Annex 1

Raptors MOU Conservation Status Assessment Report

MOS3 (2023)

Prepared by: Victoria R. Jones, Lucy Haskell, Juan Serratosa Lopez.

Contributors: Ding Li Yong, Chris Bowden, Ian Burfield, Ashley Simkins and Nicola Crockford.

Reviewers: Umberto Gallo-Orsi, Rob Martin, Mátyás Prommer, Roger Safford, Des Thompson and Jenny Weston.

Contents

1. Introduction

The Raptors MOU Text outlines a number of fundamental principles, including principle 5. that 'The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate'.

For the Meeting of Signatories (MOS) to have the overview of whether a favourable conservation status is being achieved and maintained for the species on Annex 1 of the MOU throughout their range, it could be valuable for a report to be submitted periodically by the Technical Advisory Group (TAG) to future Meetings of Signatories summarising what is known about the conservation status of Annex 1 species and highlighting any knowledge gaps.

As part of its workplan the TAG assesses parameters relating to the conservation status of Annex 1 species ahead of every MOS in order to propose amendments to the Annexes, but this has not previously been synthesized into a report for Signatories. This first pilot Conservation Status Assessment Report (CSAR) focuses on the migratory raptor species listed on Annex 1, their status, trends, conservation needs and knowledge gaps. It is based on the list of 94 species proposed by TAG as Annex 1 for MOS3 (UNEP/CMS/Raptors/MOS3/Doc.14.1 Addendum 2)[1] and the Table 1 categorisation of those species also proposed by TAG for MOS3 consideration (UNEP/CMS/Raptors/MOS3/Doc.14.1 Addendum 5).

Any future CSAR could include additional elements and TAG recognises that understanding more about the sites important for these species is another very important element of achieving and maintaining favourable conservation status for Annex 1 species. This element is not covered by this first pilot CSAR because amendments to Table 3 are under discussion at the Third meeting of Signatories (MOS3), but it would be an important component of any future CSAR.

2. Global conservation status

The IUCN Red List is widely recognised as the most authoritative and objective system for classifying species by their risk of extinction (IPBES 2019 and UN DESA. 2022). It uses quantitative criteria based on population size, rate of decline, and area of distribution to assign species to categories of relative extinction risk (IUCN 2001). The assessments are not simply based on expert opinion; they must be supported with detailed documentation of the best available data, with justifications, sources, and estimates of uncertainty and data quality (IUCN 2008). Red List Authorities are appointed to organise independent scientific review and to ensure consistent categorisation between species, groups, and assessments.

[1] https://www.cms.int/raptors/en/document/proposed-amendments-mou-text-and-annexes-0

BirdLife International is the official IUCN Red List Authority for birds. Updates to the Red List are made annually, with complete reassessments of all recognised species conducted every four to six years. Since the first comprehensive global assessment of birds in 1988 there have been six full assessments.

The following analyses are based on the 2021 IUCN Red List datasets curated by BirdLife International (Figures 1 & 2) and include the 94 species on draft Annex 1 as updated by TAG for MOS3 consideration.

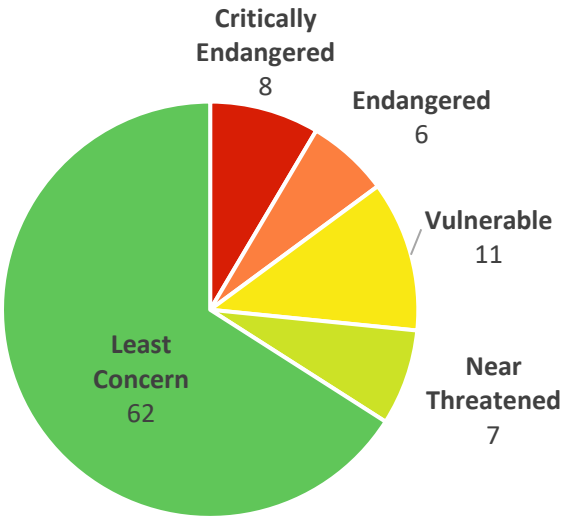

Figure 1. Global IUCN Red List Category for the 94 species of draft Annex 1 to MOS3.

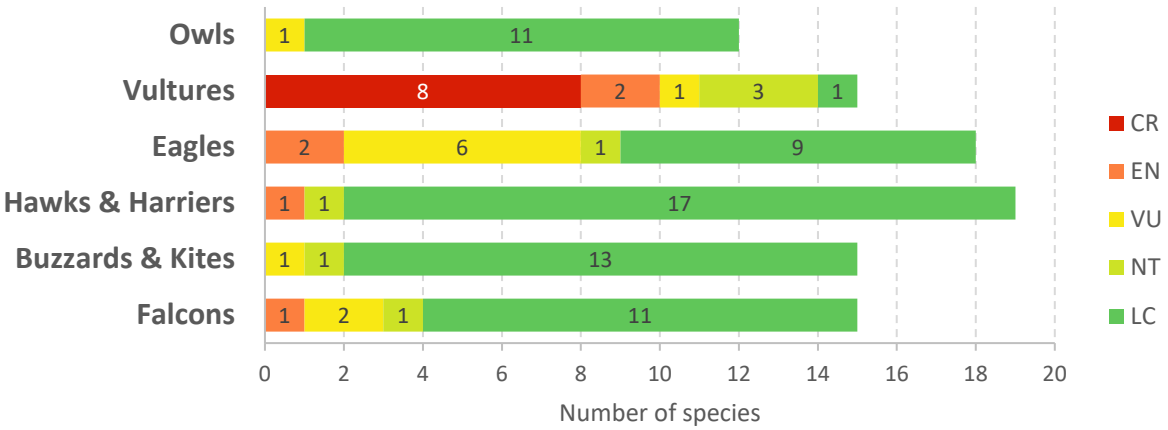

Figure 2. Global IUCN Red List Category by taxonomic group of draft Annex 1 to MOS3.

Combining all species categorised as threatened, i.e. 'Critically Endangered', or 'Endangered', or 'Vulnerable' and 'Near Threatened' 34% of all species are considered to have an elevated risk of extinction (Figure. 1). Vultures are the most threatened group with a total of 8 'Critically Endangered' species and the highest percentage of threatened or Near Threatened species (93%). The second most threatened group are eagles with 2 'Endangered' species and 50% of eagle species on Annex 1 being threatened or Near Threatened species. Hawks and harriers are the group with the lowest percentage of threatened species (5%) (Figure 2).

3. Regional Conservation Status

Regional conservation status is considered in identification of species considered to be in unfavourable conservation status which qualify for Category 2[2] of Annex 3 Table 1. TAG however recognised that although the European Red List of Birds and associated SPEC categorisation appeared to be the only whole region- level source on conservation status currently available (if region is understood to mean Europe, Africa, Middle East, Asia), there were other potential sources of information on conservation status covering different parts of the MOU's geographic extent which could warrant consideration. TAG suggested some inter-sessional work was needed between MOS3 and the fourth Meeting of Signatories (MOS4) to further define how 'regional level' should be interpreted and applied to Category 2 of Table 1; the aim of this work will be to try to ensure information at an appropriate scale from across the MOU area can contribute to identifying the species considered to have unfavourable conservation status, while ensuring the information is from a wide enough geographic area/ scale to be considered representative of the conservation status across the region concerned. This CSAR includes regional level information from Europe, and some available information from other regions on conservation status at multi-country/ sub-regional level pending the outcome of any further work from TAG.

European Conservation Status

Focusing on the regional level, around half of the Raptors MOU Annex 1 species occur in Europe. Compared with the global picture a more positive situation emerges, with a lower proportion of threatened and Near Threatened species with 23% of the Annex 1 species present in Europe categorised as regionally threatened or Near Threatened (Figure 3) on the European Red List of Birds (BirdLife International 2021)

[2] Annex 3 Table 1 Category 2: Species considered to have Unfavourable Conservation Status at a regional level within the Range States and territories listed in Annex 2 to the MOU

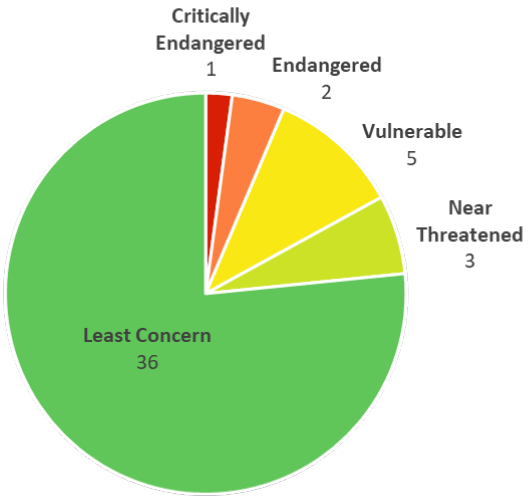

Figure 3. Regional IUCN Red List Category for the 47 European migratory raptor species included in Annex 1.

In relation to taxonomic groups, eagles and falcons have the highest proportion of threatened or Near Threatened species at European level with 33% and 40% respectively (Figure. 4). Only buzzards and kites have no threatened or Near Threatened species at European level.

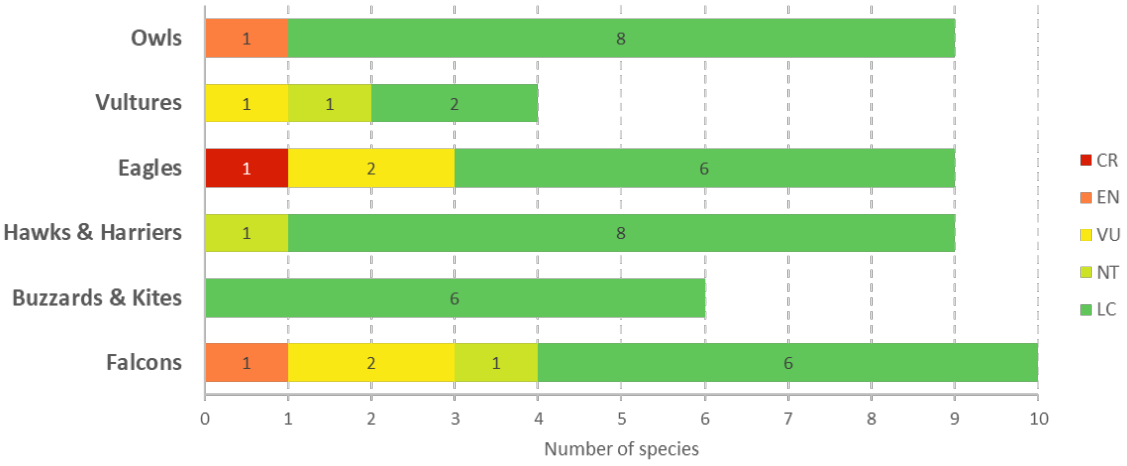

Figure 4. Conservation status of European migratory raptor species on the European Red List of Birds by taxonomic group

Compared with the previous European Red List of Birds assessment in 2015, the conservation status of three Raptors MOU Annex 1 species had worsened. Saker Falcon (*Falco cherrug)* moved from Vulnerable to Endangered, Merlin (*Falco columbarius*) from Least Concern to Vulnerable) and Red-footed Falcon (*Falco vespertinus*) from Near Threatened to Vulnerable). Seven Raptors MOU Annex 1 species had improved in conservation status: Bearded Vulture (*Gypaetus barbatus)*, Egyptian Vulture (*Neophron percnopterus)*, Greater Spotted Eagle (*Clanga clanga*) , Red Kite (*Milvus milvus*), Hen Harrier (*Circus cyaneus*), Pallid Harrier (*Circus macrourus*) and Shikra (*Accipiter badius*).. While some changes were non-genuine (relating to e.g. better data or knowledge) there are encouraging signs that conservation measures in European countries are slowing and reversing declines in some species and a strong network of Special Protection Areas may also be contributing (Ledger *et al*. 2022).

Arabian Peninsula assessment of conservation status of breeding raptors

Symes *et al.* (2015) assessed the conservation status of breeding birds of the Arabian Peninsula. Of the species relevant to the Raptors MOU, they assessed one species (Saker Falcon) as Critically Endangered in the Arabian peninsula, 5 species as Endangered in the area (Sooty Falcon *Falco concolor*, Peregrine Falcon *Falco peregrinus*, Griffon Vulture *Gyps fulvus*, Tawny Eagle *Aquila rapax*, Golden Eagle *Aquila chrysaetos*), four species as Vulnerable in the area (Bearded Vulture, Egyptian Vulture Lappet-faced Vulture *Torgos tracheliotos*, and Short-toed Snake-eagle *Circaetus gallicus*) and two species as Near Threatened in the Arabian peninsula (Lesser Kestrel *Falco naumanni* and Western Marsh-harrier *Circus aeruginosus*).

North Africa assessment of conservation status of breeding raptors

There have been some efforts to assess Red List status for sub-regions of Africa. For example Garrido *et al.* (2021)[3] assessed breeding raptors of North Africa and found that (of the species assessed which are relevant to the Raptors MOU), two species (Cinereous Vulture *Aegypius monachus* and Spanish Imperial Eagle *Aquila adalberti*) were Extinct in North Africa, seven species were Critically Endangered (Northern Goshawk *Accipiter gentilis*, Tawny Eagle *Aquila rapax*, Bearded Vulture , Rüppell's Vulture *Gyps rueppelli*, Red Kite , Lappet-faced Vulture and Marsh Owl *Asio capensis*), three species were Endangered (Montagu's Harrier *Circus pygargus*, Egyptian Vulture, Osprey *Pandion haliaetus*), two species were Vulnerable (Griffon Vulture *Gyps fulvus* and Eurasian Hobby *Falco subbuteo*) and four species Near Threatened (Short-toed Snake-eagle , Western Marsh-harrier and Sooty Falcon *Falco concolor* and Eleonora's Falcon *Falco eleonorae*).

[3] https://portals.iucn.org/library/sites/library/files/documents/RL-61-003-En.pdf

Conservation status of raptors in South Africa, Lesotho and Eswatini

Taylor *et al.* (2015) assessed the conservation status of all bird species occurring in South Africa, Lesotho and Eswatini (formerly referred to as Swaziland). In their assessment four of the species relevant to the Raptors MOU were assessed as Critically Endangered in the area (Bearded Vulture *,* Hooded Vulture *Necrosyrtes monachus,* White-backed Vulture *Gyps africanus,* White-headed Vulture *Trigonoceps occipitalis),* four as Endangered (Tawny Eagle , Black Harrier *Circus maurus,* Cape Vulture *Gyps coprotheres* and Lappet-faced Vulture) and two as Near Threatened (Red-footed Falcon and Pallid Harrier)

The authors also flagged that alongside the many cases of species with poor conservation status Lesser Kestrel had been downlisted from Vulnerable in 2000 to Least Concern in the 2015 assessment for the area, thanks to genuine improvements in its status.

An updated Red Data Book of birds in South Africa, Lesotho and Eswatini is being compiled, planned for completion in 2025.

4. Global conservation status over time - Red List Index

The Red List Index (RLI) has been developed as an indicator of trends in the status of biodiversity. It illustrates the rate of biodiversity loss in terms of the rate that species are slipping towards (or moving away from) extinction. The index is based on the number of species in different categories of extinction risk on the IUCN Red List and the movement of species between categories owing to genuine improvements or deteriorations in status (Butchart *et al.* 2004, 2005, 2007). The RLI integrates the net impacts of species improving in status and being downlisted to lower categories of threat (usually a consequence of conservation interventions) and those deteriorating in status and being uplisted to higher categories of threat (owing to declining populations and increasing threats).

RLI values relate to the proportion of species expected to remain extant in the near future without additional conservation action. An RLI value of 1.0 equates to all species being categorised as Least Concern, and hence that none is expected to go extinct in the near future. An RLI value of zero indicates that all species have gone Extinct. A downward trend in the graph line (i.e. decreasing RLI values) means that the expected rate of species extinctions is increasing (i.e. that the rate of biodiversity loss is increasing).. An upward trend in the graph line (i.e. increasing RLI values) means that there is a decrease in the expected future rate of species extinctions (i.e. a reduction in the rate of biodiversity loss).

To analyse trends in conservation status, RLIs were calculated from 1988 to 2020 for three different groups (Figure 5): all bird species, all raptors (i.e. Accipitriformes, Falconiformes, and Strigiformes), and migratory

raptor species included in Annex 1 at MOS1 in 2012 (76 species). At MOS2 in 2015 Annex 1 was expanded to 93 species and at MOS3 Annex 1 is proposed to include 94 species. To calculate the Red List Index the IUCN Red List assessment from 2022 was used, including all genuine[4] changes in the extinction risk category. This figure shows how at the begining of the period covered, MOS1 species had a higher RLI value than the other two groups, indicating a better conservation status. The steeper downward trend for this group shows that over the whole period 1988 to 2020, conservation status has deteriorated at a faster pace for MOS1 Annex 1 species than for all bird species or all raptor species. However the deterioration appears to have slowed after 2008 when the Raptors MOU came into force, with the trajectory between 2008 and 2020 being similar to that for 'all birds' and 'all raptors'.

