

Draft guide to Identification of Coffee berry borer from similar bark beetles in Papua New Guinea (Version 0.1)

Andrew Johnson, Craig Bateman and Jiri Hulcr

Introduction

The coffee berry borer (CBB), *Hypothenemus hampei*, is a serious pest of coffee worldwide. It is present in every coffee growing region except Papua New Guinea. Correct Identification of CBB in PNG is an essential part of preventing it establishing and harming the coffee industry. There are, however, many similar and mostly harmless bark beetles already present in PNG which will fly into CBB traps.

CBB is in a notoriously difficult genus of bark beetles called *Hypothenemus*. The majority of this genus feed on dead plant material, and are not a significant pest. The other economically significant *Hypothenemus* species is the Tropical nut borer (TNB), *Hypothenemus obscurus*

There are other bark beetles which may also be confused with the coffee berry borer. This guide aims to assist the identification of CBB as well as similar bark beetles likely to be encountered and confused with the coffee berry borer. This will assist in identification of similar genera, although not identification to species.

Morphology of the Coffee berry borer

This section will describe the important morphological characters needed to identify CBB from similar bark beetles. For specialist terms used in the descriptions, see the glossary.

See the figures and glossary for information on the technical terminology used in this guide.

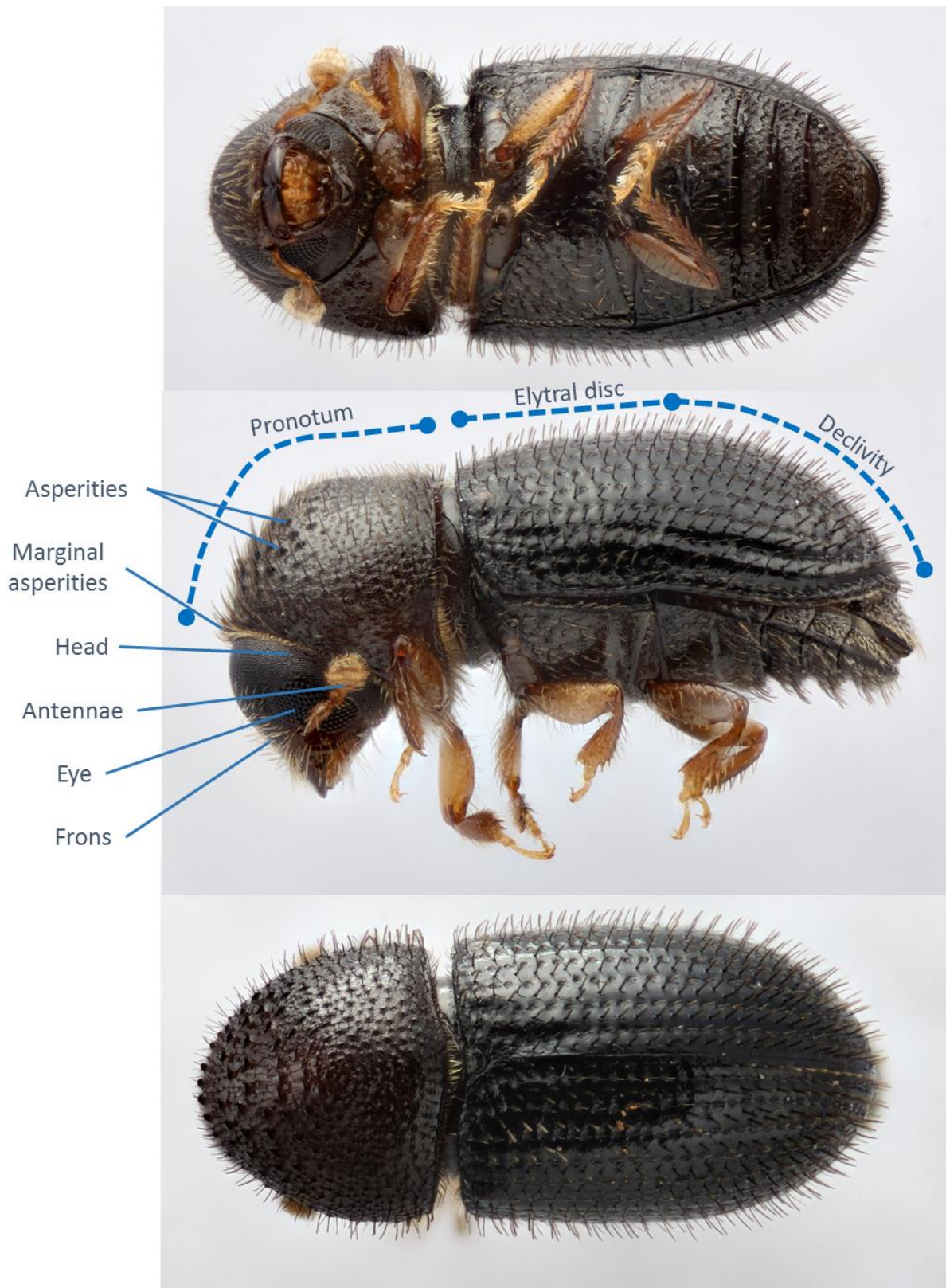


Figure 1. Labelled diagram of the Coffee Berry Borer (CBB), *Hypothenemus hampei*. Specimen from East Java, Indonesia. Photos by AJJ.

