

1 Appendix A: Tables and figures describing parameter values used for simulations, convergence  
2 diagnostics, and forecast performance of all methods.

3 Table A1. Parameter value ranges used in the simulations. All parameters were sampled  
4 uniformly from the specified ranges.

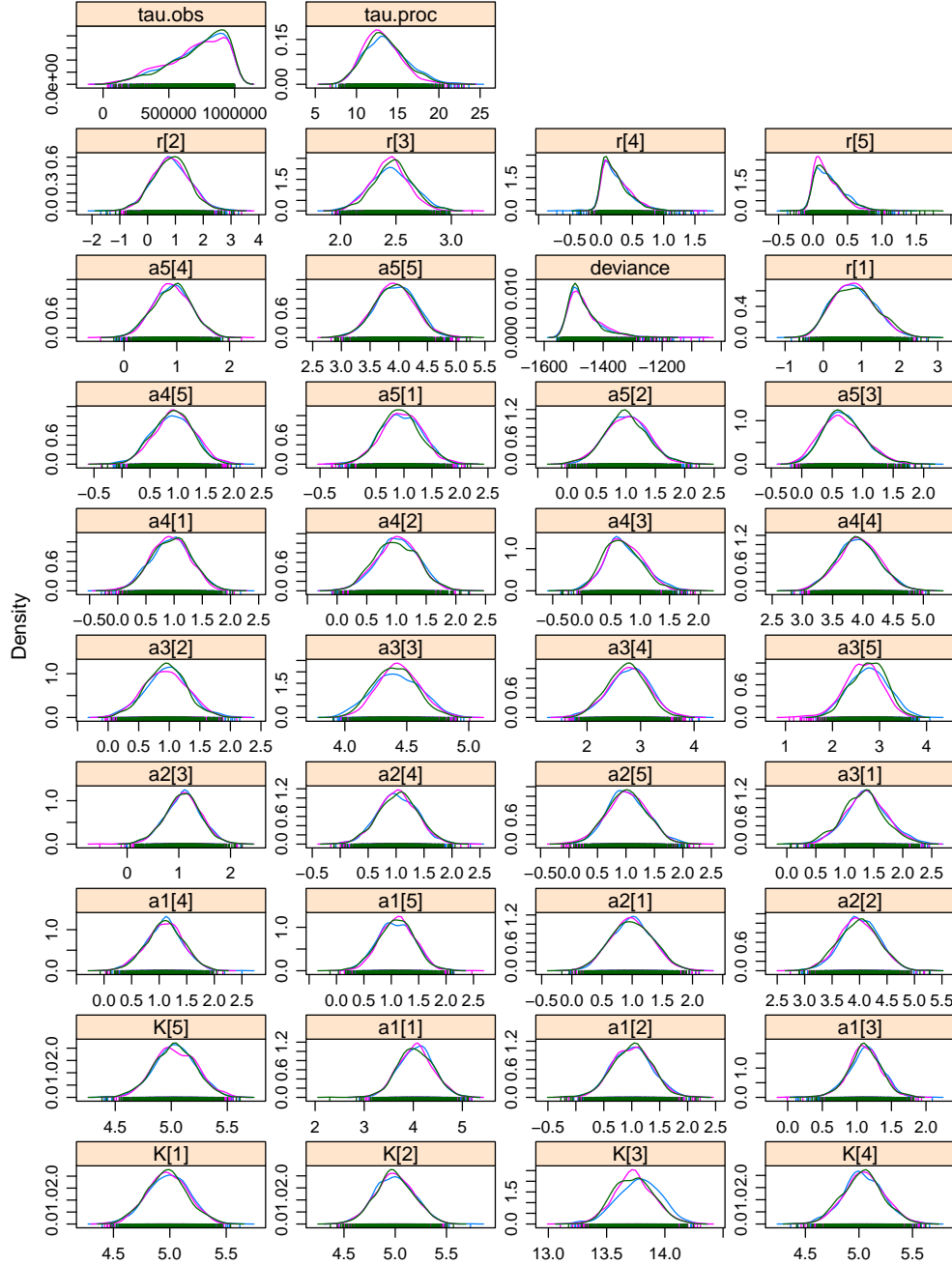
| Parameter | Values         |
|-----------|----------------|
| $a_1$     | 3.5 to 6.5     |
| $a_2$     | 0.07 to 0.13   |
| $b_1$     | 2.1 to 3.9     |
| $b_2$     | 1.4 to 2.6     |
| 5 $d_1$   | 0.28 to 0.52   |
| $d_2$     | 0.007 to 0.013 |
| $F$       | 0.025 to 0.075 |
| $\sigma$  | 0.05 to 0.15   |
| $\theta$  | 0 to 500       |
| $dt$      | 0.1            |

6 Table A2. Average forecast percent error of all simulation runs, for all forecasting methods  
7 and treatment types. The number in the parentheses is the number of species used to fit the  
8 model.

