Earthworm Burrow Morphology Through 3D Imaging

Sarah Hill, Ian Leslie, Chris Baugher, Jodi Johnson-Maynard

REACCH
Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

University of Idaho

Earthworms

- There are about 2,700 species of earthworm
- Ecological groups: Anecic, Endogeic, Epigeic
- Ecosystem Engineers
- Presence indicates soil quality
- Indicators of soil health.
- Earthworms affect aeration, hydrology, root penetration

Issues with studying earthworm burrows

- Current methods use CT Scanners
  - Expensive
  - Hard to access
  - Size limitations (complicates field work)
- Finding new methods can make studying more widely available.

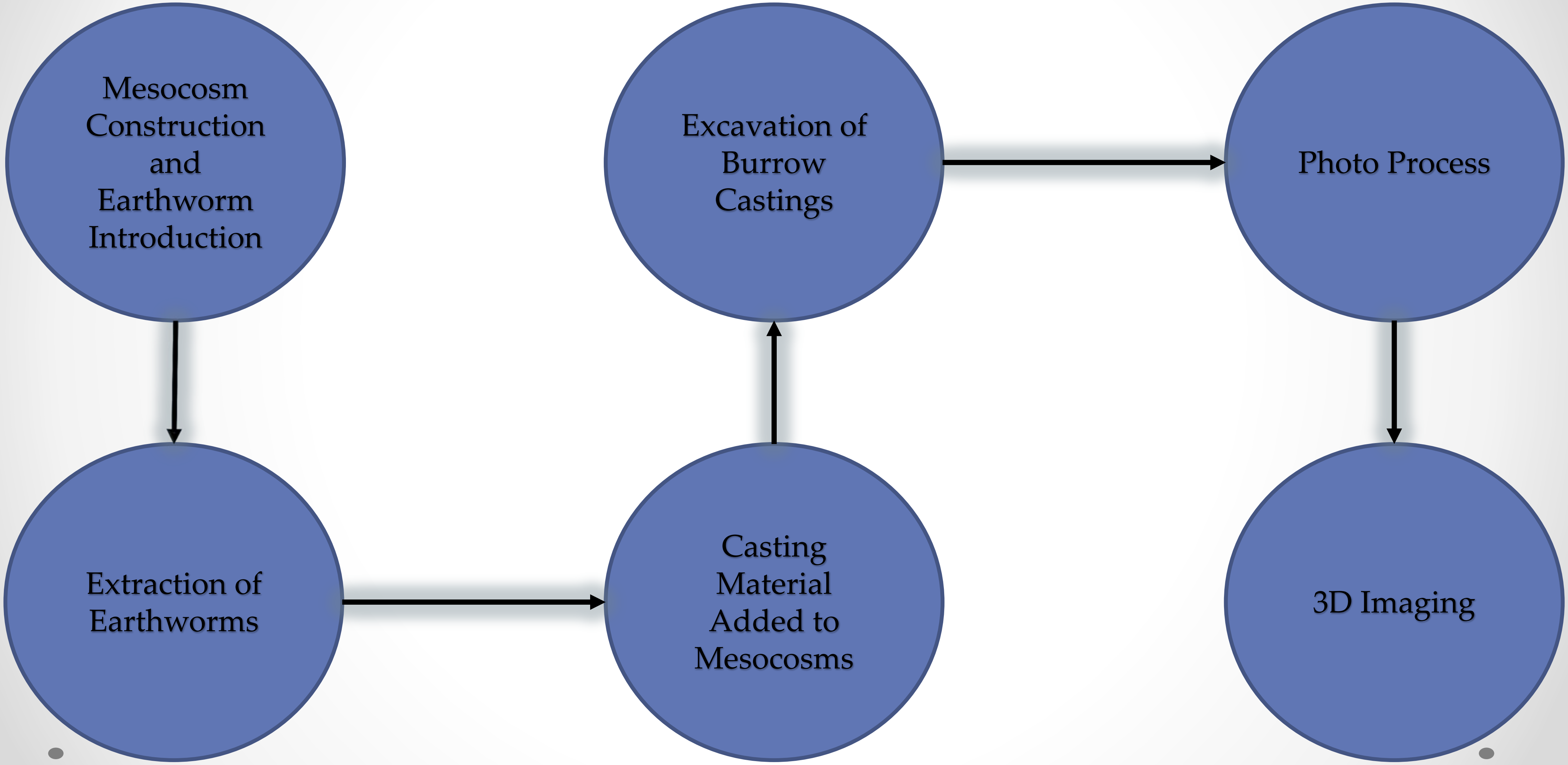
Objectives

1. Prove photogrammetry works with "simulated burrows"
2. Determine methods of creating a burrow casting
3. Produce a 3D model of a burrow casting
4. Obtain accurate volume from 3D model

