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Biological significance and conservation of biogeographical bird populations as shown by selected Mediterranean species

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Abstract – From the conservation point of view there is an important difference between species that are treated as whole and species considered as separate subspecies; these represent important components of biodiversity and deserve conservation for their potential evolution and their characteristics. EU Bird Directive shows an attempt to protect subspecific taxa, when really necessary for conservation purposes. There are some examples of species regarded as secure, if considered as whole, that turn out to be endangered or critically endangered when treated as subspecies (e.g. Mediterranean storm petrel, lanner falcon, rock partridge, Andalusian hemipode, long-tailed tit and crossbill). Status of some species should have to be modified, basing information on more objective comparison with those available for related species (e.g. the pairs Manx and Yelkouan shearwaters, European and spotless starling, and North African blue tit). Moreover, some species have a very restricted distribution, that might be considered an endemic bird area, holding two or more species with a range covering less than 50,000 km^2 (e.g.: Marmora's warbler, Cyprus warbler, Cyprus wheatear and Corsican citril finch). Here I suggest to reconsider, among future conservation priorities, the status of a number of S European species in the light of previous considerations, avoiding some paradoxes, such as incongruity of risk level, when compared to other bird species.

Riassunto – *Significato biologico e conservazione di popolazioni biogeografiche di alcune specie dell'avifauna mediterranea.* In tema di conservazione della natura, c'è una sostanziale differenza se una specie è trattata nel suo complesso o si prendono in considerazione separatamente le sue sottospecie; queste ultime rappresentano componenti molto importanti della biodiversità e meritano un'adeguata conservazione per l'intrinseco potenziale evolutivo e le loro caratteristiche uniche. L'Allegato I della Direttiva Uccelli (409/79 e 244/91) è indubbiamente un fondamentale tentativo a livello europeo di tutelare taxa sottospecifici, nei casi in cui per essi si ritengono necessarie azioni di conservazione. Tuttavia, queste indicazioni non sono state seguite in importanti occasioni; ci sono numerosi esempi di specie definite "sicure" se considerate nel loro complesso, ma che risultano "minacciate" o "minacciate in modo critico" se trattate a livello sottospecifico (esempi sono l'uccello delle tempeste mediterraneo, il lanario, la coturnice, la quaglia tridattila, il codibugnolo ed il crociere). Lo status di alcune specie dovrebbe essere corretto, sulla base di informazioni più obiettivamente confrontate con quelle disponibili di specie affini (ad esempio le coppie berta minore atlantica/berta minore mediterranea, storno/storno nero e la cinciarella algerina). Inoltre, esistono specie con una distribuzione molto circoscritta, che andrebbe correttamente considerata come un'area avifaunistica endemica, cioè ospitante due o più specie con un areale inferiore ai 50.000 km^2 (esempi sono la magnanina sarda, la silvia di Cipro, la monachella di Cipro ed il venturone corso). Alla luce delle considerazioni fatte, si propone, tra le priorità conservazionistiche dell'immediato futuro, di riconsiderare lo status di molte specie europee, evitando in tal modo alcuni paradossi, quale l'incongruità del livello di rischio per molte specie d'uccelli, se paragonata ad altre.

Biodiversity is the total variety of life on Earth, including all genes, species and ecosystems and the ecological processes of which they are part (Wilson 1988, Mc Neely *et al.* 1990); maintaining it means preserving species on the whole, and their isolated subspecies as well. Conservation is a science which clearly needs to dialogue with bureaucracy and politics. Investigations on species' status and list percentages of declining species clearly represent an important information, but it is necessary to avoid ambiguity in preserving species and habitats. Many European researchers gathered their efforts in a foundamental work, largely based on IUCN (2004) criteria, that concerns the new update of status and trend of European bird populations (BirdLife International 2004). Novelty generally brings both opportunities and risks. Since this update represents a scientific source, the main opportunity is that its contents are likely to be used as the main reference for

