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Editorial: Advances in the evolutionary ecology of termites, volume II

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Editorial on the Research Topic
Advances in the evolutionary ecology of termites, volume II

The first volume of our Research Topic was published in 2021 and included nine articles (Arab et al., 2021). At June 2023, it has been cited 56 times and it has received more than 5,000 downloads and 35,000 views; additionally, according to the Web of Science (www.webofscience.com), nearly 11,500 termite articles on various topics were published from 1975 to 2021, showing the increasing interest of scientist around the world in these amazing but unpopular eusocial cockroaches. Two years later, another 900 articles were added to this list, and we are publishing the second volume of our Research Topic. Therefore, this Research Topic summarizes the growing interest in the evolutionary ecology of termite research in nine original research articles which expand our knowledge on various aspects of these fascinating insects.

About 3,100 termite species have been described to date, but only 28 species are invasive (~0.9%) and 55 are considered pest (~1.77%) that damage structural wood and other lignocellulosic materials in natural and peri-urban forest habitats (Evans et al., 2013; Evans, 2021; Coêlho et al., 2023). However, due to global warming, the number of both invasive and pest species, including termites, is expected to increase in the coming years (Zanne et al., 2022). For this reason, it is important to understand how colonies organize and what factors influence their distribution. In recent decades, research has increasingly focused on these topics (Figure 1). This Research Topic examines the importance of termite pests in five studies. In their Original Research, Pailler et al. and Lee and Su addressed the foraging ability of four species of termites. Their results suggest that some species have enhanced foraging abilities, which could explain their invasion success. Foraging behavior in termites is primarily executed by workers, although some studies have shown that soldiers can also act as scouts and actively participate in the foraging process (Casarin et al., 2008). In this sense, the organization of social insect colonies requires sophisticated molecular mechanisms to regulate caste composition according to colony requirements, as suggested in their Original Research by Matsunami et al.

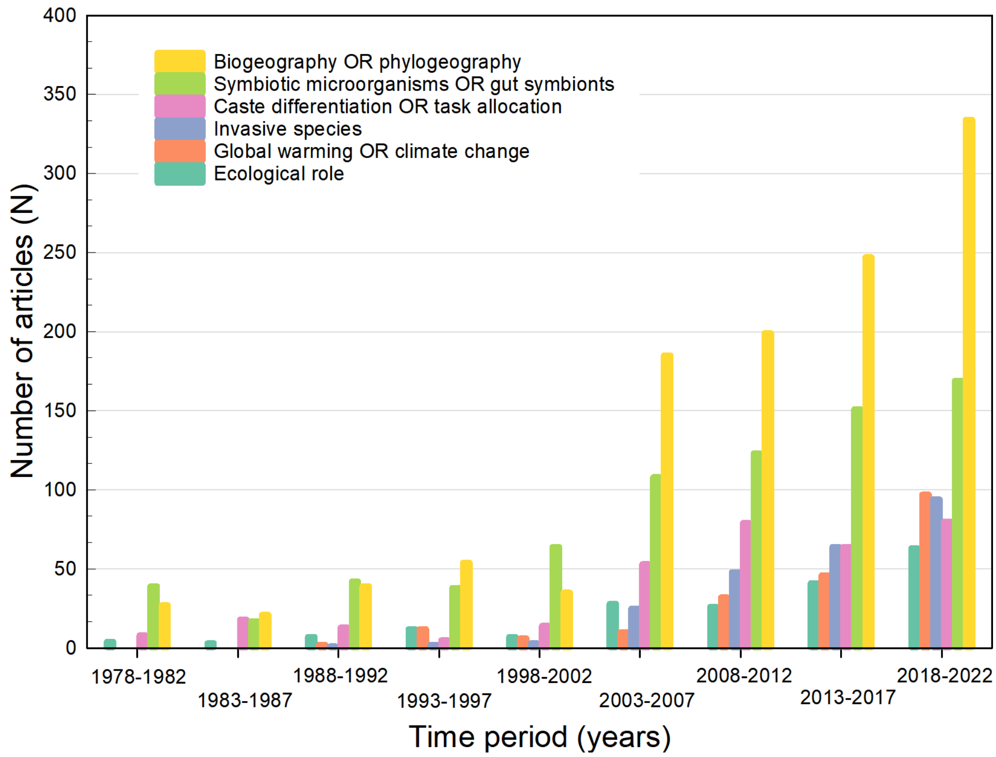

FIGURE 1
Number of articles published on termites from 1978 to 2022 in all databases available on Web of Science related with representative keywords from articles published in the present Research Topic.

The colonizing efficiency of some termites is maintained by the seasonal production of reproductive individuals, as reported by Chouvenc et al. when they dealt with the demographic development of laboratory colonies. However, social environments also put these insects at risk of contact with pathogens and create the potential for infectious events in their colonies (Rosengaus and Traniello, 2001). Protective mechanisms in termites include collective behaviors as self-isolation of infected individuals, allogrooming, cannibalism, and vibratory alarm responses (Rosengaus et al., 1999) as well as individual responses such as the production of antimicrobial compounds (Mitaka et al., 2017). Nevertheless, Moran et al. provide new evidence that infected termites did not communicate their infection status through shaking behaviors, suggesting the occurrence of other mechanisms used in communicating infection. In addition, infected workers travel to the densest part of the colony, where they can potentially benefit from grooming by healthy nestmates. It is also possible for infected individuals to visit nest areas with the strongest antimicrobial activity and disinfect themselves in the process. On the other hand, intraspecific competition could be another source of risk for a termite colony, especially for termites sharing the nesting substrate (Thorne et al., 2003; Aguilera-Olivares et al., 2017). In this Research Topic, Aguilera-Olivares et al. show the effect of intraspecific competition at individual level on morphological traits of soldiers of a one-piece nesting termite. They found that colonies that share a piece of wood produce bigger and more asymmetric soldiers compared to soldiers that develop in colonies that do not share a piece of wood. Thus, large body size in soldiers could be related with the chance of winning a battle.

Molecular and morphological analyses are useful tools to unveil the complexity of the coevolutionary dynamics between termites and their symbionts association. Non-termitid species rely on multiple lineages of flagellate protists for food digestion (Engel et al., 2009), and since protists are inherited vertically from the parents, their distribution among termite groups seems to be mediated by horizontal transfer (Tai et al., 2015). In their Original Research, Radek et al. discuss the drivers of protist diversification among non-termitid species and propose a new genus and family for a flagellate symbiont of the Serritermitidae family.

The diversification of the Termitidae is related to the expansion of the Miocene savannas. These ecosystems provided a new habitat for forest termites and a new food source (C4 grasses) that could withstand high temperatures and water scarcity (Solofondranohatra et al., 2018; Carrijo et al., 2020). In the savannas of southeastern Brazil, Alves et al. found that termites remove and consume dung from herbivore mammals more efficiently that dung beetles, thereby modulating the balance of carbon in this ecosystem.

In conclusion, the volume 2 of our Research Topic, *Advances in the Evolutionary Ecology of Termites*, addresses topics related to caste determination and task allocation, invasive biology, ecology, biogeography and phylogeography of termite species and their relationship with symbionts; which interest has increased in the last decades (Figure 1). A better understanding of termite biology at different organizational levels, *i.e.* from individual to ecosystem level, will help improve our understanding of the issues related to the impact of global warming and climate change on these insects. Moreover, it will provide valuable insights for directing conservation efforts aimed at preserving this important insect group.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by AA and DA-O. The first draft of the manuscript was written by DA-O and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

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