Feeding habits of minke whales in Korean waters

Jung Hyun Lim¹, Zang Geun Kim², Kyung-Jun Song¹, Hyeok Chan Kwon¹, Seok Gwan Choi², Yong-Rock An² and Chang-Ik Zhang¹



Pukyong National University, Korea
 Cetacean Research Institute, National Fisheries
 Research and Development Institute, Korea



Introduction

Study on minke whales in Korean waters is not so sufficient.

In spite of conducting various studies, the majority of study was concentrated to distribution and abundance

and also these studies were not yet systematically organized for conservation and management.

Furthermore, there was no report on feeding habits of minke whales in Korean waters until now.

Introduction

Objectives of this study

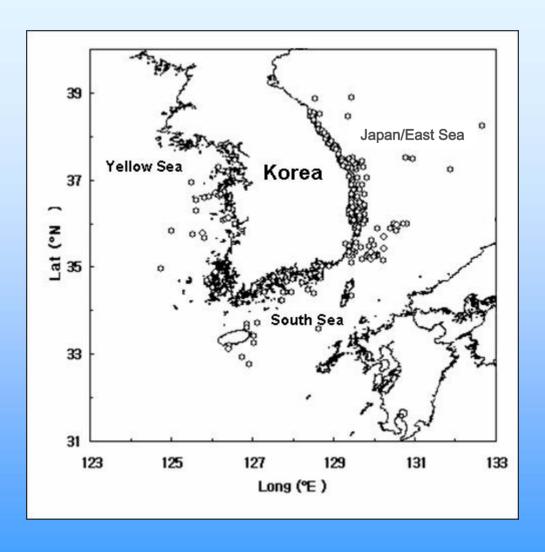
To investigate feeding habits of minke whales in Korean waters



Possibility of changes in dominant prey species according to growth condition and season



To understand ecological role of minke whales



Bycaught sites of minke whales in Korean waters

Sample size

Year	Sample size	%
2000	3	7.7
2001	8	20.5
2002	10	25.6
2003	2	5.1
2006	1	2.6
2007	13	33.3
Unidentified	2	5.1
Total	39	100.0

Analysis process of stomach contents









Methods

Relative frequency (RF)

$$RF = (N_i / N_{all}) \times 100$$

N_i = number of stomachs containing prey species i

 N_{all} = total number of stomachs

Relative weight (RW)

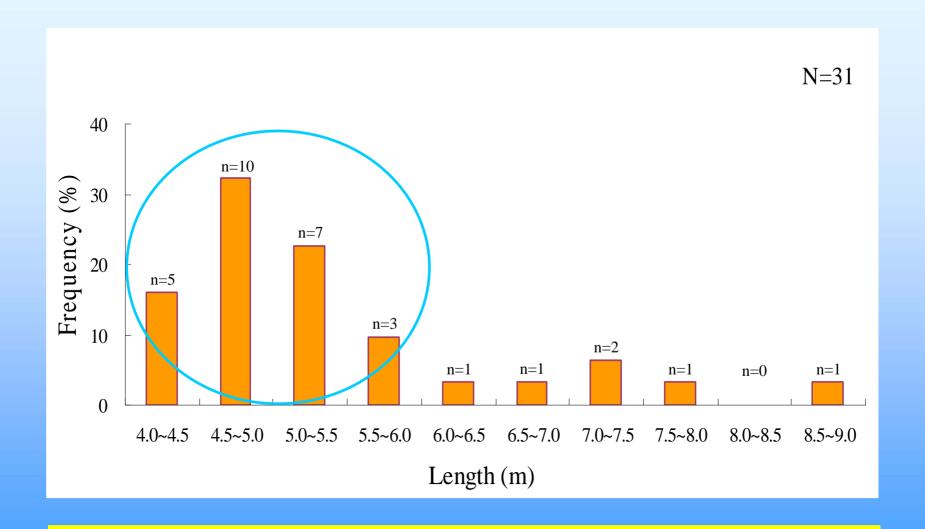
$$RW = (W_i / W_{all}) \times 100$$

W_i = weight of prey species i

W_{all} = total weight of all prey species

• Combined Rank Index (CRI) (Pitcher, 1981)

