Timing of breeding and prey switching in Rhinoceros Auklets: match-mismatch of the phenology explains between year variation of chick growth

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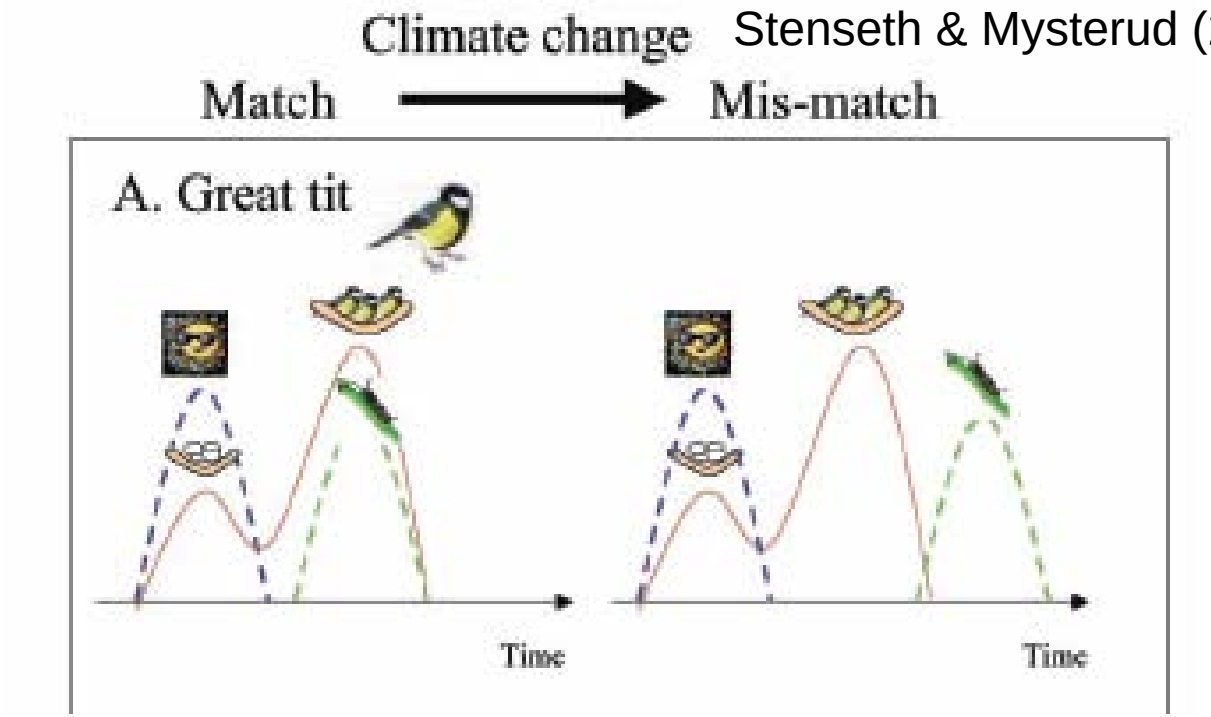
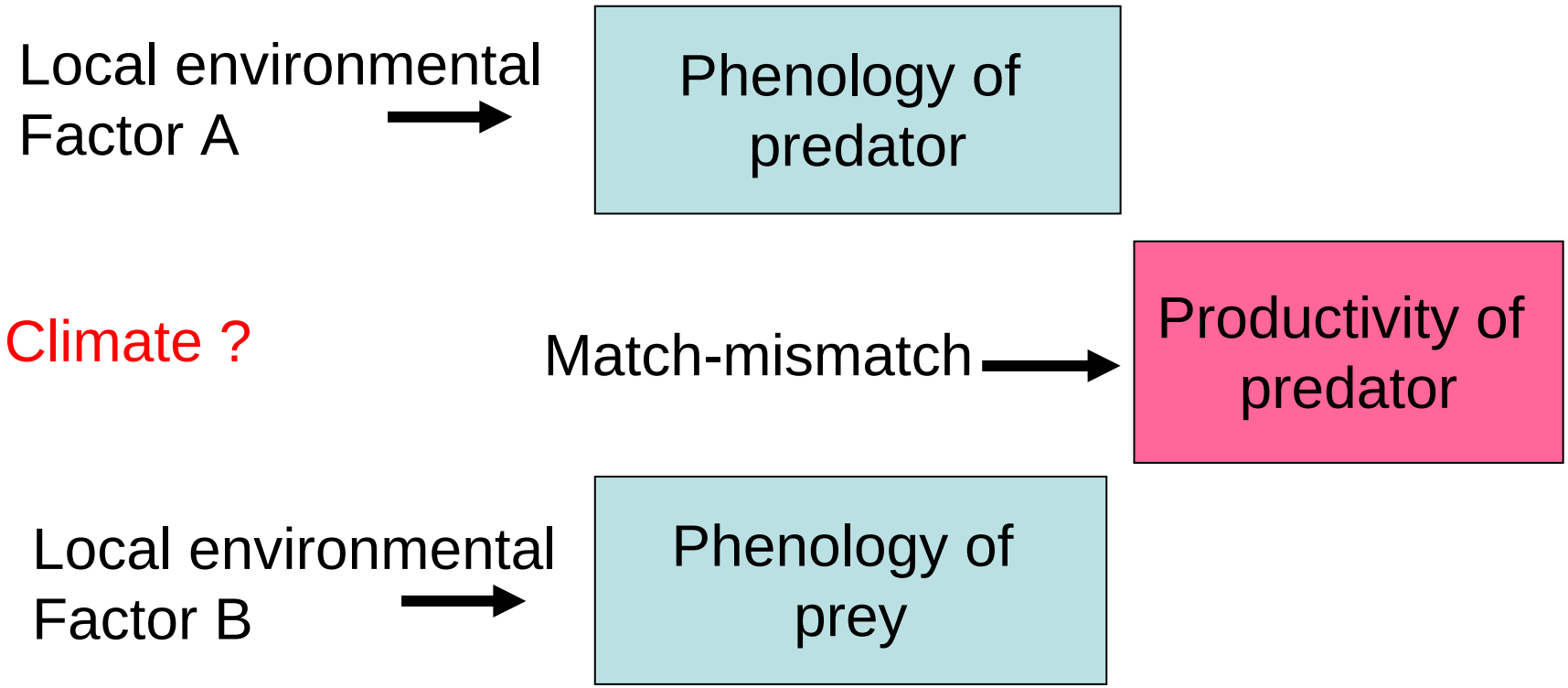
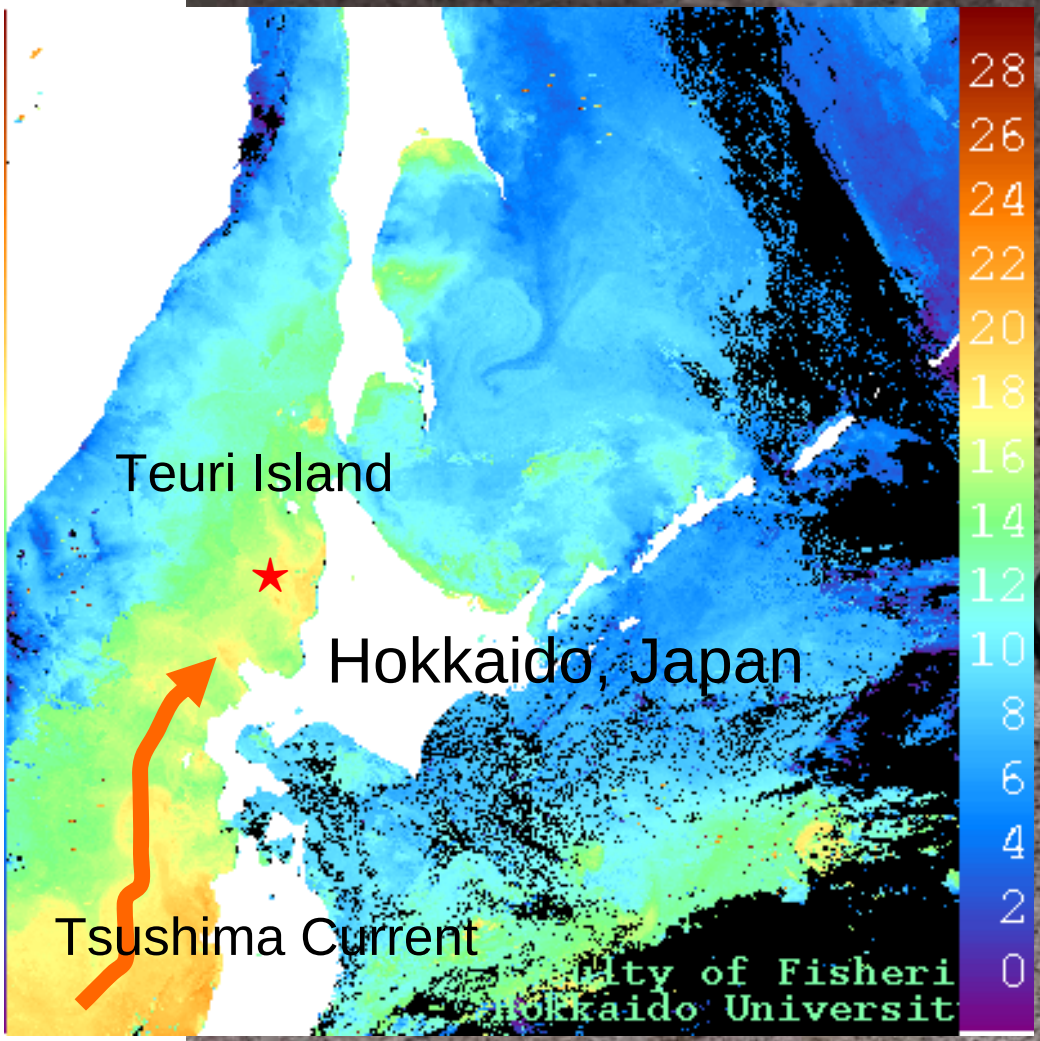


