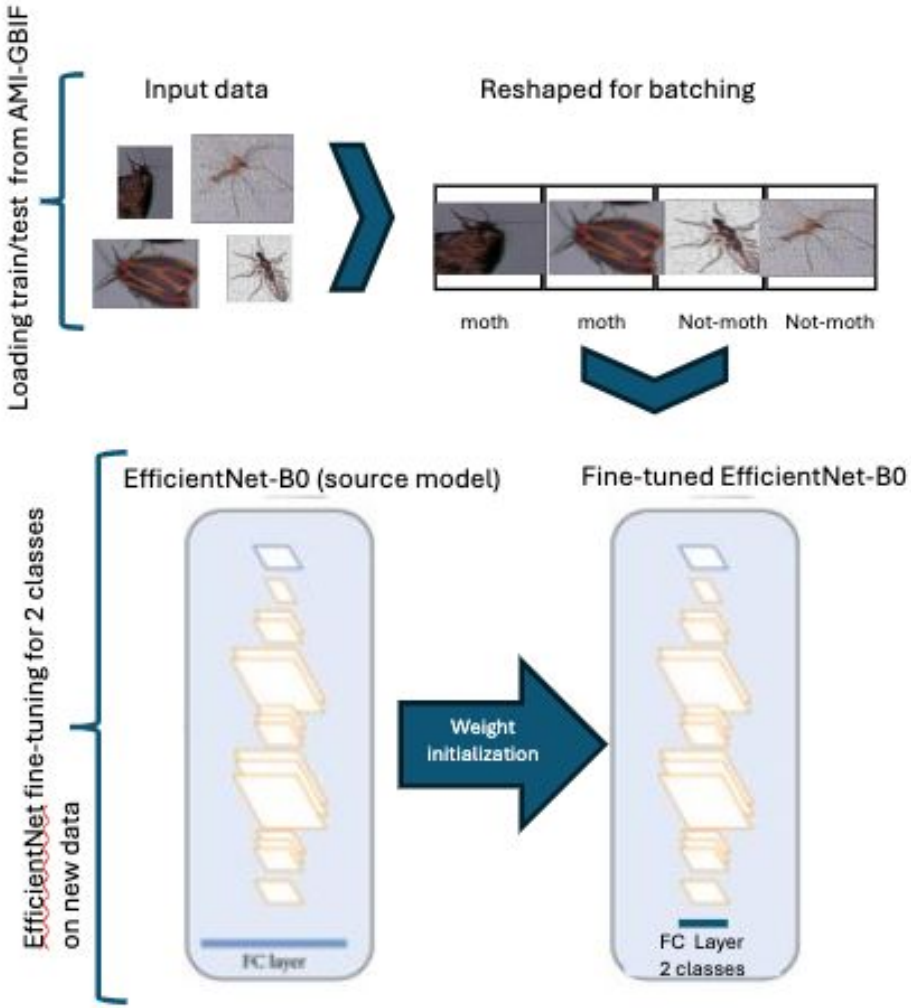
Is it a moth?

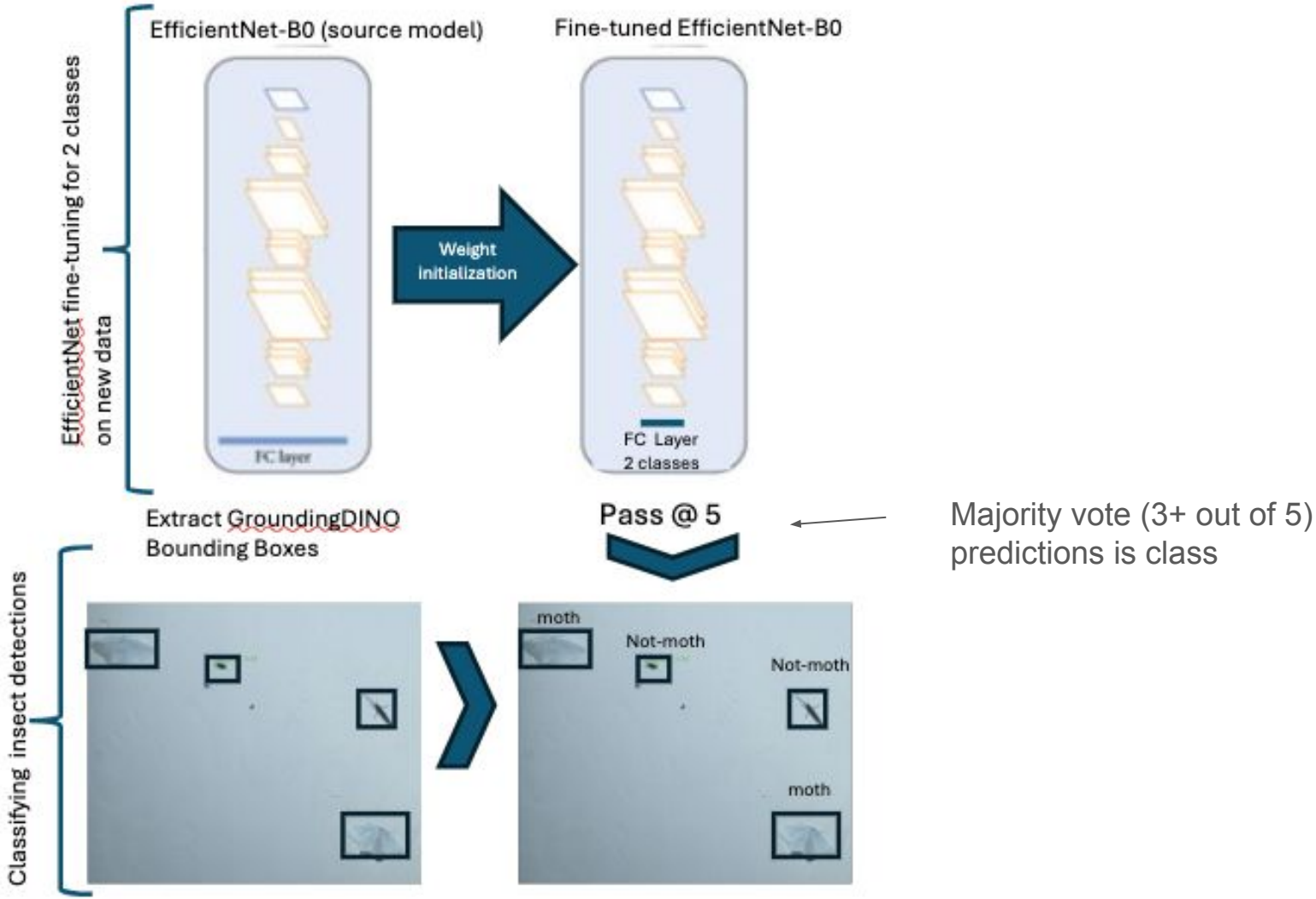
Teetly (Sanjana Yasna)

