Relation between tuna resources and atmospheric-oceanic variability in the North Pacific

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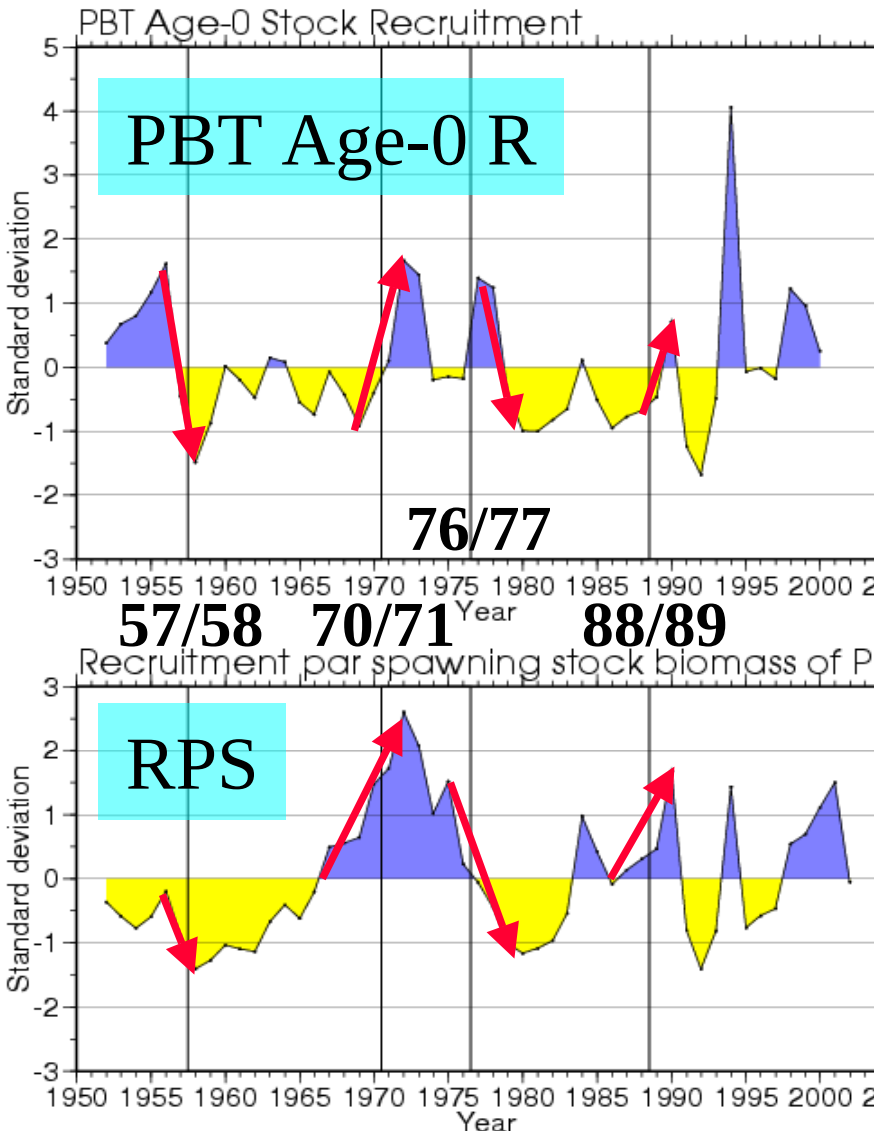
- **Impacts of environment on recruitments**
- **Species examined**: **Pacific bluefin tuna**, **Albacore** in the North Pacific, **Skipjack** in the Central and Western Pacific Ocean

