

Supplementary Material 2:

Section 2.4. Model for forecast based on a temporal sliding window

Experiment comparing the predictive performance of random forests and support vector machines

We used the time-series dataset of environmental indicators constructed in Section 2.2 for Random Forest (RF) model training. Hyperparameters were tuned by 80% training sets and 20% test sets. The same groups of predictive indicators were then fed into the optimized model for dynamic prediction. Eventually, the monthly results were validated using the ground survey points of the target month. Predicting results are shown in Figure S3, and evaluation metrics are displayed in Table S2. Ground truths are overlaid on the predictions, and evaluation metrics where RF performed better than SVM are highlighted as red.

We found that both SVM and RF were competent for the modelling task. SVM achieved a better overall accuracy most time of the year. However, RF performed better in March and April, showing greater potential in mapping the spring breeding areas for SEK. Moreover, it is noteworthy that RF seemed to demonstrate higher sensitivity and recall, which indicated that RF models were more successful in identifying presences. For prevention and control, we are more concerned with samples of presence. In other words, we expect the prediction model to be more accurate for the band occurrence region. From this perspective, the RF model is potentially more applicable to desert locust occurrence prediction, although its overall performance is worse than SVM.

The spatial distribution of the predicted areas for band occurrence of RF was similar to that of SVM. However, compared to SVM, RF provided more ‘confident’ predictions with more explicit boundaries of band occurrences and more significant gaps for the likelihood of band occurrence in the study area. The RF also showed a broader predicted area of band presence than the actual area. This resulted in better sensitivity and recall but limited specificity, so RF ended up with slightly lower overall accuracy than SVM. Ultimately, we selected SVM as the basic model in this study for a fair overall accuracy and more robust performance throughout the year.

Table S2. Comparison of evaluation metrics of SVM and RF.

Month	Evaluation Metrics													
	Accuracy (%)		Sensitivity		Specificity		ROC-AUC		Precision		Recall		F-Score	
Model	SVM	RF	SVM	RF	SVM	RF	SVM	RF	SVM	RF	SVM	RF	SVM	RF
February	74.44	71.58	0.605	0.579	0.876	0.855	0.740	0.717	0.702	0.803	0.876	0.579	0.779	0.673
March	80.15	80.59	0.693	0.704	0.933	0.910	0.813	0.807	0.926	0.889	0.693	0.704	0.793	0.786
April	82.59	83.12	0.726	0.717	0.900	0.949	0.813	0.833	0.845	0.935	0.726	0.726	0.781	0.811
May	88.68	86.29	0.889	0.904	0.881	0.821	0.885	0.862	0.958	0.838	0.889	0.904	0.922	0.870
June	85.31	72.67	0.897	0.735	0.667	0.718	0.782	0.727	0.919	0.726	0.897	0.735	0.908	0.731
July	70.00	58.77	0.617	0.646	0.771	0.528	0.694	0.587	0.698	0.585	0.617	0.646	0.655	0.614
August	76.99	78.11	0.624	0.683	0.941	0.881	0.783	0.782	0.926	0.854	0.624	0.683	0.745	0.759
September	79.81	75.90	0.631	0.771	0.920	0.747	0.776	0.759	0.853	0.758	0.631	0.771	0.726	0.764
October	66.77	61.02	0.599	0.521	0.742	0.706	0.670	0.614	0.714	0.657	0.599	0.521	0.651	0.651
November	73.41	65.57	0.750	0.710	0.712	0.577	0.731	0.643	0.786	0.709	0.750	0.710	0.767	0.709
December	73.95	71.38	0.709	0.704	0.782	0.728	0.745	0.716	0.816	0.787	0.709	0.704	0.759	0.743
Average	77.46	73.18	0.704	0.698	0.830	0.765	0.767	0.732	0.831	0.776	0.728	0.699	0.772	0.737

