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New record for Peru of the invasive Asian beetle *Xylopsocus capucinus* (Fabricius, 1781) (Coleoptera: Bostrichidae: Bostrichinae), with biological and ecological notes

BEIMER CHUQUIBALA-CHECAN[1,3*], DANIEL TINEO[1,4], MALLURI GOÑAS[1,5], VICTOR H. TABOADA-MITMA[1,6] & MANUEL A. HERNÁNDEZ-MAY[2,7*]
[1]*Centro Experimental Yanayacu, Dirección de Servicios Estratégicos Agrarios (DSEA), Instituto Nacional de Innovación Agraria (INIA), Carretera Jaén San Ignacio km 23.7, Jaén 06801, Cajamarca, Perú.*
[2]*Instituto Superior Hidalgo. Calle Cerrada de Juárez, 327 Col. Centro, C.P. 86706 Macuspana, Tabasco, México.*
[3] *bchuquibala@gmail.com; https://orcid.org/0000-0003-1543-6176*
[4] *dt.infolab@gmail.com; https://orcid.org/0000-0001-5263-6316*
[5] *mallurig17@gmail.com; https://orcid.org/0000-0002-4972-3467*
[6] *victortaboadam@gmail.com; https://orcid.org/0009-0006-7239-9390*
[7] *manuel.hz.may@gmail.com; https://orcid.org/0000-0002-4388-6361*
**Corresponding author*

Abstract

As part of our study of saproxylic fauna in cocoa (*Theobroma cacao* Linnaeus, 1753) sites in northern Peru, we present a new record of *Xylopsocus capucinus* (Fabricius, 1781) in the country. The species *X. capucinus* is considered an invasive beetle in the Bostrichidae family to Central America. Our report includes biological and ecological data from this site, as well as detailed taxonomic information and images to facilitate identification.

Key words: Beetles, borers, agroecosystems, cocoa, interception traps

Introduction

The Bostrichidae Latreille, 1802, commonly known as powder beetles due to the ability of larvae and adults to reduce wood into a fine powder (Liu 2021), are composed of approximately 600 species in 90 genera worldwide, with tropical, subtropical and arid regions being the more species-rich (Lawrence & Slipinski 2013; Zahradník & Háva 2014). In Peru, 17 species in 15 genera have been documented (Borowski 2020; Borowski & Węgrzynowicz 2007; Háva & Chaboo 2015; Juárez & González 2016; Juárez *et al*. 2016).

The beetles of this family are of economic, agricultural and forestry interest. Many of the species attack live trees of commercial importance and processed wood. Others are considered pests of stored products, including cereals, dry roots, fruits, dried tubers, and manufactured products (Bahillo-De La Puebla *et al*. 2007; Liu 2021; Liu *et al*. 2008). Ecologically, they are important because they degrade vegetal matter and participate in reintegration of nutrients into the soil (Stokland *et al.* 2012). Most of these beetles belong to the saproxylic insect group, and the adults and larvae bore into and feed on woody tissues. They also feed on hard fungi, stressed trees stems and young shoots, and on wood with fire damage (Liu 2021; Liu *et al*. 2008; Nardi & Mifsud 2014; Stokland *et al*. 2012).

The genus *Xylopsocus* Lesne, 1901, contains 18 species (Borowski 2021). Most of these species are found in Asia, Australia, the Indian Ocean and Ethiopian regions. Some species have been introduced to the Americas, including *Xylopsocus capucinus* and *X. castanoptera* (Fairmaire, 1850) (Liu 2010). Much of the biology and ecology of this genus is unknown; however, species that prefer dry and recently cut wood have been documented (Liu 2021), and *X. capucinus* is considered an invasive beetle in the Bostrichidae family to Central America (Orozco 2020). The objective of this study is to report the presence of *X. capucinus* in Peru for the first time and to provide ecological and biological data on this species in the cocoa agroecosystem.