Project Questions:

- Is a smaller dataset with a higher percentage of the minority class, moths, sufficient for the classifier to correctly identify moths?
- Around what time the Macleish traps are active are most insects detected, on average?

Moth Image Annotation Pipeline

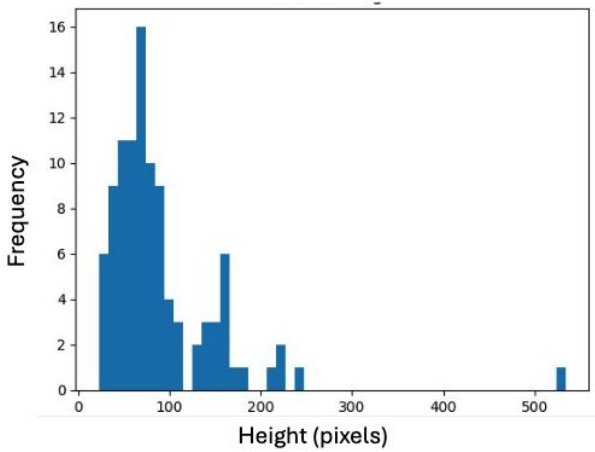

Loading train/test from AMI-GBIF
Input data
Reshaped for batching
moth
moth
Not-moth
Not-moth
EfficientNet fine-tuning for 2 classes on new data
EfficientNet-B0 (source model)
Fine-tuned EfficientNet-B0
Weight initialization
FC layer
FC Layer 2 classes

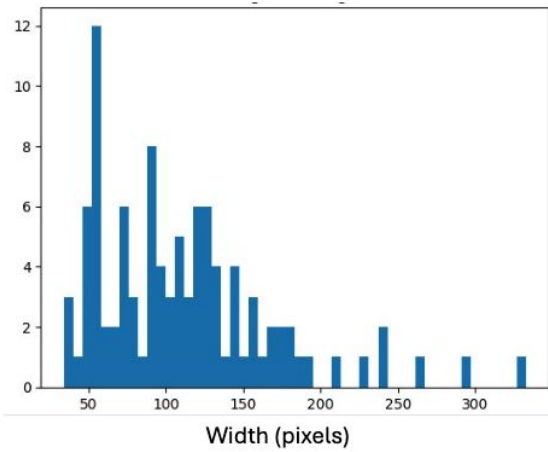

EfficientNet-B0 (source model)
Fine-tuned EfficientNet-B0
EfficientNet fine-tuning for 2 classes on new data
Weight initialization
FC layer
FC Layer 2 classes
Extract GroundingDINO Bounding Boxes
Pass @ 5
Majority vote (3+ out of 5) predictions is class
Classifying insect detections
moth
Not-moth
Not-moth
moth

Major Limitations of this Project:

1. lack of any labelled data on Macleish images -> no formal validation on Macliesh
2. Macleish images are unique due to the colored lighting the edges of its traps have.
    a. classifier seems to ambiguously classify insects on image crops saturated by blue lighting from the trap
3. Images had to be reshaped during training to shared (90 x 110) sizing -> model performance depends on image size

Huge deviations in image size, so major information loss from reshape procedure





EfficientNet Datasets, Train Test Split

Data	Number moths	Number non-moths	% Moths
Overall ami_gbif	14105	37105	27.5%
Total Dataset Train	13105	36105	26.6%
Limited Dataset Train	10000	18000	35.7%
Shared Test set	1000	1000	50%

This 50/50 split will test model's ability to truly distinguish between classes despite having a minority class

EfficientNet Fine-tuned model names:

Data	Number moths	Number non-moths	% Moths
ami_gbif	14105	37105	27.5%
Total Dataset Train	13105	36105	26.6%
Limited Dataset Train	10000	18000	35.7%
Shared Test Set	1000	1000	50%

