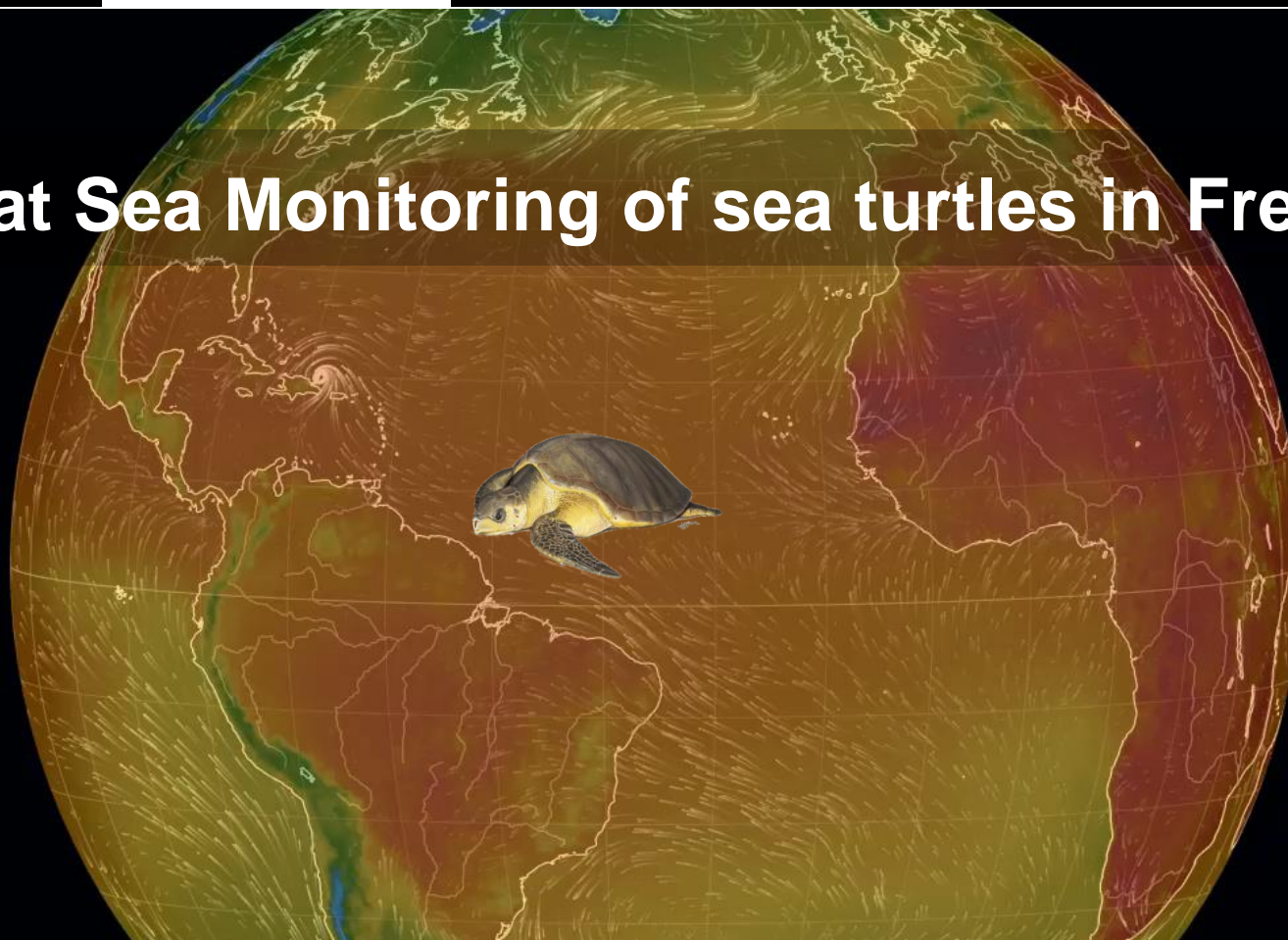


Nesting and at Sea Monitoring of sea turtles in French Guiana



Chevallier Damien & de Thoisy Benoit
(CNRS IPHC) (Kwata)

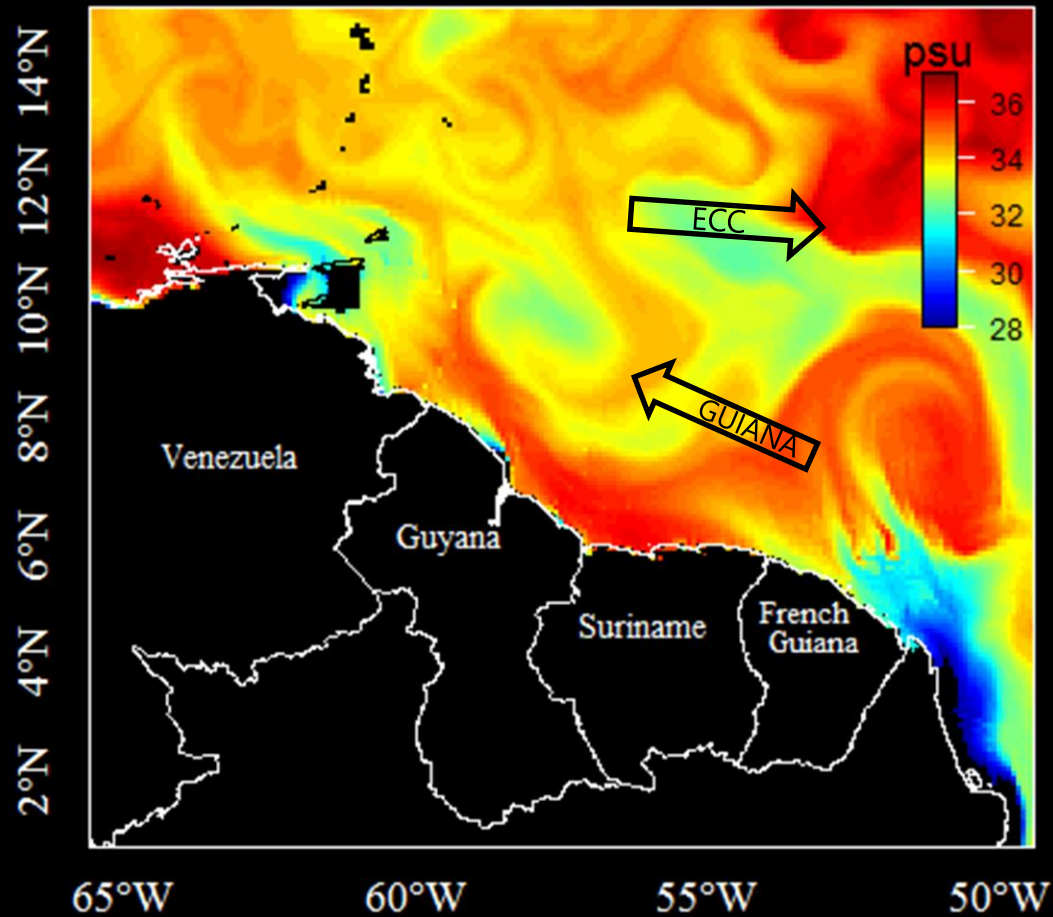


What about the situation in French Guiana ?

300km of coast and only 30km of nesting beaches

Influence of Amazon on the coast : highly dynamic

Sea Surface Salinity - Day 1



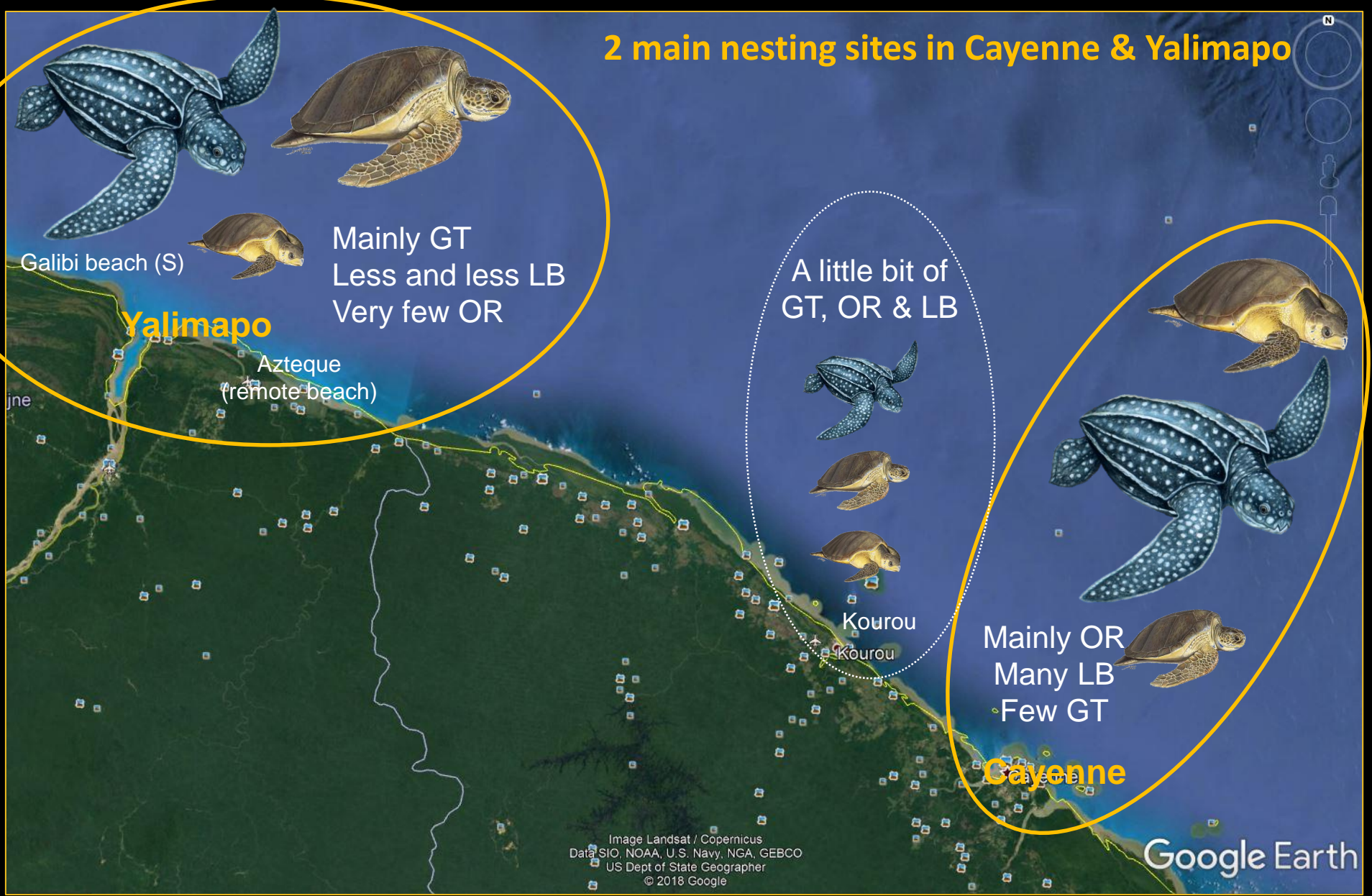
Some beaches appear / disappear under a natural cycle of erosion/accretion of the coast

Mud banks could be an obstacle for Marine turtles

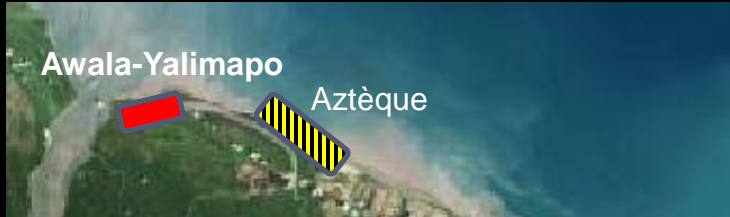


What about the Marine turtle monitoring in French Guiana ?

