Daily food requirements of Steller sea lion, Spotted seal and Ribbon seal distributed along the coast of Nemuro Strait, Hokkaido, Japan

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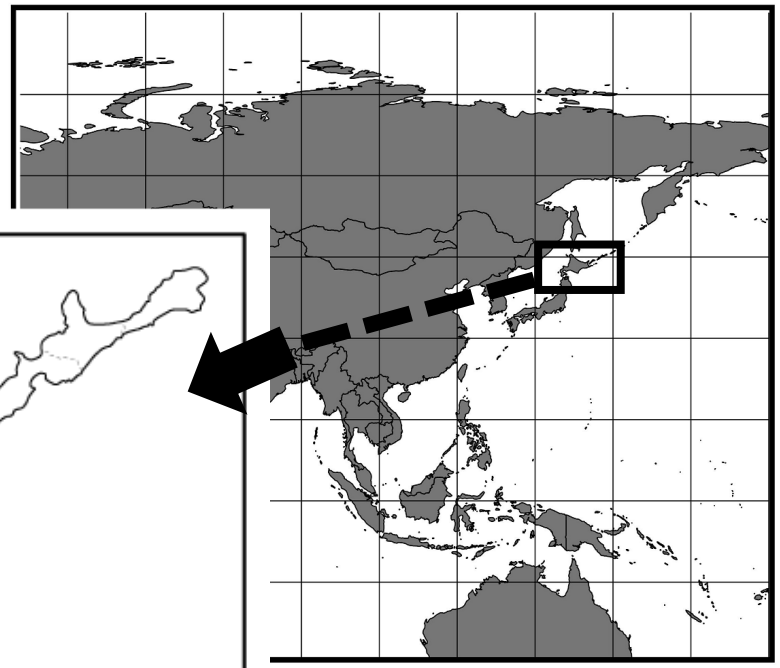
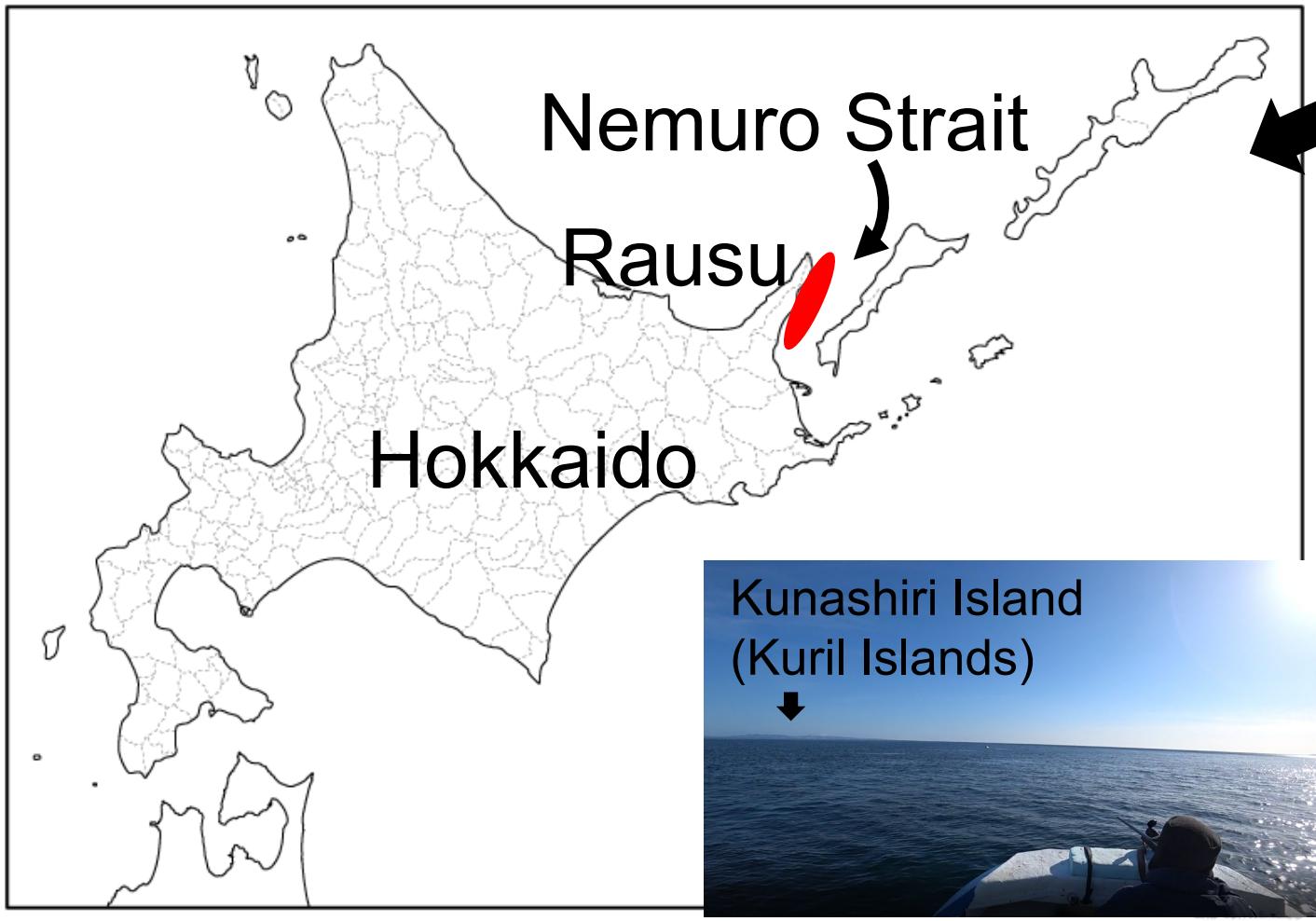
Study area:

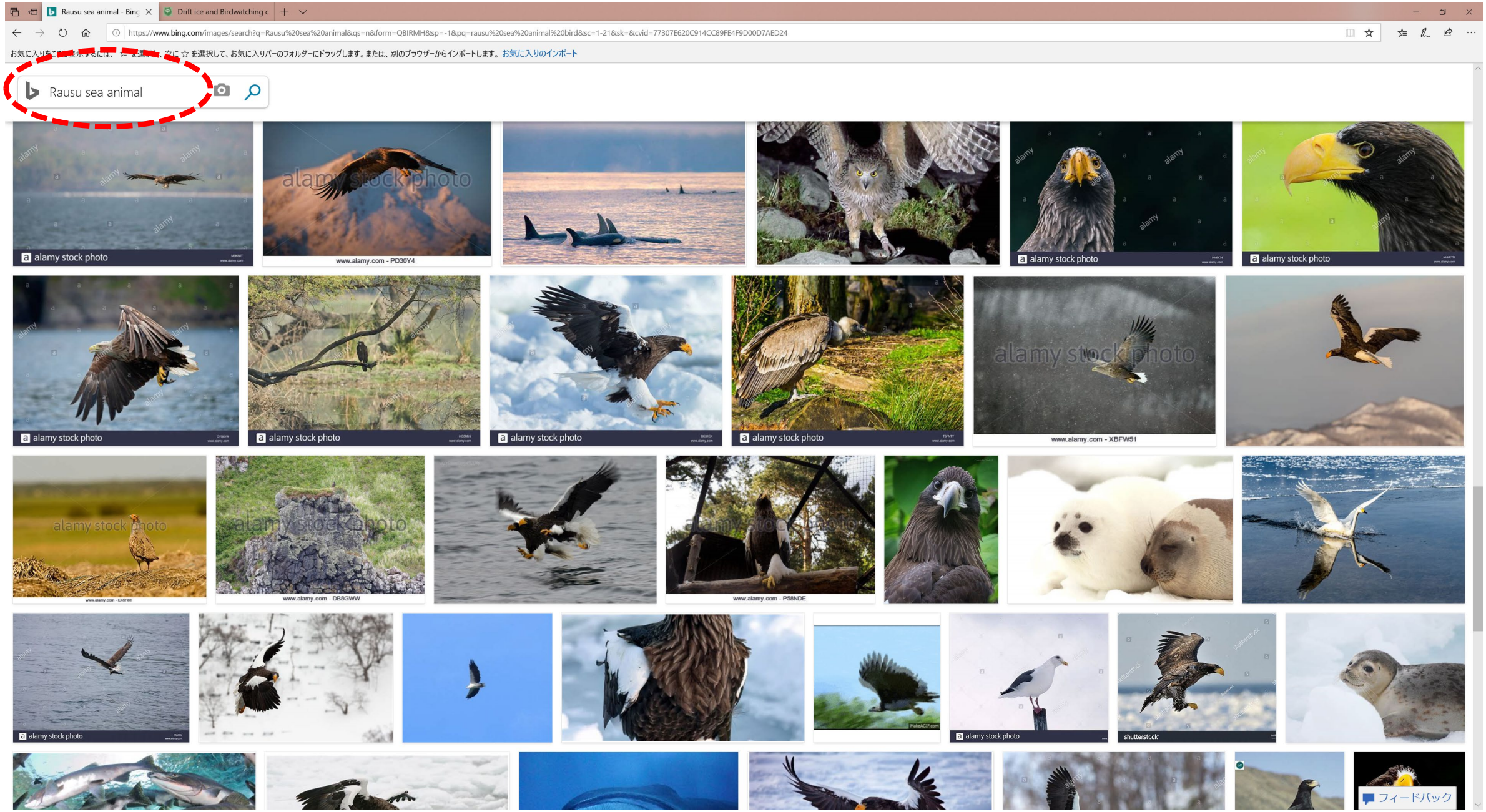
Where is the Nemuro Strait?

What is the Nemuro Strait like?





