Abundance of finless porpoise (*Neophocaena phocaenoides*) and their role in the eastern Yellow Sea ecosystem

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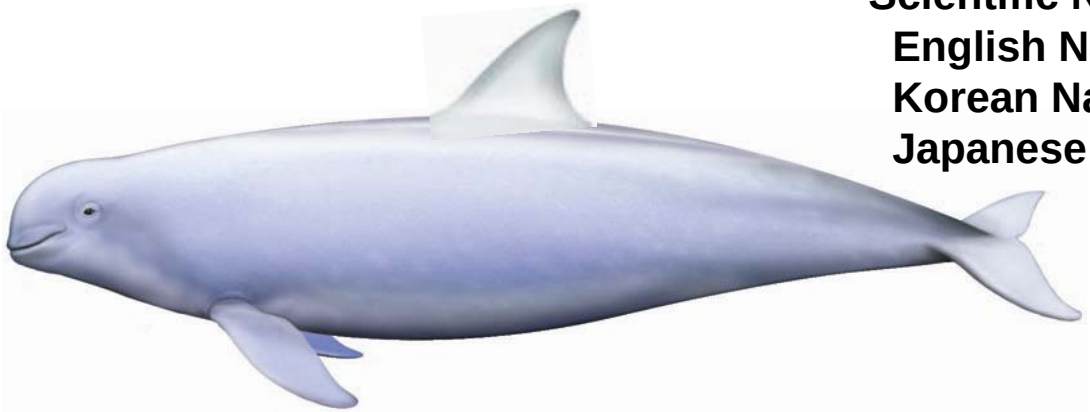
Pukyong National University

Finless Porpoise?



Scientific Name : *Neophocaena phocaenoides*
English Name : Finless porpoise
Korean Name : Sang-quang-I (상괭이)
Japanese Name : Sunameri (すなめり)

- Small species in the family Phocoenidae
- Asia endemic species
- Listed CITES Appendix I

Finless Porpoise in Korea Waters

- Finless porpoise was not a target species of whaling and Korea banned intentional catch on all cetacean
- But over 50 animals have been taken incidentally by fishing gears in the eastern Yellow Sea every year
- This species is listed on

Appendix I of CITES (Convention on International Trade in Endangered Species)

IUCN (International Union for Conservation of Nature) the Red List of threatened species as "Data deficient"

