ASSESSING THE CONSERVATION STATUS OF SEA TURTLES IN THE PACIFIC

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Risk Extinction Assessment

things to keep in mind….

- Not as easy as it might initially appear (at least to do it realistically)
- The Pacific is a vast open ocean, with small landmasses
- Multiple turtle species, widely distributed, and poorly studied (with some exceptions!)
- Some species are ocean wanderers (e.g. leatherbacks), others are more sedentary (e.g. hawksbills)

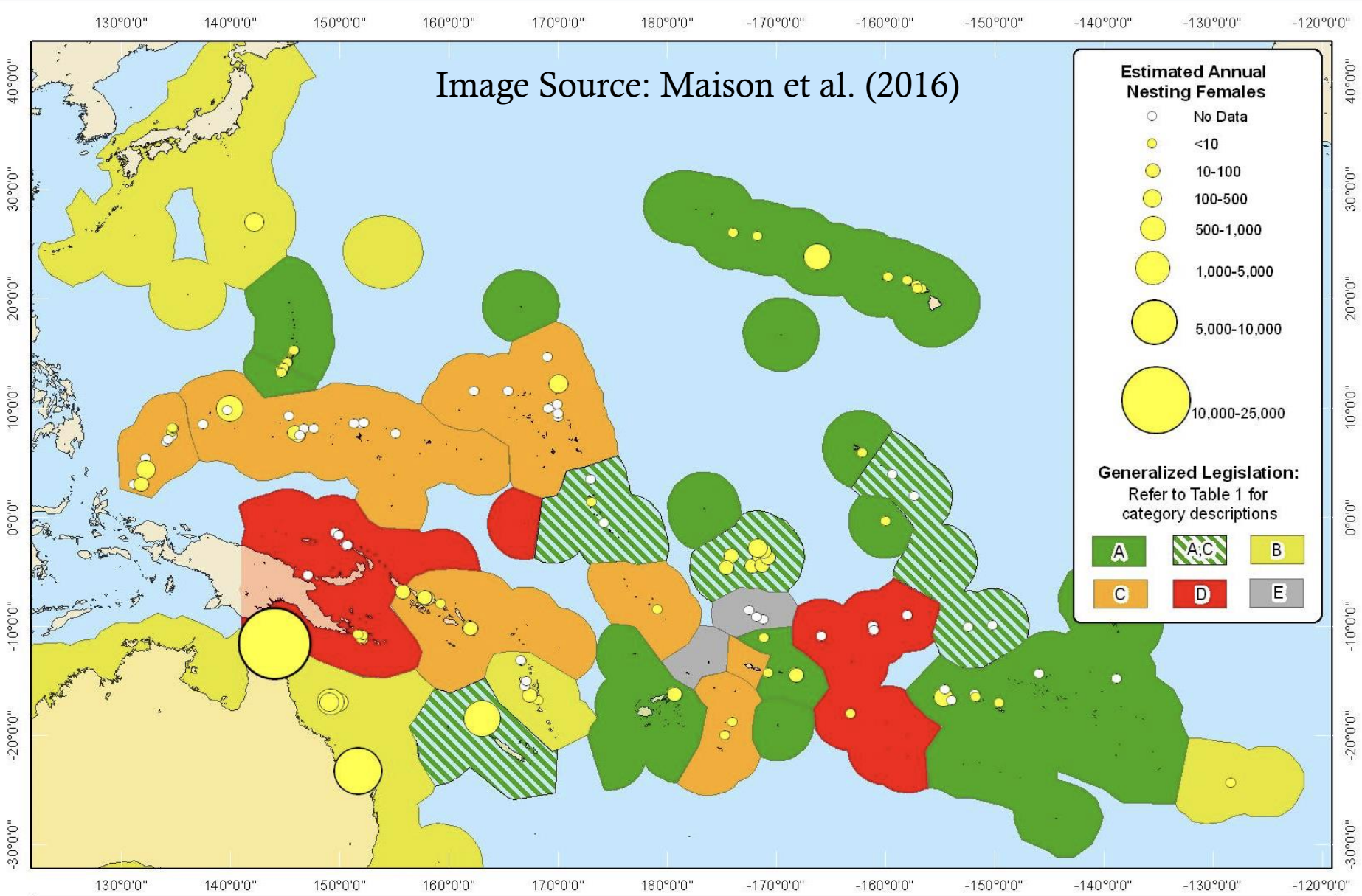


Figure 1

Green Turtle Nesting and Legislation in Oceania

This map shows nesting sites for green turtles throughout Oceania and the estimated minumum annual nesting females at each site along with the varied categories of legislation associated with each country where nesting takes place.

