

PRESENCE OF LARGE AND MEDIUM-SIZED MAMMALS IN A BURNED PINE FOREST IN SOUTHWESTERN TURKEY

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RIASSUNTO - *Presenza di grandi e medi mammiferi in pinete incendiate della Turchia sud-occidentale.* Nel periodo Novembre 2005-Agosto 2006, è stata verificata, tramite trappole fotografiche, la presenza di mammiferi di grandi e medie dimensioni in foreste di *Pinus brutia* integre e incendiate della Turchia sud-occidentale. Sono state ottenute fotografie di tre specie, cinghiale (*Sus scrofa*), volpe (*Vulpes vulpes*) e faina (*Martes foina*). Le prime due sono state rinvenute in entrambe le aree, mentre la faina è stata accertata solo in boschi incendiati. I risultati del presente studio suggeriscono che gli stadi successionali intermedi successivi ai roghi possono essere ricolonizzati dalle comunità di mammiferi.

Parole chiave: trappole fotografiche, fuoco, stadi successionali, bacino Mediterraneo

Fire has long been regarded as an ecological factor shaping Mediterranean-type communities (Trabaud, 1994). Consequently, several studies have been conducted in fire-prone environments of these ecosystems, especially regarding plant population and community dynamics. Post-fire regeneration of vegetation (e.g. Kazanis and Arianoutsou, 2004), fire effects on soil properties (e.g. Gimeno-Garcia *et al.*, 2000), and fire-adapted traits of plant species (e.g. Keeley and Fotheringham, 1998) are well documented. In Mediterranean ecosystems, the effect of fire on faunal dynamics has also been studied with regard to arthropods (e.g. Kaynaş and Gürkan, 2008), birds (e.g. Herrando and Brotons, 2002; Ukmar *et al.*, 2007) and small mammals (e.g. Fox, 1990; Haim *et al.*, 1997), while less attention has been given to the effect of fire on the presence and dynamics of large and medium-sized mammals in the

Mediterranean basin (but see Masseti and Theodoridis, 2002; Sarà *et al.*, 2006; Moreira and Russo, 2007).

Mediterranean shrublands and forests are able to recover quickly after fires (Trabaud, 1994), thanks to their fire adaptive traits (Paula *et al.*, 2009). In Mediterranean Turkey, plant communities mostly recovered within 10 post-fire years (Türkmen and Düzenli, 2005; Tavşanoğlu and Gürkan, 2009). However, the recovery process of faunal communities is longer and follows the changes in vegetation structure (small mammals: Kaynaş *et al.*, 2002; Kaynaş, 2008, insects: Kaynaş and Gürkan, 2008).

Since the presence of predators implies that of their prey species, carnivore mammals have been considered as indicators of ecosystem integrity (Gros *et al.*, 1996). Understanding the habitat requirements of large and medium-sized mammal species is very important for conservation and manage-

ment planning (Boshoff *et al.*, 2001; Finlayson *et al.*, 2008). Moreover, the distribution of these species in burned forest stands may help to show the level of recovery of the ecosystem in fire-prone environments.

In the last decades, camera trapping has been widely used for investigating the distribution of large and medium-sized mammals (Thompson, 2004), including the Near East, especially in the last five years. Serra *et al.* (2007), as an example, reported for the first time the occurrence of the sand cat, *Felis margarita*, and confirmed the presence of Ruppell's sand fox, *Vulpes ruppellii*, in the protected area of Al talila, in the desert of Tadmor (= Palmyra; Syria). Giannatos *et al.* (2006) have also used camera trapping to attest the current dispersion of various large and medium-sized mammals, including the caracal, *Caracal caracal*, in several areas of southern Turkey, such as the Termessos National Park and the reserve of Düzlerçam, Antalya. Recently, Can and Togan (2009) confirmed the presence of several large and medium-sized mammal species, such as brown bear *Ursus arctos*, gray wolf *Canis lupus* and wild cat *Felis silvestris*, in Yenice Forest, northern Turkey.

The aim of the present study was to determine whether large and medium-sized mammals use burned pine forests in Mediterranean Turkey. To answer this question, one recently burned site and a long-unburned site were selected and sampled via camera-traps in southwestern Turkey.

