LAQUES
Laboratory of
Aquatic Environmental Science

Effect of temperature change on the dominant species of *Gambierdiscus* in Japan - From a non-toxic species to a toxic species?

How global warming can potentially change the dominant species of *Gambierdiscus* in Japan from a non-toxic species to a toxic species?

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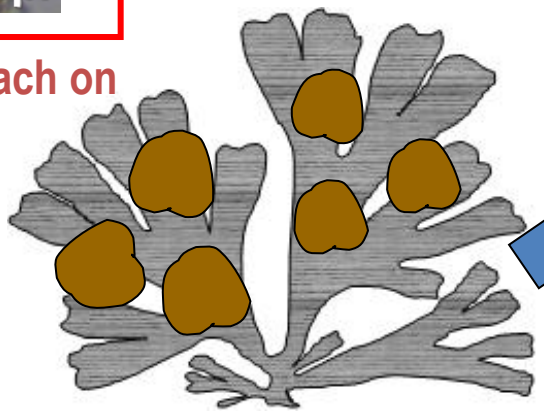
Mechanism of outbreaks of CFP

Toxic microalgae

Gambierdiscus spp.

attach on



macroalgae

fed on by

herbivorous fish

Accumulation of toxin

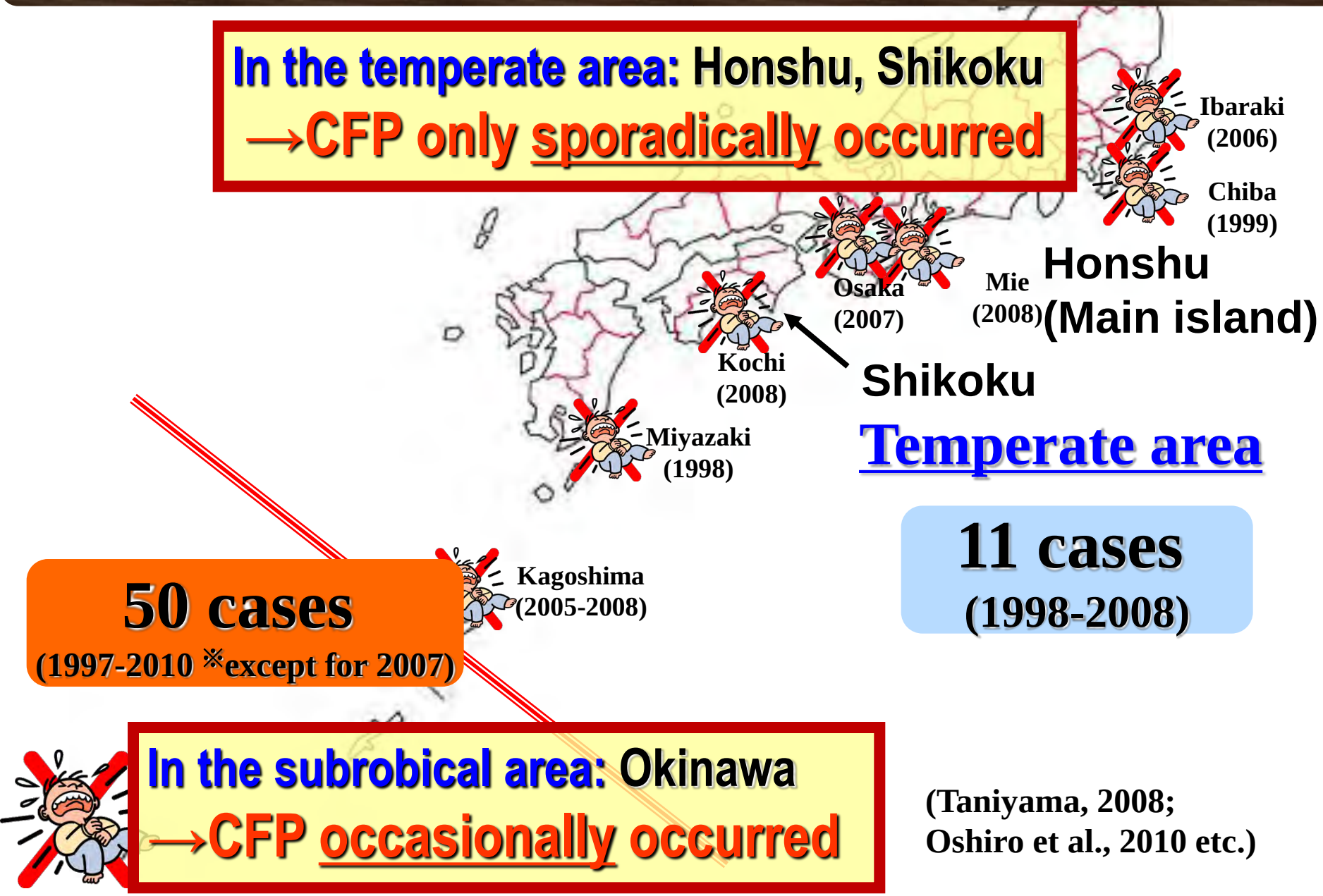
carnivorous fish

Ciguatera fish poisoning (CFP)

Food chain

Situation of ciguatera outbreaks in Japan

In the temperate area: Honshu, Shikoku
→CFP only sporadically occurred



11 cases
(1998-2008)

50 cases
(1997-2010 ※except for 2007)

In the subrobical area: Okinawa
→CFP occasionally occurred

(Taniyama, 2008;
Oshiro et al., 2010 etc.)

