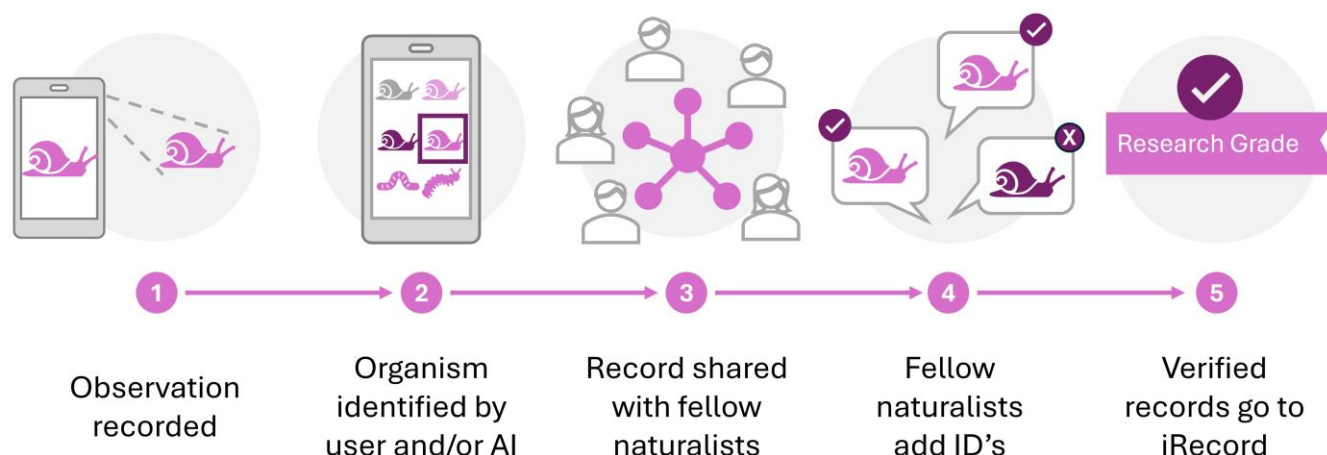# iNaturalist Earthworm Project

Project background

iNaturalist is a recording platform that has gained popularity in the UK since its launch in the USA in 2008. It enables users to submit biological records of any taxa, usually accompanied by a photograph. Users can also add identifications or comments to others' observations. Once a record reaches two-thirds agreement, it is verified (under the banner of 'Research Grade' – see **Figure 1**) and the record is then sent to iRecord (an alternative recording platform) where it undergoes verification by volunteer experts in the respective taxonomic group.


1	2	3	4	5
Observation recorded	Organism identified by user and/or AI	Record shared with fellow naturalists	Fellow naturalists add ID's	Verified records go to iRecord

Figure 1: Record submission and verification flow for iNaturalist.

iNaturalist also features an 'computer vision' artificial intelligence algorithm that suggests identifications with varying levels of confidence, based on patterns learned from previously verified Research Grade records (see Figure 2).

Earthworms are rarely identifiable with certainty in the field, as features like colour and size are far less reliable than microscopic characteristics such as head type, setae spacing, and the position and shape of the tubercula pubertatis (TP).

Over time, the iNaturalist image classification algorithm seems to have increasingly favoured identifying most earthworm observations as the Common Earthworm (*Lumbricus terrestris*), which, paradoxically, is not actually the most common species in the UK.

The aim of this project is to provide the iNaturalist image classification algorithm with photographs of reliably identified specimens, with the goal of improving its accuracy and reducing the number of misidentified earthworm records submitted to iRecord.
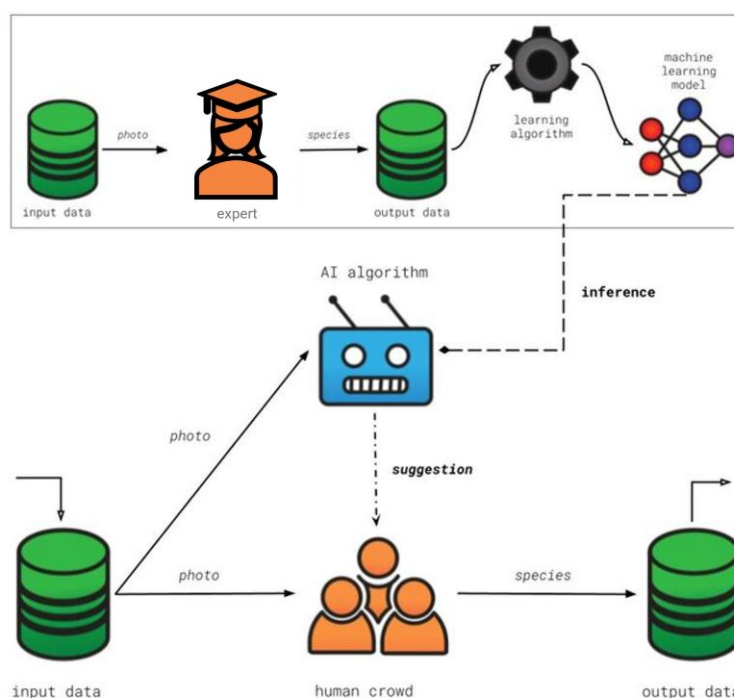
Figure 2: iNaturalist machine learning model. Diagram taken and adapted from Michelucci, Pietro & Onac, Laura & Couch, Jennifer & Sherson, Jacob & Rafner, Janet & Bekins, Shirley & Solovyev, Roman & Brodt, Kirill. (2022). Exploring CrowdBots: a new evolutionary pathway for citizen science projects. 122. 10.22323/1.418.0122.

