

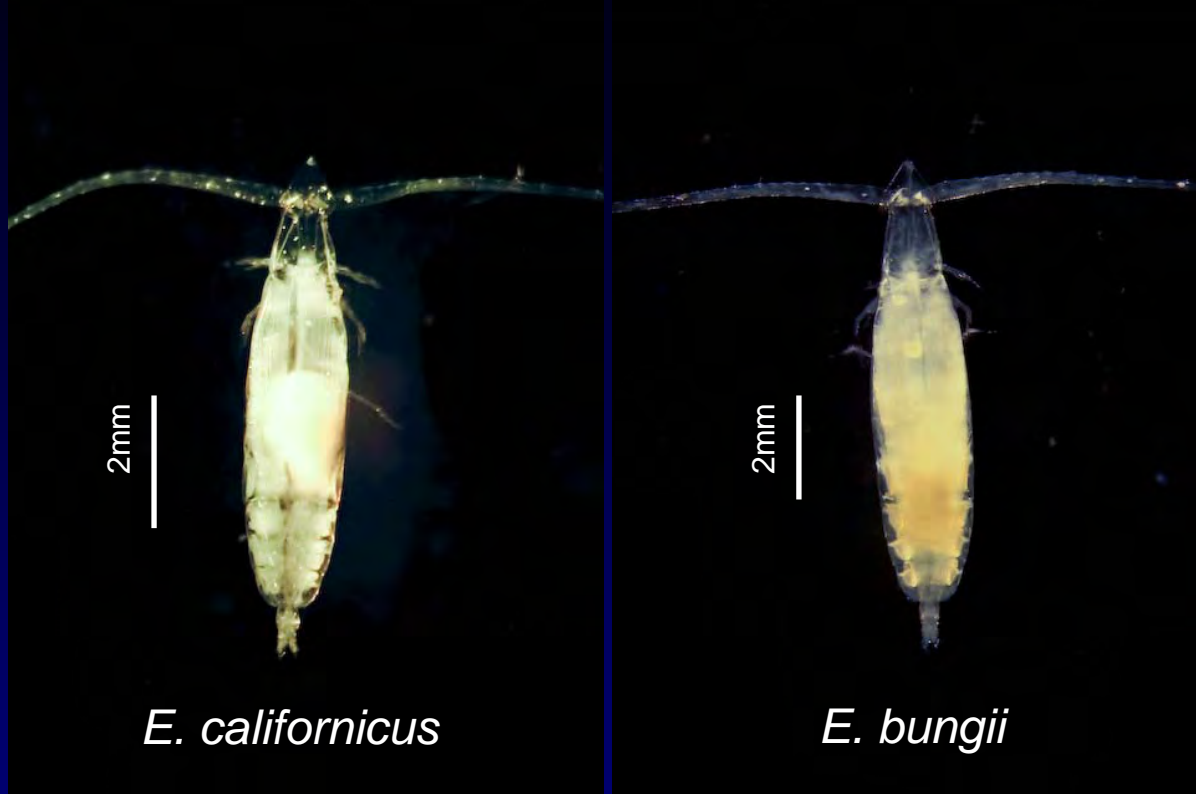
Geographical distribution and ontogenetic migration of *Eucalanus californicus* (Johnson) in the western North Pacific Ocean



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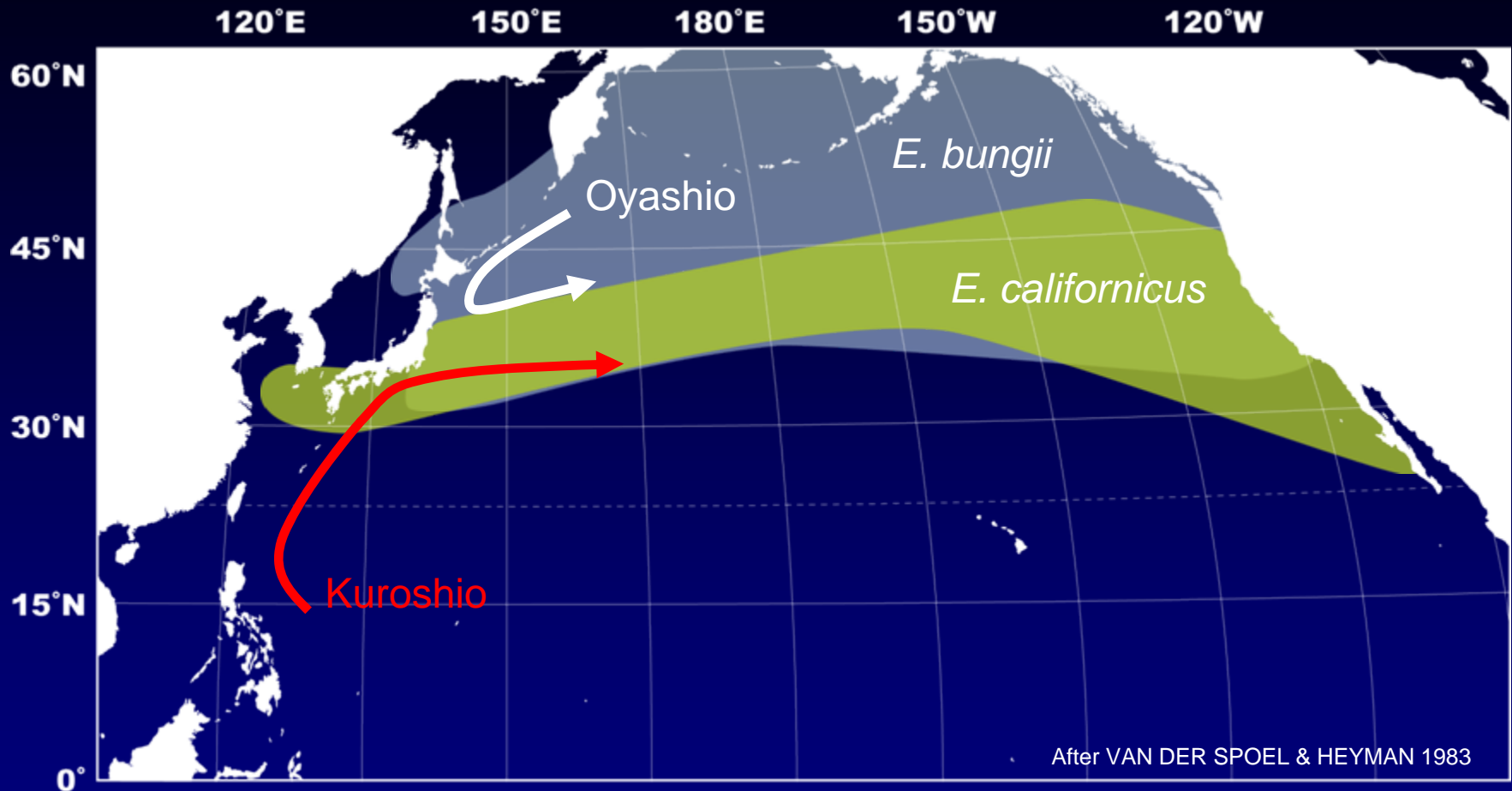
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Eucalanus californicus & *E. bungii*