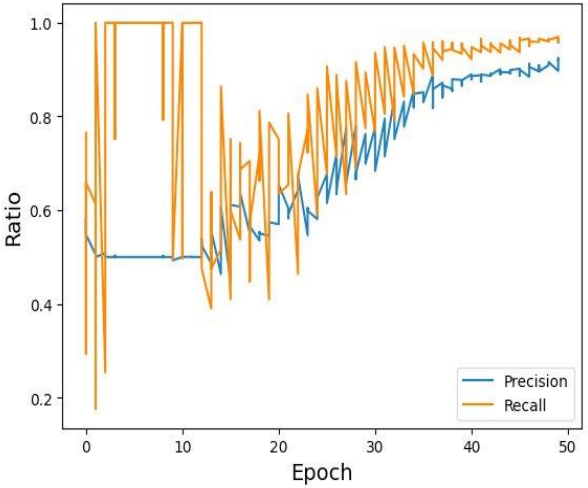
→ EfficientNet Full

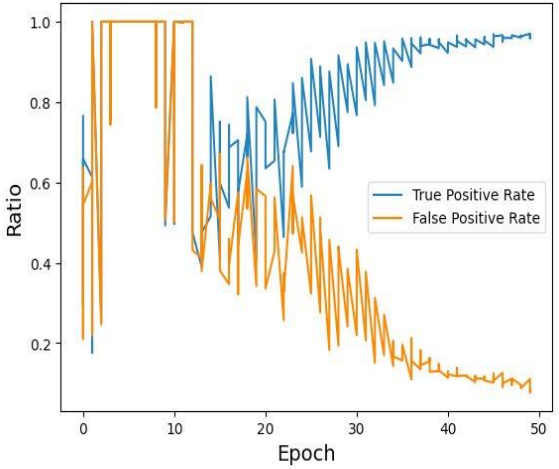
→ EfficientNet Limited

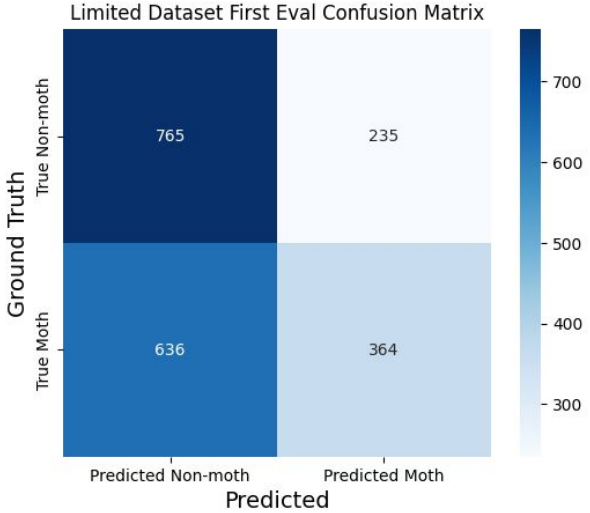
EfficientNet end-of-fine-tuning evaluation metrics: (positive class is non-moth)

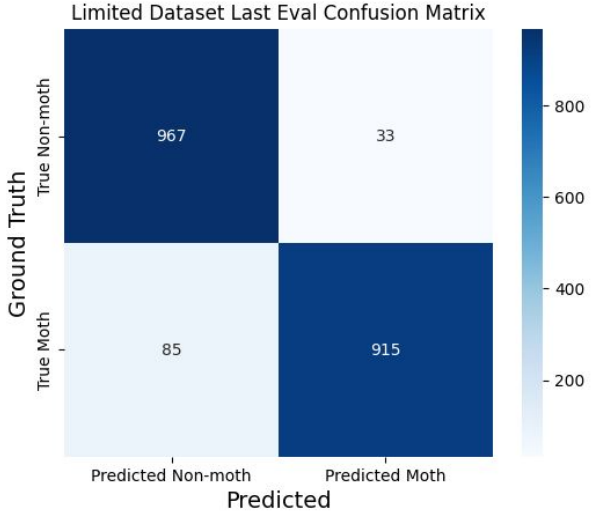
Dataset	Accuracy	Precision	Recall	True Positive Rate	False Positive Rate
Limited	94.1%	0.92	0.97	0.97	0.085
Full	**96.4%**	**0.95**	**0.98**	**0.98**	**0.055**