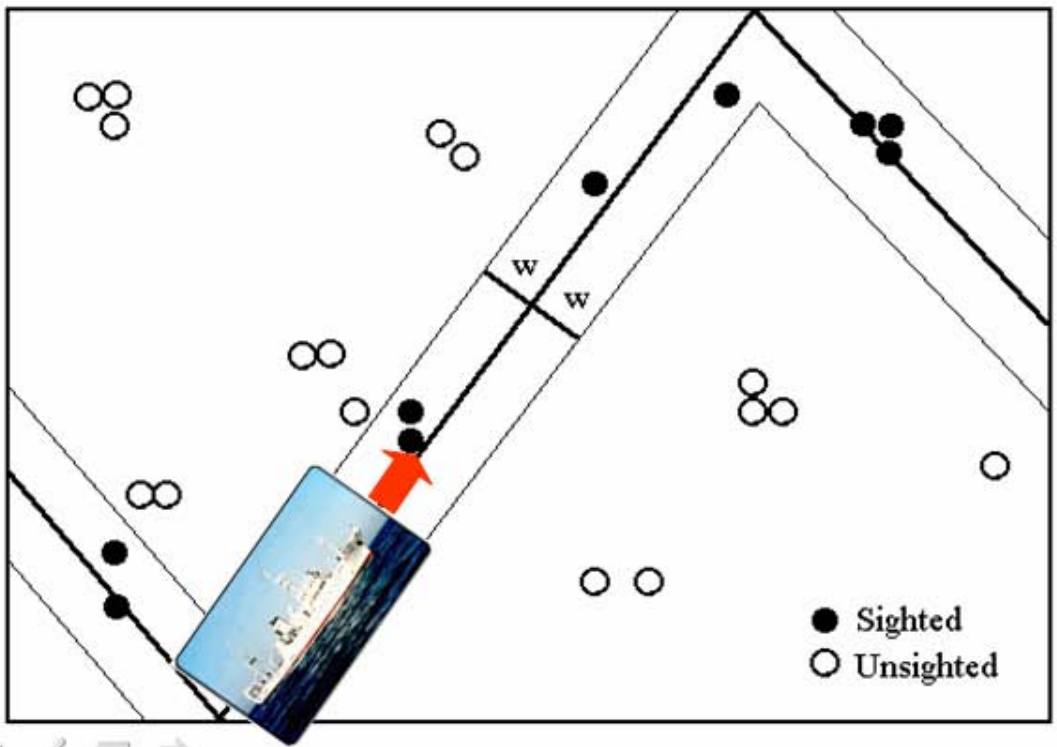
We wonder their abundance…

Finless Porpoise in Korean Waters

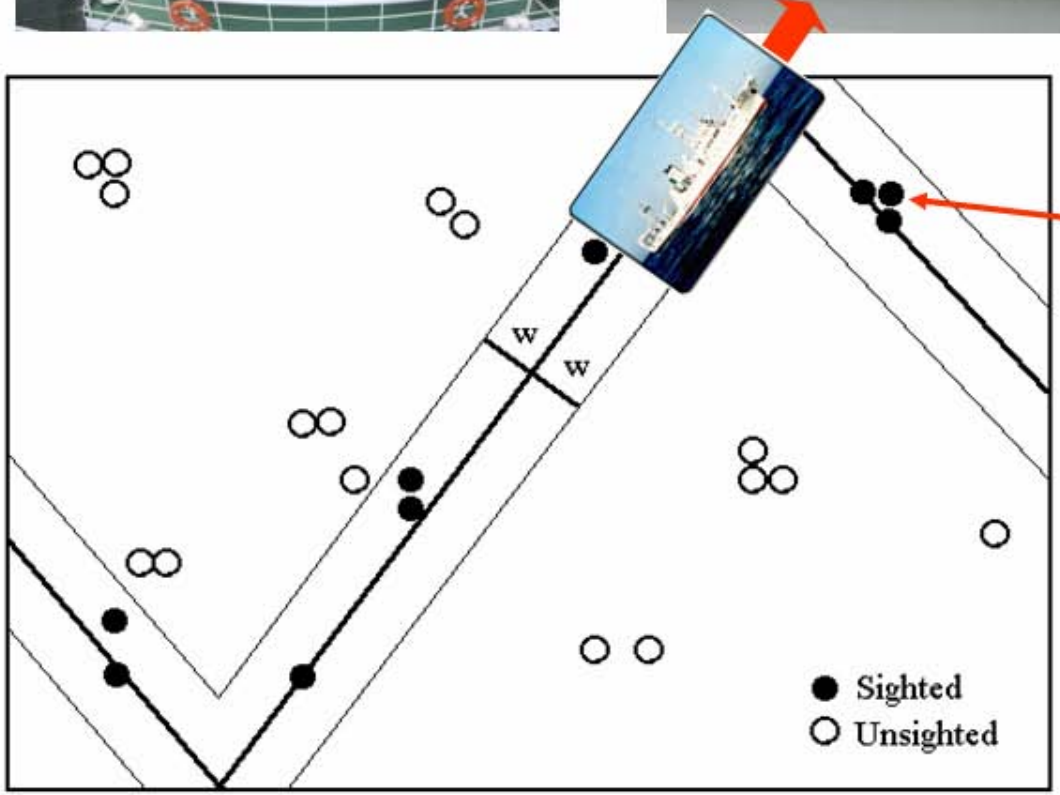
- Enmities of fisher have claimed damages in commercial fisheries due to the consumption of target species and fish disturbance by small cetaceans
- Little knowledge on interaction between finless porpoise and other organisms
- It is necessary to know their feeding habits and effects on marine organisms in Korean waters

