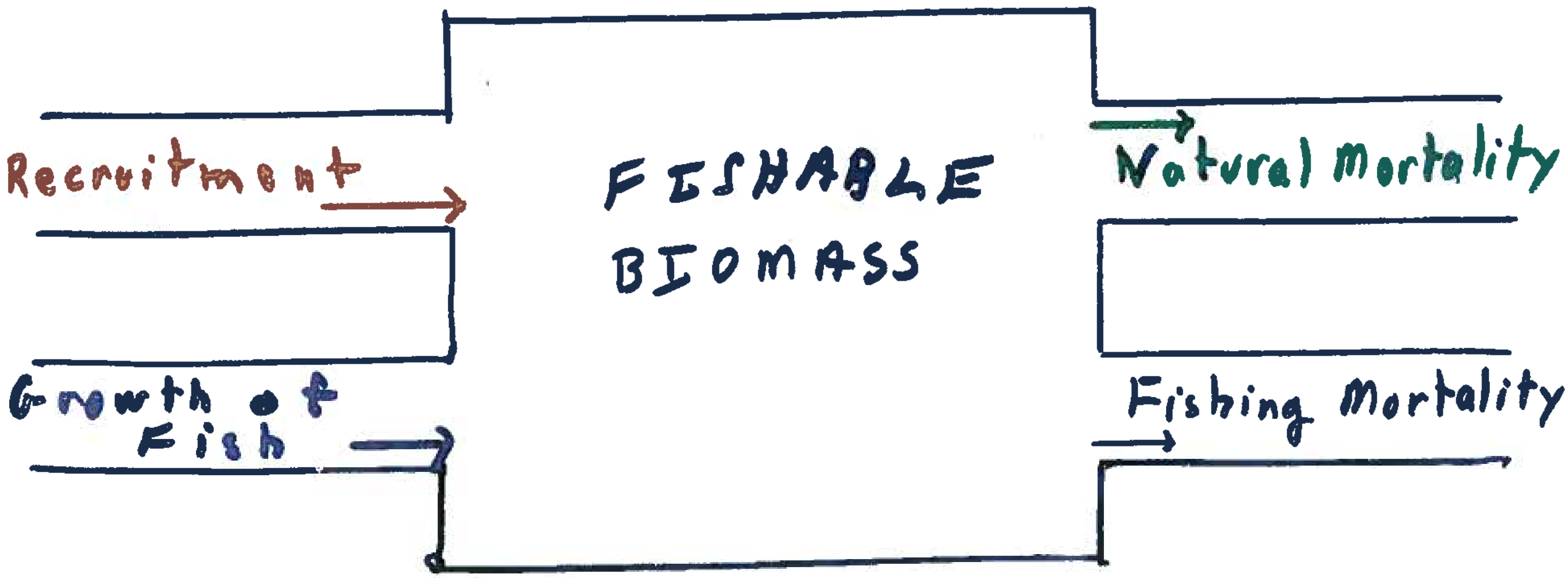
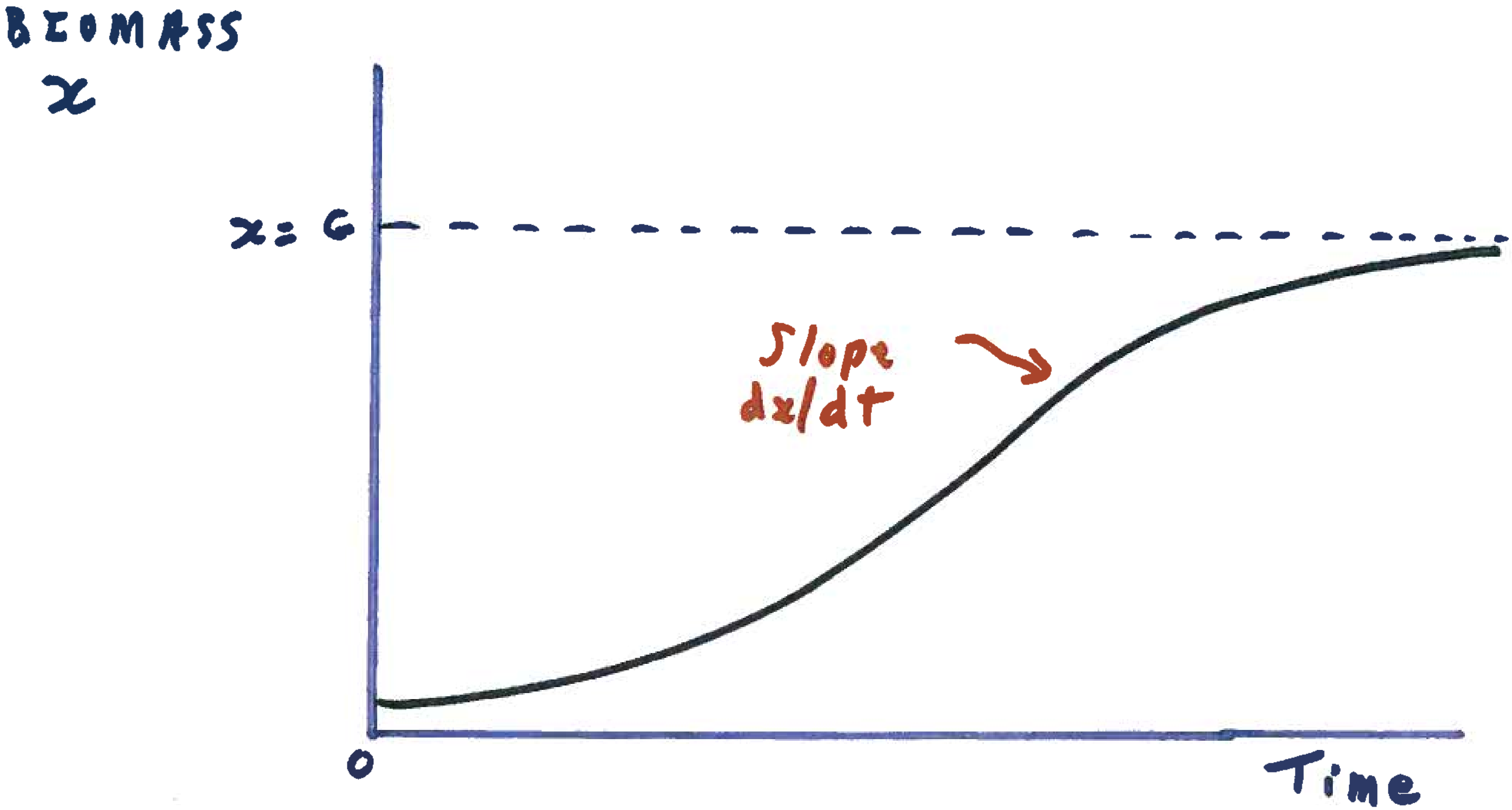


