What makes a species a priority for nature conservation?

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ABSTRACT

Prioritizing species for nature conservation should follow objective ecologically and biogeographically meaningful selection criteria. In this study, we test an approach to prioritize butterfly species for nature conservation considering the following parameters: (i) geographic distribution and endemism, (ii) vulnerability and (iii) ecological specialisation. Following these criteria, we identified 51 species of conservation priority out of the 403 European species assessed, i.e. 12.7 %. This list of species and those included in the annexes II and IV of the Habitats Directive (92/43/EEC) had only four species in common. The species selected by both approaches also differed significantly in their traits considering their distribution and ecological specialisation with the annexes of the EU Habitats Directive including many species that are neither range-restricted nor have their core distribution within Europe, and furthermore many not threatened ecological generalists. Our results suggest that species prioritization for nature conservation should follow objective criteria, such as distribution and ecological specialisation.

INTRODUCTION

Limited availability of land and financial resources makes prioritization an important task in nature conservation (Arponen, 2012). Consequently, various selection procedures exist in nature conservation, such as focusing on range restricted (endemic) species (Myers *et al.*, 2000), on species with decreasing population trends (Rodrigues *et al.*, 2006), or on species having an umbrella function (Lambeck, 1997). Furthermore, many species have been evaluated to be of high conservation value due to their occurrence in small and isolated (relict) populations, mostly located at their distribution margin (Hampe & Petit, 2005). However, mainly large (i.e. mostly vertebrate) and colourful (i.e. attractive) species have been considered until today (Roberge & Angelstam, 2004; Brambilla *et al.*, 2013). Thus, we argue that many species selected for nature conservation are of little ecological and biogeographical relevance (Habel & Schmitt, 2014).

Harrison *et al.* (2008) suggested that species selected for nature conservation should possess the following three characteristics to assess local extinction risks for species: 1. Restricted distribution range; 2. Narrow ecological niche; and 3. Occurrence at low abundance. These parameters may influence each other mutually. For example, a species' distribution and abundance in general depends on its ecological demands; Habitat generalists are able to use various resources and niches and thus occur more widespread and may mainly respond to environmental changes (Thomas, 2016). In contrast, habitat specialists depending on specific resources and/or habitat structures often rely on one specific ecosystem and thus occur geographically restricted (Thomas, 2016). Therefore, such taxa are assumed to be more susceptible to stochastic processes rendering them more vulnerable to local extinctions (Johnson, 1998; Melbourne & Hastings, 2008).

In our study we prioritize butterfly species of the European Union, following three criteria: Distribution/endemicity, threat, and ecological demands. Similar parameters have already been used in previous studies of objective species selection for nature conservation (e.g. the Red List criteria, Rodrigues *et al.*, 2006; prioritizing orchids across Europe, Gauthier *et al.*, 2010). Butterflies (such as a few other invertebrate groups, but most vertebrate groups and vascular plants) allow a rigorous test due to the fact that their taxonomy, distribution and ecology are well understood (Settele *et al.* 2009; Tshikolovets, 2011; Kudrna *et al.*, 2015; Wiemers *et al.*, 2018). Furthermore, studies showed that butterflies are increasingly suffering from global change across Europe, and current conservation strategies may fail to counteract this negative trend (see Delpon *et al.*, 2018). Harrison *et al.* (2008) only considered species that meet all of their defined criteria. We are using threshold value approach in which a general overall conservation value has to be reached, but not every single threshold has to be surpassed to be selected as species of conservation priority. We assessed species' vulnerability, endemicity, and ecological specialisation. We argue that species with severely declining populations (i.e. threatened) or strong ecological specialisation should be considered for conservation in any case, if their range is centred in the reference area, i.e. the EU. Species with strong range restriction also should be considered if they are not common generalists in their range, as some island endemics can be (Tshikolovets, 2011).

