# Life Histories of *Calanus sinicus* and *C. jashnovi* (Copepoda: Calanoida) in the Water Column of 1000 m in Sagami Bay, Central Japan

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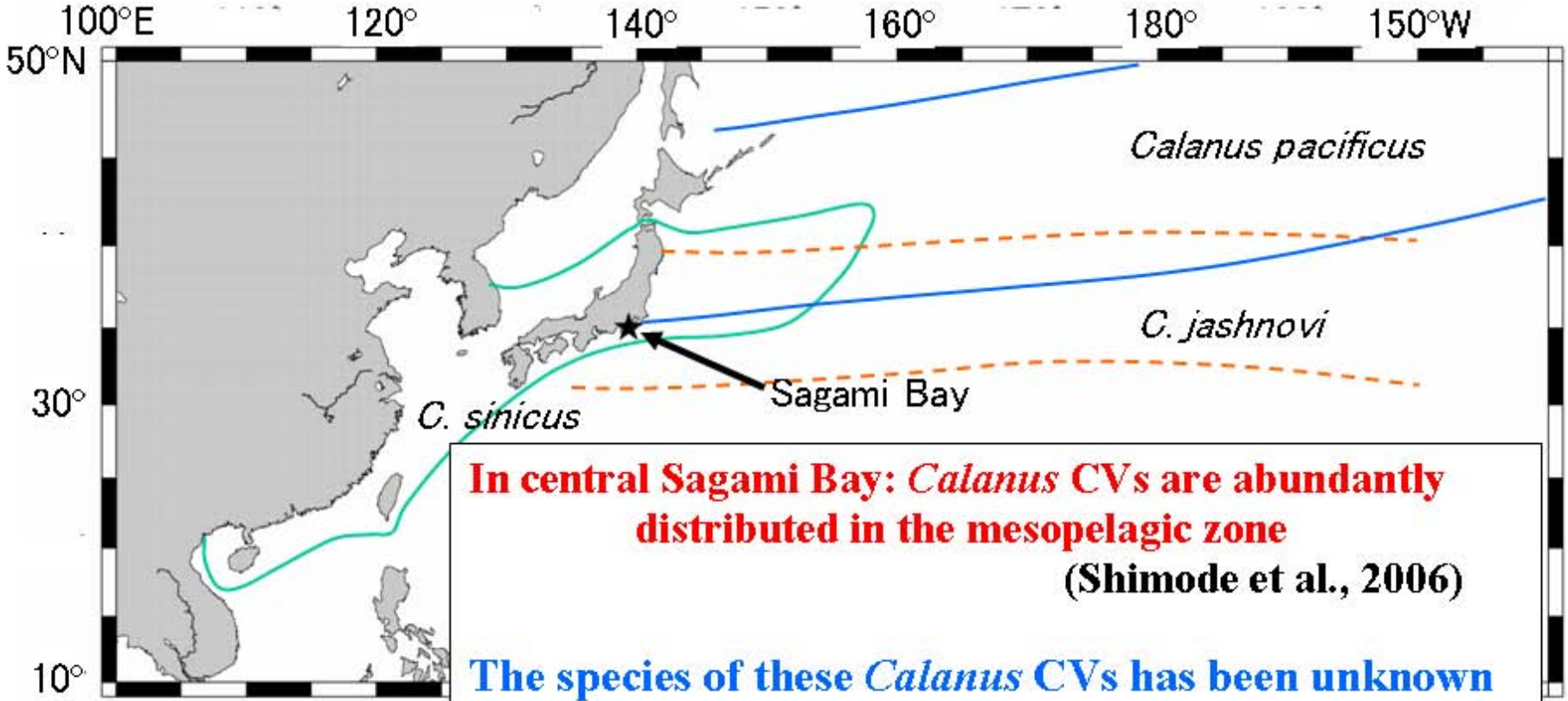
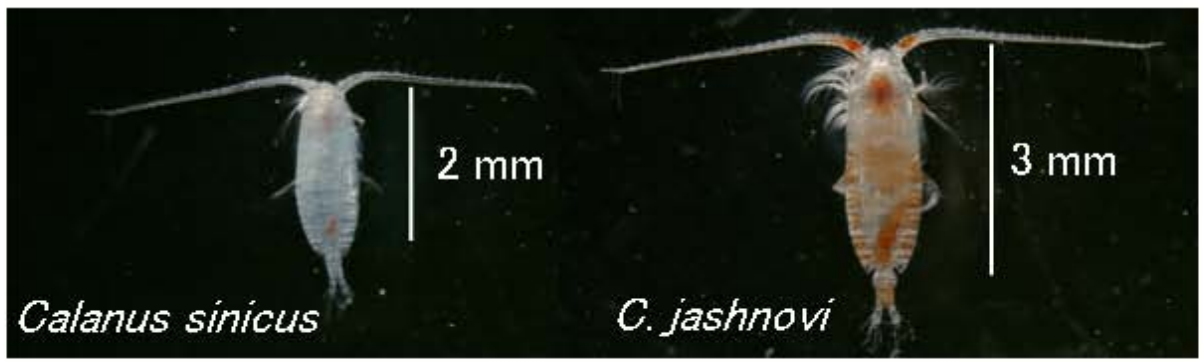
# Geographical distribution of *Calanus* in the western North Pacific



