Fishery-dependent data in a spatio-temporal context

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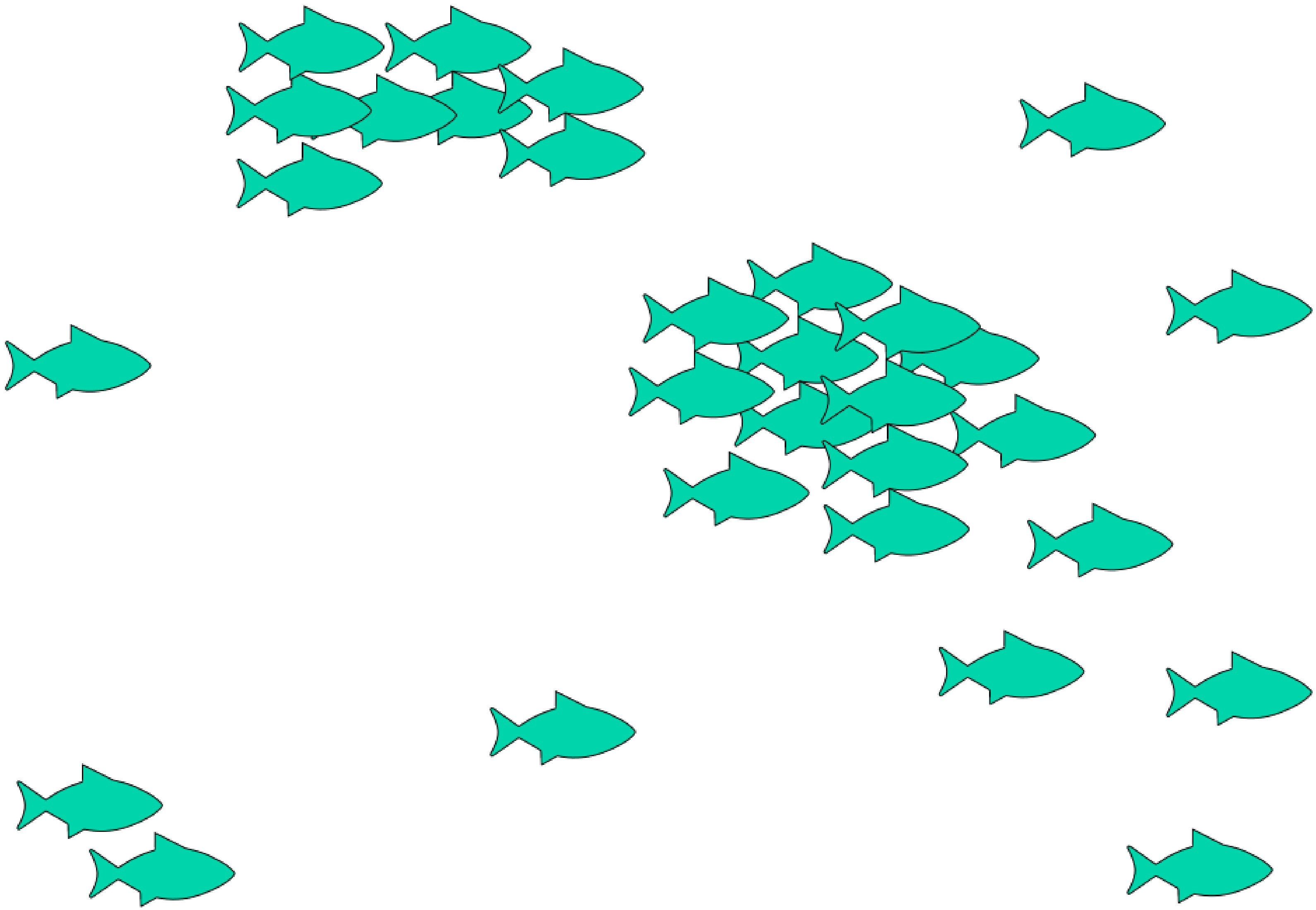
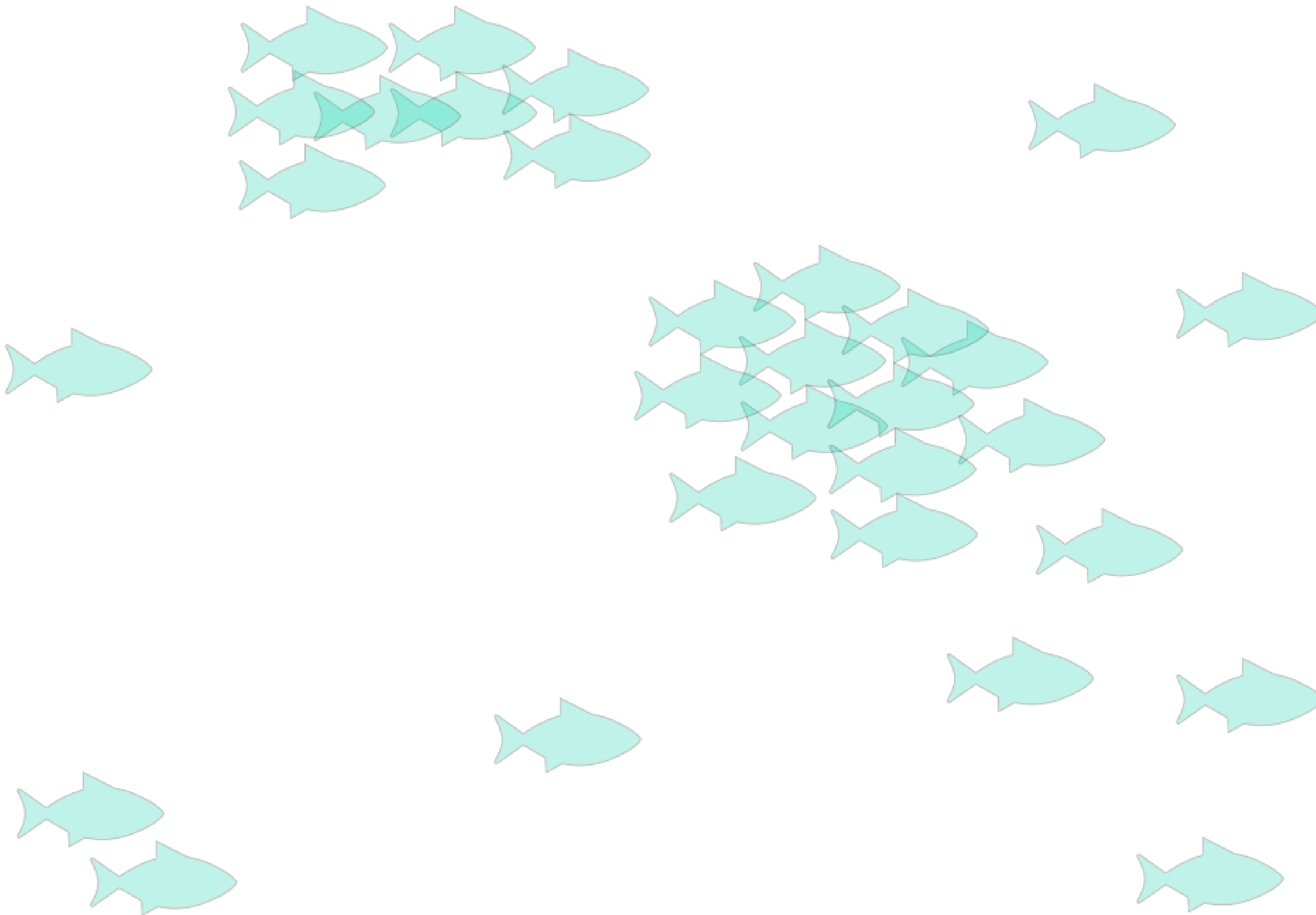
