The Beetle Problem

Species Identification & Trait Segmentation

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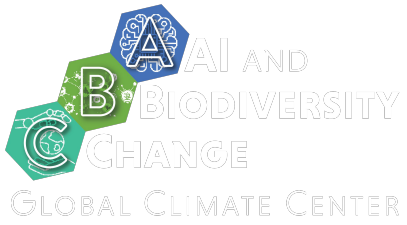


Background

- NEON sites collect beetle samples
- Processing the samples MANUALLY is impractical

Key challenges:

- Species identification takes 45 mins to several hours per specimen.
- Morphological traits measurement is tedious and hard.

As a result, tens of thousands of specimens in the NEON biorepository remain underutilized for ecological research.

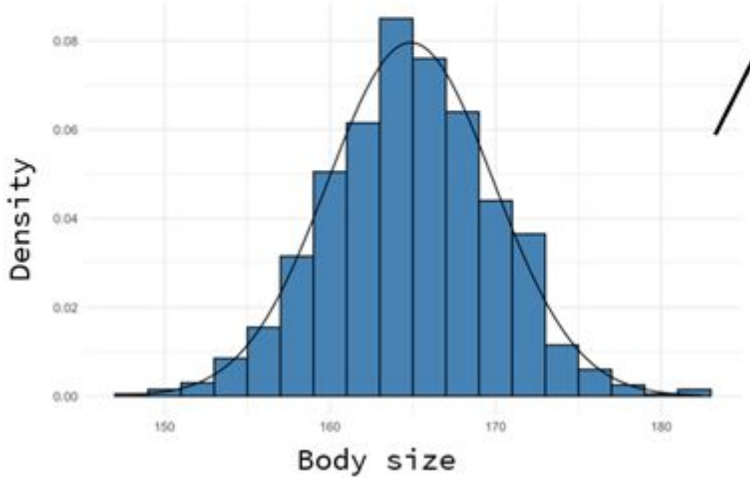
Research Question

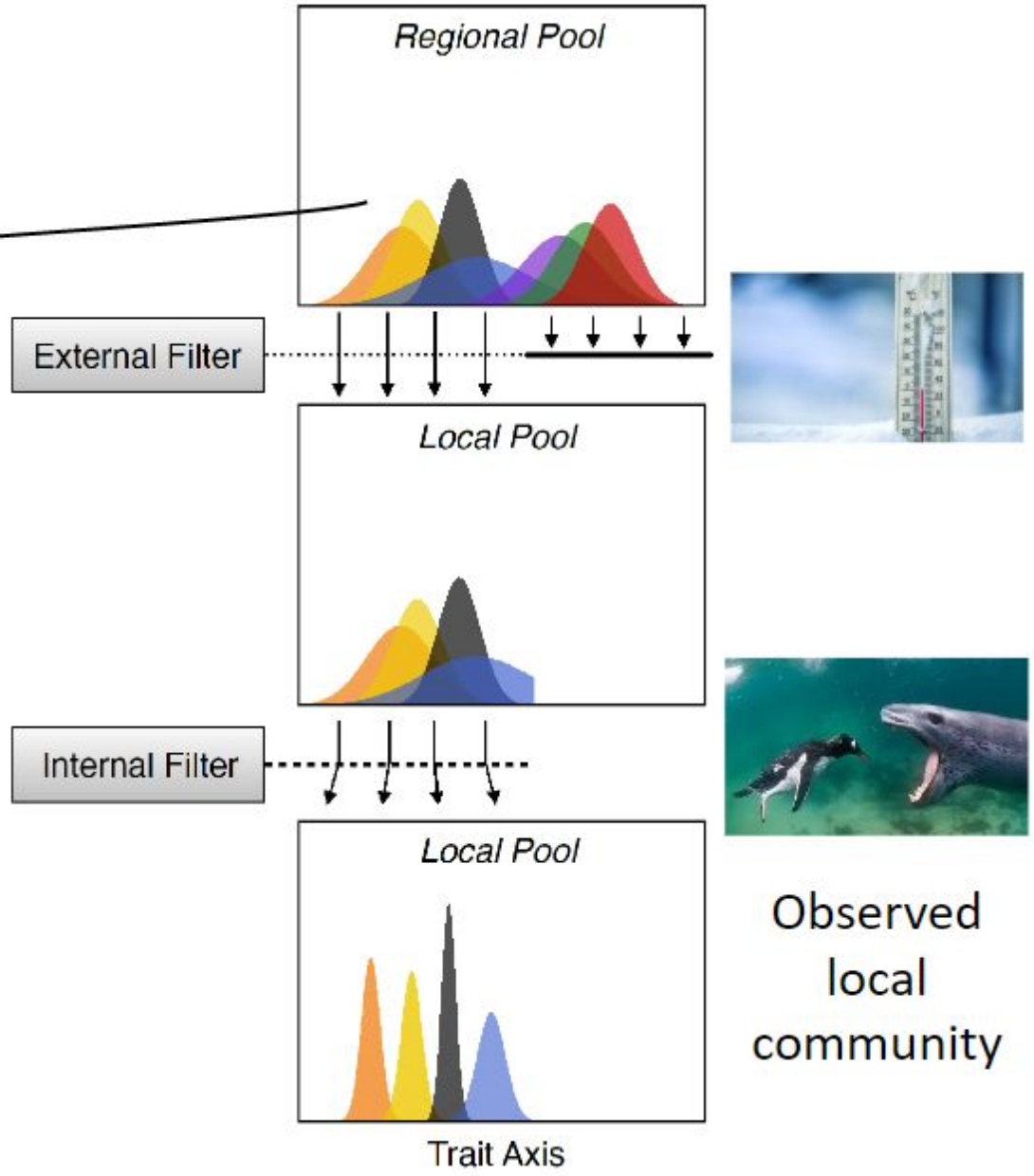
How can AI and foundation models streamline the process of morphological trait segmentation for biodiversity analysis, particularly focusing on Hawaiian beetle species?