Methods

- "Buff material" simulated burrow
  - Percent Difference between actual and model: 2.98%
- Rubber simulated burrow
  - Percent Difference between actual and model: 4.46%
- Species Used:
  - *Lumbricus terrestris*: large and create vertical burrows
  - *Aporrectodea trapezoids*: small, create horizontal burrows, backfilling and branching
- Casting Material: Dental Labstone

Workflow


Mesocosm Construction and Earthworm Introduction
Extraction of Earthworms
Casting Material Added to Mesocosms
Excavation of Burrow Castings
Photo Process
3D Imaging

Mesocosm Construction and Earthworm Introduction

- Soil was added to PVC pipe with an end cap and a wick
- Soil was conditioned for a week
- Earthworms were introduced
- Mesocosms incubated for four weeks

Earthworm Extraction

- Peristaltic pump used to raise water at a slow rate
- *Lumbricus terrestris* surfaced
- *Aporrectodea trapezoides* did not surface

Filling of Mesocosms With Casting Material

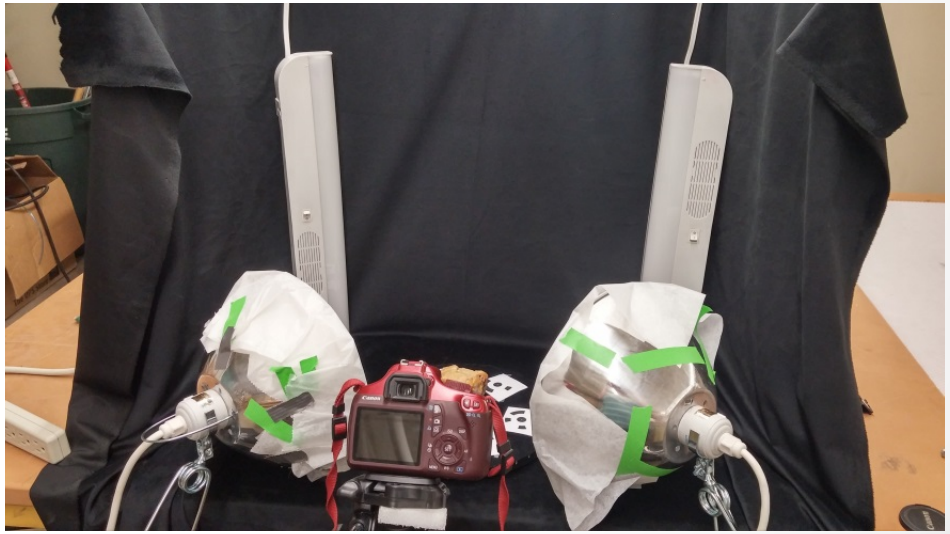
- Two different ways were used to fill the burrows
  - Syringe (fast filling)
  - Pipette (slow filling)
- Concentration of 400g/1L and 600g/1L

