Erratum

Solutions to a Degenerate System of Parabolic Equations from Marine Biology

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K.-J. Eckardt has pointed out that the proofs of the Theorems 3, 4 on existence and uniqueness and on continuous dependence on the initial and boundary values, respectively, in my paper [1] contain a gap:

Although by the maximum principle for parabolic equations a solution (u, v, w) remains in $\mathbb{R}_+ \times \mathbb{R} \times \mathbb{R}_+$ if the initial and boundary data (μ, ν, φ) are in $\mathbb{R}_+ \times \mathbb{R} \times \mathbb{R}_+$ [1, Lemma 2], the iterates in the Picard approximation procedure (3.1) may not have this property, as a counter-example given by Eckardt shows:

The degenerate system

$$u_t = u_{xx} - u$$

$$v_t = v_{xx} + u$$

$$w_x = -w$$

with constant initial and boundary data $(\bar{\mu}, \bar{\nu}, \bar{\varphi}) \in \mathbb{R}_+ \times \mathbb{R} \times \mathbb{R}_+$ has the solution $u(x, t) = \bar{\mu}e^{-t}$, $v(x, t) = \bar{\nu} + \bar{\mu}(1 - e^{-t})$, $w(x, t) = \bar{\varphi}e^{-x}$. The iterate u_i of u is the Taylor approximation of degree i to the exponential, $i = 0, 1, \dots$

Of course the gap is merely technical since the component u of the solution is known to be non-negative. Thus the proof can be completed by extending the extinction fraction $k(u)$ into the negative domain such that it remains bounded below, e.g.

$$k(u) = \begin{cases} cu + d & \text{for } u \geq 0 \\ d & \text{for } u < 0 \end{cases} \quad c \geq 0, d > 0.$$

It is then immediate that the same proof works for the more general problem (2.1)–(2.4) with (i), (ii), (iv), (v) and (iii)' instead of (iii)

$$k(u) \geq d > 0 \quad \text{for all } u \in \mathbb{R}, |k(u_1) - k(u_2)| \leq c |u_1 - u_2|, u_1, u_2 \in \mathbb{R}. \quad (\text{iii})'$$

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1. A. Wörz-Busekros: Solutions to a Degenerate System of Parabolic Equations from Marine Biology. J. Math. Biology 3, 393–406 (1976)

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