In a second step, we compared the species selected by these criteria with those listed in the annexes II and IV (hereafter annexes) of the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (hereafter Habitats Directive). Subsequently, we compared the trait space of species (cf. Ames *et al.*, 2017) selected by our own approach and the species listed in the annexes of the Habitats Directive. Based on our data and the results obtained from our comparative approach, we discuss potential advantages and

89 limitations of the three criteria suggested here, and critically reflect the challenge of
90 prioritizing in nature conservation.
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MATERIAL AND METHODS

Study species

We analysed 403 butterfly species recorded from the 28 member states of the European Union (excluding all non-European species, as the Macaronesian island endemics, for biogeographical reasons, as well as recently acknowledged cryptic species and taxa recently discovered by molecular techniques, see Wiemers *et al.*, 2018). We excluded species extinct in Europe prior to World War II, temporary vagrants, and those that are not constantly established. For controversially discussed species complexes and sister species groups, we considered the oldest species name only (Kudrna *et al.*, 2015).

Geographic distribution

We assessed the global distribution of each species from literature (Europe: Kudrna *et al.*, 2015; Asiatic part of Russia: Korshunov & Garbunov, 1995; Tshikolovets, 2011; other parts of the world: Tolman & Lewington, 1997). Distribution ranges (North-South, West-East) were measured with ArcGIS v. 10.3 using the edges at each cardinal direction. Summarized spatial coverage was generated for species with discontinuous distribution patterns. We calculated the total distribution area (km²) and the proportion of this range inside EU28. We set a range threshold of 35,000 km² (approximately the combined surface area of Sardinia and Corsica, an important hotspot of endemism in Europe) to identify range restricted endemics. To test for the sensitivity of this threshold value selected here, we repeated the selection procedure of taxa using two additional threshold values: 25.000 km² (approximately the combined surface area of Sicily or Sardinia), and 10.000 km² (approximately the size of Corsica, Crete or Cyprus).

Level of threat

Threat was assessed according to the European Red List of Butterflies (Van Swaay *et al.*, 2010). We considered all species classified as VUlnerable (VU), ENdangered (EN) and CRitically endangered (CR) in this list.

Ecological specialisation

We grouped species according their ecological specialisation. We classified species into three classes of specialisation (from generalist to specialist): (A) larval host plants: polyphagous – larvae feed on more than one plant family, oligophagous – one plant family only, monophagous – plants belonging to one single plant genus only; (B) habitat specialisation: generalist – unspecialised species using a large number of different habitat types, intermediate – species specialised on at least one habitat attribute, specialist – species restricted to one specific habitat type; (C) dispersal behaviour of adults: migratory – species translocate beyond the local level, dispersive – species with frequent exchanges among local habitats, sedentary – species with movements mainly restricted to their habitat. We then calculated median values over all three traits, and thereafter used this value as an index of ecological specialisation. Higher values indicate a high level of specialisation, low values indicate a low level of specialisation. Data for species ecological classification were compiled from Ebert and Rennwald (1991), Bink (1992), Tolman & Lewington (1997) and Tshikolovets (2011).

Species of conservation priority

The procedure for the selection of species of conservation priority follows four steps: In the first step, we assessed the global distribution of each species. We selected species having more than 50 % of their distribution range within the EU, because species having their main distribution range outside the territory of the EU should not be of the community's conservation priority. In the following steps, three criteria were applied to all remaining

species. In step 2, we assessed the level of vulnerability according to the European Red List of Butterflies (Van Swaay *et al.*, 2010). All species ranked as VU, EN or CR were selected as species of conservation priority. In step 3, we detected all species with a distribution range of less than 35,000 km² (i.e. small area endemics); of these, all non-generalist species (i.e. ecological specialisation value in the range 1.0 to 2.3) were selected (Fig. 1). In step 4, all specialist species (i.e. ecological specialisation value ranging from 1.0 to 1.3) were selected (see Fig. 1). Hence, a species was defined as a species of conservation priority because of its vulnerability, its endemism if not being a generalist, and its high ecological specialisation. We assigned the highest conservation priority to species fulfilling all three criteria (priority 1), and species fulfilling two (priority 2) or only one (priority 3) criteria to correspondingly lower levels of conservation priority.

