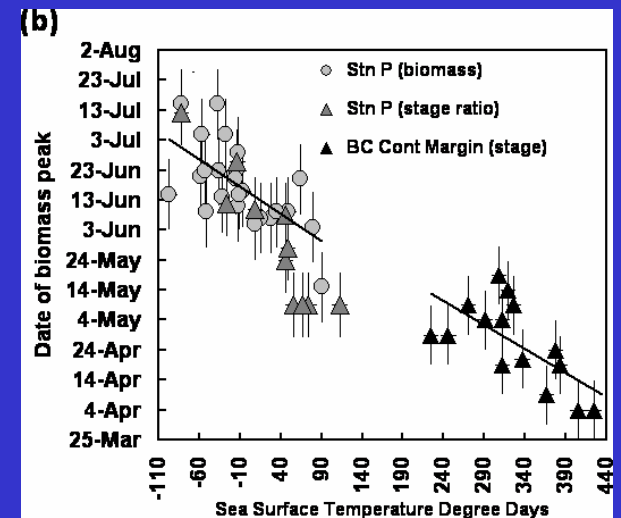
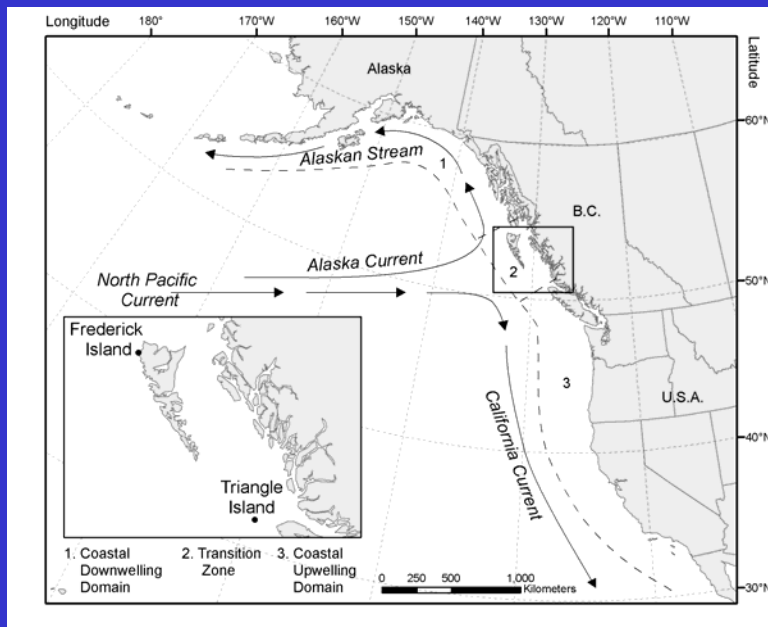


Nestling diet of Cassin's Auklet breeding in the North and South of B.C. reveals latitudinal variation in the temporal availability of zooplankton prey populations

