

# Bioeconomic analysis of the artisanal shrimp trawl fishery in the Tonkin Gulf, Vietnam

*Nguyen Viet Thanh, Arne Eide*

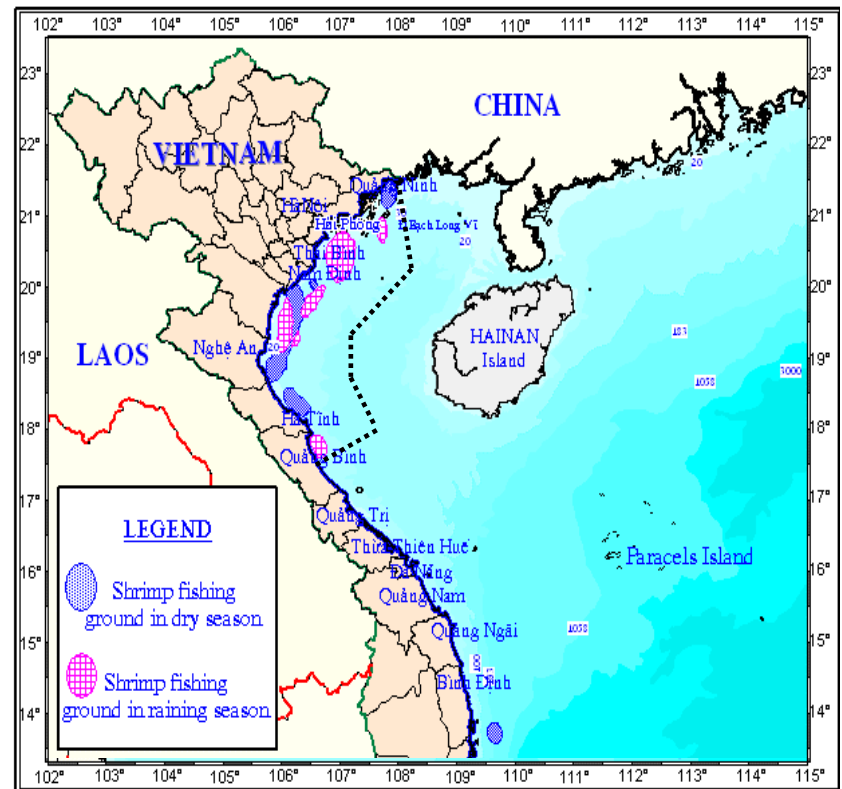
*The Norwegian College of Fishery Science, University of Tromsø*

- ❑ The Tonkin Gulf is a semi-closed gulf in the northwest of the South China Sea.
- ❑ The Gulf contributed around 16% to Vietnamese marine resources, 30% to total fishing boats and about 20% to total marine landing annually.
- ❑ Fisheries in the Gulf are small scale, multi-species and multi-gears.



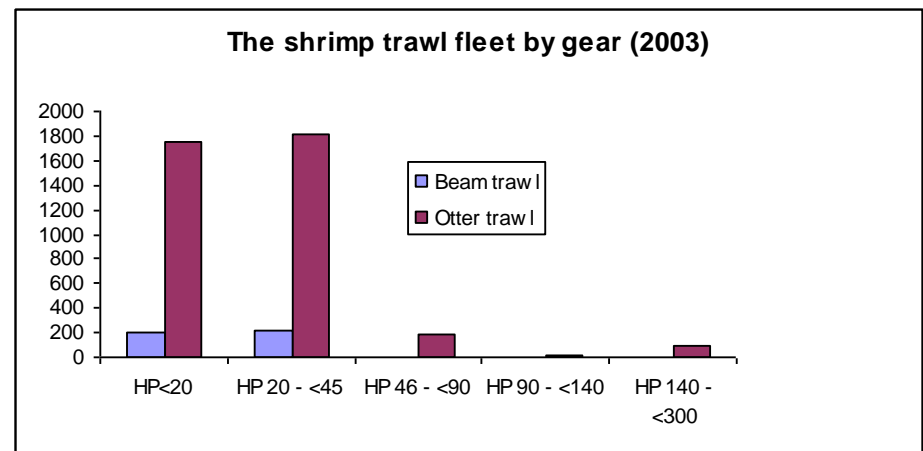
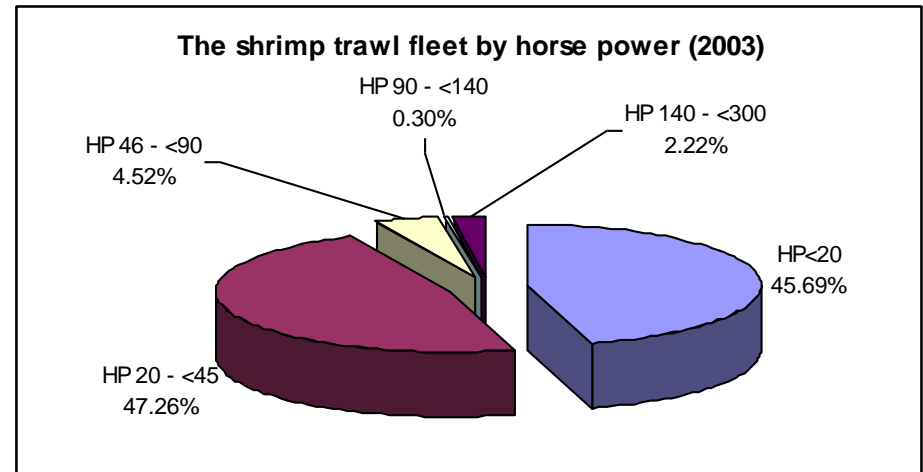
# The shrimp fishery