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the update of Annex I of Bird Directive 409/79. However, information sources on population estimates and trends provided by different countries are heterogeneous and have a variable quality; this entailed some subjective choices in the inclusion of species within the different categories. Some threatened species could run the risk not to obtain the necessary attention at European level. The aim of BirdLife International (2004) is the identification of priority species so that conservation actions can be taken to improve their status; therefore the exclusion of some species/subspecies from its official list would mean also their exclusion from conservation processes. Of course I agree with the IUCN (2004) criteria for the red list compilation, but I believe that the right moment has come to schedule, among future priorities for bird conservation, the inclusion of some biogeographical populations which are the result of an evolutionary process in progress. EU Bird Directive (709/79 and 244/91, Appendix I) shows an attempt to consider subspecific taxa, when really necessary for conservation purposes (e.g.: *Phalacrocorax aristotelis desmarestii*, *Lagopus muta helvetica*, *Alectoris graeca whitakeri*, *Alectoris graeca saxatilis*, *Perdix perdix italica*, *Perdix perdix hispaniensis*, etc.). These should be preserved for their potential evolution and acquisition of unique characteristics, which represent important components of biological diversity; if effectively isolated, they may become new species by acquiring genetic isolating mechanisms. Bird subspecies are allopatric subpopulations, generally maintained by spatial segregation, that share i) a unique geographic range or habitat, ii) a group of phylogenetically concordant array of phenotypic and genetic characters, iii) a unique natural history relative to other subdivisions of the species, (still) genetically compatible with other subpopulations (O'Brien and Mayr 1991, Amadon and Short 1992).

Each of the geographical forms classed as subspecies occupies particular areas which, all together, give the range of the species as a whole. If these geographical forms were classed as allospecies (populations derived from the same common ancestor whose ranges differ and do not touch), we would have several smaller ranges in place of a large one (Newton 2003). From the conservation point of view there is an important difference to treat a species as whole or its subspecies separately. Taxa that are apparently well differentiated, possibly young or having frequent gene flow with other subspecies, still do not reach the reproductive isolation in many populations. Sometimes results of molecular genetics contradict previous ideas about species integrity or taxonomic distinctions based on phenotypic descriptions; an interesting example is the pair *F. peregrinus*/*F. pelegrinoides* (Wink and Sauer-Gürth 1998) treated as separated species by some authors; nevertheless, even if recent molecular researches (Seibold *et al.* 1993, Wink and Seibold 1996) concluded that *pelegrinoides* is a valid species, very close to *peregrinus*, Wink *et al.* (1998), using mtDNA cytochrome b sequence, found a very high affinity between *peregrinus* and *pelegrinoides* with a genetic distance below 0.6% (distance at specific level in Falconidae family should be over 1.5%), proposing to continue to treat them as conspecific. Another interesting example concerns the sparrows; Hagemeijer and Blair (1997) list the Italian sparrow (*Passer italiae*) as a stabilized hybrid, while the authors of BirdLife International (2004) neglect it and misunderstand that the very small figure of 50-100,000 pairs of *Passer domesticus* (living only on the Alps) is the total Italian amount (thus excluding the much larger "*italiae*" population). If the subspecies level should get an appropriate acknowledgement, it could enter into official lists, when conservation status of these "subgroups" requires particular attention. The continuity of the evolutionary process through space and time means that decisions on the limits of species and their distributional boundaries are, to some extent, arbitrary, but the way in which species are defined and delineated can influence our perception of distribution patterns and diversity (Newton 2003). Assuming that a decision to treat a taxon at species or subspecies level may depend on the scientist subjectivity, on the species concept applied (Rojas 1992, de Queiroz 1998, Fraser and Bernatchez 2001, Helbig *et al.* 2002) or on methodology used (Pasquet and Thibault 1997, Haring *et al.* 1999, Sangster 2000, Sangster *et al.* 2005), a careful use of subspecies level in global approaches may result more useful and suitable for bird conservation.

