The Golden Eagle *Aquila chrysaetos* in the Aspromonte National Park: first surveys on its status and ecology

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In recent decades, the Golden Eagle *Aquila chrysaetos* population in Italy has been negatively affected by numerous environmental transformations determined through anthropogenic actions: the gradual abandonment of traditional agricultural practices, together with the remarkable decline in pasture activity, mainly at higher altitudes, represent some of the threats that directly affect the species (Mathieu & Choisy 1982, Huboux 1984, Esteve & Materac 1987, Fasce & Fasce 1992, Pedrini & Sergio 2001, 2002).

In an unfavourable context, especially in regions such as Calabria, where these negative factors have had considerable intensity, the role of protected areas has proved to be fundamental for the preservation of many species at risk: the Aspromonte National Park, in collaboration with Federparchi, has thus decided to carry out a systematic study on the Golden Eagle, a species so far never investigated in this area. The research, still ongoing, is aimed at obtaining the ecological knowledge about the local population, useful for planning, and where necessary, interventions aimed at protecting and preserving this important predator. In Calabria the Golden Eagle is sedentary, nesting and irregularly migratory (Scebba *et al.* 1993): the bibliographic surveys indicated a stable presence in the Pollino National Park with 4 pairs (Viggiani 1999, Pandolfi *et al*. 2007) and in the Aspromonte National Park, with at least one pair (Malara 1999). The historical presence of this species in the Aspromonte territory is, on the other hand, reported by Moschella (1891), who reports two killings near Reggio Calabria and a stationary pair near Africo.

The study area, located on the ionic side of the Aspromonte massif, which is warmer and more arid than the Tyrrhenian one, was chosen and the information available so far about the presence of species was obtained. The survey covered 11 observation points with an average buffer of 3.5 km on a total area of approximately 405 km^2, divided into seven research zones, with field activities covering the period December 2015 up to August 2016. For the habitat analysis, a vegetation map (Spampinato *et al.* 2008) was used, by dividing the territory into four environmental typologies (unsuitable areas, open areas, woods and reforestation) in order to calculate composition and percentages of the environmental typologies for each home range.

This research, carried out during the reproductive season, allowed to effectively monitor an area of approximately 310 km^2, which is reduced slightly when considering the overlap between some observation points and the "shadow zones".

Three pairs have been identified; this area shows high environmental heterogeneity, mainly resulting from the diversified morphology that strongly influences the present vegetation and the human activities present in this territory.

The environmental analysis of the range occupied by the three pairs (Fig. 1) shows that 53.4% of the territory (woods, reforestation and other unsuitable areas) is inadequate for hunting activities of this species. However 40.1% is potentially eligible, although several types of vegetation (e.g. *Spartium junceum* shrubs and *Pteridium aquilinum* ferns) tend to vary widely the level of soil coverage over time, usually forming sparse populations that, in some cases, may become excessively dense. Finally, it should be stressed that the category "empty areas" (6.4%) stems from the new perimeter of the protected area and includes surfaces not covered by the vegetation map by Spampinato *et al.* (2008).

The population density, computed as relationship between the number of territorial pairs and the extension of the territory (Magrini *et al*. 1987) is 7.40 pairs/1000 km^2 (Tab. 1).

The population is composed of 66.6% adults (n = 6); only one pair is formed exclusively by adults, while in the