Geographic Coordinate System: WGS84

N

0 500 1,000 2,000 3,000 4,000 Kilometers

Map by: Kim Maison, NOAA Fisheries Pacific Islands Regional Office, August 2010

Risk Extinction Assessment

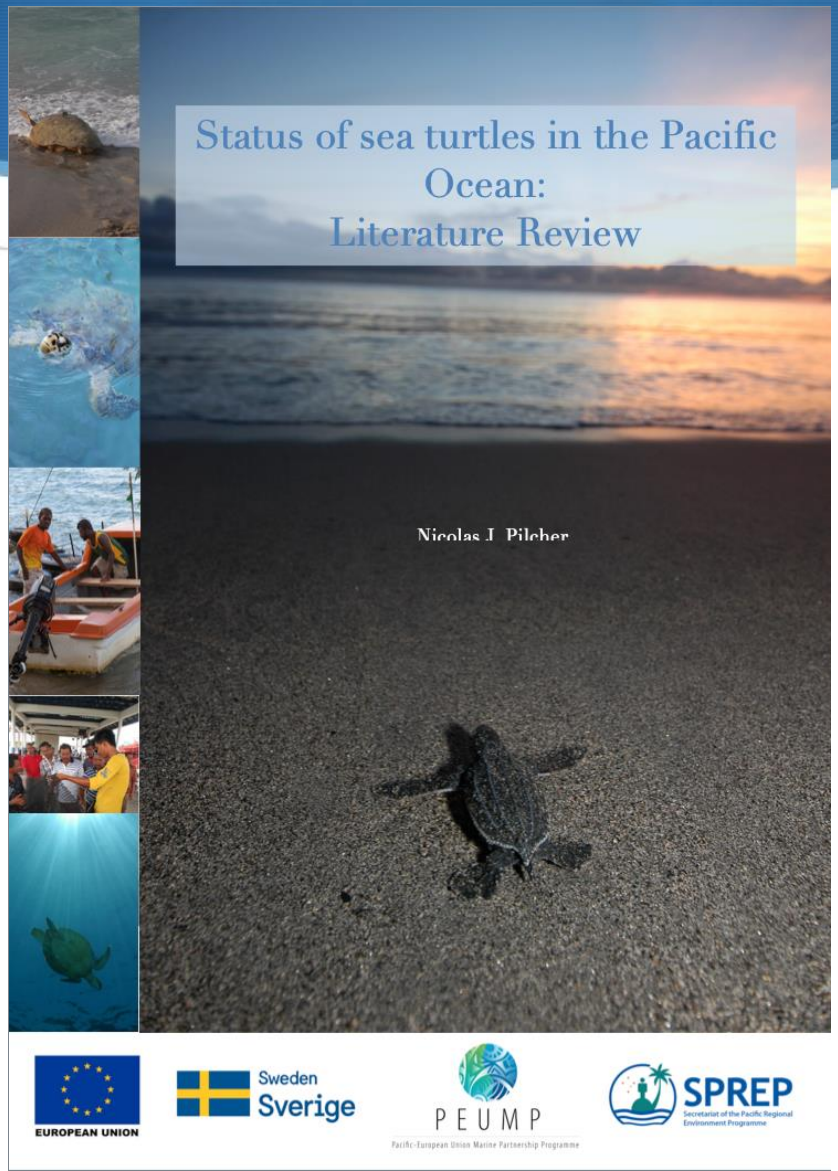
things to keep in mind….(continued)

- Some threats are poorly understood (e.g. light pollution)
- Some threats are unquantified (e.g. legal and illegal take)
- Some threats are partially quantified (e.g. bycatch)
- Few long-term data sets that provide information on turtle population trends

Key Conservation Questions

- How many animals are there and what is the trend?
- Where are they?
- What are the threats?

