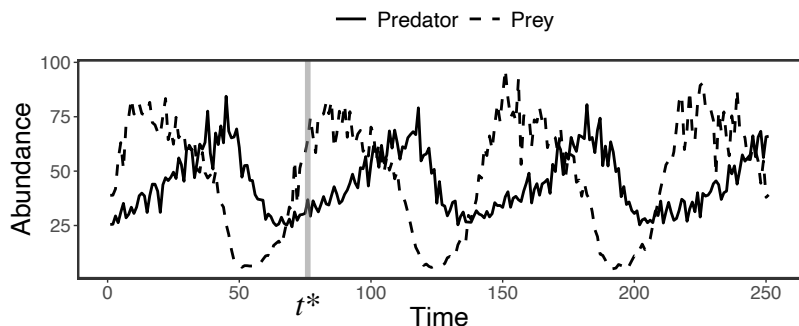


a Infer Jacobian matrix from time series with S-map

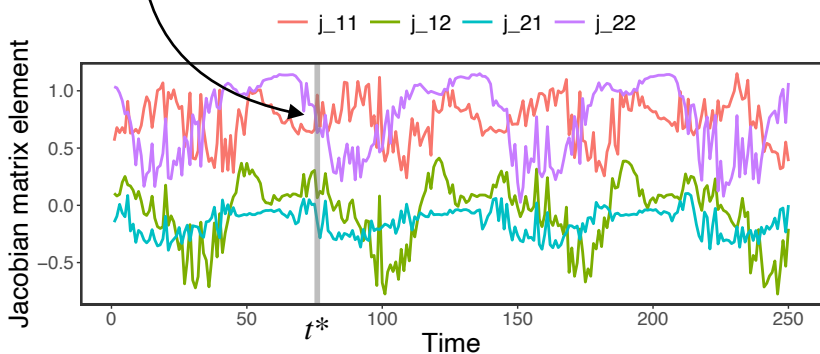
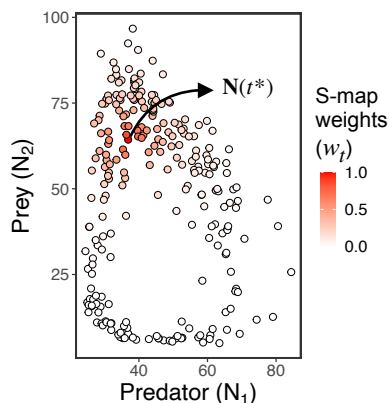


Weighted regression for each point t^* :

$$\begin{bmatrix} w_1 N_i(2) \\ w_2 N_i(3) \\ \vdots \\ w_T N_i(T+1) \end{bmatrix} = \begin{bmatrix} w_1 & w_1 N_1(1) & \dots & w_1 N_S(1) \\ w_2 & w_2 N_1(2) & \dots & w_2 N_S(2) \\ \vdots & \vdots & \ddots & \vdots \\ w_T & w_T N_1(T) & \dots & w_T N_S(T) \end{bmatrix} \begin{bmatrix} j_{i0} \\ j_{i1} \\ \vdots \\ j_{iS} \end{bmatrix}$$

Regression coefficients:
Jacobian matrix
elements

$$j_{ij} = \frac{\partial N_i(t^* + 1)}{\partial N_j(t^*)}$$



b Perform community sensitivity decomposition

Community sensitivity decomposition for each point t^* :

(1) Compute covariance matrix of perturbed abundances: $\Sigma = e^{kJ} \Sigma_i e^{kJ^T}$

(2) Compute community sensitivity: $\log |\Sigma|$

(3) Compute contribution of individual species: $\sum_{i=1}^S \log \sigma_i^2$

(4) Compute contribution of species correlations: $\log |\mathbf{P}| = \log |\Sigma| - \sum_{i=1}^S \log \sigma_i^2$