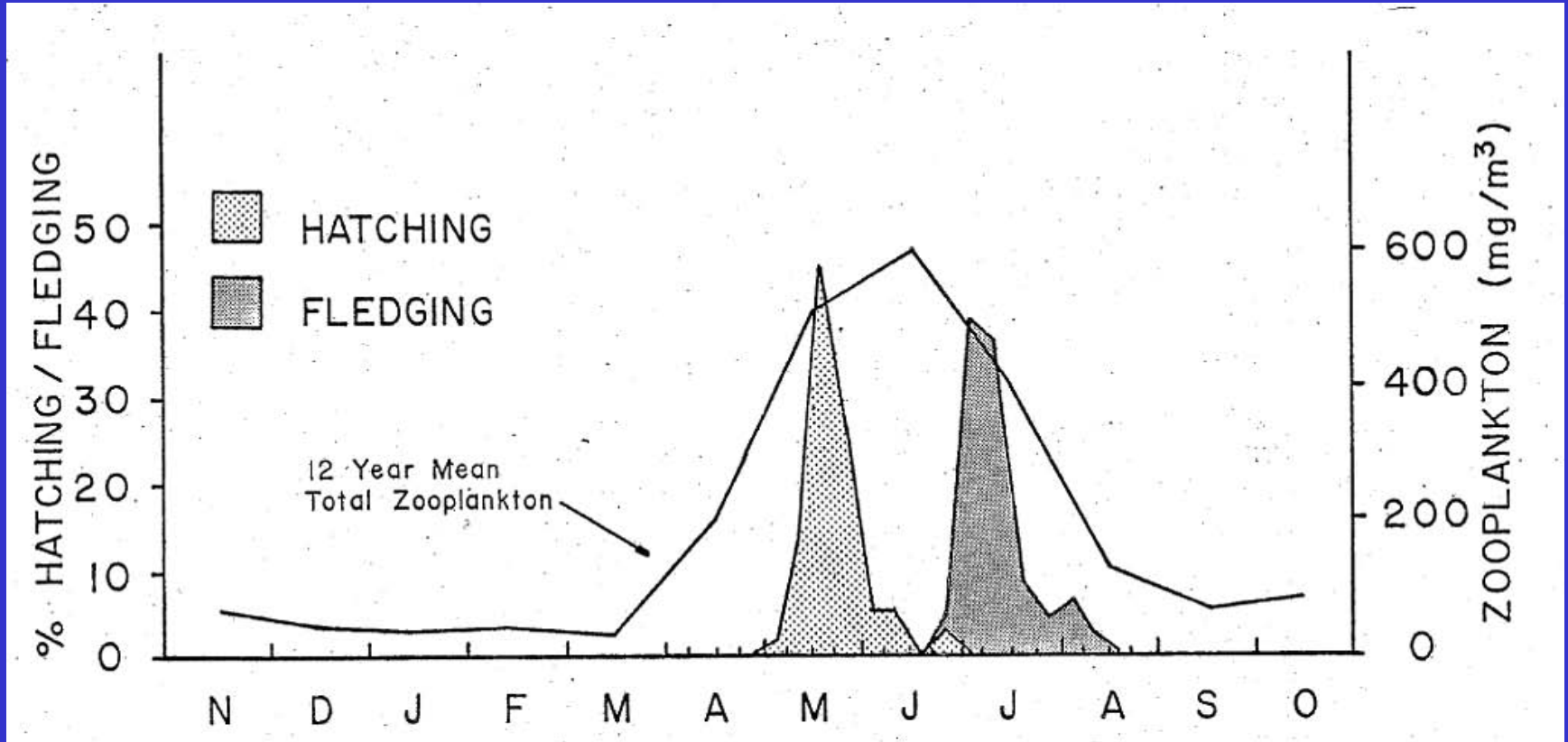


Bertram, Harfenist & Hedd CWS /SFU

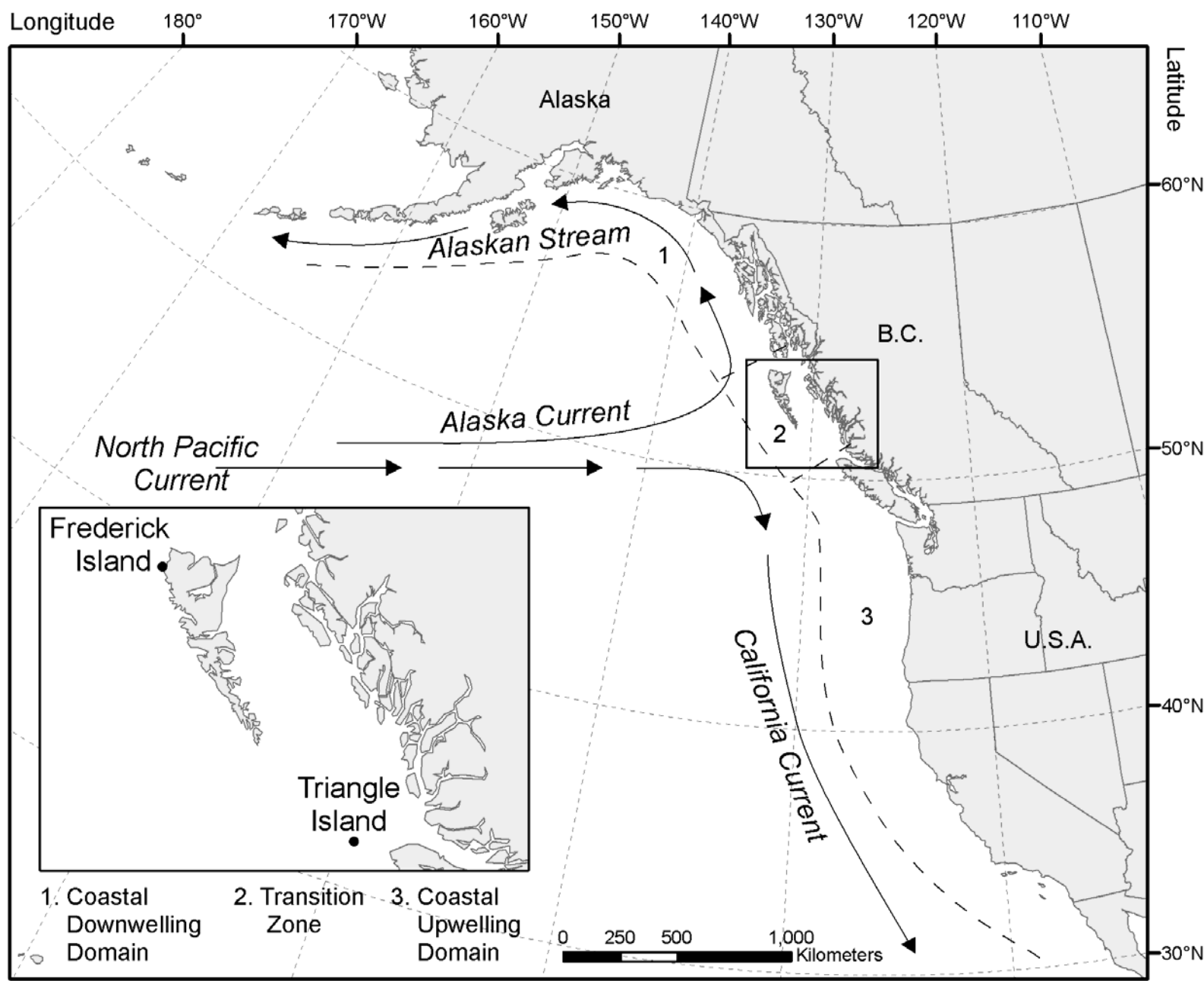
PSG , 1 Nov 2007, Victoria, BC



Timing of breeding: chick rearing coincides with seasonal zooplankton biomass



Source: Vermeer, 1981. JPR



Adult annual survival is higher on
Frederick than Triangle ($p= 0.0001$)
1994-2000

Frederick	Triangle
0.80 ± 0.02	0.71 ± 0.02

Source: Bertram, Harfenist, Smith. 2005. CJFAS 62: 2841-2853

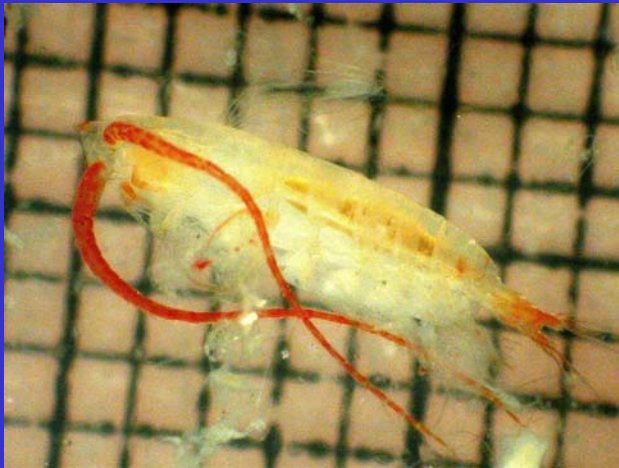
<http://www.sfu.ca/biology/wildberg/bertram/>

Nestling growth rates are highly variable on Triangle
(low in **warm** years, rapid in **cool** years)



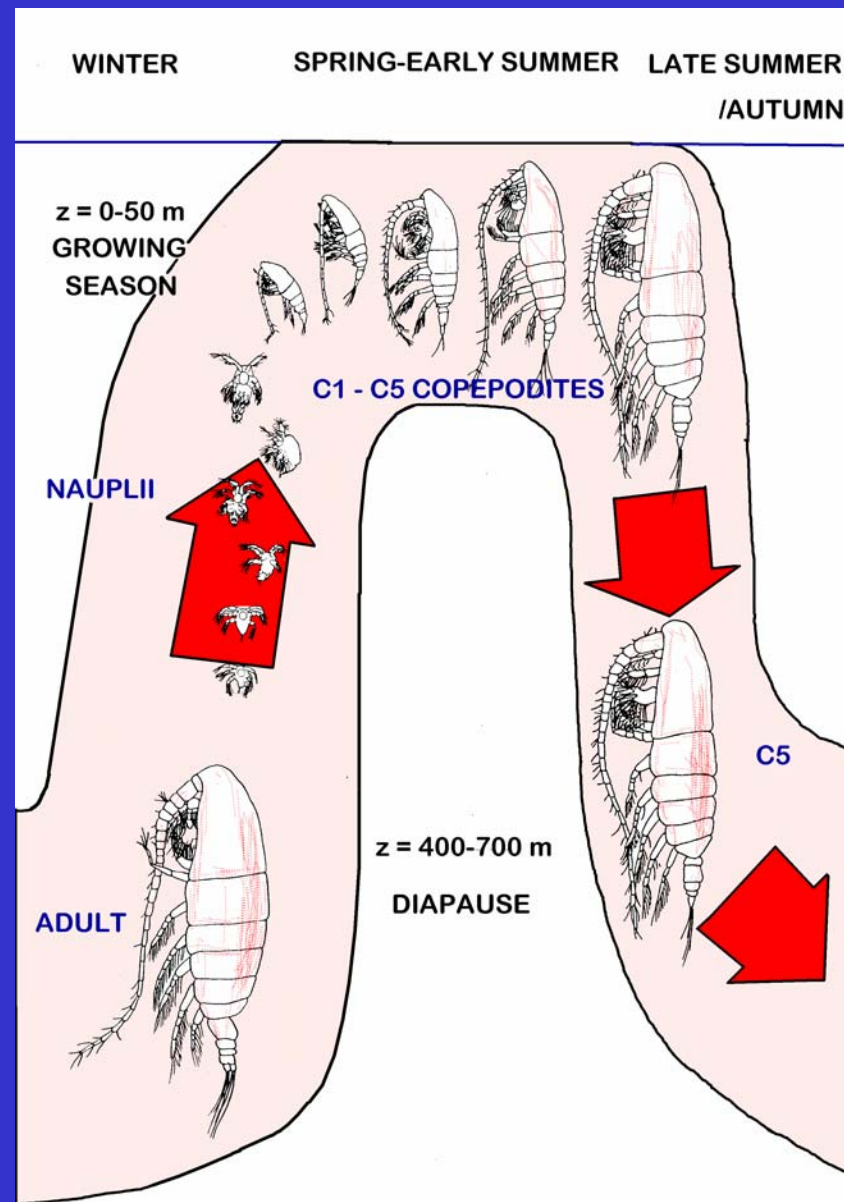
Source: Harfenist & Bertram in prep.