The study was conducted in the region of Marmaris, southwestern Turkey (36° 54' N, 28° 12' E). The climate is sub-humid Mediterranean with a dry summer period. According to the data obtained from the Turkish State Meteorological Service (Marmaris Meteorological Station, at 19 m a.s.l.), mean annual rainfall is 1212 mm, and mean annual temperature is 18.7 °C. The xerothermic period lasts five months, from May to September. Vegetation cover

is dominated by Turkish red pine *Pinus brutia* Ten. throughout the study area. The fires occurred in the past 30 years have created a mosaic of post-fire successional stages. In these sites the vegetation consists of Mediterranean maquis shrubs and phrygana sub-shrubs, predominantly *Phillyrea latifolia* L., *Quercus infectoria* Olivier, *Cistus salviifolius* L., *C. creticus* L. and *Smilax aspera* L.

A site burned in 1996 (nine years before the beginning of the study) and a long-unburned site, located next to the burned site, were selected. Both sites are on ophiolitic rocks, their altitude ranging between the sea level and 300 m a.s.l. The two study areas covered, respectively, 7090 ha and 1320 ha.

Camera trapping was used to determine the occurrence of large and medium-sized mammal species in the study sites. In August 2005, a preliminary survey lasted nine consecutive days. Afterwards, trapping was conducted bimonthly from November 2005 to August 2006 in both the burned and unburned sites. For each site, three CamTraker™ Digital camera traps with passive infrared detection systems (CamTrak South, Watkinsville, GA, USA) were regularly placed with 1 km intervals at fixed points. Cameras were kept active 24 hours a day for 7-10 consecutive days at each sampling survey.

Built-in sensors detect the presence of an animal in front of the device and activate the camera to take a snap and record the date and hour of each photograph. All traps were baited with canned tuna fish. During the sampling periods, camera traps were checked daily in order to re-bait the stations and take the photographs, which were stored in digital form for further analyses. Snaps of a same species taken within a 15 minutes period were considered as a single visit.

A total of 196 camera-trap days (97 in the burned site and 99 in the unburned one) was performed. Photographs of wild boars

Mammals in a burned pine forest

Table 1 - Results of camera trapping in burned and unburned sites.

| | Number of visits | |
|---------------------------|------------------|---------------|
| | burned site | unburned site |
| <i>Martes foina</i> | 3 | 0 |
| <i>Vulpes vulpes</i> | 2 | 2 |
| <i>Sus scrofa</i> | 1 | 4 |
| <i>Erinaceus concolor</i> | 7 | 1 |
| <i>Apodemus</i> sp. | 2 | 3 |
| <i>Sciurus anomalus</i> | 0 | 1 |

Table 2 - Success of detection of target species per 100 camera-trap days.

| Pine forest | <i>Sus scrofa</i> | <i>Martes foina</i> | <i>Vulpes vulpes</i> | Total |
|-------------|-------------------|---------------------|----------------------|-------|
| burned | 1.0 | 12.4 | 6.2 | 19.6 |
| unburned | 10.1 | 0.0 | 2.0 | 12.1 |
| Total | 5.6 | 6.1 | 4.1 | 15.8 |

(*Sus scrofa*), red foxes (*Vulpes vulpes*) and stone martens (*Martes foina*), were recorded. Red foxes and wild boars were detected in both sites, while the stone marten was found only in the burned site (Tab. 1). Non-target species such as the southern white-breasted hedgehog (*Erinaceus concolor*) and field mice (*Apodemus* sp.), were also recorded in both sites, whilst the Caucasian squirrel (*Sciurus anomalus*) was detected only in the unburned site (Tab. 1). The success of detection of target species was 15.8% (Tab. 2).

Camera trapping brought evidence that post-fire mid-successional stages are used by large and medium-sized mammals. The species detected in this study are all habitat generalist species, which can exploit various habitat types (Boitani *et al.*, 1994; Soyumert, 2004; Prigioni *et al.*, 2008; Herr *et al.*, 2010). Habitat generalist terrestrial vertebrates are able to colonize burned

Mediterranean woodlands (Sarà *et al.*, 2006), benefiting from fire-created habitat structures (Keyser and Ford, 2005). As an example, 10 years after the 1992 fire in southern Rhodes, the European fallow deer (*Dama dama*) not only had returned to the area it used to live in, but also had expanded its range (Masseti and Theodoridis, 2002).