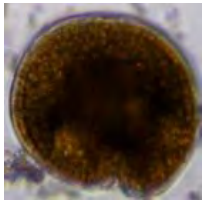
Research background(1)- *Gambierdiscus* spp. in Japan

Results of analysis of phylogeny and distribution of Japanese *Gambierdiscus* (Kuno *et al.*, 2010) showed that:

- ***Gambierdiscus* sp. type 1 and type 2 occur and distribute separately in the subtropical area and the temperate area, respectively.**
- **Type 2 was found to be non-toxic, though Ciguatera fish poisonings have occurred sporadically in the temperate area.**

Temperate area:

Honshu, Shikoku etc.

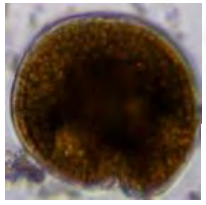


type 2

Non-toxic

Subtropical area:

Okinawa



type 1

Toxicity unknown

(Kuno *et al*. 2010, Kamikawa *et al.* 2007)

Research purpose:

In this study, we elucidate the effects of temperature & salinity on growth of *Gambierdiscus* spp. in Japan

We predict future distribution of toxic *Gambierdiscus* and the risk of CFP outbreaks in Japanese coastal regions considering global warming

Research purpose:

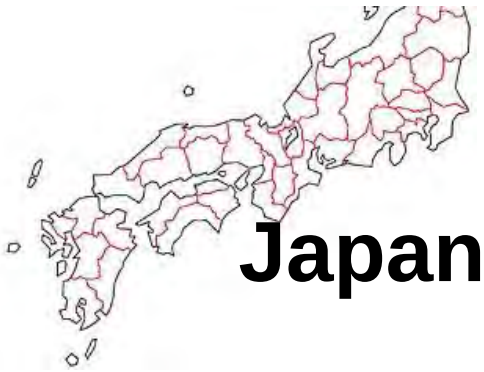
Especially, we focus on:

whether the dominant species of *Gambierdiscus* in Japan will change from **a non-toxic species** to **a toxic species** by global warming?

Gambierdiscus sp.

Non-toxic type 2

Global warming



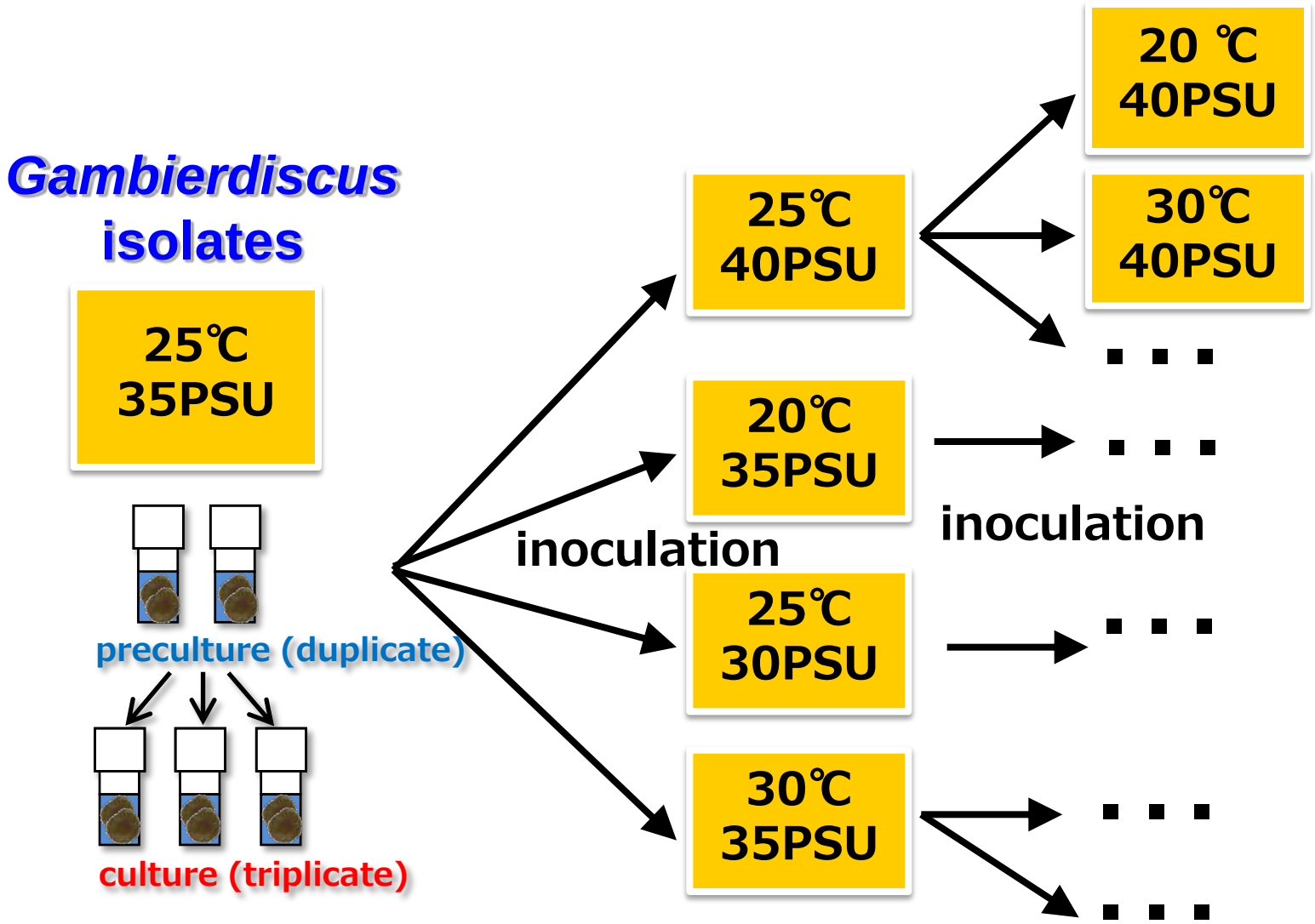
Japan

Gambierdiscus sp.