- ❑ There have been found 58 shrimp species in Tonkin Gulf, mainly belong to the family of *Penaeidae*.
- ❑ Most shrimp species are distributed along the coastal areas (shrimp fishing grounds are showed in the map)
- ❑ Shrimp spawning seasons are twice per year: February-March and June-July.



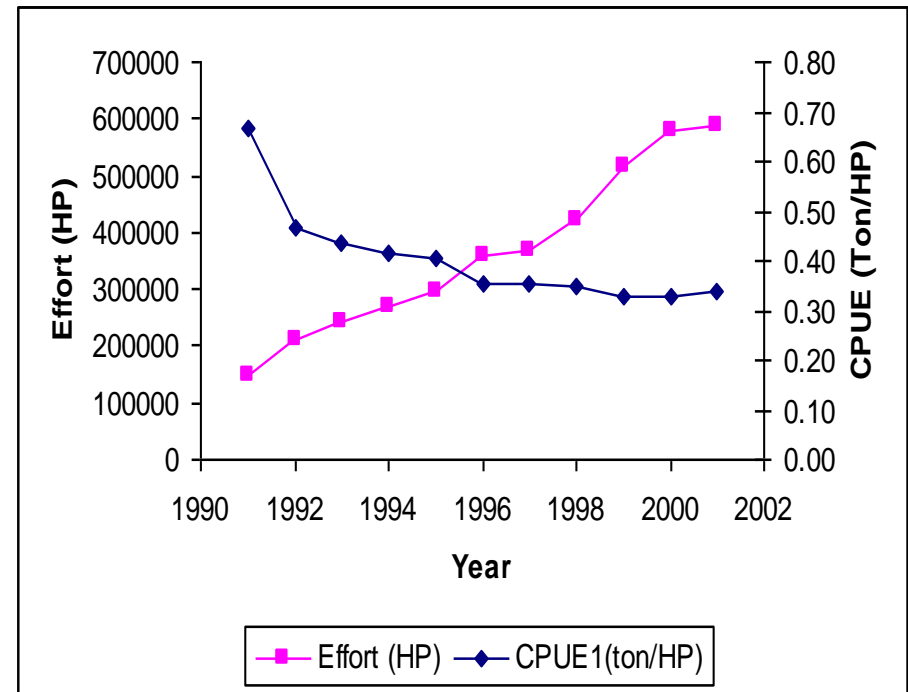
# The shrimp fishery

- ❑ The shrimp fleet (around 4000 fishing boats) occupied about 18% of the total fleet in the Gulf.
- ❑ About 93% fishing boats have engine lower than 45 HP.
- ❑ Otter trawl and beam trawl are two main fishing gears (otter trawlers are dominant).



# Previous studies

- ❑ Some studies showed that the MSY of fisheries in the coastal area of the Gulf was reached since 1994 (Long, 2001).
- ❑ The catch per unit of effort (CPUE) globally declined from 1.34 to 0.34 ton/HP/year from 1985-1997 (Son *at el*, 2003)
- ❑ Surveys by RIMF showed that density of shrimp species (*Penaeidae*) reduced a half between the period 1975-1978 (66kg/km<sup>2</sup>) and 2002 (32.01kg/km<sup>2</sup>)



# Our questions?

- What is the sustainable harvest of selected reference points?
- Is the current fishing effort of the shrimp trawl fishery too high for a sustainable exploitation?
- Must the fishing effort be reduced in order to reach the reference points?