17 km wide at its narrowest


Rausu sea animal - Bing
Drift ice and Birdwatching c
https://www.bing.com/images/search?q=Rausu%20sea%20animal&qs=n&form=QBIRMH&sp=-1&pq=rausu%20sea%20animal%20bird&sc=1-21&sk=&cvid=77307E620C914CC89FE4F9D00D7AED24
お気に入りをここに表示するには、☆ を選択して、お気に入りバーのフォルダーにドラッグします。または、別のブラウザーからインポートします。お気に入りのインポート
Rausu sea animal
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Background

GOAL **Food consumption by marine mammals**

Fundamental data

1.What do they eat?

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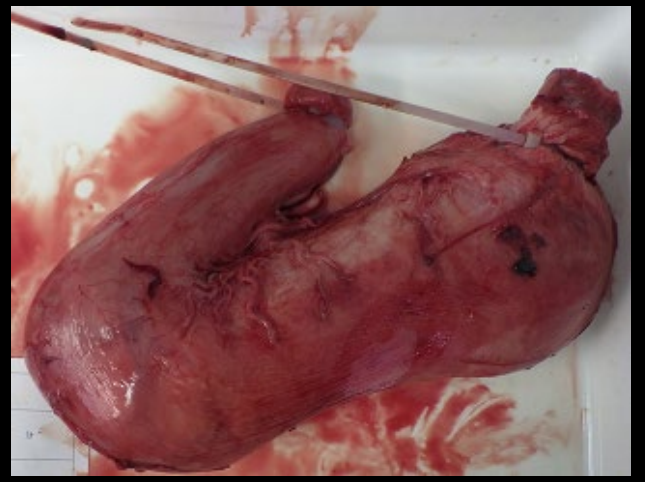


(Specimens collected by population culls or retrieved from fishing nets)

2. How much do they eat?

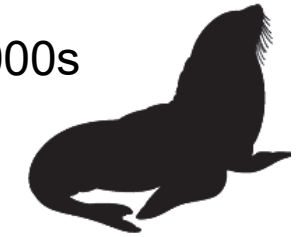
★ Energy requirements ★ Caloric density of prey etc.

Aim

1. Estimate daily food requirements using previous formula (Perez et al. 1990)

1990s

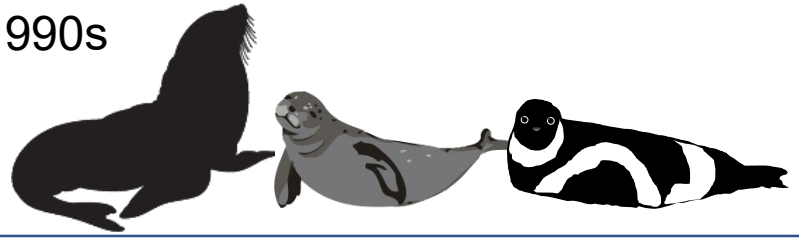
2000s



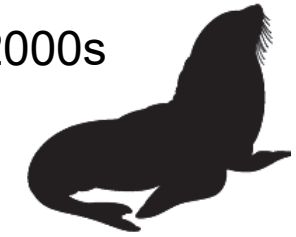
2. Estimate daily food requirements using new formula

New formula proposed by Dr. Trites (in prep.)

1990s



2000s



3. Compare

- ✓ Previous vs. new
- ✓ 1990s vs. 2000s
- ✓ Estimated vs. Measured in the field

Materials and Methods

★**Samples (Adult females)**

BW: Body weight (kg)

	n	Mean BW	min.	max.
 Steller sea lion '90s	77	301	205	410
 Steller sea lion '00s	35	286	200	370
 Spotted seal	15	133	110	185
 Ribbon seal	20	142	100	210

(Samples were collected from animals culled in winter in the 1990s and 2005-2011 on SSL)

Materials and Methods

★ Data of weight percentage of prey

- Steller sea lion: Goto et al. 2016
- Spotted seal: Goto 1999 (Ph.D. thesis)
- Ribbon seal: Deguchi et al. 2004

★Data on caloric density of each prey

Goto 1999 (Ph.D. thesis) and the following websites:

GAROP(https://garop.jp/c3/fish/10209.htm) *in Japanese*

eatsmart(https://www.eatsmart.jp/do/caloriecheck/detail/param/foodCode/9999030001317)) *in Japanese*