Limited Dataset (EfficientNet Limited) Test Metrics

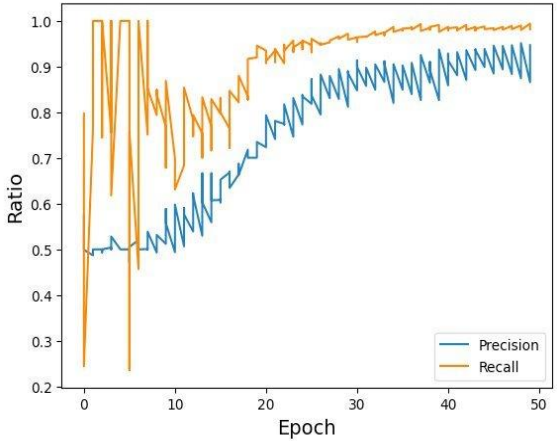


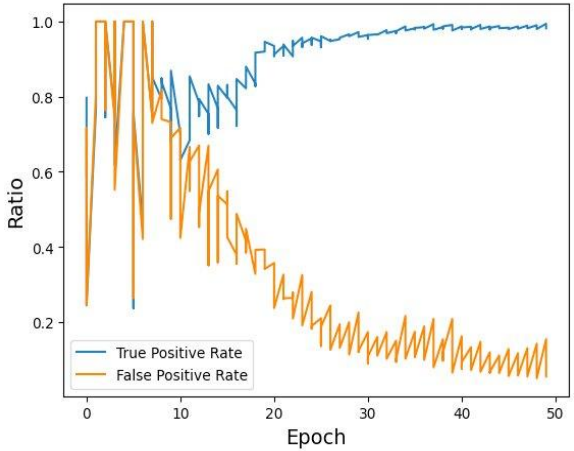


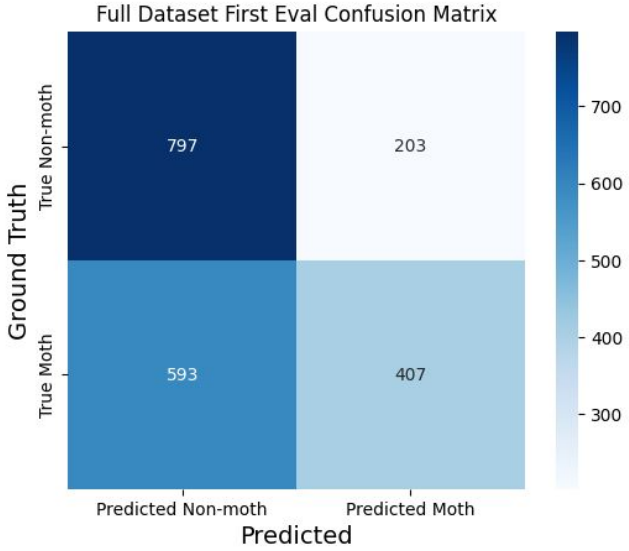


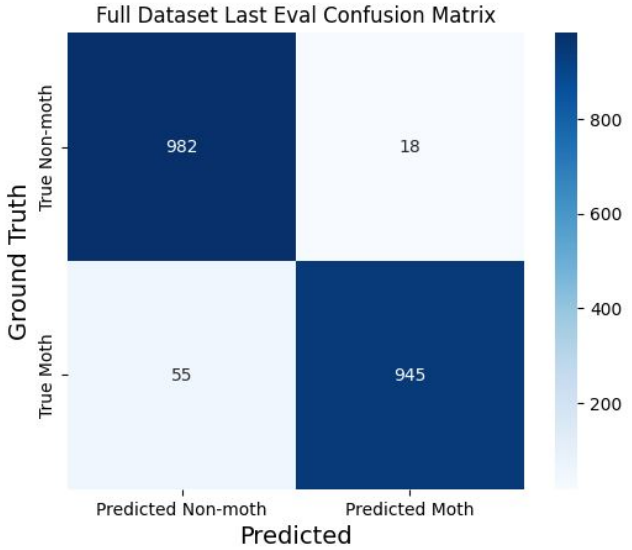


Full Dataset (EfficientNet Full) Test Metrics









EfficientNet full did better…used for classifying GroundingDino bounding boxes on Macleish images

Example case study of Macleish image in following slides…

Example crops from groundingDino

(not representative of actual image size)

main/mothitor_yolo/ama_2024-06-17_23_00_04.jpg

EfficientNet predictions:

With reshape: transform each image crop from GroundingDINO to dimensions (90,110), as this was how the images were reshaped during training and inference

Without reshape: predict image crop as is (has to be done one-by-one since uneven sizes don’t allow batching)

Pass once: take prediction from one run of model on single crop

Pass @ 5: take prediction from major opinion of 5 runs of model on single crop

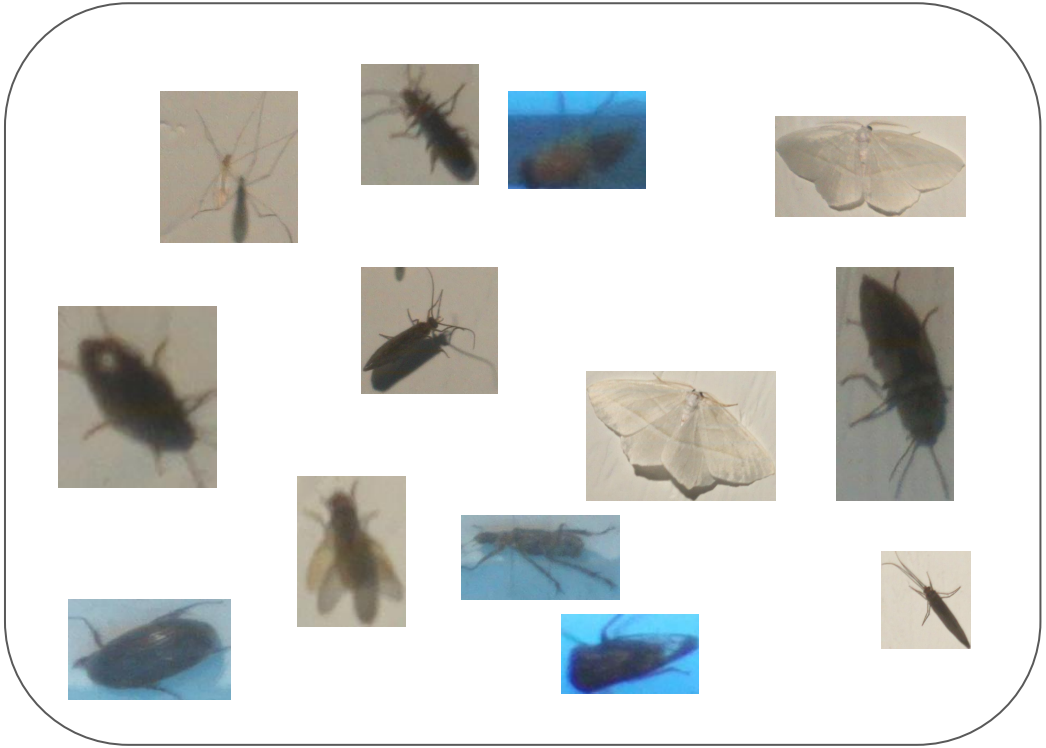
- Cutoff (if applicable): score cutoff for class needed for it to be moth
- If no cutoff, then class of each prediction is by max score, and final prediction is what 3 or more predictions agree upon