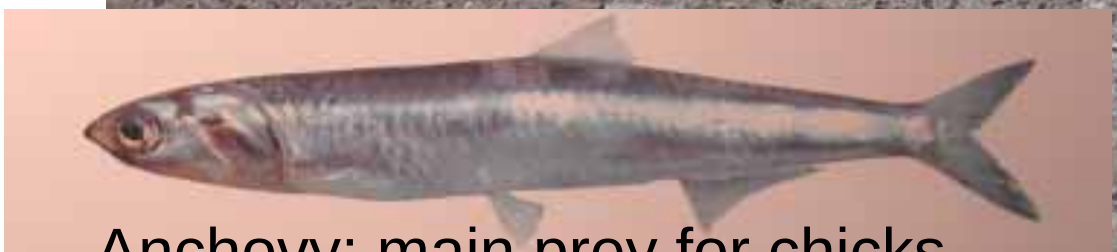
Stenseth & Mysterud (2002) PNAS

Different and independent factors affect the phenology of predator and prey ?


Local environmental
Factor A
Phenology of
predator
Climate ?
Match-mismatch
Productivity of
predator
Local environmental
Factor B
Phenology of
prey



Rhinoceros Auklets (RHAU) Piscivorous seabirds



Anchovy: main prey for chicks

Q4
Chick growth
Mass at fledging
Fledging success

Anchovy
stock size

Timing of
breeding of RHAU

Q2 13 C water ?

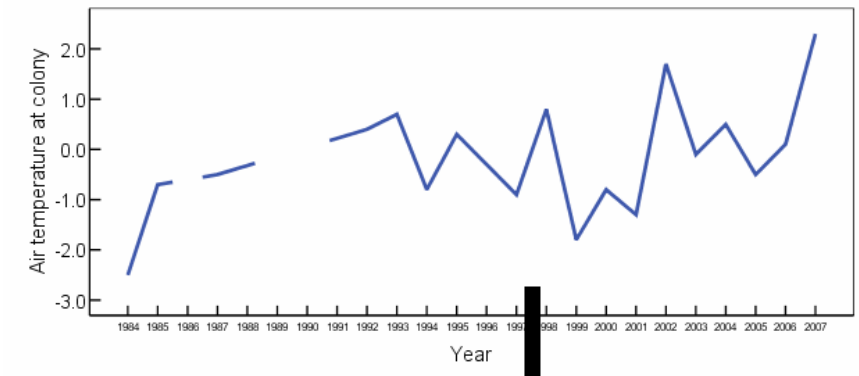
Q1 Spring air temp.?
Spring SST ?

Q5 Climate ?

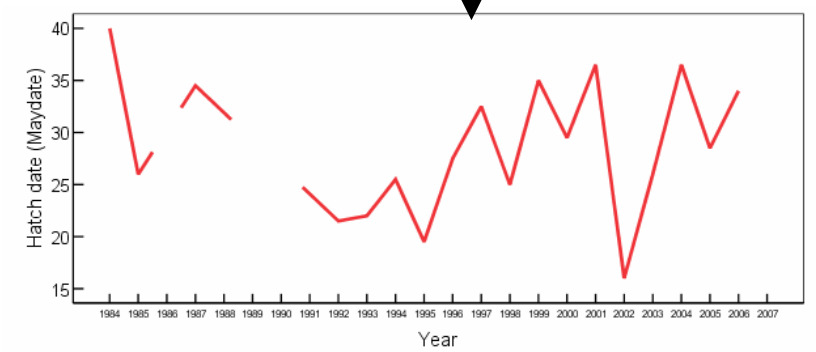
1 Factors affecting timing of RHAU’s breeding

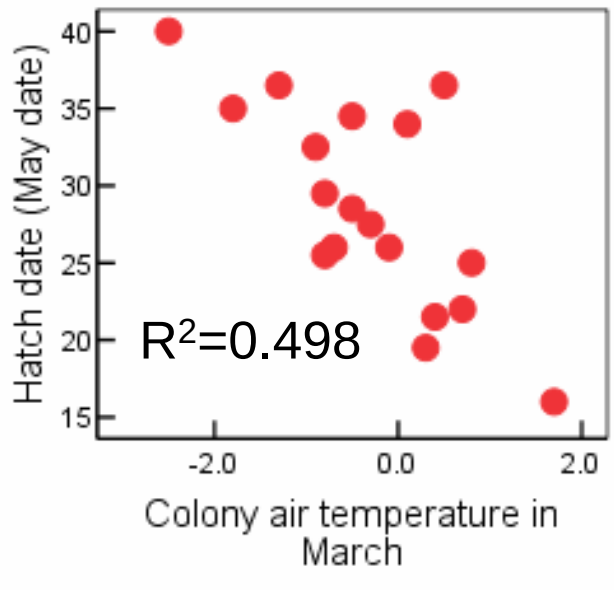
RHAU started breeding earlier when spring air temperature was high