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Material and methods

Specimens of *Xylopsocus capucinus* were collected in six cocoa sites in northern Peru (Fig. 1A, Table 1). These sites have a seasonally dry and humid tropical climate with average annual temperatures of 24 to 26°C and mean annual rainfall between 800 and 1,200 mm (Servicio Nacional de Meteorología e Hidrología del Perú [SENAMHI] 2024). In this area, December through April are months of intense rainfall, May through July are months of light rainfall, and August through November are the dry season, with minimal rainfall. Cocoa is cultivated organically under agroforestry systems with associated species, such as *Citrus sinensis* (Linnaeus & Osbeck, 1765), *Cocos nucifera* (Linnaeus, 1753), *Erythrina edulis* (Triana ex Micheli, 1877), *Inga edulis* (Martius, 1823), *Mangifera indica* (Linnaeus, 1753), *Musa* spp., *Persea americana* (Miller, 1768), and *Spondias dulcis* (Forster, 1786) (Atalaya-Marín *et al*. 2025).

The beetles were collected over the course of 15 days during the rainy season (28 May to 13 June 2024) and the dry season (17 July to 1 August 2024) using artisanal traps made with polyethylene terephthalate (PET) bottles with windows and baited with 70% ethanol (Fig. 1B). For each site, three trees separated by 20 meters were selected in a linear transect, in each tree three traps were placed, one per stratum: low stratum (1.5 meters), medium (4 meters) and high (7 meters), installing nine traps for each site, totaling 54 traps per climatic season and 108 traps in total.

The insects were labeled in the field with their biological, ecological, and geographic data, then preserved in 96% ethyl alcohol. Specimens were transported to and deposited at the Biodiversity Museum of the Centro Experimental Yanayacu of the Instituto Nacional de Innovación Agraria (INIA), where they were analyzed and morphologically classified.

Morphological observations were performed using an Olympus SZ61TR stereo microscope with an SZ2-ILST base. Macrophotography was taken with a Leica Investa 3 Stereo Microscope (model LED2500) with an integrated camera. All photographs were edited with Adobe Photoshop version 26.4.1 and stacked with Zerene Stacker software.

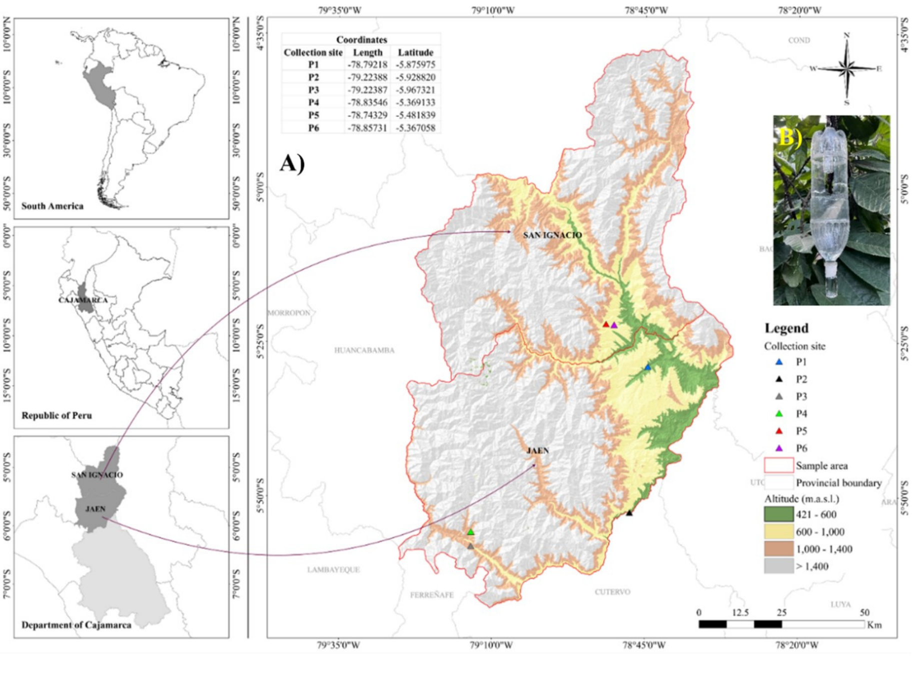

Figure 1. A, Location of cocoa sites in northern Peru; **B,** Artisanal PET trap made of baited PET with 70% ethyl alcohol.

Table 1. Cocoa sites sampled with ethyl alcohol-baited artisanal traps in northern Peru.

