Jellyfish as a predator and prey of fishes: underwater observations and rearing experiments

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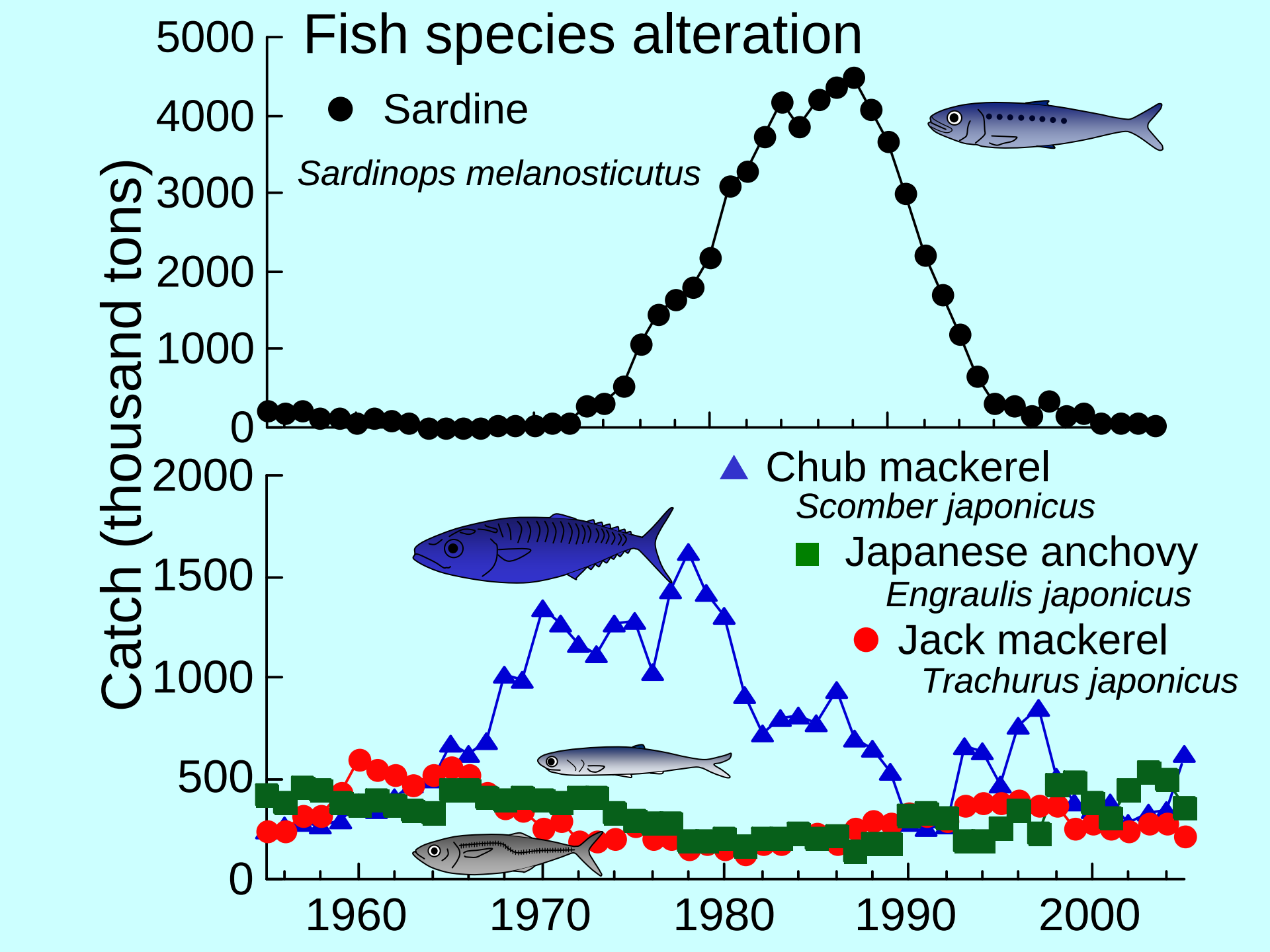
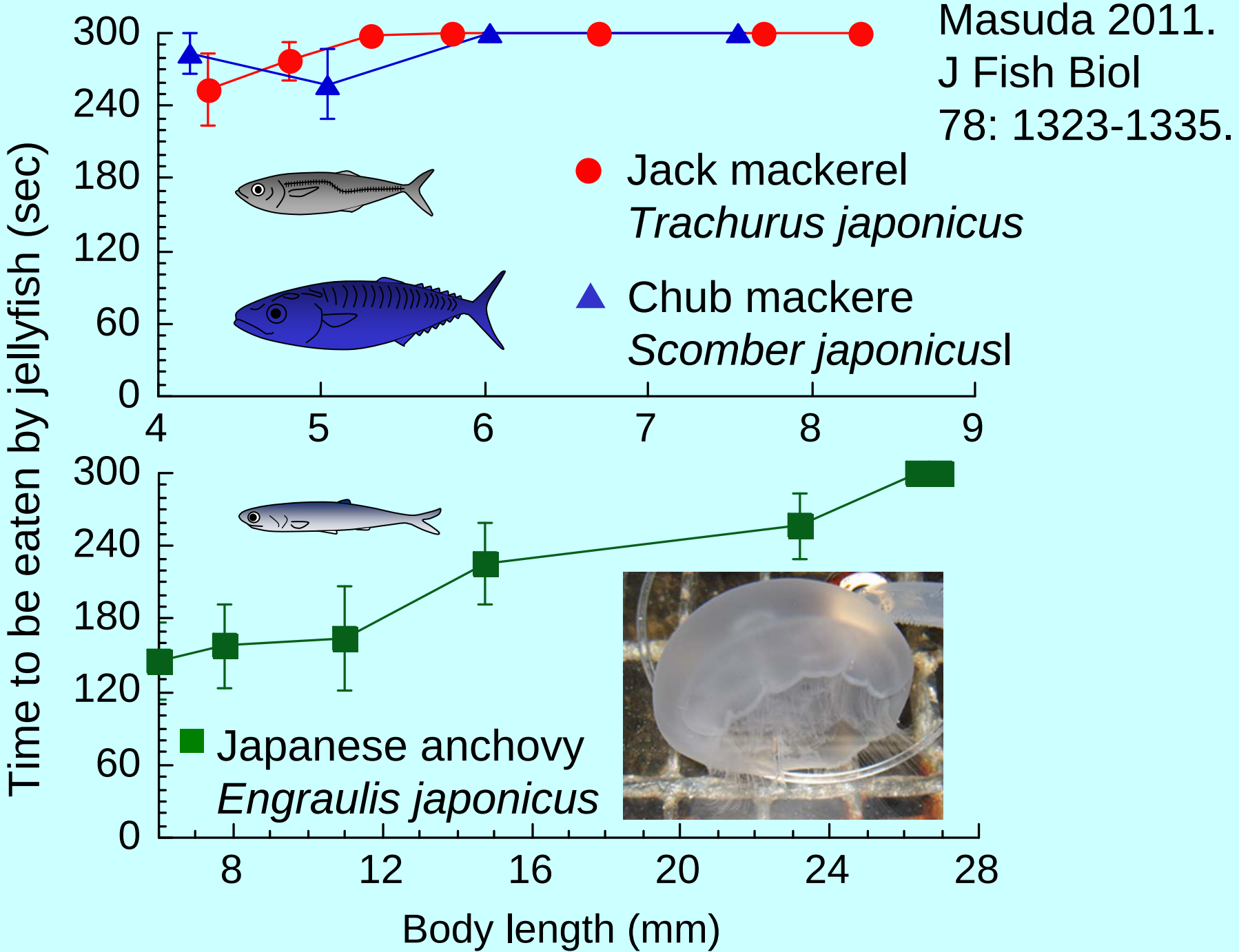
Maizuru Fisheries Research Station

Kyoto Univ.

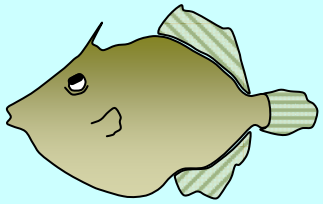

Fish species alteration
Sardine
Sardinops melanosticutus
Chub mackerel
Scomber japonicus
Japanese anchovy
Engraulis japonicus
Jack mackerel
Trachurus japonicus
Catch (thousand tons)
5000
4000
3000
2000
1000
0
2000
1500
1000
500
0
1960
1970
1980
1990
2000

Fish-jelly interaction:


Five-minute trial of survival when exposed to moon jellyfish (*Aureria* sp.)
Captured anchovy larva


Masuda 2011.
J Fish Biol
78: 1323-1335.
Jack mackerel
Trachurus japonicus
Chub mackere
Scomber japonicusl
Japanese anchovy
Engraulis japonicus
Time to be eaten by jellyfish (sec)
Body length (mm)
0
60
120
180
240
300
4
5
6
7
8
9
8
12
16
20
24
28

Tolerance to jellyfish



Threadsail filefish

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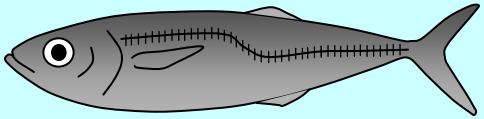
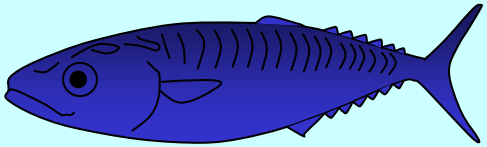
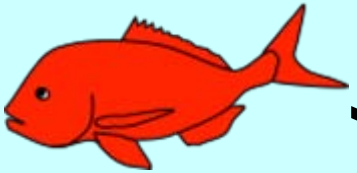


Jack mackerel



Chub mackerel

>



Red sea bream

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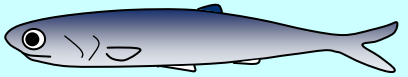
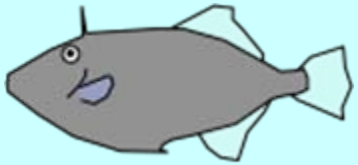


