

LIVE CAPTURE AND HANDLING OF THE EUROPEAN WILDCAT IN CENTRAL ITALY

LOLITA BIZZARRI*, MORENO LACRIMINI, BERNARDINO RAGNI

Università degli Studi di Perugia, Dipartimento di Biologia Cellulare e Ambientale, via
Elce di Sotto I, 06123 Perugia, Italia

*Corresponding author: e-mail: lolitabizzarri@gmail.com

Received 7 April 2010; accepted 25 May 2010

ABSTRACT - Between 2003 and 2006, a live-trapping of European wildcats (*Felis silvestris*) was carried out in the Apennines (central Italy). Double-door tunnel cage traps were set along trap-lines. A box containing live quails as bait was securely attached to the side of each cage. Trapping was carried out in 8 sessions at a total of 60 trap-sites, mainly inside woods (65%). The distance between the traps ranged from 146 m to 907 m and the length of each trap-line ranged from 541 m to 2632 m. There were 16 captures of 11 different wildcats, the capture success rate being 1 wildcat/209 trap-days. Nine males and 2 females were caught, suggesting sex-biased trapping selection. In addition to wildcats, 20 non-target species were captured during the 8 sessions. No animal was injured by the traps and no wildcat was endangered by narcosis or handling. The technique proved to be effective for future field studies that envisage the radio-tracking of wildcats.

Key words: *Felis silvestris*, trapping, Apennines, Italy

RIASSUNTO - *Cattura e immobilizzazione del gatto selvatico in Italia centrale.* Tra il 2003 e il 2006 è stato svolto un programma di ricerca sul gatto selvatico europeo (*Felis silvestris*) in un'area dell'Appennino centrale. Trappole a tunnel a doppio ingresso sono state distribuite lungo delle *line-trap*; a ciascun dispositivo è stato associato un *box* che ospitava esche vive (quaglie). Sono state effettuate 8 sessioni di trappolamento per un totale di 60 siti trappola, perlopiù in aree boscate (65%). La distanza tra le trappole variava da 146 m a 907 m mentre la lunghezza delle *line-trap* variava tra 541 m a 2632 m. I 16 eventi di cattura hanno permesso di marcare 11 individui diversi, 9 maschi e 2 femmine. La differenza del numero di catture tra maschi e femmine è probabilmente da attribuire ad una diversa selettività delle trappole. Durante le 8 sessioni, oltre al gatto selvatico, sono state catturate altre 20 specie di mammiferi. Nessun individuo ha subito danni a causa delle trappole. Nessun gatto selvatico catturato è stato danneggiato dalla narcosi o dalla manipolazione. Le metodologie utilizzate si sono rivelate efficaci per i programmi di ricerca che prevedono l'utilizzo del metodo radiotelemetrico applicato al gatto selvatico europeo.

Parole chiave: *Felis silvestris*, trappolamento, Appennini, Italia

INTRODUCTION

A severe decline in the historical European range of *Felis silvestris*

silvestris Schreber, 1777 occurred during the 19th century. The subspecies became extinct in the Czech Republic (IUCN, 2007), Austria (Spitzenberger,

2005), where recent sporadic sightings may be due to the spreading of the Italian population northwards (Lapini and Molinari, in press) and in the Netherlands (Nowell and Jackson, 1996), where it may be re-colonizing from populations in the Eiffel or Ardennes forests (Canters *et al.*, 2005). The wildcat is included in the CITES Appendix II and is strictly protected throughout most of its European range; it is also listed in Annex IV of the EU Habitats & Species Directive and Appendix II of Bern Convention. It is considered to be of “Least Concern” by the IUCN Red List and “Near-Threatened” in the 25 member states of the European Union (Temple and Terry, 2007). It is classed as “Threatened” at the national level in many European countries and as “Vulnerable” in Italy (Bulgarini *et al.*, 1998).

