

Variation in remigration interval is linked to foraging destination of western Pacific leatherback turtles (*Dermochelys coriacea*)

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Introduction

- Leatherback turtles obtain resources needed for reproduction in distant foraging regions, and they do not reproduce every year. The number of years separating two successive nesting seasons is termed remigration interval.
- Western Pacific leatherback turtles nesting on the northwest coast of Papua, Indonesia between April and September (boreal summer) migrate to the Northeast Pacific (NEP), North Pacific Transition Zone (NPTZ), and South China Sea (SCS; Benson et al. 2011; Fig. 1). These regions differ in habitat quality (Table 1).

Do leatherback turtles that foraged in distinct regions with different habitat quality have different remigration interval?

- Dichotomy in stable nitrogen isotope ($\delta^{15}\text{N}$) values between eastern and western Pacific foragers (Seminoff et al. 2012; Figure 1), and latitudinal and offshore-nearshore gradient in stable carbon isotope values ($\delta^{13}\text{C}$; Rau et al. 1982) can be used to infer foraging regions of nesting turtles.

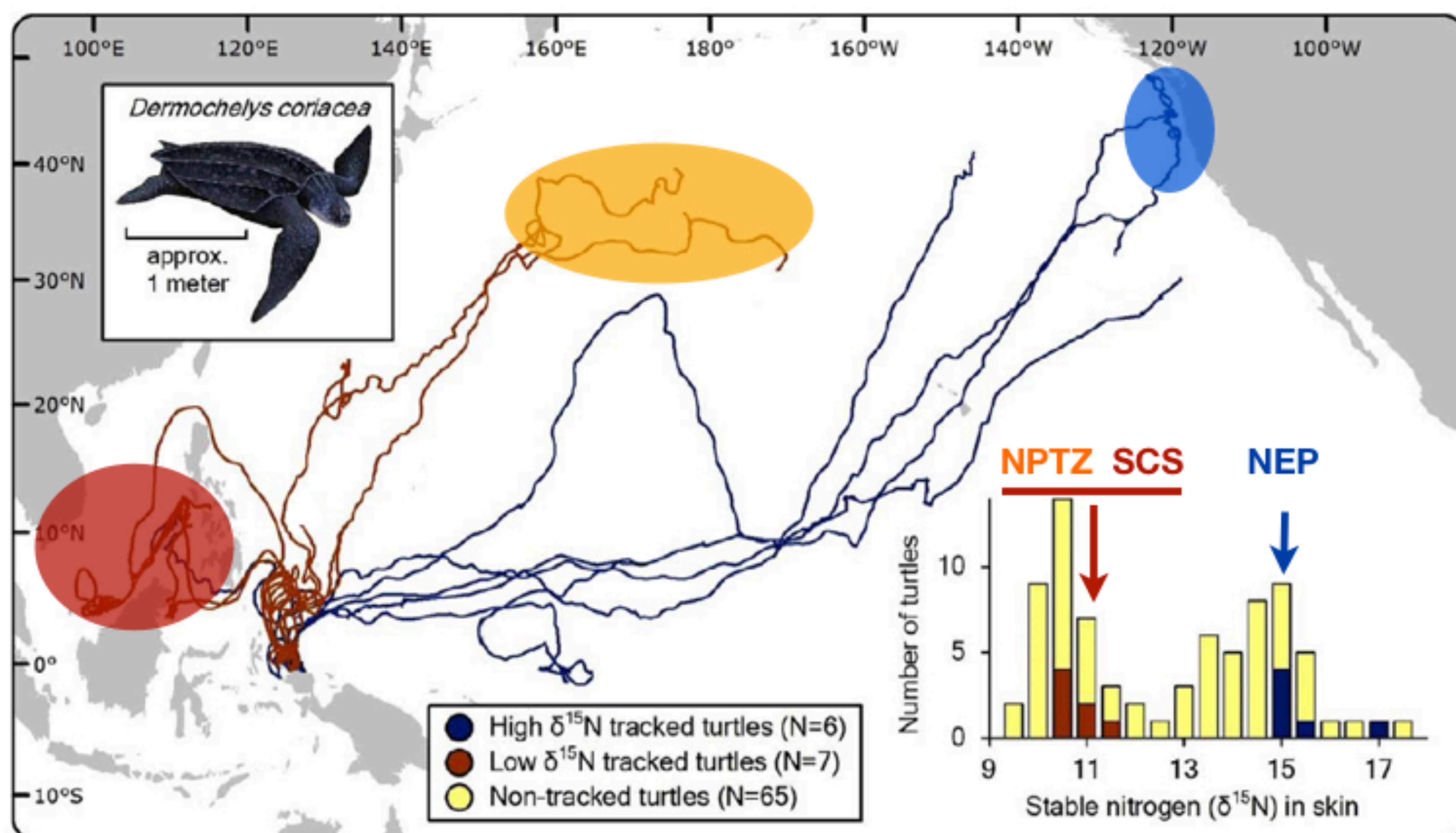


Figure 1. Foraging regions used by leatherback turtles that nest between April and September on the Bird's Head peninsula, Papua Barat, Indonesia.

Table 1. Comparison of environmental characteristics among foraging regions

	SCS	NPTZ	NEP
Latitude	Tropical	Temperate	Temperate
Distance	Closest	Intermediate	Furthest
Primary productivity	Intermediate	Lowest	Highest
Habitat	Neritic	Oceanic	Neritic
Habitat availability	Year-round	Year-round	Summer to early fall
Seasonal variability	Monsoon-driven	North and south movement of TZ	Upwelling, oceanic, and Davidson current
Interannual variability (e.g. El Niño)	El Niño reduces productivity	El Niño increases productivity	El Niño reduces productivity

Methods

- $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values in skin of satellite-tracked females were used in a discriminant function analysis. The resulting discriminant functions were then used to classify turtles sampled in 2010 and 2011.
- Remigration intervals were calculated based on tagging data, and compared among turtles classified to the three foraging regions using Analysis of Variance (ANOVA).

Acknowledgement

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Results

Objective 1: Infer foraging region of nesting turtles from their skin $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$

