S5 #2947

Distribution and prey composition of juvenile small epipelagic fishes and myctophids in the Kuroshio-Oyashio Transition Zone in spring, 2002-2004

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FRA
Fisheries Research Agency

Myctophids' relationships with commercial epipelagic species

Such as

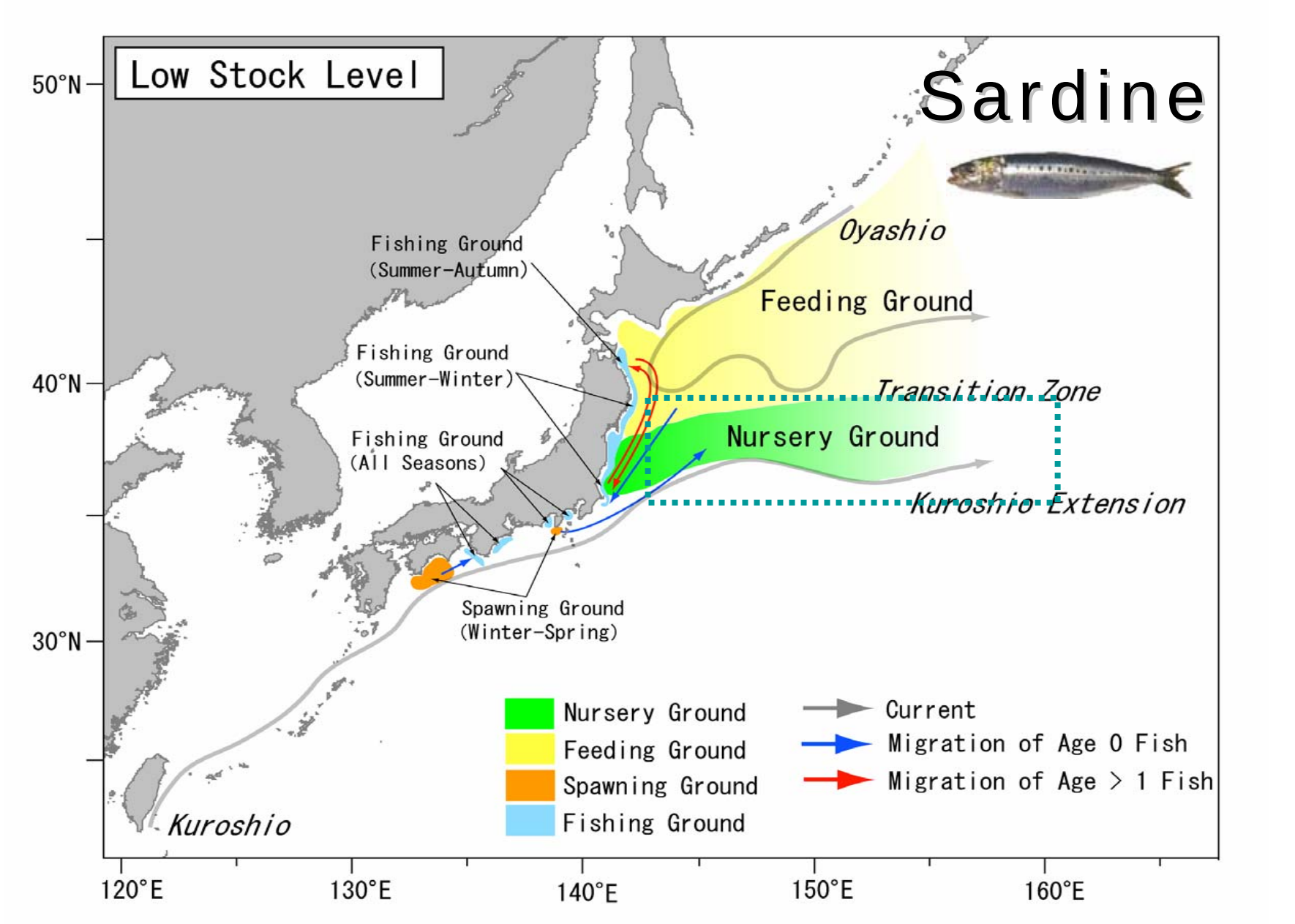
Japanese sardine (*Sardinops melanostictus*)

Anchovy (*Engraulis japonicus*)

Chub mackerel (*Scomber japonicus*)

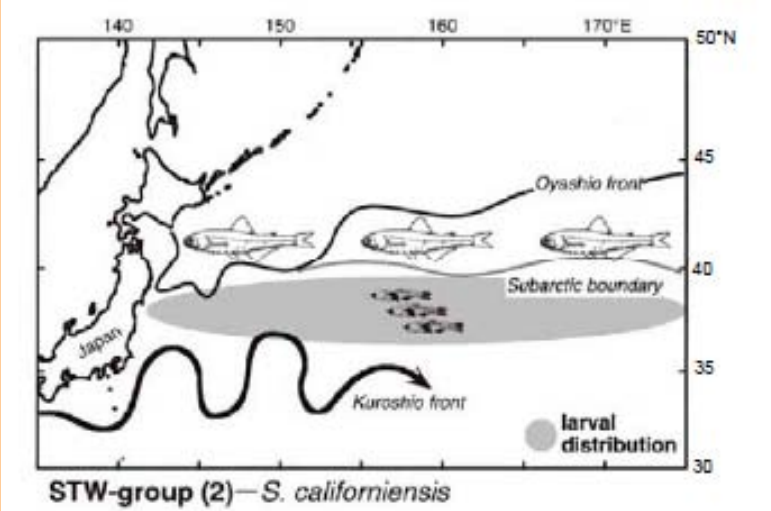
Focus on horizontal distributions and prey in the nighttime surface layer at the Kuroshio-Oyashio Transition Zone (KOTZ)

➔ the key area for recruitment of the Pacific stocks

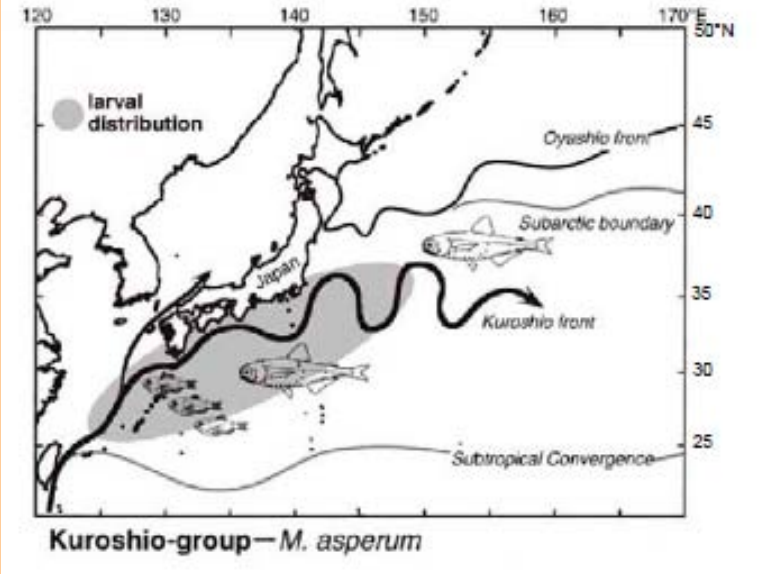


modified from Stock Assessment Report (FRA,FAJ)

