PRACTICAL FISHERIES MANAGEMENT EXERCISE:

FISHERIES DEVELOPMENT; IDENTIFICATION OF MAXIMUM SUSTAINABLE YIELD; REGULATION OF FISHING EFFORT TO MAXIMISE NET ECONOMIC BENEFITS; RECRUITMENT VARIABILITY; AND TECHNOLOGICAL CREEP

INTRODUCTION

The fisheries *refugia* concept as developed by the Regional Working Group on Fisheries (RWG-F) is based on the use of area-based or zoning approaches to fisheries management aimed at maintaining the habitats upon which fish stocks depend, as well as minimising the effects of fishing on stocks of important species in areas and at times critical to their life cycle. The fisheries *refugia* concept promotes the sustainable use of fish stocks and their habitats, and the use of criteria for the selection of sites for fisheries and habitat management interventions that focus on fish life-cycle and critical habitat linkages.

This practical exercise has been developed for the UNEP/GEF–SEAFDEC Regional Training Workshop on the Establishment and Management of Fisheries. It is aimed at supporting the training topics on "*Policy Instruments for Fisheries Management*" and "*The Concept of Fisheries Refugia*". It accompanies the lecture note entitled "*Procedure for Establishing a Regional System of Fisheries* Refugia *in the South China Sea and Gulf of Thailand*". The data contained in this exercise are hypothetical. They do not reflect actual data relating to the fisheries for the Greasy Grouper and Mangrove Red Snapper and are used in this exercise for instructional purposes only.

TASK 1 DEVELOPMENT OF DEMERSAL FISHERIES

Prepare a graph which highlights the catch in tonnes of greasy grouper and mangrove red snapper from the Gulf of Thailand during the period 1950-2000. The data required for the preparation of these graphs are provided in Table 1.

Table 1. The catch in tonnes of greasy groper and mangrove red snapper during the period 1950-2000.

Year	Greasy Grouper (*Epinephelus tauvina*)	Mangrove Red Snapper (*Lutjanus argentimaculatus*)
1950	216	243
1951	248	268
1952	275	263
1953	410	390
1954	617	510
1955	515	680
1956	812	790
1957	1003	900
1958	1453	1255
1959	1876	1600
1960	2245	1854
1961	2435	2050
1962	2675	2334
1963	2879	2534
1964	3356	2657
1965	3245	2897
1966	3342	3003
1967	3301	2980
1968	2897	3001
1969	3023	2940
1970	3313	3020
1971	3456	3005
1972	3346	2940
1973	3023	3102
1974	3109	2930
1975	2976	3145
1976	2876	3054
1977	2987	3067
1978	2899	3123

1979	3456	2786

Table 1 *cont*. The catch in tonnes of greasy groper and mangrove red snapper during the period 1950-2000.

Year	Greasy Grouper (*Epinephelus tauvina*)	Mangrove Red Snapper (*Lutjanus argentimaculatus*)
1980	3398	2657
1981	3412	2546
1982	3395	3010
1983	3375	2200
1984	3456	2312
1985	3102	2267
1986	2980	2109
1987	2865	2123
1988	2705	1567
1989	2698	1290
1990	2567	800
1991	2356	530
1992	2298	560
1993	2098	490
1994	1900	510
1995	1897	467
1996	1976	478
1997	1899	465
1998	1740	456
1999	1895	432
2000	1750	402

Question 1

a. How has the catch of Greasy Grouper and Mangrove Red Snapper evolved in the Gulf of Thailand?

b. Do you think that the declines in catches of both Greasy Grouper and Mangrove Red Snapper reflect (i) a reduction of fishing effort in the Gulf of Thailand, or (ii) indicate a reduction of the sizes of southern Greasy Grouper and Mangrove Red Snapper as a result of overfishing?

c. What types of information would fisheries managers require to determine the levels of fishing effort in the Gulf of Thailand appropriate toward maximising the sustainable yields from the Greasy Grouper and Mangrove Red Snapper resource?

d. How have fisheries managers traditionally set about obtaining the information identified in (c)?

