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Ant Network of Interactions in Art and Science

José de la Fuente[1,2]

[1]*Health and Biotechnology (SaBio), Instituto de Investigación en Recursos Cinegéticos (IREC), Consejo Superior de Investigaciones Científicas (CSIC), Universidad de Castilla-La Mancha (UCLM)-Junta de Comunidades de Castilla-La Mancha (JCCM), Ronda de Toledo 12, 13005 Ciudad Real, Spain.*

[2]*Center for Veterinary Health Sciences (CVHS), Department of Veterinary Pathobiology, Oklahoma State University (OSU), Stillwater, OK 74078, USA.*

***Corresponding Author: José de la Fuente,** *SaBio. Instituto de Investigación en Recursos Cinegéticos IREC-CSIC-UCLM-JCCM, Ronda de Toledo 12, 13005 Ciudad Real, España*

Abstract: *The study of fossil amber inclusions provides information on evolutionary interactions between different species relevant for contemporary ecology and sustainability. Ant insects evolved from Cretaceous (66 – 143.1 Mya) and are a model for these studies due to their implication in multiple networks of interactions with positive and negative ecological impact. Accordingly, and as discussed in this study, the relevance of ant species has been reflected in art representations and translational science.*

Keywords: *ant; art; arthropod; fossil; interaction*

1. Introduction

Ants (Class: Insecta; Linnaeus, 1758, Order: Hymenoptera, Family: Formicidae) evolved from Cretaceous (66 – 143.1 Mya) from vespoid wasp ancestors with low diversity until expansion in the Eocene (33.9 – 55.8 Mya) as reflected in fossil amber inclusions [1, 2] (Fig. 1A).

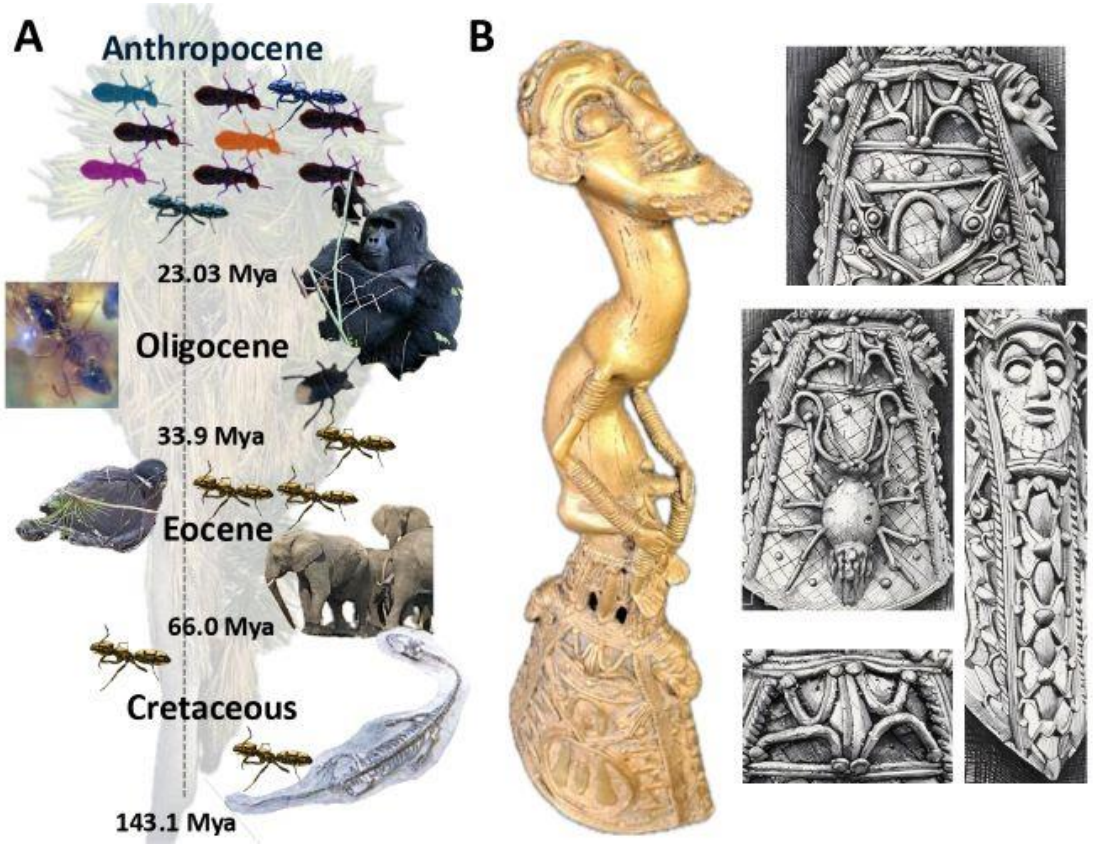

Figure 1. *Ant network of interactions and cultural representations. (A) Evolution of ant expanding diversity and interactions with multiple animal species from dinosaurs to hominids. Fossil ant in Baltic amber (Eocene) is shown. (B) Ancestral figure of Bamoun culture, Cameroon, Africa, bronze, ca. 1960-1970. Dimensions: 44 x 15 x cm, 2.4 Kg. Representations of ants interacting with human, snakes, spider and plants.*

