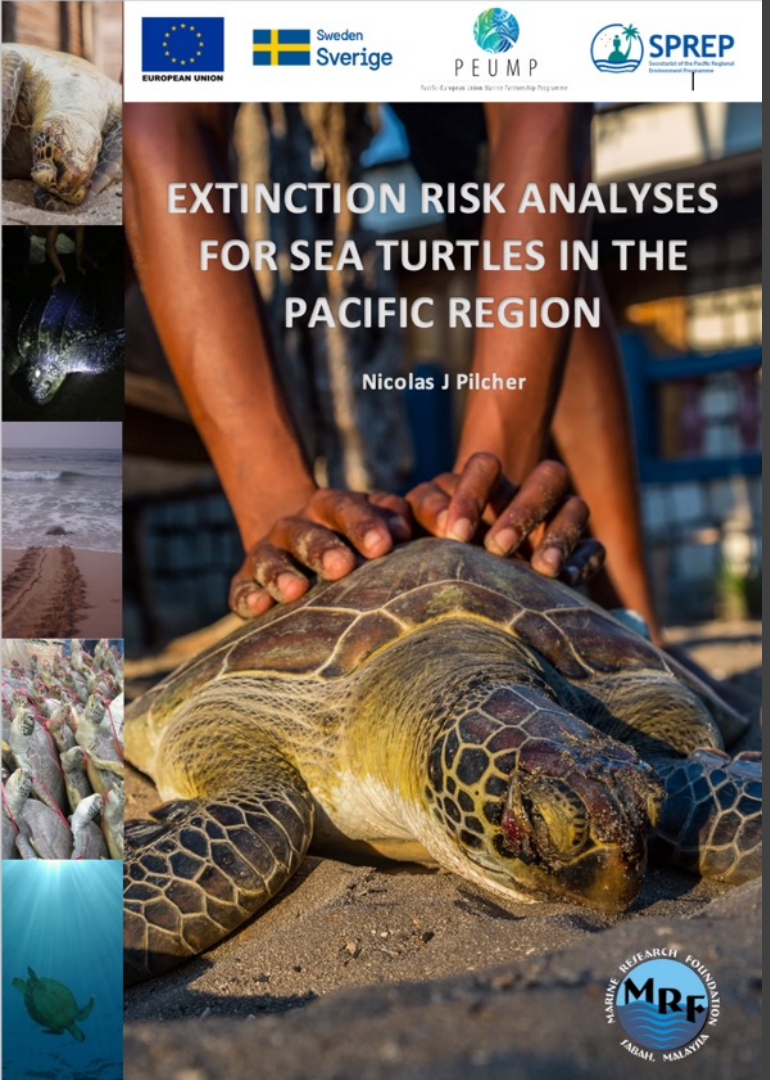


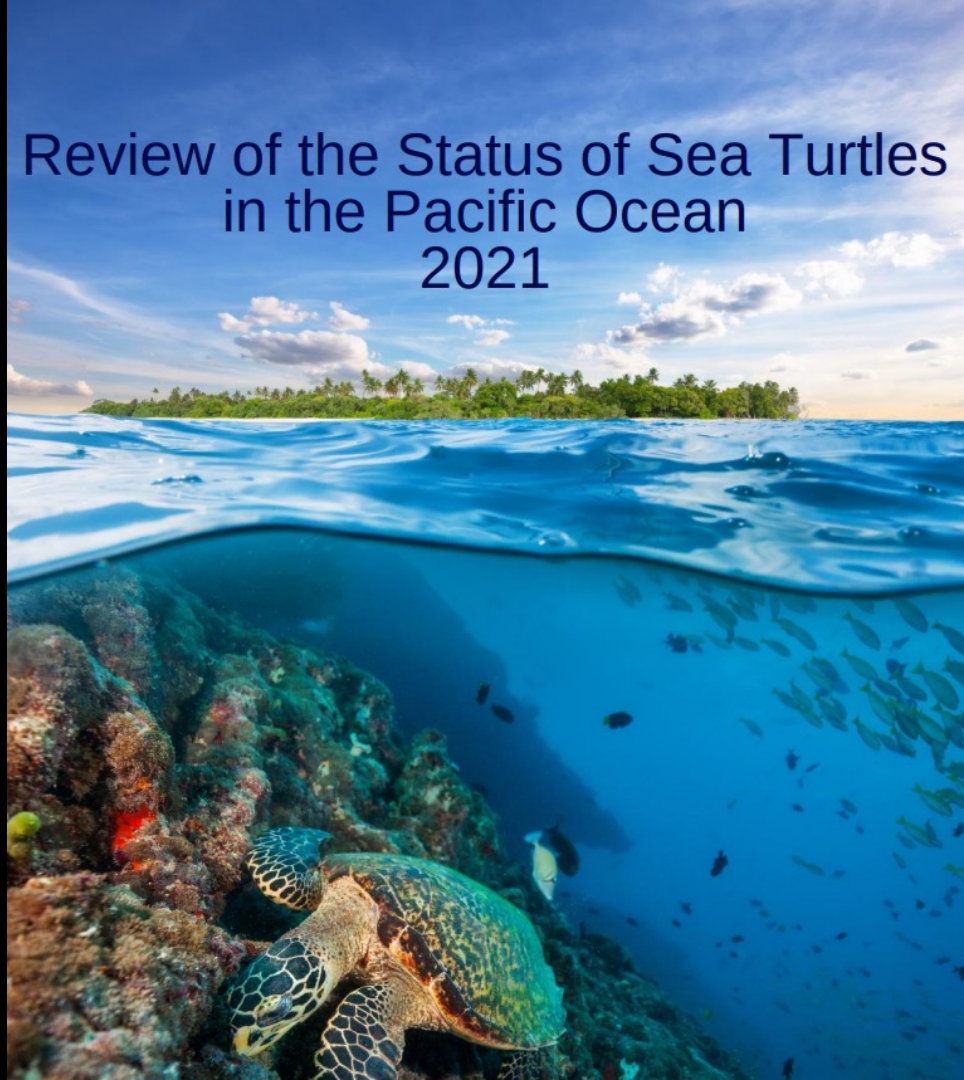
Extinction Risk Analysis for sea turtles in the Pacific Ocean