No reshape: EfficientNet Full (pass @ 1)

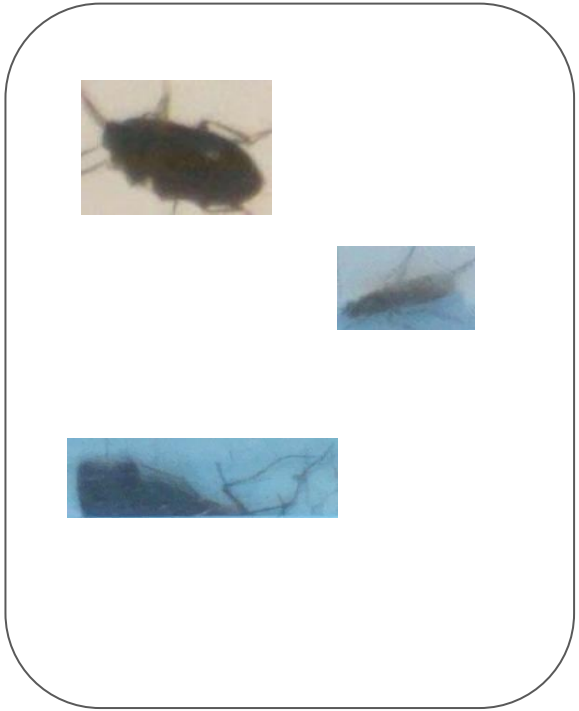
(not representative of actual image size)

Note: lighting is a major issue–model not exposed to images with insects under bluish light…so it ambiguously categorizes these insects

moth



non-moth

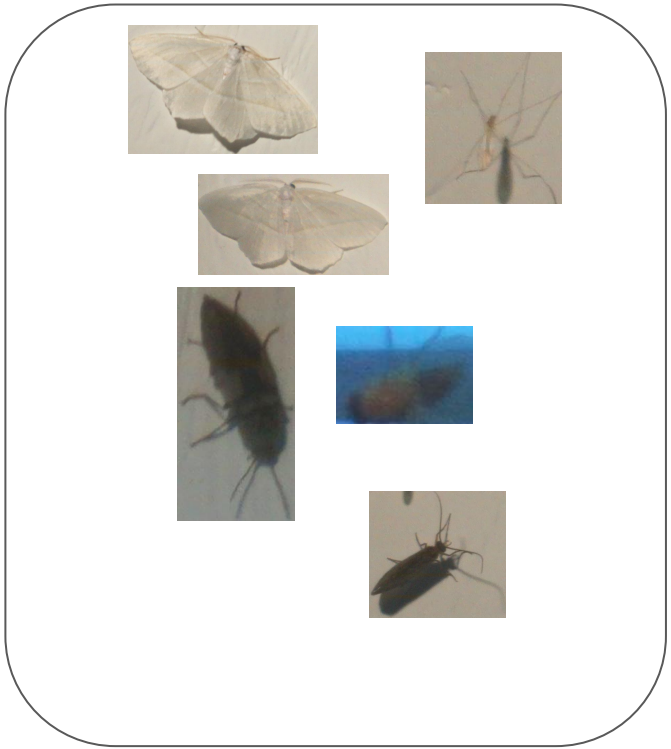


No reshape: EfficientNet Full (pass@5, cutoff 0.9999)