Spring air temp. at colony



Mean hatch date





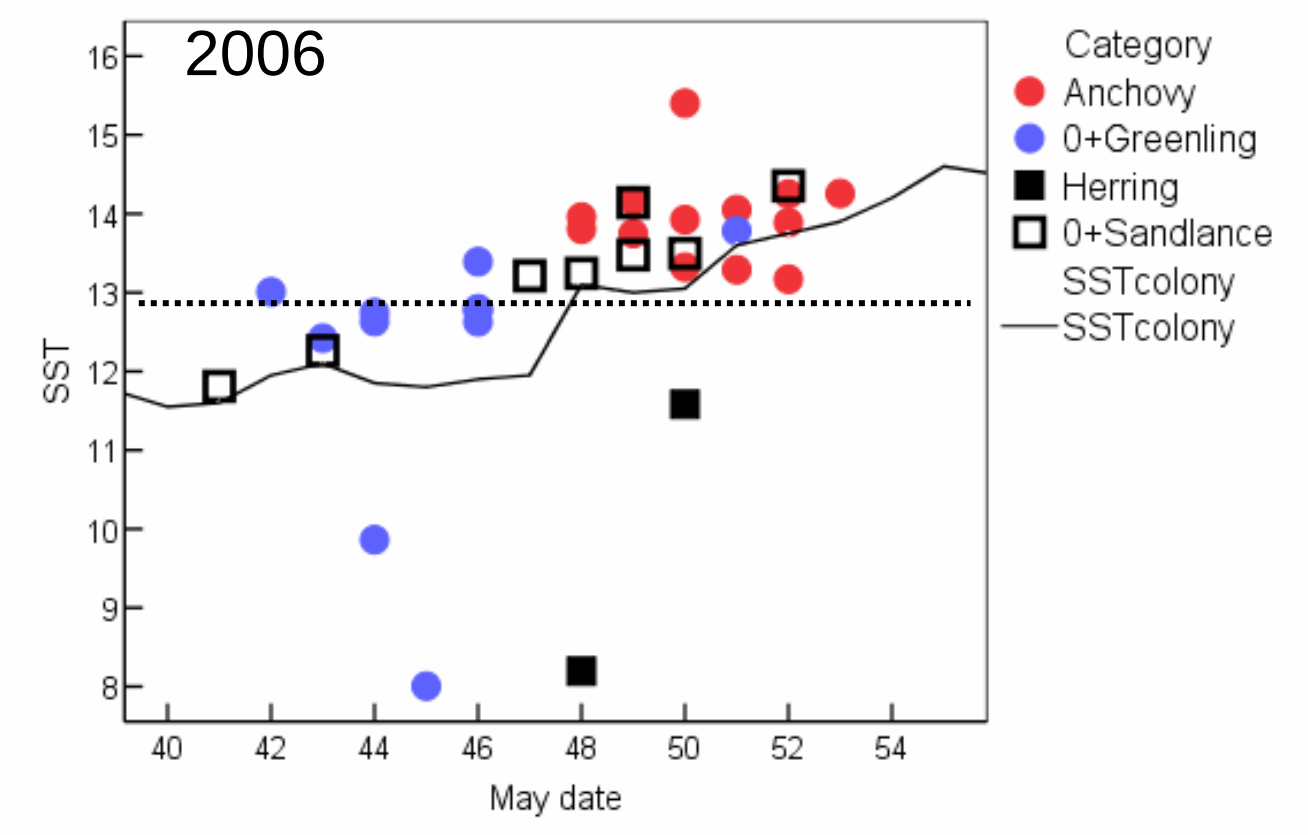
SST in March and April had marginal effects on hatch date

r2=0.179~0.191, P=0.045~0.051

2 Factors affecting timing of prey switching to anchovy

SST of waters where RHAU fed on anchovy

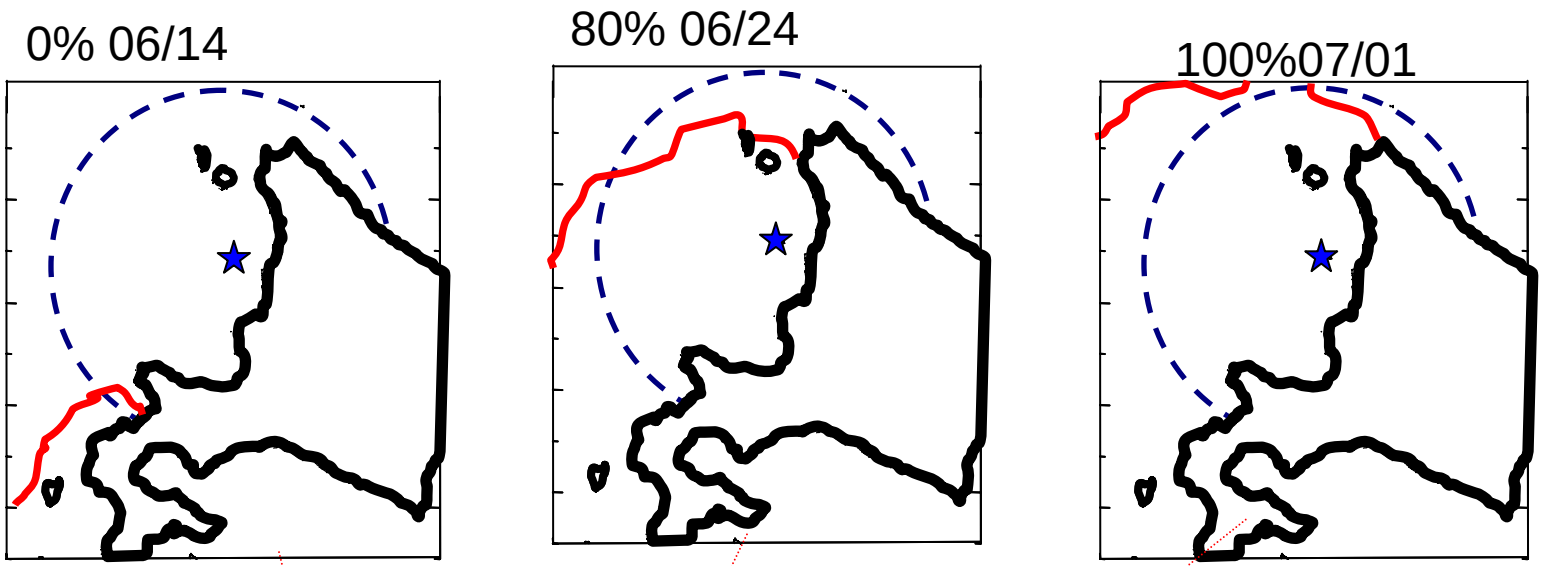
RHAU fed on anchovy in waters with SST > 13 C



