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An Evaluation on Economic Loss from Luring Purse Seine Fishery in the Gulf of Thailand

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ABSTRACT

Size of 14 commercial pelagic species, income and economic loss were studied from luring purse seine fisheries in the Gulf of Thailand during June 2004 – May 2005 by collecting the data at Samut Prakan fishing port. The average lengths of 12 commercial pelagic species were smaller than the size at first maturity. Income from total commercial pelagic species was 6,533,716.50 baht/boat/year and was 5,301,155.70 baht/boat/year for commercial pelagic species which size smaller than the size at first maturity. An evaluation on economic losses of pelagic species were estimated by comparing the economic value of species which size smaller than the size at first maturity and the size at first maturity. By using an average price at fishing port for evaluation, the economic loss was 184,861.40 baht/boat/trip or 5,545,842.15 baht/boat/year. If an average price derived from two important markets under Fish Market Division was used for evaluation, the economic loss was 357,262.75 baht/boat/trip or 10,717,882.49 baht/boat/year. The economic loss from luring purse seine fishery in the Gulf of Thailand was 2,700 million baht based on the number of fishing boat registered by luring purse seine gear in 1992.

Key words: economic loss, luring purse seine, Gulf of Thailand, pelagic fish

INTRODUCTION

In former time, the pelagic fisheries used passive gear such as bamboo stake trap. The dominant pelagic fish was Indo-Pacific mackerel. Over 70 years ago, Chinese purse seine was introduced into Thailand and became popular among mackerel fisherman, who modified this gear into Thai purse seine. After that, encircling gill net, made of synthetic fibre, was rapidly developed in Thailand and increased the marine landings. Finally, fishing method was developed to achieve more efficiency in fisheries, i.e. luring purse seine and luring purse seine with light which attracted marine animal schools before fishing. In addition, hi-technology gears such as sonar and power block were used for auxiliary fishing gear.

Marine fauna caught by luring purse seine in the Gulf of Thailand increased from 74,979 metric tonnes in 1973 to 384,633 metric tonnes in 1977. Due to fishing method of Thai purse seine and luring purse seine which were used alternately together, identification of catching data from individual fishing gear was complex and difficult. Therefore, since 1984 fisheries statistics from Thai purse seine and luring purse seine were combined together because of difficulty in data identification. The catch tendency of purse seine

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in the Gulf of Thailand was increased from 406,058 metric tonnes in 1984 to reach the highest catch, 571,654 metric tonnes, in 1992. After that, the catch decreased to 509,372 metric tonnes in 1995 and hit the lowest in 2001 and 2002, at 396,847 and 412,730 metric tonnes respectively. This indicates that, the catch was decreased more than 100 thousand metric tonnes within 10 years.

Moreover, size of most pelagic species were smaller than the size at first maturity. For example, Jutagate (1996) reported the average length of Indian mackerel caught by luring purse seine in the Gulf of Thailand during 1987-1994 was 16.50 cm, but the size at first maturity of Indian mackerel was 18.60 cm (Chullasorn and Martosubroto, 1986). Nootmorn (1989) reported that the length of round scad caught by luring purse seine and Thai purse seine in the Gulf of Thailand during 1975-1982 was 15.74 cm, but the size at first maturity of round scad was 16.20 cm (Chullasorn and Martosubroto, 1986). This indicates lack of efficiency in management measures to control utilization of fisheries resources from past to present. Instead of leaving juvenile fish to grow up for value added of fisheries resources, catching of juvenile fish had led to losses in economic and marine resources. If catching of juvenile fish was avoided and postponed to catch the size at first maturity, new recruitment would be enlarged and marine fisheries resources would be able to sustain for long time.

The objective of this study was to evaluate economic losses from catching commercial pelagic species which size smaller than the size at first maturity from luring purse seine fishery in the Gulf of Thailand.