Eye and Antennae

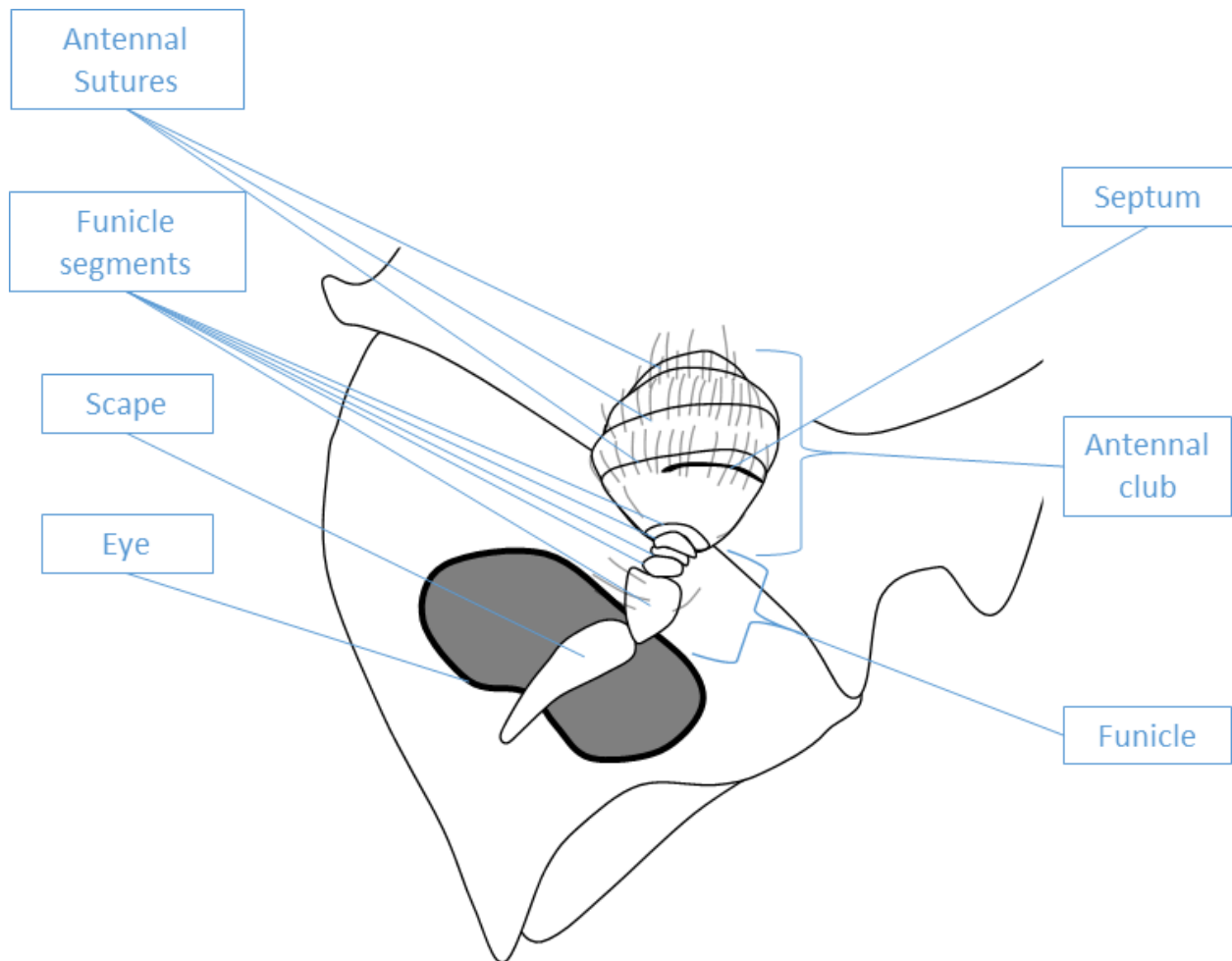


Figure 2. Labelled diagram of coffee berry borer eye and antennae.

The morphology of the eye and antennae are very important for identification of bark beetles to genus. Figure 4 illustrates these differences. This is useful to distinguish *Hypothenemus* from other bark beetles, but not CBB from other *Hypothenemus*, since there is little variation within the genera.

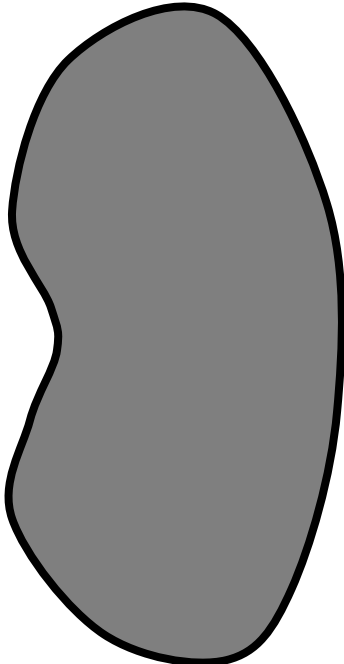
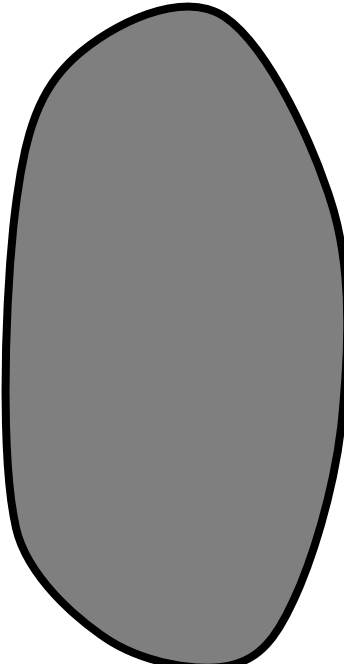
Emarginated	Entire
	
Eye is notched	Eye is not notched, the margin is rounded

Figure 3. Differences in eye shape between some bark beetles. CBB has an emarginated eye.

