A Lagrangian modeling approach for Pacific saury migrations

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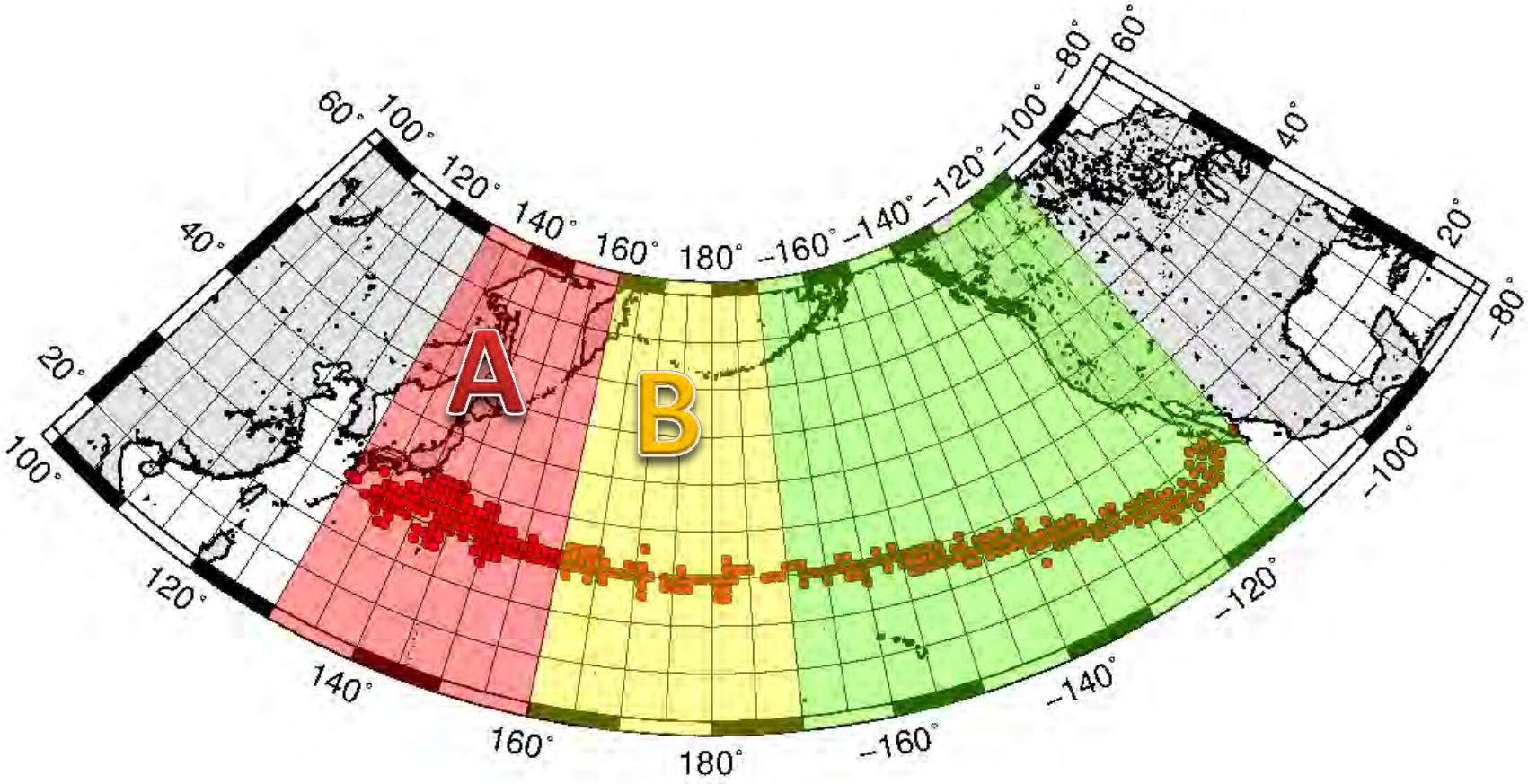
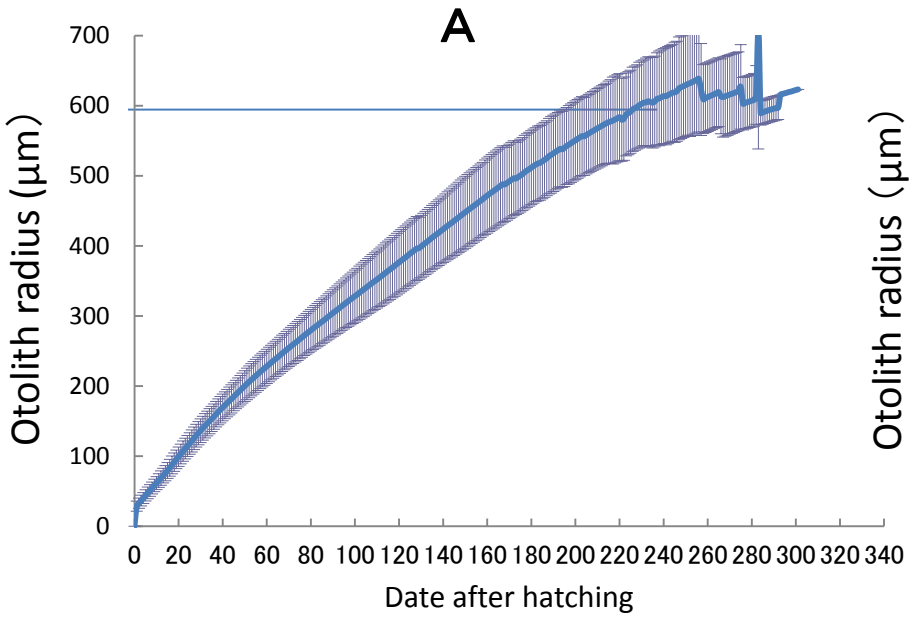
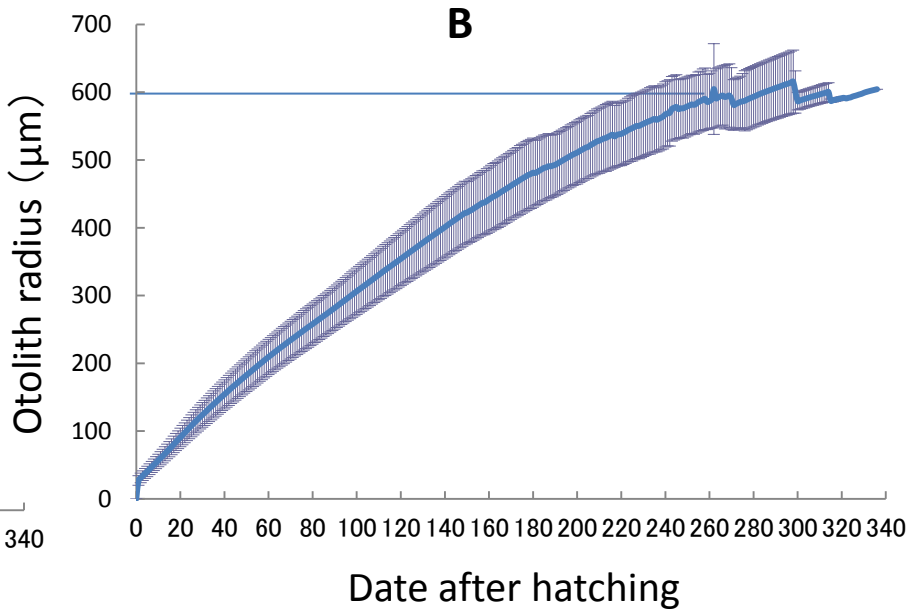
Pacific saury (Sanma) distribute widely in North Pacific.
Otolith analysis 2005 year class