Anchovy



Leather jacket

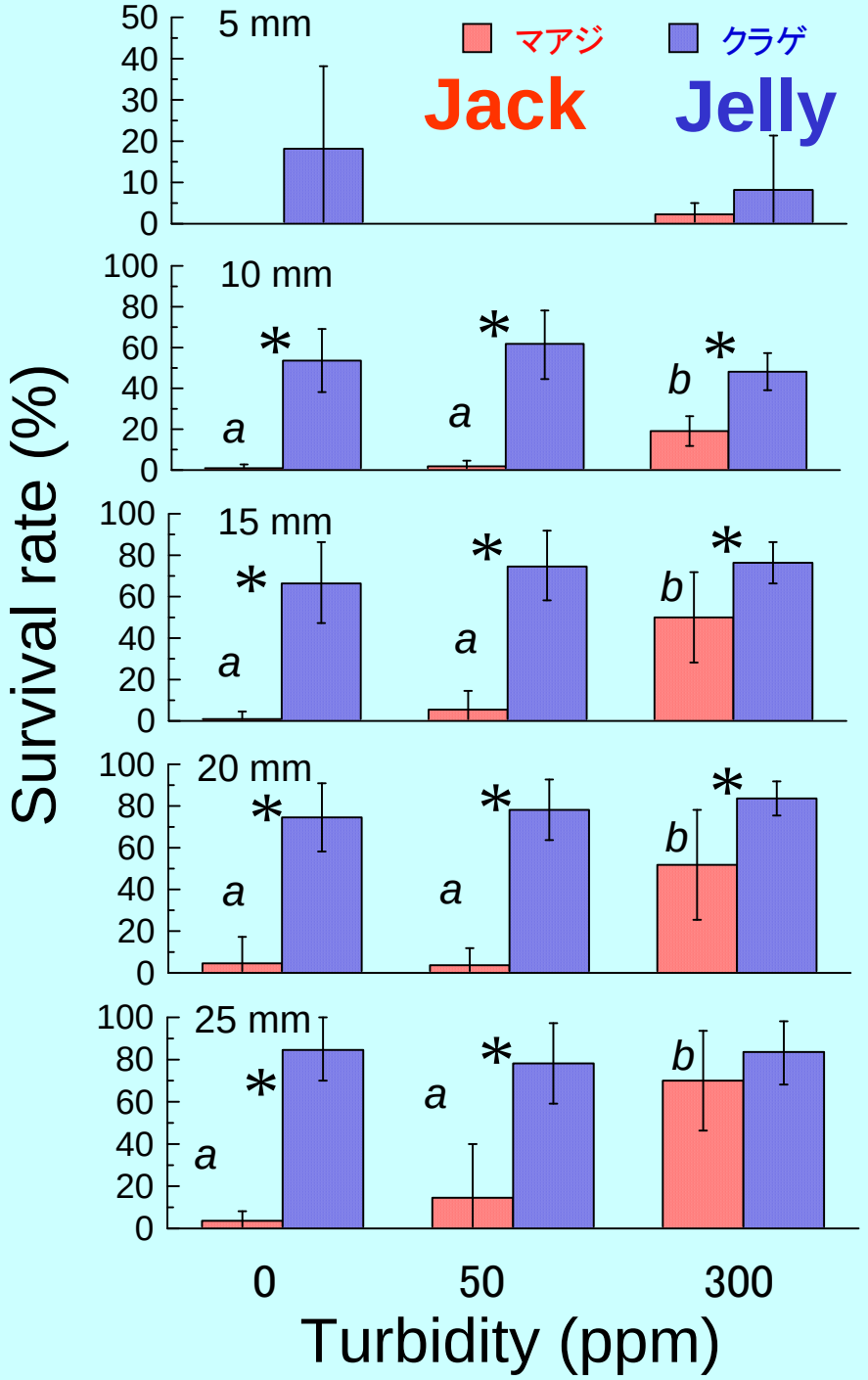
Masuda 2011. J Fish Biol 78: 1323-1335.

Miyajima et al. unpublished data.

Anchovy larvae
20 mm SL
(hatchery-reared)

Anchovy larvae rely on their transparency for predator avoidance

---> Adapted in turbid environment to avoid visual predator



Ohata, Masuda, Yamashita
2011. J Fish Biol 79: 2007-18.

Turbidity did not work as a refuge against jellyfish

Eutrophication

Hypoxia

Turbidity

*1

Jellyfish blooms

***1 Shoji et al. 2005.**
Mar Biol 147: 863-868.


Threadsail filefish feeding on giant jellyfish *Nemopilema nomurai*
(Nov 2005, Kanmuri-jima, Maizuru)

65 dph, 35mm BL, 1.4g BW

20 ind. each, duplicated

16 days feeding

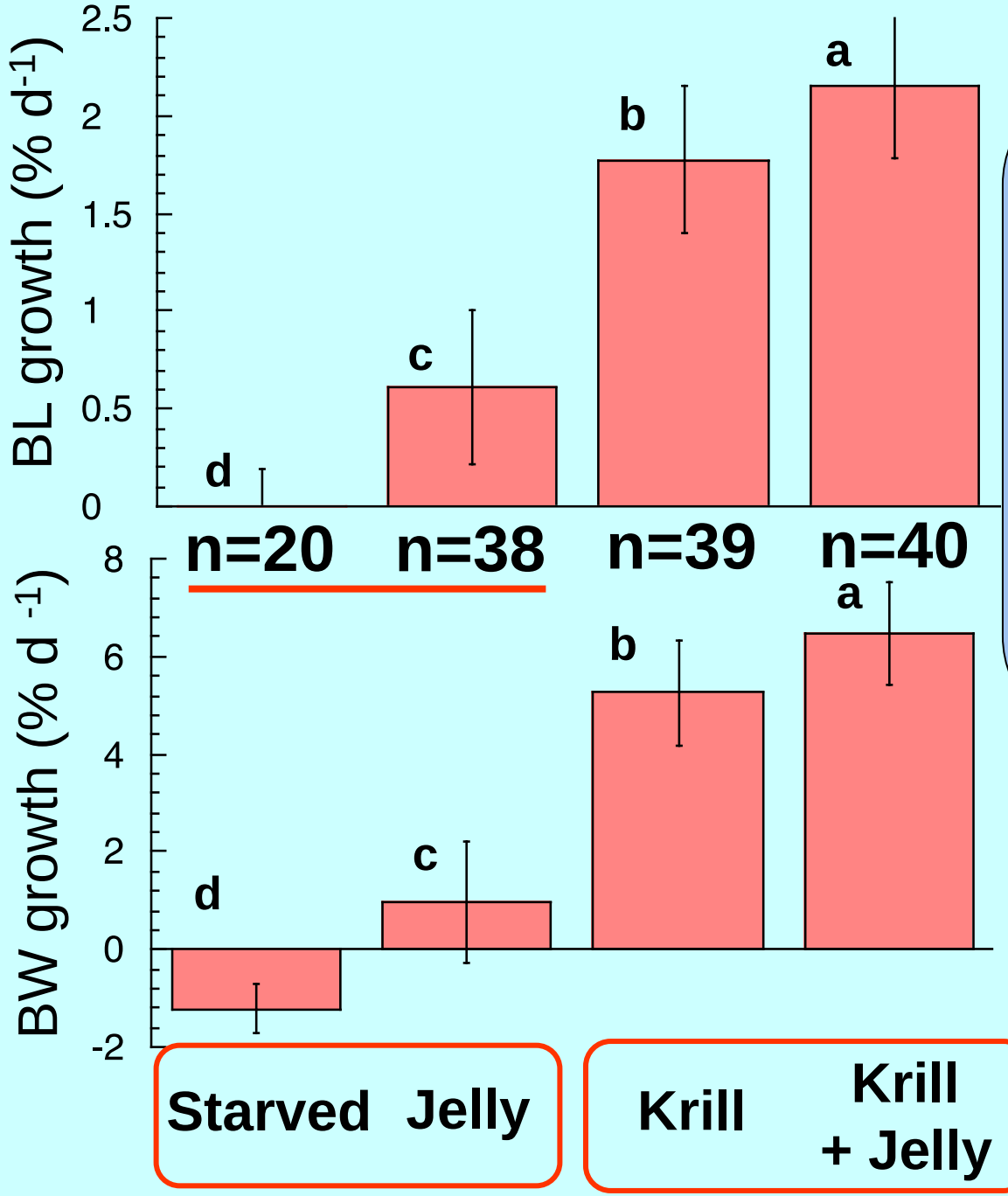
Jelly

Starved

Krill + Jelly

Krill

Yuko Miyajima feeding jelly to filefish
(Sep 2008, Maizuru Fish. Res. Stn.)



Filefish

1. can survive and grow by feeding only jellyfish

2. can attain some supplemental nutrition from jellyfish.

Miyajima, Masuda, Kurihara, Kamata, Yamashita, Takeuchi 2011. Fish. Sci. 77: 41-48.

Feeding jellyfish to red sea bream

Pagrus major

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1. Starvation
2. Moon jellyfish
3. Pellets
4. Pellets & jellyfish

(10 ind. X 3 or 7 tanks,
117 days)

Miyajima feeding jelly to red sea bream
（Sep 2010, Maizuru Fish. Res. Stn）

Four months later

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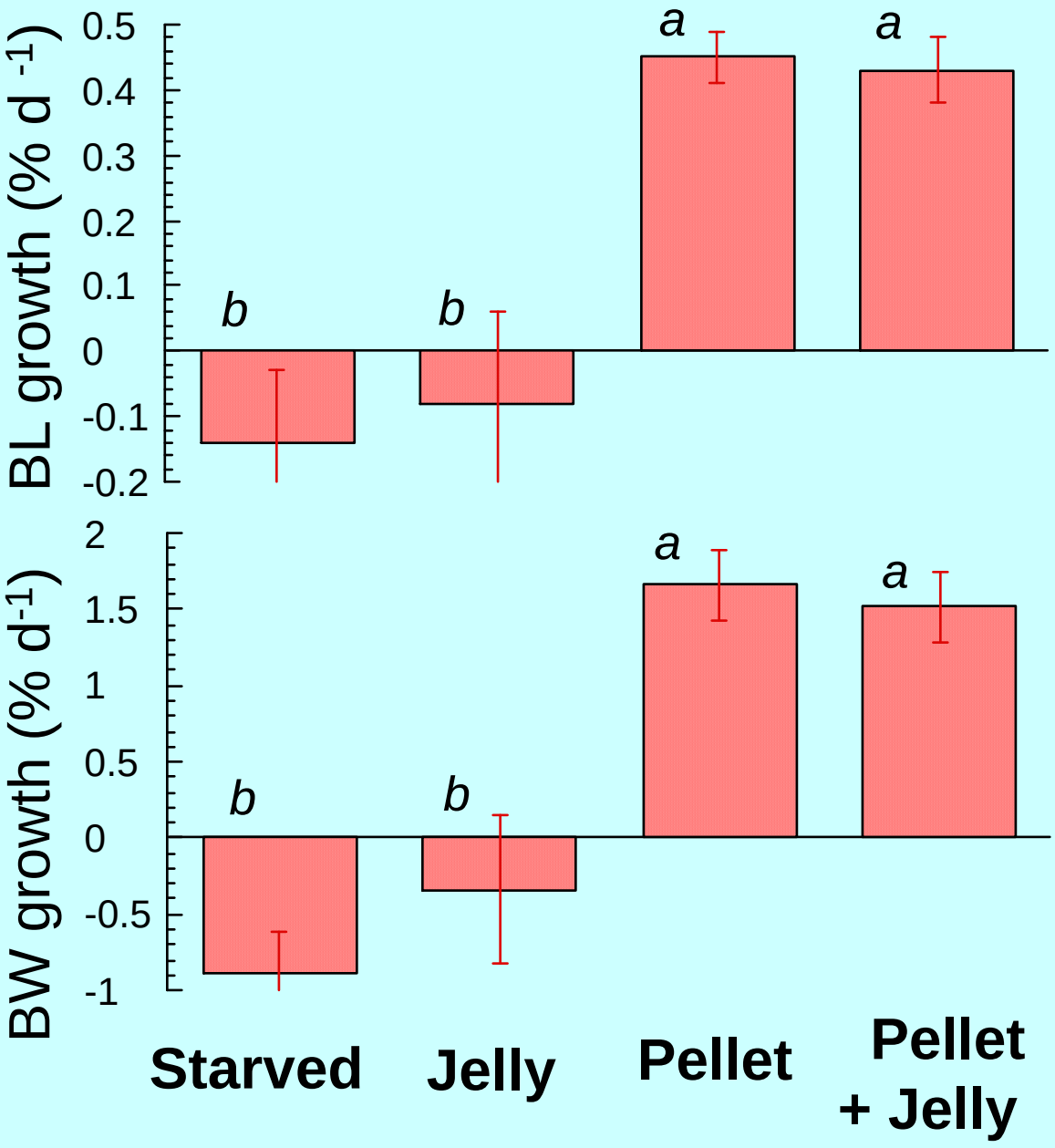
(Dec 2010, Maizuru Fish. Res. Stn)



Red sea bream cannot grow by feeding on jellyfish

Supplemental nutrition?