Seasonal life cycle of *Neocalanus plumchrus*

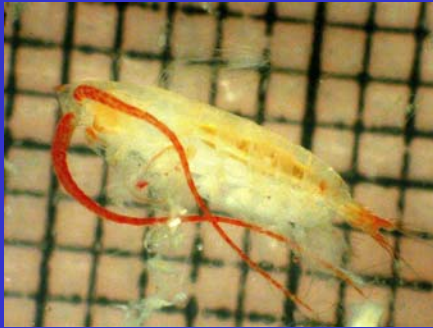


Mackas et al. 1998. CJFAS 55: 1878-1893.

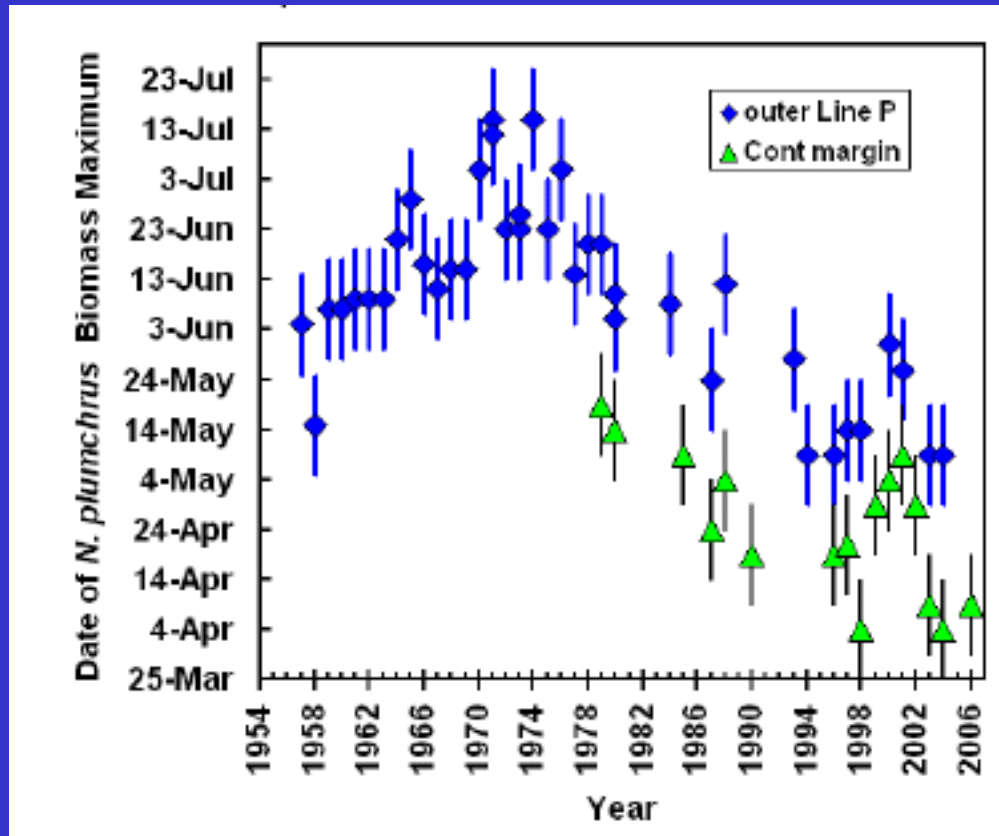
A highly profitable prey for CAAU



Major variation in timing of peak biomass for macro zooplankton

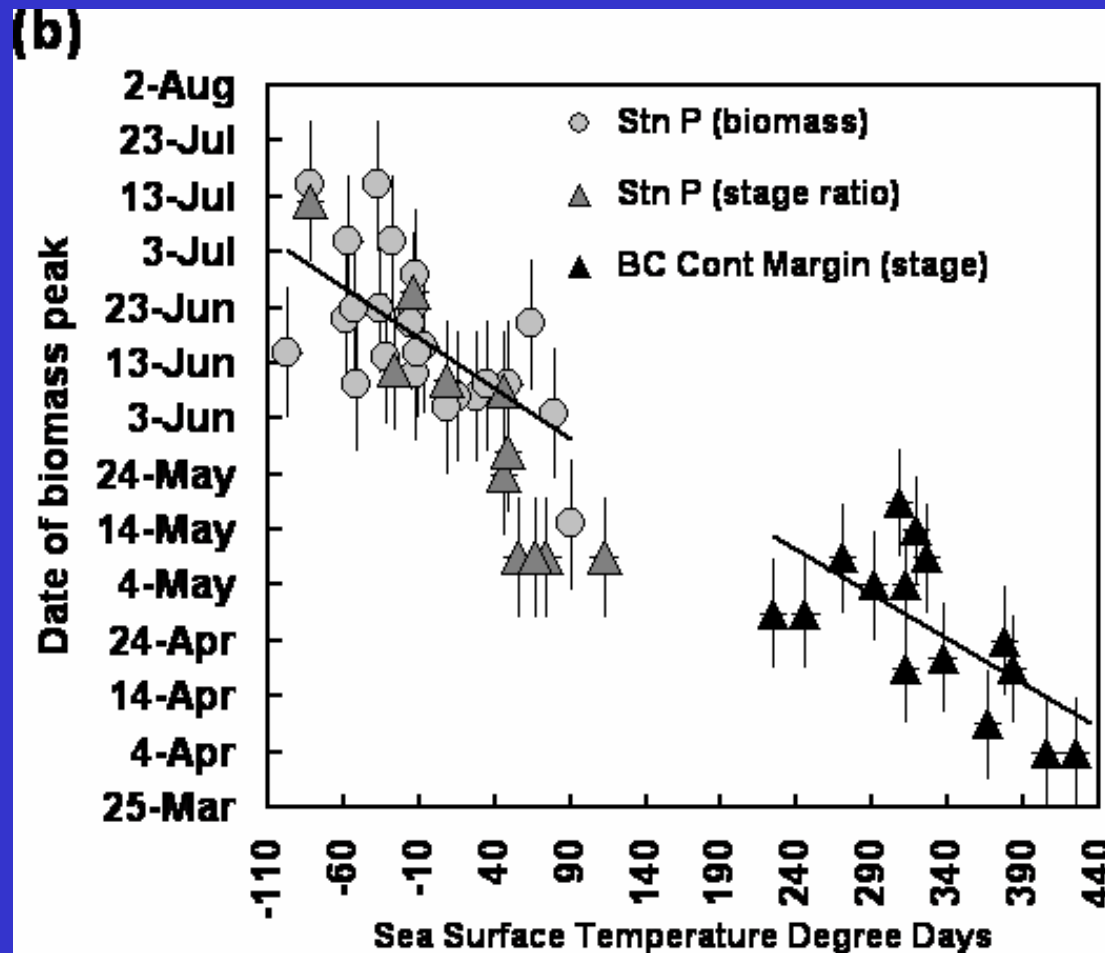


N. plumchrus



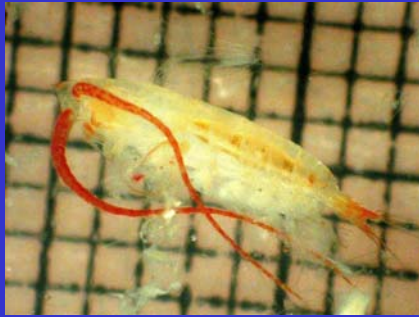
Source: DFO 2007; Mackas, Batten and Trudel 2007.