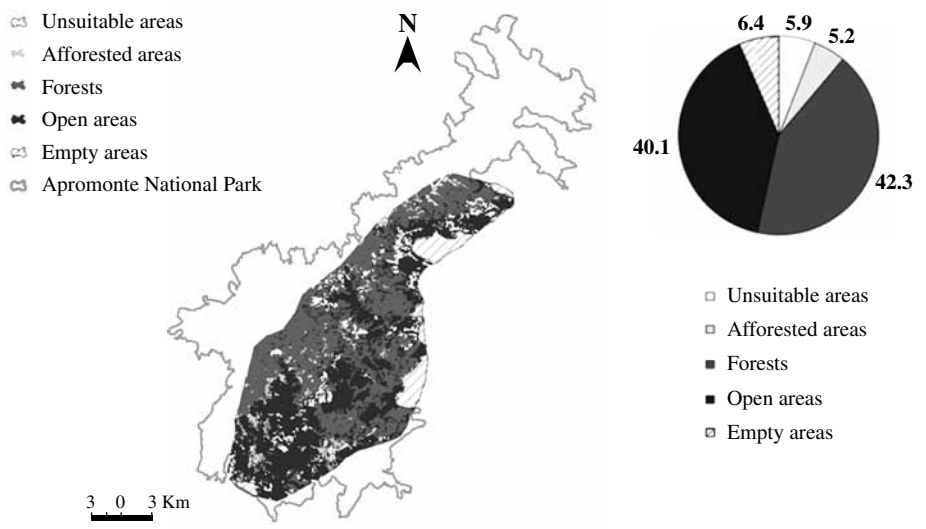

Figure 1. Study area and correspondent environmental analysis.

other two pairs only the females are mature. In these cases, the males, both sub-adults, are in between their fifth and sixth year. Tab. 2 shows the composition of these three pairs, associated with the extension of their respective territories.

In total, four nests were located at an average altitude of 755 m a.s.l. (S.E. = 19.94; n = 5). Three nests were exposed to S-SE, one to N-NW and one to N-W.

From the first surveys, carried out in pre egg laying period (December), it was found that in the 2015 season all the pairs had raised at least one young to the age of fledging; in 2016, however, all pairs had laid, but only two have successfully completed the reproduction phase (Tab. 2).

It should also be noted that at a later stage of the study, during surveys carried out in the post-reproductive period, a further pair was identified, thus bringing to four the total number of pairs for the park area; in this case the territory, unlike others, is located on the Tyrrhenian side. It is again a pair consisting of an adult and a sub-adult.

In the Aspromonte area, the abandonment of traditional agricultural practices, in particular after the floods of the 1950s, favored a general increase in the pioneer and successional vegetation stages, such as shrubs, pre-forest covers and low-density woods, resulting in a negative effect through the gradual disappearance of floral and faunal species linked to open environments, resulting in a decrease in environmental heterogeneity (Spampinato *et al*. 2008). The increase of areas with arboreal and shrub vegetation by pioneer species is particularly remarkable at elevations between 800 and 1700 m a.s.l., and determines the gradual and continuous reduction of open areas that, albeit modest in size and with their patchy distribution, diversify the only-wooded environment where they are present, thus acquiring the fundamental role of ecotones, and so constitute important hunting areas for the Golden Eagle.

The spontaneous or artificial reforestation of abandoned mountainous land is known to determine significant loss of habitat for the Golden Eagle (Watson 1997, Pedrini & Sergio 2001), such as reducing the most suitable hunting territories, causing a subsequent numerical reduction of its prey, which in turn could negatively affect its reproductive rate. Apart from these aspects, the Aspromonte is certainly an area of extreme interest for this species, for its location to the extreme south of the Italian peninsula. The density of territorial pairs found in Aspromonte appears significantly lower than in the alpine sectors where this species reaches its highest densities (Bassi 2011, this volume), but a comparison with the values detected in the central regions of our peninsula (Borlenghi 2011, this volume), as well as in other localities in Calabria (Pandolfi *et al.* 2007), would point out for the massif a high density of

Table 1. Composition of the checked pairs and extensions of their territories.

Pair	**Sex**		**Territory** (km^2)	
	M	F		
1	Ad	Ad	68.7	Mean = 80.33 (S.E. = 28.23; n = 3)
2	Sub	Ad	134	
3	Sub	Ad	38.3	

Table 2. Reproductive parameters of pairs checked during the 2016 reproductive season (n = 3).

Legend	2016
Known pairs	3
Checked pairs	3
Checked pairs during the bood	2
Laying pairs	3
Hatch failed	1
Pairs with 2 young fledged	2
Pairs with 1 young fledged	2
Total young fledged	2
Young checked only after that took off	1
Pairs with composition checked	3
Pairs of adults	1
Pairs not adults	2
% adults pairs	33%
% laying pairs	100%
% hatch success	67%
% pairs that have raised young	67%
Productivity	0.67
Take-off rate	1.00
Reproductive success	0.67

Golden Eagle, among the highest in the Apennines. This is a significant fact that needs to be deepened and confirmed during the next seasons.