What do we know?...



What do we know?…
One, six species, many RMUs

- **Green**: Eastern Pacific, North Central Pacific, Northwest Pacific, South Central Pacific, West Pacific- East Indian Ocean
- **Hawksbill**: North Central Pacific, South Central Pacific, West Pacific, West Central Pacific, East Pacific, Southwest Pacific
- **Loggerhead**: North Pacific, South Pacific
- **Leatherback**: East Pacific, West Pacific
- **Flatback:** Southwest Pacific
- **Olive Ridley:** West Pacific, East Pacific, East Pacific (arribadas)

What do we know?...
Current IUCN Assessments

- **Leatherback:** Critically endangered (West Pacific); Critically endangered (East Pacific); Vulnerable (global)
- **Hawksbill:** Critically endangered (global)
- **Loggerhead:** Vulnerable (global)
- **Green:** Endangered (global); Least Concern (North Central Pacific)
- **Olive Ridley:** Vulnerable (global)
- **Flatback:** Data deficient (IUCN criteria)

IUCN Criteria

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3].*

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

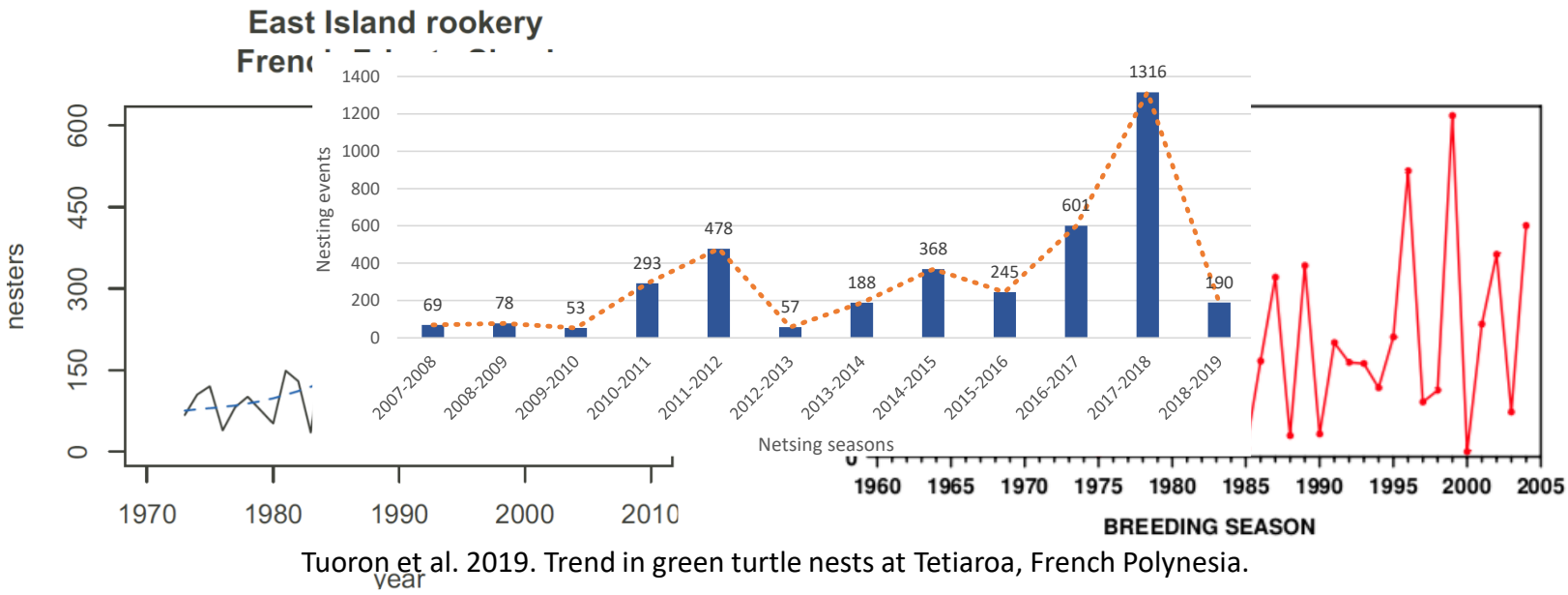
	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

IUCN Criteria



Tuoron et al. 2019. Trend in green turtle nests at Tetiaroa, French Polynesia.