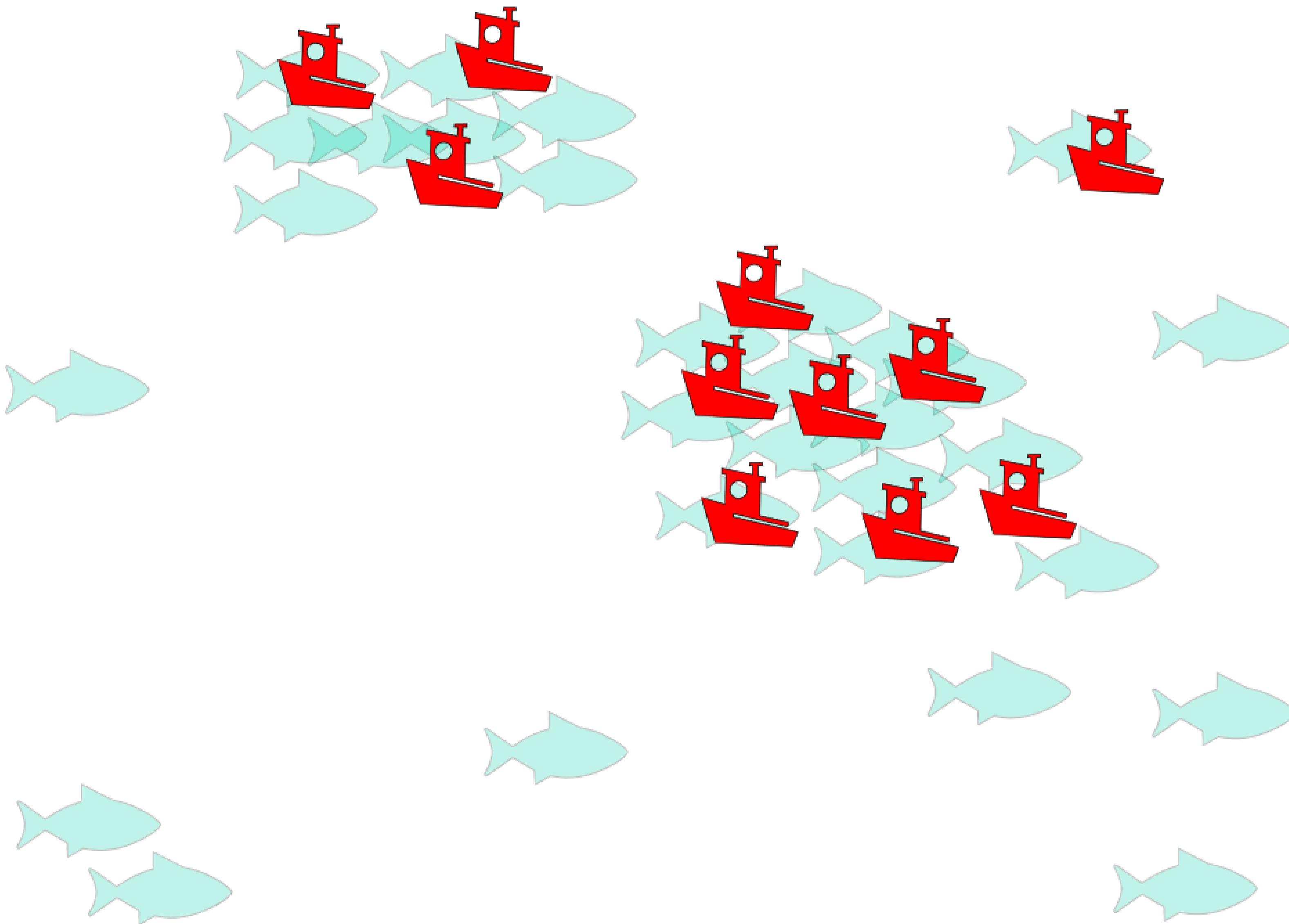
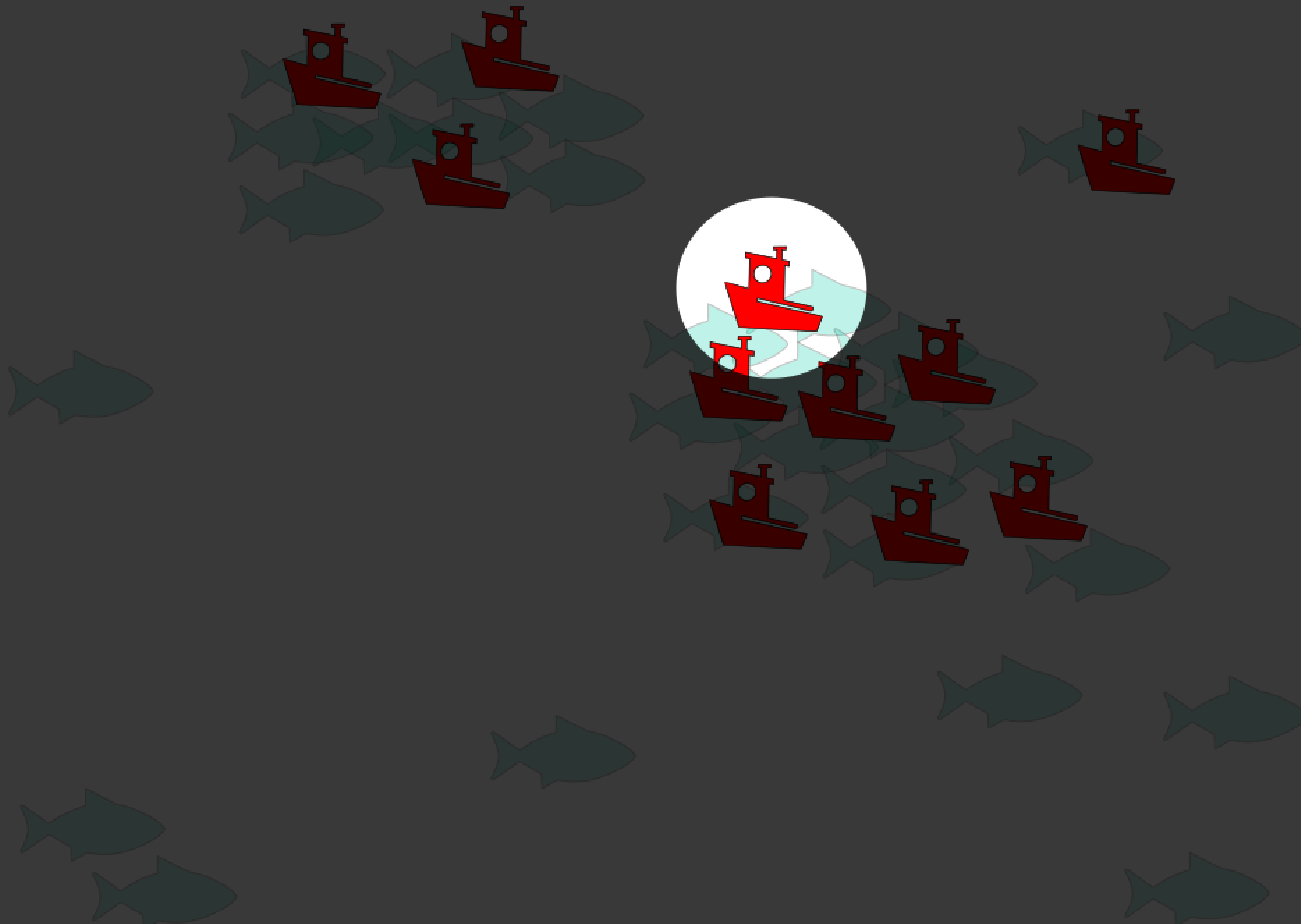
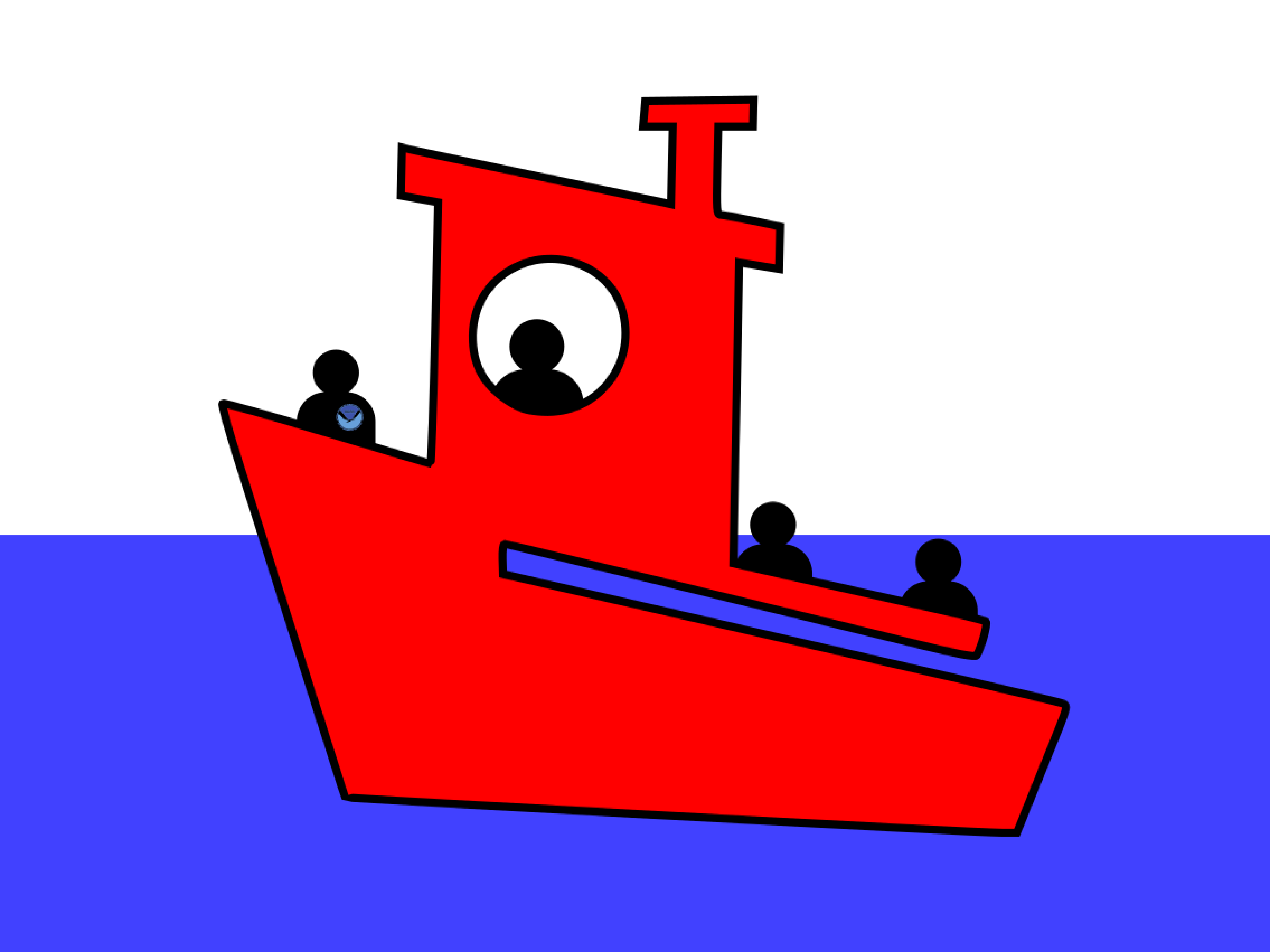
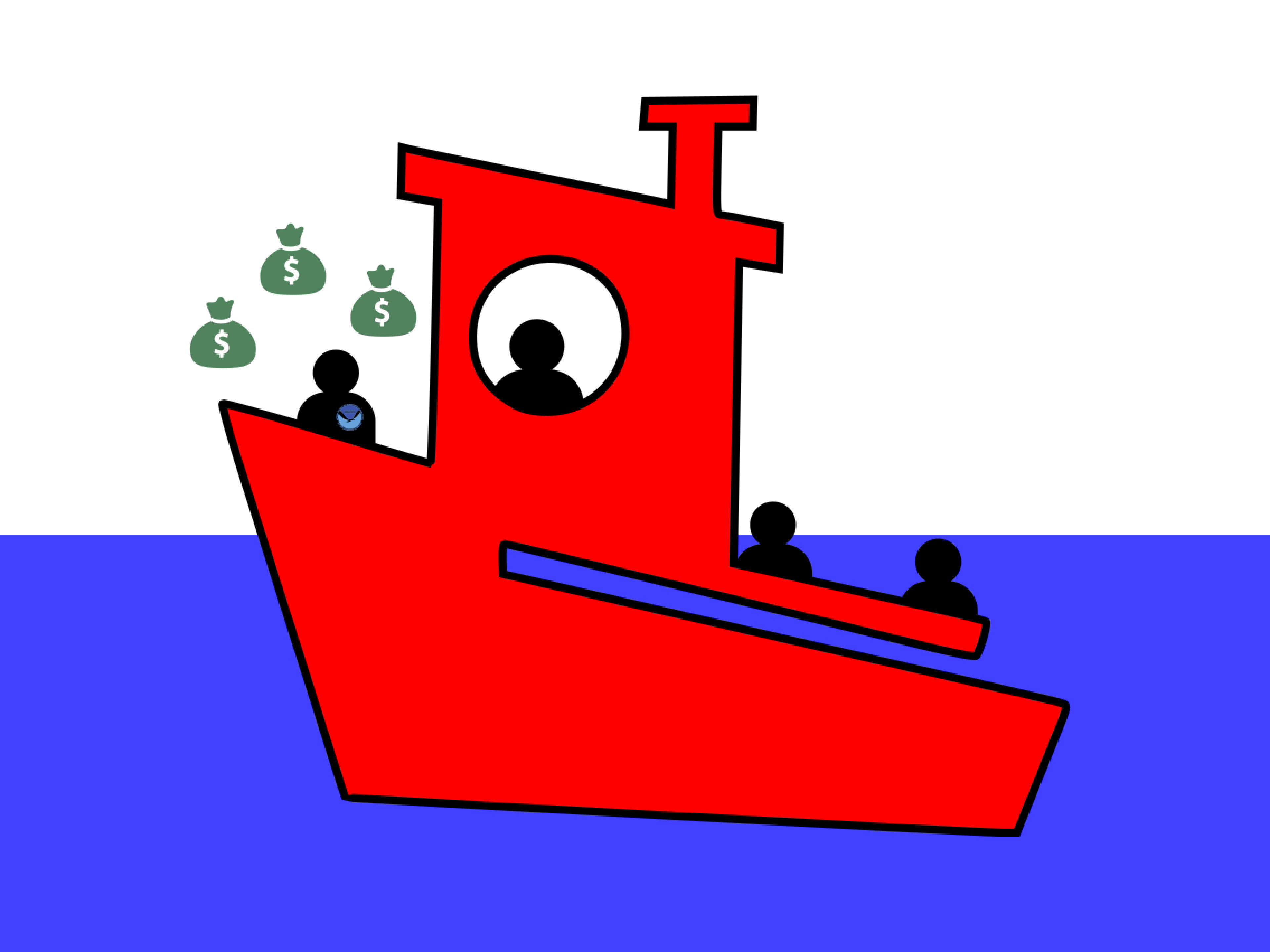