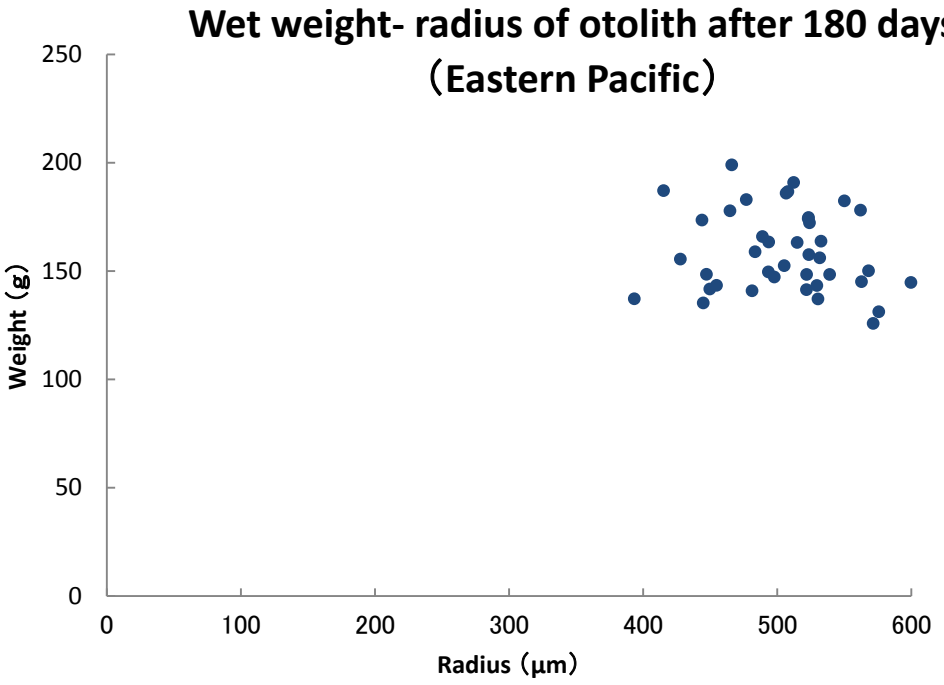


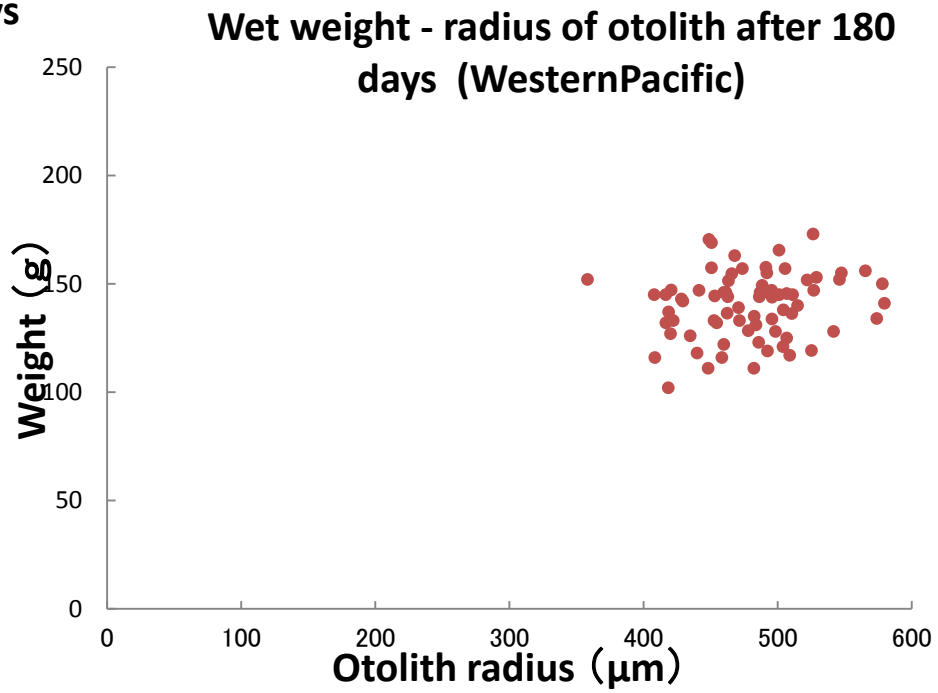




A	130E～160E	48
B	160E～170W	61

2005 year class





No relation ! Between 180 days juvenile and adult

Saury caught in the “Eastern Pacific”: Growth until 300 days is better than those in Western.