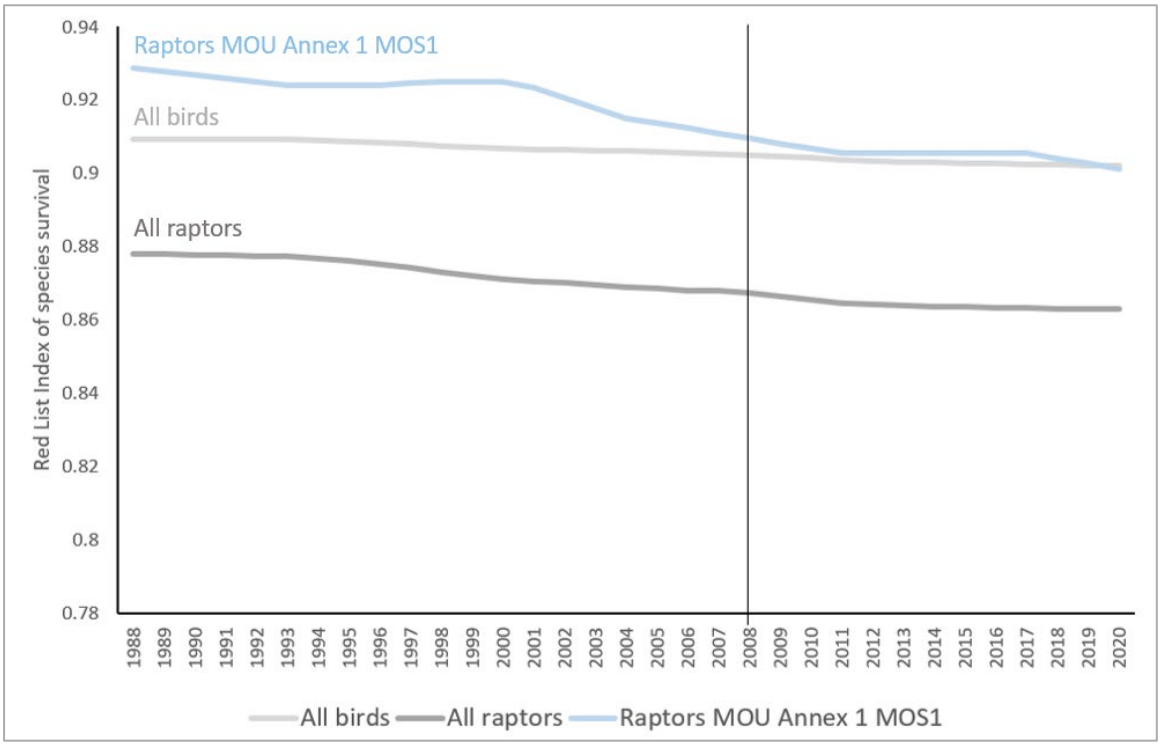

Figure 5. RLI change over time for three groups of species: all species, all raptors and migratory raptors included in Annex 1 at MOS1

Following the same methodology, with the same RLI lines for all bird species and all raptor species for comparison, a second graph (Figure 6) was created including the RLI for the Annex 1 species list being

[4] A genuine change in IUCN Red List category is one where there has been a genuine change in the species conservation status since the last assessment, while a non-genuine change is one where a change in category results from new information coming to light, a taxonomic change has altered the species concept since the last assessment etc

proposed for adoption at MOS3 (i.e. draft Annex 1 for MOS3 which includes 94 species). The RLI for this group follows a relatively steep downward trajectory, indicating deteriorating conservation status that is particularly marked between the mid-1990s and 2012, but appears to level off somewhat between 2012 and 2020 (Figure 6). By 2020 the conservation status of this 'draft Annex 1 at MOS3' group of raptor species was poorer than that for all raptors and considerably poorer than that for all bird species.

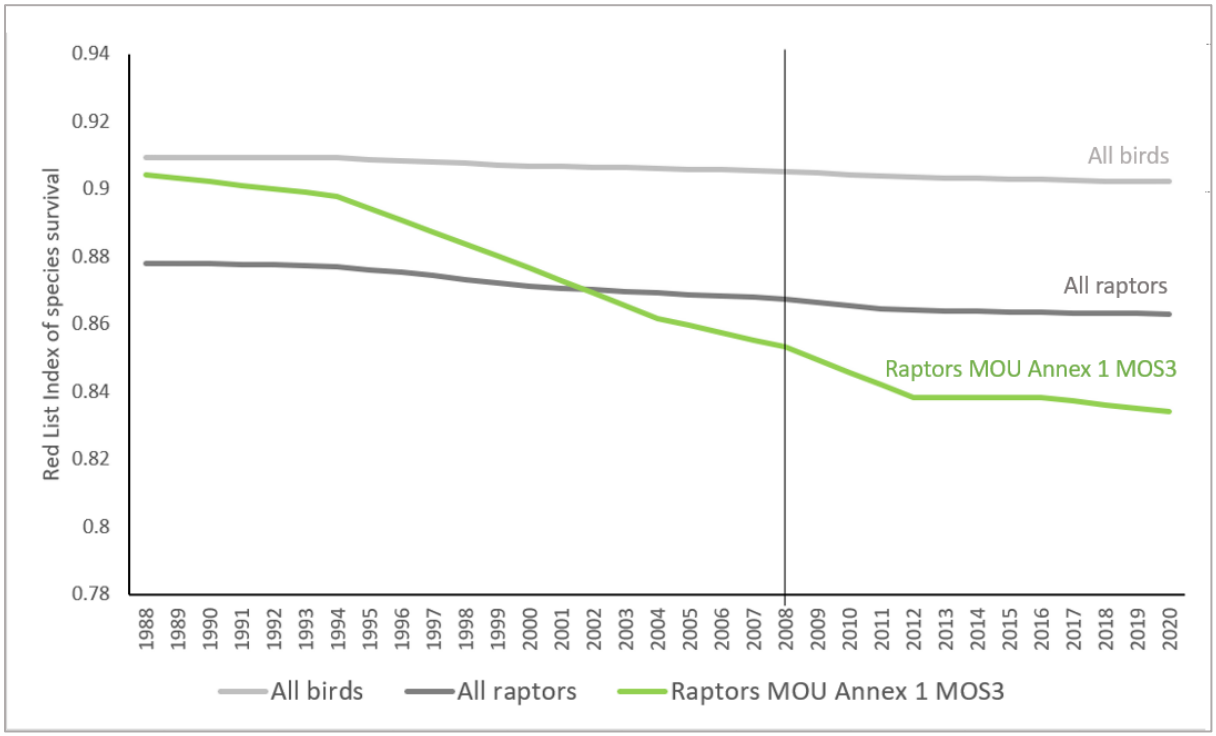

Figure 6. RLI change over time for three groups of species: all species, all raptors and raptors included in proposed Annex 1 for MOS3

The levelling off of the Annex 1 species line in Figure 5 could be interpreted as an indication that listing on the Raptors MOU might have had a beneficial effect in slowing deterioration of conservation status in those species listed on Annex 1 of the MOU since its inception or that conservation efforts more generally have helped to reduce the threats being faced by this set of species. Figure 6 shows that for the expanded species list now on Annex 1/ proposed for Annex 1 at MOS3, the conservation status trajectory since 1988 has been one of serious decline and the hope would be that listing on the Raptors MOU Annex 1 will help to slow this deterioration in conservation status by guiding the targeting of conservation interventions.

The listing of 18 new species on Annex 1 of the Raptors MOU at MOS2 (2015) included 12 vulture species, all of which are threatened or Near Threatened and this has certainly increased the conservation challenge faced

by the Raptors MOU and its Signatories. As highlighted by McClure *et al.* (2018) and Buechley and Şekercioğlu, (2016) Old World vultures have experienced the greatest deterioration in Red List status of any raptor group since 1988, and possibly of any group of birds. The Multi-species Action Plan to Conserve African-Eurasian Vultures (Vulture MsAP) adopted by CMS Parties in 2017 (Botha *et al*. 2017) laid out the challenges to be tackled and the ongoing mid-term implementation review should help to highlight whether effective action has been taken or is planned that would help to slow the deterioration in conservation status for Annex 1 species shown in Figure 6.

The fact that 10 of these Raptors MOU Annex 1 listed globally threatened species of vulture and the globally threatened Steppe Eagle (*Aquila nipalensis*) are also listed on CMS Appendix I in 2017 may also assist in encouraging effective action for these species.

5. Global population trend

It should be noted that while considerable changes in population size are needed to trigger an IUCN Red List category change, declining population trends can be an early indication that conservation status is deteriorating and this is one reason why accurate monitoring is so important. Further information and explanation of population size and trend for particular species can be found by searching for the species on the BirdLife data zone http://datazone.birdlife.org/home.

More than half (53%) of all MOU Annex 1 species are decreasing, while around one third (34%) are stable and just 11% are increasing (Figure 7). Population trends were extracted from the IUCN Red List dataset from 2021.

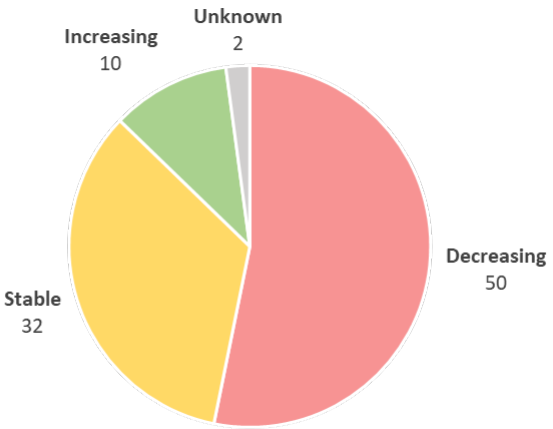

Figure 7. Global population trends for the 94 species in draft Annex 1 for MOS3

.

Overall, comparison of the conservation status of species and their population trends reveals a worrying trend. The percentage of species with decreasing populations (53%) is considerably higher than the percentage of species already considered as threatened or Near Threatened (34%). Therefore if conservation efforts for Annex 1 species are not stepped up, many more raptor species could become threatened in the future.

Examined by group (Figure 8), vultures and eagles have the highest percentage of decreasing populations (93% and 56% respectively) closely followed by falcons, and hawks and harriers.

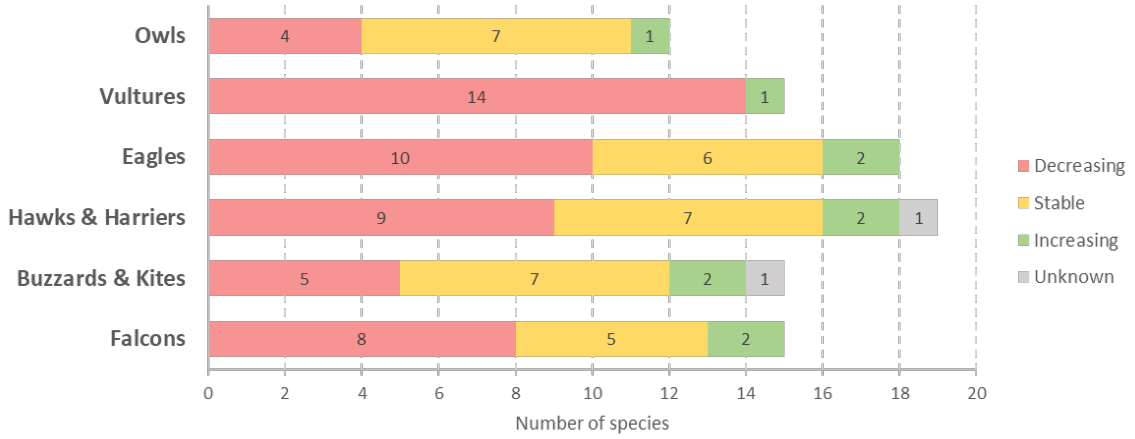

Figure 8. Global population trends of Draft Annex 1 species by taxonomic group.

Within the last 30 years Old World vultures have faced population crises across South Asia and Africa (Ogada *et al.,* 2012, 2016). Ogada *et al.* (2016) demonstrated that vulture populations are declining throughout Africa, with West and East Africa showing the greatest declines per annum.

Encouragingly, some authors indicate that after catastrophic declines in populations, some vulture species across the Indian subcontinent may be locally stabilizing as a response to interventions including the initial banning of veterinary diclofenac in 2006 (Cuthbert *et al*., 2011; Chaudhry *et al*., 2012; Prakash *et al*., 2012; Galligan *et al.* 2020; Bhusal *et al.* 2019). Populations are still perilously small however and focused conservation action remains key, including captive breeding and release and the maintenance of captive populations as a safety net.

It should be noted that population trends for a species can only be accurately assessed if adequate monitoring is undertaken and reported for that species across the geographic area. While some raptor species are relatively comprehensively monitored, for many species there are significant gaps in knowledge. Improvements in

monitoring would help to ensure that the CSAR reflects the on-the-ground reality for Annex 1 species, providing as accurate a picture as possible for Signatories.

6. Regional population trend

As outlined with regard to the section on conservation status, CSAR figures have been produced for Europe, but not at this time for other areas of the MOU's geographic scope, pending TAG work between MOS3 and MOS4 to define how 'regional level' should be interpreted and applied to Category 2 of Table 1, with implications for future CSARs.

European population trend

When focusing on the Europe regional scale a different trend can be found, with a lower percentage of decreasing populations (21%) and a higher percentage of increasing populations (38%), compared to global trends (Figure 9).

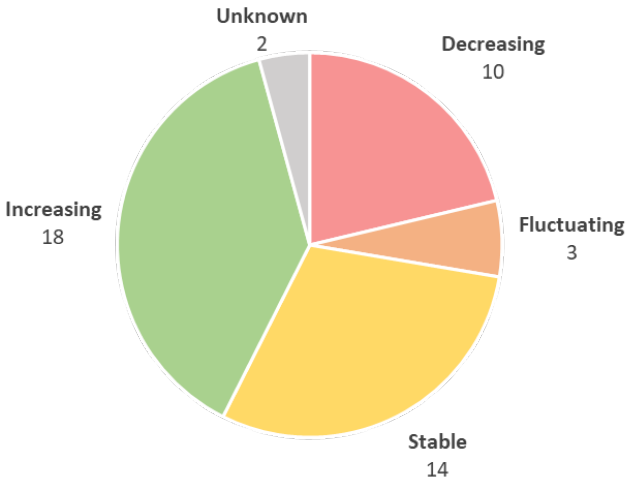

Figure 9. Regional population trends for the 47 European species included in Annex 1.

Divided by taxonomic groups falcons have the largest proportion of decreasing populations (40%) at European scale while for two groups (buzzards & kites and owls) there are no species with decreasing population trends recorded at European scale (Figure 10). Interestingly, eagles are the group with the highest percentage of increasing populations at European scale (78%) despite being the most threatened group (33% of species being threatened or Near Threatened). This is an encouraging indication that the European conservation status of some of these species might improve in the years to come.

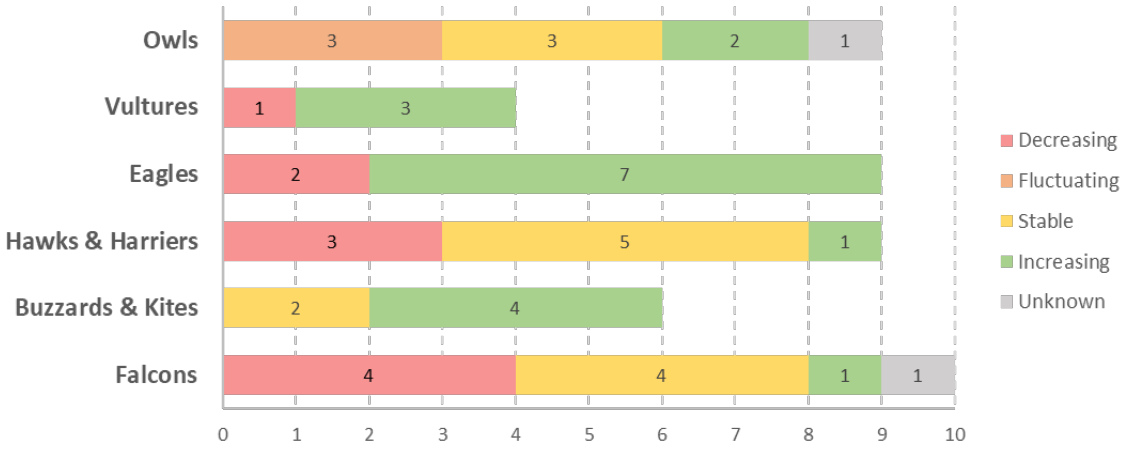

Figure 10. Population trends for the 47 European species included in Annex 1 by taxonomic group.

Population trends from within other regions

Africa

Beyond vultures, Amar (2018) commented that from the relatively few surveys that have examined changes in raptor abundance in different African regions, the overall trend is for declines, with a few exceptions (like some urban-dwelling species). For several species these declines have been described as catastrophic (Thiollay 2006). In general declines appear to be worse outside of protected areas than inside them (Thiollay 2006; Virani *et al.* 2011). Ogada *et al.* (2016) suggested the overall picture for African vultures was of declining population trend across many species.

Of the 15 Raptors MOU Annex 1 species assessed in Garrido *et al.* (2021), 73% (Northern Goshawk, Tawny Eagle, Bearded Vulture, Red Kite, Lappet-faced Vulture, Marsh Owl, Montagu's Harrier, Egyptian Vulture, Griffon Vulture, Eurasian Hobby, Short-toed Snake-eagle) appear to have a decreasing population trend regionally, 20% have unknown regional population trend (Rüppell's Vulture, Western Marsh-harrier) and only a single species (Eleanora's Falcon (7%) appears to be increasing. Examination of population trends for Raptors MOU relevant species in Taylor *et al.* (2015) for South Africa, Lesotho and Eswatini suggests that 6 out of the

10 Raptors MOU relevant species (Tawny Eagle, Black Harrier, Pallid Harrier, Bearded Vulture, Cape Vulture and Red-footed Falcon), had decreasing population trend and the other four species were assessed at that time as stable (Hooded Vulture, White-backed Vulture, White-headed Vulture and Lappet-faced Vulture).

Asia

In Asia, there have not been region or subregion level assessments of population trends in raptors. Some national results of relevance from the State of India's Birds (SoIB 2020) indicate that overall, raptors have clearly declined, with open country specialists showing a particularly strong decline both in the long term and currently. Regarding Annex 1 species, although some Annex 1 species like Western Marsh Harrier show trends that are roughly stable in the long term in India, there are knowledge gaps or uncertainties over the trends for a number of other Annex 1 species in India indicating monitoring needs. Data show that Short-toed Snake-eagle and Tawny Eagle appear to have undergone long term declines and are undergoing current declines too. Scavengers (mostly vultures) have been in severe decline over the past 25 or more years with declines in vultures in India apparently continuing beyond the catastrophic decreases caused by diclofenac twenty years ago. Elsewhere in Asia, for example Nepal, where effective steps have been taken to address veterinary diclofenac availability, along with other vulture-toxic veterinary painkillers, resident vulture population recovery trends have been documented (Galligan *et al* 2020). These positive signs of recovery have not been replicated across India nor more widely, although vulture declines in India have at least been largely halted.

7. Table 1 Category 1 changes over time

The way that species listed on Annex 1 have changed Category on Table 1 over time gives us a useful picture of the direction of change. Species qualify to be moved from Category 1 to Category 2 or Category 2 to Category 3 because of some measure of improving conservation status or trajectory, while those moving from Category 3 to Category 2 or Category 2 to Category 1 are moved because of deteriorating conservation status or trajectory.