2 main nesting sites in Cayenne & Yalimapo





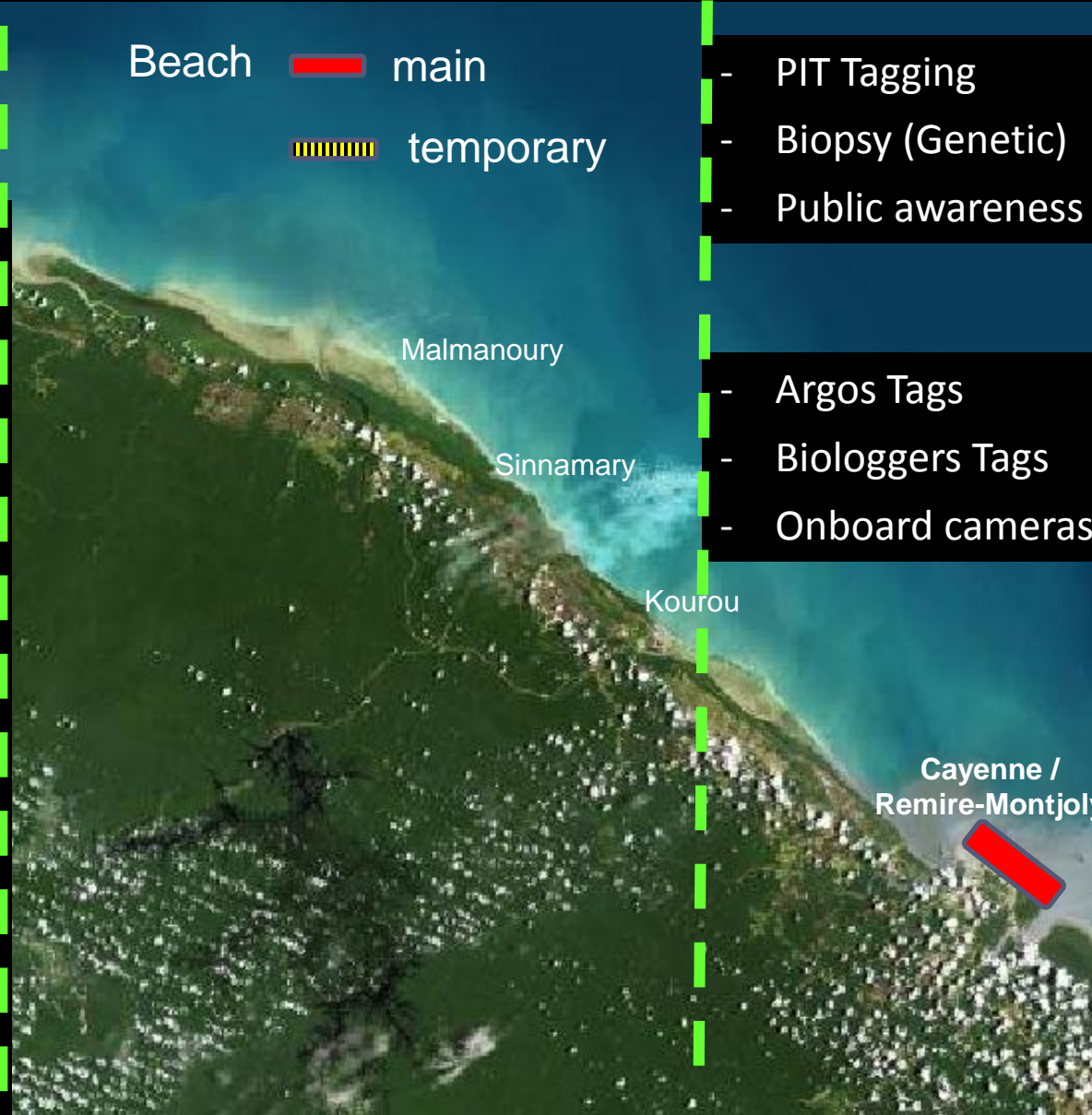
What about the Marine turtle monitoring in French Guiana ?



- PIT Tagging
- Argos Tags
- Biologgers Tags
- Onboard cameras
- GPS location of nests
- Biometric measurements
- Injuries reports
- Weighing leatherbacks (until 2011)
- Blood sample / Biopsy (Genetic, ecotoxicology)
- Habitat characterisation
- Counting eggs
- Topographic surveys
- Bathymetric surveys



Beach  main
 temporary



- PIT Tagging
- Biopsy (Genetic)
- Public awareness

- Argos Tags
- Biologgers Tags
- Onboard cameras

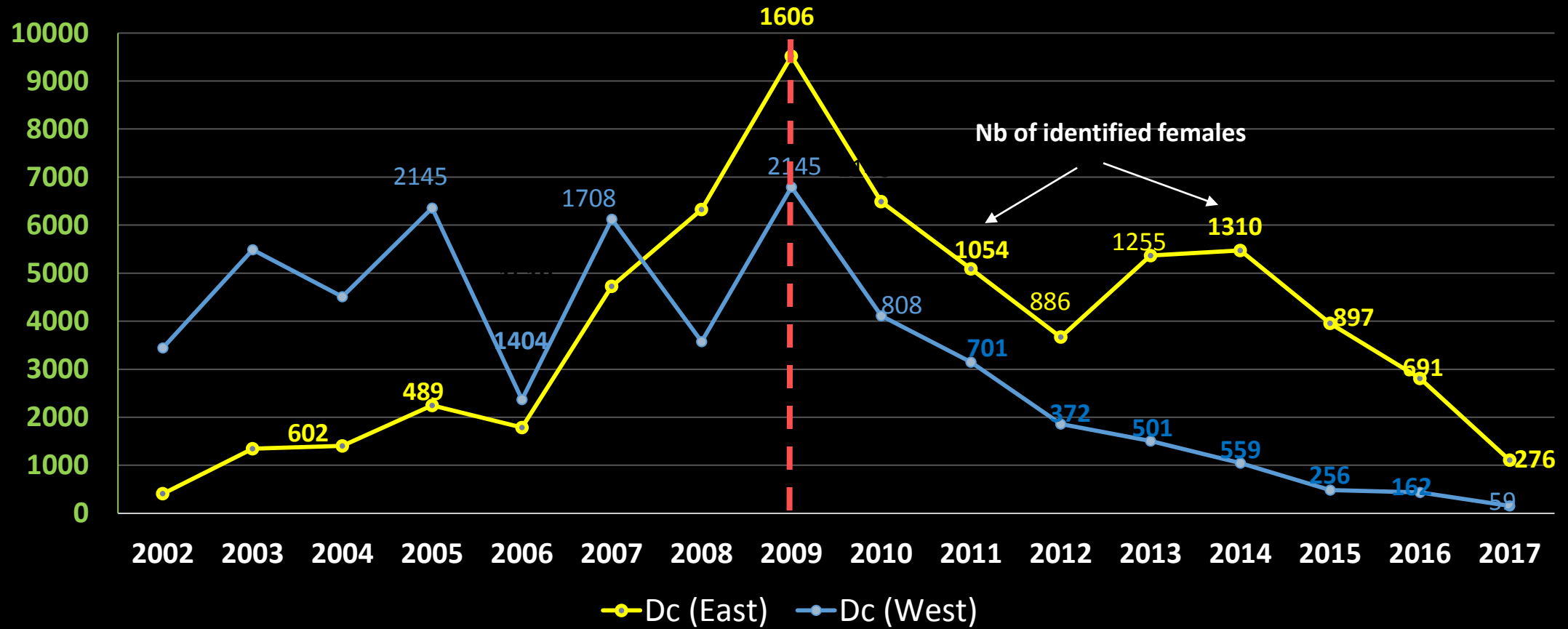




Leatherback populations decrease since 2009

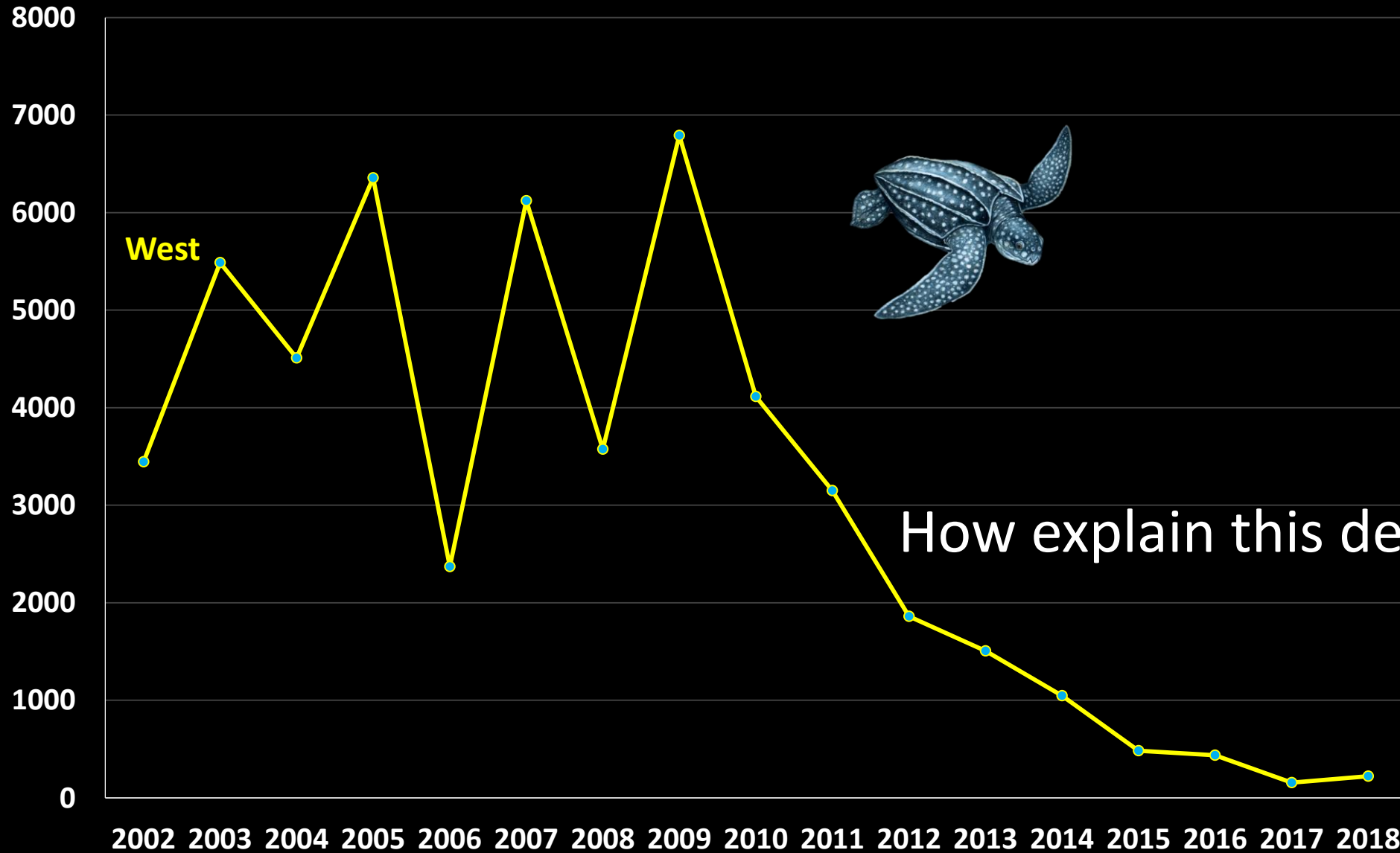
Where do they go ?