# Models

- Verhulst-Schaefer and Gompertz-Fox models

$$\frac{dX}{dt} = rX \left(1 - \frac{X}{K}\right) - qEX$$

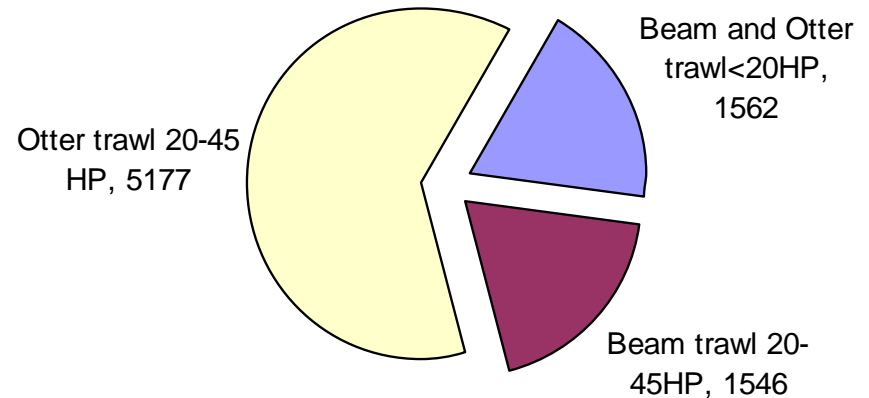
$$\frac{dX}{dt} = rX \ln \frac{K}{X} - qEX$$

- Constant price per unit of harvested biomass and constant cost per unit effort are used in this study
- A half year catch and effort data are used in accordance with the biological year of the shrimp stock in the Tonkin Gulf

# Data

- ❑ The Assessment of the Living Marine Resources in Vietnam (ALRMV) project which was supported by Danish International Development Agency (DANIDA) and carried out in Vietnam from 2000 to 2004.
- ❑ In the project, interviews were monthly conducted at local harbors. Data from the interviews were used to estimate indicators for different shrimp trawler groups.

Interviews were collected from 2000-2004



# Standardization

- ❑ In this study, shrimp trawlers (with engine lower than 45 HP) are divided into three groups.
- ❑ Otter trawlers with the engine 20-45 HP, the biggest group, are chosen as the standard group for aggregating effort of the fishery.
- ❑ Otter trawlers and beam trawlers with the engine lower than 20 HP are assumed homogeneous and will be consider as one group.
- ❑ The third group is the beam trawlers with the engine from 20-45 HP.



# Results

□ The discount rates are representative of biological considerations (5%), social accounting (10%), and private interest rates compounded by risk (20%)

□ The two models showed the same trends optimal reference points over the range of the discount rate ( $\delta = 0\% - 20\%$ )

□ estimated optimal effort values vary the most within a model (6.37-10.91%), while estimated resource rents vary the least (0.05-0.56%).

Optimal reference points (under discounting)

