PICES / S13

Estimation of prey consumption by marine mammals in the PICES regions -Update to Hunt *et al.* (2000)-

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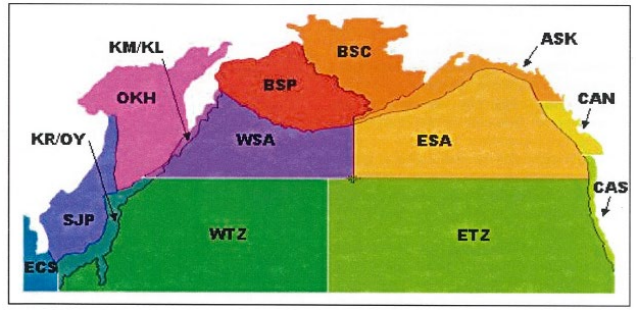
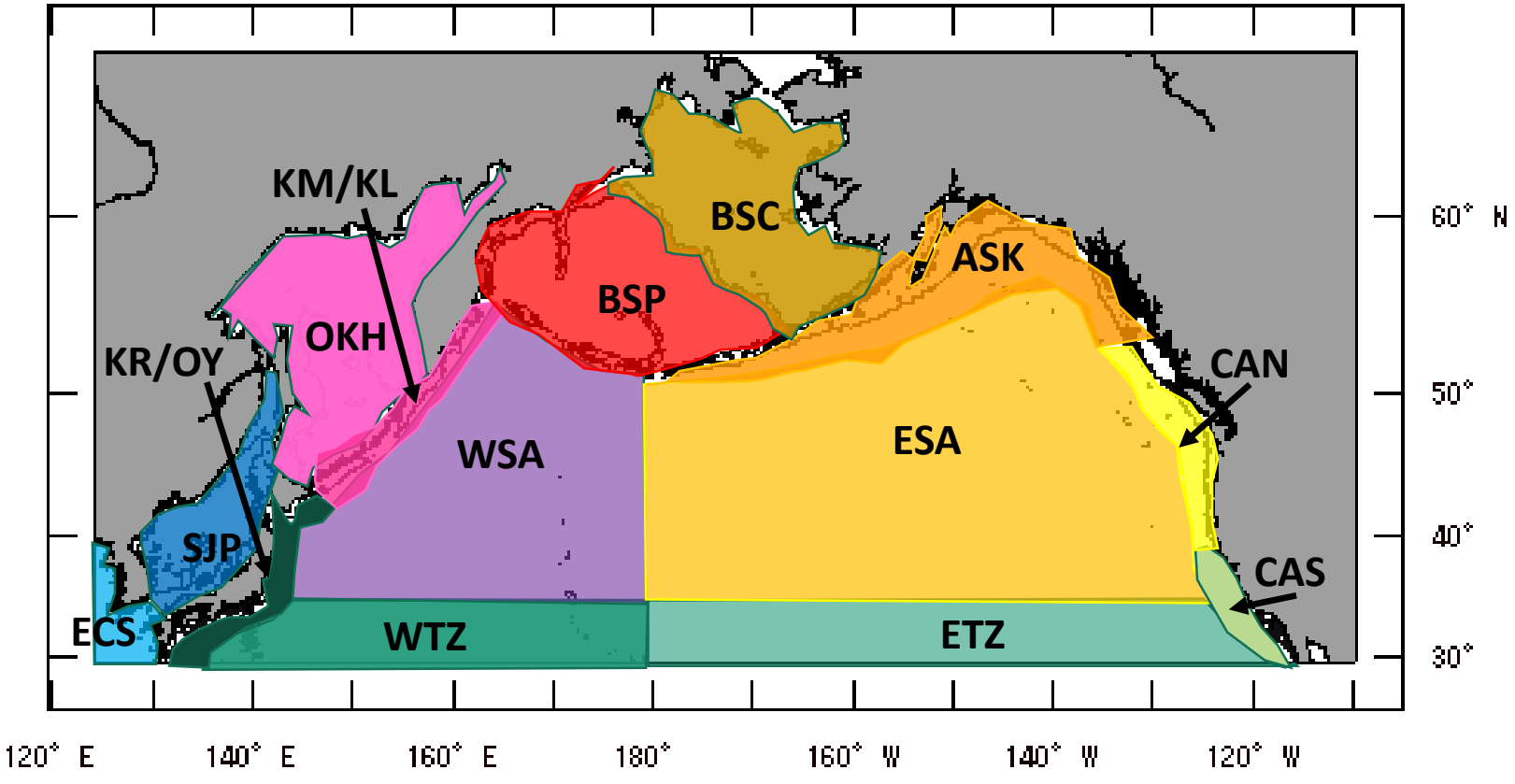
Previous study – Hunt *et al.* 2000 -