Number of Dc nests from 2002 to 2017 in the East and in the West

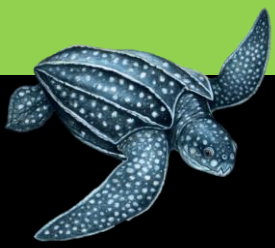




Nesting activity from 2002 to 2018 in the West: Nesting index in the Leatherback



How explain this decline...?



Decline of the Leatherback population (Awala-Yalimapo)



Survival and pace of reproduction of an endangered sea turtle population, the leatherback *Dermochelys coriacea* in French Guiana

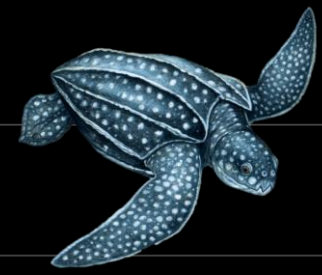
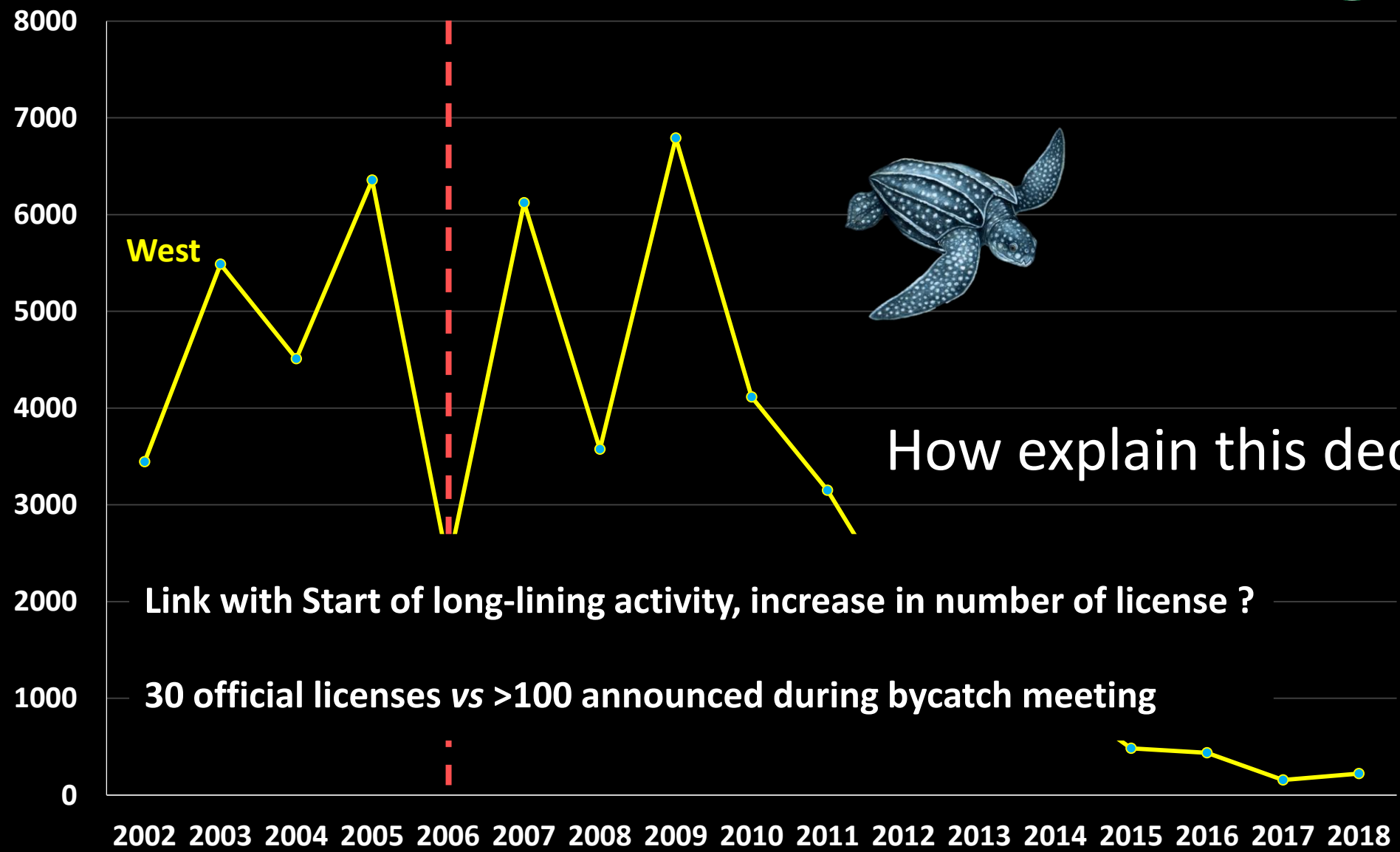
Chevallier D., **Lebreton J-D.**, et al. *In prep. Endangered species*

CMR Analyses: **46 000 females over 28 years**

- (1) Estimated mean survival : **0.79 ± 0.12** : impact of longline fishing (international scale) and other fishing activities (Fossette et al., 2014) ?
 - (2) Estimation of the interval between nesting seasons: **2.8 ± 0.3 years** (combination Estimates of probabilities of survival, departure and return).
 - (3) Average number of nesting seasons for 1 adult leatherback (based on survival): **1.8 seasons.**
- **!!! Worrying !!!: Low value for a long-lived species: ---> close to semelparity.**



Nesting activity from 2002 to 2018 in the West: Nesting index in the Leatherback



How explain this decline...?

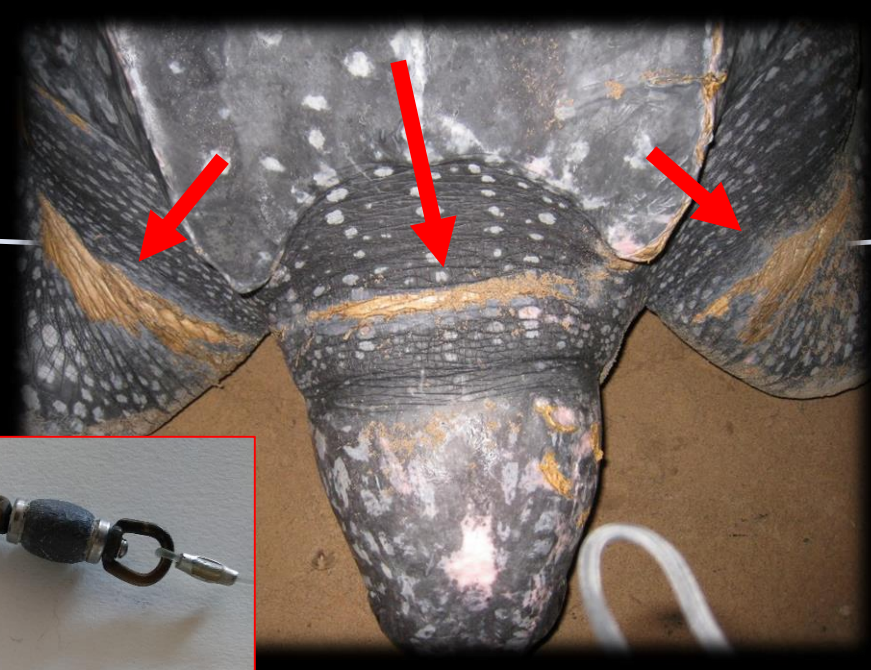
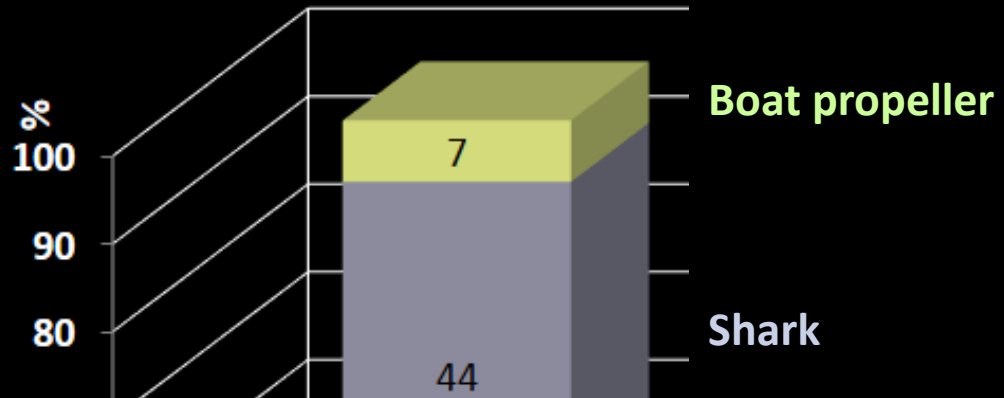
Link with Start of long-lining activity, increase in number of license ?

