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ORIGINAL RESEARCH ARTICLE

First record of the invasive powderpost beetle *Lyctus africanus* Lesne (Coleoptera: Bostrichidae) infesting wooden furniture in Italy

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Abstract
Wood-boring beetles are significant pests that can rapidly spread through wooden materials, leading to substantial global economic losses. Invasive species targeting wood are frequently detected in Europe and North America, with the recent climatic conditions in the Mediterranean where climatic conditions have facilitated their establishment. Among these, species from the Bostrichidae family are particularly noteworthy due to their impact. In this study, we report the first record of the non-native powder post beetle *Lyctus africanus*, in timber used for art crafts in Italy, indicating its spread. An early detection and rapid reporting are the most important actions in the successful management of such non-indigenous species. Additionally, we provide illustrations and diagnosis for pest identification. We then highlight the list of possible wood species hosts, provide a general overview of infestations and review the control options for this destructive pest including chemical treatments, use of pheromone traps and the search for biological agents.

Keywords Lyctinae · Wood boring insects · Pest management · Host wood species

Introduction

The genus *Lyctus* (Coleoptera: Bostrichidae: Lyctinae) comprise powderpost beetles and stands as a common pest of hardwoods (Ebeling 1978; Gerberg 1957; Ivie 2002; Liu and Schönitzer 2011). These beetles inflict significant damage mainly during their larval stage and exhibit a marked preference for starch-rich woods with large vessel diameters, making many temperate and tropical broadleaf species susceptible (Gambetta 2010; Kartika and Yoshimura 2013). Among the most vulnerable host plants are ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), oak (*Quercus* spp.), fromager (*Ceiba pentandra*), iroko (*Milicia* spp.), koto (*Pterygota macrocarpa*), limba (*Terminalia superba*), longhi (*Chrysophyllum* spp.), obeche (*Triplochiton scleroxylon*) and ramin (*Gonystylus* spp.) (Nicholas 1982; Peters et al. 2002; Chiappini and Nicoli Aldini 2011; EN350 2016).

Lyctus spp. lack the ability to generate enzymes capable of hydrolyzing cellulose or hemicellulose, limiting their activity to sapwood (Parkin 1940). The larvae, transform the sapwood into a fine, soft powder, leading to their classification as powderpost beetles (Peters et al. 2002). *Lyctus* larvae carve intricate tunnels, leaving behind a distinctive trail of destruction and causing severe damage to wood and its products, such as hardwood timbers, hardwood flooring, plywood, crating, and furniture (Kartika et al. 2021). The larvae can progressively feed mainly on the starch content inside wood regarding a long-life spam, up to one year, therefore, leading to serious damage of the wood that internally presents dense bored galleries with a compact and packed powdered frass inside (Brennan 1990; Querner 2015). After completing their larval cycle and pupation, adult beetles create circular exit holes, emerging through these holes with diameters ranging from 1 to 1.5 mm (Gambetta 2010).

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From the external view, the resulting damage is marked by the presence of these small round holes on the wood's surface used as exit of emerging adults. The damage and infestation are typically identified late due to a lack of knowledge on how to locate and monitor it, as it appears only when the adults emerge (Kartika et al. 2021).

While specific species within the *Lyctus* genus may exhibit variations in their geographic range, the overall distribution is broad. *Lyctus* beetles are known to infest hardwoods in Africa, Asia, Australia Europe and North America, (Gerberg 1957; Ebeling 1978; Halperin and Geis 1999; Peters et al. 2002; Mito and Uesugi 2004; Abood et al. 2006). In Italy the only native species of *Lyctus* reported to date are *L. linearis* (Goeze, 1777) and *L. pubescens* Panzer, 1793, while *L. brunneus* (Stephens, 1830), introduced through imported wood, has become naturalized and is now the most widespread species, significantly contributing to wood decay (Gambetta and Orlandi 1982; Chiappini et al. 2001; Robinson 2005; Palazzo et al. 2021). *Lyctus hipposideros* Lesne, 1908, *L. africanus* Lesne 1907, *L. carbonarius* Waltl, 1832, were intercepted by Gambetta and Orlandi (1982) in lumber warehouses; however, tests carried out in Italy in natural conditions showed that among them, only *L. carbonarius* has completed the biological cycle and was able to reproduce, while in laboratory conditions (20.8 °C; 50% r.h.) all these species completed their cycle.

