

Migration of Green Turtles in the Northwest Pacific: Review and Future Work

Hideaki NISHIZAWA

Graduate School of Informatics, Kyoto University

KICK-OFF meeting for PICES SEATurtle project
August 26, 2019



Contents

- 1) Introduction – Sea turtles in Japan**
- 2) Where foraging green turtles in Japan come from?
– Implications from genetics**
- 3) Connections from Japan and tropical Pacific:
Confirmation by tagging/telemetry**
- 4) Connections from rookeries in Japan and coastal
areas of Japan: Confirmation by telemetry**
- 5) Future works and challenges**

Sea turtles in Japan



Loggerhead turtle
(*Caretta caretta*)

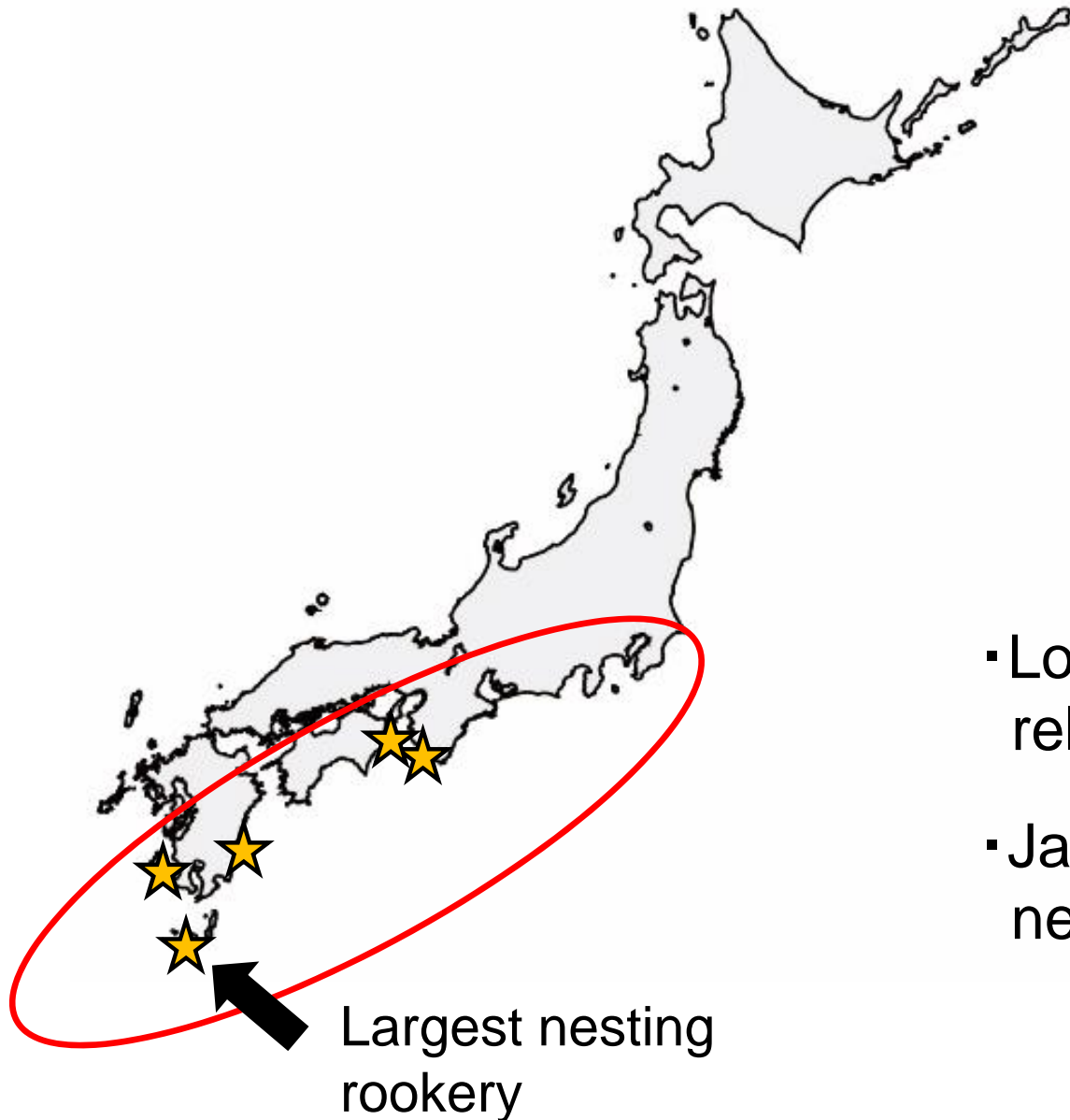


Green turtle
(*Chelonia mydas*)



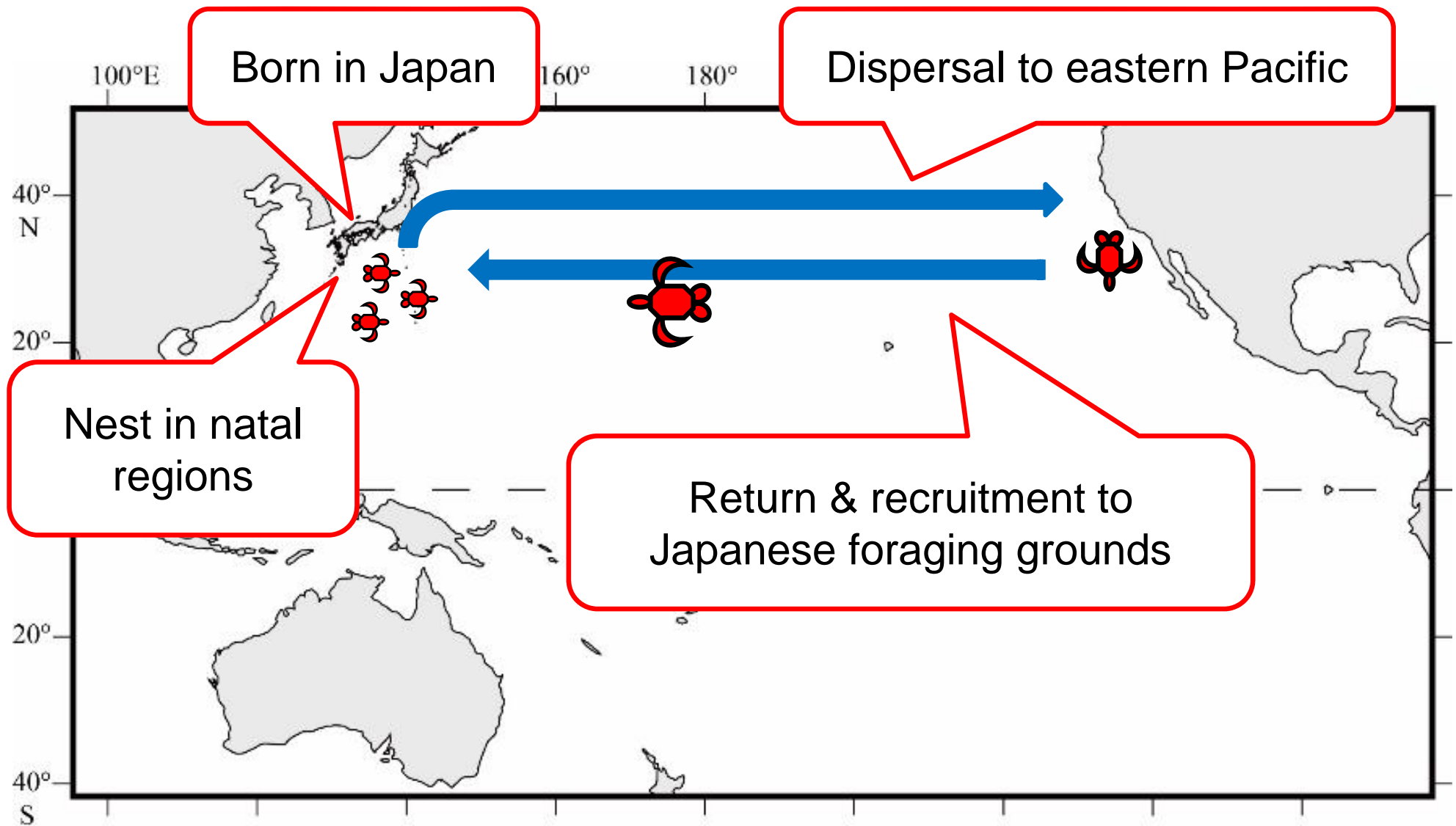
Hawksbill turtle
(*Eretmochelys imbricata*)

Loggerhead turtle (*Caretta caretta*)



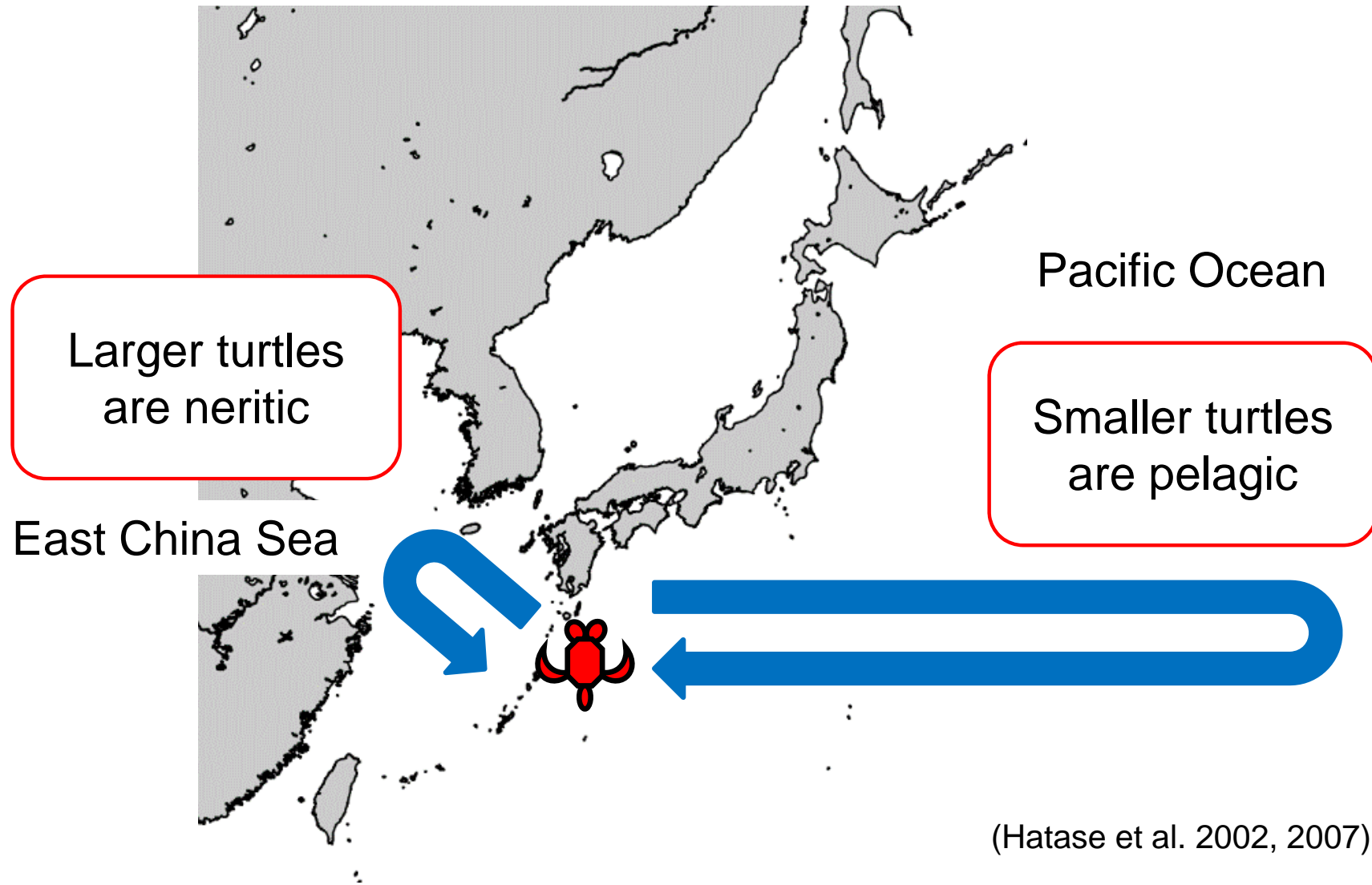
- Loggerhead turtles nest at relatively high latitudinal areas.
- Japan provides almost all nesting sites in the north Pacific.