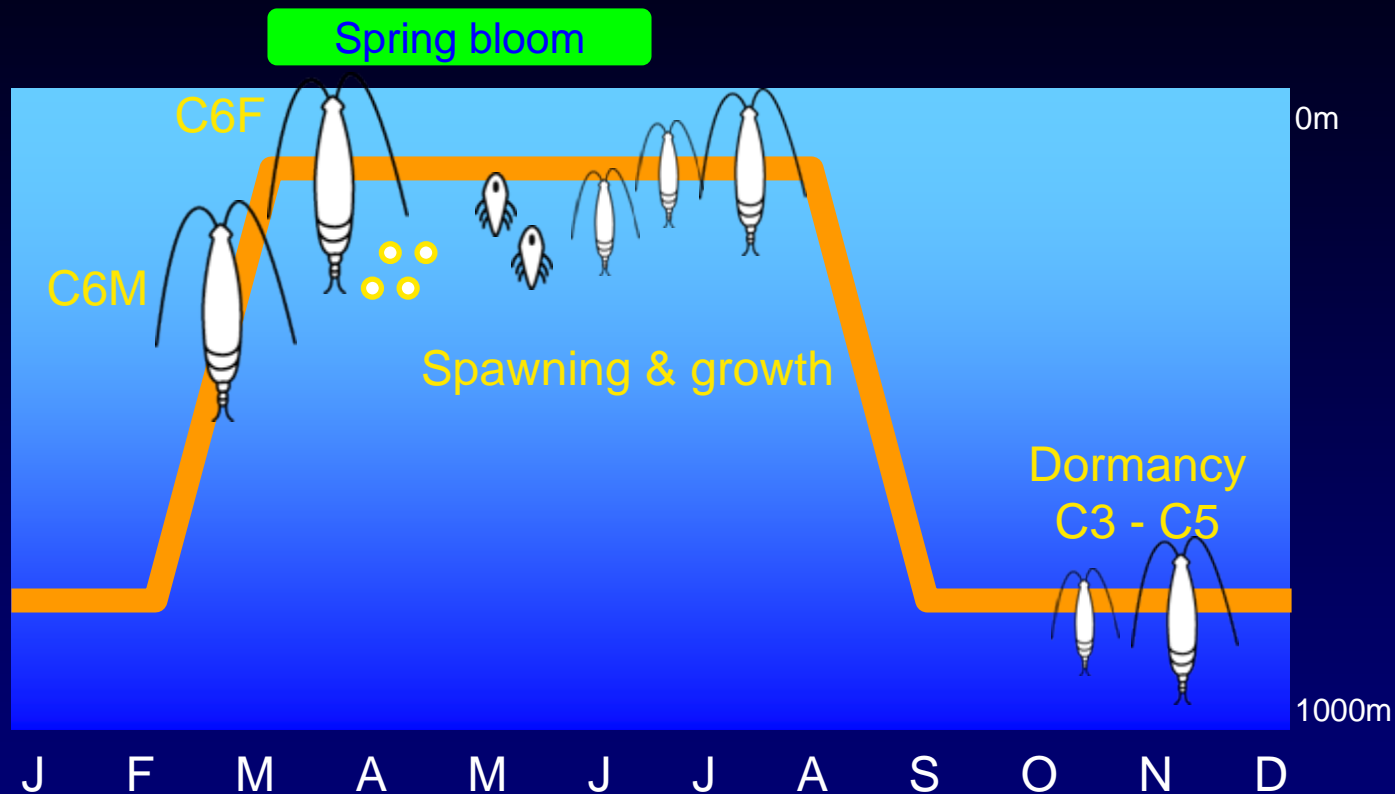
- ◆ Large bodied (> ca. 6 mm) and grazing calanoid copepods
- ◆ Sister species of *E. bungii* (Goetze 2003)
- ◆ Endemic in the North Pacific Ocean
- ◆ *E. bungii* is one of the key species in the Subarctic Pacific

Geographical distribution of *E. californicus* & *E. bungii*



- ◆ *E. californicus* is restricted to transition areas between warm and cold currents
- ◆ In the western side, latitudinal distribution of *E. californicus* is considered to be narrower than that of the eastern area

Life history of *E. bungii* in the Oyashio region



After Tsuda et al. 2004 and Shoden et al. 2005

- ◆ 1 or 2 years life cycles with seasonal ontogenetic vertical migration (OVM)
- ◆ Deep dormancy as C3 to C5 stages during autumn to winter
- ◆ Sub-surface occurrence of C6M in early spring
- ◆ Surface spawning and growth during spring to summer

Previous reports on *E. californicus*



In the western side

- ◆ Several studies in the California current region
- ◆ Seasonal OVM and dormancy as C5 and C6F between 200 and 400 m depth layers in winter (Ohman et al. 1998)



In the eastern side

- ◆ Only two ecological studies, conducted in Sagami Bay, middle of Japan (Shimode et al. 2006 and Sasaki et al. 2006)
- ◆ Surface occurrence only from Mar. to May during spring bloom season
- ◆ Dormancy as C5 and C6F below 500 m depth