Province			**Jaén**		**San Ignacio**	
District	**Bellavista**	**Jaén**	**Pomahuaca**		**Chirinos**	
Sector	**México**	**Chamaya**	**Pomahuaca**		**Tablón**	
Sites	1	2	3	4	5	6
Altitude m.a.s.l	492	508	1007	1156	926	792
Age (years)	12	42	35	8	10	38

Results

Taxon treatment

***Xylopsocus capucinus* (Fabricius, 1781)**

=*Apate capucinus* Fabricius, 1781

=*Bostrichus eremita* Oliver, 1790

=*Synodendron capucinus* Fabricius, 1792

=*Sinodendron capucinus* Fabricius, 1801

=*Apate marginata* Fabricius, 1801

=*Enneadesmus nicobaricus* Redtenbacher, 1867

Diagnosis

The length is 3.0 to 5.5 mm, the width is 1.4 to 1.7 mm, and the body is cylindrical in shape (Fig. 2A–C). The antennae are nine-segmented (Fig. 3A). The body color is black or reddish, particularly on the elytra, abdomen (Fig. 2A–C, E), antennae, and palps (Fig. 2F; Fig. 3A). The apical declivity of the elytra is abruptly deflected and flattened without tubercles or callosities (Fig. 2D). The lateral margins of the declivity are strongly elevated and crenulate upward to completely enclose the declivity (Fig. 2A–B) (Woodruff *et al.* 1978). The sides of the elytra are densely punctate or granular in front of the apical declivity (Fig. 2E) (Fisher 1950).

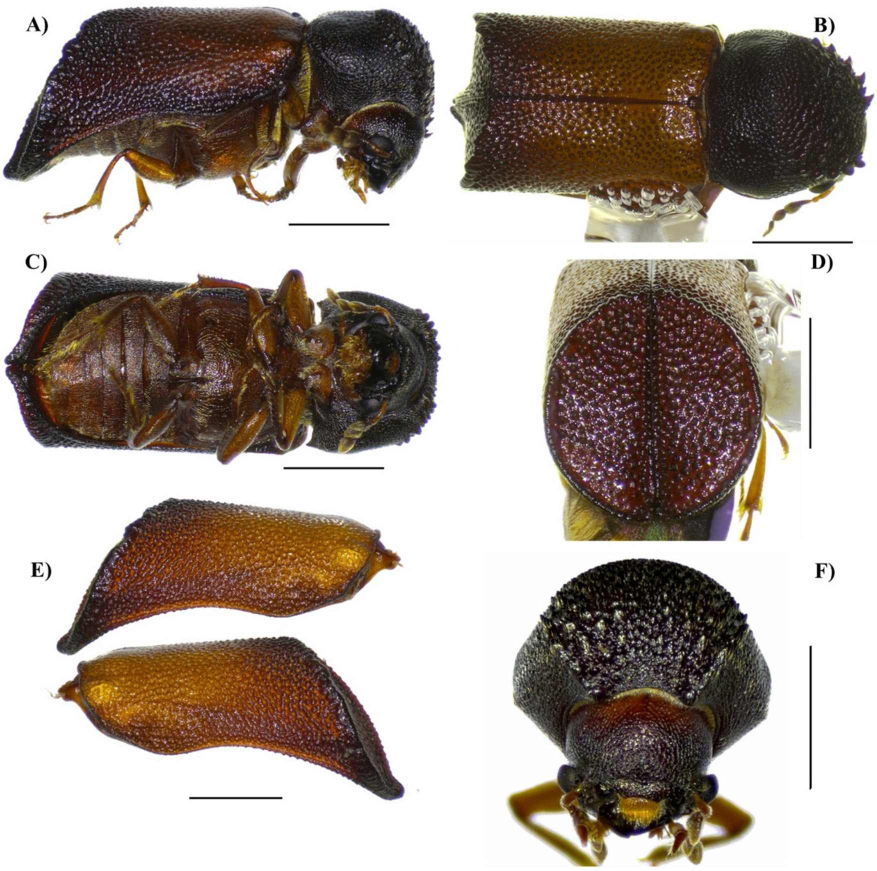

Figure 2. *Xylopsocus capucinus* collected in northern Peru. **A,** Lateral view of the male; **B,** Dorsal view of the female; **C,** Ventral view of the male; **D,** View of the fall and elytral apex of the female; **E,** Lateral view of the elytra of the male; **F,** Anterior view of the frons and pronotum of the male. Scale bar = 1 mm.