Dr Nicolas Pilcher

Marine Research Foundation

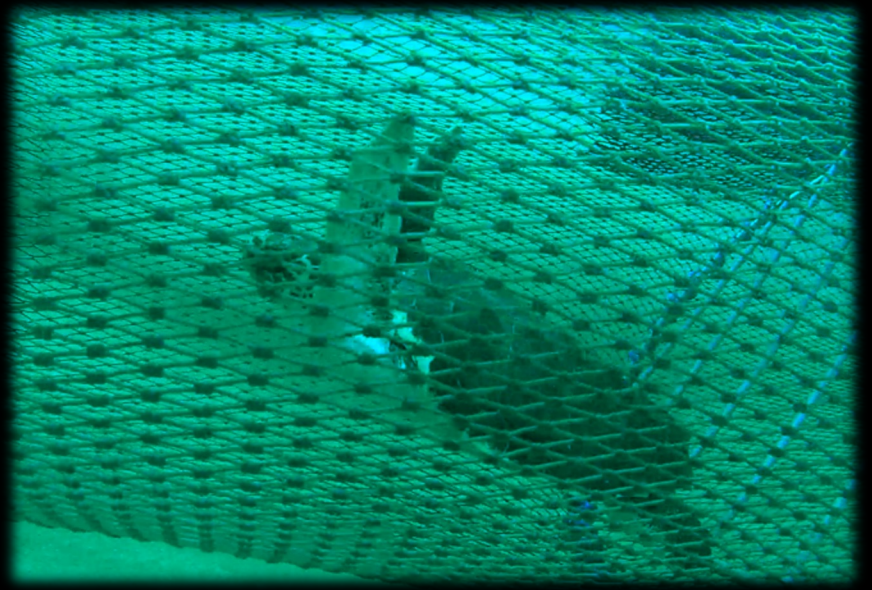
Personal involvement

- Wrote the Status Review for SPREP in 2021
- Conducted IUCN Assessments for green turtles in the NC Pacific (Hawai'i) and in the NWC Pacific (Ogasawara, CNMI, Palau)
- Directed the Papua New Guinea leatherback project 2005-2015
- Ongoing provision of advice to SPREP on sea turtle conservation plans
- Development of regional marine turtle management plans (e.g. Sulu-Sulawesi, ATSEA)



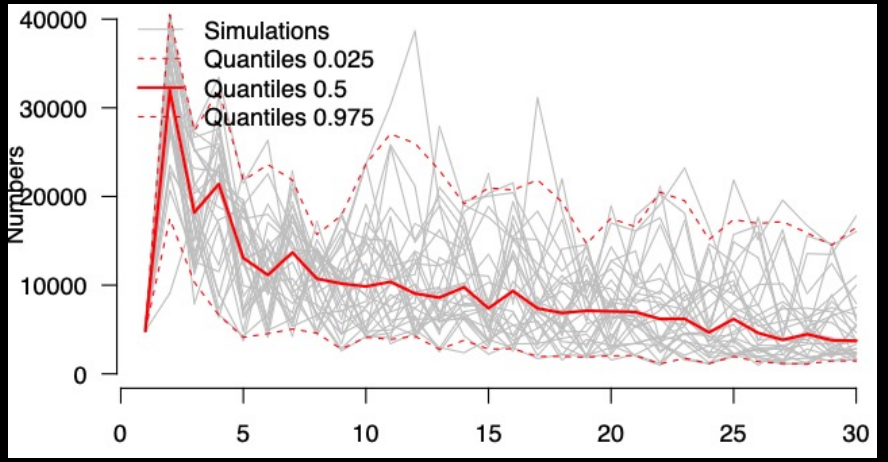
Introduction & Background

- Sea turtles in the Pacific region are important and have multiple values to local communities
- But sea turtle populations have declined significantly due to over-harvesting, bycatch in fisheries, retention when accidentally caught, and a number of other, lesser threats.