Currently, 17,386 ant species have been classified with scientific estimate of more species to be identified (https://www.antweb.org/statsPage.do). The interactions between ants and with other animal species and plants evolved from ancient times (e.g., [3, 4]) including dinosaurs during the Mesozoic Era (66 – 252 Mya) [5] and hominids in Anthropocene with ecological and cultural implications.

Culturally, ants symbolize good and bad omen, with black ants associated with good fortune, prosperity and happiness, and red ants with death, decay, and destruction risk. As illustrated in Bamoun culture, Cameroon, Africa (Fig. 1B), ants were also represented in ancient cultures with association not only with humans but also with other animal species and plants. Accordingly, and as presented in this study, ants have a key role in the network of interactions between different species as reflected in art and science [6; https://www.livelyants.com/role-of-ants-in-art-from-sculpture-to-literature].

2. ANT NETWORK OF INTERACTIONS IN ART REPRESENTATIONS

Art pieces fossil ant in Baltic amber included in the study were obtained from KGJ Collection (Ciudad Real, Spain) [7-9] (Figs. 1-3).

2.1. Art Pieces By Salvador Dalí

(Figs. 2A and 2B). Fig. 2A: The Earth Goddess (The Chef). Lithograph, 30/350, paper Arches (France). Atelier Dumas Inc., New York, Dalart N. V. Copyright 1980. Dimensions: 57 x 45.5 cm images on 74 x 53.5 cm paper. Acquired from Art Link International Corporation, Lake Worth, FL 33463, USA (www.artlinkinternational.com). Certificate of authenticity from Bruce Hochman, Salvador Dali Gallery, Inc., California, USA (https://www.daligallery.com). Selected references: [10-12]. Fig. 2B: Sirenas peinadas con coral y hormiga (Mermaids with coral combs and ant). Schirnding Bavaria. Cup mug with two handles, porcelain and gold 24K, No. 254, 1977. Dimensions: Diameter 12 cm, 11.7 cm width x 5.4 cm height of the cup. Certified and numbered on the back.