Toxic species

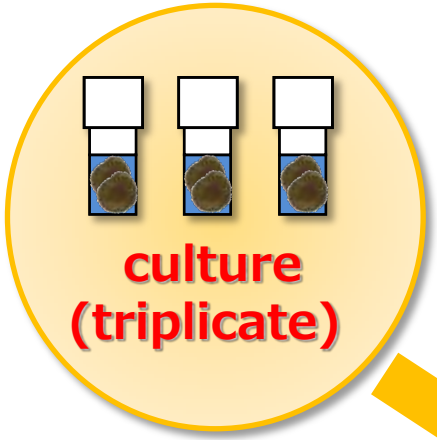
?

Research method: Stepwise method

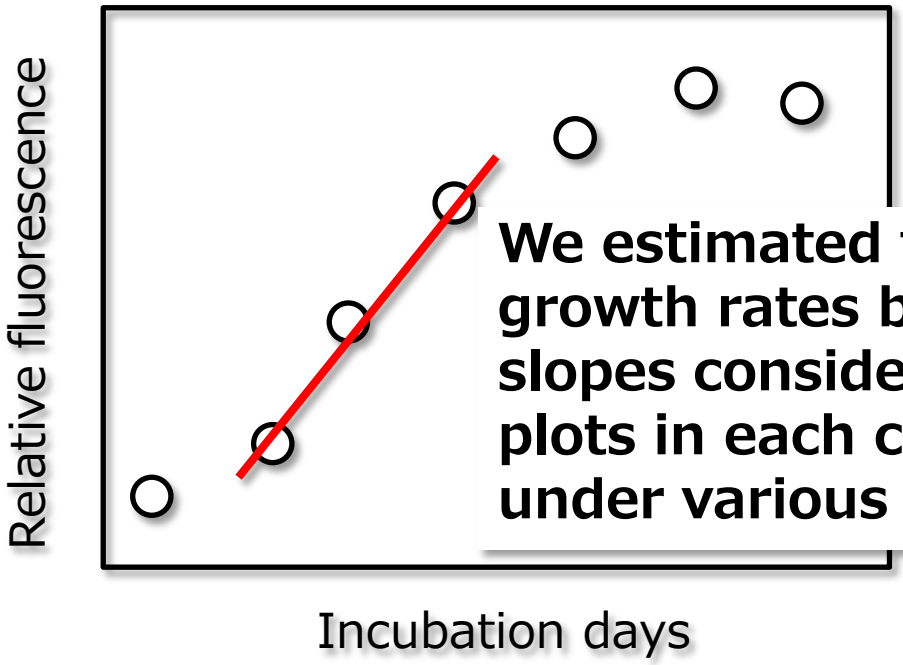


Stock culture of isolates which was incubated under a condition at 25℃ and 35PSU was transferred using a stepwise method.