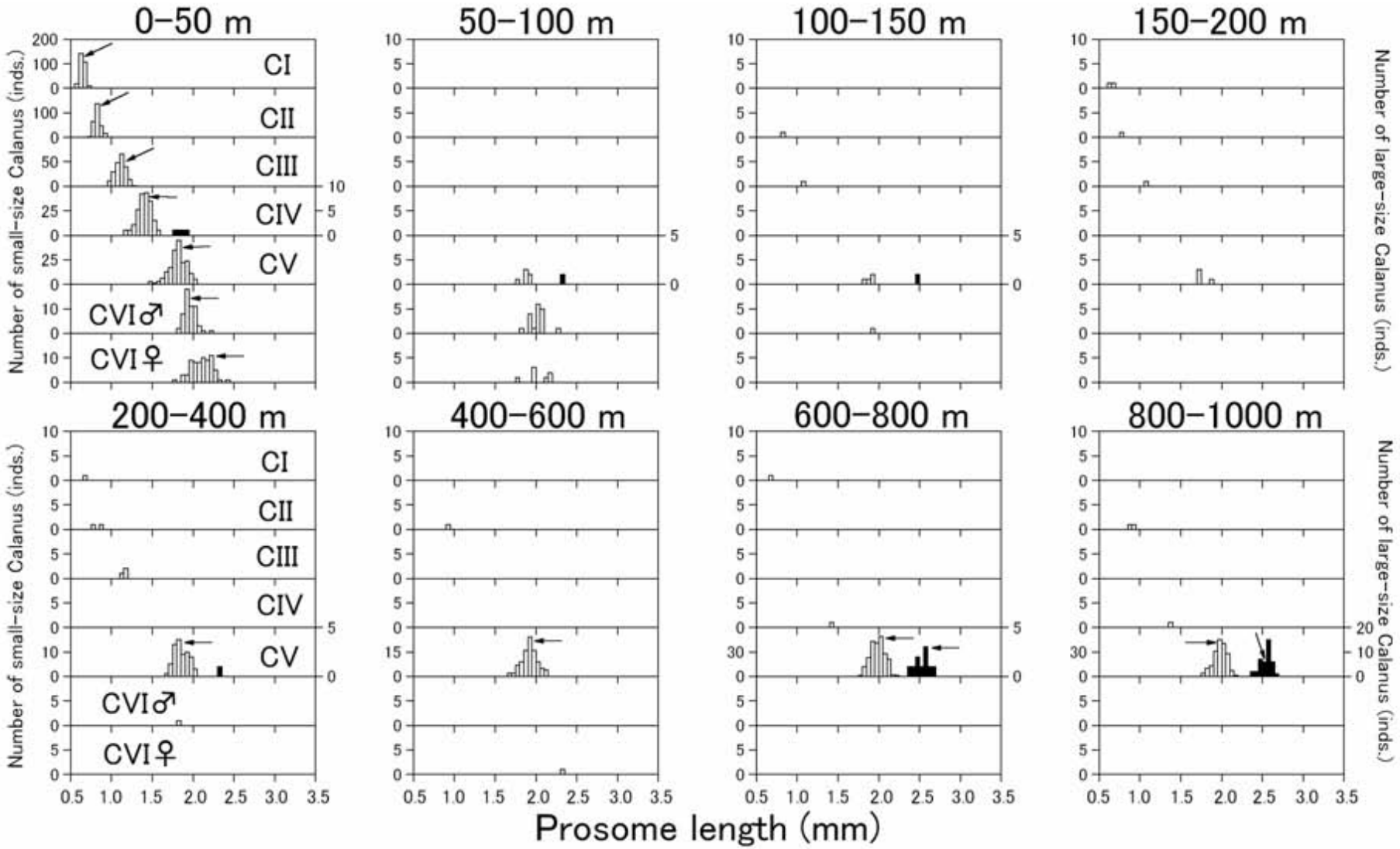

Brodsky 1965
Hulsemann 1994

**In central Sagami Bay: *Calanus* CVs are abundantly distributed in the mesopelagic zone**
**(Shimode et al., 2006)**

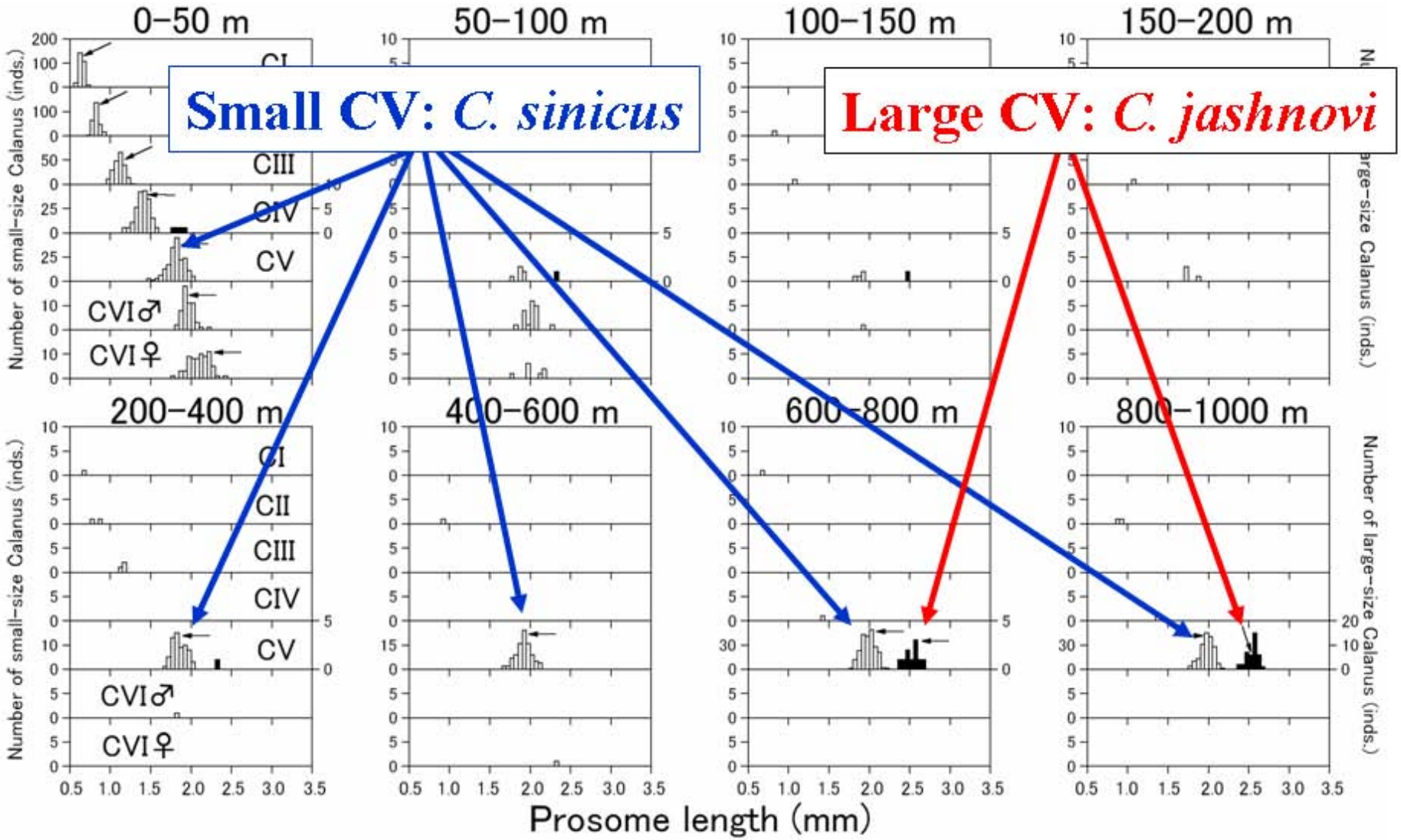
**The species of these *Calanus* CVs has been unknown**