Migration of loggerhead turtles

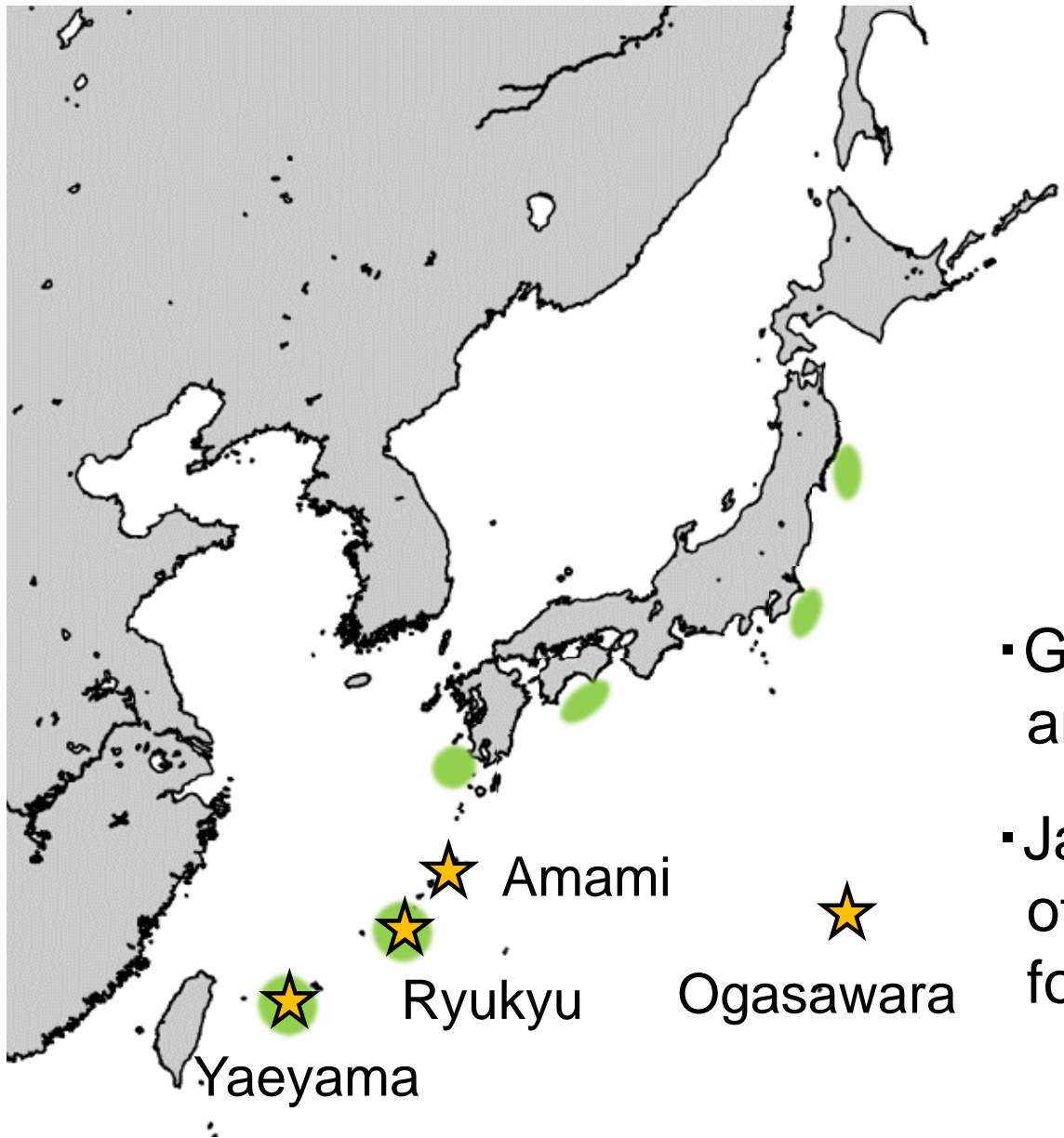


(Bowen et al. 1995, Nichols et al. 2000, Hatase et al. 2002, Polovina et al. 2004)

Migration of loggerhead turtles

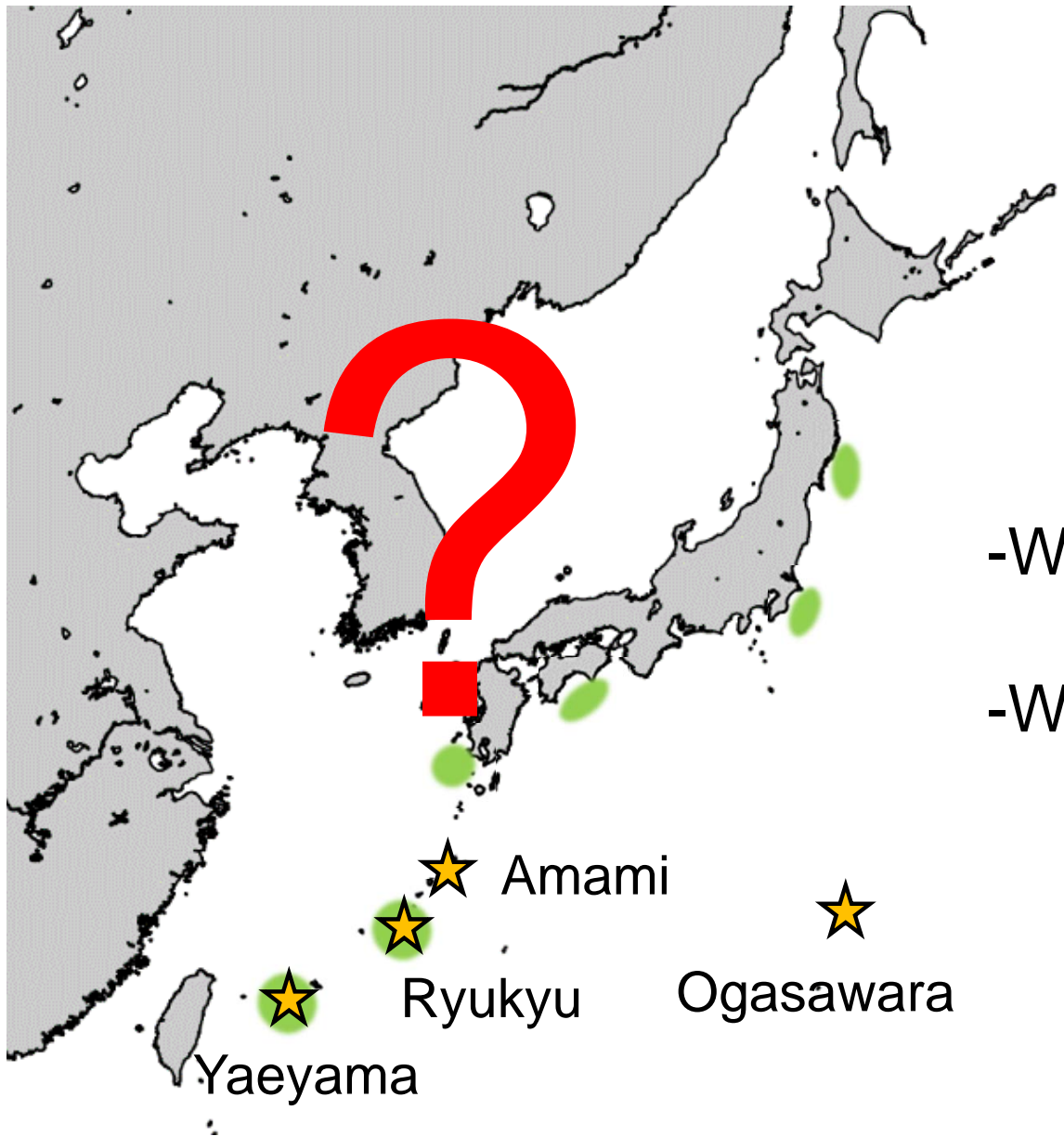


Green turtle (*Chelonia mydas*)



- Green turtles nest at tropical and subtropical areas.
- Japan provides limited number of nesting sites, but important foraging grounds.

Migration of green turtles

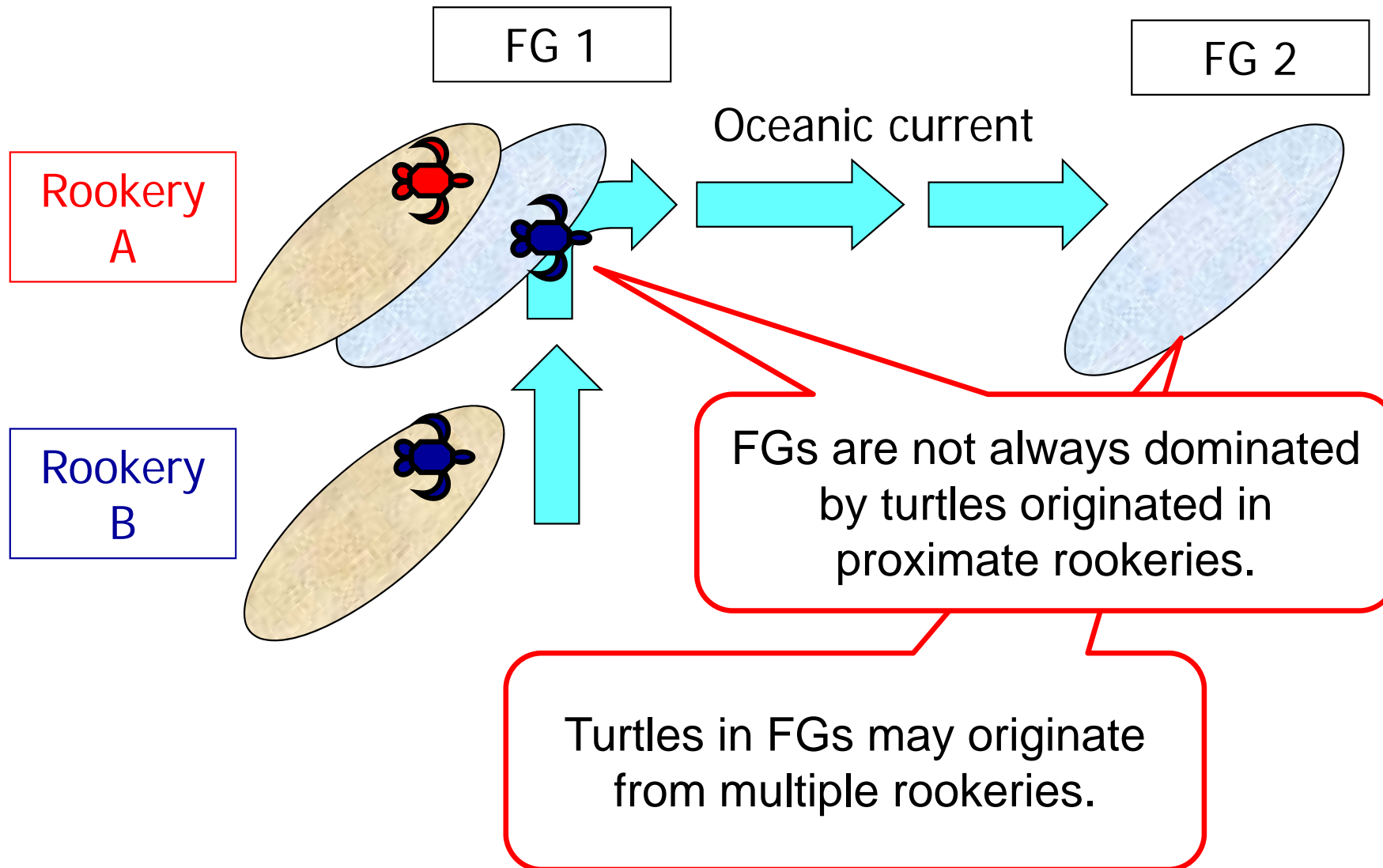


-Where do they go?

-Where do they come from?