Pilcher et al. 2011. IUCN Hawaii green turtle Red List

Limpus 2007. Green turtles on Heron Island.

IUCN Criteria

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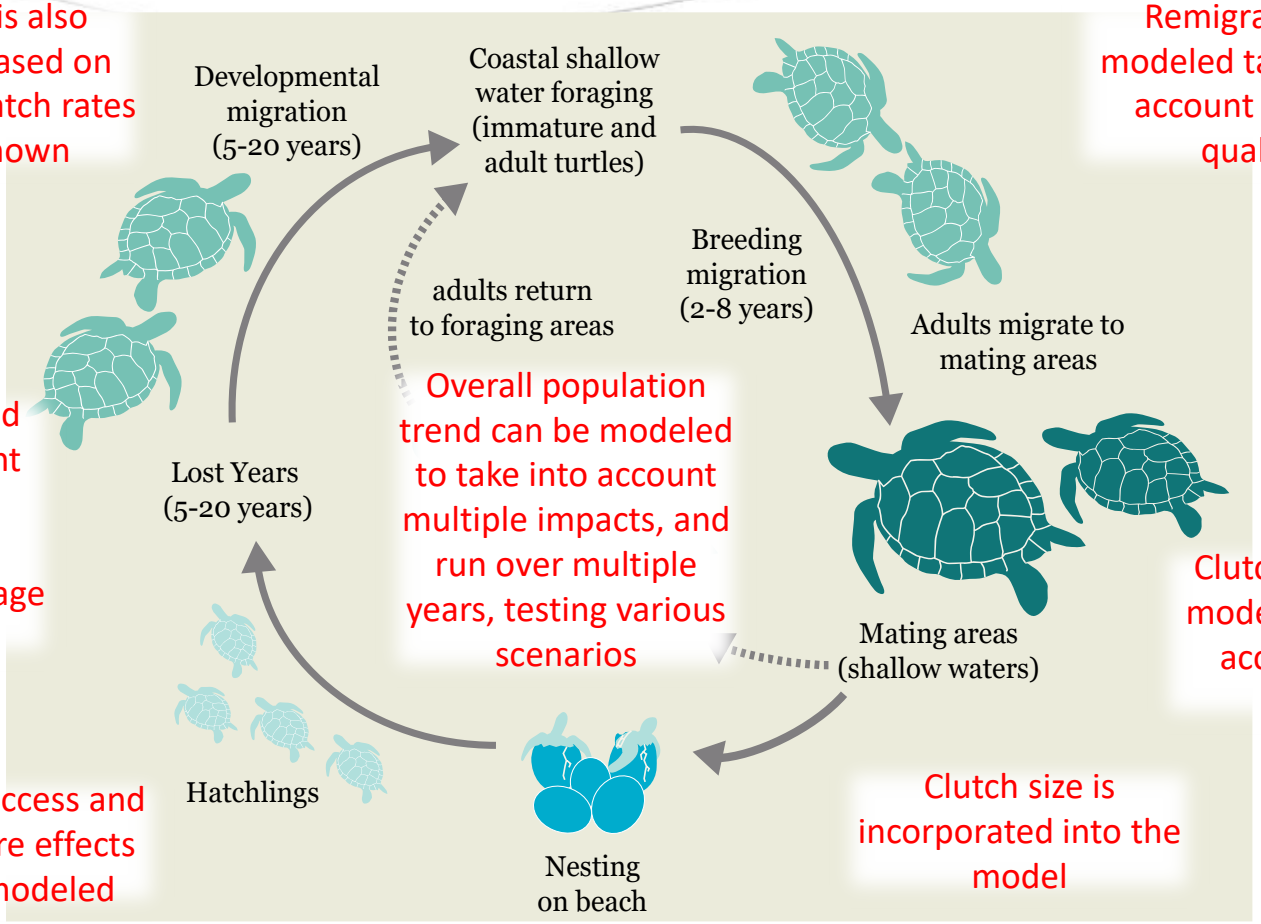
vTurtles

