

REVIEW OF THE TRIBE XYLEBORINI IN AMERICA NORTH OF MEXICO (COLEOPTERA: SCOLYTIDAE)

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Abstract

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This review of the tribe Xyleborini (Coleoptera: Scolytidae) includes two genera, *Xyleborus* Eichhoff, with 17 species, and *Xylosandrus* Reitter, containing 3 species. All species are described and most are illustrated. Keys for the separation of the genera and species are provided. Distributional and biological data are given. New combinations are: *Xyleborus obliquus* (Leconte) (= *Pityophthorus obliquus* Leconte); *X. lecontei* (Hopkins) (= *Ambrosiodmus lecontei* Hopkins), and *X. sayi* (Hopkins) (= *Anisandrus sayi* Hopkins). New synonymies are: *Xyleborus obliquus* (Leconte) (= *Ambrosiodmus linderæ* Hopkins); *X. obesus* Leconte (= *Anisandrus populi* Swaine); *X. ferrugineus* (Fabricius) (= *X. retusicollis* Zimmerman and *X. soltau* Hopkins); *X. xylographus* (Say) (= *X. inermis* Eichhoff and *X. planicollis* Zimmerman); *X. volvulus* (Fabricius) (= *X. schwarzi* Hopkins and *X. rileyi* Hopkins), and *X. howardi* Hopkins (= *X. fitchi* Hopkins). A Japanese species, *X. rubricollis* Eichhoff, is reported from the United States for the first time. A neotype is designated for *X. xylographus* (Say).

INTRODUCTION

The present study was prompted by an awareness of the lack of information concerning the systematics of the tribe Xyleborini in America north of Mexico. There is no critical review of this tribe available and the only keys to the North American species are now out of date. Swaine (1918), Blackman (1922), Dodge (1938), and Beal and Massey (1945) treated the species occurring in limited areas of North America, while Hopkins (1915), Blatchley and Leng (1916), and Chamberlin (1939) treated the entire North American fauna. Since these publications, numerous name changes have taken place. It is the purpose of this work to review the knowledge concerning this tribe in North America, to present keys, descriptions, and illustrations, and to provide additional host and distributional data.

The tribe Xyleborini includes nearly 1,500 names on a world-wide basis. Species are found in all forested areas, especially in the tropics. Browne (1961a) claims that the group dominates the Malayan scolytid fauna, containing nearly 46% of all known Malayan species. The same is probably true for other tropical areas of the world. However, only 20 species are known from North America, comprising less than 5.0% of the known scolytid fauna.

The classification of the tribe, as presented here, leaves much to be desired. Because of its size and diversity, no real improvement can be expected until a world revision is possible. At present, it seems rash to split the main genus (*Xyleborus* Eichhoff) except for the separation of a few very distinctive groups. I believe that *Xyleborus* is an assemblage of numerous species-groups and realize that some may later have to be regarded as distinct genera. I consider the tribe Xyleborini in North America to contain two genera: *Xylosandrus* Reitter (3 species) and *Xyleborus* (17 species). *Ambrosiodmus* Hopkins, *Anisandrus* Hopkins, *Prennobi* Eichhoff, and *Xyleborinus* Reitter are considered synonyms of *Xyleborus*.

HISTORY

The tribe Xyleborini was first recognized as a distinct group of Scolytidae by Eichhoff (1874), who applied the name Xyleboridae. Reitter (1913) coined the

tribal name Xyleborini and most recent authors have followed this concept. Other tribal and subfamily names applied to this group of genera have been: Xyleborinae (Hagedorn 1909), Cryphalinae (Hopkins 1915), Cryphalini (Blatchley and Leng 1916), and Xyleborina (Balachowsky 1949).

The genus *Xyleborus*, as used by all authors, was described by Eichhoff (1864) and included *Bostrichus dispar* Fabricius, *B. monographus* Fabricius, *B. dryographus* Erickson, *B. saxeseni* Ratzeburg, and *B. pfeilei* Ratzeburg. Two years later, Lacordaire (1866) designated *B. monographus* as the type of the genus. The name *Xyleborus*, however, was used earlier by Bowdich (1825) for a single species, *citri*, a "worm" found boring in the wood of an orange tree on the Madeiran Islands. He placed it "... in the second family of the third order of Cuvier's class, annelides. . . ." No specimens of Bowdich's species are in existence and the name cannot be accurately placed in any family. Since Bowdich's name refers to an unrecognizable form, an appeal was made by Thompson (1965) to the International Commission of Zoological Nomenclature to suppress *Xyleborus* Bowdich in favor of *Xyleborus* Eichhoff. This appeal is still pending.¹

Since Eichhoff's description, nearly 1,500 species have been described or placed in *Xyleborus* and the genus has been split into numerous genera. Schedl (1957), after his study of the African fauna, considered all the various genera in the Xyleborini as synonyms of *Xyleborus* except *Eccoptopterus* Motschulsky. He then broke *Xyleborus* into 26 species-groups. Wood (1961), realizing the distinctness of the groups in this tribe in North America, tentatively recognized six North American genera.

The other genus recognized here, *Xylosandrus*, was established by Reitter (1913) with *Xyleborus morigerus* Blandford as the type. This name is one of those listed by Schedl (1962) as a synonym of *Xyleborus*. However, Browne (1963) pointed out several differences which indicated that *Xylosandrus* should be regarded as a distinct genus, and he transferred 16 species of *Xyleborus* into it. Schedl (1964a) agreed with this opinion, adding 8 more species of *Xyleborus* to *Xylosandrus*. The present arrangement includes 3 species from North America.

The remaining North American genera of Xyleborini, as given by Wood (1961), are *Prennobi*, *Ambrosiodmus*, *Anisandrus*, and *Xyleborinus*. Of these, *Prennobi*, *Anisandrus*, and *Xyleborinus* were placed in synonymy by Schedl (1957). To my knowledge, *Ambrosiodmus*, treated here as a synonym, has never been formally synonymized under *Xyleborus*.

Prennobi has been the subject of considerable controversy. Browne (1961a) gave a review of its past history. After a study of a number of species, he came to the conclusion that it was a distinct genus, not at all related to *Xyleborus*, and erected a new tribe to contain it. Wood (1961) listed it as a genus of the Xyleborini. Schedl (1964b), after studying numerous species, rejected Browne's concept and referred back to his previous belief that *Prennobi* was a well-marked species-group of *Xyleborus*. I have followed Schedl's concept in this study.

METHODS

Several thousand specimens were examined during this study, but no effort was made to obtain all of the specimens deposited in various museums. The

¹While this paper was in press, the International Commission on Zoological Nomenclature made its decision concerning this case (Bull. zool. Nom. 25(1): 18-19). *Xyleborus* Bowdich was placed on The Official Index of Rejected and Invalid Generic Names in Zoology and *Xyleborus* Eichhoff was placed on The Official List of Generic Names in Zoology.

types of the species described by Leconte, Hopkins, Swaine, Zimmerman, and Drake were examined. My concepts of the species described by Eichhoff, Reitter, Fabricius, and Ratzeburg are based on either cotypic material or authentic specimens in the Eggers collection at the United States National Museum.

Since this paper is intended as a review, literature citations are kept to a minimum. References to the original description, subsequent nomenclatural changes, catalogues, and other works with extensive bibliographies are given. Thus, a reader should be able to follow the history of any species by consulting these other works.

Names listed in synonymy with reference citations refer only to species described or recorded from North America. Names in synonymy based on specimens from areas other than North America are placed in a paragraph following the North American list.

Distribution maps have been prepared for all species except *X. cavipennis* Eichhoff and *X. rubricollis* Eichhoff. Seven species are so common that instead of listing all the localities of specimens examined, I have only listed the states or provinces where the specimens originated. The species should be found in those areas wherever their host trees occur. The exact localities are plotted on the distribution maps. In the list of localities under Distribution, quotation marks indicate localities that could not be located in any source. In the following list, the abbreviations in parentheses are used in the text to indicate the locations of the type specimens: British Museum (Natural History), London (BM); Canadian National Collection, Ottawa (CNC); Karl E. Schedl, Lienz, Austria (KES); Institut Royal des Sciences Naturelles de Belgique, Bruxelles (IRSNB); Museum of Comparative Zoology, Cambridge, Mass. (MCZ); United States National Museum, Washington, D.C. (USNM); and Zoological Museum of the University, Kiel, Germany (ZMK).

BIOLOGY

All of the species in the Xyleborini are ambrosia beetles. The adults bore into the woody tissues of the host plant and feed largely on the ambrosial fungus that lines the walls of their tunnels. They breed in all sizes of host material, except roots, of both coniferous and deciduous trees and shrubs. Most species feed and reproduce in a wide variety of unrelated host species.

The entrance tunnel is constructed by the female. It penetrates the bark and extends into the sapwood for varying distances, up to approximately 2 in. The tunnel may end in an enlarged chamber, as in *Xyleborus saxeseni* Ratzeburg, or it may branch several times, as in most of the other *Xyleborus* species. Eggs are laid free along the gallery wall and the larvae wander about, feeding on the ambrosial fungus. They do not occupy cradles, as do the species in the tribes Xyloterini or Corthylini. Mature larvae construct their pupal cells along the sides of the gallery. The young adults may remain in the gallery system for a time feeding on the fungus, and successive generations may be produced in the same host plant as long as the moisture content remains favorable for growth of their food. The parental entrance hole is used for the emergence of the new generation. If mating occurs, it must take place before the young female beetles leave the gallery system since the male is unable to fly and dies within the parental nest. Winter is passed in the brood galleries or in specially constructed chambers in the wood.

The species of the Xyleborini show a social organization of extreme polygamy. The ratio of females to males may reach as high as 30-1, as in *Xyleborus saxeseni* (Schedl 1962).

Usually only unhealthy or newly felled trees or shrubs are attacked. Some species, however, are capable of attacking apparently healthy material, especially if the host has suffered some slight setback such as transplanting or drought. The amount of economic damage in North America is very low, except for serious losses of ornamental shrubs in southern Florida caused by *Xylosandrus compactus* (Eichhoff) and occasional losses to avocado trees caused by *Xyleborus saxeseni*. In the tropical areas of the world, the economic loss sometimes is tremendous. Heavily attacked trees are worthless as lumber, and in many cases, the beetles transmit plant diseases.

VARIATION

Sexual differences are very well developed in both genera. In most species, the male is much smaller than the female; the male always lacks functional wings. In addition, the median anterior margin of the pronotum is evenly rounded in the females; in the males it may be acuminate or modified in various ways. The anterior slope of the pronotum is evenly convex and is armed with prominent asperities in the females; it may be concave or flattened with very weakly developed asperities in the male. The elytra are elongate with parallel sides in the female; they may be strongly convex with arcuate sides in the males. The declivital armature is well developed in the female; it is weakly developed or obsolete in the male.

Variations between individuals of the same species and sex occur in size and general body sculpture. The maximum size variation occurs in *Xyleborus ferrugineus* (Fabricius) and is from 2.1-3.0 mm; while the minimum variation, a difference of 0.2 mm, occurs in several species.

Considerable variation in sculpture was observed in all North American species but was particularly noted in *Xyleborus ferrugineus*, *X. xylographus* (Say), *X. pini* (Eichhoff), and *X. volvulus* (Fabricius). The degree of development of the declivital armature, the depth and spacing of the stria punctures, and the punctuation of the posterior portion of the pronotum were the most variable characters observed.

Variations strictly correlated with geographical distribution were not detected, but it probably occurs, especially in the widespread species.

TAXONOMY

Members of the tribe Xyleborini may be recognized by the following combination of characters: antennal funicle five-segmented, club obliquely truncate or strongly flattened dorsoventrally. Pronotum asperate, anterior portion convex in female, flattened or concave in male; sometimes punctured in posterior third; anterior margin sometimes modified. Metepisternum visible to its posterior extremity. Declivity convex or concave, variously ornamented with tubercles or spines, these sometimes obsolete in male. Meso- and meta-thoracic tibiae broadly dilated to slightly beyond middle, then gradually narrowed to apex.

TRIBE XYLEBORINI

Tomicides Lacordaire, 1866, p. 372 (in part).

Tomicini Leconte, 1868, p. 151 (in part).

Bostrychi Zimmerman, 1868, p. 142 (in part).

- Xylebori Leconte and Horn, 1876, p. 358 (in part); Blandford, 1895, p. 191 (in part).
 Xyleboridae Eichhoff, 1879, p. 308.
 Ipxini Bedel, 1888, p. 413, 419 (in part).
 Trypodendrinae Tredl, 1907, p. 18 (in part).
 Xyleborinae Hagedorn, 1909, p. 162; Hagedorn, 1910a, p. 97 (in part); Hagedorn, 1910b, p. 149 (in part).
 Xyleborini Reitter, 1913, p. 79 (in part); Stark, 1952, p. 424; Schedl, 1962, p. 90; Wood, 1961, p. 46.
 Cryphalinae Hopkins, 1915, p. 224 (in part).
 Cryphalini Blatchley & Leng, 1916, p. 592 (in part).
 Xyleborina Balachowsky, 1949, p. 157; Nunberg, 1954, p. 57; Pfeffer, 1955, p. 189.