Possible migration pattern of dominant myctophids in the KOTZ



STW-group (2)—*S. californiensis*

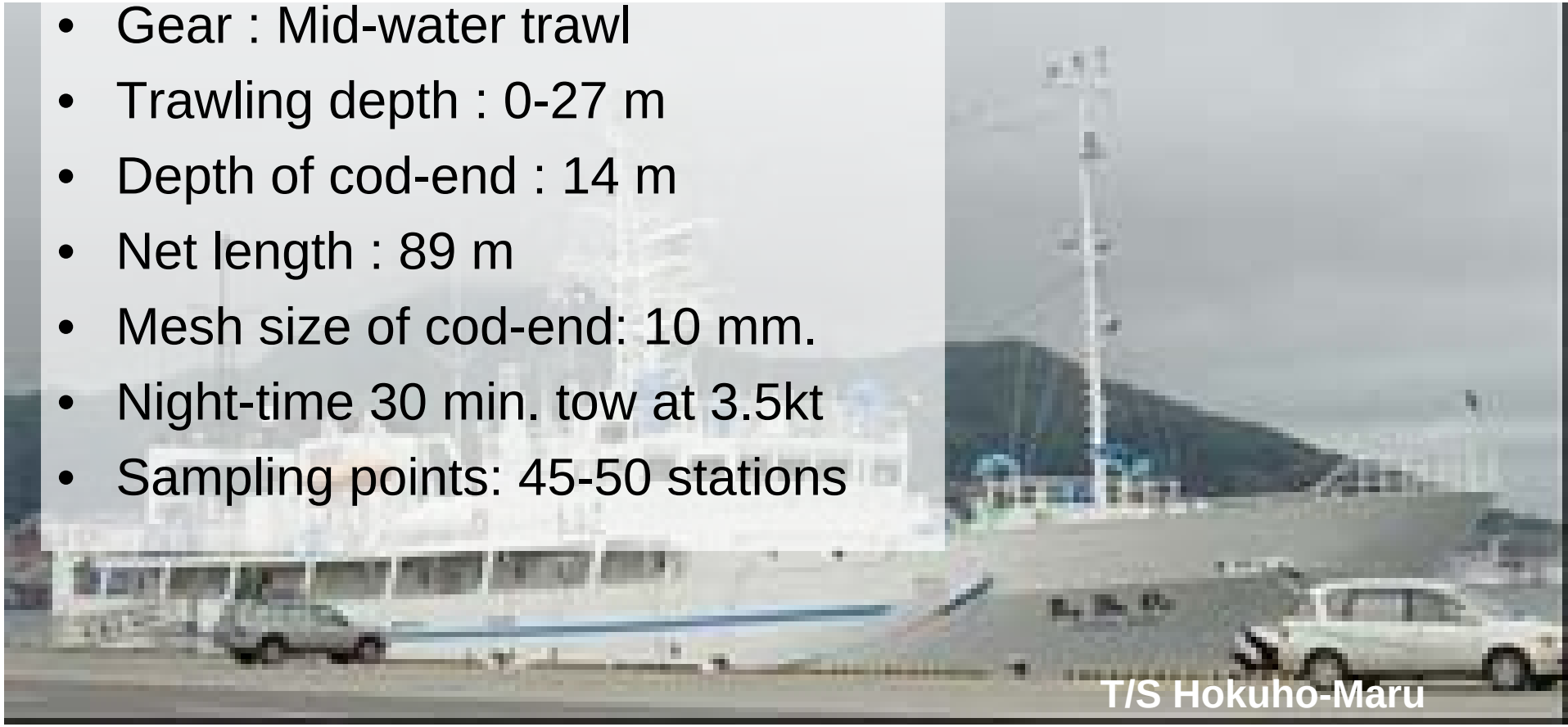


Kuroshio-group—*M. asperum*

After Sassa (2004)

Research survey for juvenile small epipelagic fishes

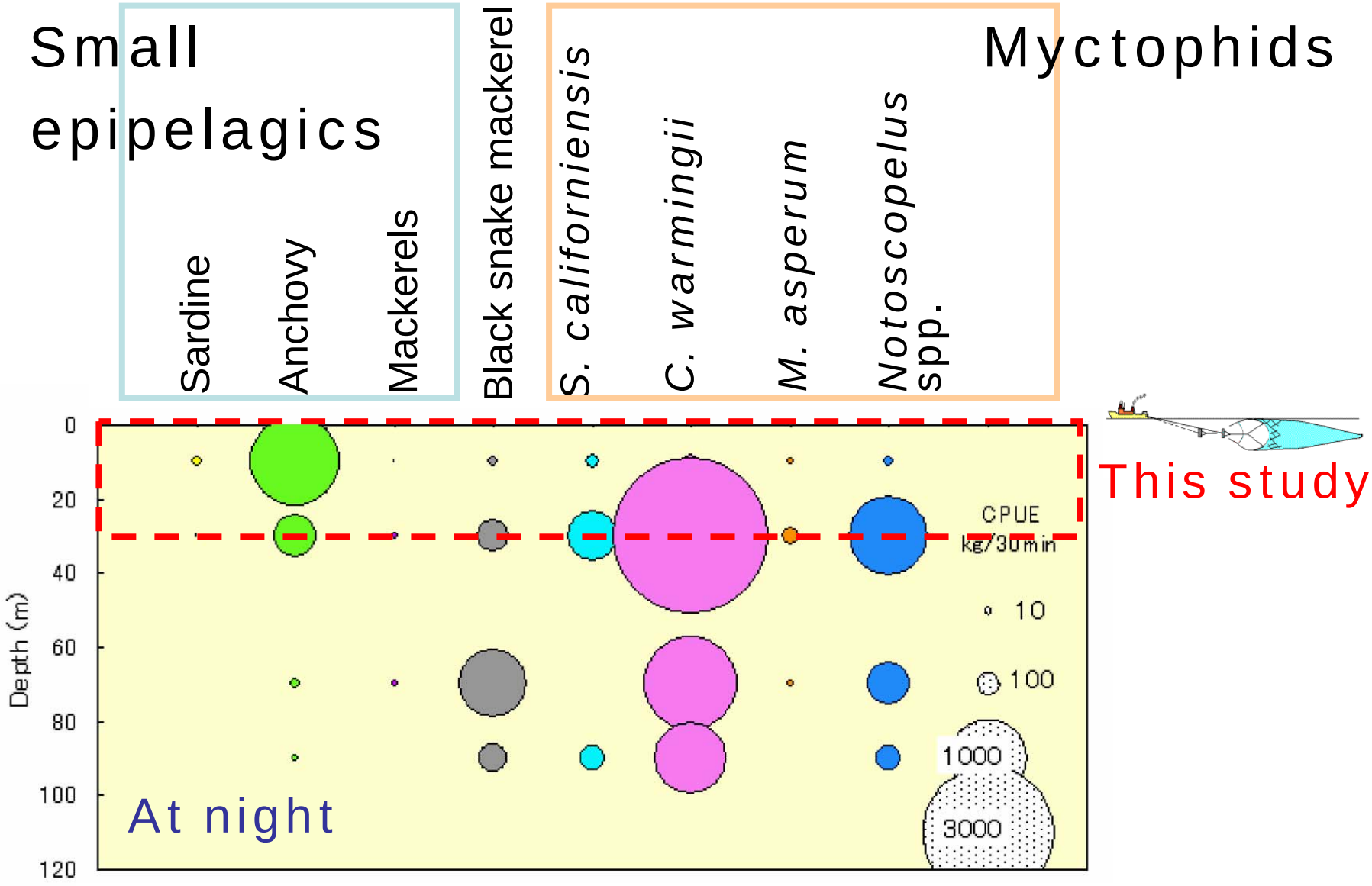
- Date : May-June, 2002-2004
- Area :143-160° E, 35-40° N
- Gear : Mid-water trawl
- Trawling depth : 0-27 m
- Depth of cod-end : 14 m
- Net length : 89 m
- Mesh size of cod-end: 10 mm.
- Night-time 30 min. tow at 3.5kt
- Sampling points: 45-50 stations