Research conducted in Mediterranean countries during the past century by Halperin and Geis (1999) has highlighted that in the genus, *L. africanus* was the primary damage agent observed in furniture crafted from plywood, door frames, and picture frames. The authors showed that approximately 95% of the infestations were attributable to *L. africanus*, emphasizing the significant impact of this species on these wooden structures, and underscoring its prevalence and potential for damage in the context of Mediterranean countries (Halperin and Geis 1999). The origins of *L. africanus* remain uncertain, with debates over whether it originated in Africa or Southeast Asia, it has a historical presence in Ethiopian regions and Southeast Asian regions and is currently widespread in pantropic areas. It was introduced into Mediterranean Basin countries, such as Morocco, Egypt and Israel in late 1960s or early 1970s wrecking plywood of different plant species (Halperin and Geis 1999). The dangerousness of this pest underscores the importance of understanding its biology and behavior to develop effective management strategies. In this context, the prompt recognition of this pest, facilitated by detailed photographic material, is essential for early detection and intervention, potentially preventing extensive damage and economic losses. Such visual aids can greatly assist in training and equipping professionals and the public to identify *L. africanus* infestations swiftly and accurately.

In this study, we report a significant infestation of Lyctinae discovered in a cupboard within the court archive of Catania, Sicily. Through morphological and anatomical examinations, the species was identified as *Lyctus africanus*, marking the first documented evidence of its naturalization in Italy. This work was carried out through a photographic documentation of damage to the wood, illustrations and diagnosis of adults and further observations on biology and distribution information on the involved species.

Materials and methods

Inspections

In January 2024, we received a report of a strong infestation from the curator of the library who observed signs of infestation determined by timber beetles in the court archive of Catania (Sicily, Italy) (37.515 N,15.087 E) (Fig. 1A, B). Consequently, inspections have been planned and began with two surveys carried out on 20th January and 20th February 2024 that showed that the damage was present in the library room, inside the cupboards located at the base of the bookcases (Fig. 1C).

The infested part was the plywood back panel (Fig. 2) which showed clear signs of infestation such as small circular holes, from which the adult insects had emerged and fine boring dust on external surface wood. Where the damage was extreme, the plywood was transformed into a mass of powder or pellets held together by a thin outer surface penetrated by numerous exit holes.

Based on information reported by the director of the court archive, the acquisition date of the furniture object of the study was reported firstly by the curators in 2010. This suggests that the furniture has remained in continuous use at the location since its acquisition. Some pieces of plywood panels were transported to the DAGRI (University of Florence) laboratories to be characterized. The plywood's manufacturing process was examined by observing and measuring its component layers: some panels were sanded at the edge and the thickness of each layer was measured using a digital caliper with 0.1 mm accuracy. Based on the observed anatomical characteristics, the species were identified using a macroscopic dichotomous key (Ruffinatto and Cantarutti 2021).

Sampling of larvae and adults

During entomological investigations the cupboard shelves were carefully inspected and when damage or traces of wood-destroying insects, such as exit holes and the presence of fine flour-like wood powder (frass), were detected;

Fig. 1 Library of the Court of Appeal of Catania (Italy): (**A**-**B**) Overview of the library premises on two levels with a balcony, consisting of open wooden shelves containing books, and closed cabinets with doors in the lower section; (**C**) one of the lower shelves infested with *Lyctus africanus*

all insects present, both dead and alive, were collected with the help of a soft brush or entomological forceps and placed in sterile tubes (Ø = 3 cm), closed with a lid, and transported to the entomology laboratory of the SAAF, Department of the University of Palermo (Italy) for identification; also the wood powder was kept in clean closed Petri dishes and taken to the laboratory for closer examination under the microscope. Plywood back panels showing signs of infestation

Fig. 2 Library of the Court of Appeal of Catania (Italy): (**A**-**B**) interior of infested shelves with emergence holes and powdery frass from larval activity in sapwood; (**C**) plywood back panel removed from the cabinet for laboratory inspection; (**D**) central ply completely destroyed by larval activity; (**E**) adults powdery and pellet-shaped frass collected in a petri dish

were carefully examined. Larvae and adults were extracted for identification, and the inner tunnels were photographed. All samples were carefully labeled.

Morphological study and illustrative photographs

Specimens were preserved in 70% ethanol for general storage, maintaining their anatomical integrity. Some were pinned or card-mounted for identification under a stereomicroscope. To examine specific morphological features critical for accurate species identification, such as genitalia, antennae, wings, legs, and mouthparts, some adults and larvae were mounted on microscope slides using Hoyer's medium, enabling detailed observation under a light microscope.

Then, they were examined through a Wild-Heerbrugg M8 stereomicroscope and with a Zeiss Universal Photomicroscope III light. Images of larvae and adult insects were taken using a Leica DM2500 compound microscope and a Leica DFC420C mounted camera with Leica Application Suite software. Body size measurements of males and females, in terms of length, were obtained using a video camera (Zeiss Axiocam ERC) mounted on a stereoscope (Zeiss Stereo Discovery.V12) and connected to AxioVision SE64 Rel. 4.9.1 software for image acquisition and analysis. To compare body length of males and females, data were checked for normality using the Shapiro-Wilk test and analyzed using a t-test (STATISTICA 10.0 for Windows).