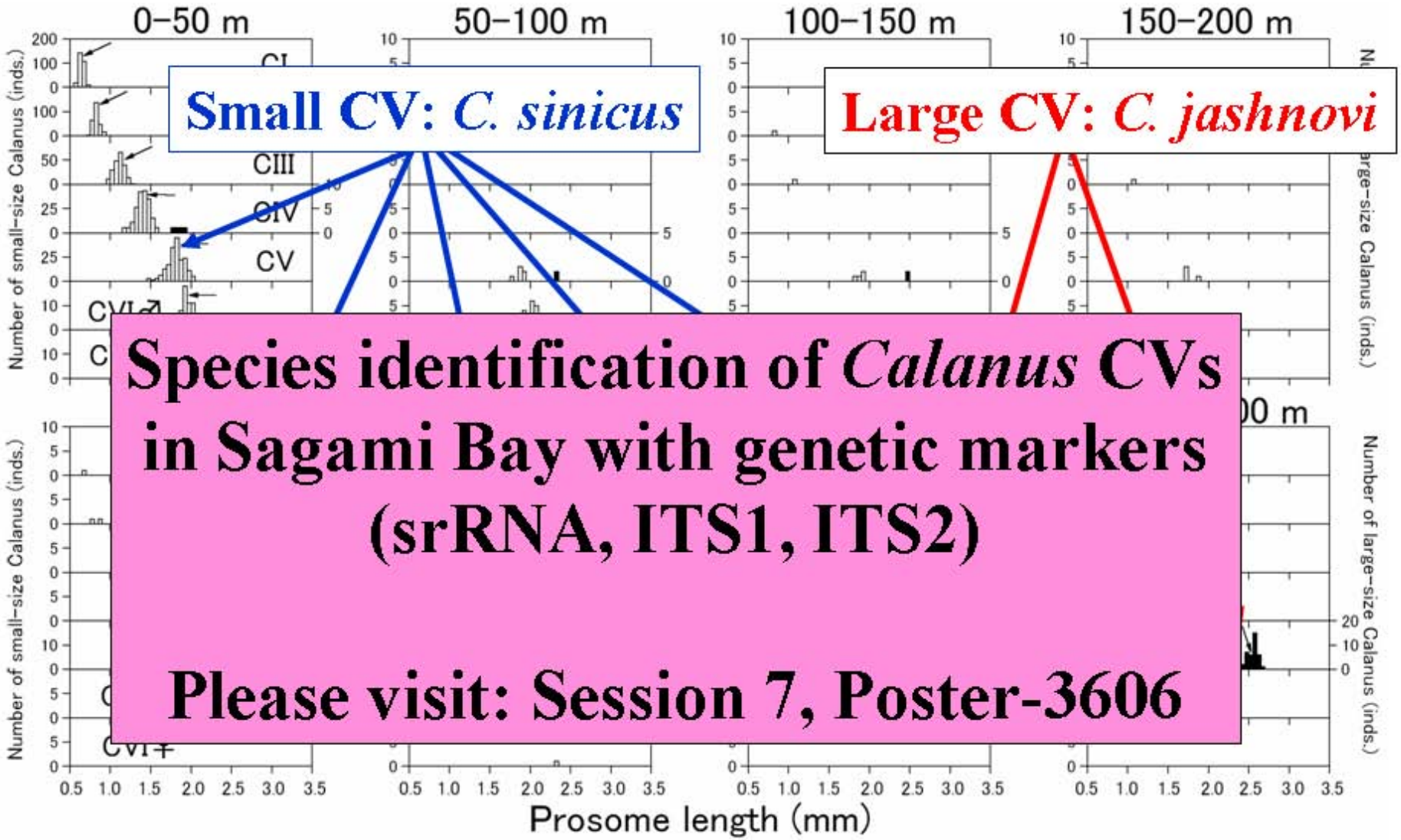
# Size-frequency distributions of *Calanus* in Sagami Bay