Male (♂). Length 4.21 mm; width 1.68 mm. **Color**: black, with reddish or light brown elytra; pronotum, apical part of elytra, antennae and palps reddish brown, or brownish yellow, abdomen reddish brown, head and front black-brown, legs reddish brown (Fig. 2A–F). **Head**: slightly convex, unarmed anteriorly, dense, finely granular and sparsely lined with short, recumbent whitish setae, with rough, longitudinal and parallel roughness on posterior margin of head; clypeus densely punctate, sparsely lined with short, recumbent white setae; suture of clypeus deeply depressed medially (Fig. 2A–B, F). **Antennae**: first antennal segment three times longer than second; third to sixth segments attached, much shorter than first; seventh to ninth segments densely lined with short, recumbent yellowish hairs, apical segment oblong (Fig. 3A). **Pronotum**: distinctly wider than long, widest behind middle; with lateral carinae, sides broadly rounded, strongly convergent anteriorly, with small, unciform tooth at apical angles; posterior angles obtusely angled; lateral margins sinuate near base; surface glabrous, densely, finely punctate and granular in basal half, densely, irregularly toothed in apical half; teeth broad, semi-erect, variable in size and rasping, with a few larger teeth on each side near apical angles (Fig. 2A–B, F). **Elytra**: base of elytra less than width of pronotum behind middle (Fig. 2B); sides slightly expanded posteriorly, closely together and broadly rounded at apices (angulate when viewed from above); surface glabrous, very fine, evenly and densely punctate, sometimes confluently punctate and granular near apical declivity (Fig. 2A–B, E); apical declivity abrupt, flattened, without tubercles or callus, lateral margins strongly elevated, crenulate toward top of declivity, and completely enclosed in declivity; sutural margins narrow, slightly elevated at apical declivity, strongly elevated at apices (Fig. 2A–B, D–E). **Abdomen**: finely and densely granular with short, recumbent yellowish setae; first visible sternite longitudinally carinate in the middle (Fig. 2C). The last visible sternite is not much longer than the anterior sternite and broadly rounded at the apex (Fig. 3. B).

Aedeagus: elongate, gradually narrowed to a fine, acuminate tip (Fig. 3C).

Female (♀). Length 4.24 mm; width 1.62 mm; differs from male by the last visible abdominal sternite, which is double the length of the anterior sternite at the middle, and very emarginate at the apex (Fig. 3D).

Distribution. *Xylopsocus capucinus* has been recorded in Burma, Cambodia, China, Comoros, India, Indonesia, Laos, Madagascar, Malaysia, Mauritius, Nepal, New Guinea, New Caledonia, Oceania, Philippines, Réunion, Sri Lanka, Taiwan, Thailand, and Vietnam (Baever *et al*. 2011; Borowski 2021; Chu & Zhang 1997; Liu 2010; Liu & Beaver 2018; Liu *et al.* 2006; Woodruff *et al*. 1978; Zhang *et al*. 2022). In the Americas: Brazil, Trinidad, Venezuela, the United States, Colombia, Bermuda, Dominica, Montserrat, and Honduras (Fisher 1950; Hilburn & Gordon 1989; Ivie 2002; Peck 2006; Orozco 2020; Seltzer *et al*. 2013; Woodruff *et al*. 1978). It is new to Peru.