Research method: Growth estimation method

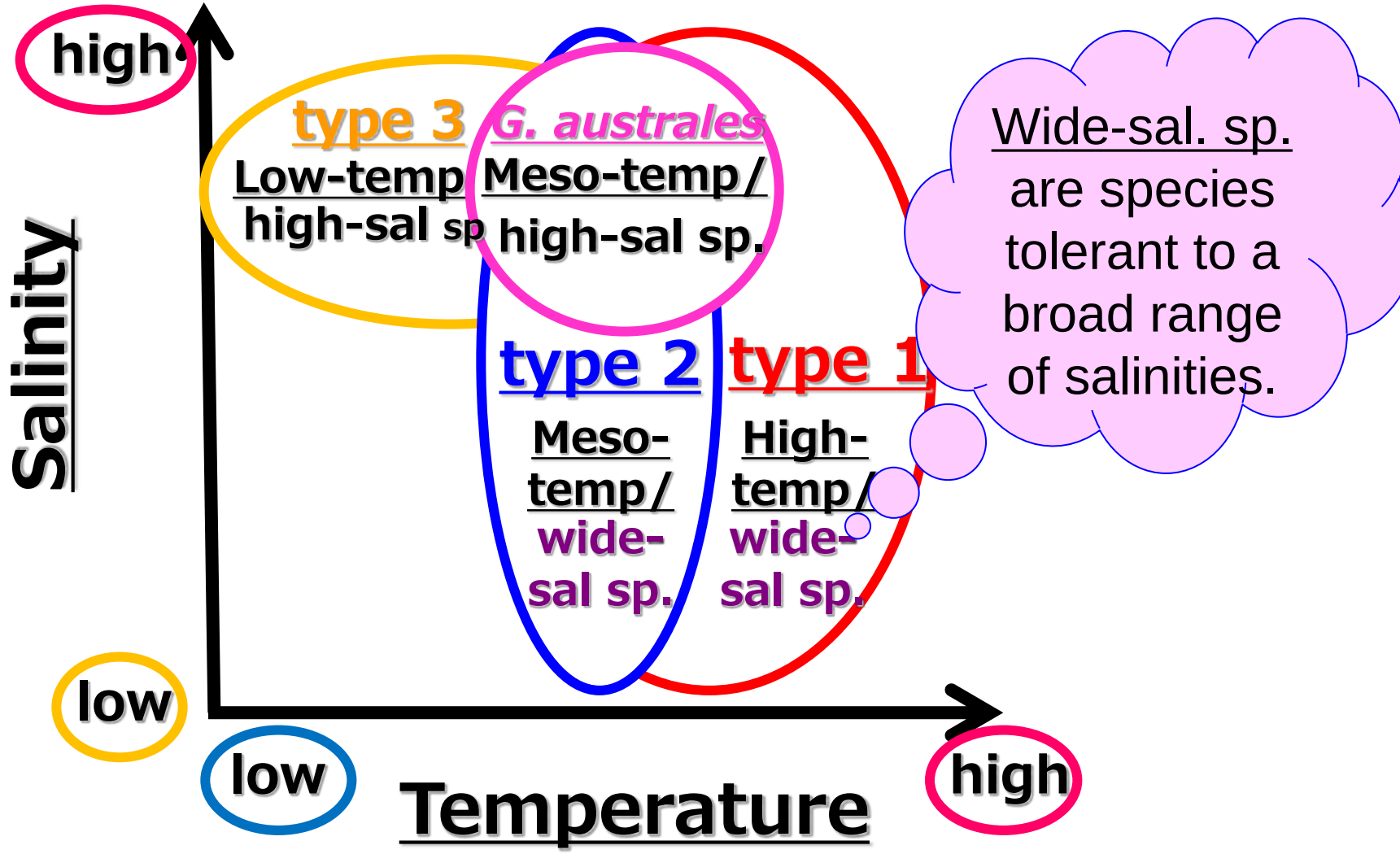


Preparation of growth curves



We estimated the growth rates by using slopes considering three plots in each culture under various conditions

Growth characteristics of Japanese *Gambierdiscus* spp.



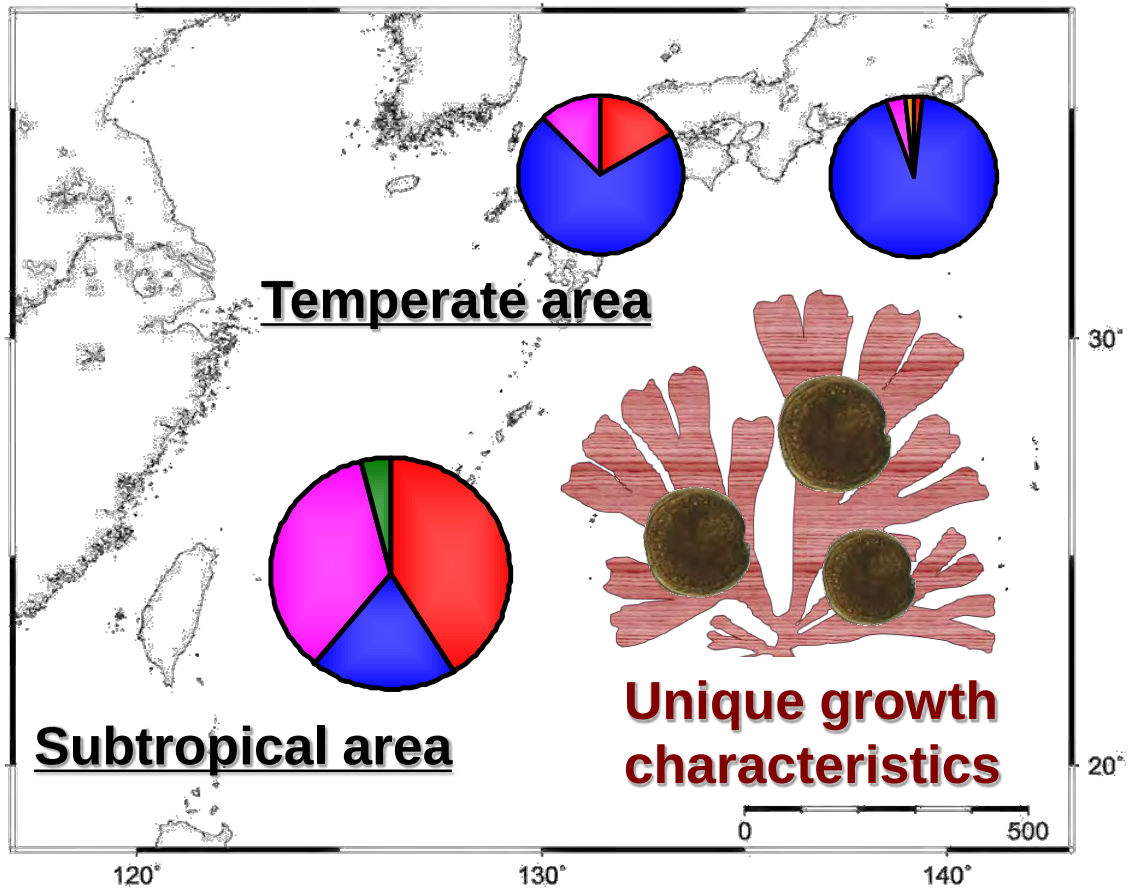
Each species has unique growth characteristic!

Which is the important factor restricting distribution of Japanese *Gambierdiscus* spp.?

Temperature ?