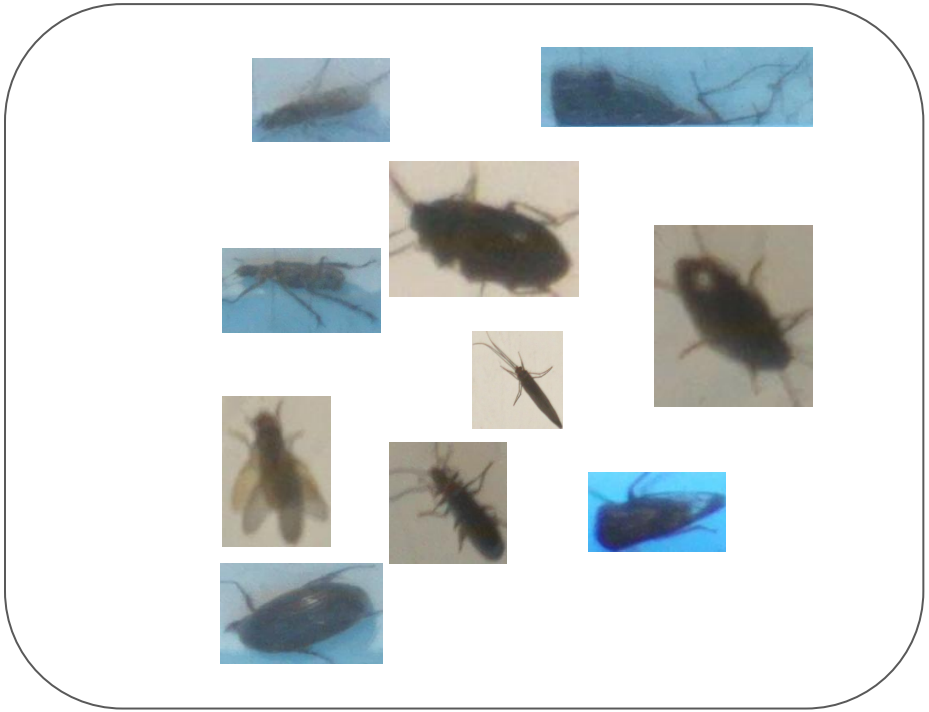
(not representative of actual image size)

Unreasonably huge cutoff for it to not overpredict moths

moth



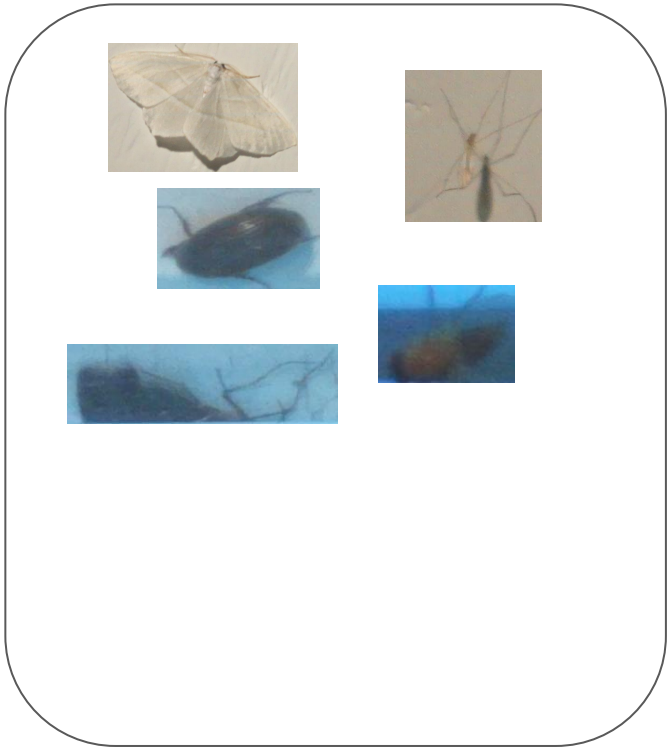
non-moth



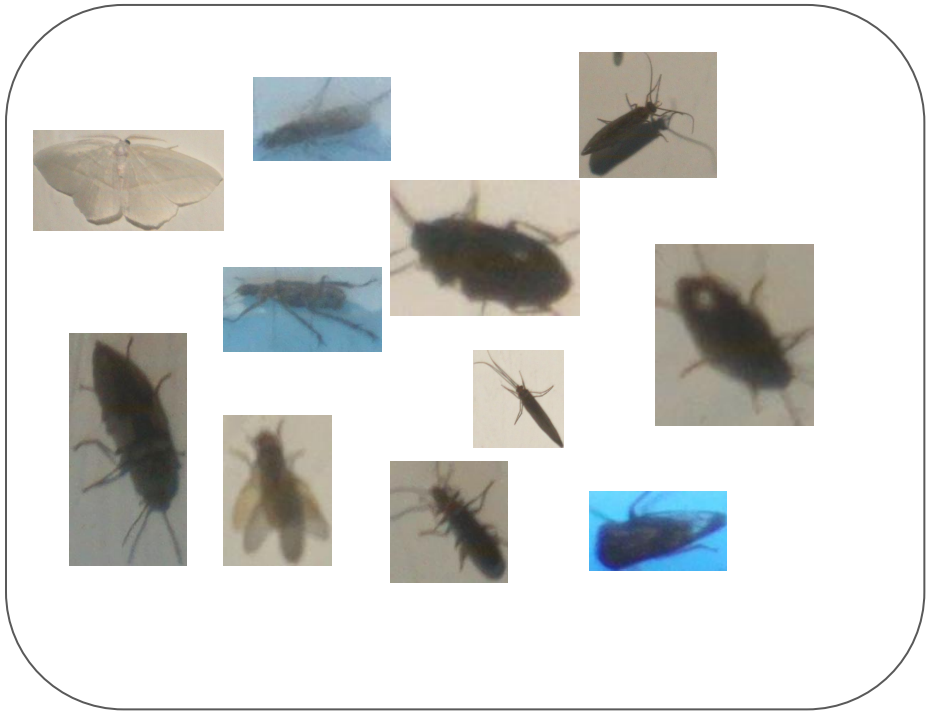
Reshape: Efficientnet Full, pass @ 1

(not representative of actual image size)