Important characters are the shape and presence of a partial septum and sutures. *Hypothenemus* have three sutures marked with setae, and a septum visible as a dark line. This can be difficult to see with poor quality specimens, or specimens with very dark antennae. The septum is sometimes easier to see when specimens are in ethanol.



Figure 4. Eye and antennae of bark beetle genera similar to CBB. From top left, *Hypothenemus*, *Cosmoderes*, *Cryphalus*, *Scolytogenes*, *Coccotrypes* and *Xylosandrus*. Diagram drawn by AJJ.

Setae on the elytra

The shape and arrangement of the setae on the elytra is important for identification of CBB from other *Hypothenemus* species. Very few *Hypothenemus* species have the same setae and arrangement as CBB. All *Hypothenemus* have a mixture of different setae types (see Figure 5). The striae setae are always in perfect rows, and are normally small and hair like, and curved. The interstriae bristles are also usually in perfect rows, and are larger and erect. Most *Hypothenemus* have interstriae bristles which are flattened and widened at the tip. CBB has interstriae bristles which are straight and slightly flattened, but not wider at the tip. The third type of setae are absent in CBB, and present in many other *Hypothenemus*. These setae are usually only on the declivity, and are not always in neat rows.

One species of *Cryphalus* similar to CBB can be easily distinguished by the elytra. On the sides, the striae setae are not in perfect rows.

It is likely that some *Scolytogenes* species from New Guinea would also have setae similar to CBB. All species found so far have interstriae bristles which are slightly curved, and are much shorter on the elytral disc than on the elytral declivity, whereas CBB have them all of a similar size. They can also be distinguished by the eye and antennae, plus the separation of the mesocoxae.

