living	Near threatened	Normal	Normal/generalist	Normal	
Eurasian bullfinch (Pyrrhula pyrrhula)	138,91	Small/short-living	Near threatened	Normal	Normal/generalist	Normal	
Mistle thrush (Turdus viscivorus)	138,91	Small/short-living	Near threatened	Normal	Normal/generalist	Normal	
House martin (Delichon urbica)	136,04	Small/short-living	Least concern	Normal	Medium/specialist	Normal	
White-winged crossbill (Loxia leucoptera)	136,04	Small/short-living	Least concern	Normal	Medium/specialist	Normal	
Eurasian blackbird (Turdus merula)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Brambling (Fringilla montifringilla)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	

Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
Collared dove (Streptopelia decaocto)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Common lizard (Zootoca vivipara)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Common redpoll (Acanthis flammea)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Dunnock (Prunella modularis)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Eurasian blackcap (Sylvia atricapilla).	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Great tit (Parus major)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
European greenfinch (Chloris chloris)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Hawfinch (Coccothraustes coccothraustes)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Quail (Coturnix coturnix)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Rosy starling (Pastor roseus)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Eurasian siskin (Spinus spinus)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Slowworm (Anguis fragilis)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Snow bunting (Plectrophenax nivalis)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Song thrush (Turdus philomelos)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Wall lizard (Podarcis muralis)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Bohemian waxwing	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	

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Species	Compensation (€)	Size/Lifespan	Extinction risk	Cultural significance	Ecological significance	Contribution to welfare	Comment
(Bombycilla garrulus)							
Yellowhammer (Emberiza citrinella)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
European Golden plover (Pluvialis apricaria)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	
Twite (Linaria flavirostris)	100,00	Small/short-living	Least concern	Normal	Normal/generalist	Normal	

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