Resource Economics – Seminar 4

Assume that the dynamics of a fish stock are accurately described by a logistic growth function

$$G(S) = gS(1 - S) \tag{1}$$

and the harvest production function is of the Gordon-Schaefer type $H = qES$ (where H is harvest, E is effort (suitably scaled), and S is the fish stock). Costs are proportional to effort, unit costs are given by w. Demand is infinitely elastic and the price is given by p.

(1) Characterize the optimal and the open-access equilibrium. Can the fish stock be harvested to extinction under open access? Could it be optimal to harvest it to extinction?

Now consider the case where the harvest function is independent of stock size $H = qE$.

(2) Under which circumstances could such a harvest function be a good approximation?

(3) Will the fish stock now be harvested to extinction under open access?

Suppose that the fish stock actually consists of two substocks S_1 and S_2 that live in spatially distinct patches. The first is a source and the second is a sink so that a proportion $b < 1$ flows from S_1 to S_2.

$$\dot{S}_1 = gS_1(1 - S_1) - bS_1 - qE_1S_1 \tag{2}$$

$$\dot{S}_2 = gS_2(1 - S_2) + bS_1 - qE_2S_2 \tag{3}$$

(4) Describe the open-access equilibrium.

(5a) What happens to equilibrium biomass and harvest under open access as a marine reserve has been created in the first patch? (5b) What happens to equilibrium biomass and harvest under open access as a marine reserve has been created in the second patch?