In the present classification of the Scolytidae, the Xyleborini are closely related to the *Poecilips*-*Ozopemon* group of the Dryocoetini.

KEY TO THE GENERA OF NORTH AMERICAN XYLEBORINI

- Anterior coxae widely separated (Fig. 1); body of females stout, less than 2.4 times longer than wide; elytra of females no more than 1.3 times longer than pronotum *Xylosandrus* Reitter
 Anterior coxae very narrowly separated or contiguous (Fig. 2); body of female more elongate, usually more than 2.3 times longer than wide; elytra of females more than 1.3 times longer than pronotum *Xyleborus* Eichhoff

GENUS *Xylosandrus* Reitter

Xylosandrus Reitter, 1913, p. 83; Wood, 1961, p. 47; Browne, 1963, p. 54; Schedl, 1964a, p. 213.

Type-species: *Xyleborus morigerus* Blandford, by monotypy.

The genus *Xylosandrus* is composed of species having the following characters:

FEMALES. Body very stout, cylindrical. Frons convex, punctures shallow, fine; longitudinal carina faint. Antennal club obliquely truncate, densely pubescent on oblique portion. Pronotum wider than long; basal and lateral margins with a fine raised line; anterior margin with a row of asperities; anterior slope with erect, closely placed asperities, these arranged in vague concentric rows; posterior portion smooth, sometimes punctate. Scutellum flat. Elytra less than 1.3 times longer than pronotum; striae punctured in regular rows, punctures fine; interspaces smooth, very finely punctured, setose; declivity convex, unarmed, ridge of seventh interspace distinct. Anterior coxae widely separated.

MALES. Much smaller than females; body strongly convex. Pronotum as long as wide, sometimes flattened or concave in anterior portion. Elytra strongly convex, narrowly rounded behind; striae and interstriae punctures distinct on disc, irregularly placed on sides; ridge of seventh interspace variably developed on declivity.

KEY TO THE NORTH AMERICAN SPECIES OF *Xylosandrus*

1. Body stout, cylindrical Females 2
 Body strongly convex Males 4

Females

2. Length 2.2–2.4 mm; interstriae setae on declivity about 1.5 times longer than width of interspace; anterior margin of pronotum with 8 to 10 asperities; eastern United States, north of Virginia 1. *germanus* (Blandford)
 Length 1.4–1.8 mm; interstriae setae on declivity more than 1.5 times longer than width of interspace; anterior margin of pronotum usually with less than eight asperities; Florida 3

3. Posterior discal portion of pronotum smooth, sometimes with very faint, scattered punctures; elytral declivity abrupt, steep; striae with very short, inconspicuous setae; anterior margin of pronotum with two to four asperities 2. *zimmermanni* (Hopkins)
- Posterior discal portion of pronotum distinctly punctured; elytral declivity gradual, sloping; striae with conspicuous setae, longer on declivity; anterior margin of pronotum with 6 to 8 (sometimes 10) asperities 3. *compactus* (Eichhoff)

Males

4. Length more than 1.4 mm; ridge of seventh declivital interspace acute 1. *germanus* (Blandford)
- Length less than 1.3 mm; ridge of seventh declivital interspace rounded 5
5. Anterior margin of pronotum slightly, but distinctly, produced in median portion, bearing two to four asperities; anterior slope of pronotum broadly convex 2. *zimmermanni* (Hopkins)
- Anterior margin of pronotum narrowly rounded in median portion, not produced, devoid of asperities; anterior slope of pronotum flattened, slightly concave in median portion 3. *compactus* (Eichhoff)

1. *Xylosandrus germanus* (Blandford)

(Map 1)

Xyleborus germanus Blandford, 1894, p. 106 (holotype ♀, Japan, BM); Felt, 1932, p. 418; Chamberlin, 1939, p. 456.

Xylosandrus germanus: Hoffmann, 1941, p. 38 (biology and additional references); Browne, 1963, p. 55.

FEMALES. Length 2.2–2.4 mm, 2.3 times longer than wide. Frons minutely reticulate, punctures widely separated, very faint. Antennal club 1.3 times longer than wide. Pronotum subcircular; anterior margin with 8 to 10 low, blunt asperities; posterior portion smooth, punctures very faint. Elytra 1.3 times longer than wide; striae punctures about twice as large as the more widely spaced interstriae punctures; interstriae setae absent or extremely minute; striae setae absent. Declivity with suture slightly elevated; interstriae setae about 1.5 times longer than interspaces; striae setae absent.

MALES. Length 1.5–1.7 mm, 2.0 times longer than wide. Frons shining, punctures very faint, widely scattered; longitudinal line faintly elevated. Pronotum broadly rounded in front, sides evenly arcuate; anterior margin smooth; anterior slope broadly convex; asperities rather numerous, not sharply elevated. Elytral striae and interstriae punctured in regular rows on disc, punctures large on discs, smaller and irregular on sides; ridge of seventh interspace acute, extending to near elytral apex. Otherwise resembles female.

HOSTS. Recorded from a large variety of woody plants. Specimens examined from: *Acer*, *Carya*, *Fagus*, *Pinus*, *Prunus*, *Quercus*, *Toxicodendron*, *Tsuga*, *Ulmus*, and *Vitis*.

DISTRIBUTION. New England States, west to Indiana and south to West Virginia (Map 1), also in Japan and Germany. Over 50 specimens examined from: **Connecticut:** Prospect and Yalesville. **Indiana:** Jefferson Co. **New Jersey:** Bloomfield, East Orange, and West Caldwell. **New York:** Oyster Bay. **Ohio:** Burlingame and Chillicothe.

Hoffmann (1941) gives **New Jersey:** Bergen Co., Essex Co., Middlesex Co., Morris Co., and Union Co. **New York:** Nassau Co., Rockland Co., and Westchester Co. **Ohio:** Lawrence Co. **West Virginia:** Cabell Co.

REMARKS. Females of this species are easily distinguished from the other North American representatives of the genus by their larger size, by the more numerous and broader asperities on the anterior margin of the pronotum, and by the absence of any striae setae (sometimes minute setae can be detected under high magnification).

Xylosandrus germanus is an introduced species and was first reported from the United States in 1932. See Hoffmann (1941) for a discussion of its biology.

2. *Xylosandrus zimmermanni* (Hopkins)

(Map 1, Fig. 5)

Anisandrus zimmermanni Hopkins, 1915, p. 68 (holotype ♀, Florida, USNM); Blatchley and Leng, 1916, p. 624; Chamberlin, 1939, p. 445.

Xylosandrus zimmermanni: Wood, 1962, p. 79.

Xyleborus biseriatus Schedl, from Brazil, is listed as a synonym by Wood (1966).

FEMALES. Length 1.4–1.6 mm, 2.0 times longer than wide. Frons minutely granulate, punctures widely separated, very faint. Antennal club 1.1 times longer than wide. Pronotum subcircular; anterior margin with two to four asperities; posterior portion smooth, shining, sometimes with a very few, faint punctures. Elytra as long as wide; striae punctures about twice as large as the widely spaced interstriae punctures; interstriae setae about as long as diameter of puncture. Declivity with suture slightly elevated; interstriae setae more than 1.5 times longer than interspaces; striae setae as on disc.

MALES. Length 1.2 mm, 2.0 times longer than wide. Frons slightly concave in center, surface shining, punctures sparse, faint; longitudinal line not evident. Pronotum subquadrate; anterior margin slightly, but distinctly produced in median portion, bearing two to four asperities; anterior slope broadly convex; asperities scattered, erect, sharply pointed. Elytral striae and interspaces punctured in regular rows on disc, punctures smaller and irregular on sides; ridge of seventh interspace poorly developed. Otherwise resembles female.

HOSTS. Wood (1962) gives *Ardisia* sp. and *Ocotea catesbiana*. One specimen in the USNM bears a handwritten note by W. H. Anderson which states that the type-series evidently came from *Chrysobalanus*.

DISTRIBUTION. Southern Florida (Map 1). Three specimens were examined from: **Florida**: Biscayne Bay (Coconut Grove?). Wood (1962) adds **Florida**: Sebring.

REMARKS. Females of *Xylosandrus zimmermanni* may be distinguished by their smaller size, by the smooth and shining posterior portion of the pronotum, by the very short striae setae, and by the less numerous asperities on the anterior margin of the pronotum.

3. *Xylosandrus compactus* (Eichhoff)

(Map 1)

Xyleborus compactus Eichhoff, 1874, p. 202 (holotype ♀, Japan, BM); Murrayama and Kalshoven, 1962, p. 247.

Xylosandrus compactus: Nunberg, 1959, p. 434.

Xyleborus morstatti Hagedorn, 1912, p. 37 (type ♀, Africa, KES); Murrayama and Kalshoven, 1962, p. 247 (= *compactus*); Schedl, 1962, p. 137 (biology and additional references).

Xylosandrus morstatti: Browne, 1963, p. 54.



MAP 1. Distribution of *Xylosandrus germanus* (closed circles), *X. compactus* (open circles) and *X. zimmermanni* (half closed circles).

FEMALES. Length 1.6–1.8 mm, 1.5 times longer than wide. Frons minutely reticulate, punctures widely scattered, very fine; epistoma finely granulate, granules small, more abundant near margin. Antennal club 1.2 times longer than wide. Pronotum subcircular; anterior margin with 6 to 8 (sometimes 10) asperities; posterior portion smooth, punctures shallow but distinct. Elytra 1.1 times longer than wide; stria punctures equal in size to interstrial punctures, distinctly impressed; interstrial setae 2.0 times longer than width of interspace; stria setae 0.5 times as long as interstrial setae. Declivity with suture slightly elevated; interstrial setae more than 1.5 times longer than interspaces; stria setae conspicuous.

MALES. Length 1.1 mm, 2.0 times longer than wide. Frons shining, punctures very faint; longitudinal line not evident. Pronotum narrowly rounded in front, sides evenly arcuate; anterior margin unmodified; anterior slope flattened, slightly concave in median portion; asperities low, obsolete. Elytral striae and interstriae irregularly punctured on disc and sides; ridge of seventh interspace rounded. Otherwise resembling female.

HOSTS. Recorded from a wide range of woody plants. Specimens examined from: *Acer*, *Cinnamomum*, *Jacobina*, *Persea*, *Rhizophora*, and the Orchidaceae.

DISTRIBUTION. Florida (Map 1), also widespread in the Oriental and Ethiopian regions. More than 200 specimens were seen from: **Florida:** Coconut Grove, Daytona Beach, Fort Lauderdale, Fort Meyers, Jacksonville, (Key) Largo, Miami, Palm Beach Co., Pinellas Co., and Winter Haven.

REMARKS. Females of this species are easily recognized by the long stria setae and by the distinct punctures on the smooth posterior portion of the pronotum.

Xylosandrus compactus is a tropical or subtropical species that has become quite common in the southern part of Florida. It was first reported in Florida by

McClanahan (1951), who reported that it was causing serious injury to avocados. It is rapidly becoming a major pest in a variety of ornamental shrubs.

A detailed biology of this species is given by Schedl (1962) under the name *X. morstatti*.

Genus *Xyleborus* Eichhoff

Xyleborus Eichhoff, 1864, p. 37; Lacordaire, 1866, p. 373, 380 (type-species designation); Schedl, 1962, p. 102 (additional references).

Anisandrus Ferrari 1867, p. 24; Eichhoff, 1879, p. 321 (= *Xyleborus*).

Premnobius Eichhoff, 1879, p. 404; Hagedorn, 1910a, p. 64; Schedl, 1957, p. 84 (= *Xyleborus*);

Browne, 1961b, p. 45 (a distinct genus); Wood, 1961, p. 47 (a distinct genus); Schedl, 1964b, p. 50 (= *Xyleborus*).

Xyleborinus Reitter, 1913, p. 83; Schedl, 1957, p. 84 (= *Xyleborus*).

Ambrosiodmus Hopkins, 1915, p. 55. NEW SYNONYMY.

Type-species: Of *Xyleborus*, *Bostrichus monographus* Eichhoff, by Lacordaire (1866); of *Anisandrus*, *Xyleborus dispar* Fabricius, monotypic; of *Premnobius*, *Premnobius cavipennis* Eichhoff, monotypic; of *Xyleborinus*, *Bostrichus saxeseni* Ratzeburg, by Chamberlin (1939); of *Ambrosiodmus*, *Xyleborus tachygraphus* Zimmerman, original designation.

In addition to the generic names above, Schedl (1962) gives the following names as synonyms: *Anaeretus* Duges, *Boroxylon* Hopkins, *Coptoborus* Hopkins, *Cryptoxyleborus* Schedl, *Cyclorhipidion* Hagedorn, *Dryocoetoides* Hopkins, *Euwallacea* Hopkins, *Heteroborips* Reitter, *Phloeotrogus* Motschulsky, *Progenius* Blandford, *Streptocranus* Schedl, *Terminalinus* Hopkins, *Theoborus* Hopkins, *Xyleborips* Reitter, and *Xyloborus* Bedel.