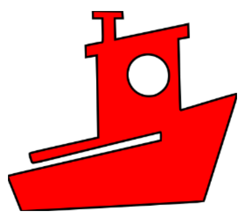






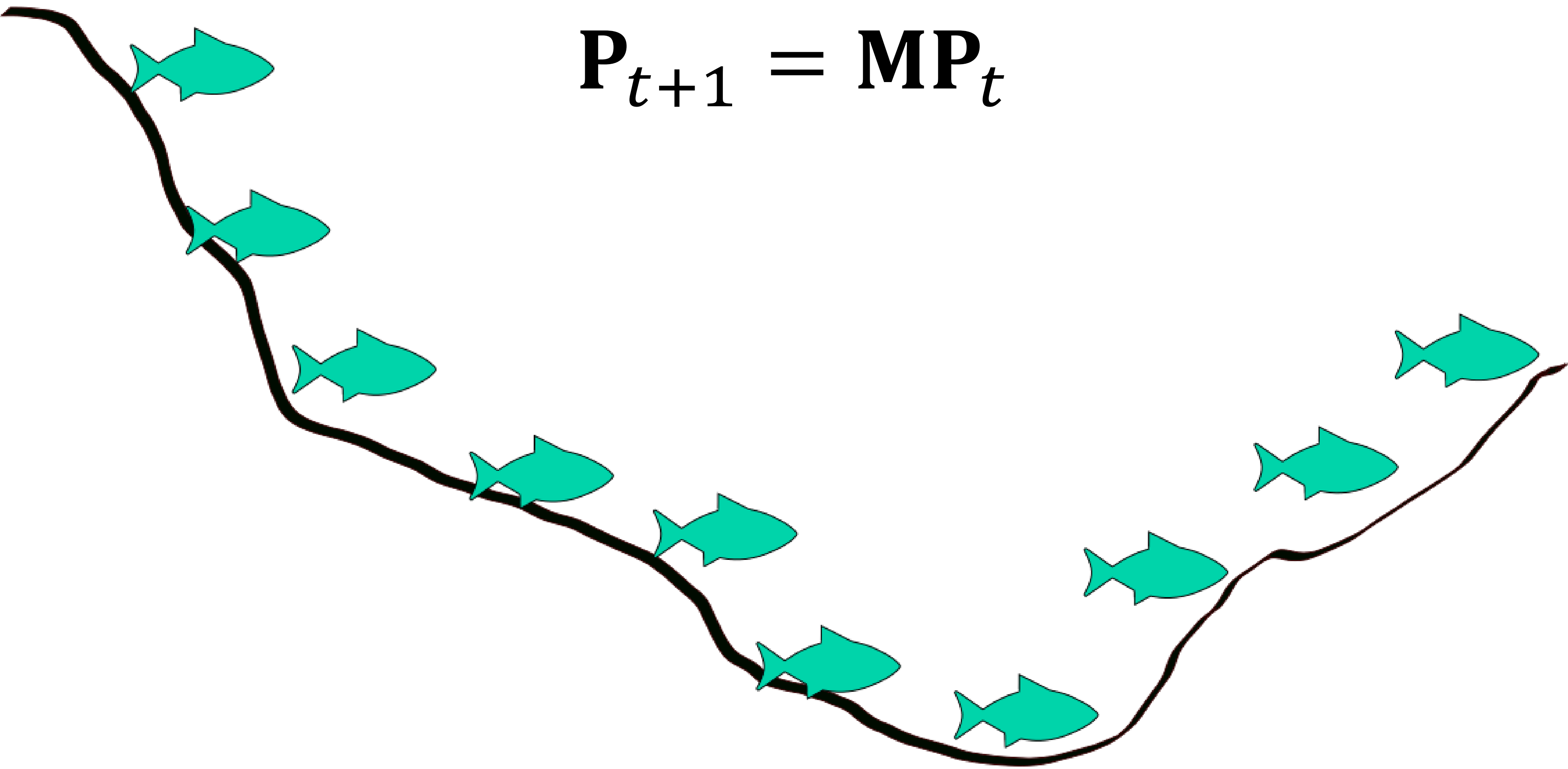
There's a lot more information in fishery data

$\times 500$



$\times 10{,}000$

Spatial structure can be induced through movement



$$\mathbf{P}_{t+1} = \mathbf{M}\mathbf{P}_t$$

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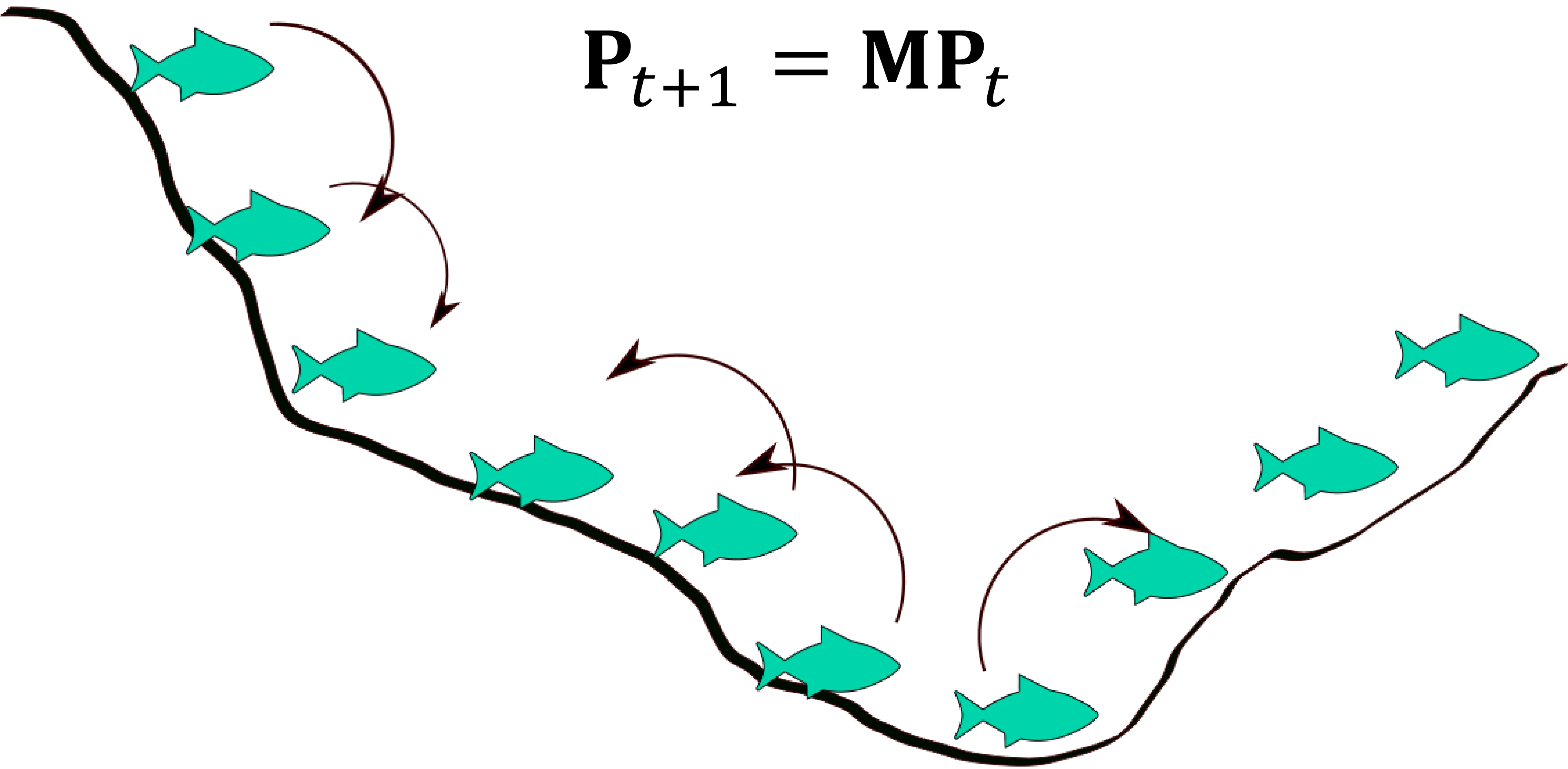