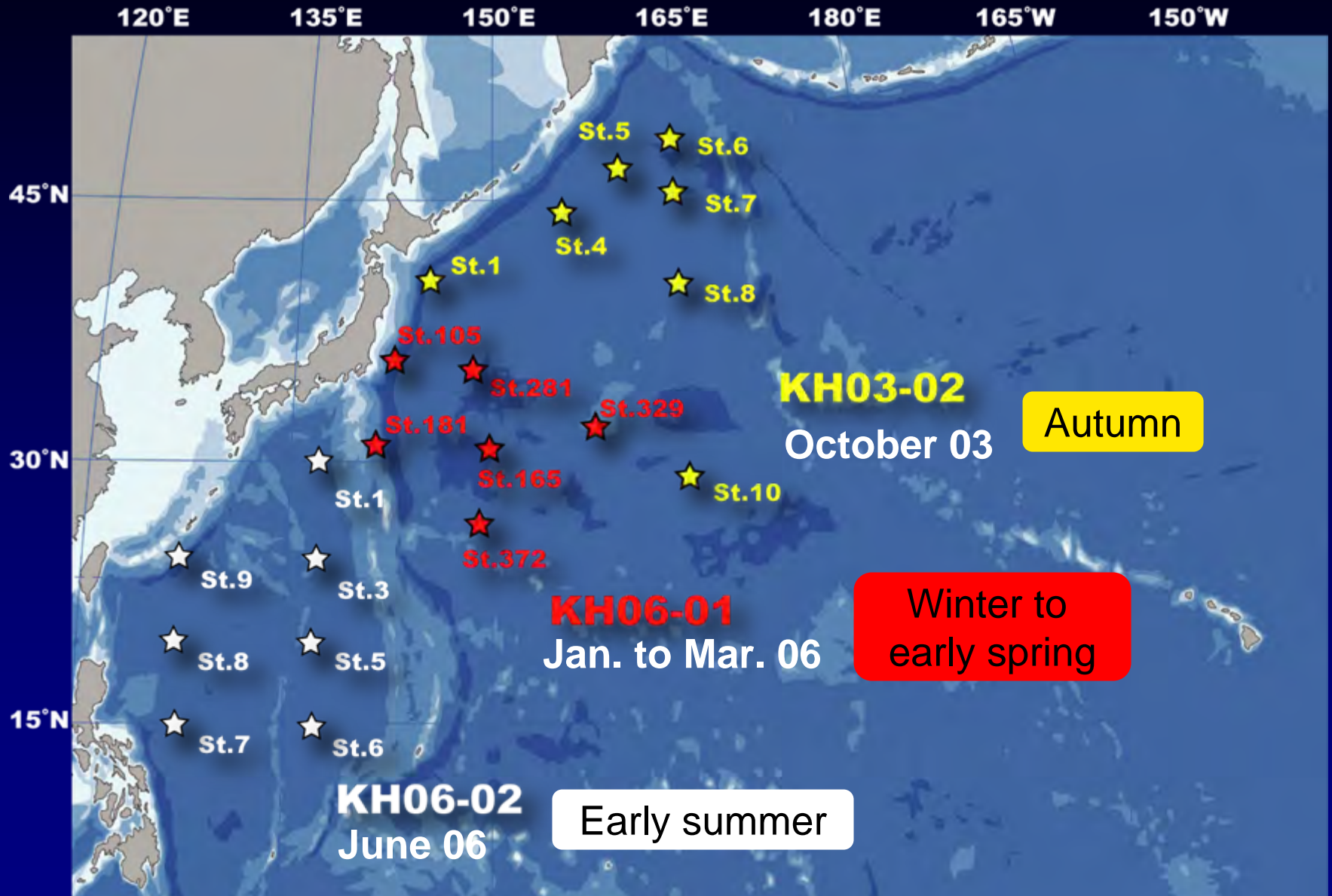
However, these studies are conducted in the **inner-bay** environment

Life history of *E. californicus* is still unclear in the western side

The aims of the this study are

- 1) To determine latitudinal distribution of *E. californicus* in the NW Pacific
- 2) To discuss seasonal OVM strategy of *E. californicus* in the western area

Methods: Sampling stations



Methods: Zooplankton samplings



Cruise no.	Year	Month	VMPS mouth area	VMPS Mesh size	Max. Sampling depth	No. of Sampling layers
KH03-02	2003	Oct.	0.25 m ²	330 μm	2,000 m	4
KH06-01	2006	Jan. - Mar.	0.25 m ²	100 μm	1,000 or 2,00 m	6
KH06-02	2006	Jun.	0.25 m ²	330 μm	1,000 m	4

