JP Journal of Applied Mathematics
Volume 13, Issues 1 & 2, 2016, Pages 11-26

A VIABILITY ANALYSIS FOR STRUCTURED MODEL OF FISHING PROBLEM

C. Jerry and M. Jerry

Abstract

In this work, we study a structured fishing model, basically displaying the two stages of the ages of a fish population, which are in our case juvenile, and adults. We associate to these model two constraints: one of ecological type ensuring a minimum stock level, the other one of economic type ensuring a minimum income for fishermen. The analytical study focuses on the compatibility between the state constraints and the controlled dynamics. Using the mathematical concept of viability kernel, we define a set of constraints combining the guarantee of consumption and a stock of resources to be preserved at all times.

Keywords and phrases: structural model, recruitment, viability kernel.

Received October 14, 2016

References

[1] J. P. Aubin, Viability Theory, Birkhaüser, Boston, 1991.

[2] J. P. Aubin, Dynamic Economic Theory. A Viability Approach, Springer, Studies in Economic Theory, Vol. 5, 1997.

[3] J. P. Aubin and P. Saint-Pierre, An Introduction to the Viability Theory and Management of Renewable Resources, J. Kropp and J. Scheffran, eds., In Progress of Artificial Intelligence in Sustainability Science, Nova Science Publ., Inc., 2005, pp. 55-96.

[4] C. Bene and L. Doyen, Storage and viability of a fishery with resource and market dephased seasonalities, J. Environ. Resour. Econ. 15 (2000), 1-26.

[5] C. Bene, L. Doyen and D. Gabay, A viability analysis for a bio-economic model, Ecol. Econ. 36 (2001), 385-396.

[6] R. J. H. Beverton and S. J. Holt, On the Dynamics of Exploited Fish Population, First Ed., Chapman & Hall, London, 1957.

[7] N. Bonneuil and K. Mullers, Viable populations in a predator-prey system, J. Math. Biol. 35 (1997), 261-293.

[8] C. W. Clark, Mathematical Bioeconomics: The Optimal Management of Renewable Resources, Second Ed., John Wiley & Sons, New York, 1990.

[9] C. W. Clark, F. H. Clarke and G. R. Munro, Renewable resources stocks, Econom. 47 (1979), 25-47.

[10] F. H. Clarke, Y. S. Ledyaev, R. J. Stern and P. R. Wolenski, Qualitative properties of trajectories of control systems: a survey, J. Dynam. Control Syst. 1 (1995), 1-48.

[11] R. B. Deriso, Harvesting strategies and parameter estimation for an age-structured model, Can. J. Fish. Aquat. Sci. 37 (1980), 268-282.

[12] L. Doyen, M. De Lara, J. Ferraris and D. Pelletier, Sustainability of exploited marine ecosystems through protected areas: a viability model and a coral reef case study, Ecol. Model. 208(2-4) (2007), 353-366.

[13] L. Doyen, D. Gabay and J. C. Hourcade, Risque climatique, technologie et viabilité, Actes des Journées du Programme Environnement Vie et Sociétés, CNRS, Session B, (1996), 129-134.

[14] R. Hilborn and C. J. Walters, Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty, Chapman & Hall, New York, 1992.

[15] M. Jerry, P. Cartigny and A. Rapaport, Can protected areas potentially enlarge viability domains for harvesting management? Nonlinear Anal.: Real World Appl. 11 (2010), 720-734.

[16] M. Jerry and N. Raïssi, A policy of fisheries management based on continuous fishing effort, J. Biol. Syst. 9(4) (2001), 247-254.

[17] M. Jerry and N. Raïssi, The optimal strategy for a bioeconomical model of a harvesting renewable resource problem, Math. Comput. Model. 36 (2002), 1293-1306.

[18] M. Jerry and N. Raïssi, Optimal strategy for structured model of fishing problem, C. R. Biol. 328(4) (2005), 351-356.

[19] M. Jerry, N. Raïssi and A. Rappaport, A viability analysis for an explicit inshore-offshore model, JP J. Appl. Math. 1(1) (2011), 41-60.

[20] J. C. Rice, Quantitative methods in recruitment, In report from the national workshop on recruitment, held in St. John's, Newfoundland, M. Sinclair, J. T. Anderson, M. Chadwick, J. Gagn, W. D. Mckone, J. C. Rice and D. Ware, eds., No. 1626 in Canadian Technical Report of Fisheries and Aquatic Sciences, Feb. 1988, pp. 148-164.

[21] W. E. Ricker, Stock and recruitment, J. Fish. Res. Board Can. 11 (1954), 559-623.

[22] W. E. Ricker, Handbook of Computations for Biological Statistics of Fish Populations, Bulletin 119, Fisheries Research Board of Canada, 1958.

[23] J. Schnute, A general theory for analysis for catch and effort data, Can. J. Fish. Aquat. Sci. 42 (1985), 414-429.

[24] H. Smith, Monotone Dynamical systems: an introduction to the theory of competitive and cooperative systems, AMS Math. Surv. and Monogr., Vol. 41, Amer. Math. Soc., Providence, R.I., 1995.

[25] S. Touzeau, Modèle de contrôle en gestion des pêches, Thèse, Université de Nice Sophia-Antipolis, 1997.