Introduction & Background

- An objective of the SPREP PEUMP BIEM project was to assess the risk of extinction of sea turtles in the region, from which National policies could be developed to improve the conservation outlook of the species.
- This risk assessment process was supported by a model called vTurtle, which simulated turtle life histories alongside possible harvest and bycatch scenarios



An example of the vTurtle model output

The IUCN Red List

- Is an extremely powerful tool
- But relies on substantial data sets, such as long-term data series of numbers of nesting turtles, and knowledge of biological traits
- Also relies on a good understanding of distribution and threats
- Many criteria are hard to meet for sea turtles in the Pacific region

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			

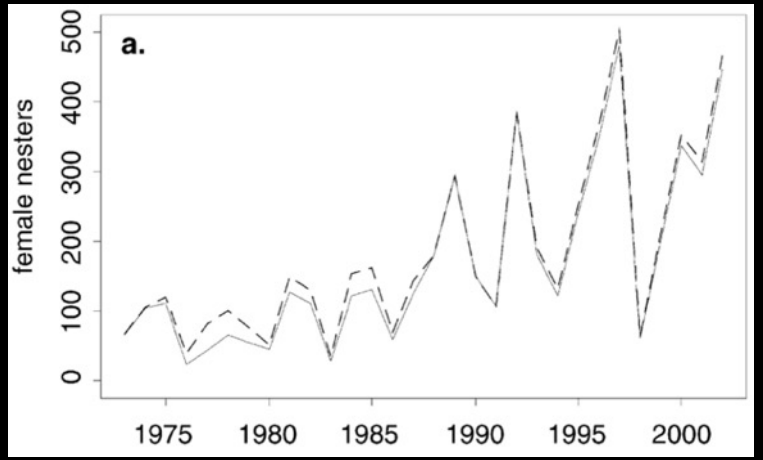
IUCN Status

Leatherback (*Dermochelys coriacea*):	Vulnerable (global) Critically endangered (West Pacific subpopulation) Critically endangered (East Pacific subpopulation)
Hawksbill (*Eretmochelys imbricata*):	Critically endangered (global)
Loggerhead *Caretta caretta*):	Vulnerable (global)
Green (*Chelonia mydas*):	Least Concern (global) Least Concern (North Central Pacific subpopulation)
Olive Ridley (*Lepidochelys olivacea*):	Vulnerable (global)
Flatback (*Natator depressus*):	Data deficient (this does not mean that there is no data available, but merely that the data have not yet been compiled and assessed using IUCN criteria

Challenges in developing Risk Assessments

Extinction risk is difficult to quantify in sea turtles.

- It takes many years to detect trends
- They are spread far and wide across the Pacific ocean making them hard to count
- Biological traits that are needed to develop extinction risk predictions are unknown for many parts of the Pacific (e.g. clutch frequency)
- In some places numbers of turtles is growing while in others the numbers are going down



When critical data points are missing, and long-term data sets are unavailable, mathematical models can predict what could be happening with a population

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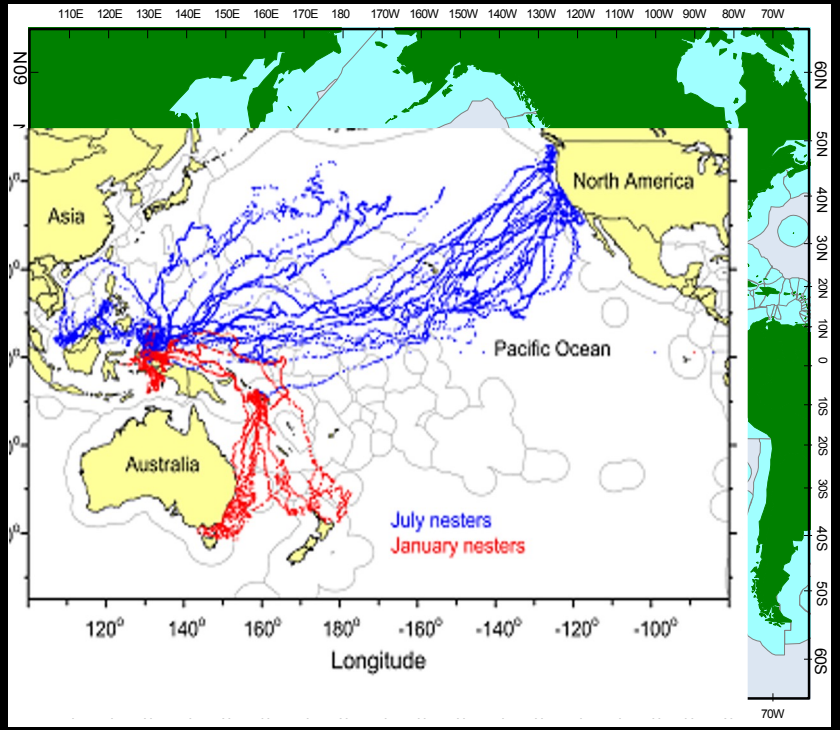
When critical data points are missing, and long-term data sets are unavailable, mathematical models can predict what could be happening with a population