Conservation biologists tried to search for methods distinguishing unambiguous units for conservation purposes, and employed evolutionarily significant units (ESU) as basic units of analysis, when evidence clearly indicated that a formally recognized species either fails to convey important evolutionary and geographical information or fails in delineating a natural entity (Riddle and Hafner 1999). "ESU" was coined by Ryder (1986) as "a subset of the more inclusive entity species, which possess genetic attributes significant for the present and the future generations of the species in question"; interestingly, ESU had both important and biological employ under the USA Endangered Species Act, the Australian Environment Protection and Biodiversity Conservation and the Canadian Species at Risk Act. Entities defined as ESU arise from the accumulation of genetic differences through the various roles of evolutionary forces through the time. However, along the years ESU concept varied very much in accordance with different criteria (e.g. Fraser and Bernatchez (2001) report eight different definitions); the lack of agreement about the concept of the ESU origins from the same philosophical and interpretative dilemmas that plague the scientific definition of species (Kelt and Brown 2000, Green 2005). Consequently, as well as the species concept, no definitive concept of ESU prevailed so far. Moreover, Crandall *et al.* (2000) proposed that ESU concepts might be replaced by a more holistic concept of species, consisting of populations with varying levels of gene flow evolving through drift and selection. Finally, Green (2005) proposed the use of the Designatable Units (DU), methodology adopted by the Committee on the status of Endangered Wildlife in Canada; determining DUs constitutes a two-part test and asks, in the first place, if putative DUs are distinguishable and, then, if they have different conservation status; DUs may also be identified on the basis of demonstrations of genetic distinctiveness, similar to those used for the recognition of the ESU (Green 2005). Species ranges are genetically, demographically, spatially, and ecologically so heterogeneous that current taxonomy cannot always capture whole relationships, but measures to prevent the reduction or the loss of the species should not be postponed for a lack of full scientific certainty. Overall, considering species as dynamic evolutionary units is less affected by the species problem and more related to conservation science (Rojas 1992).

In the last 10-20 years some species have undergone numerical and distributional range increases (e.g.: *Columba palumbus*, *Turdus merula*, *Sylvia atricapilla*, *Sylvia melanocephala*, *Regulus ignicapilla*, *Certhia brachydactyla*, *Fringilla coelebs*, *Carduelis chloris*, *Emberiza cirlus*, etc.); thus, because of their well documented and justified secure status, it seems reasonable to transfer them from the category of species with favourable conservation status, but concentrated in Europe, to "secure" category (BirdLife International 2004). Others show a scattered distribution clearly divided according to subpopulations, characterized by biological, morphological and genetic traits that allow to consider them independently. Habitat loss and fragmentation is considered by far the most pervasive threat, impacting 86% of endangered birds; over-exploitation and invasive alien species are also impacting about 30% of threatened birds (the latter 67% on islands) (Baillie *et al.* 2004); in addition, an evident difference exists between biological cycles of migrant and sedentary birds, since the density of the first is consistently influenced by conditions in different parts of the world. Small areas, such as Mediterranean islands, host many endemic taxa, among birds too; even if threatening processes vary both within and between taxonomic groups, threats to terrestrial and marine birds in these fragile ecological systems need conservation interventions to ensure their continued survival.

Hereby I report some examples of biogeographical populations that should benefit of a stricter conservation approach.

BIOGEOGRAPHICAL RELEVANCE OF PRESERVING SUBSPECIES

Cory's shearwater *Calonectris diomedea*

Assuming that *C. edwardsii* is a valid species (Hazevoet 1995), currently at least three large populations of *C. diomedea* are known, belonging to two subspecies, namely *C. d. borealis* (Atlantic islands, wintering in S America) and *C. d. diomedea*, with two populations, that differ biometrically (Massa and Lo Valvo 1986) and in their vocalizations (Bretagnolle and Lequette 1990), one in the central-western Mediterranean, wintering in S Africa, and the other in the eastern Mediterranean. According to Randi *et al.* (1989) and Wink *et al.* (1993) genetic differences between birds in Mediterranean and Atlantic colonies are of the same order generally found between subspecies, showing a moderate gene flow in Mediterranean and Atlantic *C. diomedea*. The high nest site fidelity (Jouanin *et al.* 1977, Massa and Lo Valvo 1986, Ristow *et al.* 1990, Thibault 1993, 1994, Swatschek *et al.* 1994) minimizes the immigration contribution of external individuals to the dynamics of each colony (but cf. Lo Valvo and Massa (1988) and Thibault and Bretagnolle (1998), who record interesting evidence of gene flow between the two subspecies). Different populations of Atlantic and Mediterranean *Calonectris diomedea* differ in mtDNA cytochrome b sequence as much as 1.51-1.87 %; it should be reminded the fact that between taxa recently raised to species level, *Larus cachinnans*, *L. fuscus* and *L. argentatus*, mtDNA cytochrome b divergence is 0.69-2.04 % (Helbig 1994). According to BirdLife International (2004) the populations of *C. diomedea* amount to 270-290,000 pairs, have a vulnerable status and are in decline. As other shearwaters, they show strong philopatry, with the majority of young returning to the colony where they hatched, and a very small demographic growth (e.g.: Ristow *et al*. 1990). It is evident that all three biogeographical populations need to be preserved. Additionally, some populations undergo an anachronistic and illegal over-exploitation of eggs and more recently the rat predation; for instance, people of Linosa Is. (Sicilian Channel, Italy) every year collect approximately 2-3,000 eggs from a population of about 10,000 pairs, and in the last years rats are a further reason of their low breeding success. BirdLife International (2004) includes the species among the SPEC2 category (with unfavourable conservation status, concentrated in Europe). In this case, even separating the three biogeographical populations cited above, they would remain in the SPEC2 category.