Miyajima et al. unpubl.

Tilting behavior

Defined by Uchida et al. 1993. Nippon Suisan Gakkaishi 59: 991-999.

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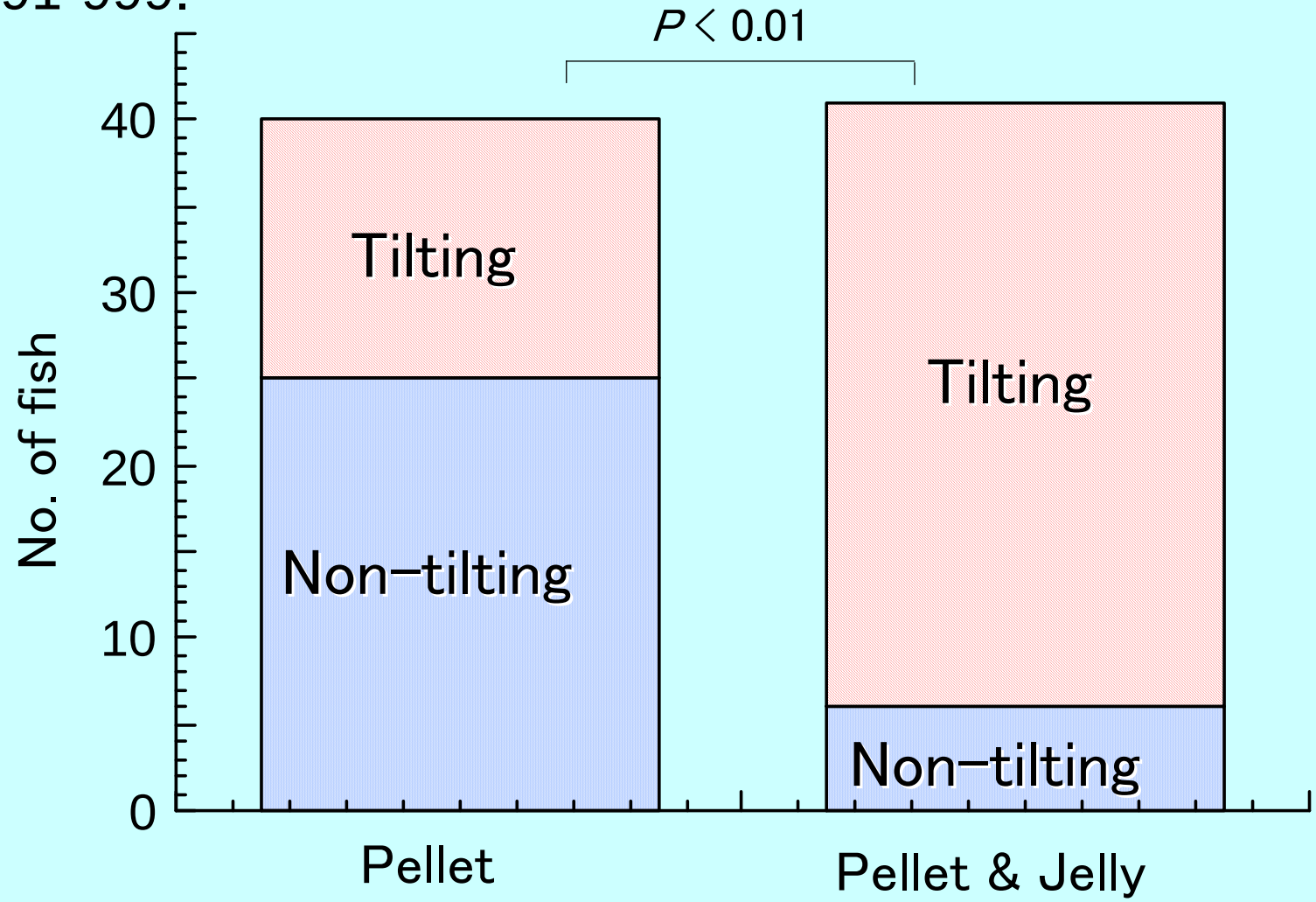
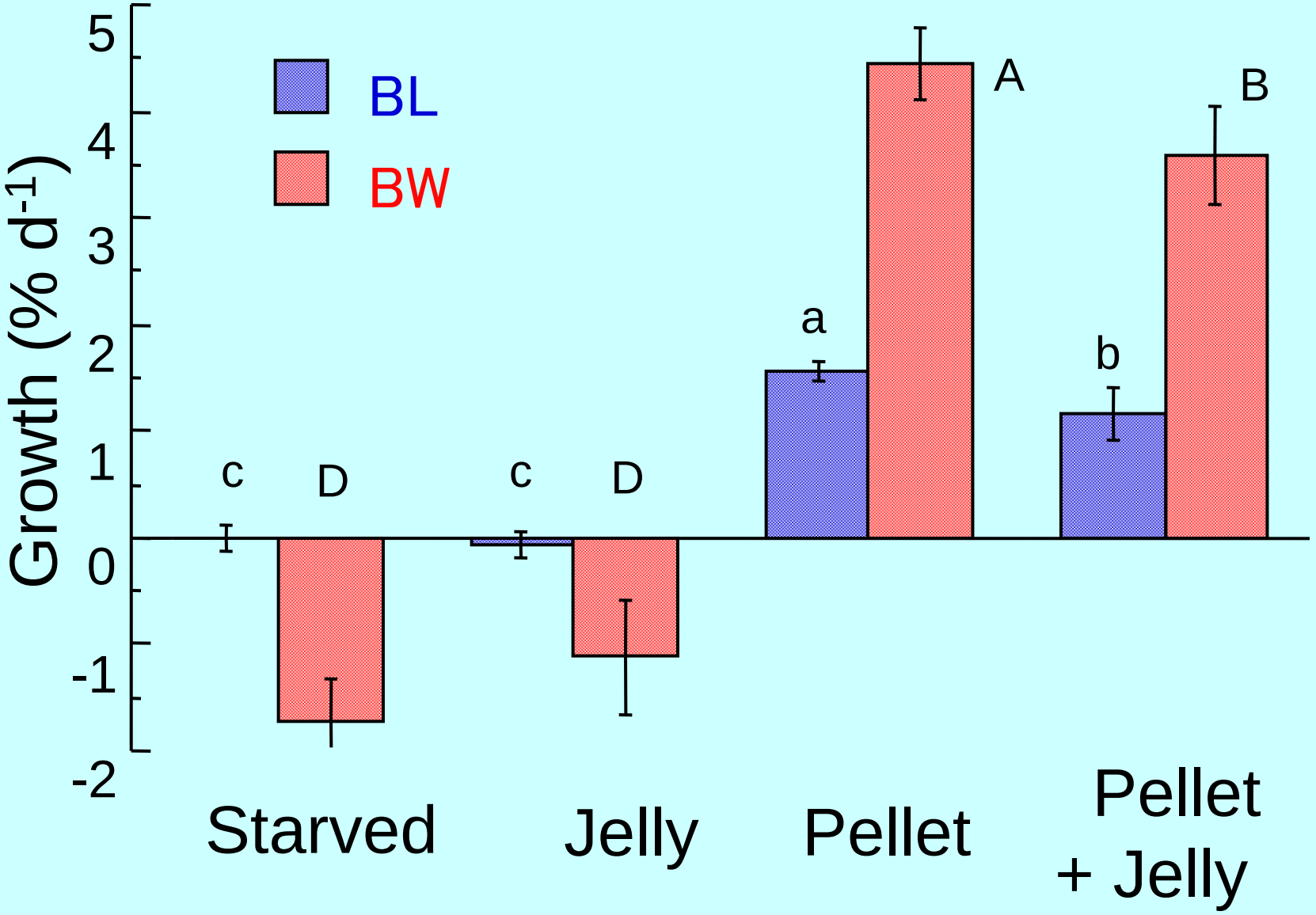
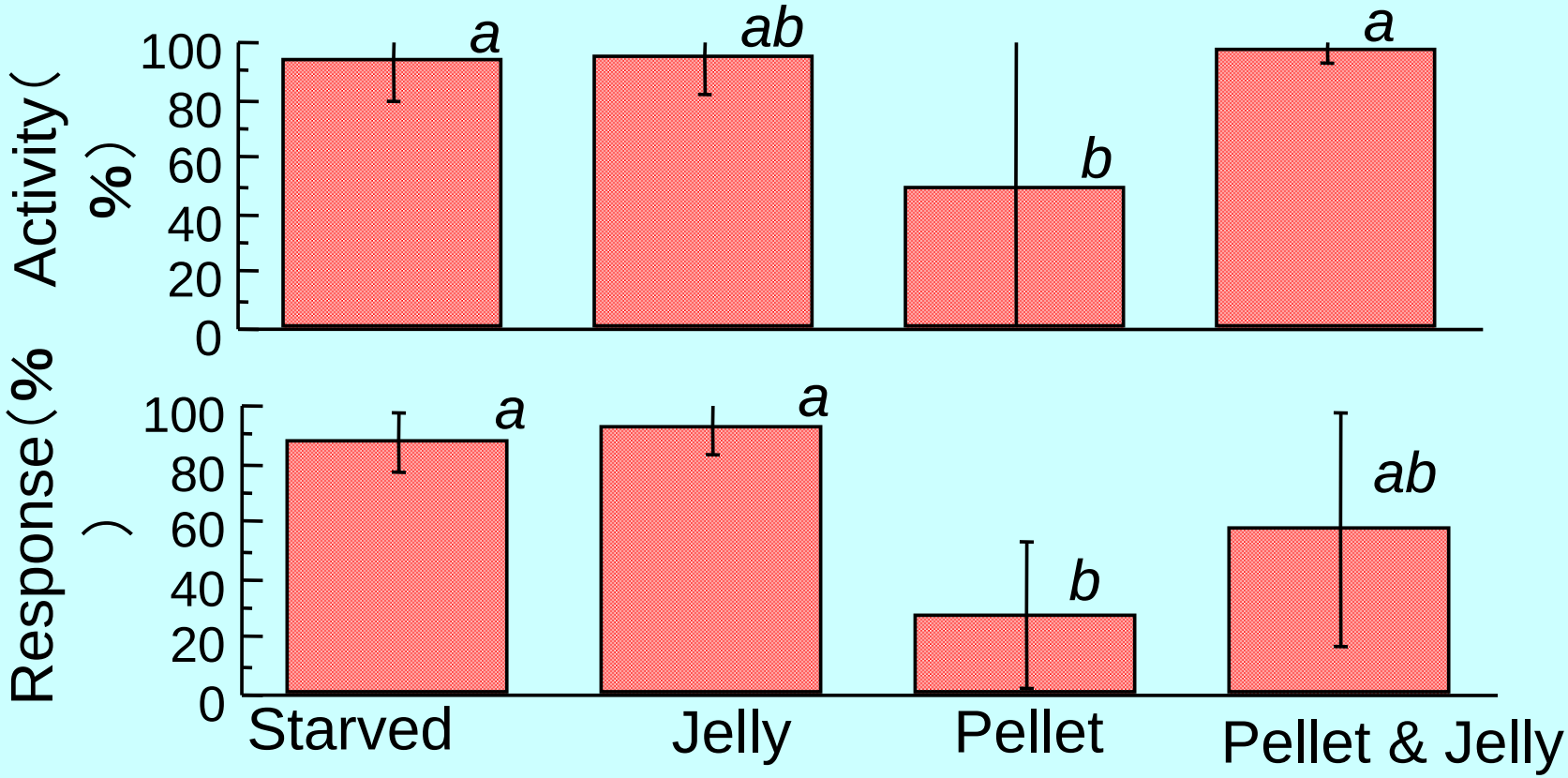



