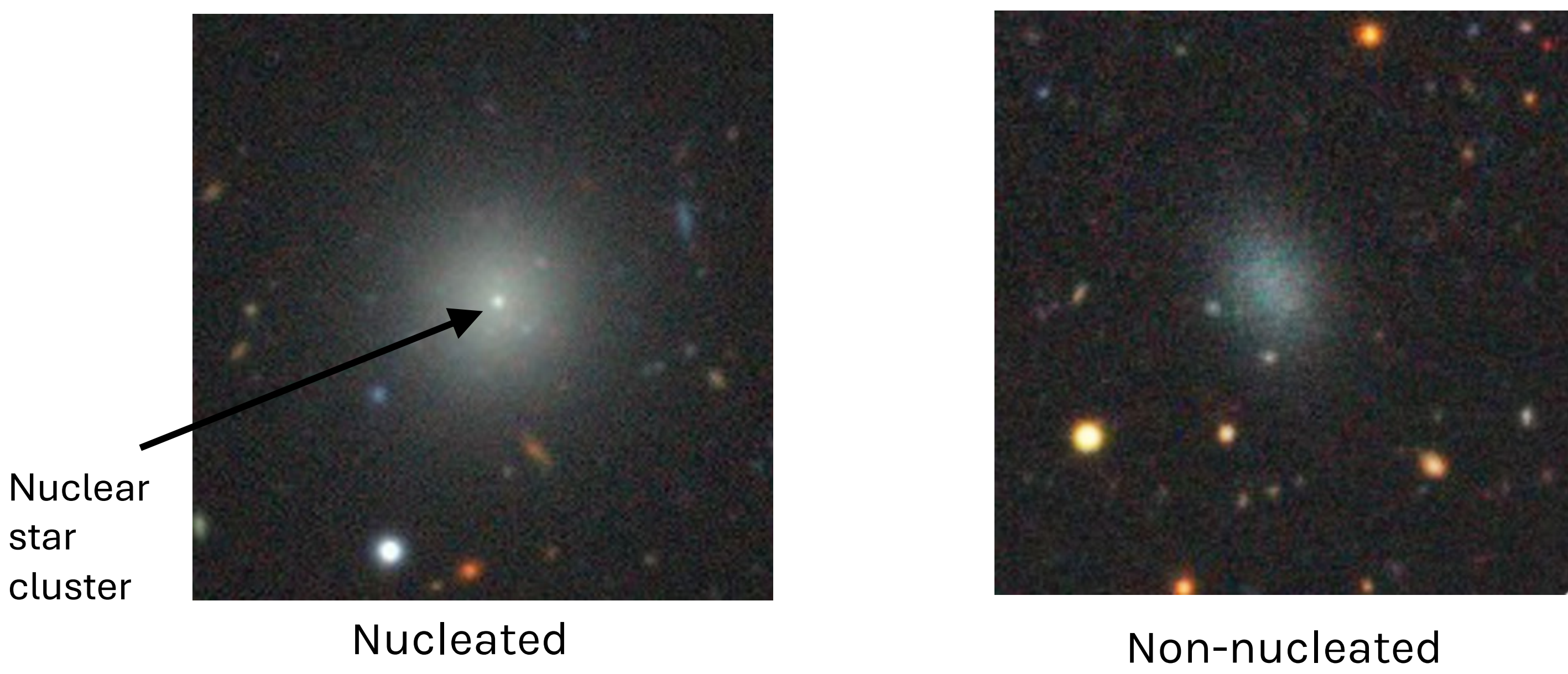


Introduction

Diffuse galaxies are a type of dwarf galaxy with a low density of stars, appearing as faint “smudges” in optical images which makes them challenging to identify. Their evolution is not well understood because they exist in very hostile environments, therefore more studies are needed to figure out how they formed.