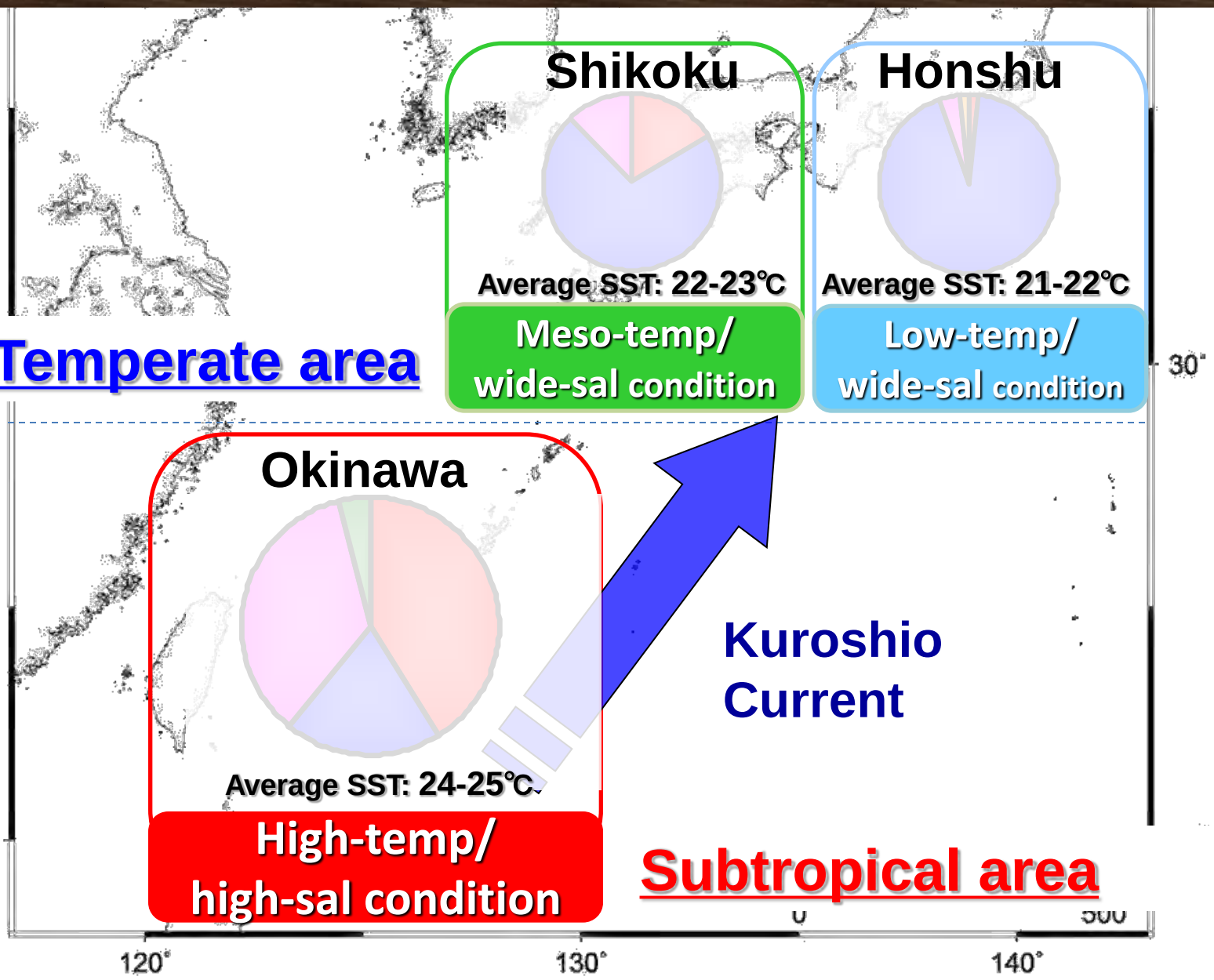
Salinity ?

Another ?



Distribution of Japanese *Gambierdiscus* spp.

Environmental conditions in each region in Japanese coast



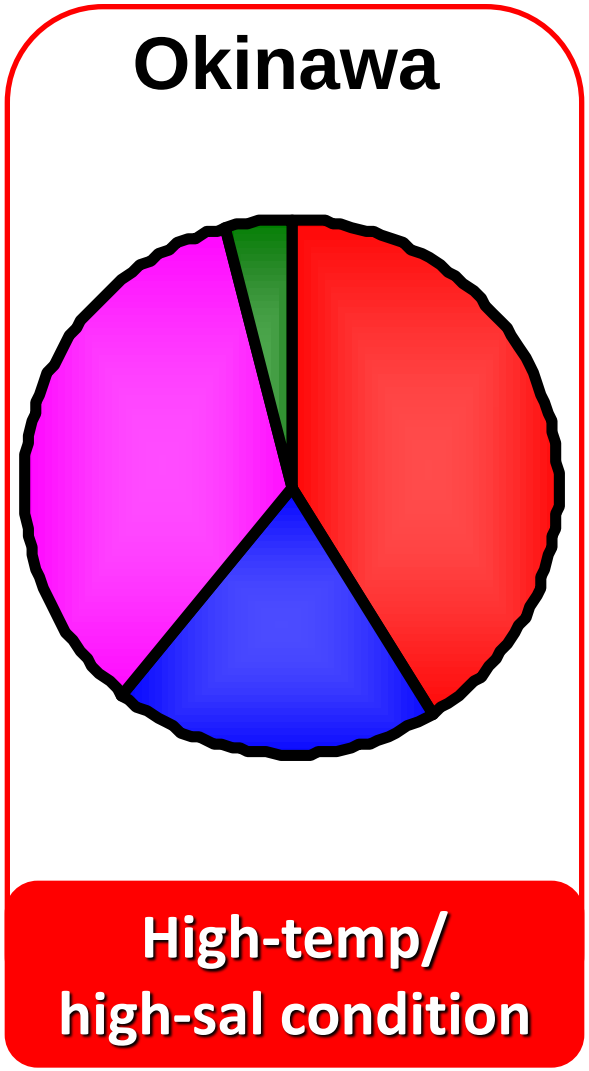
Which is the important factor restricting distribution of *Gambierdiscus* spp. in Okinawa?

In Okinawa:

Temperature ?

Salinity ?

Another ?



Which is the important factor restricting distribution of *Gambierdiscus* spp. in Okinawa?

