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First record of Black-eared Rice Rat, *Handleyomys melanotis* (Thomas, 1893) (Rodentia, Cricetidae), on a protected island off the Pacific Coast of Jalisco, Mexico, with notes on its potential threat for avian nesting species

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Abstract

Black-eared Rice Rat, *Handleyomys melanotis* (Thomas, 1893), is a small, abundant rodent thought endemic to Mexico. We present a new record of this rat on Cocinas Island off the Chamela coast of Jalisco, Mexico. On this protected island located at 19.5°N, 105.1°W, we captured 11 specimens with the physical characteristics that confirm their identity as *H. melanotis*. We explore the possible implications of this species on Cocinas Island.

Keywords

Chamela Bay Islands Sanctuary, insular mammals, *Oryzomys melanotis*, nest predation, species introduction

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Introduction

Black-eared Rice Rat, *Handleyomys melanotis* (Thomas, 1893), is thought to be a Mexican endemic species that is distributed from the states of Sinaloa and Tamaulipas to Yucatán and Quintana Roo (Ceballos and Oliva 2005; Sánchez-Cordero et al. 2020). The type locality of *H. melanotis* is at Mineral de San Sebastián in Jalisco (Hall 1981). The records on the margins of this species' geographic range are as follows: Los Limones (Sinaloa), Sierra of Tamaulipas, 3.2 km south and 16 km west from the municipality of Piedra (Quintana Roo), 4

km north-northeast of Puerto Felipe Carrillo (Quintana Roo), and Puerto Morelos (Yucatán) (Hall 1981). There are, however, records in Guatemala (Portal de Biodiversidad de Guatemala 2020), and we think that the Guatemala records need review to confirm the status of this species as a Mexican endemic. *Handleyomys melanotis* is a widespread and abundant species (up to six individuals per hectare have been observed in the region of Chamela, Jalisco), inhabiting tropical dry forest, perennial forest, and thorn forest, and frequently found in wet areas with dense vegetation (Ceballos and Miranda 2000; Ceballos 2014). In fact, an increase in its populations has been recorded, corresponding to increased deforestation and establishment of agricultural fields (Ceballos and Miranda 2000). Thus, this rat is classified as a non-endangered species, with potential to increase its distribution (Ceballos 2014).

The dorsal coloration of the body of *H. melanotis* is yellowish-brown, and the ventral hair is white with diffuse gray. The characteristic ears of this species are yellow but darker at their base (Ceballos and Miranda 2000; Ceballos and Oliva 2005). The tail is hairless, scaly, bicolored (dorsally dark and ventrally light), and longer than the head and body combined (Ceballos and Miranda 2000; Ceballos and Oliva 2005). The total length ranges between 186 and 253 mm, with a tail length between 99 and 135 mm, so it is considered a small-sized rat.

Handleyomys melanotis is nocturnal and terrestrial, living underground in burrows; however, it is also recognized as an excellent swimmer (Ceballos and Miranda 2000; Ceballos and Oliva 2005). This rat feeds on fruits, the leaves of succulent plants, and insects, but it may also potentially be an important predator of avian nests (Estrada et al. 2002; Ceballos 2014). A study of Marsh Rice Rat, *Oryzomys palustris* (Harlan, 1837), which is phylogenetically close to *H. melanotis*, has found the presence of yolk and other avian material in its stomach contents. This was observed on two islands where populations of Marsh Wren, *Cistothorus palustris* (Wilson, 1810), were highly affected by *O. palustris* (Brunjes and Webster 2003). Therefore, the presence of cricetid rodents in insular systems is an important topic of study because of the capability of these rodents for population growth, their role as potential predators of avian nests, and their association with disturbed habitats. Herein, we report for the first time *H. melanotis* from Cocinas Island off the Mexican Pacific Coast. We discuss our new records in a national context and the implications of *H. melanotis* on a protected island.