The main threats to the *taxon* are the ongoing loss, fragmentation and degradation of its habitat and domestic cats (*Felis silvestris catus*), through hybridization (Beaumont *et al.*, 2001), transmission of viral diseases (Ragni, 1993), and ecological competition.

In order to draw up an action plan for the conservation of the wild cat, it is necessary to evaluate its distribution, abundance, ecological requirements and population status. A major problem is the correct identification of field-sightings and signs of presence because the wildcat and the domestic cat are have several morphologic, biometric, genetic and behavioural traits in common (Ragni and Randi, 1985, 1986; Randi and Ragni, 1986, 1988, 1991; Ragni and Possenti, 1991, 1996;

Randi *et al.*, 2001). Photo-trapping is being increasingly used to monitor forest-dwelling, elusive and/or rare species (Karanth *et al.*, 2004; Jackson *et al.*, 2005). Nevertheless, the capture and handling of individuals is still essential to carry out radio-tracking programmes. Moreover, capturing an adequate sample of the population allows exhaustive screening in terms of sex, age, size, physical condition, health and genetic sampling.

Between 2003 and 2006, we carried out a capture programme in the Central Apennines (Italy) in order to: i) determine whether the trapping protocol adopted about fifteen years earlier in Mediterranean areas (Sforzi *et al.*, 2010) would be effective in mountainous areas, ii) confirm the presence of the felid which had been reported in the area until the 1960s (Ragni, 1972, 1981; Bizzarri, 2004).

Results are analysed and discussed in relation to those obtained by other European live-trapping projects.

STUDY AREA

Trap-lines were set in a 1500 ha wide area of south-eastern Umbria (“Paradiso di Pianciano”, Perugia province) 12° 49’ East and 42° 48’ North. The altitude of this area ranges from 400 m to 1200 m above sea level, with about half of the area located above 1000 m a.s.l. Woods cover 75% of the area (hornbeam *Ostrya carpinifolia* 55%, turkey oak *Quercus cerris* 17% and beech *Fagus sylvatica* 3%). The remaining portion is made up of secondary grasslands (9%), olive-groves (8%), farmland (7%), evergreen woods, hedges and buildings (1%). Extensive biological and semi-biological agriculture is practised; neither mineral or chemical fertilizers nor pesti-

Live capture of European wildcats

des of any type are used. Woodland is managed partly as coppice and partly for timber. Main game species are the wild boar (*Sus scrofa*), brown hare (*Lepus europaeus*) and, secondarily, pheasant (*Phasianus colchicus*), the latter being restocked annually. No predator or pest control or culling is conducted. A busy, two-lane, provincial road crosses Paradiso di Pianciano, while forest roads are used only by land-owners.

When the study area was managed as a hunting reserve, 11 wildcats of unknown sex were snare-trapped from August 1966 to August 1967 and 21 (17 males, 4 females) in the following year; from 1969 to 1977, 12 European wildcats were shot or snared (Ragni, 1972, 1981).

METHODS

We used double-door tunnel cage traps, 140 x 40 x 40 cm, with a box securely attached to the side (Fig. 1). The two components of the *apparatus* were made of the same material and were of the same shape and size, in order to look like a single object. The box contained 3-5 live quails (*Coturnix coturnix*), protected only by a rigid wire net with a 2.5 cm wide square mesh. The bait could be reached simply by

entering the trap through one of the two large square holes, which provided an unobstructed view of the familiar habitat. This trapping *apparatus* had been specially designed for wildcat trapping and successfully used in the Mediterranean area (Ragni, 2005; Sforzi *et al.*, 2010).

Between May 2003 and June 2006, eight trapping sessions were carried out, using from 4 to 9 traps in a total of 60 trap-sites. They were set at altitudes between 440 m and 1114 m (average: 694 ± 73 m), mainly inside woods (65%), along hedges (25%) and in secondary grasslands (7%) according to the habitat preferences of the wildcat in Italy (Mandrici, 2005; Ragni, 1981; Ragni *et al.*, 1987). Traps were set out along transects that were easily accessible from forest roads. The distances between the traps ranged from 146 m to 907 m (average: 299 ± 54 m); the length of the trap-lines ranged from 541 m to 2632 m (average: 1693 ± 660 m). The traps were checked at sunrise every day.