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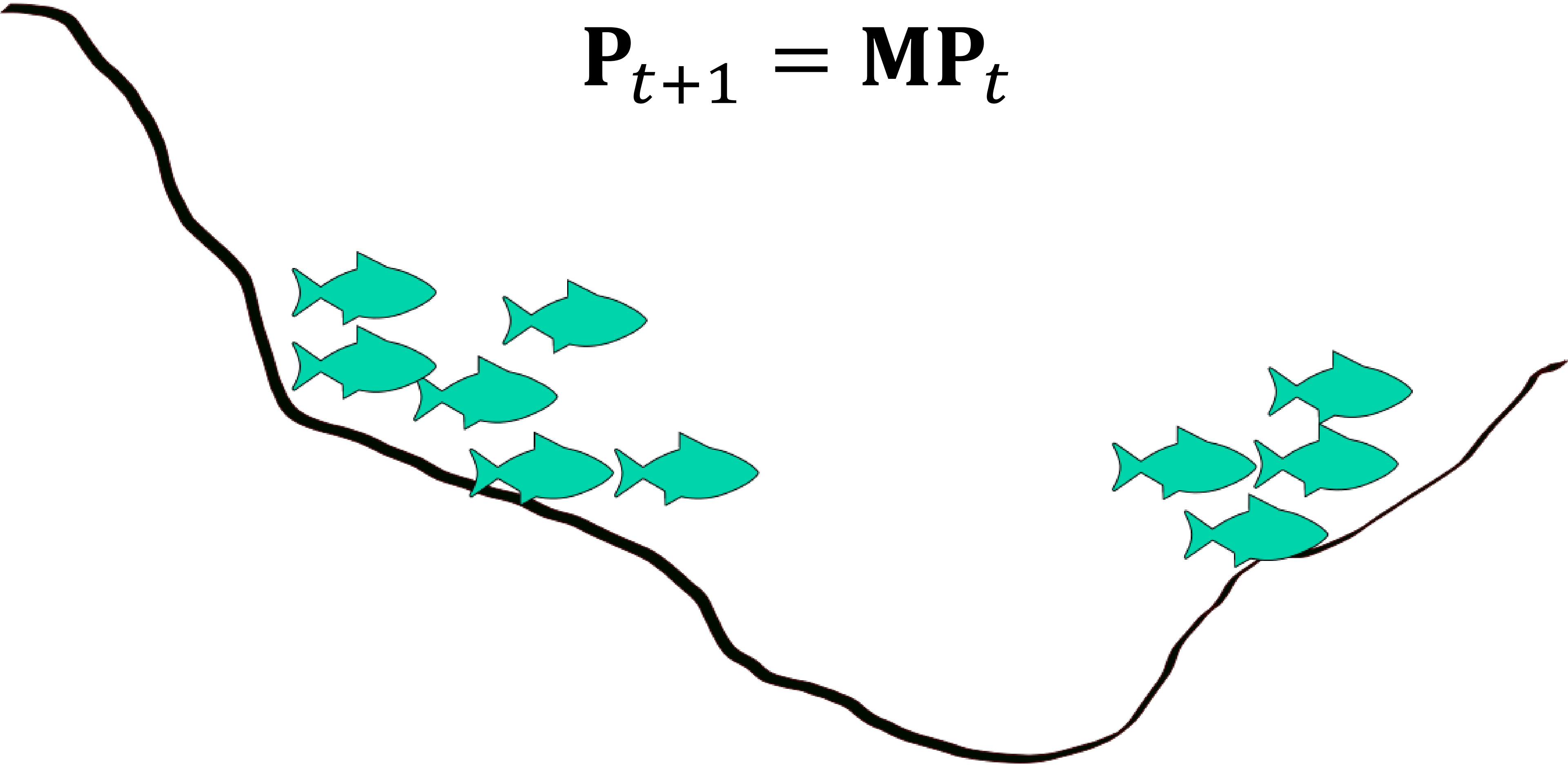
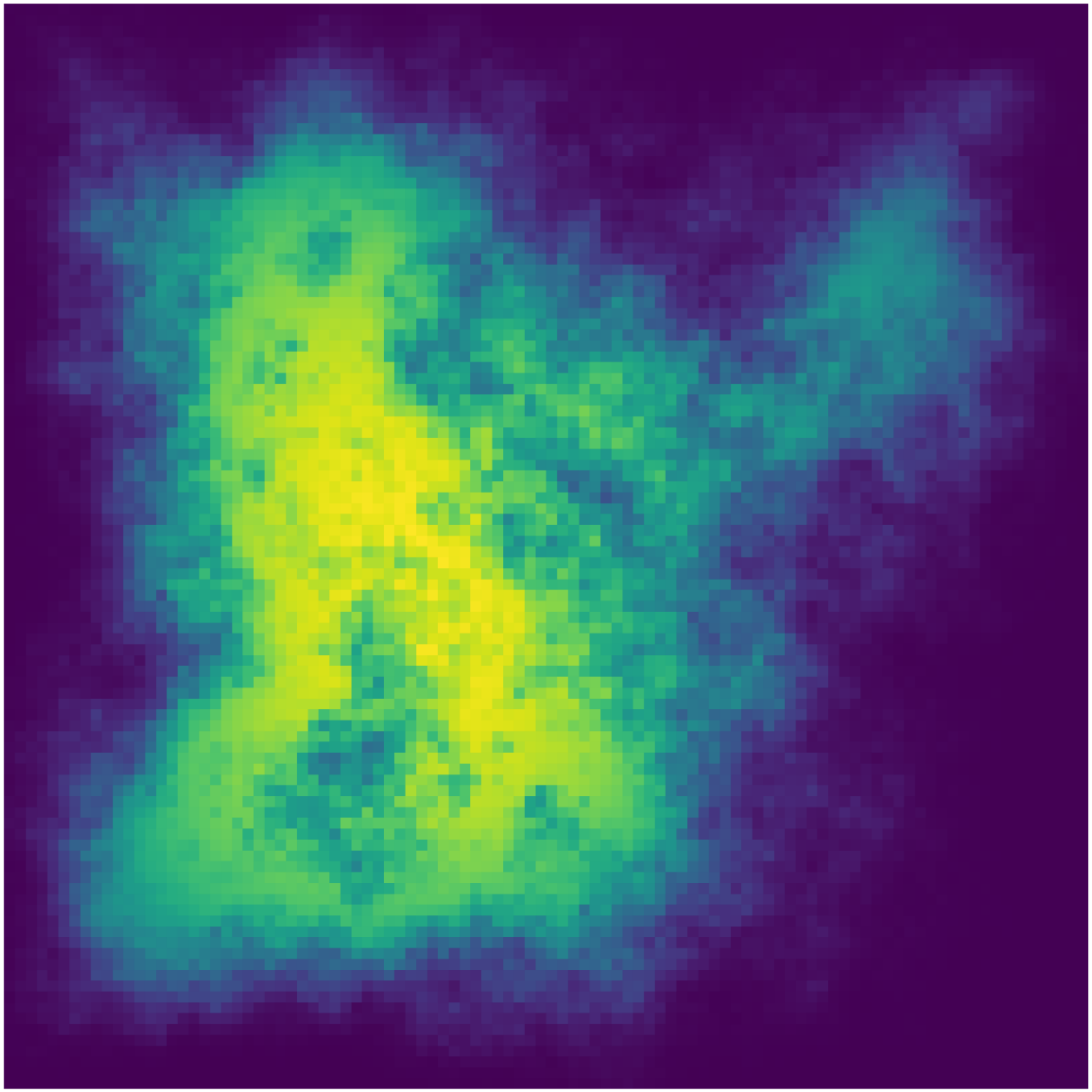
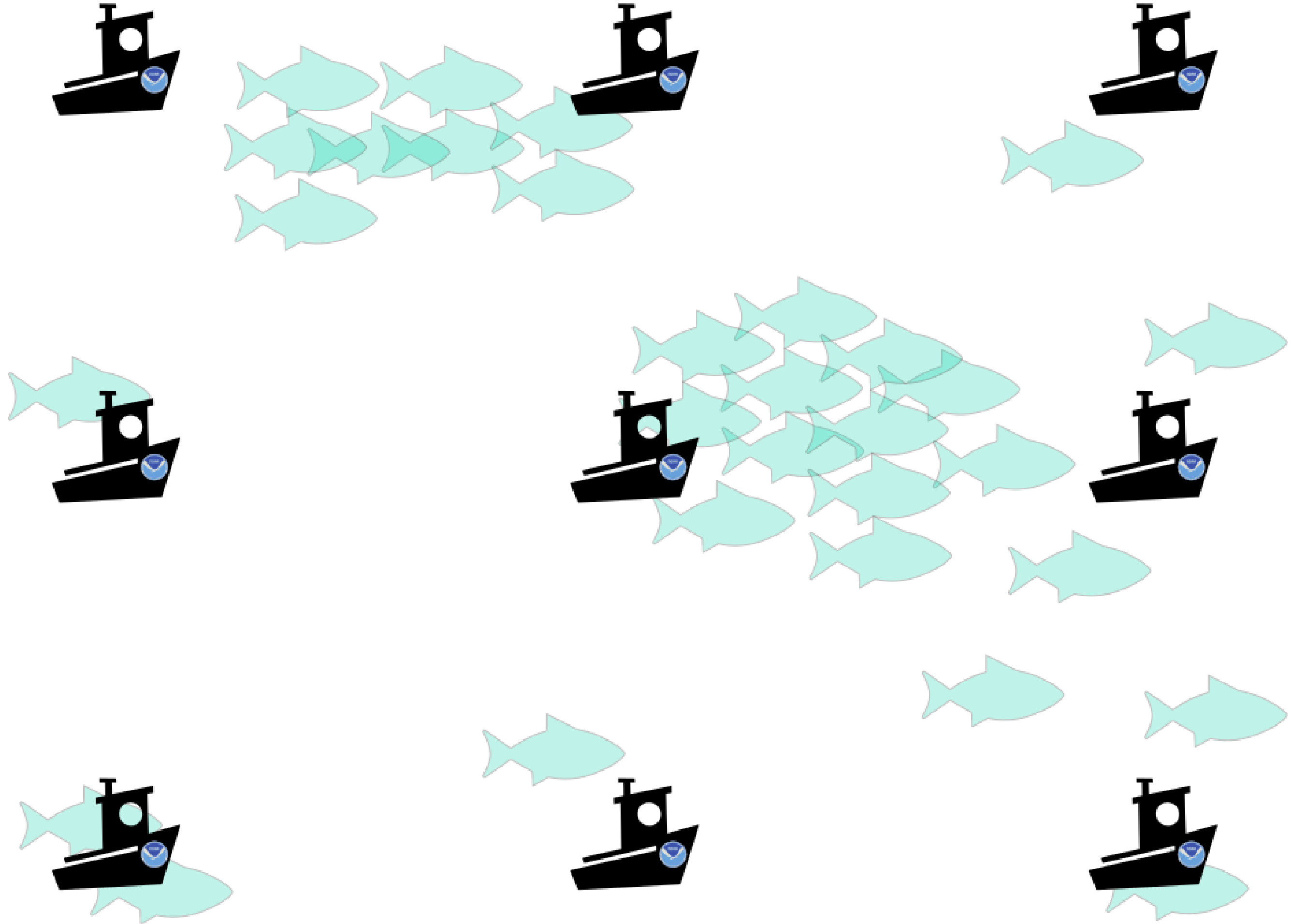