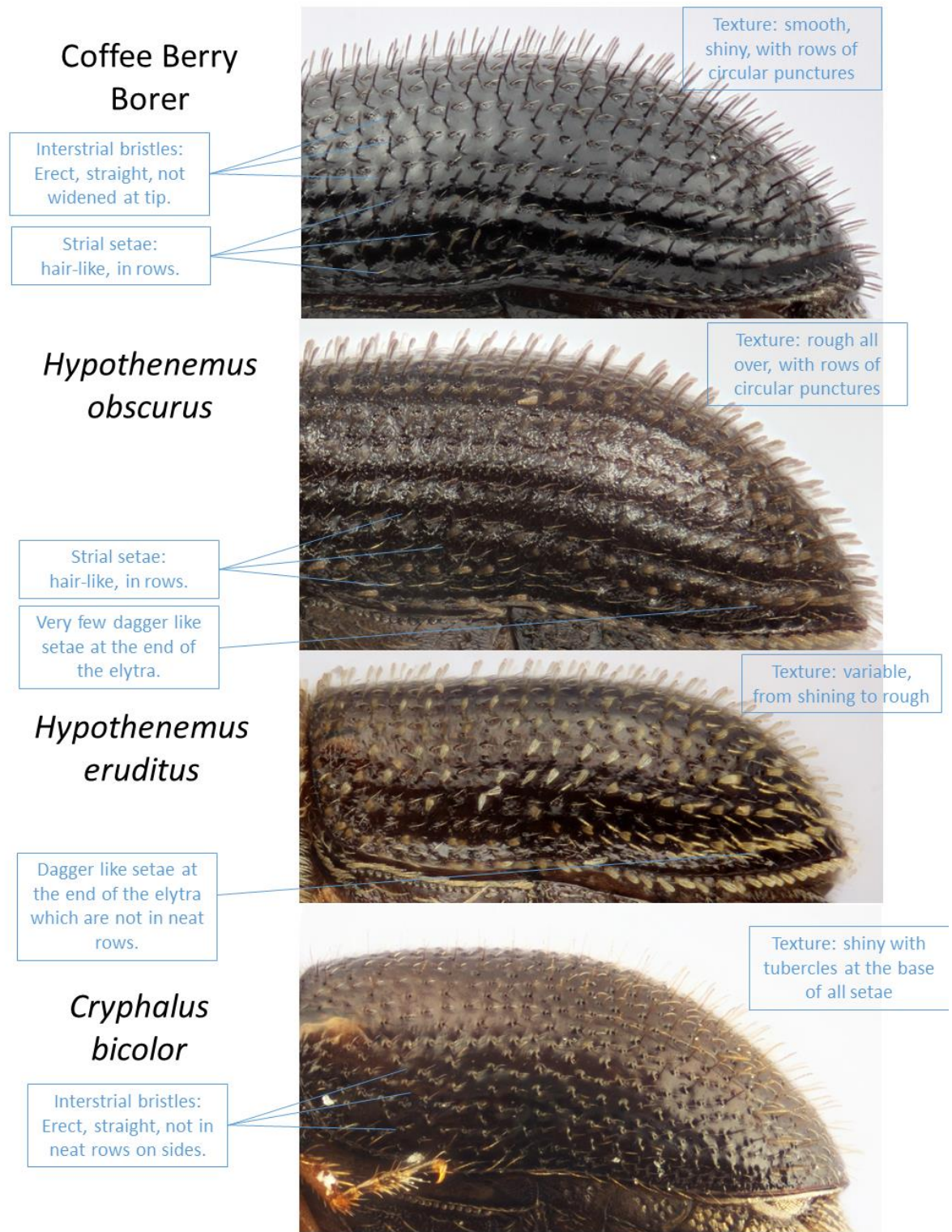


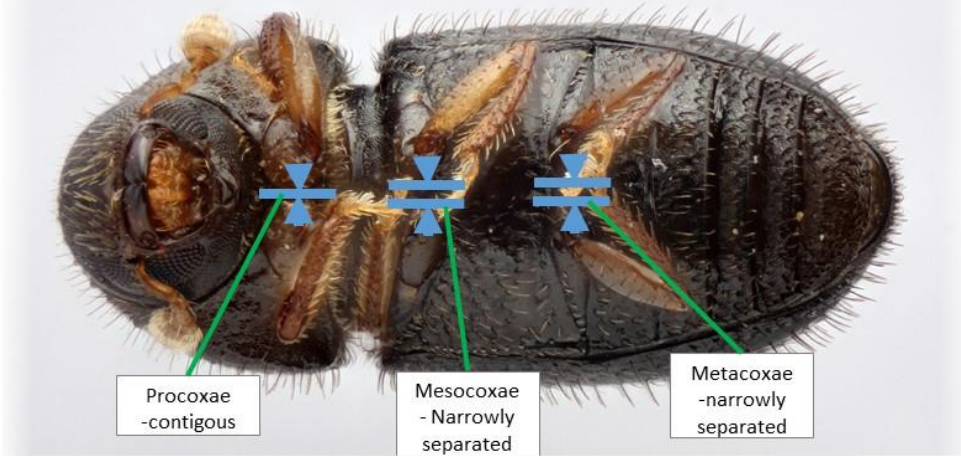
Figure 5. The elytra of CBB and similar bark beetles. The shape of the interstitial bristles and the texture of the elytra are useful characters for identification of CBB from similar beetles.

Other important characters

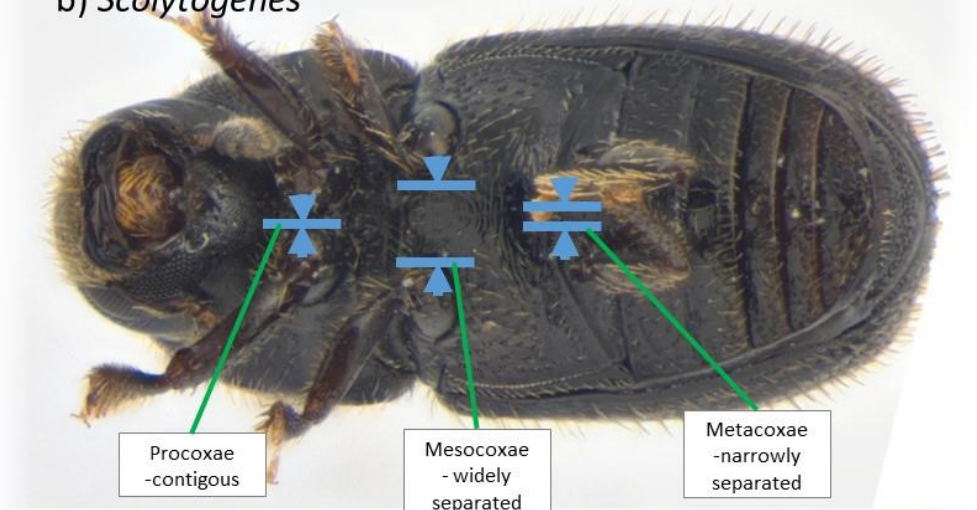
The coxae are a character which can help identify some genera. The procoxae of CBB are contiguous, meaning they are touching under normal conditions, although they may be separated if the forelimbs are held apart. Species with separated procoxae can never be contiguous. This is especially obvious in some genera such as *Xylosandrus*. The mesocoxae and metacoxae of *Hypothenemus* including CBB are separated by a similar distance. For many *Scolytogenes* species, and some *Cryphalus* species, the mesocoxae are much further apart than the metacoxae.