Weight percentage of prey



	Steller sea lion		Spotted seal	Ribbon seal	
	1990's	2000's	1990's	1990's	Caloric density (kcal/100g)
Mean body weight of adult females	301	286	132.7	142.0	
Skates		0.2			84.0
Microstomatidae sp.				0.1	163.0 ※1
Japanese anchovy		0.1			192.0
Salmonidae sp.		0.0	0.5		161.0
Japanese surf smelt	0.7		0.0		88.0
Scopelosaurus harryi				1.4	163.0 ※1
Myctophidae (lanternfish)				0.11	163.0 ※1
Pacific cod	62	3.9		0.0	124.0
Walleye pollock	9.7	83.5	96.2	71.5	147.3
Saffron cod	9.8	0.1		0.2	85.0
Mullet		6.7			128.0
Rock fishes			0.9		109
Hexagrammidae spp.		0.1			113.0
Okhotsk Atka mackerel		0.1	0.6		200.0
Blackedged sculpin		1.2			132.2
Smooth lampsucker	0.1	0.3			77.0
Eelpout		0.4		3	66.0
Japanese sand lance		0.0			125.0
Flat fishes	1.6	1.6	0.0		114.9
Unknown species	2.2	0.0	1.3	0.1	※2
Squid (magister armhook squid)	3.9	0.2	0.2	22.6	158.8
Octopuses	10.1	1.6	0.4		163.0

Weight percentage of each prey (%) & their caloric density (kcal/100g)

Steller's sea lion: calculated based on reconstructed weight of prey in samples at all stages of sexual development

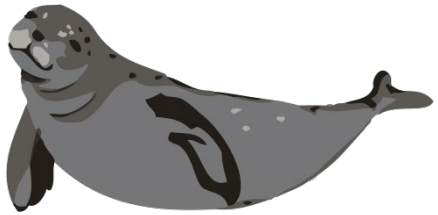
Spotted seal: calculated based on real weight of prey in adult samples

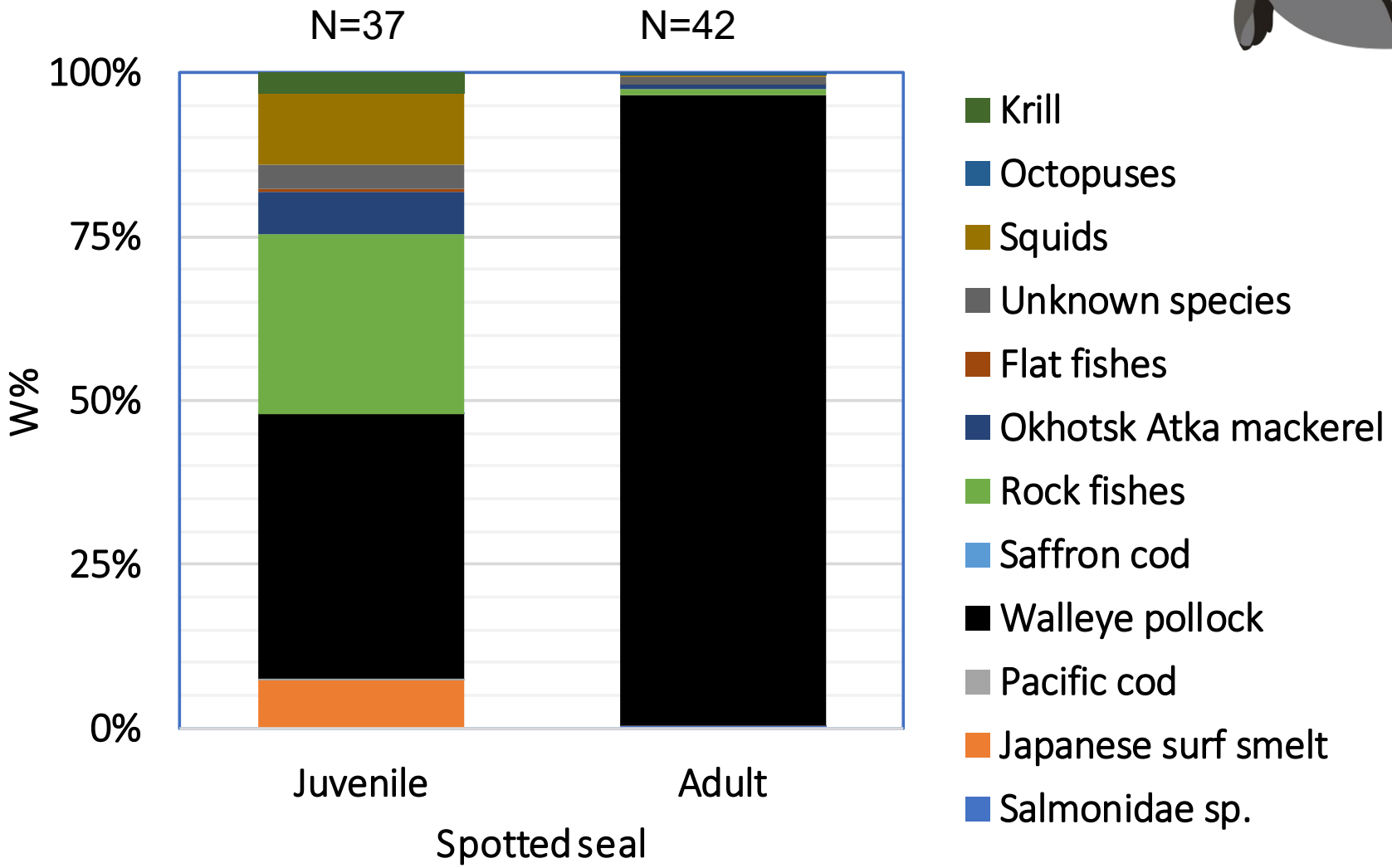
Ribbon seal: calculated based on real weight of prey in samples at all stages of sexual development