The genus *Xyleborus* is characterized by the following characters:

FEMALES. Body stout to elongate, cylindrical. Frons convex, variously punctured and carinate. Antennal club flattened dorsoventrally or obliquely truncate, margin of basal corceous area procurved or recurved, distal portion pubescent. Pronotum variable in shape; basal and lateral margins rounded or with a fine raised line; anterior margin with or without asperities; anterior slope asperate, asperities numerous, of moderate size; posterior portion smooth, asperate, or punctate. Scutellum conical or flat. Elytra more than 1.3 times longer than pronotum; striae usually punctured in regular rows, punctures variable in size and depth; interspaces smooth, variously punctured. Declivity variable, usually with teeth or spines; ridge of seventh interspace indistinct. Anterior coxae very narrowly separated or contiguous.

MALES. Usually much smaller than females. Body convex to elongate, cylindrical. Pronotum variable in shape, sometimes modified in anterior portion; asperities absent or obsolete. Elytral shape variable; striae and interstriae variously punctured. Declivital shape variable, usually with teeth or spines.

KEY TO THE NORTH AMERICAN SPECIES OF *Xyleborus*

1. Pronotum evenly convex, not modified anteriorly, asperities erect, prominent; body elongate or stout, not strongly convex Females 2
- Pronotum flattened dorsoventrally and quadrate or convex and elongate, if convex then anterior slope flattened or slightly concave or anterior margin acuminate, asperities indistinct or absent; body strongly convex or elongate, if elongate then anterior slope or margin of pronotum modified Males 18

Females

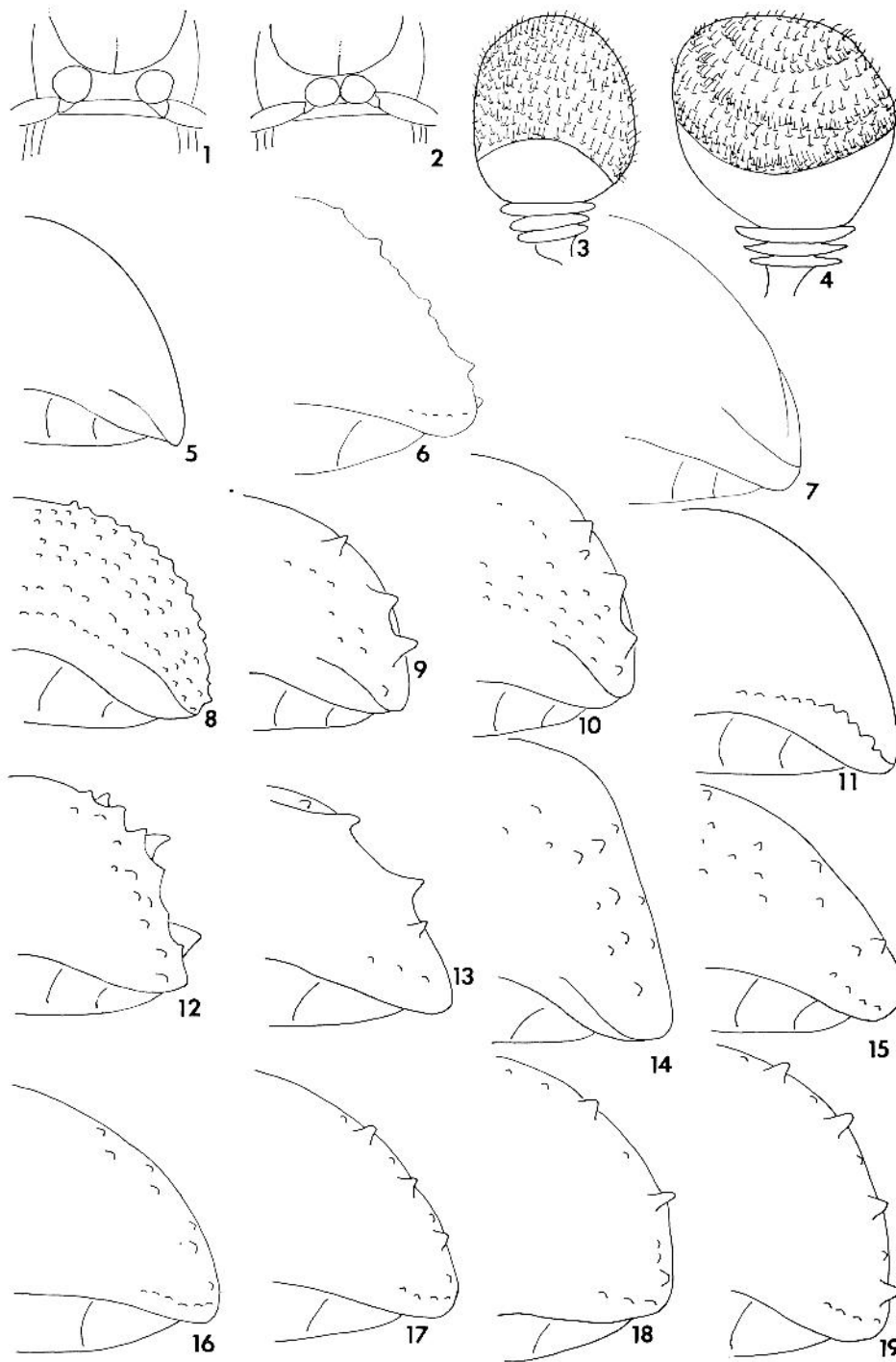
2. Antennal club strongly flattened dorsoventrally, basal corneous area small, its distal margin procurved (Fig. 3); elytra obliquely truncate behind (Fig. 6); declivity broadly, concavely excavated, acutely margined on a complete circle at periphery; southern Florida 4. *cavipennis* (Eichhoff)
- Antennal club obliquely truncate, not strongly flattened, basal corneous area larger, its distal margin recurved (Fig. 4); elytra variously rounded behind; declivity convex, concave, or flattened, not margined on upper half 3
3. Pronotum wider than long, rather coarsely asperate in front; body stout, less than 2.7 times longer than wide 4
- Pronotum longer than wide, more finely asperate in front; body slender, more than 2.7 times longer than wide 10
4. Pronotum subquadrate, anterior margin unmodified, posterior portion asperate 5
- Pronotum subcircular, anterior margin with asperities, posterior portion smooth 8
5. Declivital interspaces smooth (Fig. 7); length 2.3–2.5 mm ... 5. *obliquus* (Leconte)
- Declivital interspaces with teeth or granules; length usually more than 2.5 mm 6
6. Declivity evenly convex, not sulcate; all declivital interspaces with equal-sized granules (Fig. 8) 6. *rubricollis* Eichhoff
- Declivity sulcate; first interspace feebly granulate, second with two or three prominent teeth, interspaces three to six rather sparsely granulate 7
7. Length 2.7–2.9 mm; stria punctures on declivity distinct; declivital teeth large, longest tooth about as long as width of interspace (Fig. 9); southern Florida 7. *lecontei* (Hopkins)
- Length 3.7–3.9 mm; stria punctures on declivity indistinct; declivital teeth smaller, longest tooth much shorter than width of interspace (Fig. 10); eastern United States south to Georgia 8. *tachygraphus* Zimmerman
8. Ridge of seventh declivital interspace with three to five well-developed teeth (Fig. 11); declivity steep 9. *obesus* Leconte
- Ridge of seventh declivital interspace smooth; declivity sloping 9
9. Length 2.5–2.7 mm; anterior margin of pronotum with three or four erect asperities 10. *sayi* (Hopkins)
- Length 3.2–3.7 mm; anterior margin of pronotum with six to eight erect asperities 11. *dispar* (Fabricius)
10. Scutellum conical; lower margin of declivity, beginning about interspace 7, bearing a series of pointed tubercles, the one at end of interspace 2 the longest 12. *saxeseni* (Ratzeburg)
- Scutellum flat; lower margin of declivity acute or rounded, smooth 11
11. Declivity steep, flattened; first and second striae on declivital face distinct, diverging from suture; two distinct teeth on first striae, two smaller teeth in third interspace; upper margin of declivity bordered by at least one tubercle in all interspaces (Fig. 12) 13. *celsus* Eichhoff
- Declivity convex or sloping, never with teeth on first striae, with tubercles on first and(or) third interspaces 12
12. First declivital interspace with one small tubercle at upper level of declivity; third declivital interspace slightly elevated, with one large tooth in middle and one small tooth at upper level (Fig. 13); declivity slightly sulcate between suture and third interspace 14. *ferrugineus* (Fabricius)
- First and third declivital interspaces with equal-sized teeth; declivity not sulcate 13
13. Declivity opaque, dull 14
- Declivity shining (sometimes opaque in *pini*) 15
14. Declivity steep; tubercles of first and third interspaces very small (Fig. 14); posterior portion of pronotum alutaceous, dull; length 2.5–2.8 mm 15. *xylographus* (Say)

- Declivity broadly sloping; tubercles of first and third interspaces small, but conspicuous (Fig. 15); posterior portion of pronotum smooth, shining; length 2.4–2.7 mm 16. *affinus* Eichhoff
15. Declivity slightly flattened, oblique 16
Declivity strongly convex 17
16. Declivital granules minute (Fig. 16); posterior portion of pronotum with large punctures, surface between punctures appearing minutely scratched or irregularly punctate; eastern United States 17. *pini* Eichhoff
Declivital granules prominent (Fig. 17); posterior portion of pronotum smooth with widely spaced punctures; Florida 18. *volvulus* (Fabricius)
17. Length 2.3–2.5 mm; surface between pronotal punctures appearing minutely scratched; eastern United States 19. *howardi* Hopkins
Length 2.7–2.9 mm; surface between pronotal punctures smooth; western United States 20. *scopulorum* Hopkins

MALES

18. Antennal club strongly compressed dorsoventrally, basal corneous portion small, its distal margin procurved 4. *cavipennis* (Eichhoff)
Antennal club obliquely truncate, not strongly flattened, basal corneous portion larger, its distal margin recurved 19
19. Length 2.0 mm or less; body strongly convex 20
Length usually more than 2.0 mm (except *X. saxeseni*); body elongate 27
20. Pronotum evenly convex, not flattened 6. *rubricollis* Eichhoff
Pronotum flattened, quadrate 21
21. Posterior portion of pronotum rough, punctures large, close, surface opaque 22
Posterior portion of pronotum smooth, punctures fine, surface shining 24
22. Suture and adjoining interspaces slightly impressed on elytral disc, less so on declivity 5. *obliquus* (Leconte)
Suture and adjoining interspaces not impressed on elytral disc, slightly elevated on declivity 23
23. First three declivital interspaces with rather prominent sharp-pointed granules; length 1.5–1.7 mm 7. *lecontei* (Hopkins)
First three declivital interspaces with very small, sometimes blunt, granules; length 1.8–2.0 mm 8. *tachygraphus* Zimmerman
24. Anterior margin of pronotum serrate; elytral striae impressed; interspaces convex 11. *dispar* (Fabricius)
Anterior margin of pronotum smooth; elytral striae not impressed; interspaces flat 25
25. Length 1.3–1.6 mm 10. *sayi* (Hopkins)
Length 1.7–2.0 mm 9. *obesus* Leconte
26. Scutellum flat 27
Scutellum conical 12. *saxeseni* (Ratzeburg)

FIGS. 1–19. 1–5, *Xylosandrus* and *Xyleborus* spp.: 1, *Xylosandrus germanus*, ventral aspect showing widely separated coxae; 2, *Xyleborus ferrugineus*, ventral aspect showing contiguous coxae; 3, *Xyleborus cavipennis*, antennal club; 4, *Xyleborus ferrugineus*, antennal club; 5, *Xylosandrus zimmermanni*, lateral aspect of female declivity. 6–19, *Xyleborus* spp., lateral aspect of female declivity: 6, *cavipennis*; 7, *obliquus*; 8, *rubricollis*; 9, *lecontei*; 10, *tachygraphus*; 11, *obesus*; 12, *celsus*; 13, *ferrugineus*; 14, *xylographus*; 15, *affinus*; 16, *pini*; 17, *volvulus*; 18, *howardi*; 19, *scopulorum*.



27. Anterior portion of pronotum distinctly concave, anterior margin acuminate . 28
 Anterior portion of pronotum convex or flattened, anterior margin rounded . 32
28. Declivity very steep, first striae with two prominent teeth; teeth on interspaces much smaller 13. *celsus* Eichhoff
 Declivity convex or sloping, not steep, first striae never with teeth, with or without tubercles on first and(or) third interspaces 29
29. First declivital interspace smooth, third declivital interspace with a rather large, prominent tubercle in middle 14. *ferrugineus* (Fabricius)
 First and third declivital interspaces with equal-sized tubercles 30
30. Declivity convex, shining 31
 Declivity broadly sloping, opaque 16. *affinis* Eichhoff
31. Tubercles on first and third declivital interspaces prominent; western United States 20. *scopulorum* Hopkins
 Tubercles on first and third declivital interspaces very fine; eastern United States 17. *pini* Eichhoff or 18. *volvulus* (Fabricius)*
32. Pronotum slightly concave from posterior margin to near anterior margin 15. *xylographus* (Say)
 Pronotum not concave, flattened on anterior slope 19. *howardi* Hopkins

4. *Xyleborus cavipennis* (Eichhoff)

(Fig. 6)

Premnobius cavipennis Eichhoff, 1879, p. 404 (cotypes ♀♀, Africa and Colombia, IRSNB); Hagedorn, 1910a, p. 64; Hagedorn, 1910b, p. 98; Browne, 1961b, p. 45; Wood, 1957, p. 402. *Xyleborus cavipennis*: Schedl, 1957, p. 84; Schedl, 1962, p. 537 (additional references).