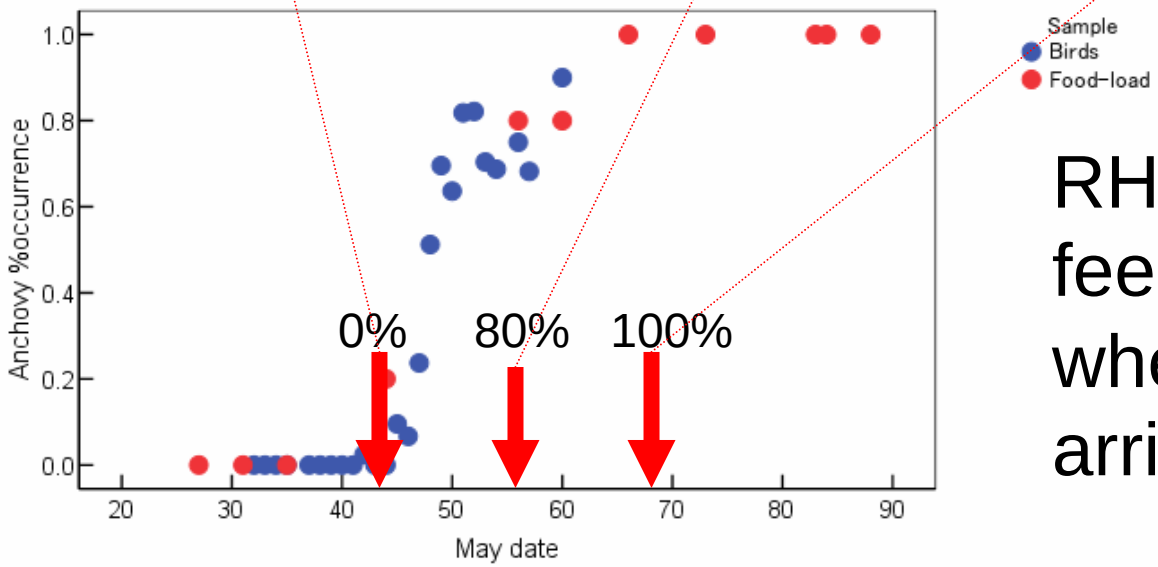
SSTs in the location where RHAU caught each species of fish