Order Tetradontiformes
Monacanthidae (filefish, leatherfish)
Tetradontidae (pufferfish)
others
Tiger puffer (Sep 2012, Shimonoseki)

Miyajima et al. unpublished



Behavior and body contents of jellyfish-fed pufferfish



Lipids（%）	7.06c	6.71c	19.4a	16.3b
DHA（%）	9.6b	12.4a	10.4b	12.1a
Glysin	27.8b	47.9b	134a	111a
Glutamic acid	39.3b	75.1a	44.3b	46.3b

(mg/100g d.b.)


Sashimi of giant jelly
Good for your health!
(July 2009, Pub in Maizuru)

Temperature of jellyfish consumption by threadsail filefish

28 ° C

25 ° C

22 ° C

13 ° C

16 ° C

19 ° C

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10 ° C

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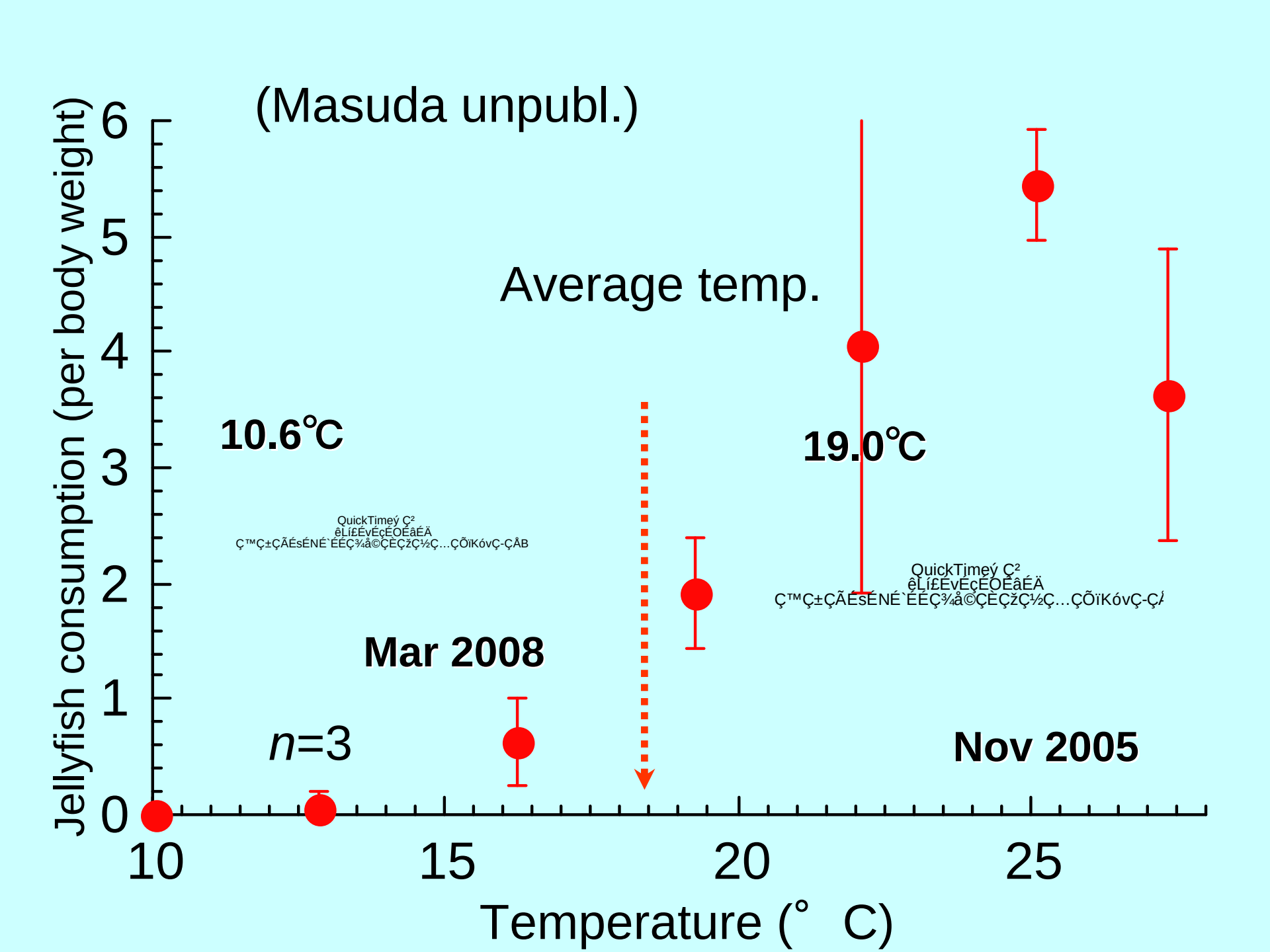
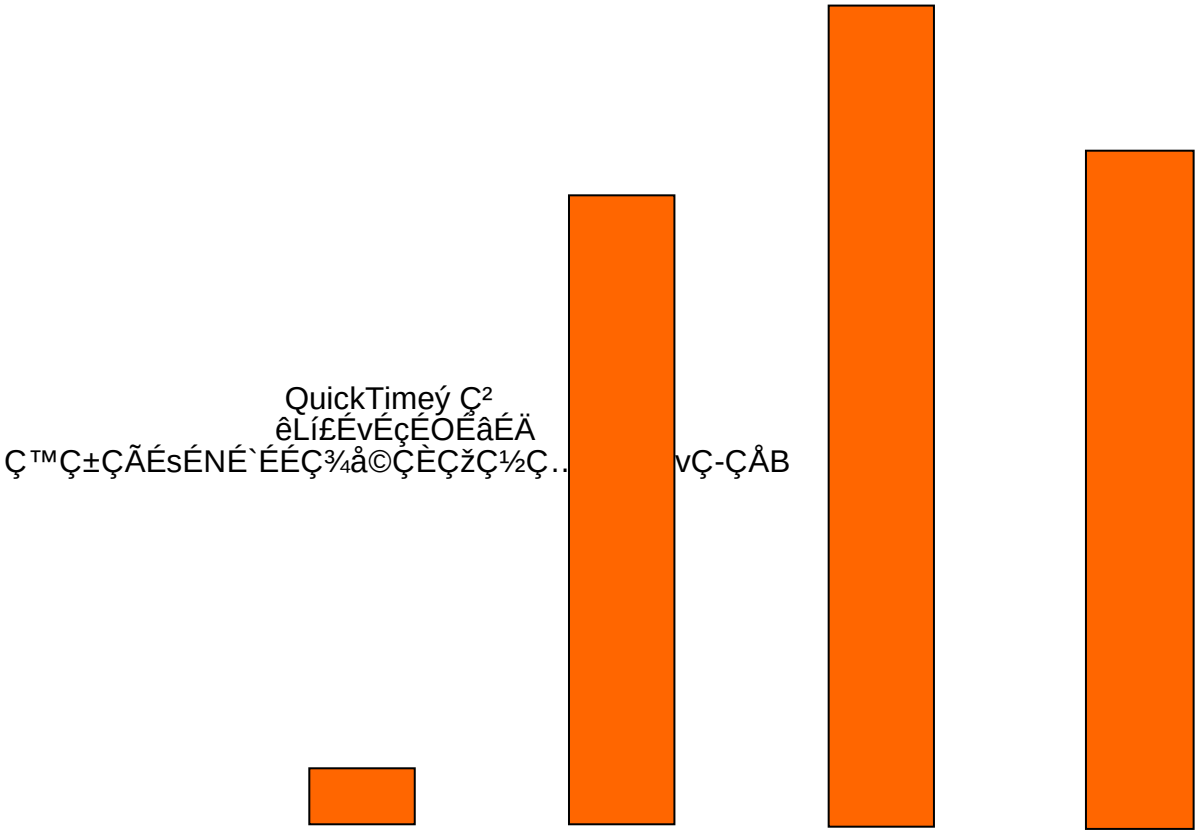
Feeding & Growth