TASK 2 IDENTIFICATION OF MAXIMUM SUSTAINABLE YIELD

The yield and fishing effort data in Table 2 can be used to estimate potential yields of Greasy Grouper and Mangrove Red Snapper from the Gulf of Thailand at a range of fishing effort levels. Using this data, prepare a graph which highlights the potential Maximum Sustainable Yields that can be taken from the stocks of Greasy Grouper and Mangrove Red Snapper in the Gulf of Thailand.

Table 2. Effort and yield data for Greasy Grouper and Mangrove Red Snapper in the Gulf of Thailand. This data was established through surplus yield analysis of catch and effort information obtained from the fishery during its developmental stages.

Effort (thousand metre net days per year)	Greasy Grouper – Yield (tonnes)	Mangrove Red Snapper – Yield (tonnes)
0	0	0
20000	1884	1615
40000	3051	2615
60000	3500	3000
80000	3232	2770
100000	2247	1926

Question 2

a. According to the effort/yield graphs prepared, what are the Maximum Sustainable Yields for Greasy Grouper and Mangrove Red Snapper in the Gulf of Thailand?

b. What is the approximate level of fishing effort (expressed as thousand metre net days per year) which will be most appropriate for the maximisation of the sustainable yields of Greasy Grouper and Mangrove Red Snapper in the Gulf of Thailand?

c. Do you think that this level of fishing effort will be appropriate for the maximisation of net economic returns from the Gulf of Thailand?

d. What types of information would fisheries managers generally require if they were to determine the level of fishing effort appropriate toward maximising net economic returns from the Gulf of Thailand?

e. How have fisheries managers traditionally set about obtaining the information identified in (d)?

TASK 3 REGULATION OF FISHING EFFORT TO MAXIMISE NET ECONOMIC BENEFITS

The yield, revenue, cost of production and effort data in Table 3 enable the identification levels of fishing effort for greasy grouper and mangrove red snapper required to optimise economic yields in the Gulf of Thailand. Using this data, prepare a graph which highlights the level of fishing effort required to optimise economic returns from fishing greasy grouper and mangrove red snapper in the Gulf of Thailand.

Table 3. Yield, revenue, cost of production and effort data obtained from the greasy grouper and red snapper fisheries during the period when they were developing.

Effort (tmnd)	Cost of Effort ($)	Yield-Greasy Grouper (tonnes)	Revenue-Greasy Grouper ($)	Yield-Red Snapper (tonnes)	Revenue-Red Snapper ($)
0	0	0	0	0	0
20000	4,086,839	1884	13,978,846	1615	11,981,868
40000	8,173,118	3051	22,635,513	2615	19,401,868
60000	12,258,323	3500	25,970,000	3000	22,260,000
80000	16,341,023	3232	23,982,308	2770	20,556,264

100000	20,428,493	2247	16,672,436	1926	14,290,659

Question 3

a. What is the level of fishing effort appropriate for the maximisation of net economic returns from fishing the greasy grouper and red snapper stocks of the Gulf of Thailand?

b. What main problem is encountered in the control of fishing effort in fisheries that are managed under open-access regimes?

c. What would be the logical fisheries management response to the problem identified in (b)?

d. Does the shift in the management of the Gulf of Thailand from an open-access regime with no fishing effort controls, to a regime of restricted access with effort controls, represent a logical management response to the problem identified in (b)?

e. What are the main types of policy instruments used to regulate fishing effort?

f. What are the main constraints in the use of the Maximum Sustainable Yield and Maximum Economic Yield Concepts in Southeast Asian fisheries?

TASK 4 RECRUITMENT VARIABILITY

Prepare a sketch of what you think the size-frequency distribution of a virgin greasy grouper stock and virgin red snapper stock would look like. Also, prepare a sketch of what the size-frequency distribution of a greasy grouper and red snapper stock would look like if they were subjected to levels of fishing effort appropriate to obtain the Maximum Sustainable Yields from these stocks.