135 species of sea birds,
47 species of marine mammals



Update issue

- **1) Abundance**

→ **Sighting surveys (JARPNII, IWC-POWER, Japan and U.S.A's domestic sighting survey) and references**

- **2) Prey consumption**

→ **New equations by Trites (in prep.)**

- **3) Days of occupancy**

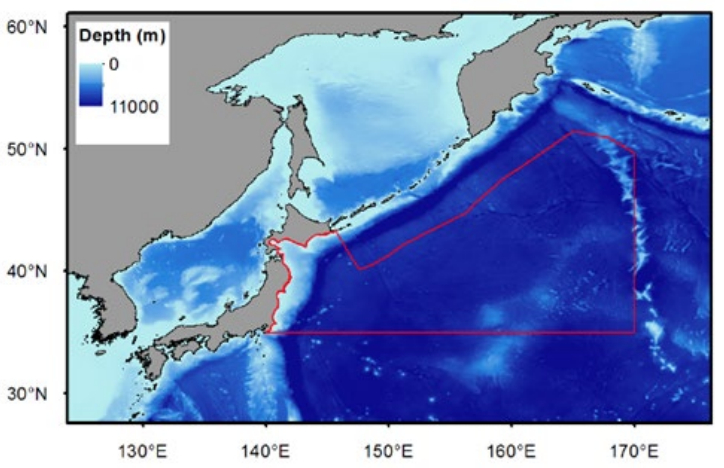
→ **122 days (June – September)**

Abundance estimation

Abundance -Cetaceans-

JARPNII

2000-2016 WSA+KR/OY



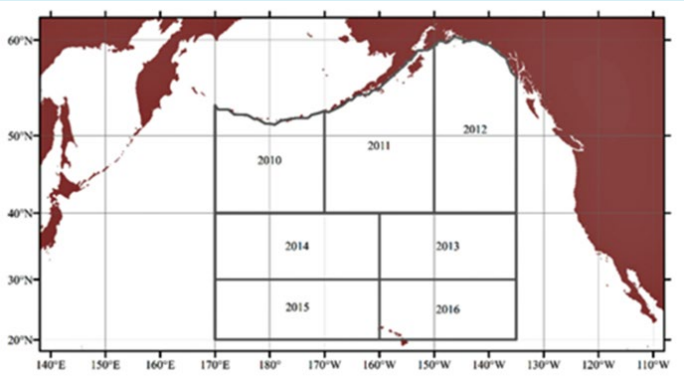
Hakamada and Matsuoka 2016

Species name	Abundance	Coefficient of Variation
Common mnke whale	3,080	0.68
Sei whale	5,086	0.38
Bryde's whale	13,306	0.25
Blue whale	958	0.46
Fin whale	3,958	0.43
Humpback whale	392	0.88
Northern right whale	416	0.65
Sperm whale	10,843	0.36

Abundance -Cetaceans-

IWC/POWER

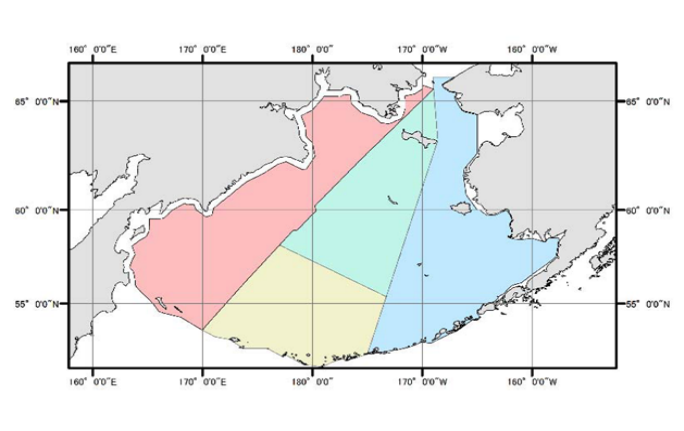
2010-2016 ASK+ESA+ETZ



Species name	Abundance	Coefficient of Variation
Sei whale	29,632	0.20
Bryde's whale	11,935	0.25
Humpback whale	14,407	0.56