Data analysis

We compiled a list containing (i) all butterfly species of conservation priority based on our selection criteria and (ii) all butterfly species listed in the annexes II and IV of the Habitats Directive. For each of these species, we collated species-specific data on its geographic distribution and endemism, level of threat, and ecological specialisation. To compare species specific trait spaces covered by the three lists defined above, we conducted an ordination analysis. First, we used the Gower dissimilarity coefficient (Gower, 1971) with Podani's (1999) extension to ordinal variables to create a distance matrix from our trait data (gowdis function in the FD package; Laliberté & Legendre, 2010; Laliberté *et al.*, 2014). We used: proportion of distribution within EU (binary: <50%/≥50%), endemism (binary: <35,000 km²/≥35,000 km²), threat (ordinal: 0=LC (Least Concern) and NT (Near Threatened), 1=VU (Vulnerable), 2=EN (Endangered); [CR (Critically Endangered) species did not occur in the final data set]), larval host specialisation (ordinal: 0=polyphagous, 1=oligophagous, 2=monophagous), habitat specialisation (ordinal: 0=generalist, 1=intermediate; 2=specialist),

and dispersal behaviour (ordinal: 0=sedentary, 1=dispersive, 2=migratory). Second, we performed a non-metric multidimensional scaling (two axes) on the Gower distance matrix using the metaMDS function in the vegan package (Oksanen *et al.*, 2016). We tested for differences between groups in the trait space using PERMANOVA (adonis function, 1000 permutations). using the envfit function. Goodness of fit and significance of environmental vectors and ordinal factors (species traits) were tested using a permutation test (envfit function with 1000 permutations). For illustration, traits were plotted posthoc to the ordination diagram. All analyses were conducted in R 3.3.1 (R Core Team, 2016).

RESULTS

Of the 403 assessed butterfly species recorded for the EU (excluding non-European territories), 159 (i.e. 39.5 %) fulfilled the first selection criterion that >50 % of the total distribution is located inside the EU's territory. The distribution of 41 of these species cover less than 35,000 km² and thus were directly identified and prioritized as EU endemics, without incorporating any further parameters. When lowering the threshold value to 25,000 km² (approximately the surface area of Sicily or Sardinia), 12 species were identified as EU endemics; and when considering a threshold value of only 10,000 km² (approximately the size of Corsica, Crete or Cyprus) we still obtained 7 species (see Appendix 3). Even when using lower threshold values here, all of these taxa which have not been identified as EU endemics, were evaluated as ecological specialists in the next steps, and thus has been identified as species of conservation priority anyway.

Eleven of all remaining butterfly species (i.e. 6.9 %) (see Fig. 1) fulfilled the criterion of vulnerability. 31 butterfly species (i.e. 19.5 %) were non-generalist small area endemics (out of the total of 40 small area endemics) (Appendix S1) and 46 butterfly species (i.e. 28.9 %) were classified as species with high ecological specialisation. In total, 51 out of the 403 species fulfilled at least one of the criteria and hence were identified to be of conservation priority. Only six species fulfilled all three criteria and thus were considered of highest conservation priority (priority 1). Eighteen butterfly species fulfilled two criteria rendering them of high conservation priority (priority 2). The remaining 27 only matched one criterion, but still justifying conservation priority (priority 3). When comparing the species selected by our criteria with the species listed on the annexes II and IV of the Habitats Directive, only four of the 32 annex species were congruent with our conservation priority species (see Table 1, Appendix S2).

The ordination analysis showed that species selected as conservation priority and species of the Habitats Directive annexes occupied different trait spaces (Fig. 2; ANOSIM $F_{1,81}=38.86$, $R^2=0.32$, $p<0.001$). Geographic distribution ($R^2=0.68$, $p<0.001$) and endemism ($R^2=0.78$, $p<0.001$), were the most important factor discriminating species of conservation priority from species listed in the Habitats Directive annexes, followed by habitat specialisation ($R^2=0.36$, $p<0.001$), level of threat ($R^2=0.14$, $p<0.01$), host specialisation ($R^2=0.08$, $p<0.01$) and dispersal behaviour ($R^2=0.08$, $p<0.01$) (Permutation test with 1000 permutations). The majority of the Habitats Directive species have wide Palaearctic distributions, low level of threat and low ecological specialisation.

DISCUSSION

Our results show that species' geographic distribution and ecological specialisation are the most important factors discriminating species of conservation priority. Most of the species selected using our criteria are not identical with the species selected by the Habitats Directive. In the following, we discuss differences between species selected by our approach and the species listed in the Habitat Directive, and then critically reflect the applicability of our selection criteria for butterflies and other organisms.