Early zooplankton peak during warm years



$$\text{Julian date} = -0.183x + 167.9$$

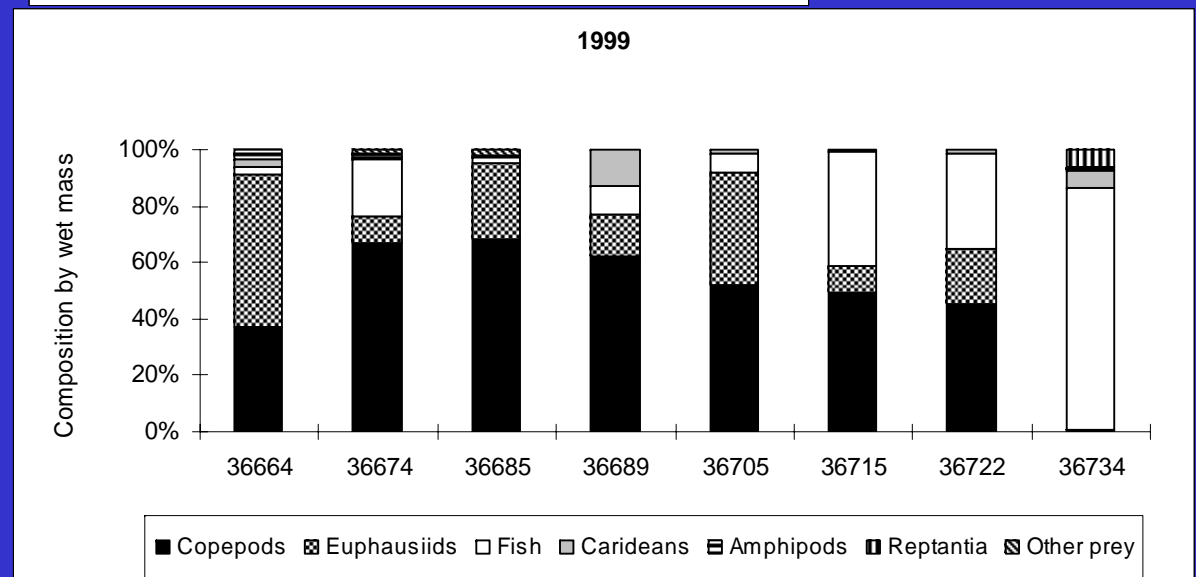
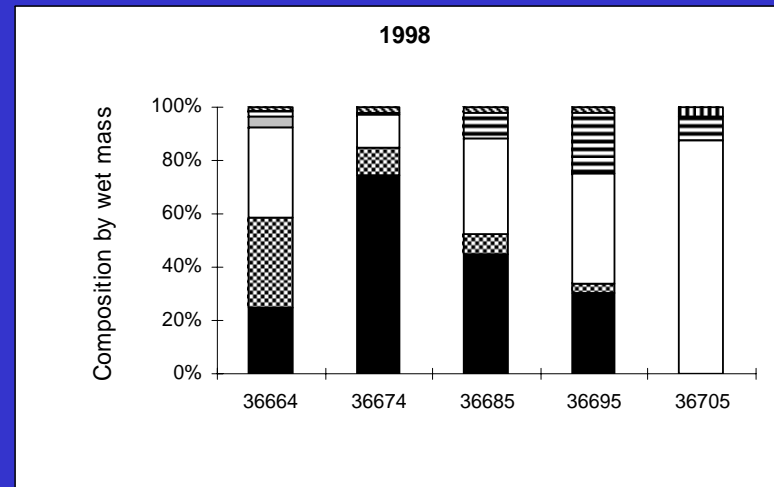
Timing of zooplankton availability is reduced when SST is warm on TRI



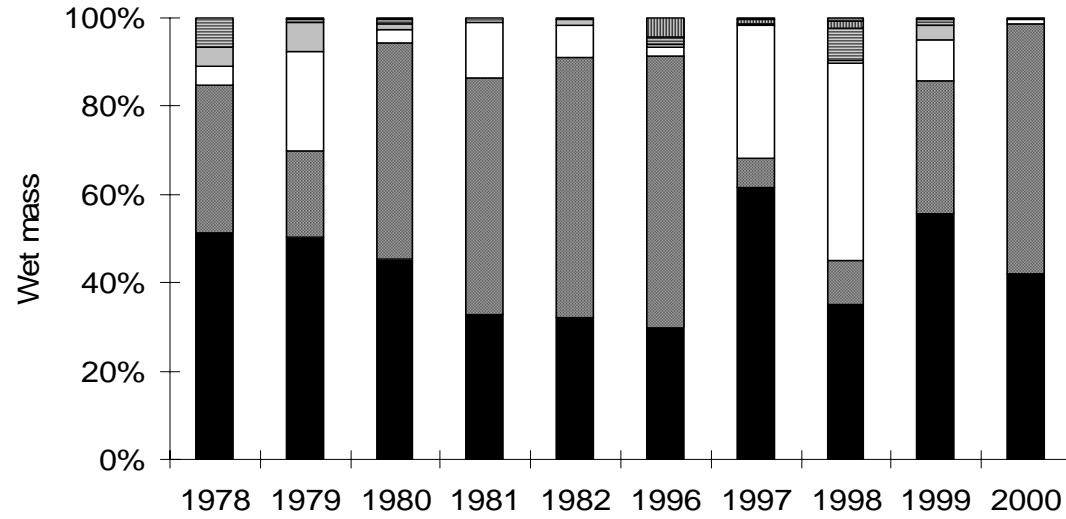
N. Critatus
(Bigger, longer and later than *N. plumchrus*)