Methods

Cocinas Island, together with seven other islands (Colorada, La Pajarera, Mamut, Negrita, San Agustín, San Andrés, and San Pedro) and four islets, forms the Santuario Islas de la Bahía de Chamela off the Pacific Coast of Mexico (Fig. 1). These protected islands are within a 1,981 ha polygon, ranging between 270 and 2,500 m from the mainland (Fig. 1). Cocinas Island is the largest island of the sanctuary, with an area of 31.69 h (840 m long by 500 m wide) and an altitude of 55 m. It is 1,800 m from the mainland. The island shows well-developed vegetation with zones of xeric vegetation, cliff vegetation, brush, and tropical dry forest (CONANP 2008). Cocinas Island has frequent human visitation because of two beaches are tourist attractions (CONANP 2008). When the islands were established as a protected area in 2008, the terrestrial fauna reported included six reptile species, but no mammals or amphibians were recorded (CONANP 2008). According to Mexican law, to establish a protected natural area, the species inhabiting the site must be known (LGEEPA 1988). Since the establishment of the sanctuary, other species such as the lizard *Urosaurus bicarinatus* (Duméril, 1856) have been reported (Hernández-Salinas et al. 2013). One justification for protecting the islands is that they harbor the only nesting colonies of *Pelecanus occidentalis* Linnaeus, 1766, *Sula leucogaster* (Boddaert, 1783), *Sula nebouxii* Milne-Edwards, 1882, *Eudocimus albus* (Linnaeus, 1758), and *Larus heermanni* Cassin, 1852 along the coast of Jalisco (CONANP 2008). During a herpetological survey of three islands with similar conditions that allow visitation (Cocinas, La Pajarera, and San Agustín), we detected crepuscular rodent activity only on Cocinas Island. Therefore, we undertook a survey to investigate the terrestrial mammal species inhabiting the island. We used 13 Sherman traps over two nights in March 2019. On the first night, we placed 13 traps in xeric vegetation located in the southeast part of the island where the presence of rodents was first detected. On the second night, we placed six traps in the same xeric vegetation spot and seven in a tropical dry forest on the eastern side of the island. All captured individuals were photographed with a Canon EOS Rebel T6 camera and released. The techniques used in this study were according to the guidelines of the American Society of Mammalogists (Sikes et al. 2011) and with Mexican wildlife legislation (SGPA/DGVS/002771/18, ext.: SGPA/DGVS/02409/19).

To discuss the present record in a national context, we used all distribution data for Mexico (550) of *H. melanotis* provided by Sánchez-Cordero et al. (2020), which were obtained from the frequently updated Comisión Nacional para el Conocimiento y uso de la Biodiversidad website. Outside of Mexico, we found only two records from Guatemala (Portal de Biodiversidad de Guatemala 2020), so we decided to use only the published Mexican records (Sánchez-Cordero et al. 2020).

Data resources

The data underpinning the analysis reported in this paper are deposited in the Mendeley Data repository at https://doi.org/10.17632/jn4sxxhxzk.1.