There are still many unknowns…

- While we have a rough idea of how many turtles might be taken in a fishery, we do not know what proportion of these they represent of the *entire* turtle stock.
- Not all fishery interactions result in tutle mortality
- In most cases, fishery bycatch numbers are not representative of the overall impact due to low observer and reporting coverage
- But fishery impacts are are major concern to sea turtles in the Pacific

Turtles are widely distributed

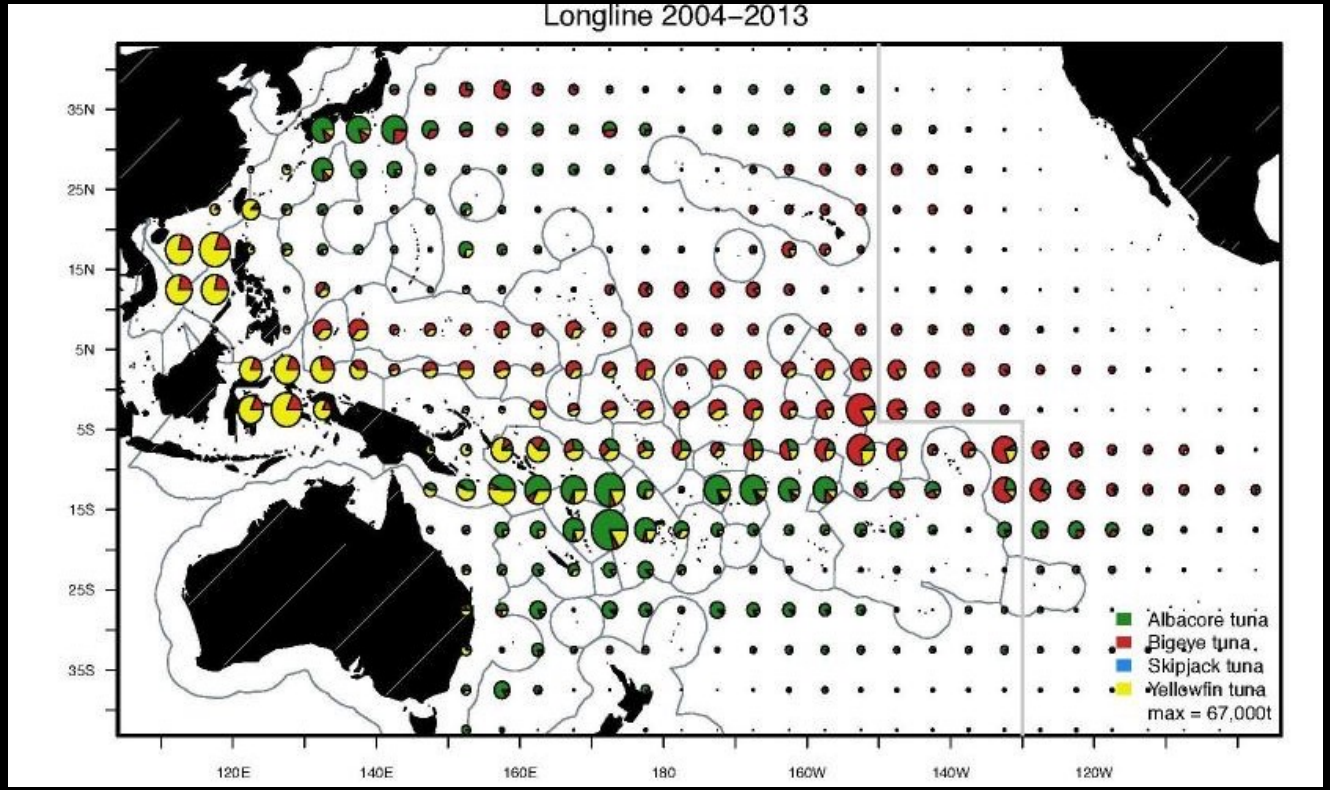


Benson et al. 2011

Hampton 2010