T/S Hokuho-Maru

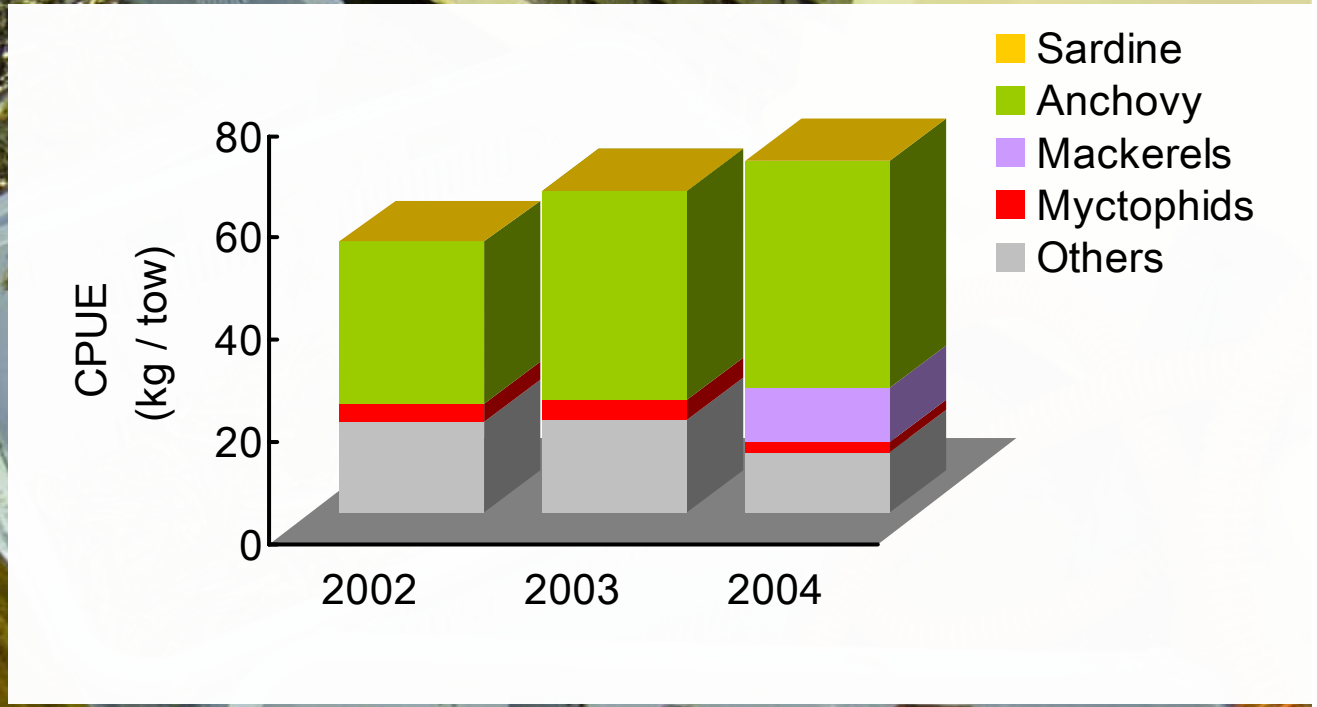
Using Mid-water Trawl for Myctophids...

- It is not the best gear for sampling myctophids, though...
- We can get both myctophids and small epipelagic fishes simultaneously.

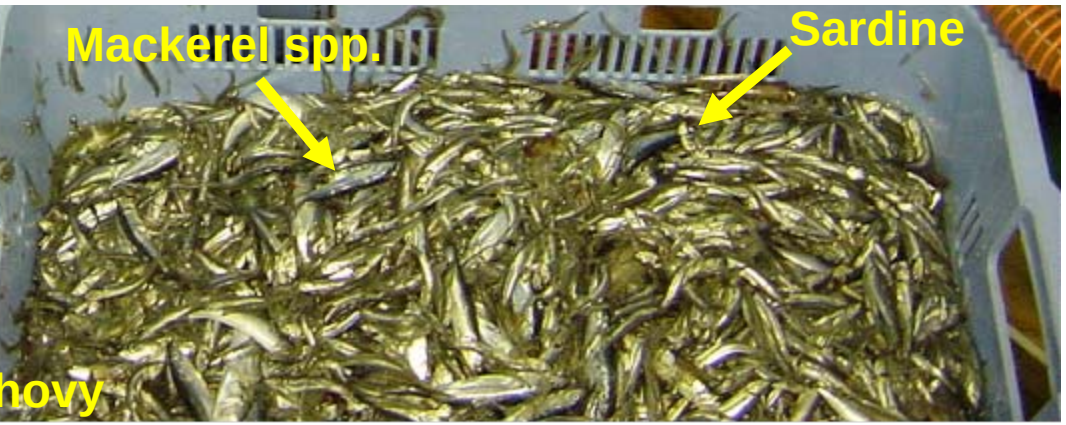


Catch in weight per 30-min tow of small pelagic fishes and predominant mesopelagic fishes by sampling depth in the KOTZ during May 1995 (modified from Yatsu et al., 2005).