* 1 Applied from the value obtained for lantern fish

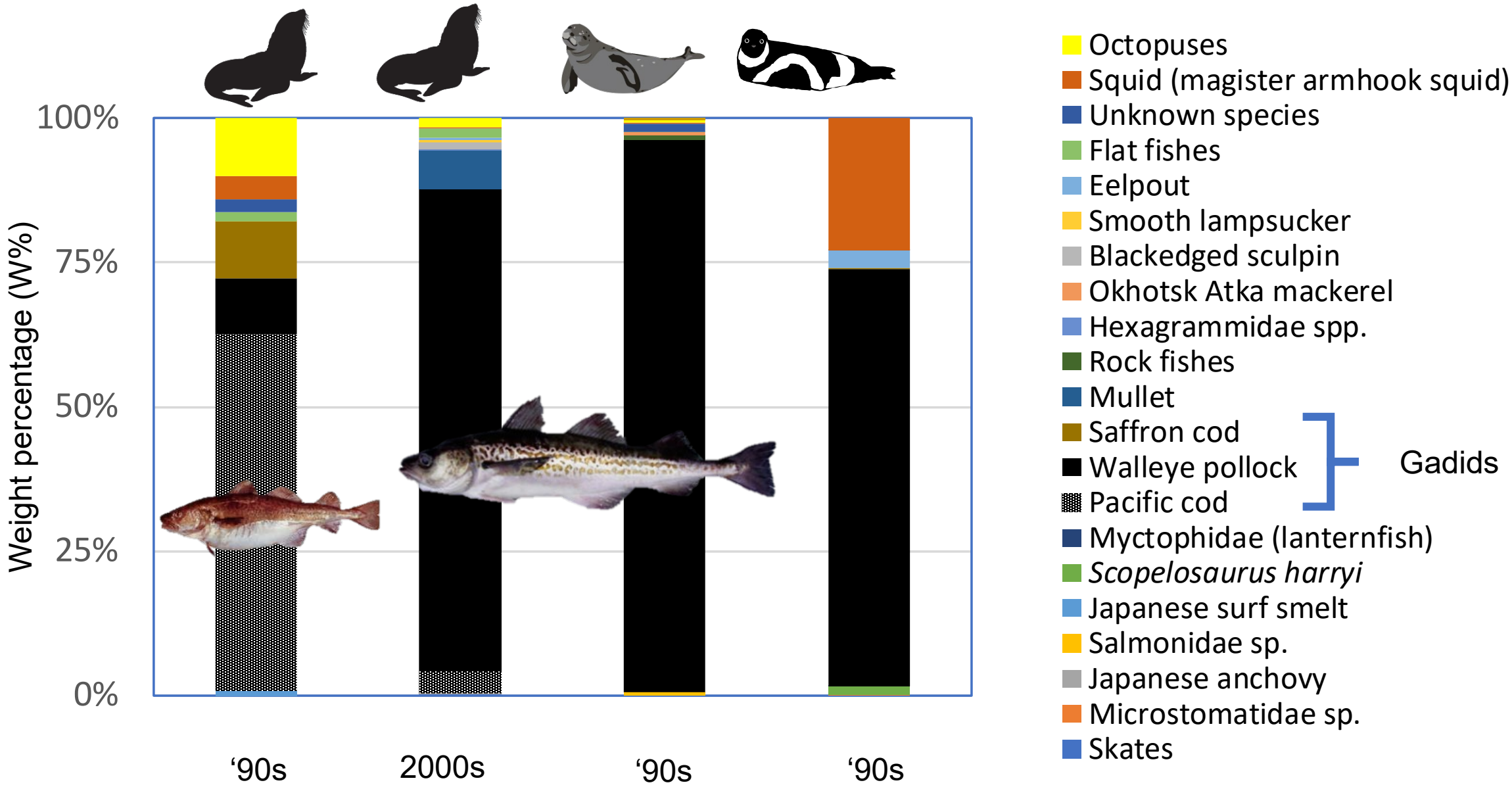
* 2 Average value of known species consumed by each pinniped

Weight percentage (W%) of prey





Weight percentage (W%) of prey



Materials and methods

2: Estimate daily prey consumption

Two formulae

(1) Perez et al. 1990

Seals: DE (kcal/day)= $200*M^{0.75}$

Steller sea lion : DE (kcal/day)=$375*M^{0.75}$

DE: Daily Energy requirement (kcal/day), M: Body mass (kg)

