



Joana Hancock RASTOMA Annual General Meeting 2020



Each nest contains about 100

Hatchlings emerge at night and make their way to the ocean.

Sea Turtle Life Cycle

Adults return to breed near the beaches where they hatched.

Females nest approximately every two years, laying 3-6 nests per season. the acean currents.

Hatchlings swim away

from land and drift with



Juvenile turtles move near shore, to seagrass beds and

coral reefs.

SEA TURTLES AT SEA

LIFE HISTORY PATTERNS



COASTAL

OCEAN

Bolten, 2003

SEA TURTLES AT SEA

LIFE HISTORY PATTERNS



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GREEN SEA TURTLE

Chelonia mydas







- Seagrass
- Macroalgae





Caretta caretta



- Jellyfish
- Crabs + lobsters
- Large shells









HAWKSBILL SEA TURTLE

Eretmochelys imbricata







- Sponges
- Coral
- Small invertebrates





COASTAL FEEDING AREAS

Coral and rocky reefs

Species: Chelonia mydas, Eretmochelys imbricata



COASTAL FEEDING AREAS

Seagrass areas

Species: Chelonia mydas, Eretmochelys imbricata, Caretta caretta



COASTAL FEEDING AREAS

Mangroves and Estuaries

Species: Eretmochelys imbricata, Caretta caretta

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SEA TURTLES AT SEA

LIFE HISTORY PATTERNS



Bolten, 2003

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OLIVE RIDLEY SEA TURTLE





Clakshmi Sawitir_cc2

- Jellyfish
- Crabs
- Lobsters
- Fish



LEATHERBACK SEA TURTLE

Dermochelys coriacea







- Jellyfish
- Salps





UPWELLING ZONES



OTHER HIGH PRODUCTIVITY AREAS



Different movement patterns between these two ocean basins indicate higher foraging success for individuals in the Atlantic, which may be linked to their higher reproductive output and healthier conservation status.

(Bailey et al. 2012 https://doi.org/10.1371/journal.pone.0036401)

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IN-WATER RESEARCH – WHY?

POPULATION STUDIES

- Species presence
- · Recruitment of juveniles, sub-adults or adults to the population in the feeding area
- · Reproductive status of the individuals of the different species
- Growth Rates
- Feeding ecology
- · Behaviour migratory, internesting, foraging
- · ...



Photo by ICAPO

Photos by Joana Hancock

IN-WATER RESEARCH – WHY?

HABITAT STUDIES

HABITAT USE

- Identify migratory routes/corridors
- Identify turtle hotspots:
 - feeding areas?
 - Mating?
 - Transitory sites?
- MPA, EEZs

HABITAT QUALITY

- Characterise the foraging habitat Available resources Quality Area Abiotic factors
- Site fidelity
- Home range

SCALE POPULATION/SPECIES BUDGET

THREATS

- Identification
- Mitigation

SEA TURTLES AT SEA



IN-WATER RESEARCH – WHY? RESEARCH PRIORITIES - ECOLOGY

- What are the population boundaries and connections that exist among rookeries and foraging grounds?
- What parameters influence the biogeography of sea turtles in the oceanic realm?
- Where are key foraging habitats?
- What are the past and present roles of sea turtles in the ecosystem?



(Witt et al. 2010 https://doi.org/10.1098/rspb.2010.2467)



IN-WATER RESEARCH – WHY?

RESEARCH PRIORITIES - THREATS

- What are the major sources of fisheries bycatch and how can these be mitigated in ways that are ecologically, economically ...?
- How can we evaluate the effects of anthropogenic factors on sea turtle habitats?
- What are the impacts of pollution on sea turtles and their habitats?
- What are the etiology and epidemiology of fibropapillomatosis, and how can this disease be managed?



Hamann et al. 2010 https://doi.org/10.3354/esr00279

IN-WATER RESEARCH – WHY?

RESEARCH PRIORITIES - CONSERVATION

- How can we effectively determine the conservation status of sea turtle populations?
- What are the most viable cultural, legal and socioeconomic frameworks for sea turtle conservation?
- Which conservation strategies are working (have worked) and which have failed?