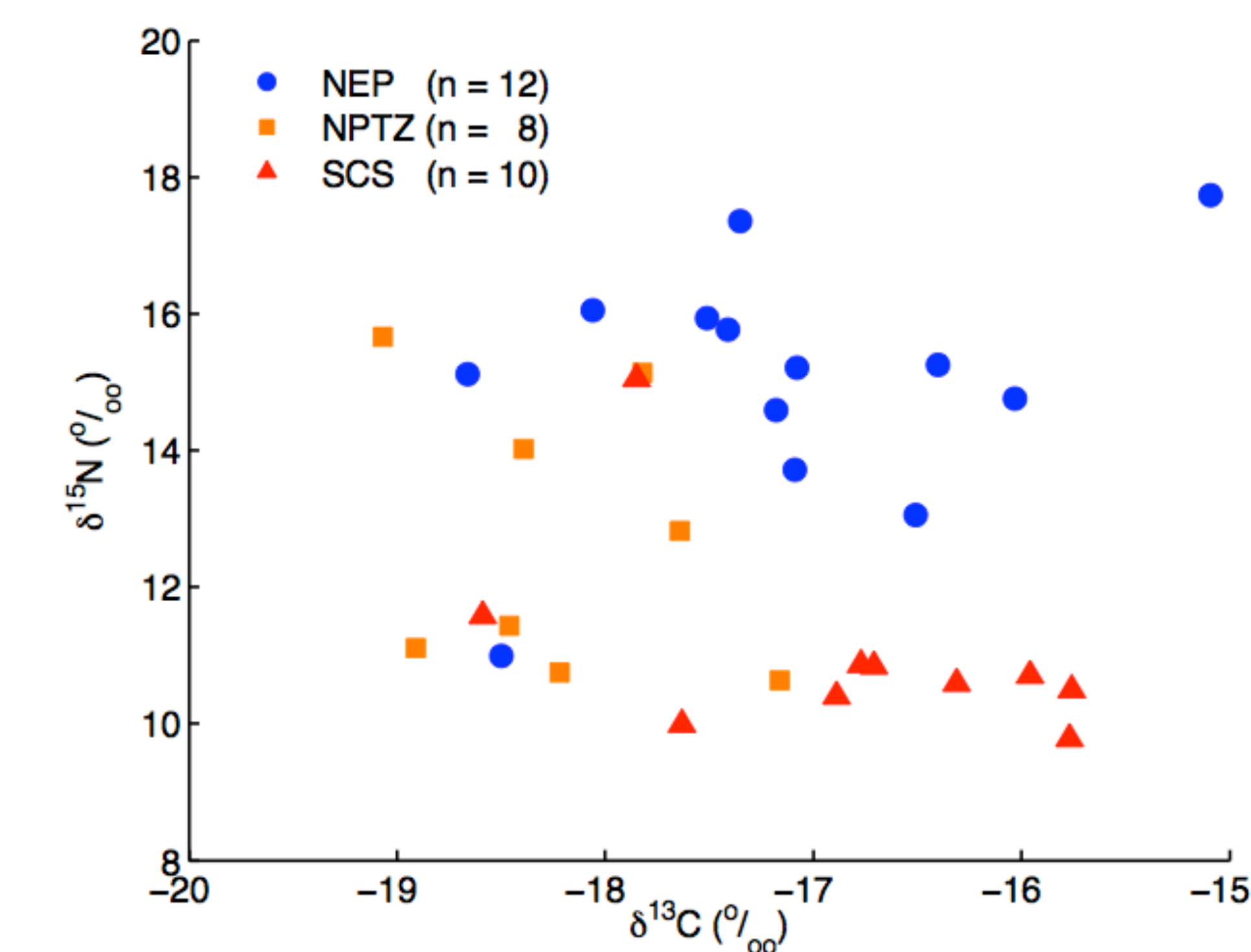


Figure 2. Skin $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ of satellite-tracked turtles

- Satellite-tracked turtles that foraged in distinct regions had distinct skin $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ (Fig. 2).
- Turtles that foraged in the NEP had greater $\delta^{15}\text{N}$, and turtles that foraged in the NPTZ had lesser $\delta^{13}\text{C}$.
- Leave-one-out cross validation indicated the discriminant functions correctly classified 23 of 31 satellite-tracked turtles (74.2%).

Objective 2: Compare remigration interval of turtles classified to distinct foraging regions