Example abundance map



Targeting varies by fleet



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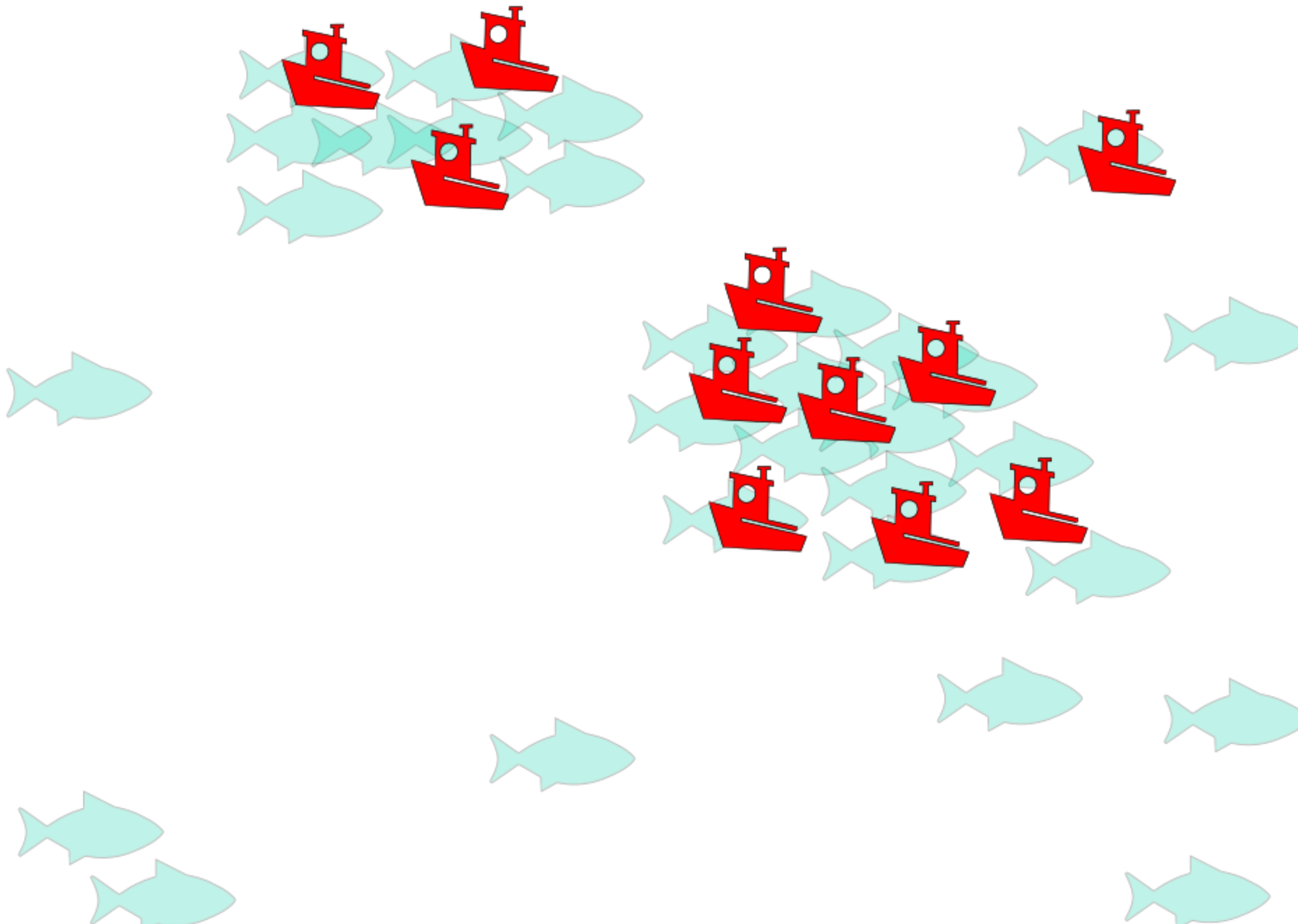

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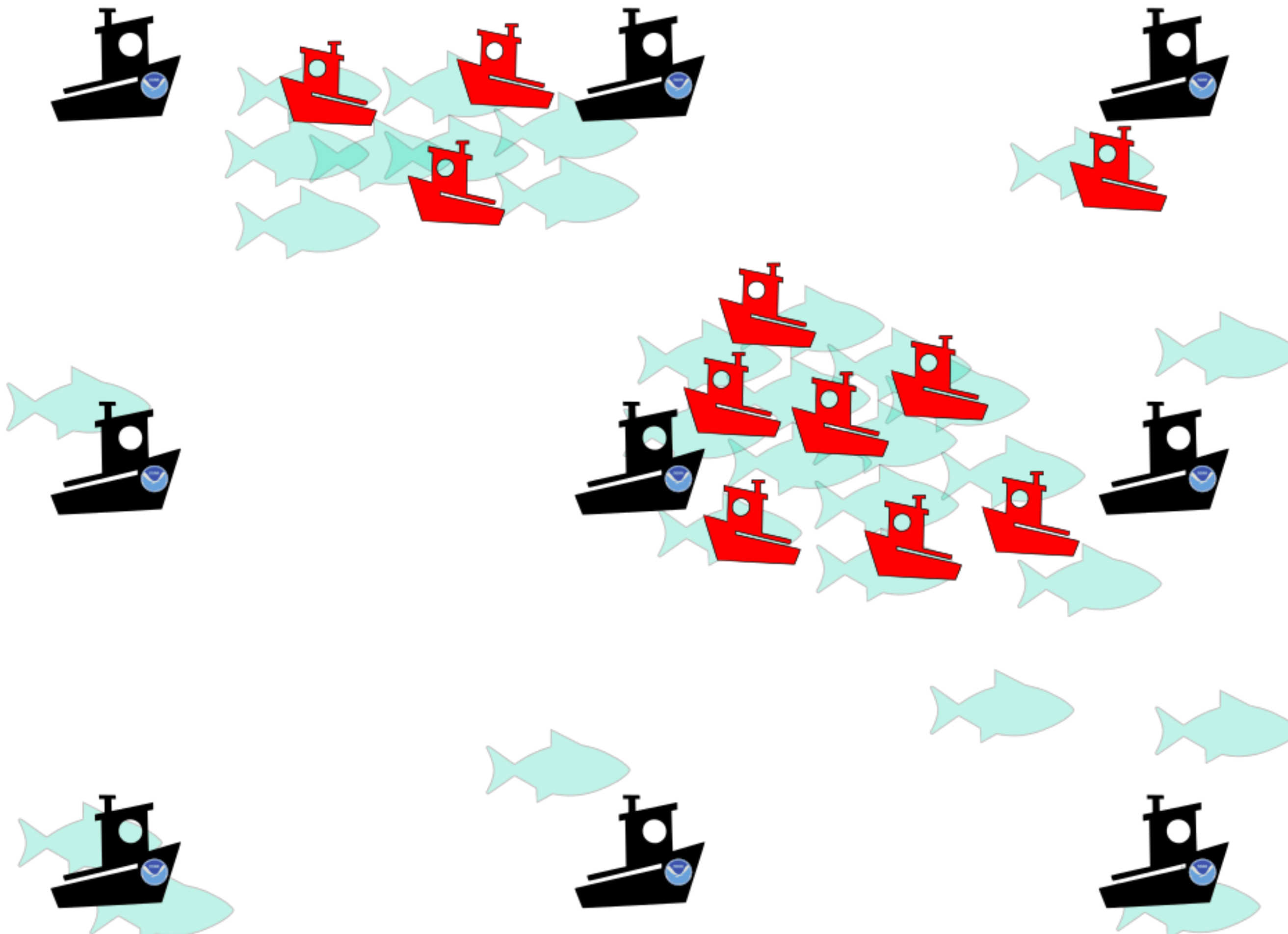