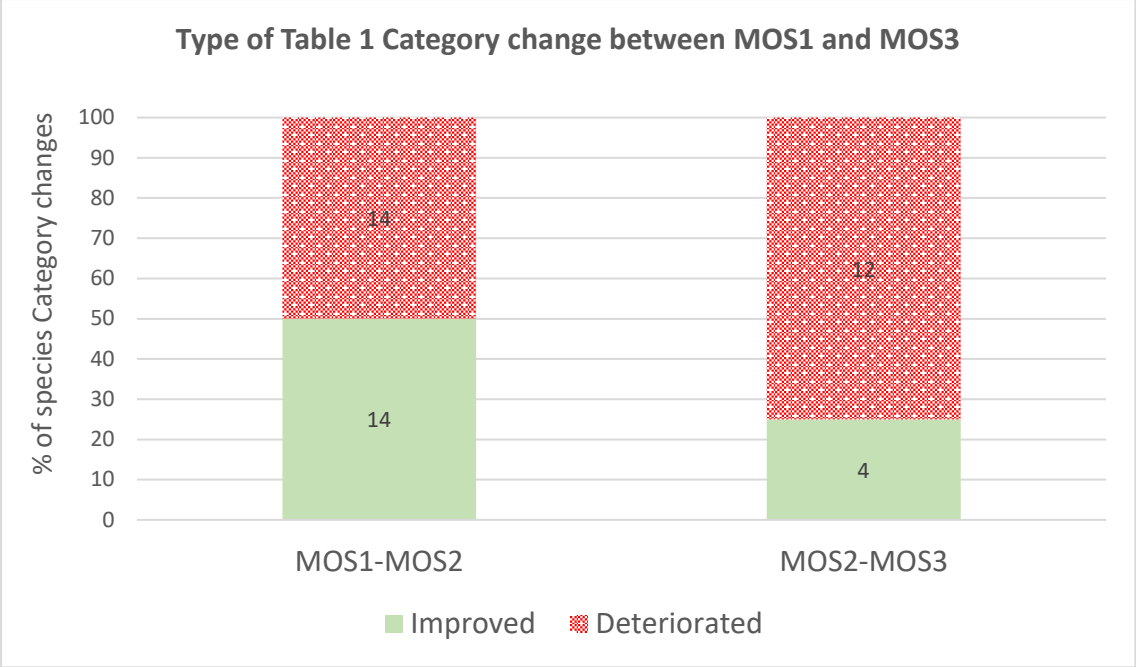

Figure 11. Percentage of Table 1 Category changes representing improving or deteriorating conservation status or trajectory between Raptors MOU MOS1 and MOS2 (the categorisation of new Annex 1 species was not counted as a change for the purpose of this analysis).

Between MOS1 and MOS3 41% of Category changes on Table 1 were implemented because of improving conservation status or trajectory and 59% deteriorating status, so there have been more negative than positive Category changes, clearly underlining the need for conservation efforts to be stepped up for Annex 1 species. Worryingly when this is broken down there is a notable difference between the MOS1 to MOS2 period 2012-2015) and the MOS2 to MOS3 period (2015-2023). Of course the time periods were different with 3 years between MOS1 and MOS2, and nearly 8 years between MOS2 and MOS3, but there was not a higher number of changes overall in this second time period (Figure 11). Between MOS1 and MOS2 there was a balance of 50:50 improvements versus deteriorations represented by Category changes, but between MOS2 and MOS3 75% of Category changes represented deteriorations and only 25% improvements, a worrying sign suggesting that the situation for Annex 1 species considerably worsened between MOS2 and MOS3. Moreover the deteriorations were not confined to a specific group, but in both time periods were spread across a wide range of groups including falcons, eagles, hawks and harriers, buzzards and kites and owls. New listing of species on Annex 1 (which were then allocated to a Category on Table 1) was not counted as a category change, so the above results are not affected by the new listing on Annex 1 of a large number of vulture species at MOS2; indeed there were no Table 1 category changes recorded for any vulture species in the period between MOS1 and MOS3.

8. Threats to species globally

Background on threat categorisation and interpretation

As the IUCN Red List Authority for birds, BirdLife collates and maintains information on the threats impacting bird species. Direct threats are the proximate human activities or processes that have impacted, are impacting, or may impact the status of the taxon being assessed (e.g., unsustainable fishing or logging, agriculture, housing developments, etc.). As for all taxa undergoing IUCN assessment, threat types are coded for the species as a whole (across its range) against the IUCN-Conservation Measures Partnership (CMP) Unified Classification of Direct Threats for analytical purposes (Salafsky *et al.* 2008). This is a hierarchical classification of the drivers of species decline, where assessors are asked to indicate the threats that triggered the listing of the taxon. Following a hierarchical structure, all species are coded for 3 levels of specificity from more generic to more accurate description of threats. For instance, a Level 1 generic threat like 'Agriculture & Aquaculture', incorporates many Level 2 categories, an example of which would be 'Livestock farming and ranching' and Level 2 threats are similarly broken down into multiple more specific Level 3 categories, for example 'Small-holder grazing, ranching or farming'.

The timing, scope, and severity of threats to species are regularly assessed in order to determine the level of impact. High impact threats affect the majority of the population and cause rapid declines, while low impact ones affect the minority and cause slower, albeit still significant, declines. More detailed information on IUCN threat classification and how threat impact scores are calculated visit http://datazone.birdlife.org/species/spcthreat.

It is worth noting that aside from the more proximate human impacts represented in the below analysis of IUCN threats data, there may be many other stressors or limitations preventing recovery of raptor populations. Therefore although the threats outlined below may indicate many of the conservation responses that will be required to improve the fortunes of migratory raptors, there may be other actions required in addition to tackle more insidious limitations like low prey availability or to reduce limitations like nest site availability to encourage population increase.

It is worth noting that some of the categorisations of threats in Salafsky *et al.* (2008) used by all IUCN Red List authorities for all taxa, are not ideal for getting the overview of the relative importance of different threats to raptors, particularly at the Level 1 resolution. For example poisoning is an important type of threat impacting raptors, and under the IUCN threat system different types of poisoning fit under different categories of threat. Poisoning from ingestion of prey containing pesticides or rodenticides would be under the level 1 threat category 'Pollution', and within that it would sit under the Level 2 category 'Agricultural and forestry effluents', while persecution using meat laced with poison- would be under Level 1 threat category 'Biological resource use', and within this, level 2 category 'Hunting and trapping terrestrial animals'. Similarly electrocution and collision with powerlines is under Level 1 threat category 'Transportation & service corridors', and within this, level 2 category 'Utility and service lines' while collision with wind energy infrastructure sits under Level 1 threat category 'Energy production & mining', and within this, level 2 category 'Renewable energy'. The overview of

threats important for raptor species below should therefore be interpreted alongside the information on IUCN threat classification https://www.iucnredlist.org/resources/threat-classification-scheme.

In the section below, graphs represent the most severe threats (i.e., those threats with the highest impact scores) per species. However, some species do not have any threats scoring as high or medium, so the highest severity of threat for some species may be categorised as low-level impact. On the other hand, one species may have several threats recorded with the same level of impact, thus several threats will be represented for that species. In the graphs that follow, three different group of species are included: Annex 1 (all species included in the Raptors MOU), Category 1 (species from Annex 1 categorised in Annex 3, Table 1 as threatened or Near Threatened), and Category 2 (species from Annex 1 not qualifying in Annex 3, Table 1 for Category 1, but with unfavourable status at regional level). When ordering threats on the graphs, the focus is on those with medium and high impact since these are likely the threats with greatest influence on the species conservation status. Further information and explanation of the threats to particular species can be found by searching for the species on the BirdLife data zone http://datazone.birdlife.org/home

Threats important for Annex 1 species

Considering Level 1 threats, the most general category, Annex 1 species appear to be affected by three main threats: 'biological resource use', 'agriculture & aquaculture', and 'transportation & service' (Figure 12). Table 1, Category 1 species (the threatened and Near Threatened component of Annex 1) follow a very similar pattern with the same three threats appearing to be the most important (Figure 13). As noted above, the 'transportation & service' category has high importance because this category encompasses power line collision and electrocution.

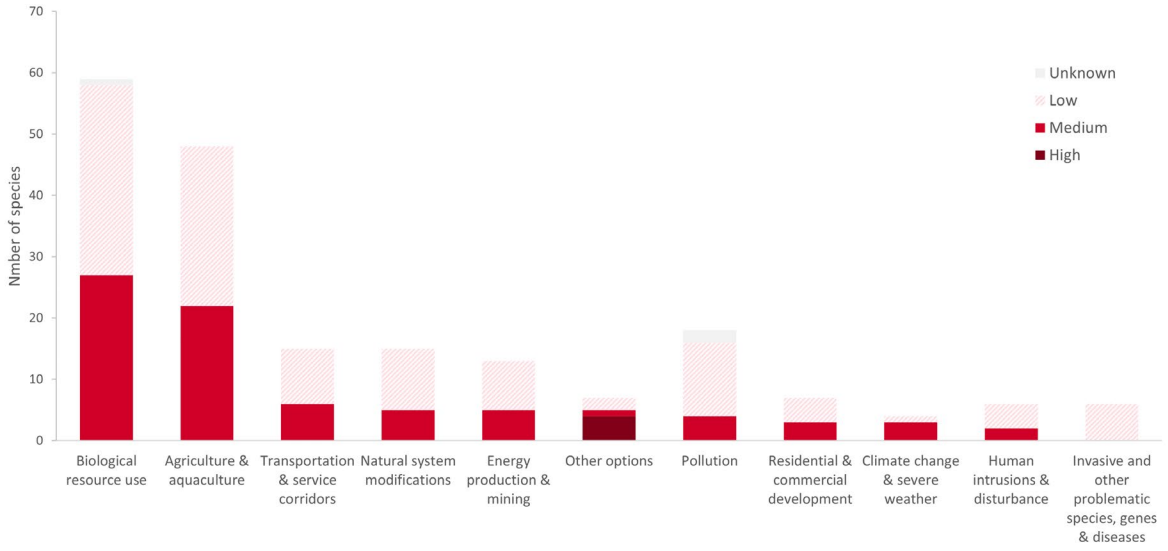

Figure 12. Highest impact Level 1 threats for Annex 1 species.

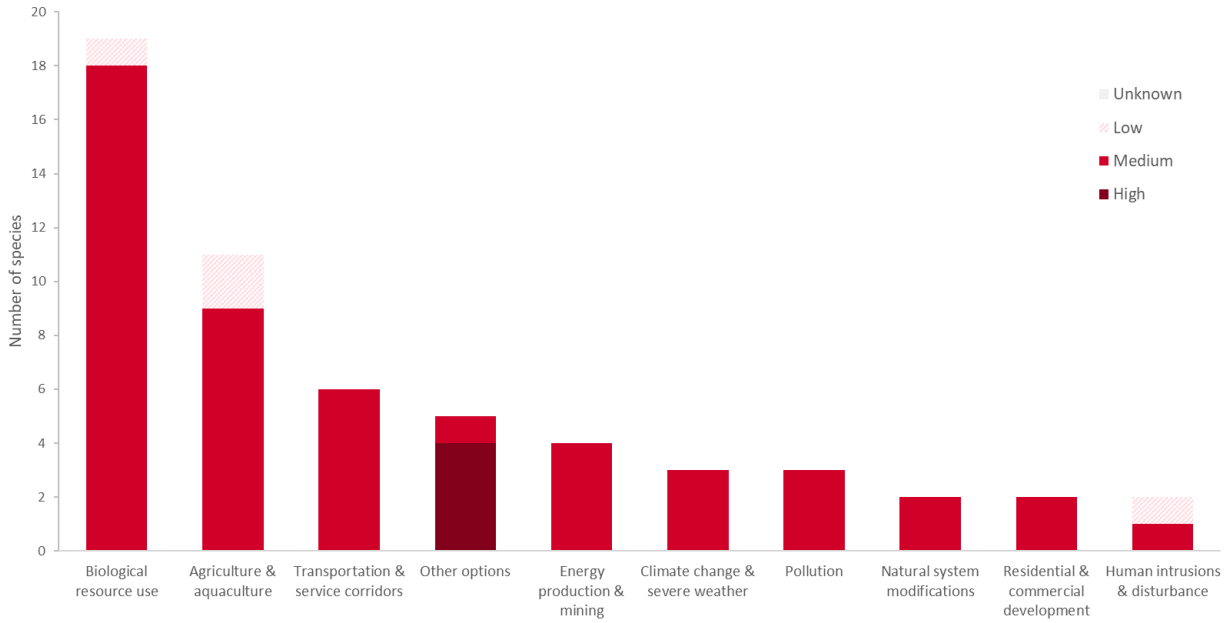

Figure 13. Highest impact Level 1 threats for Table 1 Category 1 species.

When focusing at higher resolution on Level 2 threats, for Annex 1 species the most frequent highest impact threats across species are: 'annual & perennial non-timber crops', 'hunting & trapping terrestrial animals', and 'logging & wood harvesting' (Figure 14). A similar pattern is found for Table 1 Category 1 species with the same three threats on the top positions (Figure 15).

'Annual & perennial non-timber crops' as a level 2 threat relates to loss of habitats important for raptors, such as the conversion of grasslands and forests which are rich in prey and nesting opportunities to agricultural crops which may have very limited value to many species of raptor. This is a very widespread problem affecting most Annex 1 species, so it is not surprising that this emerges as the top level 2 threat to Annex 1 species. 'Logging and wood harvesting' also relates to habitat loss where the primary motivation for the removal of the trees is to use the timber. Many Annex 1 species use woodland habitats and even species more associated with open country may rely on woodland edges for nest sites, hence the importance of this threat.

'Hunting & trapping of terrestrial animals' includes intentional and non-intentional motivations. It is the second most important level 2 threat for Annex 1 species and the top threat for the most threatened species in Category 1 of Table 1. Within this category are a variety of threats affecting raptors, from poisoning[5] (including intentional persecution of raptors for 'predator control/ livestock protection', poison put out for perceived 'problem animal'

[5] https://www.cms.int/raptors/en/page/illegal-poisoning

targets like carnivores, for ‘sentinel poisoning’ at big game carcasses or ingestion of lead from shot prey) to illegal shooting of raptors, taking of raptors like vultures and owls for belief-based use and unsustainable/ illegal trapping of falcons. Old World vultures, as obligate scavengers are particularly vulnerable to both targeted and unintentional poisoning and are killed by poachers, poisoned when they feed on deliberately poisoned carcasses or baits put out for carnivores (Buechley and Şekercioğlu, 2016; Ogada *et al*., 2016; Botha *et al.* 2017) and killed for belief-based uses including ‘traditional medicine’ (Buij *et al.* 2015). There is also increasing evidence that, like New World vultures, Old World vultures may in some places at least be exposed to high levels of lead poisoning through spent hunting ammunition (Garbett *et al.*, 2018).

Attraction of raptors to high concentrations of agricultural pest species may expose them to direct contact with pesticides and secondary poisoning through ingestion of insect, bird or mammal prey poisoned with insecticides, avicides and rodenticides (Keith and Bruggers 1998; McWilliam and Cheke 2004; Thomsett 1987). This threat fits into the IUCN threat classification scheme under level1 threat ‘Pollution’ and level 2 threat ‘Agricultural and forestry effluents’ which does feature in Figure 13, but there are likely considerable knowledge gaps regarding the scale of impact on raptor populations, so it may be of greater importance than its position in Figure 14 suggests.

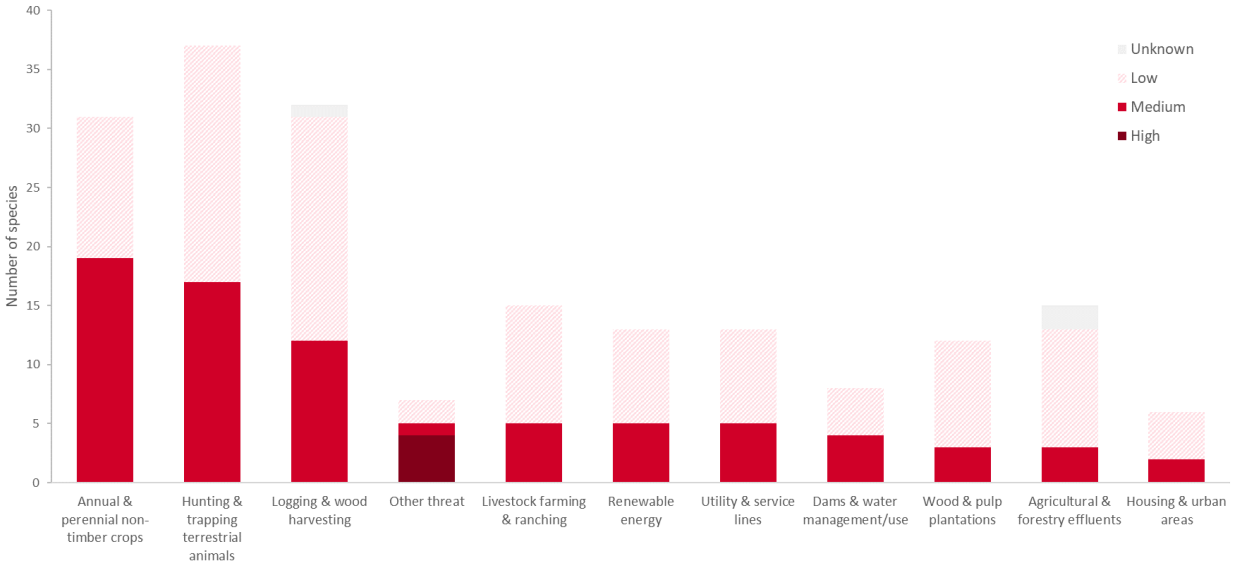

Figure 14. Highest impact Level 2 threats for Annex 1 species

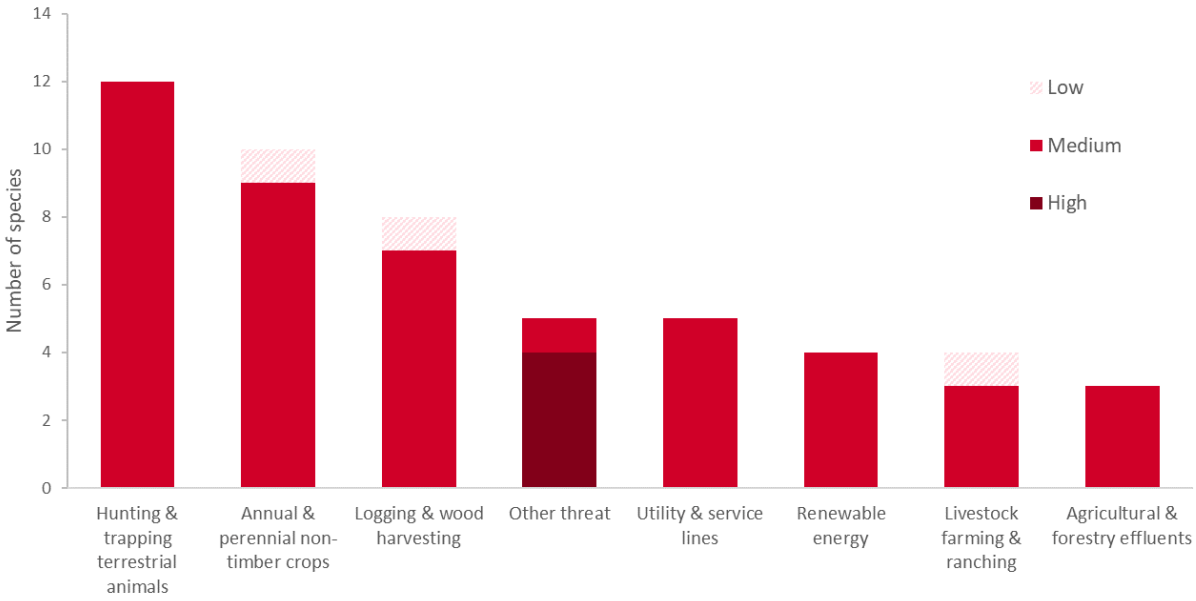

Figure 15. Highest impact Level 2 threats for Category 1 species.