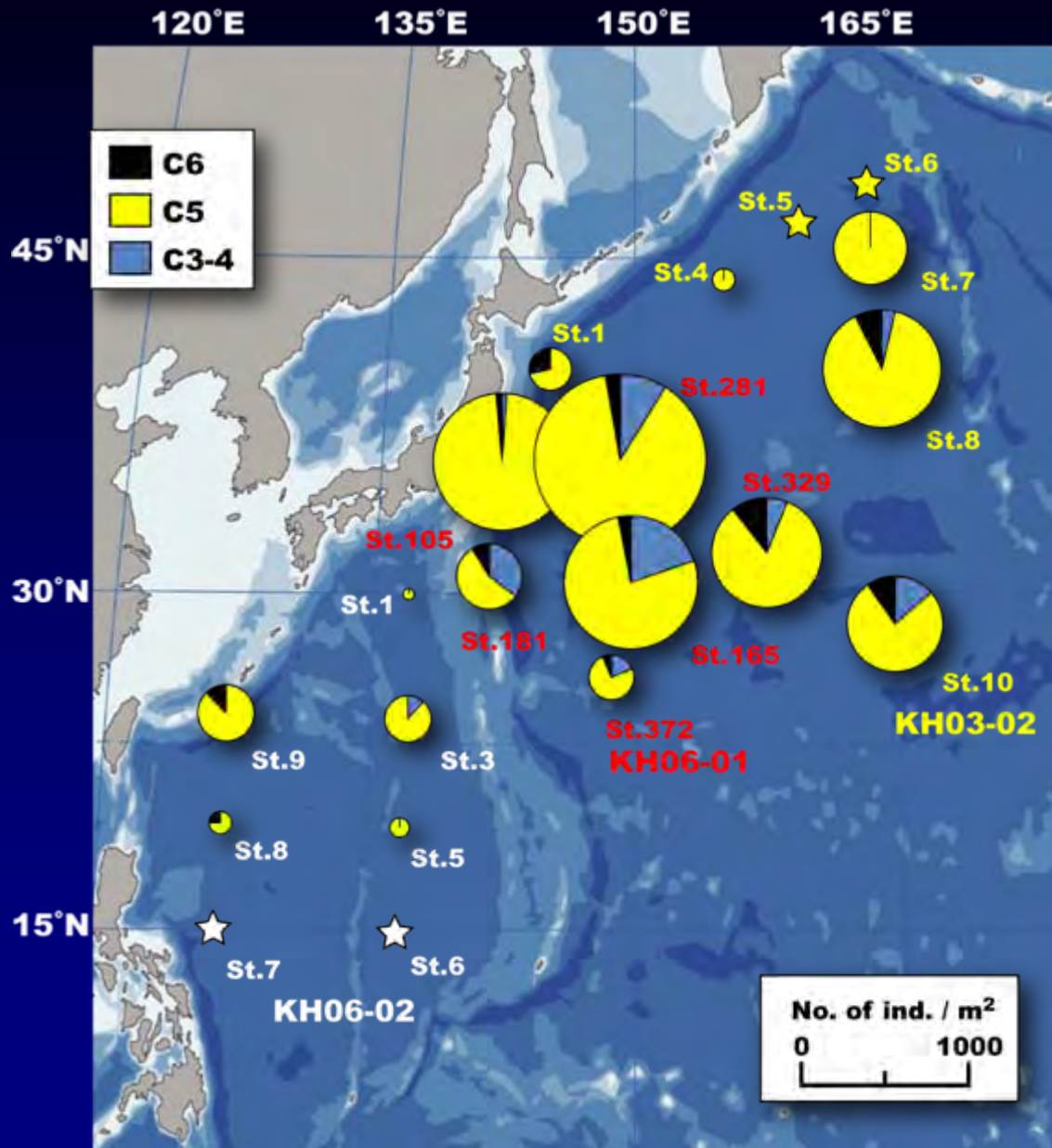


VMPS

(Vertical Multi-layer Plankton Sampler)

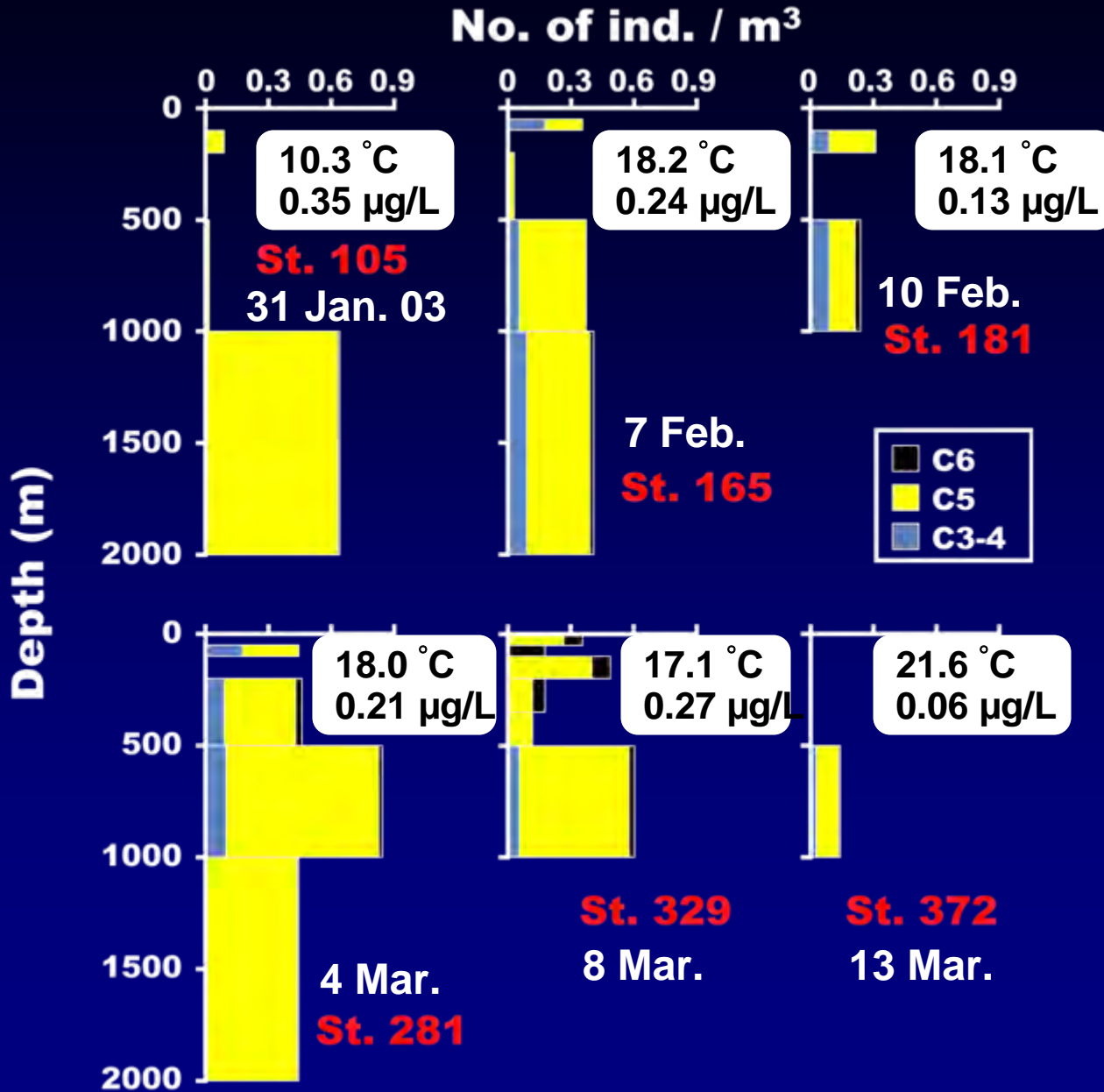
- ◆ Zooplankton samples were collected from 1,000 m or 2,000 m, using by VMPS
- ◆ At St. 1 in KH06-02, the sample was collected from only one layer from 600 m to the surface, due to a trouble on VMPS.
- ◆ Developmental stages from C1 to C6 of *E. californicus* were sorted and counted from a hole samples, and/or halves or quarters of sub-samples.
- ◆ C4 to C6 were individually identified into females and males.