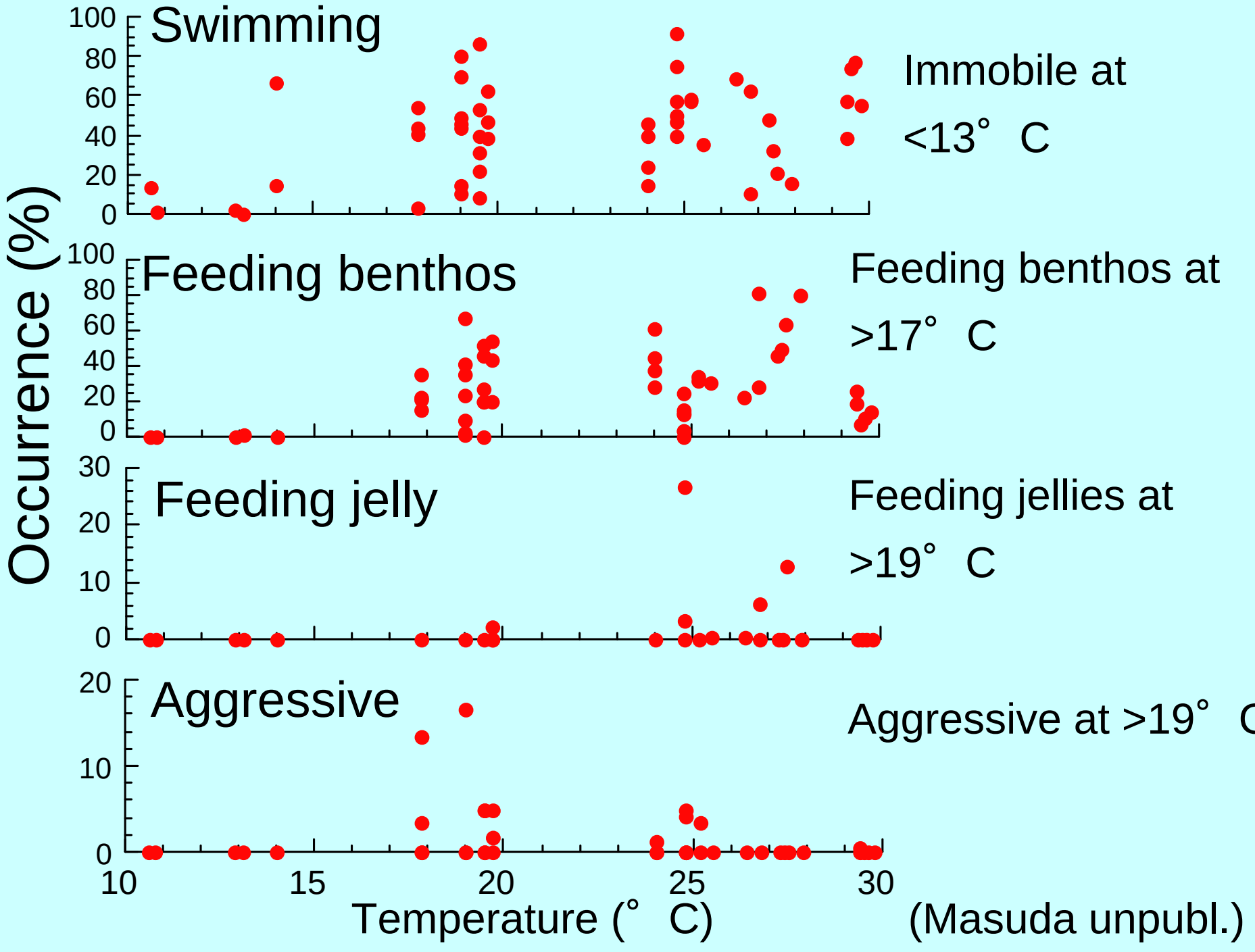
14 days


(Masuda unpubl.)
Average temp.
10.6℃
19.0℃
Mar 2008
Nov 2005
n=3
Jellyfish consumption (per body weight)
Temperature (° C)
0
1
2
3
4
5
6
10
15
20
25

Filefish feed on jellyfish (*Aurelia*) polyps



Miyajima et al. unpublished data (2012)


Swimming
Immobile at
<13° C
Feeding benthos
Feeding benthos at
>17° C
Feeding jelly
Feeding jellies at
>19° C
Aggressive
Aggressive at >19° C
Occurrence (%)
Temperature (° C)
(Masuda unpubl.)


Leatherfish feeding on giant jellyfish
(Sep 2009, Off Maizuru)

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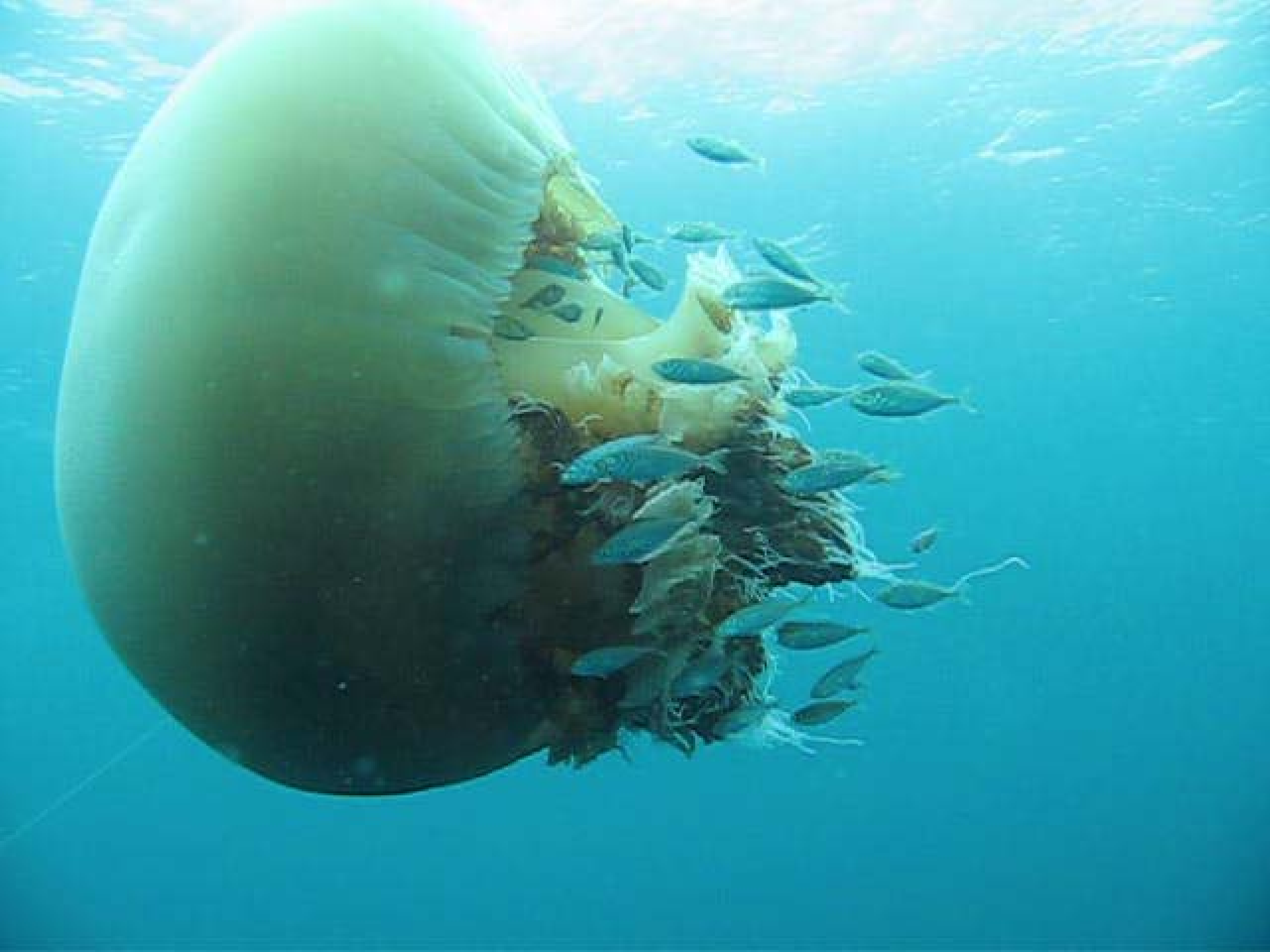
Commensalism

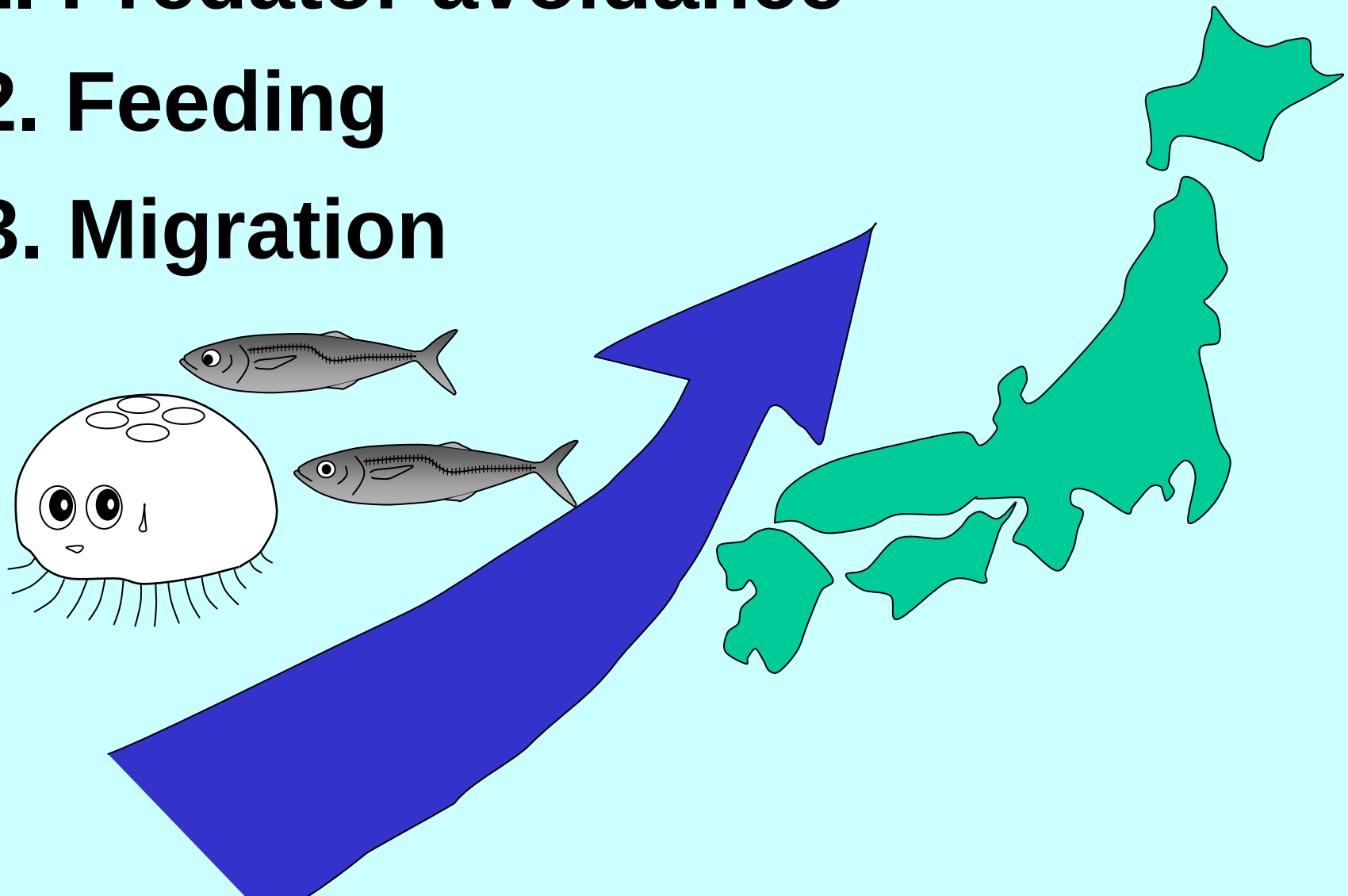
Jack mackerel associating with giant jellyfish
(Nov 2006, Kanmuri Isl., Maizuru)