Both for Level 1 and Level 2 threats[6], focusing on the threatened and Near Threatened Category 1 species, as would be expected, a higher proportion of threats associated with these species are recorded as being medium or high impact compared to Annex 1 species as a whole.

Four species have a high impact threat recorded, corresponding to the 'other threat' category. These species are White-rumped Vulture *Gyps bengalensis*, Indian Vulture *Gyps indicus*, Slender-billed Vulture *Gyps tenuirostris*, and Red-headed Vulture *Sarcogyps calvus*. This threat is related to the use of NSAIDs (Non-Steroidal Anti-Inflammatory Drugs) for veterinary purposes; many of these drugs are toxic to Old World vultures, as well as other raptor species like *Aquila* eagles and potentially some kite species when they feed on carcasses of livestock previously treated with these drugs[7]. Many veterinary NSAIDs currently in use and being licensed for use have not been safety tested on scavenging raptor species, so it may emerge that more groups are affected. Important progress has been made, particularly in limiting the veterinary use of diclofenac in some Asian countries, but significant challenges remain to reduce the impact of NSAIDs on vulture populations in Asia (Cuthbert *et al.*, 2016; Margalida and Ogada, 2018). In spite of the knowledge gained from the vulture crisis in Asia, diclofenac has been licensed for veterinary use in a number of European Union countries (Margalida and Ogada, 2018) and concerns remain that carcass management measures in place may not mitigate the risk that NSAID-contaminated carcasses could be consumed by vultures. The NSAID flunixin has been found in dead Griffon vultures with post-mortem signs of kidney failure in Spain (Zorilla *et al.* 2014) and more recently a Cinereous Vulture died on the nest in Spain, having ingested diclofenac (Herrero-Villar *et al.* 2021)

[6] Additional graphs depicting threats to Category 2 species are included in the Annex to this document
[7] www.cms.int/raptors/en/page/non-steroidal-anti-inflammatory-drugs-and-vultures

The 5th and 6th highest impact threats to Category 1 species relate to energy, specifically electrocution and collision with power infrastructure[8] and collision with wind turbines and associated infrastructure[9]. Many raptor species are electrocuted on powerlines and poles, mostly at poles when they bridge live components. In some cases the behaviour of raptors makes them prone to collision with power infrastructure (for example vultures vision is set up to scan the ground below rather than to look ahead, which increases their vulnerability to collision (Martin *et al.* 2012. Power infrastructure in open landscapes can provide an attractive elevated perch or nest site opportunity for raptors, bringing them into close contact with electrified elements. Some species of raptor are particularly affected by electrocution and collision, for example Saker Falcon suffers very high electrocution mortality rates[10] (Kovács *et al.* 2014), vulture species are affected by both electrocution and collision and some eagles like Steppe Eagle appear to suffer high mortality rates from these threats also. Bird safe designs and appropriate routing using sensitivity mapping[11] can avoid or minimise the risks, but in many countries globally, designs of power infrastructure known to be dangerous to raptors and other birds are still being used for new infrastructure and there are many dangerous powerlines and poles causing high mortality of raptor species which urgently need mitigation[12] to be applied.

IUCN threats pertain to the full range of the species, but further information on the relative importance of different threats for migratory raptor species at regional level is needed to tailor conservation priorities. It is also of note that there may be variation in the importance of different threats for subadult versus breeding age individuals. In many raptor species post-fledging mortality is expected to be relatively high as young birds leave their natal territories, but the movements of sub-adult birds are often quite wide ranging potentially bringing them into contact with threats that are less important for adult birds.

Regional understanding of threats

Europe

With the historical expansion of human popuations in Europe, habitats have gradually transformed from natural wild areas to settlements, roads, managed woodland, rivers and lakes, farmed land and pasture (BirdLife International 2021). Some species benefited, but many species have been gradually displaced. Some Annex 1 species like the Red-footed Falcon have suffered from significant loss of their food supply due to excessive use of pesticides in agriculture, which add to threat factors such as persecution and infrastructure intensification. Species monitoring has been indispensable in understanding these drivers of decline over time, and has contributed to the assessment of species' risk of extinction. As a result, informed decisions to undertake conservation actions like legal protection, ceasing the use of certain chemicals, or creating new nesting opportunities for birds have resulted in halting declines in certain species e.g., Peregrine Falcon or Red Kite (BirdLife International 2021).

[8] https://www.cms.int/raptors/en/page/electrocution
[9] https://www.cms.int/raptors/en/page/collision
[10] https://birdelectrocution.org/
[11] One such example is AVISTEP: https://avistep.birdlife.org/
[12] An interactive guide to mitigation can be found here: http://datazone.birdlife.org/info/transmit

Africa

Amar *et al.* (2018) flagged that raptor populations in Africa are being impacted by myriad threats including habitat loss as a result of rapidly growing human populations, rampant poisoning, persecution and impacts of development such as growth of the energy sector. They highlighted that human pressure on landscapes had greatly altered their function and capacity to support wildlife including raptors and their prey throughout the continent and suggested that although raptor declines had also been noted in well-known protected areas, the strongest and most widespread declines were reported from unprotected rural areas. Thiollay (2006). highlighted particularly high human pressure in west African savannas, which used to support some of the richest raptor communities, but are now greatly impoverished. Amar *et al.* (2018) underline that different raptor species are affected in different ways, with some species benefiting from conversion to farmland, but they assert that for the majority of species agricultural expansion and intensification reduces food availability and nesting habitat. The authors underline the concern that use of pesticides and other poisons associated with cultivation kills an undocumented number of raptors, with quelea and locust control likely to have significant but unquantified effects on some raptor species. Contamination of water bodies is likely to have an effect on piscivorous species like Osprey. Deliberate use of poisons to kill raptors for consumption (Amar *et al*. 2018) is potentially an issue for both raptors and human health. Other barely documented threats include accidental drowning of raptors in farm reservoirs in Southern Africa (Anderson 2000). Amar *et al.* (2018) highlight the predicted growth in Africa's energy sector, and the impacts of climate change as growing areas of threat. They explain that poorly sited or designed energy infrastructure is an increasing problem for many raptor species. One power line in Sudan may have caused the death of enough migratory Egyptian vultures to partially explain their population declines (Angelov *et al.* 2013). USAID Power Africa's[13] plans to greatly expand energy infrastructure in a number of African countries could potentially push susceptible species like African vultures, already facing a barrage of threats, further down the road to extinction. Oppel *et al.* (2022) reported that rapid expansion of power infrastructure planned in Ethiopia could result in more than 20 000 km of low and medium voltage powerlines of a design already causing significant mortality to raptors in Ethiopia. If a bird-safe design was not used in construction of this new network, coarse extrapolation suggests that more than 3,000 vultures (and many other raptor species) could be killed every year by this new network alone, not counting the annual mortality toll of existing infrastructure. Meanwhile ambitious plans for renewable energy expansion is leading to concerns about impacts of wind energy on African bird species, including raptors. Amar *et al.* also highlight concerns about large eagle species in Africa which are sensitive to both human disturbance and persecution. There are clear knowledge gaps about the trajectory of many species but what information is available suggests declining eagle populations both inside and outside of protected areas (Thiollay 2007,Thomsett 2015), with Thiollay reporting that several species were already not recorded outside protected areas back in 2006 (Thiollay 2006).

The recent Red List assessment of North African breeding raptors (Garrido *et al.* 2021) concluded that current main threats to North African breeding birds of prey are illegal killing, illegal trade, poisoning, and mortality from

[13] https://www.usaid.gov/powerafrica

infrastructure such as power lines, which are reducing breeding populations. Another important threat was use of pesticides and rodenticides in agriculture, which can have a negative impact on breeding success, reduce prey density and lead to secondary poisoning by consumption of contaminated carcasses. Loss of forest habitats, agroecosystems and wetlands due to the growth and spread of the human population was another major threat flagged to breeding raptors in the North African region likely affecting most of the species present there.

In southern Africa Taylor *et al.* (2015) flagged that the main threats to raptors in the region were loss of habitat, persecution, indiscriminate and deliberate poisoning (a particularly acute threat for vultures), collisions and electrocutions. They highlighted that the increasingly restricted and fragmented nature of many bird habitats in the region was cause for great concern, as was the increasing restriction of some raptor species to protected areas. Poisoning, whether direct or indirect, was identified as one of the major threats faced by scavenging raptors in the region. For vultures poisoning associated with big game poaching, persecution of animals perceived as a problem (often carnivores) and trade in vulture parts for belief-based use were identified as key issues.

At a grass roots level, farmer outreach and awareness programmes and engaging with local communities was seen as essential. Law enforcement and conservation agency officials were identified as needing greater awareness of the impact of poisoning events and training on the use of agrochemicals and poisons as well as the management of sites where vultures had been poisoned. Appropriate action against perpetrators is reliant on a strong chain from public awareness to report incidents, to appropriate action and management of evidence by enforcement authorities and awareness of the judiciary to apply appropriate penalties.

Taylor *et al.* highlighted that electrocution and collision is another key threat to raptors in southern Africa and that the increase in wind farm development applications may have potentially serious impacts on raptors in future.

They also pointed to decreasing prey base as an issue for raptors, with overstocking of domestic livestock, hunting or gradual displacement of wild ungulates and extermination of large predators, especially in the semi-arid rangelands of central South Africa, along with more effective and hygienic livestock husbandry resulting in a decreased food supply to scavenging raptors such as vultures, Bateleurs (*Terathopius ecaudatus)* and Tawny Eagles. At lower trophic levels, they flag that habitat degradation and widescale application of pesticides had almost certainly resulted in lower abundance of invertebrate and small vertebrate prey for raptors.

Ogada *et al.* (2016) concluded that mitigation of the scale of raptor declines will need commitment from African governments and conservation communities to save species on the verge of collapse.

Asia

In Asia, land-use change has been singled out as the most significant threat to raptor populations (Concepcion *et al.* 2018). Land-use change has knock-on impacts on populations of prey species and exacerbates the threat of human persecution given that raptors are forced to used anthropogenic landscapes more regularly.

Environmental contaminants and secondary poisoning also severely impact Asian raptor populations, with the most well-known example being the impact on several species of vultures in South and Southeast Asia by diclofenac (Schulz *et al.* 2004) and other NSAIDs[14]. Trapping (often illegal) is widely acknowledged to be a major threat to raptor populations in the East Asian Flyway (Yong *et al.* 2021). Illegal and unsustainable trapping in Mongolia, China and Russia to supply falconry and taxidermy markets outside the region has contributed to considerable declines in Saker Falcon (Kovács *et al*. 2014) and several other falcon populations (Gombobaatar *et al*. 2004, Lobkov *et al.* 2011). In Russia, Lobkov *et al.* (2011) reported that thousands of falcons were illegally caught for export in 2012–2016 and trade in falcons has increased since 2006 (Wyatt2011, Krever and Ivannikova 2020). In Southeast Asia, raptors including various migratory species are commonly traded in pet shops or on social media platforms (Paridi and Noske 2017). Other threats including poison-baits (targeting mammalian carnivores such as dogs, large cats etc) and power infrastructure (electrocution and collision) are potentially significant threats particularly for vultures but also other raptor species. These last threats are particularly important in Saudi Arabia (Shobrak et al. 2020) and probably elsewhere in the Arabian Peninsula.

In India, SoIB (2020) relates that conversion of natural habitats for primarily human use happens in nearly all habitats. Hunting and trapping for food or the pet trade is described as a threat to many species in India. Environmental toxins (like the veterinary drug diclofenac) are cited as the cause of the most precipitous decline of any group of birds—the *Gyps* vultures. SoIB (2020) suggest that hunting/trapping and environmental toxins may have a greater effect in India than is currently fully understood and they state that when specific species are targeted (e.g. for the pet trade), hunting/ trapping has the potential to drive those species to such low population sizes that they become vulnerable to extinction from other causes. Although the acute effect of NSAIDs on vultures is now well known, SoIB (2020) highlights the possibility that chronic exposure to other toxins, for example neonicotinoids and pesticides, could pose major threats to the populations of a number of species.

9. Understanding threats to raptors from tracking individuals

IUCN threat assessment provides an overview of known threats at species level taking account of what is known of the threats impacting the species across its whole global distribution. This broad scale method of assessment can potentially obscure flyway or regional level variation in threats and it is also important to recognise that there can be a time lag between threats becoming a problem for a species and those threats being recognised by experts and/ or reported in the literature. Therefore 'real time' information on what is causing mortality of raptors is a very valuable addition to complement the IUCN threat assessment.

The rapid increase in use of tracking technology and the increasing amount of information tracking devices can deliver mean that researchers who may be tracking species for a variety of different reasons have access to

[14] Non-steroidal Anti-inflammatory Drugs and vultures | Raptors (cms.int)

information on mortality of great utility for understanding threats and setting conservation priorities. In a wide collaboration coordinated by BirdLife International[15], Serratosa *et al.* (in prep.) compiled information on human-induced and natural mortality events for large migratory landbirds tracked in the African-Eurasian flyway. For the human-induced causes of death this included 251 mortality events involving individuals of Accipitridae and 151 mortality events for vulture species (Figure 16).

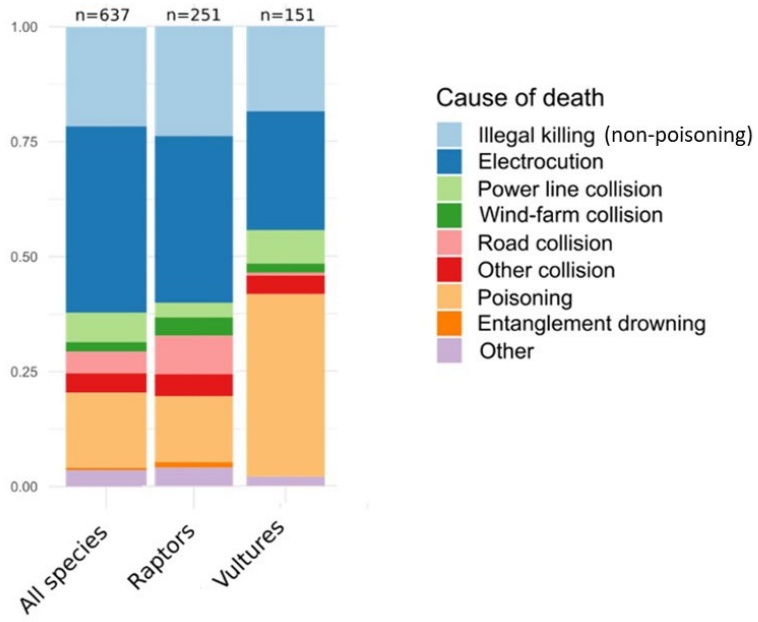

Figure 16. Human-induced causes of mortality for raptors and vutures calculated from all known human-induced causes of mortality (reproduced with kind permission of Serratosa *et al.*)

For raptors (excluding vultures) the primary identified cause of mortality was electrocution accounting for more than a third of mortality events, followed by illegal killing (non-poisoning) accounting for one quarter of mortality events with poisoning being the third most prevalent cause of mortality. For vultures, poisoning was the main cause of mortality accounting for almost 40% of deaths followed by electrocution and illegal killing (non-poisoning).

Although Serratosa *et al.* (in prep.) only examines mortality in the African-Eurasian flyway, comparing this information with the global IUCN threat analysis provides some interesting insights. Illegal killing and poisoning (depicted under 'Hunting and trapping' in Figure 14) is recognised by both analyses, but electrocution appears to be a much more important cause of mortality in Serratosa *et al.* than is recognised in the IUCN threat assessments. One possibility is that it is an under-documented threat. This seems quite likely, given that power infrastructure runs through many landscapes with low densities of people and little monitoring of this threat is in

[15] Funded through the MAVA Safe Flyways Energy project

place in many countries. It is also possible that electrocution is somewhat 'over-represented' in Serratosa *et al.* because there remains an (albeit reducing) lower threshold on the size of bird that can safely carry the kind of tags that can deliver mortality information and larger species are more likely to bridge live components of power infrastructure and therefore suffer electrocution. Increased monitoring of the impact of power infrastructure on birds will be required to have a clear picture of the relative importance of this versus other threats for migratory raptors.

Oppel *et al.* (2021) took a similar African-Eurasian flyway wide approach to assessing mortality from satellite tracking data specifically for Egyptian Vulture and found that mortality causes varied geographically. Inadvertent poisoning from rural stakeholders targeting predators occurred along most of the flyway and on breeding grounds in eastern Europe and Saudi Arabia, poisoning and collision and electrocution were the priority threats. Electrocution on small and poorly designed electricity pylons was the priority threat in Turkey, Jordan, Egypt and Ethiopia. Direct persecution for belief-based use was the priority threat in Nigeria and Niger, while other illegal killing was the priority threat in Lebanon and Syria.

