Elgersburg Summer School, March 2014
Mathematical Biology
Exercise Sheet 5– Group project

The fifth and final Mathematical Biology Exercise Sheet is a Group Project. We have included below a list of peer–reviewed published papers which all use matrix PPMs to describe conservation (increasing population abundance) or management (decreasing or controlling population abundance) strategies. Working in the groups you established in the second lecture you have the following tasks:

(i) Choose a paper from the list and use it as a basis for your own conservation or management strategy of that species. Some pointers:

   (a) You should be able to describe your strategy mathematically.

   (b) Most of the papers use sensitivity or elasticity analyses (see Exercise Sheet 2, Question (4)) to motivate strategies. You are welcome to use any machinery you have learned here or are previously aware of. Ideas include

      - Open loop control.
      - Perturbation theory (see Exercise Sheet 2, Question (4)).
      - Feedback (PID) control.
      - Optimal control.

   (c) Many existing management strategies focus on controlling asymptotic properties of the population. It may be of interest to consider transient dynamics as well.

   (d) Although you have no resource limitations; any course of action must be *biologically sensible*.

   (e) You do not have to restrict attention to matrix PPMs; you are welcome to either extend the models given or devise your own models– provided that you justify what you do.

(ii) On Friday you will present your findings and management suggestions in a 25 minute presentation in the Mathematical Biology Exercise Class. Your presentation should include

   (a) A brief summary of the paper you studied.

   (b) Your own mananagement recommendation.

   You are welcome to use either a blackboard (considering though the time limits), or beamer or powerpoint slides.

In the interest of variety we think it would be good if not every group chose the same paper!

We have pdf copies of the papers if you require them.

The population of interest in [5] is the koala population, p. 901, Table 2.

References

[1] D. Doak, P. Kareiva, and B. Klepetka, "Modeling population viability for the desert tortoise in the western mojave desert," *Ecological Applications*, vol. 4, no. 3, pp. 446–460, 1994.

[2] I. Olmsted and E. R. Alvarez-Buylla, "Sustainable harvesting of tropical trees: demography and matrix models of two palm species in mexico," *Ecological Applications*, vol. 5, no. 2, pp. 484–500, 1995.

[3] K. R. Crooks, M. Sanjayan, and D. F. Doak, "New insights on cheetah conservation through demographic modeling," *Conservation Biology*, vol. 12, no. 4, pp. 889–895, 1998.

[4] K. H. Johnson and C. E. Braun, "Viability and conservation of an exploited sage grouse population," *Conservation Biology*, vol. 13, no. 1, pp. 77–84, 1999.

[5] P. W. Baxter, M. A. McCarthy, H. P. Possingham, P. W. Menkhorst, and N. McLean, "Accounting for management costs in sensitivity analyses of matrix population models," *Conservation Biology*, vol. 20, no. 3, pp. 893–905, 2006.

[6] J. M. Arnold, S. Brault, and J. P. Croxall, "Albatross populations in peril: a population trajectory for black-browed albatrosses at south georgia," *Ecological Applications*, vol. 16, no. 1, pp. 419–432, 2006.

[7] B. Tenhumberg, S. M. Louda, J. O. Eckberg, and M. Takahashi, "Monte carlo analysis of parameter uncertainty in matrix models for the weed cirsium vulgare," *Journal of Applied Ecology*, vol. 45, no. 2, pp. 438–447, 2008.

[8] L. Mannocci, W. Dabin, E. Augeraud-Véron, J.-F. Dupuy, C. Barbraud, and V. Ridoux, "Assessing the impact of bycatch on dolphin populations: the case of the common dolphin in the eastern north atlantic," *PloS one*, vol. 7, no. 2, p. e32615, 2012.

[9] M. S. Udevitz, R. L. Taylor, J. L. Garlich-Miller, L. T. Quakenbush, and J. A. Snyder, "Potential population-level effects of increased haulout-related mortality of pacific walrus calves," *Polar Biology*, vol. 36, no. 2, pp. 291–298, 2013.