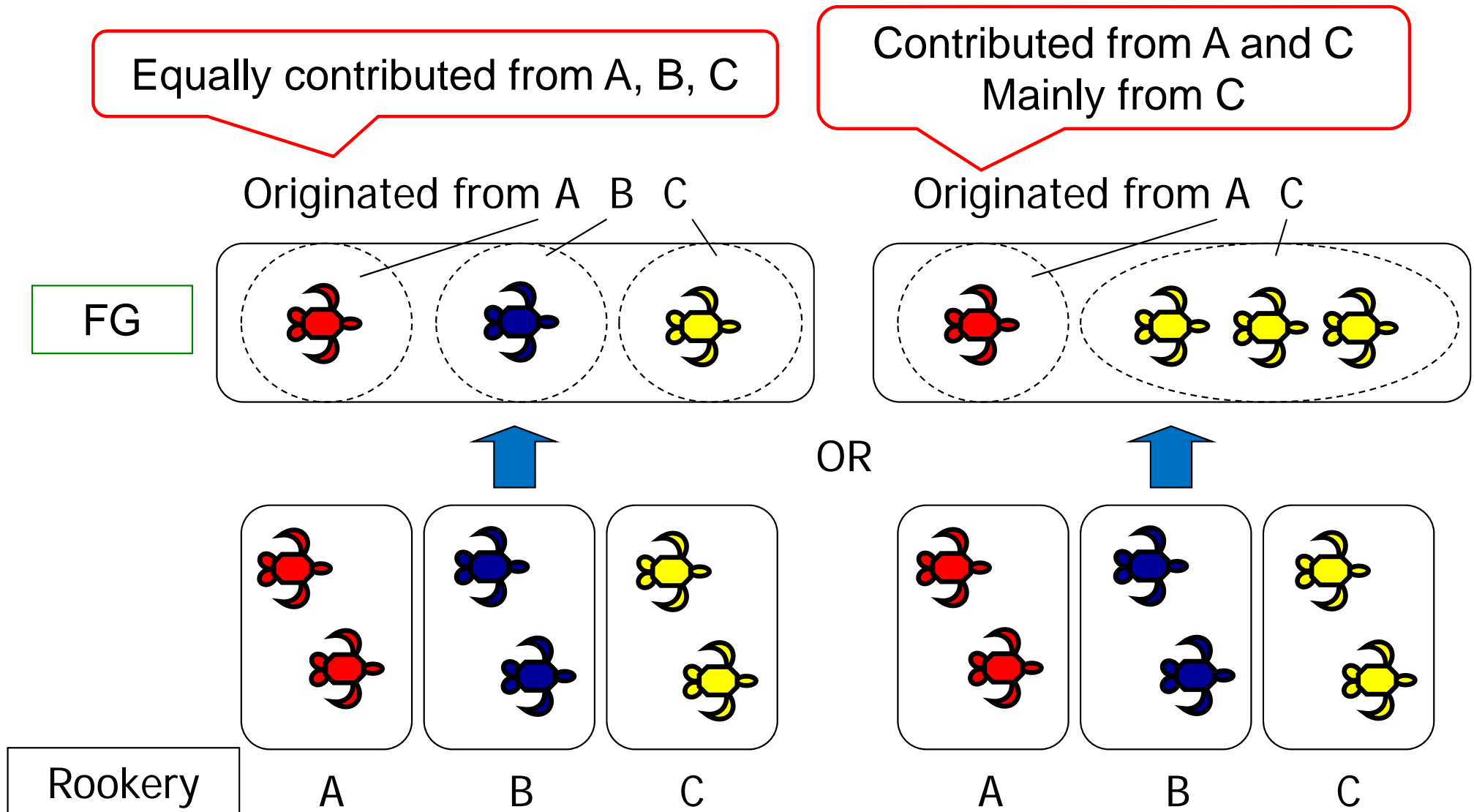
Where foraging green turtles in Japan come from? – Implications from genetics

Migration to foraging grounds (FGs)

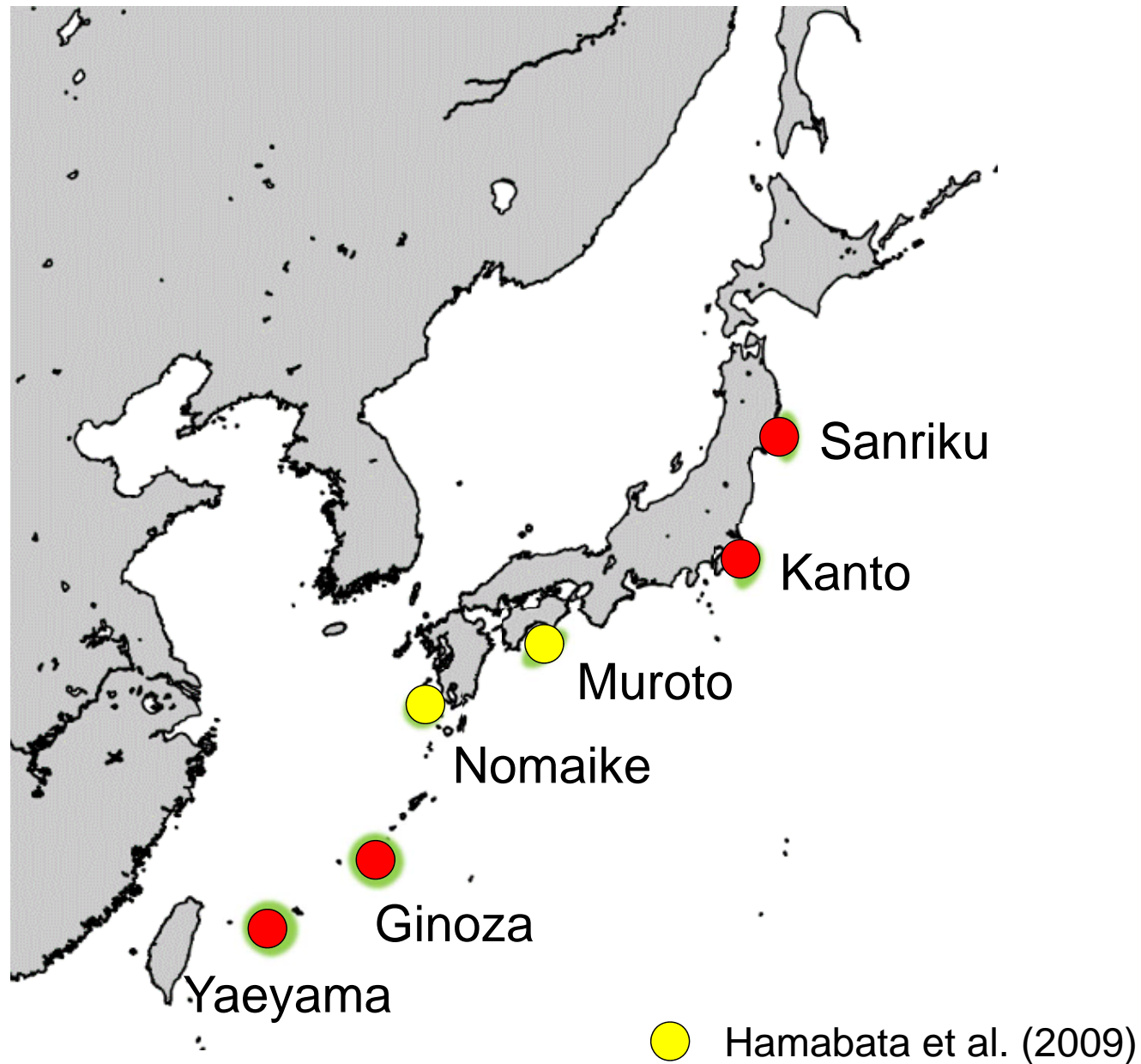


How to estimate using genetic information

Haplotypes of mtDNA can be used as markers of nesting rookeries.

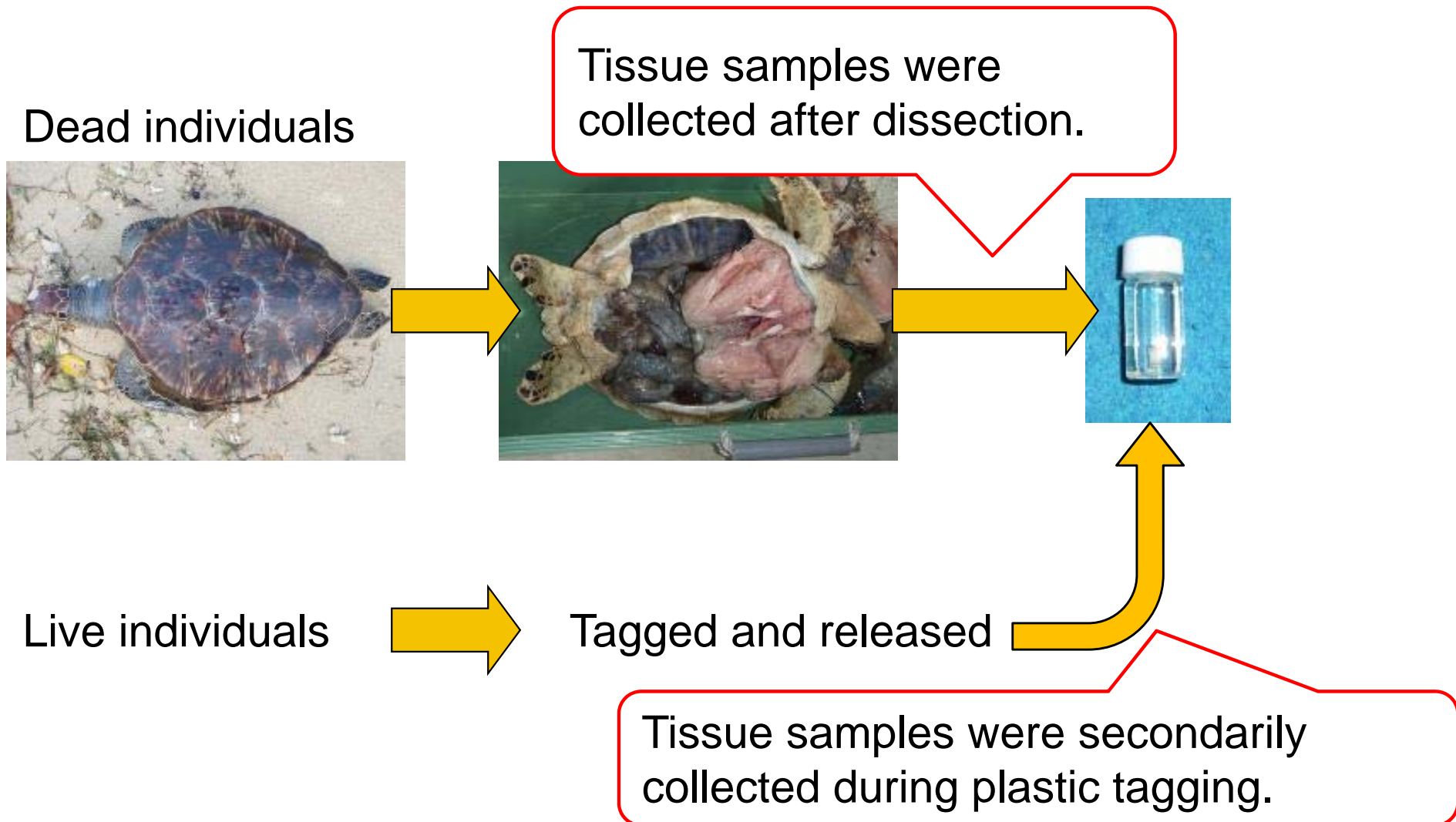


Foraging grounds in Japan



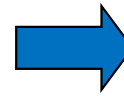
Collecting samples

Samples were collected from stranded turtles.