Question 4

a. Variable recruitment is one of the key factors which influences the success of management strategies that are based around the control of fishing effort relative to a predetermined level of fishing mortality. What are the three (3) main factors which cause recruitment variability?

b. Using the sketches which you have prepared as a component of this task, describe why fisheries which are fished close to the point of MSY are, more often than not, significantly affected by the effects of recruitment variability.

c. How does recruitment variability influence the ability of managers to determine and control the level of fishing effort appropriate to maintaining Maximum Sustainable Yields in fisheries which are fished close to the point of Maximum Sustainable Yield?

d. Do you think that the recruitment variability issue has affected the ability of managers of the greasy grouper and red snapper fisheries to maintain the Maximum Sustainable Yields or Maximum Economic Yields from the greasy grouper and red snapper stocks?

TASK 5 TECHNOLOGICAL CREEP

It was recently identified that the agency responsible for the management of the greasy grouper stock are unable to appropriately determine the improvement of the efficiency of the greasy grouper fishing fleet, and hence determine real effort in the greasy grouper fisher. Scientists predict that the efficiency of the greasy grouper fishing fleet has improved at a rate of approximately 2% per year. The adjusted effort over time provides for significant comparisons of real effort versus nominal effort in the greasy grouper fishery.

Tables 4 highlights the effect of this 2% annual improvement in the efficiency of greasy grouper fishers on real effort and catch per unit effort in the greasy grouper Fishery. Prepare a graph which highlights the relationship between nominal effort and real effort in the greasy grouper fishery over time. Also, prepare a graph which highlights the relationship between nominal catch per unit effort and real catch per unit effort in the fishery for the greasy grouper fishery.

Table 4. The results of modelling which was aimed at determining the effects of an annual 2% improvement in the efficiency of greasy grouper fishers on real effort and real catch per unit effort for greasy grouper in the Gulf of Thailand.

Year	Catch	Nominal Effort (tmnd)	Adjusted (Real) Effort (tmnd)	Nominal Catch Per Unit Effort (kg per tmnd)	Adjusted (Real) Catch Per Unit Effort (kg per tmnd)
1960	2245	50000	50000	45	45
1961	2435	50000	51000	49	48
1962	2675	50000	52020	54	51
1963	2879	50000	53060	58	54
1964	3356	50000	54122	67	62
1965	3245	50000	55204	65	59
1966	3342	50000	56308	67	59
1967	3301	50000	57434	66	57
1968	2897	50000	58583	58	49
1969	3023	50000	59755	60	51
1970	3313	50000	60950	66	54
1971	3456	50000	62169	69	56
1972	3346	50000	63412	67	53
1973	3023	50000	64680	60	47
1974	3109	50000	65974	62	47
1975	2976	50000	67293	60	44
1976	2876	50000	68639	58	42
1977	2987	50000	70012	60	43
1978	2899	50000	71412	58	41
1979	3456	50000	72841	69	47
1980	3398	50000	74297	68	46
1981	3412	50000	75783	68	45
1982	3395	50000	77299	68	44
1983	3375	50000	78845	68	43
1984	3456	50000	80422	69	43
1985	3102	50000	82030	62	38
1986	2980	50000	83671	60	36
1987	2865	50000	85344	57	34
1988	2705	50000	87051	54	31
1989	2698	50000	88792	54	30
1990	2567	50000	90568	51	28
1991	2356	50000	92379	47	26
1992	2298	50000	94227	46	24
1993	2098	50000	96112	42	22
1994	1900	50000	98034	38	19
1995	1897	50000	99994	38	19
1996	1976	50000	101994	40	19
1997	1899	50000	104034	38	18
1998	1740	50000	106115	35	16
1999	1895	50000	108237	38	18
2000	1750	50000	110402	35	16