MATERIALS AND METHODS

Study site and sample collection

The data were collected monthly during June 2004 – May 2005 at Samut Prakan fishing port. Most of luring purse seine fishing boats in the Gulf of Thailand operated in the same fishing ground which is the central Gulf of Thailand, outside the coast of Prachuap Khiri Khan, Chumporn and Surat Thani Provinces. Therefore, in this study sample is only one fishing port. The data collected were fishing ground, fishing effort, catch and fish price. Fish samples were collected from fish store room at the amount of 50-60 kg/ room for species classification and length measurement.

Income

Cost structure

The cost data were collected by interviewing fishing boat's captain or owner. The cost was divided into two groups, i.e. fixed cost and variable cost. Calculate the fixed cost as follows:

$$FC = D + (id + rK)$$

Calculate the variable cost as follows:

VC = Operating Cost + Labor Cost + Own Labor cost

Income structure

Income depended on quantity, price and demand – supply of each species. Calculate the income as follows:

$$TR = \sum_{s=1}^{n} Y_s P_s$$

Calculate the net profit as follows:

Net Profit = Total income – Total cost

An evaluation on economic losses from luring purse seine fishery

Economic losses can estimate number and weight of each commercial pelagic species which size smaller than size at first maturity by length-weight relationship, von Bertalanffy Growth Equation and Exponential Decay Model. This method can estimate weight of each commercial pelagic species which the size at first maturity also. An evaluation on economic losses

of pelagic species were estimated by comparing the economic value of species which size smaller than the size at first maturity and the size at first maturity as follows:

1. Calculate the body weight of each species which size smaller than the size at first maturity using length-weight relationship equation (Sparre and Venema, 1992)

$$W_0 = aL_0^b$$

2. Calculate the number of each species which size smaller than the size at first maturity

$$Nt_n = \frac{\textit{catch of species which size smaller than the size at first maturity (kg/day)}}{W_o}$$

3. Calculate the number of each species which size smaller than the size at first maturity and grow up to size at first maturity with applied the exponential decay model (Sparre and Venema, 1992). The condition of each species was closed population. Decrease of population was mortality only.

$$Nt_p = Nt_n \times e^{-z\Delta t}$$

4. Calculate Δt by von Bertalanffy Growth Equation (Sparre and Venema, 1992)

$$L_t = L_\infty (1-e^{-K(t_t-t_o)})$$

5. Calculate the body weight of each species which size at first maturity

$$W_c = aL_c^b$$

6. Calculate total weight of each species which size at first maturity

$$W_p = Nt_p \times W_c$$

7. Calculate the value of species which size at first maturity

value of species which size at first maturity = $(W_1 * \text{price}) + (W_2 * \text{price}) + \ldots + (W_n * \text{price})$

8. Calculate the economic losses from catching the species which size smaller than the size at first maturity

Economic loss = value of each species when size at first maturity – value of each species when size smaller than the size at first maturity

This study refers to record of researchers on length-weight relationship, L-infinity (L_∞), growth parameter (K), total mortality (Z), initial condition parameter (t_o) and size at first maturity from biological data of each species in the Gulf of Thailand and adjacent waters.

RESULTS AND DISCUSSION

Length

The average length of 12 commercial pelagic species were smaller than the size at first maturity, but 2 species, namely rainbow sardine (*Dussumieria acuta*) and goldstripe sardinella (*Sardinella gibbosa*) were larger than the size at first maturity (Table 1).

Compare length of some pelagic species in this study to previous record found that, the average length of Indian mackerel caught from luring purse seine fishery in the Gulf of Thailand during 1987-1994 was 16.50 cm (Jutagate, 1996), but this study was 16.28 cm. In 1987-1994, minimum and maximum lengths of Indian mackerel were 7.00 and 26.00 cm respectively while this study was 6.50 and 25.00 respectively.

Nootmorn (1989) studied the population dynamics of round scad in the Gulf of Thailand during 1975-1981 and found that the minimum length, maximum length and average length were 7.50, 29.50 and 15.74 cm respectively, but in this study the maximum length and average length were 23.50 and 14.48 cm respectively; however, the minimum length was equal.