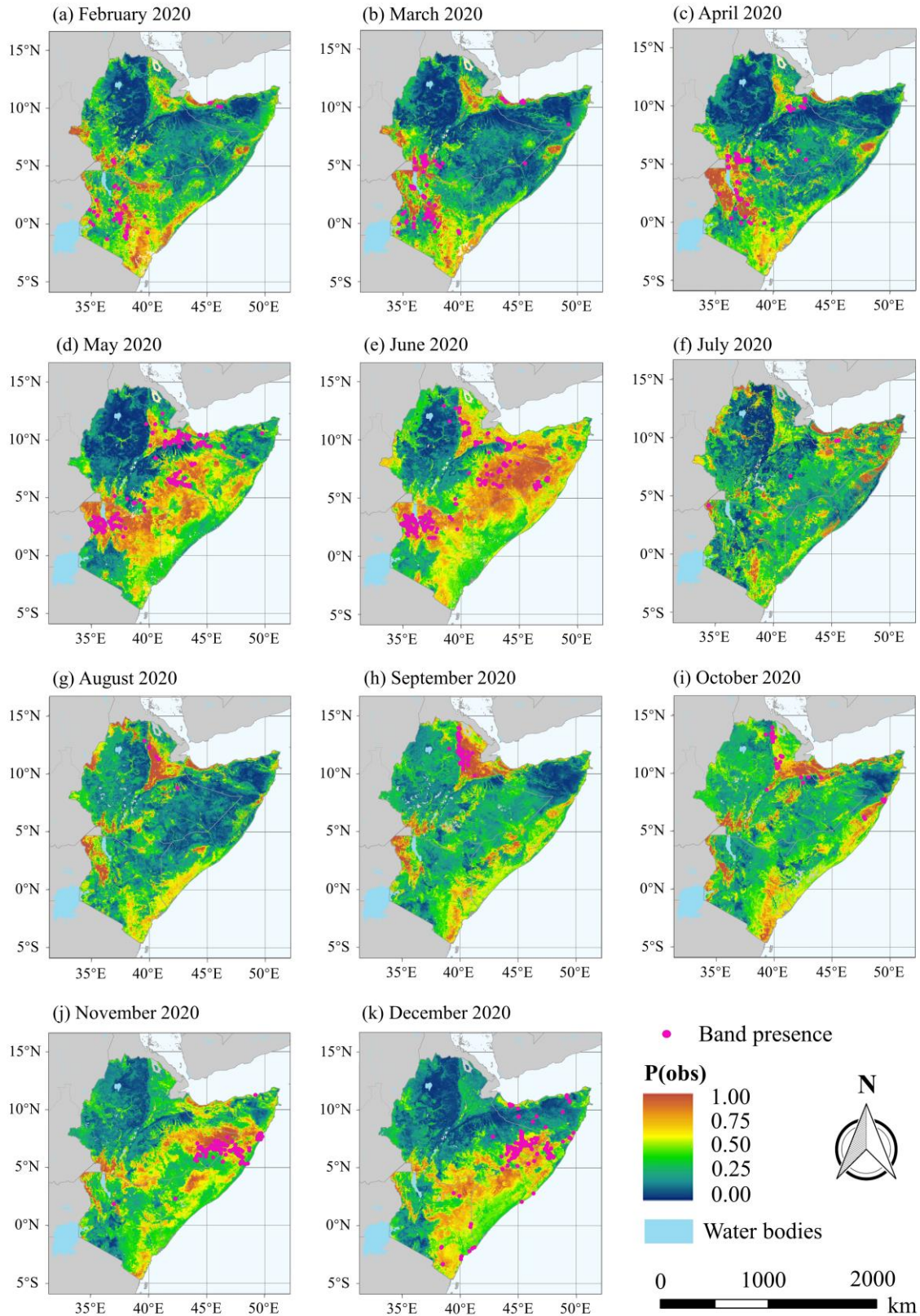


Figure S3. Dynamic predicted probability of observing desert locust band presences with monthly ground truths of band presences in SEK from February 2020 to December 2020.