30 official licenses vs >100 announced during bycatch meeting

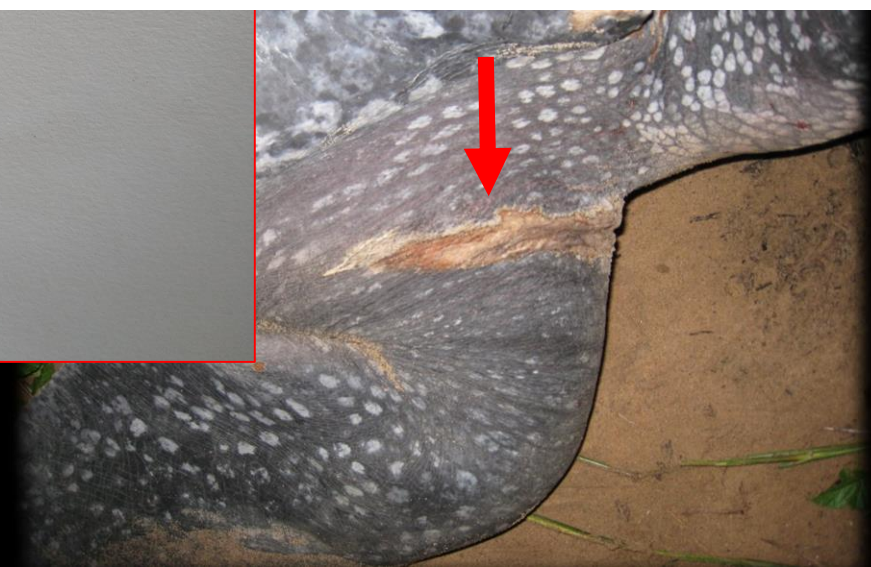
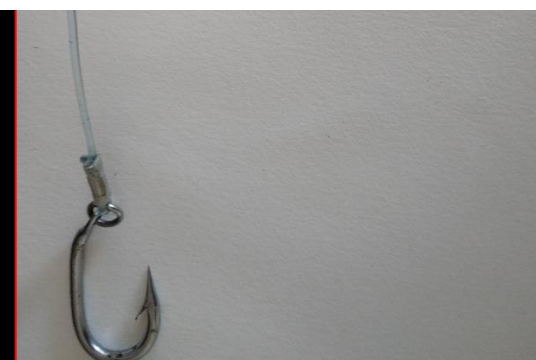
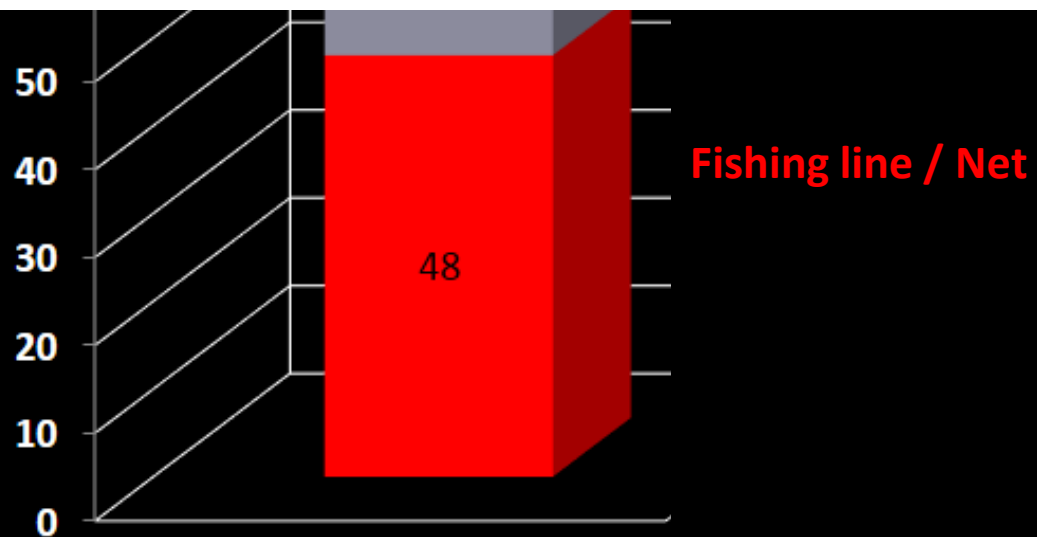
RESULTS: Bycatch and indirect consequences of bycatch

Western nesting site: Amana Natural Reserve in 2012:

46% of nesting females were injured including...

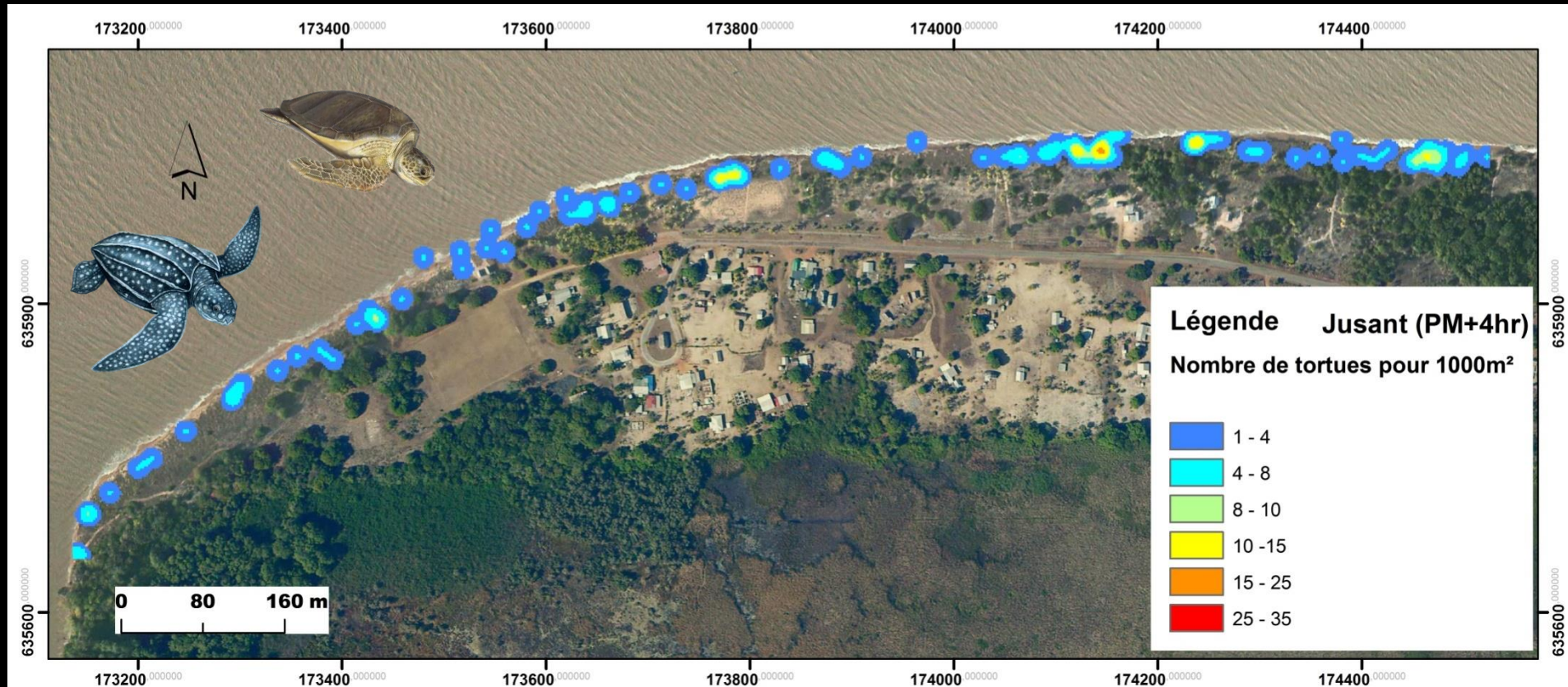


Bycatch is not the only threat...

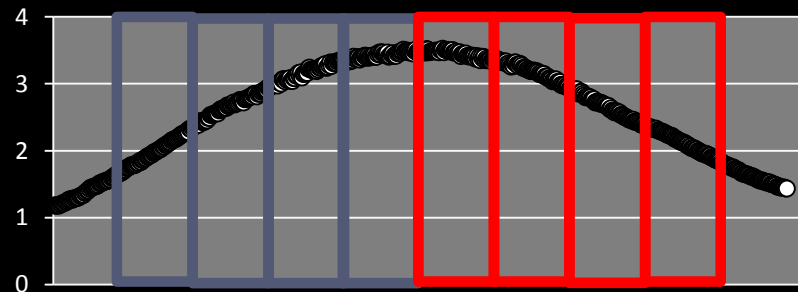


RESULTS: Influence of water heights on sea turtles spatial distribution on the beach

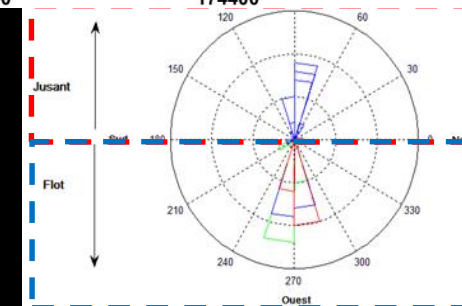
➤ privileged sectors according to water heights



