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Scavenging insects found on a carcass of the endangered Galápagos sea lion *Zalophus wollebaeki*

Insectos carroñeros encontrados sobre un cuerpo de lobo marino de Galápagos *Zalophus wollebaeki*

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Zalophus wollebaeki is a species of sea lion endemic to the Galápagos Islands. Dead bodies of Galápagos sea lions are frequently found on beaches, but little is known about their decomposers. The objective of this study is to report a sample of insects found on a sea lion carcass. In November 2022, a dead *Z. wollebaeki* was found on Caamaño Islet, from which we collected and identified pupae and adult of scavenging insects. We found 2 species of beetles and 1 of fly. The specimens were identified as *Phaleria manicata* (Coleoptera: Tenebrionidae), *Dermestes ater* (Coleoptera: Dermestidae), and *Galopagomyia inoa* (Diptera: Sarcophagidae). *Phaleria manicata* and *G. inoa* are reported for first time on a carcass of a sea lion. In the Galápagos, scavenging insects and their role in the decomposition process are little known. Consequently, more studies should focus on understanding the ecological role of scavenger communities in the different ecosystems of the Galápagos Islands.

Key words: Coastal ecosystems; decomposition; endemic species; insular scavengers.

El lobo marino (*Zalophus wollebaeki*) es una especie endémica de las Galápagos. Cadáveres de lobos marinos de las Galápagos se encuentran con frecuencia en las playas, pero poco se conoce sobre sus descomponedores. El objetivo del presente trabajo es reportar una muestra de insectos encontrados sobre un cadáver de lobo marino. En noviembre de 2022 se halló un cuerpo de *Z. wollebaeki* en el islote Caamaño del que se recolectaron e identificaron pupas y adultos de insectos carroñeros. Se encontraron 2 especies de escarabajos y 1 de mosca. Los especímenes fueron identificados como: *Phaleria manicata* (Coleoptera: Tenebrionidae), *Dermestes ater* (Coleoptera: Dermestidae) y *Galopagomyia inoa* (Diptera: Sarcophagidae). *Phaleria manicata* y *G. inoa* se reportan por primera vez en el cuerpo de un lobo marino. En las Galápagos, los insectos carroñeros y el papel que desempeñan en el proceso de descomposición son poco conocidos. Por lo tanto, más estudios se deben focalizar en comprender el papel ecológico de las comunidades de descomponedores en los distintos ecosistemas de las Islas Galápagos.

Palabras clave: Descomponedores insulares; descomposición; ecosistemas costeros; especies endémicas.

Zalophus wollebaeki Sivertsen, 1953 (Carnivora: Otariidae) is a species of sea lion, endemic of the Galápagos Islands (Alava and Salazar 2006), Ecuador. The IUCN has classified the Galápagos sea lion as an endangered species (EN) due to a significant decrease in its populations over the last 40 years. This decline has been attributed mainly to natural events (*e.g.*, El Niño events) and infectious diseases (*e.g.*, Canine Distemper virus; Trillmich 2015). Carcasses of sea lions are frequently found on beaches. For example, between the years 2008 and 2012, Denkinger *et al.* (2015) reported 308 dead Galápagos sea lions at Wreck Bay, the Galápagos Islands. However, as far as we know, there is no information about carrion-eating insects associated with carcasses of this species.

Carrion-eating insects (*e.g.*, flesh flies and dermestid beetles), and other decomposers, are important for ecosystems because they help to recycle dead biomass, which is an ephemeral and rich resource (Barton *et al.* 2013). Species identification and knowledge about their biology would contribute to better understanding of processes in beach ecosystems of the Galápagos Islands. In this study, we report the insects found on a decaying body of *Z. wollebaeki*, and discuss the role of scavenging insects in the functioning of the coastal ecosystems of the Galápagos.