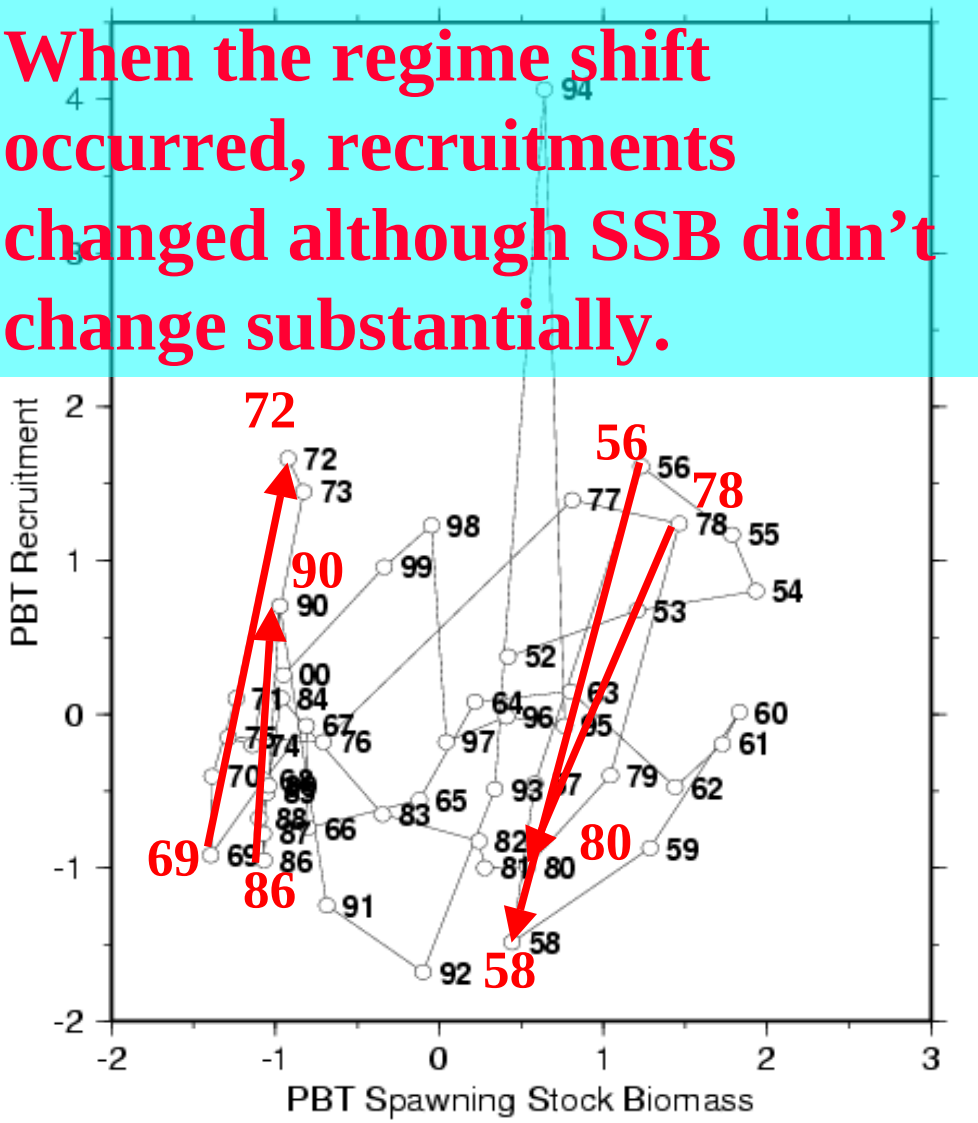
- Relation with climate regime shift
- Long-term variability and its periodicity
- Spatial aspects of environmental variability impacts
- Summary conclusion