The comparison between the average extension of the currently-known home ranges along the peninsula (Fasce 1984, this volume, Magrini *et al*. 2001, this volume, Pedrini *et al.* 2002, this volume, Bassi 2011, this volume, Borlenghi 2011, this volume) and the density of pairs in Aspromonte indicates that eagles tend to maximize the use of the potentially suitable areas, the ionic one in particular, thus contracting the entire distribution area in the province of Reggio Calabria. On the Pollino massif, where the suitable environment for the Golden Eagle are much larger than in Aspromonte, the four territorial pairs under study had territories with an average extension of 333 km^2 (Viggiani 1999). A good amount of prey in the Aspromonte territories could therefore be the factor allowing for the presence of territorial pairs with restricted home ranges compared to the rest of the Apennines.

In absence of any confirmed information about the number of pairs present in the past, it is not possible to draw conclusions on the status of this species in this territory: in the light of current knowledge, it is likely that, at least in part, the abandonment of many traditional activities in the internal areas, especially in a small mountain massif like Aspromonte, has triggered evident recolonization of open areas by woodland and reduced favorable habitats (Perna *et al.* 2007). For territorial individuals, this loss seems to be partially compensated in the Aspromonte area by the occurrence of several herds of goat *Capra hircus* scattered throughout the territory. In fact the Golden Eagle takes advantage of the herd movements along the paths crossing several rocky cliffs, where each year it preys on many goats (Mammoliti *pers. comm.*). This hunting technique is carried out also on wild goats, present with at least five groups in the park territory. The threat factors associated with the presence of electricity cables and structures represent, in three out of four territories, a real danger. It is therefore appropriate to intervene by adapting these structures to the new criteria for the protection of wild birds from electrocution and collision, as defined also in the technical reports by the Council of Europe (Hass *et al*. 2005).

In Aspromonte, 37.5% of individuals are sub-adults and this could mean that the change-over by the adult eagles are more frequent than one might believe.

Finally, with regard to phenology, the only information available is for the pair whose reproductive phase has been followed at all stages (Fig. 2). More precisely, egg laying took place between 4th and 8th April, hatching between 19th and 22nd May and finally fledging between 28th July and 1st August.

This study, due to its preliminary character, can be considered only partially exhaustive; in the next years, in fact, knowledge on the many aspects concerning the ecology of the species in Aspromonte should be deepened, and in particular more data on the reproductive parame-

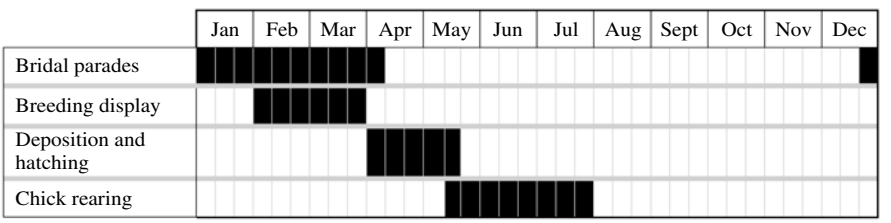

Figure 2. Steps of the reproductive phase.

ters, food preferences and dispersal movements of young should be collected.

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REFERENCES

Bassi E., 2011. Sintesi del censimento contemporaneo di Aquila reale (*Aquila chrysaetos*) e Gipeto (*Gypaetus barbatus*) nell'ambito dei progetti di monitoraggio delle popolazioni nidificanti nel settore lombardo e trentino del Parco Nazionale dello Stelvio. Anni 2004-2011. Parco Nazionale dello Stelvio. Relazione interna in collaborazione con Callovi I., Sotti F., Diana F., Sartirana F., Trotti P., Bragalanti N. & Pedrotti L., pp. 46.

Borlenghi F., 2011. L'aquila reale. Biologia, status e conservazione. Ed. Belvedere, Latina.

Esteve R. & Materac J., 1987. L'Aigle royal *Aquila chrysaetos* en Haute-Savoie: bilan et perspectives. Nos Oiseaux 39: 13-24.

Fasce L. & Fasce P., 1992. Aquila reale. Pp. 601-611. In: Brichetti P., De Franceschi P. & Baccetti N., Fauna d'Italia. Aves I: Gavidae-Phasianidae. Ed. Calderini, Bologna.