Hakamada *et al*. 2017a, 2017b
Inai *et al*. 2018

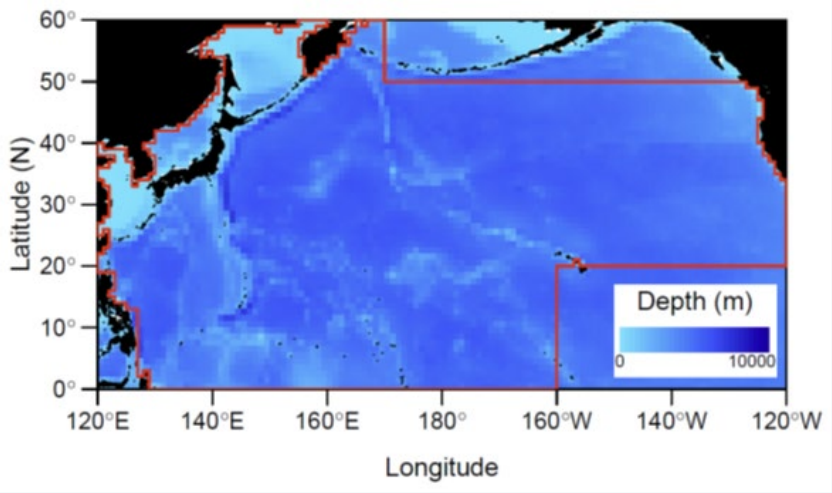
2017-2019 BSP+BSC



Abundance -Cetaceans-

NRIFSF (JAPAN) sighting surveys 1983–2006

ECS+SJP+KR/OY+ OKH+KM/KL+ WSA+ESA+WTZ+ETZ



Kanaji *et al*. 2017

Species name	Abundance	Coefficient of Variation
Spinner dolphin	904,473	0.20
Melon-headed whale	147,597	0.34
Rough-toothed dolphin	102,893	0.24
False killer whale	74,101	0.31
Pantropical spotted dolphin	1,886,022	0.20
Short-finned pilot whale	154,595	0.20
Common bottlenose dolphin	93,170	0.55
Risso's dolphin	349,309	0.24
Striped dolphin	1,766,025	0.15
Short-beaked common dolphin	1,428,857	0.42
Pacific white-sided dolphin	418,090	0.45
Northern right whale dolphin	56,899	0.52
Dall's porpoise	1,022,987	0.04

Abundance -Cetaceans-

U.S.A. sighting surveys 1991–2014

CAN+CAS

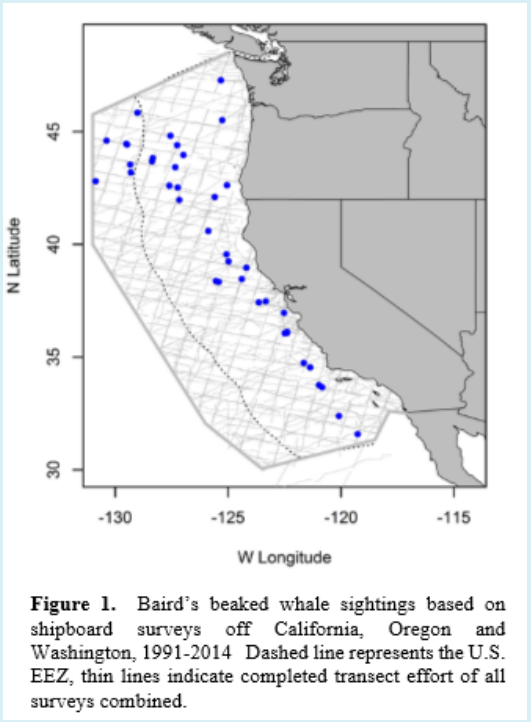


Figure 1. Baird's beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2014 Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