Burrow Castings Excavation

- PVC cut using a dermal
- Soil excavating very slowly and carefully

Photogrammetry

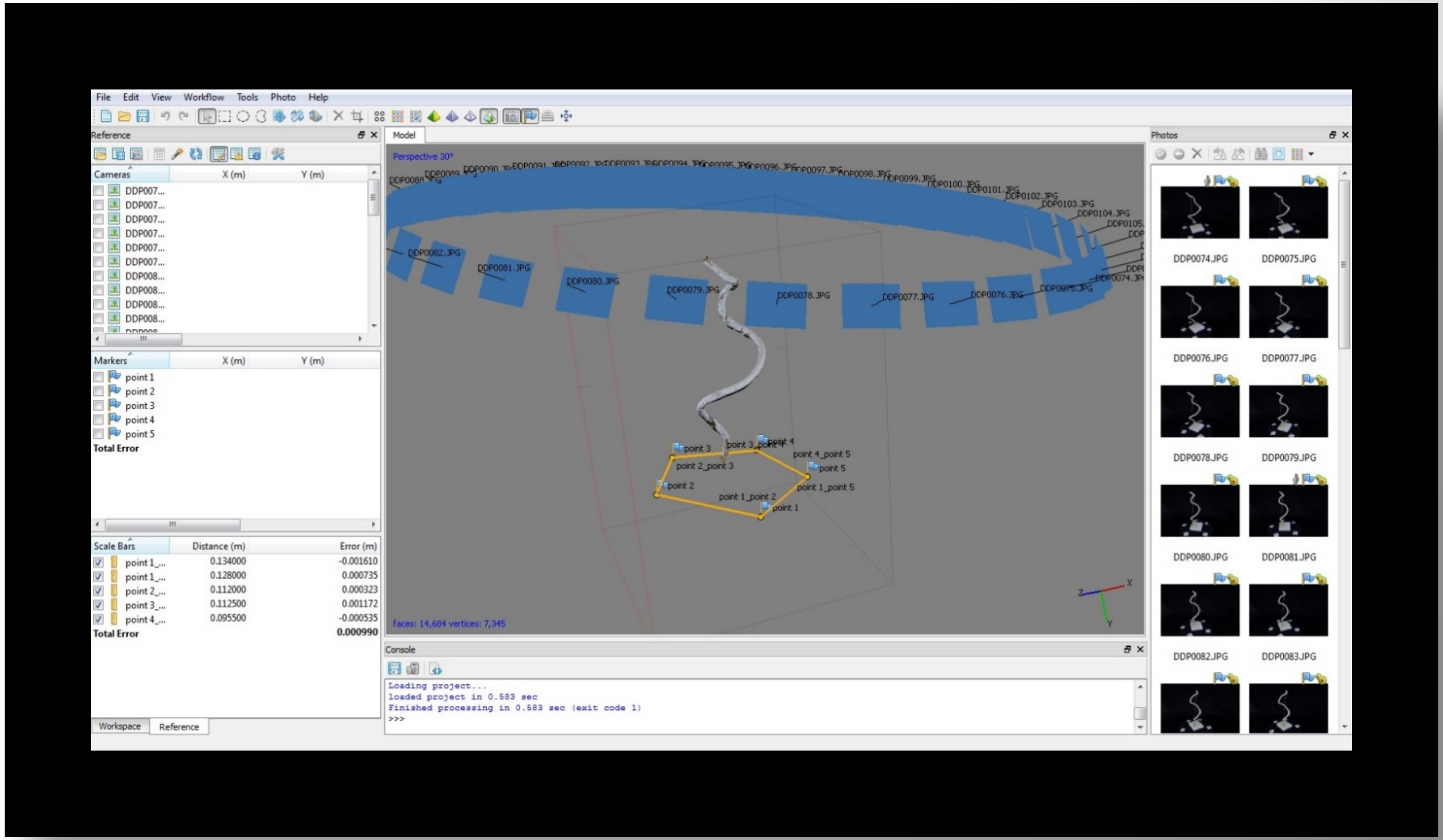
- Turntable used to rotate burrow structure



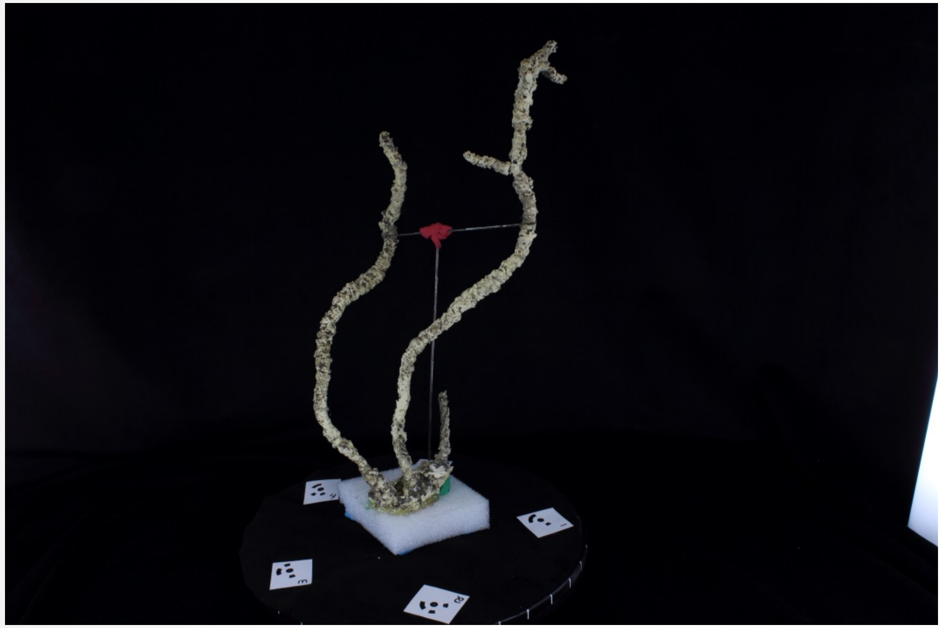
- Photos taken at different degrees to catch more detail