Myctophids were dominant next to anchovy (except 2004)



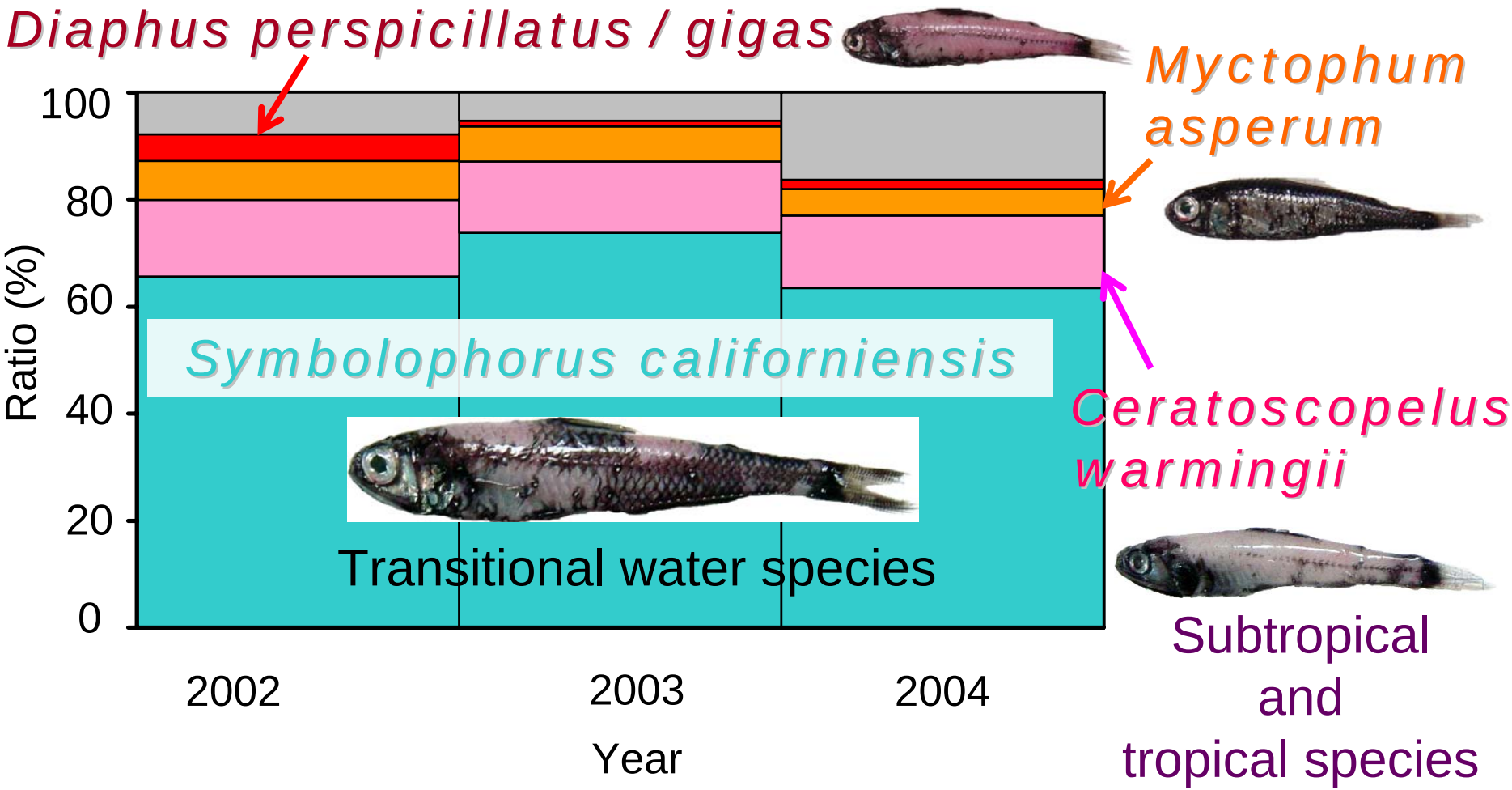
CPUE of myctophids are 3.6, 3.9 and 2.0 kg / tow in ’02, ’03 and ’04, respectively.



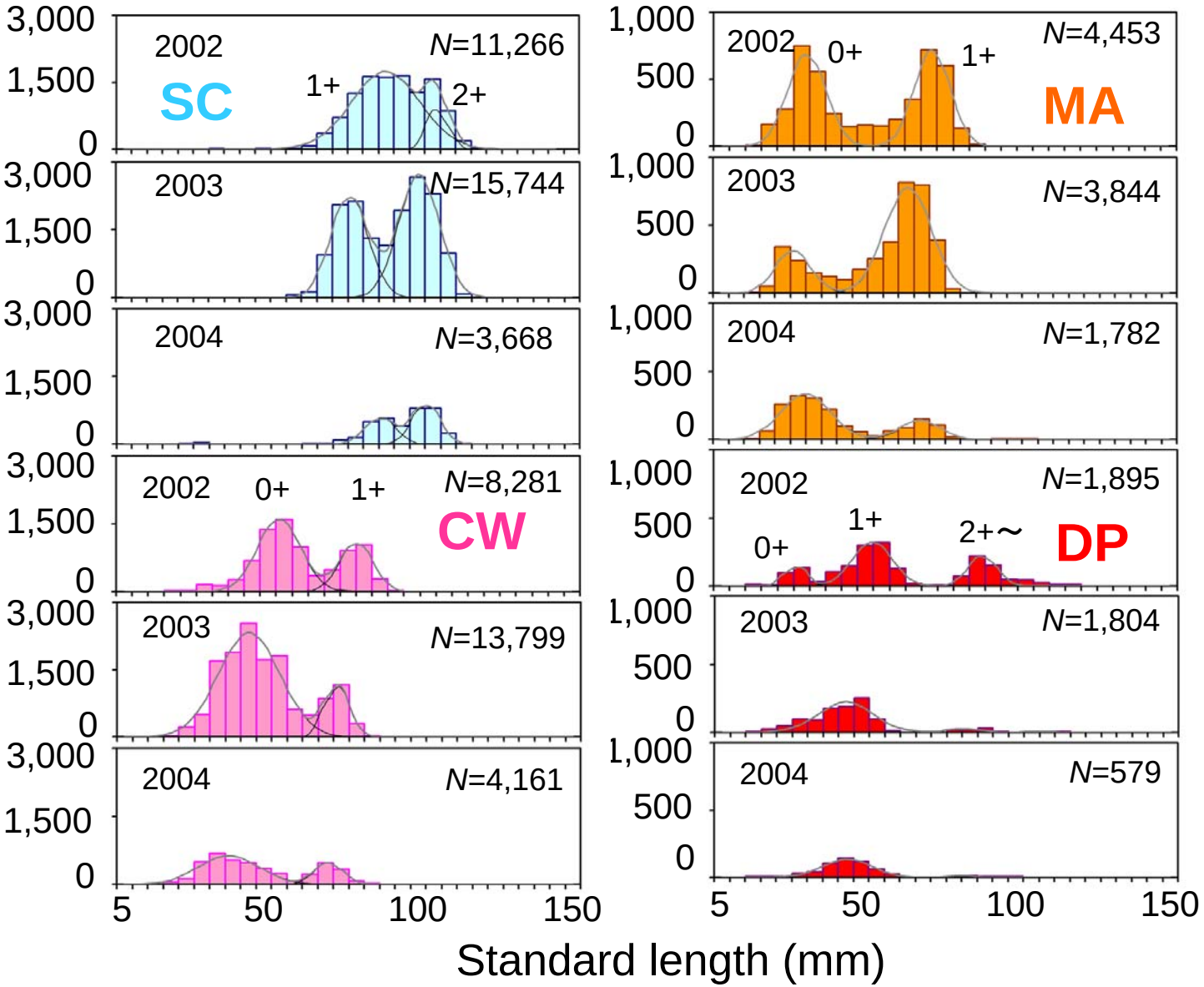
The Dominant myctophids

4 dominant species account for more than 80% of all the myctophids (19-29 species).