(2) Trites (in prep): reported at last meeting in Yokohama

Seals (**MEDIUM cost of living)**

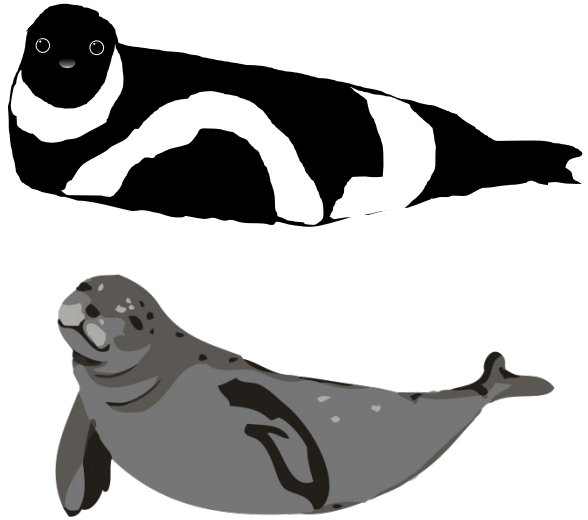
：R (kg/day) = $0.101555\ M^{0.8387}$

Steller sea lion (**HIGH cost of living)**

：R(kg/day) = $0.37222\ M^{0.7144}$

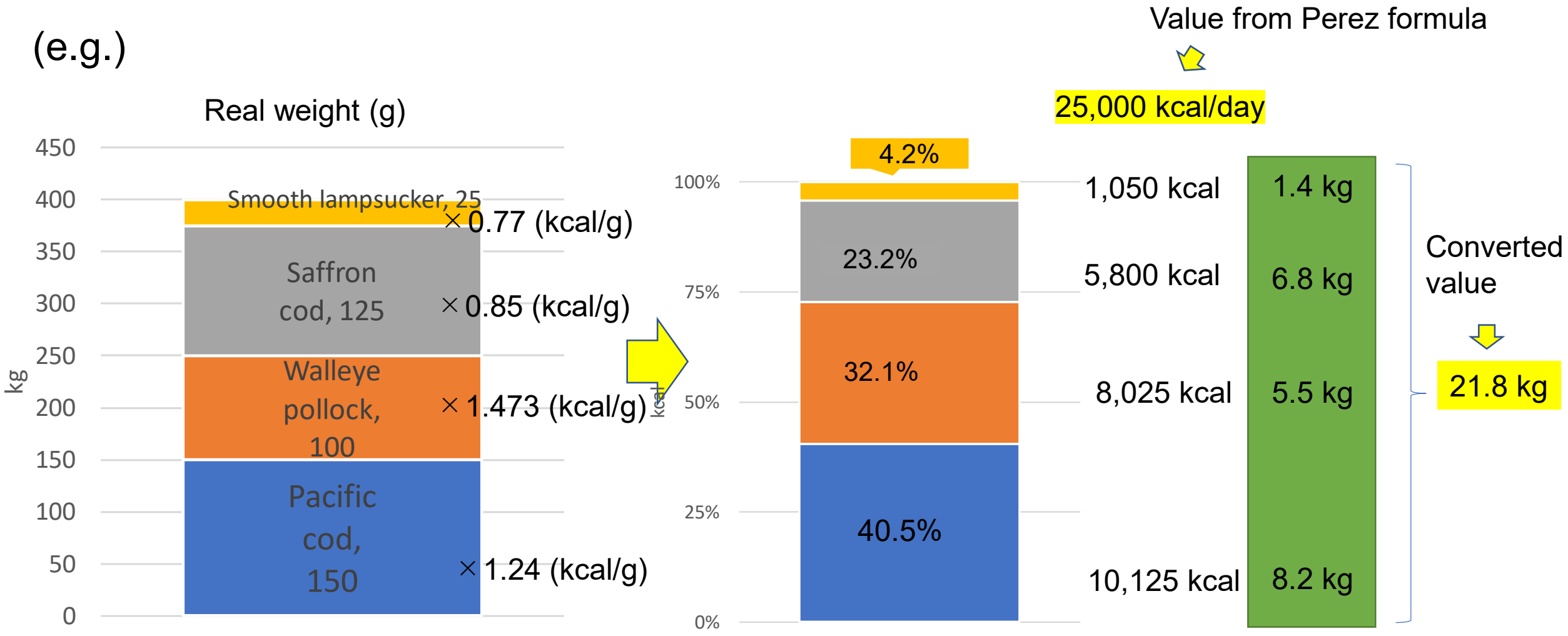
R: Daily ration (kg/day)

MEDIUM cost of living



HIGH cost of living

Conversion of Daily Energy requirement (DE: kcal/day) to Daily ration (R: kg/day)