Further work to analyse satellite tracking mortality information would be informative, and extension of this approach in Central and East Asian parts of the MOU range could provide useful insights to help direct conservation action.

10. Other limitations on population growth and recovery

It is worth noting that aside from the more direct threats represented in the above section, there may be many other stressors or limitations preventing recovery of raptor populations. For example many raptors may be limited in some way by low food availability, with many factors limiting their prey base (Taylor *et al.* 2015). Botha *et al.* (2017) considered this issue significant for vultures in Africa and South-east Asia and relevant in Europe, but not a significant threat in South Asia. Kovács *et al*. (2014) considered that grassland habitat conversion and changes in grazing regime among other factors had likely affected the prey base for Saker Falcons. These kinds of stressors may be difficult to address in the short term.

Some raptor populations may be limited by availability of nest sites on breeding grounds. Depending on the species, some migratory raptors nest in trees, or cavities, some on cliffs or on the ground and some use abandoned nests of other species. Provision of artificial nest sites such as pole-mounted platforms or nest boxes (for example Rahman *et al.* 2016) can increase breeding density where nest sites are in short supply or indeed increase breeding success and productivity in some cases. Both can have a positive effect at population level. When formulating conservation actions for migratory raptor species, it may be necessary to consider both actions to address direct and indirect threats and more pervasive stressors.

All those above may directly or indirectly be connected to climate change, which is perhaps the biggest unknown factor affecting population sizes and trends of raptor species. Extreme weather phenomena resulting from climate change, especially when they occur in the breeding season may affect populations rapidly and directly. At the same time, the gradual, but continuous change of climate and parallel changing local weather patterns, habitat distribution, prey populations, etc. due to shifting climate is likely having significant impact on the distribution range, sizes, trends, behaviour, breeding phenology, etc. of raptor populations (Martinez-Ruiz *et al.* 2023). In the long term, these factors may have an impact on the conservation status of raptors which is equal to, or potentially even greater than, that caused by other major threats. Therefore, long-term monitoring of species including habitat monitoring, and evaluating data in the light of climate change is very important.

11. Important sites

Annex 3 Table 3 of the Raptors MOU recognises internationally important sites for migratory raptors listed on Annex 1 and an expanded Table 3 first presented at MOS2 is under discussion at MOS3. Further analysis related to the site network for raptors will therefore be pended until the next CSAR. Effective identification, management, national designation/ protection where appropriate and monitoring of the sites important for raptors is a vital contribution to securing raptor populations. An effective network of sites for raptors will help meet Annex 1 species needs at all stages of their annual cycle, when breeding, on passage or non-breeding. However a site-based approach to conservation will not serve all species well and for the species which are widely distributed through the landscape at low density, or the stages of their annual cycle where this is the case, wider policy measures are likely to be required.

12. Habitats

Migratory raptors are found in a very wide variety of different habitats. While some individual species, like Merlin, are able to exploit a variety of habitat types, others, like Northern Goshawk or Marsh Harrier are more specialist. Many migratory raptor species have quite specific nest site preferences, for example many species show a preference for cliff nesting, but it is worth noting that nest site choice is also influenced by degree of disturbance or persecution experienced by the population and many species may be capable of utilising a wider range of breeding sites than they are currently demonstrating. BirdLife International records the habitats used by the world's bird species following the standard terms used in the IUCN Red List Habitats (Version 3.1) https://www.iucnredlist.org/resources/habitat-classification-scheme, with a similar hierarchical structure of two levels as previously showed for threats. The two levels of the hierarchy are self-explanatory, as they use familiar habitat terms that take into account biogeography and latitudinal zonation. Moreover, each habitat is scored regarding its importance for the species as suitable, major, marginal, or unknown. For this report, only habitats

recorded as ‘suitable’ and ‘major’ are included. ‘Suitable’ meaning that the species occurs in the habitat regularly or frequently and ‘major’ meaning that the habitat is suitable, and furthermore it is important for the survival of the species.

Three groups of species were included in the analysis (Annex 1, Category 1, and Category 2). In the graphs habitats are presented in order of decreasing total number of species for which that habitat is considered of major importance.

Regardless of the different groupings, four habitats share the top positions of importance: forest, grassland, savanna, and rocky areas (Figures 17 to 19). This result highlights the great importance that these types of habitats have for a large proportion of species included in the Raptors MOU and thus the relevance of their conservation. Additional graphs covering level 2 habitats can be found in the Annex to this document.

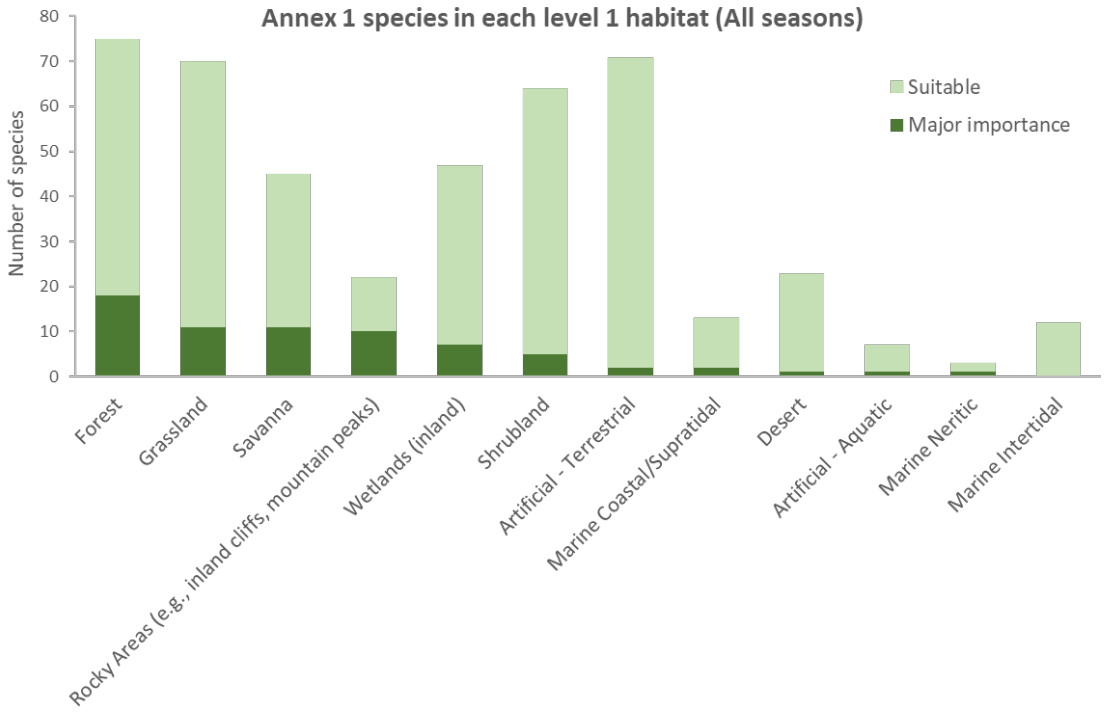

Figure 17. Level 1 Habitat preferences for Annex 1 species.

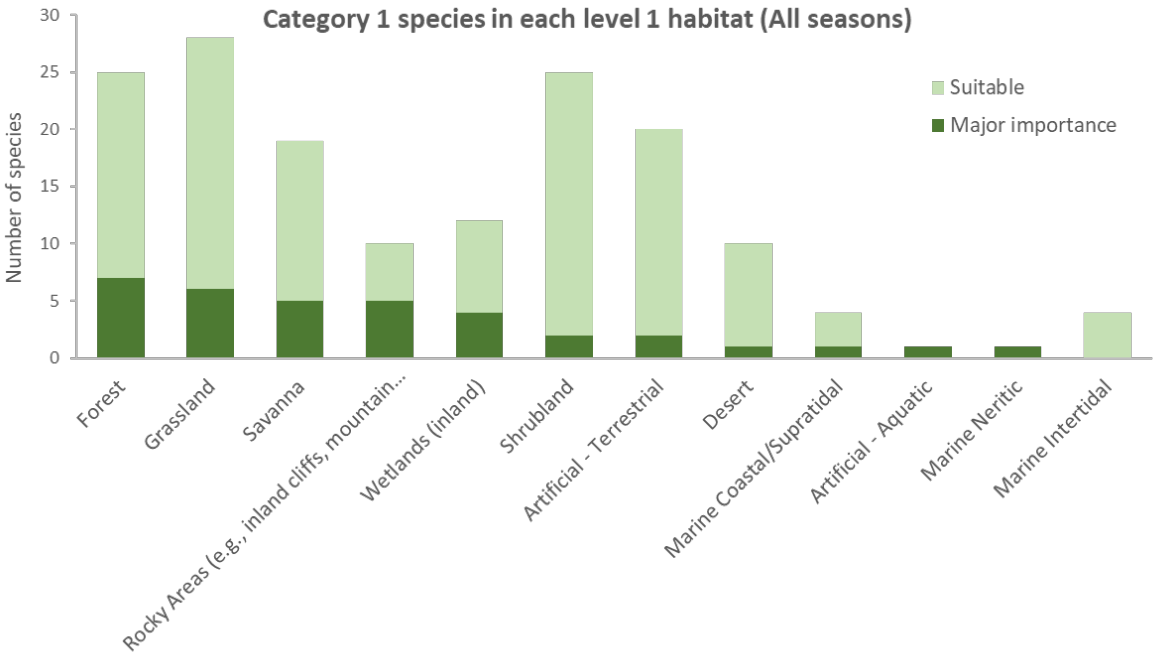

Figure 18. Level 1 Habitat preferences for Category 1 species.

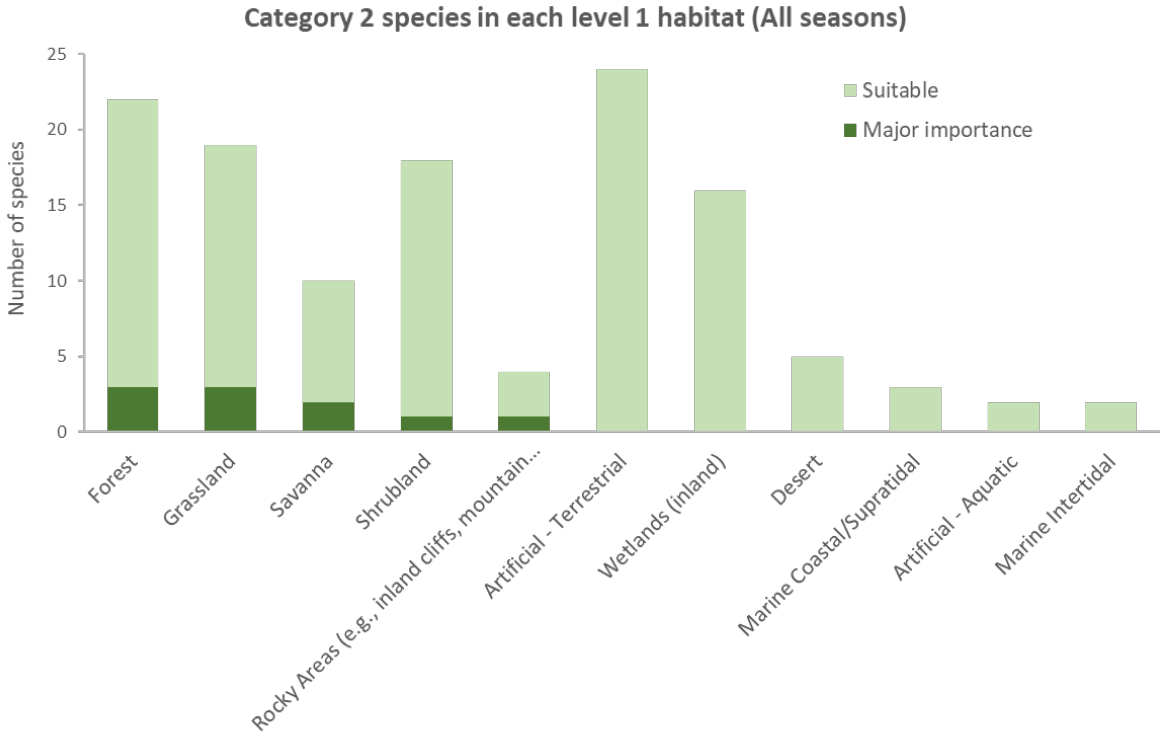

Figure 19. Level 1 Habitat preferences for Category 2 species

13. Migratory routes

Migratory raptors frequently use thermals over the land to aid their flight on migration and generally minimise flight over large bodies of water because of its energetic costs. Their migratory routes are also influenced by topography both because favourable updrafts that aid energy efficient migration can be associated with topographic features such as ridgelines for example and because high mountain ranges can act as a barrier.

The combined effect of these behavioural, physiological, topographical and geographical factors can mean that most of the population of some raptor species can be funnelled along narrow routes or concentrated over a few weeks of the year in restricted areas of land known as bottlenecks. Examples of such routes used by large numbers of raptors in the Rift Valley-Red Sea flyway would be birds migrating from more northerly breeding grounds along the western shore of the Gulf of Aqaba, continuing through Saudi Arabia to cross into Africa at the bottleneck of the Bab el Mandeb Strait between Yemen and Djibouti. Another important route would be through the Levant, northern Sinai and down the eastern coast of the Gulf of Suez, continuing down the eastern coast of Egypt. In the western side of the African-Eurasian flyway, an important crossing point and associated bottleneck would be the Straits of Gibraltar between Spain and Morocco. Within the African-Eurasian flyway there are many more such important routes and bottlenecks (Porter 2005, Buechley *et al*. 2018, Jobson *et al.* 2021).

The concentration of migratory raptors in particular geographic areas on migration means that threats such as illegal shooting, construction of barriers or poorly sited energy infrastructure, if located in these areas, can potentially have a disproportionately large impact on raptor populations, undermining conservation efforts and investment in other parts of the flyway.

Our understanding of the movements of raptors is improving all the time and advances in tracking technology mean that it is becoming more feasible to track even the smaller species of raptor, improving our understanding of which species can be considered migratory, where different populations go at different times of year, and helping to identify and locate threats important for different species. Tracking technology is now regularly being used to give real-time information on the status of tracked individuals and there have been many cases of sick, injured or otherwise grounded tagged birds being rescued and rehabilitated, often through international cooperation. This may be particularly important in the case of globally threatened species where the loss of even a few individuals can have population level effects. Tracking technology is also providing information helpful in some cases for locating, identifying and prosecuting criminal activity (for example Murgatroyd *et al.* 2019, Ewing *et al.* 2023).

14. Conservation actions

In its role as IUCN Red List Authority for birds, BirdLife International documents and categorises the conservation actions required to safeguard all globally threatened and Near Threatened species across the species' range. Analysing the most recent information on conservation actions from the data associated with the 2022 IUCN Red List assessment, the most frequently reported conservation actions needed across Annex 1 species are in the categories of site/area management, awareness and communications, site/area protection, legislation, compliance and enforcement and policies and regulations (Figure 20). For the most threatened species, the Critically Endangered species, ones, species recovery and ex-situ conservation actions are also frequently reported to be required.

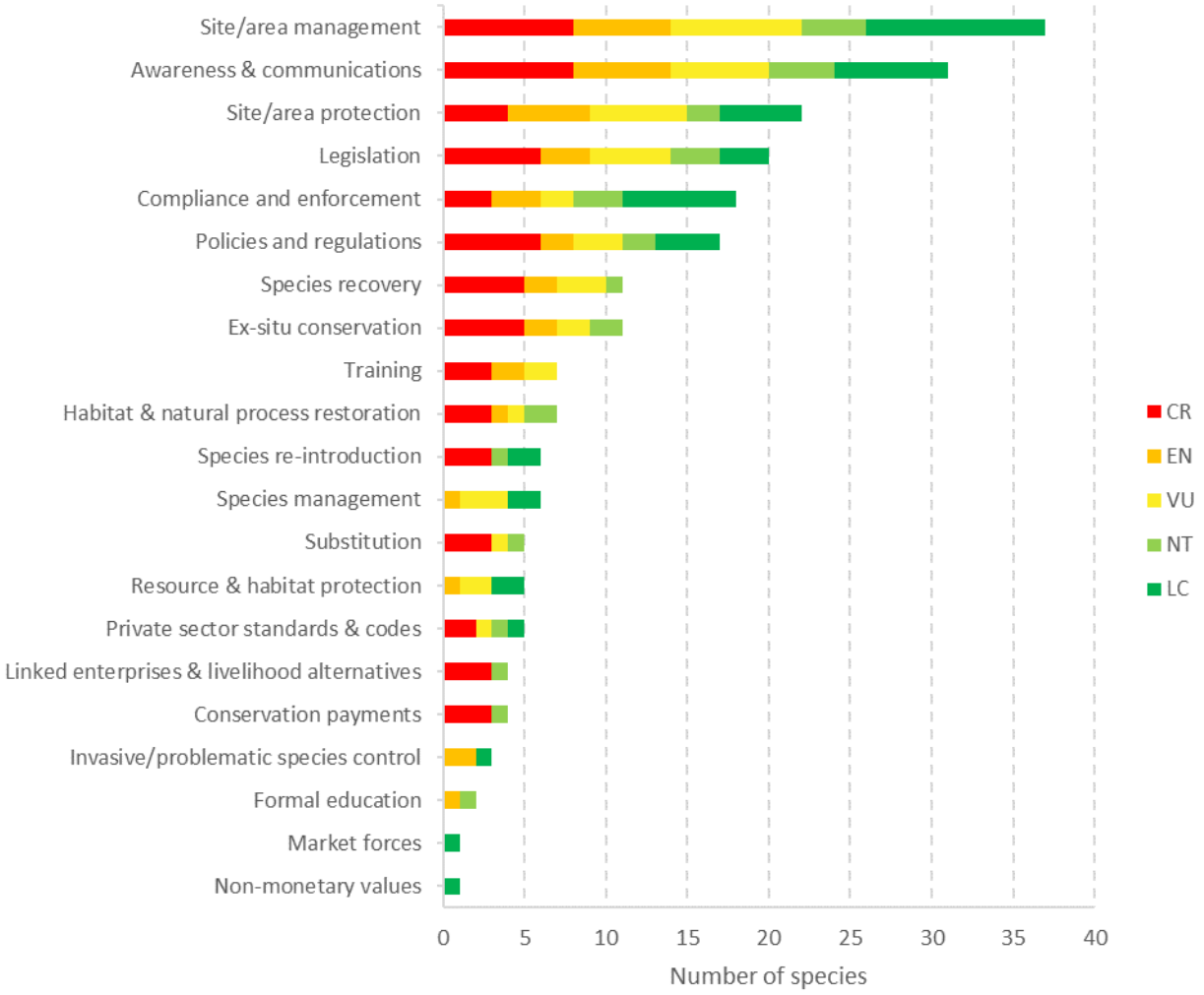

Figure 20. Assessment of conservation actions needed for Annex species 1 in relation to their IUCN Red List status.