We wonder their roles in the sea…

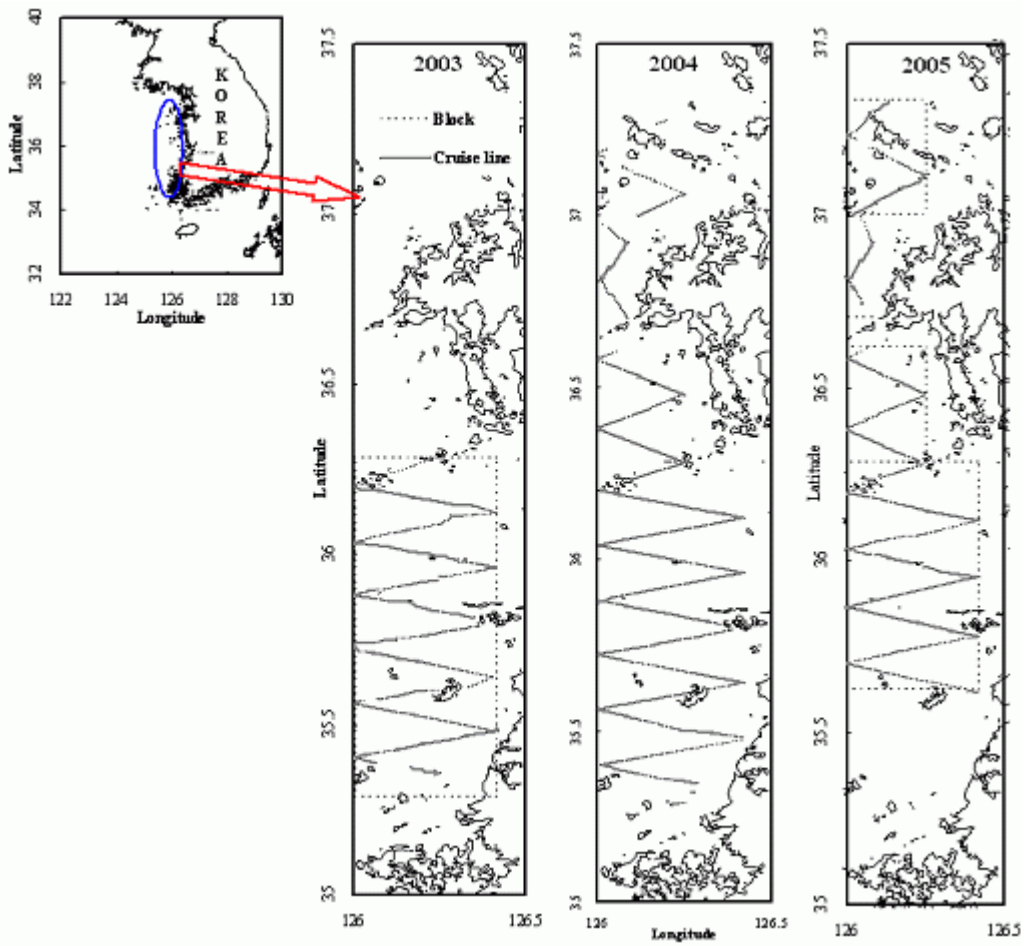
Line Transect Survey

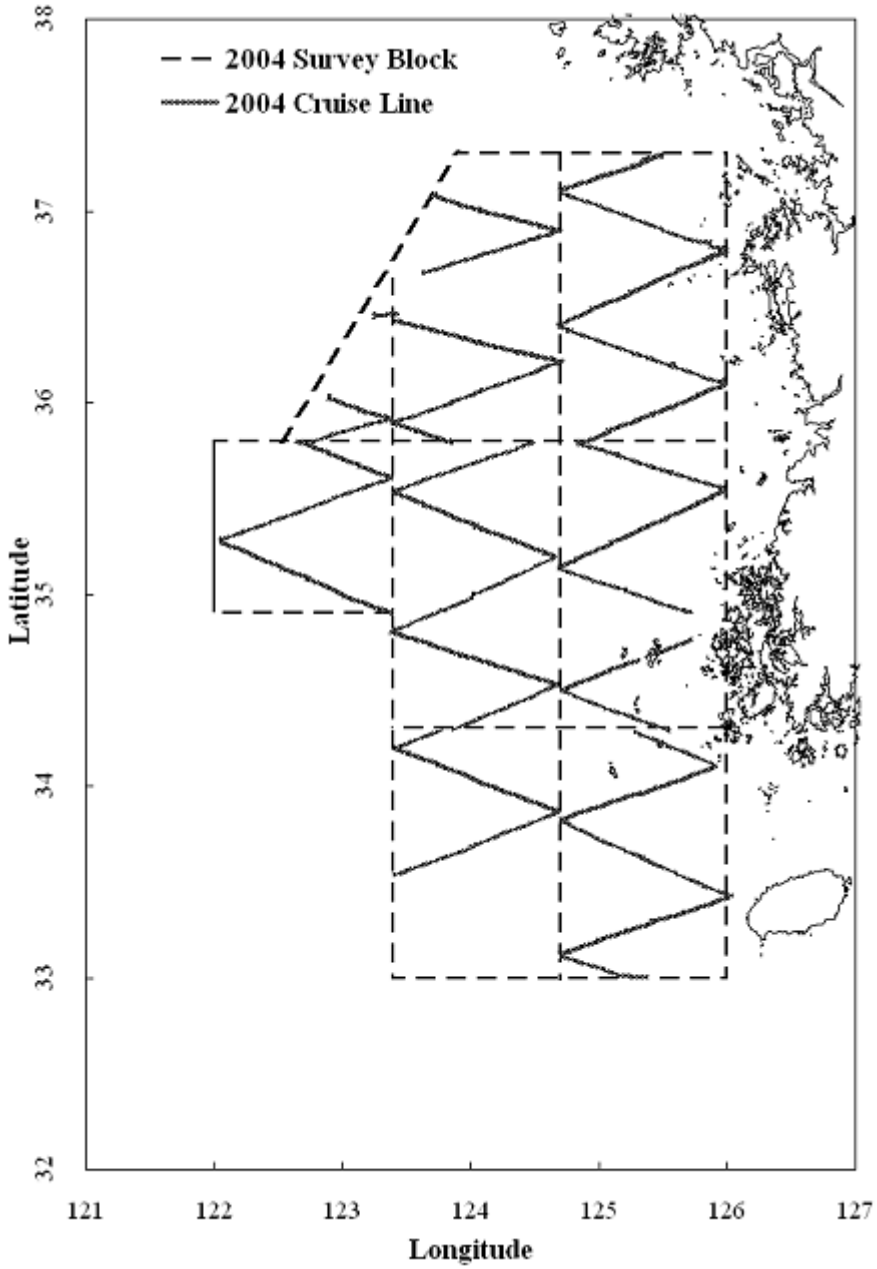


Line Transect Survey



Materials and Methods





- Three line-transect surveys in inshore
- A line-transect survey in offshore

Materials and Methods

Estimation

Abundance (N)

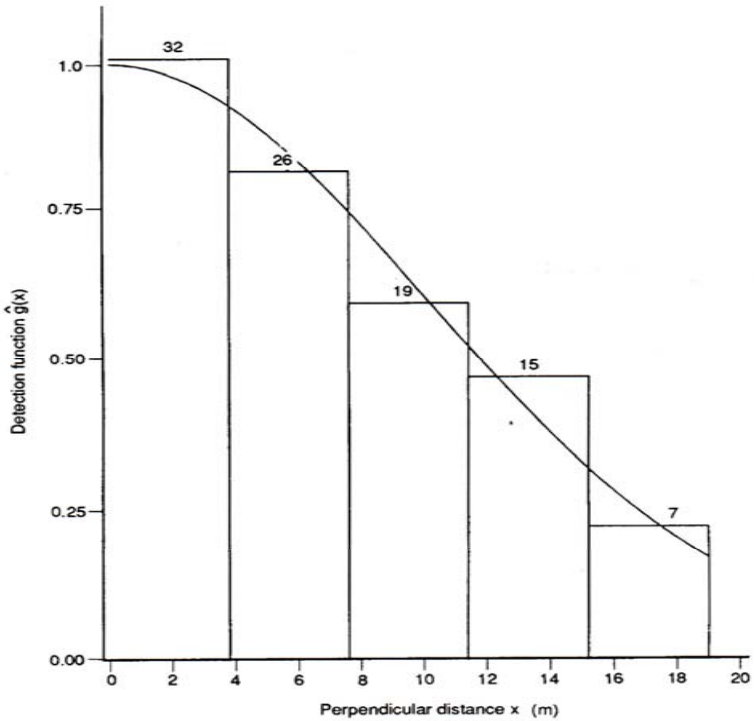
$$N = \frac{E(n)E(s)f(0)A}{2L}$$

E(n) : Number of observed pods
E(s) : Mean size of pod
f(0) : Probability density function evaluated at x=0
A : Area
L : Total length of the transect lines surveyed