Schaefer population dynamics

$$p_{s,t+1} = p_{s,t} + \ rp_{s,t}\left(1 - \frac{\sum_s p_{s,t}}{K_t}\right)$$

$$K_t \sim \text{LogNormal}\left(\log(\overline{K}) - \frac{0.1^2}{2}, 0.1^2\right)$$

VAST makes model fitting easy

$$r_1(s,t) = 1 - \exp([1 - a_i \exp(p_1(s,t)])$$

$$\Pr\left(C_{s,t} > 0\right) = r_1(s,t)$$

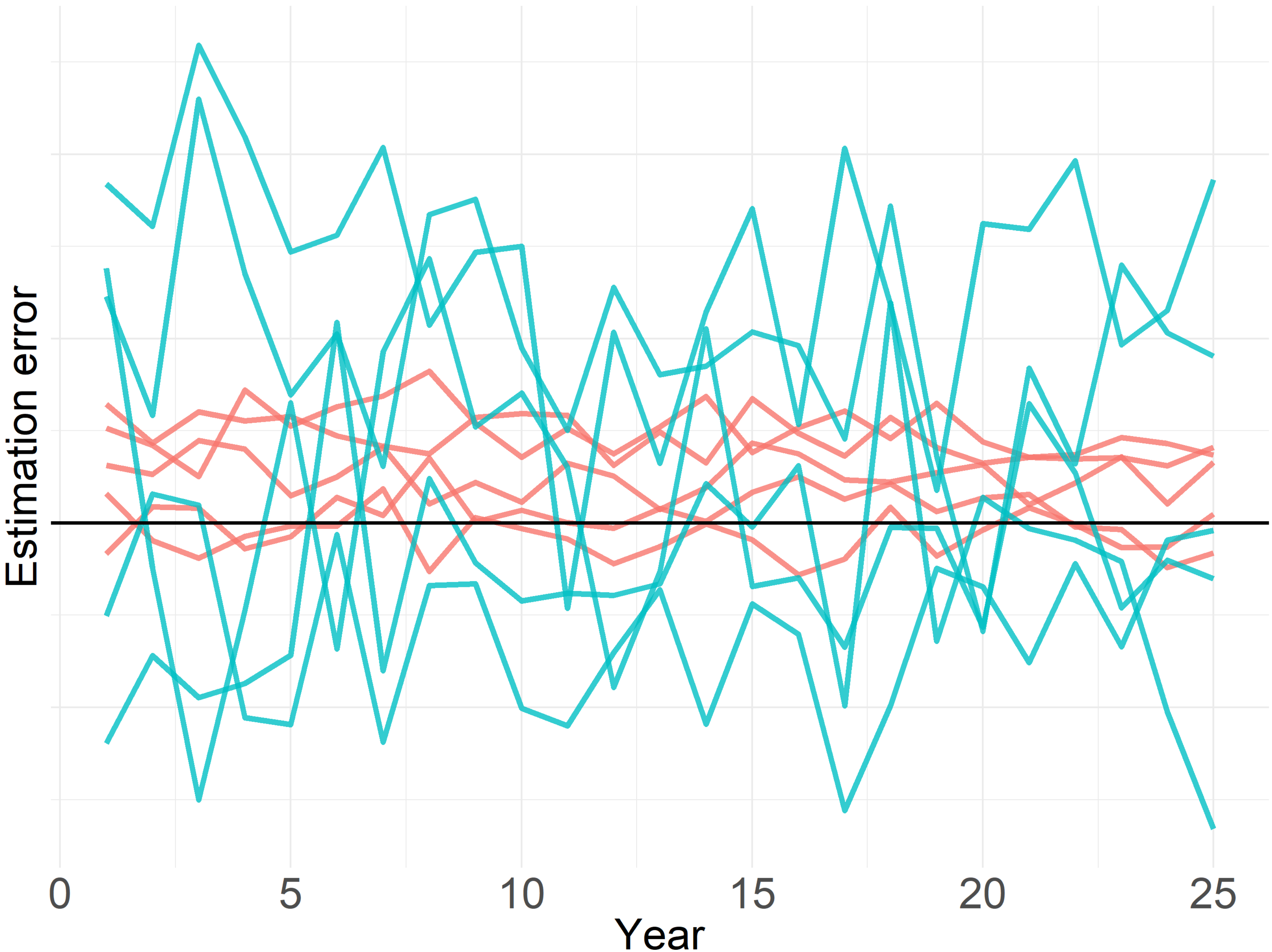
$$r_2(s,t) = \frac{a_i \exp(p_1(s,t))}{r_1(s,t)} \exp(p_2(s,t))$$