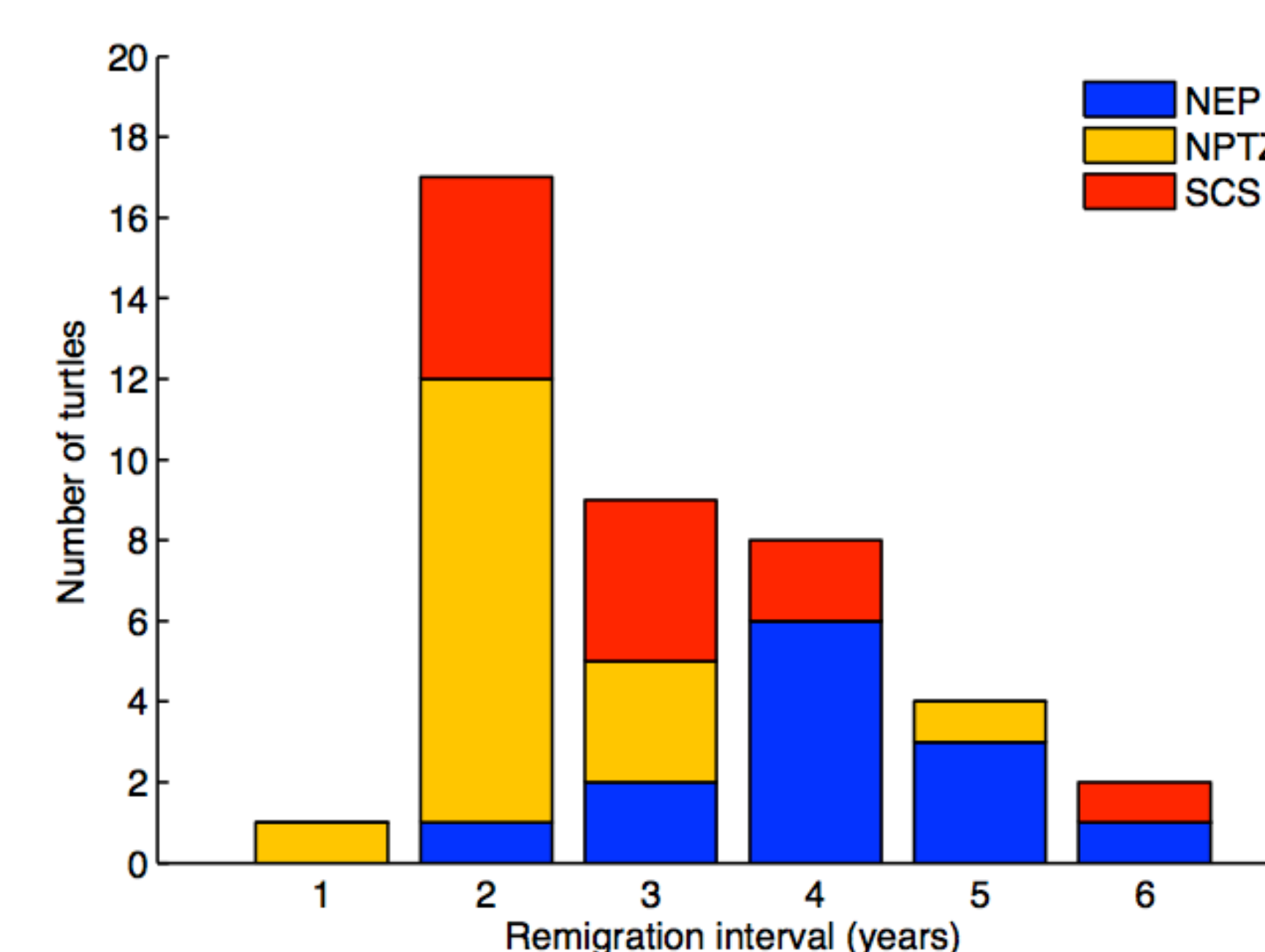


Figure 3. Frequency distribution of remigration interval of turtles assigned to the NEP, NPTZ, and SCS. Only turtles with >70% group membership probability were included.