Carretta *et al.* 2018

Species name	Abundance	Coefficient of Variation
Blue whale	1,647	0.07
Fin whale	9,029	0.12
Humpback whale	1,729	0.03
Common minke whale	636	0.72
Gray whale	20,990	0.05
Sperm whale	1,997	0.57
Cuvier beaked whale	3,224	0.67
Killer whale	1,078	-
Baird's beaked whale	2,697	0.60
Mesoplodont beaked whale	3,044	0.54
Harbor porpoise	85,007	-
Dall's porpoise	25,750	0.45
Pacific white-sided dolphin	26,814	0.28
Risso's dolphin	6,336	0.32
Common bottlenose dolphin	2,377	-
Striped dolphin	29,211	0.20
Common dolphin	1,071,166	-
Northern right whale dolphin	26,556	0.44

Abundance -Pinniped-

Steller sea lion

https://4travel.jp/travelogue/11128257

Sub regions	Abundance	References
SJP	+	+
KR/OY	553	Burkanov *et al*. 2008
OKH	8,582	Burkanov *et al*. 2015
KM/KL	9,201	Burkanov *et al*. 2008
OKH	8,582	Burkanov *et al*. 2015
WSA	+	+
BSP	1,500	Loughlin *et al*. 1992
BSC	9,930	Loughlin *et al*. 1992
ASK	39,800	NOAA 2018
CAN+CAS	13,800	NOAA 2018

Abundance -Pinniped-

Northern fur seal

www.konicaminolta.com

Sub regions	Abundance	References
SJP	+	+
KR/OY	+	+
OKH	188,832	Kuzin 2010
KM/KL	112,601	Burkanov *et al*. 2007
OKH	188,832	Kuzin 2010
WTZ	+	+
WSA	+	+
BSP	200,000	PICES 2000
BSC	1,002,500	Hill and DeMaster 1998
ASK	+	+
ESA	637,561	NOAA 2018
ETZ	+	+
CAN+CAS	14,050	NOAA 2018

Daily prey consumption

Estimation of daily prey consumption

Trites *et al*. (in prep)

LOW cost of living

$$R = 0.80M^{0.63}$$

R = daily ration (kg/day), M = mass (kg)

- Right whale
- Sperm whale
- Cuvier's beaked whale
- Bottlenose dolphin
- Pacific walrus
- Northern elephant seal
- Australian sea lion
- Sea Otter

Estimation of daily prey consumption

Trites *et al*. (in prep)

MEDIUM cost of living

$$R = 0.10M^{0.84}$$

R = daily ration (kg/day), M = mass (kg)

- Fin whale
- Beluga (white) whale
- Long-finned pilot whale
- Stripped dolphin
- Spinner dolphin
- Rough-toothed dolphin
- Risso's dolphin
- South American sea lion
- South African fur seal
- Ringed seal
- Grey seal
- Harp seal
- Harbour seal

Estimation of daily prey consumption

Trites *et al*. (in prep)

HIGH cost of living

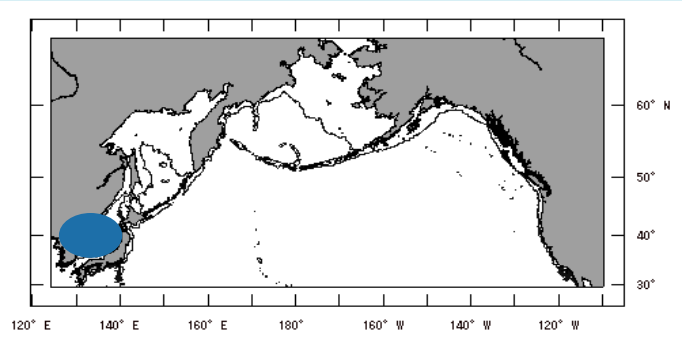
$$R = 0.37M^{0.71}$$

R = daily ration (kg/day), M = mass (kg)

- Humpback whale
- Common minke whale
- Killer whale
- Pacific white-sided dolphin
- Dusky dolphin
- Common dolphin
- Commerson's dolphin
- Harbour porpoise
- Steller sea lion
- California sea lion
- New Zealand sea lion
- Northern fur seal
- Antarctic fur seal

