

EDITORIAL

EUROPEAN BADGER (*MELES MELES*) BIOLOGY, ECOLOGY AND MANAGEMENT: DO WE KNOW ENOUGH?

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The European badger (*Meles meles*) is a mustelid with a particularly large body size (total length of 0.7-1.1 m) and mass (on average >10 kg, and seasonally and locally sometime >20 kg). It exhibits semi-fossorial habits, with individuals resting in burrows - referred to as “setts” - during the day and foraging at night [1]. It is present in most of Europe, with exception of northern Scandinavia, the northern latitudes of the European part of Russia, as well as Atlantic and most Mediterranean Islands [2].

A quick search for the keywords “*Meles meles*” in the Web of Science database (<https://webofknowledge.com>) on 9 December 2016 yielded over 1,500 items published between 1945 and end November 2016, a large majority of them being scientific papers focusing on this mustelid species alone. In fact, a recent bibliographical analysis [3] indicated that *Meles meles* is no less than the fifth most published carnivore species worldwide, behind the red fox (*Vulpes vulpes*), the wolf (*Canis lupus*), the brown bear (*Ursus arctos*) and the harbour seal (*Phoca vitulina*), and well ahead of the lion (*Panthera leo*) or the tiger (*Panthera tigris*).

The interest in the natural history (initially mostly related to hunting purposes) of the European badger is ancient, as revealed by the dates of publication of the first two known monographs focusing exclusively on it, in 1898 [4] and 1914 [5], respectively. Thereafter, review knowledge on the biology and natural history of *M. meles* has predominantly been transmitted through the successive books of Ernest Neal, published, reedited and updated on several occasions between 1948 and 1996 [6-9], as well as that of Long & Killingley in 1983 [10]. *Meles meles*, and Eurasian badgers *Meles* spp. in general, have otherwise been the focus of a large amount of scientific research over the past 4-5 decades, essentially starting with the seminal studies of Hans Kruuk in England and Scotland (for a review, see [11]). Although initial research was fuelled by the desire to learn more about the diet and social life of this species, a large amount of the subsequent research was primarily driven by the need to better understand the role of this mustelid as a reservoir and vector of bovine tuberculosis (bTB) to cattle [12] in UK and the Republic of Ireland; and therefore to better manage the species and control the disease.

Even though a large body of the scientific literature on European badgers emanate from the British Isles, several studies have been carried out, from the 1990s onward, in numerous countries of Continental Europe. These research projects have essentially focused on four main aspects: population ecology, resting site characteristics and selection, spatio-temporal ecology and feeding habits; and the globally available knowledge on this species has recently been synthesized by Do Linh San [13] and Roper [1].

With so much information collected so far on *M. meles*, and the obvious lack of baseline knowledge on - for example - a large majority of carnivore species [3], one may therefore wonder whether there is still a need to carry on such extensive research on this relatively common, widespread and globally Least Concern mustelid [2]. Surprisingly maybe, the answer is “yes”. Previous studies have indeed shown that this species exhibits both ecological and social flexibility (within populations) and plasticity (between populations); on a fundamental research standpoint, it therefore represents an interesting model to investigate how environmental factors *sensu lato* affect its biology and ecology. Two aspects that are particularly variable are European badgers’ feeding ecology (with local specialisms) and socio-spatial organization (from solitary to group living, with some variability in the degree of territoriality) [1, 13]. However, despite a large body of literature, no fully conclusive explanations to the large variations observed have yet been provided. Within this context, *M. meles* has also been considered a model species to study the evolution of sociality in mammals [14], with the spatio-temporal distribution of resources and other factors affecting demographic parameters probably playing a determinant role (review in [13]). On a more applied standpoint, although research revolving around bTB control and associated badger management has made significant progress (see review of management strategies in [15]), there remain significant knowledge gaps if bTB prevalence and incidence, and associated economic losses should ultimately be reduced to more tolerable levels, and the disease even be eradicated, if possible at all. Interestingly, studies have shown that both the socio-spatial organization and feeding habits of European badgers may affect their ranging behaviour and habitat use at different periods of the year and therefore play a significant role in disease transmission - being from badger to cattle or vice-versa (e.g. [16, 17]). This reminds us that, in general, a sound understanding of any species’ biology and ecology is required in order to develop sound management plans thereof, for example in relation to disease control as in the case of badgers and bTB. Fundamental research is therefore needed and is to be encouraged, even if it does not seem to have immediate practical implications.

In October 2013, we organized the 1st International Badger Symposium in Edmonton, Alberta, Canada. Our aim was to bring together, for the first time, scientists from four continents in order to review our current knowledge on the systematics, biology (including behaviour and ecology), conservation and research techniques currently used to study the world’s badger species. This information has now been published in a comprehensive edited book [18]. Sadly, several European badger biologists could not attend the symposium and we therefore felt appropriate to provide the opportunity to those of them interested to publish some of their latest research findings in a Special Issue of *Wildlife Biology in Practice*.

This Special Issue contains three original contributions dealing with badger diet in a human-managed ecosystem, sett site selection in an atypical habitat (peat bog with coal pits) and badger setts' 3D topography, as well as a review of recent ecological studies on European badgers in the Western Carpathian Mountains. It also includes a technical note that cautions that using severely biased trappability estimates could have serious consequences for - notably - badger management and vaccination studies. We also wish to mention that three additional papers were reviewed and accepted with major corrections, but were later retracted by the respective authors with the view to allow enough time for significant improvements (additional data collection or analyses) before resubmission.

There is no doubt that further studies need to, and will be, conducted on *M. meles*, and we are convinced that these will reveal several of the remaining mysteries of the biology and ecology of this atypical and fascinating mustelid.

Acknowledgements

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