Concerns about MSY approaches

- Environmental variability
- Ecosystem perspective
- Behavior of fishermen

The Tragedy of the Commons

The population problem has no technical solution; it requires a fundamental extension in morality.

Garrett Hardin

At the end of a thoughtful article on the future of nuclear war, Wiesner and York (*1*) concluded that: "Both sides in the arms race are . . . confronted by the dilemma of steadily increasing military power and steadily decreasing national security. *It is our considered professional judgment that this dilemma has no technical solution.* If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation."

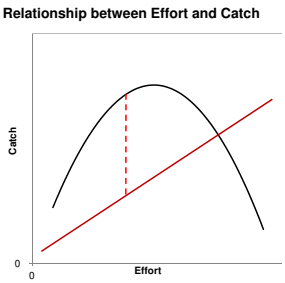
sional judgment. . . ." Whether they were right or not is not the concern of the present article. Rather, the concern here is with the important concept of a class of human problems which can be called "no technical solution problems," and, more specifically, with the identification and discussion of one of these.

It is easy to show that the class is not a null class. Recall the game of tick-tack-toe. Consider the problem, "How can I win the game of tick-tack-toe?" It is well known that I cannot, if I as-

From Hardin (Science 1968)

Concerns about MSY approaches

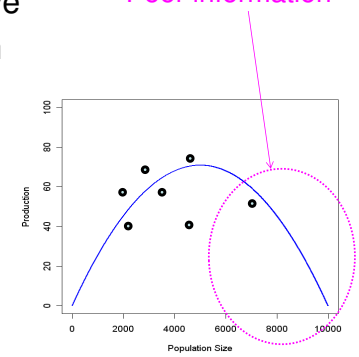
- Environmental variability
- Ecosystem perspective
- Behavior of fishermen
- Economical aspects
  (Cost should be taken into account -> MEY)



Concerns about MSY approaches

- Environmental variability
- Ecosystem perspective
- Behavior of fishermen
- Economical aspects
- Several uncertainties
  (in data, estimation, model etc.)

Poor information



Concerns about MSY approaches

- Environmental variability
- Ecosystem perspective
- Behavior of fishermen
- Economical aspects
- Several uncertainties
- Age structures ?
- Stock (population) structures?

….

Estimation of surplus production

Equation 4

$$U_t = CPUE_t = \frac{C_t}{E_t} = q \times N_t$$

Equation 14

$$\Rightarrow U_t = CPUE_t = \frac{C_t}{E_t} = q \times B_t$$

Equation 13

$$B_{t+1} - B_t = r B_t \left(1 - \frac{B_t}{K}\right)$$

Equation 15

$$B_t = B_{t-1} + r B_{t-1}\left(1 - \frac{B_{t-1}}{K}\right) - C_{t-1}$$

Estimation of surplus production

Equation 14

$$U_t = CPUE_t = \frac{C_t}{E_t} = q \times B_t$$

Equation 15

$$B_t = B_{t-1} + r B_{t-1}\left(1 - \frac{B_{t-1}}{K}\right) - C_{t-1}$$

Equation 16

$$\Rightarrow \sum_t (\log U_t - \log qB_t)^2 \Rightarrow \min$$

Unknown parameters: K, r, q, B0