CRI = rank of RF × rank of RW



Size distribution of minke whales collected in Korean waters from 2000 to 2007

Results

Prey species

	Common name	Species name		
Crustaceans	Euphausiacea	Euphausia pacifica		
	Southern rough shrimp	Trachysalambria curvirostri		
	Amphipoda	Unidentified amphipods		
Fishes	Pacific anchovy	Engraulis japonicus		
	Big-eyed herring	Sardinella zunasi		
	Horse mackerel	Trachurus japonicus		
	Yellow goosefish	Lophius litulon		
Cephalopods	Common squid	Todarodes pacificus		
	Mimika bobtail	Euprymna morsei		

Prey species (crustaceans)







A: Euphausia pacifica

B: Trachysalambria curvirostri

C: Unidentified amphipods

Prey species (fishes)









A: Engraulis japonicus B: Sardinella zunasi

C: Trachurus japonicus D: Lophius litulon

Prey species (cephalopods)





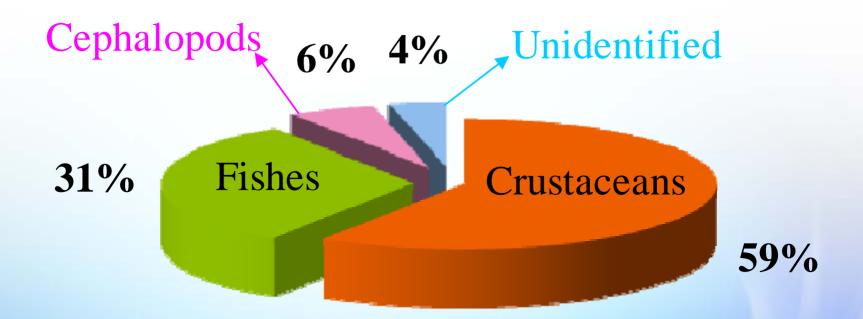
A: Todarodes pacificus B: Euprymna morsei

Relative importance in terms of CRI

		N	RF	W (g)	RW	Rank of RF	Rank of RW	CRI
Crustaceans	Euphausiacea	30	76.9	15,211	82.6	1	1	1
	Southern rough shrimp	1	2.6	11	0.1	5	10	50
	Unidentified amphipods	1	2.6	31	0.2	5	9	45
Fishes	Pacific anchovy	6	15.4	991	5.4	3	2	6
	Big-eyed herring	1	2.6	8	0.0	5	11	55
	Horse mackerel	1	2.6	64	0.3	5	8	40
	Yellow goosefish	1	2.6	766	4.2	5	3	15
	Unidentified fishes	8	20.5	529	2.9	2	4	8
Cephalopods	Common squid	1	2.6	66	0.4	5	7	35
	Mimika bobtail	1	2.6	386	2.1	5	5	25
	Unidentified cephalopods	1	2.6	8	0.0	5	11	55
Unidentified	Unidentified remains	2	5.1	339	1.8	4	6	24
Total				18,410	100.0		1	

