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A capture of a lesser bandicoot rat *Bandicota bengalensis* (Rodentia, Muridae) at Callao Port, Perú: anecdotal record or potential invasive alien species?

Captura de una rata bandicota menor *Bandicota bengalensis* (Rodentia, Muridae) en el puerto de Callao, Perú: ¿registro anecdótico o especie exótica invasora?

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Abstract

The Lesser bandicoot rat *Bandicota bengalensis* (Gray and Hardwicke, 1833) is a murid rodent distributed mostly in Asia that can cause substantial negative economic impact in urban and rural areas. Until now, the species has been mostly restricted to the Asian region; and no specimen has been captured or reported as a stowaway arriving to an American port. Here, I report on one specimen captured in Callao's maritime port, Peru, during sanitary inspection surveillance, identified based on external and cranial characteristics, and similar meristic reported values. This finding shows the potential threat of this species as an invasive alien species and highlights the need for strengthening invasive species protocols on ships.

Resumen

La rata bandicota menor *Bandicota bengalensis* (Gray & Hardwicke, 1833) es un roedor múrido distribuido principalmente en Asia que puede causar un impacto económico negativo sustancial en las zonas urbanas y rurales. Hasta ahora, la especie se ha restringido principalmente a la región asiática y ningún espécimen ha sido capturado o reportado como polizón en un puerto americano. Aquí, reporto un espécimen capturado en el puerto marítimo del Callao, Perú, durante una inspección sanitaria, identificado en base a características externas y craneales, y valores morfométricos similares. Este hallazgo muestra la amenaza potencial de esta especie como especie exótica invasora y destaca la necesidad de fortalecer los protocolos de especies invasoras en los barcos.

Introduction

Rodentia is the most diverse order of mammals in the world, comprising about 2552 species out of 6339 extant mammals (Burgin et al. 2018). Although approximately 150 mammal species are considered to be pests, only 20 are considered important, and less than ten are commensal and/or peridomestic (Proctor 1994). Three pest species have a global distribution: the house mouse *Mus musculus* Linnaeus, the house or black rat *Rattus rattus* Linnaeus, and the brown or Norway rat *R. norvegicus* Gray (Long 2003). A few others have also a large distribution such as the lesser bandicoot rat *Bandicota bengalensis* (Gray, 1835), although this species is mostly restricted to Asia (Agrawal 2000; Musser & Carleton 2005).

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Bandicota bengalensis is the most important rodent pest in both urban and rural areas in many Asian countries; occupying and damaging large areas of field crops (Proctor 1994). Until now, no records for this species, either dead or alive, have been reported in the Americas. Here, I report on one specimen of *B. bengalensis* captured in Callao's maritime port, Peru, during sanitary inspection surveillance and discuss the implications of this finding as it pertains to a threat to American biodiversity by a potential invasive alien species (IAS) due to shipping activity.

Material and methods

A female rat was captured at the DP World Maritime Terminal (12°3.55'S; 77°8.87'W), in a ship container from India on 15 October 2011, during sanitary surveillance undertaken by the International Sanitary Authority of the Regional Health Authority of Callao. The specimen was handed to the Peruvian National Health Institute (**INS**) where it was identified as *Rattus rattus* and later forwarded to me for confirmation. The specimen was deposited at the Museo de Historia Natural, **UNMSM**, and catalogued as **MUSM** 37682. I used a morphological and morphometric approach to identify the specimen. I took the external measurements from the specimen tag in millimeters. The head-and-body length (**HBL**) was estimated by subtracting the tail length (**TL**) from the total length; the feet length includes the claws. Because the specimen was in poor condition, an accurate weight could not be obtained. All cranial and mandibular variables were measured to the nearest 0.1 mm using dial calipers. These variables are described in Musser (1979), Musser and Brothers (1994), and Agrawal (2000), and illustrated in Musser (1979). Anatomical terminology follows Musser and Brothers (1994) and Talmale and Pradhan (2009). External measurements of this specimen are: total length, 353 mm; tail length, 181 mm; feet length (with claw), 39 mm; ear length, 22 mm. The skull measurements of the specimen fit those reported by Musser and Brothers (1994) and Agrawal (2000) in all variables (Table 1).