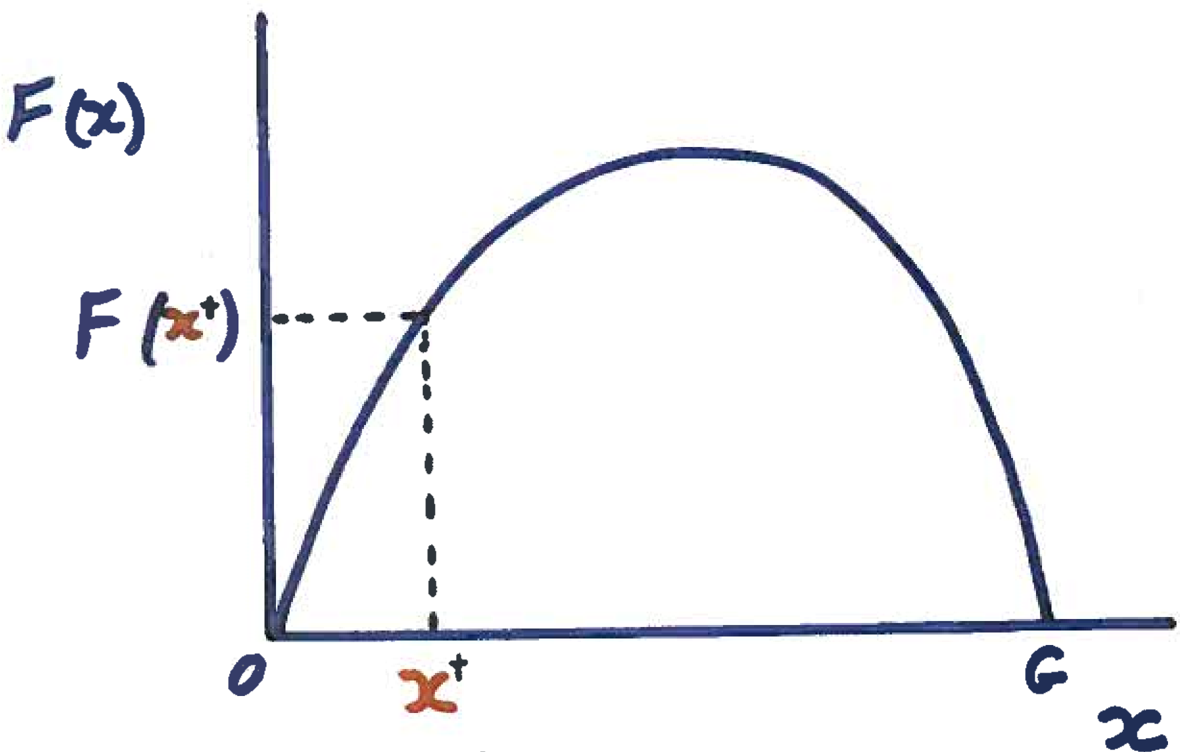
Recruitment
Growth of Fish
FISHABLE BIOMASS
Natural Mortality
Fishing Mortality



Logistic Model of Population Growth

$$\left[\frac{dx}{dt} = F(x) \; ; \; \frac{d^2x}{dt^2} = F'(x) \right]$$

The Schaefer Model



When $x = x^+$, the "sustainable" harvest is:

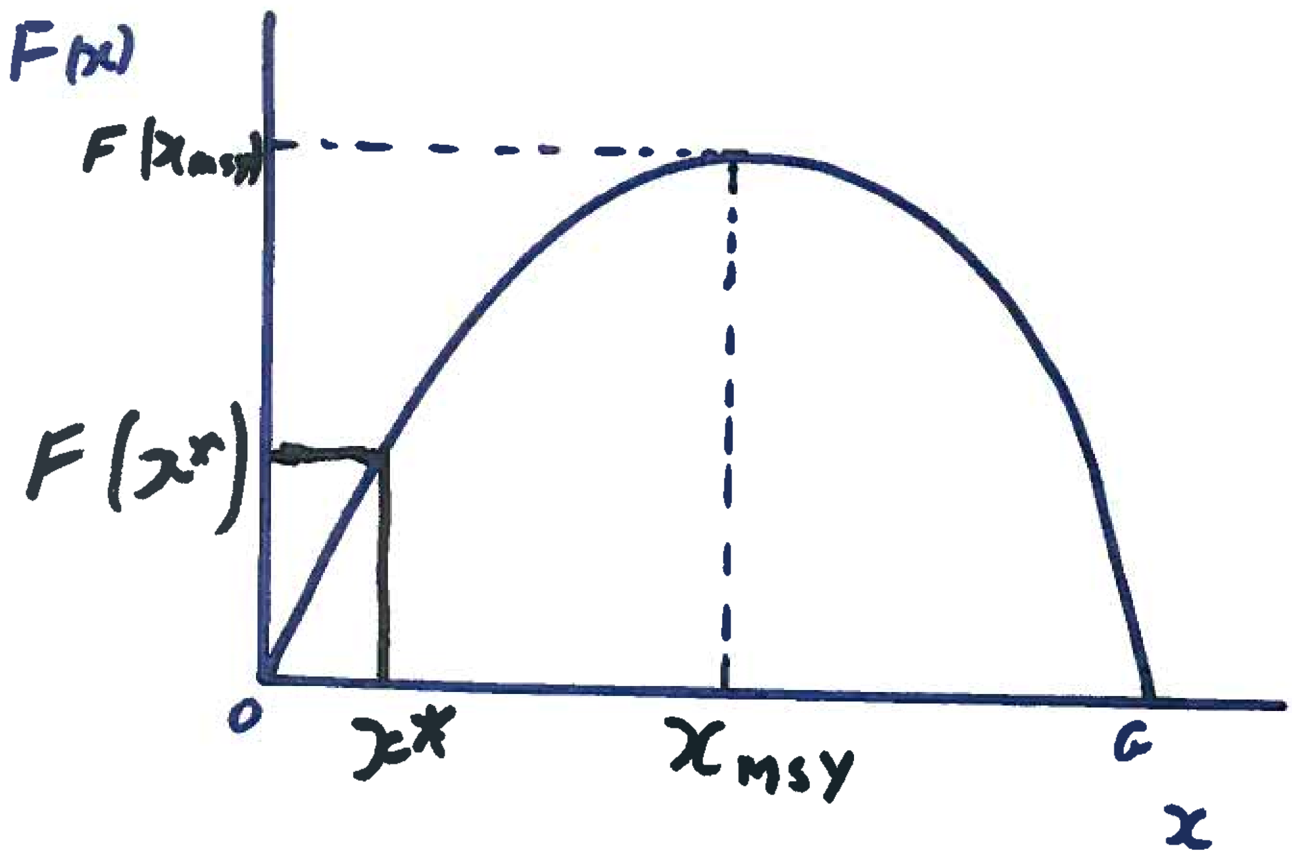
$h = F(x^+)$

Note that:

$dx/dt = F(x) - h$

If $h = F(x)$, $dx/dt = 0$

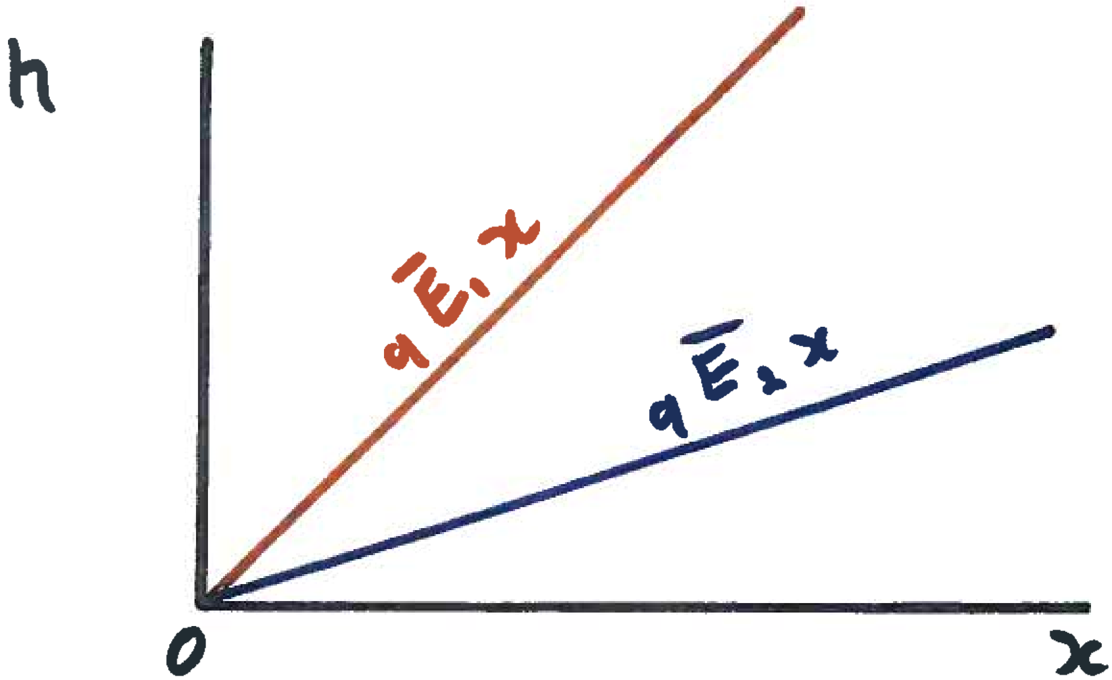
The Schaefer Model cont.