Prey consumption by marine mammals in each sub regions

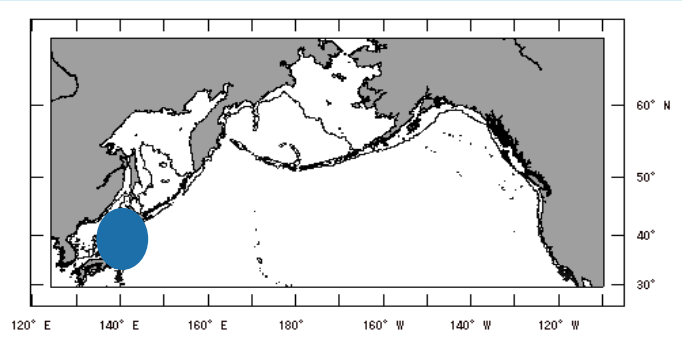
Sea of Japan (SJP)



Twelve cetacean species and three pinniped species

Hunt *et al.* 2000		**This study**
2 species	→	**2 species**
73 thousand tons		**110 thousand tons**

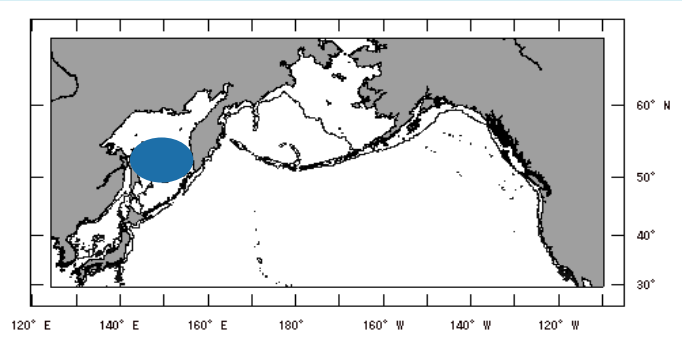
Kuroshio/Oyashio Region (KR/OY)



Thirty cetacean species and four pinniped species

Hunt *et al.* 2000		**This study**
6 species	→	**16 species**
532 thousand tons		**1.2 million tons**

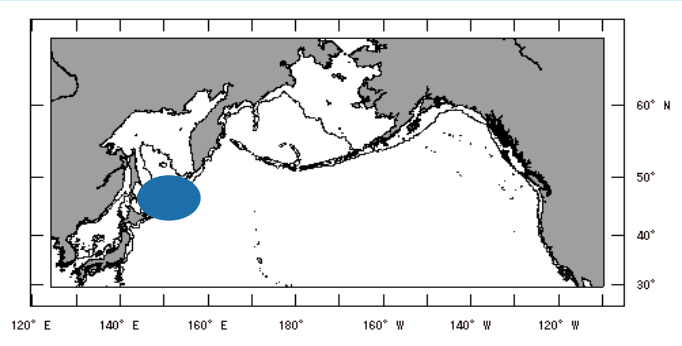
Sea of Okhotsk (OKH)



Twelve cetacean species and six pinniped species

Hunt *et al.* 2000		**This study**
11 species	→	**13 species**
1.3 million tons		**2.4 million tons**

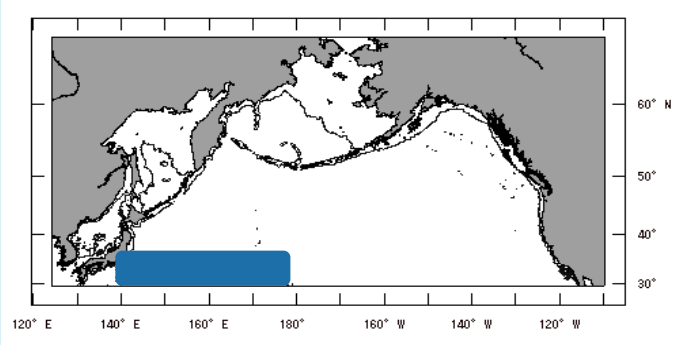
Kurile Islands Region (KM/KL)



Fifteen cetacean species and four pinniped species

Hunt *et al.* 2000		**This study**
7 species	→	**3 species**
4 million tons		**74 thousand tons**