- vTurtles is a model designed and built specifically for this project by Prof. Marc Girondot a the University of Paris-Saclay
- It is an amalgamation of models that assess individual sea turtle life stages
- It has the ability to model mortality due to take, bycatch, skewed temperatures (climate change issues) and habitat quality (which affects foraging efficiency, and therefore growth)

vTurtles

Mortality is also modeled, based on take and bycatch rates where known

Remigration is modeled taking into account habitat quality



Growth is modeled taking into account habitat quality, hatchling size, minimum and average adult sizes

Overall population trend can be modeled to take into account multiple impacts, and run over multiple years, testing various scenarios

Clutch frequency is modeled taking into account habitat quality

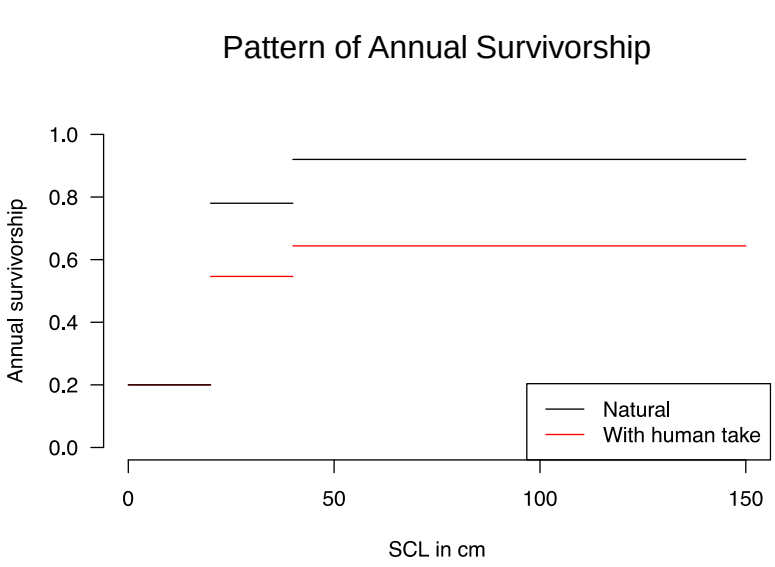
Hatching success and temperature effects are also modeled

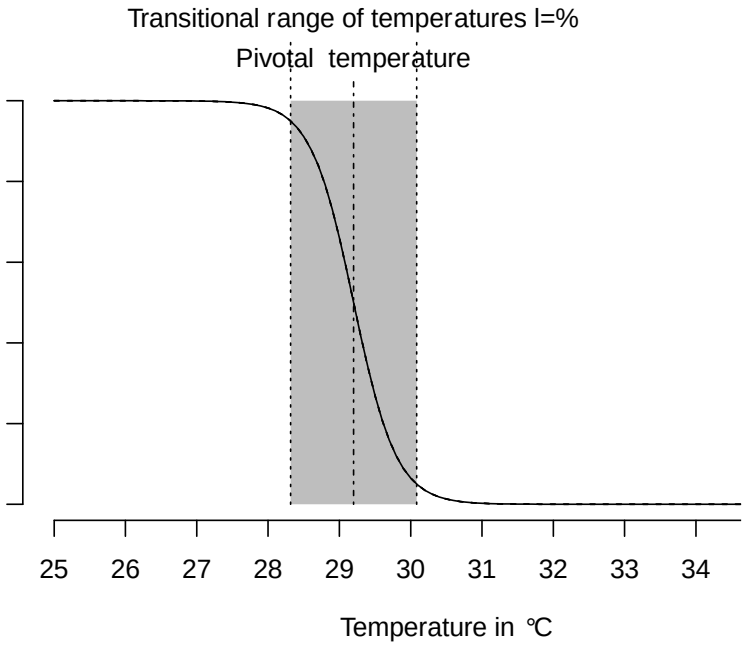
Clutch size is incorporated into the model