Result: Geographical distribution of *E. californicus*



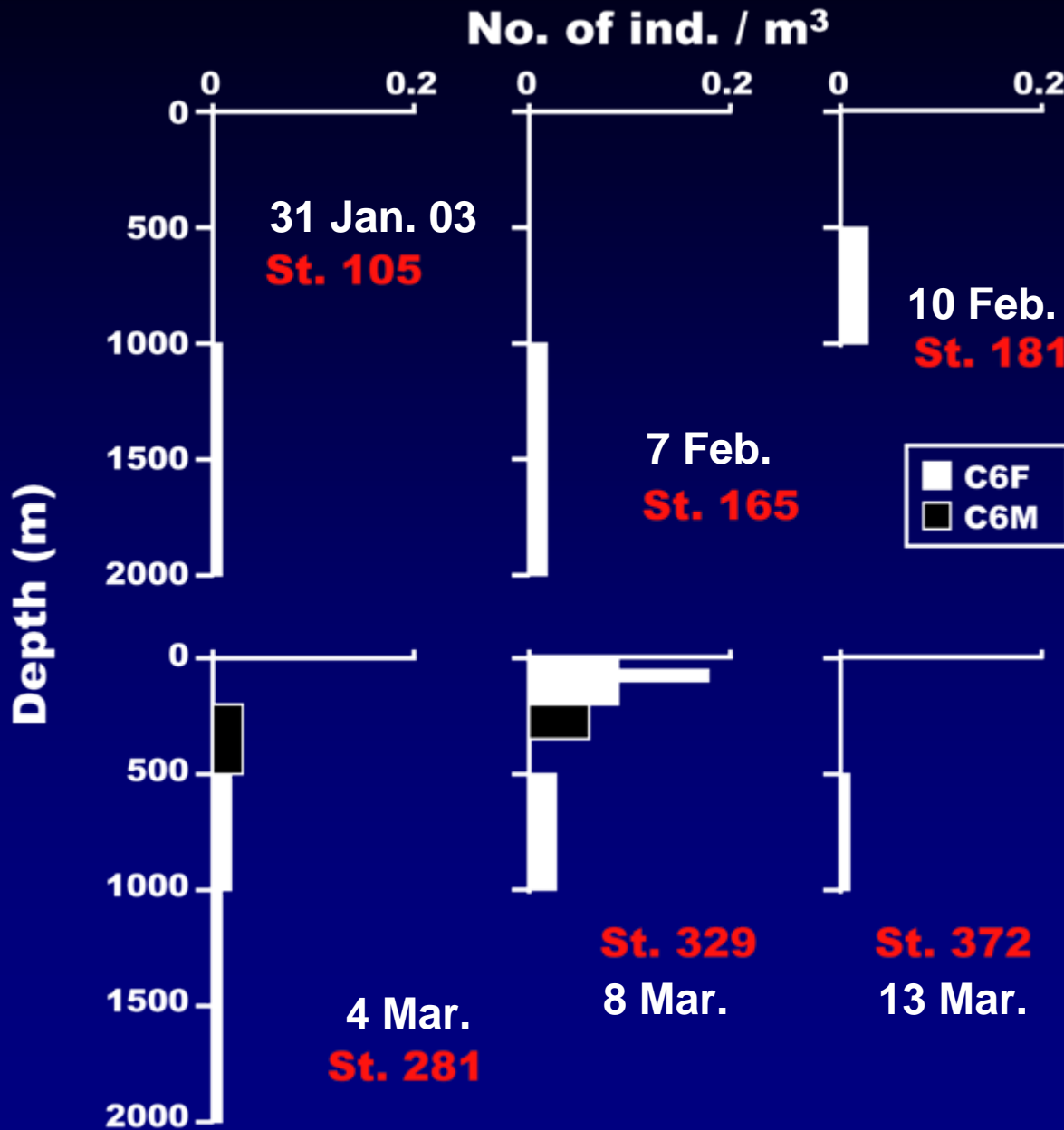
- ◆ Occurrence from 20 to 45 °N
- ◆ High abundances from 30 to 40 °N
- ◆ C5 dominating every stations

Vertical distribution: winter to early spring



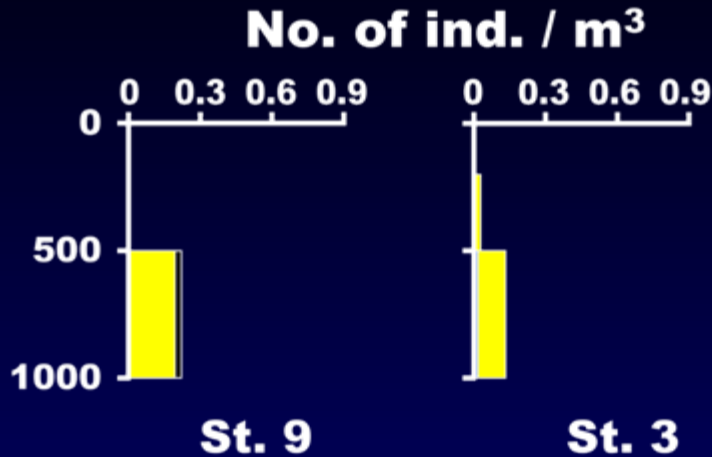
- ◆ In Jan., almost all individuals below 1,000 m depths.
- ◆ From Feb. to Mar., increase of the abundances between the surface and 500 m depth, except for St. 372
- ◆ In particular at St. 281 and 329, adult individuals upper 500 m depth
- ◆ Suggesting upward OVM from Feb.