# Size-frequency distributions of *Calanus* in Sagami Bay



# Size-frequency distributions of *Calanus* in Sagami Bay




**Species identification of *Calanus* CVs in Sagami Bay with genetic markers (srRNA, ITS1, ITS2)**

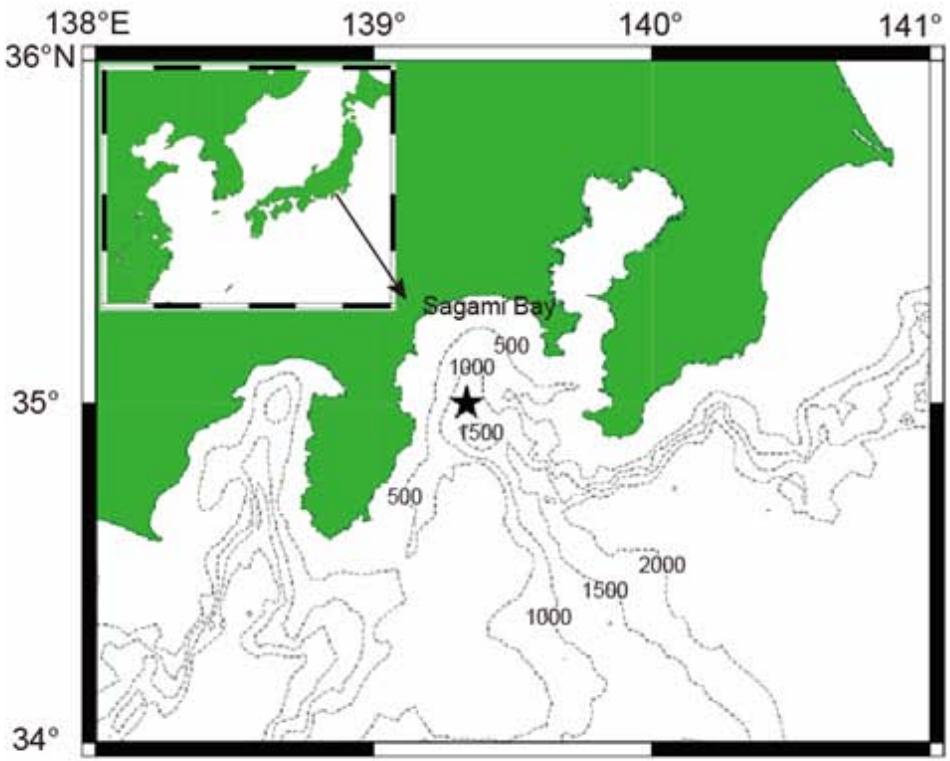
**Please visit: Session 7, Poster-3606**

# Aim of this study

To obtain basic information on life histories of *Calanus sinicus* and *C. jashnovi* in off-shelf waters of Sagami Bay, with special reference to the CVs in the mesopelagic zone

# Materials & Methods

- A fixed station (1500-m depth)
- Monthly samplings from May 2002 to January 2004, in total 22 times
  - 13 times: Vertical Multilayer Plankton Sampler (100-μm): 0-1000 m
  - 9 times: Norpac net (100-μm): 0-200 m
- Water temperature and salinity by CTD observation
- Chl-*a* concentration by water sampling and fluorometric methods





# Hydrography

## Temperature

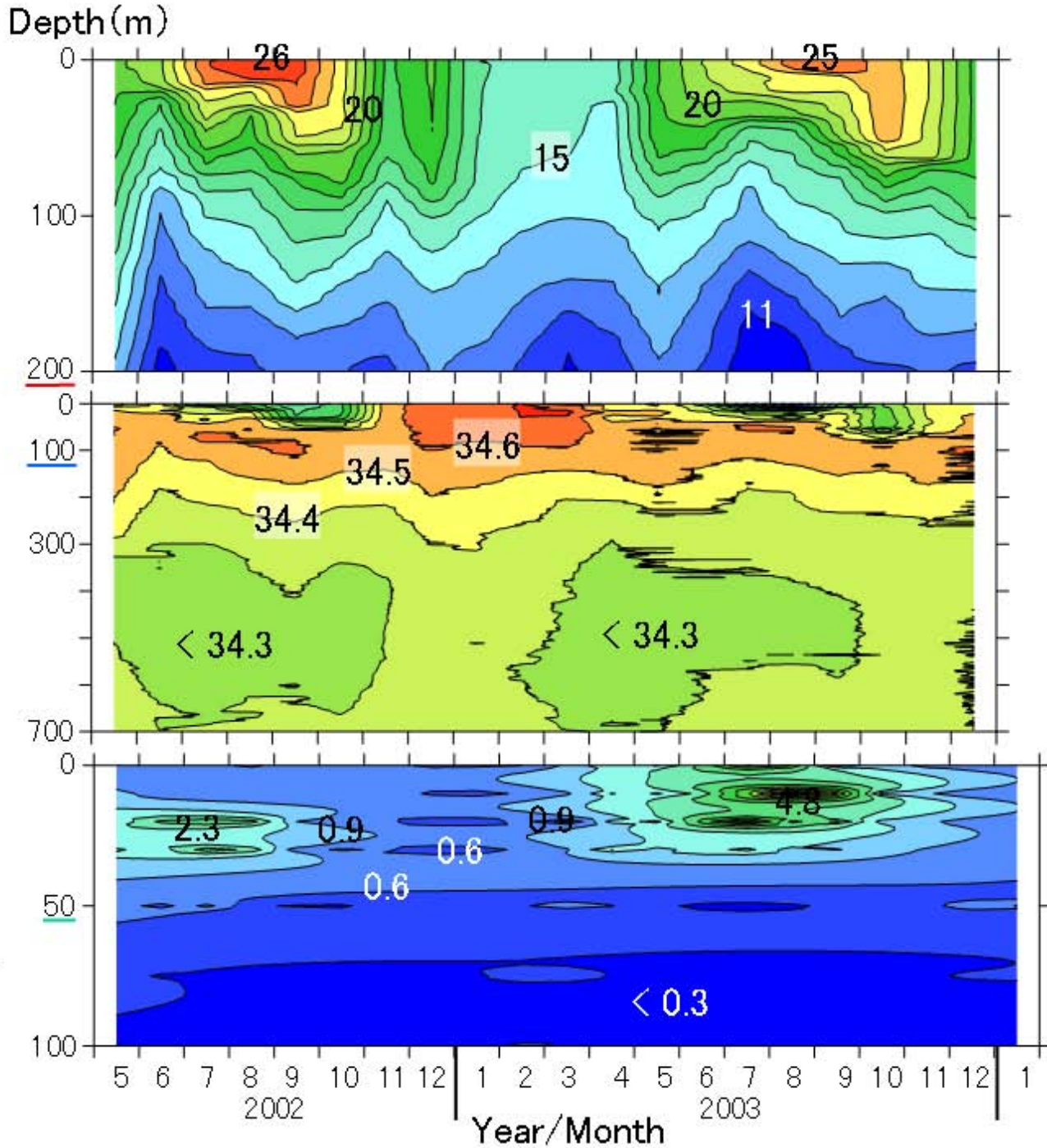
- Seasonal change in the upper 200 m
- Surface: 15°C in Feb. to 26°C in Aug.-Sep.