Identification of the insect pest was performed using the identification keys and the morphological description (Gerberg 1957; Delobel and Tran 1993; Geis 1996; Liu 2010a; Liu and Geis 2019). Furthermore, Altson (1924), Geis (1996), Chiappini and Aldini (2011), Liu and Schönitzer (2011) and Lawrence et al. (2022) were consulted for closest species diagnosis, current terminology and abbreviations for morphological structures. The original description by Lesne (1907), has been also considered.

The damages were documented with a Canon 7D or a Canon 350D digital camera provided with a Canon MP-E 65 mm macrolens (Canon Inc., Tokyo, Japan). All photos were integrated using the freeware CombineZP Hadley (2011) and processed in Adobe Photoshop. Collected specimens are preserved in the collection of the Department SAAF, University of Palermo (Sicily, Italy).

Abbreviations:

At, antenna; ES, epicranial suture; F, femur; FL, frontal lobe; LA, labrum; Lb, labium; Lp, labial palp; Md, mandible; MET, metasternum; Mp, maxillary palp; MSP, medial spur; Mx, maxilla; Par, paramere; PC, postclypeus; PCL, postclypeal lobe; Pen, penis; R, radial cell; RP_{3+4}, radius posterior branches 3 and 4; TS, tibial spur; VER, vertex; VP, vaginal palp.

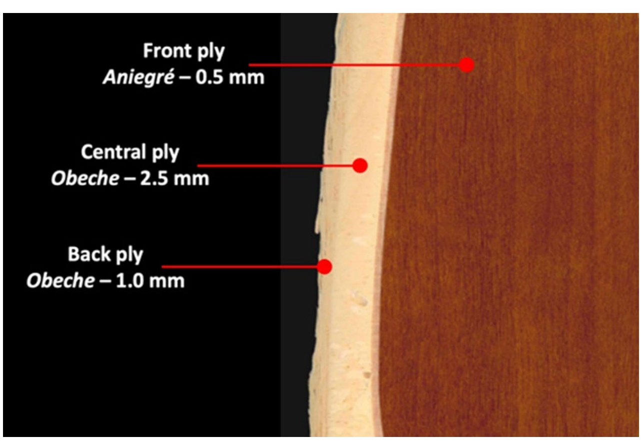

Fig. 3 The structure of the plywood panel, whose central layer was attacked by *Lyctus africanus*

Results and discussion

Plywood analysis

The examined plywood consists of three plies of two different tree species: obeche (*T. scleroxylon*) and aniegré (*Aningeria altissima*). Obeche (or Obece), a species in the Malvaceae family, subfamily Helicteroideae, is traded under other commercial names as Samba (in Ivory Coast), Ayous (in Nigeria, and Cameroon) and Wawa (in Ghana). These names generally depend on the country of origin but all refer to the same wood species. Heartwood is indistinguishable from sapwood: both are yellowish-white in color. Obeche has a medium to low density (350–500 kg/m³). It is highly suitable for rotary cutting and is therefore widely used in plywood production. The texture is medium to coarse. Anatomically, the wood contains large, dispersed vessels, which make it particularly attractive to lyctid beetles, as these vessels can host eggs laid by female insects. Obeche is classified in durability class 5 (DC5, non-durable) according to EN 350 standards. As obeche, aniegrè has many different commercial names as Asanfena (common in Ghana) and Mukali (used in some regions of Central Africa) it is included in the Sapotaceae family. The heartwood is initially yellowish-white when fresh, transitioning to a light pinkish-brown hue as it ages. Its texture ranges from fine to medium. The laboratory analysis of the back panel removed from the cabinet showed that plywood is made of a distinctive and uncommon asymmetrical characteristic across the three plies. The face veneer is made of a thin layer (0.5 mm) of aniegré, while the back, acting as the balancing sheet (back veneer), is composed of 1.0 mm veneer of obeche.

The core (central layer), also made of an obeche veneer, is the thickest, measuring 2.5 mm (Fig. 3).

This asymmetry prevents the plywood from being balanced. Consequently, when the panel is removed from its support, it exhibits the characteristic curvature (cupping) of asymmetrical plywood.

Structural damage by *Lyctus* larvae

The layer attacked by the insects is the central one (Fig. 4A). No significant signs of damage are observed on the back or, understandably, on the exposed face. This is because the exposed face is very thin and impregnated with a finishing varnish, while the back veneer, being relatively thin, probably does not provide a suitable environment, from the dimensional point of view, for the development of insect larvae.