Additional: Can we finetune BioClip or any foundation model for identification of hawaiian beetle species?

Slide taken from Easy Traits: BeetlePalooza'24

WHY?





Observed local community

Project Goals

1. *Develop a pipeline for precise segmentation and measurement of key beetle traits, such as body size, abdomen size, thorax size, and elytra length &width.*
2. *Fine-tune existing foundation models (e.g. BioClip) to help identify Hawaiian beetle species with a greater level of accuracy.*

Method : Fieldwork

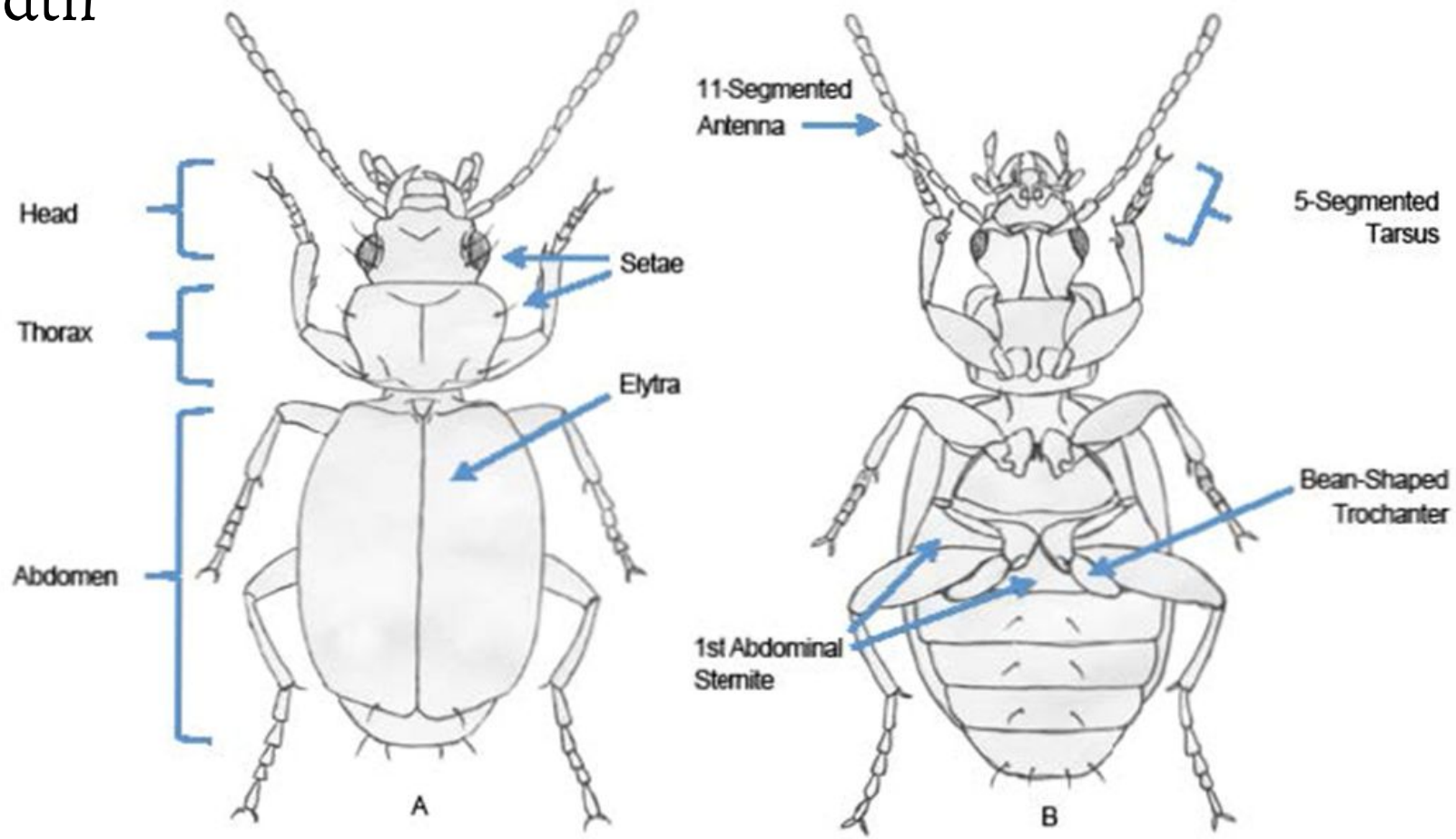
- Beetles are not sampled in winter at NEON-PUUM site
- We will not be collecting new pit trap samples

Method : Labwork

- Trait Measurement of already collected & processed samples

Labwork: Measure Traits

- Elytra Length & Width
- Full Body Size
- Abdomen size
- Thorax Size



Images taken from Easy Traits : BeetlePalooza'24

Labwork: Step. 1 Segment Beetle

Individual Beetle

Segmented Beetle

Beetle (NO BG)