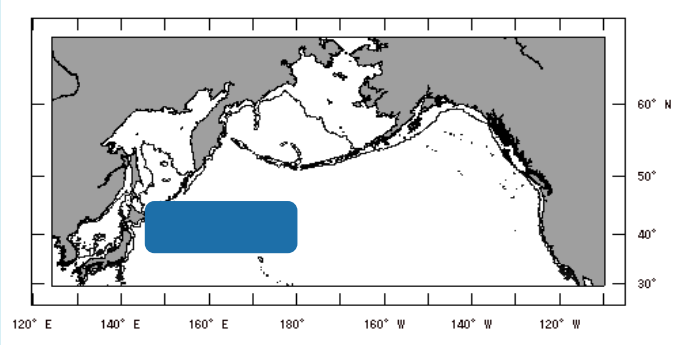
Western Tropical Zone (WTZ)



Twenty-five cetacean species

Hunt *et al.* 2000		**This study**
10 species	→	**4 species**
9.2 million tons		**1.9 million tons**

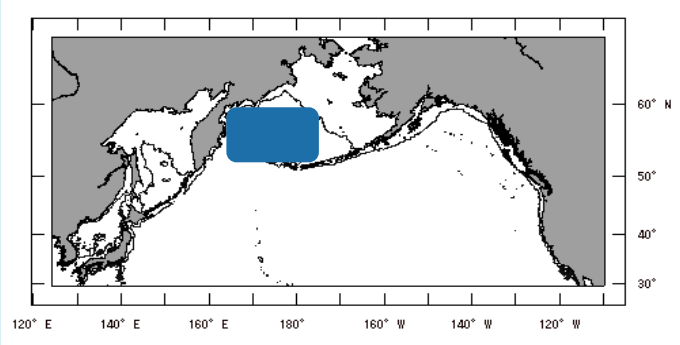
Western Subarctic (WSA)



Twenty-six cetacean species and two pinniped species

Hunt *et al.* 2000		**This study**
1 species	→	**13 species**
180 thousand tons		**7.0 million tons**

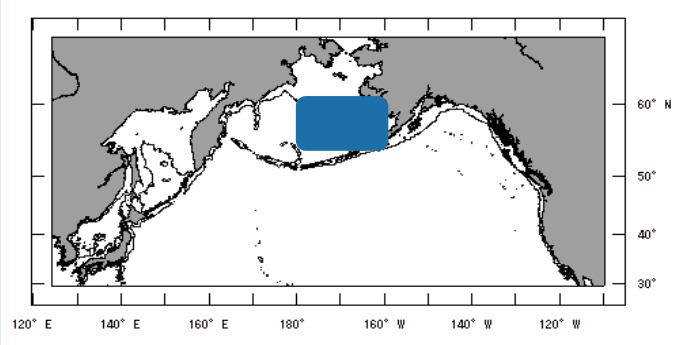
Bering Sea Pelagic (BSP)



Eleven cetacean species and eight pinniped species

Hunt *et al.* 2000		**This study**
6 species	→	**6 species**
487 thousand tons		**330 thousand tons**

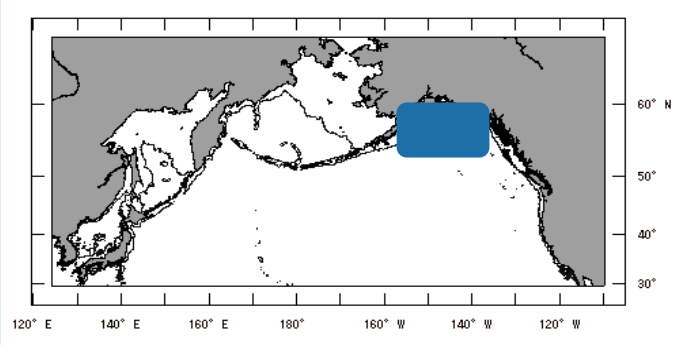
Bering Sea Coastal (BSC)



Eleven cetacean species and nine pinniped species

Hunt *et al.* 2000		**This study**
7 species	→	**8 species**
1.6 million tons		**555 thousand tons**