## Salinity

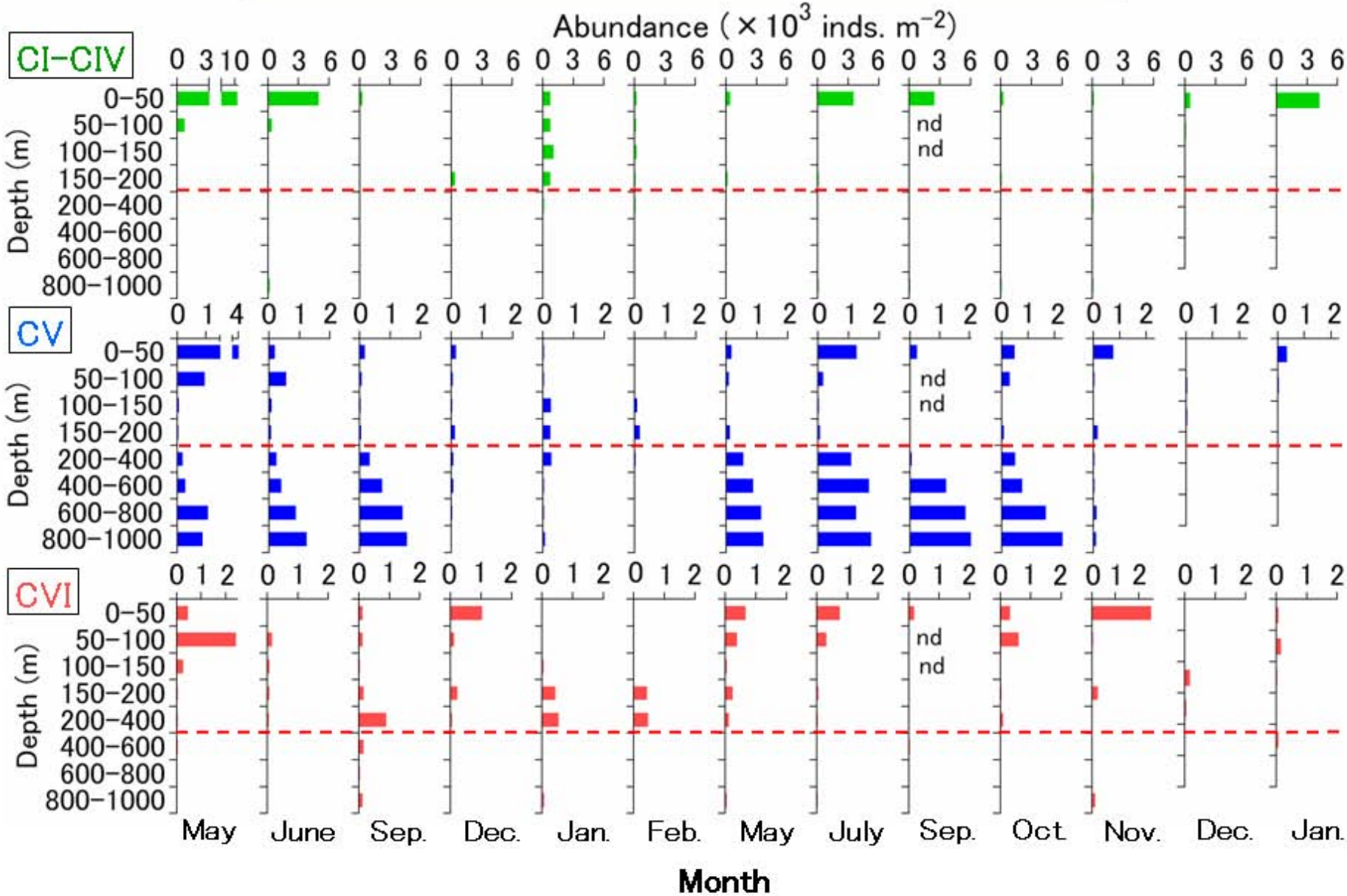
- Seasonal change in the upper 100 m
- Surface minimum: 33.2-33.4 psu in Aug.-Sep.
- Low-salinity water: < 34.3 in 300-700 m

## Chlorophyll-*a*

- Seasonal change in the upper 50 m
- Subsurface maximum: 2-5 μg $l^{-1}$ in Spring-Summer