FEMALES. Length 2.8–3.1 mm, 3.2 times longer than wide. Frons finely punctate, sparsely granulate over surface; longitudinal line faintly evident. Antennal club 1.1 times longer than wide. Pronotum 1.2 times longer than wide; anterior margin rather broadly rounded, unarmed; asperities on anterior slope broad, slightly elevated, extending as far back on disc as on sides; posterior portion smooth, brightly shining, punctures small, widely separated, distinct. Elytra 1.8 times longer than wide; sides parallel on basal three-fourths, truncate behind; striae punctures large, shallow, in regular rows; interspaces smooth, shining, punctures numerous, often in two rows, much smaller than striae punctures. Declivity abrupt, concave, acutely margined on a complete circle, lateral portion with two (sometimes three) distinct teeth, granules sometimes visible along suture; face of declivity punctured.

MALES. Not available. See Browne (1961b) for a description and figure.

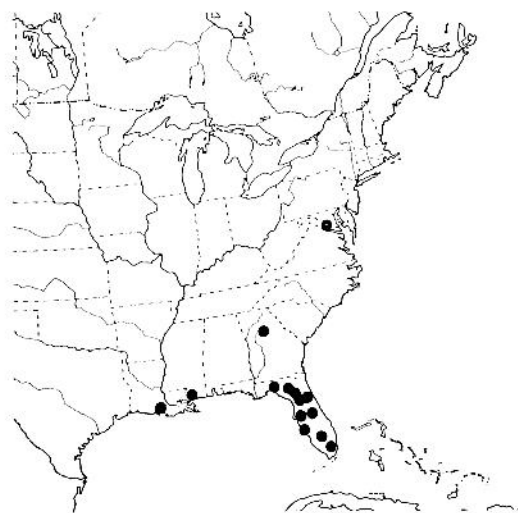
HOSTS. Only recorded from *Rhizophora* in the United States (Wood 1957) but known from numerous hosts throughout the world (Browne 1962; Schedl 1962/63).

DISTRIBUTION. Southern Florida, also throughout the Neotropical and Ethiopian regions. Ten specimens were examined from: **Florida:** Homestead, Miami, Royal Palm State Park, Sanford, and Zolfo Springs.

REMARKS. This species is unlike any other species of *Xyleborus* occurring in North America. The characters of the antennae and declivity, as mentioned in the key and description, will immediately identify it.

Browne (1961b) and Schedl (1962) discuss the biology of this species in Africa and their comments are probably applicable to North American conditions.

*Specimens not seen.



MAP 2. Distribution of *Xyleborus obliquus*.

5. *Xyleborus obliquus* (Leconte) new combination

(Map 2, Fig. 7)

Pityophthorus obliquus Leconte, 1878, p. 432 (holotype ♀, Florida, MCZ); Hagedorn, 1910a, p. 73 (additional references); Hagedorn, 1910b, p. 101; Blatchley and Leng, 1916, p. 633. *Ambrosiodmus obliquus*: Blackman, 1928, p. 148; Chamberlin, 1939, p. 440. *Ambrosiodmus linderæ* Hopkins, 1915, p. 56 (holotype ♀, Virginia, USNM); Blatchley and Leng, 1916, p. 613; Chamberlin, 1939, p. 440; Beal and Massey, 1945, p. 148. New SYNONYMY.

FEMALES. Length 2.3–2.5 mm, 2.6 times longer than wide. Frons faintly punctured and sculptured over surface, more strongly sculptured on lateral portions. Antennal club 1.6 times longer than wide. Pronotum subquadrate; anterior margin broadly rounded, smooth; asperities on anterior slope erect, rather large; posterior portion asperate, asperities small, scarcely elevated, blunt; surface between asperities minutely reticulate. Elytra 1.5 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; stria punctures closely placed, large; interspaces smooth, punctures small, in definite rows basally, becoming indefinite toward declivity. Declivity convex; suture and first interspace slightly elevated; first and third interspaces minutely granulate, other interspaces smooth; ridge of seventh interspace slightly elevated at elytral apex, smooth.

MALES. Length 1.5–1.7 mm, 1.7 times longer than wide. Frons flattened, with an indistinct tuberculate median elevation; surface very faintly punctate, punctures widely scattered. Pronotum wider than long, flattened, almost truncate in front; asperities obsolete; surface minutely reticulate, faintly punctured. Elytra strongly convex, widest in posterior third; suture impressed below elytral surface on disc; striae and interspaces as in female. Declivity strongly convex, resembling female.

HOSTS. Specimens examined from: *Betula*, *Carya*, *Castanea*, *Lindera*, and *Persea*.

DISTRIBUTION. Eastern and southeastern United States (Map 2). Forty specimens were examined from the following localities: **District of Columbia:**

Washington. **Florida:** Gainesville, Homestead, Lake Co., Manatee Co., Orange Co., Orange Heights, Pinellas Co., Saint Johns, and Suwannee Co. **Georgia:** Milner. **Louisiana:** New Iberia. **Mississippi:** Nicholson. **Virginia:** Rosslyn.

REMARKS. Females of this species are easily distinguished by their stout body, by the smooth anterior pronotal margin, and by the convex, unmodified elytral declivity.

The types of *Pityophthorus obliquus* and *Ambrosiodmus linderæ* were compared and found to represent the same species.

6. *Xyleborus rubricollis* Eichhoff

(Fig. 8)

Xyleborus rubricollis Eichhoff, 1874, p. 202 (holotype ♀, Japan, location not known); Hagedorn, 1910a, p. 110 (additional references); Hagedorn, 1910b, p. 156.

FEMALES. Length 2.5–2.7 mm, 2.4 times longer than wide. Frons distinctly punctured, minutely reticulate, shining, faintly impressed at upper level of eyes, slightly protuberant below. Antennal club as long as wide. Pronotum subquadrate; anterior margin broadly rounded, smooth; asperities on anterior slope large, erect; posterior portion asperate, asperities low, blunt; surface between asperities minutely reticulate. Elytra 1.4 times longer than wide; sides parallel on basal two-thirds, broadly rounded behind; stria punctures (except in first striae) very large, closely placed; interspaces smooth on disc, becoming granulate toward declivity. Declivity with striae impressed, punctures as large as on disc; interspaces convex, each with a row of prominent granules, those on third interspace slightly larger.

MALES. Length 1.6–1.8 mm, 2.0 times longer than wide. Frons flattened; transverse impression shallower; surface very faintly punctate. Pronotum as long as wide; anterior margin narrowly rounded; asperities very low, blunt; posterior portion roughened. Elytra 1.5 times longer than wide, narrowly rounded behind; striae and interspaces as in female. Declivity strongly convex; suture and first interspace distinctly elevated; interspaces smooth.

HOST. *Quercus* species.

DISTRIBUTION. Known in the United States only from Maryland, also widespread in Japan. Fifteen specimens have been examined from: **Maryland:** Ridgely, 15 Sept. 1942; W. H. Anderson; ex. oak stump.

REMARKS. Females of this species are easily recognized by the granulate declivital interspaces and by the very large stria punctures.

This Japanese species is here reported from the United States for the first time. It is obviously an introduced species and is probably now established, since a series was collected in a presumably natural situation.

7. *Xyleborus lecontei* (Hopkins) new combination

(Map 3, Fig. 9)

Ambrosiodmus lecontei Hopkins, 1915, p. 56 (holotype ♀, Florida, USNM); Blatchley and Leng, 1916, p. 614; Chamberlin, 1939, p. 440; Beal and Massey, 1945, p. 147.

FEMALES. Length 2.7–2.9 mm, 2.3 times longer than wide. Frons slightly protuberant above epistoma; surface dull, punctures shallow, widely separated. Antennal club as long as wide. Pronotum subquadrate; anterior margin broadly rounded, smooth; asperities on anterior slope large, erect; posterior portion faintly asperate, asperities scarcely elevated, blunt; surface between asperities minutely

reticulate. Elytra 1.4 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; stria punctures large, deeply impressed; interspaces smooth, punctures smaller, slightly impressed, becoming granulate toward declivity. Declivity convex; suture and first striae impressed; punctures of sutural interspace large, deep; second interspace elevated, with at least three prominent teeth, the largest of these about as long as width of an interspace; interspaces 3 to 6 distinctly granulate; ridge of seventh interspace entire, smooth.

MALES. Length 1.5–1.7 mm, 1.3 times longer than wide. Frons broadly concave, cavity very shallow; punctures of surface large, shallow. Pronotum broader than long; anterior margin broadly emarginate; anterior portion flattened, asperities obsolete; surface shining, punctures shallow, sparse. Elytra strongly convex, narrowly rounded behind; striae and interspaces as in female. Declivity convex, steep; suture and first interspace slightly elevated; remaining striae impressed, punctures large, deep; first, second, and third interspaces granulate, granules small, sharp-pointed; other interspaces smooth.

HOSTS. Specimens examined from: *Carya*, *Terminalia*, *Pleiogynum*, and "Palm."

DISTRIBUTION. Florida, also the West Indies (Map 3). More than 50 specimens have been examined from: **Florida:** Bell Glade, Biscayne Bay, Brevard Co., "Brookside", Dade Co., Gainesville, Indian River City, Key West, Marion Co., Miami, Orange Co., Orlando, Osceola Co., Pinellas Co., and Seminole Co.

REMARKS. This species and *X. tachygraphus* Zimmerman form a distinct group among North American Xyleborini, characterized by the prominent teeth on the second declivital interspace of the female. Females of *X. lecontei* can be distinguished from *X. tachygraphus* by their smaller size, by the more distinct declivital punctures, by the larger declivital teeth, and by their southern distribution.

8. *Xyleborus tachygraphus* Zimmerman

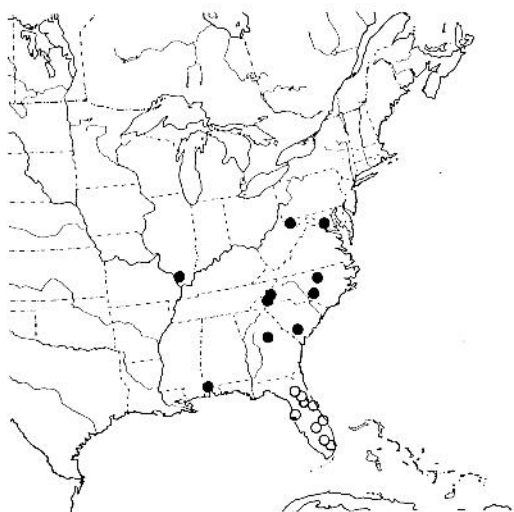
(Map 3, Fig. 10)

Xyleborus tachygraphus Zimmerman, 1868, p. 144 (holotype ♀, North Carolina, MCZ); Hubbard, 1897, p. 22 (biology); Swaine, 1909, p. 156 (additional references); Hagedorn, 1910a, p. 112 (additional references); Hagedorn, 1910b, p. 157.

Ambrosiodmus tachygraphus: Hopkins, 1915, p. 57; Blatchley and Leng, 1916, p. 614; Chamberlin, 1939, p. 441; Beal and Massey, 1945, p. 149.

FEMALES. Length 3.7–3.9 mm, 2.3 times longer than wide. Frons convex, densely punctured above the level of the eyes, lightly punctured to impunctate on semitriangular area above epistoma. Antennal club 2.1 times longer than wide. Pronotum subquadrate; anterior margin broadly rounded, almost truncate, unarmed; asperities on anterior slope large, erect; posterior portion asperate, asperities small, scarcely elevated, surface between asperities minutely reticulate. Elytra 1.4 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; stria punctures large, closely placed; interspaces smooth, punctures small, indistinct, becoming granulate toward declivity. Declivity convex; suture and first striae impressed, punctures indistinct; second interspace elevated slightly with two or three obvious teeth, the length of the largest of these much less than the width of an interspace; interspaces 3 to 6 granulate; ridge of seventh interspace entire, undulating.

MALES. Length 1.8–2.0 mm, 1.4 times longer than wide. Frons broad, flat, smooth; punctures large, shallow, indistinct. Pronotum broader than long,



MAP 3. Distribution of *Xyleborus tachygraphus* (closed circles) and *X. lecontei* (open circles).

flattened; sides strongly rounded; anterior margin very broadly rounded; asperities on anterior portion absent; surface minutely reticulate, faintly punctured. Elytra strongly convex, widest in posterior third, narrowly rounded behind; striae and interspaces as in female. Declivity very strongly convex; suture and first interspace very slightly elevated; striae impressed, punctures deep; first, second, and third interspaces very sparsely granulate, granules small; other interspaces smooth.

Hosts. Probably most deciduous trees in its range. Specimens examined from: *Acer*, *Betula*, *Carya*, *Castanea*, *Cercis*, *Fagus*, *Liriodendron*, and *Rhus*.