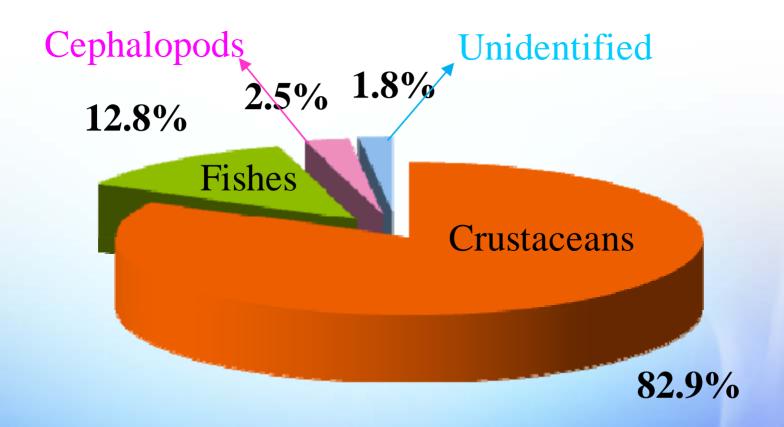
Composition of prey species

Frequency



Composition of prey species

Weight



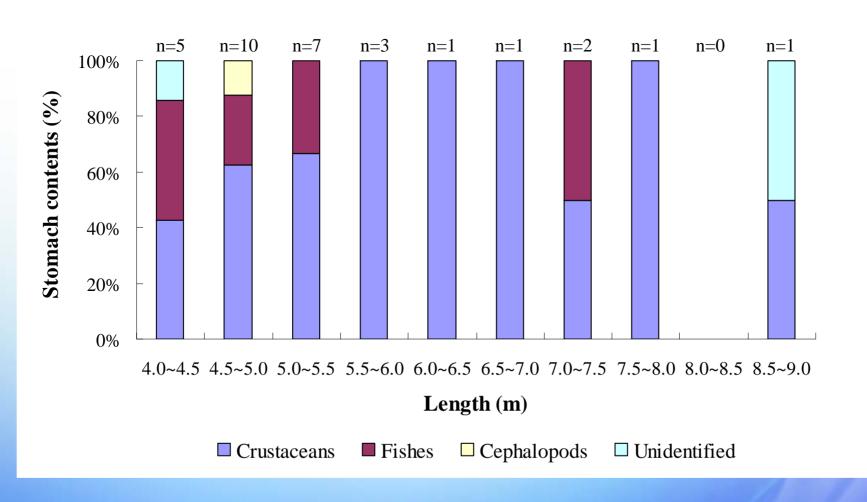
Number of prey species

Number of	Dway anadag		Total		
prey species	Prey species	N	%		
1	Euphausiacea	25	64.1		
	Pacific anchovy	3	7.7		
	Unidentified amphipods	1	2.6		
	Total	29	74.4		
2	Euphausiacea + Unidentified fishes	4	10.3		
	Pacific anchovy + Big-eyed herring	1	2.6		
	Common squid + Horse mackerel	1	2.6		
	Pacific anchovy + Unidentified fishes	1	2.6		
	Unidentified fishes + Unidentified cephalopods	1	2.6		
	Total	8	20.5		
6	E + PA + YG + SRS + MB + UF*	1	2.6		
	Total	1	2.6		
Unidentified	Unidentified remains	1	2.6		
	Total	1	2.6		
	Number of samples	39	100.0		

^{*} E: Euphausiacea, PA: Pacific anchovy, YG: Yellow goosefish, SRS: Southern rough shrimp, MB: Mimika bobtail, UF: Unidentified fishes