Diffuse Galaxy Examples

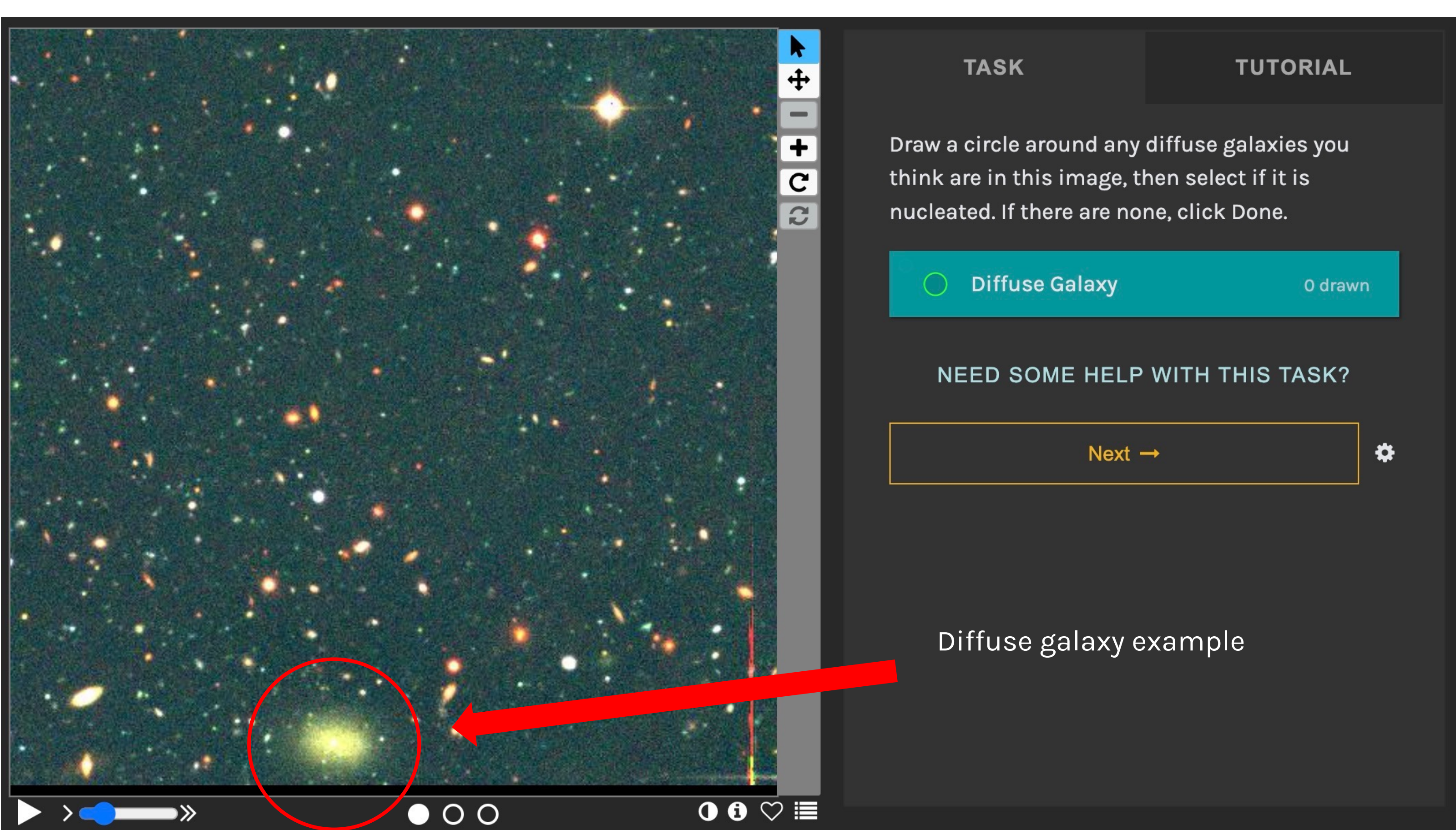


Our goal is to search the Fornax galaxy cluster for diffuse galaxies because of its close proximity to us and clusters are where these objects are commonly found. We aim to construct a visual catalog of diffuse galaxies in the Fornax through Zooniverse, a popular citizen science platform, to not only study their evolution but also improve automated detection of these galaxies.