Vertical distribution: winter to early spring

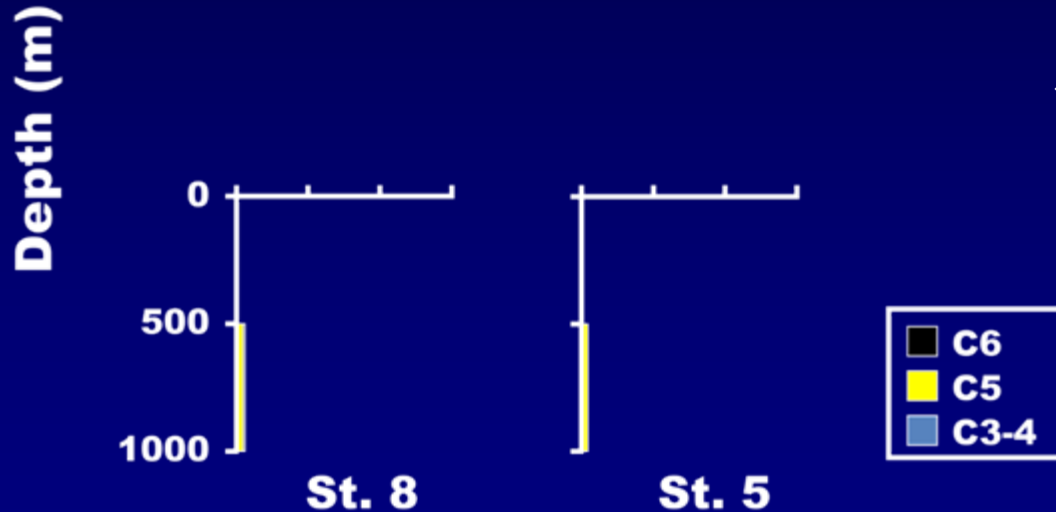


- ◆ Increase of adult abundances from Feb. to Mar.
- ◆ Subsurface occurrence of adult males
- ◆ New recruitments from the deep C5 population

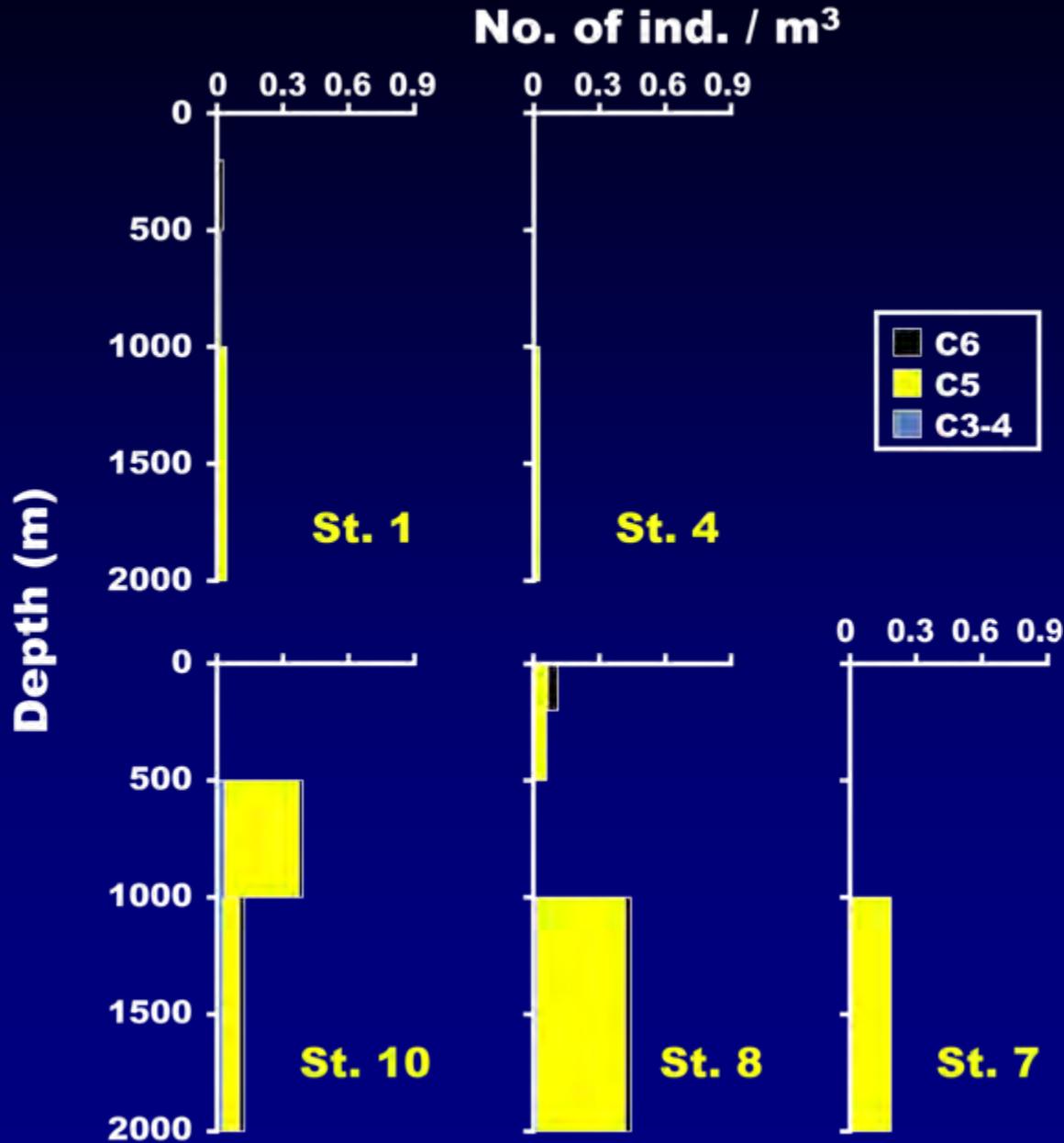
Vertical distribution: early summer (June)



- ◆ Almost all individuals below 500 m depth.
- ◆ 88% C5 and 8% C6F
- ◆ Deep dormancy as C5 stages
- ◆ Suggesting downward OVM before early summer.