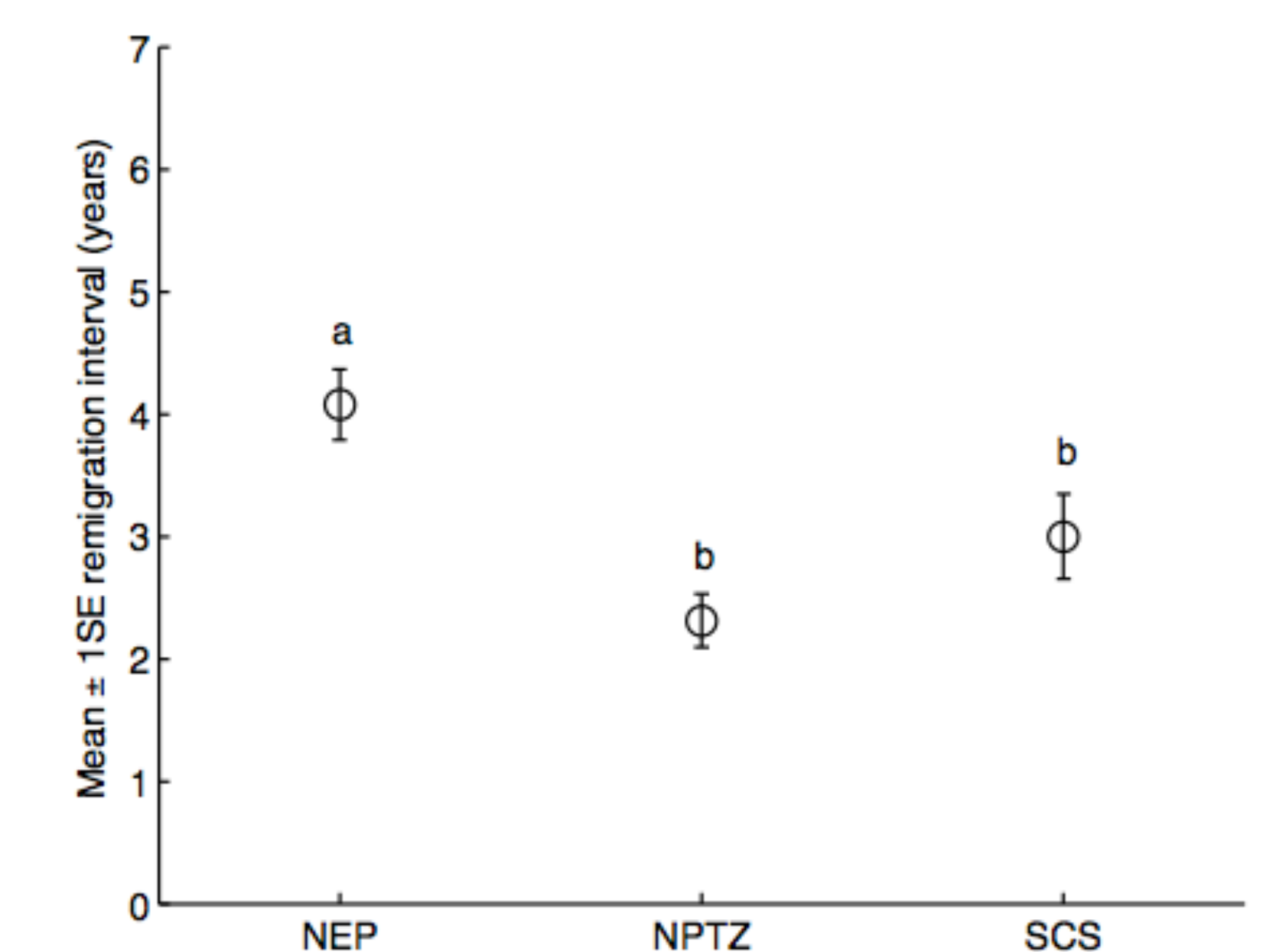


Figure 4. Mean remigration intervals of turtles assigned to the NEP, NPTZ, and SCS. Only turtles with >70% group membership probability were included.

Table 2. Variation in two observed remigration intervals within individuals

Remigration intervals (years)	Frequency	Foraging region
2 - 2	2	NPTZ, SCS
2 - 3	2	SCS
3 - 2	1	NPTZ
3 - 4	2	NEP
6 - 2	1	NPTZ ¹

¹ 50% group membership probability. The six-year remigration interval observed might be due to the turtle being missed by beach patrol during one or two nesting seasons.

Conclusions

- Stable carbon and nitrogen isotope values can be used to infer foraging region of leatherback turtles nesting during boreal summer in Papua, Indonesia. Variation in skin $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ reflects differences in isotopic values of primary producers, which is influenced by biogeochemical processes. N_2 fixation in SCS and NPTZ lowers $\delta^{15}\text{N}$, and denitrification in the NEP results in greater $\delta^{15}\text{N}$. Variation in $\delta^{13}\text{C}$ reflects the difference in growth rates of primary producers. Nutrient-rich neritic waters of SCS and NEP supports greater phytoplankton growth rates than oceanic NPTZ.
- Turtles that foraged in the NEP had longer remigration intervals (Fig. 3,4)
- Six of eight individuals with more than one observed remigration intervals exhibited variation (Table 2).
- Turtles that foraged in the NEP had longer remigration interval, which could be a consequence of foraging in the furthest and highly variable region. Great interannual variability in nesting numbers may be observed due to variable remigration intervals within a population (Hays 2000).