PDF (probability of density function)

$$f(0) = \frac{1}{\int_0^{x_{max}} g(x)dy}$$

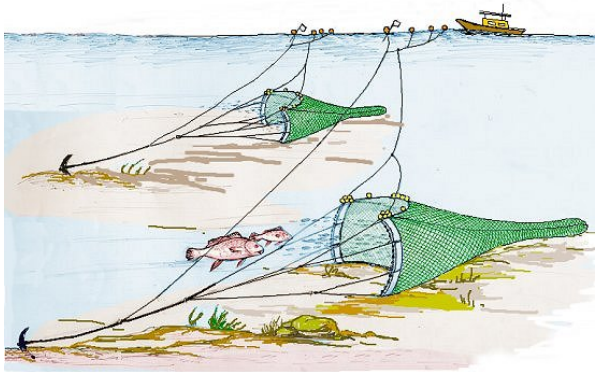
x_{max} : Most far observation distance , g(x) : Detection function of perpendicular distances x



Computer program
Distance 5.0 (Thomas et al., 2005)

Feeding Habits

- **Stomach contents sampling**



Large stow net

Bycatch

Auction

A total of 163 samples were analyzed from 2002 to 2005

IRI (Index of Relative Importance)

$$IRI = (RN + RW) \times RF$$

- **RN : Relative number of prey**
- **RW : Relative weight of Prey**
- **RF : Relative frequency of prey**

Ecopath Model

Biota	Groups used in the model
Cetacean and Sharks	Apex predator Finless porpoise Baleen whale
Fishes	Pelagic fish Semi-demersal fish Benthic-demersal fish
Cephalopods	Cephalopod
Benthos	Benthic-feeder Epifauna Gastropod Infauna
Planktons	Zooplankton Phytoplankton
Others	Algae Detritus

Data

- Korean Fisheries Year Book (MOMAF, 2006)
- Grouping of organisms in the Yellow Sea referred to Trites *et al*. (1999)

ECOPATH Model

- The Ecopath is an approach for analyzing trophic interactions in fisheries resources systems (Christensen and Pauly 1992, Christensen 1995)
- The Ecopath represents components of the ecosystem and their feeding interactions

Mass-Balance Equation

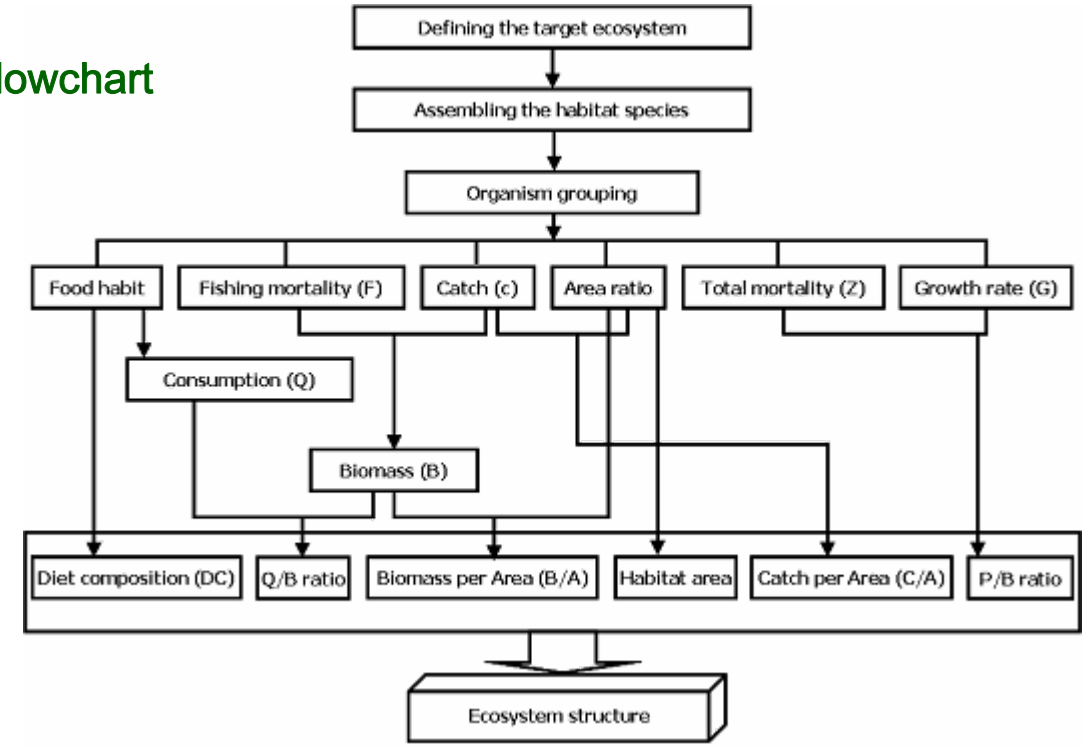
$$P_i = Y_i + B_i \cdot M2_i + E_i + BA_i + P_i \cdot (1 - EE_i)$$