In Okinawa:

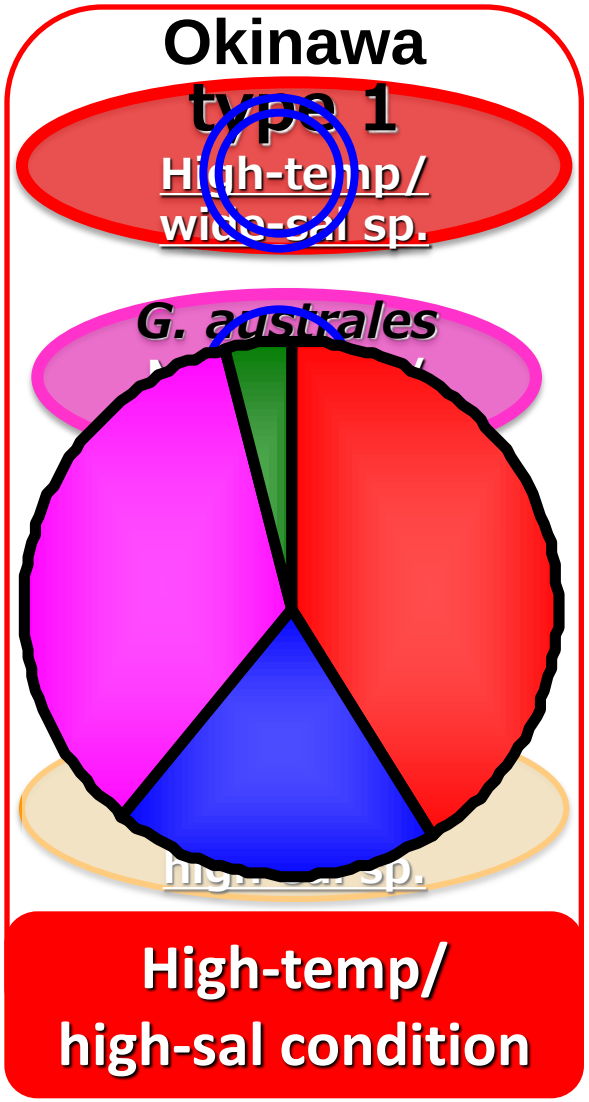
Temperature

Salinity

Another

?

?



Temperature is the important factor for the distribution

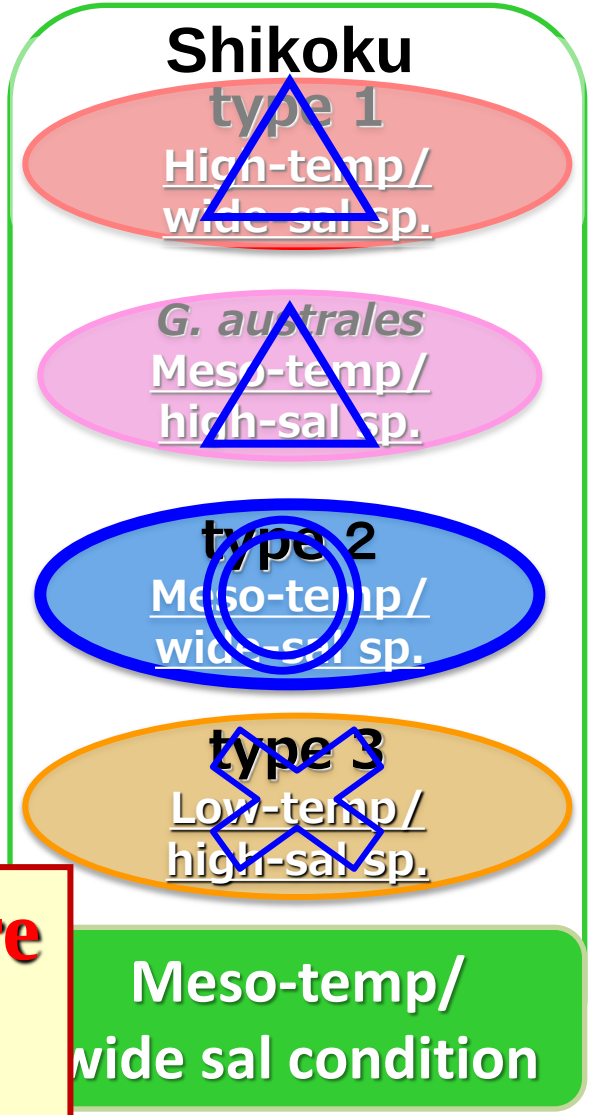
What is the important factor restricting distribution of *Gambierdiscus* spp. in Shikoku?

In case of Shikoku:

Temperature

Salinity

Another



Salinity as well as **temperature** are important factors for their distribution

Which is the important factor for the distribution in Honshu?

Okinawa

type 1
High-temp/
wide-sal sp.

G. australes
Meso-temp/
high-sal sp.

type 2
Meso-temp/
wide-sal sp.

type 3
Low-temp/
high-sal sp.

Shikoku

type 1
High-temp/
wide-sal sp.

G. australes
Meso-temp/
high-sal sp.

type 2
Meso-temp/
wide-sal sp.

type 3
Low-temp/
high-sal sp.

Honshu

type 1
High-temp/
wide-sal sp.