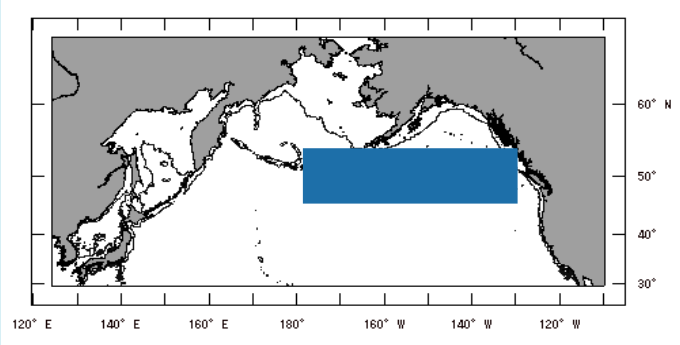
Gulf of Alaska continental shelf (ASK)



Fourteen cetacean species and eight pinniped species

Hunt *et al.* 2000		**This study**
4 species	→	**7 species**
166 thousand tons		**426 thousand tons**

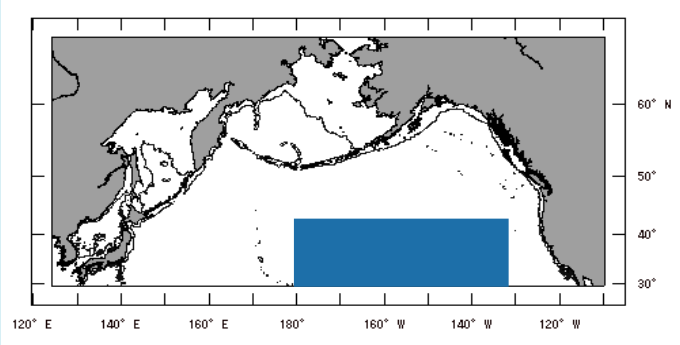
Eastern Subarctic (ESA)



Fourteen cetacean species and two pinniped species

Hunt *et al.* 2000		**This study**
0 species	→	**5 species**
- tons		**6.1 million tons**

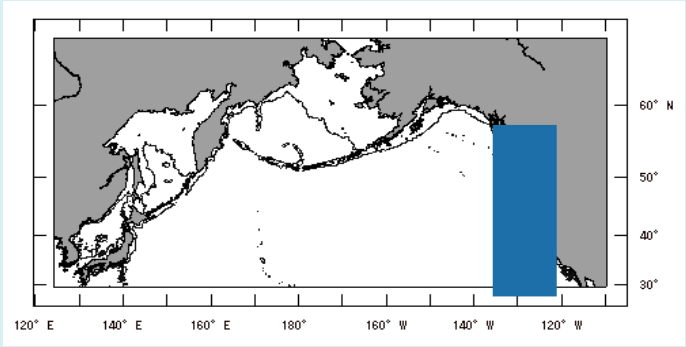
Eastern tropical zone (ETZ)



Twenty-three cetacean species and three pinniped species

Hunt *et al.* 2000		**This study**
0 species	→	**6 species**
- tons		**68 thousand tons**

California current North/South (CAN+CAS)



Twenty-four cetacean species and seven pinniped species

Hunt *et al.* 2000		**This study**
10 species	→	**25 species**
660 thousand tons		**7.4 million tons**

Summary and Conclusion

Prey consumption by marine mammals in each sub regions of PICES 2019

Sub region of PICES	Prey consumption (t)
SJP (Sea of Japan)	110,105
KR/OY (Kuroshio/Oyahio Region)	1,257,261
OKH (Sea of Okhotsk)	2,489,719
KM/KL (Kurile Islands Region)	74,154
WTZ (Western tropical zone)	1,967,471
WSA (Western subarctic)	7,043,799
BSP (Bering Sea Pelagic)	330,376
BSC (Bering Sea continental shelf)	555,830
ASK (Gulf of Alaska continental shelf)	426,482
ESA (Eastern Subarctic)	6,155,404
ETZ (Eastern tropical zone)	68,089
CAN+CAS (California current North/South)	7,488,613
Total	**27,967,303**

Summary

- **The estimation of prey consumption by marine mammals could up-dated using new abundance estimations and equations in PICES region.**
- **Total prey consumption by marine mammals during feeding season is estimated to 27.9 million tons in PICES region. (13.0 million tons / PICES 2000)**
- **The new abundance was obtained in several regions. More accurate prey consumption could be estimated.**

Thank you for your attention!

Special thanks to
Kaoru Hattori
Yoko Goto