Energy-Balance Equation

Consumption = Production + Respiration + Unassimilated food

Ecopath Model

- Ecosystem modeling flowchart



- Input parameters

  - Biomass (B)
  - Production (P)
  - Production/Biomass (P/B) ratio
  - Consumption/Biomass (Q/B) ratio
  - Diet composition (DC)
  - Catch (C)

  Referred to Fisheries Year Book (MOMAF, 2006), feeding habits (Papers, Books) and pior ecosystem modeling study (Trites *et al.*, 1999)

Ecopath Model

- Diet Compositions

	Prey/Predator	1	2	3	4	5	6	7	8	9	10	11	12
1	Apex predator	0.02											
2	Finless porpoise	0.101											
3	Baleen whale	0.012											
4	Pelagic fish	0.337	0.2	0.3	0.042	0.012	0.061	0.005	0.005				
5	Semi-demersal fish	0.235	0.1	0.1	0.075	0.143	0.041	0.00099	0.01				
6	Benthic-demersal fish	0.056	0.01		0.002	0.004	0.01	0.003	0.0001				
7	Cephalopod	0.238	0.25	0.4	0.081	0.089	0.199	0.108	0.001				
8	Benthic feeder		0.44		0.192	0.099	0.149	0.07	0.031				
9	Epifauna				0.061	0.049	0.06	0.015	0.009				
10	Gastropod					0.03	0.01	0.01	0.01				
11	Infauna				0.051	0.1	0.06	0.02	0.028				
12	Zooplankton			0.2	0.404	0.444	0.3	0.435	0.585	0.3			0.24
13	Algae							0.005	0.137		0.6		
14	Phytoplankton				0.019					0.35	0.4	0.5	0.76
15	Detritus				0.074	0.031	0.11	0.327	0.184	0.35		0.5	
	Sum	1	1	1	1	1	1	1	1	1	1	1	1