In Europe the biodiversity protection framework has contributed to the successful recovery of many threatened species and protection and restoration of key habitats (BirdLife International 2021). These have arisen thanks to the establishment of a network of protected areas, collaboration to conserve sites and to take action for species often across borders. Yet, the authors suggest effort has to date been insufficient. Therefore, future conservation efforts in Europe should seek to deliver more fundamental change at a bigger scale. Collaboration between decision-makers and conservation practitioners should be expanded while securing greater involvement from consumers, producers, landowners and other businesses. (BirdLife International 2021).

McClure *et al.* (2018) highlight similar priorities in terms of conservation actions to protect raptors include preventing mortality and conserving key sites and priority habitats. They flag the need to identifying and safeguard important sites for raptor populations, particularly focusing on adequate protection for sites supporting important populations of threatened or declining raptor species. The fact that many raptor populations are

declining even within designated protected areas underlines the need for any designation to be accompanied by appropriate monitoring, management, and, where necessary, enforcement actions. The site-based approach to conservation alone will clearly not be effective and particularly for the many wide ranging raptor species susceptible to poisoning of various kinds, protected areas alone are unlikely to suffice to conserve species (McClure *et al.* 2018).

In Southern Africa, Taylor *et al.* (2015) highlighted the need for grass roots farmer outreach and awareness programmes and engaging with local communities. Law enforcement and conservation agency officials were identified as needing greater awareness of the impact of poisoning events, training on the use of agrochemicals and poisons as well as management of sites where vultures have been poisoned.

In Asia beyond the need to address availability of veterinary diclofenac and other raptor-toxic NSAIDs (Galligan et al 2020), there is a need to address use of poison-baits targeting carnivores and reduce electrocution and collision of raptors with power infrastructure. Additional conservation needs mentioned in SoIB (2020) for India, include the careful regulation and monitoring of environmental toxins, the management and conservation of key habitats that are under-represented in the Protected Area network (like grasslands), and maximisation of the conservation potential of multi-use landscapes within India's conservation planning.

Many of the motivations behind important threats like illegal killing including poisoning of various kinds have their route in lack of awareness and lack of enforcement, so it is not surprising that 'Awareness and communications' and 'Establishing and Enforcing Law and Policy' are frequently recommended categories of conservation action across raptor species. In some cases successful approaches will need to bring local communities on board and balance enforcement approaches with education and awareness approaches that help build alternative livelihoods or address the underlying motivations behind human induced threats to raptors.

McClure *et al.* (2018) suggest that for some species or countries, conservation actions that might bring the most immediate change are to improve legislation, its implementation and enforcement, and implement policy changes, such as improved regulation in the use of poisons or mitigation of dangerous powerlines. They also flag the importance of implementation of recommended actions in existing international Species Action Plans

such as the Multi-Species Action Plan to Conserve African-Eurasian Vultures (Botha *et al.*, 2017). McClure *et al.* also point to the importance of engagement in Inter-governmental task forces to address specific threats, such as the CMS Energy Task Force and the CMS Intergovernmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean.

Specific guidance and tools already exist to support Signatories in tackling many of the top threats to raptors https://www.cms.int/raptors/en/threats and further exchange of experience between Signatories is an important means of improving practice across the geography of the MOU. Many Signatories have significant experience they could share with other countries and greater international cooperation is needed in fundraising efforts to ensure countries lacking the resources to implement effective conservation measures for raptors can receive support to bolster their activities.

Conservation action for raptors can be highly effective. Indeed, conservation efforts have saved several raptor species from close to extinction (Butchart *et al*. 2006). Reintroductions and effective conservation action have

improved the fortunes of several Annex 1 raptors species (Red Kite and Lesser Kestrel among them) and many more require similar attention.

15. Knowledge gaps

Following the same structure as threats and habitats, associated with the Red List species datasets held by BirdLife International, a hierarchical system is implemented to categorise gaps in our knowledge of species. In the dataset associated with the 2022 IUCN Red List, two thirds of the 94 species included in draft Annex 1 for MOS3 have an assessment of priority areas of research. Figure 21 shows the number of species for which a particular area of research, monitoring or conservation planning has been identified as a priority (several of these areas can be identified for a single species).

Despite the importance of this information in assessing conservation status and tracking effectiveness of conservation action, some of the most frequently highlighted gaps relate to population trends and sizes from both research and monitoring perspectives with most assessed species having this as a priority gap. There is a concerning lack of information on population size and trend for many threatened species. The risk with such gaps in monitoring is that stakeholders may be unaware of deterioration in conservation status, declining populations or extirpations and therefore unable to act in time to take effective action where and when it is needed. Knowledge gaps also mean that stakeholders may be unaware of new or emerging threats until their impacts are very significant.

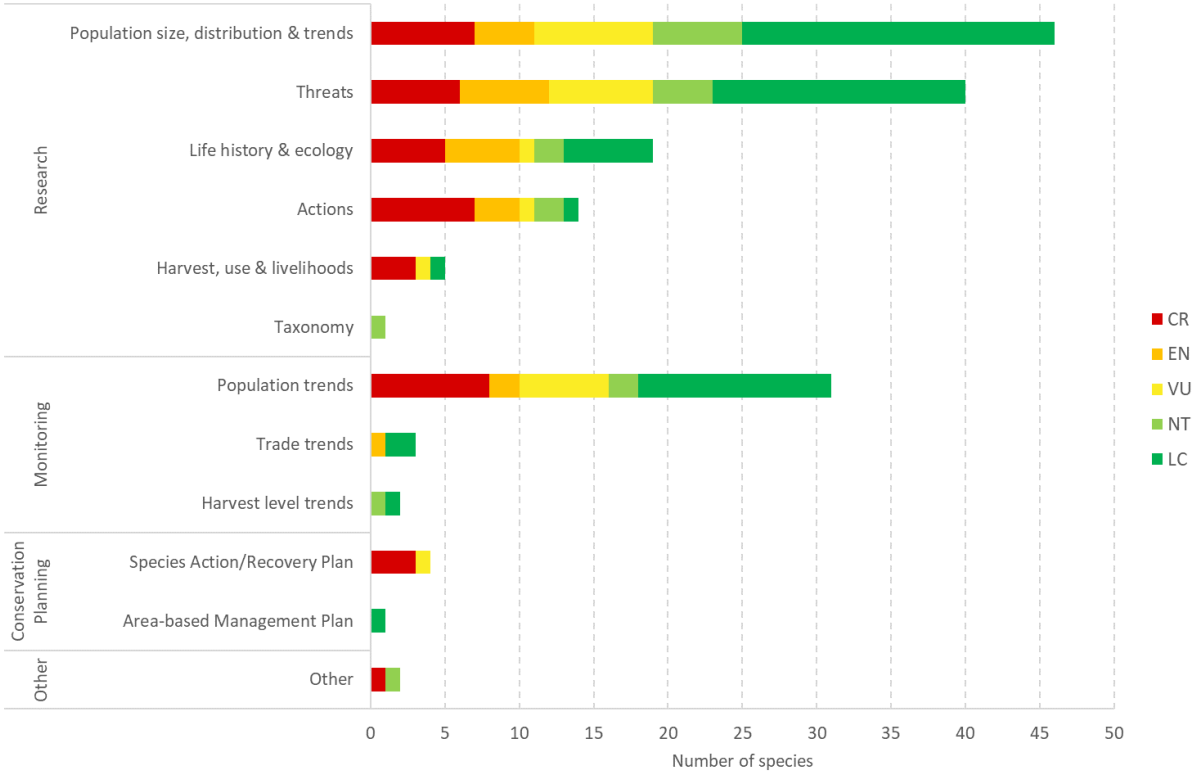

Figure 21. Priority areas of research of Annex 1 species

Ensuring stakeholders have sufficient knowledge to take effective conservation action in time requires monitoring to be in place at least for at least a selection of Annex 1 species across a representative set of areas. McClure *et al.* (2018) highlights the value of improving long-term monitoring for conservation action to be appropriately targeted and effectiveness of interventions to be assessed, an essential element of improving practice.

Research and monitoring is not of course evenly distributed among species; there are considerable biases, as Buechley *et al*. (2019) point out, with the majority of research tending to focus on the largest, most visible and/or 'charismatic' species and already identified issues, in geographic locations where most researchers live and where there is more funding available (Griffiths & Dos Santos, 2012; Martín-López, González, & Montes, 2011). This limits our ability to adequately assess the status of many species and to identify, document and address emerging threats (Martín-López *et al.,* 2011). Buechley et al, (2019) found that ten species (1.8% of all raptors) received nearly one-third of all raptor research (32%), while over one-fifth of all raptors (21%, 116 species) had zero research publications with owls being the least-studied group of raptors. They found that threatened raptors and those with declining populations are less studied. Amar *et al.* (2018) also looked at biases in research, examining the literature on 67 diurnal raptor species that are resident breeders in sub-Saharan Africa. They found more studies in Southern Africa (62%) than in all other regions of Africa combined with East Africa being the next best studied region of Africa with 23% of studies followed by West Africa (12%). Examining their findings from the perspective of Raptors MOU Annex 1 species highlighted nine Annex 1 species with five or fewer publications on them in the literature. Amar *et al.* found most studies focused on feeding ecology and distribution and abundance, with the least number of studies on behaviour and movement ecology. Garrido *et al.* (2021) flagged a significant lack of information on distribution, population size and trends, as well as threats relating to North African breeding raptors, with 42% of the raptor species they assessed having unknown population trends. The authors flagged an urgent need for collaborative research and monitoring in North Africa, especially on the size and distribution of breeding raptor populations and the specific impact of threats on them.

To minimise extinction risk from an emerging threat it needs to be identified rapidly. During the Asian vulture crisis, populations of three Gyps vulture species collapsed by more than 96% in 10 years (Prakash 1999, Gilbert *et al*., 2002), as McClure *et al.* point out, this provides a stark demonstration of the need to detect trends quickly to act and prevent extinction.

The Peregrine Fund's Global Raptor Impact Network (www.globalraptors.org), GRIN has joined forces with the African Raptor Databank to expand globally while adding functionality to track population levels and demography. If adopted by raptor researchers and multi-lateral conventions global monitoring programs such as GRIN could help channel independent researcher efforts to facilitate future Red List assessments, prescribe management actions, and identify critical areas for conservation (McClure *et al.* 2018). Buechley *et al.* (2019) called for a shift in scientific and conservation resources towards developing countries. Greater collaboration on raptor research could be achieved for example through joint funding applications that recognise and channel funds to help bolster monitoring by local researchers including in developing countries, and link the research through to conservation action. These collaborations could lead to more equitable and geographically balanced research capacity and build the skills of an important network of young researchers. Şekercioğlu, (2012b).

suggests that channelling investment from for example European countries towards developing countries could simultaneously promote biodiversity conservation, poverty reduction and socio-political development in the places that need it most.

There is much work to be done to improve coordination of monitoring efforts, but efforts are beginning to build a more cohesive monitoring network in the eastern African-Eurasian flyway to cover some important bottleneck sites on one of the most important flyways, building on the considerable skills of existing researchers, providing experience exchange and sharing guidance. With so many threats facing migratory raptors, stakeholders need to redouble their efforts nationally, and reach out internationally to maximise collective success.

Europe has a long history of data collection and environmental surveillance. Many countries have established surveying and monitoring programmes (e.g. PECBMS) and contribute to international data collection projects (e.g. European Bird Portal), leading to the region having a comparatively good biodiversity knowledge database (BirdLife International 2021). Despite this there are significant geographic, geopolitical and taxonomic biases in the quality of data available on the distribution and status of some species.

Some efforts are underway in some African countries to undertake repeated road surveys and some efforts at repeating nesting surveys, and in terms of systematic monitoring, the African bird atlas project shows great promise. South Africa's Southern African Bird Atlas Project 1 and 2, a successful country-wide citizen science atlas project is in the process of being rolled out in Nigeria and Kenya with the involvement of citizen scientists. It is hoped that this approach can be expanded further and start to fill some of the identified knowledge gaps, while building monitoring capacity.

SoIB (2020) highlights that India needs to expand monitoring efforts to track the abundance and ranges of species, to promote more research to understand causes of population and range change, and to create an enabling framework to respond rapidly to early warnings of decline. In India the Common Bird Monitoring Programme (CBMP) was initiated by the Bombay Natural History Society in 2015 (SoIB 2020). In Kerala – surveys have been underway since 1990 (SoIB 2020). As a result, birds are perhaps better known in Kerala than in any other Indian State. Building on this, the Kerala Bird Atlas was launched in 2015. Over 1,000 volunteer birdwatchers are taking part in the Kerala Bird Atlas. The project uses citizen science and will result in the first-ever systematic bird atlas for any State in India.

Schemes like this will need to be adopted elsewhere in Asia if knowledge gaps are to be filled sufficiently for accurate assessment of conservation status and population trend of migratory raptors throughout their ranges.

16. Comparing Raptors MOU Annexes with CMS Appendices

Since 11 Raptors MOU Annex 1 listed species were added to CMS Appendix I at COP12 in 2017, CMS Appendix I now provides good coverage of Raptors MOU Table 1, Category 1 species. Of the Raptors MOU Table 1 proposed Category 1 species, the only species not already listed which could readily qualify at species

level for CMS Appendix I (i.e. is globally Endangered or Critically Endangered on the global IUCN Red List) is Black Harrier. This species has been re-classified from Vulnerable on the global IUCN Red List to Endangered since MOS2, but even prior to its global IUCN up-listing TAG3 recognised this species as a potential priority for development of an international species action plan or other coordinated conservation measures. It may be beneficial to conservation efforts for this species if it was proposed for listing on CMS Appendix I at a future CMS COP.

As regards CMS Appendix II, it is notable that no Strigiformes at all are covered on CMS Appendix I or Appendix II, whereas all migratory members of Accipitriformes and Falconiformes are currently covered on Appendix II under family level or species-specific listings.

Snowy Owl (*Bubo scandiacus)* is on Raptors MOU Annex 1 and is categorised in Category 1 of Table 1 at MOS3 as it has moved from Least Concern to Vulnerable on the global IUCN Red List since MOS2 in 2015. It is the only remaining Raptors MOU Annex 1 species that is globally Vulnerable or Near Threatened and that could therefore clearly qualify for CMS Appendix II at the level of the whole species, but is not yet covered by a CMS Appendix II listing. This species could potentially be proposed for Appendix II by a CMS Party at a future CMS COP.

17. International species action plan gaps

Part of the TAG workplan Activity 2, Task 2.3 was to review the measures needed to address problems facing the most threatened species listed on Annex 1 to the Raptors MOU, and to consider ways in which to prioritise future efforts to develop international Species Action Plans for migratory birds of prey. TAG progressed this work at, and in the lead up to TAG3 in 2018 using Annex 3, Table 1 from MOS2 with updates from the IUCN Red List assessment as the list of the most threatened species on Annex 1, but also including Tawny Eagle, which at the time was under IUCN Red List review and was subsequently up-listed from globally Least Concern to Vulnerable on the IUCN Red List, thus qualifying it for Category 1 of Table 1.

The Table of information compiled for discussion at TAG 3 is Annex 2 to: https://www.cms.int/raptors/en/document/species-action-planning-most-threatened-migratory-birds-prey.

It contains IUCN Red List, CMS Appendix and CITES listing at that time, a brief overview of the threats facing the species according to the BirdLife International database. Annex 2 also contains information and, if available, weblinks to existing Species Action Plans and any previous Action Plans which may have been superseded, Birdlife International database information on conservation actions in place, as well as those proposed but not necessarily implemented already. TAG3 were asked to review the information compiled, highlight additions or improvements and discuss which species were considered underrepresented in terms of conservation attention and action.

'Gap' species identified as in poor conservation status (Category 1 of Table 1) without any formal Action Plan and with few proposed conservation actions included Beaudouin's Snake-eagle (*Circaetus beaudouini*) and Tawny Eagle. Other species noted for discussion were Black Harrier, Pallas's Fish-eagle (*Haliaeetus*

leucoryphus), Steller's Sea-eagle (*Haliaeetus pelagicus*) and Steppe Eagle which had quite a number of conservation actions listed, but appeared to be lacking any formal international Action Plan. TAG3 participants reported that an International Action Plan for the Steppe Eagle had been initiated at a meeting in September 2018 of the Russian Raptor Research and Conservation Network and that efforts should be made to join up efforts across the range of this species.

Some other Table 1, Category 1 species were noted to have an international Action Plan under development; For example, a dedicated Working Group had been established by the Coordinating Unit to develop an International Single Species Action Plan for the Sooty Falcon. Other species had international Action Plans which were relatively old and due for review including Red-footed Falcon, Pallid Harrier and Spanish Imperial Eagle. Likewise, in 1996, an International Action Plan was developed for the Eastern Imperial Eagle which was followed by a regional Species Action Plan for the Southern Caucasus in 2006. The Saker Falcon had a detailed Global Action Plan adopted by CMS Parties in November 2014. The 15 species of Old World vultures had been comprehensively covered by the Vulture MsAP, with some vulture species also covered by specific Regional or Flyway Action Plans, such as Bearded Vulture, Egyptian Vulture and Cinereous Vulture.

TAG discussed which species were a high priority for development of international species action plans and concluded that coordinating on development of an international action plan for Steppe Eagle was a high priority, and that Black Harrier and Pallas's Fish Eagle were both priority species for international species action planning or other coordinated conservation measures. TAG felt that it would be beneficial to gather more information on Beaudouin's Snake Eagle to support identification of priority actions, and noted that Tawny Eagle was badly affected by poisoning and could benefit from further focus (noting that many of the actions called for under the Vulture MsAP would also benefit Tawny Eagle). TAG3 recognised that although an international Species Action Plan can be a useful vehicle to stimulate and coordinate measures on the ground to alleviate the threats to a species, it is only a tool to guide conservation actions and the effectiveness of Species Action Plans in stimulating effective action on the ground varied significantly and might be something to look at in more detail in future.