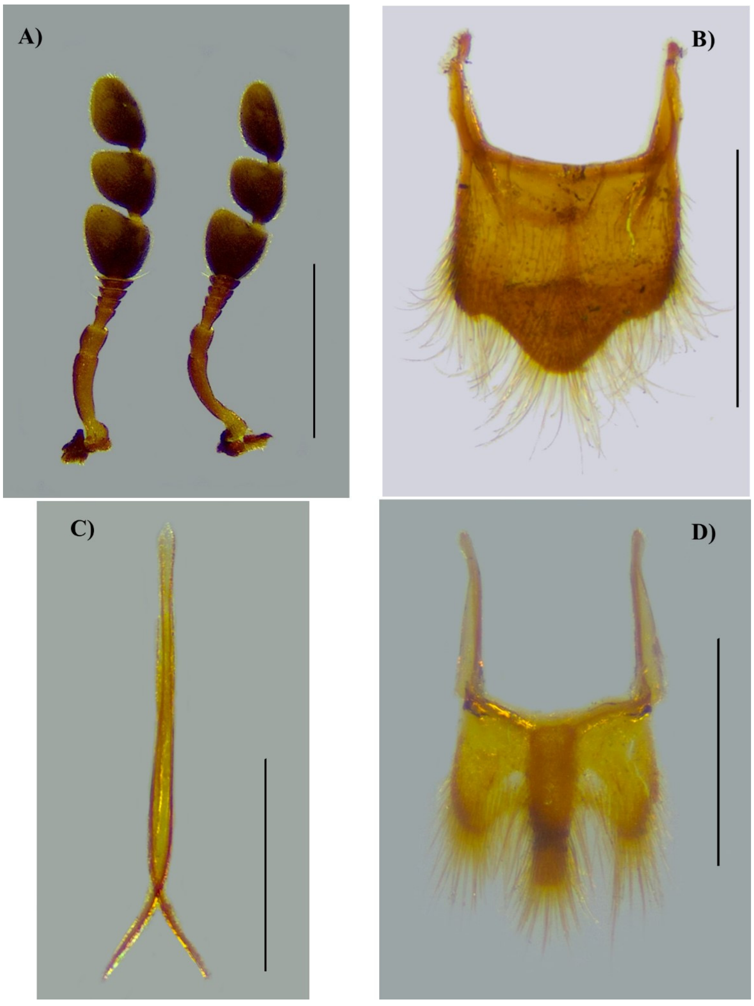

Figure 3. *Xylopsocus capucinus* collected in northern Peru. **A,** Antennae of the female; **B,** View of the last abdominal segment of the male; **C,** Ventral view of the aedeagus; **D,** View of the last abdominal segment of the female. Scale bar = 0.5 mm.

Ecological data. Of the 108 traps placed across two seasons, 29 traps collected 52 *X. capucinus* individuals. Site four recorded the highest abundance (26 individuals, 50%) at the highest altitude (1156 m.a.s.l.) and youngest age (eight years). This was followed by site three with 14 individuals (27%), 1007 m.a.s.l. and 35 years old. Site five registered the lowest abundance with two individuals (4%) and an altitude of 926 m.a.s.l. and ten years (Fig. 4).