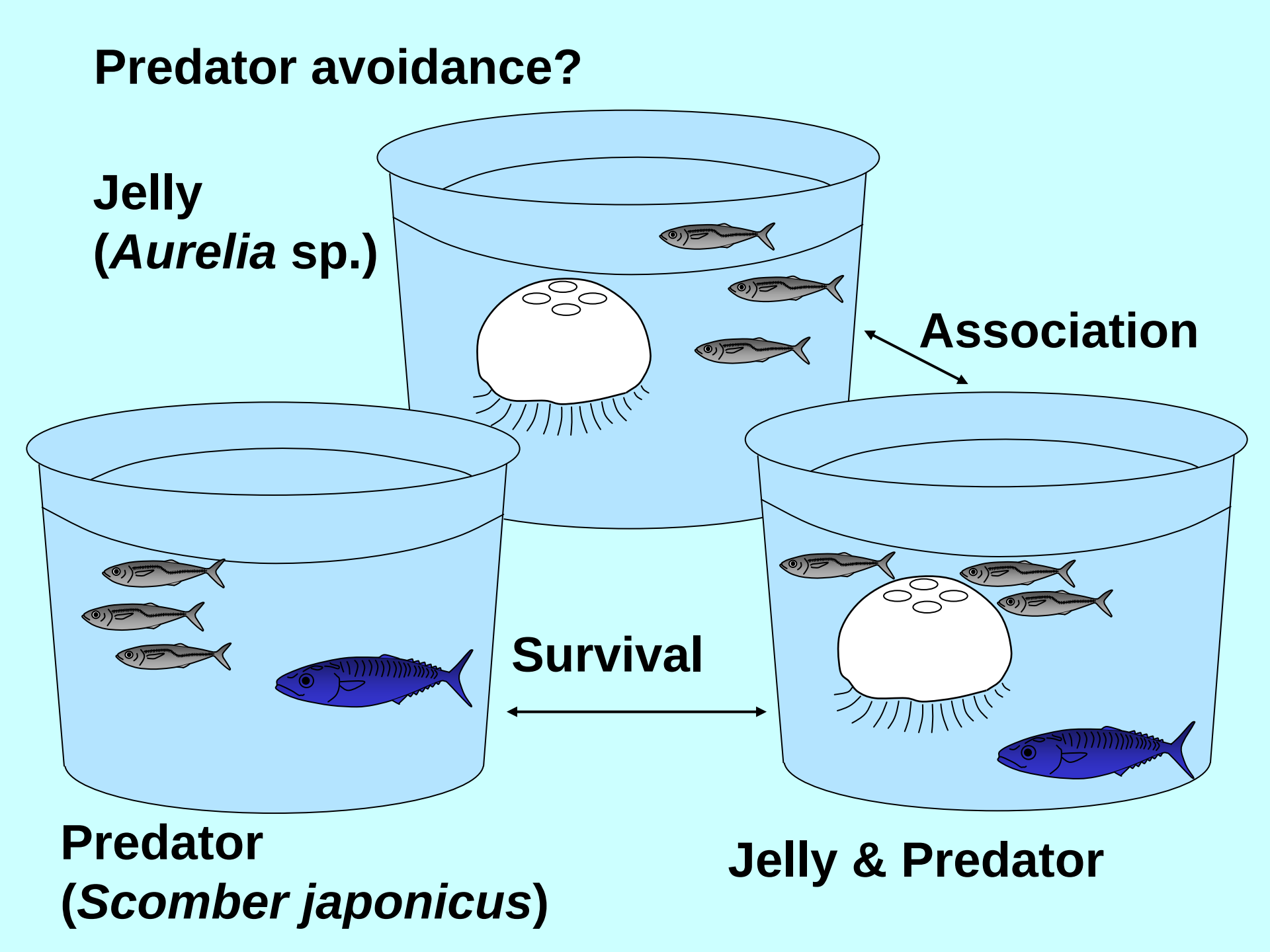



Jack mackerel associating with
Japanese sea nettle
Chrysaora melanaster
(Jun 2008, Maizuru)

Why jack associates with jellies?

1. Predator avoidance
2. Feeding
3. Migration



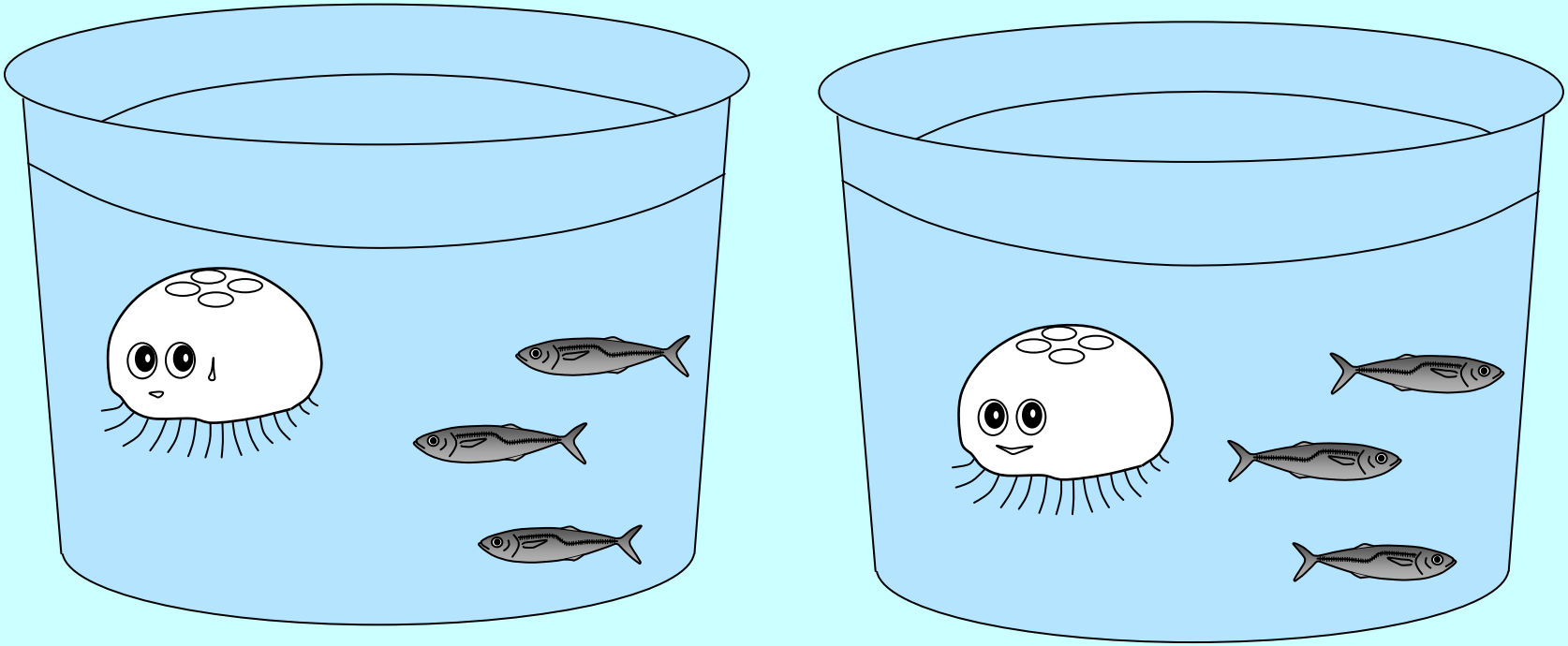

Predator avoidance?
Jelly
(*Aurelia* sp.)
Association
Survival
Predator
(*Scomber japonicus*)
Jelly & Predator

Jelly

Predator

Jelly & Predator

Feeding jelly to jack

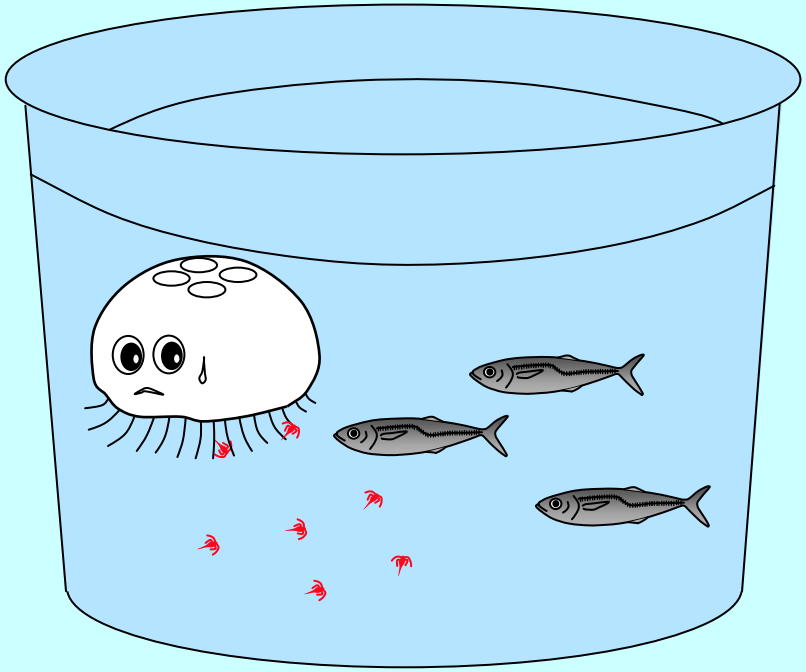


Provide jellyfish
(Aurelia* sp.*)
to jack mackerel

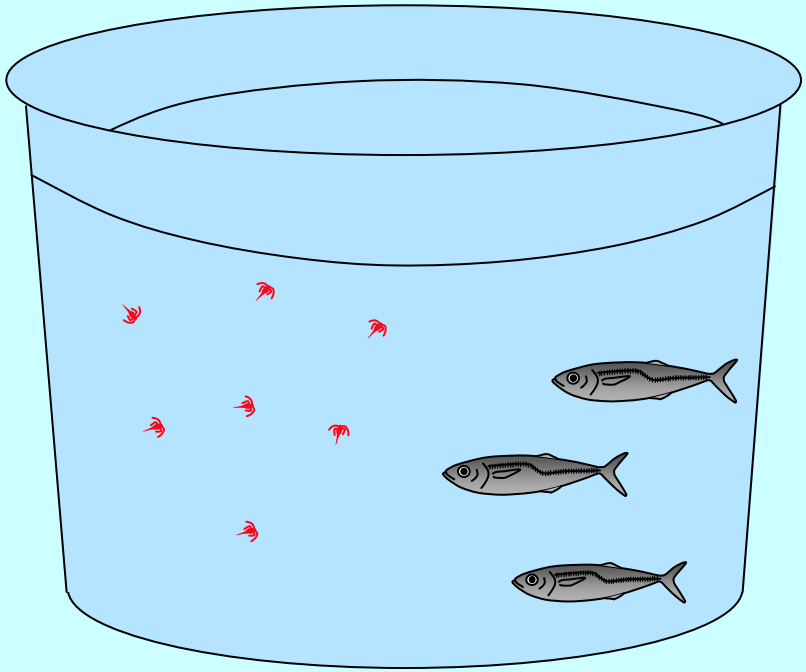
→No feeding

Masuda 2006. Fish Sci 72: 1225-1235.

Jack utilize jelly as a prey collector ?