European and Mediterranean storm petrel *Hydrobates pelagicus*

As the other petrels, this is a k-selected species, showing a very high breeding site fidelity (Amengual *et al*. 1999, Lo Valvo and Massa 2000). Extinction probability should be higher for species with low intrinsic rates of increase, compared to r-selected species, when population is small (Pimm *et al*. 1988). Additionally, two biometrically and genetically distinct subspecies have been recorded, one (*H. p. pelagicus*) in the Atlantic, and the other (*H. p. melitensis*) in the Mediterranean, the latter characterized by a larger size and some different reproductive parameters (Hemery and D'Elbée 1985, Catalisano *et al*. 1988, Bretagnolle 1992, Lo Valvo and Massa 2000, Lalanne *et al*. 2001). Divergence between *pelagicus* and *melitensis* possibly resulted from paleogeographic changes in the Strait of Gibraltar, making isolation of the Mediterranean population possible. The latter, indeed, shows a very low genetic differentiation, unlike the Atlantic population (Cagnon *et al*. 2004). In total, Mediterranean basin hosts 8,500-15,200 pairs of *melitensis*, a very small proportion of the whole European population, estimated between 430,000 and 510,000 pairs (BirdLife International 2004). A major factor limiting the breeding distribution of this species is the presence of safe colony sites on islands, that is why the Mediterranean populations are so depleted. Tucker and Heath (1994) considered the species as localized (= with populations highly concentrated in few sites), while BirdLife International (2004) changed the status to secure, thanks to improved knowledge of the Atlantic distribution and numbers, which show a stable trend. From the conservation point of view, it should be a prerequisite condition to treat *melitensis* separately, maintaining it in the SPEC2 category; Mediterranean populations, indeed, are declining and critically threatened in their breeding sites, due to human impact and rat predation (Massa and Sultana 1991).

Lanner falcon *Falco biarmicus*

Its global European population is estimated as much as 480-900 pairs, the majority of which lives in Turkey and Italy. If we consider the species as whole, Europe holds a tiny proportion of the global range. As regards its subspecific status, it is clearly differentiated in morphologically distinguishable isolated populations, breeding in S Europe and small part of Middle East (*Falco b. feldeggii*), in N Africa (*F. b. erlangeri*), and in Africa, S of Sahara (*F. b. biarmicus*). In Europe the species is considered SPEC3, vulnerable (BirdLife International 2004); for conservation purposes, it should be more consistent to consider these sedentary biogeographical populations, among which apparently there is no gene flow, as separated taxa and to include the "rare" European subspecies within the SPEC2 category.

Rock partridge *Alectoris graeca*

It is one of three Mediterranean endemic species of the genus *Alectoris*; endemic to Alps, Apennines, Balkans and Sicily, it has undergone a continuing decline over the last decades, mainly due to hunting. Listed as SPEC2 by Tucker and Heath (1994) and BirdLife International (2004), it is subdivided into populations, fairly distinguishable and described as distinct subspecies. Genetic data partially support subspecies subdivisions, and allow to delimite distinct conservation units. According to Lucchini and Randi (1998) and Randi *et al.* (2003), populations from Apennines and Balkans were probably connected by gene flow since the last glacial maximum, through a late Pleistocene Adriatic landbridge, while estimates of divergence times suggested that Sicilian rock partridges were isolated for more than 200,000 years. Deglaciated Alps were probably colonized by two distinct source populations, bringing about differences observed between eastern and western populations. Rock partridges in Sicily, formally recognized as *A. g. whitakeri*, met the criteria for a distinct evolutionary significant unit; Randi *et al.* (2003) identified two major mtDNA phylogroups, splitting partridges from Sicily vs. all the other sampled populations at an average genetic distance of 0.035, corresponding to 65% of the average distance between closely related species of *Alectoris*. Interestingly, bottleneck and mismatch analyses indicate that rock partridges lost variability through past population declines, and did not expand recently. Assuming the uniqueness of this taxon, very declining and critically endangered in the few Sicilian sites where scanty populations still survive, on an area certainly smaller than 5,000 km^2, it should be more consistent to treat this subspecies separately from the others, listing it within the SPEC1 category (species of global conservation concern). Noteworthy is that the Bird Directive lists *A. g. whitakeri* and *A. g. saxatilis* in the Annex I.