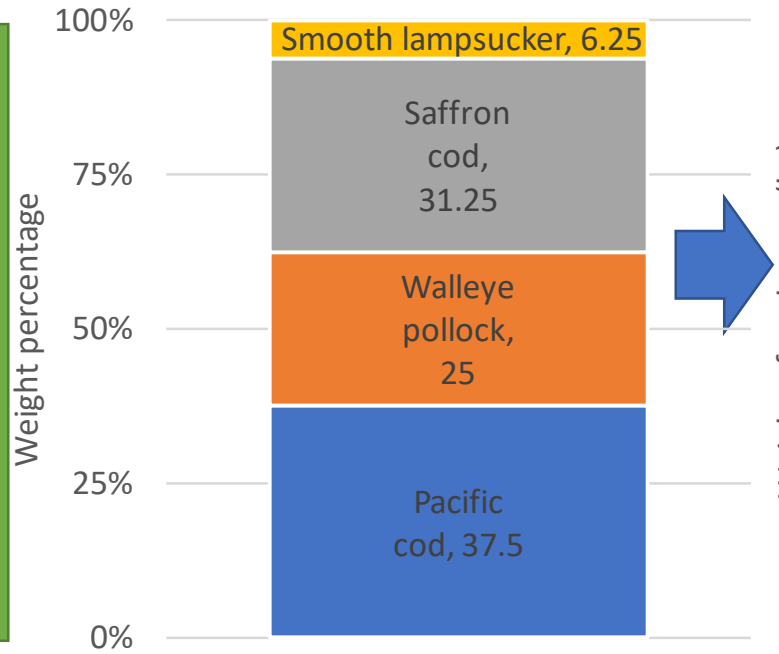


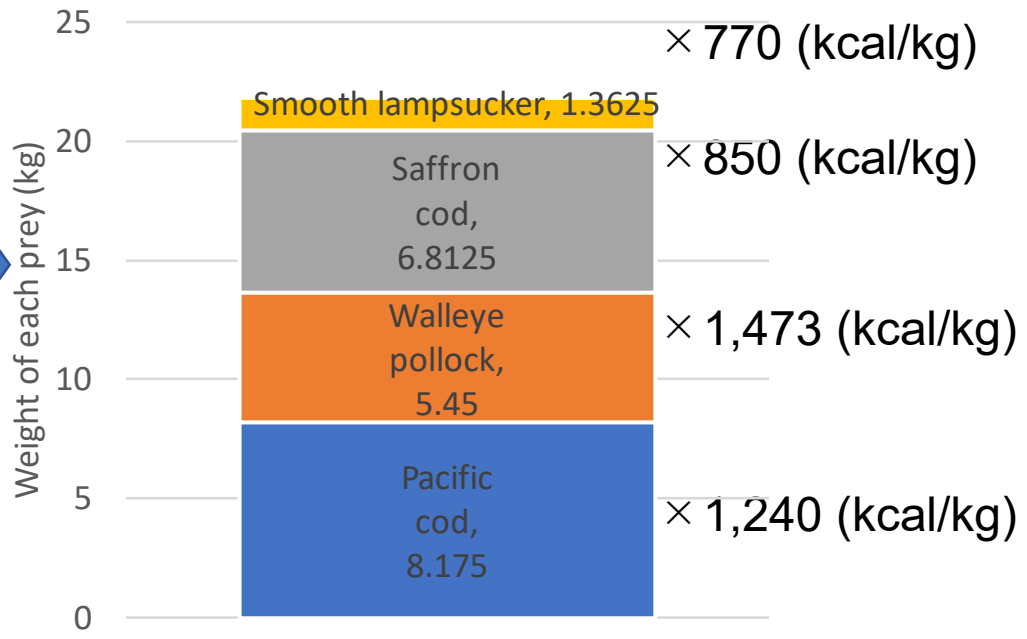
Calculating Daily Energy requirement (DE: kcal/day) using Daily ration (R: kg/day)

(e.g.)

Value from Trites formula

21.8 kg





Converted value

1,049.1 kcal

5,790.6 kcal

8,027.9 kcal

10,137.0 kcal

SUM

25,004.6 kcal/day

Results

Daily consumption of adult female Steller sea lion, Spotted seal & Ribbon seal



		Steller sea lion		Spotted seal	Ribbon seal
		1990s	2000s	1990s	1990s
Mean body weight of adult females (kg)		301	286	132.7	142.0
Energy requirement (kcal/day)	Perez	27,099.2	26,079.9	7,819.2	7,671.4
	Trites	27,848.0	30,496.7	8,814.9	8,851.8
Daily consumption (kg/day)	Perez	21.4	18.1	5.3	5.8
	Trites	22.0	21.2	6.1	6.5

Perez: Perez et al.1990
Trites: Trites, in prepp.