Water heights

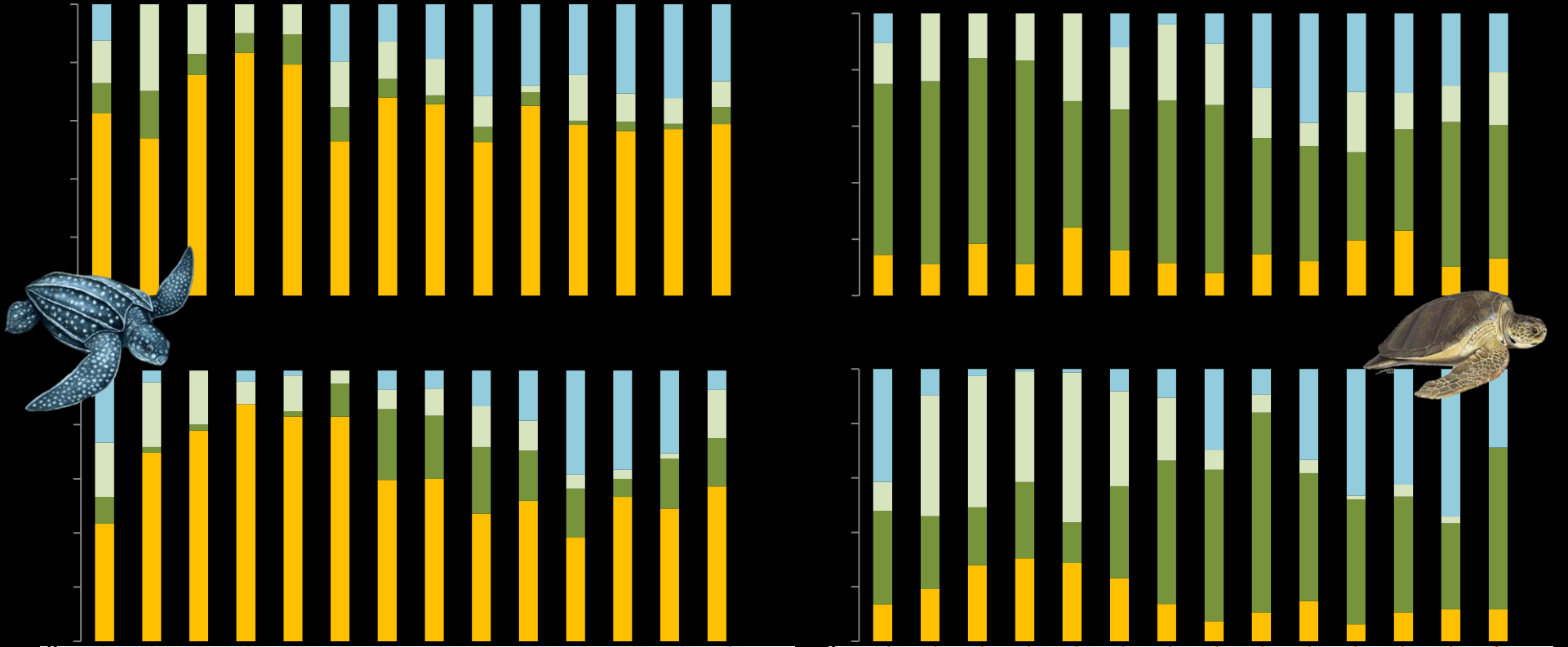


Low tide
Rising tide



RESULTS: Influence of topography and subtract on nesting distribution

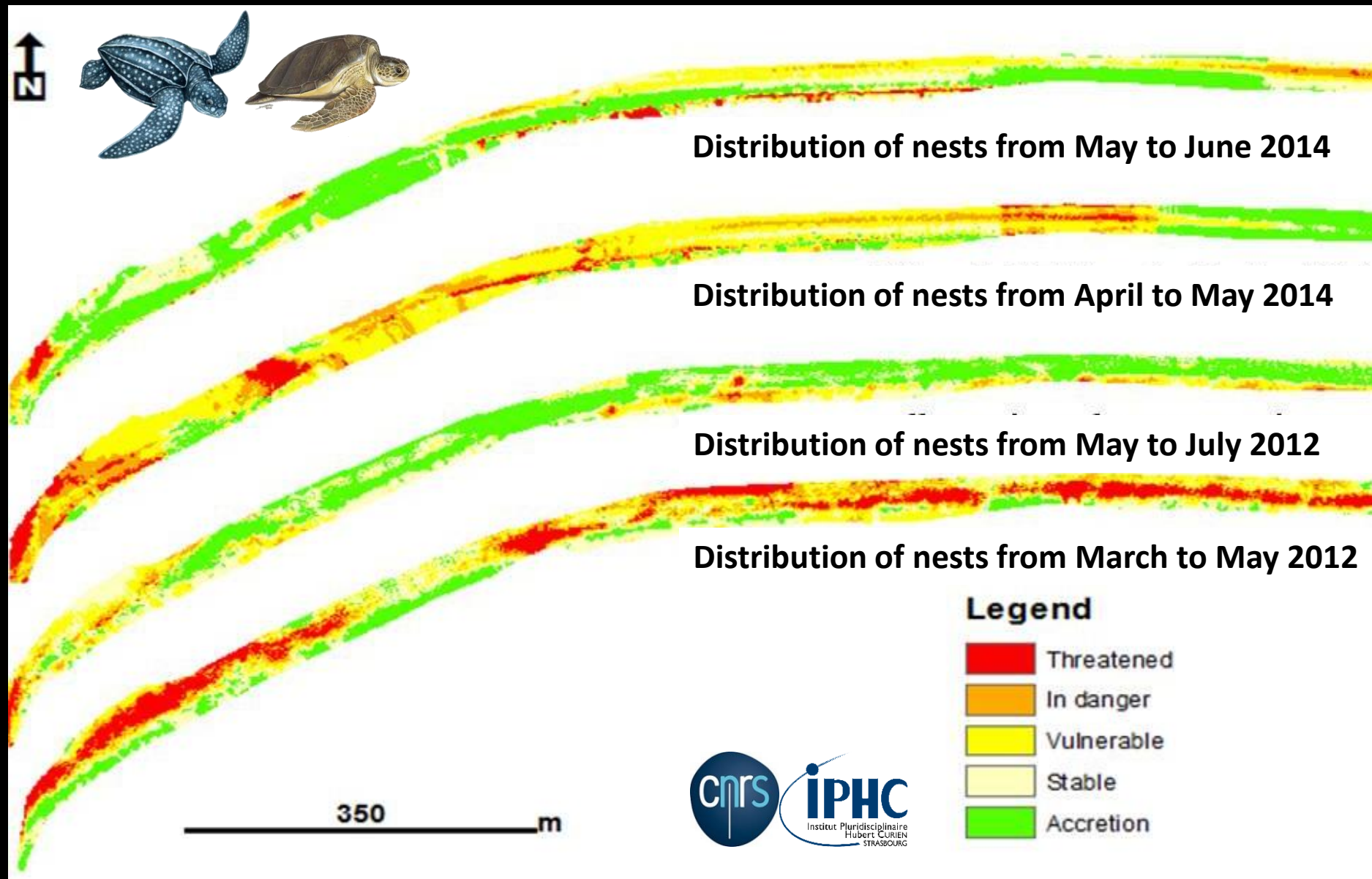
-  Sand
-  Vegetation
-  S/V
-  Lower slopes



- Nesting behavior different according to the species:
- **Leatherback**: Sandy backshore
 - **Green turtles**: Vegetation

Péron et al. 2013

RESULTS: Nests vulnerability in Awala-Yalimapo



Péron et al. *In prep.*

➤ **36% of nests destroyed each year....** but coastal dynamics is not the only cause of decline

RESULTS: Marine turtle monitoring

Northwest Atlantic Leatherback Turtle (*Dermochelys coriacea*) Status Assessment

Prepared by the Northwest Atlantic Leatherback Working Group

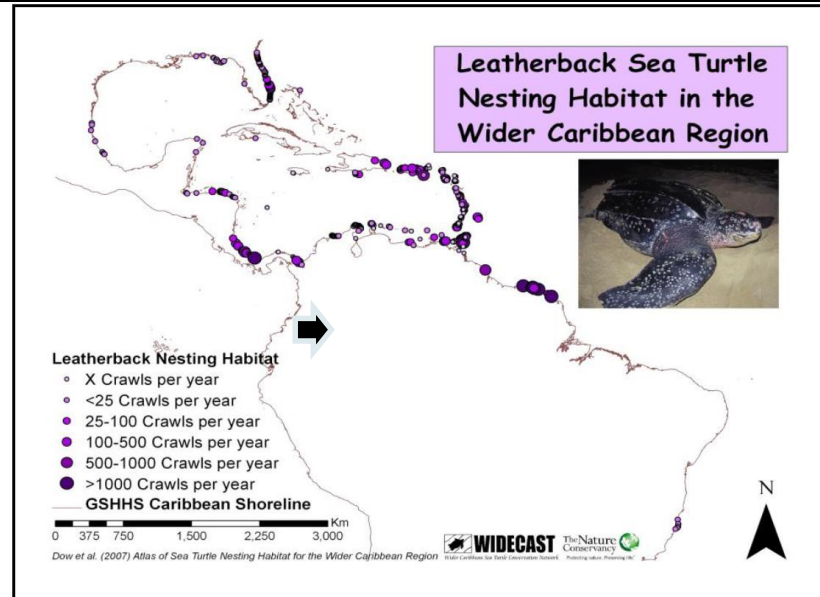
Bryan Wallace and Karen Eckert
(Compilers and Editors)



Generously supported by the National Fish and Wildlife Foundation, with additional funding provided by SeaWorld Parks and Entertainment Inc.



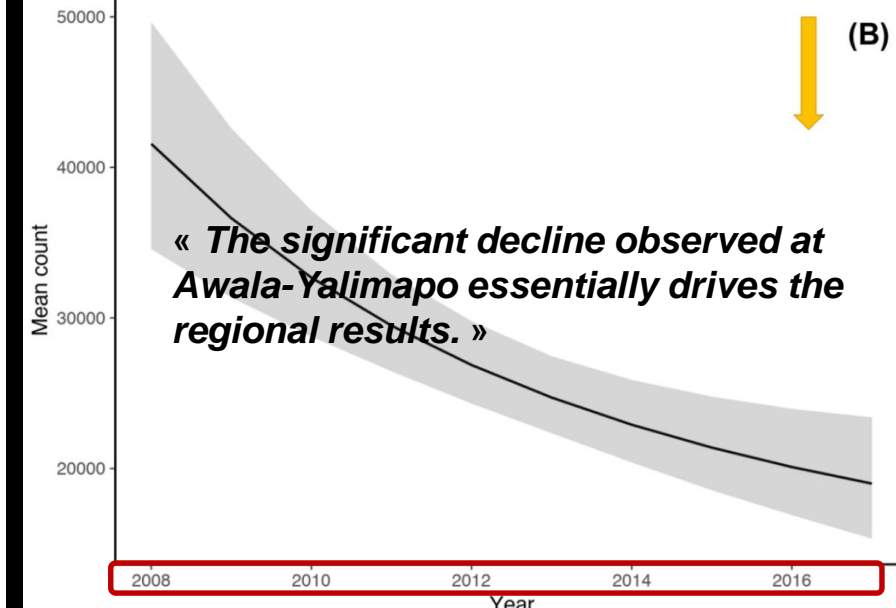
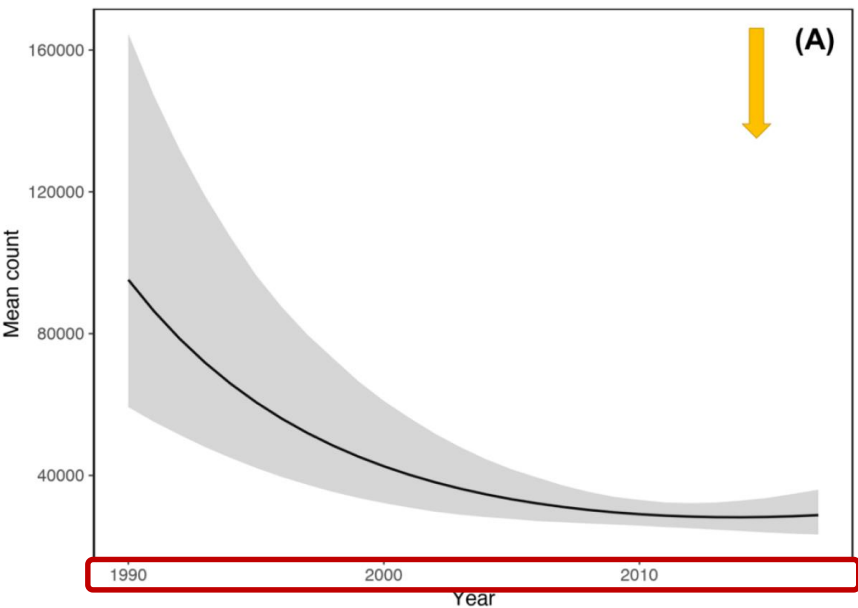
2018



Distribution of nesting sites for NWA leatherback turtles. Source: Dow et al. 2007.