The central laminated board of the plywood is extensively damaged by the larvae of *L. africanus* (Fig. 4). The larvae bored extensive tunnels (Fig. 4D-G), which render the wood structurally compromised, converting it into fine powder or compacted pellets (Fig. 4H). This infestation pattern is distinctly different from the front (Fig. 4B) and back ply (Fig. 4C), which primarily display emergence holes.

The infestation of *L. africanus* in the analyzed plywood can be explained by the wood's high starch content and suitable pore size, both of which are critical factors for Lyctid beetle development. Wood susceptibility is determined by its characteristics; *Lyctus* spp. prefers woods with large vessel diameters (> 70 µm), a moisture between 8 and 25% (optimum 15%) and starch content higher than 3%, a crucial nutrient for *Lyctus* species, influencing fecundity, oviposition behavior and survival rates (Gambetta 2010; Kartika and Yoshimura 2013). Obeche (*T. scleroxylon*), a primary component of the plywood, is known for its large, dispersed vessels and relatively high starch reserves, making it particularly vulnerable to *Lyctus* spp. attack. These anatomical and chemical characteristics provide an optimal environment for female beetles to lay eggs and for larvae to develop within the wood. Such extensive destruction highlights the beetle's potential for significant economic impact in Italy. The absence of protective treatments further facilitated infestation, highlighting the need for preventative measures such as varnish sealing or chemical preservatives.

Morphological diagnosis and taxonomic framework of *Lyctus africanus* Lesne, 1907

Study material

40 ♂: ITALY: Sicily, Library of the Court of Appeal of Catania 20.I.2024, E. Peri leg.; 38 ♀ with the same label as the previous one.

The Lyctinae is a well-supported subfamily of Bostrichidae, which can be divided into three tribes, Lyctini, Trogoxylini and Cephalotomini (Liu and Schönitzer 2011; Liu and Geis 2019).

The members of the subfamily Lyctinae, to which *L. africanus* belong, differ from others Bostrichidae subfamily in the following features: the flattened elongate body; the prothorax not forming a hood over the head which is prognathous, visible from above; 11 antennal segments with a two-segmented terminal club (Figs. 5D and 6B) (except *Cephalotoma* spp. with 3-segmented club); metacoxae widely separated by a wide flattened process of the first visible abdominal segment (Fig. 5F); tarsi five segmented, with the first segment very small and the fifth segment almost as long as all the preceding segments combined (Fig. 6J, K); the simple tarsal claws simple (Fig. 6J, K) (Geerberg 2008; Liu and Geis 2019).

The diagnostic features of the genus *Lyctus* in the tribe Lyctini are the metathoracic femur slender, not ellipsoidal or subglobose (Fig. 6K); punctures and pubescence of elytra seriate, appressed (Fig. 5A, B); antennal club with both segments not elongated and with apical segment equal to or longer than penultimate, ovoid becoming attenuated toward apex (Fig. 6B); supraocular lobe and side margins of frontal lobe not raised (Fig. 5E) (Liu and Geis 2019).

Lyctus africanus most closely resembles *L. brunneus* (Stephens, 1830), from which it is differentiated by the contiguous, continuous, unelevated frontal lobes and lateral lobes of the postclypeus without distinct notch between them (Fig. 5E), by the lateral margins of pronotum subparallel, narrowed toward base (Fig. 5H) and by dense conspicuous fringe of silky hairs on the distal margin of the fourth sternite on female (Fig. 5F) while *L. brunneus* has a distinct notch between frontal lobe and postclypeal lobe, lateral margins of pronotum sinuate and the female does not have the fringe of hairs on the distal margin of the fourth sternite (Geerberg 1957; Liu and Geis 2019).

According to Geerberg (1957) *L. africanus* adults also present antennae approximately as long as the pronotum, penultimate segment of antennal club shorter and broader than last; outer margin of mandibles notched at middle (Fig. 6C); labrum (Fig. 6E) bilobed and fringed with long silky hairs; thorax subquadrate, pronotum shiny, punctate whit anterior angle obtusely rounded, posterior angles acute