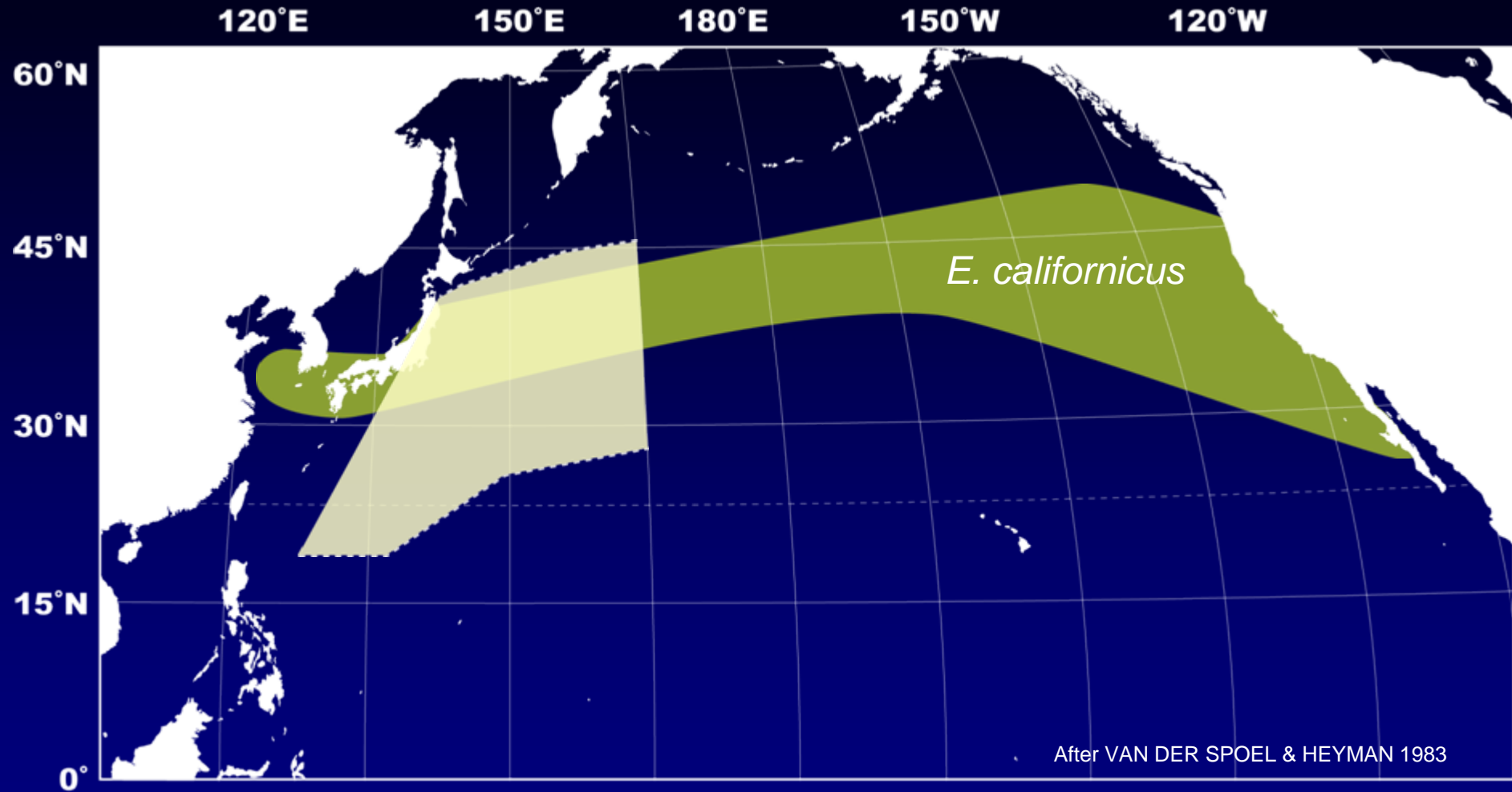


Vertical distribution: autumn (October)



- ◆ Almost all individuals below 500 or 1,000 m depth, except for St. 8
- ◆ 83% C5 and 10% C6F

Summary 1: geographical distribution

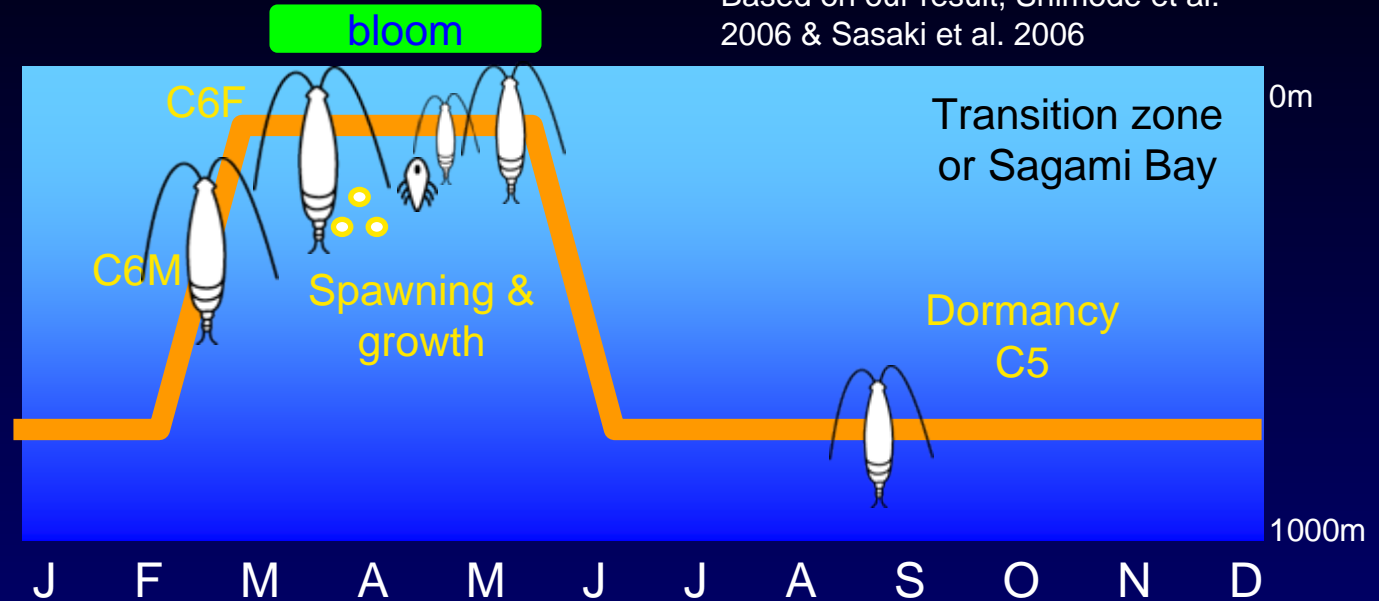


- Wide ranges of the latitudinal distribution in the western side of the North Pacific, which were a comparable to the eastern side.
- However, the higher abundances were restricted from 30 to 40 °N, which were almost identical to the transition region between Kuroshio and Oyashio currents.