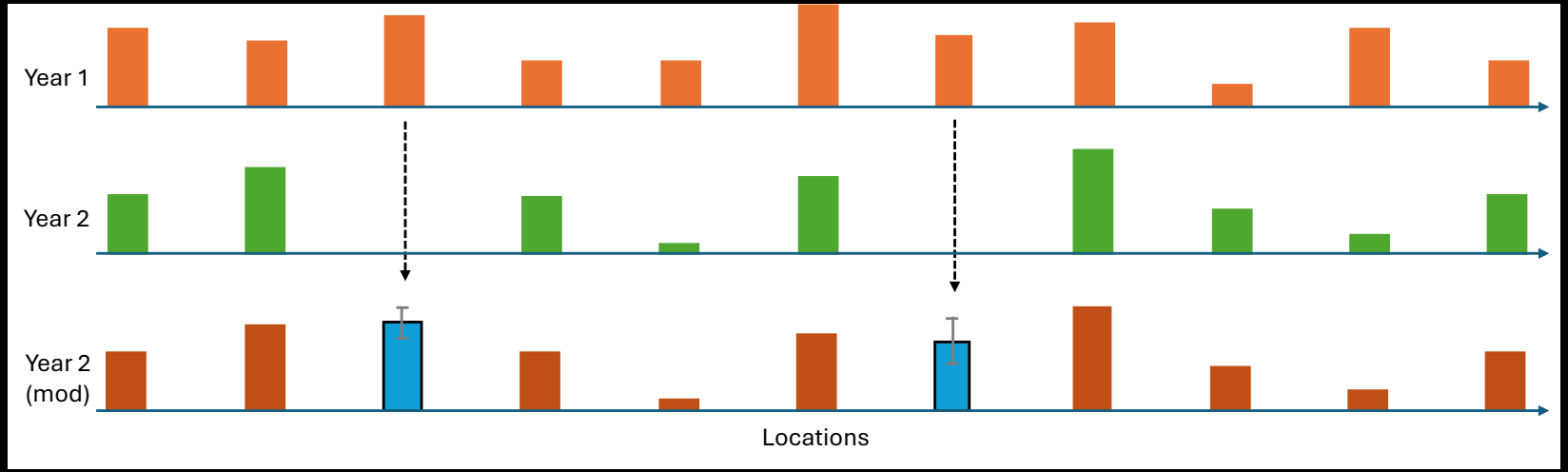
- Distribution is uneven
- Distribution varies by species
- Some species are more oceanic voyagers than others (e.g. loggerheads, leatherbacks)
- That also means bycatch also impacts different species in different places

Fisheries effort is also widely distributed



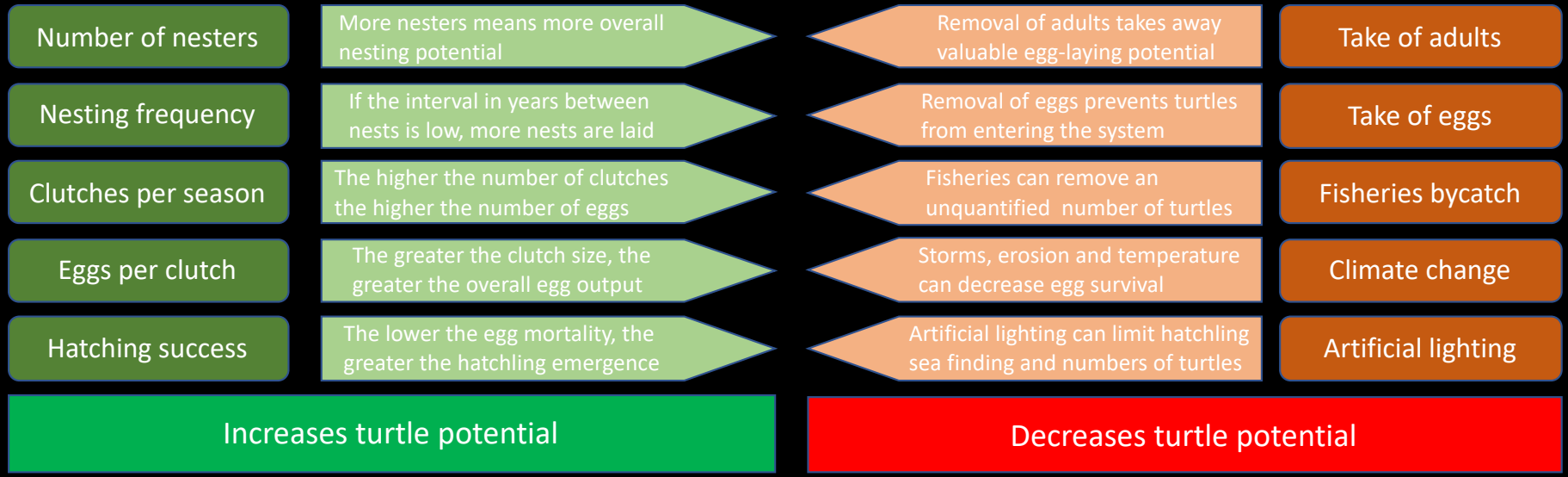
Harley et al. 2015

How a model can help



An example of how modelling can fill gaps in knowledge in sea turtle populations

The *imaginary balance scale* investigated by vTurtle to determine extinction risk for sea turtles in the Pacific region