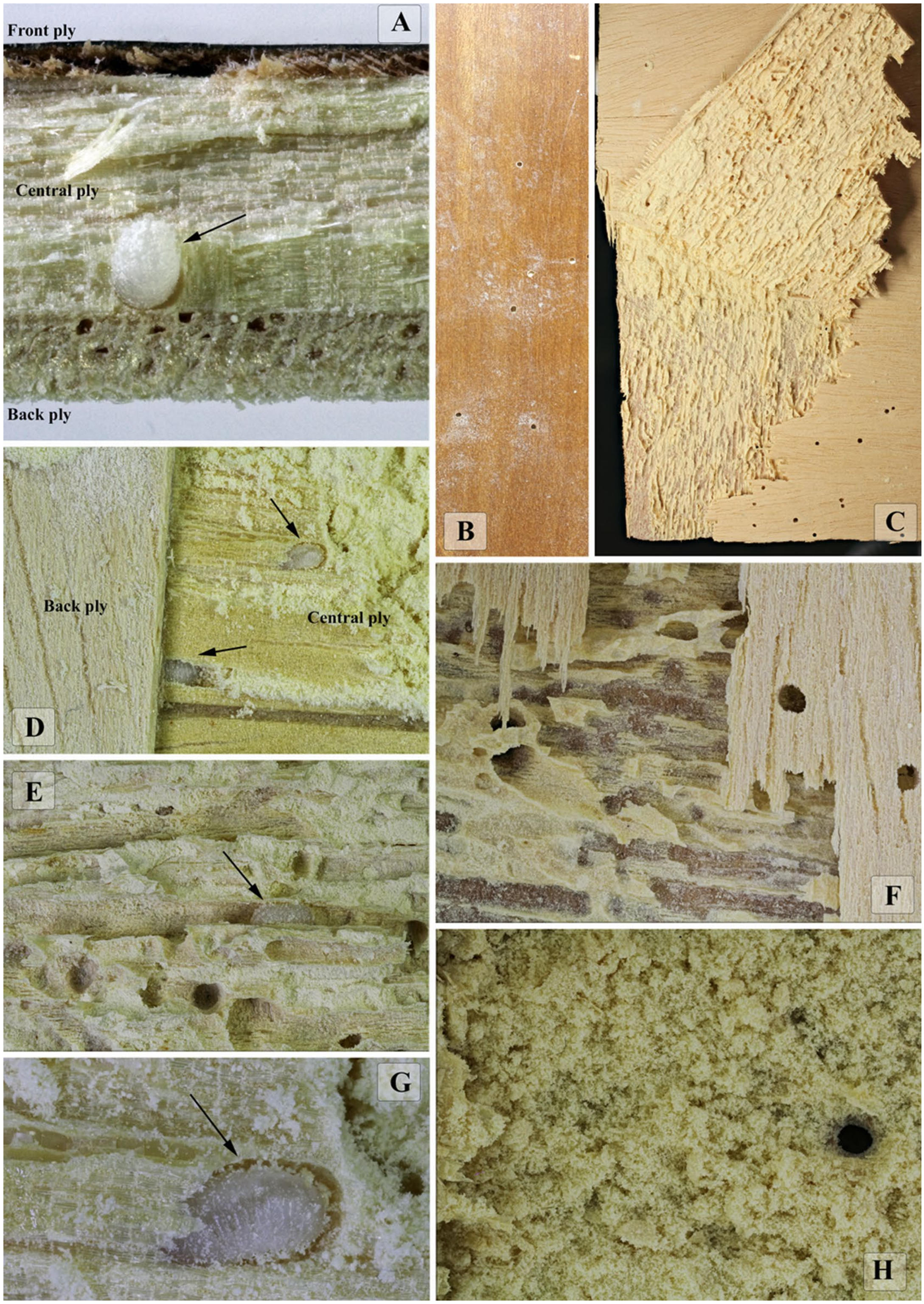

Fig. 4 Damages caused by *Lyctus africanus* on cupboard plywood back panels; arrows indicate the larvae inside the galleries: (**A**) Cross-section of plywood showing its three layers; (**B**) front ply of plywood and (**C**) back ply with emergence holes, this bottom layer has been lifted to reveal the bored galleries; (**D**-**G**) the middle layer completely destroyed by tunnels excavated by the larvae; (**h**) wood converted to a mass of powder or pellets

Fig. 5 Adults of *Lyctus africanus* (see abbreviation in Material and Methods): (**A**-**C**) lateral, dorsal and ventral habitus; (**D**) prothorax and head in ventral view; (**E**) head in dorsal view; (**F**, **G**) ventral view of metasternum and abdomen (the arrows in " F " indicate the fringe of hairs on the distal margin of the 4th sternite, which is lacking in the male; the double white arrow the distance between metacoxae) (**H**) dorsal head and pronotum (the arrows indicate the obtusely rounded anterior angles of pronotum). Scale bar: 300 μm

Fig. 6 Adults of *Lyctus africanus* (see abbreviation in Material and Methods): (**A**) hind wing; (**B**) female and male antennae; (**C**) mandible; (**D**) maxilla and labium, ventral view; (**E**) labrum and postclypeus; (**F-H**) male genitalia; (**I**) apex of ovipositor in female genitalia; (**J**) prothoracic leg; (**K**) metathoracic leg. Scale bar: 100 µm, unless labeled otherwise

and lateral margins denticulate (Fig. 5H); elytra approximately 3 times length of thorax, slightly less than twice as long as wide with parallel sides, presenting striae with single row of punctations, separated by carinulae bearing single row of fine, sparse hairs (Fig. 5A-B); abdomen not shiny, faintly punctate (Fig. 5F-G); tibial spur on prothoracic leg prominent, larger than first 2 tarsal segments (Fig. 6J). The male is distinguished from the female by the lack of silky hair on the distal margin of the fourth sternite (Fig. 5G).