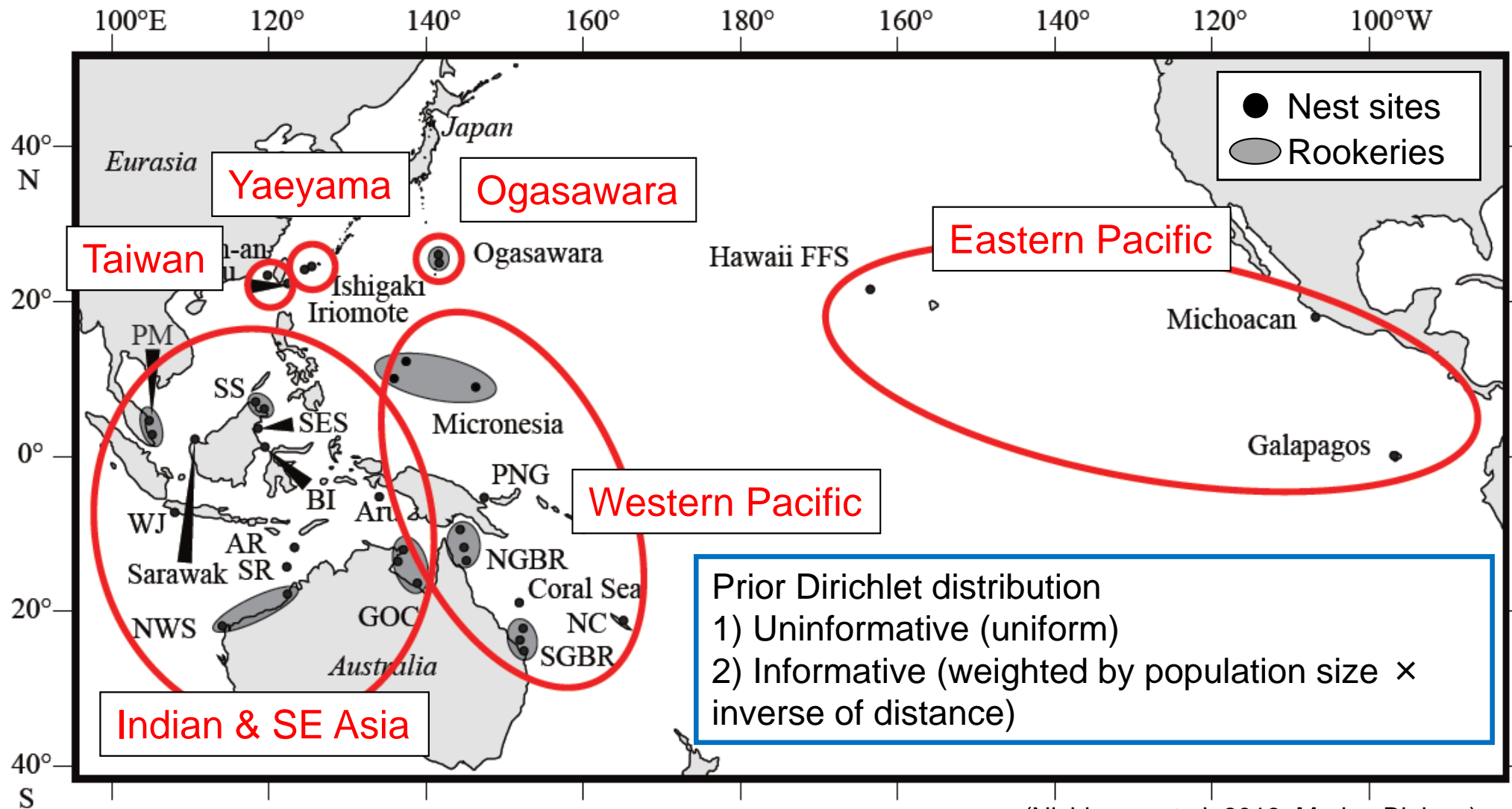


Source populations

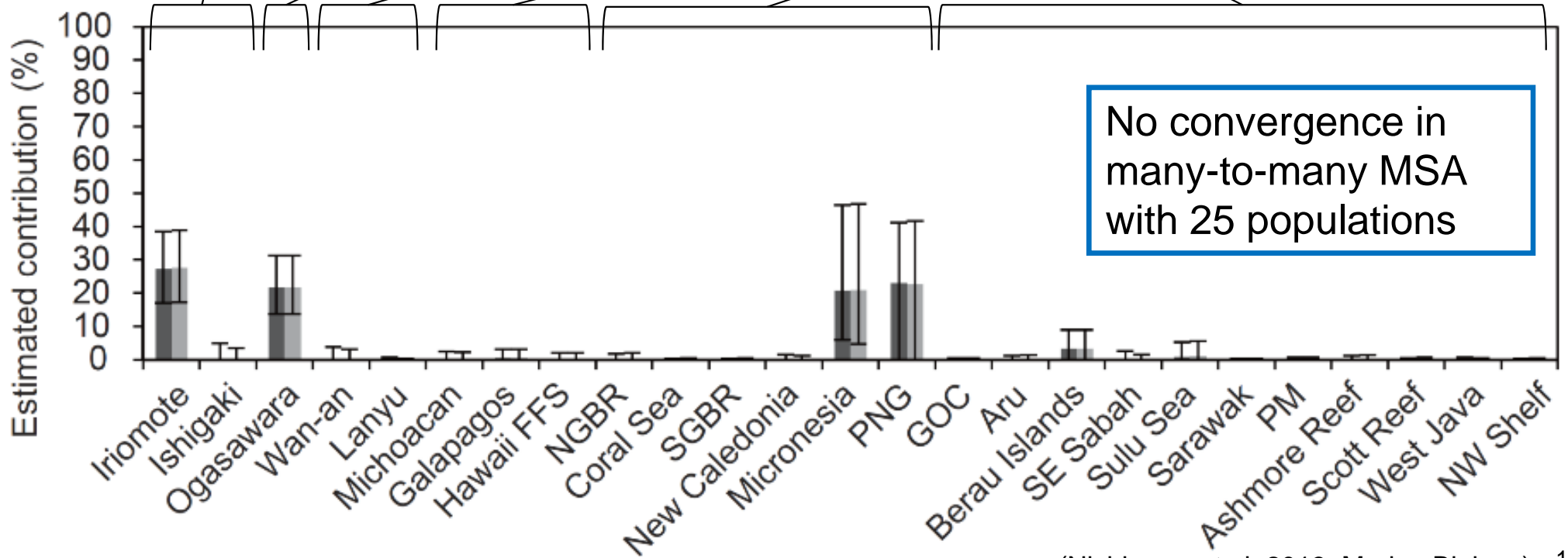
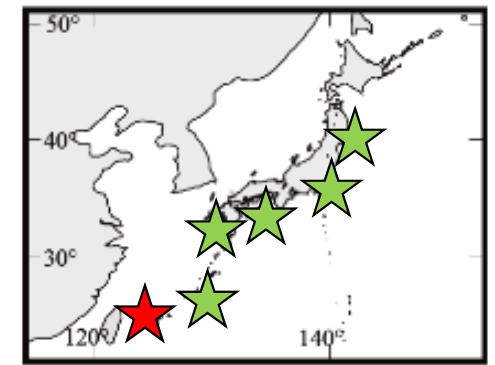
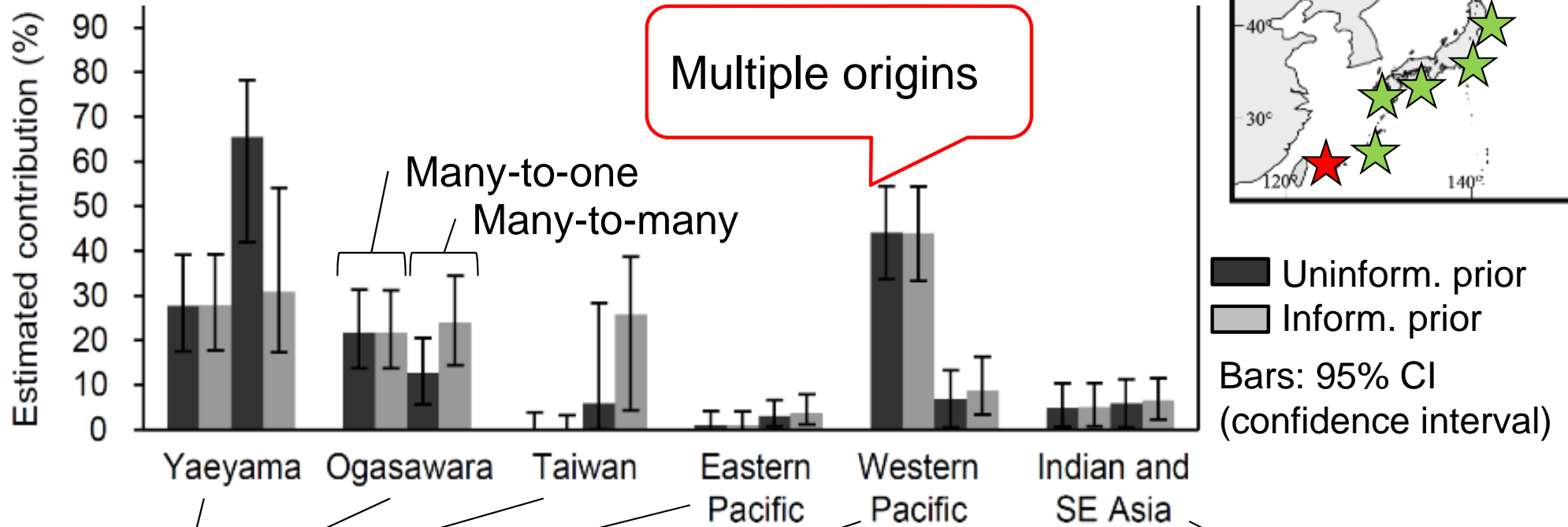
- Yaeyama (Nishizawa et al. 2011)
- Other rookeries in the Pacific and Southeast Asia (Dethmers et al. 2006 etc.)