moth



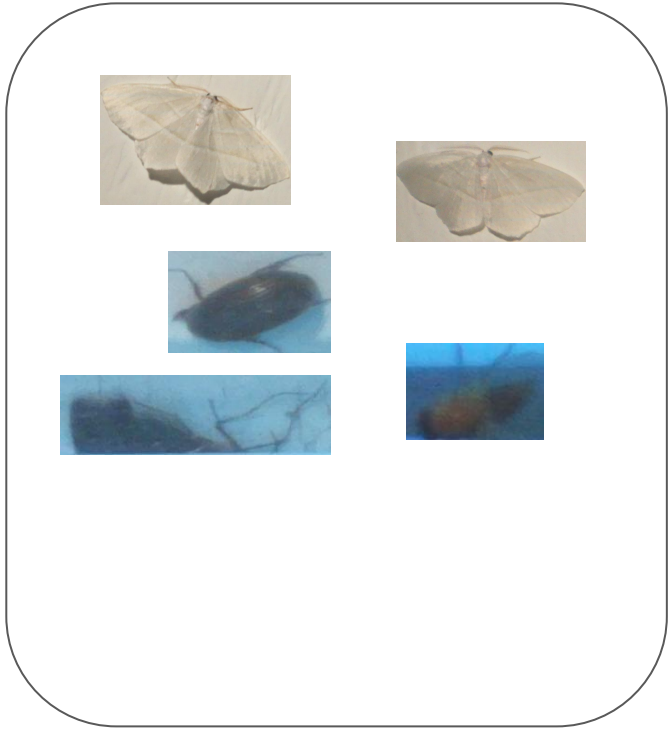
non-moth



Reshape: efficientnet full (pass@5, choose max)

(not representative of actual image size)

moth



non-moth

Detected both obvious moths! But then again, I don’t know my moths

Conclusion between the transformations

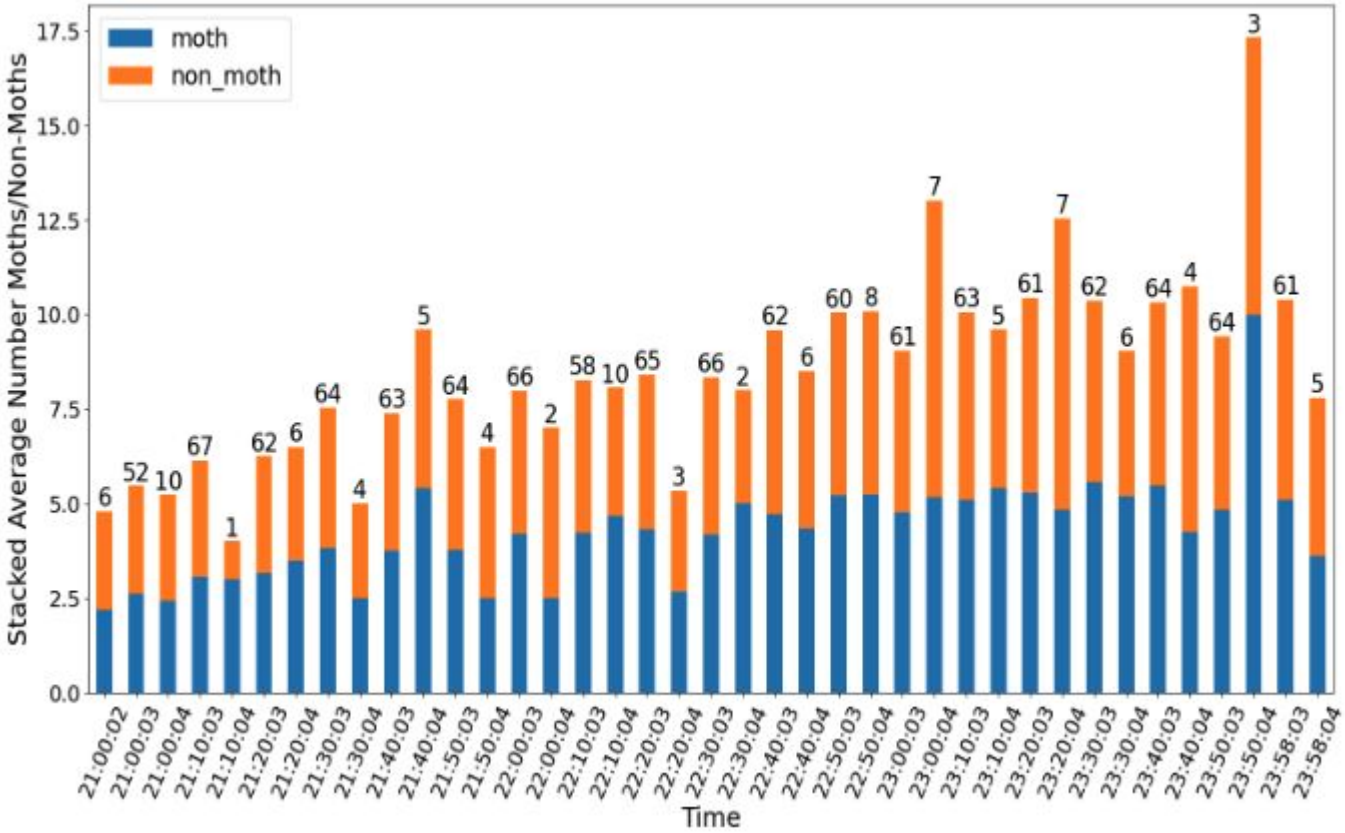
Fine-tuned efficientnet cannot generalize to the Mothitor dataset during inference without image sizes it’s used to…it has learned image attributes in context to the shape by which it was trained…