G. australes
Meso-temp/
high-sal sp.

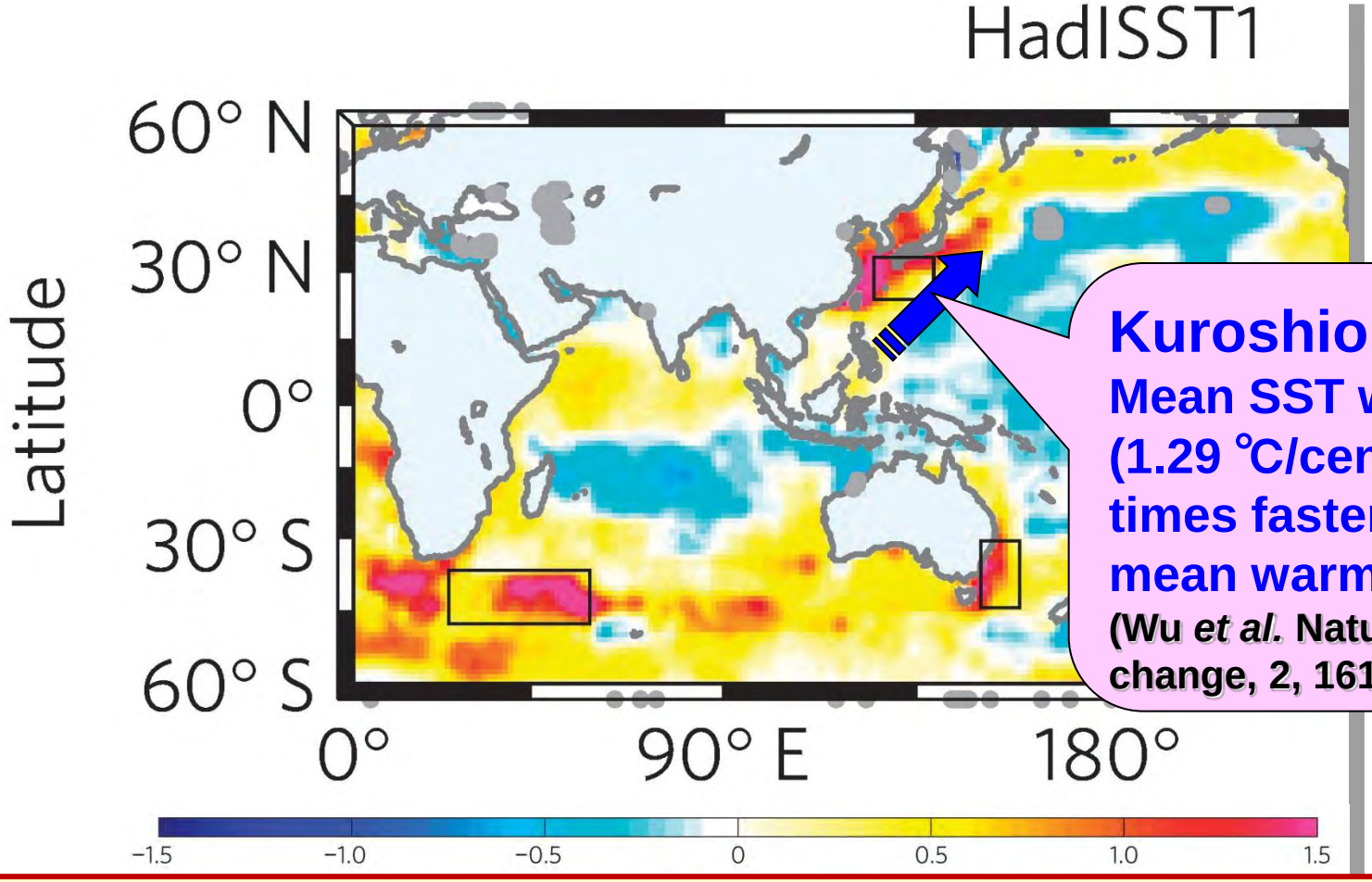
type 2
Meso-temp/
wide-sal sp.

type 3
Low-temp/
high-sal sp.

Low-temp/
wide sal condition

Both temperature and salinity are found to be important factors for their distribution

Water temperature in Japanese coastal regions



Kuroshio Current

Mean SST warming rate (1.29 ℃/century) is two times faster than global mean warming rate(0.62).

(Wu *et al.* Nature climate change, 2, 161-166, 2012)

In Japanese coastal regions, surface sea temperature has increased for past century