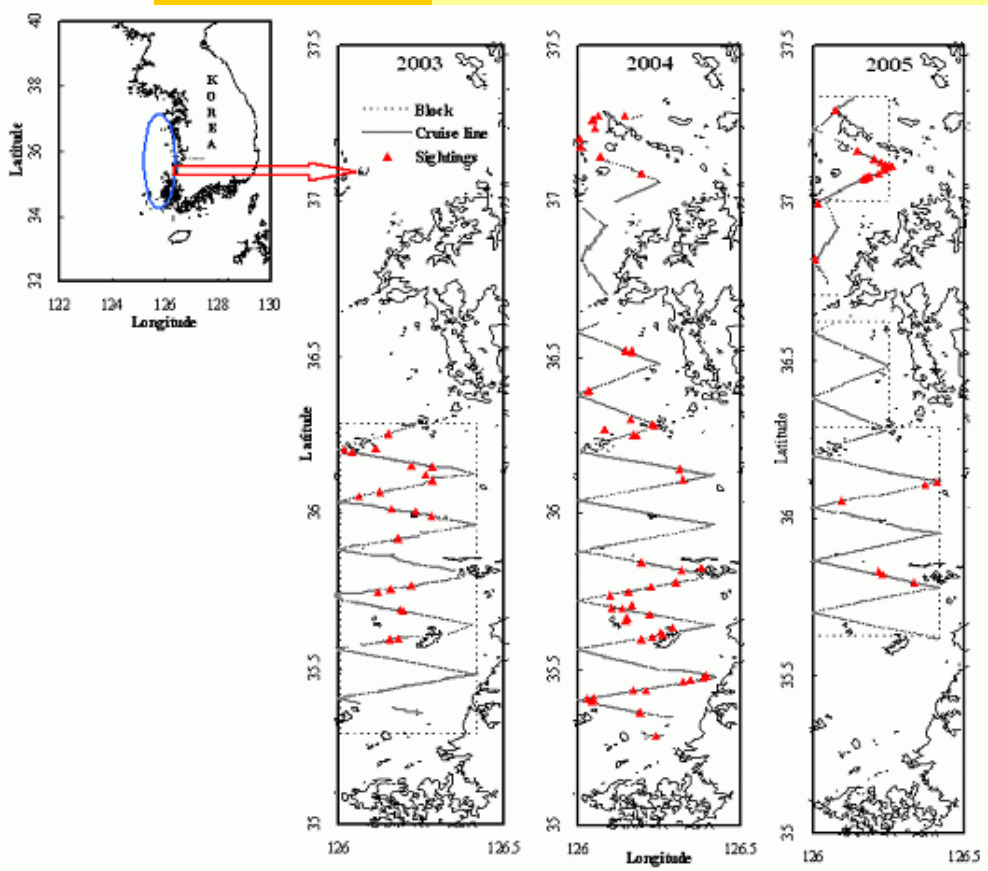
Ecopath Model

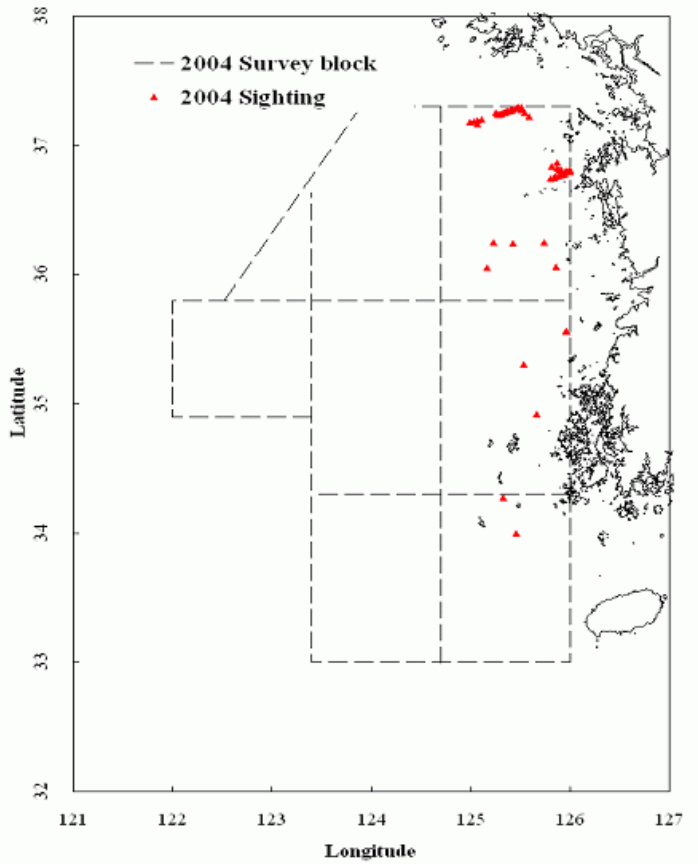
- Basic Input Parameters

Group name	Habitat area (fraction)	Biomass in hab. Area (t/km^2)	Production/ biomass (/year)	Consumption/ biomass (/year)	Catch (t/km^2)
Apex predator	1.000	0.001	0.280	11.156	0.000
Finless porpoise	1.000	0.01	0.325	13.110	0.0001
Baleen whale	1.000	0.000	0.296	8.331	0.000
Pelagic fish	1.000	0.184	1.457	3.650	0.158
Semi-demersal fish	1.000	0.076	1.296	2.226	0.067
Benthic-demersal fish	1.000	0.092	0.909	2.611	0.059
Cephalopod	1.000	0.381	0.586	10.667	0.112
Benthic-feeder	1.000	0.393	3.268	7.690	0.312
Epifauna	1.000	0.201	1.092	5.777	0.096
Gastropod	1.000	0.178	0.894	5.777	0.029
Infauna	1.000	0.237	1.643	12.000	0.185
Zooplankton	1.000	12.246	5.546	22.000	-
Algae	1.000	0.847	10.000	22.000	0.000
Phytoplankton	1.000	12.506	410.069	-	-
Detritus	1.000	-	-	-	-

Results

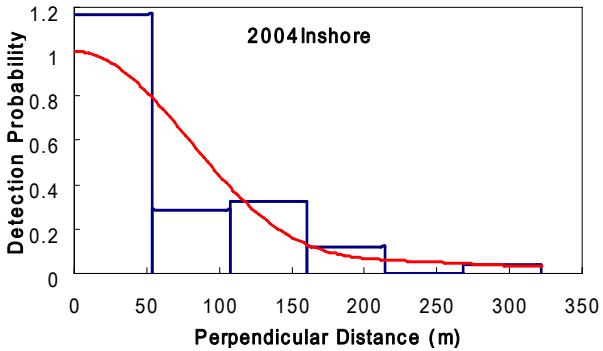
	2003 Inshore	2004 Offshore	2004 Inshore	2005 Inshore
Survey effort (km)	400.2	1,951.6	577.1	446.7
Survey area (km^2)	5144.9	58,435.2	7357.1	5642.2
Number sighted (individual)	24(48)	70(92)	48(84)	28(52)
Sighting rate (ind./km)	0.0525	0.0359	0.0797	0.0583