Images taken from Easy Traits : BeetlePalooza'24

Labwork : Step. 2 Segment Elytra

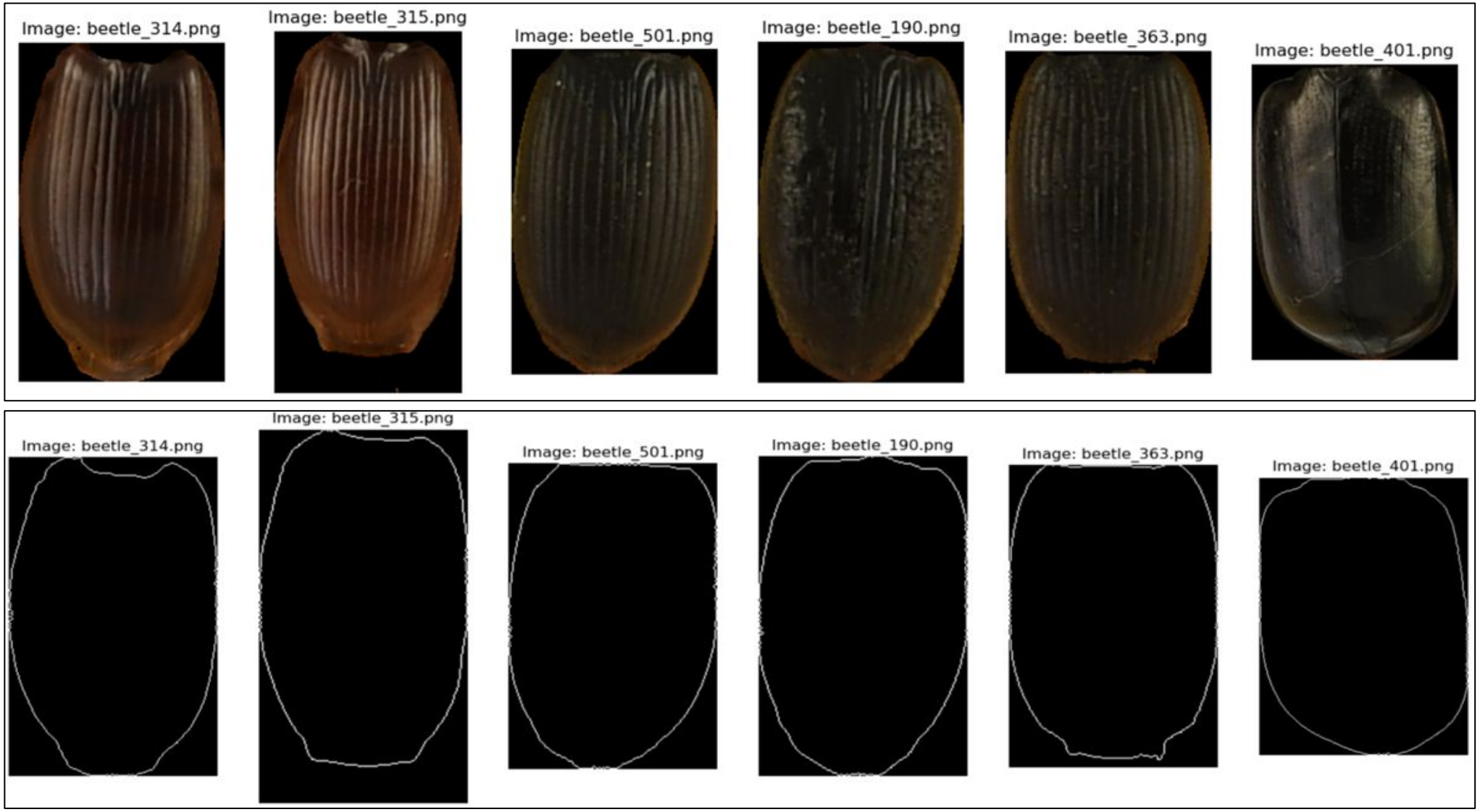
Beetle (NO BG)

Elytra Segmented

Elytra

Images taken from Easy Traits : BeetlePalooza'24

Labwork : Step. 3 Elytra Edge Detection



Images taken from Easy Traits : BeetlePalooza'24

Labwork : Step 4. Landmarks, length & width

Image: beetle_314.png
Area: 39905.50