Variability of PBT recruitments

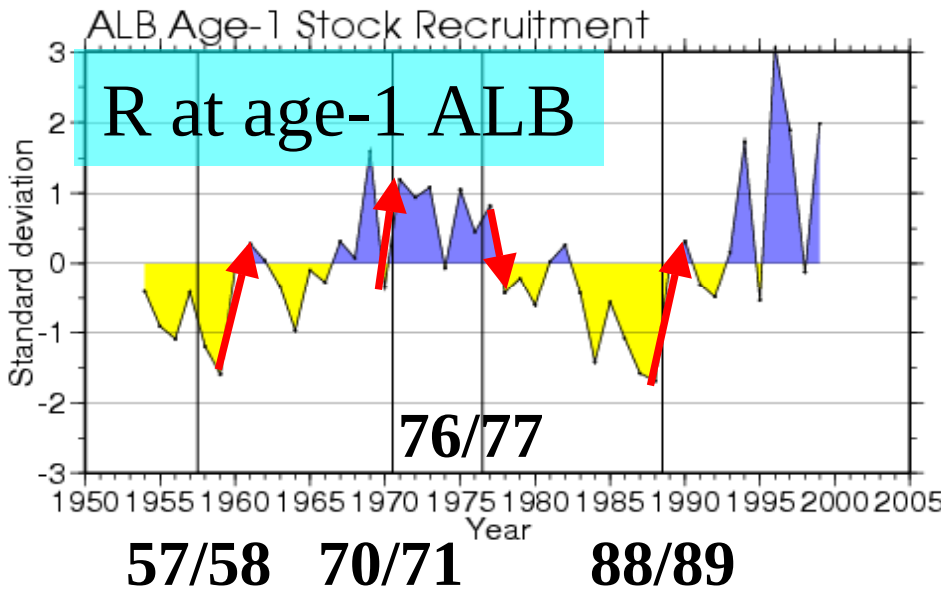
Stock-Recruitment Relationship

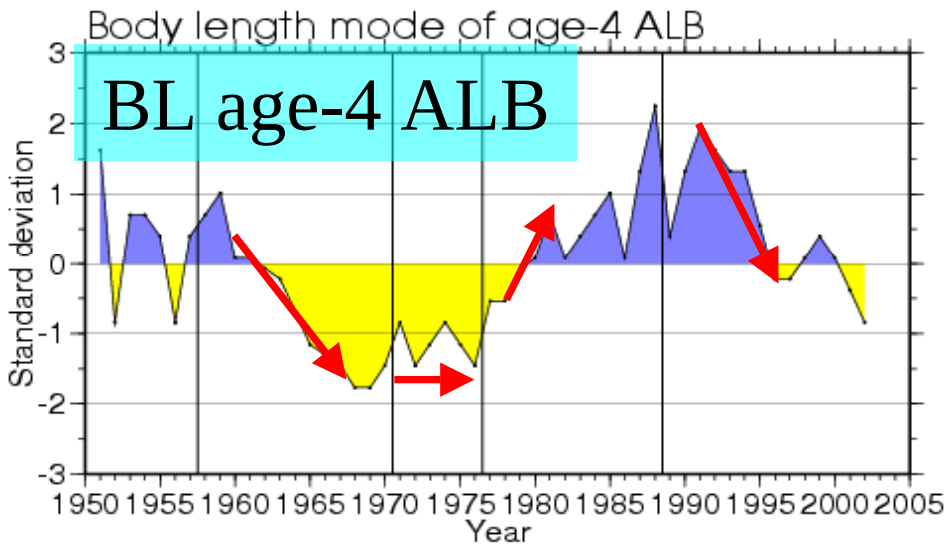


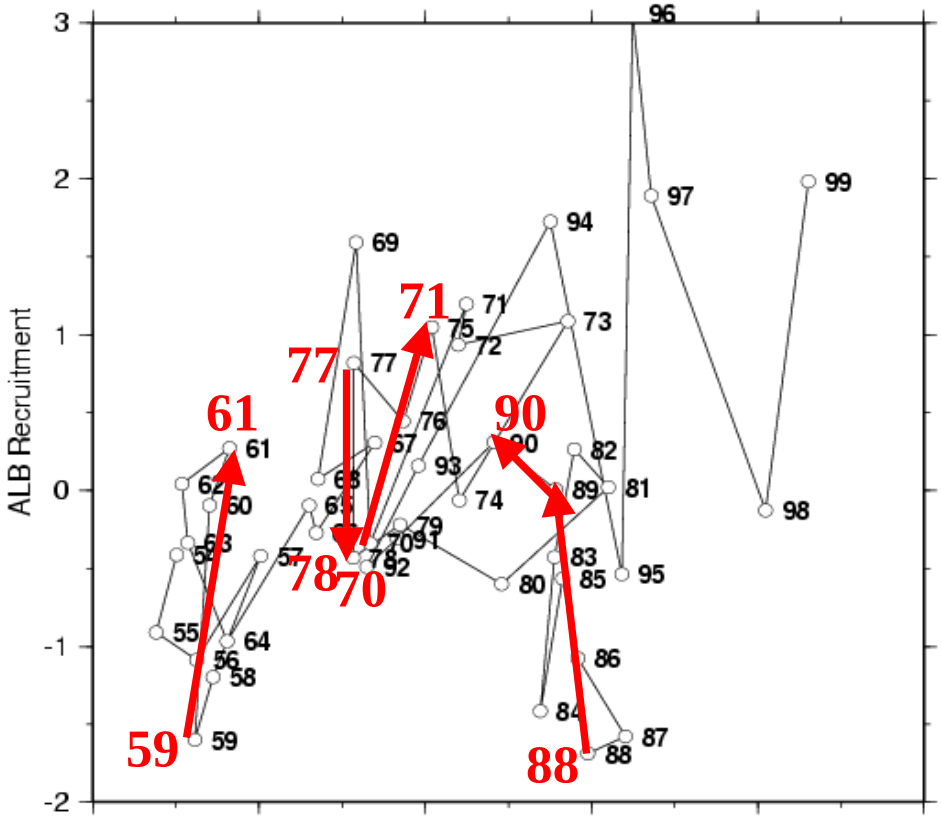
When the regime shift occurred, recruitments changed although SSB didn't change substantially.