DISTRIBUTION. Eastern United States north of Florida (Map 3). More than 30 specimens were examined from: **Alabama:** Mobile. **District of Columbia:** Washington. **Georgia:** Macon. **Illinois:** Union Co. **Maryland:** "Bell". **North Carolina:** Black Mountain, Cedar Mountain, Durham, Southern Pines, and Tryon. **South Carolina:** Holly Hill. **Virginia:** Falls Church, Rosslyn, and Vienna. **West Virginia:** Dellslow.

REMARKS. This species is very closely related to *X. lecontei* but the females may be distinguished by their larger size, by their less strongly sulcate declivity, by the smaller declivital teeth, and by the more northern distribution.

9. *Xyleborus obesus* Leconte

(Map 4, Fig. 11)

Xyleborus obesus Leconte, 1868, p. 159 (holotype ♀, Virginia, MCZ); Schwarz, 1886, p. 45 (?= *pyri*); Swaine, 1909, p. 155 (additional references); Hagedorn, 1910a, p. 107 (additional references); Hagedorn, 1910b, p. 155.

Xyleborus (Anisandrus) obesus: Swaine, 1910, p. 161.

Anisandrus obesus: Hopkins, 1915, p. 69; Blatchley and Leng, 1916, p. 625; Swaine, 1918, p. 125; Dodge, 1938, p. 53; Chamberlin, 1939, p. 445.

Xyleborus serratus Swaine, 1910, p. 162 (lectotype ♀, (Bright 1967), Quebec, CNC No. 9327); Hopkins, 1915, p. 69 (= *obesus*).

Anisandrus populi Swaine, 1917, p. 22 (lectotype ♀, (Bright 1967), Quebec, CNC No. 9313); Chamberlin, 1939, p. 446. **NEW SYNONYMY.**

MAP 4. Distribution of *Xyleborus obesus*.

FEMALES. Length 3.3–3.7 mm, 2.3 times longer than wide. Frons slightly impressed above epistoma on each side of a faint longitudinal carina; punctures of surface large, shallow, more strongly impressed on lateral portions. Antennal club 1.2 times longer than wide. Pronotum as long as wide; sides arcuate; anterior margin broadly rounded, with two to four prominent asperities; asperities on anterior slope erect, prominent; posterior portion minutely reticulate, opaque, punctures small, impressed, and rather numerous. Elytra 1.3 times longer than wide; sides parallel on basal two-thirds, narrowly rounded behind; striae punctures large, impressed; interspaces smooth, punctures less than half the size of striae punctures, not placed in regular rows on disc. Declivity convex; first striae more deeply impressed than others; interspaces smooth, shining; ridge of seventh interspace elevated, with three to five small, prominent teeth.

MALES. Length 1.7–2.0 mm, 1.8 times longer than wide. Frons broad, flat, shining, very sparsely punctured above epistoma, more strongly punctured at sides. Pronotum slightly broader than long, convex, broadly rounded in front; asperities of anterior portion obsolete; surface smooth, shining, very faintly punctured. Elytra strongly convex, widest at about middle, narrowly rounded behind; striae and interstriae as in female, but punctures finer. Declivity strongly convex, unmodified.

HOSTS. Probably all deciduous trees in its range. Specimens seen from: *Acer*, *Betula*, *Fagus*, *Liriodendron*, *Populus*, and *Quercus*.

DISTRIBUTION. Eastern Canada, northeastern United States west to the Great Lakes and south to West Virginia (Map 4). More than 250 specimens from the following localities were examined. **CANADA:** **Ontario:** Ottawa and Rosseau. **Quebec:** Hull, Isle Perrot, and Ste. Anne de Bellevue. **UNITED STATES:** **Connecticut:** Hampton. **New Jersey:** Hopatcong. **New York:** Cranberry Lake and West Point. **Pennsylvania:** Frankford and Pittsburgh. **West Virginia:** Morgantown. **Wisconsin:** Clintonville. Also reported by Dodge (1938) from **Minnesota:** Hennepin Co., Ithaca Park, and Ramsey Co.

MAP 5. Distribution of *Xyleborus sayi*.

REMARKS. Females of this species are recognized by the very steep elytral declivity when compared with *X. sayi* or *X. dispar*, and by the acute margin of the seventh declivital interspace, which bears several well-developed teeth.

The lectotype of *A. populi* and Leconte's type of *X. obesus* were compared. The type specimens do show some differences, particularly in regard to the dentation of the seventh declivital interspace and the size of the stria punctures. An examination of more than 50 paralectotypes of *A. populi* and nearly 100 specimens of *X. obesus* in the CNC showed the same range of variation in these characters. In the absence of any consistent morphological or biological differences, only one species can be recognized.

Dodge (1938) stated that the galleries are in the outer ½-in. portion of the wood and are biramous. Each tunnel is constructed by a single female, who occupies it with her brood.

10. *Xyleborus sayi* (Hopkins) new combination

(Map 5)

Xyleborus obesus var. *minor* Swaine (not Stebbing), 1910, p. 164 (lectotype ♀, (Bright 1967), Quebec, CNC No. 9315) (preoccupied).

Anisandrus sayi Hopkins, 1915, p. 68 (holotype ♀, West Virginia, USNM); Blatchley and Leng, 1916, p. 625; Chamberlin, 1939, p. 446; Beal and Massey, 1945, p. 151.

Anisandrus minor: Blatchley and Leng, 1916, p. 624.

Xyleborus neardus Schedl, 1950, p. 893; Wood, 1957, p. 403 (= *sayi*).

FEMALES. Length 2.5–2.7 mm, 2.3 times longer than wide. Frons minutely granulate, very faintly punctured over surface, more strongly sculptured at sides; longitudinal elevation very faint, extending from epistoma to upper level of eyes. Antennal club 1.2 times longer than wide. Pronotum as long as wide; sides arcuate; anterior margin broadly rounded, with three or four prominent asperities; asperities on anterior slope very large, prominent; posterior portion smooth, minutely reticulate, shining, faintly punctured. Elytra 1.3 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; stria punctures rather large, closely placed; interspaces smooth, impunctate. Declivity convex;

first striae slightly more impressed than others; all interspaces very faintly granulate; ridge of seventh interspace slightly elevated, usually smooth but may be broadly undulating.

MALES. Length 1.3–1.6 mm, 1.7 times longer than wide. Frons broad, flat, shining and faintly punctured, slightly more strongly punctate on sides. Pronotum as long as wide, convex, broadly rounded in front; asperities obsolete; surface minutely reticulate, shining, very faintly punctured. Elytra strongly convex, widest at, or about, middle, narrowly rounded behind; striae and interspaces as in female but finer. Declivity strongly convex; unmodified.

HOSTS. Probably all deciduous trees in its range. Specimens seen from: *Acer*, *Betula*, *Carya*, *Fagus*, *Fraxinus*, *Juglans*, *Sassafras*, and *Tilia*.

DISTRIBUTION. Widely distributed in eastern Canada and in the eastern United States as far south as Georgia (Map 5). More than 400 specimens were seen from the following localities: **CANADA:** **Ontario:** Ottawa and Toronto. **Quebec:** Isle Perrot, Knowlton, and Ste. Anne de Bellevue. **UNITED STATES:** **Connecticut:** "Lynne". **Georgia:** 38 mi SW. of Clayton. **Maine:** Strong. **Maryland:** Silver Spring. **Michigan:** Detroit. **New Jersey:** Whippany. **New York:** Buffalo, Ithaca, near Rensselaerville and West Point. **North Carolina:** Pisgah Mountains and Tyron. **Pennsylvania:** "Clarks Valley." **Virginia:** Falls Church and Rosslyn. **West Virginia:** Pocahontas Co. and Morgantown.

REMARKS. *Xyleborus sayi* is most closely related to *X. dispar* but the females of *X. sayi* may be readily distinguished by their smaller size, by the fewer asperities on the anterior margin of the pronotum, by the more shining pronotal surface, and by the longer elytral setae.

11. *Xyleborus dispar* (Fabricius)

(Map 6)

Apate dispar Fabricius, 1792, p. 363 (cotypes ♀ ♂, Germany, ZMK).

Bostrichus dispar: Herbst, 1793, p. 113.

Xyleborus dispar: Eichhoff, 1864, p. 38; Riley and Howard, 1890, p. 279; Schwarz, 1893, p. 63; Hubbard, 1897, p. 22; Swaine, 1909, p. 152 (additional references); Hagedorn, 1910a, p. 101 (additional references); Hagedorn 1910b, p. 153; Hopkins, 1915, p. 67; Schedl, 1960, p. 11.

Tomicus dispar: Thomson, 1865, p. 369.

Anisandrus dispar: Ferrari, 1867, p. 26.

Scolytus pyri Peck, 1817, p. 205 (type ♀, Massachusetts, destroyed?); Schwarz, 1888, p. 138 (?= *dispar*); Riley and Howard, 1890, p. 279 (= *dispar*); Schedl, 1960, p. 11 (= *dispar*).

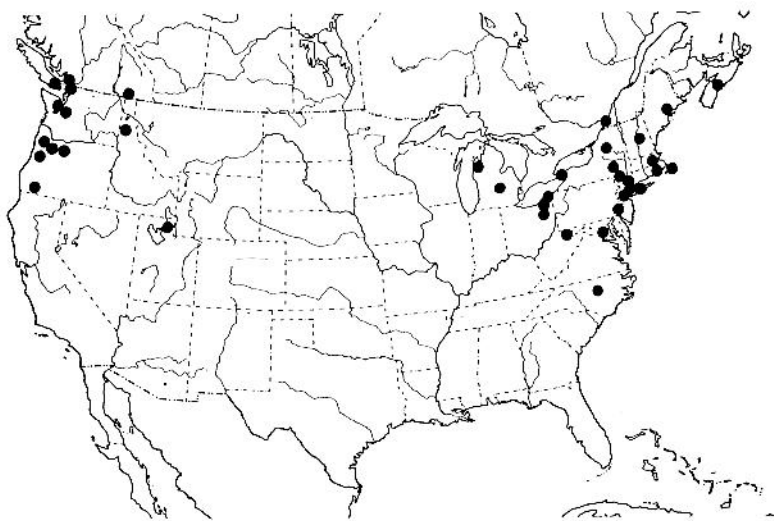
Tomicus pyri: Harris, 1852, p. 80.

Xyleborus pyri: Zimmerman, 1868, p. 144; Swaine, 1909, p. 153 (additional references).

Anisandrus pyri: Hopkins, 1915, p. 69; Blatchley and Leng, 1916, p. 626; Chamberlin, 1939, p. 444; Beal and Massey, 1945, p. 150; Chamberlin, 1958, p. 185.

Anisandrus swaini Drake, 1921, p. 203 (holotype ♀, New York, USNM); Chamberlin, 1939, p. 444; Wood, 1957, p. 403 (= *pyri*).

FEMALES. Length 3.2–3.7 mm, 2.0 times longer than wide. Frons minutely reticulate, opaque, punctures rather large but very shallow, more strongly punctured on lateral portions; surface very slightly impressed on epistoma on each side of a faintly elevated longitudinal carina. Antennal club 1.1 times longer than wide. Pronotum as long as wide; sides arcuate; anterior margin broadly rounded, with six to eight prominent asperities; asperities on anterior slope very large, prominent; posterior margin minutely reticulate, opaque, punctures very faint, small. Elytra 1.3 times longer than wide; sides parallel on basal three-

MAP 6. Distribution of *Xyleborus dispar*.

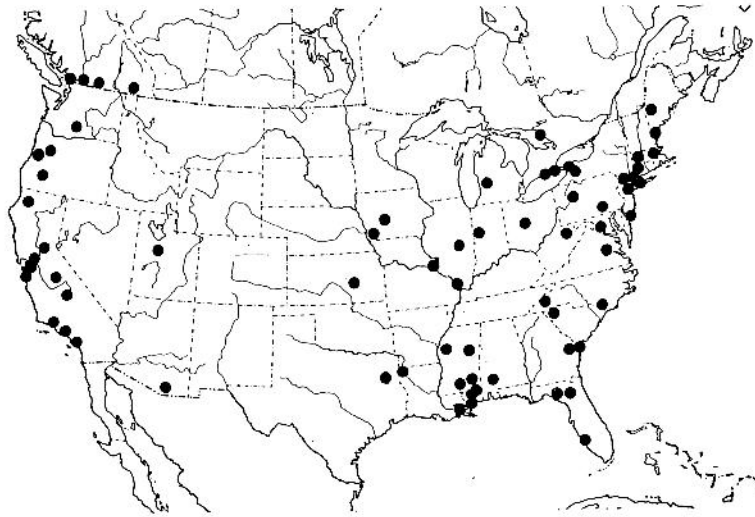
fourths, rather narrowly rounded behind; stria punctures rather large, closely placed; interspaces smooth, shining, becoming granulate near declivity, punctures less than half the size of stria punctures and not in regular rows on disc. Declivity convex; first and third interspaces slightly elevated; all interspaces faintly granulate; ridge of seventh interspace acute, elevated, and unbroken.

MALES. Length 1.8–2.1 mm, 1.6 times longer than wide. Frons broad, flat, minutely reticulate, shining, median longitudinal carina reduced to a low, broad tubercle. Pronotum slightly broader than long, strongly convex; narrowly rounded in front; asperities very low and faint; surface minutely reticulate, shining, faintly punctured. Elytra strongly convex, widest at about middle, rather broadly rounded behind; striae and interstriae resembling female. Declivity strongly convex; unmodified.