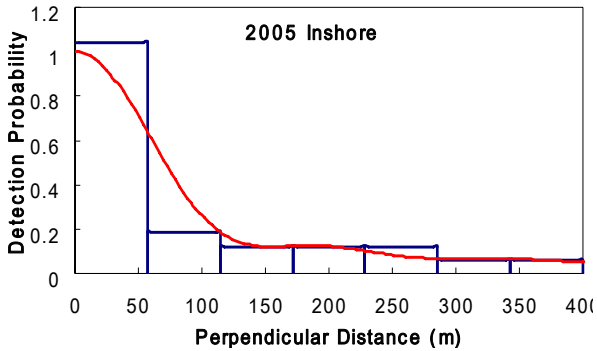


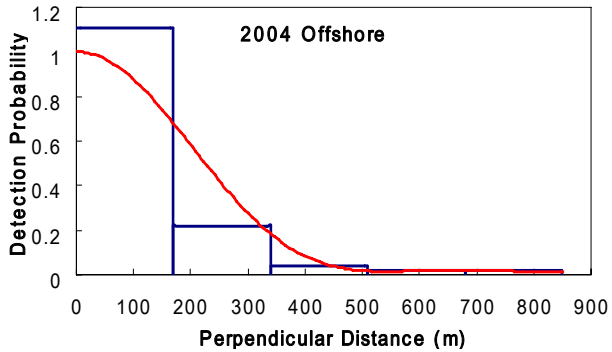


Abundance

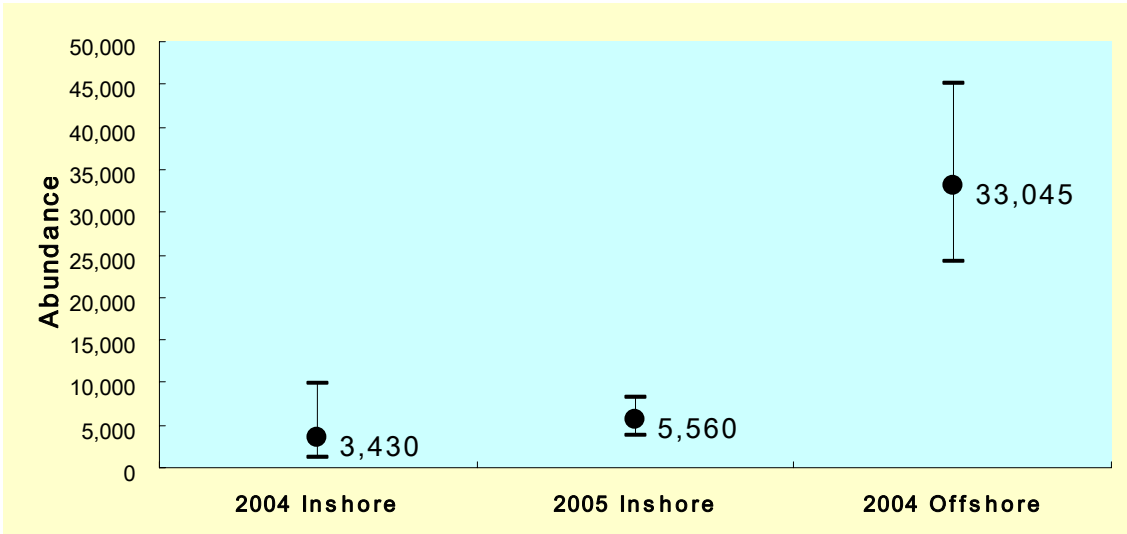
- PDF (probability of density function)







- Abundance



Feeding Habits

- Pray item
  - Pisces
    2 orders 5 families 8 species
  - Crustacea
    1 order 8 families 13 species
  - Cephalopoda
    3 orders 3 families 3 species

- IRI : Index of Relative Importance

  Pisces : 53.7%

  Crustacea : 34.0%

  Cephalopoda : 12.3%

Konosirus punctatus

Trichiarus lepturus

Crongon affinis

Trachypenaeus curvirostris

Euprymna morsei

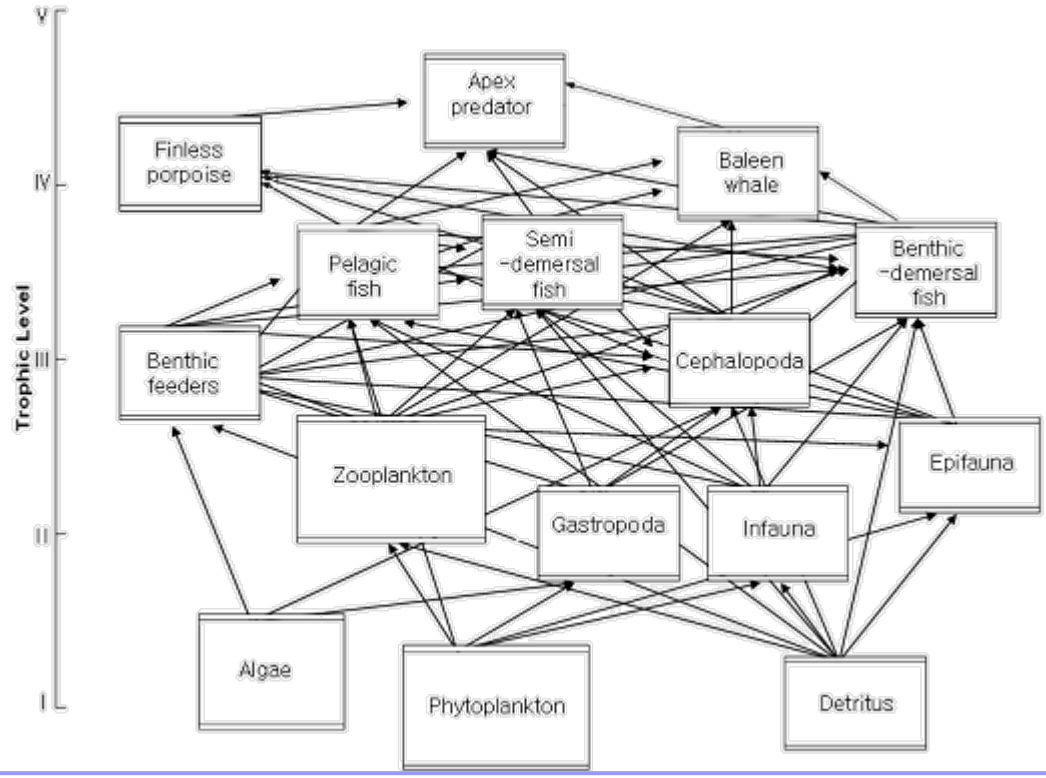
Todarodes pacificus

Results

Trophic Level

Group name	Trophic level
Apex predator	4.48
Finless porpoise	4.12
Baleen whale	4.07
Pelagic fish	3.5
Semi-demersal fish	3.55
Benthic-demersal fish	3.51
Cephalopod	3
Benthic feeders	2.92
Epifauna	2.39
Gastropod	2
Infauna	2
Zooplankton	2.32
Algae	1
Phytoplankton	1
Detritus	1