H: 285 W: 173
Shoulder: 138.00

Area : 0.23
H: 0.68 W: 0.41
Shoulder: 0.33

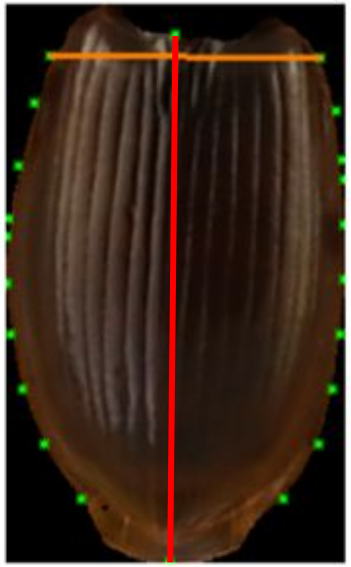


Image: beetle_315.png
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Shoulder: 116.00

Area : 0.17
H: 0.60 W: 0.34
Shoulder: 0.28

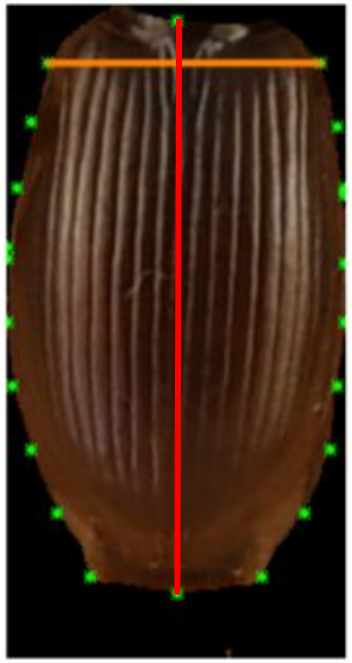

Image: beetle_501.png
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Shoulder: 132.00