Zooniverse Search

We divided the Fornax cluster into a set of nearly 15,000 images for volunteers to visually inspect on our Zooniverse project, titled *Blobs and Blurs: Extreme Galaxies in Clusters*. We used a combination of optical images from the **Fornax Deep Survey¹** (FDS) and the **Dark Energy Camera Legacy Survey²** (DECaLS) to identify diffuse galaxies over a wide range of size and brightness. These images were presented to volunteers on Zooniverse as shown below:

Project Interface on Zooniverse



No prior astronomical knowledge was needed to participate in our project. We provided a simple tutorial and comprehensive field guide for volunteers to become familiar with the objects, image types, and what to look for when classifying. For each image they came across, they were tasked with the following:

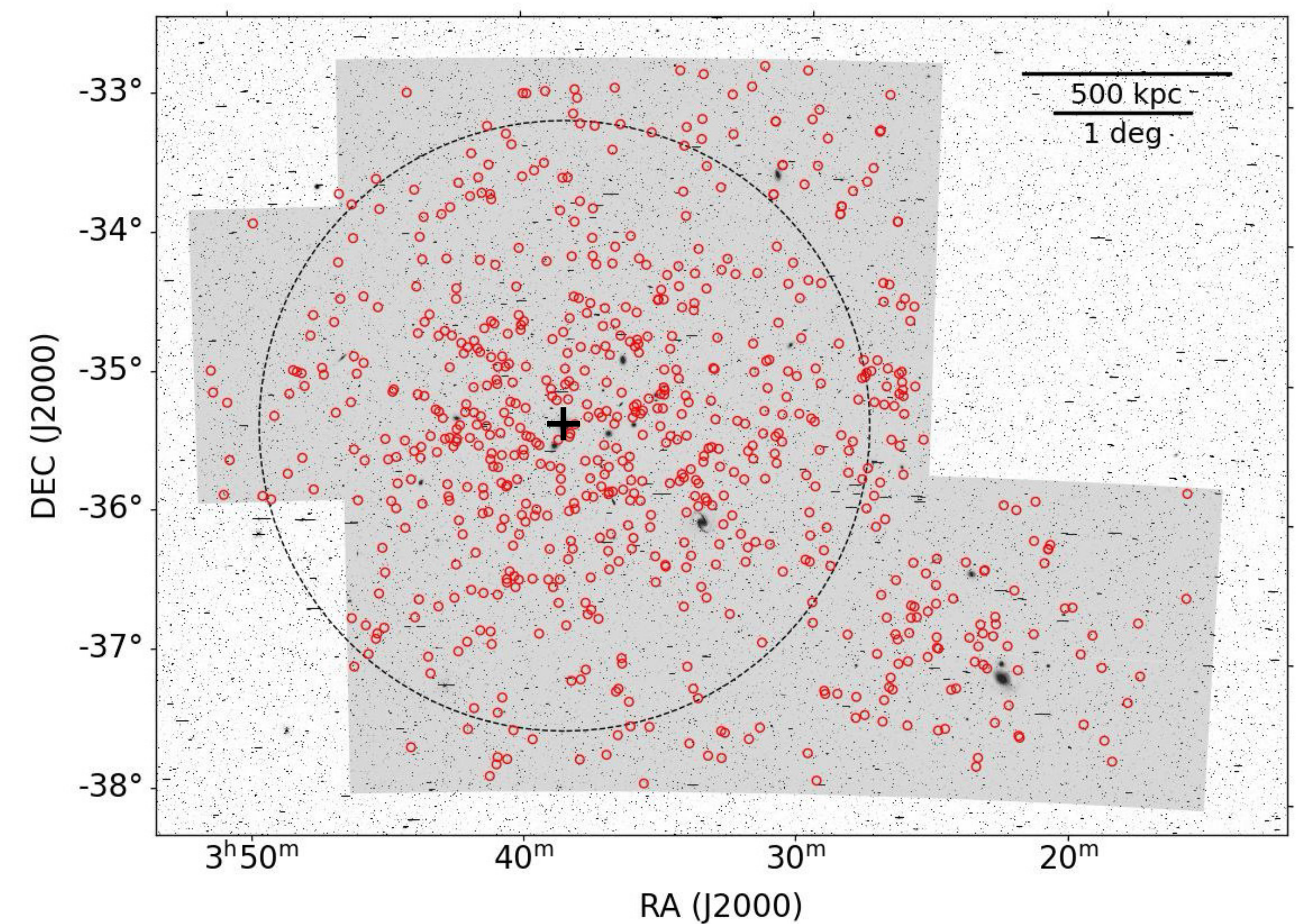
Task	Draw a circle around any diffuse galaxies you think are in this image.
Subtask	Is this diffuse galaxy nucleated? (select yes or no)

