# Discussion Document

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**Abstract**

Discussion on Data Assimilation

*Keywords:* Data Assimilation

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## 1 Introduction

## 2 Kot Model

Here is the Kot (1992) Model used in Figure 1.

$$\begin{aligned}
\frac{dS}{dt} &= D\left[S_i\left(1+\epsilon\sin\frac{2\pi}{T}t\right)-S\right]-\frac{\mu_1}{Y_1}\frac{SH}{K_1+S}\\
\frac{dH}{dt} &= \mu_1\frac{SH}{K_1+S}-DH-\frac{\mu_2}{Y_2}\frac{HP}{K_2+H}\\
\frac{dP}{dt} &= \mu_2\frac{HP}{K_2+H}-DP
\end{aligned}$$

## 3 Competition Model

Here is my stab at putting together a competion model with predators.

$$
\begin{aligned}
\frac{dx_1}{dt} &= r_1 x_1 - r_1 x_1 \left( \frac{x_1 + \alpha_{12} x_2 + \alpha_{13} x_3}{K_1} \right) \\
\frac{dx_2}{dt} &= r_2 x_2 - r_2 x_2 \left( \frac{x_2 + \alpha_{21} x_1 + \alpha_{23} x_3}{K_2} \right) - \beta_{24} x_2 x_4 \\
\frac{dx_3}{dt} &= r_3 x_3 - r_3 x_3 \left( \frac{x_3 + \alpha_{31} x_1 + \alpha_{32} x_2}{K_3} \right) - \beta_{35} x_3 x_5 \\
\frac{dx_4}{dt} &= \beta_{24} x_2 x_4 - c_4 x_4 \\
\frac{dx_5}{dt} &= \beta_{35} x_3 x_5 - c_5 x_5
\end{aligned}
$$

- $x_1$ is coral (`Coral`) , $x_2$ is tall algae (`Macroalgae`) , $x_3$ is short algae (`Turf`) , $x_4$ is fish that eat tall algae (`Browser`) and $x_5$ is the fish that eat short algae (`Grazer/detritivore`).
- $r_1$, $r_2$ and $r_3$ are the recruitment parameters for coral, tall algae and short algae, respectively.
- $K_1$ (up to 65%), $K_2$ (up to 100%) and $K_3$ (up to 60%) are the carrying capacity parameters for coral, tall algae and short algae, respectively.
- $\alpha_{ij}$ is the competition of $x_j$ on $x_i$.
- $\beta_{ij}$ is the predation success of $x_j$ on $x_i$.
- $c_i$ is the mortality rate for species $x_i$.

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**References**

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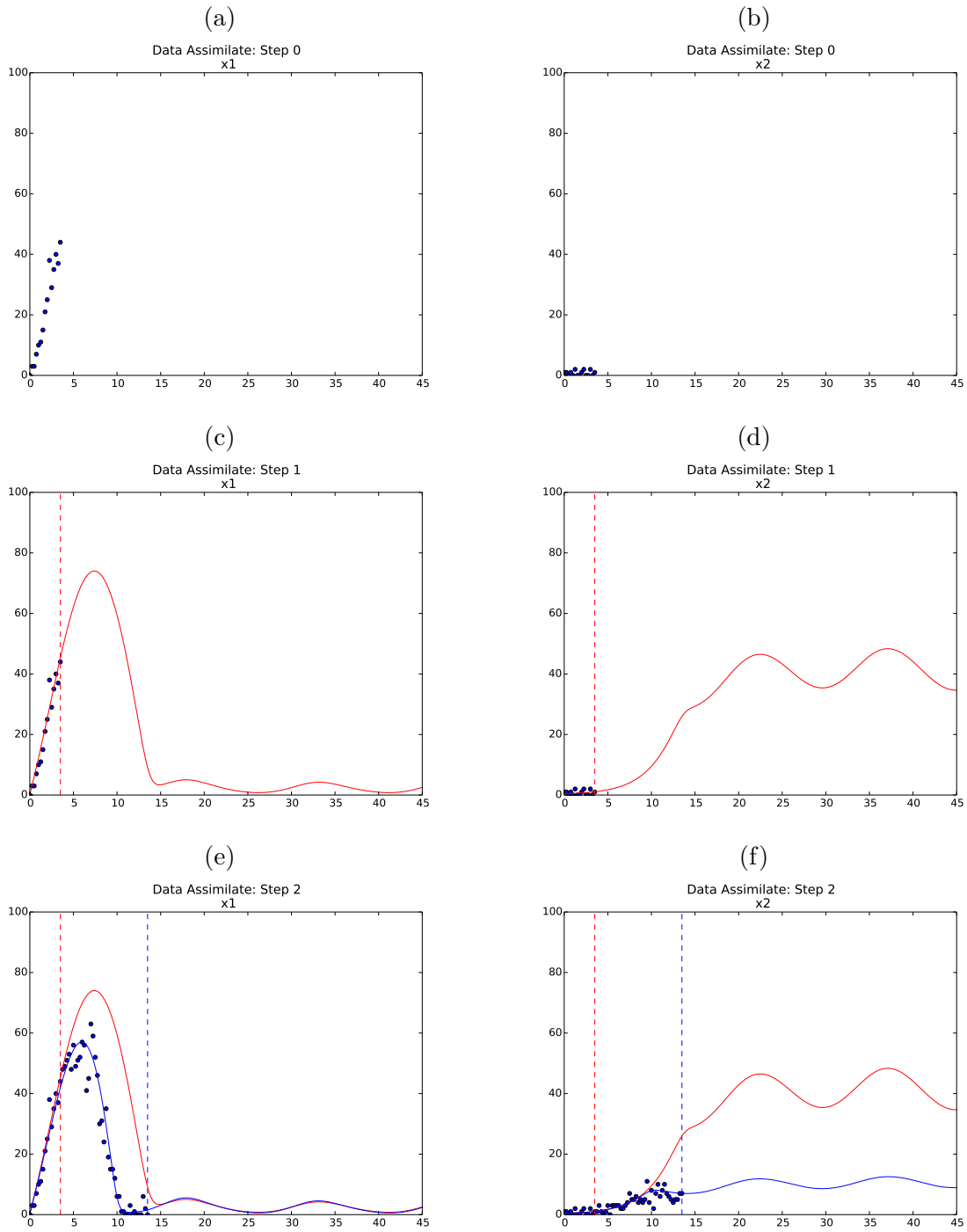


Figure 1: Data for (a) x1, (b) x2 , (c) data with fitted model for x1, (d) data with fitted model for x2, (e) additional data and updated fitted model for x1 and (f) additional data and updated fitted model for x2.