vTurtles – Pacific hawksbills

- Initial.population.size <- 1550
- number.of.years <- 20
- number.of.years.stabilization <- 300
- average.hatchling.size.in.cm <- 3.9
- average.adult.size.in.cm <- 74.55
- minimal.adult.size.in.cm <- 53.3
- TSD.parameters <- c(P = 29.2, S = -0.3)
- CTE <- c(mean=29.5, sd=2)
- hatching.success <- 0.6905
- eggs.per.clutch <- c(mean=129.044, sd=49.75),
- eggs.per.clutch.min <- 40,
- clutch.per.season <- c(0.0, 0.1, 0.3, 0.3, 0.1)
- survival <- data.frame (SCL=c(0, 20, 40), s=c(0.2, 0.78, 0.92))
- HumanTake <- data.frame (SCL=c(0, 20, 40), r=c(0.0, 0.3, 0.3))
- habitat.mean <- 0.6
- habitat.sd.interseason <- 0.2
- habitat.sd.intraseason <- 0.05

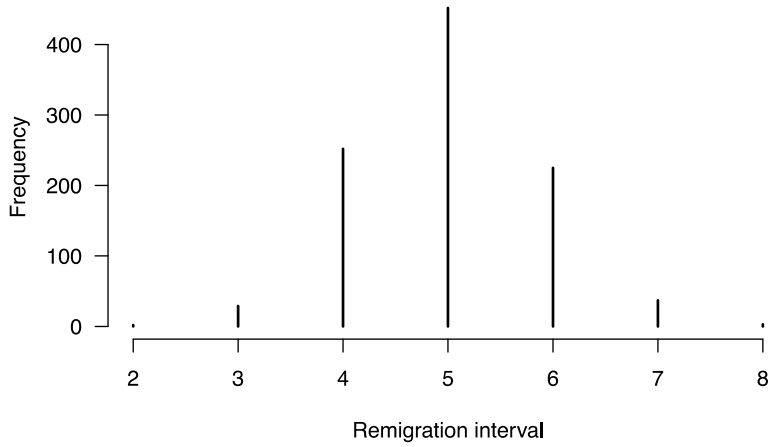
vTurtles – Pacific hawksbills



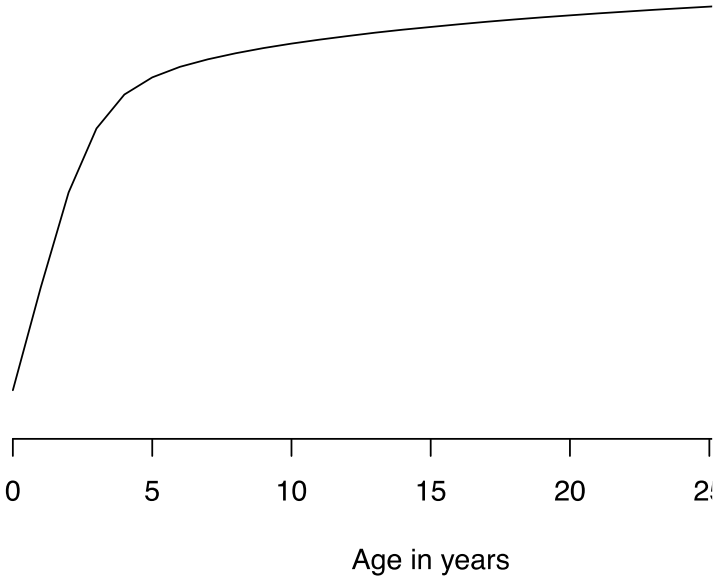


vTurtles – Pacific hawksbills

Pattern of Remigration Intervals (renesting frequency)