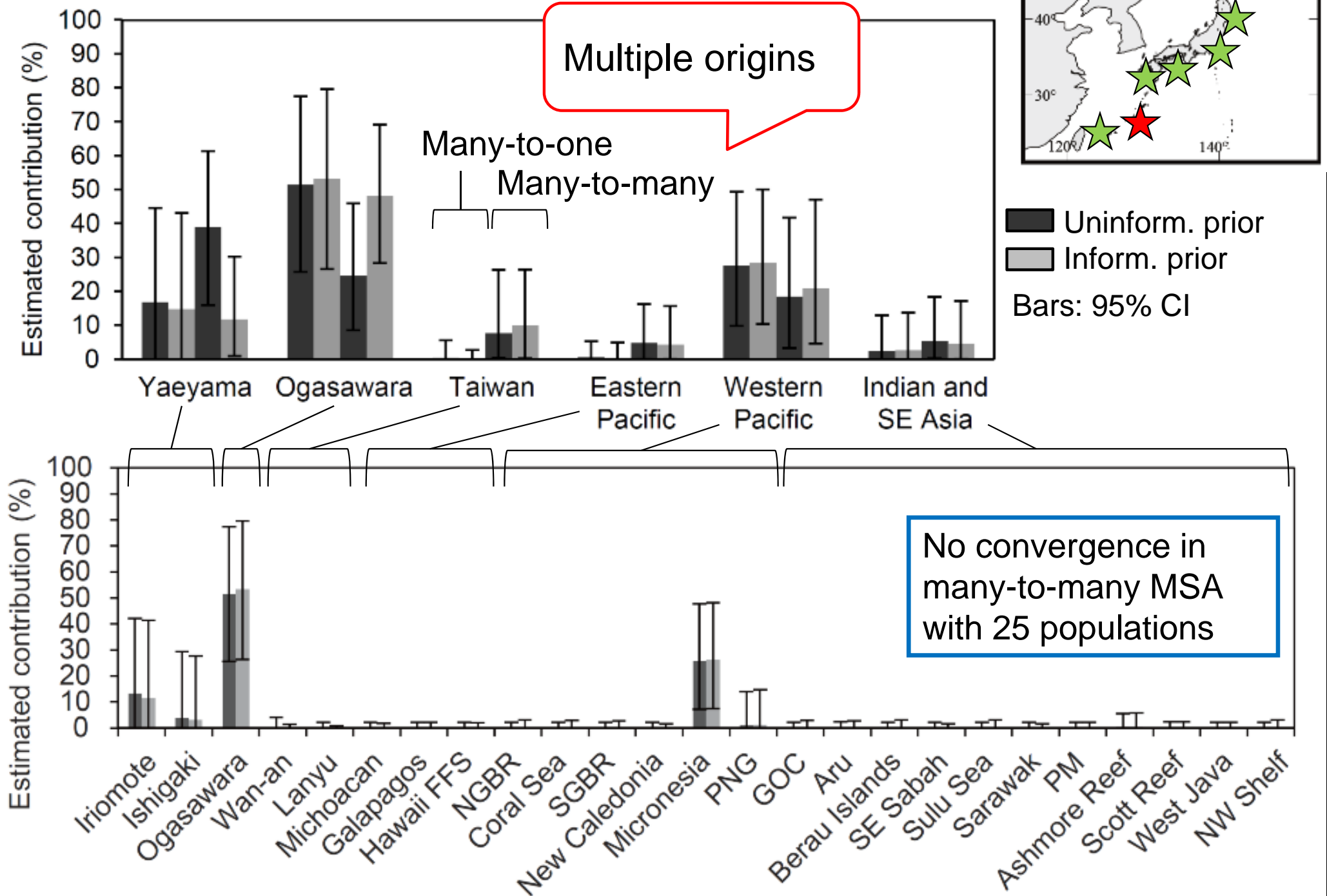
- 1) 25 rookeries
- 2) 6 regions



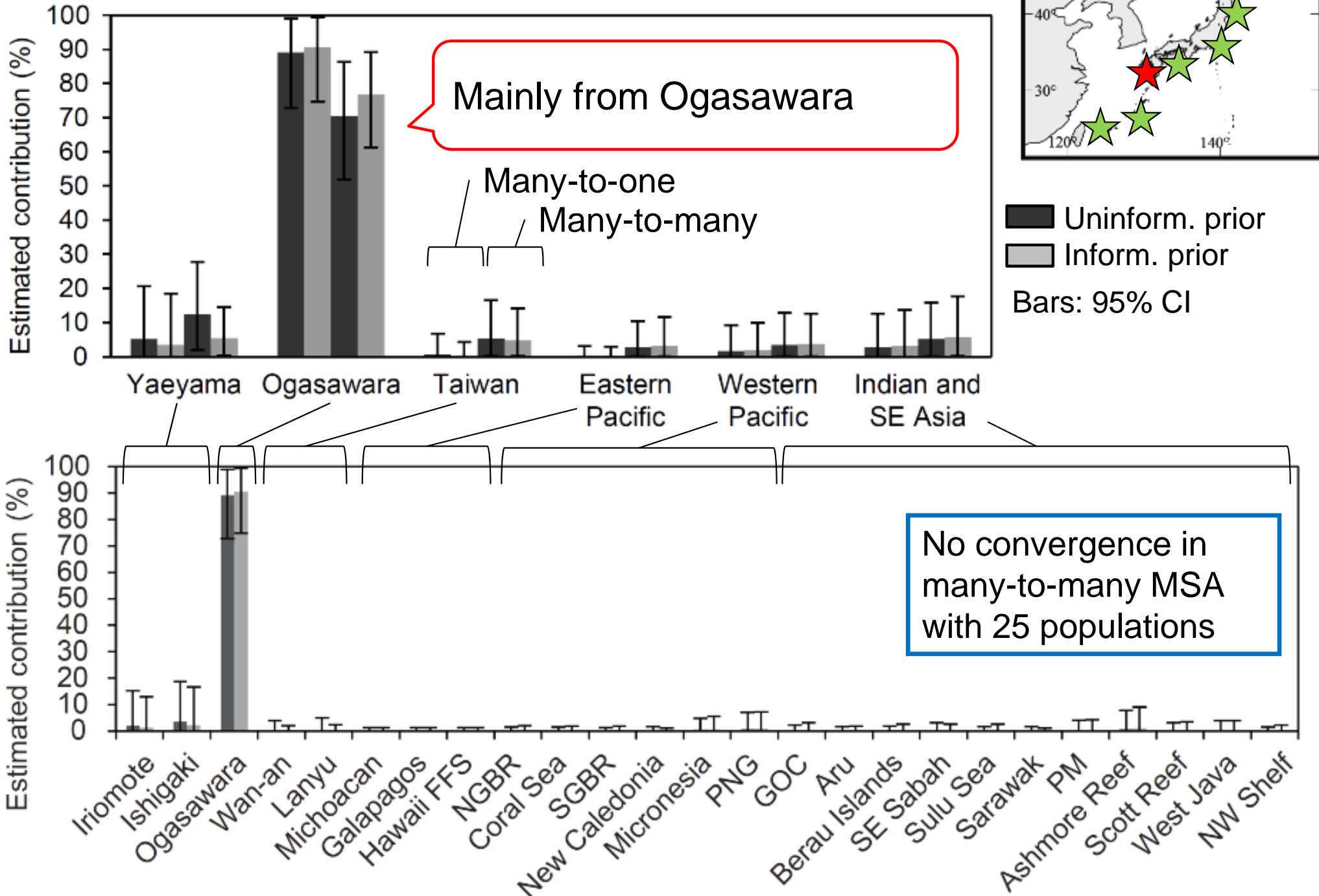
Contribution to Yaeyama FG



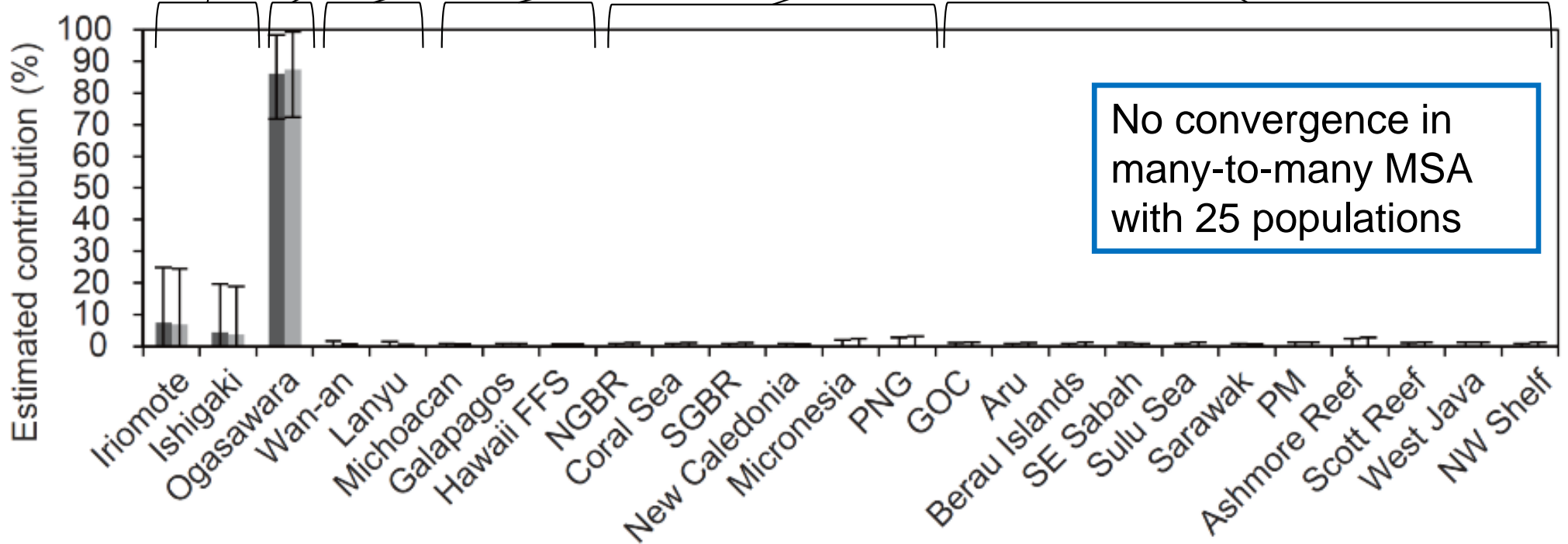
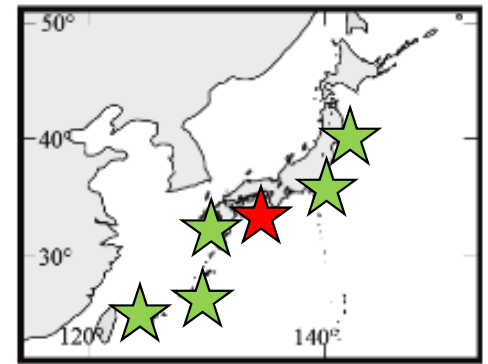
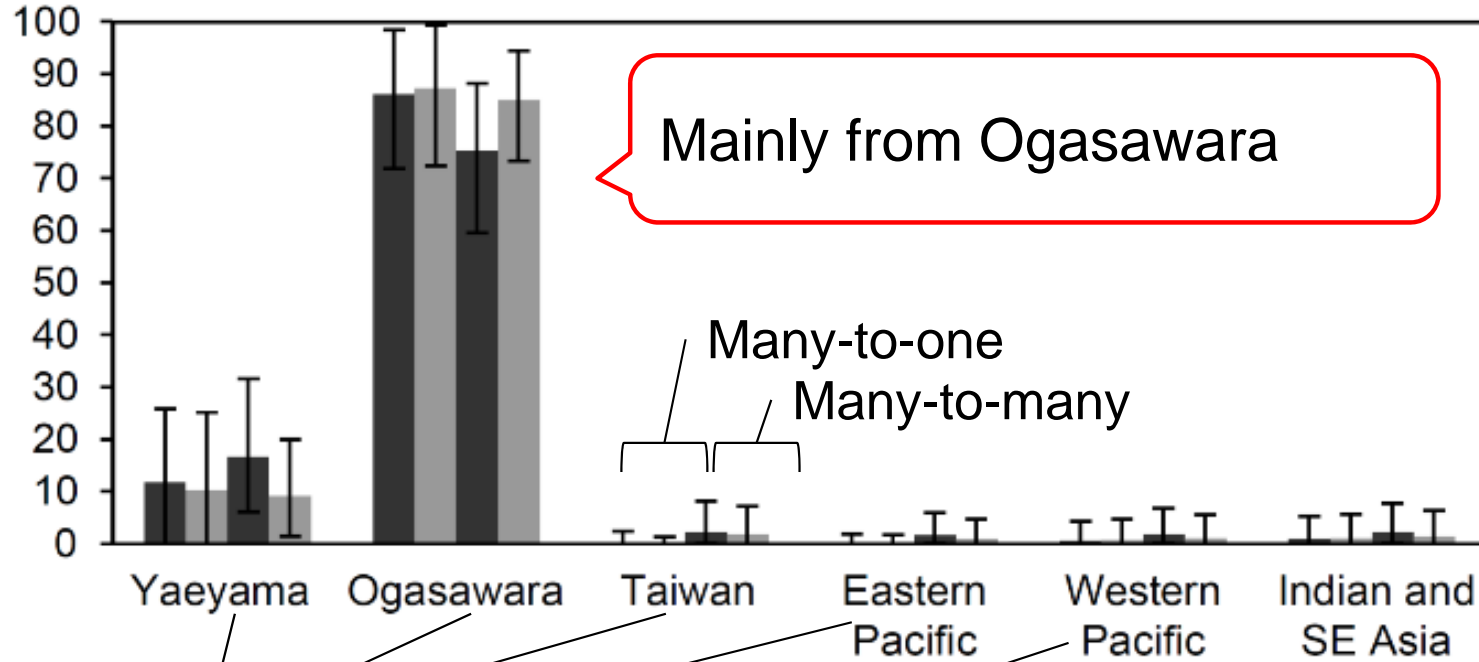
Contribution to Ginoza FG



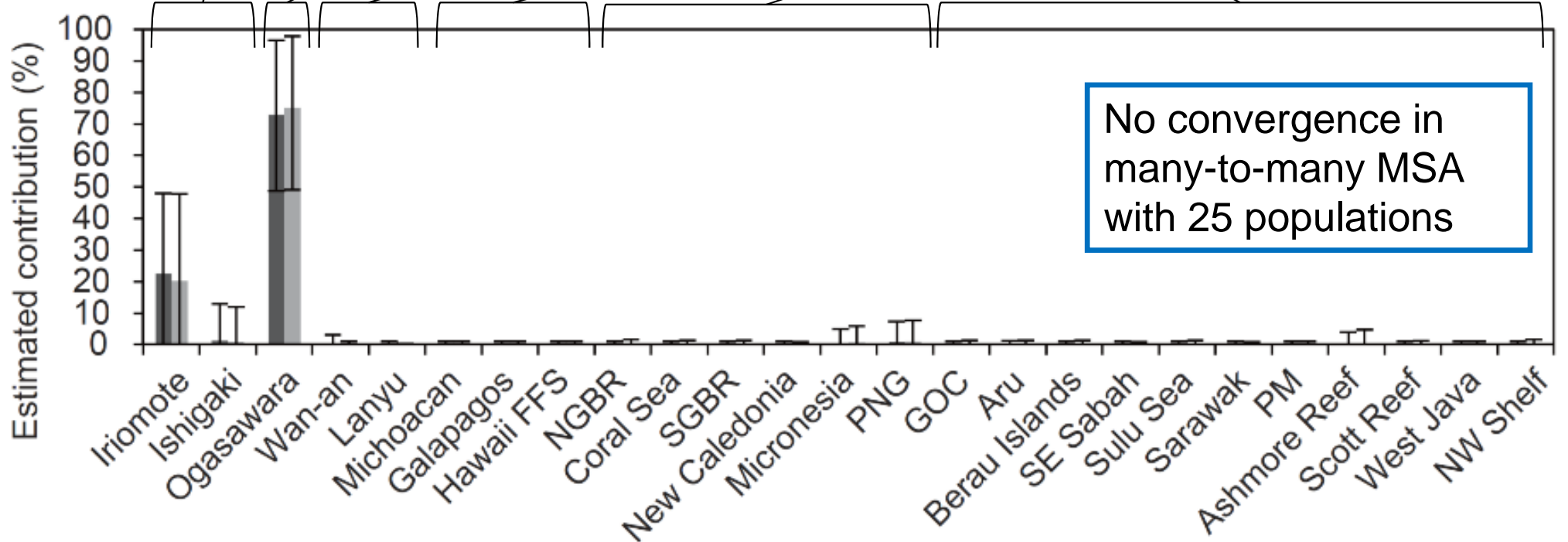
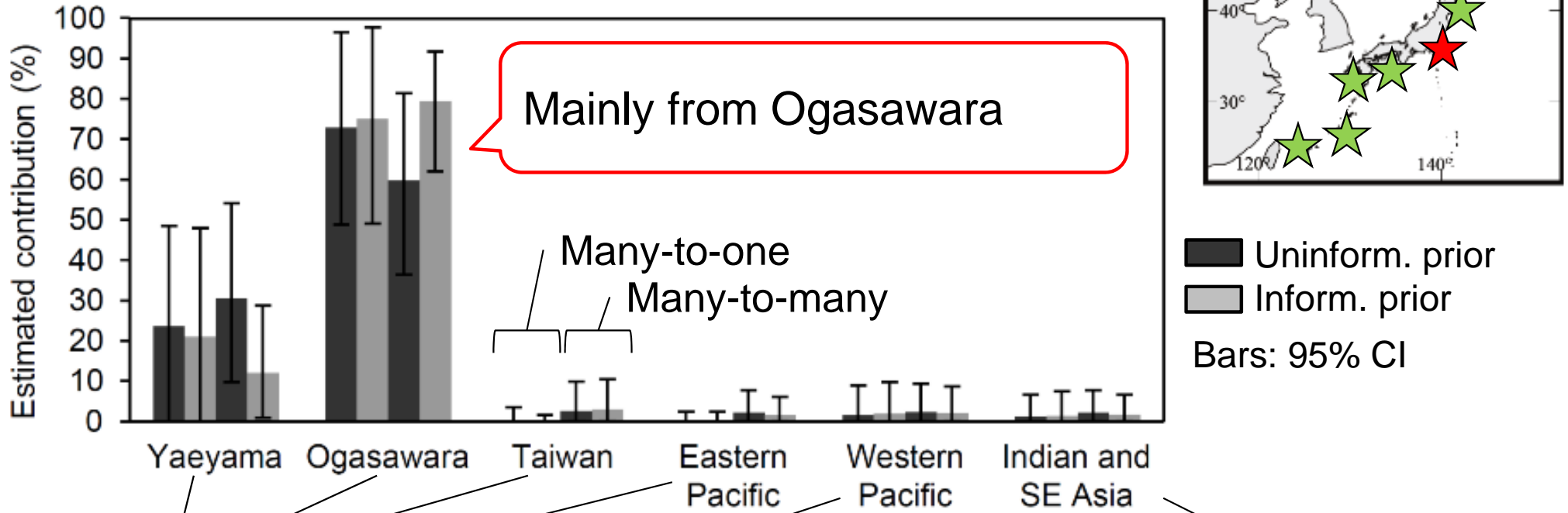
Contribution to Nomaike FG