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Participating in the project

Anyone attending Invertebrate Study Days at the Natural History Museum is invited to take part in this project by collecting live earthworms and bringing them to the session. Please note that any earthworms collected for this project will need to be euthanised and identified under a microscope during the Invertebrate Study Day. Identification of the specimens will be undertaken by experienced volunteers or by those with less experience with guidance from an earthworm specialist.

Collecting earthworms

1. Collect earthworms either **the evening before or the morning of the session** and bring them to the session. Collect specimens from up to three distinct site/substrate combinations.

2. **Only collect adult earthworms,** as juveniles cannot be identified to species. Only adults have the fleshy band (clitellum or "saddle") located about one-third along the body, whereas juveniles lack this.

3. Store earthworms in a **sealed container**, such as a takeaway box or jam jar.

4. **Keep earthworms from different sites or substrates in separate containers** (one container per site/substrate). Complete Table 1 (below) for each site/substrate combination. Grid references can be determined during the session if unknown.

5. A **suitable substrate should be collected alongside the earthworm and placed in the container**. Suitable substrates include soil, leaf litter, or compost – ideally, the same substrate from which the earthworm was collected.

Table 1: Earthworm collection data table

	Site/substrate 1	Site/substrate 2	Site/substrate 3
Name of collector			
Date collected			
Location name (and postcode)			
6-figure grid reference			
Substrate collected from			
Broad habitat (such as garden or woodland)			

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Photographing earthworms

1. **Assign reference numbers** to each earthworm specimen. The code will consist of two letters (indicating the site/substrate combination) and two numbers (indicating the individual specimen). The activity coordinator will assist you with generating your specimen reference numbers.

2. **Create a label** for each specimen showing its reference number. Use pencil or alcohol-resistant ink - do not use standard pen ink as this will run when placed in ethanol.

3. **Photograph each live specimen** with its label on a natural background, such as soil or leaf litter (see Figure 3).

Figure 3: Example photo of live earthworm with label.

4. **Upload the photograph to iNaturalis**t along with the corresponding data from Table 1.

5. **Record the identification in iNaturalist** as Lumbricidae.

6. **Place the earthworm and label in a tube of ethanol**. This will both euthanise and preserve the specimen for identification under the microscope at a later time.

Identifying earthworms

1. **Training on earthworm identification** and the necessary resources will be provided during the Invertebrate Study Day for volunteers wishing to participate in species identification.

2. **Species identification** of each specimen will be carried out by multiple individuals and verified by the activity coordinator.

3. **Enter determinations on iNaturalist**
   a. **Where you are the first person to reach a species-level ID**: Log in, locate the record, and click "**Add ID**" to submit your species identification and add a note stating that "**the specimen was identified using a microscope and the FSC earthworms AIDGAP**".
   b. **Where another volunteer has already entered a correct species ID**: If a correct ID is already entered, click "**Agree**" on that species determination.

4. **Research Grade status:** once a record achieves two-thirds agreement, it becomes Research Grade and is sent to iRecord, where it will be verified by the National Earthworm Recording Scheme and incorporated into the UK's national earthworm species dataset.
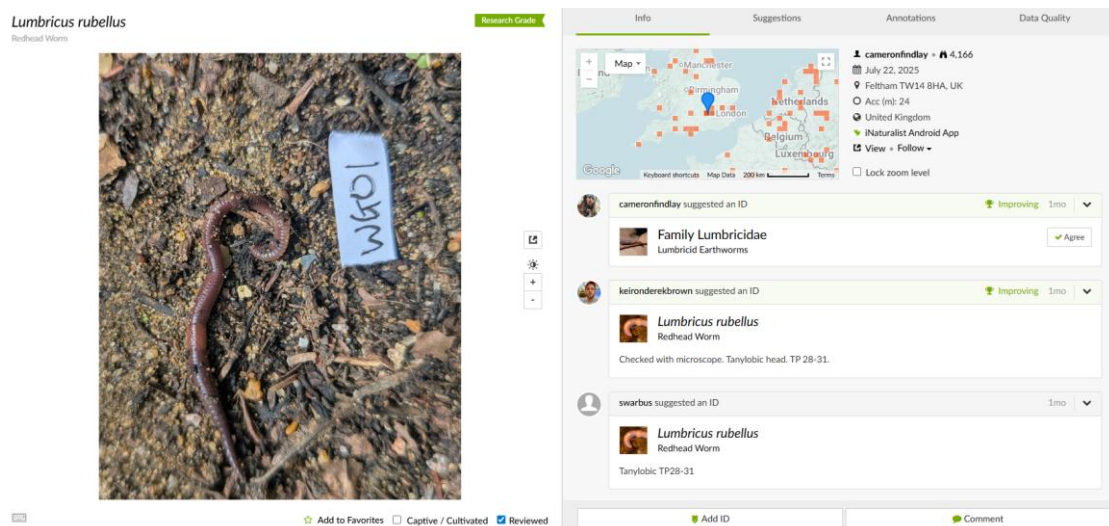
Figure 4: Example iNaturalist entry following species identification by two session volunteers.