Terrestrial vertebrates, especially generalist species (Andrén, 1994), have also been reported to largely exploit habitat mosaics (Law and Dickmand, 1998). Fire, providing for a mosaic of successional stages within a homogeneous landscape matrix may enhance the coexistence of large and medium-sized mammal species with different habitat preferences (Fisher and Wilkinson, 2005).

In contrast, enhanced small mammal populations in early post-fire stages in Mediterranean forest habitats have been considered

as a consequence of the lack of predator species (Torre and Díaz, 2004). Accordingly, also in the Marmaris region the abundance of small mammals is higher in early and middle post-fire successional stages than in older sites (Kaynaş, 2008). Since the lack of data on the effects of fire on the distribution of large and medium-sized mammal species in Mediterranean ecosystems, the preliminary results of the present study provide some useful information about the recolonising process of burned sites by mammalian communities. More detailed studies are needed to determine the pattern of habitat use of fire-created landscapes by mammals.

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REFERENCES

- Andrén H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. *Oikos*, 71: 355-366.
- Boitani L., Mattei L., Nonis D. and Corsi F. 1994. Spatial and activity patterns of wild boars in Tuscany, Italy. *J. Mammal.*, 75: 600-612.
- Boshoff A.F., Kerley G.I.H. and Cowling R.M. 2001. A pragmatic approach to estimating the distributions and spatial requirements of the medium - to large-sized mammals in the Cape Floristic Region, South Africa. *Diversity Distr.*, 7: 29-43.
- Can Ö.E. and Togan İ. 2009. Camera trapping of large mammals in Yenice forest, a global intact mammal region in Turkey: locals versus camera traps. *Oryx*, 43: 427-430.
- Finlayson G.R., Vieira E.M., Priddel D., Wheeler D., Bentley J. and Dickman C.R. 2008. Multi-scale patterns of habitat use by re-introduced mammals: A case study using medium-sized marsupials. *Biol. Conserv.*, 141: 320-331.
- Fisher J.T. and Wilkinson L. 2005. The response of mammals to forest fire and timber harvest in the North American boreal forest. *Mammal Rev.*, 35: 51-81.
- Fox B.J. 1990. Changes in the structure of mammal communities over successional time scales. *Oikos*, 59: 312-329.
- Giannatos G., Albayrak T. and Erdoğan A. 2006. Status of the Caracal in protected areas in south-western Turkey. *Cat News*, 45: 23-24.
- Gimeno-Garcia E., Andreu V. and Rubio J.L. 2000. Changes in organic matter, nitrogen, phosphorus and cations in soil as a result of fire and water erosion in a Mediterranean landscape. *Eur. J. Soil Sci.*, 51: 201-210.
- Gros P.M., Kelly M.J., Caro T.M. 1996. Estimating carnivore densities for conservation purposes: indirect methods compared to baseline demographic data. *Oikos*, 77: 197-206.
- Haim A., Rozenfeld A. and Izhaki I. 1997. Post-fire response of shrews (*Crocidura suaveolens*) on Mount Carmel, Israel. *Mammalia*, 61: 527-536.
- Herr J., Schley L., Engel E. and Roper T.J. 2010. Den preferences and denning behaviour in urban stone martens (*Martes foina*). *Mammal. Biol.*, doi:10.1016/j.mambio.2008.12.002.
- Herrando S. and Brotons L. 2002. Forest bird diversity in Mediterranean areas affected by wildfires: a multi-scale approach. *Ecography*, 25: 161-172.
- Kaynaş B.Y. 2008. Studies on long-term effects of fire on small mammal community and changes of community structure after fire in *Pinus brutia* forest ecosystems. Ph.D. thesis, Depart-