Variability of ALB recruitments in the North Pacific Ocean

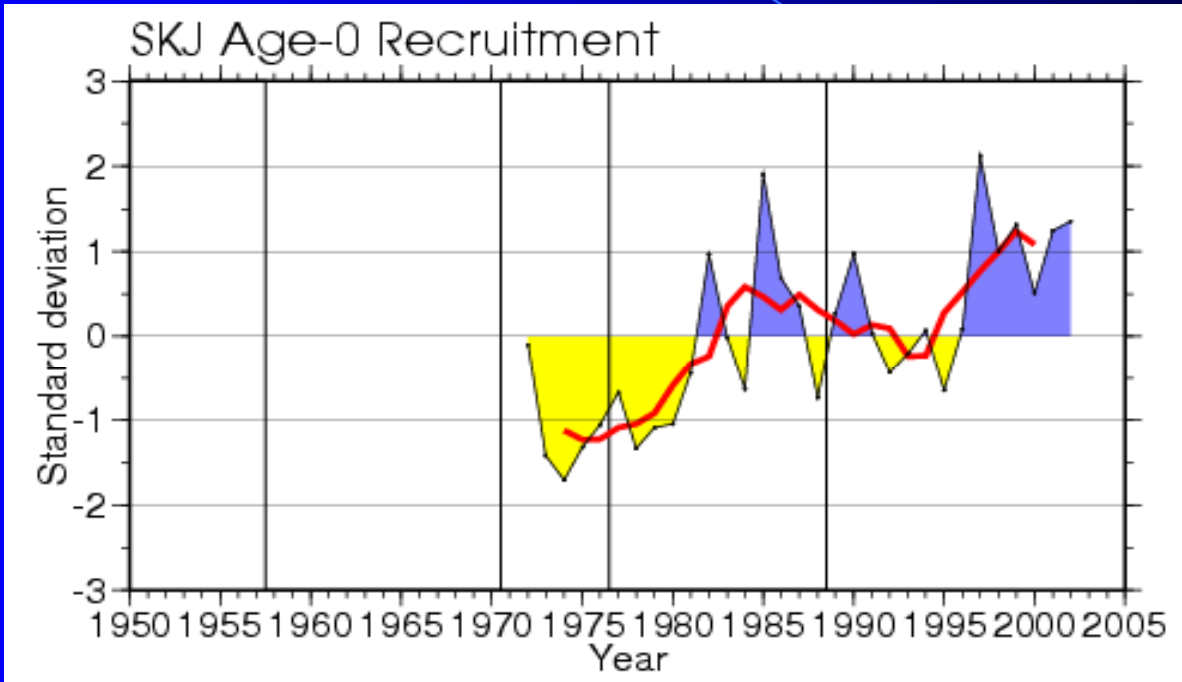






When the regime shift occurred, recruitments are changed rapidly despite of stable spawning stock level.

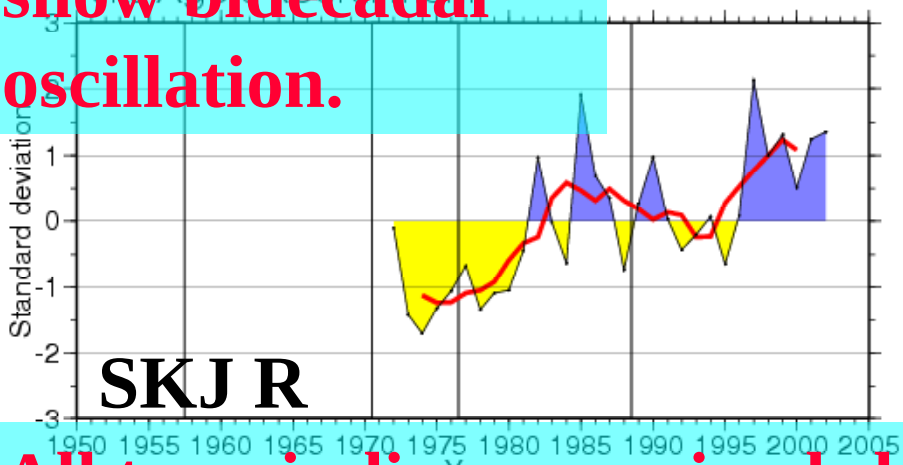
Variability of SKJ recruitments in the Central and Western Pacific