Bertram et al. 2001. PiO 49:
283-307

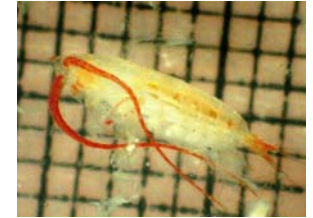
Hedd et al. 2002. MEPS
229:221-232



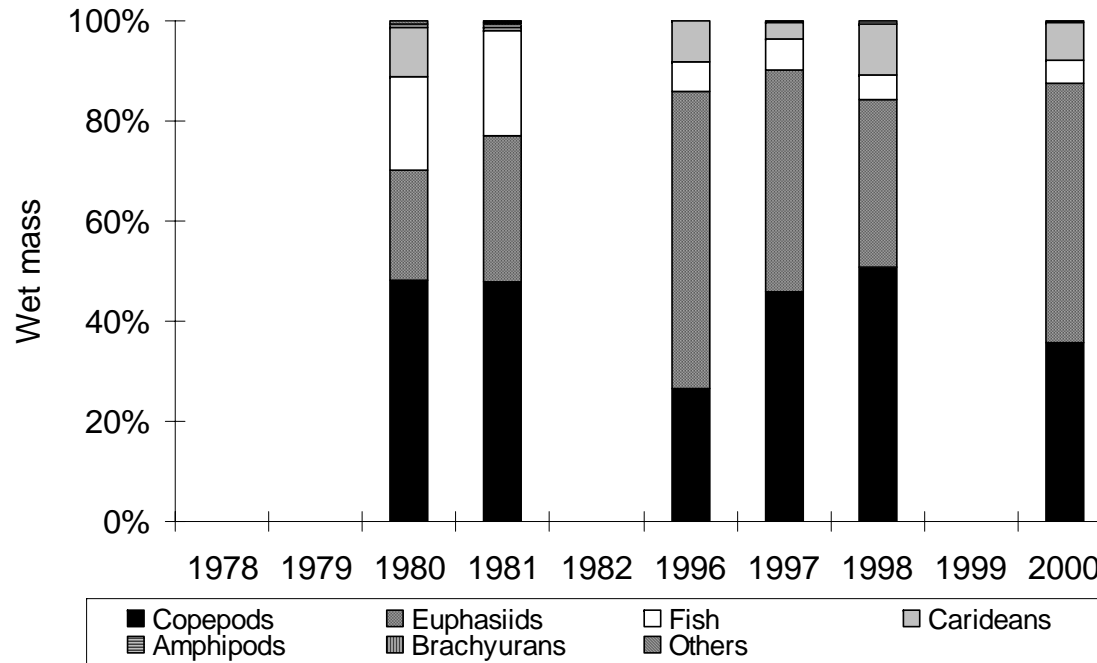
Triangle



99% cV



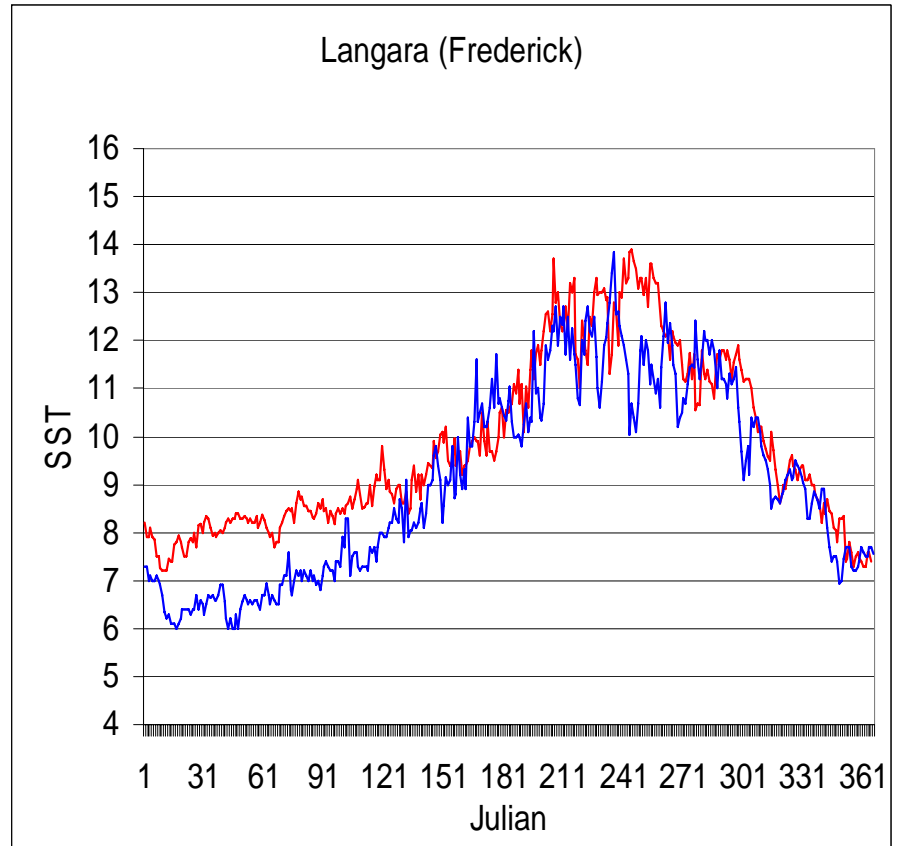
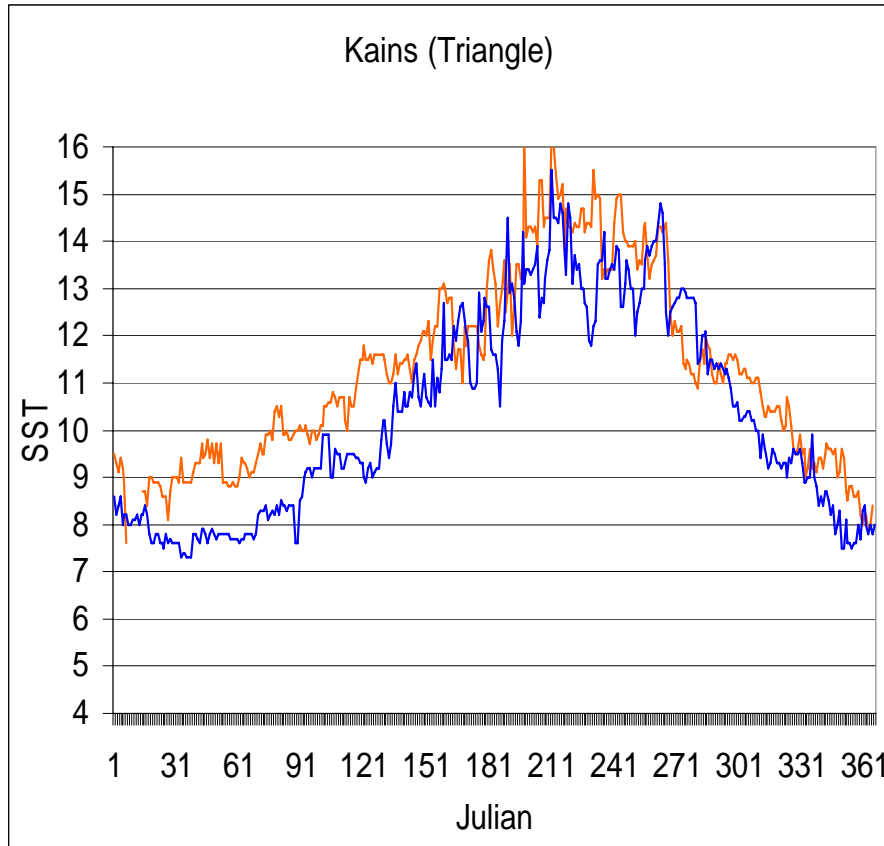
Frederick



“Temperature is probably the most important factor governing the shorter development duration in southern latitudes”

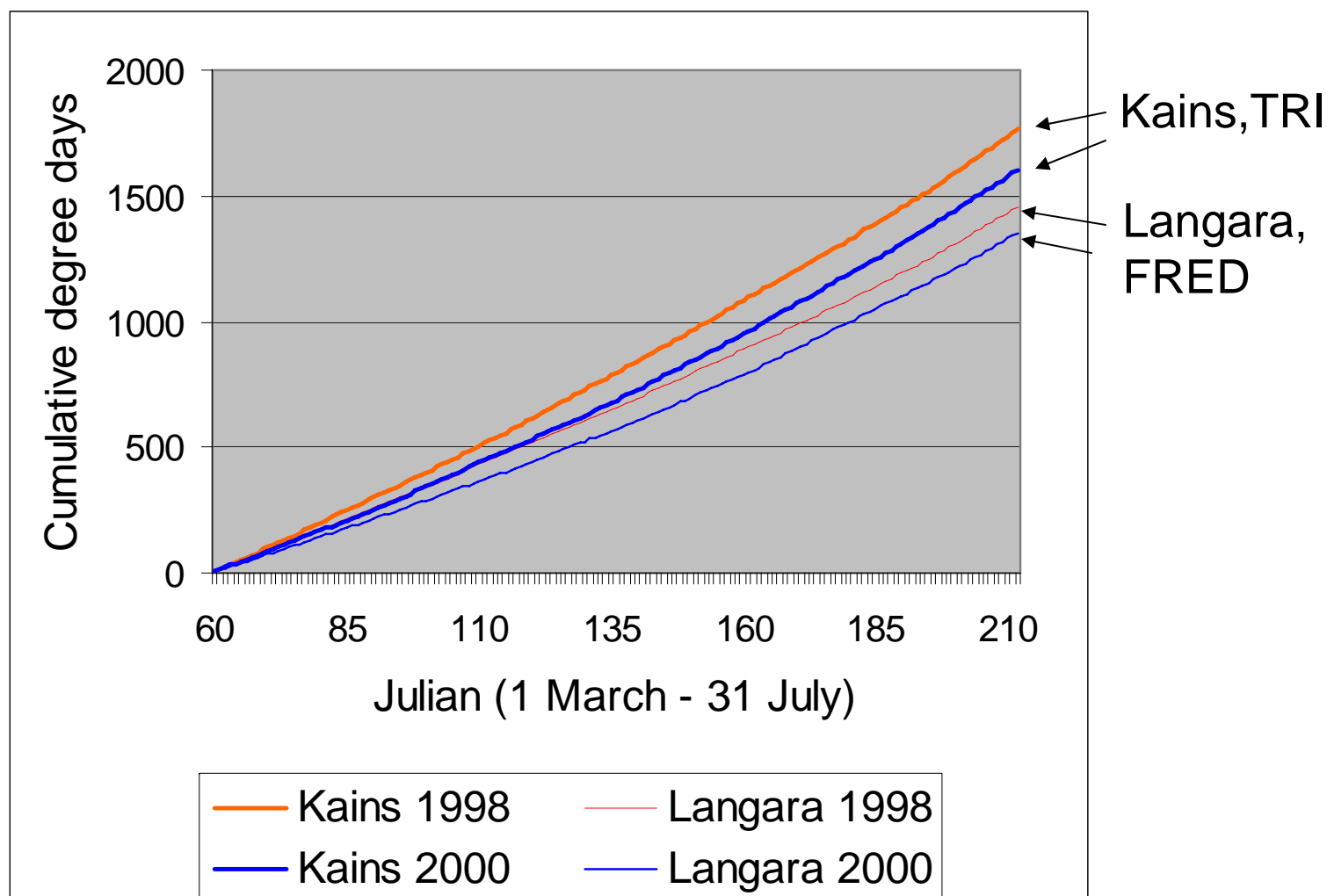
Batten et al. 2003. Latitudinal differences in the duration of development of *Neocalanus plumchrus* copepodites. Fisheries Oceanography 12: 201-208.