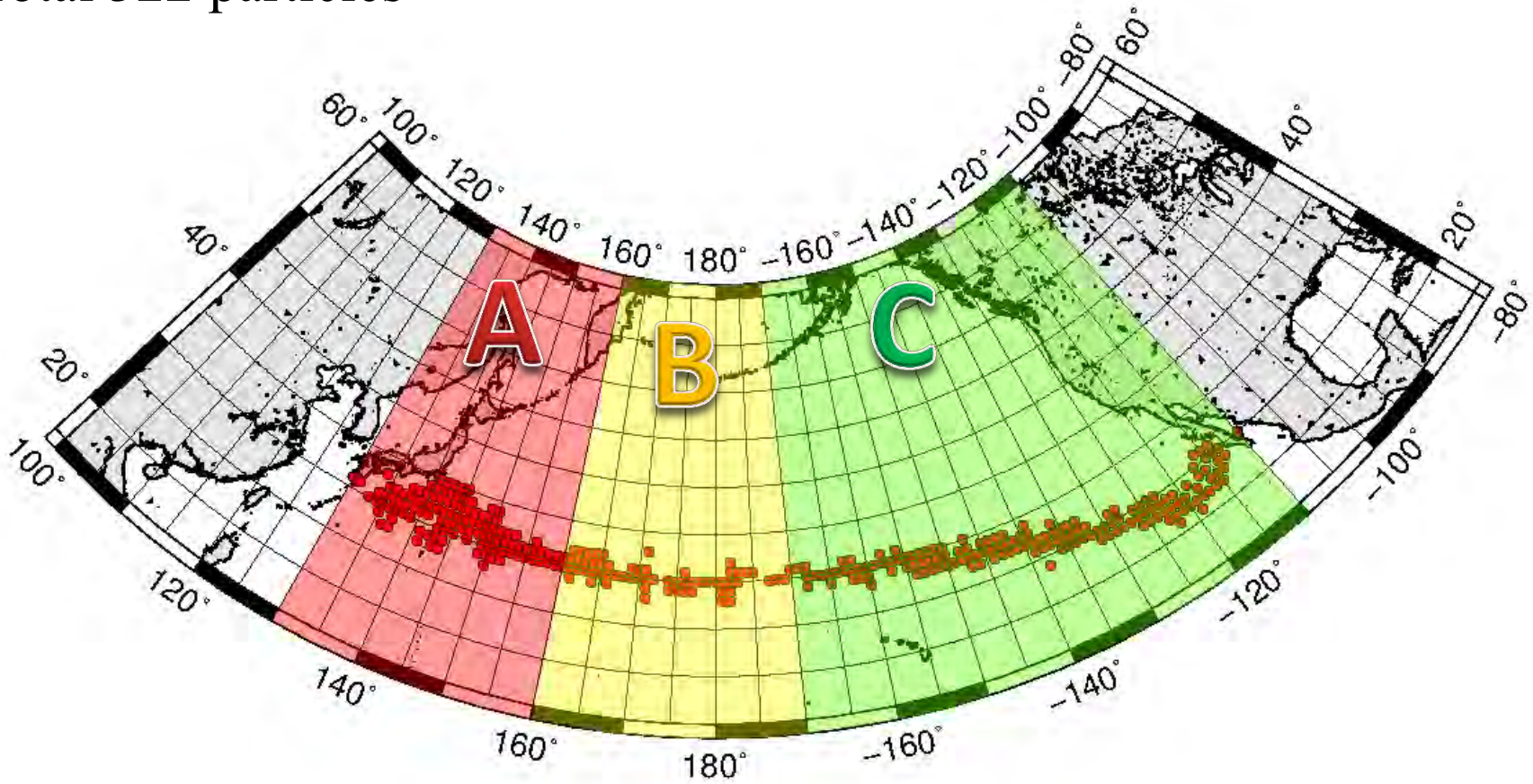
HOWEVER

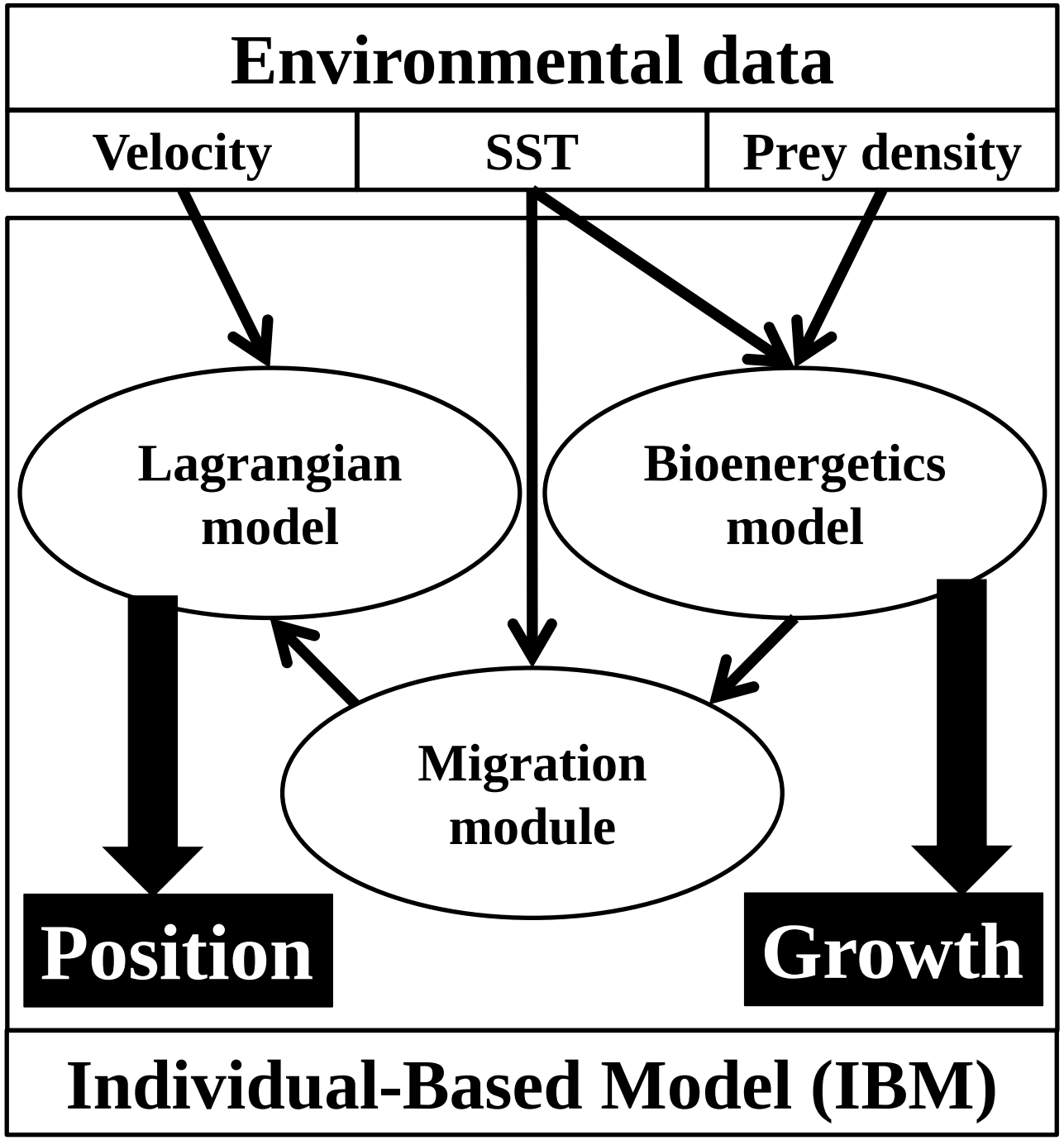
There is no co-relation between early growth and adult weight

So we use numerical simulation

Initial position 2002, Feb.1st

- 130°E － 110°W, 18.5 ≤ T ≤ 20.0 °C （Iwahashi et al. ,2006)
- Total 322 particles




Environmental data
Velocity
SST
Prey density
Lagrangian model
Bioenergetics model
Migration module
Position
Growth
Individual-Based Model (IBM)

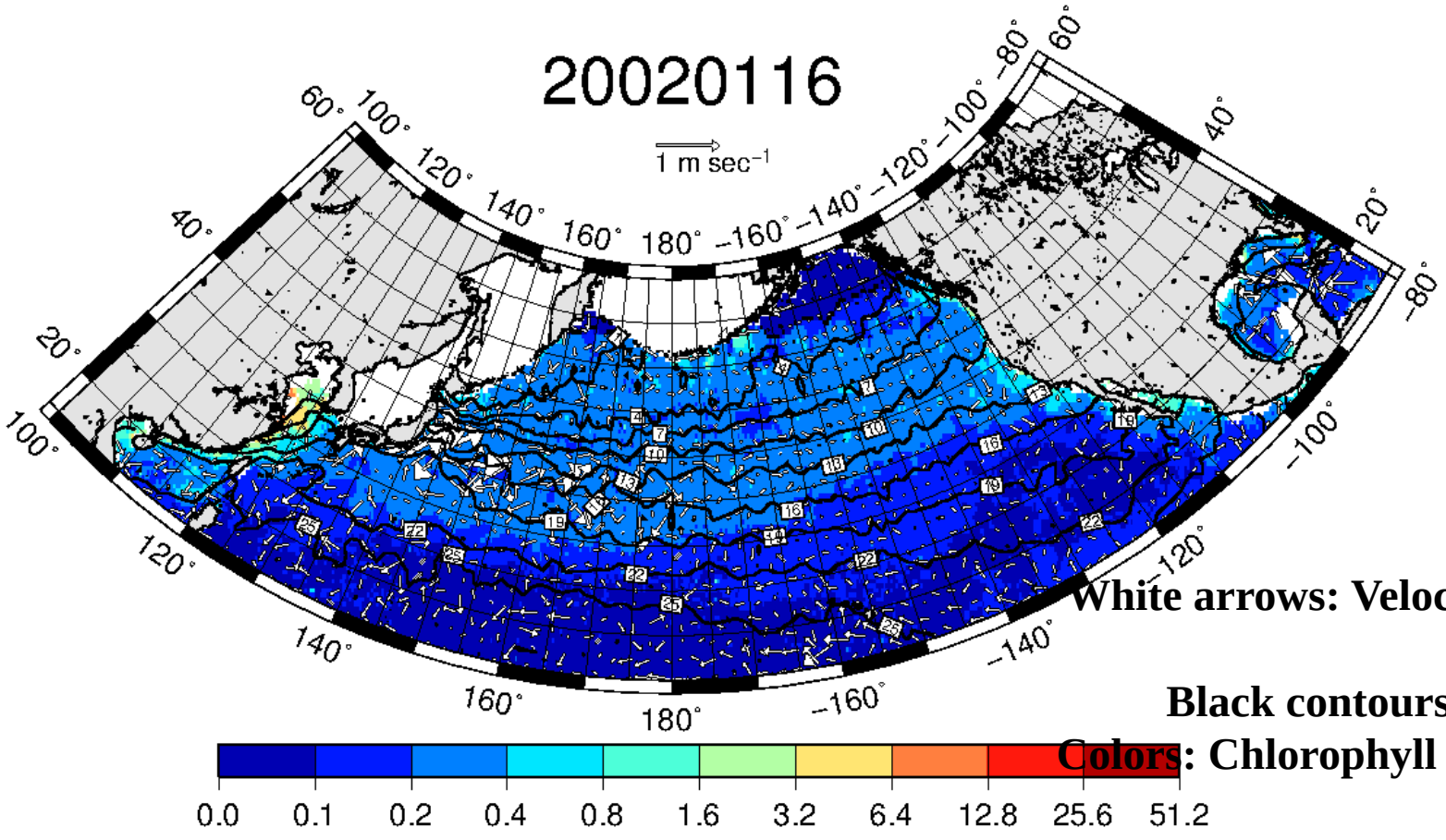
① Environmental data

Velocity: Ambe08 (1/3º) (D. Ambe, FRA)
estimated from satellite altimetry and drifting buoy

SST: MODIS/Terra (1/12º) (T. Kameda, FRA)

Chlorophyll *a*: SeaWiFS (1/12º) (T. Kameda, FRA)

1.0 [mg chl *a* m^{-3}] is converted into **ZS** 0.38 [g m^{-3}], **ZL** 0.75 [g m^{-3}], **ZP** 0.15 [g m^{-3}] (Ikeda et al., 2008)



White arrows: Velocity (m sec^{-1})

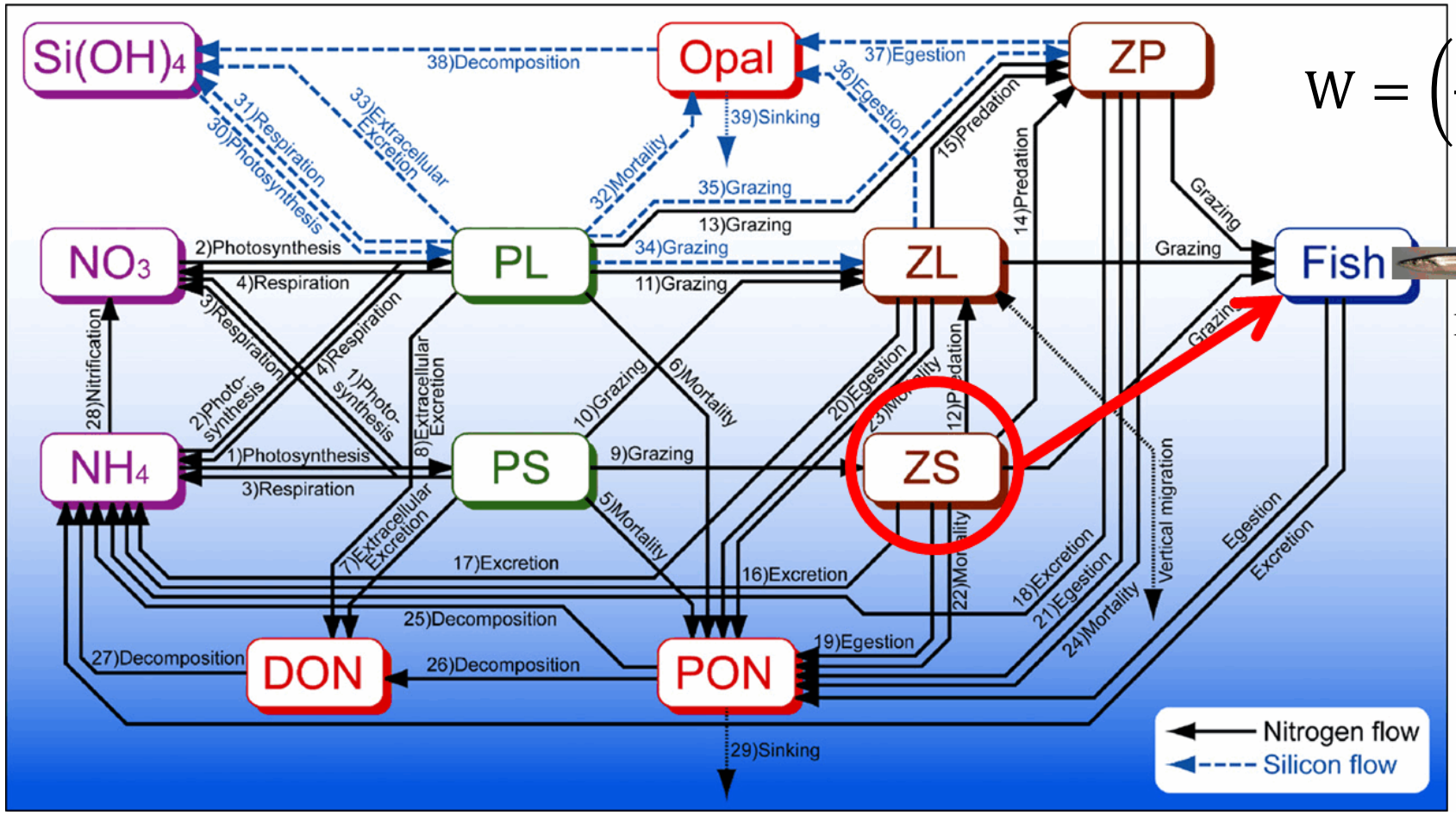
Black contours: SST (ºC)