No shift to other nesting sites

➤ **Decline at the regional level**



The ocean: a heterogeneous habitat

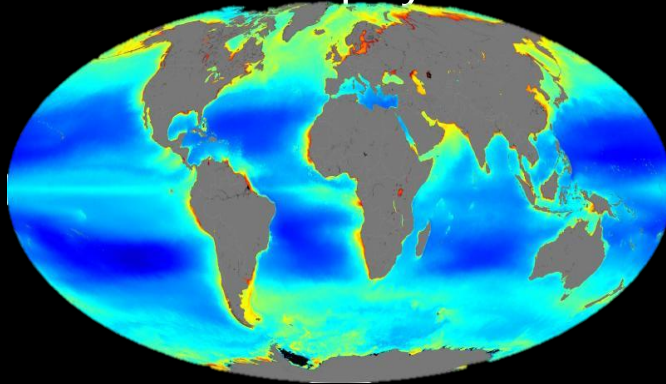
Seasonality of the marine environment

Heterogeneity marine environment

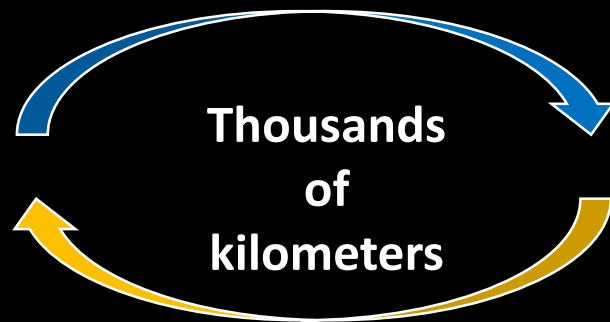


Resource availability

Chlorophyll *a*

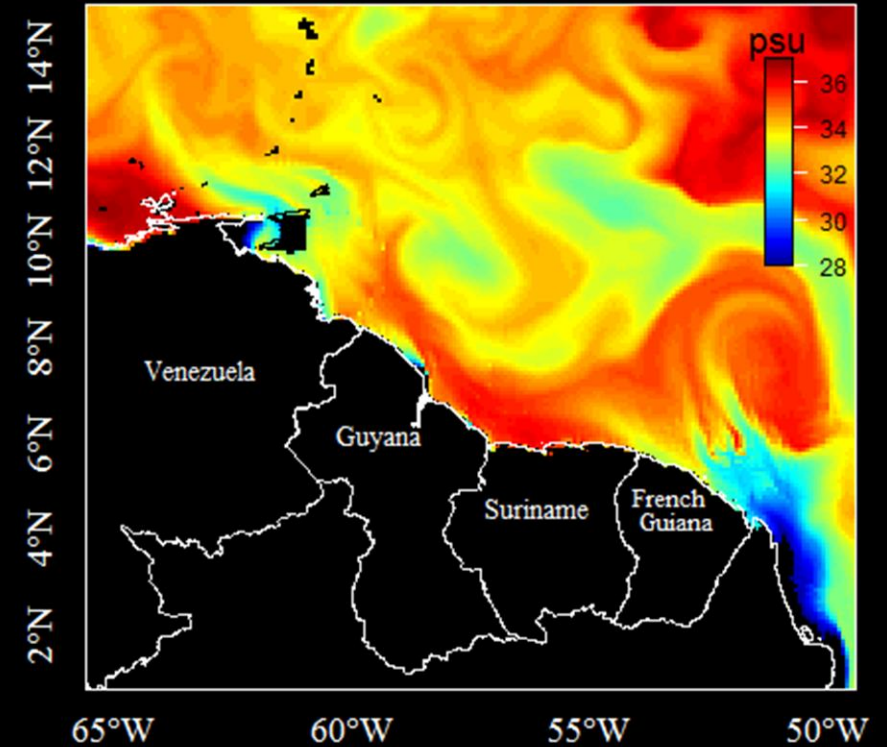


Breeding site
Nesting site



Feeding site

Sea Surface Salinity - Day 1



The ocean: a heterogeneous habitat

How these three species adjust their behavior
in response to this dynamic environment ?

Habitat use

Reproduction

Internesting



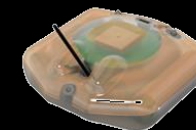
Dynamic oceanographic
environment Data



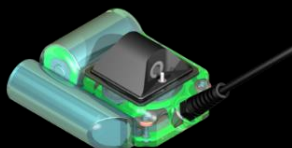
Dispersion and behavior of
marine turtles species



SEAPODYM



ARGOS
CLS™



RESULTS: Migration

Progress in Oceanography 140 (2016) 56–71
 Contents lists available at ScienceDirect
Progress in Oceanography
 journal homepage: www.elsevier.com/locate/pocean

The influence of oceanographic features on the foraging behavior of the olive ridley sea turtle *Lepidochelys olivacea* along the Guiana coast

Philippe Chambault^{a,*}, Benoît de Thoisy^b, Karine Heerath^c, Anna Conchon^d, Sébastien Barrioz^e, Virginie Dos Reis^f, Rachel Berzins^g, Laurent Kelle^h, Baptiste Picardⁱ, Fabien Roquet^j, Yvon Le Maho^k, Damien Chevallier^l

^aORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Strasbourg cedex 2, France
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^cORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Paris cedex 12, France
^dCentre de Recherche, Centre de Biogéographie, Université de la Guayane, 97333 Rimoussin, France
^eOffice National de la Chasse et de la Pêche Sauvage – Centre technique Guyane, Campus agro-pêche, BP 316, 97379 Bourouville, France
^fORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^gCentre d'Étude Biologique de Cayenne, ORSTOM, ORSTOM, Université de la Guayane, 97300 Maripasoula, France
^hORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
ⁱORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^jORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^kORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^lORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France

Biological Conservation 184 (2015) 36–43
 Contents lists available at ScienceDirect
Biological Conservation
 journal homepage: www.elsevier.com/locate/bcon

Identification of key marine areas for conservation based on satellite tracking of post-nesting migrating green turtles (*Chelonia mydas*)

Marie Baudouin^{a,*}, Benoît de Thoisy^b, Philippe Chambault^c, Rachel Berzins^d, Mathieu Entraygues^e, Laurent Kelle^f, Avasania Turry^g, Yvon Le Maho^h, Damien Chevallier^{i,*}

^aORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Strasbourg cedex 2, France
^bINRAE, UR1213, Université de Guyane, BP 6752, 97338 Cayenne cedex, France
^cORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Paris cedex 12, France
^dOffice National de la Chasse et de la Pêche Sauvage – Centre technique Guyane, Campus agro-pêche, BP 316, 97379 Bourouville, France
^eORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^fORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^gORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
^hORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France
ⁱORCID iD: 0000-0001-7714-0265 (art. 23 sur ResearcherID) Cayenne, France

PLOS ONE

RESEARCH ARTICLE
Dispersal and Diving Adjustments of the Green Turtle *Chelonia mydas* in Response to Dynamic Environmental Conditions during Post-Nesting Migration

Philippe Chambault^{1,2,*}, David Pinaud³, Vincent Ventrone^{4,5}, Laurent Kelle⁶, Mathieu Entraygues⁷, Christophe Guinet⁸, Rachel Berzins⁹, Karim Billo¹⁰, Philippe Gaspar¹¹, Benoît de Thoisy¹², Yvon Le Maho¹³, Damien Chevallier¹⁴

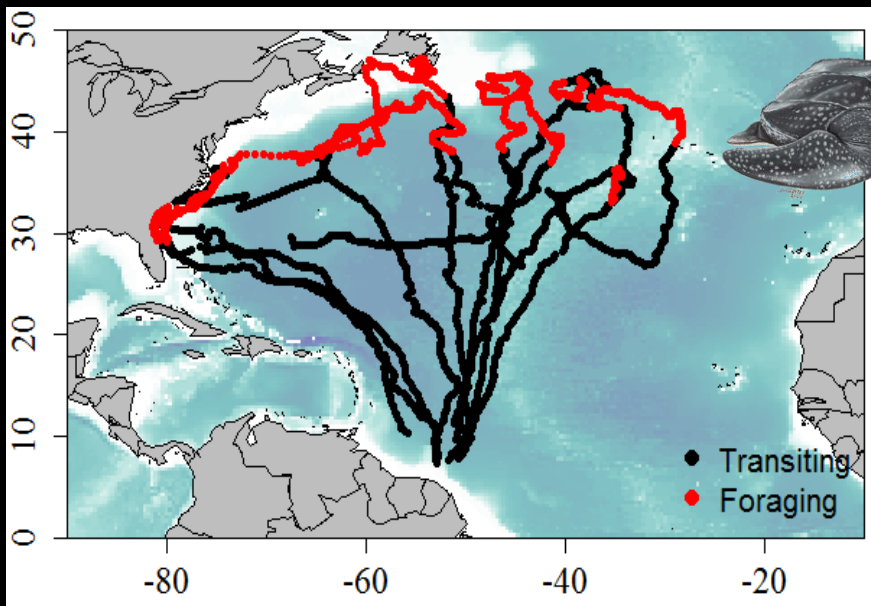
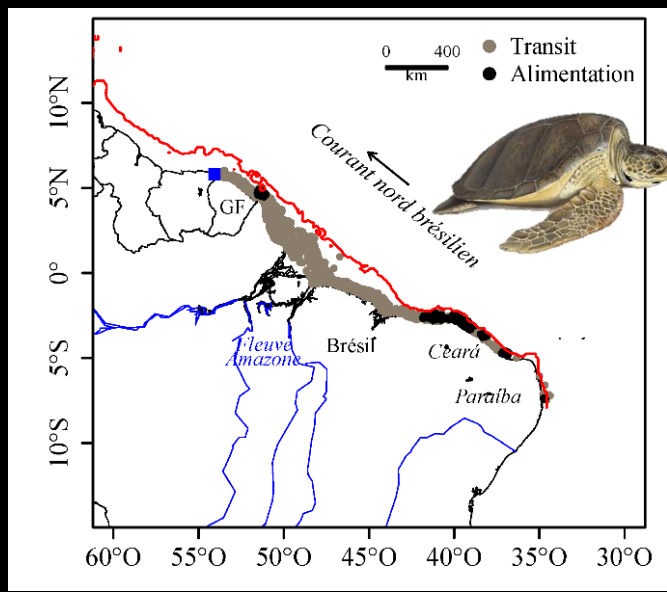
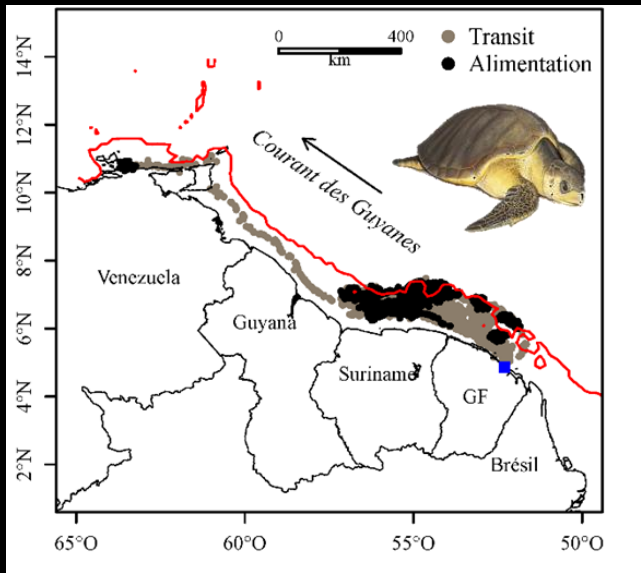
¹ Université de Strasbourg, Institut Pluridisciplinaire Hubert Curien, 23 rue Beaucourt, F-67087 Strasbourg cedex 2, France; ² CNRS, UMR 7175 CNRS-Université de la Guayane, F-97338 Cayenne cedex 2, France; ³ Centre de Biologie Biogéographique de Cayenne, UMR 7175 CNRS-Université de la Guayane, 97333 Rimoussin, France; ⁴ Laboratoire d'océanographie et de géosciences, UMR 6102 CNRS, 28 avenue de l'école, BP 64500 Vieux-Éclair, France; ⁵ CNRS Guyane, UMR 3468, av. Charley, 97338 Cayenne, France; ⁶ WWF Guyane, N° 5, L'Association WWF, F-97338 Cayenne, France; ⁷ Office National de la Chasse et de la Pêche Sauvage – Centre technique Guyane, Campus agro-pêche, BP 316, 97379 Bourouville, France; ⁸ WWF Guyane, Marché Amical 85, Penmarc'h, Surinam, 9 Coléata Localisation Sautelles, Direction Océanographie Sautelles, 6-10 rue Maréchal, 97333 Rimoussin, France; ⁹ Association Nautica, 10 avenue Pasteur, BP 672, F-97338 Cayenne cedex, France