- ment of Biology, Hacettepe University, Turkey, 112 pp. (in Turkish with English abstract).
- Kaynaş B.Y. and Gürkan B. 2008. Species richness and abundance of insects during post-fire succession of a *Pinus brutia* forest in a Mediterranean region. *Pol. J. Ecol.*, 56: 165-172.
- Kaynaş B.Y., Tavşanoğlu Ç. and Gürkan B. 2002. Species diversity of small mammal community in different stages of post-fire succession in Marmaris National Park, Turkey. In: Viegas X.V. (ed.), Proceedings of the IV International Conference on Forest Fire Research – 2002 Wildland Fire Safety Summit, Luso, Coimbra, Portugal [CD-ROM].
- Kazanis D. and Arianoutsou M. 2004. Long-term post-fire vegetation dynamics in *Pinus halepensis* forests of Central Greece: a functional group approach. *Plant Ecol.*, 171: 101-121.
- Keeley J.E. and Fotheringham C.J. 1998. Smoke-induced seed germination in California chaparral. *Ecology*, 79: 2320-2336.
- Keyser P.D. and Ford W.M. 2005. Influence of fire on mammals in eastern oak forests. In: Dickinson M.B. (ed.), Fire in Eastern Oak Forests: Delivering Science to Land Managers, Proceedings of a Conference, Ohio, USA, 180-190.
- Law B.S. and Dickman C.R. 1998. The use of habitat mosaics by terrestrial vertebrate fauna: implications for conservation and management. *Biodivers Conserv.*, 7: 323-333.
- Masetti M. and Theodoridis N. 2002. Recording the data on the former and present distribution of the free-ranging deer populations on Rhodes. In: Masetti M. (ed.), Island of deer. Natural history of the fallow deer of Rhodes and of the vertebrates of the Dodecanese (Greece). City of Rhodes, Environment Organization, Rhodes, 169-180.
- Moreira F. and Russo D. 2007. Modelling the impact of agricultural abandonment and wildfires on vertebrate diversity in Mediterranean Europe. *Landscape Ecol.*, 22: 1461-1476.
- Paula S., Arianoutsou M., Kazanis D., Tavsanoglu Ç., Lloret F., Buhk C., Ojeda F., Luna B., Moreno J.M., Rodrigo A., Espelta J.M., Palacio S., Fernández-Santos B., Fernandes P.M. and Pausas J.G. 2009. Fire-related traits for plant species of the Mediterranean Basin. *Ecology*, 90: 1420.
- Prigioni C., Balestrieri A., Remonti L. and Cavada L. 2008. Differential use of food and habitat by sympatric carnivores in the eastern Italian Alps. *Ital. J. Zool.*, 75: 173-184.
- Sarà M., Bellia E. and Milazzo A. 2006. Fire disturbance disrupts co-occurrence patterns of terrestrial vertebrates in Mediterranean woodlands. *J. Biogeogr.*, 33: 843-852.
- Serra G., Scheisch Abdallah M. and Al Qaim G. 2007. Occurrence of Ruppell's Fox, *Vulpes rueppelli*, and Sand Cat, *Felis margarita*, in Syria. *Zool. Middle East*, 42: 99-101.
- Soyumert A. 2004. Studies on habitat preference of *Vulpes vulpes* (red fox) and *Meles meles* (Eurasian badger) in Köprülü Kanyon National Park. M.Sc. thesis, Department of Biology, Hacettepe University, Turkey, 72 pp. (in Turkish with English abstract).
- Tavşanoğlu Ç. and Gürkan B. 2009. Post-fire regeneration of a *Pinus brutia* (Pinaceae) forest in Marmaris National Park, Turkey. *Int. J. Bot.*, 5: 107-111.
- Thompson W.L. (ed.) 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Island Press, Washington, USA, 429pp.
- Torre I. and Díaz M. 2004. Small mammal abundance in Mediterranean post-fire habitats: a role for predators? *Acta Oecol.*, 25: 137-143.

- Trabaud L. 1994. Postfire plant community dynamics in the Mediterranean Basin. In: Moreno J.M. and Oechel W.C. (eds), *The role of fire in Mediterranean-type ecosystems*. Springer-Verlag, New York, 1-15.
- Türkmen N. and Düzenli A. 2005. Changes in floristic composition of *Quercus coccifera* macchia after fire in the Çukurova region (Turkey). *Ann. Bot. Fennici*, 42: 453-460.
- Ukmar E., Battisti C., Luiselli L. and Bologna M.A. 2007. The effect of fire on communities, guilds, and species of breeding birds in burnt and control pinewoods in central Italy. *Biodivers Conserv.*, 16: 3287-3300.