In November 2022, a dead body of an adult male of *Z. wollebaeki* was found at Caamaño islet (0° 45´ S, 90° 16´ W; Figure 1) in a mixed state of decomposition; some bones were exposed but also muscle and skin were present (Figure 2a, b). The Caamaño islet is known as a breeding and resting place for sea lions (Wolf and Trillmich 2007) and is located between the south of Santa Cruz and northwest of Santa Fe Islands (Figure 1). For identification purposes we collected a small sample of only adult beetles and fly pupae from the carcass; larvae of dermestid beetles and flies were abundant but we did not collect those because of the difficulties to identify immature stages. The pupae were reared until they emerged as adult flies, we used plastic containers with absorbent paper in the base, kept

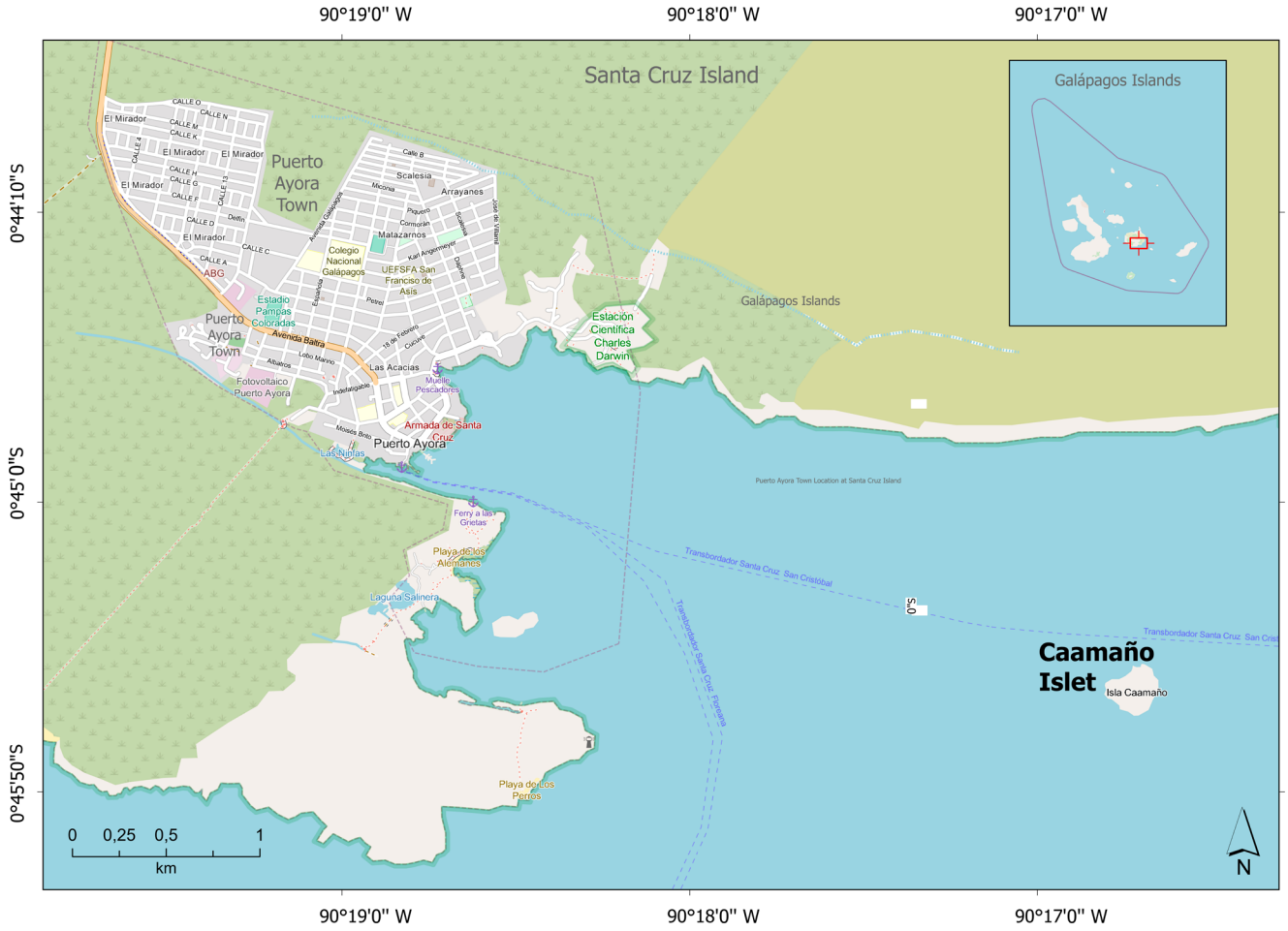

Figure 1. Location of Caamaño Islet in relation to Santa Cruz Island in the Galápagos Islands. Inset: the marine reserve of the Galápagos Islands, Ecuador.

at room temperature (21.5 °C) and high humidity (95 %). The adult specimens were frozen and then were mounted with pins and identified with relevant taxonomic keys (De Souza-Lopes 1978; Kingsolver 1991; Triplehorn 1991; Peacock 1993; Peck 2006 for Coleoptera, and Brown *et al.* 2009 for Diptera), and by comparing them with the holdings of the Invertebrate Collection of the Charles Darwin Research Station (ICCDRS), the Galápagos Islands, Ecuador.

The examined dead sea lion carried a tag with the code 6B3-698F (1905), assigned by the long-term project "Biología poblacional y salud del lobo marino de Galápagos" started by F. Trillmich and now led by O. Krüger from Bielefeld University in Germany. Records of this project indicate that this animal was born on October 13, 2012. The skeleton of this sea lion is preserved at the Vertebrate Collection of the Charles Darwin Research Station, the Galápagos, Ecuador, with the accession number VCCDRS 3303.

