ON A NONLINEAR SIZE-STRUCTURED PHYTOPLANKTON-ZOOPLANKTON AGGREGATION MODEL

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Abstract. We develop a nonlinear size-structured phytoplankton-zooplankton aggregation model. We establish a comparison principle and construct monotone sequences to show the existence of a weak solution. We also prove that this solution is unique. As an example, we construct a pair of upper and lower solutions for a large class of initial data to which all the theory presented applies.

Keywords. Phytoplankton-Zooplankton, Aggregation, Size-structured model, Existence-uniqueness

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1 Introduction

In this paper, we consider the following initial boundary value problem that describes the dynamics of a nonlinear size-structured phytoplankton-zooplankton (prey-predator) system

$$
\begin{aligned}
u_t + (g_1(x,t)u)_x &= \frac{1}{2}\int_0^x \beta(x-y,y)u(x-y,t)u(y,t)dy \\
&\quad - \int_0^\infty \beta(x,y)u(x,t)u(y,t)dy \\
&\quad - m_1(x,t,\varphi^u,\varphi^z)u && (x,t)\in(0,\infty)\times(0,T), \\
z_t + (g_2(x,t)z)_x &= -m_2(x,t,\varphi^u,\varphi^z)z && (x,t)\in(0,\infty)\times(0,T), \\
g_1(0,t)u(0,t) &= \int_0^\infty \gamma_1(y,t,\varphi^u,\varphi^z)u(y,t)dy && t\in(0,T), \\
g_2(0,t)z(0,t) &= \int_0^\infty \gamma_2(y,t,\varphi^u,\varphi^z)z(y,t)dy && t\in(0,T), \\
u(x,0) &= u_0(x) && x\in(0,\infty), \\
z(x,0) &= z_0(x) && x\in(0,\infty),
\end{aligned}
$$

$$(1.1)$$