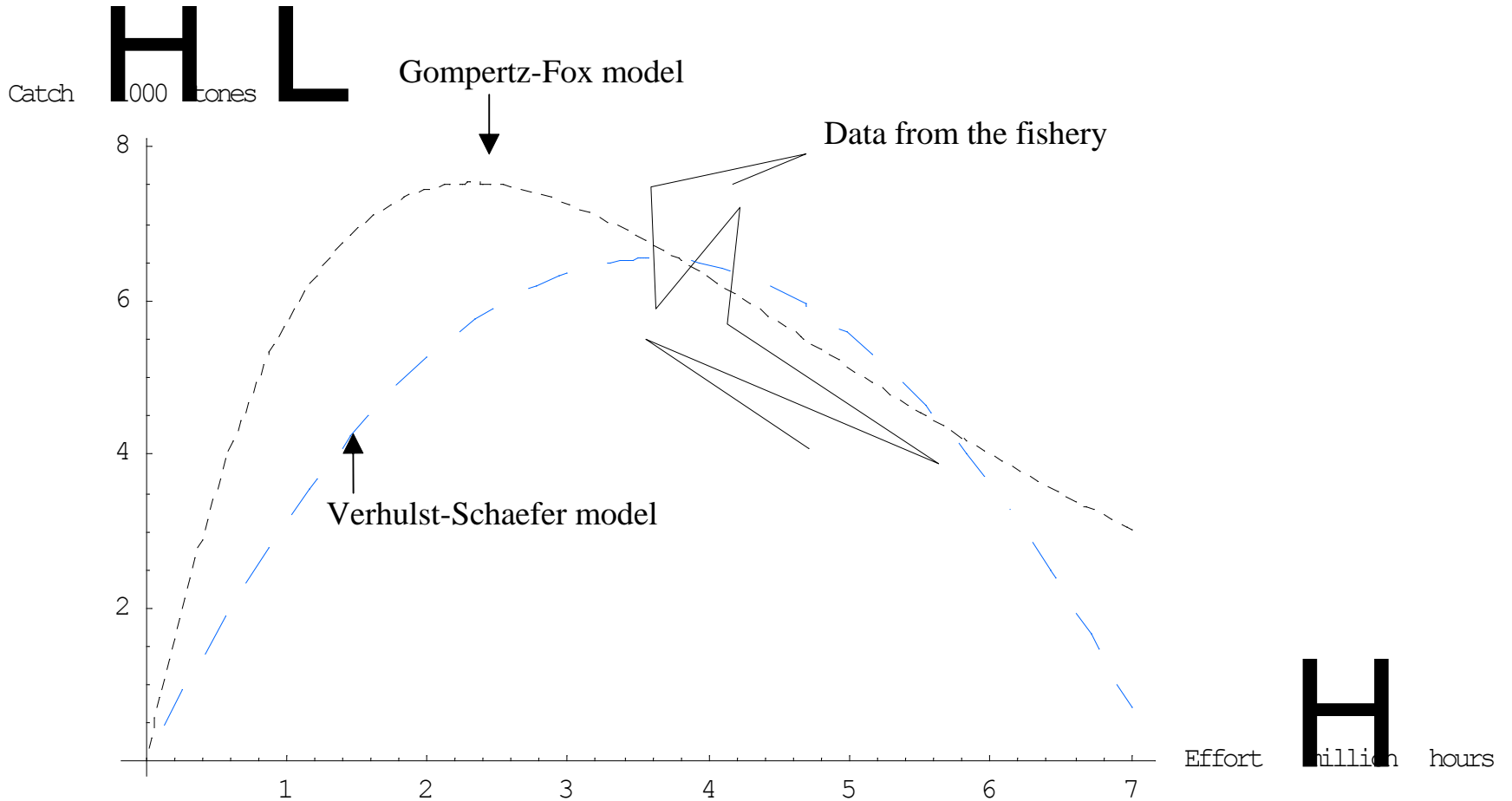
<i>Models</i>	$\delta$ (%)	$Y^*$ ( $10^6\text{kg}$ )	$E^*$ ( $10^6\text{hour}$ )	$X^*$ ( $10^6\text{kg}$ )	$\pi^*$ ( $10^9\text{VND}$ )	$CPUE^*$ ( $\text{kg}/\text{hour}$ )
<b>Verhulst-Schaefer</b>	0	5.53345	2.18137	11.66760	57.156187	2.536686
	5	5.60297	2.23073	11.55280	57.126581	2.511720
	10	5.66832	2.27880	11.44100	57.041850	2.487414
	20	5.78732	2.37115	11.22620	56.723531	2.440723
	$\infty$	6.25477	4.36275	6.59427	0	1.433676
<b>Gompertz-Fox</b>	0	7.05241	1.57845	20.55050	113.772728	4.467934
	5	7.20065	1.69317	19.56080	113.387150	4.252763
	10	7.31203	1.80103	18.67380	112.359594	4.059916
	20	7.45235	1.99751	17.16010	109.001376	3.730820
	$\infty$	6.05070	4.22040	6.59427	0	1.433679