|   | Forecast method | Overall | No noise | Low noise | High noise | Short series | Long series | Low harvest | High harvest |
|---|-----------------|---------|----------|-----------|------------|--------------|-------------|-------------|--------------|
|   | MS-Map (1)      | 29.6%   | 12.7%    | 23.9%     | 33.8%      | 29.6%        | 28.2%       | 29.6%       | 28.2%        |
|   | MS-Map (2)      | 18.3%   | 11.3%    | 14.1%     | 22.5%      | 19.7%        | 15.5%       | 19.7%       | 15.5%        |
|   | MS-Map (3)      | 15.5%   | 9.9%     | 11.3%     | 21.1%      | 16.9%        | 14.1%       | 16.9%       | 14.1%        |
|   | Schaefer (1)    | 45.1%   | 40.8%    | 40.8%     | 49.3%      | 45.1%        | 45.1%       | 45.1%       | 45.1%        |
| 9 | LV3 (1)         | 45.1%   | 49.3%    | 46.5%     | 45.1%      | 46.5%        | 45.1%       | 45.1%       | 46.5%        |
|   | LV3 (2)         | 45.1%   | 49.3%    | 46.5%     | 43.7%      | 46.5%        | 43.7%       | 43.7%       | 45.1%        |
|   | LV3 (3)         | 40.8%   | 38.0%    | 39.4%     | 43.7%      | 40.8%        | 42.3%       | 40.8%       | 42.3%        |
|   | HP (1)          | 32.4%   | 0.0%     | 22.5%     | 39.4%      | 33.8%        | 31.0%       | 31.0%       | 33.8%        |
|   | HP (2)          | 29.6%   | 0.0%     | 19.7%     | 38.0%      | 28.2%        | 28.2%       | 28.2%       | 29.6%        |
|   | HP (3)          | 16.9%   | 0.0%     | 8.5%      | 25.4%      | 8.5%         | 22.5%       | 16.9%       | 18.3%        |

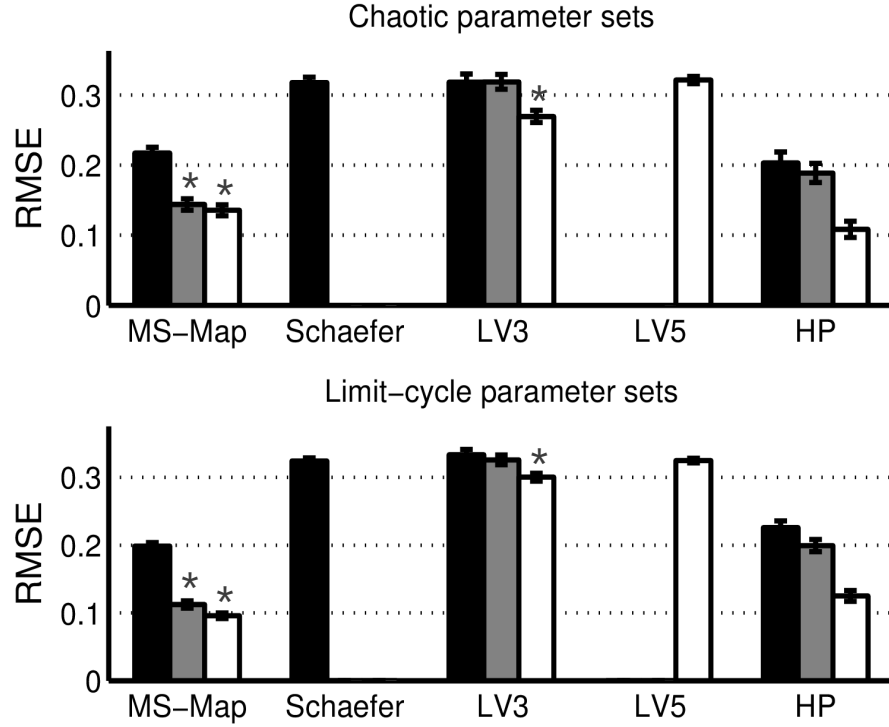
10 Table A3. Initial parameter values used for the LV5 MCMC fitting routine. Initial conditions  
 11 for species  $X_1, X_2, X_3$  were set to the correct values. The standard deviation of the observation  
 12 error and process noise were initiated at 0.3.

| Parameter      | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ |
|----------------|-------|-------|-------|-------|-------|
| $x_{i,1}$      | *     | *     | *     | 3     | 3     |
| $a_{j \neq i}$ | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |
| $a_{j=i}$      | 4.0   | 4.0   | 4.0   | 4.0   | 4.0   |
| $r$            | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |
| $K$            | 5     | 5     | 14    | 5     | 5     |



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15 Figure A1. Example of posterior probability distributions for all parameters in the LV5  
 16 state-space model. The three lines in each plot represent the three MCMC chains.



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18 Figure A2. Average 3-step ahead RMSE of all forecasting methods for all simulations with  
19 noise, partitioned by chaotic parameter sets (top-panel) and limit-cycle parameter sets (bottom-  
20 panel). Significant differences in median RMSE were tested using a Mann-Whitney U-test and  
21 are denoted by an asterisk ( $p < 0.05$ ). Using Levene's test, no significant differences were found  
22 in RMSE variance across chaotic vs limit cycle parameter sets. LV3 is the Lotka-Volterra three-  
23 species model, LV5 is the Lotka-Volterra five-species model, and HP is the Hastings-Powell  
24 (control) model. Black, gray and white bars are the model fit using time series from one, two,  
25 and three species, respectively.