The legs are also a useful character for distinguishing *Hypothenemus* from other genera, but not CBB from other *Hypothenemus*, particularly the hind tibia. This requires a good microscope with diffuse lighting, or the legs mounted on a slide. *Hypothenemus* have very few spines on the legs. These are usually only at the apex of the leg. The shape is also narrow and quite straight. Many other genera have spines which extend at least a third of its length at the apex, and are usually broader with a rounded edge.

a) *Hypothenemus*



b) *Scolytogenes*



c) *Xylosandrus*

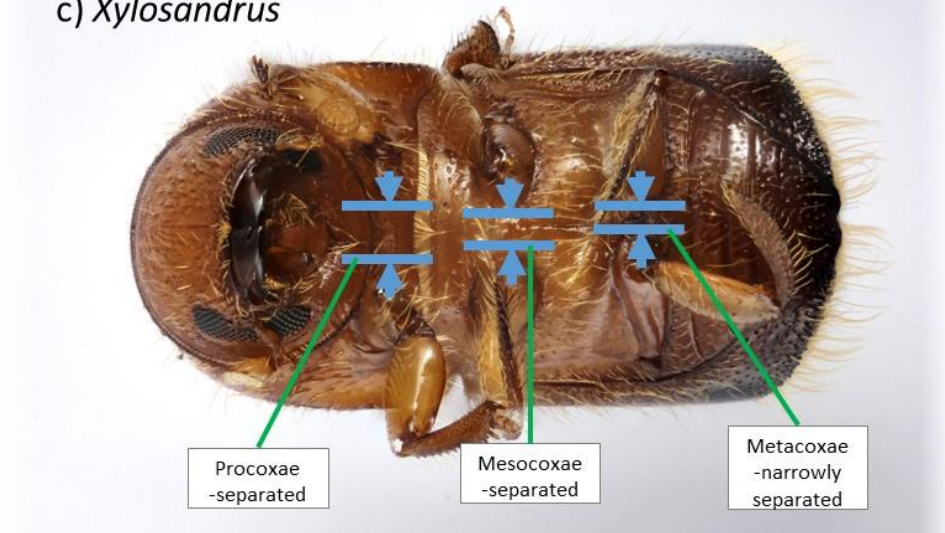


Figure 6. The Separation of the coxae is useful to tell some genera apart. Not shown are *Cryphalus*, which usually is the same as A (rarely B), *Cosmoderes* and *coccotrypes* which are also the same as A. Photos by AJJ.

Morphology of male CBB

Male *Hypothenemus* spend their entire life in the coffee bean. They are unlikely to be found on their own.

They can be easily distinguished from the females by their smaller size (typically 1.2mm), smaller eye, and shorter body shape.



Figure 7. Male coffee berry borer. Photo by AJJ.

Male *Hypothenemus* are often very difficult to identify to species because they usually have different morphology from the females. For many species, the males not described or known. Generally, however, they have longer setae, which is sometimes not flattened, and similar to that of CBB. Therefore, males should never be used for diagnosis or identification of CBB.

The Tropical Nut Borer (TNB), *Hypothenemus obscurus*

The tropical nut borer (TNB) is another pest species of *Hypothenemus* which is not yet known from PNG or Australia. It is of particular concern to the Macadamia nut industry, where it causes millions of dollars of damage in Hawaii where the TNB was recently introduced.

This species is much more difficult to distinguish from other *Hypothenemus* than CBB, due to many species sharing similar characters. Generally, it can be identified by the size (1.3 to 1.8mm), the flattened setae in rows, the very rough microtexture of the elytra, and the presence of very few dagger-like interstitial setae on the declivity. Molecular barcodes are available for this species (Mitchel and Maddox, 2010?) for molecular based identification.

Other bark beetles in the genus *Hypothenemus*

The species diversity of *Hypothenemus* is mostly in Africa and the Americas. There are 10 named species recognized from the Austro-Pacific region (Hulcr et al, 2015), and there is likely to be many cryptic species which cannot be easily distinguished.

Most species live in twigs and vines. They usually feed on a very wide range of host species.

They can be distinguished from other bark beetles by the antennae with sutures and a septum, the emarginated eye, the presence of asperities on the margin and slope of the pronotum, the contiguous procoxae and closely separated mesocoxae, and the hind tibia which have almost no spines except at the end.

New galleries usually contain just one beetle, a female. Some new galleries of *H. birmanus* collected in Aiyura contained multiple females. Most species have males which are much smaller than the females, and never leave the gallery.

The species most commonly found in New Guinea are *Hypothenemus birmanus* and *H. eruditus*