# Results

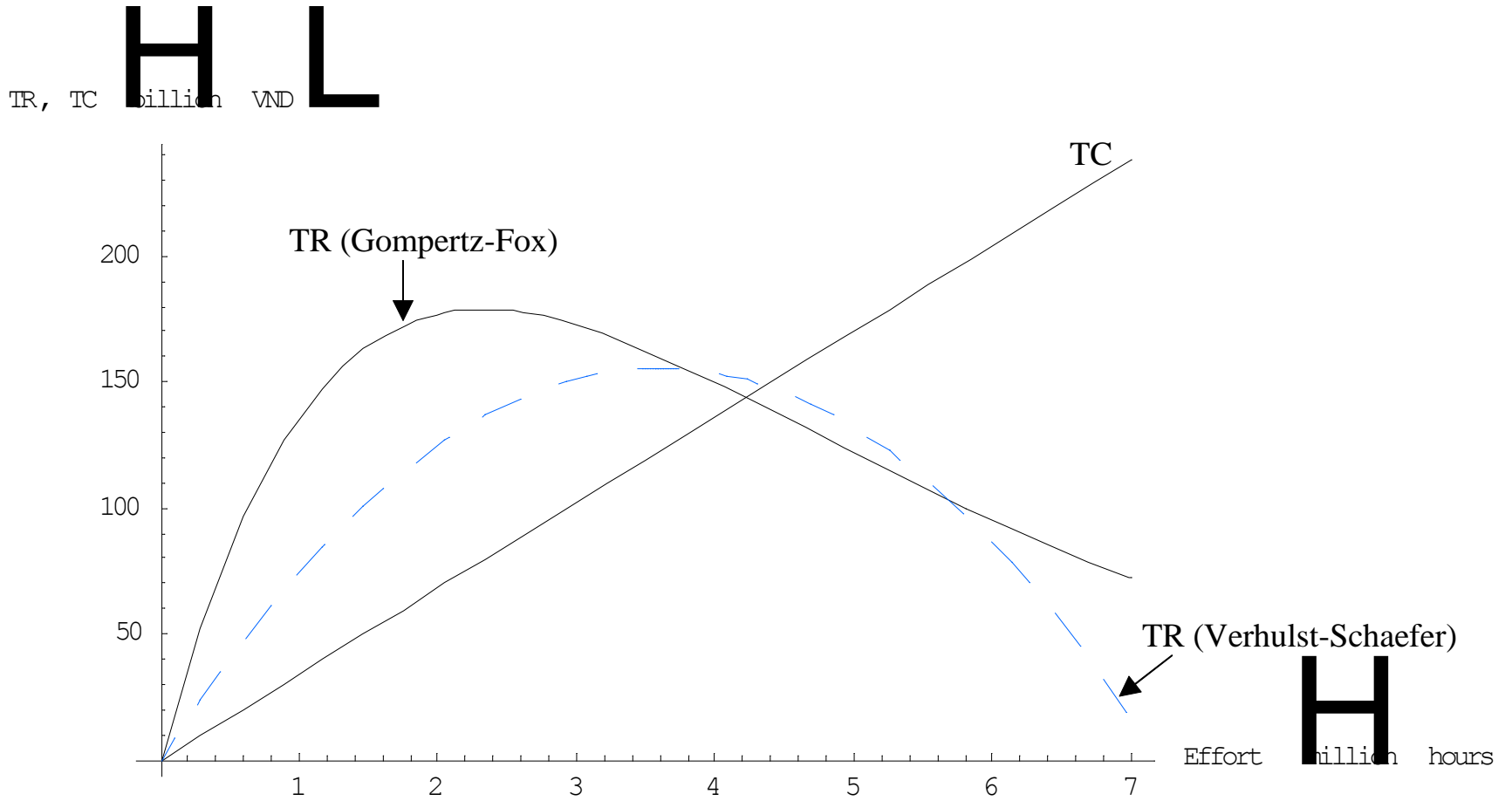
- The two models showed that the fishery was overexploited both in terms of maximizing yield and maximizing resource rent.

	Data from the fishery (2004)	MSY		MEY	
		Verhulst-Schaefer	Gompertz-Fox	Verhulst-Schaefer	Gompertz-Fox
Catch ( $10^6$ kg)	4.780080	6.54969	7.53417	5.53345	7.05241
Effort ( $10^6$ towing hours)	4.126225	3.59904	2.32426	2.18137	1.57845

# Results



# Results



# Discussion

- ❑ The results from the two models showed the open access yield of the fishery was around 6,000 tones for a half year (12,000 tones per year).
- ❑ The open access yield figure is in accordance with the official catch statistic (around 11,445 tones in 2003).
- ❑ In comparison with the shrimp biomass, which was estimated about 5426 tones for a half year (2003), the shrimp population have an annual growth which in biomass terms exceeds the population size at some points during the year.

# Discussion

The current fishing effort should be reduced to achieve selected reference points

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Reference point	Verhulst-Schaefer model	Gompertz-Fox model
<i>MSY</i>	12 %	44 %
<i>MEY(at 10% discounted rate)</i>	45 %	56 %

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Data ranges of catch and effort were small which may give poor background for choosing a priority model.

In this study, a range of reference points, which derived from the two models are chosen in order to take consideration of uncertainty in practice

It also need more data in order to have reasonable advices for the fishery.

# Conclusion

- ❑ The surplus production models should be applied in a flexible way regarding to the biological characteristics of the stock.
- ❑ For the fast growing species in tropical areas such as shrimps in the Tokin Gulf, using data from the enumerator program could be one way to reduce the problems of insufficient statistic data.
- ❑ In this study, a range of reference points was chosen, this could also be one way to deal with uncertainty in practice in case of insufficient statistic data.

# Future work

□ Longer time series catch and effort data should be collected and analyzed in order to:

- Give reasonable reference points
- Give reasonable advices for the fishery
- Take into account the effect of seasonality in the weather