Alsharawi, Ziyad; **Ben Haj Rhouma, Mohamed**

The discrete Beverton-Holt model with periodic harvesting in a periodically fluctuating environment. (English) Zbl 1184.92047

Adv. Difference Equ. 2010, Article ID 215875, 18 p. (2010).

Summary: We investigate the effect of constant and periodic harvesting on the Beverton-Holt model in a periodically fluctuating environment. We show that in a periodically fluctuating environment, periodic harvesting gives a better maximum sustainable yield compared to constant harvesting. However, if one can also fix the environment, then constant harvesting in a constant environment can be a better option, especially for sufficiently large initial populations. Also, we investigate the combinatorial structure of the periodic sequence of carrying capacities and its effect on the maximum sustainable yield. Finally, we leave some questions worth further investigations.

MSC:

92D40 Ecology
91B76 Environmental economics (natural resource models, harvesting, pollution, etc.)
39A60 Applications of difference equations

Full Text: DOI EuDML

References:

[1] Kelleher K, Willmann R, Arnason R: \textit{The Sunken Billions, the Economic Justification for Fisheries Reform}. The World Bank, Washington, DC, USA; 2009.

[2] Azar, C; Holmberg, J; Lindgren, K, Stability analysis of harvesting in a predator-prey model, Journal of Theoretical Biology, 174, 13-19, (1995)

[3] Brauer, F; Soudack, AC, Stability regions and transition phenomena for harvested predator-prey systems, Journal of Mathematical Biology, 7, 319-337, (1979) · Zbl 0397.92019

[4] Brauer, F; Soudack, AC, Stability regions in predator-prey systems with constant-rate prey harvesting, Journal of Mathematical Biology, 8, 55-71, (1979) · Zbl 0406.92020

[5] Dai, G; Tang, M, Coexistence region and global dynamics of a harvested predator-prey system, SIAM Journal on Applied Mathematics, 58, 193-210, (1998) · Zbl 0916.34034

[6] Myerscough, MR; Gray, BF; Hogarth, WL; Norbury, J, An analysis of an ordinary differential equation model for a two-species predator-prey system with harvesting and stocking, Journal of Mathematical Biology, 30, 389-411, (1992) · Zbl 0749.92022

[7] Xiao, D; Ruan, S, Bogdanov-Takens bifurcations in predator-prey systems with constant rate harvesting, No. 21, 493-506, (1999), Providence, RI, USA · Zbl 0917.34029

[8] Tang, S; Chen, L, The effect of seasonal harvesting on stage-structured population models, Journal of Mathematical Biology, 48, 357-374, (2004) · Zbl 1058.92051

[9] Xiao, Y; Cheng, D; Qin, H, Optimal impulsive control in periodic ecosystem, Systems & Control Letters, 55, 558-565, (2006) · Zbl 1129.49308

[10] Zhang, X; Shuai, Z; Wang, K, Optimal impulsive harvesting policy for single population, Nonlinear Analysis: Real World Applications, 4, 639-651, (2003) · Zbl 1011.92052

[11] Braverman, E; Mamdani, R, Continuous versus pulse harvesting for population models in constant and variable environment, Journal of Mathematical Biology, 57, 413-434, (2008) · Zbl 1143.92327

[12] Ludwig, D, Harvesting strategies for a randomly fluctuating population, Journal du Conseil pour l'Exploration de La Mer, 39, 168-174, (1980)

[13] Xu, C; Boyce, MS; Daley, DJ, Harvesting in seasonal environments, Journal of Mathematical Biology, 50, 663-682, (2005) · Zbl 1066.92057

[14] Sinha, S; Parthasarathy, S, Unusual dynamics of extinction in a simple ecological model, Proceedings of the National Academy of Sciences of the United States of America, 93, 1504-1508, (1996) · Zbl 0851.92021

[15] Chau, NP, Destabilising effect of periodic harvest on population dynamics, Ecological Modelling, 127, 1-9, (2000)

[16] Berezansky, L; Braverman, E, On impulsive beverton-Holt difference equations and their applications, Journal of Difference Equations and Applications, 10, 851-868, (2004) · Zbl 1068.39005

[17] Tang, S; Cheke, RA; Xiao, Y, Optimal implusive harvesting on non-autonomous beverton-Holt difference equations, Nonlinear Analysis: Theory, Methods & Applications, 65, 2311-2341, (2006) · Zbl 1119.39011

[18] AlSharawi, Z; Rhouma, M, Coexistence and extinction in a competitive exclusion Leslie/gower model with harvesting and stocking, Journal of Difference Equations and Applications, 15, 1031-1053, (2009) · Zbl 1176.92050

[19] AlSharawi, Z; Rhouma, M, The beverton-Holt model with periodic and conditional harvesting, Journal of Biological Dynamics, 3, 463-478, (2009) · Zbl 1342.91025

[20] Clark CW: \textit{Mathematical Bioeconomics, the Optimal Management of Renewable Resources, Pure and Applied Mathematics}. 2nd edition. John Wiley & Sons, New York, NY, USA; 1990:xiv+386.

[21] Cushing, JM; Henson, SM, A periodically forced beverton-Holt equation, Journal of Difference Equations and Applications, 58, 193-210, (1998)

[22] Elaydi, S; Sacker, RJ, Nonautonomous beverton-Holt equations and the cushing-henson conjectures, Journal of Difference Equations and Applications, 11, 337-346, (2005) · Zbl 1084.39005

[23] Schreiber, SJ, Allee effects, extinctions, and chaotic transients in simple population models, Theoretical Population Biology, 64, 201-209, (2003) · Zbl 1104.92053

[24] Schreiber, SJ, Chaos and population disappearances in simple ecological models, Journal of Mathematical Biology, 42, 239-260, (2001) · Zbl 0977.92032

[25] Cushing, JM; Henson, SM, Global dynamics of some periodically forced, monotone difference equations, Journal of Difference Equations and Applications, 7, 859-872, (2001) · Zbl 1002.39003

[26] Kocic, VL, A note on the nonautonomous beverton-Holt model, Journal of Difference Equations and Applications, 11, 415-422, (2005) · Zbl 1084.39007

[27] AlSharawi, Z, Periodic orbits in periodic discrete dynamics, Computers & Mathematics with Applications, 56, 1966-1974, (2008) · Zbl 1165.37311

[28] AlSharawi, Z; Angelos, J; Elaydi, S; Rakesh, L, An extension of Sharkovsky's theorem to periodic difference equations, Journal of Mathematical Analysis and Applications, 316, 128-141, (2006) · Zbl 1125.39001

[29] Braverman, E; Saker, SH, On the cushing-henson conjecture, delay difference equations and attenuant cycles, Journal of Difference Equations and Applications, 14, 275-286, (2008) · Zbl 1158.39004

[30] Woeginger, G, When Cauchy and holder met Minkowski: a tour through well-known inequalities, Mathematics Magazine, 82, 202-207, (2009) · Zbl 1227.97035