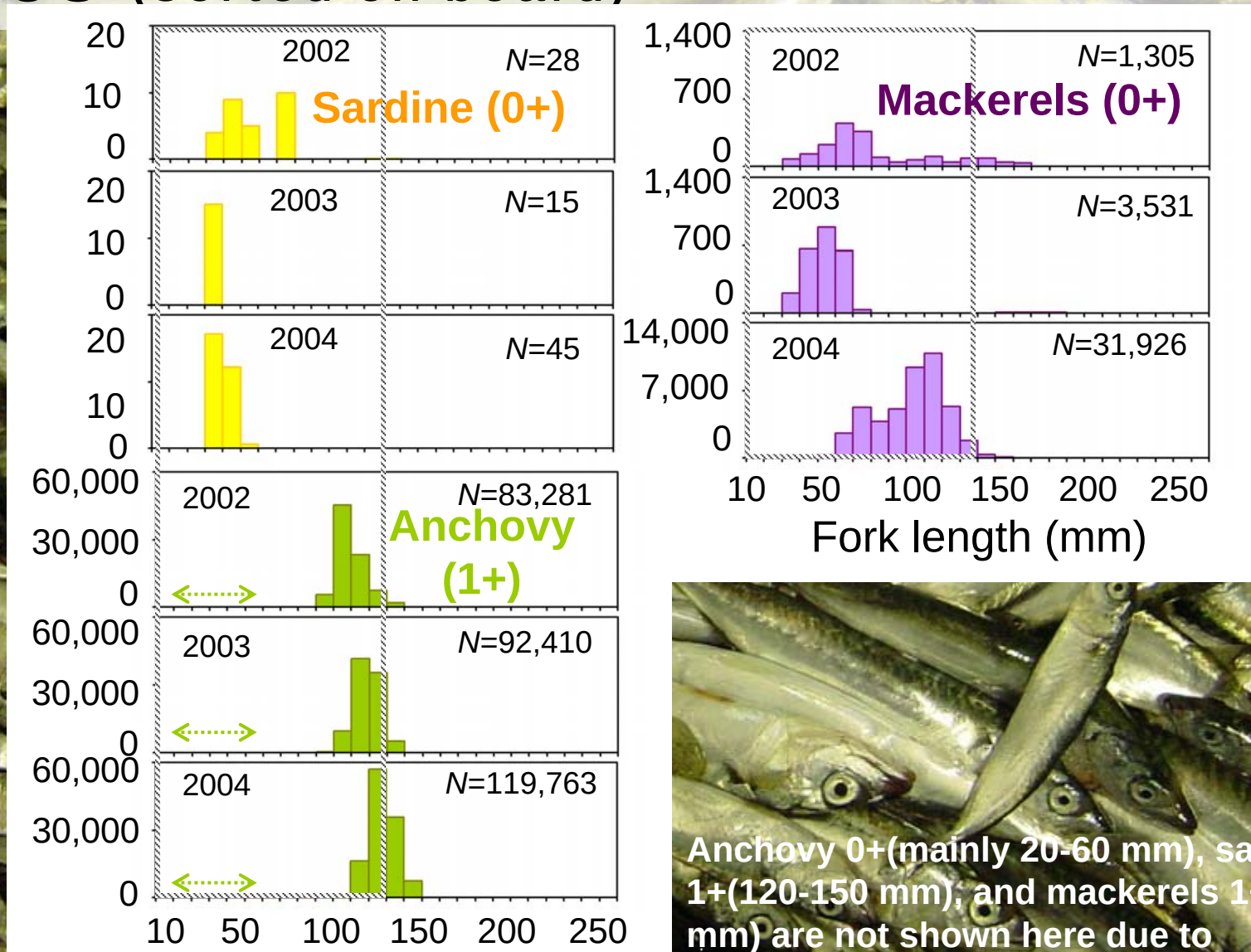
Catch in weight (on board)



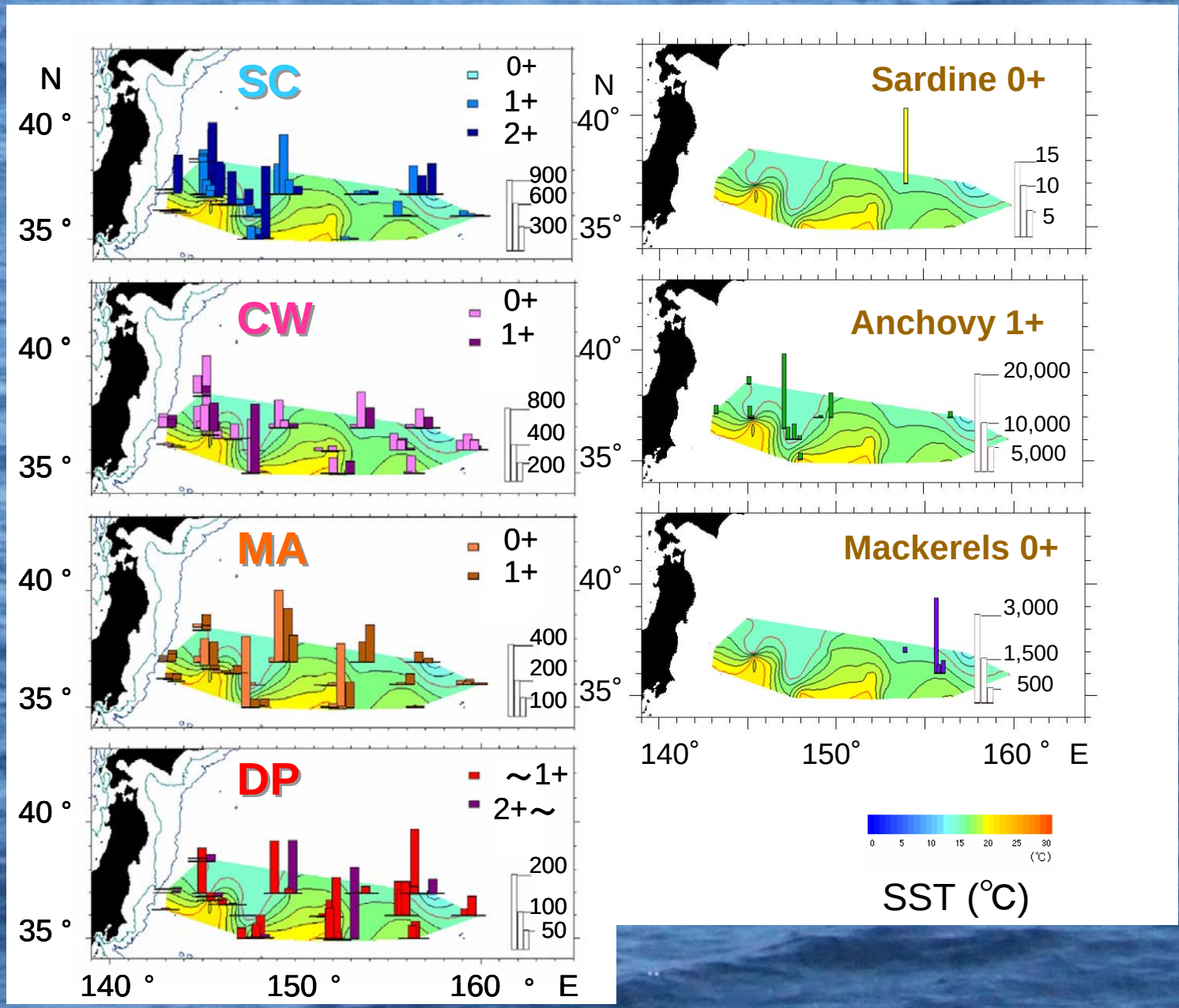
Body length of myctophids
(sorted on board)