All caught wildcats were transferred from the trap to a wooden box and transported to a handling room situated in the study area. They were immobilised with a mixture of Ketamine HCl (0.05 ml/kg) and Medetomidine (0.08 ml/kg) with the help of an expert wildlife veterinarian.



Figure 1 - The model of trap used.

The drugs were injected intramuscularly. During handling, an ophthalmic ointment was applied to the eyes, as they normally remained open. Biometric, morphological and health screening was carried out. Specimens were identified by coat-colour pattern (Ragni and Possenti, 1996), photographed and fitted with radio-transmitter collars and/or microchips. Blood and hairs were taken for genetic analysis. When present, ectoparasites were collected. Each cat was then put into a wooden box that was sheltered from light and noise, and released when it was fully awake.

Capture effort was expressed as trap-days (number of traps x number of days of activity). All means were expressed \pm Standard Deviation ($z = \pm 2.58$).

A capture index (CI) was calculated as: number of trapped individuals / number of trap-days.

We used Spearman's rank correlation test (Siegel, 1956) to evaluate the relationship between the number of individuals captured and the following variables: number of trap-days per trap-session, altitude a.s.l., distance from buildings (m) and distance from roads (m).

RESULTS

A total of 3352 trap-days were carried out (Tab.1). Wildcats were trapped sixteen times (1 wildcat/209.5 trap-days) for a total of eleven individuals, 9 males and 2 females (1/304.7 trap-days) and the capture index was 0.003. The number of trap-days needed to capture the first cat in each session ranged from 22 to 77 (mean = 48.7 ± 26 ; Tab. 1).

A mean of 19 ± 7 (min-max = 3-38) days needed before a wildcat was caught after the activation of the traps. The relationship between the number of trap-days per trapping session and the

number of individuals caught was not significant ($\chi^2 = -0.408$, $N=8$).

All wildcats caught were transferred to the handling room within 31 minutes (± 7 m). On average, handling started 6 hours and 20 minutes (± 2 h40min) after checking of the traps, according to the availability of the veterinarian. Six minutes and 30 seconds (± 1 min45sec) elapsed between the injection of the Ketamine and Domitor mixture and narcosis. The first signs of awakening were seen 38 minutes (± 4 min40sec) after the time of injection. The specimens were fully awake 4 hours (± 54 min) after injection.

Ten adult individuals and a 4 months old female were caught. The weight of adult males ranged from 2950 to 5000 g (average: $3642 \text{ g} \pm 546$); the adult female weighed 2040 g and the yearling 1000 g. All specimens were radio-collared, except for the yearling female, which was fitted with a microchip, and one male, which was suffering from an advanced cancerous syndrome and died three days after capture. Twenty non-target species (159 specimens) were captured during the 8 sessions (Tab. 2). None of both the target and non-target trapped animals suffered any injury, apart from minor abrasions of the orbital and nasal regions caused by their attempts to open the doors.

The first male wildcat trapped was run over and killed by a car 65 days after capture. None of the other wildcats seem to be affected by the radio-collar, as we could verify by recaptures or direct contacts.

Wildcats were caught between 465 m and 1050 m a.s.l. (average: 784 ± 162 m; Tab. 3). The relationship between this

Live capture of European wildcats

Table 1 - Monitoring session (S), number of wildcats caught and catching success (CS). No catching success is presented for wildcat re-capture (sessions 3, 4, 7). N. of traps: maximum number of active traps (* re-capture; (*) capture and re-capture in the same session).