Supongpan and Saikliang (1987) reported length of longtail tuna, kawakawa, frigate mackerel, hardtail scad and yellowfin scad from sonar fishing purse seine in the Gulf of Thailand and found that the average length, minimum length and maximum length of 5 species were larger than this study.

Decrease in size of pelagic species from luring purse seine fishery in the Gulf of Thailand was due to purse seine development which had reached the highest efficiency in 1974. Ever since,

Table 1 Length of commercial pelagic species from luring purse seine fishery in the Gulf of Thailand during in June 2004 – May 2005.

Species	Min. length (cm)	Max. length (cm)	All sample		Smaller than size at first maturity		Size at first maturity (cm)	Reference
			Average length (cm)	SD	Average length (cm)	SD		
Rastrelliger kanagurta (Cuvier, 1817) Indian mackerel	6.50	25.00	16.28	2.92	14.86	1.86	18.60	Chullasorn and Martosubroto, 1986
Euthynnus affinis (Cantor, 1849) Kawakawa	9.00	41.50	23.21	6.02	22.89	5.83	37.50	Klinmuang, 1981
Auxis thazard thazard (Lacepàde, 1800) Frigate mackerel	10.50	36.50	22.27	6.25	21.83	5.96	34.10	Klinmuang, 1981
Selaroides leptolepis (Cuvier, 1833) Selar scad	6.50	21.50	11.97	2.21	10.60	1.33	13.20	Dwiponggo *et al*., 1986
Dussumieria acuta Valenciennes, 1847 Rainbow sardine	11.00	21.00	16.97	1.48	13.51	0.44	14.20	Chullasorn and Martosubroto, 1986
Decapterus russelli (R¸ppell, 1830) Indian scad	7.50	23.50	14.48	2.54	13.22	1.58	16.20	Chullasorn and Yusukswad, 1978
Rastrelliger brachysoma (Bleeker, 1851) Indo-Pacific mackerel	7.50	20.50	13.08	2.00	12.63	1.57	17.50	Chullasorn and Martosubroto, 1986
Atule mate (Cuvier, 1833) Yellowtail scad	5.00	25.50	13.57	3.00	13.33	2.84	21.50	Premkit *et al*., 2004
Sardinella gibbosa (Bleeker, 1849) Goldstripe sardinella	3.00	20.50	16.43	2.00	12.23	1.62	13.12	Nasuchon and Rotjanaratana, 2000
Selar crumenophthalmus (Bloch, 1793) Big-eye scad	8.00	26.00	14.67	3.16	13.56	2.32	18.00	Dy-Ali, 1988
Thunnus tonggol (Bleeker, 1851) Longtail tuna	9.00	43.50	18.01	8.44	15.85	4.55	39.60	Klinmuang, 1981
Megalaspis cordyla (Linnaeus, 1758) Hardtail scad	5.50	31.50	15.99	4.92	14.57	3.22	25.00	Reuben *et al*., 1992
Parastromateus niger (Bloch, 1795) Black pomfret	8.00	21.50	14.48	3.11	12.93	2.42	19.12	Dwiponggo *et al*., 1986
Scomberomorus commerson (Lacepède, 1801) Spanish mackerel	9.50	29.50	13.73	2.43	13.73	2.43	58.30	Supongpan and Chayakul, 1979

luring purse seine has continuously caused decrease in size of pelagic species in the Gulf of Thailand. Luring purse seine fishery also causes over fishing and unbalance maximum sustainable yield. Boonchuwong and Laowapong (1988) estimated that the maximum sustainable yield of pelagic fish in the Gulf of Thailand and the Andaman Sea was 450,000 metric tonnes while over fishing occurred in 1983 and 1985, being 512,000 and 588,500 metric tonnes respectively. Luring purse seine creates organic matters from decomposed coconut leaf for small marine animals. Light was also attractive to marine animal schools which enables luring purse seine as an efficient gear in catching high quantity of marine animals from limited areas in the Gulf of Thailand. This situation minimize reproductive chance making marine fisheries resources become less abundant for fisheries at present.