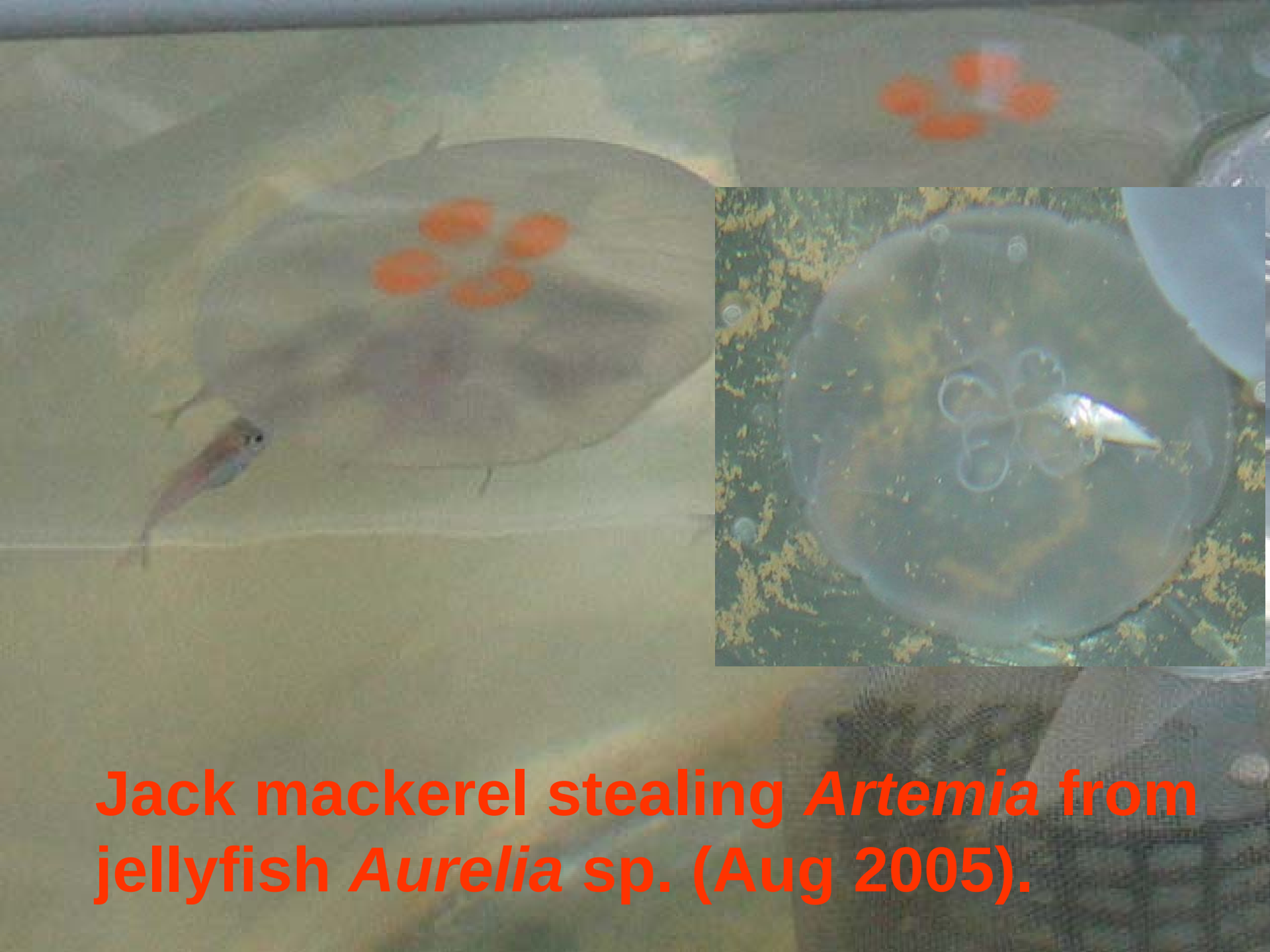


***Artemia* & Jellyfish**



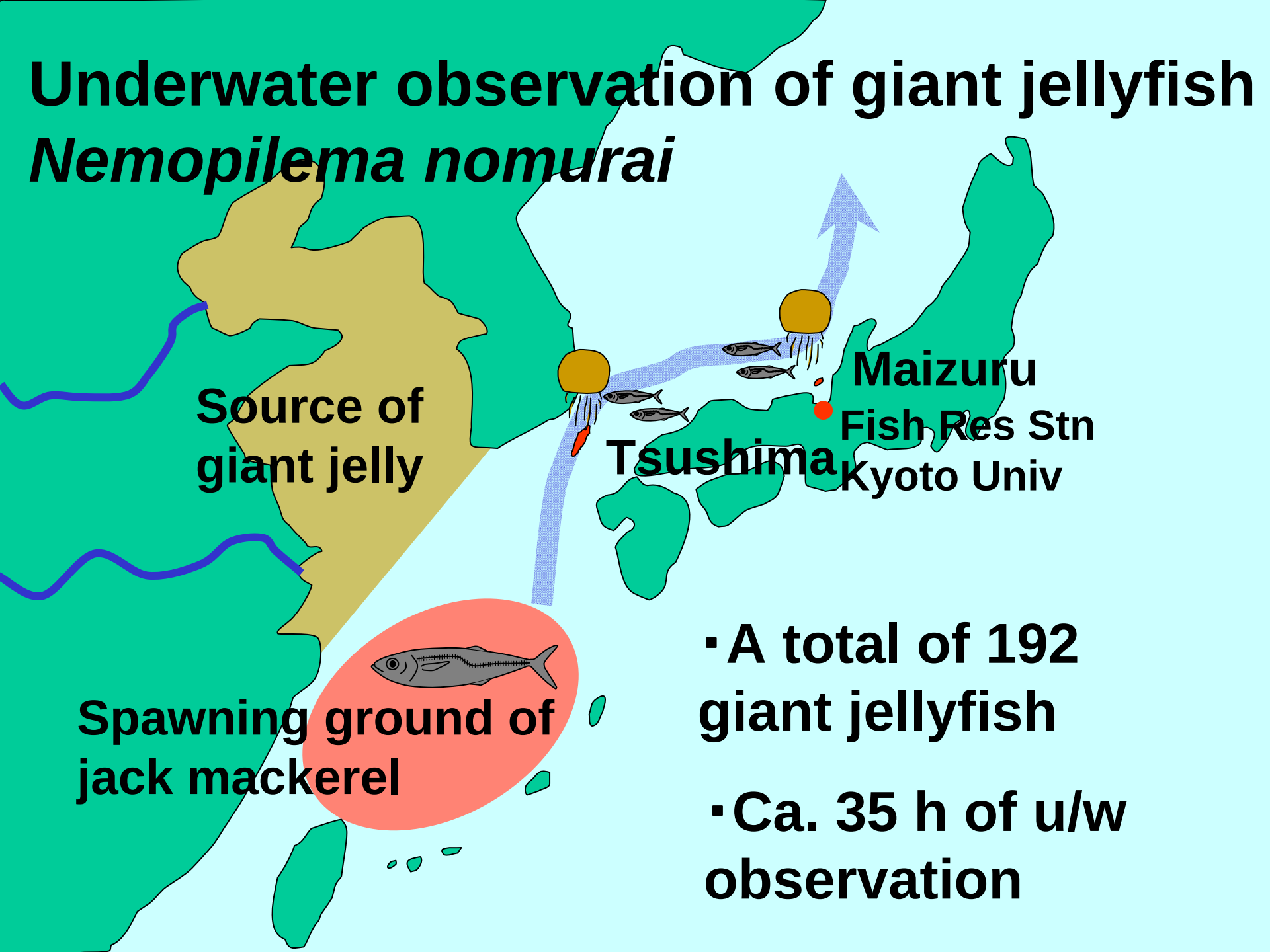
Artemia

Masuda et al. 2008. Fish Sci 74: 276-284.

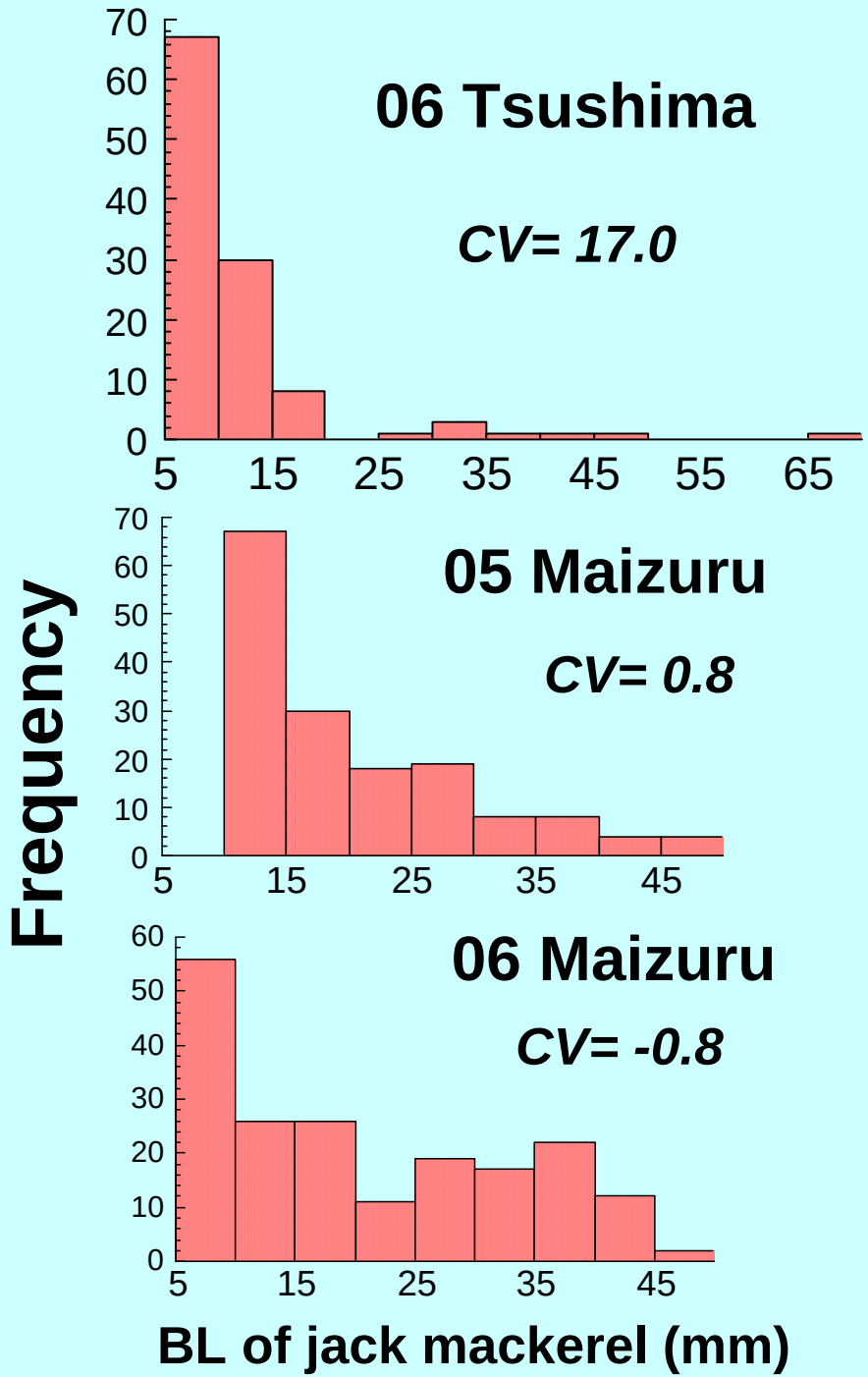


Jack mackerel stealing *Artemia* from jellyfish *Aurelia* sp. (Aug 2005).