Area : 0.60
H: 1.06 W: 0.67
Shoulder: 0.57

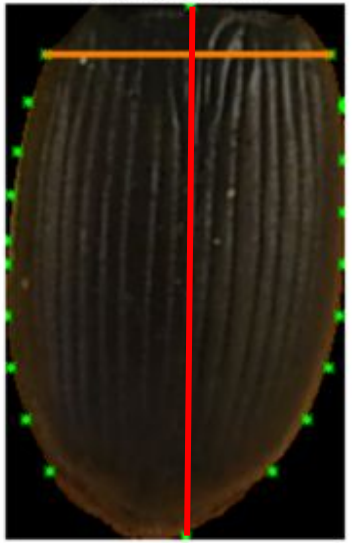

Image: beetle_190.png
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Shoulder: 120.00

Area : 0.56
H: 1.06 W: 0.64
Shoulder: 0.52

Image: beetle_363.png
Area: 32900.50
H: 241 W: 158
Shoulder: 133.00

Area : 0.61
H: 1.03 W: 0.68
Shoulder: 0.57

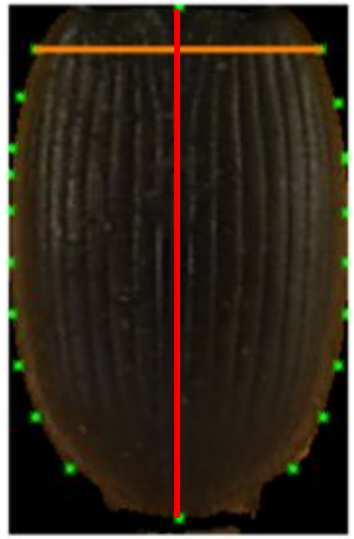