On the remains of this sea lion, we found 2 species of beetles and 1 of fly. Regarding the beetles, 2 specimens of *Phaleria manicata* Boheman, 1858 (Coleoptera: Tenebrionidae; ICCDRS 49998, 49999) were identified based on the following morphological characters: pronotum bearing coarse setae, apical angle of rotibial strongly lobed and without constriction on outer margins, distance between eyes less than the diameter of one eye in ventral view, long setae along distal margins of abdominal sterna and femur present (Triplehorn 1991; Figure 2c). In addition, 3 specimens of *Dermestes ater* DeGeer, 1774 (Coleoptera: Dermestidae; ICCDRS 49995, 49996, 49997) were identified based on: face of coxa concave, median ocellus absent, elytral apex lacking serrations and spines, abdominal venter with pattern, and lateral sulcus opposite of coxa (Kingsolver 1991; Figure 2d). Finally, 4 adult specimens of fly belonging to *Galopagomyia inoa* Walker, 1849 (Diptera: Sarcophagidae: ICCDRS 50000, 50001, 50002, 50003) were identified by abdominal tergite VI-VII with a distinctive pair of plates and marginal bristles (De Souza-Lopes 1978; Figure 2e).

In this study, we reported 3 species of insects found on a decaying body of *Z. wollebaeki*: the Galápagos endemic fly, *Galopagomyia inoa* and 2 beetles, 1 introduced, *Dermestes ater,* and the other endemic, *Phaleria maniacata* (Peck 2006; Sinclair 2009, 2023).

Scavenging insects, such as Diptera and Coleoptera, are widely recognized for their role in the colonization and decomposition of carcasses (Genise *et al.* 2000; Campobasso *et al.* 2001; Sinclair 2009). However, despite their

significance, we know little about carrion insects and their function in the ecosystems of the Galápagos. Beatles of the genera *Phaleria* and *Dermestes* have been found to forage the remains of marine species of the Peruvian coast (*e.g.*, green turtle, magnificent frigatebird, blue-footed booby; Giraldo-Mendoza 2019; Iannacone *et al.* 2023). Therefore, the presence of these genera using the corpse of a marine mammal at the Galápagos Islands makes sense in a biogeographic context by the affinities of the biota of the Pacific coast of South America (*i.e.,* Chile, Ecuador and Perú) with the Galápagos islands (*e.g.*, Bisconti *et al.* 2001).