Comparing the Perez and Trites formulae

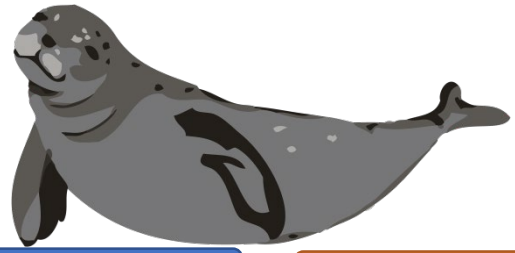
Perez

Trites

1990s

21.4kg (27,099kcal)/ day

22.0 kg (27,848kcal)/ day



Perez

Trites

5.3kg (7,819kcal)/d ay

6.1kg (8,814kcal)/ day

Perez

Trites

5.8kg (7,671kcal)/ day

6.5kg (8,852kcal)/ day

2000s

18.1 kg (26,080kcal)/ day

21.2 kg (30,497kcal)/ day

Comparing the 1990s and 2000s

	Steller sea lion	
	1990s	2000s
Mean body weight of adult females (kg)	301 (not significant)	286
Perez et al. 1990		
Energy requirement (kcal/day)	27,099.2	26,079.9
Daily consumption (kg/day)	21.4	18.1
Trites in press		
Energy requirement (kcal/day)	27,848.0	30,496.7 ?!
Daily consumption (kg/day)	22.0	21.2

Weight percentage of prey

	Steller sea lion		
	1990s	2000s	Caloric density (kcal/100g)
Mean body weight of adult females	301	286	
Skates		0.2	84.0
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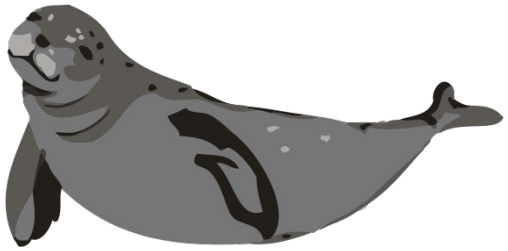
Squid (magister armhook squid)	3.9	0.2	158.8
Octopuses	10.1	1.6	163.0

Comparisons with field data



Insufficient data

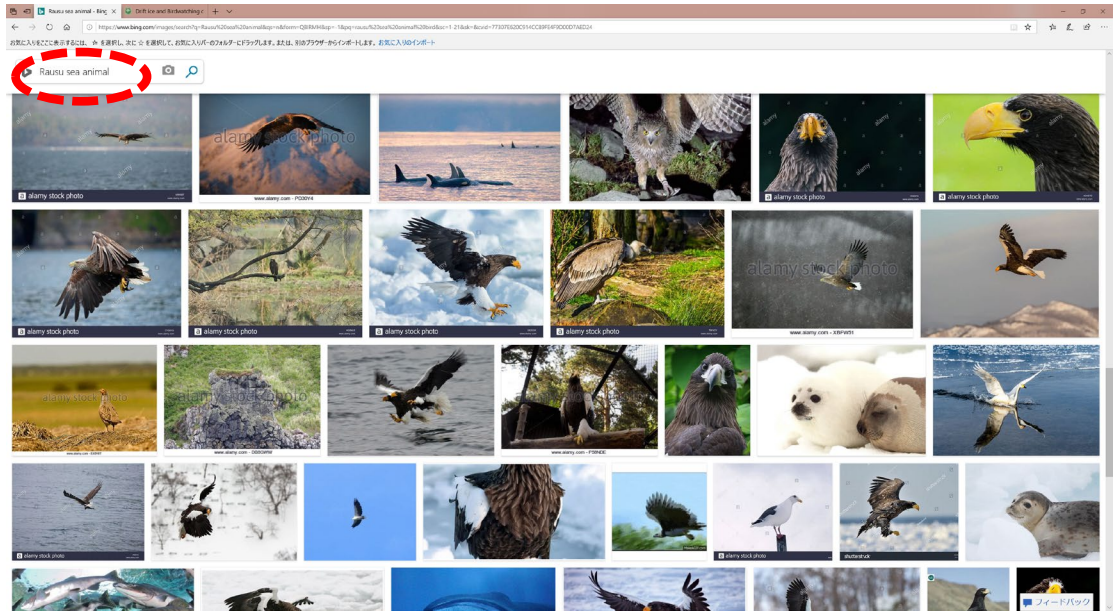
	Field (reconstructed)		Field (Raw Data)
1990s	22.0 kg (27,848 kcal)/day	15.5 kg (18,685 kcal)/ Single meal	6.1 kg (8,814kcal)/day	2.7kg (3,936 kcal)/ Single meal
		3.5-32.2 kg (4,331-39.577 kcal)		1.7-3.7 kg (2,511-5,514 kcal)
2000s	21.2 kg (30,497 kcal)/day	16.1 kg (23,161 kcal)/ Single meal		
		0.2-42.2 kg (184-62,101 kcal)		

Future research (1)

- Insufficient population data
- Energetic information for pinniped prey varies seasonally

Future research (2)

- Poor information about other marine mammals (Killer whales, dolphins & cetaceans)



The Nemuro Strait is an interesting region

What do they eat?

★Thank you for your kind attention!

Acknowledgements

★ This study was partially conducted by the Fishing Industry/Communities Promotion Organization.
★Ms. Sarah Mather
★Dr. Kaoru Hattori
★Dr. Tsutomu Tamura
★Members of Wakkanai & Kushiro Fisheries Research Institute