Distribution and endemism

We exclusively prioritized species with >50 % of their global distribution range being located inside the EU. This not only ensures the selection of species for which the EU has the main responsibility, but also the inclusion of the species' most important populations in terms of conserving intraspecific variability. Nevertheless, we have to acknowledge that populations found at distribution margins frequently contain unique genetic information (Hampe & Petit, 2010; Habel *et al.*, 2011). Consequently, our selection procedure does not consider such independent evolutionary lineages. However, we argue that the purpose of a list of European species of conservation priority should primarily safeguard species having their main distribution inside the EU, and only secondarily to protect genetically unique populations (for similar argumentation see Gauthier *et al.*, 2010 and Schatz *et al.*, 2014). In contrast to our approach, species with populations inside the EU, but occurring there at the margin of the species global distribution range, are clearly over-represented in the annexes of the Habitats Directive, as well as in National Red Lists (e.g. Reinhardt & Bolz, 2012). Prominent examples are *Lycaena helle*, *Phengaris nausithous*, *P. teleius*, *Colias myrmidone*, *Coenonympha oedippus*, and *C. hero*.

About 10 % of the 403 butterfly species assessed with more than 50 % of their range inside the EU show a range restriction to <35,000 km² and thus were evaluated as European endemics. A large proportion of these species are restricted to peninsulas (*Plebejus zullichi*, *P. hespericus*, *Polyommatus galloï*), on islands (*Argynnis elisa*, several *Hipparchia* species, *Zerynthia cretica*), or mountain ranges (*Erebia aethiopella*, *E. calcaria*, *E. scipio*). Such species are assumed to be more threatened by extinction than widespread taxa as they often possess limited plasticity to respond on environmental changes. Successful preservation of such range-restricted species demands permanent monitoring (McKinnney, 1997) and efficient habitat management (Van Dyke, 2008). However, not all range-restricted species may respond sensitive to environmental changes and thus has been classified as generalists in our selection procedure (e.g. *Papilio hospiton*, *Lasiommata paramegaera*).

Threat

Eleven of the 154 species with more than half of their geographic distribution inside the EU are listed as vulnerable (6 species) or endangered (5) according the European Red List (van Swaay *et al.*, 2010). In consequence, their selection as species of conservation priority was mandatory. All these species are specialists of open or semi-open habitats, i.e. found mainly in natural or semi-natural grasslands. These habitats are strongly decreasing due to the abandonment of extensive traditional land-use regimes, agricultural intensification and the transformation of these grassland sites into arable land and settlements (Habel *et al.*, 2016; Delpon *et al.*, 2018). The protection of these species might also act as an 'umbrella' for the conservation of unique and diverse semi-natural grasslands, which host many other declining plant and animal species.

Ecology

About 25 % of the species having more than half of their distribution inside the EU were classified as ecological specialists. These species provide a limited potential to respond to environmental changes and thus are particularly prone to local extinction (van Dyke, 2008), when compared with ecological generalists (Fontaine *et al.*, 2007). These species may also act as umbrellas to conserve their endangered habitats, including its flora and fauna (Thomas *et al.*, 2009). Hence, the butterfly species selected by this criterion represent different, but also rare and endangered ecosystems, such as semi-natural grasslands (*Spialia sertorius*, *Lycaena tityrus*), high altitude grasslands and rocky places (*Arícia morronensis*, *Erebia gorge*, *E. melas*), transitional habitats between forest and open land (*Hamearis lucina*), forest-steppes (*Hipparchia fagi*), Mediterranean scrublands (*Laeosopis roboris*, *Glaucopsyche paphos*) and light broad-leaf forests (*Favonius quercus*). The fact that a broad ecological coverage is considered here underlines the explanatory power of this criterion.

However, not all of these specialists are necessarily declining or endangered. *Lycaena tityrus* for example is a still widely distributed species although being a specialist species of grassland patches of higher habitat quality, but can also be found in heathlands (Tshikolovets, 2011). Therefore, this species is not in need for conservation for its own survival, but may help to stop the vanishing of rare habitat types across Europe. Thus, its inclusion as species of conservation priority is rather justified by its umbrella function. More critically questioned should be *Favonius quercus*, which is of conservation priority according to our criteria. The species' larvae is strongly specialised on oaks, but the species is widely distributed across Europe. Consequently, this species might be the only one selected by our approach that is not helpful for conservation prioritization decisions.