2006

a) Foraging range and 13 C water

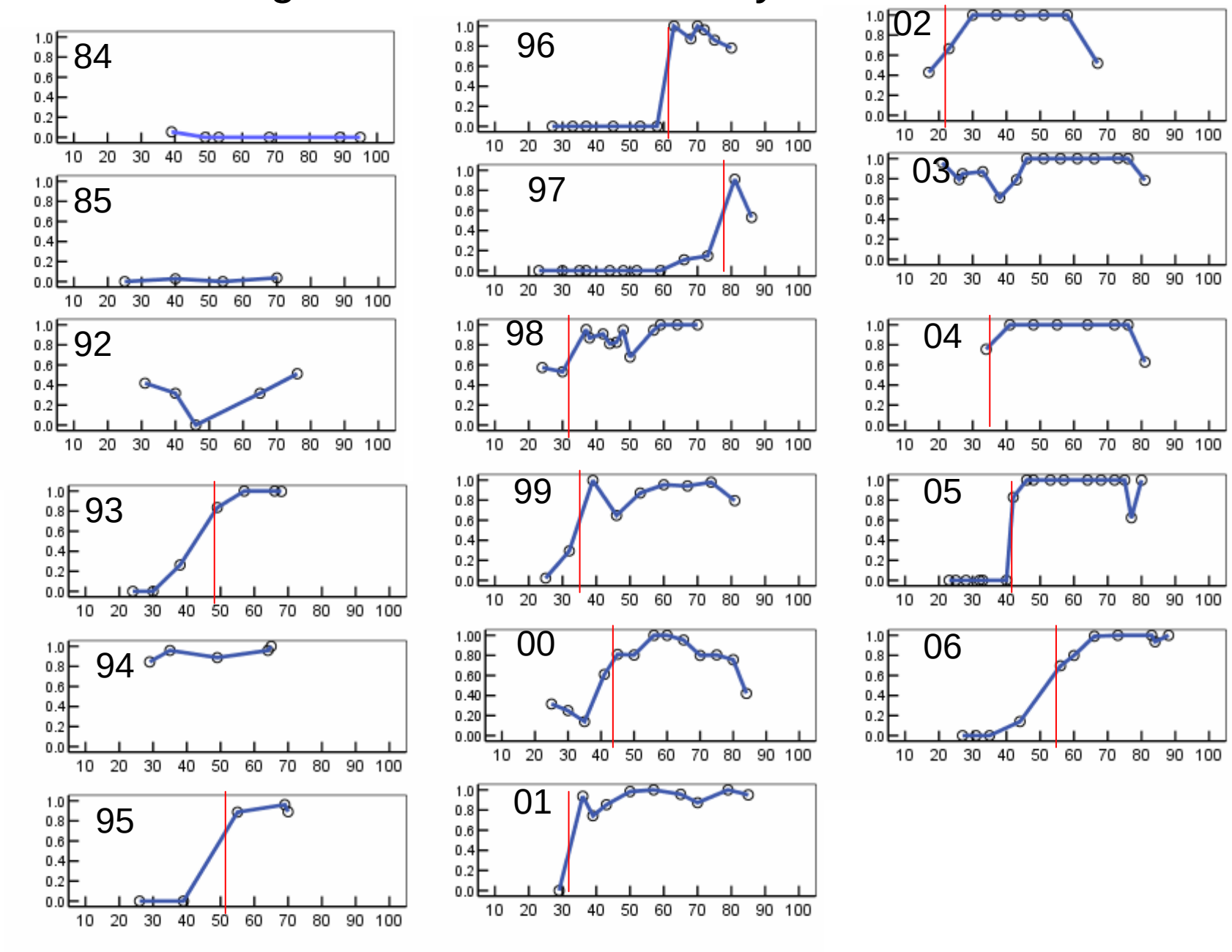


b) Seasonal change of %occurrence of anchovy

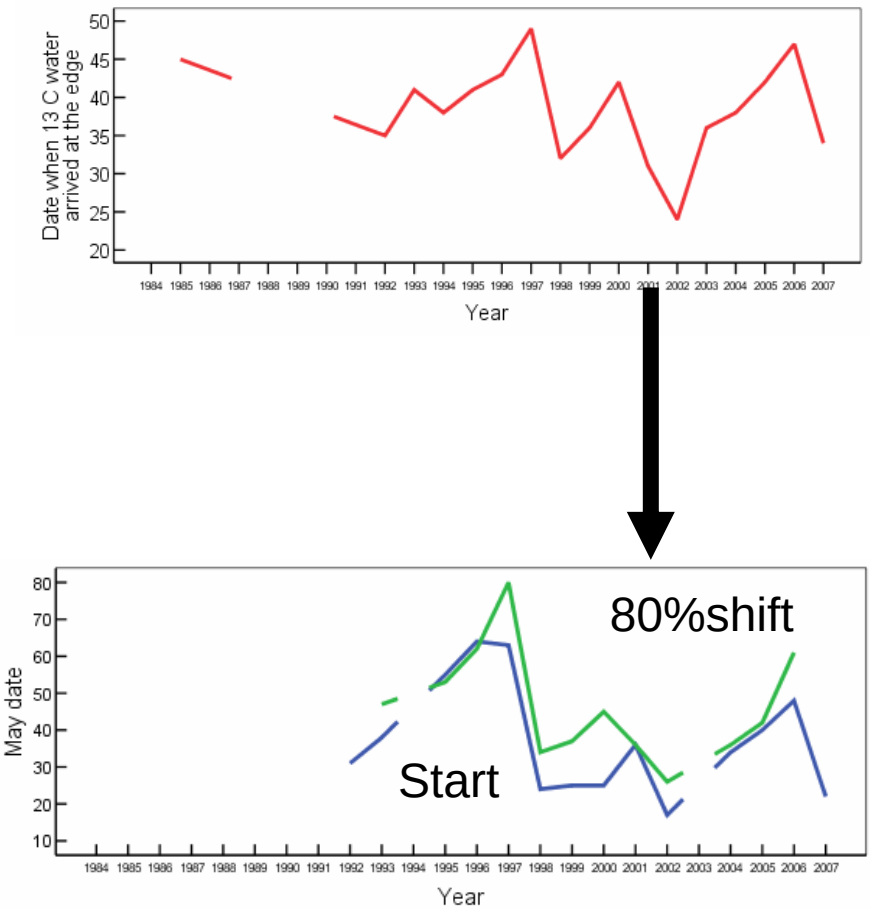


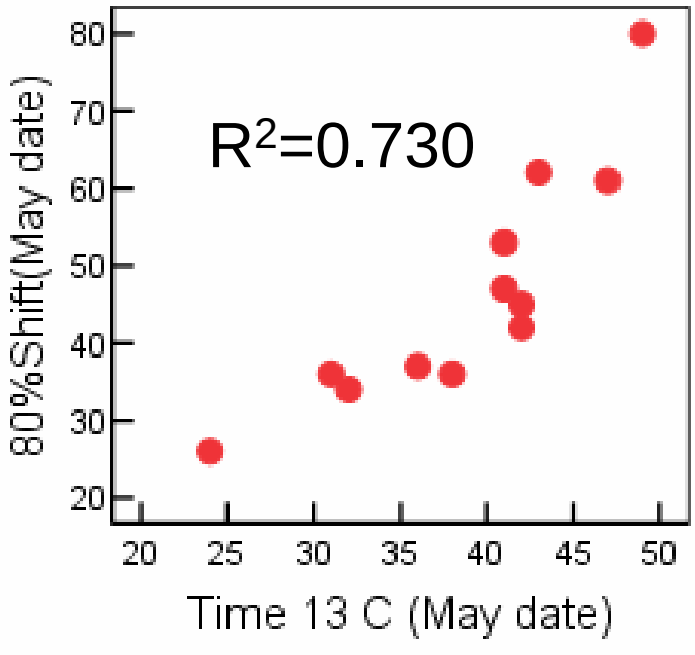
RHAU started to feed on anchovy when 13 C water arrived in the range

Seasonal change in %mass of anchovy in diet



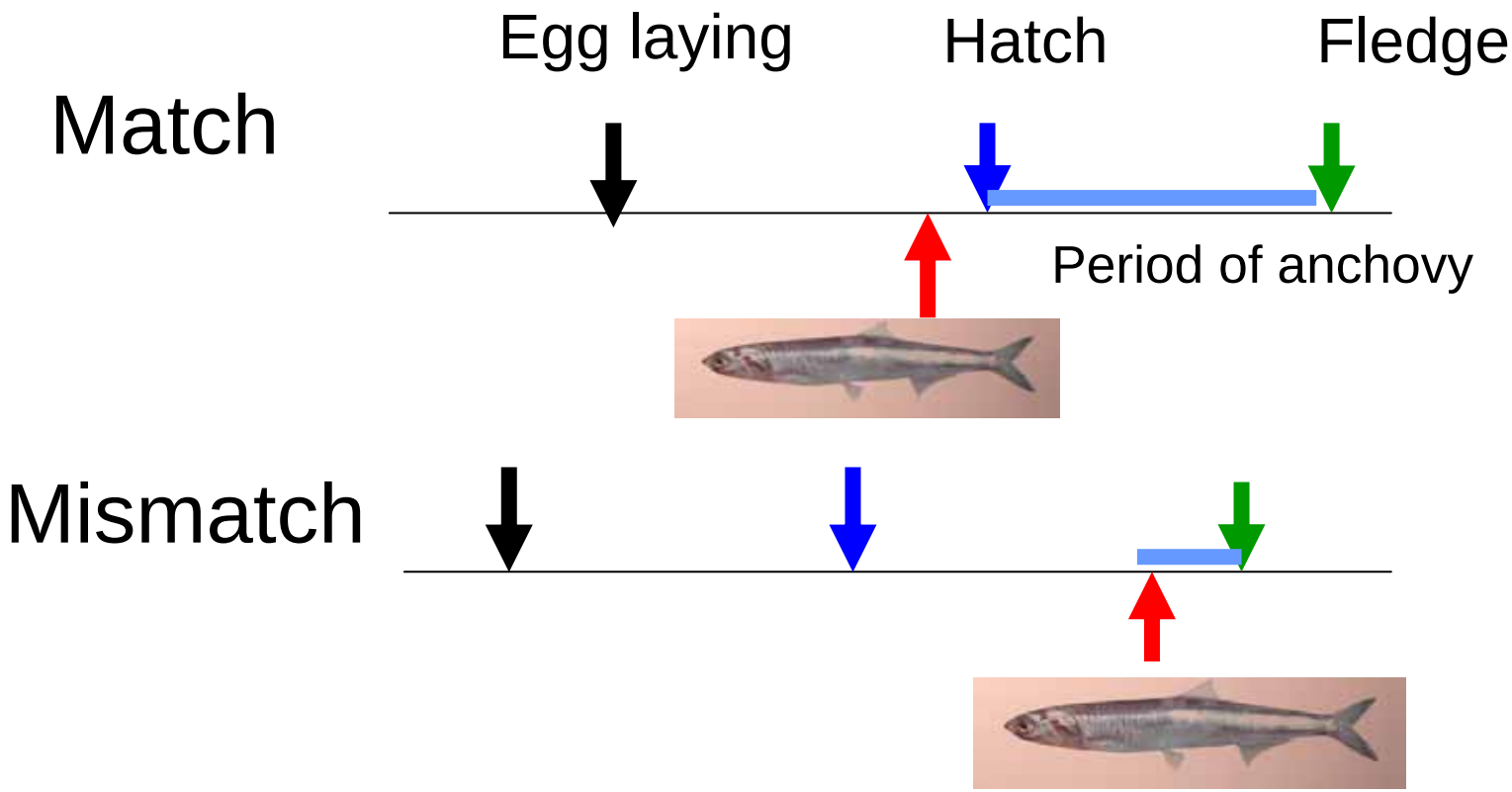
Date of arrival of 13 C water in the foraging range



