

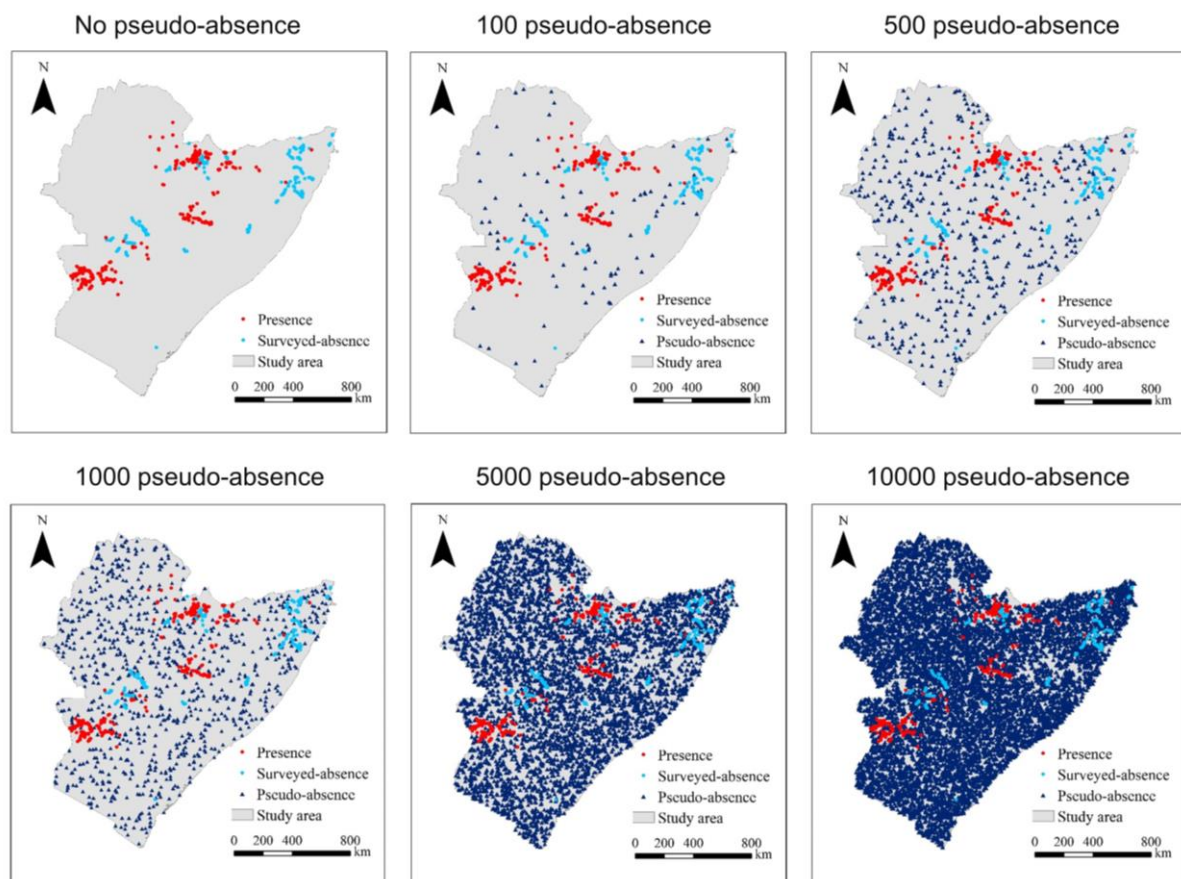
## Supplementary Material 1:

### Section 2.1.3 Pseudo-absence generation

#### Experiment on the accuracy of prediction models at different presence-absence ratios

We also conducted an experiment to test accuracy at different presence-absence ratios in May 2020 (month with the amplest ground points for validation). The training model and evaluation method were kept consistent with those described in Materials and Methods, with the number of PA from 0 to 10000 being the only variable (see Fig S1.).