$$C_{s,t} \mid C_{s,t} > 0 \sim \mathrm{LogNormal}(r_2(s,t), \sigma^2)$$

VAST makes model fitting easy

$$p_1(s,t) = \beta_1(t) + \omega_1(s) + \varepsilon_1(s,t)$$

$$p_2(s,t) = \beta_2(t) + \omega_2(s) + \varepsilon_2(s,t)$$



Estimation error
0
5
10
15
20
25
Year

The bias is there for a reason

$$\mathbf{Y} = \beta_0 \mathbf{1} + \boldsymbol{\omega}$$

$$\boldsymbol{\omega} \sim MVN(0, \boldsymbol{\Sigma})$$

$$(\Sigma)_{ij} = k(s_i, s_j)$$

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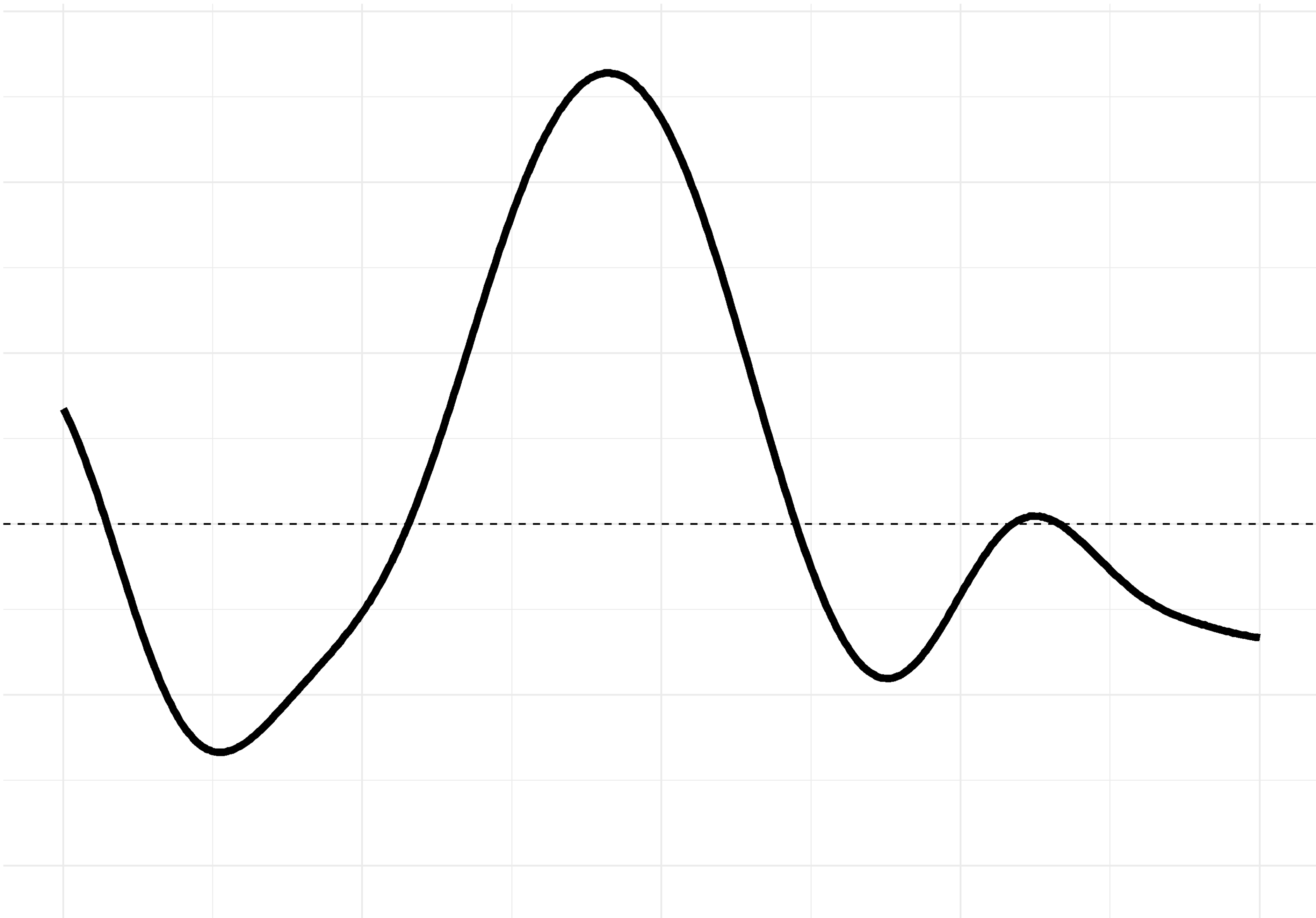
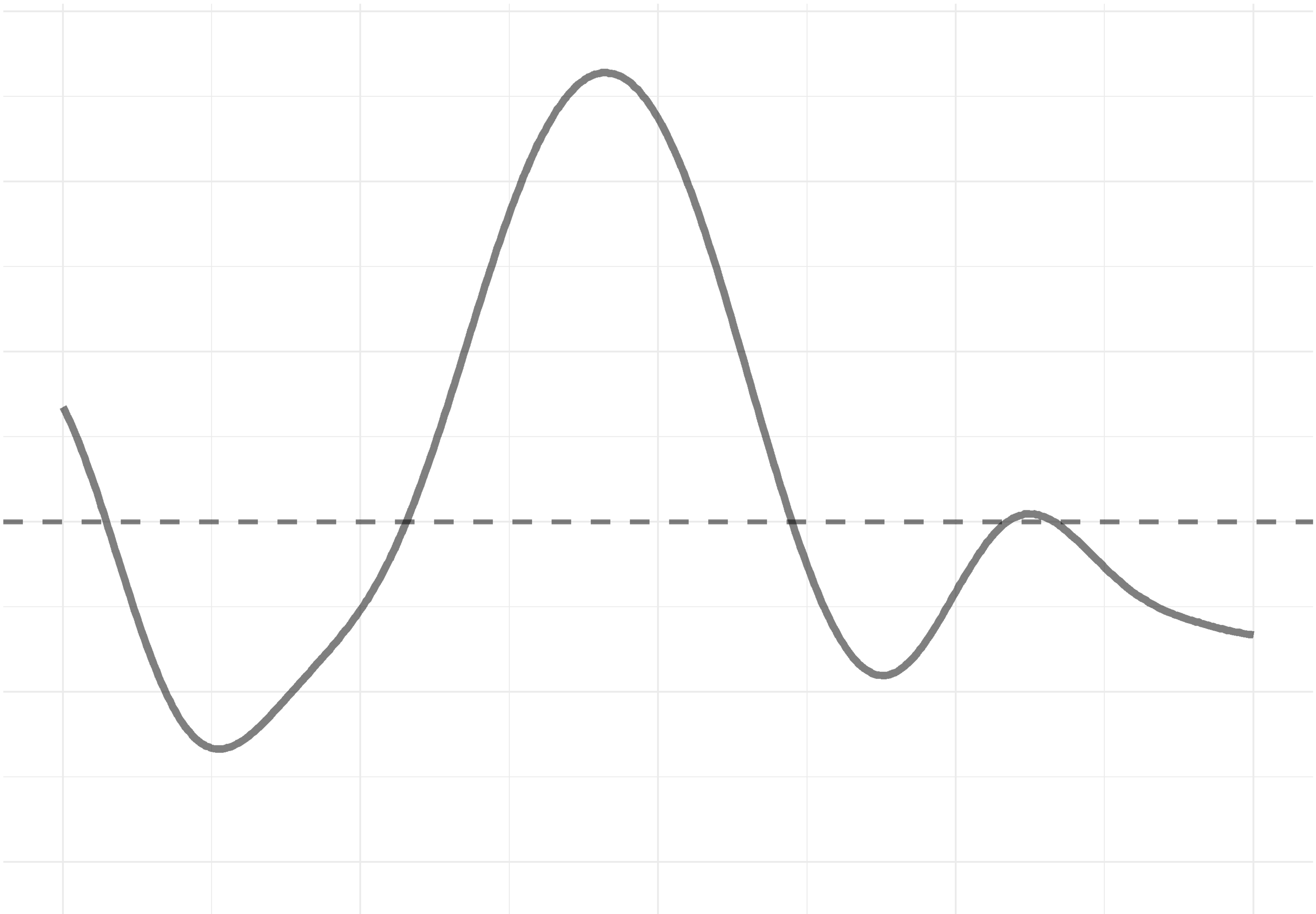
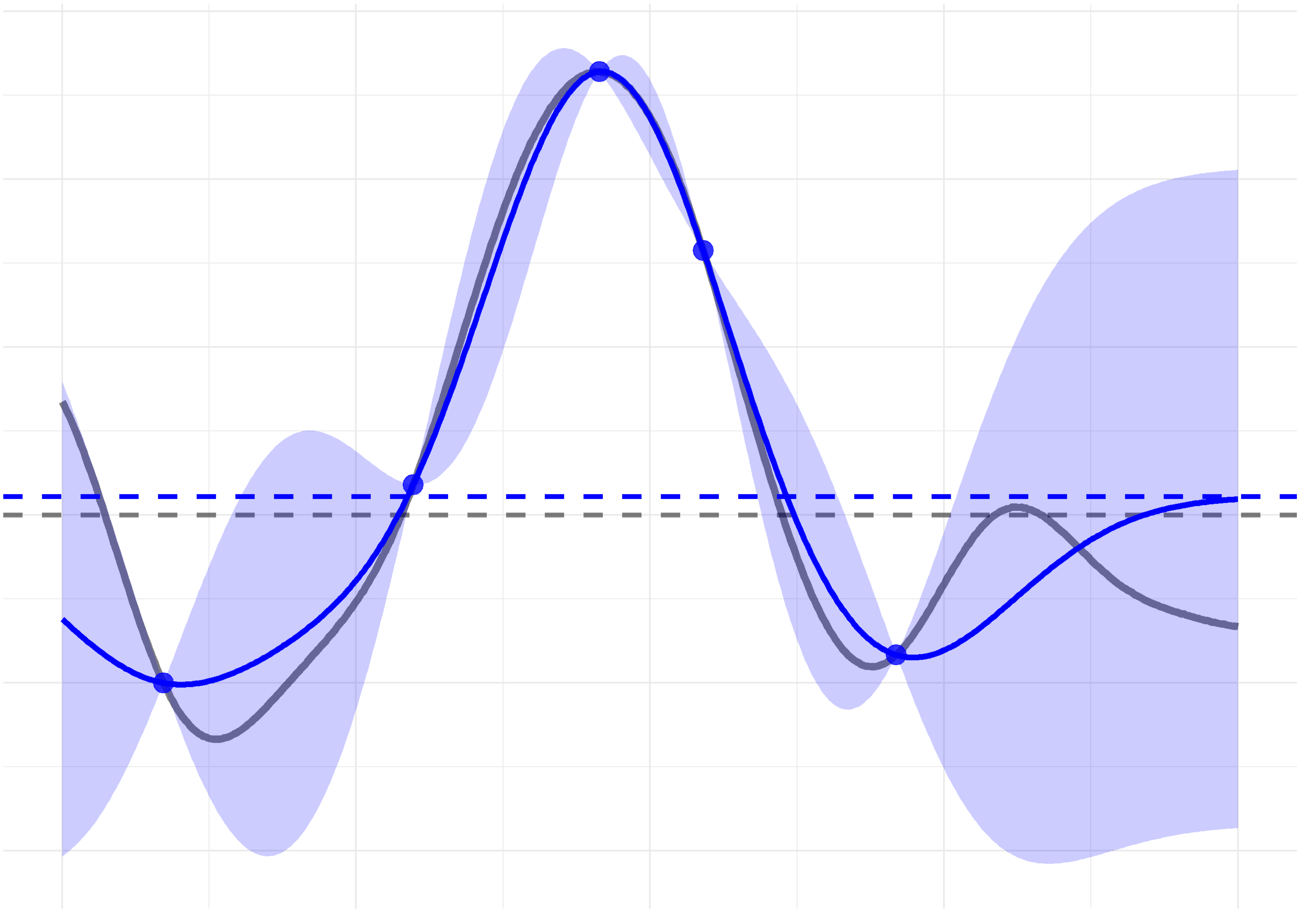
True process