Colors: Chlorophyll *a* (mg m^{-3})

② Bioenergetics model

NEMURO.FISH

North Pacific Ecosystem Model for Understanding Regional Oceanography
For Including Saury and Herring



$$W = \left(\frac{KL}{6.13}\right)^3$$

KL < 2.5

Ito et al. (2004), Megrey et al. (2007), Mukai et al. (2007)

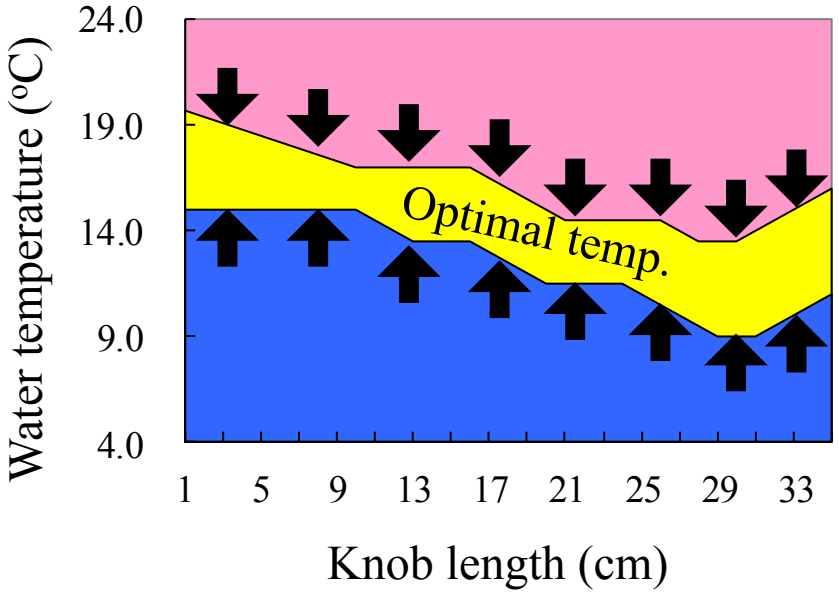
③ Migration module

Feeding migration

Saury search for local optimal habitats.

(1) Optimal temperature for fish

(2) Maximum growth for fish

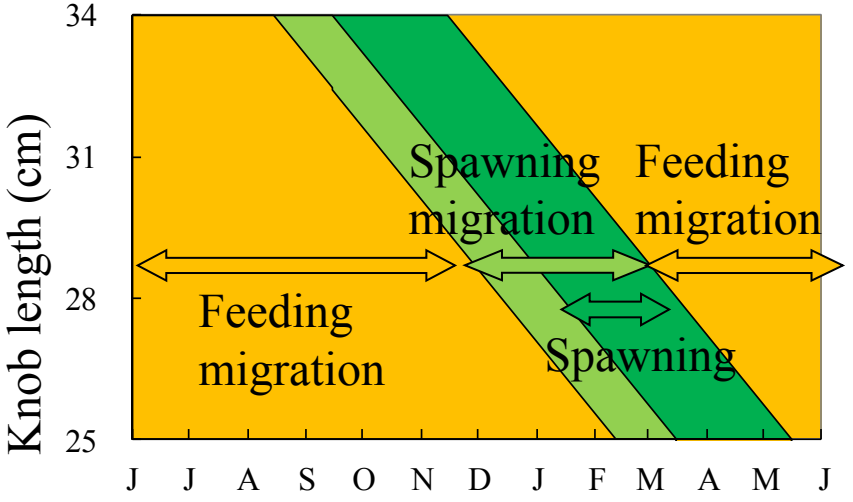


Spawning migration

Spawning migration starts 1 month before the spawning beginning date, depending on knob length (> 25 cm), and the duration is 2 months.

(1) Spawning temperature (17 – 25 °C)

(2) Maximum growth for larvae



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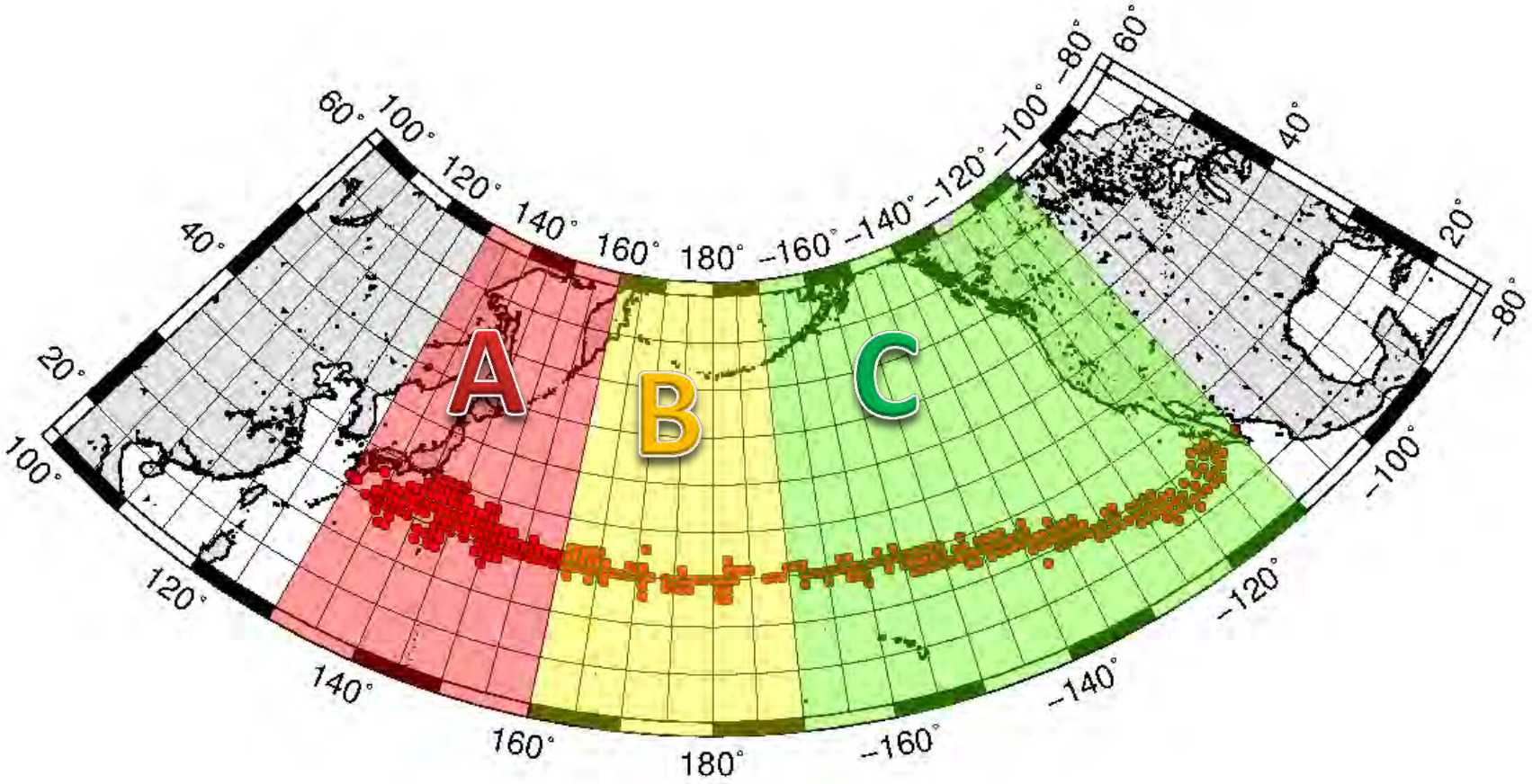
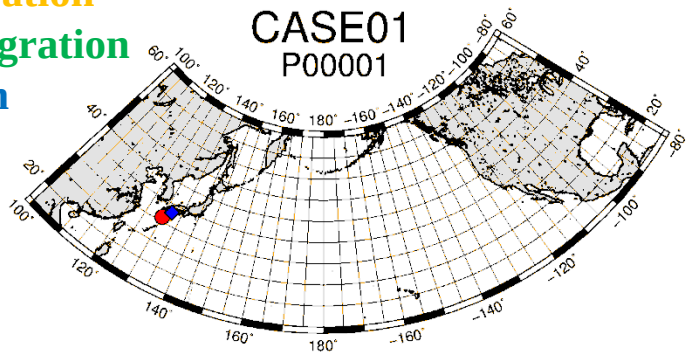
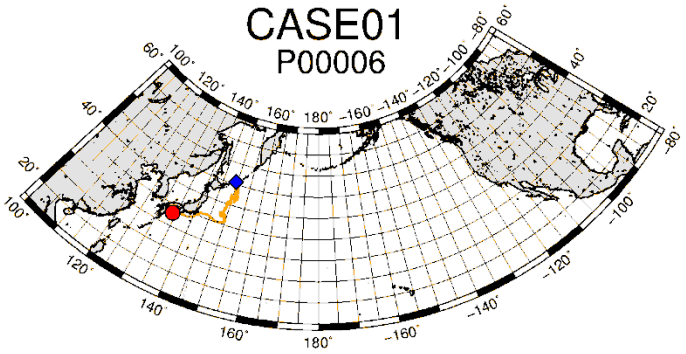
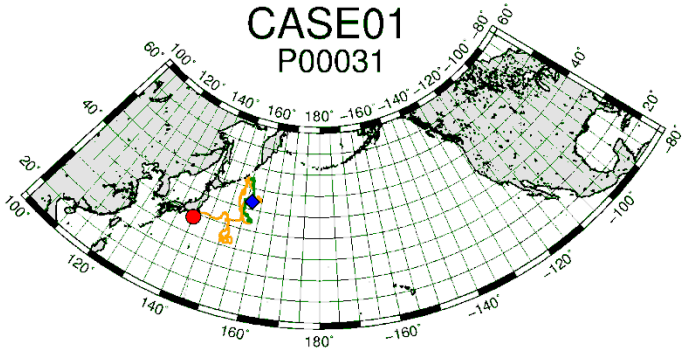


