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# DYNAMIC MODELLING FOR ASSESSING THE IMPACT OF MARINE DEBRIS ON THE POPULATION OF SEA TURTLES

*(Pemodelan Dinamik untuk Menilai Kesan Serpihan Marin Terhadap Populasi Penyu Laut)*

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*ABSTRACT*

Marine debris has significant impacts on marine animals including the sea turtles, which are particularly vulnerable to the presence of waste in the marine environment. We propose a novel mathematical model with three compartments to examine this effect: the sea turtle population, the concentration level of pollution inside sea turtles' bodies, and the concentration level of pollution in marine environment. We locate the equilibrium points (also known as equilibria) for the suggested model and perform an analytical check on their stability. We also use the bifurcation analysis to examine how changing a model parameter affects the stability of the model's equilibria. Our findings demonstrated the existence of two equilibria: the sea turtles' survival equilibrium and their extinction equilibrium. The eigenvalues of the Jacobian matrix applied to the proposed model have been used to demonstrate the conditions for stability of these equilibria. The resulting bifurcation diagram demonstrates that both equilibrium points undergo transcritical bifurcations when the values of response intensity of toxicity parameter is varied. The findings of this study can help local or national governments make decisions and educate the public about sea turtle conservation in order to sustain sea turtle populations in the future.

*Keywords*: dynamics model; sea turtle; marine debris; stability; bifurcation

*ABSTRAK*

Serpihan marin mempunyai kesan yang besar terhadap haiwan laut termasuk penyu, yang sangat terdedah kepada kehadiran sisa di persekitaran marin. Kami mencadangkan model matematik baru dengan tiga petak untuk mengkaji kesan ini: populasi penyu laut, tahap kepekatan pencemaran di dalam badan penyu laut, dan tahap kepekatan pencemaran dalam persekitaran marin. Kami mencari titik keseimbangan untuk model yang dicadangkan dan melakukan pemeriksaan analisis terhadap kestabilan mereka. Kami juga menggunakan analisis bifurcation untuk mengkaji bagaimana perubahan parameter model mempengaruhi kestabilan keseimbangan model. Penemuan kami menunjukkan kewujudan dua titik keseimbangan: kewujudan penyu laut (terus hidup) dan kepupusan penyu. Nilai eigen yang diperolehi daripada matriks Jacobian telah digunakan untuk menunjukkan syarat-syarat untuk kestabilan titik-titik keseimbangan ini. Rajah dwicabangan yang terhasil menunjukkan bahawa kedua-dua titik keseimbangan menjalani dwicabangan jenis transkritikal apabila nilai parameter keamatan tindak balas divariasikan. Penemuan kajian ini diharapkan dapat membantu kerajaan tempatan atau nasional membuat keputusan dan mendidik orang ramai mengenai pemuliharaan penyu laut bagi mengekalkan populasi penyu laut pada masa akan datang.

*Kata kunci*: model dinamik; penyu; serpihan marin; kestabilan; dwicabangan

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