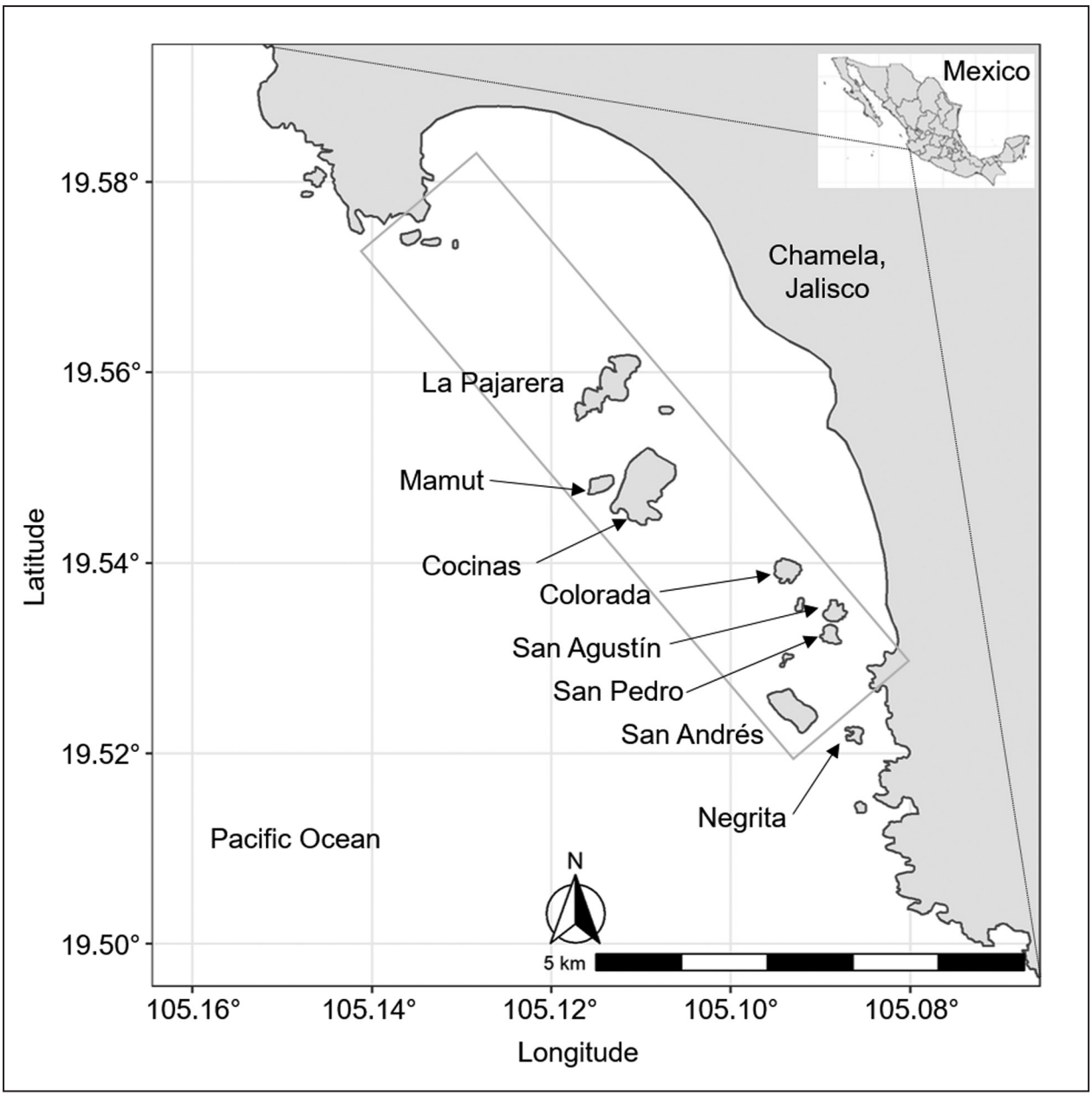

Figure 1. Map of the coast of Chamela, Jalisco, Mexico, with the location of Cocinas Island and other protected islands, part of the Santuario Islas de la Bahía de Chamela.

Results

***Handleyomys melanotis* (Thomas, 1893)**
Figure 2

New records. MEXICO – **Jalisco** • Santuario Islas de la Bahía de Chamela, Cocinas Island; 19.5469°N, 105.1097°W; 19 m alt.; 26.III.2019; Soria-González V. H., Sánchez-Velázquez R. obs.; 8 individuals captured; photographed between 07:00 h and 08:00 h (Fig. 2); no voucher specimens available; adults, sex indet. • same locality; 19.5474°N, 105.1088°W; 23 m alt.; 27.III.2019; Soria-González V. H., Sánchez-Velázquez R. obs.; 3 individuals captured; photographed between 07:12 and 07:28 (Fig. 2); no voucher specimens available; adults, sex indet.

Identification. The 11 individuals captured had the typical coloration of *H. melanotis*: yellowish-brown fur on the dorsum and white with diffuse gray fur on the ventrum (Ceballos and Miranda 2000; Ceballos and Oliva 2005) (Fig. 2). The yellow coloration of the ears, with dark fur at their base, is also typical of *H. melanotis* (Ceballos and Miranda 2000; Ceballos and Oliva 2005). All specimens possessed a hairless, scaly tail, longer than the body and head combined (Ceballos and Miranda 2000; Ceballos and Oliva 2005) (Fig. 2). The individuals also possessed the characteristic bicolored tail, which is light-colored ventrally and dark dorsally (Ceballos and Miranda 2000; Ceballos and Oliva 2005). Another similar species occurring in the region of Chamela is *Oryzomys couesi* (Alston, 1877), which is a bigger rat with the tail equal in length to the body and head length combined and a brown dorsum.