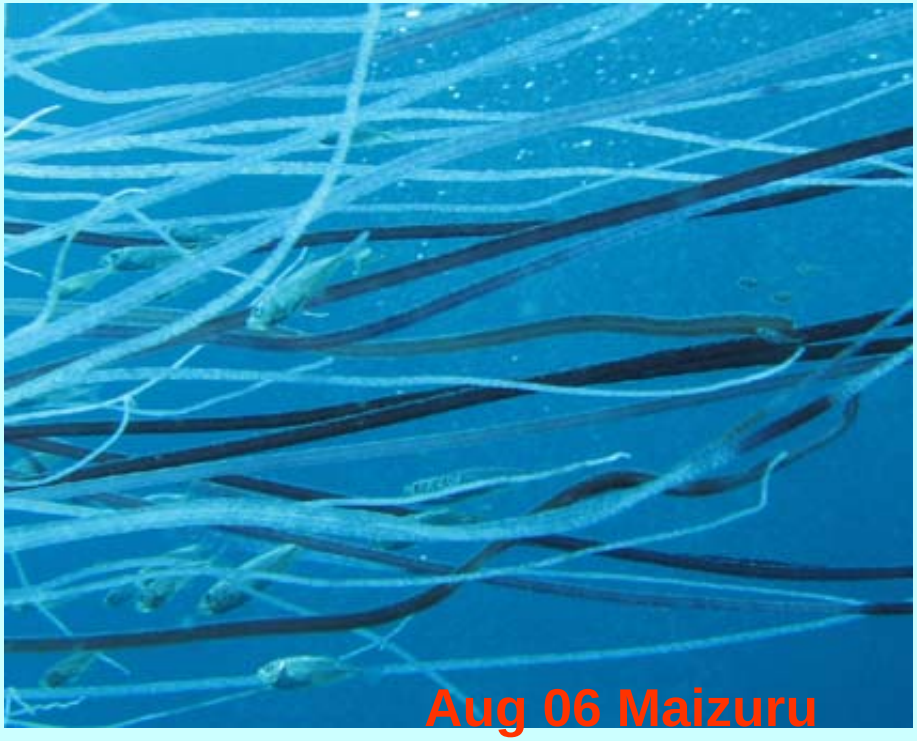
Underwater observation of giant jellyfish *Nemopilema nomurai*



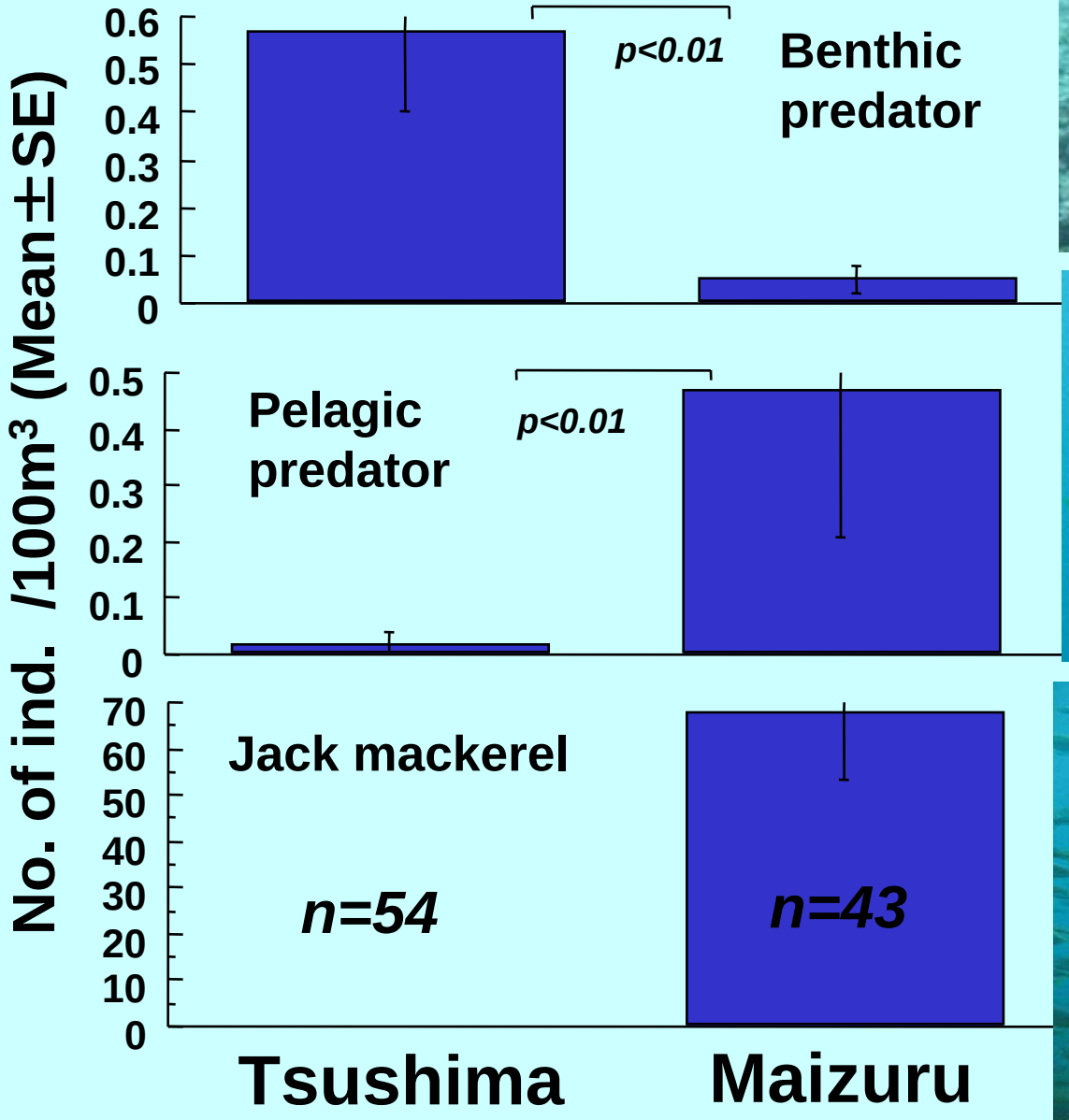
- A total of 192 giant jellyfish
- Ca. 35 h of u/w observation

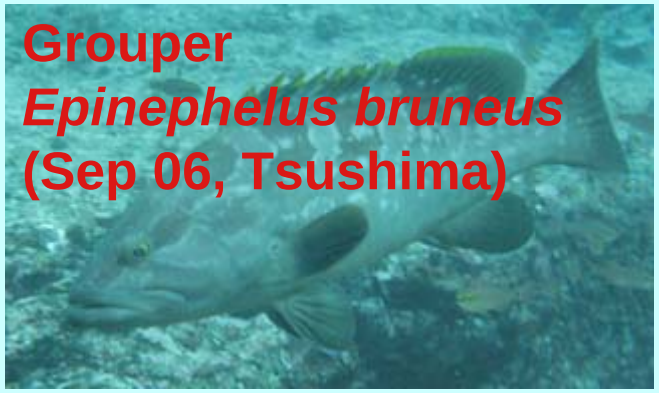

Frequency
06 Tsushima
CV= 17.0
05 Maizuru
CV= 0.8
06 Maizuru
CV= -0.8
BL of jack mackerel (mm)


Sep 06 Tsushima


Aug 06 Maizuru

Predator density assessed by Fin-kick transect





Masuda 2009a Hydrobiologia 616: 269-277.

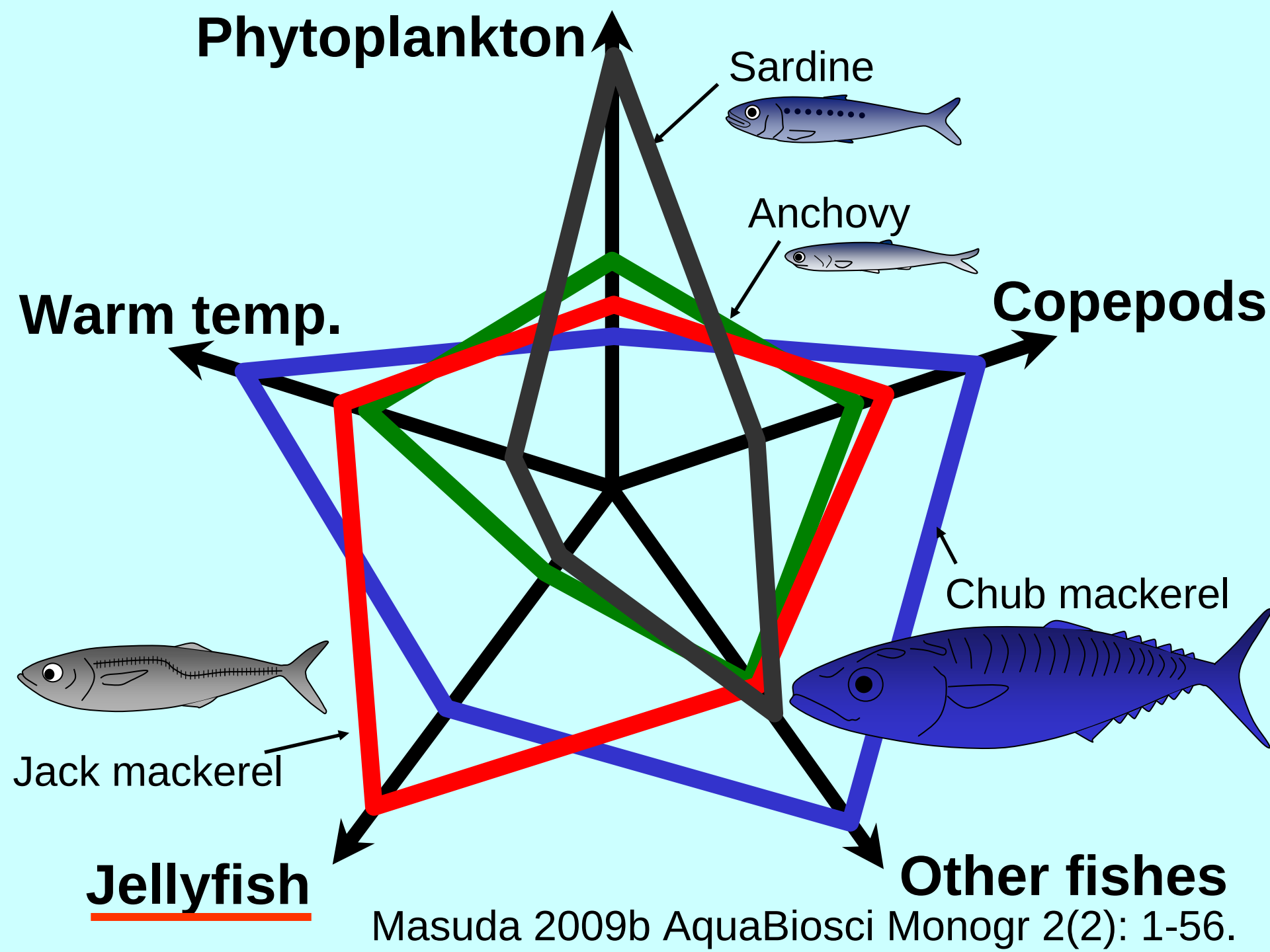
Function of association with jellyfish gradually change ontogenetically

Feeding

Hiding

Aggregating

& Migration



Masuda 2009b AquaBiosci Monogr 2(2): 1-56.

Conclusion

Fish-jelly interaction is species-specific and size (stage) dependent

Jellyfish can be energy and nutritious source for fishes

To prevent jellyfish blooms

1) Reduce fishing pressure

2) Conserve habitats for reef fish

(Nov 2009, off Maizuru)

Reproduction