In general, tenebrionids like *Phaleria manicata* colonize fresh corpses, while dermestids prefer corpses in an advanced state of decomposition (López-Caro *et al.* 2019). The simultaneous presence of these beetles on the body of *Z. wollebaeki* at Caamaño islet could be explained by a transitional stage of decomposition of the carcass, with some parts more decomposed than others. Previously, *P. manicata* was reported eating dung from the Galápagos sea lions (Peck 2006), and here we document its presence on a decomposing body. In this study, we also report for the first time the presence of the carrion fly *G. inoa* on a carcass of *Z. wollebaeki*.

Previously, larvae of *G. inoa* have been recorded in exposed eggs of the east Pacific green sea turtle (*Chelonia mydas*), and inside the eggs and on hatchlings of giant

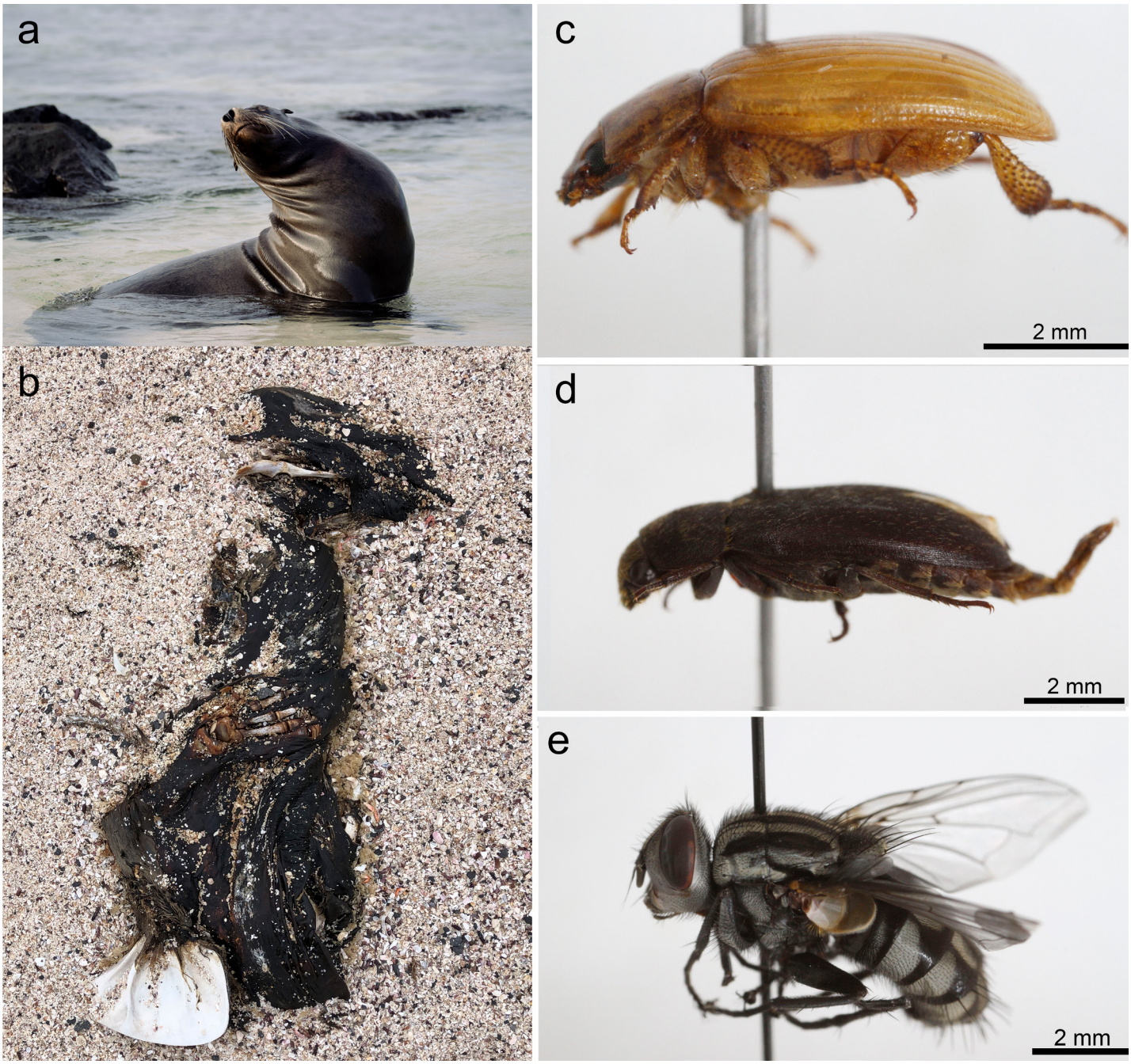

Figure 2. *Zalophus wollebaeki*: a) adult (photo by J. M. Garcia); b) corpse of the adult male VCCDRS 3303 at Caamaño islet, Galápagos, Ecuador (photo by A. Childs). Specimens collected: c) *Phaleria manicata* ICCDRS 49998, d) *Dermestes ater* ICCDRS 49996, e) *Galopagomyia inoa* ICCDRS 50002.

tortoises of Santiago Island *Chelonoidis darwini* (Sinclair 2023). The notes on the giant tortoise of Santiago as a host of *G. inoa* comes from the notes associated with specimens ICCDRS-12660, 12662, and 12663. The collector of those specimens mentioned to us: *"When the egg hatched, the fly entered and lay the eggs in the tortoise' venter. The flies may dig tunnels to reach the eggs. We raised some larvae flies feeding them with blood of tortoises and the larvae became adults"* (Cruz Márquez, pers. comm).

