Economic photo consensus classifications for citizen science camera trapping

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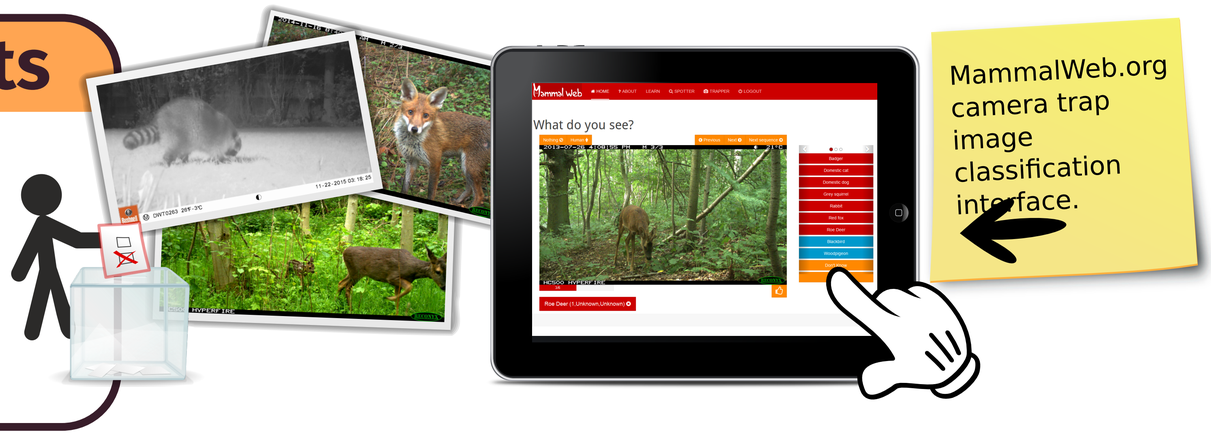
1. Camera traps produce large datasets

- Up to *millions* of photos [1].
- So ecologists ***crowdsource*** their classifications online for volunteers to **"vote"** on, such as our project **MammalWeb.org** in NE England.



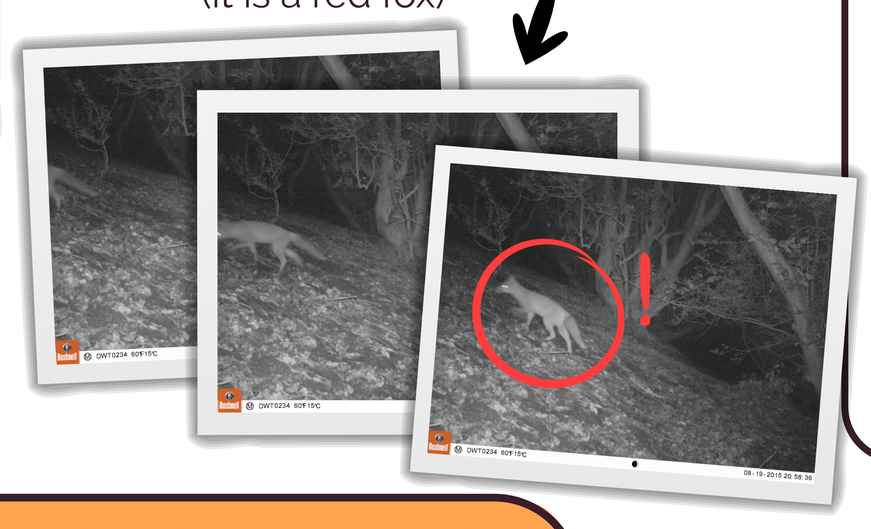
2. And some photos are hard to classify...

- Even with many votes, it's hard to be sure.
- Smaller projects like ours have high photo to "voter" ratios (~97,000 photos for ~200 users)...

...Is there a more economical voting system?

Hard to classify one photo.

Easier to classify one ***sequence***. (it is a red fox)