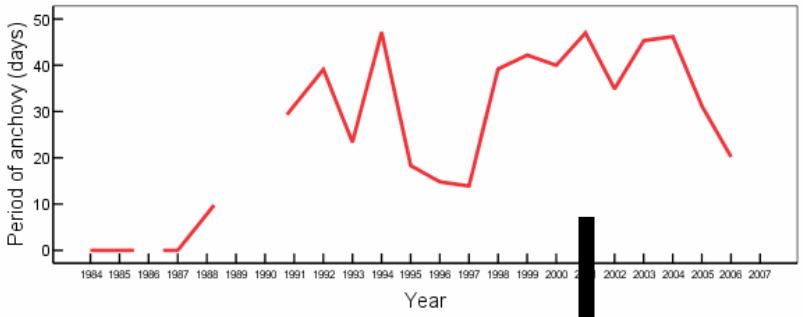


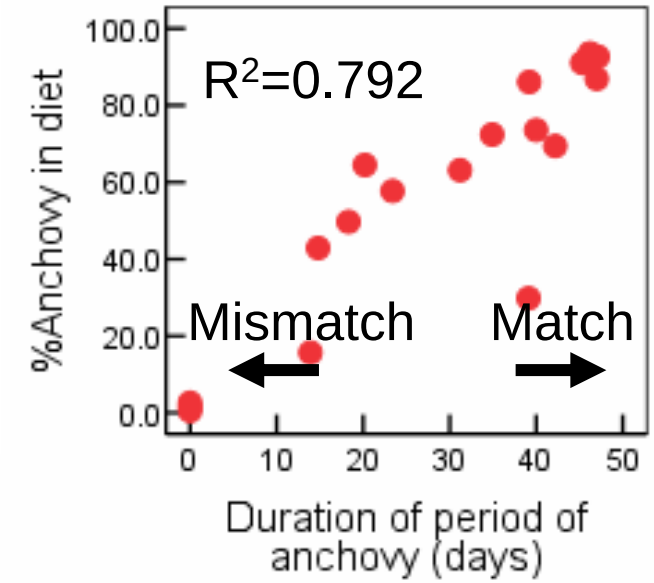
Date of prey switching to anchovy

3 Match-mismatch and energy value of food-load

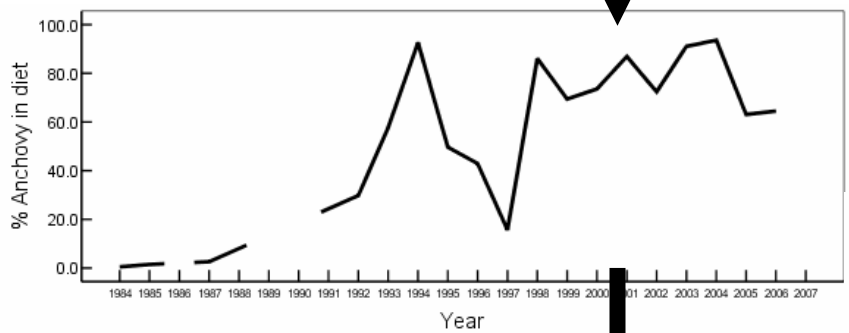


Duration of the period of anchovy

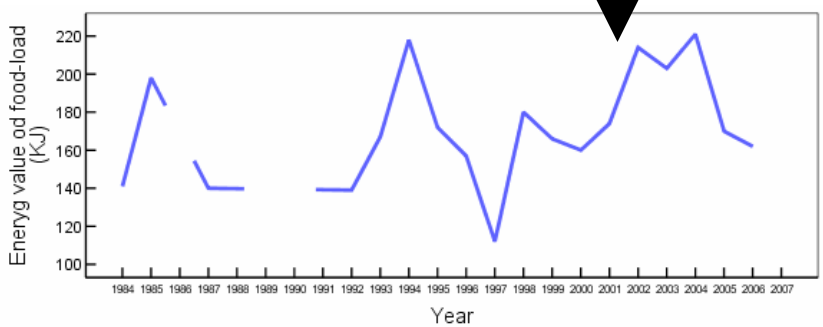


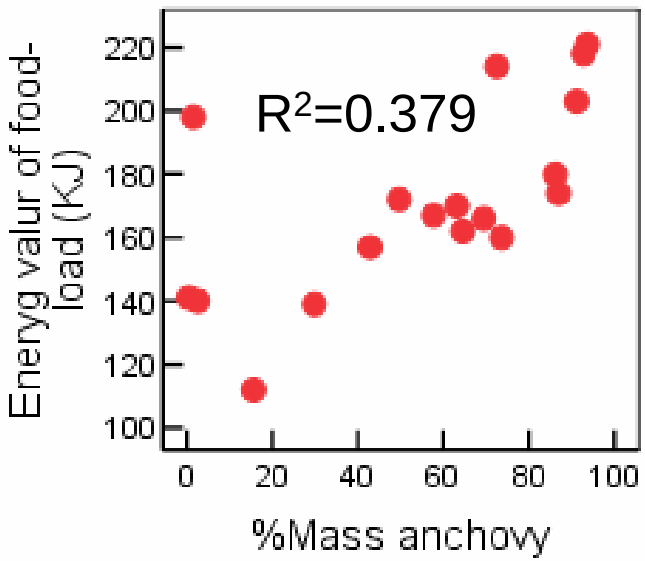


%anchovy in chick diet



Energy value of food-load

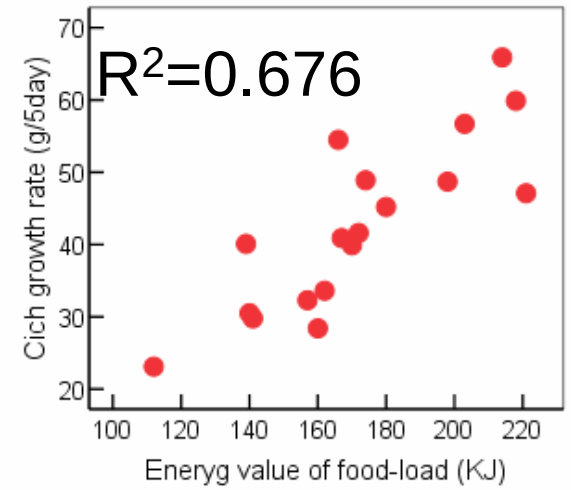




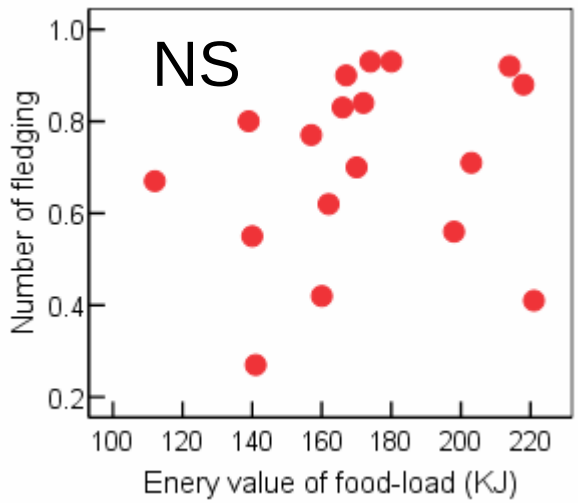
4 Reproductive consequences ?