MSY - Maximum Sustained Yield (Harvest)

$$x_{msy} = \frac{G}{2}$$

From the Schaefer Model

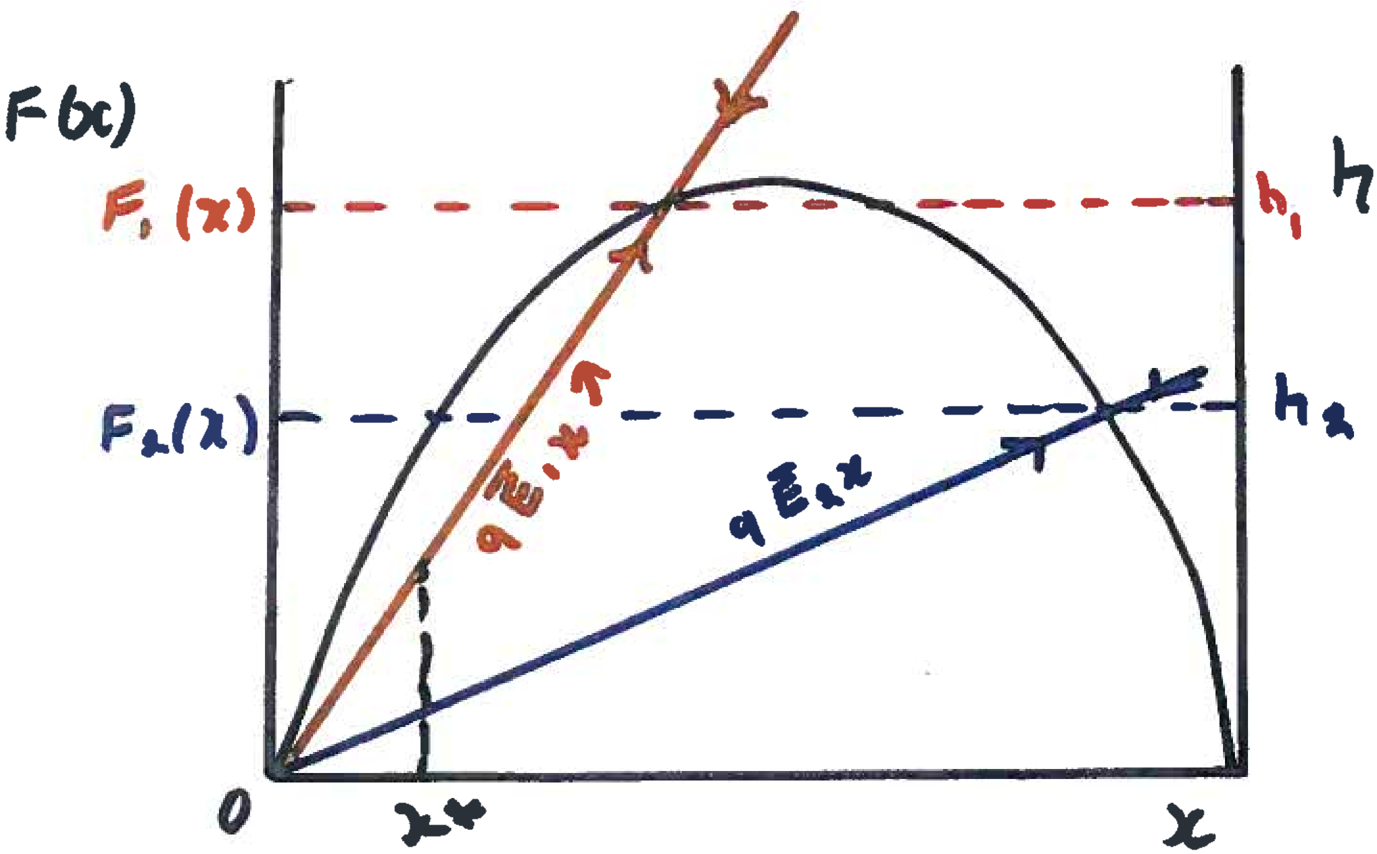


$\bar{E}_1$ and $\bar{E}_2$ are two constant rates of E, $\bar{E}_1 > \bar{E}_2$. q is the same in both cases

- The figure shows the relationship between h and x, given a constant rate of E.