Lighting is ambiguous and confuses model, as that’s not explicitly part of its training data

Future steps:

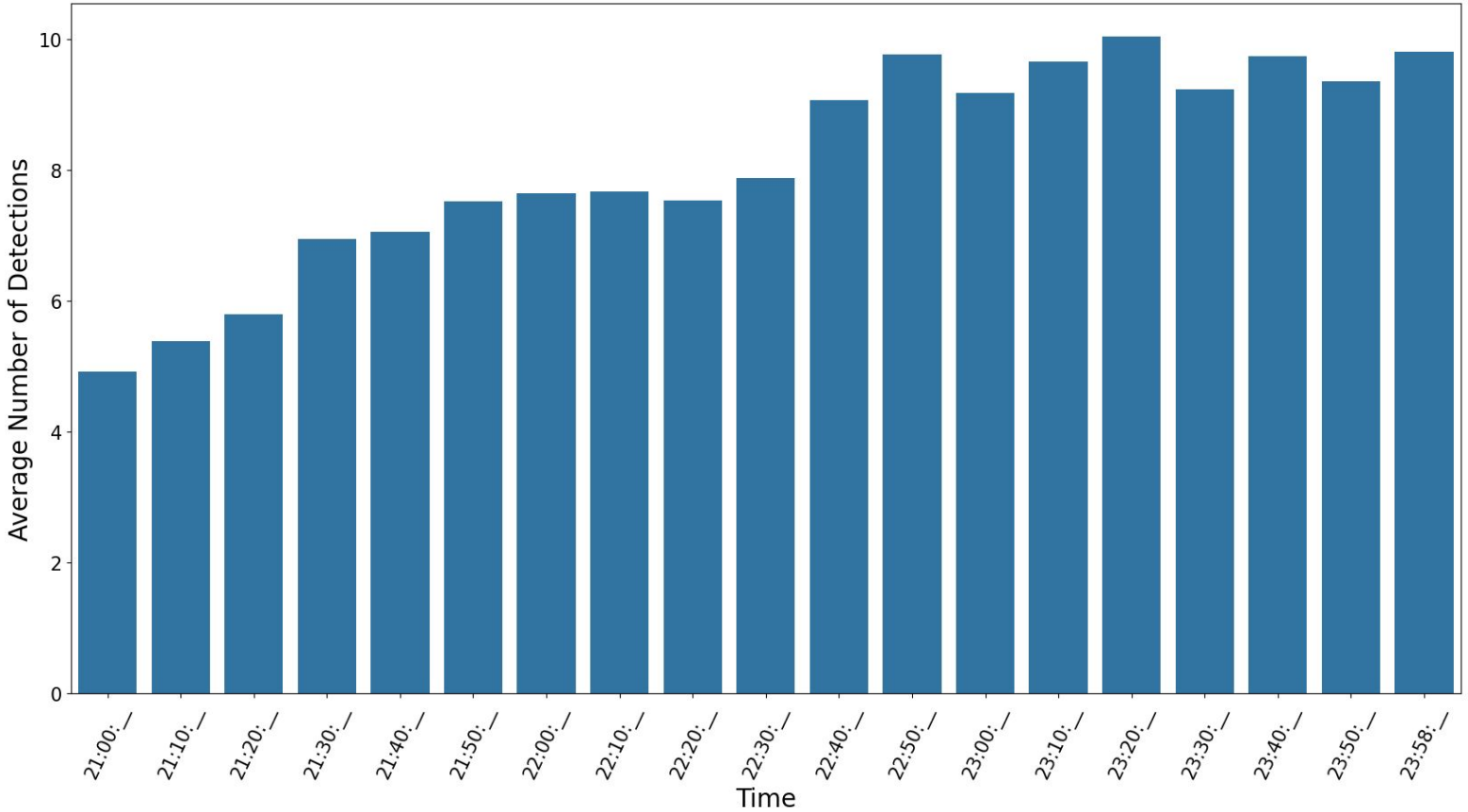
- train images without rgb, but all black-and-white
- Do evaluation on models without reshaped test set

EfficientNet Full pass @ 5 predictions were done on all Macleish images bounding boxes, to get…



Due to uneven skew of # images at specific times, next slide is revised graph faceted by hour and minute

Insect trap usage can be limited to after 11pm (most insects after 11 pm)



Conclusions:

Q: Is a smaller dataset with a higher percentage of the minority class, moths, sufficient for the classifier to correctly identify moths?

A: Yes, EfficientNet limited only has 2% less accuracy despite being trained on a bit over half the full dataset. *Significance: If Macleish were annotated in the future, it would likely be sufficient supplement for training a more relevant classifier.*

Q: Around what time the Macleish traps are active are most insects detected, on average?

A: After 11 pm. *Significance: Mariana and her lab can likely limit insect trap usage to a smaller timespan after 11 pm, as the number of insects detected is considerably lower before 11 pm.*