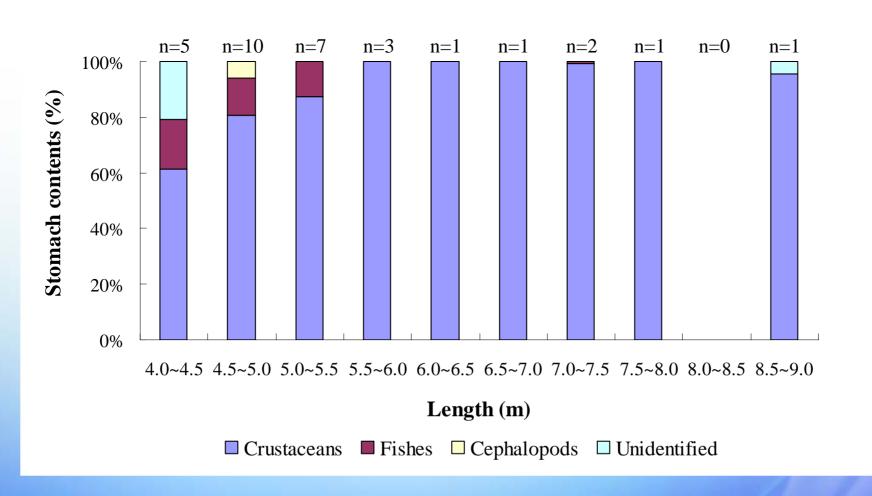
Composition of prey species by length

Frequency



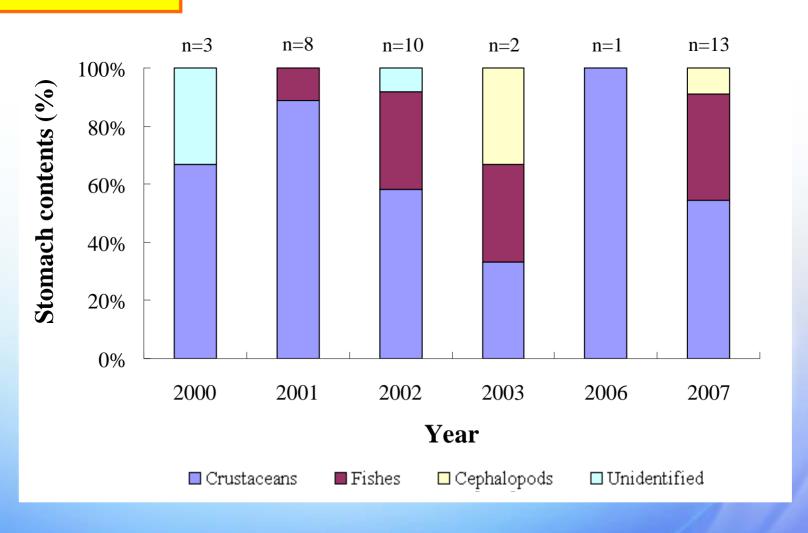
Composition of prey species by length

Weight



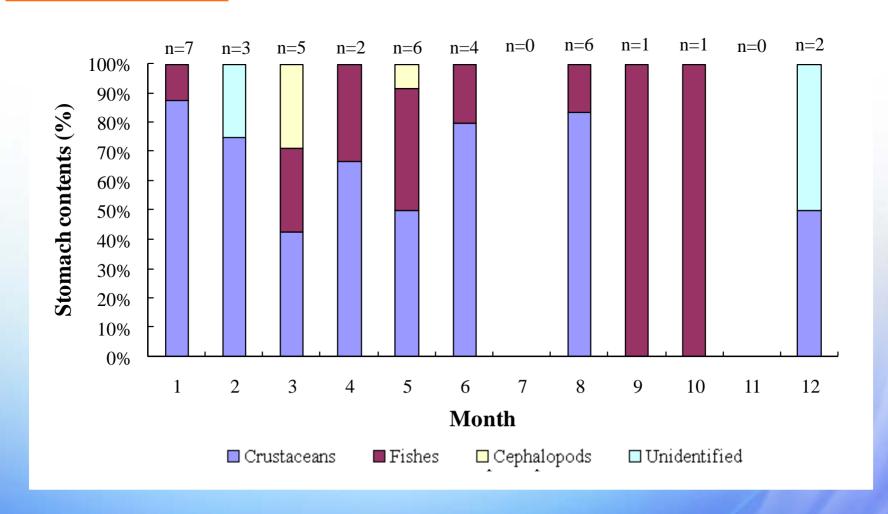
Composition of prey species by year

Frequency



Composition of prey species by month

Frequency



Discussion

- Feeding habits
 Minke whales seem not to prefer specific prey species.
- Role of minke whales in marine ecosystems Feed on several kinds of fishes in addition to small crustaceans
 - > Play an important role in this area as top predators

Further research is needed
 To estimate ecological role of minke whales in Korean waters through studies on feeding habits and ecosystem modeling

- Changes in prey species according to growth condition, year and month
 - Further research is needed
 To investigate the possibility of changes in dominant prey species of minke whales in Korean waters according to growth condition, year and month using more samples

Comparison with other studies on the feeding habits of minke whales

Limitations of this study

- Insufficient to investigate the feeding habits
- → Sampling areas did not fully cover the whole habitat of minke whales.

Thus, the whole habitat area should be covered in the future study.