The external female genitalia (Fig. 6I) consist of the muscled ovipositor, sclerotized rods, and 2 basal pieces bearing 2 segmented vaginal palpi bearing sensory pits and setae.

The hind wings (Fig. 6A) have the radial cell (R) without lumen, the apical field containing one support sclerites (SS) consisting of a pigmented area elliptical in shape, the radius posterior branches 3 and 4 (RP_{3+4}) and the medial spur (MSP) about straight nearly reaching wing margin (Lawrence et al. 2022).

The measurement of body size in males and females revealed a mean (±SE) length of 3.18 ± 0.09 mm and 3.12 ± 0.05 mm respectively. No statistical differences in body length were observed between sexes ($t = 0.55$; $df = 50$; $p = 0.57$).

In *L. africanus*, sexual dimorphism is evident, with the most distinct feature observed in the female. Unlike the male (Fig. 6G), the female exhibits a conspicuous fringe of hairs along the distal margin of the fourth sternite (Fig. 6F). This characteristic has been well-documented and serves as a key diagnostic trait for differentiating between the sexes (Geerberg 1957).

The larvae are C-shaped, enlarged at the thorax, variable in size and usually 3.2–4 mm (Fig. 7A-C), oligopod with legs distinct and 3-segmented (Fig. 7G) and body surface completely free of anchoring hooks, possibly because larval activity occurs in a relatively tender wood, that can be burrowed more easily. The larvae have chisel-shaped mandibles, without teeth but linear and sharp (Fig. 7E, I); 3-segmented antennae (Fig. 7D) with an accessory appendage and 1-segmented labial palps (Fig. 7E, F). The abdomen bears 8 spiracles, the last is oval and much larger than all others (Fig. 7C, H).

Distribution

Apparently endemic to Southeast Asia and to Ethiopian region, *L. africanus* is a pan-tropical species trending to have a cosmopolitan distribution (Halperin and Geis 1999; Liu and Geis 2019). Currently recorded from Africa, including Algeria, Burundi, Congo, Egypt, Ethiopia, Madagascar, Morocco, Nigeria, Rwanda, Sudan, Uganda, and Sokotra; North America, specifically the United States and Canada; Australia and Oceania, with records from Northern Australia and Papua New Guinea; and Asia, where it has been found in Israel, Palestine, the Philippines, Syria, Turkey, Pakistan, India, Iran, Nepal, Thailand, Malaysia, Japan, Jordan, Oman, Saudi Arabia, and China (Spencer 1965; Iwata 1982; Ho 1995; Halperin and Geis 1999; Hagstrum and Subramanyam 2009; Furukawa 2010; Liu 2010b; Beaver et al. 2011; Geis 2015; Liu and Beaver 2018; Bader and Al-Jboory 2023; Zhang et al. 2024).

In Europe the species was recorded from Switzerland, Portugal, Czech Republic, Belgium, England, France, Germany, Poland, Spain, (Hagstrum and Subramanyam 2009; Beaver et al. 2011; Baena and Zuzarte 2013; Chittaro and Sanchez 2019; Konvička 2023).

Regarding Italy, *L. africanus* was found by Gambetta and Orlandi (1982) on wood of limba (*Terminalia superba*) (Combretaceae), tola (*Prioria balsamifera*) (Fabaceae) e fromager (*Ceiba samauma*) (Malvaceae) during inspections of imported timber yard.

Biology and host plants species

Lyctus africanus is a polyphagous species; its host range includes *T. scleroxylon* (obeche) and *Eriodendron anfractuosum* (Malvaceae); *Pycnanthus angolensis* (ilomba) (Myristicaceae); *Canarium schweinfurthii* (aiélé) and *Aucoumea klaineana* (okoumé) (Burseraceae); meranti (*Shorea* spp.) (Dipterocarpaceae); *Faidherbia albida*, *Havardia albicans*, *Vachellia nilotica*, *Glycyrrhiza lepidota*, *G. glabra*, *Delonix regia* and *Albizzia* spp. (Fabaceae); *Moringa peregrina* (Moringaceae); *Prunus armeniaca* (Rosaceae); *Bambusa* spp. (Poaceae); *Eucalyptus gomphocephala* (Myrtaceae); *Grevillea robusta* (Proteaceae); *Morus alba* (Moraceae) (Spencer 1965; Iwata 1982; Halperin and Geis 1999; Liu and Beaver 2018; Liu and Geis 2019; Bader and Al-Jboory 2023).