# Vertical distribution of *Calanus sinicus*



# Seasonal change of *C. sinicus*

CI-CIV in 0-200 m

- Occurrence throughout the year

CV in 0-200 m

- Occurrence throughout the year

CV in 200-1000 m

- High abundance in spring-fall
- Low abundance in early winter

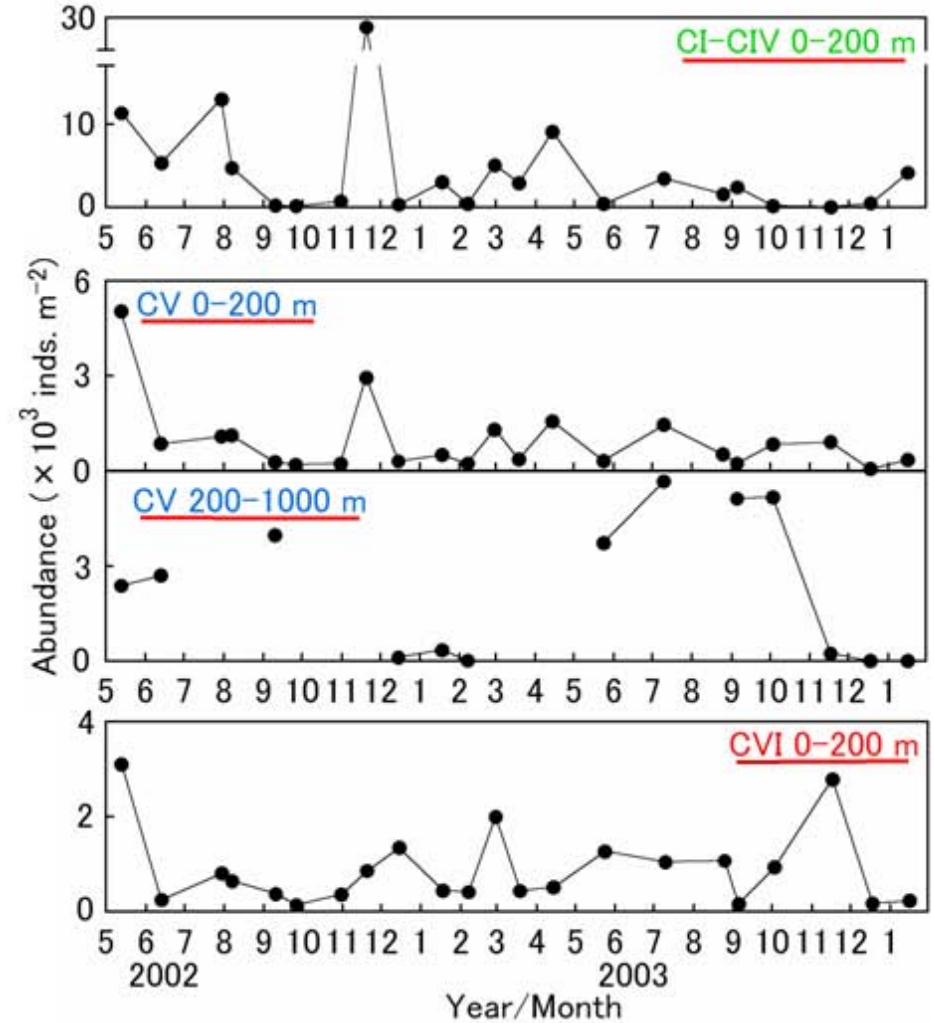
CVI in 0-200 m

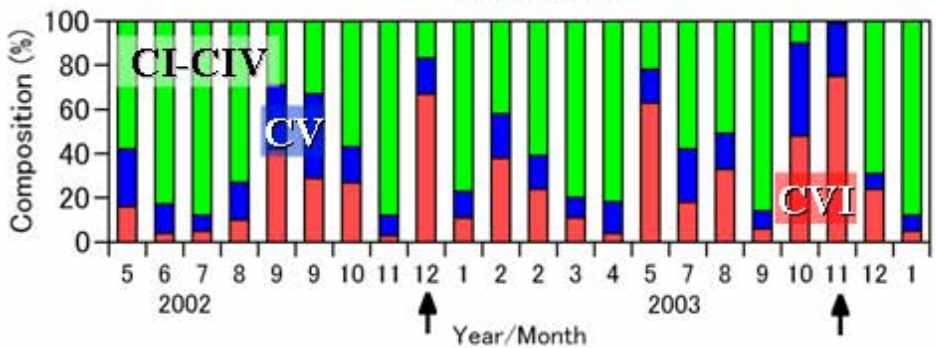
- Occurrence throughout the year
- High abundance in early winter

Seasonal change in stage composition at 0-200 m

- CVI occupied ca. 70 % in early winter

- Deep-water CVs emerged from diapause and matured in early winter



# Discussion – Comparison with other areas

## a: Coastal-shelf waters

| Area | Depth of water column (m) | Annual mean (inds./$m^{-2}$) | Max (inds./$m^{-2}$) | Reference |
|---|---|---|---|---|
| Kii Channel, Japan | 50 | 8600 | 26500 | Uye, 2000 |
| Yellow Sea, China | 80 | - | 25110 | Pu et al, 2004a |
| Harima-nada, Japan | 30 | 3480 | 18000 | Uye, 2000 |
| Yellow Sea, China | 78 | - | 16892 | Wang et al, 2004 |
| Yellow Sea, China | 70 | - | 12000 | Pu et al, 2004b |
| Suruga Bay, Japan | 30 | - | 2109 | Itoh et al, 2005 |
| Sagami Bay, Japan | 100 | 921 | 1908 | Shimode et al, 2006 |