HOSTS. Probably all deciduous trees in its range, also infrequently collected from conifers. Specimens seen from: *Acer*, *Aesculus*, *Betula*, *Castanea*, *Fagus*, *Fraxinus*, *Prunus*, *Rosa*, *Salix*, and *Tsuga*. In addition it is reported from: *Alnus*, *Crataegus*, *Liriodendron*, *Pinus*, *Plananus*, *Populus*, *Punica*, and *Quercus* (Essig 1926) and *Celtis*, *Gleditsia*, and *Ilex* (Beal and Massey 1945).

DISTRIBUTION. Eastern North America west to the Lake States and south to North Carolina; western Canada and the Pacific Northwest states; also Europe and Asia (Map 6). More than 500 specimens from numerous localities were examined from the following provinces and states: CANADA: **British Columbia**, **Nova Scotia**, **Ontario**, and **Quebec**. UNITED STATES: **Idaho**, **Maine**, **Massachusetts**, **Michigan**, **New Hampshire**, **New Jersey**, **New York**, **North Carolina**, **Ohio**, **Oregon**, **Pennsylvania**, **Rhode Island**, **Utah**, **Virginia**, **Washington**, and **West Virginia**.

REMARKS. From *X. sayi*, females of this species are distinguished by their larger size, by the smooth seventh declivital interspace, and by the more numerous asperities on the anterior margin of the pronotum.

MAP 7. Distribution of *Xyleborus saxeseni*.

An examination of several hundred specimens from Europe and North America showed that there was no basis for continuing to recognize two species, i.e., *X. dispar* in Europe and *X. pyri* in North America.

12. *Xyleborus saxeseni* (Ratzeburg)

(Map 7)

Bostrichus saxeseni Ratzeburg, 1837, p. 167 (type ♀, Europe, destroyed); Hagedorn, 1910a, p. 113 (additional references).

Xyleborus saxeseni: Ferrari, 1867, p. 21; Eichhoff and Schwarz, 1896, p. 609 (= *xylographus*); Swaine, 1909, p. 158 (additional references); Blatchley and Leng, 1916, p. 616; Swaine, 1918, p. 127; Blackman, 1922, p. 118; Beal and Massey, 1945, p. 153; Wood, 1957, p. 403; Chamberlin, 1958, p. 186; Schedl, 1960, p. 11 (= *xylographus*); Wood, 1960a, p. 68 (a good species); Schedl, 1962, p. 498 (biology and additional references); Wood, 1962, p. 79; Schedl, 1962/63, p. 63 (a good species).

Xyleborinus saxeseni: Reitter, 1913, p. 83; Chamberlin, 1939, p. 457.

Xyleborus xylographus of authors nec Say; Swaine, 1909, p. 157 (additional references).

Xyleborus quercus Hopkins, 1915, p. 63 (holotype ♀, Mississippi, USNM); Blatchley and Leng, 1916, p. 616; Chamberlin, 1939, p. 450; Wood, 1962, p. 79 (= *saxeseni*).

Xyleborus pecanis Hopkins, 1915, p. 63 (holotype ♀, Mississippi, USNM); Blatchley and Leng, 1916, p. 617; Chamberlin, 1939, p. 450; Wood, 1962, p. 79 (= *saxeseni*).

Xyleborus floridensis Hopkins, 1915, p. 63 (holotype ♀, Florida, USNM); Blatchley and Leng, 1916, p. 617; Chamberlin, 1939, p. 450; Wood, 1962, p. 79 (= *saxeseni*).

Xyleborus arbuti Hopkins, 1915, p. 64 (holotype ♀, California, USNM); Chamberlin, 1939, p. 451; Wood, 1957, p. 403 (= *saxeseni*).

Xyleborinus tsugae Swaine, 1934, p. 204 (holotype ♀, British Columbia, CNC No. 3815; Chamberlin, 1939, p. 457; Wood, 1957, p. 403 (= *saxeseni*)).

Xyleborinus libocedri Swaine, 1934, p. 205 (holotype ♀, Oregon, CNC No. 3816); Chamberlin, 1939, p. 457; Wood, 1957, p. 403 (= *saxeseni*).

In addition to the above North American names, Schedl (1962) gives the following names as synonyms: *aesculi* Ferrari, *decolor* Boieldieu, *dohrni* Wollaston, *dryographus* Ratzeburg, *subdepressus* Rey, and *xylographus* Thomson.

FEMALE. Length 2.0–2.2 mm, 2.6 times longer than wide. Frons minutely reticulate, punctures distinct but faint; longitudinal line very faint, extending beyond upper level of eyes. Antennal club as long as wide. Pronotum 1.2 times longer than wide; sides parallel on posterior two-thirds, broadly rounded

anteriorly; anterior slope with numerous low asperities; posterior portion minutely reticulate, punctures very fine and shallow. Elytra 1.7 times longer than wide; stria punctures impressed, larger than the more widely spaced interstria punctures; interspaces smooth on disc, becoming uniserrately granulate toward declivity. Declivital surface dull, reticulate; first and third interspaces slightly elevated, with a row of tubercles; apical portion of ninth interspace forming lower margin with several acute tubercles; interstria setae longer.

MALE. Length 1.5 mm, 2.6 times longer than wide. Frons faintly impressed just above epistoma, convex above this impression to upper level of eyes; surface minutely reticulate, very faintly punctured. Pronotum broadly rounded in front; anterior slope with low, scattered asperities; posterior portion minutely reticulate. Elytral punctures faint; striae marked by rows of setae. Declivity slightly concave; granules of first and third interspaces acute, sparse. Otherwise resembles female.

Hosts. Specimens examined from nearly all genera of deciduous trees, also *Libocedrus*, *Pinus*, and *Tsuga*.

DISTRIBUTION. Common throughout southern Canada and the United States (Map 7). More than 500 specimens were examined from numerous localities in the following provinces and states: **CANADA: British Columbia and Ontario. UNITED STATES: California, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Utah, Virginia, and Washington.**

REMARKS. Females of *X. saxeseni* are easily recognized by the conical scutellum, a character unique among North American *Xyleborus*. In addition, the characters of the declivity, as given in the key, will aid in distinguishing this species.

Almost all the references listed by Swaine (1909) under *X. xylographus* refer to *X. saxeseni* and most of the later references under *X. xylographus* in the Index to American Economic Entomology also refer to *X. saxeseni*. This confusion in names began in 1896 when Eichhoff and Schwarz stated that *X. xylographus* and *X. saxeseni* were the same species; subsequent authors continued the error. Actually the two species are completely different. For further information, see my remarks under *X. xylographus*.

My concept of *X. saxeseni* is based on specimens in the CNC determined by Eggers in 1907 and on specimens in the Eggers collection in the USNM.

Schedl (1962) gives a good general biology of this species.

13. *Xyleborus celsus* Eichhoff

(Map 8, Fig. 12)

Xyleborus celsus Eichhoff, 1867, p. 400 (type ♀, America Borealis, destroyed); Swaine, 1909, p. 151 (additional references); Hopkins, 1915, p. 62; Blatchley and Leng, 1916, p. 623; Swaine, 1918, p. 128; Blackman, 1922, p. 119; Dodge, 1938, p. 54; Chamberlin, 1939, p. 454; Beal and Massey, 1945, p. 154 (biology).

Xyleborus biographus Leconte, 1868, p. 160 (holotype ♂, Illinois, MCZ); Eichhoff, 1878, p. 399 (= *celsus*?); Hopkins, 1896, p. 249 (= *celsus*).

FEMALE. Length 3.8–4.5 mm, 2.7 times longer than wide. Frons shining, rather densely punctured, with a median, longitudinal smooth space. Antennal club about as long as wide. Pronotum 1.2 times longer than wide; anterior margin

MAP 8. Distribution of *Xyleborus celsus*.

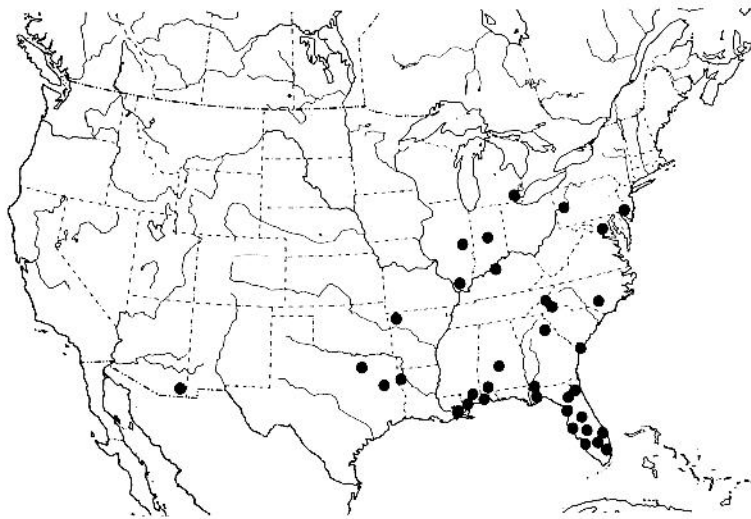
broadly rounded, unarmed; asperities on anterior slope rather small and low, increasing slightly in size on sides; posterior area smooth, brightly shining, punctures small, impressed, not close. Elytra 1.9 times longer than wide; sides parallel on anterior three-fourths, broadly rounded behind; stria punctures large, close; interspaces smooth, punctures small, not in regular rows. Declivity abrupt, steep; two large acute teeth situated on first stria; first interspace strongly widened, smooth, opaque, with several small teeth at upper level; second and third interspaces not widened, second modified like first, third with small teeth throughout, forming lateral margin of declivity.

MALE. Length 2.3–2.7 mm, 2.7 times longer than wide. Frons broad, shining, smooth in median portion, finely reticulate and opaque laterally, punctures indistinct. Pronotum 1.2 times longer than wide; sides slightly arcuate; anterior margin drawn into a pronounced point; anterior slope distinctly concave, asperities obsolete; posterior area shining, punctures larger and closer than in female. Elytra 1.5 times longer than wide, resembling female. Declivity convex, more sloping than female; armature resembling female but teeth smaller and punctures finer.

HOSTS. Specimens seen only from *Carya* species.

DISTRIBUTION. Eastern United States west to Kansas (Map 8). Several hundred specimens from numerous localities were examined from the following states: **Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Vermont, Virginia, and West Virginia.**

REMARKS. This is the largest species of *Xyleborus* occurring in North America. The female is easily recognized by the steep declivity with two large teeth on the first stria. It is closely related to *X. monographus* of Europe, but differs by its larger size and by the larger, more prominent teeth on the elytral declivity.

MAP 9. Distribution of *Xyleborus ferrugineus*.**14. *Xyleborus ferrugineus* (Fabricius)**

(Map 9, Figs. 2, 4, 13)

Bostrichus ferrugineus Fabricius, 1801, p. 388 (holotype ♀, Cuba, ZMK).*Xyleborus ferrugineus*: Zimmerman, 1868, p. 145; Schedl, 1962, p. 425 (additional references, biology, and figure); Browne, 1962, p. 47 (biology).*Xyleborus fuscatus* Eichhoff, 1867, p. 400 (holotype ♀, Carolina, destroyed); Blatchley and Leng, 1916, p. 622; Swaine, 1918, p. 128; Blackman, 1922, p. 118; Chamberlin, 1939, p. 453; Beal and Massey, 1945, p. 155 (figures); Schedl, 1960, p. 8 (= *ferrugineus*); Wood, 1960b, p. 64 (= *ferrugineus*).*Xyleborus impressus* Eichhoff, 1867, p. 400 (holotype ♀, Massachusetts, IRSNB); Swaine, 1909, p. 154 (additional references); Hagedorn, 1910a, p. 105 (additional references); Hagedorn, 1910b, p. 154; Blatchley and Leng, 1916, p. 622; Swaine, 1918, p. 128; Chamberlin, 1939, p. 453; Schedl, 1960, p. 8 (= *ferrugineus*).*Xyleborus retusicollis* Zimmerman, 1868, p. 146 (holotype ♂, Maryland, MCZ); Swaine, 1909, p. 156 (additional references); Hagedorn, 1910a, p. 110 (additional references); Hagedorn, 1910b, p. 156. NEW SYNONYMY.*Xyleborus nyssae* Hopkins, 1915, p. 66 (holotype ♀, South Carolina, USNM); Blatchley and Leng, 1916, p. 622; Chamberlin, 1939, p. 455; Schedl, 1960, p. 8 (= *ferrugineus*).*Xyleborus soltau* Hopkins, 1915, p. 66 (holotype ♀, Louisiana, USNM); Blatchley and Leng, 1916, p. 621; Chamberlin, 1939, p. 455. NEW SYNONYMY.

In addition to the above North American names, Schedl (1962) places the following names in synonymy: *amplicollis* Eichhoff, *argentinensis* Schedl, *bispinatus* Eichhoff, *hopkinsi* Beeson, *insularis* Sharp, *notatus* Eggers, *obtusipennis* Eggers, *schedli* Eggers, *subitus* Schedl, *tanganus* Hagedorn, and *trypanaeoides* Wollaston.