Results

I identified the specimen as *Bandicota bengalensis* using external and cranial characteristics, and comparisons with published descriptions (Musser & Brothers 1994, Agrawal 2000, Talmale & Pradhan 2009). The pelage is moderately long and coarse, with long guard hairs. The dorsal pelage is greyish brown, and the venter is light grey. The tail is dark and monocolored, and about the size of head and body length; and the ears are almost round in outline (Fig. 1). The skull is heavy with broad proodont incisors. The nasals and premaxillae are short. The incisive foramina are long extending posteriorly up to the first lamina of first upper molar and narrower at the posterior end. The bullae are large. The coronoid process is strong and high, and the capsular process is also conspicuous. The molars are hypsodont with three laminae (Fig. 2). This description agrees with those reported by Musser and Brothers (1994), Agrawal (2000),

Table 1. Descriptive measurements of a stowaway specimen of ***Bandicota bengalensis*** (MUSM 37682) captured at Port of Callao, Perú; and compared with the measurements presented by Musser & Brothers (1994) and Agrawal (2000). Mean ± SD and observed range (in parentheses) in millimeters, followed by sample size, are listed for each measurement.

Variables	Musser & Brothers 1994	Agrawal (2000)	MUSM 37682
Length of head and body	185.1 ± 9.70 (161-208) 39	179 ± 21 (132-237) 115	172
Length of tail	143.3 ± 9.70 (112-163) 35	148 (99-202)	181
Length of hind foot	33.3 ± 1.80 (27-38) 39	33.7 ± 2 (29-39)115	39
Length of ear	21.8 ± 1.00 (20-24) 39	—	22
Greatest length of skull	39.8 ± 1.59 (36.0-43.9) 37	—	44.5
Occipitonasal length	37.8 ± 1.56 (33.4-41.3) 37	39.1 ± 2.6 (33.3-45.5) 72	41.8
Zygomatic breadth	22.4 ± 0.90 (20.6-25.2) 37	—	25.19
Interorbital breadth	6.0 ± 0.31 (5.3-6.6) 39	—	6.14
Length of nasals	11.8 + 0.70 (9.8-13.3) 38	12.6 ± 0.9 (11.5-15.0) 39	13.51
Breadth of rostrum	8.5 + 0.61 (7.3-9.9) 39	—	8.78
Breadth of braincase	16.4 ± 0.48 (15.2-17.5) 39	—	15.95
Height of braincase	12.3 ± 0.44 (11.1-13.0) 39	—	12.9
Breadth of zygomatic plate	5.1 ± 0.30 (4.5-5.6) 38	—	6.25
Depth of zygomatic notch	2.4 ± 0.40 (1.6-3.1) 38	—	3.1
Length of diastema	12.2 + 0.81 (10.5-13.8) 38	—	13.8
Length of incisive foramina	8.1 ± 0.46 (7.0-9.3) 29	8.2 ± 0.55 (7.3-9.6) 39	8.65
Breadth of incisive foramina	2.4 ± 0.23 (1.9-2.8) 39	—	2.1
Length of bony palate	8.4 ± 0.37 (7.6-9.4) 39	—	8.78
Breadth of bony palate at first molar	3.2 ± 0.33 (2.3-3.6) 39	—	3.72
Breadth of bony palate at third molar	3.9 ± 0.31 (3.3-4.8) 39	—	4.29
Breadth of mesopterygoid fossa	2.3 ± 0.30 (1.8-3.0) 38	—	2.25
Length of auditory bulla	8.1 ± 0.44 (7.3-9.0) 38	8.9 ± 0.45 (7.7-9.8) 39	8.8
Alveolar length of maxillary molar row	7.2 ± 0.39 (6.6-8.3) 39	7.15 ± 0.4 (5.9-8.0) 72	7.83
Length of palate	—	24.3 ± 1.5 (22.1-27.9) 40	26