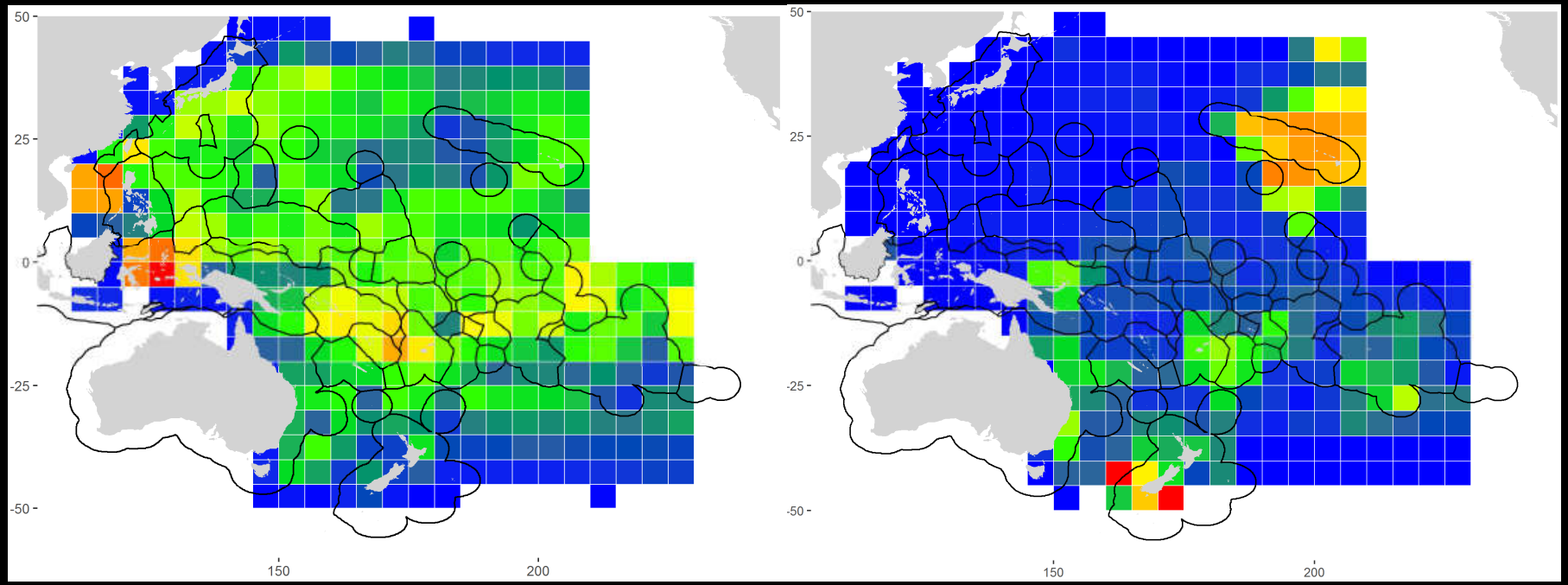


What goes into a model?

Biological traits	
Terrestrial	Data sources
Annual number of nesting female turtles	Reports, publications, data sets, models
Trend in number of nesting females	Reports, publications, data sets, models
Turtle dispersal range (tracking)	Reports, publications, models
Turtle dispersal range (genetics)	Reports, publications, models
Turtle dispersal range (isotopes, microchemistry)	Reports, publications, models
Remigration interval (distribution of number of years between effective nesting season)	Reports, publications, data sets, by proxy, models
Clutch frequency (distribution of number of clutches within a season)	Reports, publications, data sets, by proxy, models
Nesting success (ratio between clutches and tracks)	Reports, publications, data sets, by proxy, models
Hatching (probability that an egg ends incubation) & emergence success (probability that an egg produces a juveniles reaching the surface of the beach)	Reports, publications, data sets, by proxy, models
Natural sex ratio (inter-annual and intra-annual distribution of sex in embryos)	Reports, publications, data sets, by proxy, models
Natural hatchling survival probability	Publications, by proxy
Marine	Data sources
Natural adult survival probability	Publications, by proxy
Natural subadult survival probability	Publications, by proxy
Natural juvenile survival probability	Publications, by proxy