Figure 2. Specimens of *Handleyomys melanotis* captured on Cocinas Island, off the coast of Jalisco, Mexico. Some characteristics of species, such as the black coloration in the base of the ear (**A, C, D**), hairless tail (**B, D**), long tail (**B**), yellowish-brown dorsal hair (**B, D**), and white with diffuse gray ventral coloration hair (**A, C**) are observed. Photographer: Victor Hugo Soria-González.

Remarks and distribution. Most (73%) individuals were captured in xeric shrubs close to Cocinas beach (Fig. 3: N1_26.III.19), the most visited beach on Cocinas Island, where human activity is most intense. The other rats were captured in tropical dry forest vegetation (Fig. 3: N2_27.III.19). Of the 550 previous records of *H. melanotis* in the country, 63 are from the state of Jalisco, and three of these are from the Chamela region. The new records of *H. melanotis* on Cocinas Island are 2 km west off the coast of Chamela (Fig. 3). The occurrence of *H. melanotis* on Cocinas Island implies that this species either has recently arrived to the island or that it is a long-time component of the island's fauna.

Discussion

We confirm the presence of *Handleyomys melanotis* on Cocinas Island, where only two potential predators have been recorded, the snakes *Conophis vittatus* Peters, 1860 and *Boa constrictor* Linnaeus, 1758 (CONANP 2008). Our records slightly extend the known geographic range of *H. melanotis* by 2 km from the nearest known occurrence on mainland Jalisco (Sánchez-Cordero et al. 2020).

The arrival of *H. melanotis* may have been recent, either accidental due to tourism or naturally by swimming 1,800 m to Cocinas from the mainland (Ceballos and Oliva 2005; CONANP 2008; Ceballos 2014). If not a recent arrival to the island, *H. melanotis* may have been present on the islands since the rapid increase in sea level about 7,000–8,000 years ago (Ramírez-Herrera et al. 2004).

If *H. melanotis* recently invaded Cocinas Island, it could potentially be a threat to avian nesting species, which in Jalisco only nest in the Santuario Islas de la Bahía de Chamela (CONANP 2008). The possible impact of *H. melanotis* on the bird fauna of Cocinas Island is exasperated by the capacity of this rat species for the population growth (Ceballos 2014) and its potential as a nest predator (Estrada et al. 2002). In our small survey, we captured 11 specimens, setting only 13 traps per night for two nights, suggesting a considerable population size. We suggest that *H. melanotis* may be a nest predator, as already known for insular rats of the genus *Oryzomys*