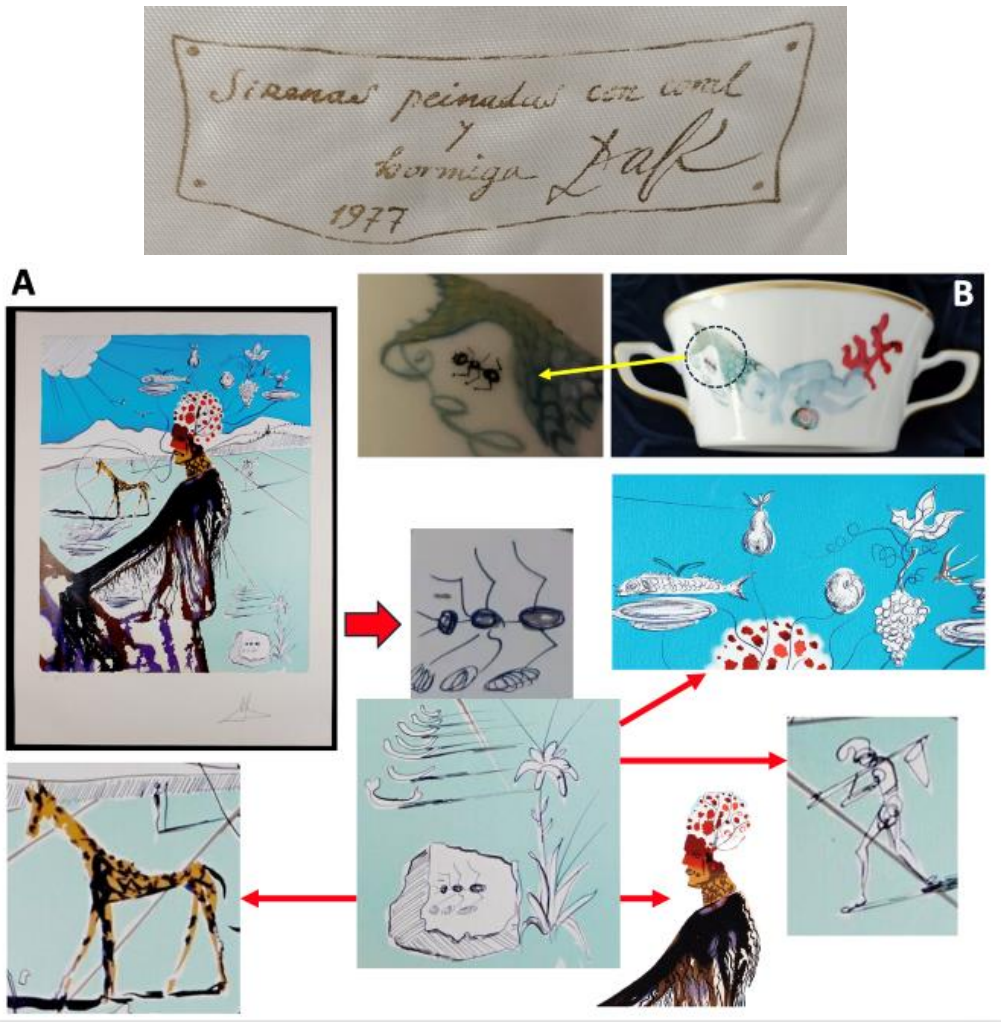

Figure 2. *Representations of ants and interactions with other species inspired by Salvador Dalí art pieces. (A) The Earth Goddess (The Chef). (B) Sirenas peinadas con coral y hormiga (Mermaids with coral combs and ant). The ant network of interactions are shown with red arrows.*

It has been suggested that Dalí included ant representations in his pieces after seeing them eat the remains of small animals when he was young. However, we have to consider that Dalí not only included ants in his art, but also illustrated the interactions between these arthropods and other animal and plant species including humans, ruminats, birds and fishes together with fruits, leaves and flowers (Figs. 2A and 2B).

2.2. Ant Covered Building Art Installation in Havana, Cuba, May 14, 2012

(Fig. 3). Photograph by Richard Bradley, Alamy Limited Stock Photo (6 - 8 West Central, 127 Olympic Avenue, Milton Park, Abingdon, Oxon, OX14 4SA, United Kingdom; https://www.alamy.com). Dimensions: 29.4 x 44.3 cm. With individual Alamy licence agreement (https://www.alamy.com/terms/default.asp).

Figure 3. *Representation of interactions between ants and humans in the urban environment. Ant covered building art installation in Havana, Cuba, May 14, 2012. The ant-human interactions are highlighted with red arrows.*

3. Ants: Art ´n Translational Science

Art and science are interconnected and collaborate in multiple ways (e.g., [9, 13-15]). As illustrated in Figures 2 and 3, art representations showed ant interactions with multiple species and presence in urban context. These artisitc representations illustrate and inspire translational science. Ants can have both positive and negative impacts on ecosystems and human activities, with actions as both ecosystem engineers and potential pests depending on ant species and the environmental conditions [16, 17; https://www.uk.envu.com/pest-management/pest-news/pest-blog/the-impact-of-ants-are-they-really-a-problem]. For example, ants have positive effects on soil aeration and water infiltration promoting plant growth while contributing to nutrient cycling through consumption and dispersion of organic matter such as dead animals and insects. Additionally, some ant species are predators of pest insects, symbionts of certain fungi, seed dispersal´s or components of food web and reduction of plant damage with ecological implications. On the negative side, ants may interfere with pest control, compete with other animals for food and resources affecting their diversity and development, consume seeds, invade homes, gardens and other urban areas with potential food contamination, induction of allergic reactions and property damage. Therefore, through evolution, ants have adapted to various environments ranging from the forest floor to the treetops with complex social structures and foraging

strategies, and interaction with other arthropods such as mites and nematods ranging from phoretic (mites using ants for transport) to parasitic behaviours [18, 19]. Based on these evidence, establishment and maintainance of ant colonies by removing debris and dead insects may contribute to clean and dry environment in the ant colony to discourage mite proliferation.

4. Conclusion

Scientific advances may lead the generation of plant and ant derived compounds for the control of ant populations and to produce pesticides and insecticides against different plant pathogens [20-23]. These compounds may be also used to control ant populations and associated risks in the urban environment. Furthermore, future advances in paleoproteomics may lead to the identification of ant-derived proteins with evolutionary and translational science implications [24].

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I would like to acknowledge that art pieces included in the study are from KGJ Collection (Ciudad Real, Spain).

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AUTHOR'S BIOGRAPHY

José de la Fuente is a Physicist and currently a Professor of Molecular Biology and Biotechnology in the SaBio group at the IREC (CSIC-UCLM-JCCM), Spain and the Oklahoma State University, USA. He is interested in innovative research approaches and his work focuses on systems biology of host-vector-pathogen molecular interactions, and translation of this basic information into development of effective vaccines and other interventions for the control of infectious diseases affecting human and animal health worldwide, ticks and tick-borne diseases, Alpha Gal Syndrome, Vaccinology and Quantum Vaccinology.

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