In the Galápagos, the absence of big scavengers, such as vultures, and population declines of primary consumers, *e.g.*, *Buteo galapagoensis*, the Galápagos hawk (Jaramillo *et al.* 2016), could have an impact in the decomposition process. The lack of large scavengers would increase the amount of available biomass and its temporal availability, allowing smaller consumers, like invertebrates, to dominate the decomposition process (*e.g.*, Moleón *et al.* 2017; Muñoz-Lozano *et al.* 2019; Redondo-Gómez *et al.* 2022). In this context, Redondo-Gómez *et al.* (2022), studied the communities of vertebrate and invertebrate scavengers on a small Mediterranean island, and noted that when comparing sea and land scavenger communities, the vertebrate scavengers dominated the decomposition in the sea, while the invertebrate scavengers dominated on land.

Finally, the Galápagos may be an interesting place to study the diversity of scavenger arthropods, their patterns of succession and other ecological aspects in the different habitats of the islands. For example, how different are the scavenger communities and the decomposition processes between the coastal arid environments and the more humid highlands of the Galápagos?

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Literature cited

Alava, J. J., and S. Salazar. 2006. Status and conservation of otariids in Ecuador and the Galápagos Islands. Pp. 495–519 *in* Sea Lions of the World (Trites, A.W., *et al*. eds.). Alaska Sea Grant College Program, University of Alaska Fairbanks. Anchorage, U.S.A.

Barton, P. S., *et al*. 2013. The role of carrion in maintaining biodiversity and ecological processes in terrestrial ecosystems. Oecologia 171:761-772.

Bisconti, M., *et al*. 2001. Biogeographic relationships of the Galapagos terrestrial biota: parsimony analyses of endemicity based on reptiles, land birds and *Scalesia* land plants. Journal of Biogeography 28:495-510.

Brown, B. V., *et al*. 2009. Manual of Central American Diptera: Volume I. NRC Research Press. Ottawa, Canadá.