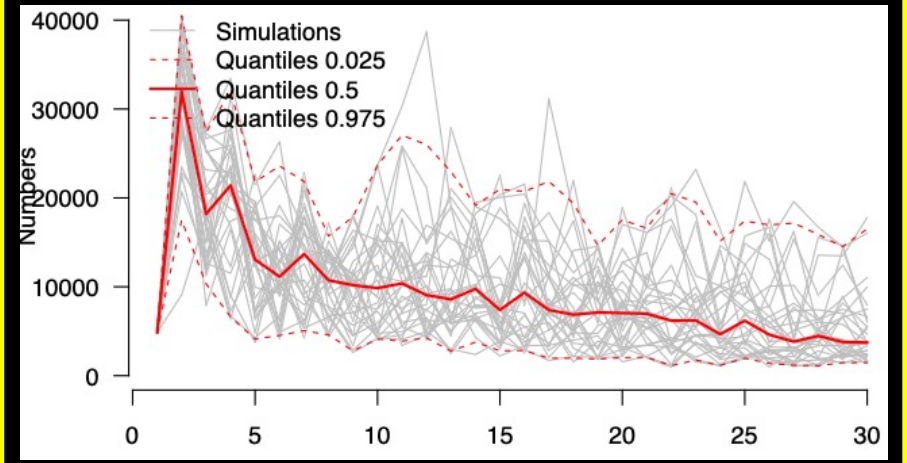
Threats	
Terrestrial	Data sources
Hatchling predation (on beaches)	Reports, publications, by proxy
Direct take of adult turtles (on beaches)	Reports, publications, current project
Direct take of eggs	Reports, publications, current project
Nesting habitat loss (complete loss of habitat due to erosion)	Reports, publications
Nesting habitat loss (sub-lethal condition for development)	Reports, publications
Nesting habitat alteration (temperature)	Reports, publications, current project, by proxy
Pollution (obstacles for adults)	Reports, publications, current project, by proxy
Pollution (obstacles for juveniles)	Reports, publications, current project, by proxy
Chemical pollution (alteration of development)	Reports, publications, current project, by proxy
Thermal pollution by objects on the beach	Reports, publications, current project, by proxy
Marine	Data sources
Commercial fisheries bycatch (juveniles)	Reports, publications, current project, SPC
Commercial fisheries bycatch (sub-adults)	Reports, publications, current project, SPC
Commercial fisheries bycatch (adults)	Reports, publications, current project, SPC
Artisanal fisheries bycatch (juveniles)	Reports, publications, current project
Artisanal fisheries bycatch (sub-adults)	Reports, publications, current project
Artisanal fisheries bycatch (adults)	Reports, publications, current project
Climate change (rising water temperatures)	Reports, publications, global data sets
Habitat alteration / loss (foraging grounds)	Reports, publications
Plastics / solid waste ingestion / entanglement	Reports, publications, local data

But there are challenges…

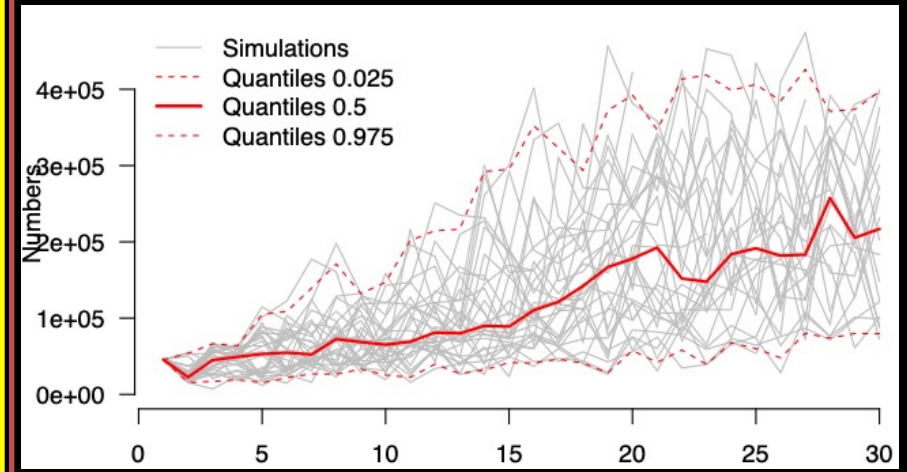


Hotspot graphics of reported effort (left) and observer coverage (right; as a proportion of hooks) for longline fleets in the WCPFC-CA from 2003 to 2017. Image adapted from: Peatman et al. 2018b