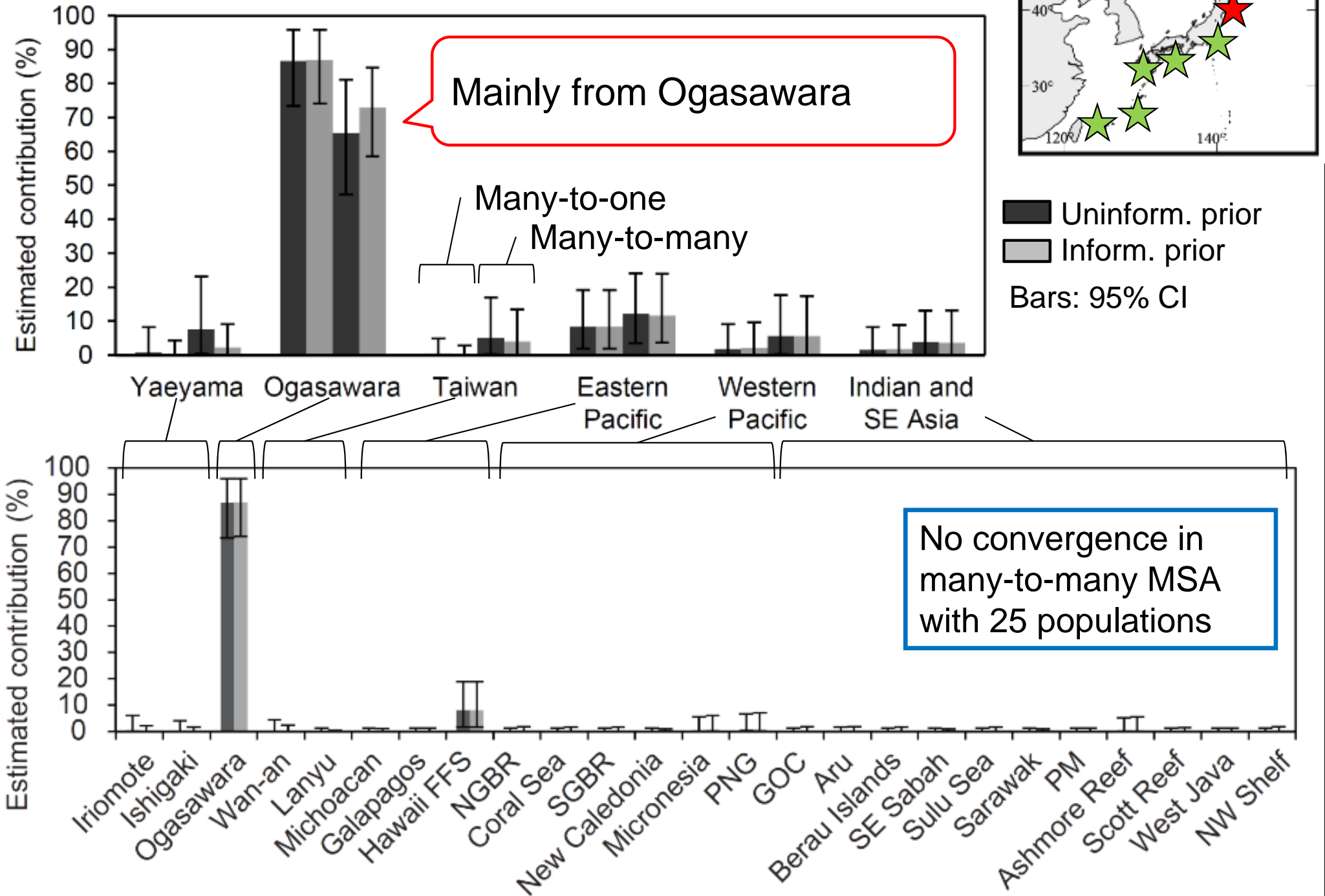
Contribution to Muroto FG



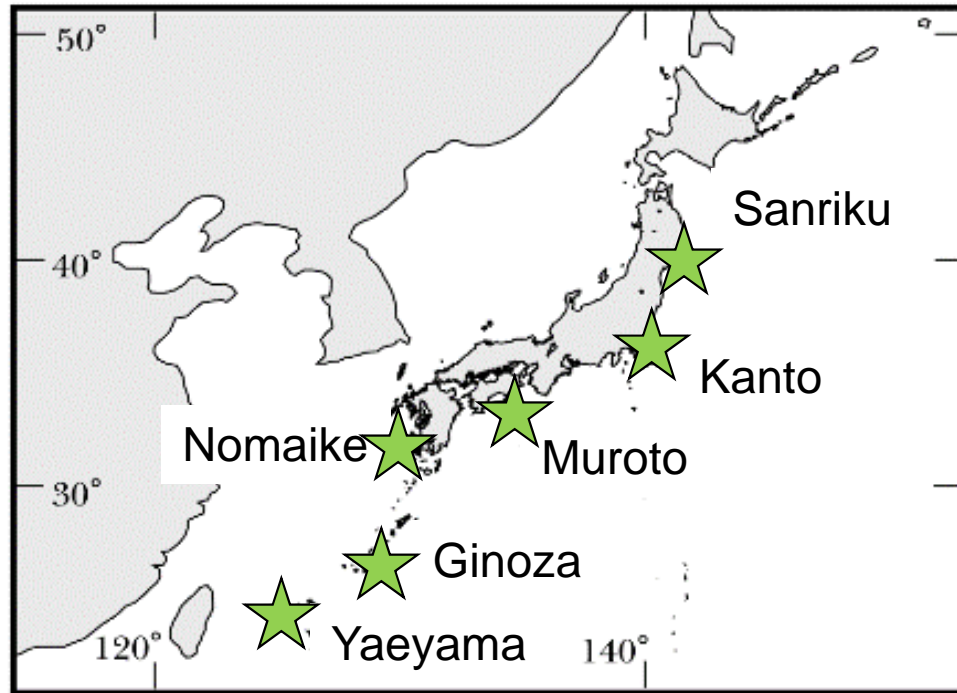
Contribution to Kanto FG



Contribution to Sanriku FG



Comparisons among FGs



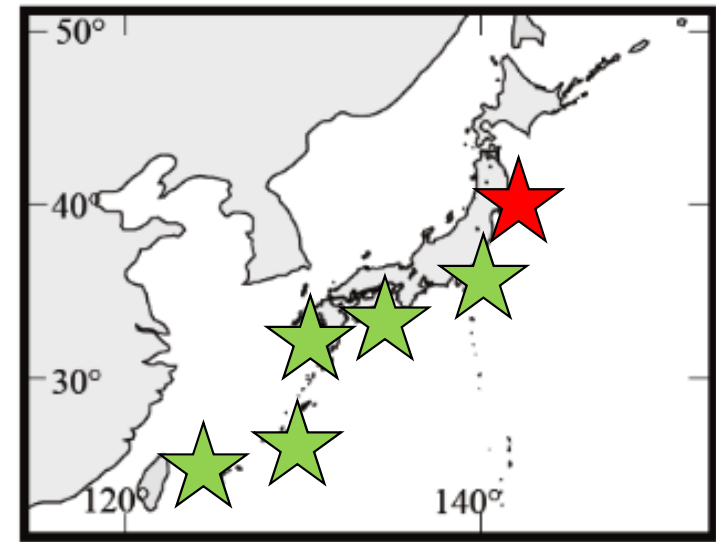
Significant correlation between geographic distance and genetic distance matrices (Mantel test: $r = 0.692$, $p < 0.01$)

Comparison in haplotype frequency (p-values of exact tests)

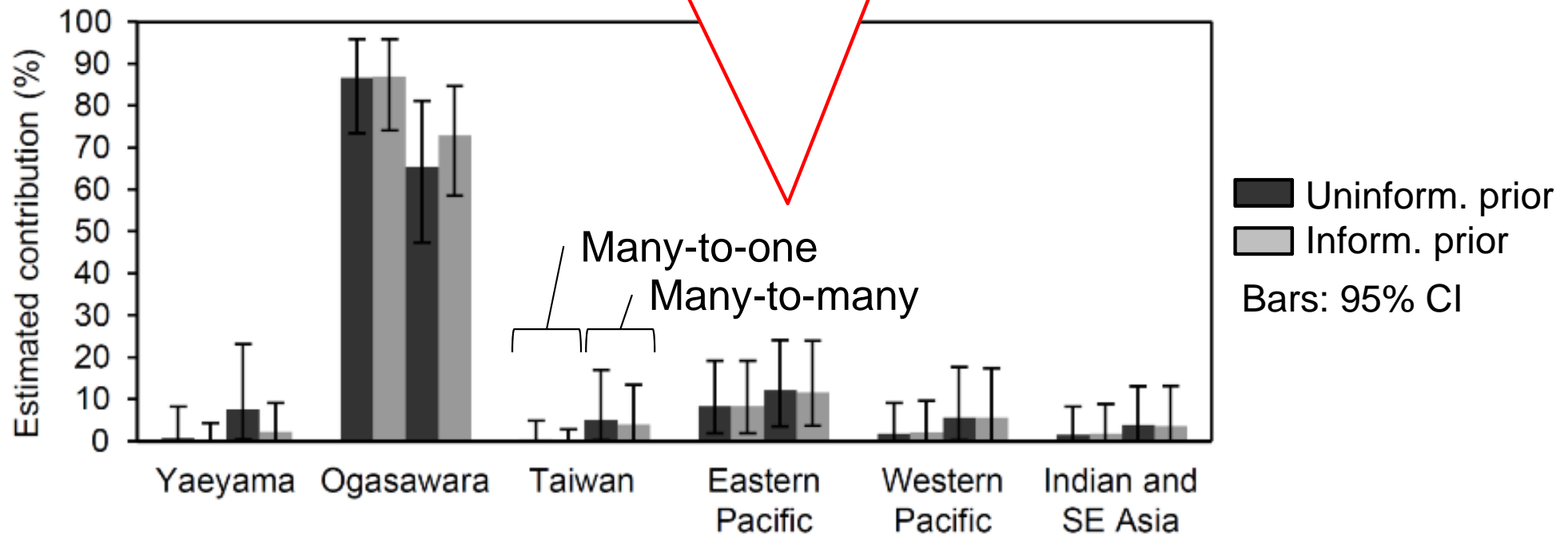
	N	Yaeyama	Ginoza	Nomaike	Muroto	Kanto
Yaeyama	142					
Ginoza	20	0.347				
Nomaike	38	< 0.00001	0.046			
Muroto	60	< 0.00001	0.008	0.449		
Kanto	47	< 0.00001	0.156	0.019	0.041	
Sanriku	39	< 0.00001	0.005	0.091	0.239	0.055

Red values indicate significances after sequential Bonferroni corrections.