Campobasso, C. P., G. Di Vella, and F. Introna. 2001. Factors affecting decomposition and Diptera colonization. Forensic Science International 120:18-27.

Denkinger, J., *et al*. 2015. Urban life of Galapagos sea lions (*Zalophus wollebaeki*) on San Cristobal Island, Ecuador: colony trends and threats. Journal of Sea Research 105:10-14.

De Souza-Lopes, H. 1978. Sarcophagidae (Diptera) of Galapagos Islands. Revista Brasileira de Biología 38:595-611.

Genise, J. F., *et al*. 2000. Insect trace fossil associations in paleosols: The *Coprinisphaera* Ichnofacies. Palaios 15:49-64.

Giraldo-Mendoza, A. 2019. New species of the genus *Phaleria* Latreille (Tenebrionidae: Diaperinae) from northern coast of Peru. Revista Chilena de Entomología 45:277-282.

Iannacone, J., *et al*. 2023. Cadaveric entomofauna in stranded marine vertebrates on the Central Coast of Peru. Graellsia 79:e195.

Jaramillo, M., *et al*. 2016. The diet of the Galapagos Hawk (*Buteo galapagoensis*) before and after goat eradication. Journal of Raptor Research 50:33-44.

Kingsolver, M. J. 1991. Dermestid beetles (Dermestidae, Coleoptera). Pp. 115-136 *in* Insect and mite pests in food: An illustrated key (Gorham, J. R, ed.). Agriculture Handbook No. 655, US Department of Agriculture. Washington D. C., U.S.A.

López-Caro, J. B., *et al*. 2019. Coleoptera associated with carcasses of mammals: design of a cage for the protection of the carcass while sampling necrocolous arthropods. Southwestern Entomologist 44:659-666.

Moleón, M., *et al*. 2017. Carnivore carcasses are avoided by carnivores. Journal of Animal Ecology 86:1179-1191.

Muñoz-Lozano, C., *et al*. 2019. Avoidance of carnivore carcasses by vertebrate scavengers enables colonization by a diverse community of carrion insects. PLoS One 14:1-22.

Peacock, E. R. 1993. Adults and larvae of hide, larder and carpet beetles and their relatives (Coleoptera: Dermestidae) and of derodonti beetles (Coleoptera: Derodontidae). Royal Entomological Society of London. London, United Kingdom.

Peck, S. 2006. The beetles of the Galápagos Islands, Ecuador: evolution, ecology, and diversity (Insecta: Coleoptera). NRC Research Press. Ottawa, Canadá.

Redondo-Gómez, D., *et al*. 2022. Comparing scavenging in marine and terrestrial ecosystems: a case study with fish and gull carcasses in a small Mediterranean island. Basic and Applied Ecology 59:92-104.

Sinclair, B. J. 2009. Dipteran biodiversity of the Galápagos. Pp. 98-117 *in* Diptera diversity: status, challenges and tools (Pape, T., D. Bickel, and R. Meier, eds.). BRILL. Leiden, Netherlands.

Sinclair, B. J. 2023. An annotated checklist of the Diptera of the Galápagos Archipelago. Zootaxa 5283:1-102.

Trillmich, F. 2015. *Zalophus wollebaeki*. *In*: IUCN 2015. The IUCN Red List of Threatened Species. Version 2015.3.1 www.iucnredlist.org. Accessed on May 18, 2023.

Triplehorn, C. A. 1991. A review of the genus *Phaleria* Latreille from the Western Hemisphere (Coleoptera: Tenebrionidae: Phaleriinae). The Coleopterists Bulletin 45:258-270.

Wolf, J. B. W., and F. Trillmich. 2007. Beyond habitat requirements: Individual fine-scale site fidelity in a colony of the Galapagos sea lion (*Zalophus wollebaeki*) creates conditions for social structuring. Oecologia 152:553-567.

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