Sustainable harvest (yield) : $h = F(x)$

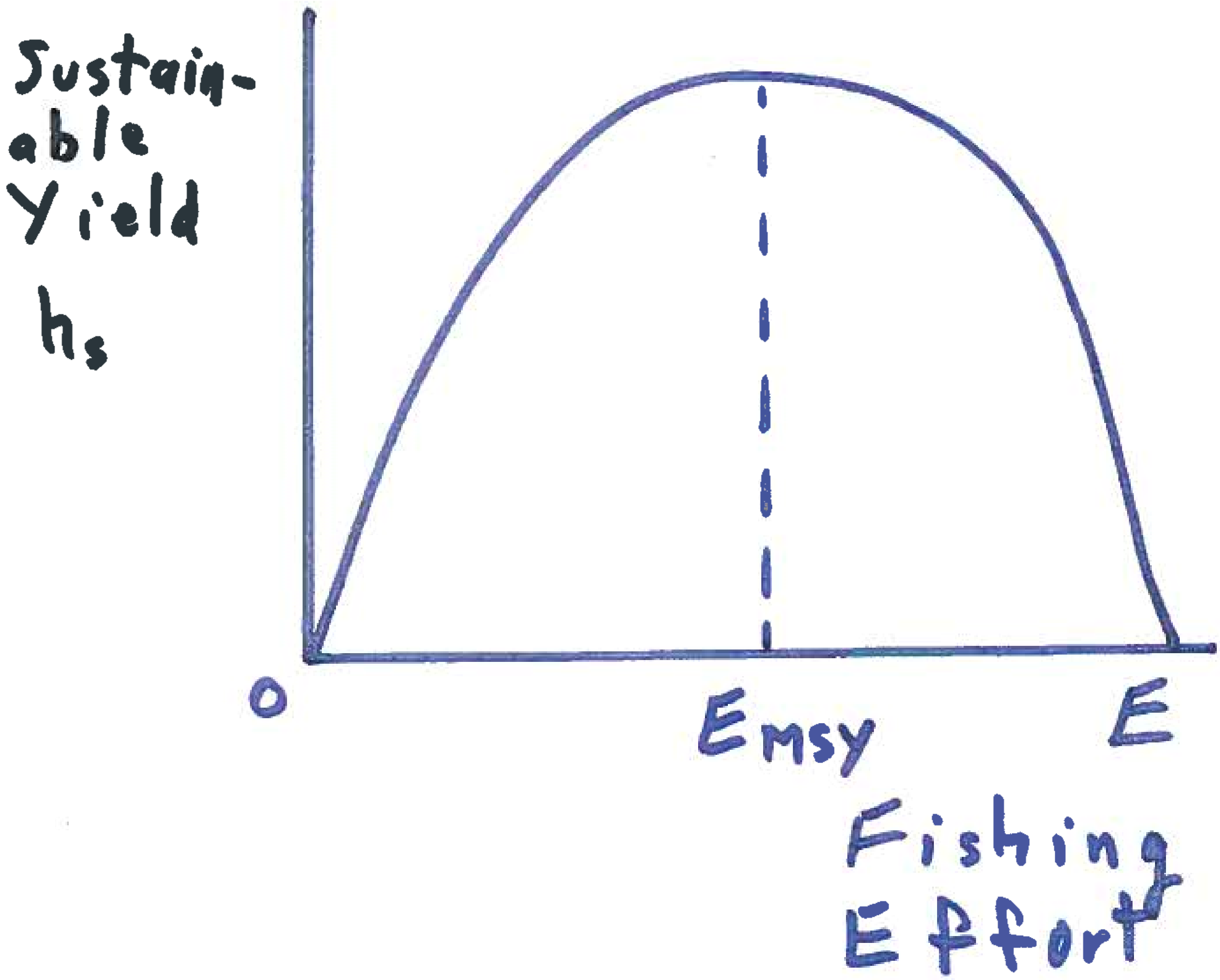
Question: what is the sustainable yield or harvest, given that: $E = \bar{E}_1$; $E = \bar{E}_2$?