Revisit to Sanriku FG



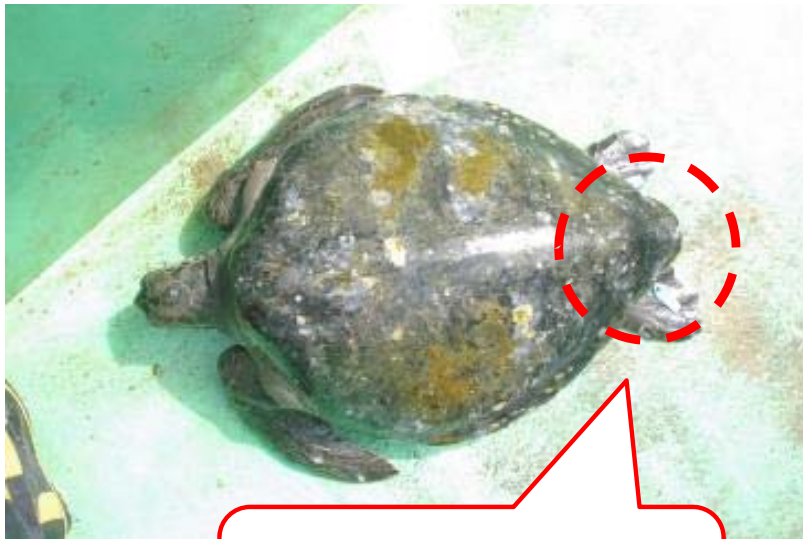
Small but significant contribution from the eastern Pacific?



Black turtles in Japan?

Black turtle (*Chelonia mydas agassizii*)

- Subspecies of green turtles
- Nest in the eastern Pacific

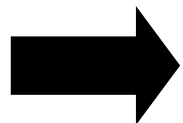


Heart-shaped
black carapace



Gray plastron

(Nishizawa et al. 2014: Endangered Species Research)



Migration from the eastern Pacific to Japanese coastal area

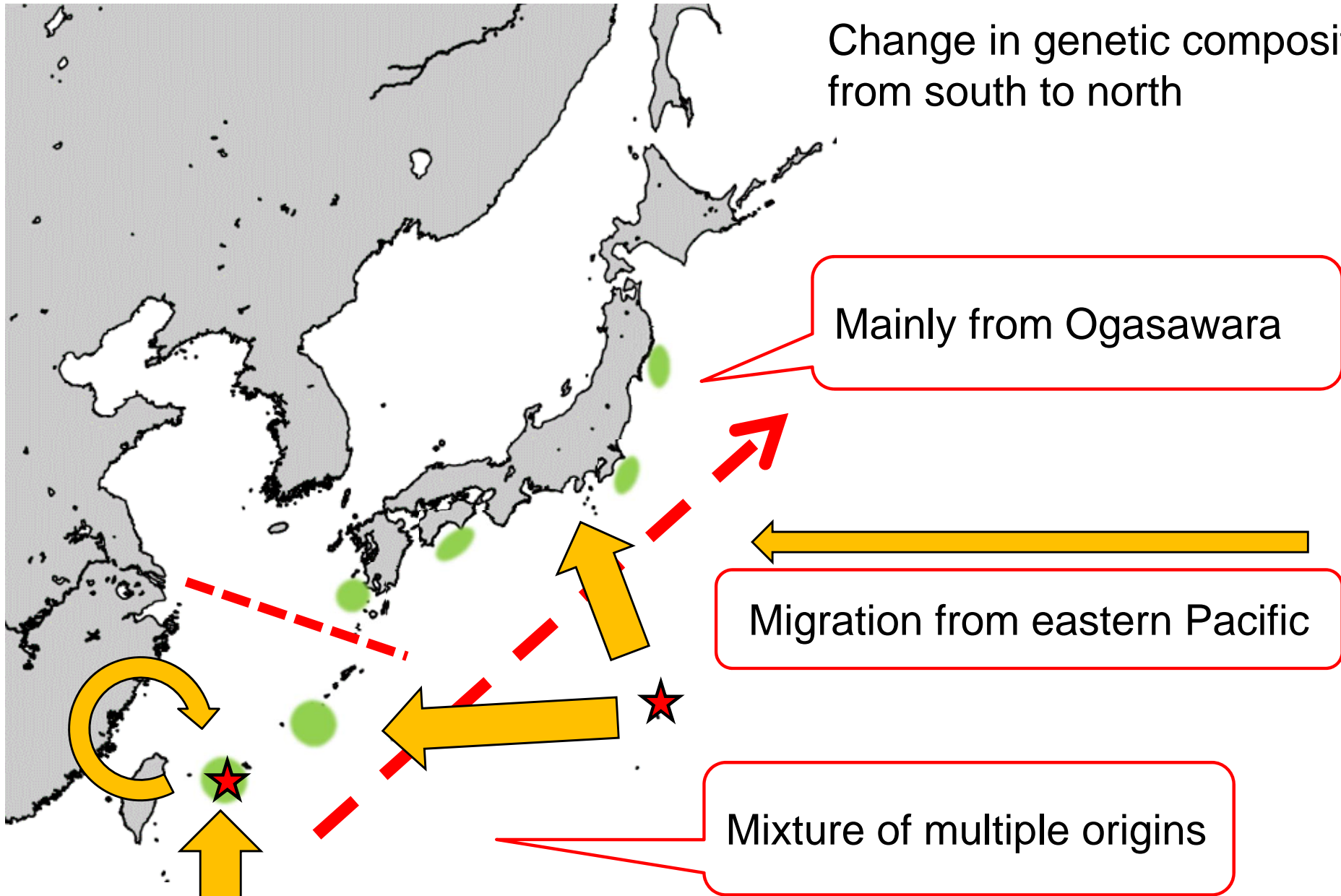
Origins of Foraging Green Turtles in Japan

Change in genetic composition
from south to north

Mainly from Ogasawara

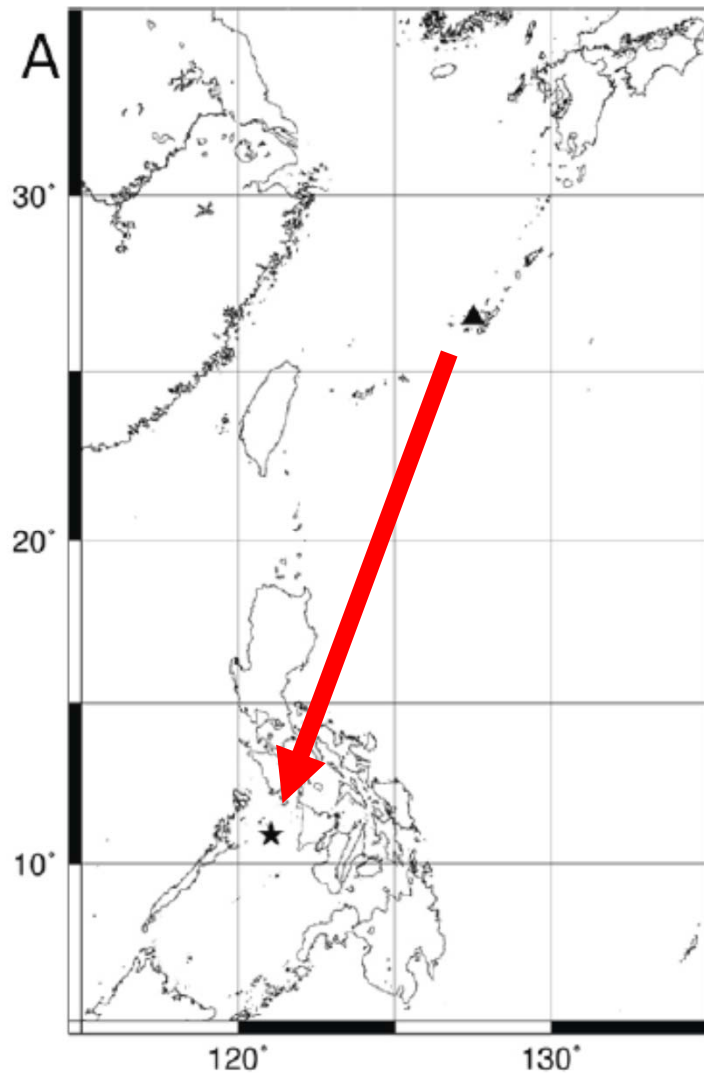
Migration from eastern Pacific

Mixture of multiple origins



Connections from Japan and tropical Pacific: Confirmation by tagging/telemetry

Connections from Japan and Tropical Pacific



(Hayashi 2015: Fauna Ryukyuna)

Hayashi (2015)

A green turtle was bycaught, tagged, and released at Okinawa (SCL 80.5 cm) in 2008



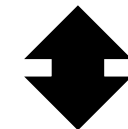
Recaptured at Philippines in 2012

Foraging?

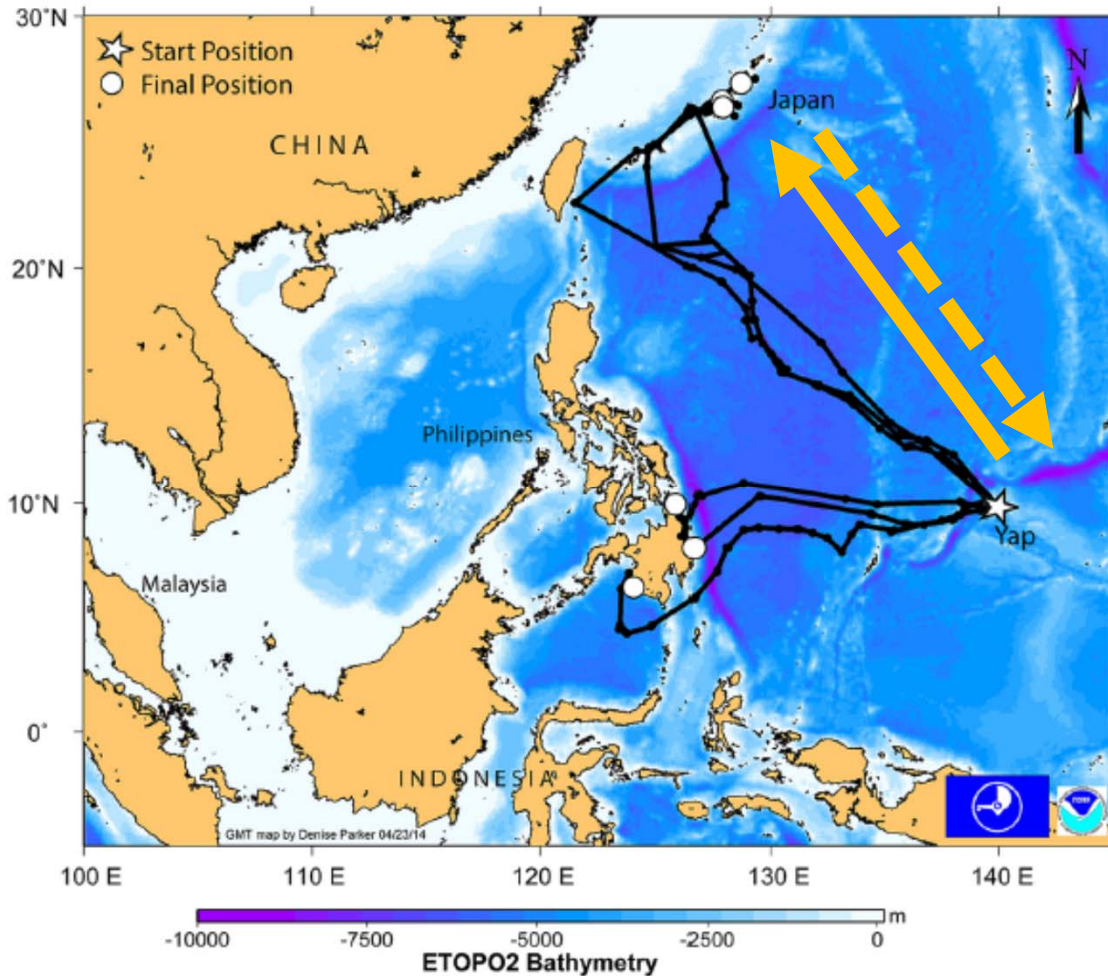
Coastal areas around the southern islands of Japan

Reproducing?