The challenge to prioritize

Only four species (i.e. *Argynnis elisa*, *Erebia calcaria*, *E. sudetica*, *Polyommatus golgus*) selected by our criteria are also among the 32 species listed in the annexes of the Habitats Directive. Consequently, the trait space calculated for the species of both lists only partly overlap, and the trait space obtained by the species of the Habitats Directive annexes is much broader if compared with the trait space of the species identified by our criteria. This underlines that the species being of conservation priority according to our approach represent very specific ecological and biogeographical characteristics if compared with the species listed in the Habitats Directive, which are much more general. The most important variable distinguishing species between our list and the Habitats Directive is the criterion of geographic distribution. The ranges of the majority of the butterfly species of the Habitats Directive extend across Asia, with their core area of distribution located outside the EU (Tshikilovets, 2011). All these taxa have been excluded by our approach in the first step.

We have to acknowledge here, that species were selected by experts in a time (1992) when the EU was much smaller than it is today. Furthermore, despite of existing shortcomings identified for the Habitats Directive, the selection of species listed on the annexes has been modified and improved during the past years (see for critical comments also Cardoso, 2012; Maes *et al.*, 2013; Essens *et al.*, 2017). Nevertheless, in our eyes, coining species mostly existing outside of the reference area is not fulfilling the goal of selecting the most appropriate species for nature conservation prioritization in that particular area. Consequently, such species in our opinion should be replaced by others better matching the regional conservation needs. Our findings go in line with similar studies indicating the need to improve the selection of species for nature conservation. For example, studies showed the quality of data strongly affect the list of taxa selected for nature conservation. For example, expert knowledge may better explain the extinction risk of EU butterflies than coarse scale grid cell data (van Swaay *et al.*, 2011). Other studies underlined that prioritizing procedures at

different spatial scales may produce mismatches between EU and national Red Lists (Maes *et al.*, 2019), but multi-national programs may help to make nature conservation more efficient (see Kark *et al.*, 2009).

Critical reflection and conclusion

Our approach might be criticised for its coarse and rather simple classification procedure. However, the general information required to evaluate a species will often also be available for taxonomically less well-known groups of arthropods, and thus might be appropriate also decision makers in conservation management (see also Gauthier *et al.*, 2010). Nevertheless, the criteria selected here need to be adjusted to other taxa and regions in every single case. For example, for large vertebrates, also demography (age structure, sex-ratios) is of high relevance in evaluating the occurrence and viability of populations and the status of a species. Furthermore, population size might be a key role when evaluating the status of a species. Performing such adaptations, we envisage the application of our approach to many more taxonomic groups than just butterflies, not only in Europe, but also in other regions of the world, including the tropics.

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458 Table 1: Selection of species being of conservation priority by each of the criteria based on the 403 butterfly species known for the EU (excluding
 459 all non-European parts such as Macaronesia). Note that one species can be listed in one, two or even three of the criteria considered in our study
 460 (threat, endemism, and ecological specialisation) in parallel.