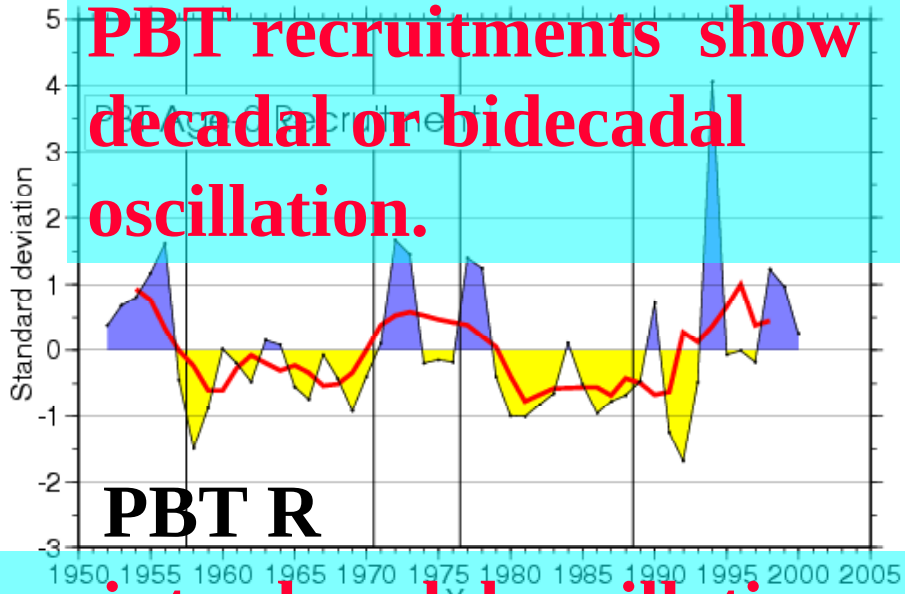
Fluctuations of recruitment have no typical relationship with the Climate Regime Shifts. Recruitments show an increasing trend from 1970's with bidecadal oscillation.

Long-term variability in PBT, ALB and SKJ in the North Pacific

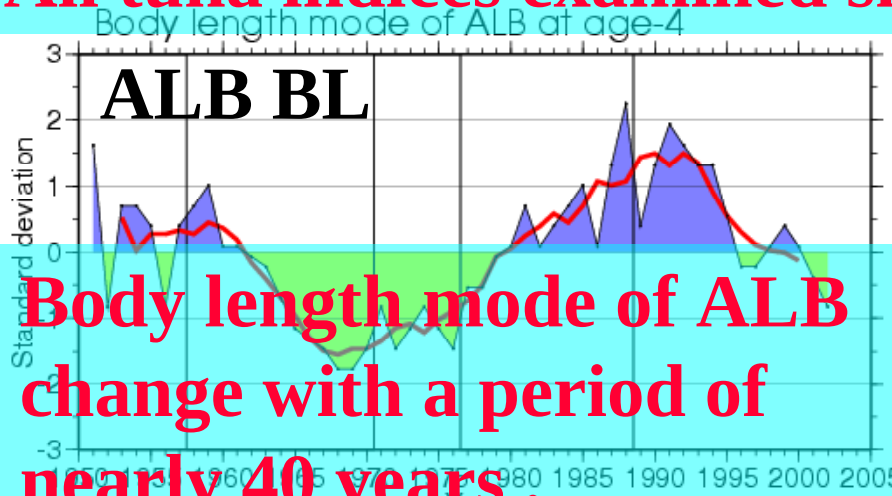
SKJ recruitments show bidecadal oscillation.



PBT recruitments show decadal or bidecadal oscillation.



All tuna indices examined show interdecadal oscillations.



Body length mode of ALB change with a period of nearly 40 years .

ALB recruitments change with a period of nearly 30 years .

Correlation between Recruitments and Climate Indices

Using five-year running mean.

	ALPI	WP	SOI	NINO 1+2	PDO Jan	SST in SPA
PBT	-0.30	-0.05	0.36	-0.03	-0.40	0.45
ALB	-0.32	-0.02	0.02	-0.06	-0.39	0.50
SKJ	0.44	0.71	0.23	0.53	0.36	0.92

PBT R increased in years of La Niña, weak Aleutian Law and warm in the Central Pacific.