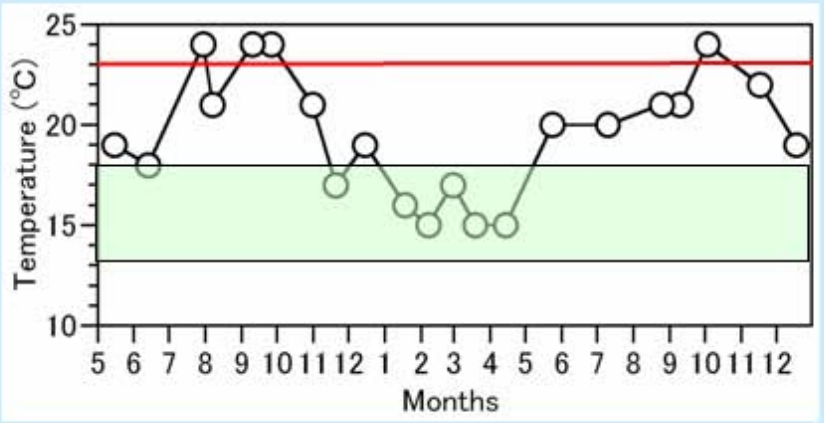
## b: Off-shelf waters

| Area | Depth of water column (m) | Annual mean (inds./$m^{-2}$) | Max (inds./$m^{-2}$) | Reference |
|---|---|---|---|---|
| Off Kii-Bohso Pens., Japan | 150 | 8031 | 67805 | Kidachi &Itoh, 1979 |
| Sagami Bay, Japan | 25 | - | 29000 | Shimode et al, 2006 |
| Sagami Bay, Japan | 1000 | 6814 | 13011 | Present Study |
| Nearshore, Shikoku, Japan | 150 | 5385 | 11250 | Uye, 2000 |
| Offshore, Shikoku, Japan | 150 | 1545 | 3750 | Uye, 2000 |

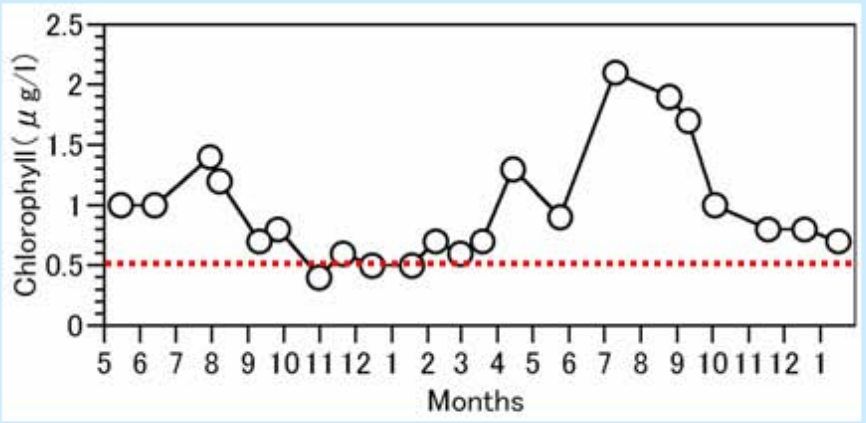
# Questions

- How are the off-shelf populations maintained despite the adverse conditions, such as highly fluctuating temperature and food resources in the epipelagic layer ?
- What is the importance of the deep CVs in maintaining the off-shelf populations?

# Discussion – Environmental conditions




Mean temperature in 0–50 m




Mean Chl-*a* ( > 0.2 μ m) in 0–50 m

**13-18°C: optimal range for egg-production rate**
**23°C: upper limit of egg-production (Wang et al., 2003)**

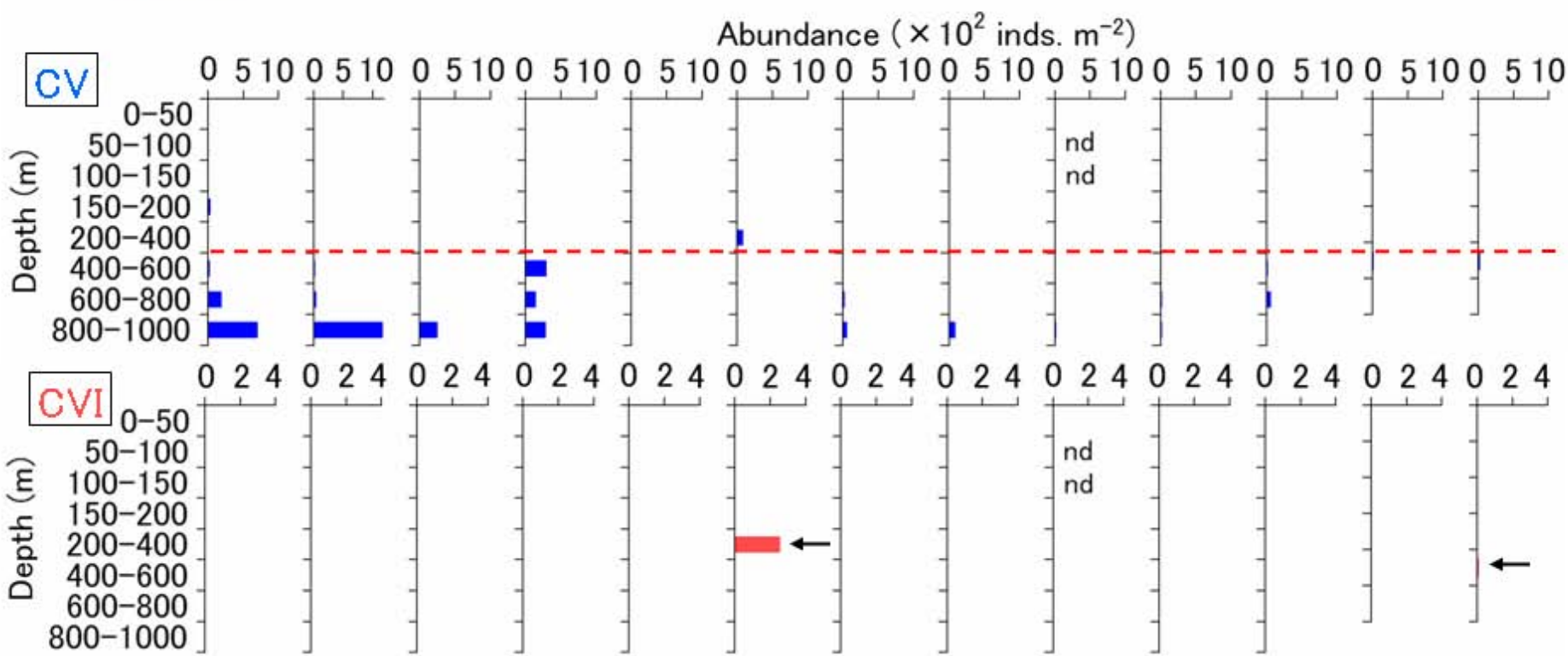
**0.5 μg/l ( > 5μm): decrease of egg-production rate (Uye, 2000)**