Body length of small epipelagic fishes (sorted on board)



Horizontal distribution (in 03, for example)



Overlap index

(Pianka,1973)

$$O_{jk} = \frac{\sum p_{ij} p_{ik}}{\sqrt{\sum p_{ij}^{\,2} \sum p_{ik}^{\,2}}}$$

p_{ij}, p_{ik} : the proportions of i^{th} station occupied by the j^{th} and the k^{th} fishes, respectively.

0.9≦OI<1.0

0.8≦OI<0.9

0.7≦OI<0.8

0.0≦OI<0.7

	Small epipelagic fishes				Myctophids									
	Sardine	Anchovy	Chub mackerel	Spotted mackerel	SC 0+	SC 1+	SC 2+	CW 0+	CW 1+	MA 0+	MA 1+	DP 0+	DP 1+	DP 2+ ~
Sardine														
Anchovy	0.85													
Chub mackerel	0.03	0.02												
Spotted mackerel	0.02	0.04	0.76											
SC 0+	-	-	-	-										
SC 1+	0.27	0.31	0.21	0.41	-									
SC 2+	0.26	0.30	0.03	0.05	-	0.86								
CW 0+	0.01	0.11	0.34	0.58	-	0.55	0.26							
CW 1+	0.03	0.06	0.10	0.15	-	0.30	0.34	0.28						
MA 0+	0.03	0.08	0.30	0.54	-	0.39	0.17	0.53	0.37					
MA 1+	0.11	0.11	0.27	0.44	-	0.50	0.24	0.51	0.13	0.76				
DP 0+	0.04	0.00	0.04	0.03	-	0.05	0.08	0.13	0.87	0.27	0.07			
DP 1+	0.02	0.04	0.48	0.83	-	0.39	0.06	0.62	0.13	0.65	0.66	0.08		
DP 2+ ~	0.01	0.00	0.03	0.03	-	0.07	0.10	0.12	0.93	0.29	0.03	0.92	0.01	

2002

Sardine														
Anchovy	0.30													
Chub mackerel	0.00	0.02												
Spotted mackerel	0.00	0.02	0.76											
SC 0+	-	-	-	-										
SC 1+	0.10	0.45	0.09	0.08	-									
SC 2+	0.04	0.62	0.01	0.01	-	0.60								
CW 0+	0.64	0.48	0.04	0.06	-	0.29	0.54							
CW 1+	0.51	0.40	0.18	0.20	-	0.28	0.46	0.86						
MA 0+	0.00	0.00	0.00	0.00	-	0.02	0.01	0.44	0.48					
MA 1+	0.00	0.51	0.00	0.06	-	0.49	0.81	0.63	0.55	0.08				
DP ~ 1+	0.00	0.01	0.32	0.52	-	0.24	0.03	0.32	0.40	0.63	0.15			
DP 2+ ~	0.01	0.17	0.00	0.04	-	0.24	0.36	0.10	0.34	0.00	0.16		0.00	

2003

Sardine														
Anchovy	0.21													
Chub mackerel	0.00	0.31												
Spotted mackerel	0.01	0.30	0.98											
SC 0+	-	-	-	-										
SC 1+	0.00	0.43	0.00	0.00	-									
SC 2+	0.00	0.45	0.00	0.00	-	0.96								
CW 0+	0.00	0.24	0.00	0.00	-	0.34	0.23							
CW 1+	0.00	0.17	0.00	0.00	-	0.43	0.24	0.69						
MA 0+	0.29	0.31	0.00	0.00	-	0.53	0.54	0.15	0.05					
MA 1+	0.07	0.23	0.22	0.21	-	0.00	0.00	0.05	0.01	0.08				
DP ~ 1+	0.00	0.00	0.00	0.00	-	0.01	0.00	0.05	0.03	0.00	0.32			
DP 2+ ~	0.00	0.10	0.00	0.00	-	0.01	0.01	0.46	0.00	0.00	0.00		0.00	

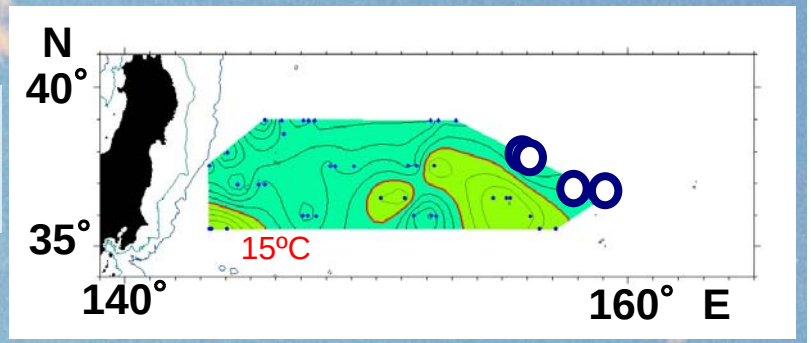
2004

Prey analysis

SAMPLING

- Two nights (11pm-3am) in May 2002 at 4 stations (o)
- Midwater trawl for fishes: towed at 0-80 m (mainly 0-27 m) depth
- NORPAC net for macro-zooplankton: mesh size 335 μm, from 150 m or 40 m depth to sea surface

4 Stations: sardine, anchovy, mackerels, and myctophids were caught together.



Stations and water temperature at 100 m depth

HANDLING COPEPODS

Copepods in stomachs and NORPAC net samples were

- identified for their species or genera.
- counted.
- measured for prosomal length.
- estimated for dry weights from length-weight relationships (for copepods in stomachs).