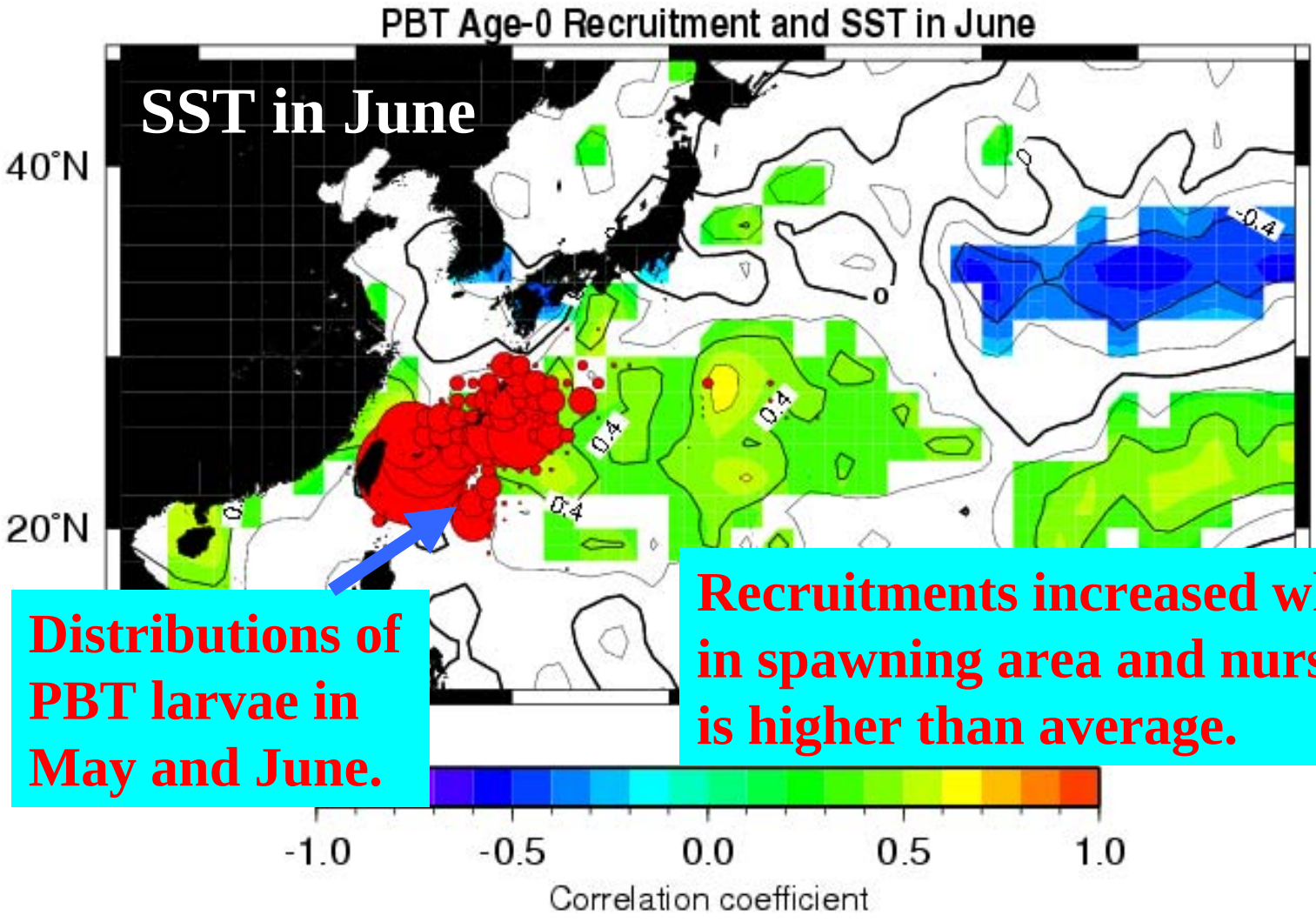
ALB R is similar with PBT but no significant with SOI.

SKJ R shows significant relation with ALPI, WP and Niño1+2.

Recruitments increased in years of high SST in the spawning area.

Correlation map between PBT recruitment and SST

Using five-year running mean.