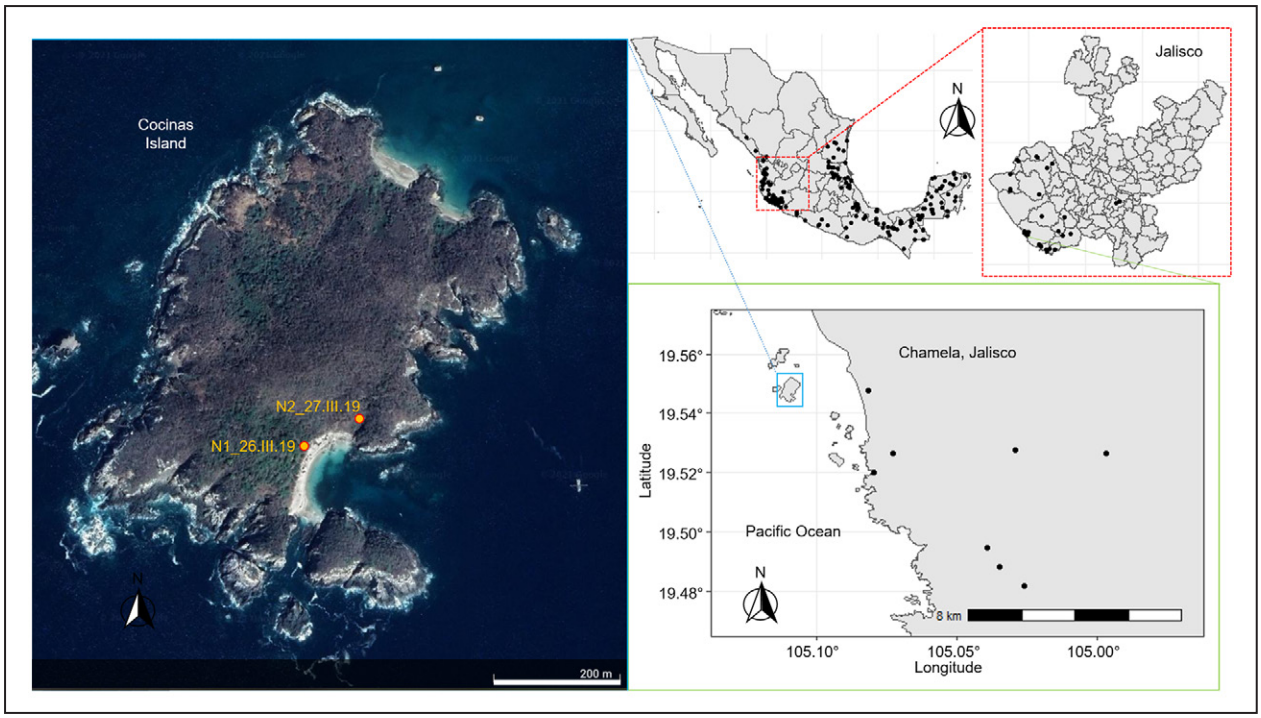

Figure 3. Records of *Handleyomys melanotis* in the state of Jalisco. Orange circles: new records in xeric vegetation (N1_26.III.19) and tropical dry forest (N2_27.III.19) on Cocinas Island. Black circles: previously known occurrences in Mexico; data obtained from Sánchez-Cordero et al. 2020. (Map data: Google, ©2021 CNES/Airbus, SIO, NOAA, US Navy, NGA, GEBCO.)

(Brunjes and Webster 2003). Hence, role of the diet of *H. melanotis* as a threat to bird populations must be determined (Barbier et al. 2021). The swimming abilities of this species (Ceballos 2014) and the small distances among the islands (e.g., Cocinas Island 640 m from La Pajarera Island and 1,500 m from Colorada Island) suggest the potential for further dispersal of *H. melanotis* to other islands in this protected area.

Alternatively, *H. melanotis* may not have been detected during the study to decree the island a protected area but was present. We speculate that after a rise in the sea level, populations of *H. melanotis* would have been cut off from the mainland, only the largest island, Cocinas, would maintain a population, and the smaller populations on other islands would be prone to extinction (Frankham 1997). If *H. melanotis* has historically been on Cocinas, then a divergence of the insular population of *H. melanotis* from mainland counterparts is very plausible, as insular rodent populations present high rates of microevolution (Pergams and Ashley 2001). This has been documented for other rodent species that contribute to the regional biodiversity (Millien 2006; Amori et al. 2008; Anadón-Irizarry et al. 2012; Indorf and Gaines 2013; Rowe et al. 2019). Morphological and genetic research looking for divergence of the Cochinas Island and mainland populations of *H. melanotis* is needed. Of note, morphological and genetic divergence of arboreal lizards in the Santuario de las Islas de la Bahía de Chamela have been reported, so an ancient invasion of *H. melanotis* could similarly result in divergence and contribute to biodiversity (Siliceo-Cantero et al. 2016, 2020). If *H. melanotis* rat has been present on Cocinas Island for millennia, sharing the habitat with avian nesting species without affecting their populations, and the island is a natural reservoir for this species (Kier et al. 2009; Veron et al. 2019). Thus, we recommend further study to determine if the population diverges from its mainland counterparts and if *H. melanotis* is a real threat to nesting avian species. This knowledge will help make rapid decisions for conservation purposes.

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Authors' Contributions

Conceptualization: HS. Funding acquisition: ISO. Investigation: HS, VSG. Resources: GC, LLL. Supervision: HS. Visualization: VSG. Writing – original draft: HS. Writing – review and editing: JBM, GC, ISO.

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