S	Date	N. traps	Trap-days	Wildcats caught	Code	Wildcats re-caught	1 st CS	2 nd CS	3 rd CS
1	31 May - 19 Aug 03	9	679	2	M1, M2	0	24	285	-
2	30 Sept 03 - 28 Mar 04	9	530	1	M3	0	22	-	-
3	04 Aug - 07 Sept 04	7	239	4	M3*, M4(*)	3	63	-	-
4	06 Oct - 28 Nov 04	8	344	4	M5(*), M6, M7	1	34	193	300
5	07 Jan - 06 Mar 05	4	226	1	M8	0	77	-	-
6	10 Mar - 17 Jun 05	8	630	0	-	0	-	-	-
7	20 Sep - 19 Nov 05	7	273	4	M5*, M9, F1, F2	1	72	131	131
8	03 Apr - 12 Jun 06	8	431	0	-	0	-	-	-

parameter and the number of individuals captured was not significant ($P = 0.480$, $N=11$).

Ten wildcats were trapped in woods, 4 in hedges and 2 in secondary grassland (Tab. 3).

No significant relationship emerged between the number of individuals captured and the distance (Tab. 3) between the traps and both human settlements (average: 1535 ± 578 m, min-max: 186-2786 m; $P = 0.152$, $N=14$) and the provincial road (average: 1357 ± 582 m, min-max: 156-2316 m $P = -0.107$, $N=8$).

DISCUSSION

The trapping *apparatus* and protocol pro-

proved just as effective in the Apennines as they had been in Mediterranean areas, the overall trapping success being almost identical to that reported for the Maremma Regional Park (CI = 0.003; 1 wildcat/333 trap-days; Ragni, 2005) and *F. s. libyca* in Sardinia (CI = 0.0035; 1 wildcat/286 trap-days; Ragni, unpubl.).

Trapping success was lower than in Switzerland and Slovenia where the results were 1 wildcat/52.9 trap-days (Dötterer and Bernhart, 1996) and 1 wildcat/57.7 trap-days (Potočnik *et al.*, 2002), respectively.

The different results may depend on a lower population size in the Apennines or to different trapping protocols.

Table 2 - Number of individuals (N) caught for each non-target species.

Species	N
Tawny owl (<i>Strix aluco</i>)	1
Sparrowhawk (<i>Accipiter nisus</i>)	3
Italian sparrow (<i>Passer montanus</i>)	2
Tree sparrow (<i>Passer montanus</i>)	1
Great tit (<i>Parus major</i>)	1
Pheasant (<i>Phasianus colchicus</i>)	42
Quail (<i>Coturnix coturnix</i>)	3
Hooded crow (<i>Corvus corone cornix</i>)	6
Magpie (<i>Pica pica</i>)	1
Turtle dove (<i>Streptopelia turtur</i>)	2
Black rat (<i>Rattus rattus</i>)	25
Wood mouse (<i>Apodemus sylvaticus</i>)	1
Crested porcupine (<i>Hystrix cristata</i>)	28
Western hedgehog (<i>Erinaceus europaeus</i>)	9
Beech marten (<i>Martes foina</i>)	9
Western polecat (<i>Mustela putorius</i>)	1
Eurasian badger (<i>Meles meles</i>)	9
Red fox (<i>Vulpes vulpes</i>)	10
Dog (<i>Canis lupus familiaris</i>)	3
Domestic cat (<i>Felis silvestris catus</i>)	2

Indeed, neither Dötterer and Bernhart (1996) nor Potočnik *et al.* (2002) worked with trap-lines.

Both in the Apennines and Slovenia, more male than females wildcats were captured (9/2 and 7/2, respectively). This might be due to a sex ratio different from the classical 1:1 or to the ranging behaviour of males, which should perustrate wider areas than females or, more probably, to the higher diffidence towards the traps

showed by females, as we could observe in captivity (Ragni, unpubl.). The failure to capture wildcats in 2 of the 8 sessions suggests that only one trapping session may be insufficient to verify the presence/absence of the felid even if the number of trap-days is high. Indeed, in the 2 sessions in which no wildcats were caught, the traps were active for a number of trap-days higher than the average of the eight sessions. No problems were encountered in the

Live capture of European wildcats

Table 3 - Characteristics of wildcats captured in each trapping session(S) and capture sites; A: adult (over two years old), SA: sub-adult (1-2 years old), J: juvenile (less than one year old); *: re-capture; sec. gras.: secondary grassland.