Hamann et al. 2010; Rees et al. 2016

BEFORE YOU START

1. WHY?

2. MONITORING DESIGN

Some considerations:

Before you select sites and monitoring methodologies:

DO YOUR HOMEWORK!

- · Have turtles been sighted in your proposed study area?
- What are the species that may use this area?
- What types of habitat does your study area offer?
- Are there any limitations to methods (e.g. environmental conditions, visibility)
- Are there any threats identified in the area?

WHERE TO START

- Fishermen
- Spearfishermen
- Scuba divers







WHERE TO START

- Fishermen/bycatch
- Poaching evidence
- Strandings
- Local bush markets







By-catch



Turtle meat at local market in São 25 Tomé before legislation

WHERE TO START

→The site(s) selected should ideally include known or historically known feeding areas

 \rightarrow Methods must be adequate to the study site, chosen according to:

- habitat characteristics
- turtle behaviour
- study objectives
- > Available resources + permits

Methods do not need to be standardized between different study areas

BUT...

- \rightarrow Each study must be constant in the technique used once it is adopted
- → Methods must be structured in such way that we can infer larger geographical areas

POPULATION STUDIES

METHODS OVERVIEW

SURVEY vs MONITORING?

AIMS:

- Detection of sea turtle presence
- Identification of species
- · Quantification of abundances and densities
- Size classes
- Population parameters (recruitment, mortality, residency)

Commonly used:

- (1) Sighting or capturing turtle by snorkeling and/or scuba diving
- (2) Entrapment nets
- (3) Boat transects
- (4) Captures in collaboration with fishermen
- (5) Collaboration with diving companies/citizen science

POPULATION STUDIES

FREQUENCY AND TIMING

- Ideally, sampling should be conducted during the non-breeding season (but depends on objectives – e.g. males)
- If sampling is conducted during the breeding season, then consideration must be given to the fact that some portion of resident adults will not be present during the sampling period and/or that transitory adults may be encountered.
- Monitoring should be conducted at least annually
- Monitoring dates should remain constant from year to year.



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Photos: Joana Hancock

POPULATION STUDIES

DETECTION AND ABUNDANCES INDEXES

	METHOD	INDEX	COST	EFFORT	AREA COVERED
DIRECT	Hand Capture	CPUE	Low	Medium	Small
		CMR	Low	Medium	Small
	Entrapment Net	CPUE	Low	Medium	Small
		CMR	Low	High	Small
INDIRECT	Boat/Snorkel transect	CPUE	High	Medium	Large
	Fishing Industry/ Fishermen	CPUE	Low	High	Large
		CMR	Low	High	Large
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POPULATION STUDIES

DATA COLLECTION AND ANALYSIS

Estimations of relative abundance are usually derived from:

- Catch Per Unit of Effort (CPUE)
- Capture Mark -Recapture (CMR)

CPUE quantifies the effort, usually turtles captured/sighted by time

CMR allows the estimation of number of turtles based on captures/sightings

Data should be handled as in any CMR situation

Data should be stored in a database

POPULATION STUDIES INDIRECT CAPTURE METHODS



Boat – Snorkeling – Diving transects

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POPULATION STUDIES DIRECT CAPTURE METHODS

INDIVIDUAL IDENTIFICATION

- Identification of individuals
- Individual behaviour
- Growth rates
- Residency times
- Diseases

TAG LOSS INTERFERENCE DISEASE



Photo by Programa Tatô

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POPULATION STUDIES DIRECT CAPTURE METHODS







Photos by Joana Hancock





POPULATION STUDIES

DIRECT CAPTURE METHODS

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<u>Methods</u>

Photos of both sides of a turtle's face collected from biologists & tourists. Turtles ID'd by eye only. Photos quality checked & capture histories for selected reefs created & analyzed using open & closed population models in R (Rcapture package). Capture occasions = 1 month.