Further study

Detailed investigation based on **DNA analysis** from stomach contents

Summary

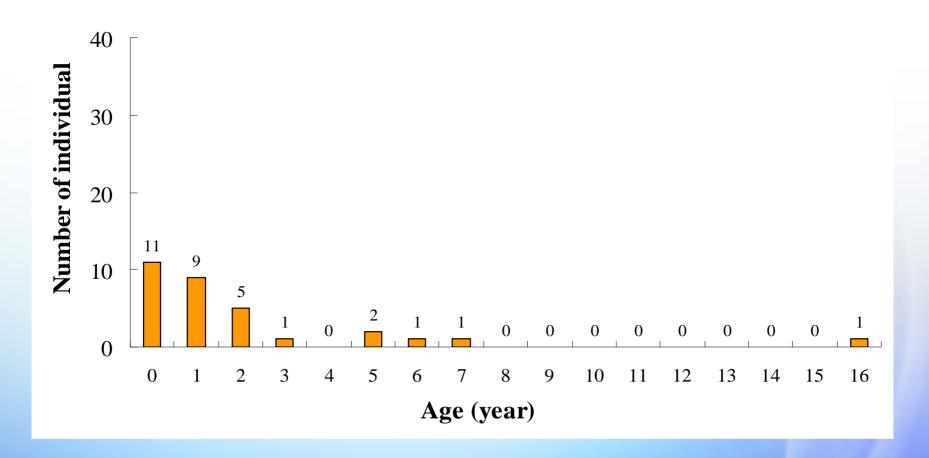
- This is the first study on feeding habits of minke whales in Korean waters.
- 3 Crustaceans, 4 Fishes and 2 Cephalopods were identified.
- Euphausia pacifica was the most important prey species of minke whales in Korean waters.

Thank you ©

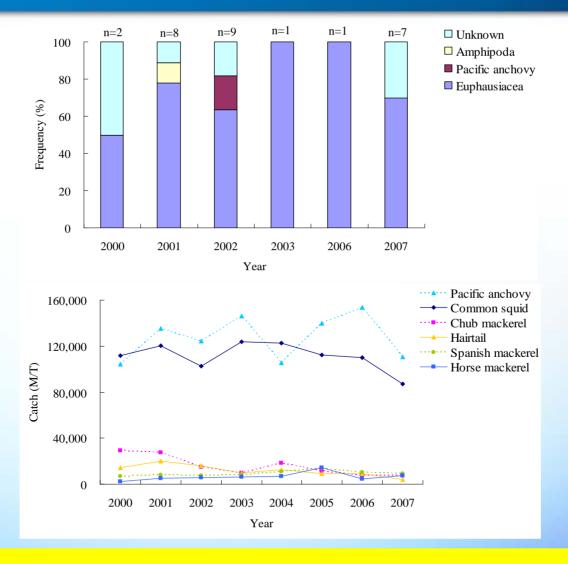
Table 1. Clones identified using 18S rDNA primer set

Name	Species	Family	Sequence identity	Frequency
AJ18S1	Euphausia pacifica	Euphausiidae	875/889 (98%)	1
AJ18S2-1	Euphausia pacifica	Euphausiidae	881/885 (99%)	1
AJ18S2-2	Euphausia pacifica	Euphausiidae	881/882 (99%)	1
AJ18S2-3	Euphausia pacifica	Euphausiidae	878/882 (99%)	1
AJ18S2-4	Euphausia superba	Euphausiidae	881/882 (99%)	1
AJ18S3	Euphausia superba	Euphausiidae	815/829 (98%)	1
AJ18S4	Euphausia eximia	Euphausiidae	821/833 (98%)	1
AJ18S5	Parathemisto gaudichaudi	Hyperiidae	816/827 (98%)	1
Euphausia pacifica	-	Euphausiidae	. ,	3
TP18S1-1	Hippoglossoides dubius	Pleuronectidae	888/890 (99%)	1
TP18S1-2	Hippoglossoides dubius	Pleuronectidae	888/890 (99%)	1
TP18S1-3	Hippoglossoides dubius	Pleuronectidae	889/890 (99%)	1
TP18S2-1	Mimachlamys varia	Pectinidae	882/883 (99%)	1
TP18S2-2	Mimachlamys varia	Pectinidae	880/883 (99%)	1
TP18S2-3	Mimachlamys varia	Pectinidae	882/883 (99%)	1
TP18S2-4	Mimachlamys varia	Pectinidae	880/883 (99%)	1
TP18S2-5	Mimachlamys varia	Pectinidae	878/883 (99%)	1
TP18S3	Illex coindeti	Ommastrephidae	1097/1194 (91%)	1
TP18S4	Illex coindeti	Ommastrephidae	1098/1193 (92%)	1
TP18S5	Illex coindeti	Ommastrephidae	1100/1198 (91%)	1
TP18S6	Illex coindeti	Ommastrephidae	1105/1201 (92%)	1
TP18S7-1	Illex coindeti	Ommastrephidae	1104/1200 (92%)	1
TP18S7-2	Illex coindeti	Ommastrephidae	1102/1202 (91%)	1
Hippoglossoides dubius		Pleuronectidae		1
Mimachlamys varia		Pectinidae		3