Future water temperature in Japanese coastal regions

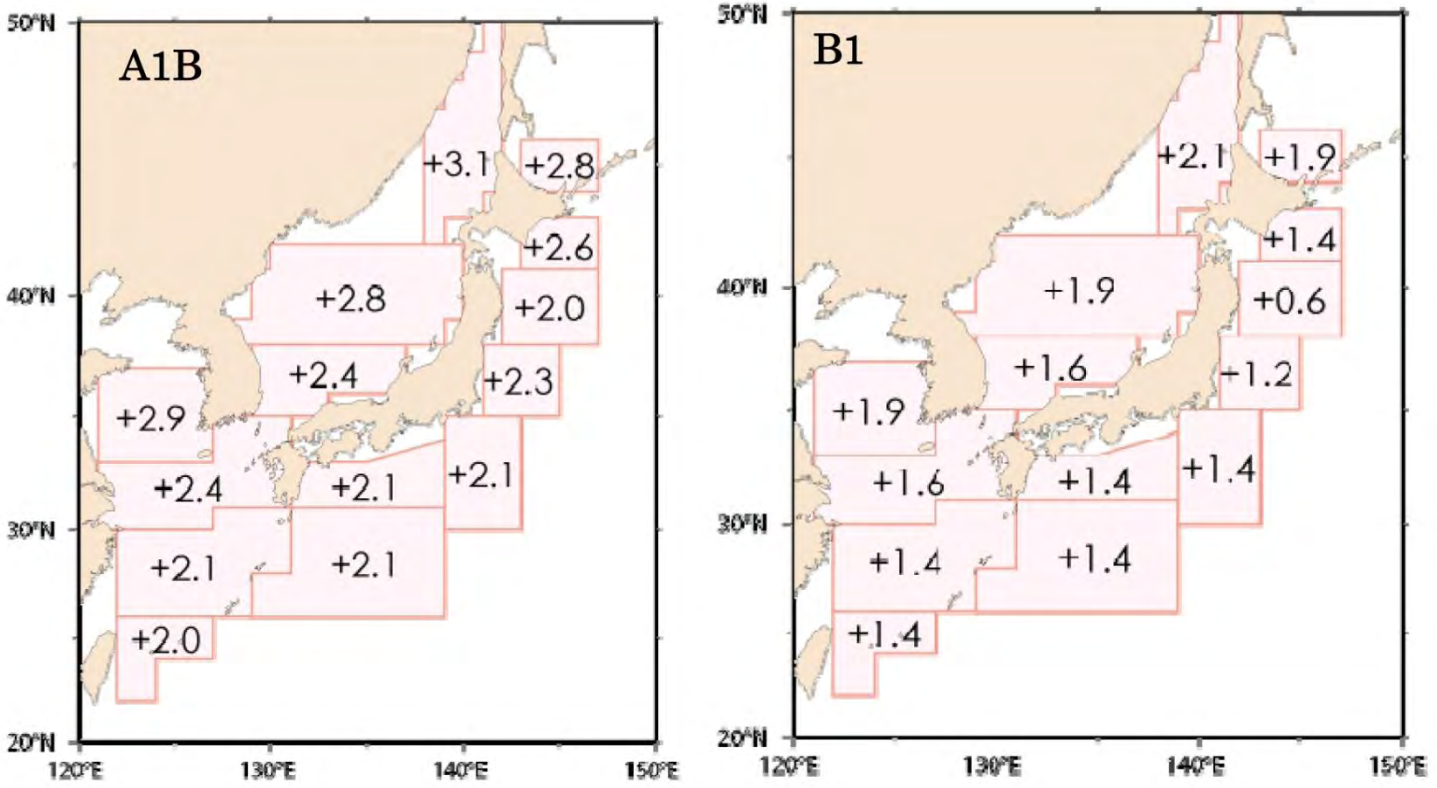
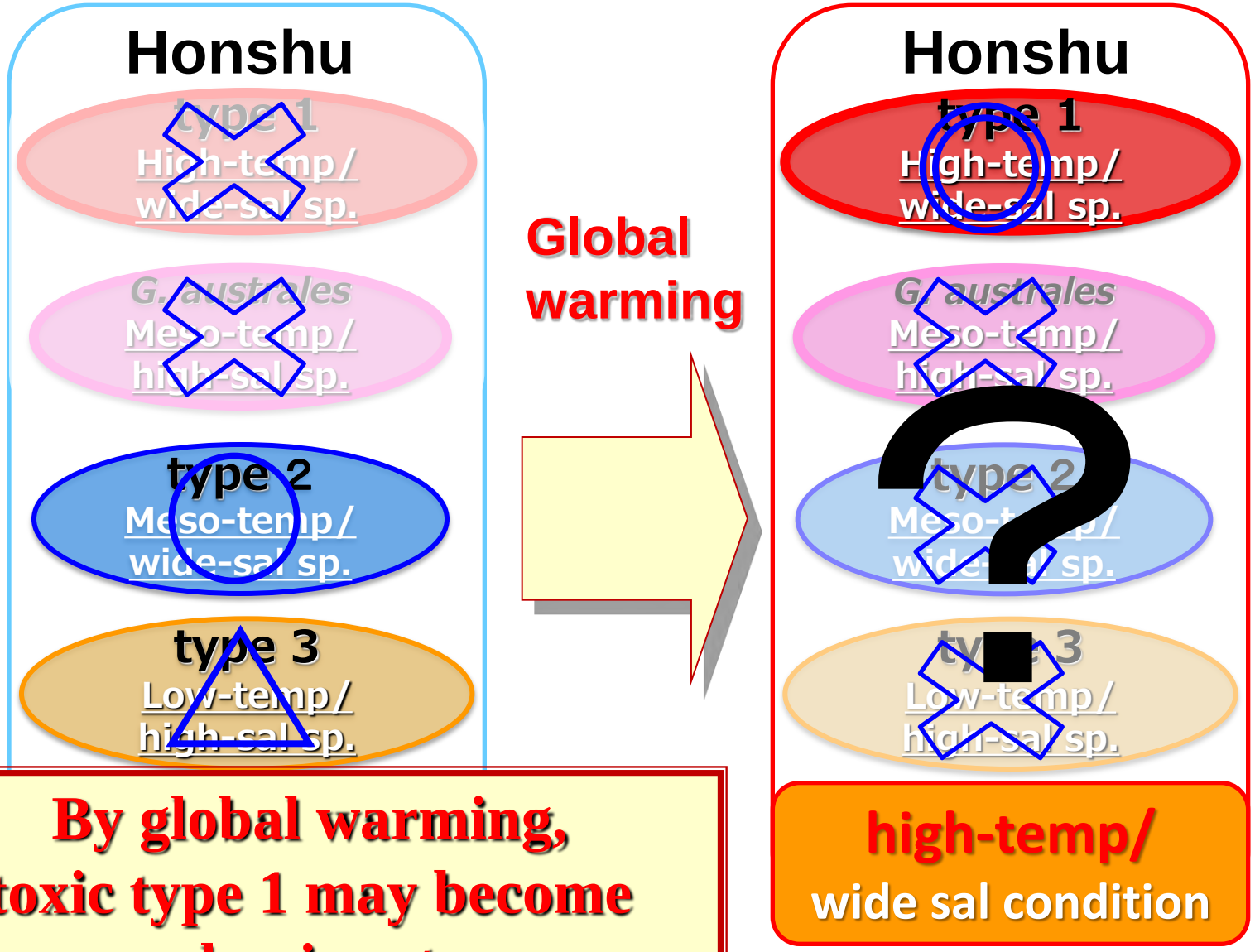


Fig. Estimation of future sea surface temperature (SST) in Japanese coastal waters. A1B: results estimated byA1B scenario, B1: results estimated by B1 scenario. Estimated by Japan Meteorological Agency

Further increases in sea surface temperature are predicted in Japanese coastal waters

By global warming, which species becomes dominant in Honshu, main island of Japan?



By global warming, toxic type 1 may become dominant

Summary:

Each Japanese *Gambierdiscus* species has unique growth characteristic.

Surface sea temperature and salinity may restrict and regulate their distribution/ bloom formation.

Global warming

The dominant species may change from **a non-toxic species** to **a toxic species**

Ciguatera may occur occasionally in Honshu, main island of Japan !

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