Andalusian hemipode *Turnix sylvaticus*

Almost certainly it has become extinct in Europe, and it is on verge of extinction in N Africa. Violani and Massa (1993) found remarkable biometrical differences between the Mediterranean form (*T. s. sylvaticus*) and sub-Saharan and asiatic ones, concluding that its extinction does mean the disappearance of a Mediterranean endemism for ever; following them, Mediterranean subspecies should be included in the SPEC1 category, not SPEC3, as BirdLife International (2004) did.

Long-tailed tit *Aegithalos caudatus*

Widespread and common species everywhere in Europe, where global populations cover less than half of its global distribution. Consequently its status is considered secure in the NonSPEC^E category (BirdLife International 2004). However, there are some geographically isolated populations, whose subspecific status is clearly recognized (e.g. *A. c. siculus* in Sicily); their sedentary habits and probable absence of gene flow with other populations should bring conservation scientists to treat them separately.

European and Mediterranean crossbills *Loxia curvirostra*

Variability in the cone crop of coniferous trees is thought to be the most important cause of the nomadic nature of this species; nevertheless, nomadism did not prevent the isolation of geographical forms. This species is a very interesting example of evolutionary process in progress. Crossbills with a slender bill feed on several conifer species, whereas those with a strong bill feed only on pines, which have cones larger than other conifers. Correlation between cone scales length and the index of bill curvature supports the hypothesis that bill size is an adaptive character for feeding on pine cones (Lavauden 1924, Massa 1987, Knox 1990, Clouet 2003). Fossils prove that *L. curvirostra* was definitely present in S Europe and the Near East at least from the middle Würmian onwards and probably throughout the Würmian, and that larger birds (*L. pytyopsittacus* size) existed at least in a limited area of the W Alps from the glacial maximum onwards; S European crossbills were isolated from their Siberian congeners during the early and middle Würmian (Tyrberg 1991). Large-billed crossbills on Mediterranean islands and N Africa are probably descendants of Pleistocene populations living on dominant conifers. They must have fed mainly on pine cones, since other conifers were absent or rare W of Urals. A centrifugal spread from central European populations northwards and southwards may have produced large-billed forms (Eck 1981), such as *L. scotica*, *L. pytyopsittacus* and Mediterranean populations; feeding on pines and evolving relatively long tongues which increased probing ability (Benkman 1987) on exploiting conifers regularly fruiting for extended periods, they acquired the potential to become sedentary (Massa 1987, Senar *et al.* 1993, Clouet and Joachim 1996, Clouet 2003). From analysis of mtDNA, species formation in birds is estimated to take around 2.5 million years, varying between 0.2 and 5.5 million years, while subspeciation is estimated to take a short time, sometimes less than 10,000 years (Newton 2003); it is not certain that an isolation period of c. 10,000 years is sufficient for speciation to take place. The three taxa of Crossbills (*Loxia curvirostra*, *L. scotica* and *L. pytyopsittacus*) show no consistent differences in either mithocondrial DNA or nuclear microsatellite sequences, and substantial overlap in the main morphological character (bill depth) that supposedly separates them (Piertney *et al.* 2001). They occur as different ecotypes, differing in body size, call notes, bill size, colours and food preferences. Selective pressures were sufficiently strong to trigger and enhance morphological evolution and rapid local adaptation to resources, without necessarily promoting the development of reproductive barriers between morphs (Questiau *et al.* 1999). Following Groth (1993), N American crossbills belong to eight sibling species, where mated pairs contain members of the same morphotype in areas where different forms are sympatric. European crossbills possibly belong to different species as well, even if it is currently not clear how these forms avoid interbreeding in the wild (see Knox 1990 for *L. scotica*). Mediterranean populations consist of small flocks, generally of tens, rarely of hundreds, so local, sedentary and strictly linked to pine forests that may be considered as endemic taxa; consequently, their status is never secure and deserves a particular attention.