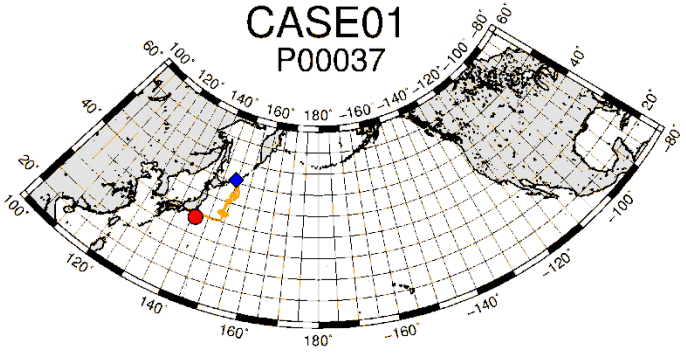
Born in「A」, spawning in「A」(130g～) after 2yrs

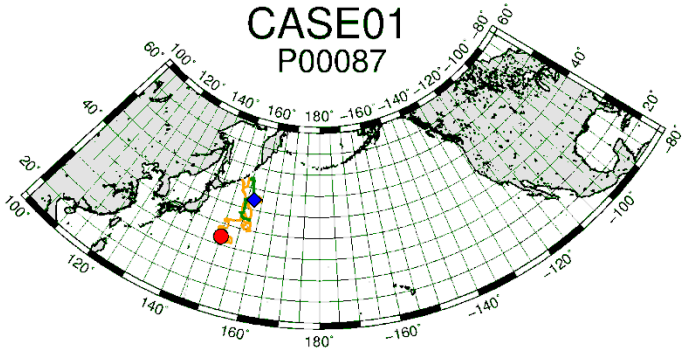
Initial position
Feeding migration
Spawning migration
Final position