Tropical Pacific rookeries



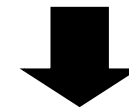
Connections from Japan and Tropical Pacific



(Kolinski et al. 2014: Micronesica)

Kolinski et al. (2014)

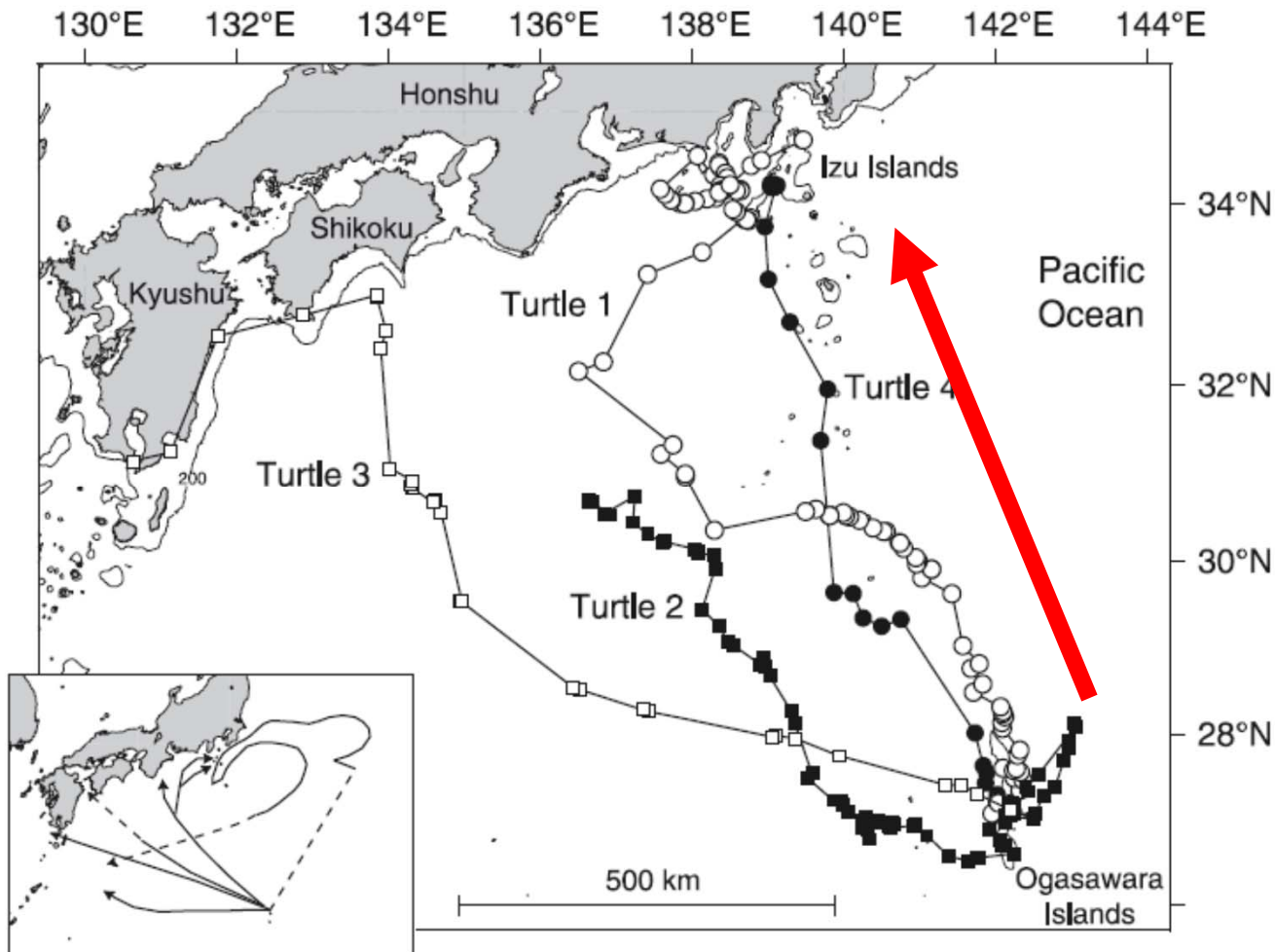
Satellite tracking of nesting green turtles at Micronesia



Turtles nesting at Micronesia utilize the southern islands of Japan as foraging grounds

Connections from rookeries in Japan and coastal areas of Japan: Confirmation by telemetry

Post-nesting migration



(Hatase et al. 2006: Oecologia)

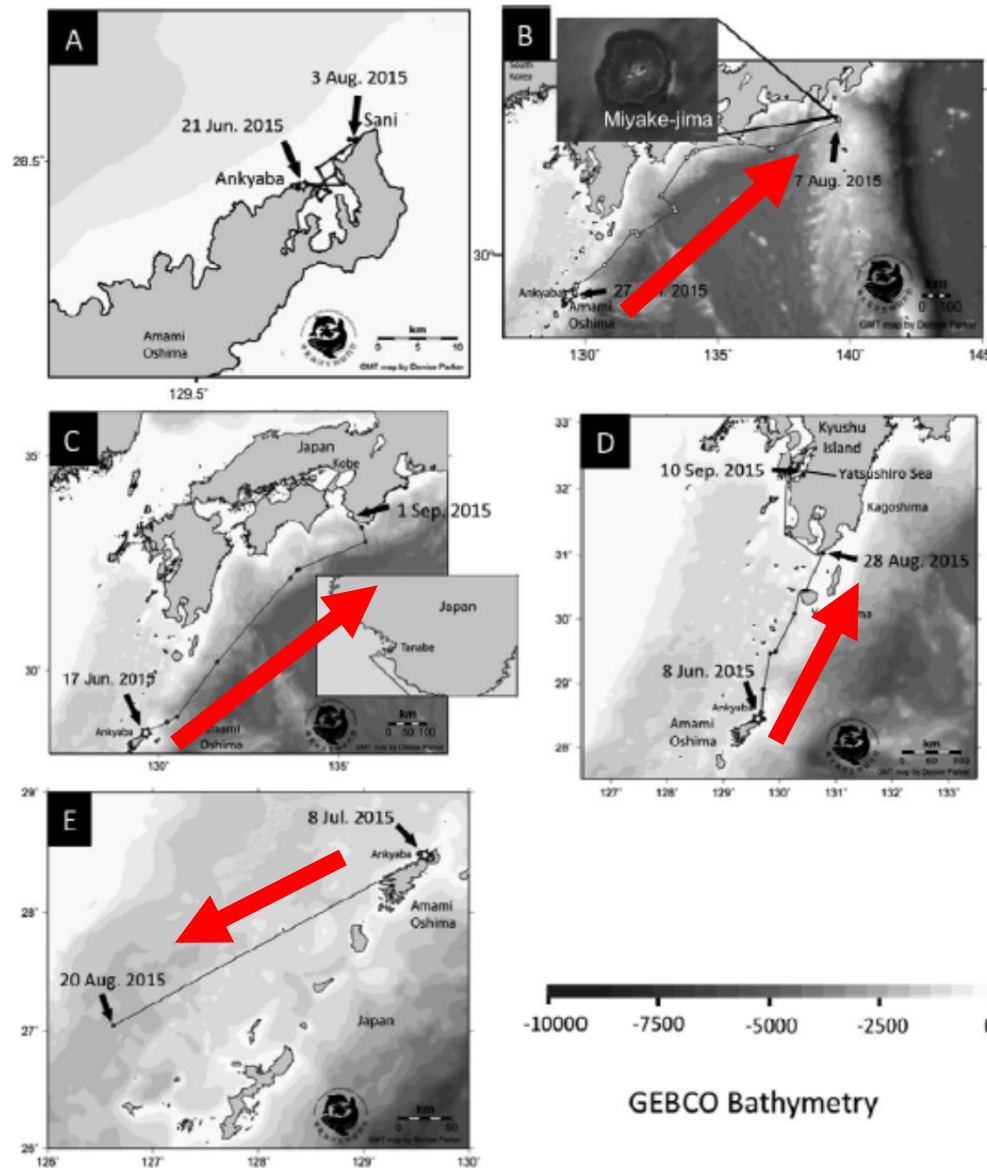
Hatase et al. (2006)

4 green turtles were tracked from Ogasawara rookery



Turtles moved to the coastal area around mainland of Japan

Post-nesting migration



(Oki et al. 2019: Chelonian Conserv Biol)

Oki et al. (2019)

5 green turtles were tracked from Amami-Oshima rookery



3 turtles moved to the coastal area around mainland of Japan

1 turtle moved to the southwest of the island

Future works and challenges

Summary

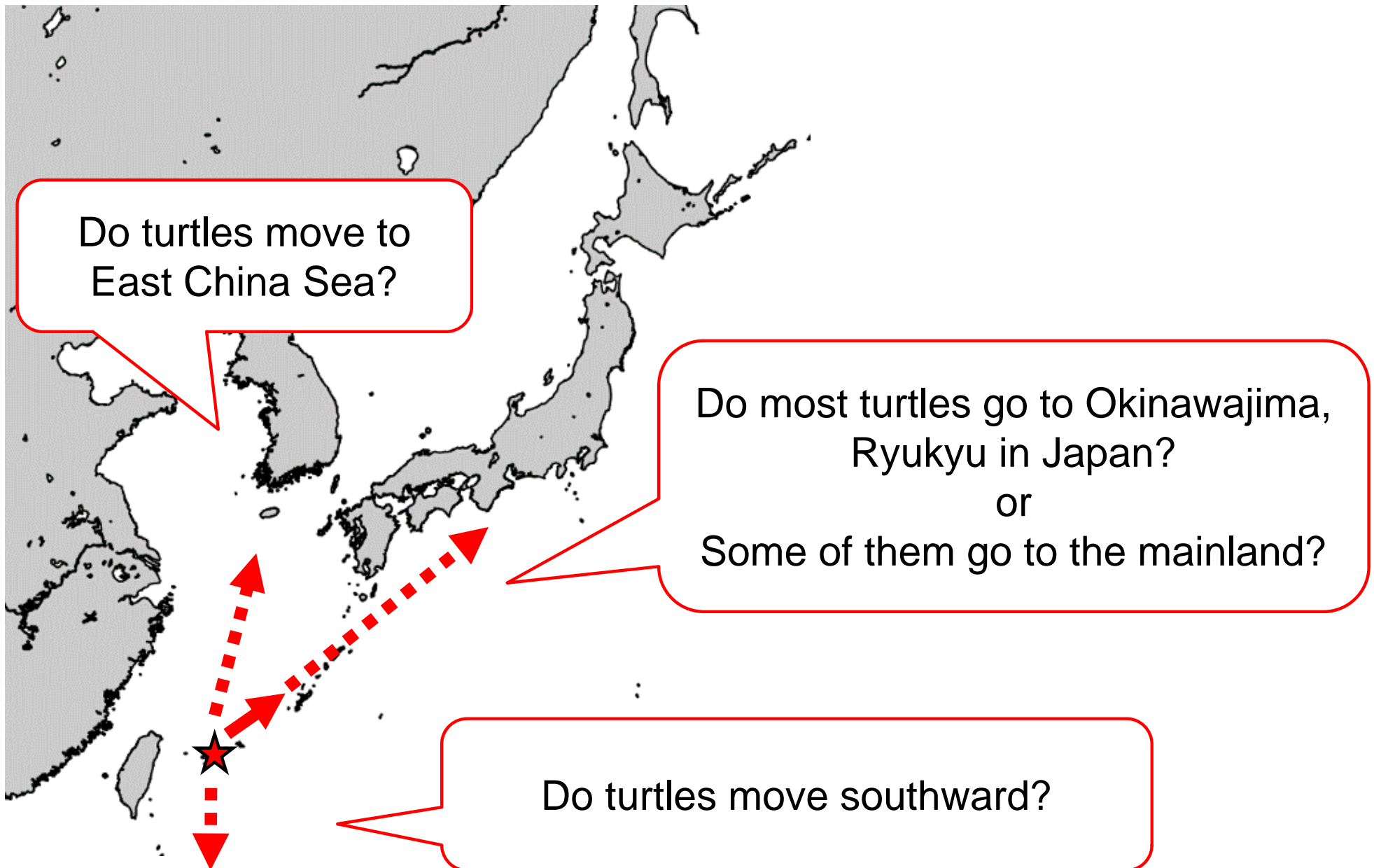
Coastal areas around mainland of Japan are utilized by green turtles originated from Japanese rookeries.

Coastal areas around the southern islands (Ryukyu Islands) of Japan are utilized by green turtles originated not only from Japanese rookeries, but also from tropical Pacific rookeries.

Implications by genetic analysis have generally been confirmed by tagging/telemetry studies.

Only one individual was tracked from Yaeyama rookery; therefore, more tracking studies will be needed.

Potentials for Iridium tracking in Japan



Acknowledgements

Collaborators

**O. Abe, N. Arai, T. Fukuoka, A. Goto, T. Hamabata, R. Hayashi, K. Hirate,
E. Inoguchi, H. Ishii, M. Kinoshita, K. Kobayashi, Y. Naito, T. Narazaki,
K. Narushima, J. Okuyama, K. Sato, H. Suganuma, S. Tanaka, S. Tanizaki**

Assistances in the Fieldwork

**K. Ichikawa, D. Imakita, Y. Kawabata, T. Mogi, Y. Obe, R. Tabata, T. Yasuda,
T. Yokota, H. Watanabe, Members of Ishigaki Island Sea Turtle Research
Group**