Energy value of food-load determined chick growth

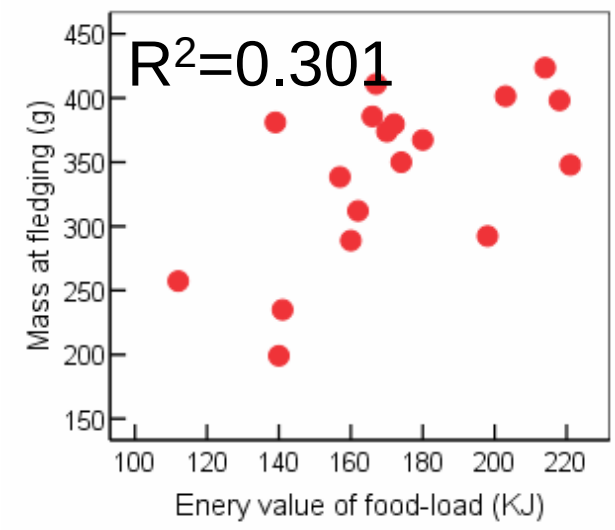
Chick growth rate



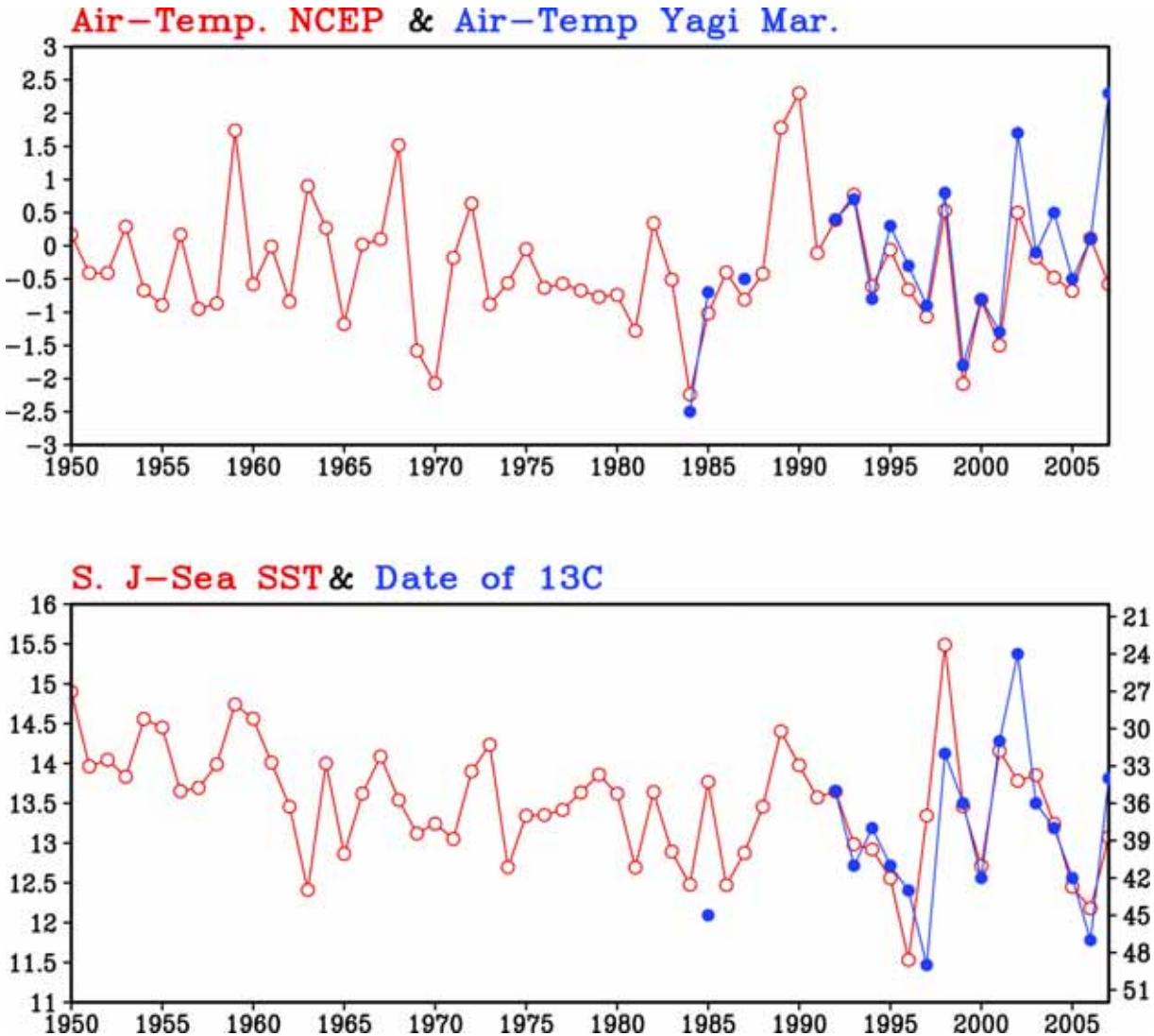
Fledging success



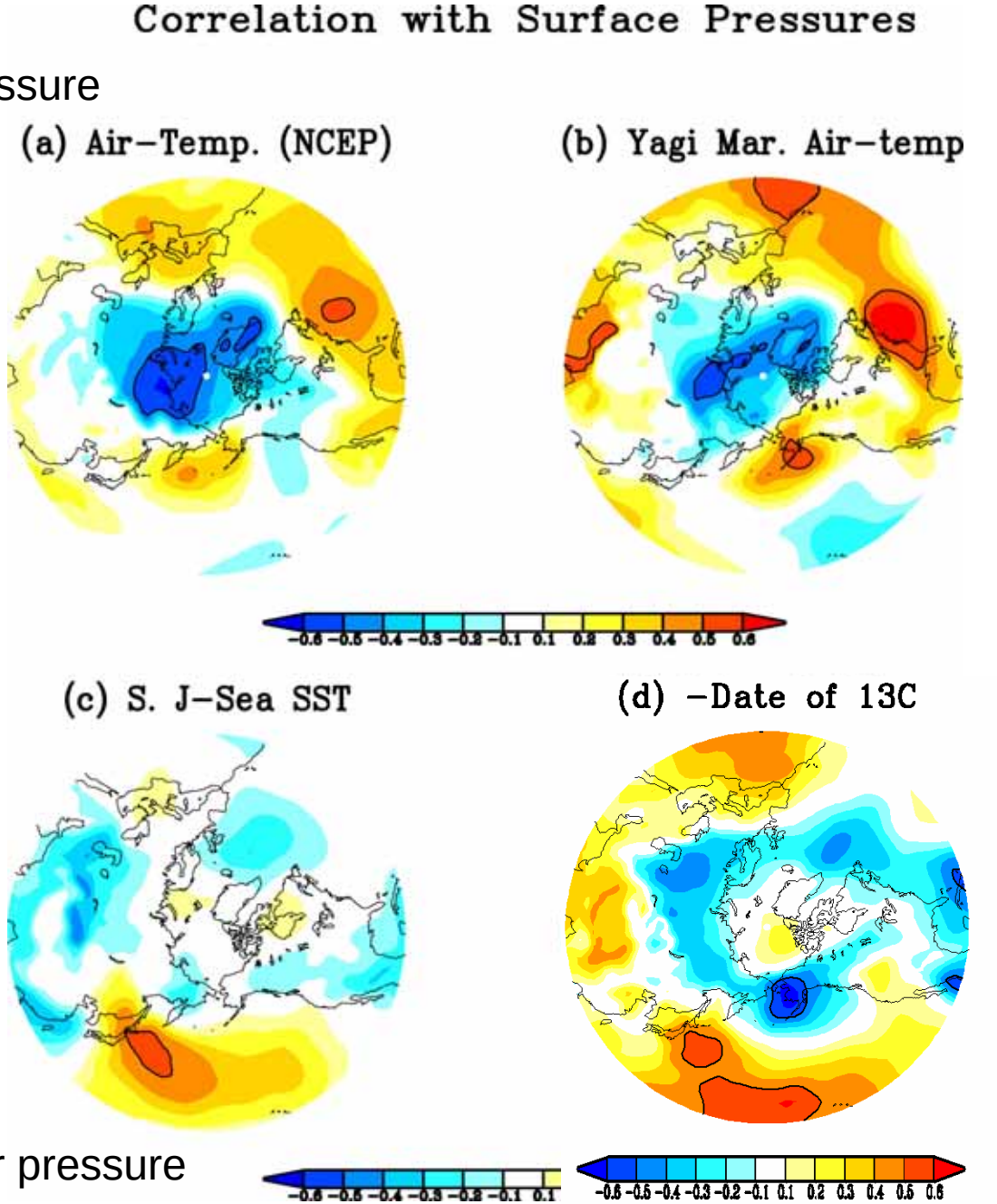
Mass of fledgling



5 Does air pressure pattern affect local weather that determine phenology of prey and predators ?


Air−Temp. NCEP & Air−Temp Yagi Mar.
3
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
−3
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
S. J−Sea SST & Date of 13C
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
11
21
24
27
30
33
36
39
42
45
48
51
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