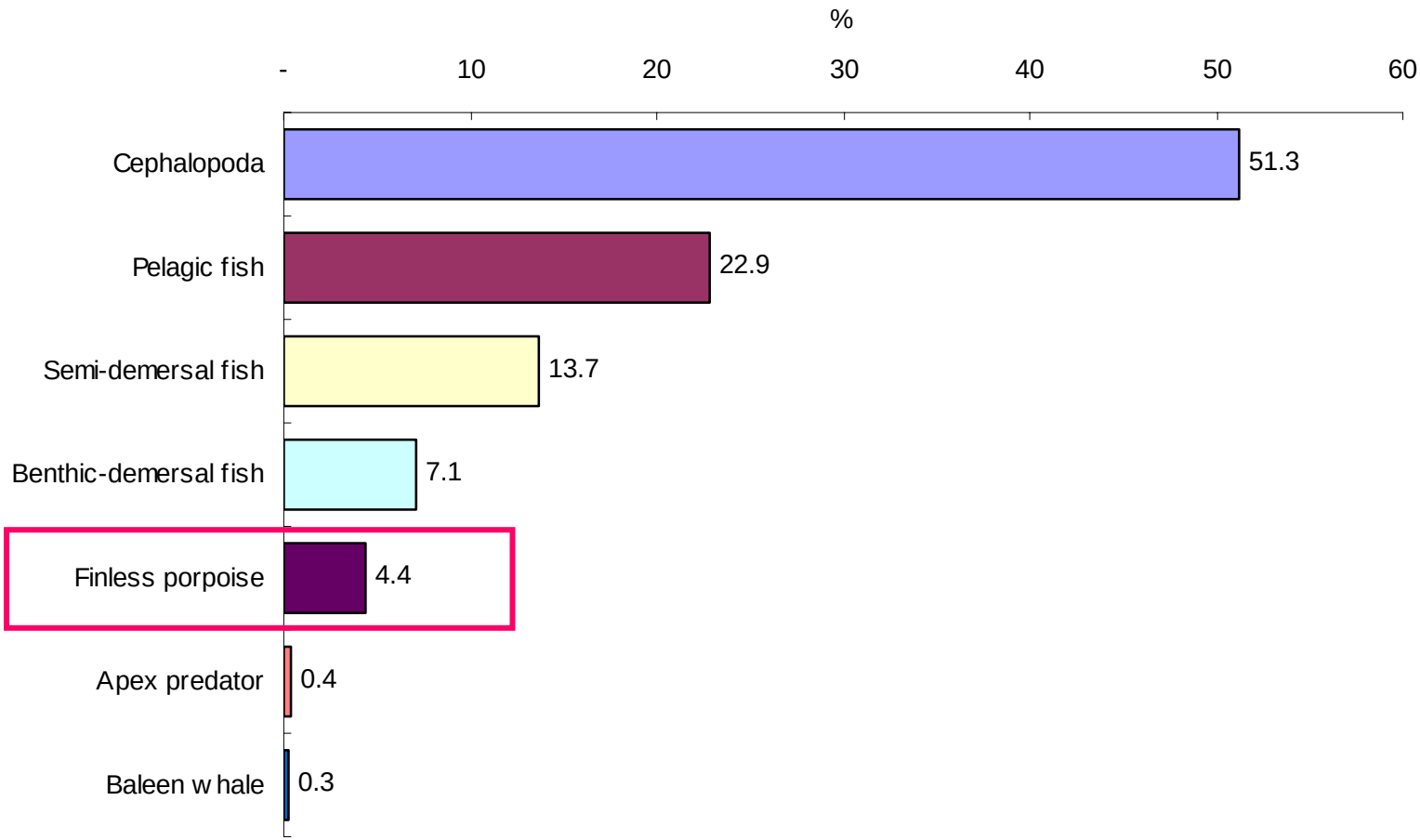
Ecosystem Structure



- **Primary producer : Detridus, Phytoplankton and Aalgae**
- **Primary consumer : Zooplankton, Infauna, Gastropod, Epifauna and Benthic feeder**
- **Secondary consumer : Cephalopods, Demersal fish, Semi-demersal fish and Pelagic fish**
- **Terminal consumer : Apex predator, Finless porpoise and Baleen whale**

Results

- Relative contribution (%) of species to the total flow of energy



Abundance

- The most abundant cetacean in the eastern Yellow Sea
- Other studies in Hong Kong and Japan

Research	N	D (N/km^2)	Area (km^2)
This study	38,605	0.603	64,077
Jefferson *et al*., 2002	217	0.163	1,332
Yoshida *et al*., 1997	3,093	3.180	972

Status

- Finless porpoise is not considered to be “depleted” or “endangered”
- Insufficient data and few surveys to evaluate trends in abundance

Discussions

- Finless porpoise was classified as terminal consumer and linked with and affect to all of secondary consumers in the eastern Yellow Sea
- Height contribution to energy flow at trophic level IV
- Effects of climate change to finless porpoise?

Finless porpoise is opportunistic feeder ➔ Change of the proportions of organisms in the eastern Yellow Sea may not affect to abundance finless porpoise immediately

But the productivity or the distribution (MacGarvin and Simmonds,1996)

- Prey species of this animal are commercial target of fisheries
- Finless porpoise and fisheries are may influencing each other

Resource consumption ←→ Bycatch

Any questions?