Findings: Leatherback sea turtles



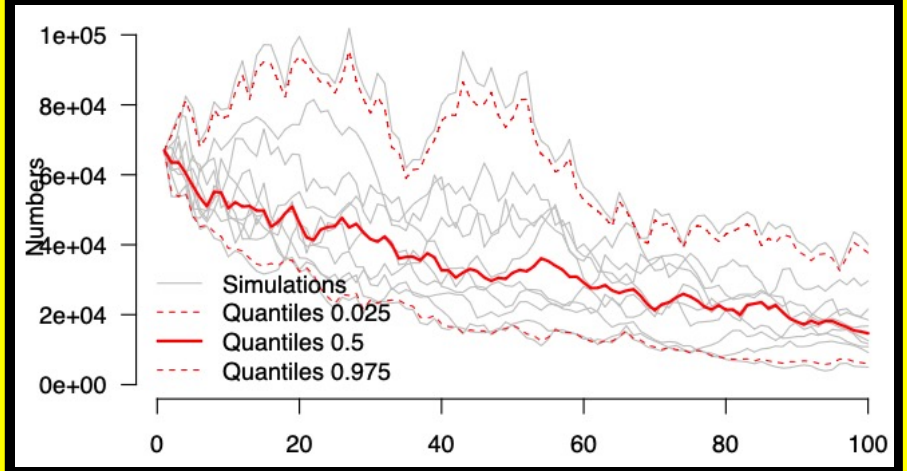
Survivorship: 0.200 0.800 0.835
Take: 0.001% 0.001% 0.001%
Bycatch: 0% 0.01% 0.01%



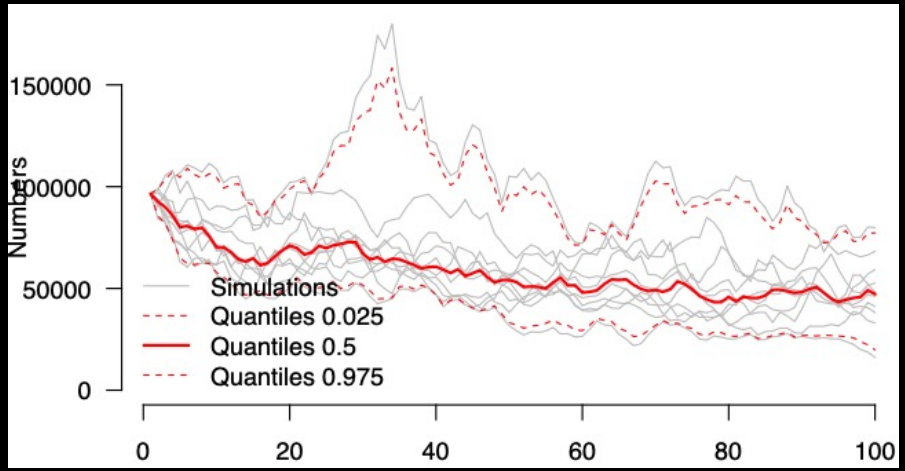
Survivorship: 0.300 0.800 0.847
Take: 0.001% 0.001% 0.001%
Bycatch: 0.001% 0.001% 0.001%

Population outlook is not good given the take and loss of eggs to predators on nesting beaches, and continued bycatch of adults (left). Population only stablises when beach conservation projects and bycatch reduction are implemented (right).

Findings: Loggerhead sea turtles



Survivorship: 0.20 0.80 0.846
Take: 0.000% 0.0005% 0.0001%
Bycatch: 0% 0.01% 0.01%



Survivorship: 0.30 0.80 0.846
Take: 0.00% 0.00% 0.00%
Bycatch: 0.00% 0.05% 0.01%

Population outlook requires substantial decrease in mortality of various life stages. At present levels of bycatch seem to be significantly impacting the population.Population would also benefit from programmes that result in higher survival of young life stages.

Management Options

The following key actions are recommended at national and regional levels to improve the conservation outlook for sea turtles in the Pacific region:

1. Addressing mortality of eggs and hatchings on nesting beaches
2. Addressing incidental capture of all age classes in commercial and artisanal fisheries
3. Addressing the loss of nesting females on nesting beaches
4. Addressing local consumption of sea turtles and their products
5. Improved data collection – fisheries and communities

EUROPEAN UNION
Sweden Sverige
PEUMP
SPREP

	Regional	National	Management required
Green turtle ***Chelonia mydas***	Least concern	Australia: Least concern Other countries and territories: Endangered	Manage turtle use / harvest Reduce bycatch
Hawksbill turtle ***Eretmochelys imbricata***	Critically Endangered	All countries and territories: Critically Endangered	Reduce turtle use / harvest Reduce egg consumption / loss Reduce bycatch
Leatherback turtle ***Dermochelys coriacea***	Critically Endangered	All countries and territories: Critically Endangered	Reduce turtle use / harvest Reduce egg consumption / loss Reduce bycatch
Loggerhead turtle ***Caretta caretta***	Endangered	All countries and territories: Endangered	Reduce egg consumption Reduce bycatch
Olive Ridley turtle ***Lepidochelys olivacea***	Critically Endangered	Australia: Critically Endangered	Reduce egg consumption Reduce bycatch

Thank you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