3D Imaging & Video Capture

- Photos were converted into different formats
- Imported into software
- 3D model was created
- Video capture software used to take videos
- Photos -> Model about 3 hours



Mesocosm Results (*Lumbricus terrestris*)

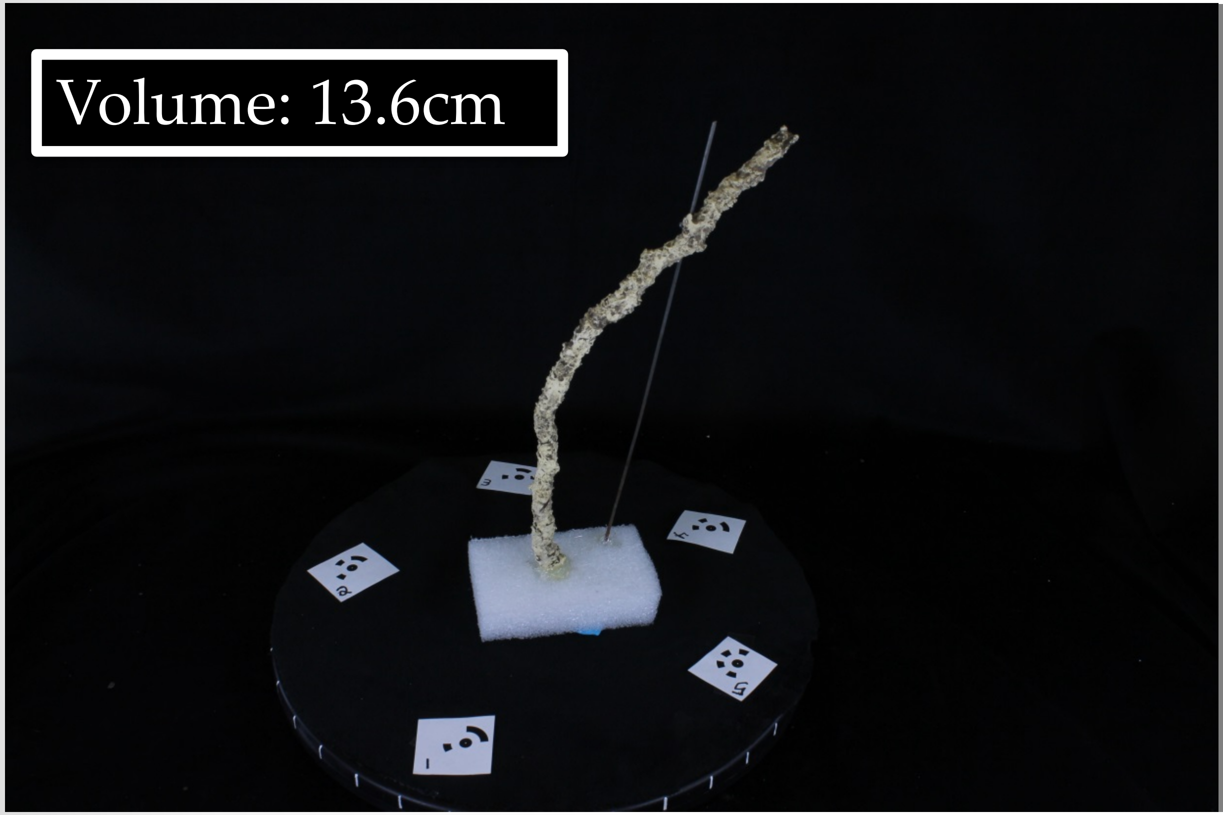


3D Software Calculated Volume: 58 cm

Mesocosm Results (*Lumbricus terrestris*)

Percent Difference: 5.3%

Mesocosm Results
(*Lumbricus terrestris*)



Percent Difference: 1.45%

Mesocosm Results (*Aporrectodea trapezoides*)

- Found the earthworms that didn't come out during saturation

- Burrows were not completely filled, very fragile

Extension

- Research Question: Can photogrammetry be used to understand earthworm burrows?
- Importance: Drought Increase, Soil Health, Farm Management
- Extension-based Resource: Website giving visuals on burrow structure
- Stakeholders: Farmers

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