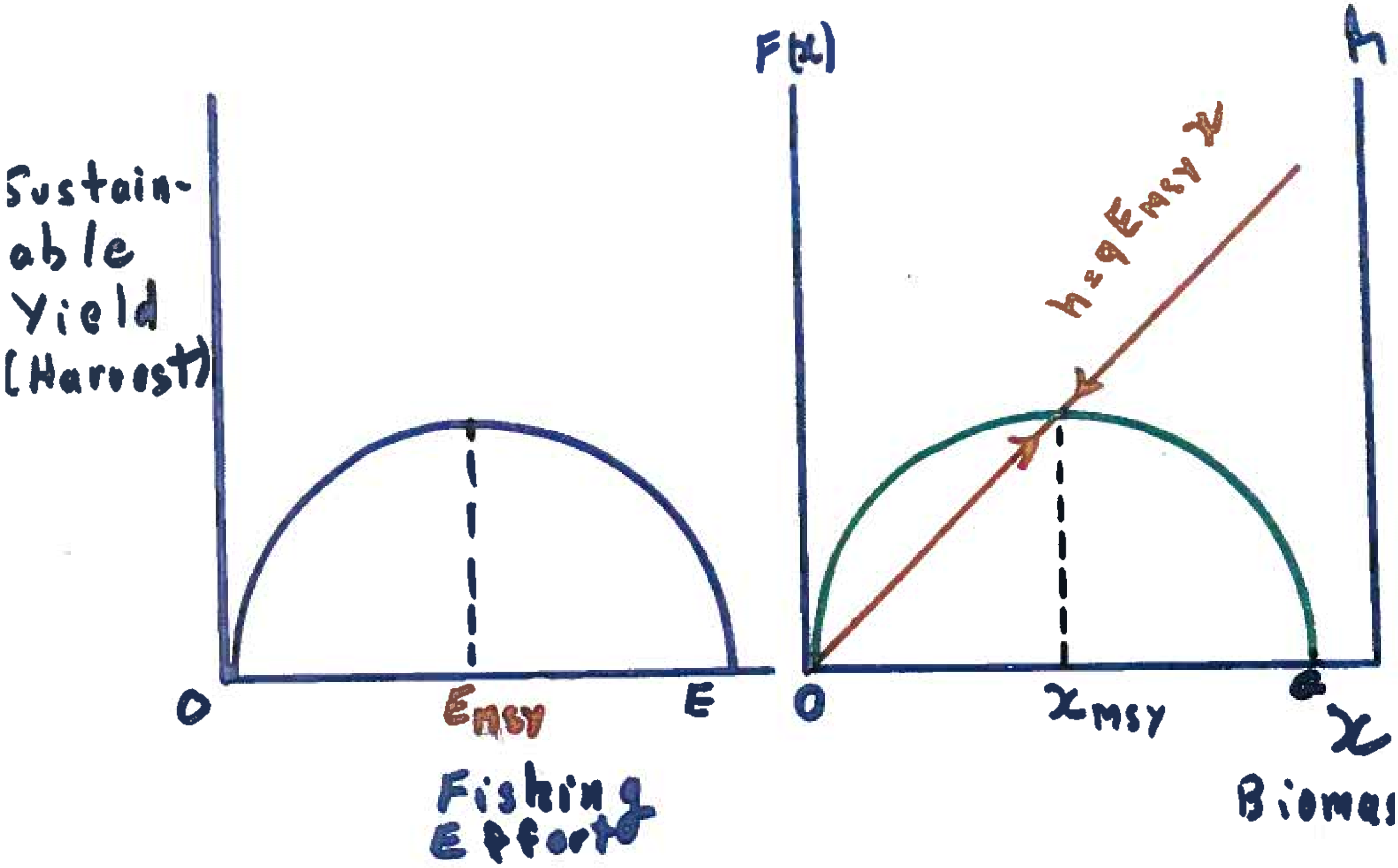


Answers: If $E = \bar{E}_1$, sustainable harvest is: $h = h_1$; if $E = \bar{E}_2$, sustainable harvest is $h = h_2$

If $E > E_{msy}$, then x will be driven down below x_{msy}.
"Biological overfishing" will have occurred.

Sustainable Yield (Harvest) and Fishing Effort (from the Schaefer model)