Criteria	N species	Prioritized by the respective criterion
Distribution (>50% EU)	159	These 159 species were all tested for the three follow-up criteria
Threatened (VU, EN, CR)	11	<i>Erebia sudetica</i> , <i>Hipparchia fagi</i> , <i>H. sbordonii</i> , <i>Plebejus zullichi</i> , <i>Polyommatus galloi</i> , <i>P. golgus</i> , <i>P. humedasmae</i> , <i>P. orphicus</i> , <i>Pseudochazara amymone</i> , <i>P. orestes</i> , <i>Pyrgus cirsii</i>
Small area endemics (<35,000 km ²) not being generalists	31	<i>Argynnis elisa</i> , <i>Erebia aethiopella</i> , <i>E. calcaria</i> , <i>E. hispania</i> , <i>E. nivalis</i> , <i>E. palmarica</i> , <i>E. scipio</i> , <i>E. sudetica</i> , <i>E. zapateri</i> , <i>Glaucopsyche paphos</i> , <i>Hipparchia blachieri</i> , <i>H. christenseni</i> , <i>H. neomiris</i> , <i>H. sbordonii</i> , <i>Melanargia pherusa</i> , <i>Melitaea asteria</i> , <i>Plebejus hespericus</i> , <i>P. psyloritus</i> , <i>P. zullichi</i> , <i>Polyommatus galloi</i> , <i>P. golgus</i> , <i>P. humedasmae</i> , <i>P. nephrohiptamenos</i> , <i>P. orphicus</i> , <i>P. violetae</i> , <i>Pseudochazara amymone</i> , <i>P. orestes</i> , <i>P. williamsi</i> , <i>Pseudophilotes barbagiae</i> , <i>Spialia therapne</i> , <i>Zerynthia cretica</i>
Ecological specialists	39	<i>Aricia morronensis</i> , <i>Cupido decoloratus</i> , <i>Erebia aethiopella</i> , <i>E. calcaria</i> , <i>E. gorge</i> , <i>E. hispania</i> , <i>E. melas</i> , <i>E. mnestra</i> , <i>E. nivalis</i> , <i>E. scipio</i> , <i>E. styx</i> , <i>E. sudetica</i> , <i>E. zapateri</i> , <i>Favonius quercus</i> , <i>Hamearis lucina</i> , <i>Hipparchia neomiris</i> , <i>Laeosopis roboris</i> , <i>Lycaena tityrus</i> , <i>Melitaea asteria</i> , <i>M. parthenoides</i> , <i>Plebejus hespericus</i> , <i>P. psyloritus</i> , <i>P. zullichi</i> , <i>Polyommatus admetus</i> , <i>P. fabressei</i> , <i>P. fulgens</i> , <i>P. golgus</i> , <i>P. humedasmae</i> , <i>P. nivescens</i> , <i>P. violetae</i> , <i>Pseudochazara amymone</i> , <i>P. graeca</i> , <i>P. orestes</i> , <i>P. williamsi</i> , <i>Pseudophilotes barbagiae</i> , <i>Pyrgus cirsii</i> , <i>Satyrrium acaciae</i> , <i>Spialia sertorius</i> , <i>S. therapne</i>

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Figure 1: Flow-chart of our selection procedure, consisting of the following chronological steps: (1) Global species distribution (excludes all species having their major distribution outside the EU); (2) vulnerability (selects all species classified as being endangered in the EU according to the IUCN Red List); (3) Endemicity (identifies species with restricted distribution ranges less than 35,000 km²; (4) Ecological specialisation (identifies species with specific habitat demands).

Figure 2: Ordination plot (Non-metric Multidimensional Scaling, two axes, stress= 0.116) of trait space occupied by species of conservation priority (green) and species of the annexes of the EU Habitats Directive. Coloured spider graphs show centroids and hulls of each group. Each dot shows the position of one or more species, scaled by the number of species at each position (maximum 7). Black arrows (binary traits: endemicity, range size 0 = $\geq 35,000$ km², 1 = $< 35,000$ km²; geographic distribution, distribution within Europe 0 = $> 50\%$, 1 = $\leq 50\%$) and trait labels (ordinal traits) show the position of traits in the trait space. Disp=Dispersal behaviour, Hab=Habitat specialisation, Host=Larval host specialisation, for each: low, intermediate, high; Threat according to IUCN list (LC=Least concern, VU=Vulnerable, EN=Endangered). Please note that no species with low habitat specialisation are included.

Appendix S1: Percentage of the distribution range inside EU assessed for all butterfly species considered for our study. “ $> 50\%$ EU” indicates that more than half of the distribution range is located inside EU. These species were incorporated for subsequent steps and are shaded in grey. Species labelled in the row “Endemics” fulfil the criterion of being European endemics, i.e. a distribution of less than 35,000 km² and more than 50% of this range inside EU. Species in parenthesis are generalists and are not included in our list of species of conservation priority. The two species in squared brackets are small area endemics, but having more than 50% of their distribution range outside EU (in both cases in Switzerland).

488

489 Appendix S2: Overview of species ecology and distribution for all butterfly species
490 considered in our study, as follows: distribution ranges more than 50% inside EU, threatened
491 species according IUCN, range restriction to less than 35,000km² (but more than 50 % of this
492 range within the EU), ecological specialisation (according to demands of larval food plant,
493 habitat and the dispersal behaviour, which generates one combined index of specialisation
494 (median across the other three parameters)). Based on these factors, we identify species of
495 conservation priority, also following three steps of priority level (1-3, high to low). Species
496 listed in the annex II and/or IV of the Habitats Directive are additionally given.

497

498 Appendix S3: Overview of EU endemic butterflies, with different threshold values, such as
499 distributions less than 35,000 km², 25,000 km² and 10,000 km².