ECO6143 Natural-Resource Economics
Final exam April 2006
University of Ottawa
Closed book exam
Professor: Louis Hotte
Time allowed: 3h00

1. Review question (50 points): Exclusive ownership with a positive discount rate A fishery is exploited by a single fisher in the absence of any transaction costs. The total cost of harvest for year t is given by

$$C_t = C(h_t, x_t), \tag{1}$$

where x_t and h_t respectively denote the fish stock and harvest level at year t, with $\partial C/\partial h > 0$ and $\partial C/\partial x < 0$. The biological mechanism of the fish population is given by:

$$x_{t+1} = x_t + g(x_t) - h_t, \tag{2}$$

where $g(x_t)$ is the natural growth of the fish stock. The fisher takes the price of fish p as given and it is constant thru time. His discount rate is equal to r.

(1) Solve for the present-value maximizing problem of the fisher assuming a given initial stock x_0. Interpret the first-order conditions.
(2) Derive the steady-state exploitation conditions.
(3) Assume now that $C_t = c(x_t)h_t$, with $c'(x_t) < 0$.
  (a) How does the steady-state value of $g'(x_t)$ compare to the discount rate? Explain with the help of a graphic.
  (b) What happens when the discount rate becomes arbitrarily large. Interpret.
  (c) Assume now that $c'(x_t) = 0$.
    (i) What is the effect of increasing the discount rate on the steady-state stock of the resource?
    (ii) What happens when the discount rate becomes arbitrarily large? Compare your answer with that of (3b) and explain.

2. The problems of the commons (50 points)
In 1968, G. Hardin wrote a very influential article in which he predicted that the rise in population on Earth would lead to an extreme overexploitation of natural resources. His message is based on arguments quite similar to the logic of the *Prisoner's dilemma* (PD).

Although the PD may be valid in various contexts, many have argued that not all resources are subject to such a dismal outcome. Alternative representations have been proposed in which people may be induced to cooperate more readily. Those include repeated play of the PD game, the chicken game, and the assurance game, which have been analyzed in class.

(1) Represent the problem of resource overexploitation with the help of a simple PD game and explain.

(2) Show why repeated interactions of the PD game may lead to cooperation between individuals.
(3) Modify the basic payoff structure of the PD game in order to show that even in one-shot games, cooperation may not be so hard to sustain, i.e. with the chicken and the assurance games. Discuss.
(4) Define and compare private property and common property as two alternative property regimes for the management of natural resources.