List of stomachs

Number of fish (range of body length in mm)

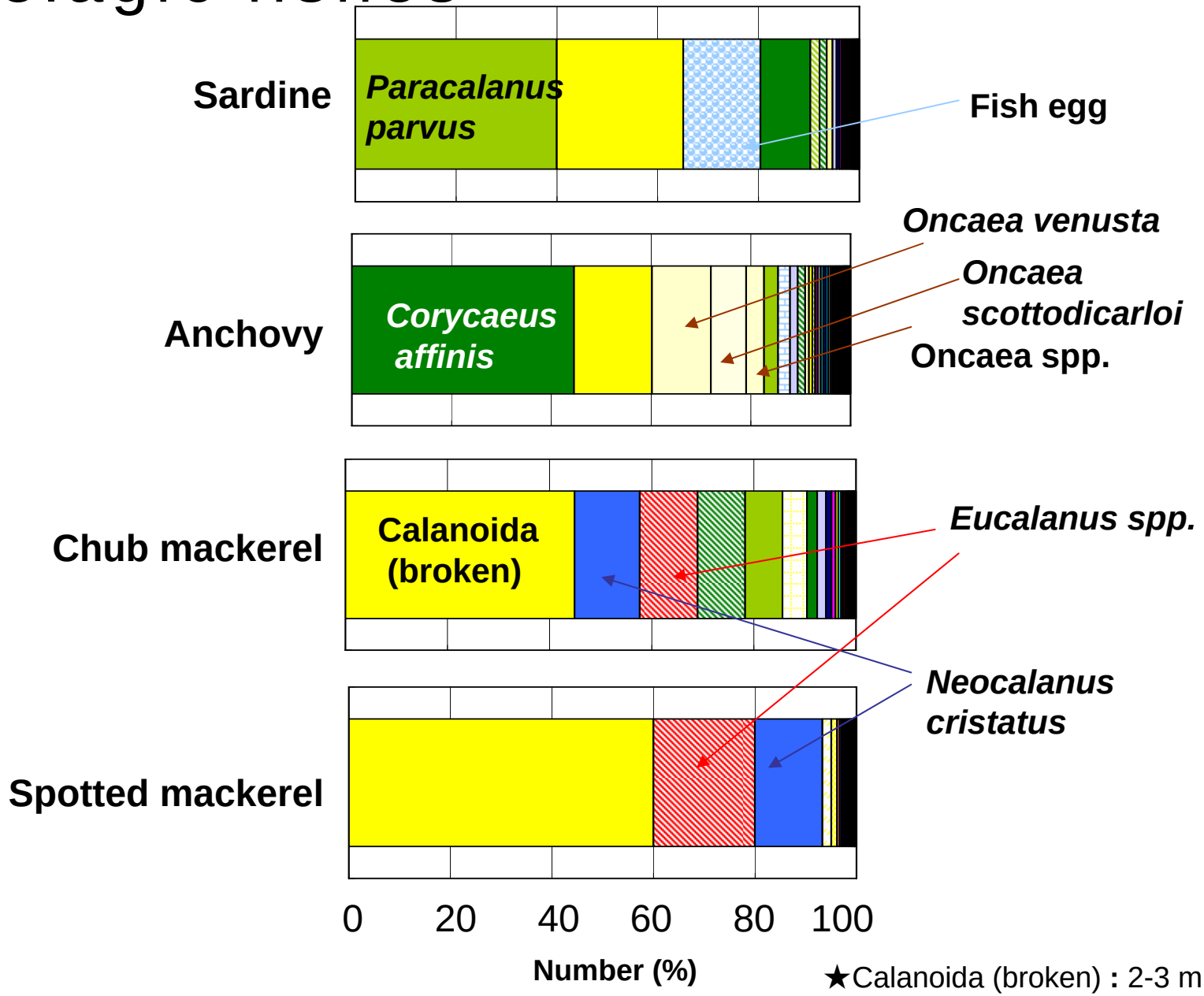
Epipelagic fishes, *N*=80

- Japanese sardine: 10 (34.5-52.6)
- Anchovy: 40 (35.5-57.4)
- Chub mackerel *Scomber japonicus*: 8 (47.4-137.6)
- Spotted mackerel *S. australasicus*: 22 (49.5-151.1)

Juvenile (J) and adult (A) myctophids, *N*=270(J=99, A=171)

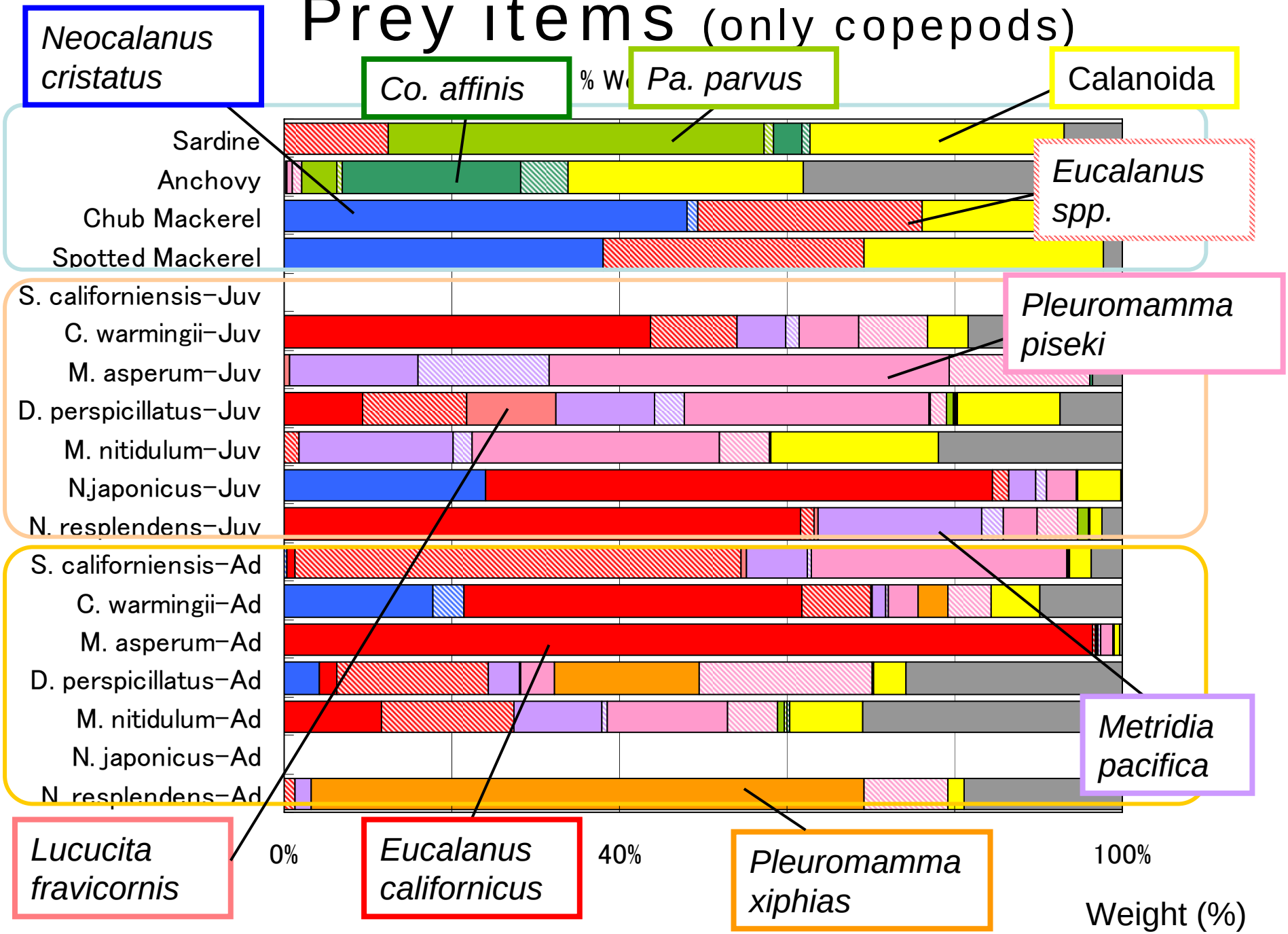
- *S. californiensis* : J=0, A=32 (71.0-108.7)
- *C. warmingii* : J=32 (22.1-66.1), A=38 (68.6-82.0)
- *M. asperum* : J=7 (21.0-46.4), A=18 (56.9-75.6)
- *D. perspicillatus* : J=29 (25.2-55.2), A=31 (74.3-146.9)
- *M. nitidulum* : J=9 (19.1-43.2), A=40 (50.7-63.6)
- *Notoscopelus japonicus* : J=11 (29.1-37.6), A=1 (92.8)
- *N. resplendens* : J=11 (21.9-35.1), A=11 (64.9-78.4)