Date	Wildcat caught	Age	Weight (g)	Altitude a.s.l.	Vegetation	Distance to buildings (m)	Distance to road (m)
3 Jun 03	M1	A	4125	625	wood	1622	1015
2 July 03	M2	A	3750	775	wood	2786	2077
9 Oct 03	M3	A	5000	550	wood	524	394
11 Aug 04	M3*	A	-	475	hedges	272	175
13 Aug. 04	M4	A	3500	465	hedges	372	158
18 Aug. 04	M4*	A	-	465	hedges	414	156
4 Sep 04	M3*	A	-	490	hedges	186	156
21 Oct 04	M5	A	3500	1000	wood	1859	2018
10 Nov 04	M5*	A	-	925	wood	1859	1976
10 Nov 04	M6	A	3750	1000	wood	2040	2018
23 Nov 04	M7	SA	3200	1025	wood	1876	2177
27 Jan 05	M8	A	3000	575	wood	1461	758
2 Oct 05	F1	SA	2040	1025	wood	2058	2197
5 Oct 05	M5*	A	-	1050	sec. grass.	2043	1965
18 Oct 05	F2	J	1000	1050	wood	2408	2151
18 Oct 05	M9	A	2950	1050	sec. grass.	2774	2316

handling protocol. None of the individuals released and monitored through radio-tracking showed any sign of anomalous behaviour resulting from handling (Bizzarri, 2004).

The average weight of the adult males captured was slightly lower than that recorded on the Apennines by Ragni in 1981 (average 3808 g) and decidedly lower than that reported by Potočnik *et al.* in Slovenia in 2002 (5716 g).

According to Lups (1993), Dötterer and Bernhart (1996), and Potočnik *et al.* (2002), our results suggest that there has been an increase in the altitudinal limit of the distribution of the European wildcat from 800 m (Schauenberg, 1981) to above 1000 m a.s.l. This trend could be due to the milder winters and

less abundant snowfalls occurred in the last decades. On the Apennines, it has been observed that felids do not frequent areas where snow cover is deeper than 20 cm and lasts for more than 100 days per year (Ragni, 1981). During the research period, these conditions never occurred in the study area. Small, long-standing, sparsely-populated human settlements and extensive agriculture seem compatible with the presence of European wildcats. Indeed, five captures were made at less than 600m from buildings. Such proximity to man, however, could increase the risk of hybridisation or infection due to the presence of domestic cats (Ragni 1981, 1993; Beaumont *et al.*, 2001); this situation

was never verified in the study period. A greater threat is probably posed by road traffic.

According to the data, the wildcat is widely distributed in the whole trapping area. By radiotracking, population density has been assessed to be 1.2 wildcat per 1000 hectares (Bizzarri, Ragni, unpubl.).

The opportunistic approach applied does not allow us to analyse the habitat preferences of wildcats and could have caused the absence of correlation between the number of specimens captured and the environmental factors considered. Live quails were used as bait to attract and capture as many individuals as possible, whilst to obtain sound information on habitat selection, either through mechanical or photographic trapping (Anile *et al.*, 2009), no attractor should be used.

Although the capture of non-target species caused the loss of only 4.8% of trap-days, the low specificity of our trap model could lower the trapping success of the target species.

The high number of pheasants and, consequently, foxes captured depended on the massive release of the first species for hunting purposes, whilst the trapping of black rats and porcupines may be due to the ecological criteria adopted by farmers in the study area. In the absence of such contingencies, the percentage of non-target species would probably have been similar to those reported by Dötterer and Bernhart (1996) and Potočnik *et al.* (2002).