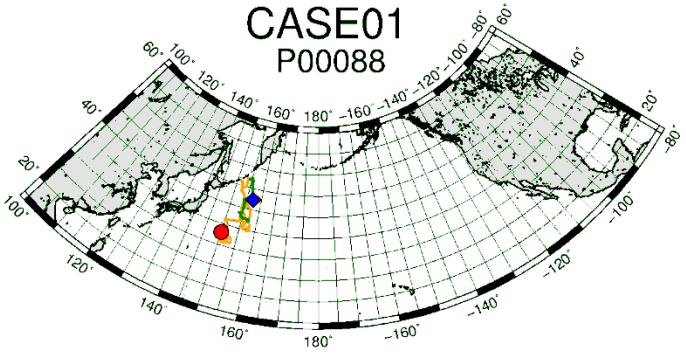




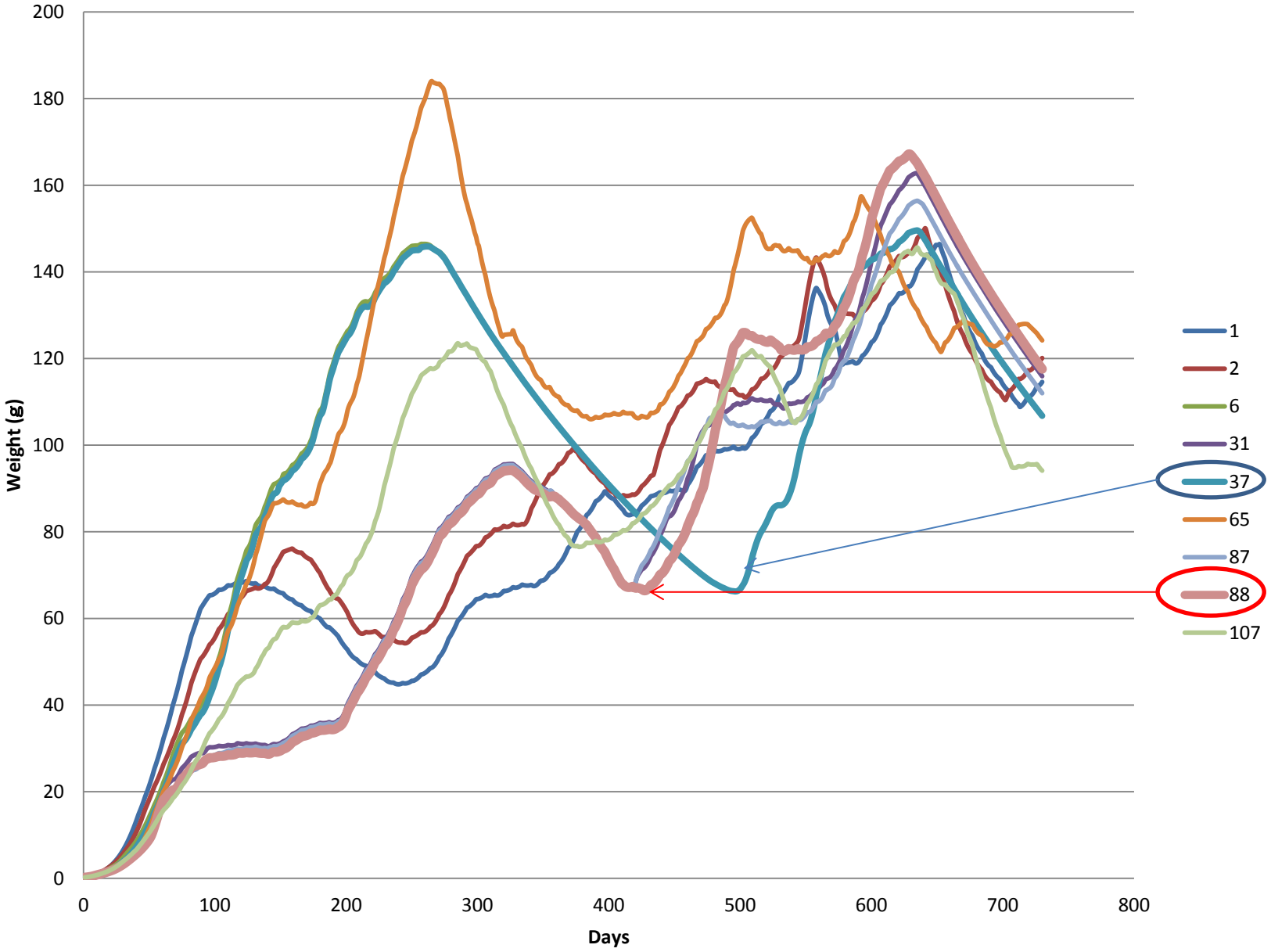




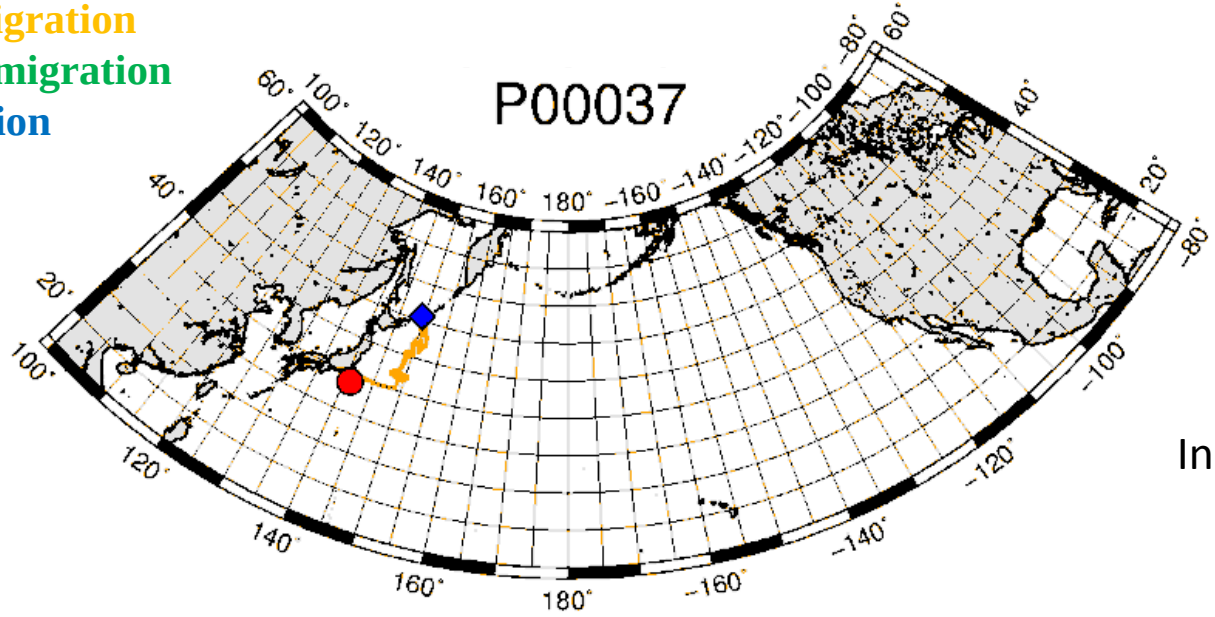




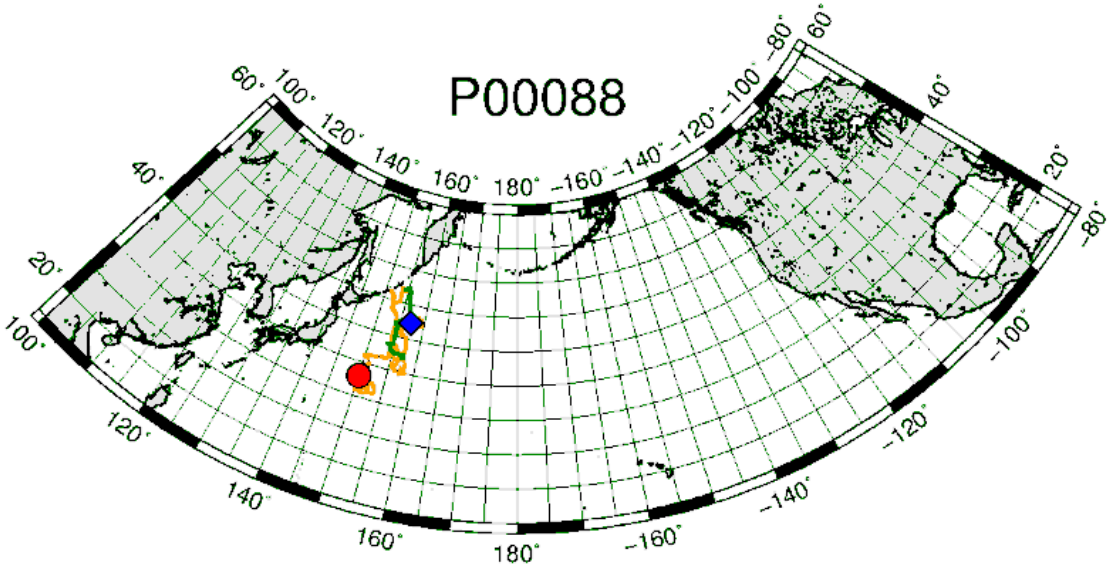
Born in “A” Begin spawning in “A”



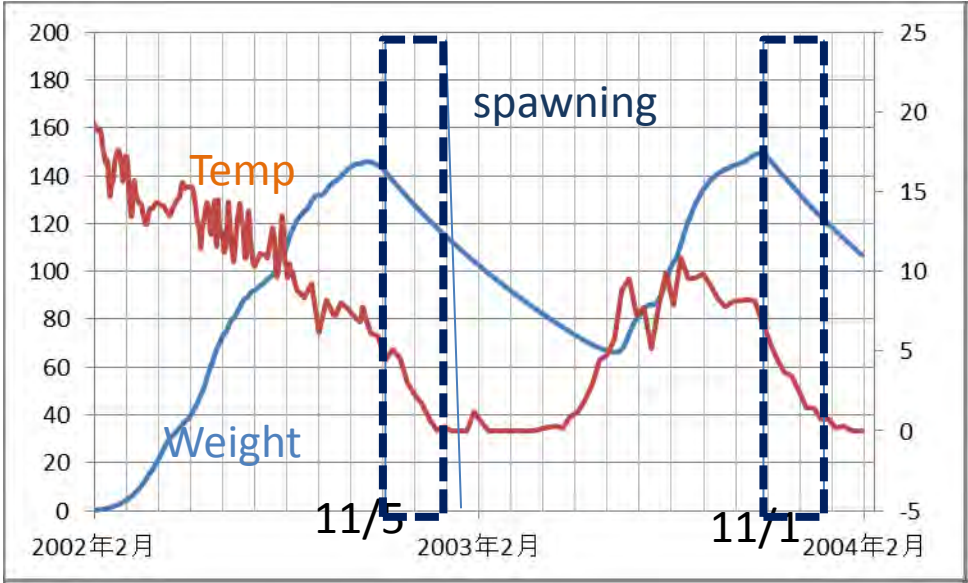
Initial position
Feeding migration
Spawning migration
Final position