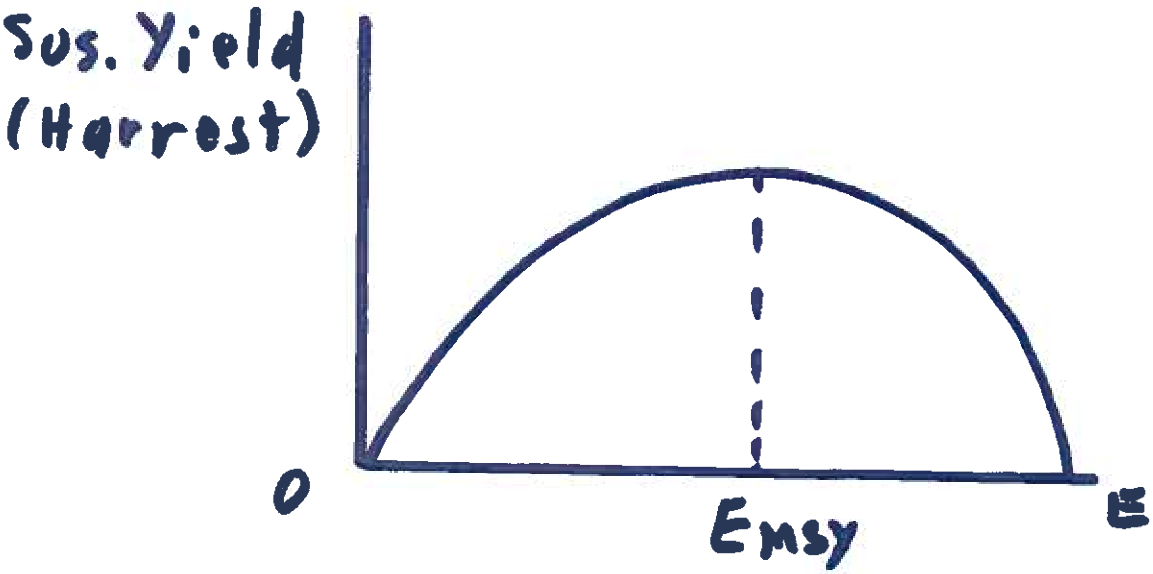


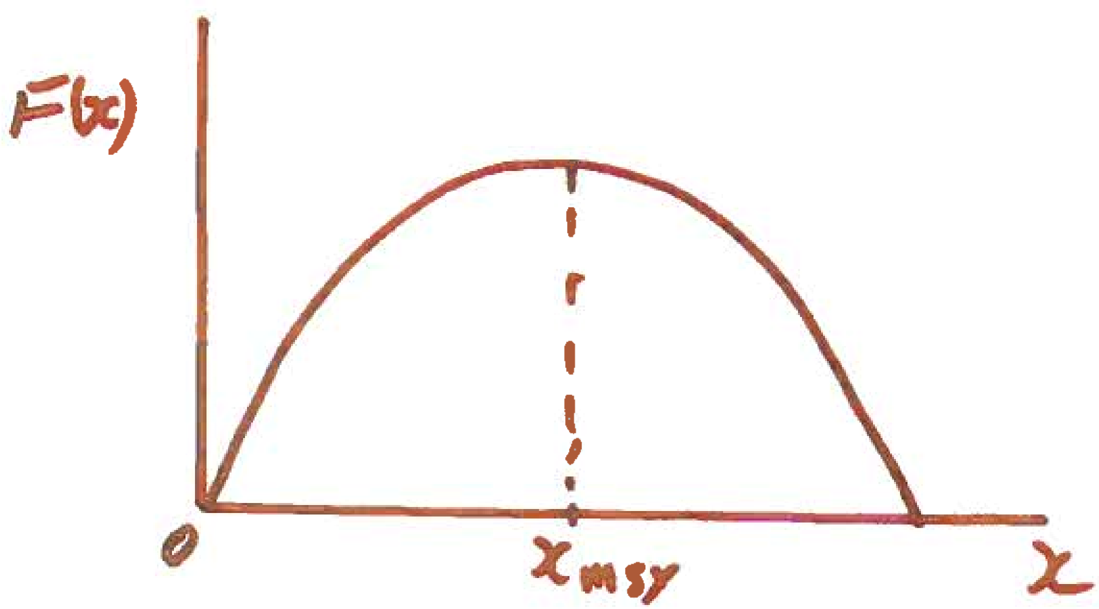
The sustainable yield (harvest) associated with $E = E_{msy}$ is:

$$h_s = F(x_{msy})$$

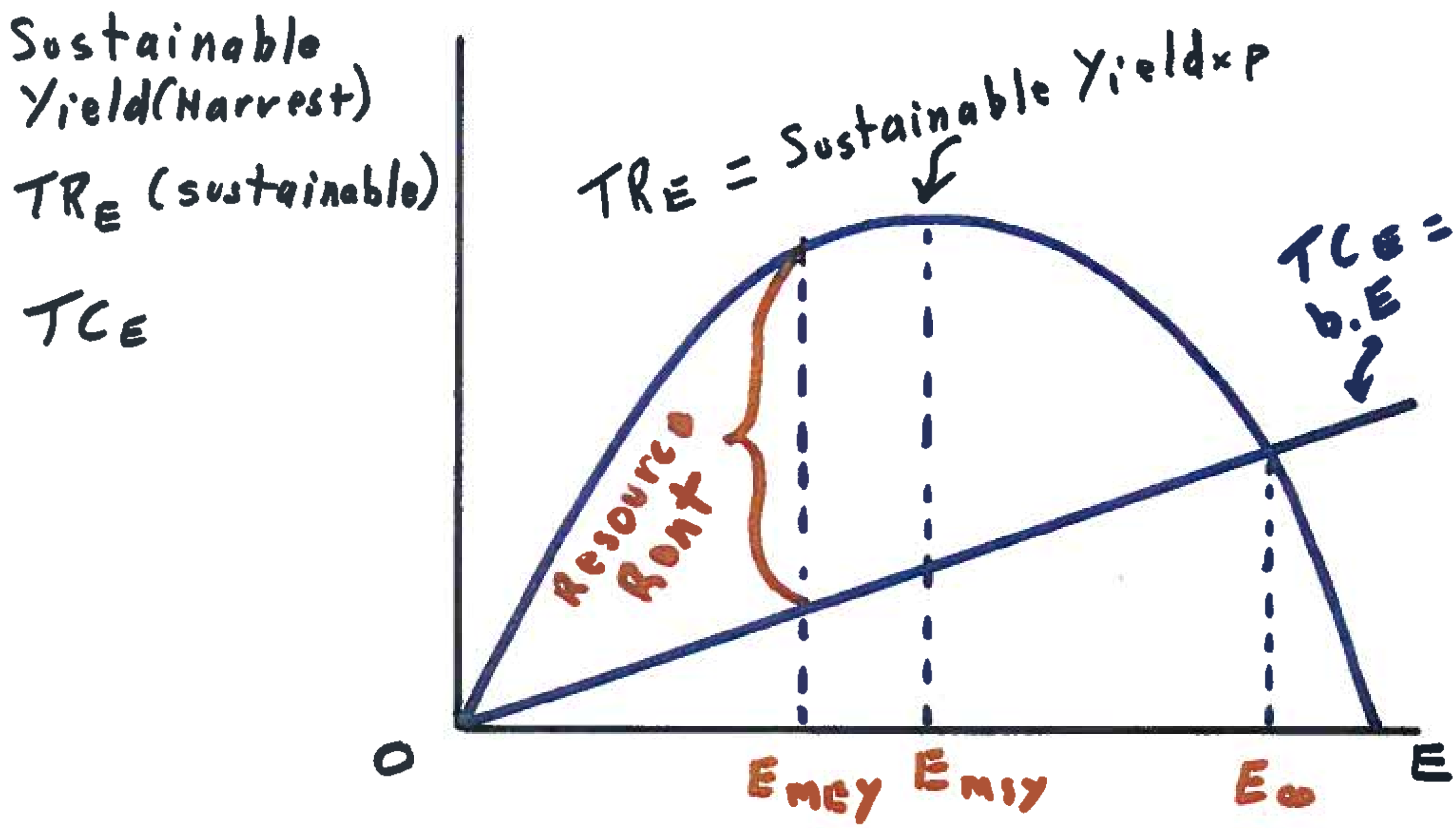
The Marine Biologist's Concept of "Biological Overfishing"