Generally warmer around Triangle than Frederick



1998, 2000

A cool year on Triangle is most like a warm year on Frederick



N. plumchrus peak timing biomass

$$\text{Julian date} = -0.183x + 167.9$$

Always earlier on Triangle

	1998	2000
Triangle	22 April	2 May
Frederick	17 May	7 June

Equation from Mackas, Batten & Trudel 2007

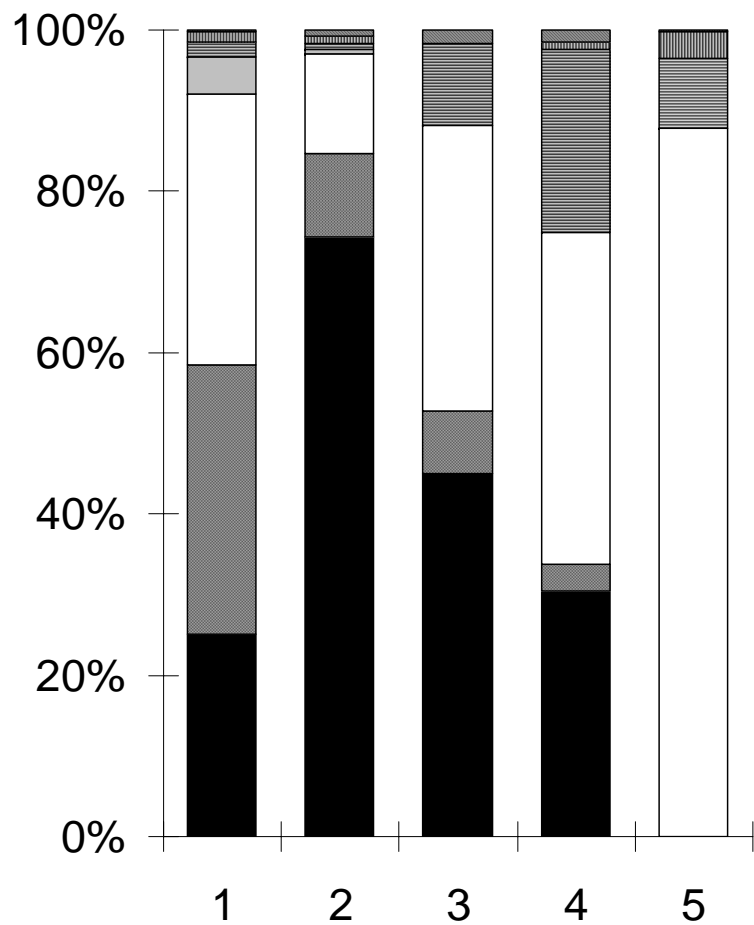
Difference in “window” is narrower on Triangle

Early and narrow vs late and broad

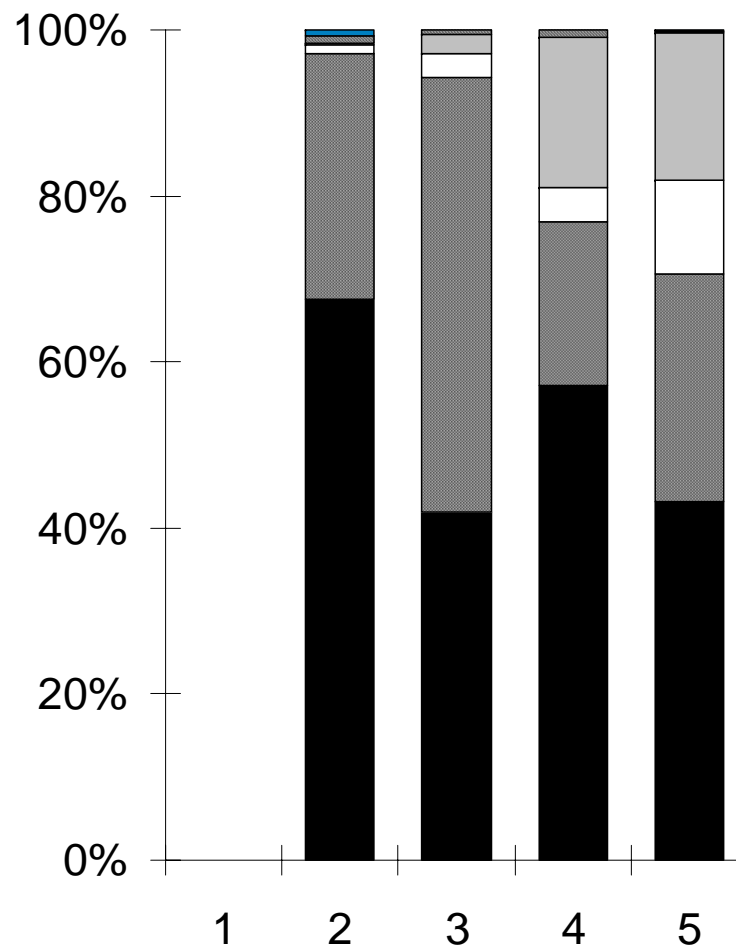
	1998	2000	Difference (d)
Triangle	22 April	2 May	10
Frederick	17 May	7 June	21