Since the above gap analysis of species action planning was undertaken for TAG3, one of the species considered, Red Kite has been downlisted on the IUCN Red List to Least Concern following successful conservation action, so no longer qualifies for Category 1 of Table 1, but unfortunately the conservation status of a number of other Annex 1 species has deteriorated, resulting in these species being up-listed on the global IUCN Red List and newly qualifying for Category 1 of Table 1.

Further work may therefore be needed by TAG to assess gaps in species action planning for these species: Snowy Owl, Scissor-tailed Kite (*Chelictinia riocourii)*, Mountain Hawk-eagle (*Nisaetus nipalensis)*, Forest Buzzard (*Buteo trizonatus*) and Oriental Hobby (*Falco severus)*.

18. Conclusions

Overall this Conservation Status Assessment Report makes clear that urgent conservation action is needed to improve the conservation status and population trajectories of the 94 species listed on Annex 1 at MOS3. Particular focus is needed to try to stem and reverse declines in the one third of Raptors MOU species that are globally threatened or Near Threatened.

There are many tools to assist Signatories in achieving this collectively. To reverse the fortunes of migratory raptors on Annex 1 Signatories will need to address key threats with much greater urgency and cooperate to encourage other Signatories and range states also take necessary action. In some cases there may be a need to amend national legislation to improve protection of migratory raptor species. In many cases the need may be for improved enforcement of existing legislation to ensure the protections afforded to migratory raptor species are a reality on the ground. Delivering adequate resourcing of enforcement authorities along with appropriate training is a challenge in some countries. In many countries there is a reliance on members of the public or NGOs to detect and report illegal activity and few cases of illegal, killing, taking or trade of raptors are brought to court; in even fewer cases are penalties applied or deterrent in scale. Training of judiciary is also needed in many cases.

There are inter-governmental task forces (and associated guidance) already set up under CMS to address some of the key issues such as Illegal killing, taking and trade (e.g. MIKT[16] and ITTEA[17] and development of a roadmap underway- in the Middle East), preventing poisoning[18] and reconciling energy development with the conservation of migratory birds (ETF[19]), which many Signatories are already members of. Other Signatory and non-Signatory range states may also benefit from joining, sharing experience and accessing guidance and all stakeholders can play a role in encouraging new country representatives to join.

Species Action Plans at various scales list the priority actions for different species, and Signatories can ensure these actions are undertaken within their jurisdiction and in cooperation with other range states for the species. For vulture range states implementation of the Vulture MsAP would be a very important means of achieving improvements in the conservation status and population trajectories of these species on Table 1 Category 1 (and would benefit other raptor species too). Alongside greater implementation of existing Species Action Plans there are some other species for which greater international cooperation around a shared set of priorities could be beneficial and for which development of new international species action plans would be warranted.

Focused efforts for specific species can be very effective as is clear from the downlisting of Red Kite (on the IUCN Red List and in terms of Raptors MOU Table 1 category) following highly effective conservation measures, including reintroduction to some areas of former range. There would be benefit in sharing lessons learned from successful cases like this to support Signatories in taking similar efforts for other species. Certainly to succeed in reversing the fortunes of Annex 1 migratory raptors will require going beyond current range state Signatories

[16] https://www.cms.int/en/taskforce/mikt
[17] https://www.cms.int/en/taskforce/ittea
[18] https://www.cms.int/en/workinggroup/preventing-poisoning-migratory-birds
[19] https://www.cms.int/en/taskforce/energy-task-force

collectively stemming declines within their jurisdictions, to taking effective conservation measures to restore populations in both current and former range states.

Despite raptors being a charismatic group there remain major gaps in knowledge for many species about their ecology, movements, the key areas used at different stages of their annual cycle, which threats are the highest priority to address and even basic information to allow conservation status and population trajectory to be determined are missing for many species. For many species there are both global and regional level knowledge gaps. These knowledge gaps hamper our ability to detect and act on issues as well as our ability to track the effectiveness of our actions to conserve migratory raptors.

More broadly investment and support for monitoring efforts is clearly needed globally, as is experience sharing and improved coordination of the monitoring efforts that are already underway in the African-Eurasian flyway. In addition to field-based monitoring, tracking technology has a lot to offer in terms of insights, and it is important that maximum use is made of the data associated with tracked birds. This is particularly the case where the target species is globally threatened and potential costs to the individual from carrying a tag must be carefully balanced with the conservation benefits of gaining greater insight. Best practice guidance should be promoted to ensure such costs to tagged individuals are minimised and Anderson *et al.* (2020)[20] is a useful contribution in this regard.

This pilot CSAR does not examine the internationally important sites for migratory raptor species, as the content of Annex 3 Table 3 is under discussion at MOS3, but post-MOS3 this would be an important element of any future CSAR. Effective conservation of internationally important sites for migratory raptors and ensuring threats are effectively addressed at these sites and habitat appropriately managed will be a very important means for Signatories to support Annex 1 raptor populations.

Furthermore, many raptor species are particularly vulnerable to threats such as illegal shooting at bottleneck sites or insensitive placement of infrastructure or other developments that could cause high mortality at points in migratory journeys where they are particularly vulnerable. This vulnerability is often caused by a combination of geography, topography, migratory behaviour and physiological limits, but also by the fact that some species a very high proportion of the population may pass through particular areas in a confined number of weeks of the year. Signatories which are custodians of these areas of great multispecies importance and vital for maintaining healthy flyway level populations, have a particular level of responsibility regarding management and threat reduction efforts and particular responsibility to ensure permissions are not granted for major infrastructure and other projects proposed near these areas if they will have negative impacts on migratory raptors that cannot be adequately mitigated.

Effective conservation of Annex 1 raptors will require greater and more synergistic cooperation. Existing Signatories and other stakeholders can encourage non-Signatory range states to sign the Raptors MOU, Signatories with experience in monitoring, reintroduction or tackling particular threats can share their experience and actively contribute to capacity building through initiating meetings, webinars, training and exchange. Signatories with greater access to financial resources can support work in lower income countries or jointly

[20] See https://www.cms.int/raptors/en/page/research-and-guidelines

fundraise for projects to benefit species of shared interest. NGOs can work with national authorities on projects and proposals, can assist with monitoring, work directly with local communities and national authorities to tackle threats including through developing alternative livelihood opportunities, contribute to detection and reporting of illegality, support awareness raising and conservation work, and help implement action plans. Each Signatory needs to deliver more effective conservation measures more rapidly, but effective conservation for migratory raptors may also hinge on the extent to which each Signatory can also help catalyse more effective conservation measures in partnership with others outside of their national borders.

19. References

Amar, A., Buij, R., Suri, J., Sumasgutner, P. and Virani, M.Z. 2018 Chapter 18:Conservation and Ecology of African Raptors in J. H. Sarasola *et al.* (eds.), *Birds of Prey*, Springer International Publishing AG. pp419-455 https://doi.org/10.1007/978-3-319-73745-4_18

Angelov, I., Hashim, I., Oppel, S. 2013 Persistent electrocution mortality of Egyptian Vultures *Neophron percnopterus* over 28 years in East Africa. *Bird Conserv Int* 23:1–6

Anderson, M.D. 2000 Raptor conservation in the Northern Cape Province, South Africa. *Ostrich* 71:25–32

Anderson, D., Arkumarev, V., Bildstein, K., Botha, A., Bowden, C. G. R., Davies, M., Duriez, O., Forbes, N. A., Godino, A., Green, R. E., Krüger, S., Lambertucci, S. A., Orr-Ewing, D., Parish, C. N., Parry-Jones, J. & Weston, E. 2020. A practical guide to methods for attaching research devices to vultures and condors. *Vulture News* 78a: 1 -72. IUCN Species Survival Commission Vulture Specialist Group Technical Publication No.1. http://dx.doi.org/10.4314/vulnew.v78ai1.1

Bhusal, K. P., Chaudhary, I. P., Dangaura, H. L., Rana, D. B. & Joshi, A. B. 2019 Nesting of Critically Endangered Slender-billed Vulture *Gyps tenuirostris* more than decade in Nepal. *Vulture Bulletin*. Bird Conservation Nepal.

BirdLife International 2021 *European Red List of Birds*. Luxembourg: Publications Office of the European Union

Botha, A., Andevski, J., Bowden, C.G.R., Gudka, M., Safford, R., Williams, N.P. 2017. *Multi-species action plan to conserve African-Eurasian Vultures (Vultures MSAP).* In:CMS Raptors MOU Technical Publication No. 4. CMS Technical Series No. 33. Coordinating Unit of the CMS Raptors MOU, Abu Dhabi, United Arab Emirates.

Buechley, E.R., Şekercioğlu, Ç.H. 2016 The avian scavenger crisis: looming extinctions, trophic cascades, and loss of critical ecosystem functions. *Biol. Conserv*. 198, 220–228

Buechley E. R, Oppel S., Beatty W.S., Nikolov S. C., Dobrev V., Arkumarev V., Saravia V., Bougain C., Bounas A., Kret, E., Skartsi T., Aghababyan K., Frehner E., and Şekercioğlu, C. H. 2018.

Identifying critical migratory bottlenecks and high-use areas for an endangered migratory soaring bird across three continents. *Journal of Avian Biology* 49: e01629.

Buechley E.R., Santangeli A., Girardello, M., Montague H.C., Clegg N., Oleyar D., McClure C.J.W., Şekercioğlu C.H. 2018 Global raptor research and conservation priorities: Tropical raptors fall prey to knowledge gaps. *Diversity and Distributions*. 2019;25:856–869 DOI: 10.1111/ddi.12901x

Buij, R., Nikolaus, G., Whytock, R., Ingram, D.J., Ogada, D. 2015 Trade of threatened vultures and other raptors for fetish and bushmeat in West and Central Africa. *Oryx*, 1-11

Butchart, S.H.M., Stattersfield, A.J., Collar, N.J., 2006 How many bird extinctions have we prevented? Oryx 40, 266–278.

Chaudhry, M.J.I., Ogada, D.L., Malik, R.N., Virani, M.Z., Giovanni, M.D., 2012 First evidence that populations of the critically endangered Long-billed Vulture *Gyps indicus* in Pakistan have increased following the ban of the toxic veterinary drug diclofenac in south Asia. *Bird Conserv*. Int. 22, 389–397.

Concepcion, C. B., Bildstein, K. L., Collar, N. J., & Katzner, T. E. 2018 Conservation threats and priorities for raptors across Asia. Birds of Prey*: Biology and conservation in the XXI century*, 395-418.

Cuthbert, R.J., Taggart, M.A., Saini, M., Sharma, A., Das, A., Kulkarni, M.D., Deori, P.,Ranade, S., Shringarpure, R.N., Galligan, T.H., Green, R.E., 2016. Continuing mortality of vultures in India associated with illegal veterinary use of diclofenac and a potential threat from nimesulide. *Oryx* 50, 104–112.

Ewing, S.R., Thomas, C.E., Butcher, N., Denman, B., Douglas, D.J.T., Anderson, D.I.K., Anderson, G.Q.A., Bray J., Downing, S., Dugan, R., Etheridge, B., Hayward, W., Howie, F., Roos, S., Thomas, M., Weston, J., Smart, J., Wilson, J.D. 2023 Illegal killing associated with gamebird management accounts for up to three-quarters of annual mortality in Hen Harriers *Circus cyaneus*. *Biological Conservation*, https://doi.org/10.1016/j.biocon.2023.110072

Galligan, T. H., Bhusal, K. P., Paudel, K., Chapagain, D., Joshi, A. B., Chaudhary, I. P., Chaudhary, A., Baral, H. S., Cuthbert, R. J. and Green, R. E. 2020. Partial recovery of Critically Endangered *Gyps vulture populations in Nepal. Bird Conservation International 30(1): 87-102.*

Garbett, R., Herremans, M., Maude, G., Reading, R.P., Amar, A., 2018 Raptor population trends in northern Botswana: a re-survey of road transects after 20 years. *Biol. Conserv*. 224, 87–99.

Garbett, R., Maude, G., Hancock, P., Kenny, D., Reading, R., Amar, A., 2018 Association between hunting and elevated blood lead levels in the critically endangered African white-backed vulture *Gyps Africanus*. Sci. Total Environ. 630, 1654–1665.

Garrido, J.R., Numa, C., Barrios, V., Qninba, A., Riad, A., Haitham, O., Hasnaoui, H., Buirzayqah, S.,Onrubia, A., Fellous-Djardini, A., Saheb, M., Rousselon, K., Cherkaoui, S.I., Essetti, I., Noaman, M., Radi, M., Cuzin, F., Irizi, A., Monchaux, G., Hamdi, N., Monti, F., Bergier, P., Ouni, R., Etayeb, K., Chokri, M.A., Azafzaf, H., Gyenge, P., Si Bachir A. and Bakass, B. 2021 The conservation status and distribution of the breeding birds of prey of North Africa. IUCN: Gland, Switzerland. xvi + 102pp.

Gilbert, M., Watson, R.T., Ahmed, S., Asim, M., Johnson, J.A., 2002 Breeding and mortality of Oriental White-backed Vulture *Gyps bengalensis* in Punjab Province, Pakistan. *Bird Conserv. Int*. 1, 311–326

Gombobaatar, S., Sumiya, D., Shagdarsuren, O., Potapov, E., and Fox, N. 2004. Saker Falcon (*Falco cherrug milvipes* Jerdon) mortality in Central Mongolia and population threats. *Mongolian J. Biol. Sci*. 2, 13–21. doi: 10.22353/mjbs.2004.02.13

Griffiths, R. A., & Dos Santos, M. 2012 Trends in conservation biology: Progress or procrastination in a new millennium? *Biological Conservation*,*153*, 153–158. https://doi.org/10.1016/j.biocon.2012.05.011

Herrero-Villar, M., Delepoulle, É., Suárez-Regalado, L., Solano-Manrique, C., Juan-Sallés, C., & Iglesias-Lebrija, J., Camarero P.R.,, González F., Álvarez E. and Mateo R., 2021 First diclofenac intoxication in a wild avian scavenger in Europe. *Science Of The Total Environment*, 782 https://doi.org/10.1016/j.scitotenv.2021.146890

IPBES 2019 Global Assessment Report on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn. 1,148 pages. https://doi.org/10.5281/zenodo.3831673

Jobson, B., Allinson, T., Sheldon, R., Vansteelant, W,. Buechley, E., Oppel, S. and Jones, V.R. 2021 Monitoring of migratory soaring birds in the East African-Eurasian flyway: a review and recommendations for future steps. *Sandgrouse* 43:1-23

Keith, J.O., Bruggers, R.L. 1998 Review of hazards to raptors from pest control in Sahelian Africa. J Raptor Res 32:151–158

Kovács, A., Williams, N. P. and Galbraith, C. A. 2014 Saker Falcon *Falco cherrug* Global Action Plan (SakerGAP), including a management and monitoring system, to conserve the species. Raptors MOU Technical Publication No. 2. CMS Technical Series No. 31. Coordinating Unit - CMS Raptors MOU, Abu Dhabi, United Arab Emirates.

Krever, V. G., and Ivannikova, T. O. (eds) 2020 Wildlife trade in the Russian Federation. Moscow: WWF Russia.

Laurance, W.F., Sayer, J., Cassman, K.G., 2014 Agricultural expansion and its impacts on tropical nature. *Trends Ecol. Evol.* 29, 107–116.

Ledger, S.E., Rutherford, C.A., Benham, C., Burfield, I.J., Deinet, S., Eaton, M., Freeman, R. et al. 2022 Wildlife comeback in Europe: opportunities and challenges for species recovery. London, UK: ZSL, BirdLife International and the European Bird Census Council.

Lobkov, E., Gerasimov, Y., and Gorovenko, A. 2011 Status of the Kamchatka Gyrfalcon (Falco rusticolus) population and factors affecting it in: Gyrfalcons and Ptarmigan in a Changing World, Vol. II, eds R. T. Watson, T. J. Cade, M. Fuller, G. Hunt, and E. Potapov (Boise, ID: The Peregrine Fund), 280–290. doi: 10.4080/gpcw.2011.0127

Martin, G.R., Portugal, S.J. and Murn, C.P. 2012 Visual fields, foraging and collision vulnerability in Gyps vultures. Ibis, 154: 626-631. https://doi.org/10.1111/j.1474-919X.2012.01227.x

Martín-López, B., González, J. A., & Montes, C. 2011 The pitfall-trap of species conservation priority setting. *Biodiversity and Conservation*, 20, 663–682. https://doi.org/10.1007/s10531-010-9973-z

Martínez-Ruiz, M., Dykstra, C. R., Booms, T. L. & Henderson, M. T. 2023 Conservation Letter: Effects of Global Climate Change on Raptors. *Journal of Raptor Research*. 57(1). Pp. 92-105. DOI: https://doi.org/10.3356/JRR-22-75

McClure, C. J. W., Westrip, J. R. S., Johnson, J. A., Schulwitz, S. E., Virani, M. Z., Davies, R., Symes, A., Wheatley, H., Thorstrom, R., Amar, A., Buij, R., Jones, V. R., Williams, N. P., Buechley,

E. R. and Butchart, S. H. M. 2018 State of the world's raptors: distributions, threats, and actions. *Biological Conservation* https://doi.org/10.1016/j.biocon.2018.08.012

McWilliam, A.N., Cheke, R.A. 2004 A review of the impacts of control operations against the red-billed quelea (*Quelea quelea*) on non-target organisms. *Environ Conserv* 31:130–137

Murgatroyd, M., Redpath, S.M., Murphy, S.G., Douglas D.J.T, , Saunder R. and Amar A. 2019 Patterns of satellite tagged hen harrier disappearances suggest widespread illegal killing on British grouse moors. *Nat Commun* **10**, 1094 https://doi.org/10.1038/s41467-019-09044-w.

Ogada, D.L., Keesing, F., Virani, M.Z., 2012 Dropping dead: causes and consequences of vulture population declines worldwide. *Ann. N. Y. Acad. Sci*. 1249, 57–71.

Ogada, D., Shaw, P., Beyers, R.L., Buij, R., Murn, C., Thiollay, J.M., Beale, C.M., Holdo, R.M., Pomeroy, D., Baker, N., Krüger, S.C., Botha, A., Virani, M.Z., Monadjem, A.,Sinclair, A.R.E. 2016. Another continental vulture crisis: Africa's vultures collapsing toward extinction. *Conserv. Lett*. 9, 89–97.