Fasce L. & Fasce P., 1984. L'Aquila reale in Italia: ecologia e conservazione. LIPU serie scientifica. Parma.

Fasce P. & Fasce L., 2003. L'Aquila reale *Aquila chrysaetos* in Italia: un aggiornamento sullo status della popolazione. Avocetta 27: 10.

Haas D., Nipkow M., Fiedler G., Schneider R., Haas W. & Schuremberg B., 2005. Protecting birds from power lines. Nature and environment, Council of Europe Publishing 140: 1-70.

Huboux R., 1984. Contribution a une meilleure connaissance du régime alimentaire de l'Aigle royal *Aquila chrysaetos* en période de reproduction pour les Alpes du Sud et de la Provence. Bull. Cent. Rech. Orn. Provence 6: 30-34.

Magrini M., Perna P., Angelini J. & Armentano L., 2001. Tendenza delle popolazioni di Aquila reale *Aquila chrysaetos*, Lanario *Falco biarmicus* e Pellegrino *Falco peregrinus* nelle Marche e in Umbria. Avocetta 25: 57.

Magrini M., Ragni B. & Armentano L., 1987. L'Aigle royal dans la partie centrale des Appennins: Pp. 33-36. In: Actes 1er coll. Int. sur l'Aigle en Europe. Maison de la nature, Briançon.

Malara G., 1999. Nidificazione dell'Aquila reale, *Aquila chrysaetos*, sull'Aspromonte. Riv. ital. Orn. 69: 137-138.

Mathieu R. & Choisy J.P., 1982. L'Aigle royal dans le Alpes Méridionales Françaises de 1964 à 1980. Essai sur la distribution, les effectifs, le régime alimentaire et la reproduction. Bievre 4: 1-32.

Moschella G., 1891. Gli uccelli di Reggio Calabria ovvero notizie sull'Ornis locale. Avicula 30-31.

Pandolfi M., Tanferna A., Gaibani G., Perna P., Tripepi M., Storino P., Urso S. & Mingozzi T., 2007. L'Aquila reale *Aquila chrysaetos*, il Lanario *Falco biarmicus* e il Pellegrino *Falco peregrinus* in Calabria e nel Parco Nazionale del Pollino: consistenza e status delle popolazioni. In: Magrini M., Perna P. & Scotti M. (eds), Atti Conv. Aquila reale, Lanario e Pellegrino nell'Italia peninsulare - Stato delle conoscenze e problemi di conservazione, 160 pp.

Pedrini P., Rizzolli F. & Sergio F., 2002. L'Aquila reale (*Aquila chrysaetos*) nel Parco Adamello Brenta. Relazione conclusiva (1997-2001). Museo Tridentino di Scienze Naturali.

Pedrini P. & Sergio F., 2002. Regional conservation priorities for a large predator: Golden Eagle (*Aquila chrysaetos*) in the Alpine range. Biological conservation 103: 163-172.

Pedrini P. & Sergio F., 2001. Golden Eagle *Aquila chrysaetos* density and productivity in relation to land abandonment and forest expansion in the Alps. Bird Study 48: 194-199.

Perna P., Angelini J., Armentano L., Cristiani G., Gambaro C., Magrini M., Pandolfi M. & Ragni B., 2007. L'Aquila reale *Aquila chrysaetos*, il Lanario *Falco biarmicus* e il Pellegrino *Falco peregrinus* nelle Marche. In: Magrini M., Perna P., Scotti M. (eds), Atti Conv. Aquila reale, Lanario e Pellegrino nell'Italia peninsulare - Stato delle conoscenze e problemi di conservazione, 160 pp.

Scebba S., Moschetti G., Cortone P. & Di Giorgio A., 1992/93. Check-list degli uccelli della Calabria aggiornata a gennaio 1993. Sitta 6: 33-45.

Spampinato G., Cameriere P., Caridi D. & Crisafulli A., 2008. Carta della biodiversità vegetale del Parco Nazionale dell'Aspromonte (Italia meridionale). Quad. Bot. Appl., 19: 3-36.

Viggiani G., 1999. Siti di nidificazione di Aquila reale nel Parco Nazionale del Pollino. Avocetta 23: 120.

Watson J., 1997. The Golden Eagle. T. & A.D. Poyser, London.