1998 - WARM

Triangle



Frederick



■ Copepods

■ Euphausiids

□ Fish

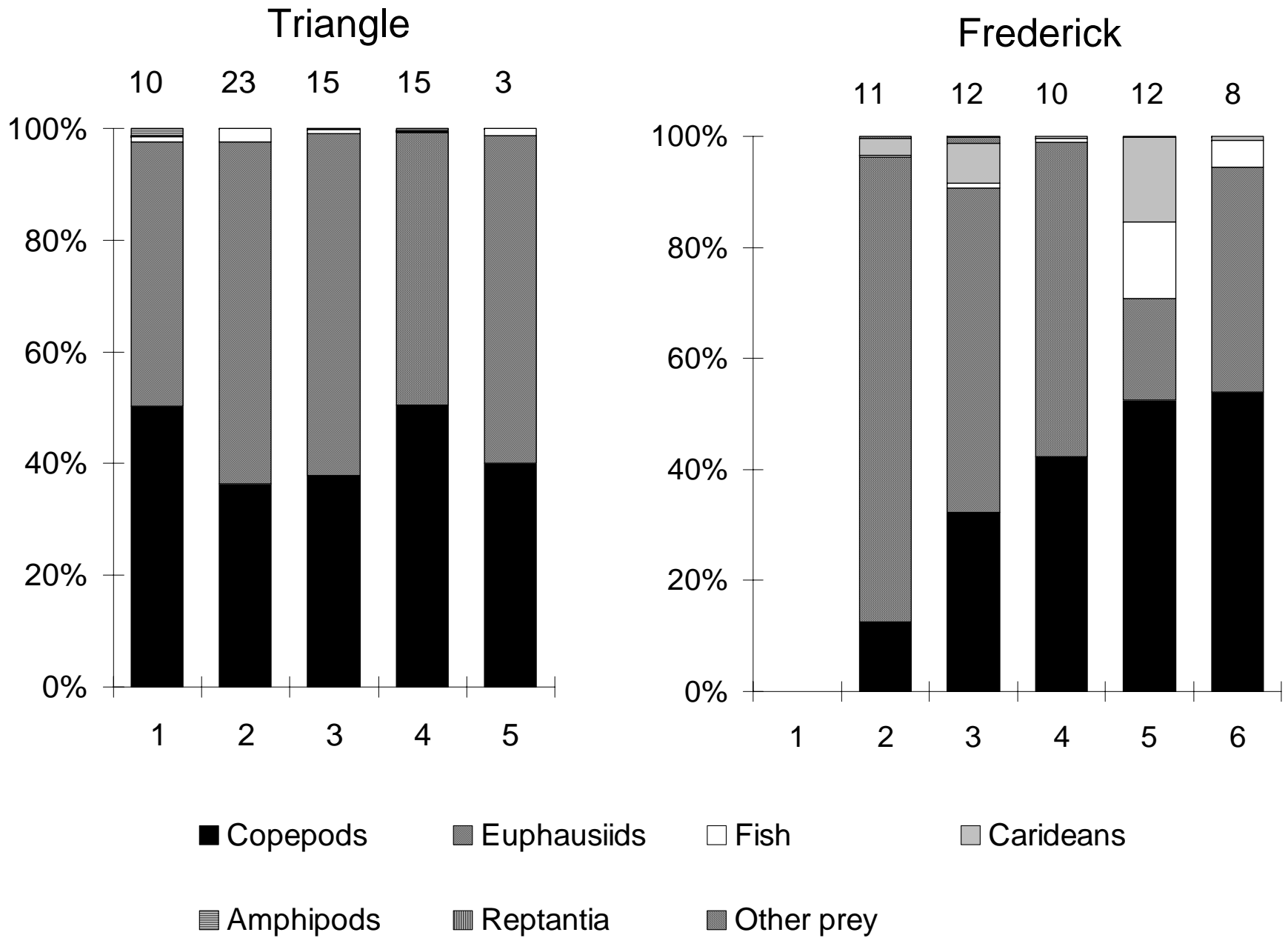
■ Carideans

▨ Amphipods

▨ Reptantia

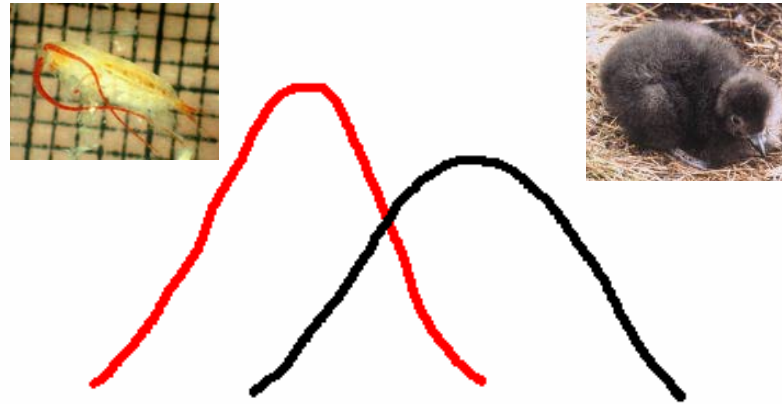
▨ Other prey

2000 - COOL



WARM; e.g., 1998

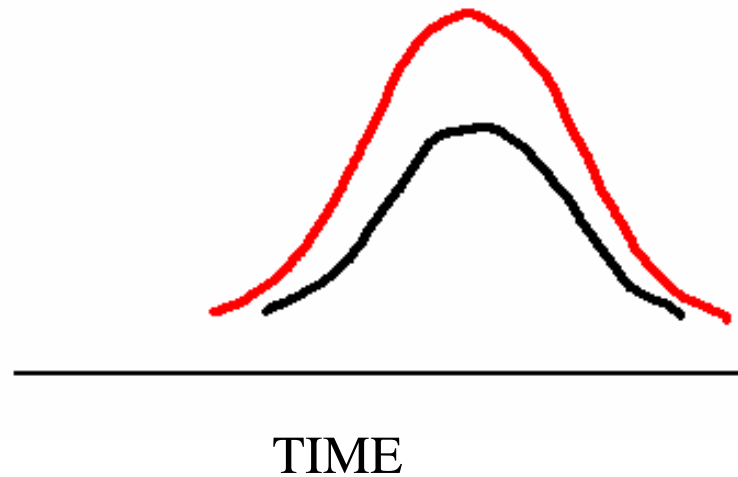
TRIANGLE



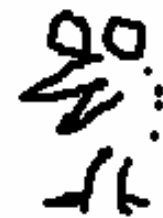
MIS-MATCH



FREDERICK

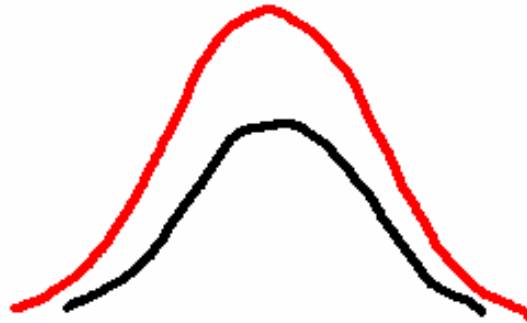


MATCH



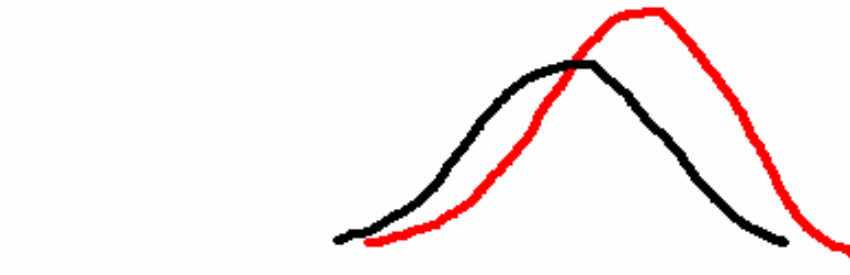
COOL; e.g., 2000

TRIANGLE



MATCH

FREDERICK



mis - MATCH

TIME

Conclusions

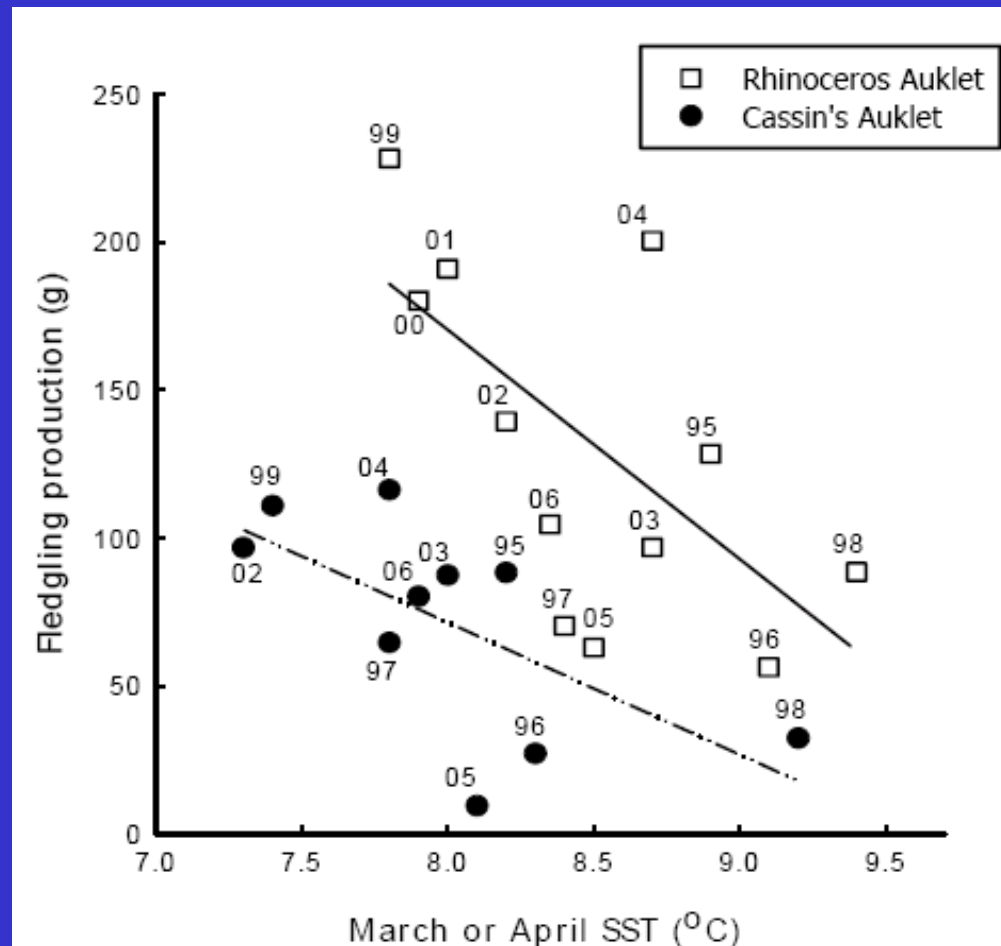
- *Neocalanus cristatus* stage 5 copepodites are a key prey species on both colonies
- Diet reveals latitudinal variation in the temporal availability of *N. cristatus*, related to temperature

Warm – prey diminishes on TRI, constant on Fred

Cool – constant on Tri, increases on Fred

- Opportunity for mismatch between *N. cristatus* availability and chick rearing is greater on Triangle than on Frederick