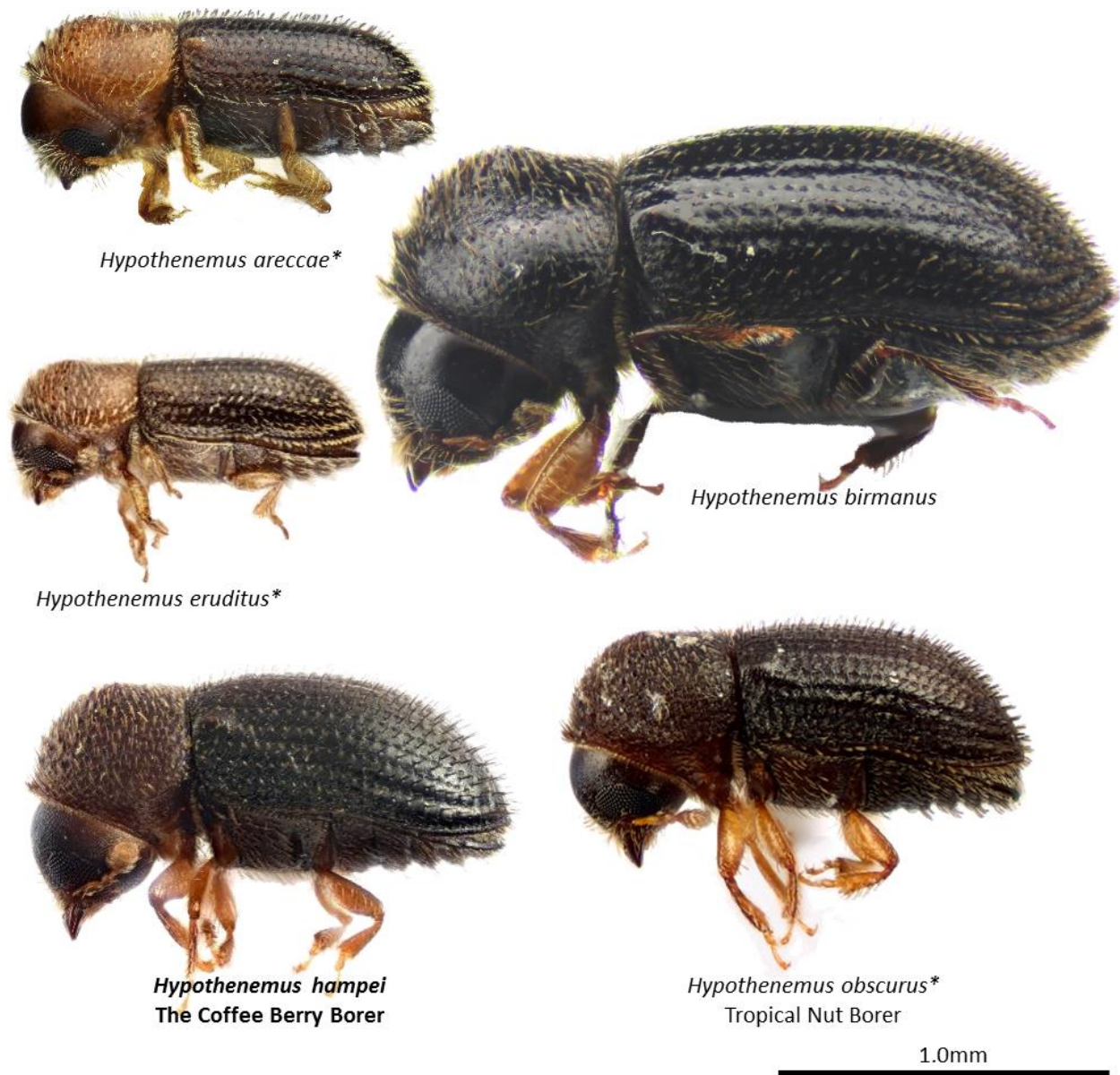


Figure 8. Examples of *Hypothenemus* species found in New Guinea. Photos by AJJ.

Similar genera: *Cryphalus*

Cryphalus are very common and diverse in PNG. They can be distinguished by the antennae, which have sutures but do not have a septum (see Figure 4). The majority of species also have dense, short interstitial ground vestiture.

Most species also have their third tarsal segment bilobed extending either side of the fourth tarsi, whereas *Hypothenemus* always has a single lobe projecting under the fourth tarsi. This is however not clear in some species, especially those that are very small.

There are also two other genera, *Margadillius* and *Hypocryphalus* which are essentially the same as *Cryphalus* with five or three funicle segments respectively.

New galleries usually contain two beetles, a male and a female.

Host: *Cryphalus* are usually found under bark or pith of twigs of trees, although some species are found in vines or herbaceous material. Most species feed on only one type plant. There are many species which feed on many different trees.