All considering, we propose the following trapping protocol: in a 15-20 km² large area, 3 sessions of 300 continuous trap-days should be carried out, each sampling area being as far apart and equidistant as possible from

the other two. For each session, 3 trap-lines of at least 8 traps each, should be laid down. If implementation of this protocol does not lead to the capture of at least one wildcat, the taxon may be considered absent in the study area during the study period.

REFERENCES

- Anile S., Bizzarri L., Ragni B. 2009. Camera trapping the European wildcat (*Felis silvestris silvestris*) in Sicily (Southern Italy): preliminary results. *Hystrix It. J. Mamm.* (n.s.) 20(1): 55-60.
- Beaumont M., Barratt E. M., Gottelli D., Kitchener A. C., Daniels M. J., Pritchards J. K. and Bruford M. W. 2001. Genetic diversity and introgression in the Scottish wildcat. *Molecular Ecology*, 10: 319-336.
- Bizzarri L. 2004. European wildcat (*Felis silvestris silvestris* Schreber, 1777) biology and conservation in Italy. PhD thesis, University of Perugia, Perugia: 1-123. [In Italian].
- Bulgarini F., Calvario E., Fraticelli F., Petretti F., Sarrocco S. (eds) 1998. Libro Rosso degli Animali d'Italia - Vertebrati. WWF Italia, Roma.
- Canters, K.J., Thissen, J.B.M., van Diepenbeek, A., Jansman, H.A.H., Goutbeek, K. 2005. The wildcat (*Felis silvestris*) finally recorded in the Netherlands. *Lutra*, 48 (2): 67 - 90.
- Dötterer M. and Bernhart F. 1996. The occurrence of wildcats in the southern Swiss Jura Mountains. *Acta Theriologica*, 41(2): 205-209.
- IUCN 2007. *Felis silvestris silvestris*. In: IUCN 2007. European Mammal Assessment: <http://ec.europa.eu/environment/nature/conservation/species/ema>. Downloaded on 22 February 2008.
- Jackson R.M., Roe J.D., Wangchuk R., Hunter D.O. 2005. Surveying Snow Leopard populations with emphasis on