Summary 2: life history in the NW Pacific



Based on our result, Shimode et al. 2006 & Sasaki et al. 2006



Almost identical OVM strategies between *E. californicus* and *E. bungii* are

- ◆ 1 (or 2 ?) year life cycle
- ◆ Seasonal ontogenetic vertical migration (OVM)
- ◆ Dormant in deeper layers
- ◆ Sub-surface occurrence of C6M in early spring
- ◆ Surface spawning and growth during bloom seasons

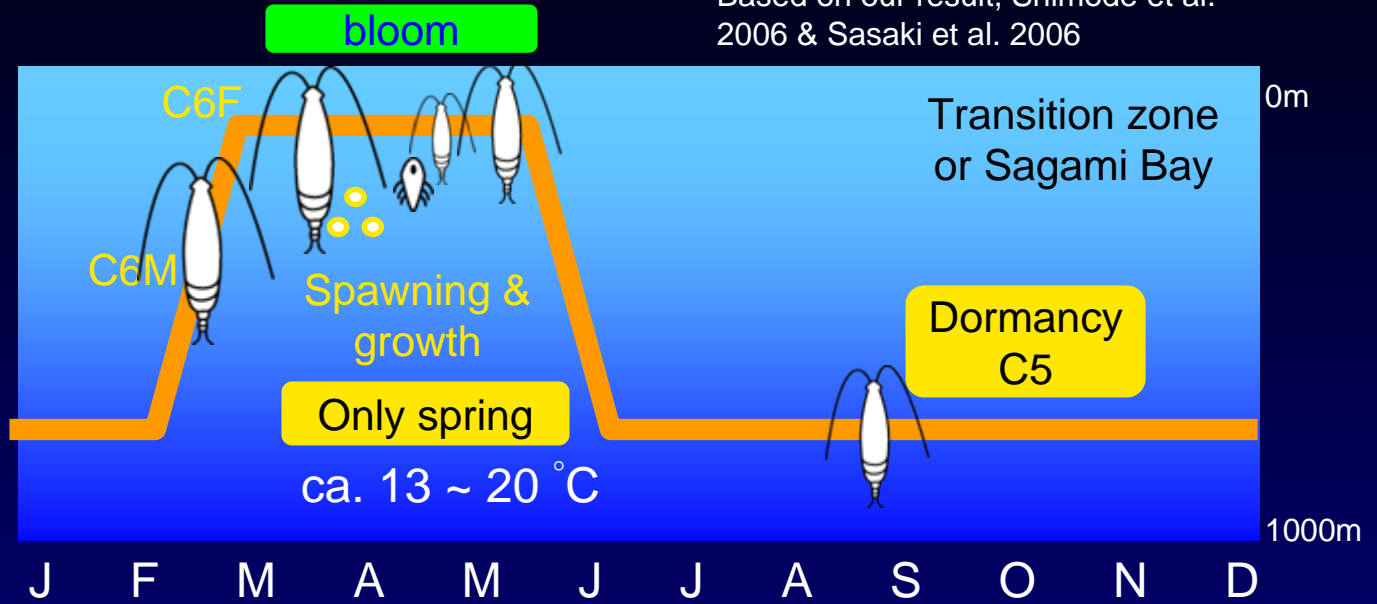
Summary 2: life history in the NW Pacific



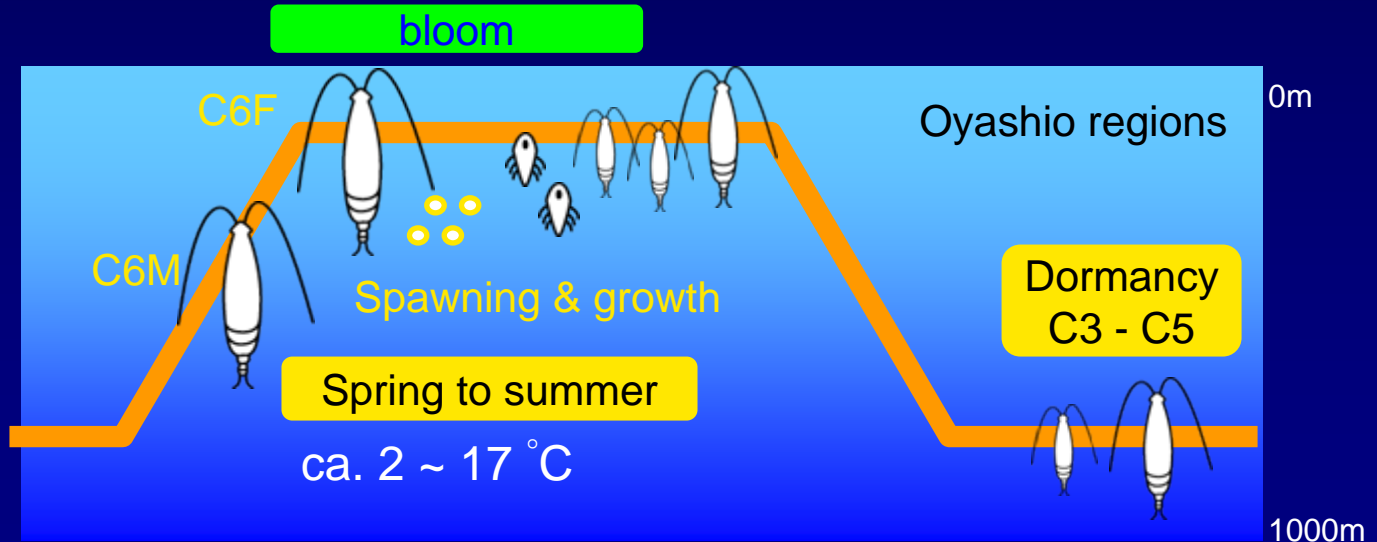
Based on our result, Shimode et al. 2006 & Sasaki et al. 2006



E. californicus



E. bungii



After Tsuda et al. 2004 and Shoden et al. 2005

Feature studies



- ◆ Do the northern or southern deep populations of *E. californicus* migrate into the surface during spring or bloom seasons ?
- ◆ Can they spawn and grow in high or low temperature conditions ?
- ◆ What is a factor separating the latitudinal distributions between *E. californicus* and *E. bungii* ?



E. californicus



E. bungii

Studies on relationships between temperature and egg production, and growth will be needed

Acknowledgements



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Thank you for your attention