N=31



The annual change and commercial catch



The annual change in relative frequency of prey species of minke whales and commercial catch in the East Sea.

Scientific whaling in Japan

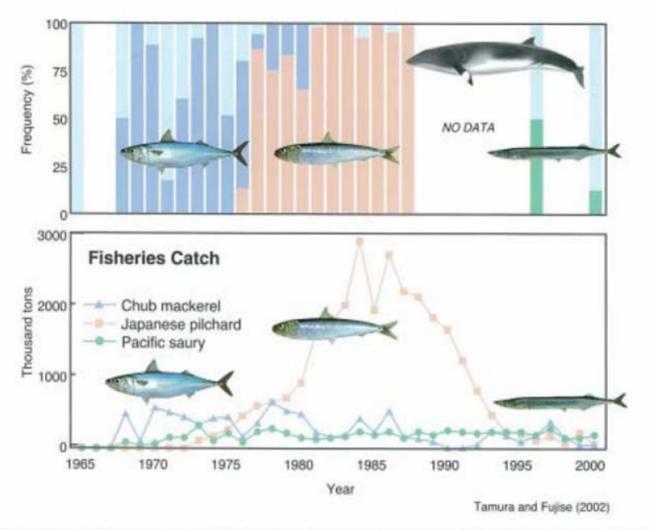
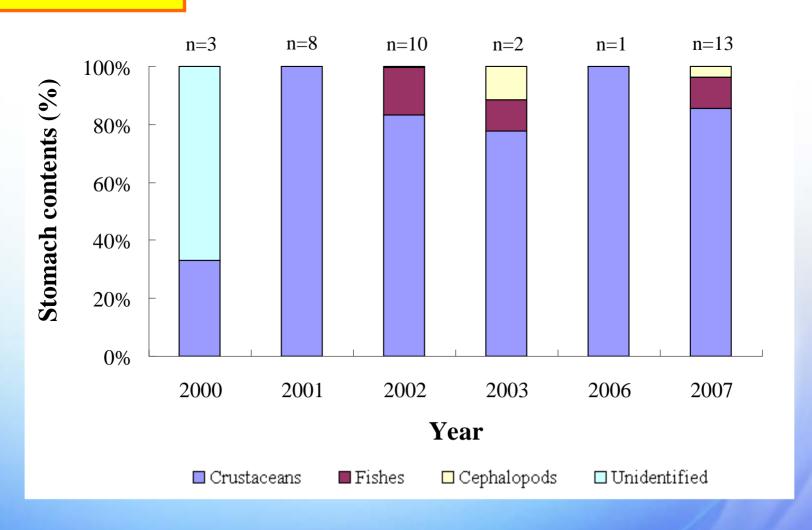


Fig. 48. The annual change in relative frequency of dominant prey species of common minke whales and commercial catch in Pacific side of Hokkaido.

Tamura and Fujise (2002)

Composition of prey species by year

Weight



Composition of prey species by month

Weight