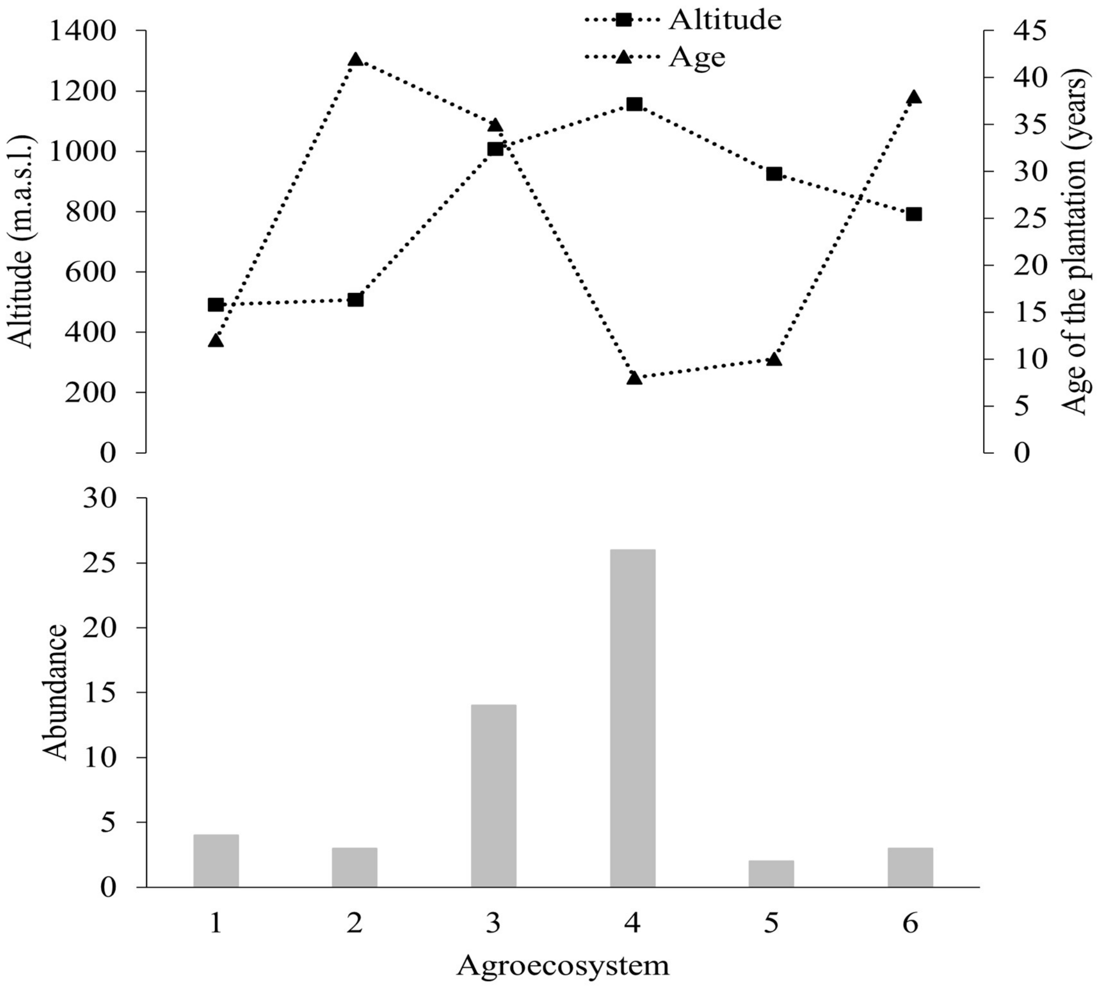

Figure 4. Recorded abundance of *X. capucinus* by site with respect to altitude (m.a.s.l.) and years of cocoa sites in northern Peru.

Xylopsocus capucinus was present in both seasons. Thirty-four individuals (65%) were collected during the rainy season, and 18 individuals (35%) were collected during the dry season. The rainy season recorded the highest values for precipitation (mm), temperature (°C), and humidity (%). The species was present in most of the sites, only in sites five, where it was not recorded in the dry season (Table 2, Fig. 5).

Table 2. Recorded abundance of *X. capucinus* by season and requeriments of habit in cocoa agroecosystems in northern Peru.

		Sites						
	Season	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Abundance	Rain	1	1	12	16	2	2	34
	Dry	3	2	2	10		1	18
Precipitation (mm)	Rain	19.91		64.95		22.55		
	Dry	9.91		23.55		1.40		
Temperature (°C)	Rain	30.16		19.4		27.20		
	Dry	29.82		18.7		27.29		
Humidity (%)	Rain	83.10		52.52		58.19		
	Dry	73.12		46.62		53.03		

Most specimens were collected in the low vertical stratum, with 25 individuals, followed by the high stratum with 15 and the middle stratum with 12. In sites one, three and four, *X. capucinus* was present in all three strata, compared to two and five, which were only recorded in the low stratum with three and two individuals respectively, and in six, where it was only recorded in the middle and high stratum (Table 3).

Table 3. Recorded abundance of *X. capucinus* by stratum in cocoa sites in northern Peru.

	Sites						
Stratum	1	2	3	4	5	6	Total
Low	1	3	7	12	2	0	25
Medium	1	0	5	4	0	2	12
High	2	0	2	10	0	1	15
Total	4	3	14	26	2	3	52