Spring air pressure



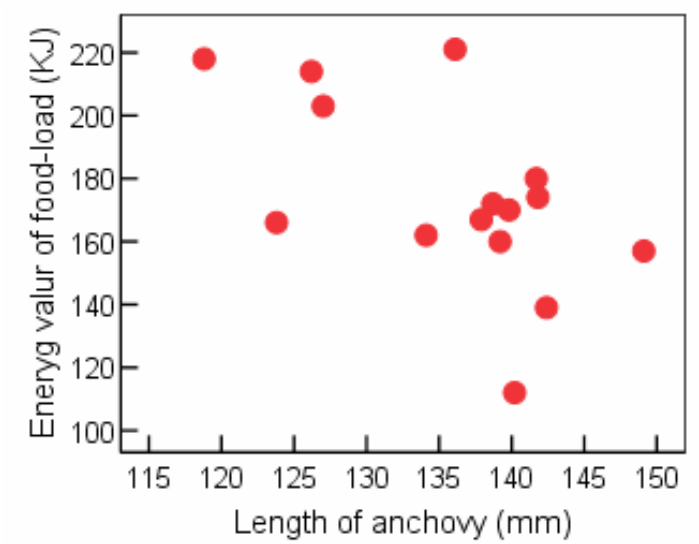
Winter air pressure

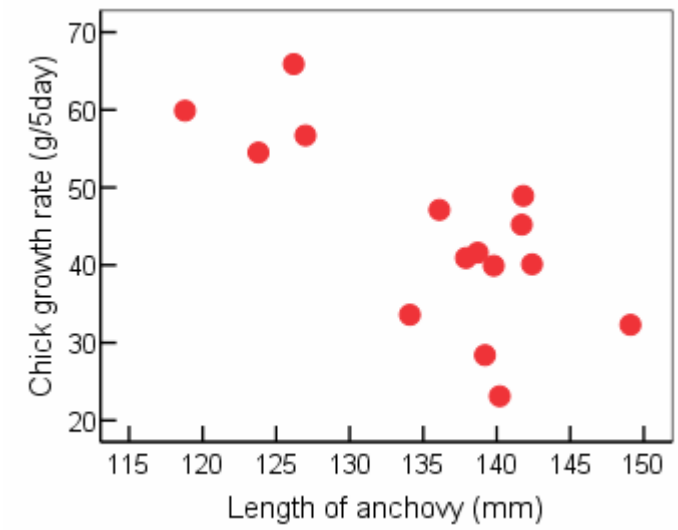
Different air pressure patterns seem to control each of spring air temperature and date of the arrival of 13 C water in the foraging range of RHAU

Conclusion

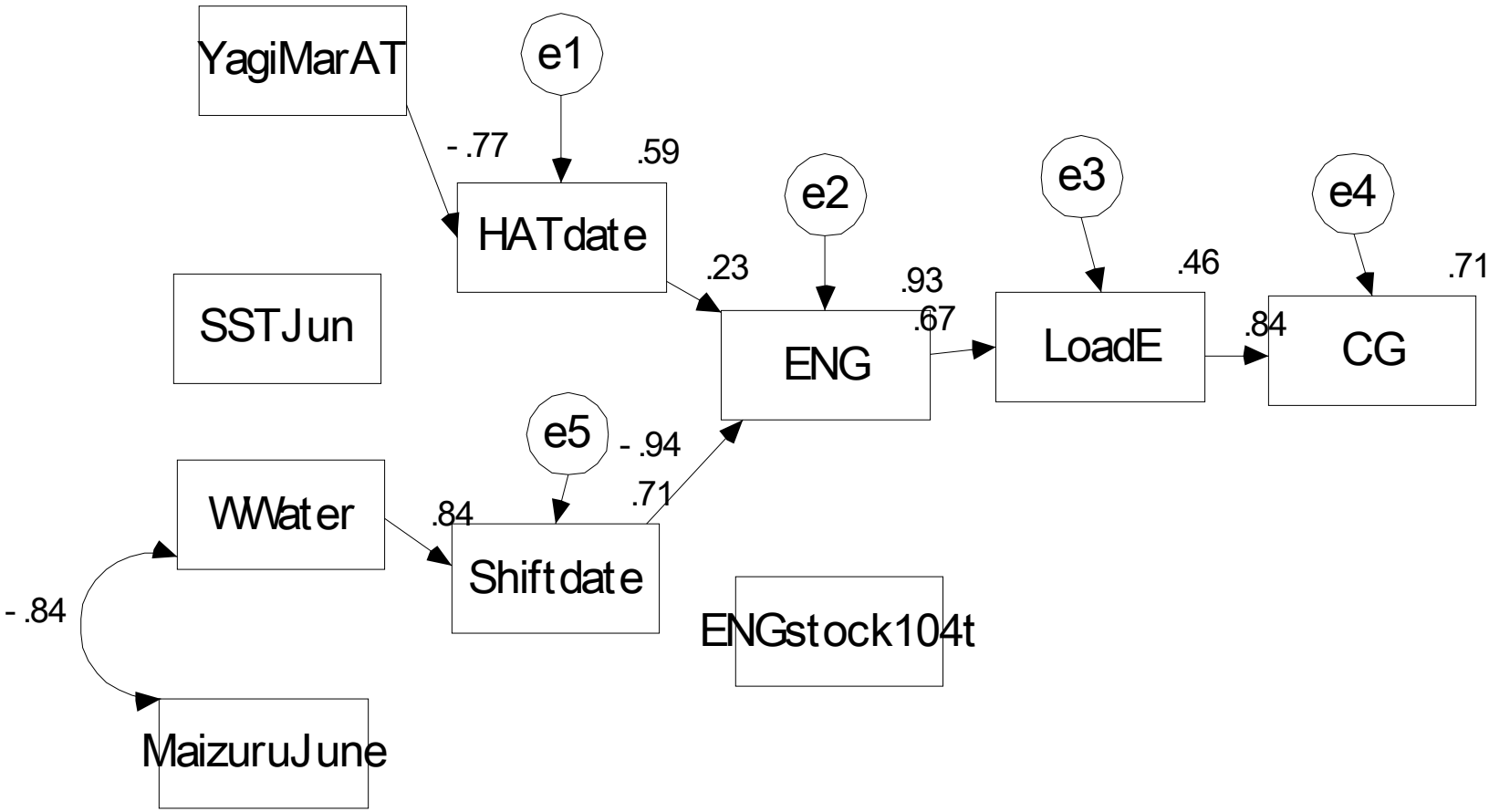
- RHAU does not adjust timing of breeding to peak availability of profitable prey, anchovy.
- Different air pressure patterns affects phenology of RHAU and that of anchovy, and creates match-mismatch.

In years when RHAU brought back larger anchovy, chick growth was smaller





SST in June and date 13C water arrived in the range did not affect the size of anchovy



Result of path Analyses