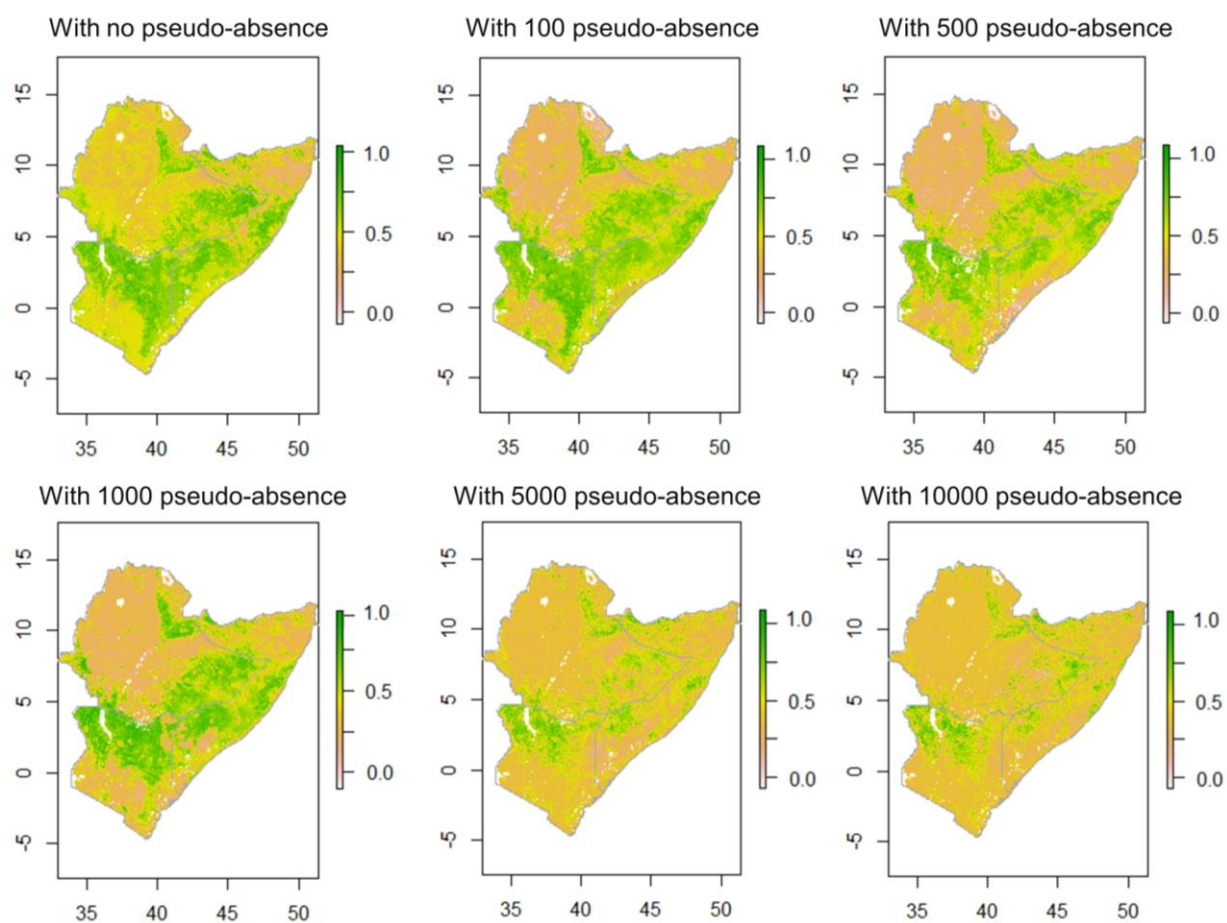
Evaluation and prediction results are displayed in Table S1 and Figure S2. The highest accuracy was achieved when around 500 PA points were generated. Either more or fewer PA points generated will make the prediction less accurate. Moreover, predicting results suggested that as the proportion of PA points increases, the range of anticipated hopper band occurrence decreases. As mentioned initially, due to the tricky location of newborn hopper bands, a finer range of predictions may not lead to higher accuracy and precision. We can allow a more extensive predicted range than the actual range in prevention and control because no one wants to miss the emergence of any hopper bands as they may develop into the next swarm. Therefore, we ultimately selected 500 PA points in this study.



**Figure S1.** Spatial distribution of the different numbers of pseudo-absence points generated.

**Table S1.** Evaluation of predicting results with different numbers of pseudo-absence.

Number of pseudo-ab- sences	Prediction Model Evaluation						
	Accuracy	Sensitivity	Specificity	ROC-AUC	Precision	Recall	F score
0	0.8272	0.8487	0.8010	0.8249	0.8382	0.8487	0.8434
100	0.8565	0.8661	0.8450	0.8556	0.8697	0.8661	0.8679
500	0.8868	0.8886	0.8814	0.8850	0.9577	0.8886	0.9218
1000	0.8097	0.8860	0.7491	0.8175	0.7372	0.8860	0.8048
5000	0.7907	0.7446	0.8095	0.7771	0.6143	0.7446	0.6732
10000	0.8237	0.7557	0.8397	0.7977	0.5268	0.7557	0.6208



**Figure S2.** Predicting possibility of band presence with different numbers of pseudo-absence.