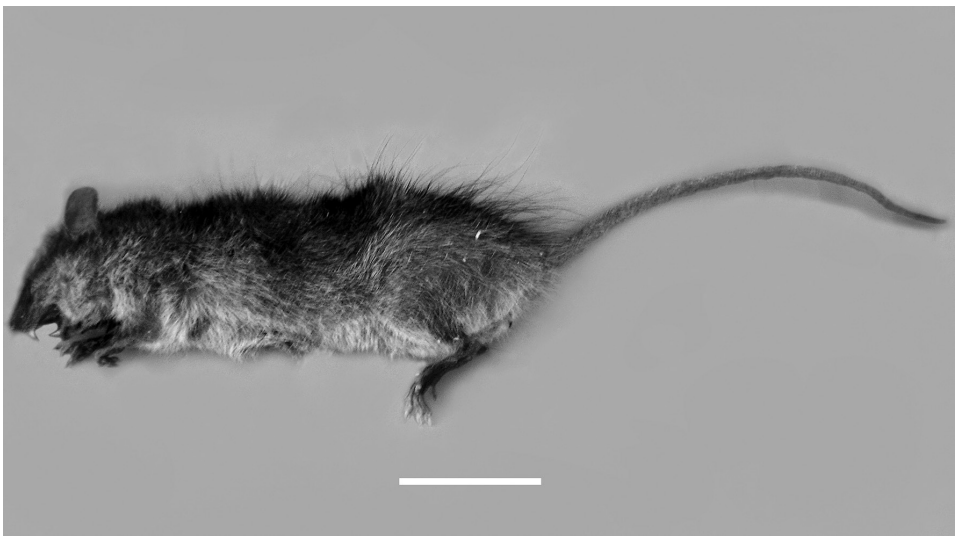

Figure 1. Specimen of ***Bandicota bengalensis*** (MUSM 37682) captured at port of Callao, Peru. The scale represents 50 mm.

and Talmale and Pradhan (2009).

Discussion

Bandicota bengalensis is distributed throughout India, Bangladesh, Burma, Myanmar, Nepal, Pakistan, Sri Lanka, on various islands on the Sunda Shelf and in Saudi Arabia (Musser & Carleton 1993, 2005), and here is reported for the first time at Callao port, Peru, South America. This finding indicates this species was able to survive as a stowaway on the ship for several weeks, and that it could be confused with *Rattus rattus*, thus demonstrating the necessity of continuous and rigorous ship inspections.

Figure 2. Dorsal, ventral and lateral views of cranium and mandible of ***Bandicota bengalensis*** (MUSM 37682) captured at port of Callao, Peru. The scale represents 10 mm.

In south and southeast Asia, *Bandicota bengalensis* has had a close commensal relationship with humans since early in the twentieth century. It is mainly a pest of agriculture and the predominant field rat in many parts of India, Bangladesh, Burma, Pakistan and Thailand (Brooks & Fiedler 1999, Qamar et al. 2019). It has also invaded cities, towns, and villages and has become the main urban commensal in Bombay, Calcutta, Madras, Dhaka, Rangoon and Bangkok (Brooks & Fiedler 1999, Parshad 1999). In small towns and villages, it frequently occurs inside and outside houses and food stores (Brooks & Rowe 1987). Because of its ability to survive on ships long enough to reach international ports of call, *B. bengalensis* is a potential high-risk invasive alien species (IAS), capable of invading regions via shipping and other modes of transportation. Nonetheless, an extensive survey of the literature (Zoological Record search) or in open sources like **VertNet**, Google Scholar, **GBIF**, etc., failed to find a record of invasion or as a stowaway in the Americas, either by ship or other means. Extension of range of distribution of rodent species such as *Rattus norvegicus* and *R. rattus* in the Americas is a known fact since the European conquest. *B. bengalensis* may have a similar capacity to disperse worldwide and should be viewed with great concern.

Based on this finding, hopefully anecdotical, I suggest that ship inspection protocols be strengthened, so that all records of potentially invasive alien species be recorded, and information shared with the scientific community. According to current protocols dead rodents should be incinerated because of the danger of infection (Jacob 1985). While I agree with implementation of this protocol I suggest that, prior to incineration, trained personnel should take photographs to scale and also collect tissue samples (e.g., a finger, a piece of ear, hairs) for genetic analysis (Chaval et al. 2016); and report to a competent agency (NAVMED P-5052-26. 2008). At present, ship records for potentially IAS rodents do not in-

clude the aforementioned steps and results of findings are not apparently shared with the scientific community, probably because rodents are confused with the black or the brown rat. These records could shed light on IAS as potential hazards based on frequency of occurrence and means of transportation employed, providing a baseline for the ecology of potential IAS. Uniting data on the causes of introduction and establishment of IAS can improve early-warning and eradication schemes (Early et al. 2016). Lack of records of *Bandicota bengalensis* from other countries likely indicate that specimens on ships are destroyed before examination by a specialist. Improved IAS detection, data recording and data sharing protocols for shipping activity can provide a useful tool to prevent the spread of IAS and subsequent economic, environmental and health consequences (WHO 2019).

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