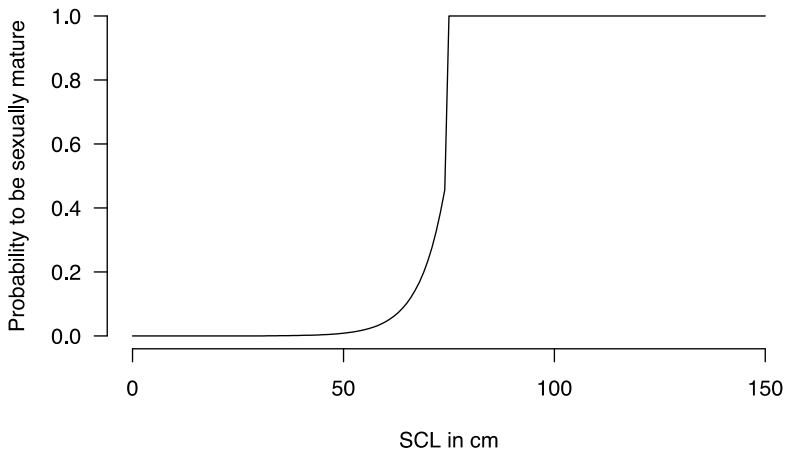


Pattern of growth in cm / yr

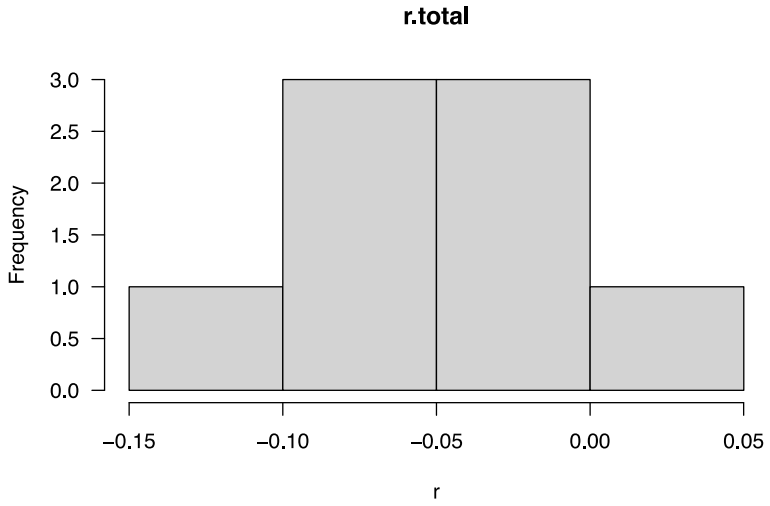


vTurtles – Pacific hawksbills

Probability of becoming sexually mature based on CCL

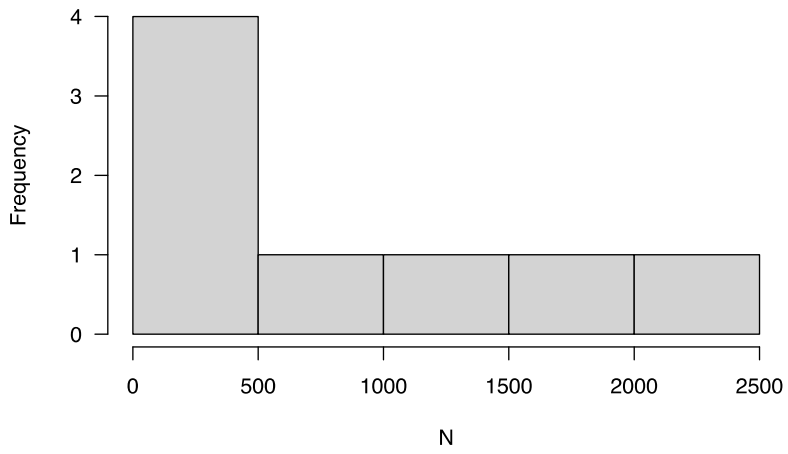


Instantaneous growth rate (r)