- Resource is reduced below the level associated with MSY





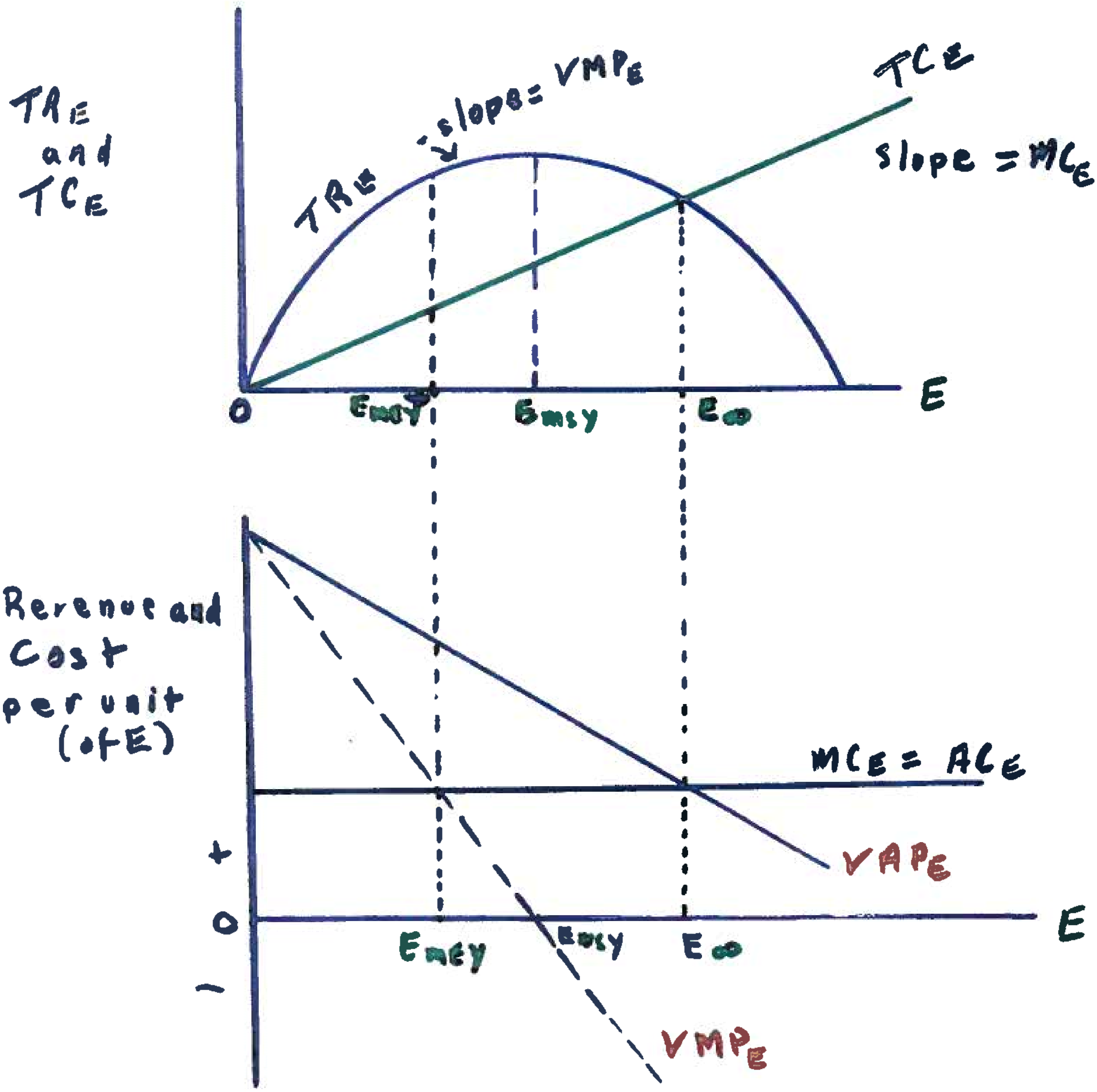
H. Scott Gordon Model



Resource Rent = $TR_E - TC_E$

MEY - Maximum Economic Yield

E_∞ - E corresponding to: Bionomic Equilibrium (to be explained)



TR_E and TC_E
slope = VMP_E
TC_E
slope = MC_E
TR_E
O
E_MEY
E_MSY
E_∞
E
Revenue and Cost per unit (of E)
MC_E = AC_E
VAP_E
+
0
−
VMP_E