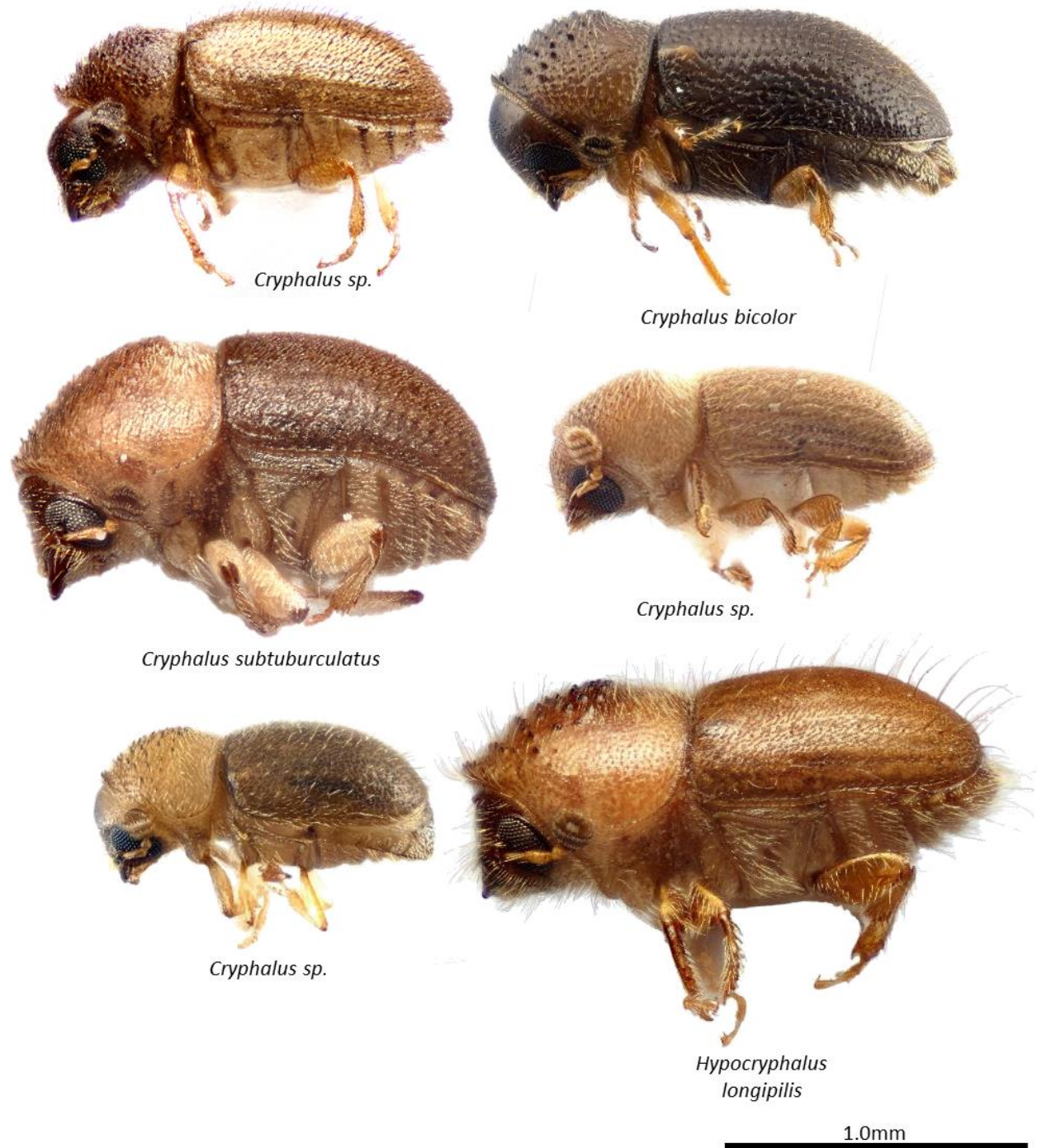


Figure 9. Examples of *Cryphalus* species found in New Guinea. Photos by AJJ.

Similar genera: *Cosmoderes*

Cosmoderes is closely related to *Hypothenemus* (Johnson et al, in prep). It lives very differently, with both males and females of a similar size and both able to fly. New galleries will usually contain two beetles, one male and one female.

They can easily be distinguished from *Hypothenemus* by the antennae, which the antennal club is large and completely without sutures, and the antennal funicle is short with just two segments

They are commonly collected in vines, and will occasionally fly into CBB traps.



Figure 10. Examples of *Cosmoderes* species very similar to those found in New Guinea. Photos by AJJ.

Similar genera: *Scolytogenes*

Scolytogenes is a very diverse genus with lots of variation in shape and size. They can be identified by their antennal club which does not have sutures, and does have a septum (Figure 4). The mesocoxae are usually much more widely separated than the metaxocae (illustrated in Figure 6)

Ptilopodius is a similar genus which lacks the septum on the antennae, but otherwise very similar to *Scolytogenes*. They are easily distinguished from *Cosmoderes* by the antennae with three or more funicle segments, and the smaller antennal club, and the widely separated mesocoxae. They are also typically smaller than most *Scolytogenes*

Scolytogenes species usually feed on one particular type of plant. Some species live under the bark, while others live in the large leaves. New galleries usually contain two beetles, a male and a female.



Scolytogenes sp.



Scolytogenes papuanus



Scolytogenes sp.



Scolytogenes sp.



Scolytogenes sp.



Ptilopodius sp.



Ptilopodius sp.

1.0mm

Figure 11. Examples of *Scolytogenes* and *Ptilopodius* found in New Guinea. Photos by AJJ.

Similar genera: *Coccotrypes*

Coccotrypes are a very diverse genus found throughout the tropics. They live in a wide range of host materials, with some species in bark, some in petioles and many living in seeds. The seed feeding species in particular are often a similar shape to CBB.

The antennae of *Coccotrypes* also lack a septum, and the hind tibiae are widened and have several spines which are not restricted to the very end as in CBB. Many species also have a flattened pronotum.

New galleries usually contain only one beetle, a female. The males are much smaller and mate with their siblings, and do not usually leave their gallery.



Figure 12. Examples of species in the genus *Coccotrypes*. Photos by AJJ.

Similar genera: *Xylosandrus*

Xylosandrus are one genus in a very diverse group of ambrosia beetles (Tribe Xyleborini). They are one of the most commonly collected bark beetles in traps. They can be pests to stressed trees. In particular, *Xylosandrus compactus* usually attacks and kills living twigs. Occasionally this species also goes into coffee berries.

They all have a very large head and pronotum, which is almost as big as the elytra. They can be identified by their widely spaced procoxae (Figure 6). This is especially obvious in *Xylosandrus compactus* and *X. morigerus*, but only narrowly separated in *X. crassiusculus*. There are many other genera of beetles which have a very similar appearance, but do not have separated procoxae.

New galleries usually contain only one beetle, a female. The males are much smaller and mate with their siblings, and do not usually leave their gallery. The galleries of *Xylosandrus* usually are in twigs or branches, going into the wood or pith, where the beetles farm fungi for nutrition.