Habitat shift to mesopelagic zone will be advantageous for maintaining off-shelf population

Relationships between emergence of deep CVs into epipelagic zone in early winter and low-chlorophyll levels in early winter are still unknown

# Vertical distribution of *Calanus jashnovi*

- CI-CIV: not collected with VMPS

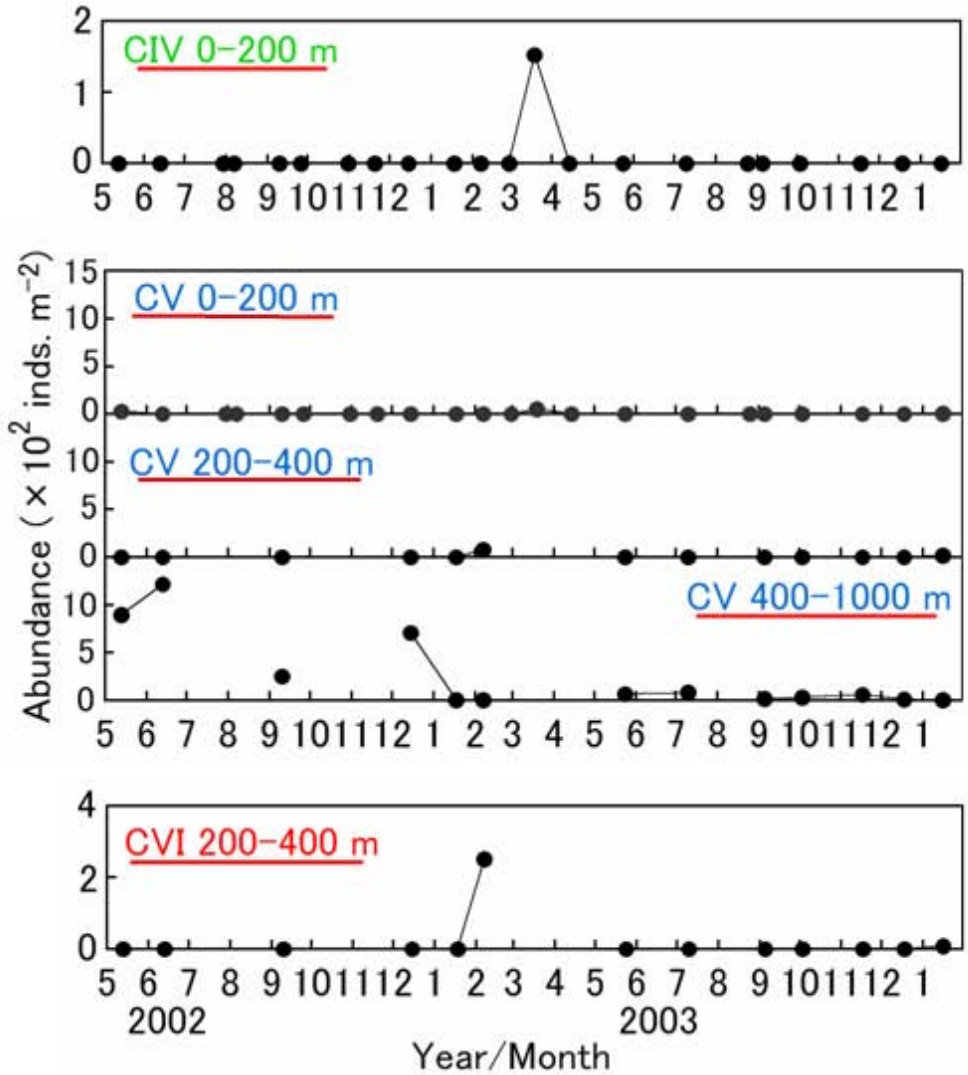



- Most individuals of CV were distributed below 400 m
- CVI occurred in 200-400 m

# Seasonal change of *C. jashnovi*

- Occurrence of CV in 400-1000 m (2002)
- All CVs had lipid storage
- Sporadic occurrence of the other stages
- No marked seasonal patterns

- *C. jashnovi* may not complete its life cycle in off-shelf waters in Sagami Bay
- Deep CVs might be in diapause and advected from outside the bay
- Main habitat of *C. jashnovi* is still unknown



# Conclusion

- **In Sagami Bay, major part of CVs in the mesopelagic zone is comprised of *C. sinicus* while a minor fraction of *C. jashnovi*.**

- ***Calanus sinicus* CVs showed bimodal vertical pattern, suggesting behavioral differentiation within a population.**

- ***Calanus sinicus* CVs in the mesopelagic zone may play a role in maintaining their off-shelf populations.**

- ***Calanus jashnovi* in the mesopelagic zone may be in diapause and transported from outside the bay.**