FEMALE. Length 2.1–3.0 mm, 2.8 times longer than wide. Frons minutely reticulate, punctures scattered, sparse, and faintly impressed; longitudinal carina smooth, faintly elevated. Antennal club 1.2 times longer than wide. Pronotum 1.2 times longer than wide; sides parallel; anterior margin broadly rounded, smooth; asperities on anterior slope numerous, not strongly elevated; posterior portion smooth, shining, or opaque, punctures small, very faint. Elytra 1.8 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; striae punctures impressed in regular rows, moderate in size; interspaces smooth,

shining, punctures sparse, about the size of stria punctures. Declivity convex, sloping; second interspace faintly impressed below the level of the slightly elevated first and third interspaces; first interspace with several small teeth at upper level and one large prominent tooth in middle; interspaces 4, 5, and 6 with several small teeth.

MALE. Length 2.0–2.3 mm, 2.5 times longer than wide. Frons broader, minutely reticulate, and faintly punctured. Pronotum 1.2 times longer than wide; sides slightly arcuate; anterior margin drawn into an acute point; anterior slope distinctly concave, asperities obsolete; posterior area shining to opaque, punctures small, faint. Elytra 1.5 times longer than wide, sides slightly arcuate, rather narrowly rounded behind; sculpture and vestiture resembling female. Declivity sloping, armature resembling female but teeth smaller.

HOSTS. Recorded from a wide range of host plants. North American specimens were examined from: *Castanea*, *Fraxinus*, *Quercus*, and *Taxodium*. In addition, it is recorded from *Juglans*, *Nyssa*, and *Pinus* (Chamberlin 1939) and *Fagus* and *Liquidambar* (Beal and Massey 1945). See Browne (1962) or Schedl (1962) for a worldwide host list.

DISTRIBUTION. Eastern United States from New York and Michigan south (Map 9), also found in almost all tropical and subtropical areas of the world. A large number of specimens from numerous localities were examined from the following states: **Alabama, Arizona, Arkansas, District of Columbia, Florida, Georgia, Indiana, Kentucky, Louisiana, Maryland, Michigan, Mississippi, North Carolina, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Texas, and West Virginia.**

REMARKS. The female of *X. ferrugineus* is easily recognized by the flattened, or sometimes slightly sulcate, elytral declivity which has one large tooth in the middle of the third interspace and several small teeth at the upper margin of the first and third interspace of each elytron. In addition, it is exceeded in size only by *X. celsus*.

The type of *X. soltau* was examined and found to represent a typical female *X. ferrugineus*. The type of *X. retusicollis* was found to be a male *X. ferrugineus* by comparison with males taken in association with females.

Blackman (1922), Beal and Massey (1945), Browne (1962) and Schedl (1962) discuss the biology of this species.

15. *Xyleborus xylographus* (Say)

(Map 10, Fig. 14)

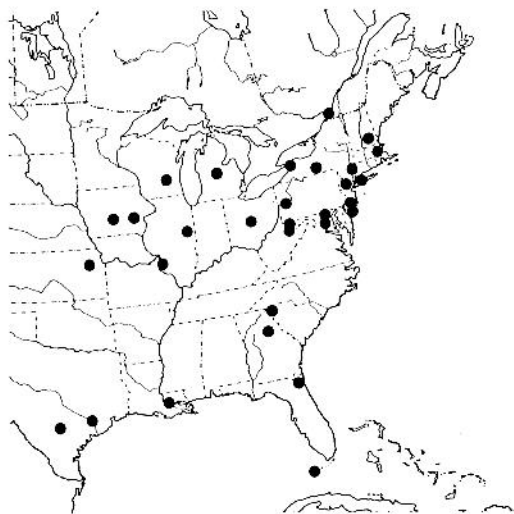
Bostrichus xylographus Say, 1826, p. 256 (neotype ♀, present designation, North Carolina, CNC No. 9518).

Xyleborus xylographus: Zimmerman, 1868, p. 145; Swaine, 1909, p. 157 (additional references); Hagedorn, 1910a, p. 112 (additional references); Hagedorn, 1910b, p. 157; Blatchley and Leng, 1916, p. 621; Swaine, 1918, p. 127; Dodge, 1938, p. 54; Chamberlin, 1939, p. 451; Beal and Massey, 1945, p. 157; Schedl, 1960, p. 11; Schedl, 1962/63, p. 63.

Xyleborus inermis Eichhoff, 1867, p. 401 (type ♀, Cuba, destroyed); Swaine, 1909, p. 157 (additional references); Hagedorn, 1910a, p. 106 (additional references); Hagedorn, 1910b, p. 157; Blatchley and Leng, 1916, p. 618; Chamberlin, 1939, p. 451; Schedl, 1962/63, p. 63 (? = *xylographus*). **NEW SYNONYMY.**

Xyleborus planicollis Zimmerman, 1868, p. 145 (holotype ♂, Pennsylvania, MCZ); Hubbard, 1897, p. 20 (= *fuscatus*); Swaine, 1909, p. 154 (additional references); Hagedorn, 1910a, p. 105 (additional references); Hopkins, 1915, p. 61 (a good species); Blatchley and Leng, 1916, p. 617; Beal and Massey, 1945, p. 157; Chamberlin, 1939, p. 450. **NEW SYNONYMY.**

Xyleborus canadensis Swaine, 1917, p. 24 (lectotype ♀, (Bright 1967), Quebec, CNC No. 9311); Swaine, 1918, p. 127; Chamberlin, 1939, p. 455; Wood, 1957, p. 403 (= *xylographus*).



MAP 10. Distribution of *Xyleborus xylographus*.

FEMALE. Length 2.5–2.8 mm, 3.0 times longer than wide. Frons minutely reticulate, shining, punctures shallow and scattered; longitudinal carina indicated by a broad, smooth, slightly elevated line. Antennal club 1.3 times longer than wide. Pronotum 1.2 times longer than wide; sides parallel; anterior margin broadly rounded, smooth; asperities on anterior slope low and numerous; posterior portion smooth and brightly shining, punctures fine. Elytra 1.8 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; stria punctures in regular rows, large, impressed; interspaces smooth, shining, punctures numerous, less than half the size of stria punctures. Declivity convex, flattened, minutely reticulate, opaque; first and third interspaces very slightly elevated, each with two or three minute granules; second interspace slightly granulate; first stria diverging from suture in middle.

MALE. Length 2.2–2.4 mm, 3.0 times longer than wide. Frons broad, minutely reticulate and very faintly punctured. Pronotum 1.1 times longer than wide, strongly flattened, sides arcuate; anterior margin broadly rounded; disc longitudinally concave from near base to near anterior margin; surface shining densely punctured; vestiture in concave portion consisting of flattened, almost scale-like setae. Elytra 1.8 times longer than wide; sides parallel on anterior two-thirds, narrowly rounded behind; sculpture resembling female. Declivity steep, flattened, opaque; sutural interspace not widened, slightly elevated at apex; all interspaces faintly granulate.

Hosts. The preferred host appears to be *Quercus*; it is also recorded from *Carya*, *Castanea*, *Juglans*, and *Pinus* (Beal and Massey 1945).

DISTRIBUTION. Eastern Canada and United States, west to Kansas, south to Florida and Texas (Map 10), also Cuba. Several hundred specimens were examined from numerous localities in the following provinces and states: **CANADA: Quebec.** **UNITED STATES: District of Columbia, Florida, Georgia, Illinois, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Texas, Virginia, West Virginia, and Wisconsin.**

REMARKS. Females of this species can be recognized by the steep, opaque, finely granulate elytral declivity and by the rather large stria punctures.

The original type-series of Say is not in existence, having been destroyed with the rest of Say's collection. There is, however, one specimen in the CNC, ex Harris collection, that Swaine (1918), Wood (1960a) and Schedl (1962/63) have considered to be Say's species. They have based their descriptions and opinions on this specimen, and since the types are lost, this specimen is hereby designated the neotype of *Bostrichus xylographus* Say. It bears the labels "744, N. C.; *Tomicus xylographus* Say, 744, teste Say" and "*X. inermis* Eichh., Det. K. Schedl, 1962." It also bears a red label "NEOTYPE, *Bostrichus xylographus* Say, CNC No. 9518."

Xyleborus xylographus has been confused with *X. saxeseni* for a long time. Eichhoff and Schwarz (1896) first proposed the synonymy of the two species, evidently based on a misidentification of *X. saxeseni* by C. V. Riley. Subsequent authors accepted this synonymy until almost all of the literature dealing with *X. xylographus* actually refers to *X. saxeseni*. Swaine (1918) recognized the true *X. xylographus* based on his examination of the specimen now designated the neotype. Recently the problem received renewed emphasis when Schedl (1960), not having seen a true *X. xylographus*, stated that the two species were synonymous. This statement was questioned by Wood (1960a) and influenced Schedl to examine the neotype. After this examination, Schedl (1962/63) considered the two species as distinct taxa. He felt, however, that because of certain questions concerning Say's name, he could not recognize the name *X. xylographus*. Instead he labeled the neotype "*Xyleborus inermis* Eichh." and stated that *X. inermis* and *X. xylographus* were probably the same. The question concerning Say's name arises from the fact that in the original description Say stated that his species "... is abundant in forests of the pine, to which it is very destructive. Immediately beneath the bark, on the wood, it excavates a rectilinear groove, with short, equal, lateral grooves at right angles with the proceeding." Since *X. xylographus* is an ambrosia beetle occurring mainly in hardwoods, Say's statement about the host and galley is in error; it probably refers to a species of *Pityophthorus*, *Orthotomicus*, or *Ips*.

The synonymizing of *X. inermis* is based on the identification of the neotype by Schedl mentioned above. The type of *X. planicollis* was compared with males taken in association with females and found to represent *X. xylographus*.

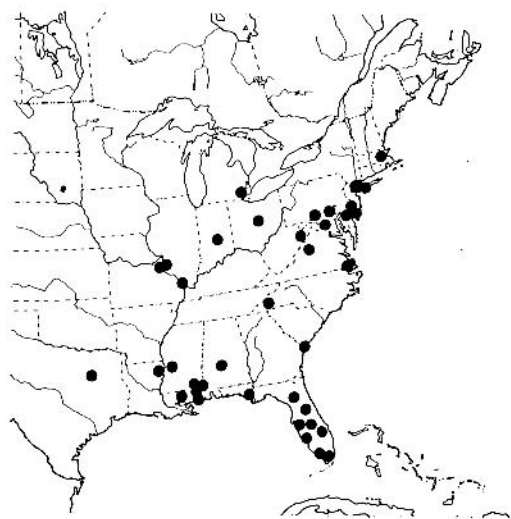
16. *Xyleborus affinus* Eichhoff

(Map 11, Fig. 15)

Xyleborus affinus Eichhoff, 1867, p. 401 (cotypes ♂ ♀, America Borealis, USNM); Swaine, 1909, p. 151 (additional references); Hagedorn, 1910a, p. 98 (additional references); Hagedorn, 1910b, p. 152; Blatchley and Leng, 1916, p. 618; Blackman, 1922, p. 118; Chamberlin, 1939, p. 452; Beal and Massey, 1945, p. 158; Wood, 1960b, p. 71; Schedl, 1962, p. 331 (additional references as *X. mascarensis*).

The following names are given as synonyms: *mascarensis* Eichhoff (Wood 1960b), *affinus* var. *parvus* Eichhoff, *affinus* var. *fuscobrunneus* Eichhoff, *proximus* Eggers, *sacchari* Hopkins, and *subaffinus* Eggers (Schedl 1962).

FEMALE. Length 2.3–2.8 mm, 2.9 times longer than wide. Frons minutely reticulate, shining; punctures large, rather closely placed; longitudinal carina very faint to obsolete. Antennal club as long as wide. Pronotum 1.1 times longer than wide; sides parallel; anterior margin rather broadly rounded, smooth;



MAP 11. Distribution of *Xyleborus affinis*.

asperities on anterior slope low, numerous; posterior portion smooth, shining, faintly punctured. Elytra 1.7 times longer than wide; sides parallel on basal two-thirds, broadly rounded behind; striae punctures moderate in size, slightly impressed in regular rows; interstriae smooth, shining, punctures small, rather sparse. Declivity broadly convex, sloping; surface dull, opaque; all interspaces with one to four small granules, these larger on first and third interspaces, sometimes absent on second; interspace 7 forming a low, sharp, lateral margin.

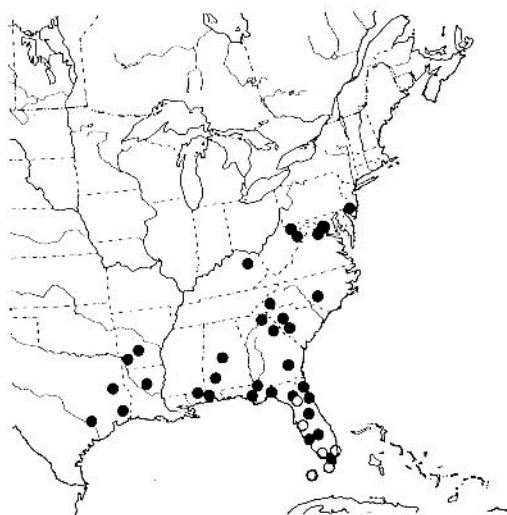
MALE. Length 1.7–2.0 mm, 2.2 times longer than wide. Frons broader, minutely reticulate, duller; punctures faint. Pronotum 1.1 times longer than wide; sides arcuate; anterior margin drawn into a blunt point; anterior slope flattened, concave; asperities small and very fine; posterior portion smooth, shining, finely punctured. Elytra 1.3 times longer than wide, strongly convex; sides parallel, broadly rounded behind; sculpture resembling female. Declivity steep, convex, rather closely resembling female.