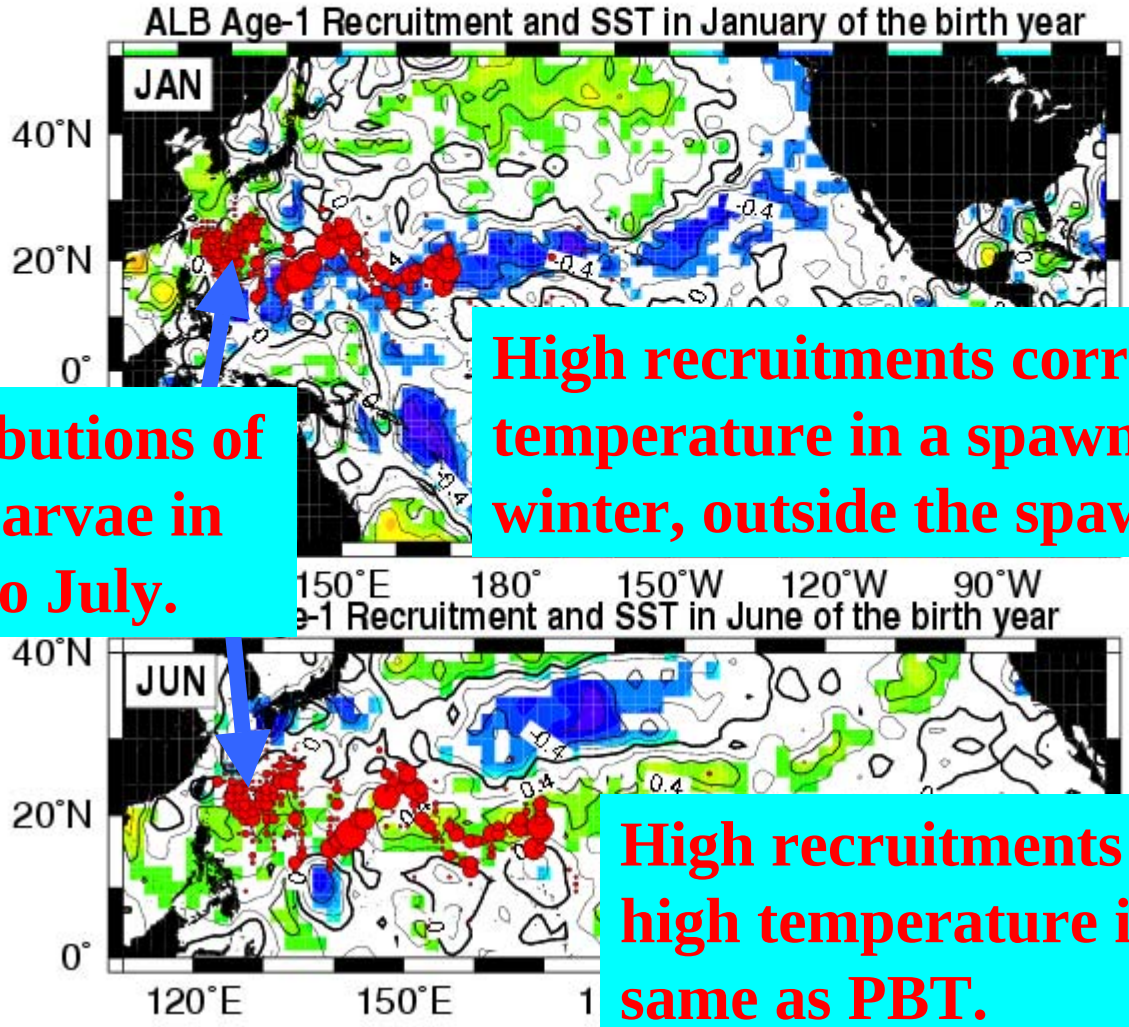


Distributions of PBT larvae in May and June.

Recruitments increased when SST in spawning area and nursery area is higher than average.

Correlation map between ALB recruitment and SST

Using five-year running mean.



Distributions of ALB larvae in May to July.