- camera trapping. A handbook. Sonoma, California, The Snow Leopard Conservancy: 73.
- Karath K.U., Chundawat R.S., Nichols J.D., Kumar N.S. 2004. Estimation of tiger densities in the tropical dry forests of Panna, Central India, using photographic capture-recapture sampling. *Animal Conservation*, 7: 285-290.
- Lapini L. and Molinari P. (in press). Nach zehn Jahren taucht in Kärnten die Wildkatze wieder auf. Carinthia II.
- Lüps P. 1993. Die Wildkatze: Keine verwilderte Hauskatze. Berichte der St. Gallischen *Naturwissenschaftlichen Gesellschaft* 86: 619-640.
- Mandrici A. 2005. Il gatto selvatico europeo (*Felis silvestris silvestris* Schreber, 1777) in Italia: distribuzione storica e attuale, preferenze ambientali, status conservazionistico. PhD thesis University of Perugia, 108 pp.
- Nowell K. and Jackson P. (eds) 1996. Wild Cats, Status Survey and Conservation Action Plan. IUCN/SSC Cat Specialist Group: 1-382.
- Potočnik H., Kljun F., Račnik J., Skrbinišek T., Adamič M. and Kos I. 2002. Experience obtained from box trapping and handling wildcats in Slovenia. *Acta Theriologica*, 47(2): 211-219.
- Ragni B. 1972. Il gatto dei boschi. In: Una vita per la natura. WWF (ed), 249-329.
- Ragni B. 1981. Gatto selvatico, *Felis silvestris* Schreber, 1777. In: M. Pavan (ed.), Distribuzione e biologia di 22 specie di Mammiferi in Italia. Consiglio Nazionale delle Ricerche, AQ/1/142-164, Roma, 105-113.
- Ragni B., 1993. The crucial problem of in vivo identification of wildcat and recognition of hybrids with domestic cats. Proc.Conf. of the seminar on the biology and conservation of the wild cat (*Felis silvestris*), Environmental encounters, Council of Europe, 16: 80-84.
- Ragni B. 1993. Status and conservation of the wildcat in Italy. Environmental encounters, Council of Europe, 16: 40-41.
- Ragni B. 2005. Presenza e ipotesi di reintroduzione di Mammiferi “significativi” nel Parco Nazionale del Circeo. In: Zerunian S. (ed.), Habitat, flora e fauna del Parco Nazionale del Circeo. Ufficio Gestione Beni ex ASFD, Sabaudia, 99-110.
- Ragni B., Lapini L., Perco F. 1987. Situazione attuale del gatto selvatico *Felis silvestris silvestris* e della lince *Lynx lynx* (L.) nell’area delle Alpi sud-orientali. *Biogeographia*, 13: 867-901.
- Ragni B. and Possenti M. 1991. Genetica e problemi di conservazione in popolazioni italiane di gatto selvatico. Genetics and Wildlife Conservation. *Ricerche di Biologia della Selvaggina* 18: 165-173.
- Ragni B. and Possenti M. 1996. Variability of coat-colour and markings system in *Felis silvestris*. *Italian Journal of Zoology*, 63: 285-292.
- Ragni B. and Randi E. 1985. Situazione tassonomica degli attuali felini italiani. Biologia dei Vertebrati. IV Congresso Associazione Alessandro Ghigi.
- Ragni B. and Randi E. 1986. Multivariate analysis of craniometric characters in European wildcat, domestic cat and African wildcat (genus *Felis*). *Zeitschrift für Säugetierkunde*, 51: 243-251.
- Randi E., Pierpaoli M., Beaumont M., Ragni B. and Sforzi A. 2001. Genetic identification of wild and domestic cats (*Felis silvestris*), and their hybrids using bayesian clustering methods. *Molecular Biology and Evolution*, 18 (9): 1679-1693.
- Randi E. and Ragni B. 1988. Analisi della variabilità genetica in alcune specie di Carnivori ed applicazioni gestionali. *Ricerche di Biologia della Selvaggina*, 14: 501-506.

- Randi E. and Ragni B. 1991. Genetic variability and biochemical systematics of domestic and wild cat population (*Felis silvestris*: Felidae). *Journal of Mammalogy*, 72(1): 79-88.
- Schauenberg P. 1981. Elements d'ecologie du chat forestier d'Europe *Felis silvestris* Schreber, 1777. *Revue Ecologie (Terre et Vie)*, 35: 3-36.
- Sforzi A., Bizzarri L., Ragni B., Paoloni D. 2010. Reconstitution of an European wildcat viable population in the Maremma Regional Park: a twenty years experience. In: E. Randi, B. Ragni, L. Bizzarri, N. Agostini, G. Tedaldi, (eds), *Biologia e conservazione dei Felidi in Italia*. Atti del convegno - Santa Sofia (FC) 7-8 Novembre 2008. Ente Parco Nazionale Foreste Casentinesi.
- Siegel S. 1956. *Nonparametric statistics for the behavioral sciences*. McGraw-Hill: New York, Toronto, London.
- Randi E., Pierpaoli M., Beaumont M., Ragni B., Sforzi A. 2001. Genetic identification of wild and domestic cats (*Felis silvestris*), and their hybrids using bayesian clustering methods. *Mol. Biol. Evol.*, 18 (9): 1679-1693.
- Spitzenberger F. 2005. Rote Liste der Säugetiere Österreichs. In: Zulka K.-P. (ed.), *Rote Listen gefährdeter Tiere Österreichs*. Böhlau, Wien, Köln, Weimar.
- Temple H.J. and Terry A. (eds) 2007. *The Status and Distribution of European Mammals*. Luxembourg, Office for Official Publications of the European Communities. VIII + 48pp.