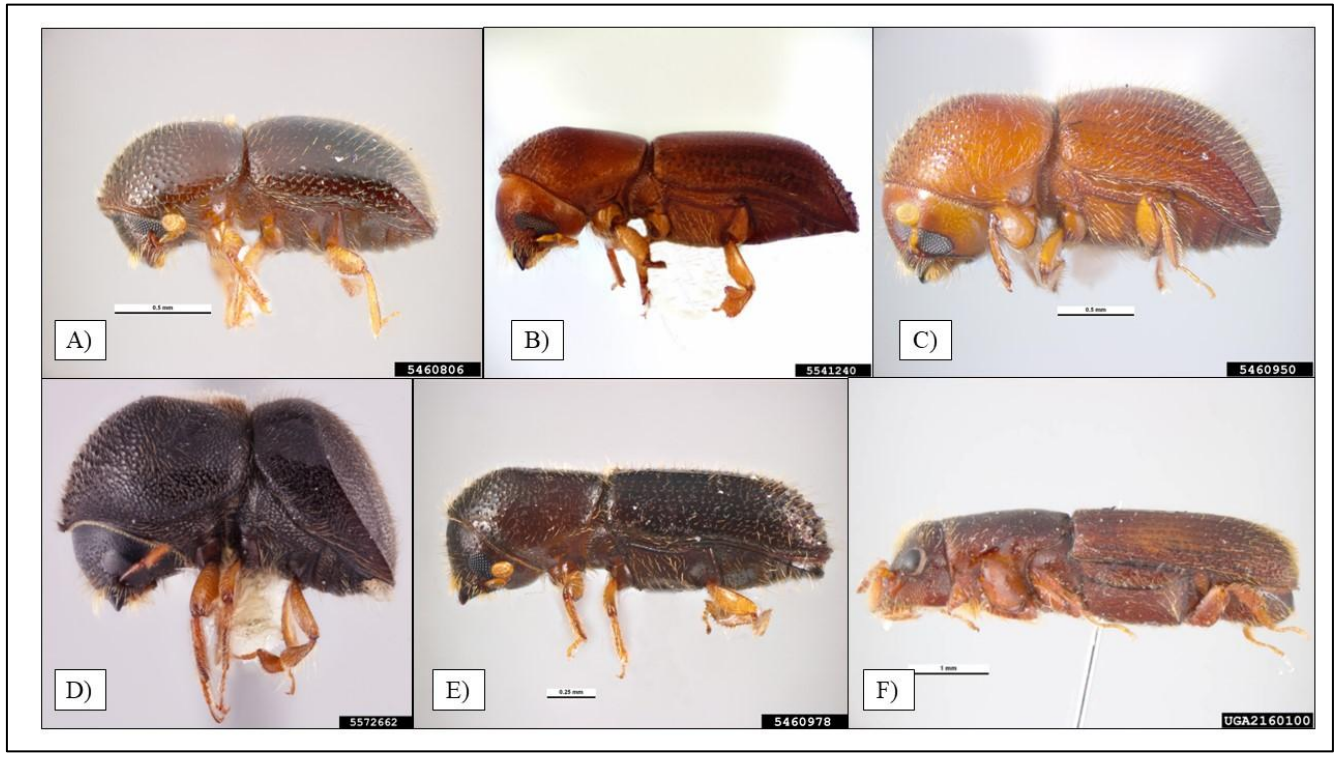
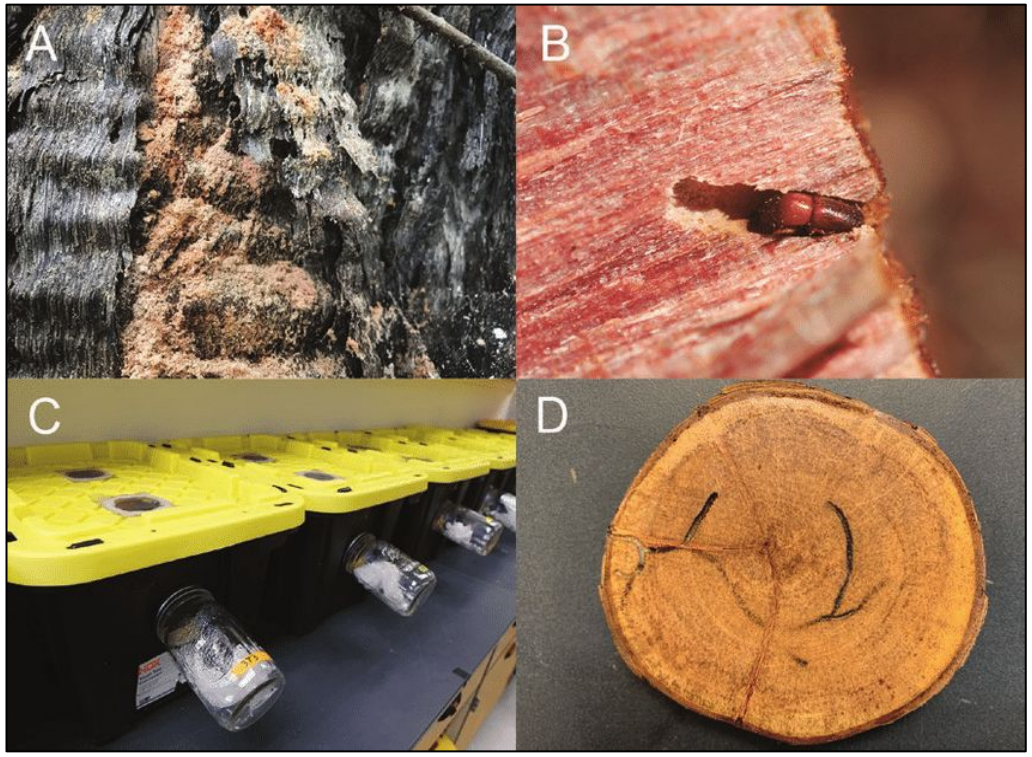


Image: beetle_401.png
Area: 57529.00
H: 311 W: 217
Shoulder: 180.00

Area : 1.16
H: 1.39 W: 0.97
Shoulder: 0.81

More: Hawaiian Beetle Identification





Ambrosia Beetle (L) and Rapid ʻōhiʻa Death (ROD)

More: Hawaiian Beetle Identification

Coconut Rhinoceros Beetle (CRB)

Thank You ...