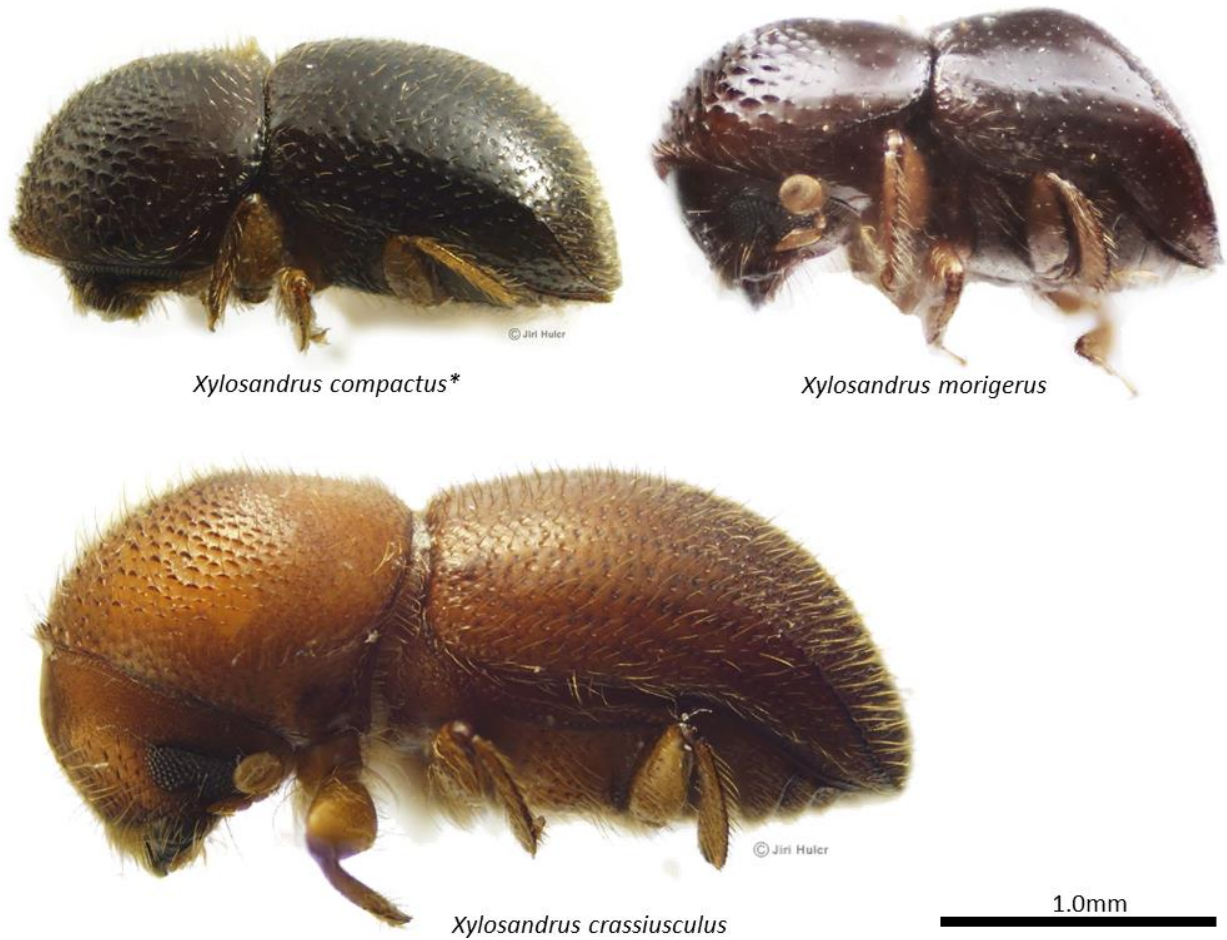


Figure 13. Examples of species of *Xylosandrus* present in New Guinea. Photos by Jiri Hulcr and AJJ.

Other Scolytine genera.

There are thousands of species of bark beetles, with hundreds present in PNG. The other genera present in PNG should be easily distinguished from the coffee berry borer.

Xyleborini in particular are very diverse, and are routinely caught in CBB targeted traps due to their attraction to ethanol. For a Comprehensive guide to the genera and species of Xyleborini, see the book by Hulcr and Cognatio (2012)



1.0mm

Figure 14. Examples of Other Scolytine genera. Show above are *Ficicis porcatatus* and *Xyleborus affinis*. Photos by AJJ.

Glossary

Antennal club	The widened, large part at the end of the antennae
Coxae	The part which the leg joins the body
Elytron (Plural = Elytra)	The hard wing case of a beetle.
Emarginated	Notched. This ius normally used to describe the shape of the eye, where the notch is usually around or above the base of the antennae.
Funicle	the part of the antennae between the scape and the club, which is made up of two or more funicle segments including the pedicel

Interstrial bristles	The setae found along the interstriae of the elytra. These are the largest and most prominent setae on the elytra of CBB.
Pedicel	The second segment of the antennae, which is usually round and wider than the others. It is also the called the first funicle (or funicular) segment.
Pronotum	The upper surface of the first segment of the thorax. In bark beetles, this is large and looks like a helmet over the head.
Scape	The first segment of the antennae, which is usually elongate.
Setae	The hairs, scales or bristles of an insect