HOSTS. Various hardwood trees. Specimens seen from: *Betula*, *Carya*, *Castanea*, *Celtis*, *Diospyra*, *Liquidamber*, *Mimosa*, *Quercus*, and *Robinia*.

DISTRIBUTION. Eastern United States east of a line from Michigan to Texas, south of New York (Map 11), also found in most tropical and subtropical areas of the world. Several hundred specimens were seen from numerous localities in the following states: **Alabama, Delaware, District of Columbia, Florida, Illinois, Indiana, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Texas, Virginia, and West Virginia.**

REMARKS. Females of *X. affinis* are rather easily distinguished from the females of other North American *Xyleborus* by the dull, opaque, broadly sloping elytral declivity. Among North American species, it is most similar to *X. volvulus* (Fabricius) but the more convex, shining, more strongly tuberculate elytral declivity of *X. volvulus* will distinguish it from *X. affinis*.

Schedl (1962) gave an excellent, complete biology of this species under the name *X. mascarensis*.



MAP 12. Distribution of *Xyleborus pini* (closed circles) and *X. volvulus* (open circles).

17. *Xyleborus pini* Eichhoff

(Map 12, Fig. 16)

Xyleborus pini Eichhoff, 1867, p. 401 (type ♀, Carolina, destroyed); Swaine, 1909, p. 155 (additional references); Hagedorn, 1910a, p. 109 (additional references); Hagedorn, 1910b, p. 155.

Xyleborus pubescens Zimmerman, 1868, p. 145 (holotype ♀, Southern states, MCZ); Swaine, 1909, p. 155 (additional references); Hagedorn, 1910a, p. 109 (additional references); Hagedorn, 1910b, p. 156; Chamberlin, 1939, p. 452; Beal and Massey, 1945, p. 156; Schedl, 1951/52, p. 163 (= *pini*).

FEMALE. Length 2.4–2.8 mm, 2.7 times longer than wide. Frons minutely reticulate, opaque, punctures sparse, faintly impressed; longitudinal carina evident, slightly elevated, extending from epistomal margin to above upper level of eyes. Antennal club 1.1 times longer than wide. Pronotum 1.3 times longer than wide; sides parallel; anterior margin broadly rounded, smooth; asperities on anterior slope low, numerous; posterior portion shining, frequently appearing scratched between punctures, punctures a little larger than in *X. volvulus*, with irregular outlines. Elytra 1.7 times longer than wide; sides parallel on basal two-thirds, broadly rounded behind; stria punctures large, distinctly impressed in regular rows; interspaces smooth, shining, punctures numerous, these less than half the size of the stria punctures. Declivity steep; surface usually shining, sometimes with opaque patches or entirely opaque; first and third interspaces slightly raised, bearing three to five small granules; ridge of seventh interspace weakly developed.

MALE. Not seen.

HOSTS. No host recorded in the literature can be considered correct, due to the confusion between *X. volvulus* and this species. It probably occurs in various hardwood and softwood trees.

DISTRIBUTION. Eastern United States from New Jersey south (Map 12). Nearly 400 specimens were examined from the following localities: **Alabama:** Birmingham and Flathead. **Arkansas:** Hope and Hot Springs National Park. **District of Columbia:** Washington. **Florida:** Chipola Lake, Fort Meyers, Gainesville, Key West, Lake Placid, Monticello, Palmdale, Paradise Key, Royal

Palm State Park, St. John Co., and Volusia Co. **Georgia:** Decatur Co., Demorest and Waycross. **Kentucky:** Morehead. **Louisiana:** Winnfield. **Mississippi:** Lucedale. **New Jersey:** "Orange Mountains" and Woodbury. **North Carolina:** Biltmore and Southern Pines. **South Carolina:** Aiken, Spartanburg, and Tryon. **Texas:** Bastrup State Park, Call, "Fedor", and Nacogdoches. **Virginia:** Falls Church. **West Virginia:** Dellslow, Justice, and Smokehole.

REMARKS. This species is very difficult to distinguish from *X. volvulus*. Females of *X. pini* may be distinguished by the very small granules on the first and third declivital interspaces and by the shining pronotal surface, which is slightly roughened around the moderately sized, irregular punctures. The pronotal surface between the punctures frequently appears minutely scratched. The distribution will help in some cases.

18. *Xyleborus volvulus* (Fabricius)

(Map 12, Fig. 17)

Bostrichus volvulus Fabricius, 1775, p. 454 (cotypes ♀♀, America Ligno ("Cuba?"), ZMK).

Hylesinus volvulus: Fabricius, 1801, p. 394.

Xyleborus volvulus: Eggers, 1929, p. 47.

Xyleborus hubbardi Hopkins, 1915, p. 65 (holotype ♀, Florida, USNM); Blatchley and Leng, 1916, p. 619; Chamberlin 1939, p. 453; Schedl, 1951/52, p. 164 (= *volvulus*).

Xyleborus schwarzi Hopkins, 1915, p. 65 (holotype ♀, Florida, USNM); Blatchley and Leng, 1916, p. 620; Chamberlin, 1939, p. 453. NEW SYNONYMY.

Xyleborus rileyi Hopkins, 1915, p. 65 (holotype ♀, Florida, USNM), Blatchley and Leng, 1916, p. 619; Chamberlin, 1939, p. 452. NEW SYNONYMY.

FEMALE. Length 2.3–2.7 mm, 2.7 times longer than wide. Frons resembling *X. pini* except longitudinal carina not as evident. Antennal club as in *X. pini*. Pronotum 1.2 times longer than wide; otherwise as in *X. pini* except posterior portion smooth, not marked by scratches between punctures, punctures fine, edges regular. Elytra 1.7 times longer than wide; otherwise as in *X. pini*. Declivity as in *X. pini* except granules of first and third interspaces larger and ridge of seventh interspace more strongly developed.

MALE. Not seen.

HOST. Unknown for North American species, but probably various deciduous trees and shrubs.

DISTRIBUTION. Southern Florida (Map 12), also most tropical and subtropical regions of the world. Fifty specimens examined from: **Florida:** Biscayne Bay, Capron, Gainesville, Key West, Myakka River St. Park, Naples, and Plantation Key.

REMARKS. Females of this species may be distinguished from *X. pini* by the comparatively larger declivital granules, by the smooth posterior portion of the pronotum, and by the round pronotal punctures with trim edges.

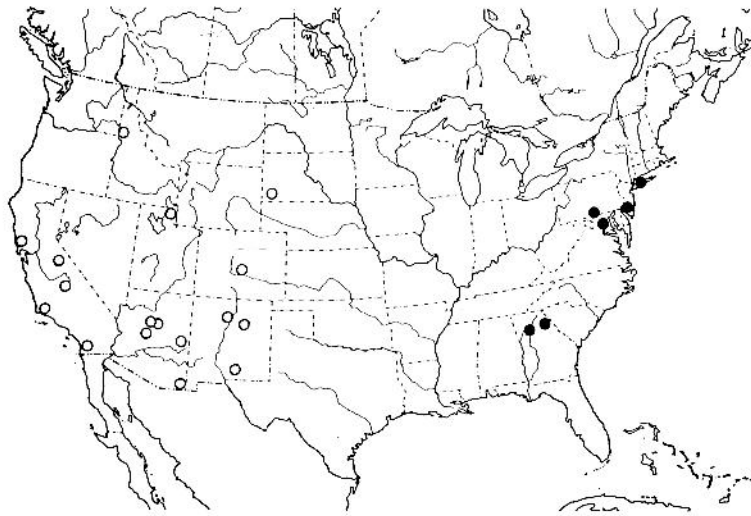
The types of *X. hubbardi*, *X. schwarzi*, and *X. rileyi* were examined. Although they do exhibit minor differences, the same range of variation was seen in most series of *X. volvulus* examined. In the absence of any consistent morphological differences, only one species can be recognized.

19. *Xyleborus howardi* Hopkins

(Map 13, Fig. 18)

Xyleborus howardi Hopkins, 1915, p. 65 (holotype ♀, Washington, D.C., USNM); Blatchley and Leng, 1916, p. 620; Chamberlin, 1939, p. 453.

Xyleborus fitchi Hopkins, 1915, p. 66 (holotype ♀, New York, USNM); Blatchley and Leng, 1916, p. 620; Chamberlin, 1939, p. 453; Beal and Massey, 1945, p. 159; Wood, 1962, p. 79. NEW SYNONYMY.



FEMALE. Length 2.2–2.7 mm, 2.9 times longer than wide. Frons minutely reticulate, shining; punctures rather large and shallow; longitudinal carina faint, indicated by a smooth, raised line. Antennal club as long as wide. Pronotum 1.1 times longer than wide; sides parallel; anterior margin broadly rounded, smooth; asperities on anterior slope low, numerous; summit prominent; posterior portion smooth and shining, punctures larger than in *X. scopulorum*, surface between punctures appearing minutely scratched. Elytra 1.8 times longer than wide; sides parallel on basal three-fourths; broadly rounded behind; stria punctures moderate in size, impressed in regular rows; interspaces smooth, shining, more than half as large as stria punctures. Declivity broadly convex, steep; lateral margins and apex rounded; first and third interspaces very feebly elevated, each with five to seven small, but prominent, sharp-pointed tubercles, these smaller than in *X. scopulorum*.

MALE. Length 1.9–2.2 mm, 2.8 times longer than wide. Frons broad, shining, minutely reticulate; punctures very faint. Pronotum 1.1 times longer than wide; sides slightly arcuate; anterior margin narrowly rounded; anterior portion flattened, very slightly concave on each side of a faintly elevated line, coarsely punctured, asperities obsolete; posterior portion smooth, faintly punctured, surface between punctures appearing very faintly scratched. Elytra 1.5 times longer than wide; sides parallel, broadly rounded behind; suture faintly impressed on disc; otherwise resembles female. Declivity resembling female except tubercles of first and third interspaces slightly larger.

DISTRIBUTION. Eastern United States (Map 13). More than 50 specimens examined from the following localities: **District of Columbia:** Washington. **Georgia:** Athens and Dunwoody. **Maryland:** Beltsville. **New Jersey:** Buena. **New York:** Long Island. **North Carolina:** "Bent Creek." **Pennsylvania:** Mt. Alto. **Virginia:** Falls Church.

REMARKS. This species is closely related to *X. scopulorum* and evidently replaces it in the eastern United States. Females of *X. howardi* are smaller and the declivital tubercles are smaller and less acute.

The types of *X. howardi* and *X. fitchi* were compared and found to represent the same species. Further comparisons of more than 50 specimens showed that no distinction of species was possible.

20. *Xyleborus scopulorum* Hopkins

(Map 13, Fig. 19)

Xyleborus scopulorum Hopkins, 1915, p. 66 (holotype ♀, South Dakota, USNM); Chamberlin, 1939, p. 455.

FEMALE. Length 2.7–2.9 mm, 2.8 times longer than wide. Frons minutely reticulate, opaque; punctures moderately numerous, faintly impressed; longitudinal carina faintly indicated by a small smooth area between eyes. Antennal club as long as wide. Pronotum 1.3 times longer than wide; sides parallel; anterior margin broadly rounded, smooth; asperities on anterior slope low, rather numerous; summit prominent; posterior portion smooth, brightly shining, punctures small, close, faintly impressed. Elytra 1.8 times longer than wide; sides parallel on basal three-fourths, broadly rounded behind; striae punctures large, distinctly impressed in regular rows; interspaces smooth, shining, punctures rather numerous, about half the size of striae punctures. Declivity broadly convex, steep; lateral margins and apex rounded; first and third interspaces feebly elevated, each with five to seven fairly large, sharp-pointed tubercles.

MALE. Length 2.2–2.5 mm, 2.8 times longer than wide. Frons broad, shining, minutely reticulate, punctures faintly impressed. Pronotum 1.2 times longer than wide; sides arcuate; anterior margin acuminate; anterior portion concave, coarsely punctate, finely asperate toward summit and on sides; posterior portion smooth, very finely punctate. Elytra 1.5 times longer than wide; sides parallel, broadly rounded behind; suture depressed below elytral surface on posterior half of disc; otherwise resembles female. Declivity resembling female except suture depressed on upper portion and tubercles of first and third interspaces slightly larger.

HOSTS. Various western conifers. Specimens seen from *Pinus* and *Pseudotsuga*.

DISTRIBUTION. Western United States (Map 13) and Mexico. More than 200 specimens from many localities were examined from the following states: **Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, South Dakota, and Utah.**

REMARKS. This species is closely related to *X. howardi* but the females differ by their larger size, by the larger declivital tubercles, and by the western distribution.

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