Moreover, this pest has been also reported as a pest of stored commodities as oilseed of cotton and peanut and root product of licorice and dried potatoes (Hagstrum and Subramanyam 2009).

This study presents the first documented occurrence and development of the non-native powderpost beetle, *L. africanus*, in timber used in Italy, suggesting that, after its fortuitous discovery in imported timber (Gambetta and Orlandi 1982), the species has become established and spread, and can cause significant damage to wood products. Given that early detection and prompt reporting are critical for the effective management of invasive species, we also provide detailed illustrations and diagnostic tools to aid in accurate species identification. Wood-boring beetles are among the most significant pests, causing substantial economic damage worldwide (Brockerhoff et al. 2006a). These insects are easily transported in nearly all types of wood material,

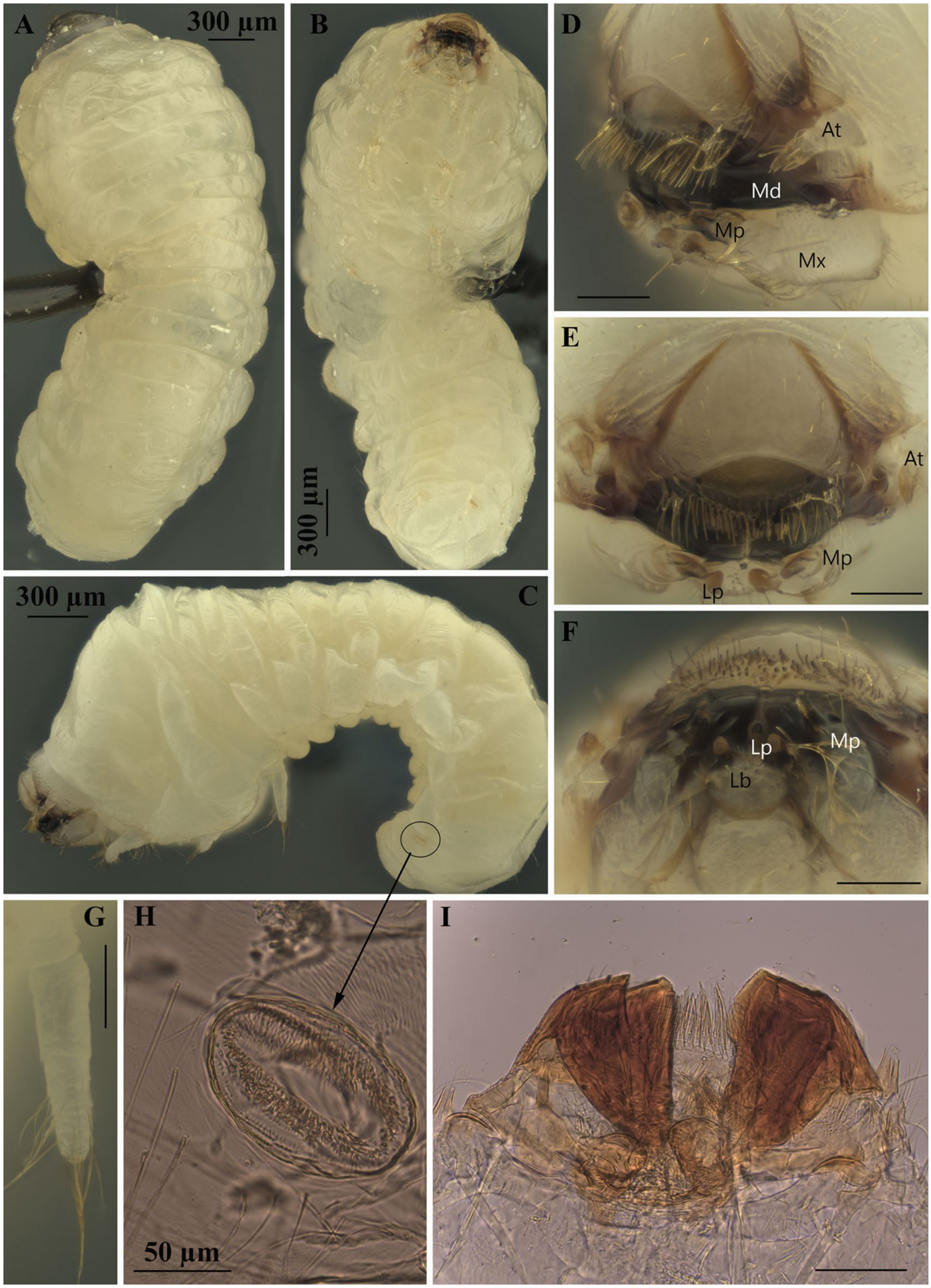

Fig. 7 Mature larva of *Lyctus africanus* (see abbreviation in Material and Methods): (**A**-**C**) dorsal, ventral and lateral view, mounted on a black a support where the larva was glued (the black circle indicates last spiracle); (**D**-**F**) larval biting mouthparts in dorso-lateral, front-dorsal and ventral view; (**G**) metathoracic leg; (**H**) the last abdominal spiracle; (**I**) mandibles. Scale bar: 100 µm, unless labeled otherwise