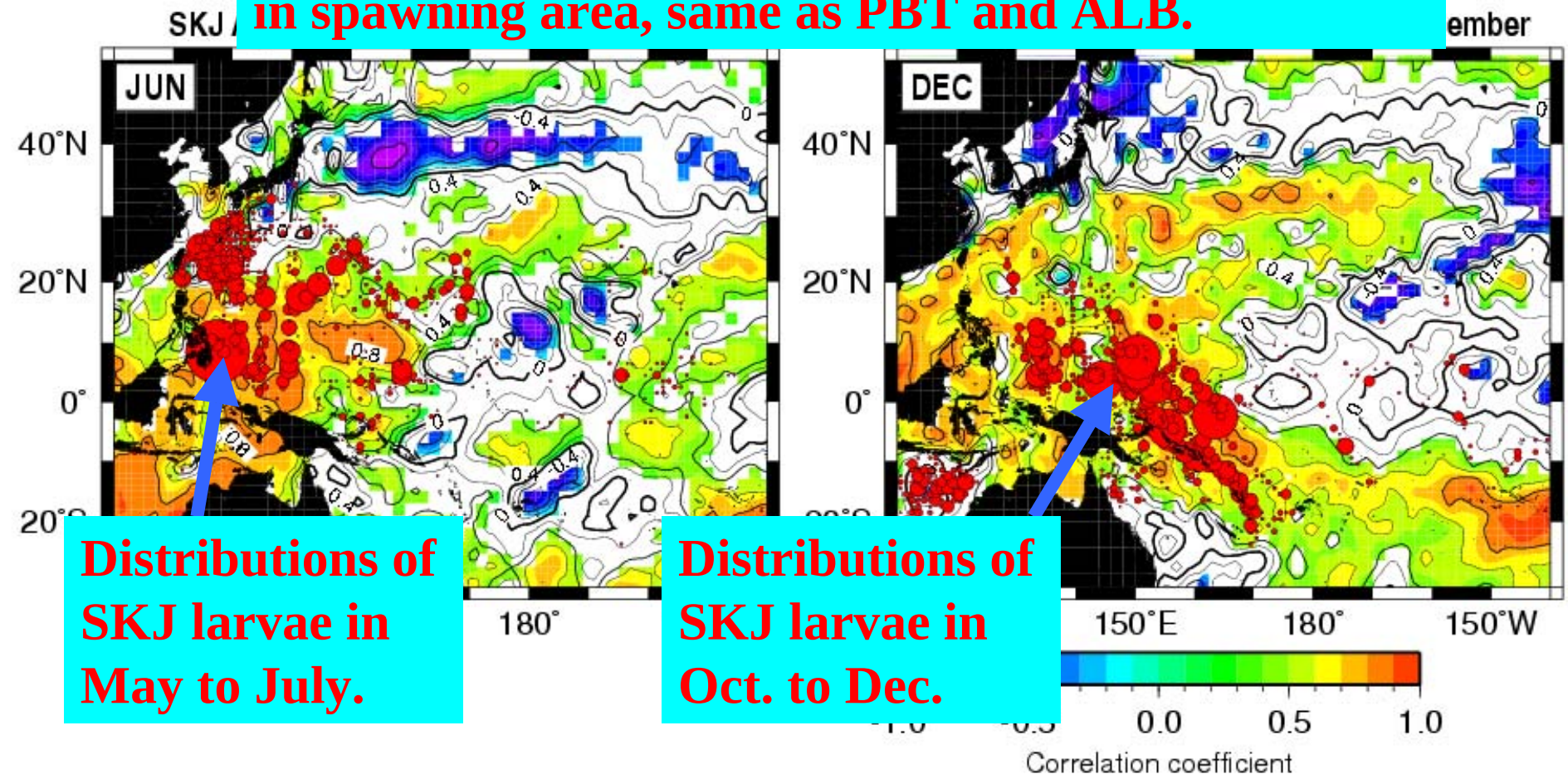
High recruitments correspond to low temperature in a spawning area during winter, outside the spawning season.

High recruitments correspond to high temperature in spawning area, same as PBT.

Correlation map between SKJ recruitment and SST

Using five-year running mean.

High recruitment corresponds to high temperature in spawning area, same as PBT and ALB.



Distributions of SKJ larvae in May to July.

Distributions of SKJ larvae in Oct. to Dec.

Summary conclusion

- **When the regime shift occurred, PBT and ALB change their recruitment level rapidly, without showing rapid change in spawning stock biomass.**
- **Recruitments of three tuna stocks show inter-decadal oscillations, and also show significant correlations with some of climate indices, especially those related to ENSO.**
- **All of three tuna recruitments increased when the SST in the spawning area is higher than average.**
- **Climate change are considered to have direct impacts on environment of tuna, to change larval survival rate in their breeding grounds, and then change recruitments.**