Stomach contents of juvenile small epipelagic fishes



★Calanoida (broken) : 2-3 mm PL

Prey items (only copepods)



Body size of copepods

both stomach contents & NORPAC net

Epipelagic fishes

Paracalanus parvus

Corycaeus affinis

Oncaea venusta

O. scottodicarloi

Mackerels > 120 mm FL

*Neocalanus cristatus**

Eucalanus californicus

Rhincalanus nasutus

Lucucita flavicornis

Myctophids < 130 mm SL

Pleuromamma piseki

Metridia pacifica

Euchirella rostrata

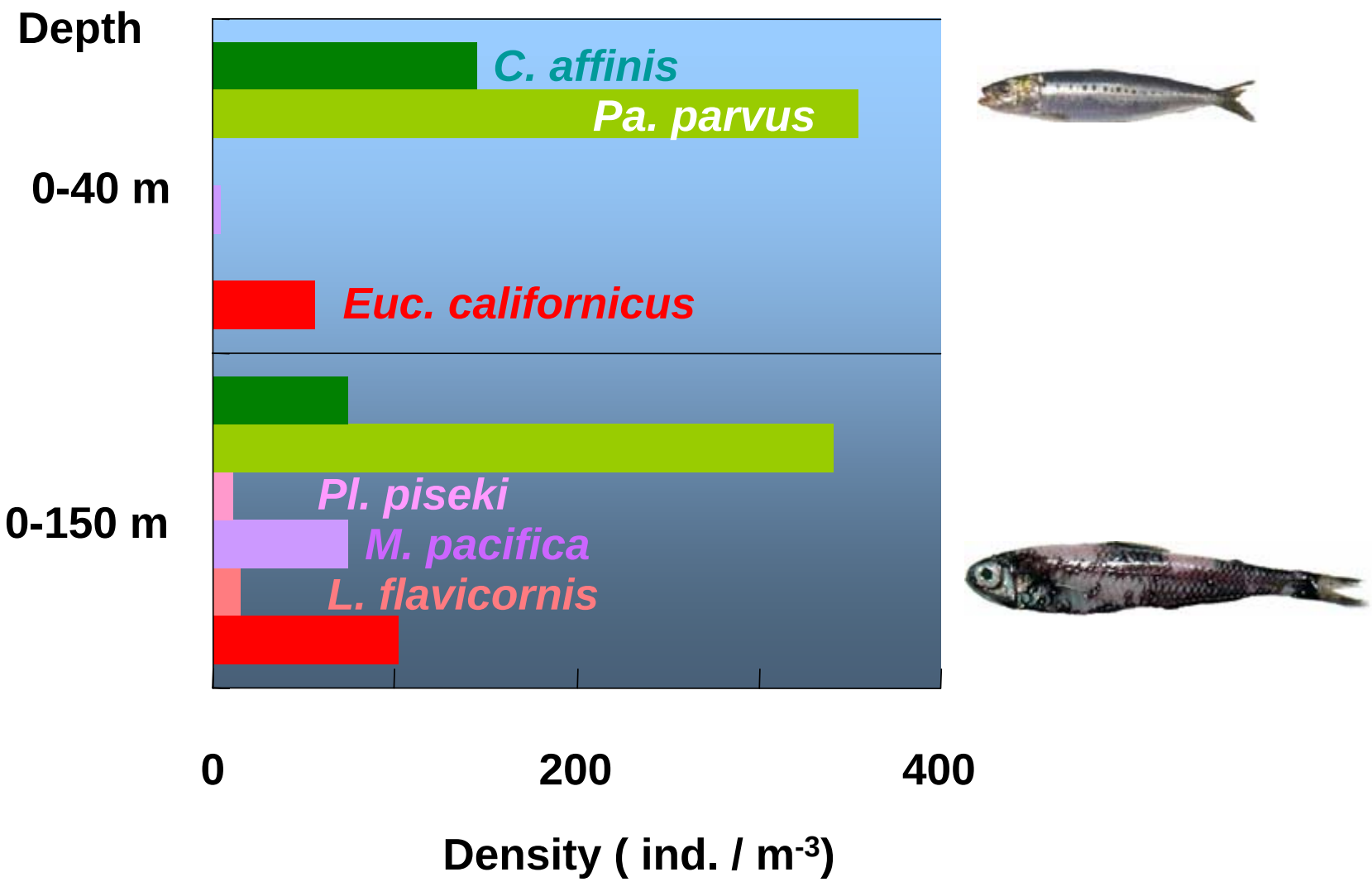
*Pl. xiphias**

0 3 6 9

Prosomal length (mm)

* Not caught by NORPAC net here.

Density of the copepods



N. cristatus and *Pl. xiphias* were not caught by NORPAC net here.

Sea surface

Small copepods

40 m

Eucalanus californicus

Large copepods

(except *E. californicus*)

150 m

V e r t i c a l m i g r a t i o n

Non -vertical migration (Subsurface - intermediate)

D a i l y

S e a s o n a l*

Oyashio

M. pacifica

N. cristatus

Kuroshio

Pl. xiphias

Euc. californicus

L. flavicornis

Pl. piseki

(* surface-intermediate layer in spring)

Summary

In the nighttime surface layer of the KOTZ (in spring)

- **Abundance of myctophids**: change considerably
- **Composition of the dominant myctophids**: stable

S. californiensis
C. warmingii
M. asperum
D. perspicillatus / gigas

- **Horizontal distribution of the dominant myctophids**:
  wide regardless of their abundance
  different from that of juvenile small epipelagic fishes
- **Prey copepods of the dominant myctophids**: large copepods in deeper than 40m depth, while small epipelagic fishes prey upon small copepods in shallower than 40m depth

Conclusion

These results suggest occurrences of resource partitioning between juvenile small epipelagic fishes and the dominant myctophids in terms of habitat and prey.

Acknowledgements

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THANK YOU.