ARTICLE IN PRESS
 Deep-Sea Research Part I
Deep-Sea Research I
 journal homepage: www.elsevier.com/locate/jdr

The Gulf Stream frontal system: A key oceanographic feature in the habitat selection of the leatherback turtle?

Philippe Chambault^a, Fabien Rogge^b, Simon Benhamou^c, Alberto Baudena^d, Elixiane Panthel^e, Benoît de Thoisy^f, Marc Ronolo^g, Virginie Dos Reis^h, Rodrigue Craswonⁱ, Mathieu Bruncker^j, Yvon Le Maho^k, Damien Chevallier^l

^a Université de Strasbourg, IFREMER, UMR 7178 F-67087 Strasbourg, France
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^d Institut de Recherche pour le Développement, IRD, Montpellier, France
^e Institut de Recherche pour le Développement, IRD, Montpellier, France
^f Institut de Recherche pour le Développement, IRD, Montpellier, France
^g Institut de Recherche pour le Développement, IRD, Montpellier, France
^h Institut de Recherche pour le Développement, IRD, Montpellier, France
ⁱ Institut de Recherche pour le Développement, IRD, Montpellier, France
^j Institut de Recherche pour le Développement, IRD, Montpellier, France
^k Institut de Recherche pour le Développement, IRD, Montpellier, France
^l Institut de Recherche pour le Développement, IRD, Montpellier, France



RESULTS: Nesting season

Journal of Marine Systems 105 (2017) 115–123

Contents lists available at ScienceDirect

Journal of Marine Systems

journal homepage: www.elsevier.com/locate/jmarsys



Habitat use and diving behaviour of gravid olive ridley sea turtles under riverine conditions in French Guiana


Philippe Chambault^{a,b,*}, Lucie Giraudou^{a,b}, Benoît de Thoisy^c, Marc Bonola^{a,b}, Laurent Kelle^d, Virginie Dos Reis^e, Fabian Blanchard^e, Yvon Le Maho^{a,b}, Damien Chevallier^{a,b}

^a Université de Strasbourg, Institut Pluridisciplinaire Hubert Curien, 23 rue Bequerel, 67087 Strasbourg Cedex 2, France
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^d WWF Guyane, N°5 Lotissement Kaloury, F-97300 Cayenne, France
^e UMR LISIA, Université de Guyane, CNRS, IRD/IMER, 5/Navigation (France de Guyane, Demoteur de Surin), BP 477, F-97331 Cayenne, France

Vol. 55: 235–248, 2016
doi: 10.3354/meps11813

MARINE ECOLOGY PROGRESS SERIES
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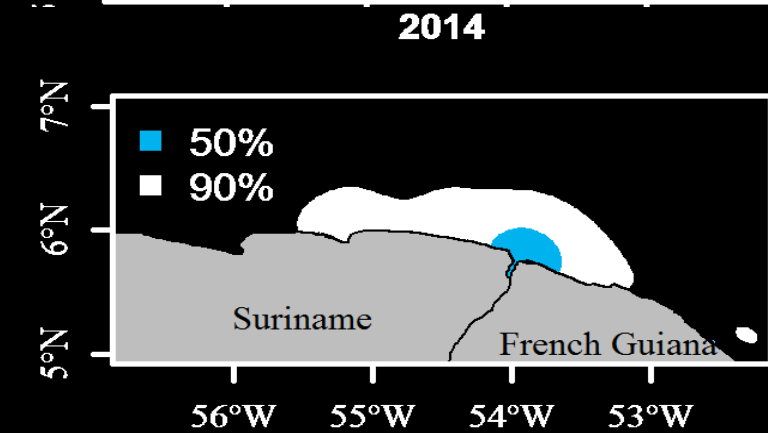
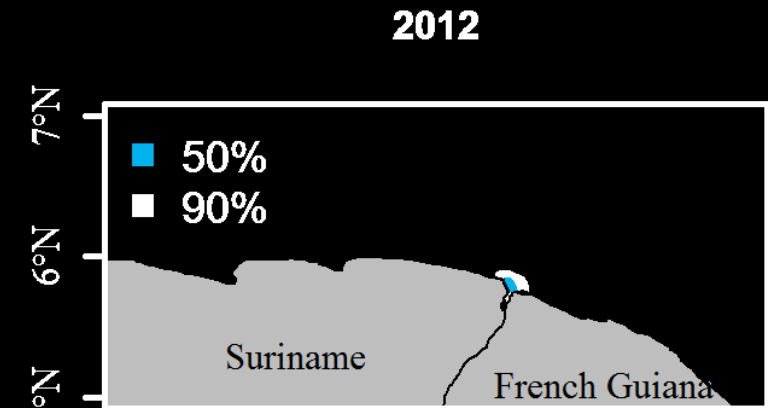
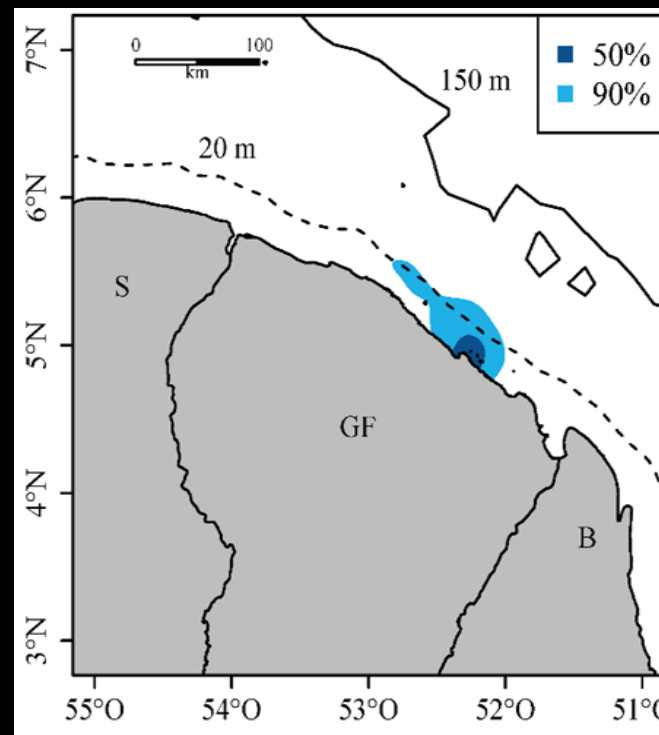
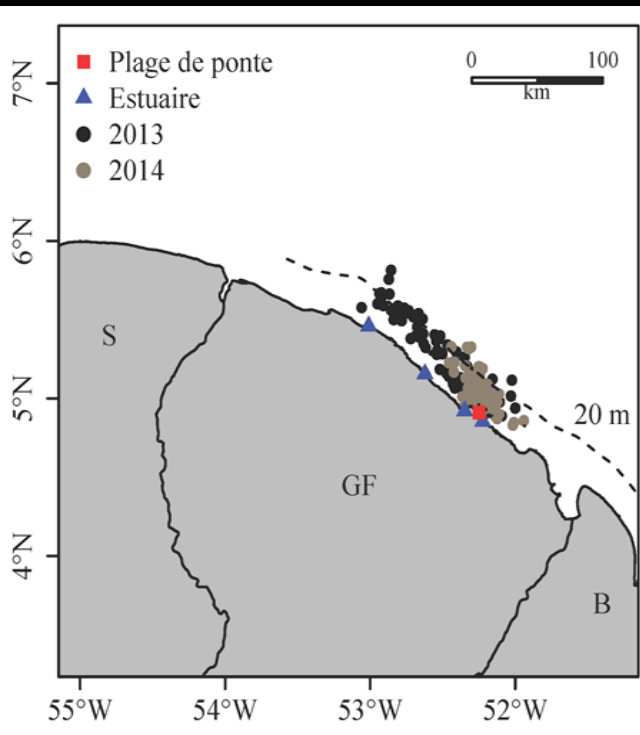
Published August 2016