An image was retired after it had been classified by 10 volunteers. We required that at least 4 volunteers identify the same object for it to be considered a diffuse galaxy candidate.

Results

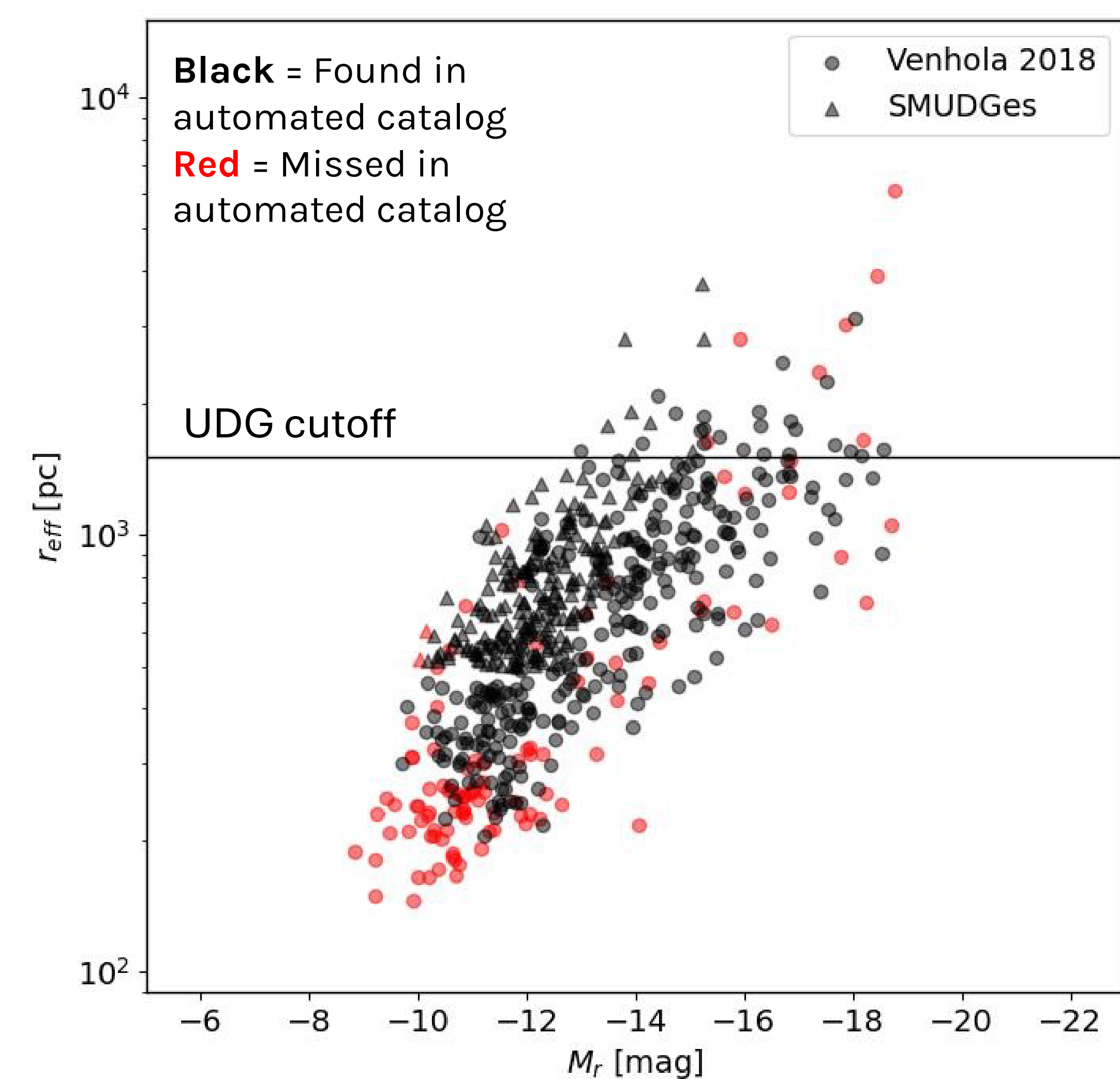
Our Zooniverse project was launched in June 2023 and reached completion in around a month, thanks to the help of over 700 volunteers. In total, volunteers found over 600 diffuse galaxy candidates in Fornax!