allowing them to evade detection effortlessly (Brockerhoff et al. 2006b). They are recognized as a highly successful invasive group (Haack 2006; McCullough et al. 2006). In Mediterranean regions, characterizedby the suitable climate and the high diversity of woody plants and ecological conditions have favored the establishment of several coleopteran alien species during the last decades (Work et al. 2005; Kirkendall and Faccoli 2010; Rassati et al. 2016). In the case of *L. africanus* it is likely that the presence of the species is nowadays underestimated also in consideration that it can be confused with the congeneric similar species *L. brunneus*.

Among these species, alien true powder post beetles began to raise concerns with the increase in global trade following the Second World War, leading to an increasingly alarming situation where Lyctine beetles are now frequently sent for identification (Pospischil 2017). *Lyctus africanus* is recognized as an economically important *Lyctus* species due to the considerable damage caused to wood artifacts and the recent explosions of infestations in some areas, as documented for example in Japan (Furukawa 2010). Infestations of *L. africanus* have been recorded in other regions of the Mediterranean basin, such as Israel and Jordan (Bader and Al-Jboory 2023). In these regions, *L. africanus* was responsible for approximately 95% of all infestations reported on plywood furniture, door frames, and picture frames (Halperin and Geis 1999). The case study that we report about this infestation indicates the presence of *L. africanus* in Italy and suggests that its occurrence may be underestimated. However, quantitative data on damage severity will require further investigation.

The limiting factors for *Lyctus* beetles attack are the pore size and starch richness of the wood; the female lay their eggs beneath the surface of the wood, inserting their ovipositor into the pores. Therefore, if the structure of a wood species is such that the pores are too small to accommodate the ovipositor or contains insufficient starch, that species will be immune to attack; susceptible wood species are therefore coarse-grained woods with larger pores than fine-grained woods. Hardwoods vulnerable to *Lyctus* attack can be protected by sealing their pores with paint, varnish, or other treatments. This aligns with preventative methods like excluding sapwood that is rich in starch or pre-treating the wood with preservatives (Howick 1999).

Control measures

Effective management of *L. africanus* infestations requires a combination of preventive measures, chemical treatments, and monitoring strategies. The use of kiln-dried wood with low starch content is a key preventive measure, as this reduces the susceptibility of wood to infestation by this pest, which primarily targets starch-rich sapwood (Hedjazi and Soleymani 1967). Chemical treatments, such as fumigation with sulfuryl fluoride, have proven effective in eliminating the different *Lyctus* stages infesting wooden structures (Williams and Sprenkel 1990). The use of gamma irradiation also showed promising results (Zahran et al. 2016). Additionally, monitoring techniques, including the deployment of pheromone traps, are essential for early detection of adult beetles and provide a proactive approach to managing populations before significant damage occurs (Kartika et al. 2015). Integrating these strategies can minimize the risk of infestation and effectively manage existing populations, thereby reducing the economic impact of this destructive pest.

Conclusion

Rapid detection and accurate identification of *Lyctus* species are effective tools for helping to eradicate them in new introduction sites (Ide et al. 2016). The photographic materials permit an accurate identification of *L. africanus* and and its earlier detection. This aspect is the critical first step to develop appropriate and sustainable control measures for such pests (Trematerra and Pinninger 2018; Adler et al. 2022; Peri et al. 2024). This should be followed by a comprehensive set of strategies and protocols designed to prevent or mitigate factors that promote such insect infestations toward wooden furniture. Our study documented the naturalization of *L. africanus* in Italy and highlighted the potential risks it poses, including the possibility competing with *L. brunneus*, which, after its introduction in Europe, had already replaced the native *L. linearis* (Liu and Geis 2019). However, research on competitive interactions between these species in natural conditions is needed to assess whether such a shift is taking place. Future research should focus on the development of integrated pest management strategies for *L. africanus*, including the identification and evaluation of potential biological control agents as recently observed in other libraries (Belokobylskij et al. 2024). This approach could provide a sustainable and environmentally friendly solution for mitigating infestations, preserving wooden artifacts, and minimizing the ecological impact of this species.

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Declarations

Data availability Data are available on request by the authors.

Competing interests Authors declare no conflict of interest. Dr Salvatore Guarino is a managing Editor for this journal.

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