Income

Total income of luring purse seine fishery in the Gulf of Thailand was 286,926.39 baht/boat/trip or 8,607,791.70 baht/boat/year. Pelagic species was the majority income, 221,291.19 baht/boat/trip while income of 14 commercial pelagic species was 217,790.55 baht/boat/trip (Table 2). Total income from this study is higher than the year 1999 which was 7,430,161.50 baht/boat/year (Supongpan, 2000). This is probarbly due to increase in fish price. For example, average price of Indian mackerel at 2 important markets under Fish Market Division, Bangkok and Samut Prakan Fish Market, in 1999 was 26 baht/kg (Fish Marketing Organization, n.d. A), in 2004 was 40 baht/kg (Fish Marketing Organization, n.d. B) while the price at fishing port was 30 baht/kg. Average price of scad in 1999 was 12 baht/kg (Fish Marketing Organization, n.d. A), in 2004 was 27.50 baht/kg while the price at fishing port was 20 baht/kg.

An evaluation on economic losses

Income of commercial pelagic species was 217,790.55 baht/boat/trip. If divided the pelagic species which size smaller than the size at first maturity, re-analyze the average length (Table 1) and use the fish price at fishing port, the value was 176,705.19 baht/boat/trip (Table 4). When the pelagic species grow up to size at first maturity, the value was 361,566.60 baht/boat/trip. The economic losses were 184,861.40 baht/boat/trip or 5,545,842.15 baht/boat/year.

If an average price at two important markets under Fish Market Division was used for evaluation, the economic losses were 357,262.75 baht/boat/trip or 10,717,882.49 baht/boat/year. The economic losses from luring purse seine fishery in the Gulf of Thailand were 2,700 million baht based on the number of fishing boat registered by luring purse seine gear in 1992.

High value of total mortality (Z) in this

Table 2 Income of luring purse seine fishery in the Gulf of Thailand during June 2004 – May 2005.

Species	Income		
	Baht/boat/trip	Baht/boat/year	Percent
Total	286,926.39	8,607,791.70	100.00
Sub-total pelagic fish	221,291.19	6,638,735.70	77.12
Commercial pelagic	217,790.55	6,533,716.50	75.90
Other pelagic	3,500.64	105,019.20	1.22
Sub-total demersal fish	19,296.81	578,904.30	6.73
Sub-total trash fish	12,769.47	383,084.10	4.45
Sub-total squid & cuttlefish	33,566.40	1,006,992.00	11.70
Sub-total others	2.52	75.60	0.001

Table 3 Evaluate on economic losses of commercial pelagic species which size smaller than the size at first maturity from luring purse seine fisheries in the Gulf of Thailand during June 2004 – May 2005.

Species	L_0 (cm)	W_0 (g)	Catch (kg/boat/day)	Nt_n (tail/boat/day)	L_c (cm)	W_c (g)	Dt	Nt_p (tail/boat/day)	W_p (kg/boat/day)	Price (baht/kg)	Estimate value (baht/boat/day)
Indian mackerel	14.86	32.13	447.68	13,934	18.60	66.59	0.1914	5,269	350.84	30.00	10,525.17
Kawakawa	22.89	192.91	285.28	1,479	37.50	857.60	0.3897	312	266.81	25.00	6,670.31
Frigate mackerel	21.83	201.74	136.15	675	34.10	765.54	0.4447	191	146.10	25.00	3,652.62
Selar scad	10.60	10.76	144.15	13,403	13.20	22.21	0.1892	4,515	100.29	18.00	1,805.13
Rainbow sardine	13.51	20.19	17.57	871	14.20	23.62	0.0699	530	12.50	14.00	175.04
Indian scad	13.22	24.15	80.51	3,334	16.20	44.53	0.2139	2,030	90.37	16.00	1,445.85
Indo-Pacific mackerel	12.63	21.23	108.44	5,108	17.50	60.54	0.2956	837	50.66	35.00	1,773.11
Yellowtail scad	13.33	25.03	65.01	2,598	21.50	113.79	0.6747	39	4.39	20.00	87.74
Goldstripe sardinella	12.23	12.39	19.31	1,559	13.12	20.91	0.1338	404	8.44	14.00	118.15
Big-eye scad	13.56	44.34	52.91	1,194	18.00	103.84	0.2539	291	30.20	20.00	604.08
Longtail tuna	15.85	78.91	34.26	435	39.60	1,207.13	0.1938	230	277.57	30.00	8,327.10
Hardtail scad	14.57	42.05	46.38	1,104	25.00	209.96	0.5391	370	77.54	11.00	852.90
Black pomfret	12.94	83.42	2.24	27	19.12	265.55	0.7990	6	1.37	80.00	110.00
Spanish mackerel	13.73	24.83	2.51	102	58.30	1,607.43	0.9018	27	42.39	95.00	4,026.86