ADJUSTMENT OF THE STATUS OF SOME SPECIES

Yelkouan shearwater *Puffinus yelkouan*

Assuming that *P. mauretanicus* is a separate species (Heidrich *et al.* 2000), Europe holds 13-33,000 pairs on a geographic range of about 100,000 km^2 (almost exclusively on islands), representing more than 95% of the whole population. Although data about trends during 1990-2000 were not available for certain countries (4 out of 9, that is 45%) and only four countries considered this species stable, Tucker and Heath (1994) and BirdLife International (2004) record it as stable and with secure status (respectively including it in SPEC4 and NonSPEC^E categories, that is with favourable conservation status, but concentrated in Europe). However, the whole population of this species is very small and scattered on islets (differently from the SPEC2 *P. puffinus* and *C. diomedea*, large colonies are rare in *P. yelkouan*) and no new nesting colony has been recorded (differently from *P. puffinus*, which has established since 1977 on a N American island off Newfoundland, far from any other known colony: Storey and Lien 1985). From the conservation point of view, the place of *P. yelkouan* should have been more correctly within SPEC2, with vulnerable status.

European starling *Sturnus vulgaris* and spotless starling *Sturnus unicolor*

The first is a widespread breeder across most of Europe, where less than half of its global population lives; it has been introduced in S Africa (1897), Australasia (1856-1881) and N America (1844-1890), where currently it has a population of one hundred millions of individuals and is considered as an agricultural pest and vector of parasites and diseases (Lever 2005). According to Feare (1989) a downward trend has occurred in N European populations, probably not due to usual fluctuations; in recent times the global population was estimated as much as more than 23,000,000 pairs, and underwent a moderate decline (>10%) in the northern countries, balanced by an increase in the southern ones (Feare 1989, BirdLife International 2004). The second species is endemic to western Mediterranean; European populations represent >50% of global range. Despite its limited distribution, European global population (> 2,100,000 pairs) has recently increased. *S. vulgaris* was transferred from NonSPEC to SPEC3, while *S. unicolor* status remained the same (NonSPEC^E = SPEC4) (Tucker and Heath 1994, BirdLife International 2004). This is contradictory; the criterion used was mainly the recent trend, but the difference of natural history, population amount and range distributions do not justify the discrepancy.

North African blue tit *Parus teneriffae*

Following Salzburger *et al.* (2002), Canary and N African populations belong to a distinct species from *P. caeruleus*. Europe holds a small population of the subspecies *ultramarinus* on the isle of Pantelleria (Sicilian Channel, Italy); it shows a very low productivity (Lo Valvo and Massa 1995), possibly balanced by a limited winter mortality. According to criteria of BirdLife International (2004) *P. caeruleus* is a NonSPEC^E; they do not treat *P. teneriffae*, but the unfavorable status of this species not concentrated in Europe should bring to the SPEC3 decision for it.

ENDEMIC BIRD AREAS

It is known that of the 127 bird species that became extinct in the last 400 years, 116 (91 %) were island species, which, therefore, disappeared at a rate 40 times faster than continental ones (Newton 2003). All the taxa restricted only to some archipelagoes (e.g.: Canary Is., Sardinia-Corsica, Balearic Is., Cyprus, etc.) should be recorded within a separate list, demanding attention at the highest level. Some birds, indeed, cover a distribution that may be considered as Endemic Bird Area (EBA), holding two or more restricted range species (= with a range covering less than 50,000 km^2) (Long *et al.* 1996). Stattersfield *et al.* (1998) already included Cyprus among EBA of the world, giving to it a high priority; moreover, they listed Corsican mountains among secondary EBA (fewer than two species are entirely confined to it), pointing out that if *Serinus citrinella corsicanus* was recognized as a separate species, Corsica, Sardinia, Elba and off-lying islands would be qualified as an EBA. Afterwards, Sangster (2000), giving to *Serinus corsicanus* the species rank, proposed to include Corsica among EBA. Actually, Sardinia, Corsica and Tuscany Is., amounting to less than 35,000 km^2, could be qualified as an EBA; nevertheless, following the Important Bird Areas global criteria (A level, category 2) (Fishpool and Evans 2001), Balearic Islands, Sardinia, Corsica and Tuscany archipelago, amounting to less than 50,000 km^2 area, could be qualified as an EBA, since they host the following taxa that have a range covering less than 50,000 km^2: *Puffinus mauretanicus* (Balearic Is.), *Sylvia sarda* (including *balearica*) (Balearic Is, Corsica, Sardinia, with a possible extension to Pantelleria Is.), *Sitta whiteheadi* (Corsica), *Serinus corsicanus* (Sardinia, Corsica and Tuscany archipelago). Thus, the following species listed as NonSPEC^E category (BirdLife International 2004) show a concentration that should be used as a prerequisite to include them in the SPEC2 category.