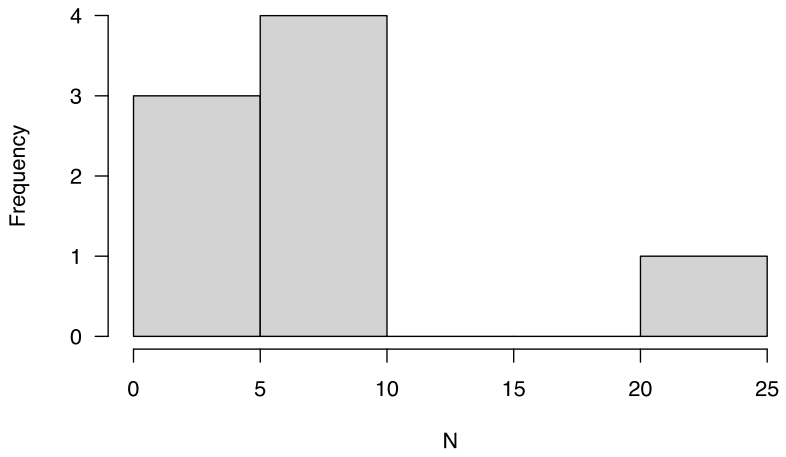


vTurtles – Pacific hawksbills

Number of individuals at the end of simulation

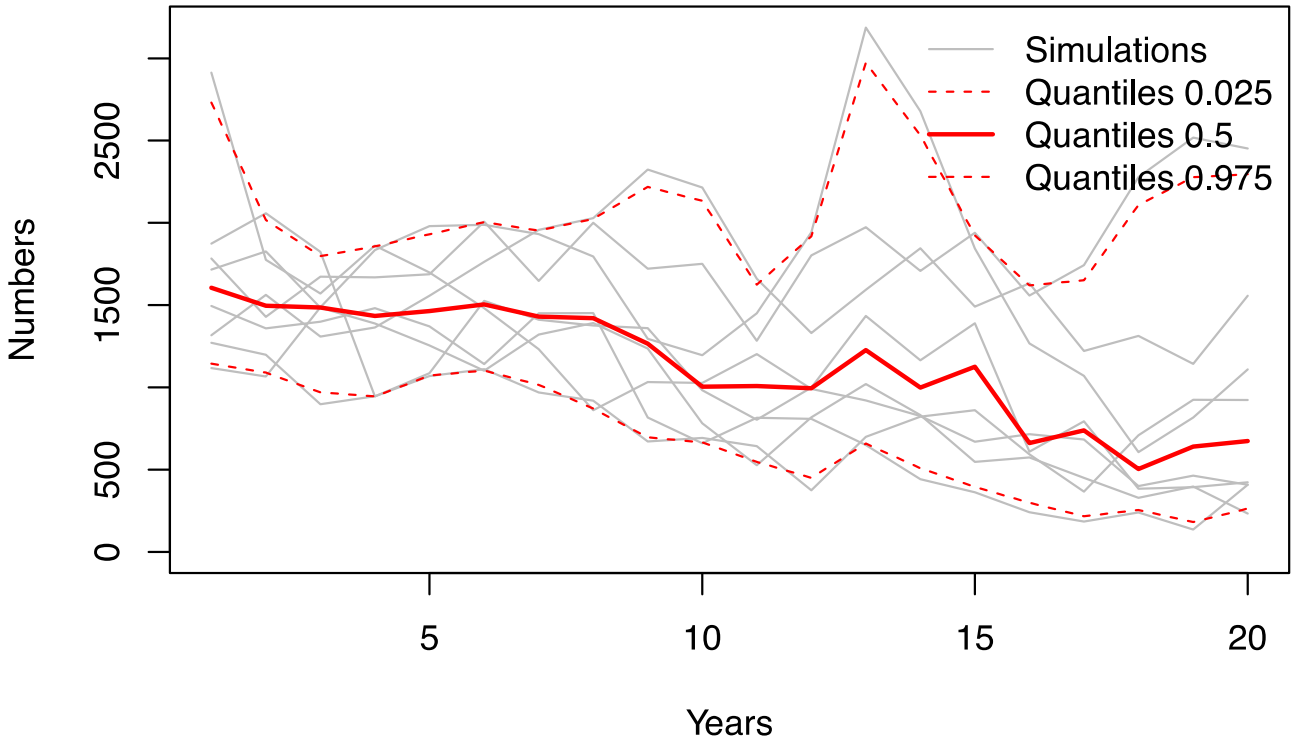


Number of nesting females at the end of simulation



vTurtles – Pacific hawksbills

Modeled total numbers of males and females in all age classes



vTurtles – Next steps

- Testing and refining
- Peer – review to understand model and to establish realistic scenarios to be tested (e.g. rates of take by age class, temperature change effects, etc.)
- Running model for all scenarios
- Final reporting to SPREP
- Publication of model in peer-reviewed literature