Oppel, S., Arkumarev, V., Bakari, S., Dobrev, V., Saravia-Mullin, V., Adefolu, S., Sözüer, L.A., Apeverga, P.T., Arslan, Ş., Barshep, Y., Bino, T., Bounas, A., Çetin, T., Dayyoub, M., Dobrev, D., Duro, K., El-Moghrabi, L., ElSafoury, H., Endris, A., Asswad, N.G., Harry, J.H., Ivande, S.T., Jbour, S., Kapsalis, E., Kret, E., Mahamued, B.A., Manu, S.A., Mengistu, S., Moussa Zabeirou, A.R., Muhammad, S.I., Nakev, S., Ngari, A., Onoja, J., Osta, M., Özuslu, S., Petrovski, N., Popgeorgiev, G., Pourchier, C., Qaneer, T., Ruffo, A., Shobrak, M., Sidiropoulos, L., Skartsi, T., Sözüer, Ö., Stara, K., Tesfaye, M., Topi, M., Vavylis, D., Velevski, M., Vorpsi, Z., Wondafrash, M., Xeka, E., Yeniyurt, C., Yordanov, E., Nikolov, S.C., 2021 Major threats to a migratory raptor vary geographically along the eastern Mediterranean flyway. *Biological Conservation*: 109277.

Oppel, S., Ruffo, A.D., Bakari, S., Tesfaye, M., Mengistu, S., Wondafrash, M., Endris, A., Pourchier, C., Ngari, A., Arkumarev, V., Nikolov, S.C., 2022 Pursuit of 'sustainable' development may contribute to vulture crisis in East Africa. *Bird Conservation International* 32: 173-187

Paridi, A., and Noske, R. A. 2017 The illegal trade of Indonesian raptors through social media. Kukila 20, 1–11.

Porter, R.F. 2005 Soaring bird migration in the Middle East and North East Africa: the bottleneck sites. BirdLife International, Cambridge, UK.

Prakash, V., 1999 Status of vultures in Keoladeo National Park, Bharatpur, Rajasthan, with special reference to population crash in *Gyps* species. *J. Bombay Nat. Hist. Soc*. 96, 365–378. Prakash, V., Bishwakarma,

Prakash, V., Bishwakarma, M.C., Chaudhary, A., Cuthbert, R., Dave, R., Kulkarni, M., Kumar, S., Paudel, K., Ranade, S., Shringarpure, R., Green, R.E., 2012 The population decline of *Gyps* vultures in India and Nepal has slowed since veterinary use of diclofenac was banned. *PLoS One* 7, e49118.

Rahman, L., Purev-Ochir, G., Batbayar, N., Dixon, A. 2016 Influence of nest box design on occupancy and breeding success of predatory birds utilizing artificial nests in the Mongolian steppe. *Conservation Evidence* 13:21-26

Salafsky, N., Salzer, D., Stattersfield, A., Hilton-Taylor, C., Neugarten, R., Butchart, S., Collen, B., Cox, N., Master, L., O'Connor, S. and Wilkie, D. 2008 A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions. *Conservation Biology* 22(4): 897-911

Şekercioğlu, Ç. H. 2012b Promoting community-based bird monitoring in the tropics: Conservation, research, environmental education, capacity-building, and local incomes. *Biological Conservation*, *151*, 69–73.

Shobrak, M., Alasmari, S., Alqthami, A., Alqthami, F., Al-Otaibi, A., Al Zoubi, M., El Moghrabi, L., Jbour, J., Arkumarev, V., Oppel, S., Asswad N.G., and Nikolov S.C. 2020 Congregations and threats of migratory Egyptian Vultures Neophron percnopterus along the southwest coast of Saudi Arabia. Sandgrouse 42: 248-258.

Shultz, S., Baral, H.S., Charman, S., Cunningham, A.A,, Das, D, Ghalsasi, G.R, Goudar, M.S,, Green, R.E,, Jones, A,, Nighot, P, ,Pain, D.J,, Prakash, V. 2004 Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. *Proc R Soc B* 271:S458–S460

SoIB 2020 *State of India's Birds, 2020: Range, trends and conservation status*. The SoIB Partnership. Pp 50.

Symes, A., Taylor, J., Mallon, D., Porter, R., Simms, C. and Budd, K. 2015 *The Conservation Status and Distribution of the Breeding Birds of the Arabian Peninsula*. Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority

Taylor, M. R., Peacock, F., Wanless, R.M., (eds). 2015 *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa. Johannesburg, South Africa

Thiollay J.M. 2006 The decline of raptors in West Africa: Long-term assessment and the role of protected areas. *Ibis* 148(2):240 – 254. DOI:10.1111/j.1474-919X.2006.00531.x

Thiollay J.M. 2007 Raptor declines in West Africa: comparisons between protected, buffer and cultivated areas. *Oryx* 41:322–329

Thomsett, S. 1987 Raptor deaths as a result of poisoning quelea in Kenya. *Gabar* 2:33–38

Thomsett, S. 2015 Eagle Hill, Kenya: changes over 60 years*. Scopus* 34:24–30

UN DESA. 2022 *The Sustainable Development Goals Report 2022* - July 2022. New York, USA: UN DESA. © UN DESA. https://unstats.un.org/sdgs/report/2022/

Virani, M.Z., Kendall, C., Njoroge, P., Thomsett, S. 2011 Major declines in the abundance of vultures and other scavenging raptors in and around the Masai Mara ecosystem, Kenya. *Biol Conserv*. 144:746–752

Wyatt, T. 2011 The illegal trade of raptors in the Russian Federation. Contemp. *Justice Rev.* 14, 103–123. doi: 10.1080/10282580.2011.565969

Yong, D. L., Heim, W., Chowdhury, S. U., Choi, C. Y., Ktitorov, P., Kulikova, O*., et al.,* J. K. 2021. The state of migratory landbirds in the East Asian Flyway: Distributions, threats, and conservation needs. *Frontiers in Ecology and Evolution*, 9, 613172.

Zorrilla, I., Martinez, R., Taggart, M. A. and Richards, N. 2014 Suspected flunixin poisoning of a wild Eurasian griffon vulture from Spain. *Cons. Biol.* 29: 587-592.

20. Annex

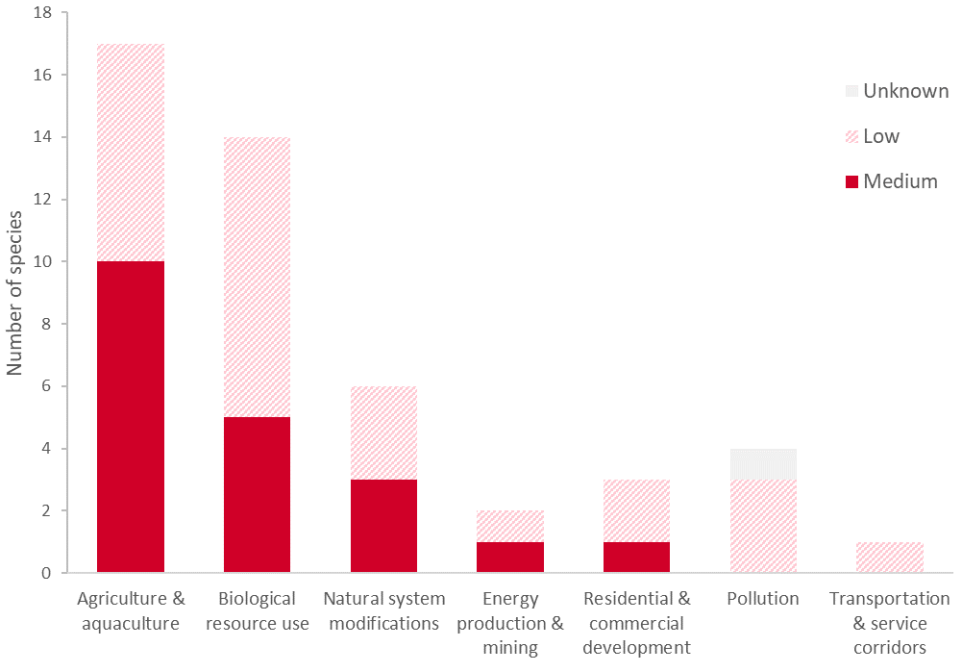

Figure A. Most severe Level 1 threats for Category 2 species

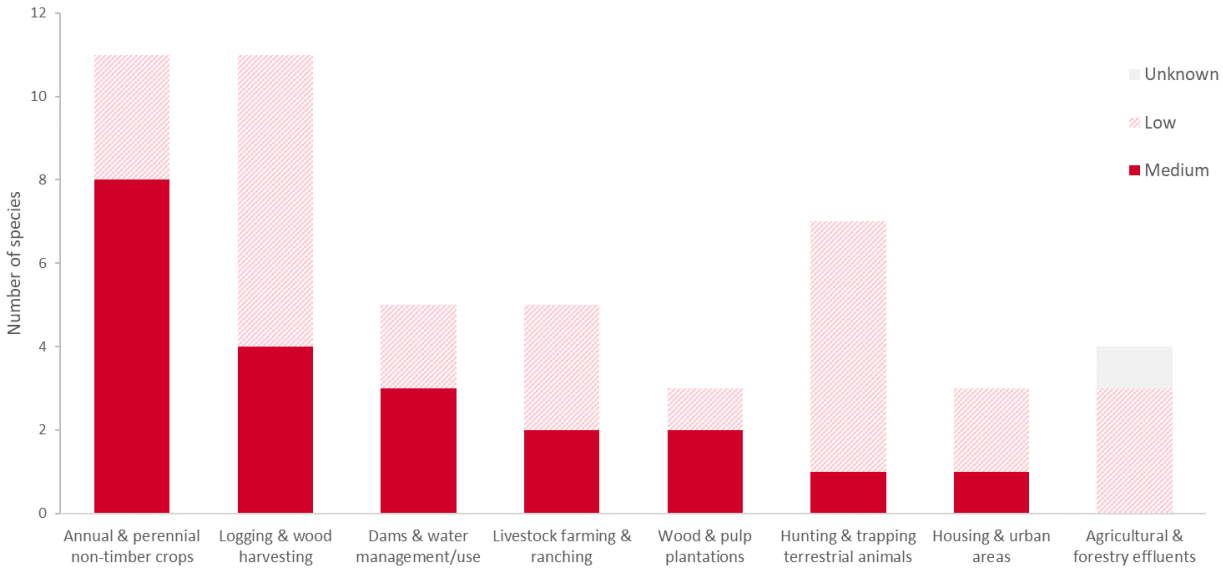

Figure B. Most severe Level 2 threats for Category 2 species.

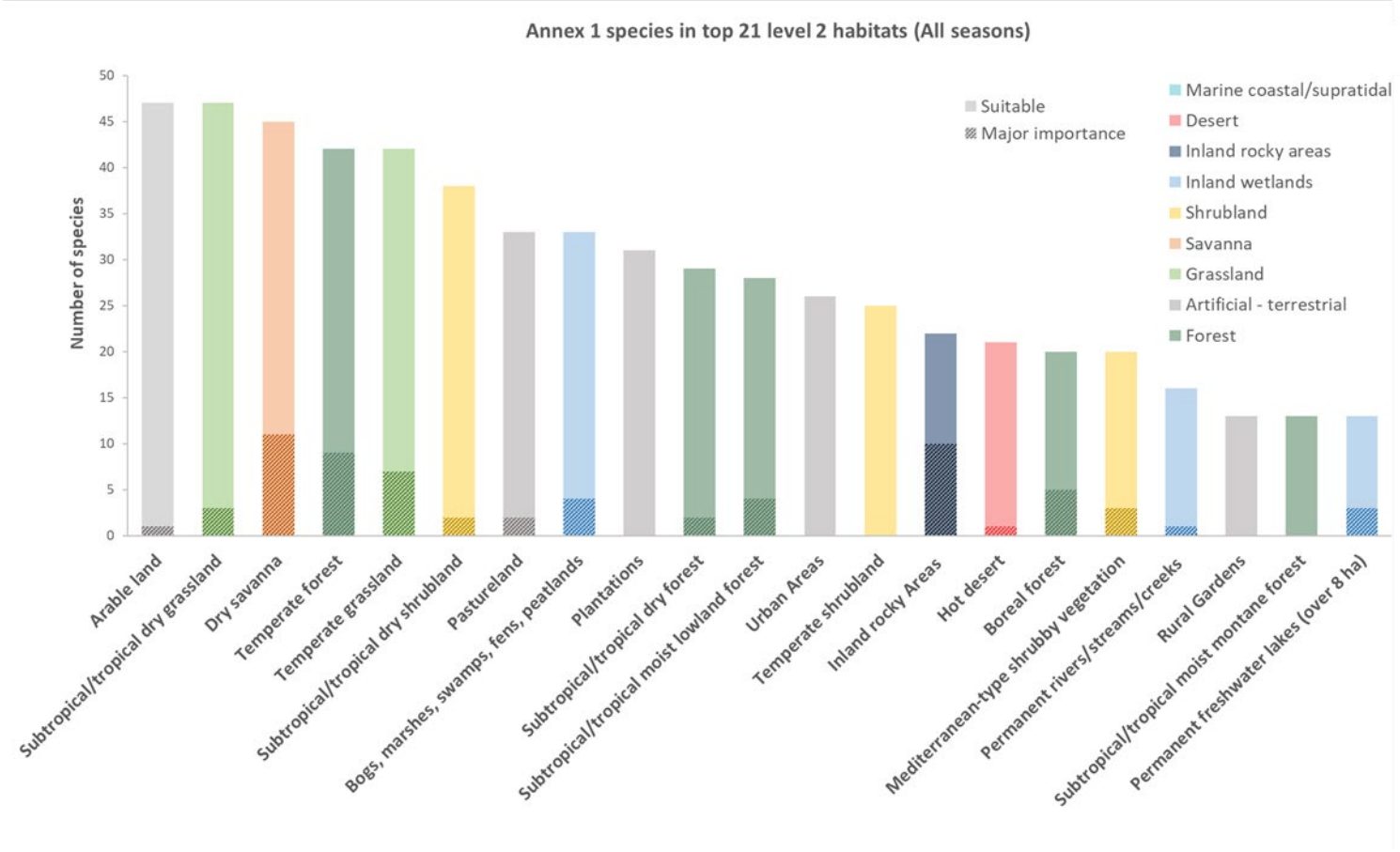

Figure C. Level 2 habitat preferences for Annex 1 species.

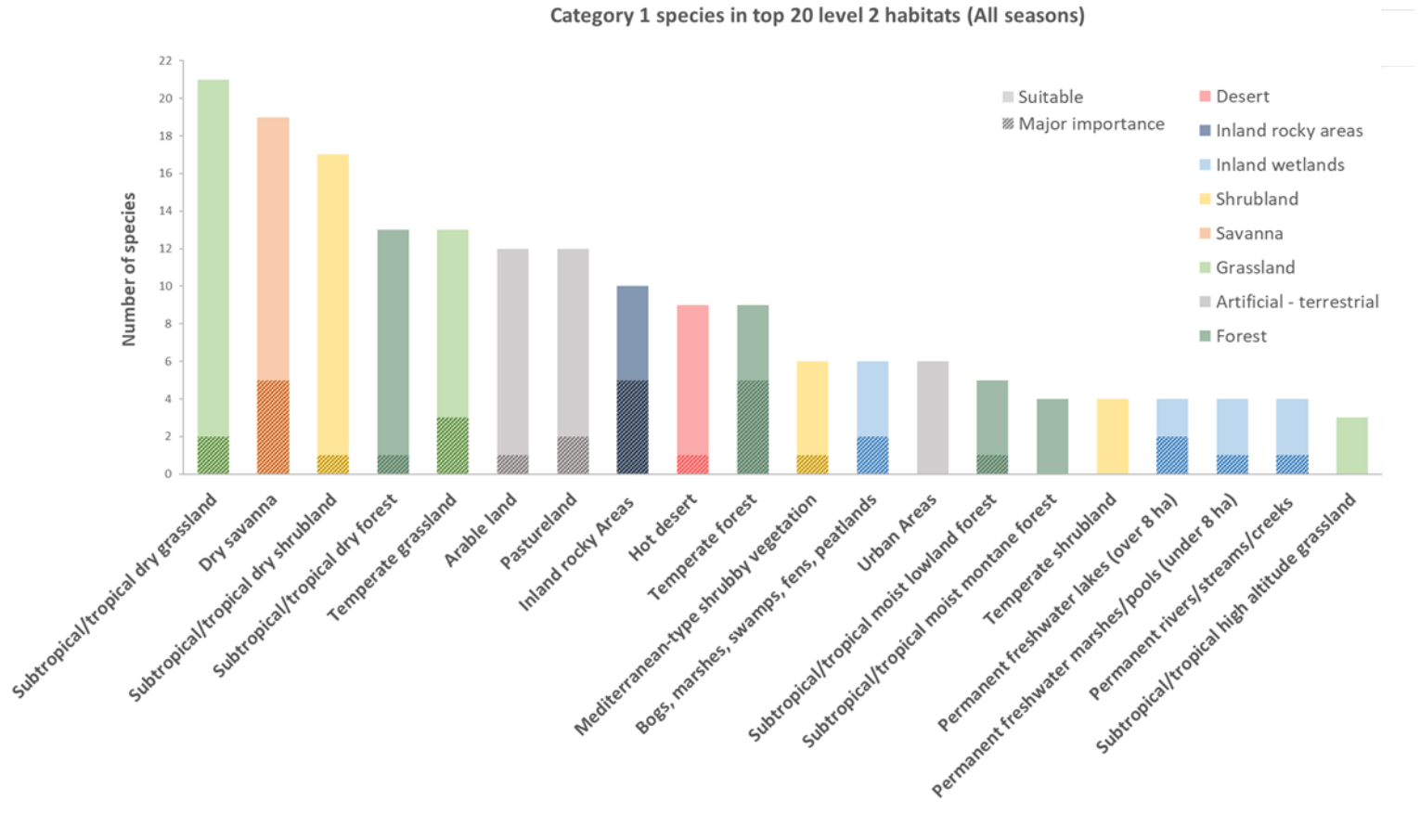

Figure D. Level 2 habitat preferences for Category 1 species.