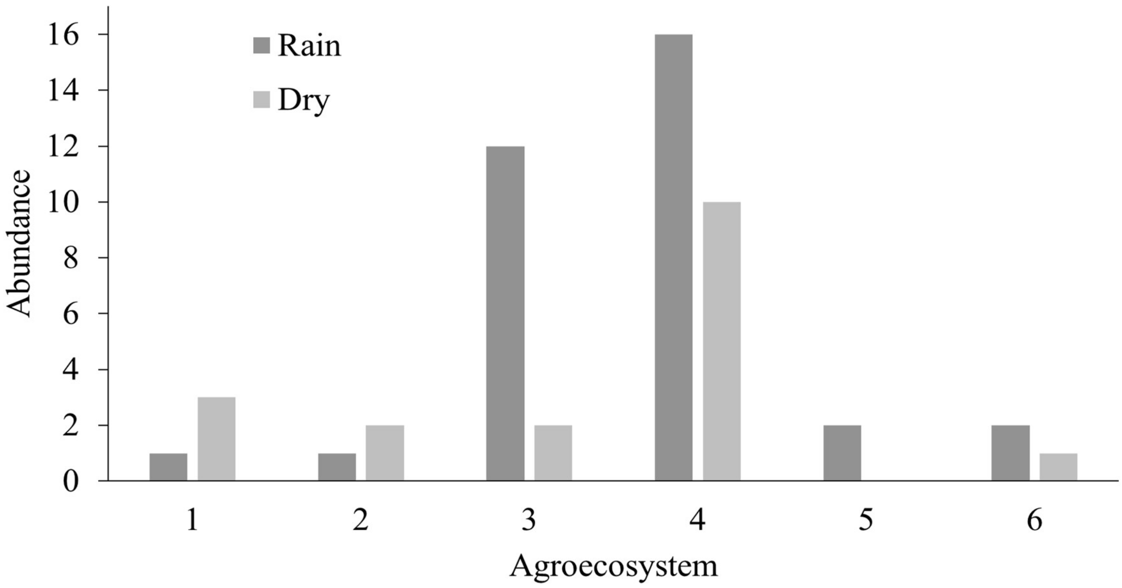

Figure 5. Recorded abundance of *X. capucinus* by climatic season in cacao sites in northern Peru.

Discussion

The new record of *Xylopsocus capucinus* in northern Peru, together with recent records in Central and South America (Beaver *et al*. 2011; Fisher 1950; Hilburn & Gordon 1989; Ivie 2002; Liu 2010; Orozco 2020; Peck 2006; Seltzer *et al*. 2013; Woodruff *et al*. 1978), confirms the active expansion of this invasive species. Due to its mode of introduction, *X. capucinus* can be accidentally distributed as larvae or adults through the importation of wood products, such as branches, logs, and furniture (Ivie 2002; Liu *et al*. 2022; Woodruff *et al*. 1978). This is a common method of dispersal for saproxylic insects. Currently, the route by which this beetle was introduced to Peru is unclear, as is whether it was actively dispersed from adjacent countries or passively introduced by wood imports.

Fisher (1990) provides a list of hosts for this species, including *Mangifera indica* (mango) and *Persea americana* (avocado) are found in the cocoa agroecosystem in Peru. The presence of these hosts across six sites in both dry and rainy seasons indicates that *X. capucinus* is established in the cocoa.

Xylopsocus capucinus did not show marked seasonality, as beetles were collected in both seasons, suggesting that these insects are not affected by rainfall. Beeson & Bhatia (1973) indicated that in India, the beetles are present between May and November without marked peaks in abundance. The life cycle is annual and may extend up to two years (Woodruff *et al*. 1978).

The altitudinal distribution showed that the highest, youngest site with low temperature and humidity recorded the highest number of *X. capucinus* individuals. Humidity is an important environmental factor in the distribution and adaptation of some Bostrichidae species (Crowson 1981). Furthermore, it is likely that *X. capucinus* beetles in this agroecosystem use resources such as wood stressed or damaged by medium-to-low temperatures and increased UV exposure (Hodkinson 2005; Woodruff *et al*. 1978). Similarly, although there have been no reports of this species of beetle attacking cocoa plants, more attention should be given to the increase in populations in the agroecosystem because this species has been recorded attacking apparently healthy trees (Silva *et al*. 2014; Woodruff *et al*. 1978).

Likewise, the beetle has been associated with a disease caused by fungi *Ceratocystis fimbriata* (Ellis & Halsted, 1890), which could cause the death of plants (Orozco 2020; Silva *et al*. 2014). Similarly, the vertical distribution, suggests that the beetles fly in agroecosystems in the low stratum (1.5 m), differing with that reported in Mexico by Geronimo-Torres *et al*. (2021a, 2021b) in a mangrove and tropical rainforest ecosystem, respectively and Vega-Badillo *et al*. (2018) in subcaducifoliated tropical forest, where they report that some species of Bostrichidae do not show preferences for any type of stratum, since the distribution of their abundance is similar in shape.

Finally, more research is needed to detect the sources of distribution of this exotic species, as well as systematic studies, which will allow clearer inferences about population dynamics, altitudinal distribution and seasonal patterns.

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Author contributions

Authors contributed equally to this work.

Conflicts of interest

The authors have declared that no competing interests exist.

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