Table 4 Economic losses of commercial pelagic species which size smaller than the size at first maturity from luring purse seine fishery in the Gulf of Thailand during June 2004 – May 2005.

Species	Value of pelagic species which size smaller than the size at first maturity (baht/boat/trip)	Estimate value of pelagic species which the size at first maturity (baht/boat/trip) [1]	Economic losses baht/boat/trip [2]	baht/boat/year[3]
Indian mackerel	56,407.97	94,726.54	38,318.57	1,149,557.08
Kawakawa	51,350.40	60,032.76	8,682.36	260,470.76
Frigate mackerel	24,507.00	32,873.56	8,366.56	250,996.90
Selar scad	9,081.18	16,246.21	7,165.04	214,951.07
Rainbow sardine	1,106.93	1,575.39	468.46	14,053.65
Indian scad	7,246.03	13,012.68	5,766.65	172,999.41
Indo-Pacific mackerel	6,831.84	15,957.96	9,126.12	273,783.64
Yellowtail scad	5,850.72	789.66	-5,061.05	-151,831.63
Goldstripe sardinella	868.83	1,063.39	194.56	5,836.88
Big-eye scad	4,762.20	5,436.74	674.53	20,236.01
Longtail tuna	5,241.78	74,943.91	69,702.13	2,091,063.84
Hardtail scad	2,922.02	7,676.10	4,754.08	142,622.48
Black pomfret	302.40	989.98	687.58	20,627.34
Spanish mackerel	225.90	36,241.72	36,015.82	1,080,474.71
Total	**176,705.19**	**361,566.60**	**184,861.40**	**5,545,842.15**

Remark [1] Estimate value in Table 3 multiply fishing day (9 day/trip)

[2] Estimate value of pelagic species which the size at first maturity – value of pelagic species which size smallor than the size at first maturity

[3] Economic losses (baht/boat/trip) multiply trip/year (30 trip/year)

study causes marine fauna rapid mortality and growth up to size at first maturity in small amount. For example yellowtail scad (*A. mate*), the total mortality (Z) was 6.24 per year, asymptotic length (L_∞) was 25.79 cm and growth parameter (K) was 1.284 per year. Currently, luring purse seine catches yellowtail scad 2,598 tail/boat/day and grow up to size at first maturity only 39 tail/boat/day (Table 3). Assessment of marine fisheries status does not cover every population size which could lead to some incorrect parameters making evaluation on economic losses in this study uncertainly.

Furthermore, some parameters of marine fauna in the Gulf of Thailand are lacking, so such parameters in adjacent waters were used in this study. In addition, some parameters from previous studies were collected for separated sex data, but the data in present study from fishing port were not sex-separted. Thus, in order to get more precise results, both parameters should be combined and re-calculated for the average value.

CONCLUSION

The economic loss from luring purse seine fishery in the Gulf of Thailand was 184,861.40 baht/boat/trip or 5,545,842.15 baht/boat/year. If an average price at two important markets under Fish Market Division was used for evaluation, the economic loss was 357,262.75 baht/boat/trip or 10,717,882.49 baht/boat/year. The economic loss from luring purse seine fishery in the Gulf of Thailand was 2,700 million baht based on the number of fishing boat registered by luring purse seine gear in 1992.

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