1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

Fig. 2. Plotting cumulative number of hawksbill turtles versus sampling occasion (1 month) creates discovery curves. Curve flattens when the current pop. has been photographed & increases when new turtles are photographed (2013-2016 data).

Table 1. Number & size of turtles photographed at Coco Bodu Hithi & Coco Polm Dhuni Kolhu resorts by guests and staff (2013-2016).

Resort / Atoll	Photographed Turtles	Population estimate [from RCapture]	Avg. SCL Hawksbill	Avg. SCL Green
Coco Palm Dhuni Kolhu (Baa)	70 Hawksbill 21 Green 5 Olive Ridley	DKHR: 30.3 +/- 1.8 Muthaafushi: 42.3 +/-3.4 Kiufengali: 6.6 +/- 1.0	44.9±8.6 cm	61.3±20.2 cm
Coco Bodu Hithi (North Male)	94 Hawksbill 4 Green	BHHR: 34.2 +/-1.2 BHTP: 42.1 +/- 1.6 BH Thila: 27.9 +/- 5.8	43.6±6.8	67.8±25.1

Determining size at maturity

A hawksbill turtle was photographed over 3 years as it matured. At 60 cm SCL, it had a small tail, at 62 cm, it had a more noticeable tail. This has helped us narrow down **size at maturity**, now assumed to be >60 cm for male hawksbills in the Maldives.



Fig. 6. HK307 photographed over 3 years. <60 cm SCL in left photo & small tail, 62 cm SCL in right photo & larger tail. Photos © Chiara Furnagalli.

Population change over time



Fig. 7. Variation in resident turtle populations at 6 sites over 3 or 6 month intervals. Based on results from Rcapture open population models. There does not appear to be any seasonal variation.

(Hudgins & Fumagalli https://oliveridleyproject.org/wp-content/uploads/2017/07/ISTS-ORP-poster-2017.pdf



POPULATION STUDIES

DIRECT CAPTURE METHODS



In-water observations



By-catch / strandings

HABITAT CHARACTERIZATION

MAPPING



Beca-Carretero et al. 2020 https://doi.org/10.1002/aqc.3312

FORAGING ECOLOGY

HABITAT USE + DIET



FORAGING ECOLOGY STABLE ISOTOPES High VS. Denitrification Trophic Level δ¹⁵N (‰) N fixation VS. More Less Low productive productive In-shore Off-shore Benthic/ice Pelagic associated More Less δ¹³C (‰) negative negative

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FORAGING ECOLOGY INDIVIDUAL BEHAVIOUR

- Telemetry
- Specialized sensors





Photos by Programa Tatô

FORAGING ECOLOGY INDIVIDUAL BEHAVIOUR



Hochscheid et al. 1999 https://www.jstor.org/stable/24853202

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ADULT HABITAT USE

MIGRATORY CORRIDORS



Leatherback turtle – Gabon (From Witt et al. 2018)



Green turtle – Bioko (Mettler et al. 2019 https://doi.org/10.1371/journal.pone.0213231)⁴²

ADULT HABITAT USE

THREAT MITIGATION



EXAMPLE:

 Satellite tracking and a switching state-space model to determine the internesting movements

Utilization distribution (UD) of olive ridley sea turtles (Lepidochelys olivacea) tagged from Mayumba National Park.

The UD shows that the proposed Transboundary Park encompasses the majority of the turtle distribution. Star indicates tagging location.

(Maxwell et al., 2011 https://doi.org/10.1371/journal.pone.0019905)

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VIDEO LISTS DIRECT CAPTURE METHODS

CAPTURE TECHNIQUES (Eastern Pacific – ICAPO): https://www.youtube.com/watch?v=cCJHkBm_Wvg

SEA TURTLE RODEO (USA): https://www.youtube.com/watch?v=qwXaEVdE1AE

COLLABORATION WITH FISHERMEN (São Tomé – Programa Tatô): https://www.youtube.com/watch?v=-1BBBqWX5bk

HABITAT CHARACTERIZATION

USING UNDERWATER DRONE (Cameroon – AMMCO): https://youtu.be/ohWXygdAYq8

QUESTIONS?