Marmora's warbler *Sylvia sarda*

It may be considered as an endemic taxon, very concentrated in few islands. According to Shirihai *et al.* (2001) it is a superspecies comprising two insular allospecies, *S. balearica*, endemic to Balearics, and *S. sarda*, living in Corsica, Sardinia, Tuscany Is. and Pantelleria Is. It is considered as secure, its overall trend is unknown, and the whole population estimate is very low (56-110,000 pairs, according to Tucker and Heath 1994, 29-75,000 pairs according to BirdLife International 2004); as the small population of Pantelleria probably became extinct, the species is eventually in decline. However, it is contradictory that this local species falls within NonSPEC^E category, while the Dartford Warbler *S. undata*, with 1,900,000-3,700,00 pairs widespread over more than 1,000,000 km^2, even if depleted and subjected to large historical decline, lies in the SPEC2.

Cyprus warbler *Sylvia melanothorax*

Endemic only to Cyprus, formerly listed as SPEC2 (Tucker and Heath 1994), its global population, thanks to a better estimate of previous figures, now amounts to 70-140,000 pairs (BirdLife International 2004).

Cyprus wheatear *Oenanthe cypriaca*

Endemic to Cyprus, previously listed as SPEC2 (Tucker and Heath 1994), its global population, according to a new by far larger estimate (90-180,000 pairs: BirdLife International 2004), now is considered out of danger. As the previous species, it inhabits an EBA, covering less than 8,000 km^2 (Stattersfield *et al.* 1998).

Citril finch *Serinus* [*citrinella*] *corsicanus*

Barbagli and Violani (1997) pointed out that the adjective *corsicanus* should be adopted as the correct name instead of *corsicana*, agreeing in gender with the generic name *Serinus* (masculine) and not with the specific name *citrinella*, a feminine noun placed in apposition. Pasquet and Thibault (1997) considered distinctive ecology, vocalizations, plumage pattern, measurements and genetic differences between *corsicanus* and *citrinella* within the limit of subspecies/species; however, Sangster (2000) reinterpreted their findings and considering that there are strong evidences that both taxa have unique evolutionary histories proposed *corsicanus* as a valid species. The small and probably stable population of *corsicanus* (<85,000 pairs) (BirdLife International 2004) is restricted only to Sardinia, Corsica and Tuscany islands.

CONCLUSIONS

The list of bird species discussed above cannot be considered comprehensive. It emphasizes some emblematical examples, which allow highlighting the root question requiring an imperative answer to achieve a rational conservation strategy. It should take into account species not only as systematic entities, but also as biological ones, evolving and possibly composed by isolated populations, genetically shaped by drift and selection. Other subspecies or evolutionary significant entities would deserve more attention (e.g.: *Accipiter nisus wolterstorffi*, *Accipiter gentilis arrigonii* from Corsica and Sardinia, *Parus palustris siculus* from Sicily); recognition both of species and populations below the species level for assessment must be guided by the general objective of preventing elements of biodiversity from becoming extinct. The main conservation aim should be to preserve both evolutionary processes and ecological viability of populations by maintaining all the genetic populations within the species so that the process of evolution would not be excessively compelled. If there is substantial concern that an isolated population of a species is on verge of extinction, this information should be used to achieve an official status enabling formal protection; following Alström and Mild (2004), the main advantage of classifying all least-inclusive taxa (giving primacy to evolutionary history) as species is that they receive more attention, which can be crucial for endangered taxa. The acknowledgement of conservation status for isolated populations at risk of extinction is an action taken in the process of using science in support of policy. Policy on endangered species conservation is based on designation of extinction risk status for recognizably distinct biological entities; what is required are biological units that may be designated on the basis of their conservation status, not necessarily on their taxonomical status, with the general objective of preventing irreplaceable units of biodiversity from becoming extinct.

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