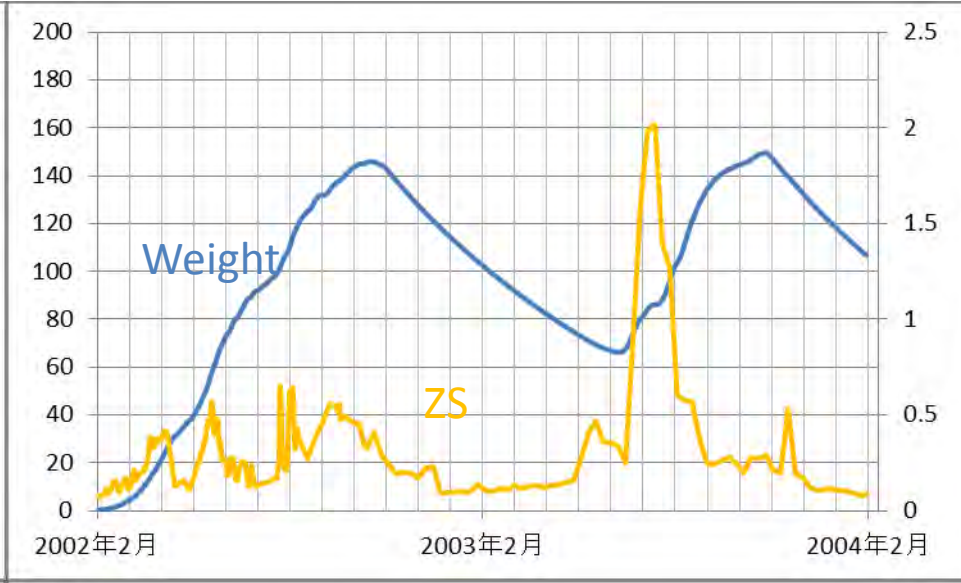


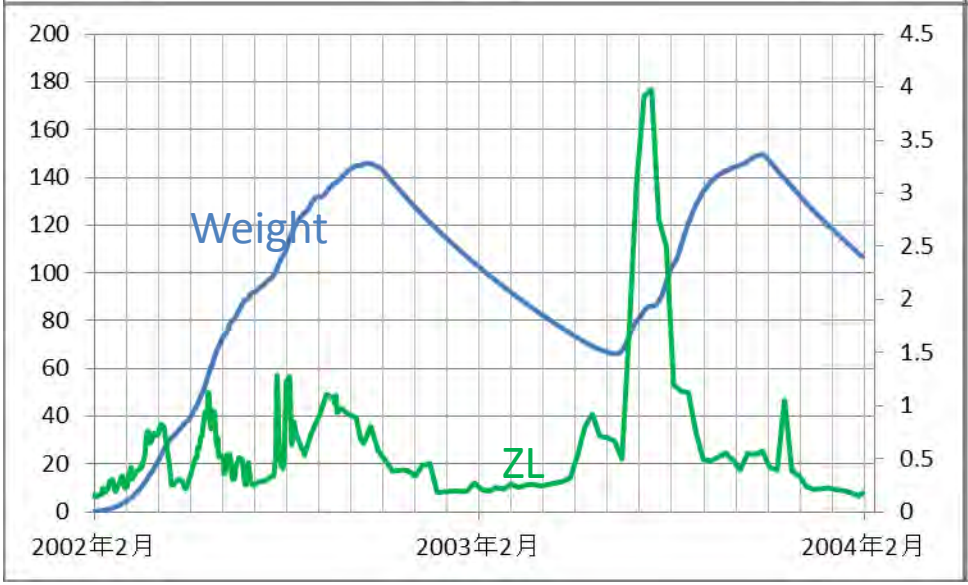
Initial :good growth

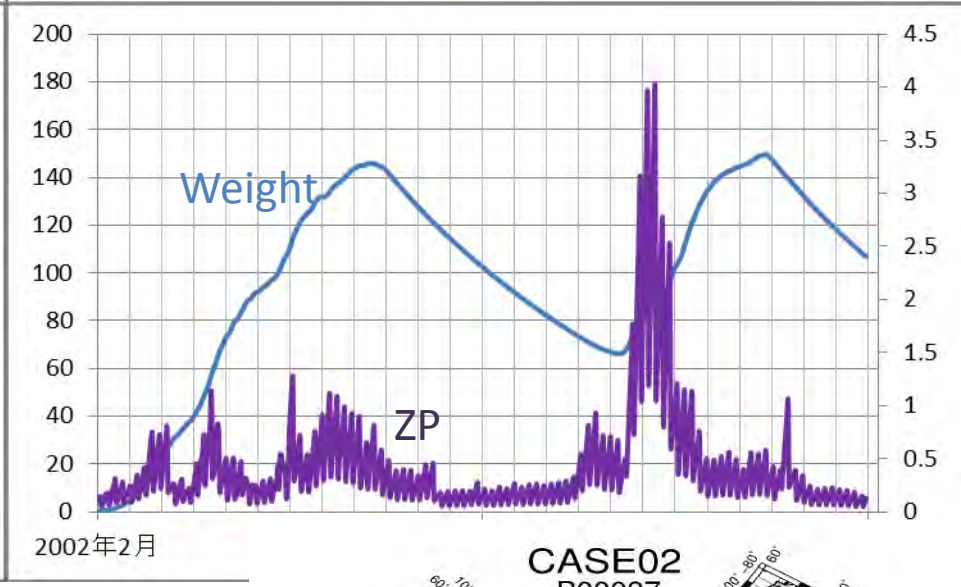


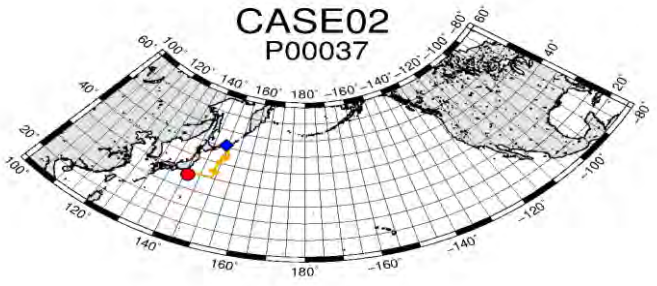
Final : heavy


spawning
Temp
Weight
11/5
11/1
2002年2月
2003年2月
2004年2月

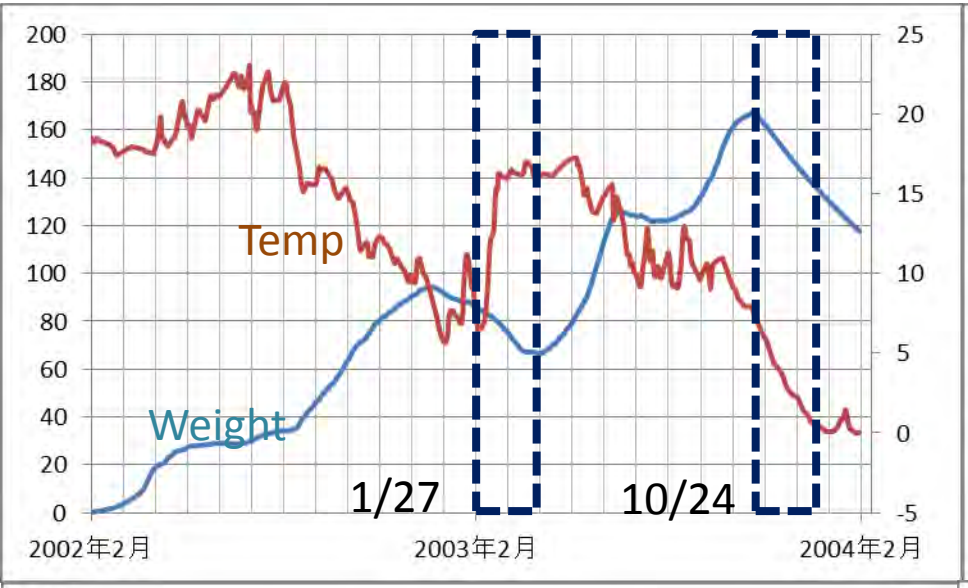

Weight
ZS
2002年2月
2003年2月
2004年2月

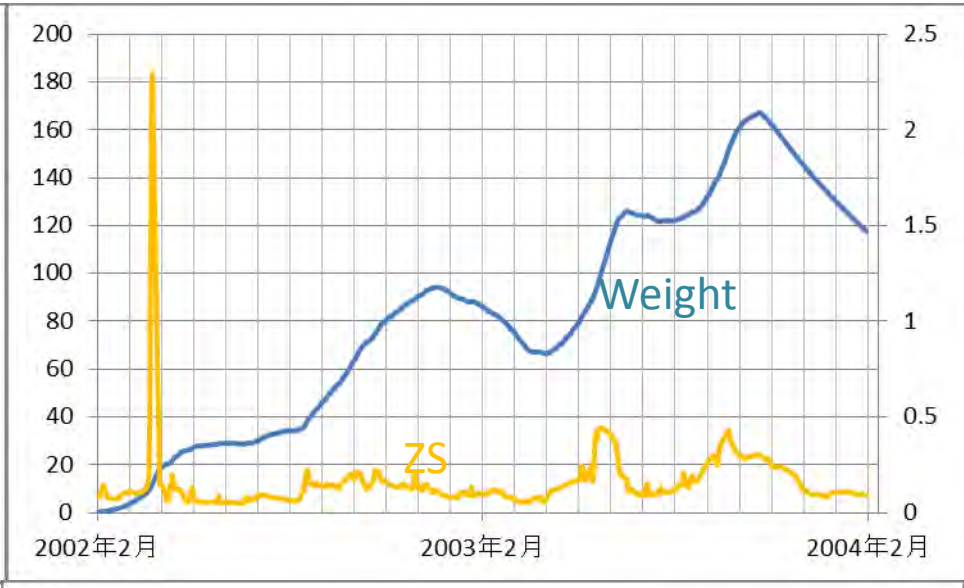

Weight
ZL
2002年2月
2003年2月
2004年2月


Weight
ZP
2002年2月

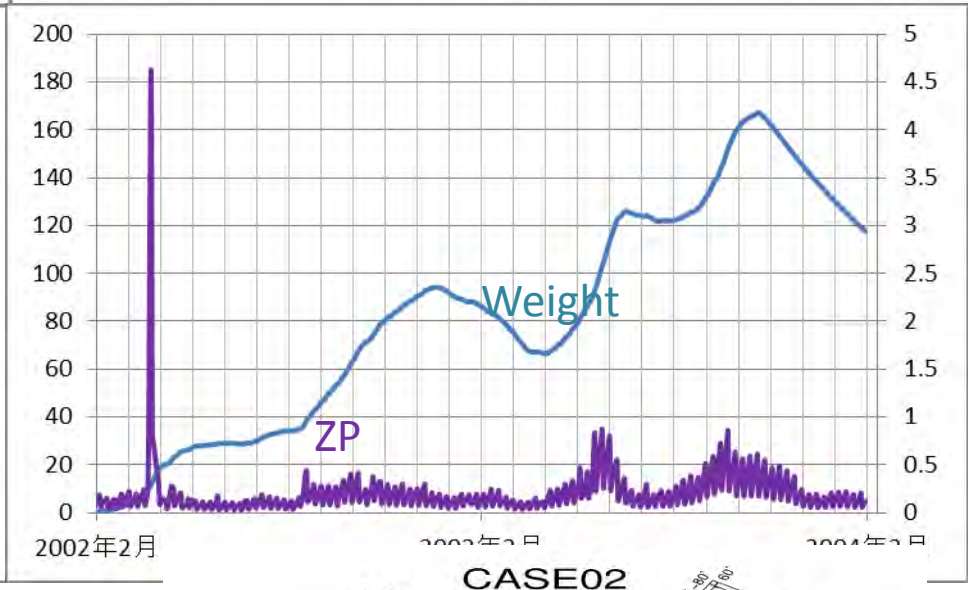

CASE02
P00037

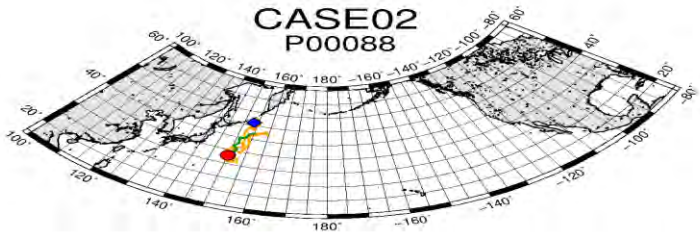
Saury No. 37


Temp
Weight
1/27
10/24
2002年2月
2003年2月
2004年2月

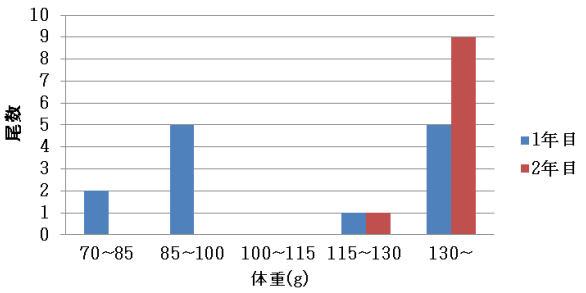

Weight
ZS
2002年2月
2003年2月
2004年2月

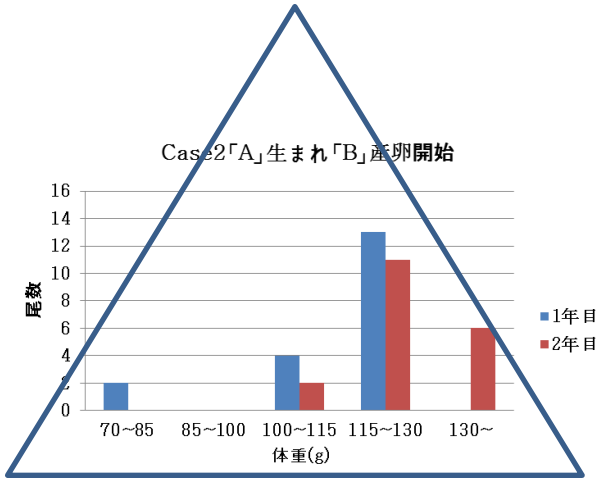

Weight
ZL
2002年2月
2003年2月
2004年2月

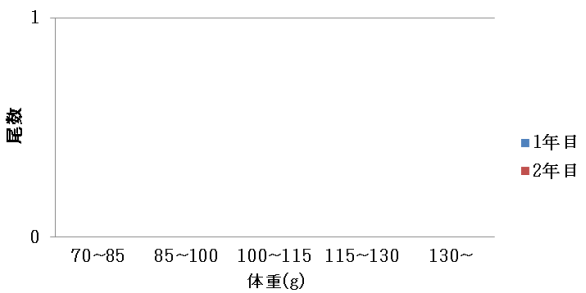

Weight
ZP
2002年2月

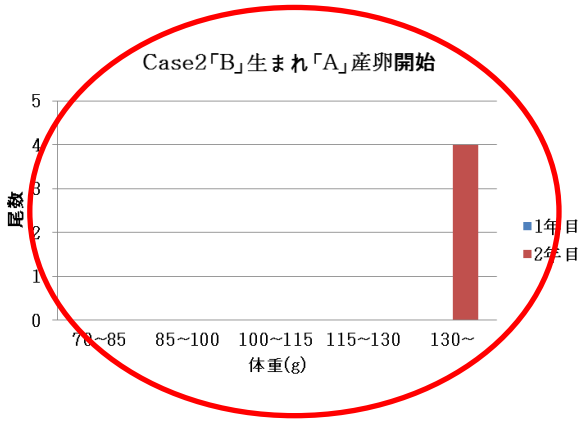

CASE02
P00088