○ = Diffuse galaxy candidate

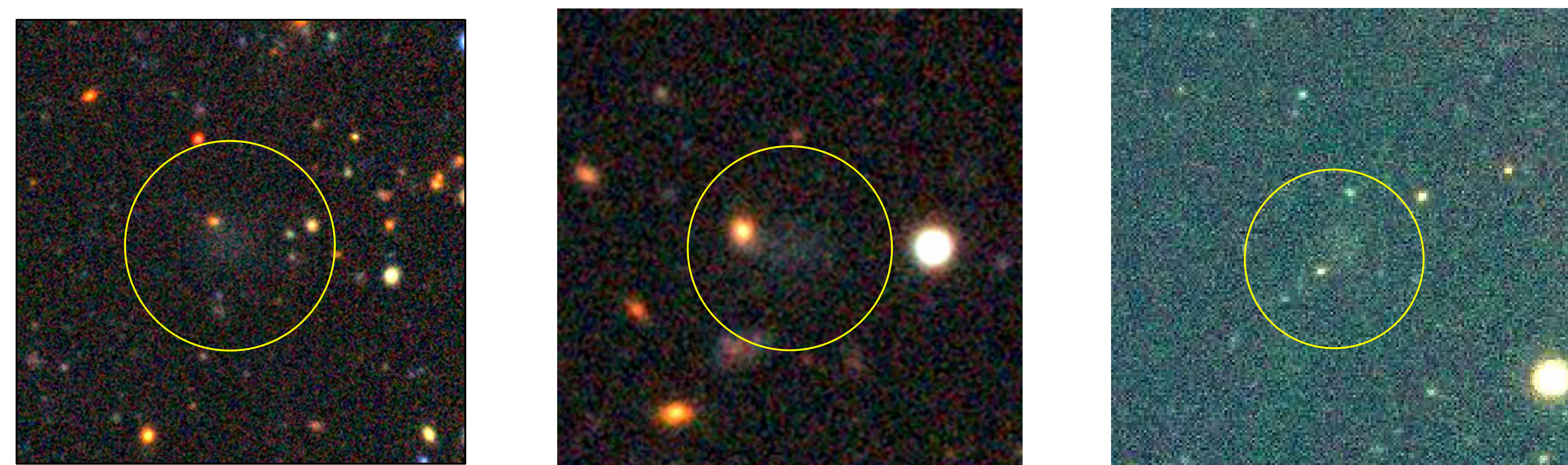


Comparison with two automated catalogs:

- We found 80-98% of the same diffuse galaxies
- Small, faint diffuse galaxies represent our detection limit
- We identified around 50 diffuse galaxies not present in these automated catalogs and 3 candidates not present in any existing automated or visual catalogs (shown below)



Previously unknown diffuse galaxy candidates not cataloged in other searches³



Future Work

More comparisons with automated catalogs need to be conducted to see where our visual catalog outperformed automated detection algorithms. Currently, we are in the process of fitting the structural parameters of our catalog to investigate the distribution of diffuse galaxies within the cluster and global trends in the nucleated fraction.



Check out our project on Zooniverse using this QR code!

References:

1. Iodice, 2016, ApJ, 820, 42
2. Dey, 2019, ApJ, 157, 168
3. Venhola (2018, 2022), Zaritsky (2022), Ferguson (1989), Eigenthaler (2018)