2005: a warm, poor year on Triangle

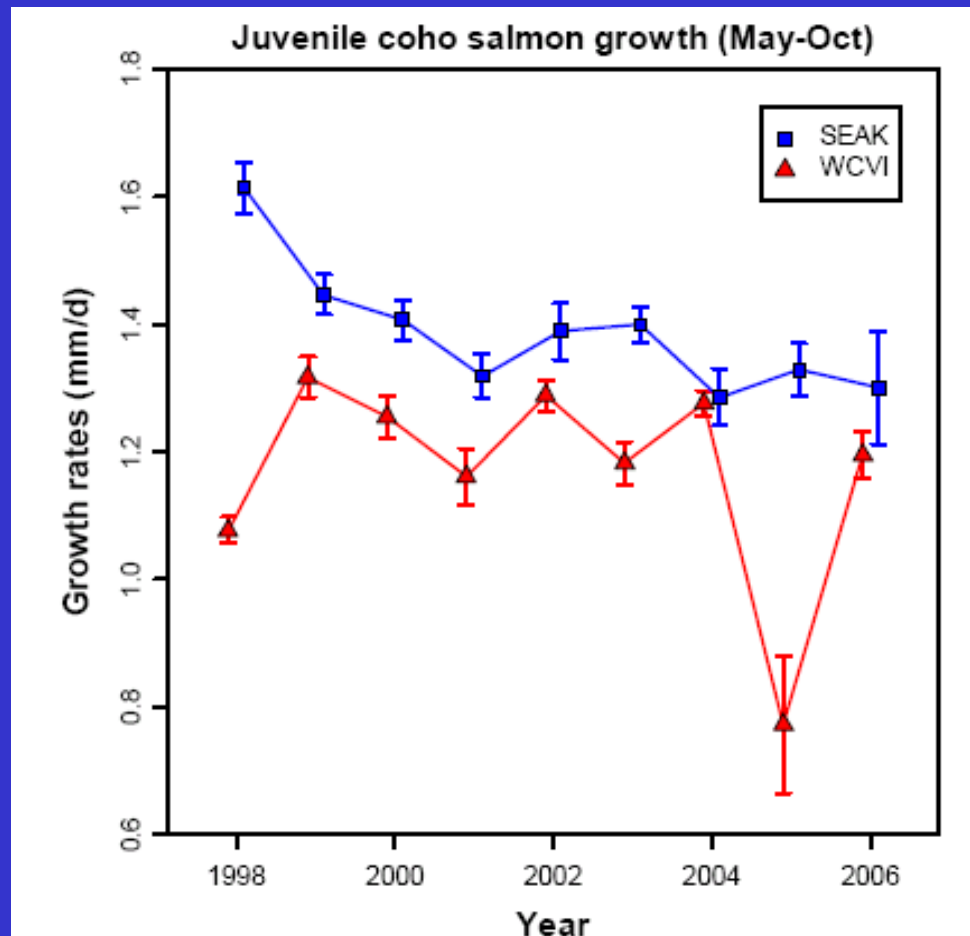


Source: DFO 2006; M. Hipfner, pers. Comm.

2005 results are consistent

- Failure on TRIANGLE (<10% copepods)
- Success on FREDERICK
- (Mark Hipfner, pers. comm.)

Salmon growth mirrors seabird performance



Source: DFO, 2007;
Trudel et al. 2007

Acknowledgements

- Field crews
- “Nestucca” oil spill Trust Fund
- Canadian Climate Change Action Fund
- Canadian Wildlife Service
- Centre for Wildlife Ecology (CWE @ SFU)
- NSERC grants to Fred Cooke (CWE @ SFU)
- Canadian Coast Guard
- Haida Forest Guardians
- BC Parks
- Mark Hipfner, CWS
- Moira Galbraith, Dave Mackas, DFO @ IOS
- Mark Trudel, DFO @ PBS

SUMMARY
THE MATCH-MISMATCH SONG
(SUNG TO THE TUNE OF “MONSTER MASH”)

ON TRIANGLE THE AUKLETS FORAGE IN THE SURFACE AT NIGHT
WHEN THE NEOCALNUS COPEPOD TIMING IS RIGHT
WHEN IT'S COLD THE PREY REALLY HANGS AROUND
BUT WHEN IT'S WARM THEY GO WAY BACK DOWN

IT'S A MISMATCH !!!
WITH THE CHICK HATCH
GONE IN A FLASH
IT'S A MISMATCH !!!