3. Vote on *sequences* of photos

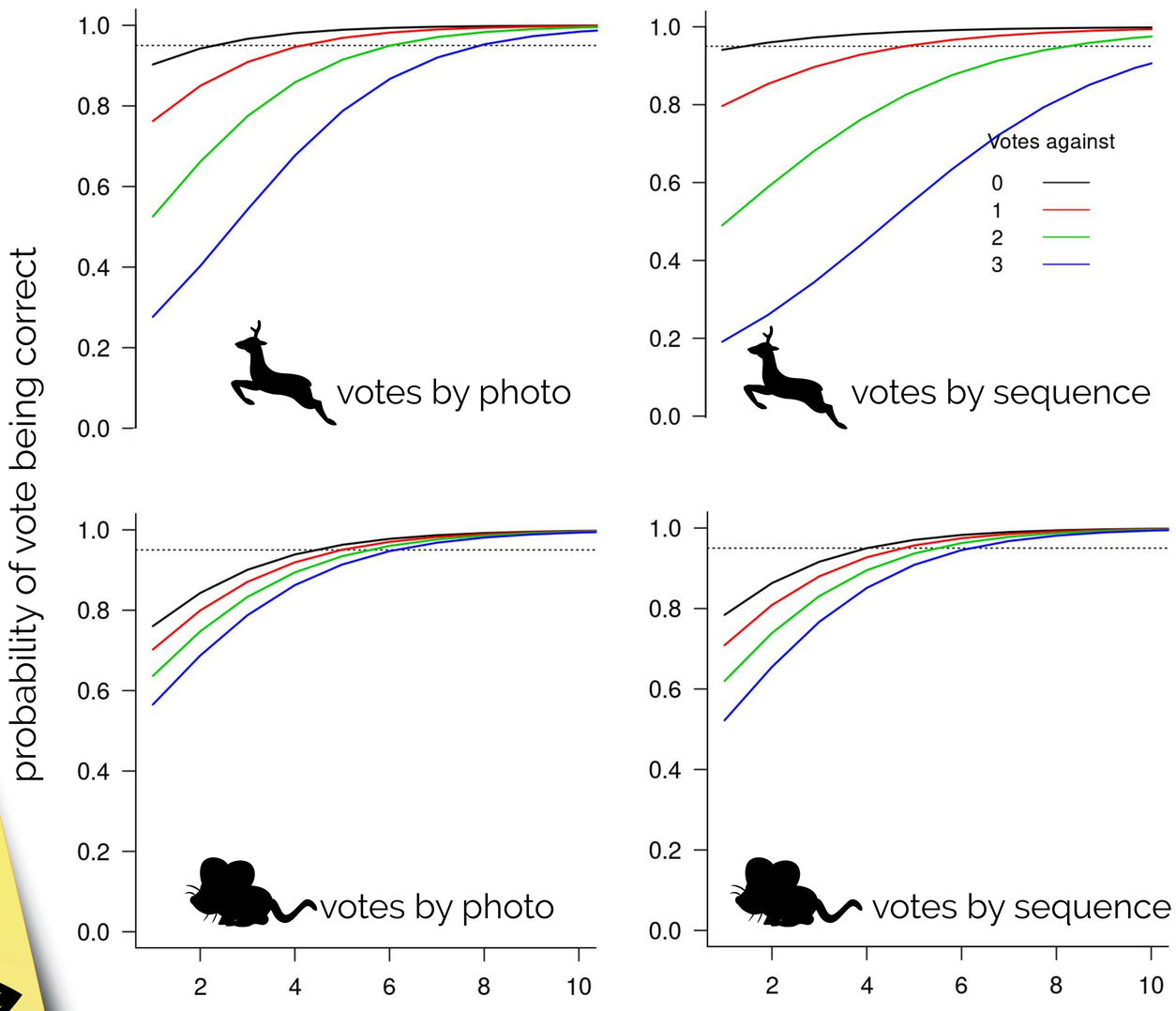
- Camera traps take multiple photos in a sequence per trigger ("burst mode").
- On our website, users have to vote on all photos in a **sequence** instead of random individual photos.

Will contextual info from adjacent photos aid voting?

4. It helps... but by how much?

- Sequence level voting marginally increases confidence across all species:
  - For easier to classify species (e.g. roe deer), votes for them gives high confidence. But votes against incurs higher penalty on confidence.
  - For harder to classify species (e.g. small rodent), they need more votes to reach high confidence.

Of 110,000 votes on 55,000 photos taken between Mar 2015-Nov 2016:
We selected 10 species of interest + "nothing", and sampled up to 200 photos and sequences for each based on availability of "gold standard" classifications.
Gold standard classifications are ones done by us to validate user votes.



Summary & next steps

- Sequence level voting aids identifying animals in photos, but only slightly increases certainty.
- Photo level votes may be sufficient for large datasets (~millions of photos).
- But for smaller projects, will voting by sequence arrive at a positive identification *faster*?

Reference: [1] Swanson et al. (2016) *Conservation Biology* 30(3):520–531. **Poster PDF & more information here:** https://git.io/v1apT **or use QR code:**