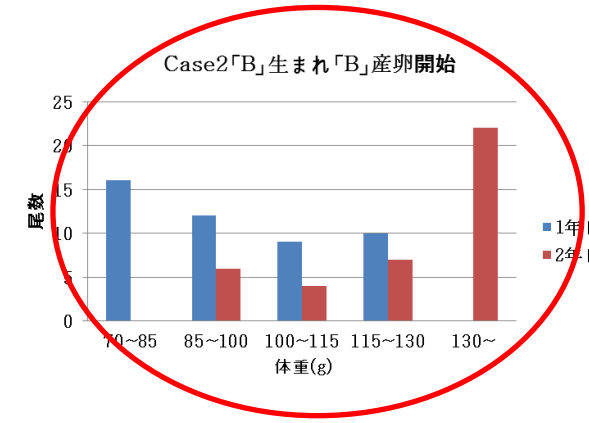
Saury No.88

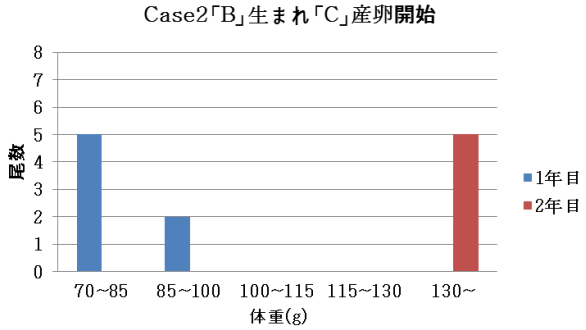

Case2「A」生まれ「A」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目

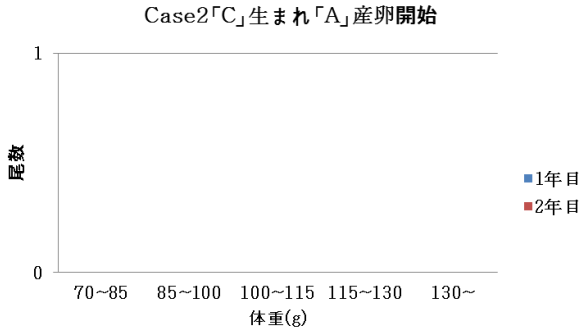

Case2「A」生まれ「B」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目

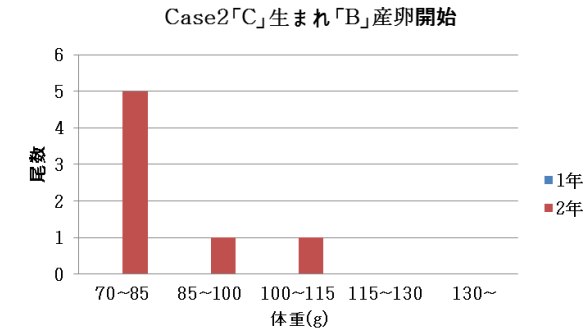

Case2「A」生まれ「C」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目

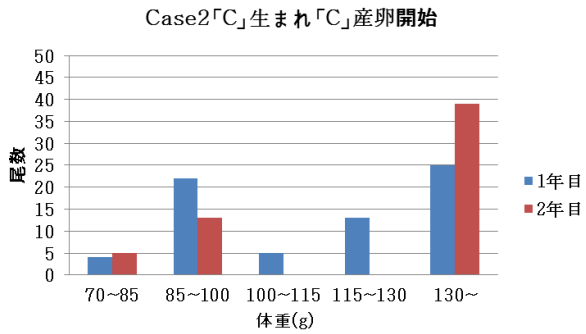

Case2「B」生まれ「A」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目


Case2「B」生まれ「B」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目


Case2「B」生まれ「C」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目


Case2「C」生まれ「A」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目


Case2「C」生まれ「B」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目


Case2「C」生まれ「C」産卵開始
尾数
体重(g)
70~85
85~100
100~115
115~130
130~
1年目
2年目

Thank you !!

おなかすいた～～

Not saury but “SANMA”