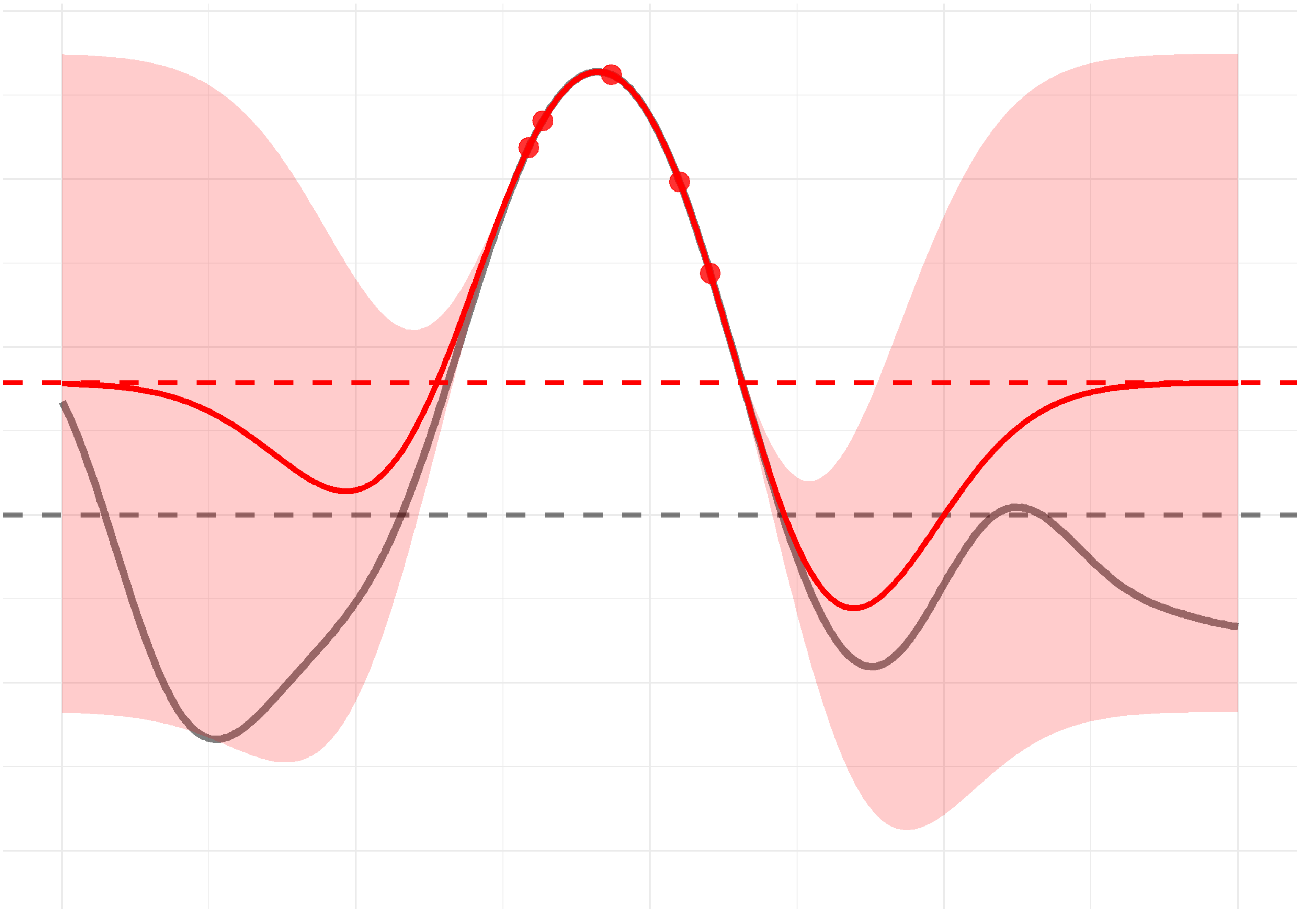
True process



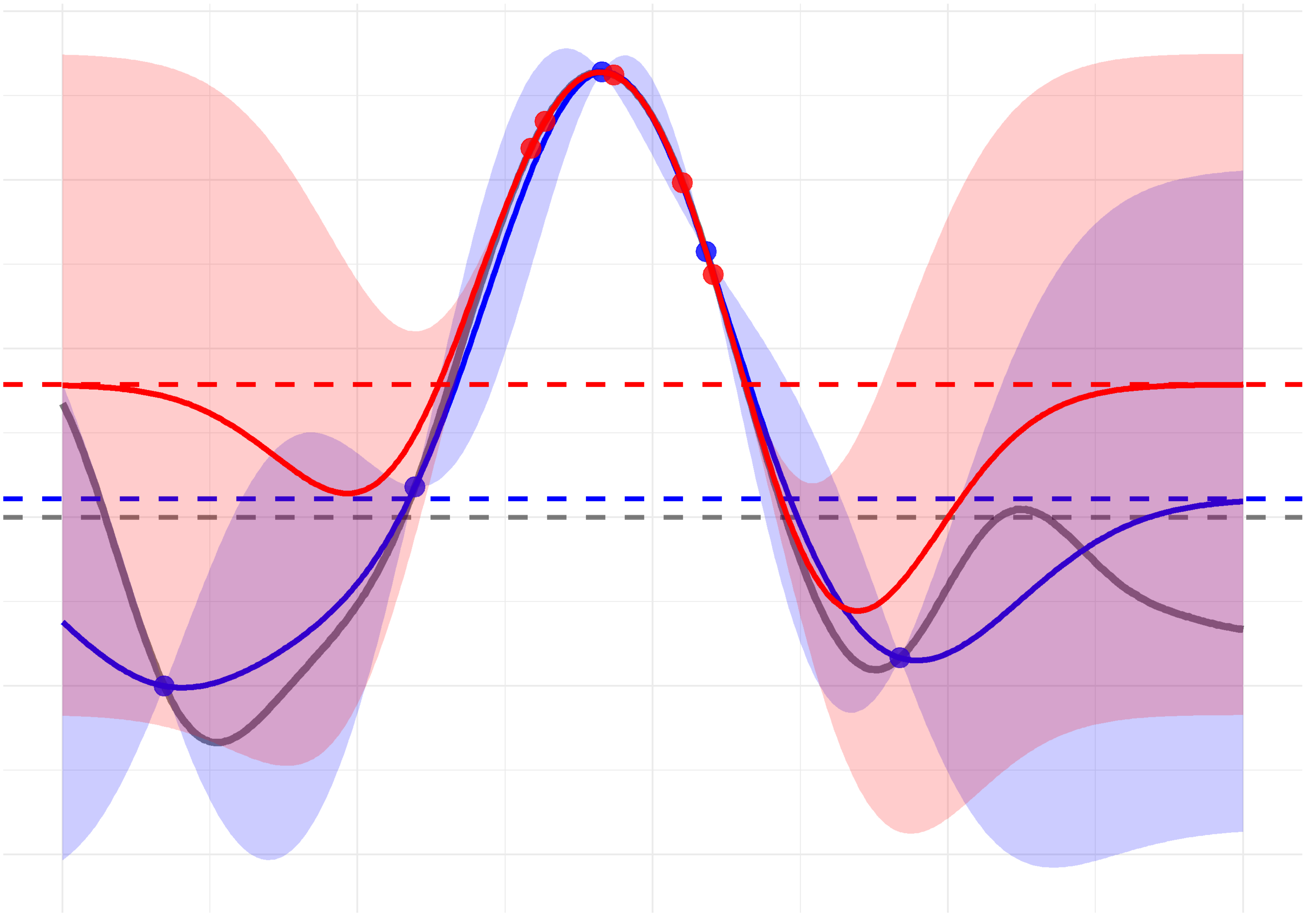
Random sampling



Preferential sampling



All together now



There's a lot left to do

$$\log(\text{CPUE}_s) = \boldsymbol{\mu}_s + \boldsymbol{\omega}_d + \boldsymbol{\epsilon}_s$$

$$\log\left(\text{CPUE}_f\right) = \boldsymbol{\mu}_f + \boldsymbol{\omega}_d + \boldsymbol{\omega}_q + \boldsymbol{\epsilon}_f$$

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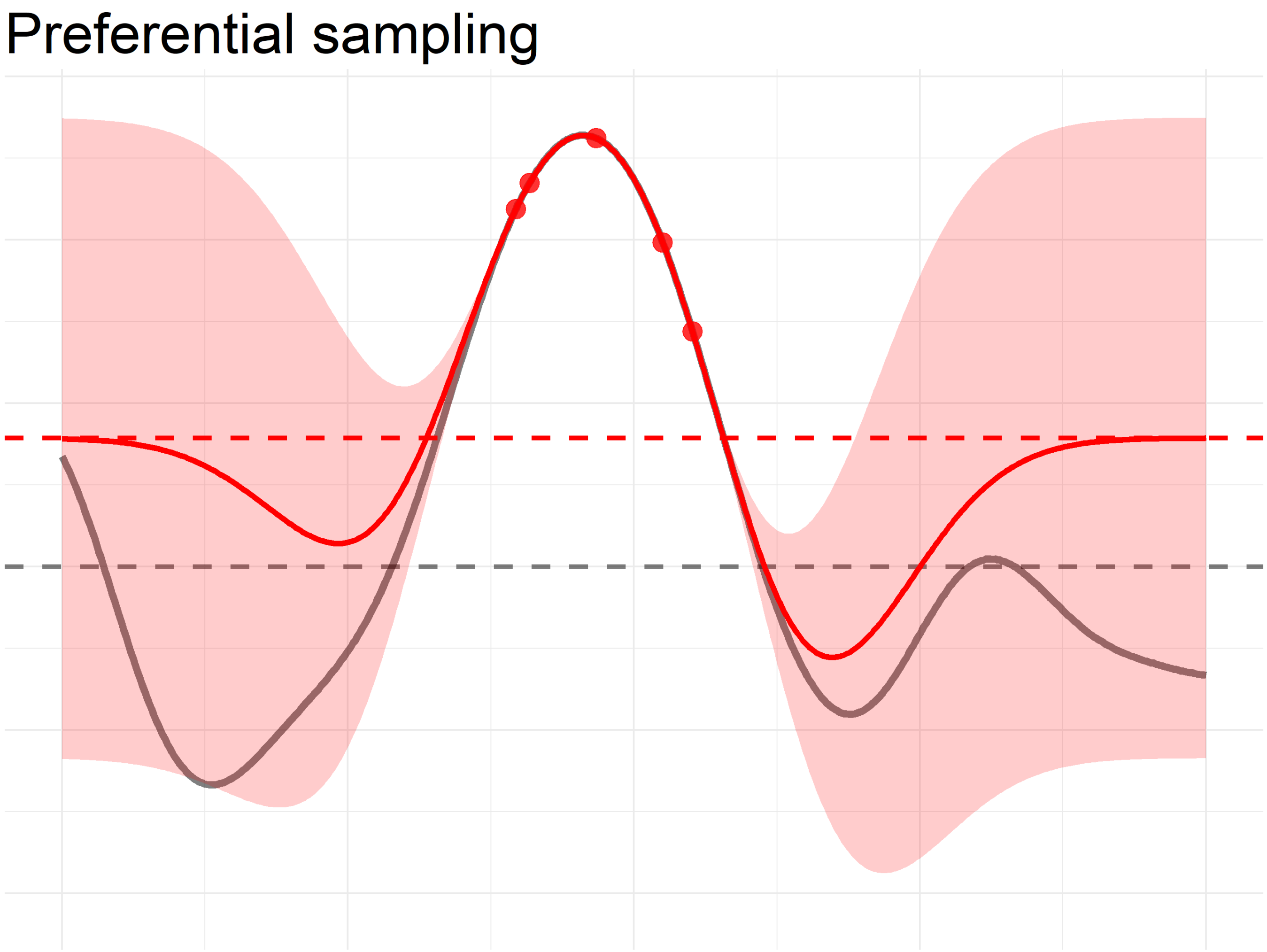

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