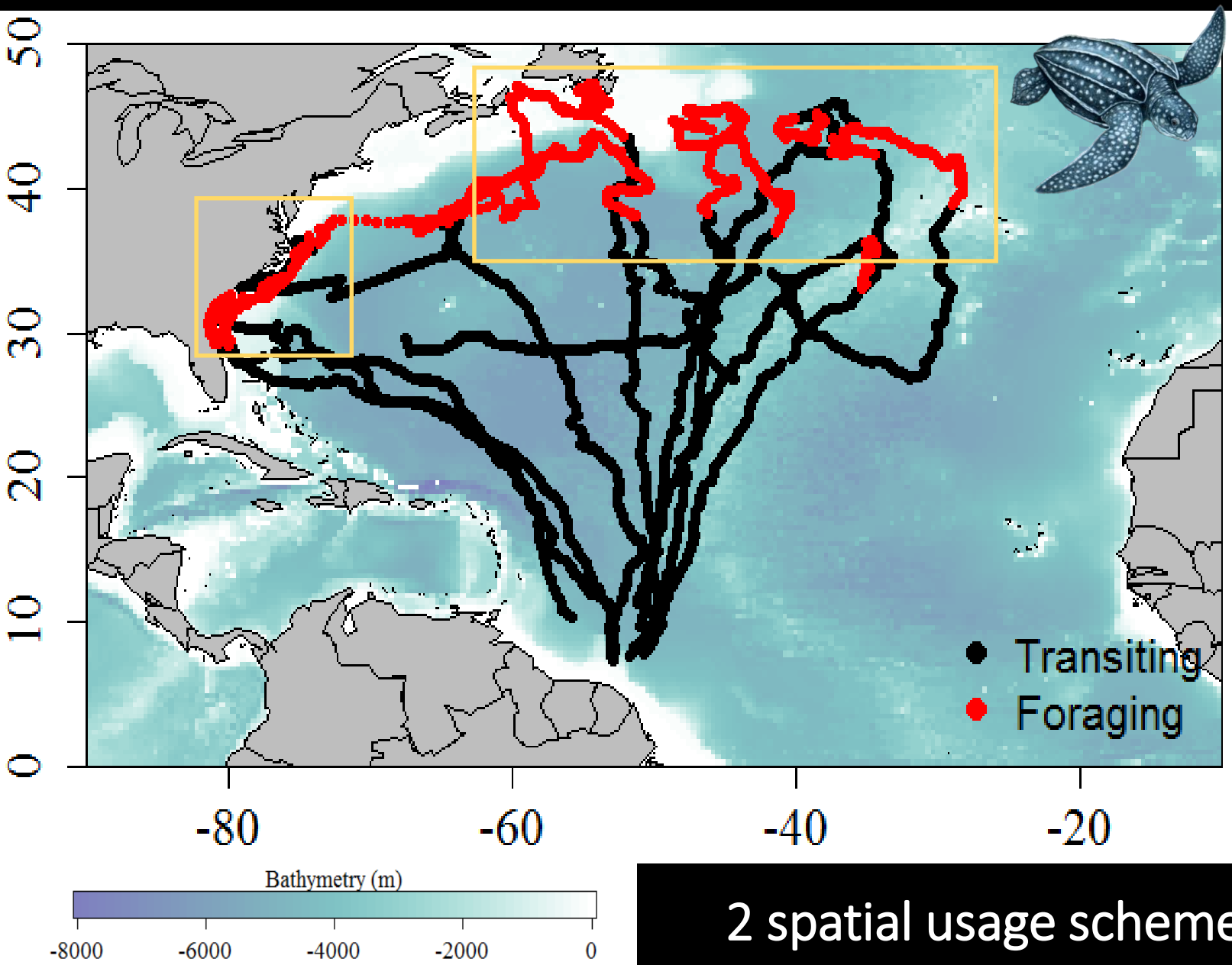
Inter-nesting behavioural adjustments of green turtles to an estuarine habitat in French Guiana

Philippe Chambault^{1,2,*}, Benoît de Thoisy³, Laurent Kelle⁴, Rachel Berzins⁵, Marc Bonola^{1,2}, Héléne Delvaux⁶, Yvon Le Maho^{1,2}, Damien Chevallier^{1,2}

¹Université de Strasbourg, Institut Pluridisciplinaire Hubert Curien, 23 rue Bequerel, 67087 Strasbourg cedex 2, France
²CNRS, UMR 7178, 23 rue Bequerel, 67087 Strasbourg cedex 2, France
³Association Kwata, 16 avenue Pasteur, BP 672, 97335 Cayenne cedex, France
⁴WWF Guyane, N°5 Lotissement Kaloury, 97300 Cayenne, France
⁵Office National de la Chasse et de la Faune Sauvage-Cellule technique Guyane, Campus agronomique, BP 316, 97379 Kourou cedex, France
⁶DEAL Guyane, Route du Vieux-Port, BP 603, 97328 Cayenne cedex, France



RESULTS: Trajectory & Feeding area



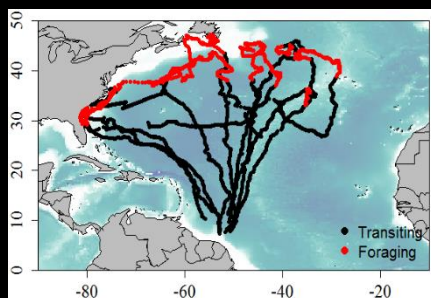
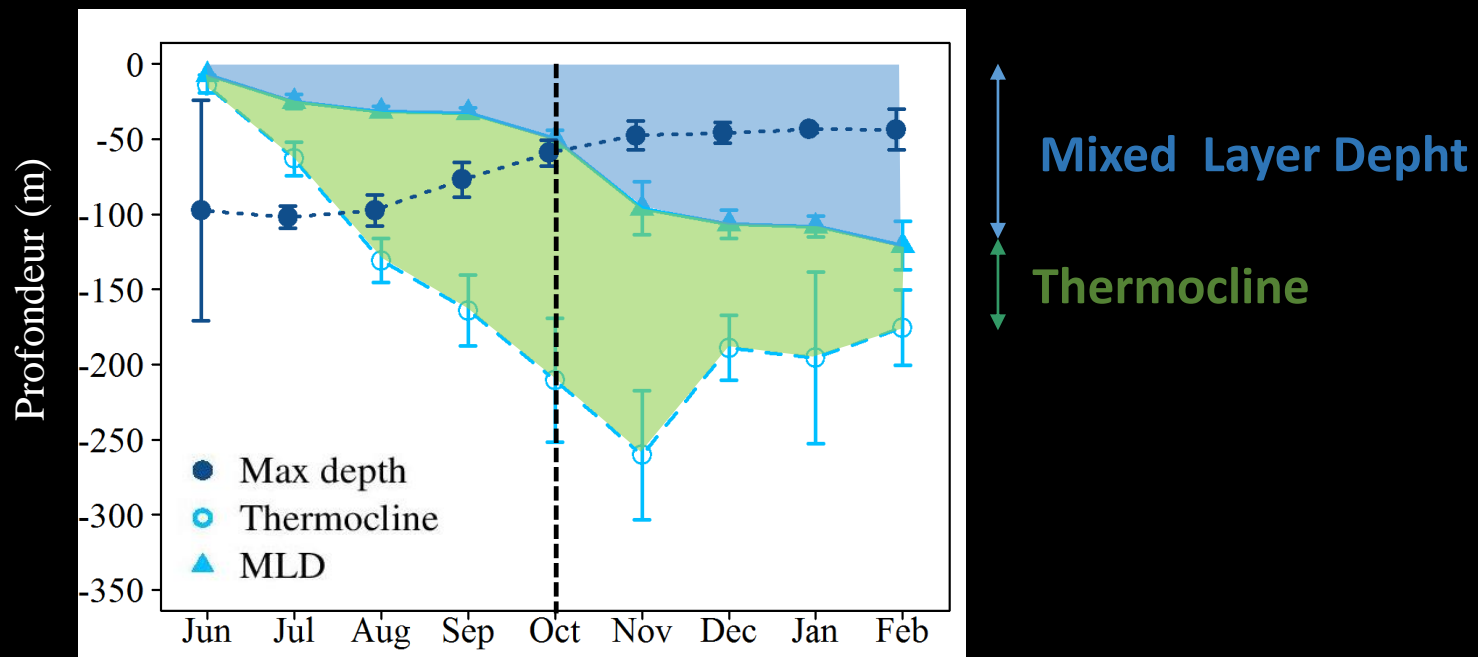
Distance to reach Foraging areas:
 5615 ± 1456 km

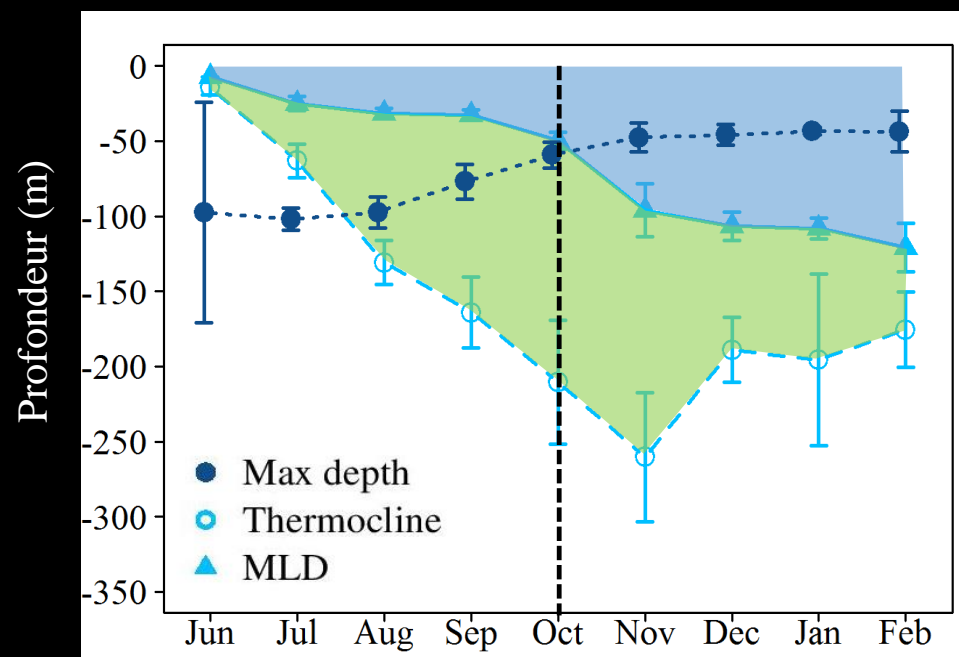
Time to reach Foraging areas:
 71 ± 12 day

Transit speed:
 56 ± 28 km / day

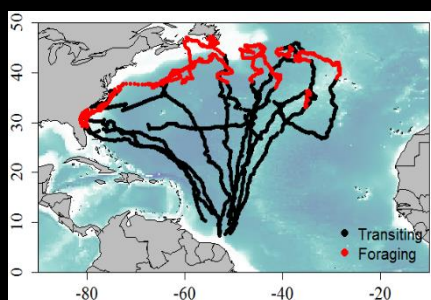
Speed during feeding:
 36 ± 31 km/d

2 spatial usage schemes Coastal vs. Pelagic

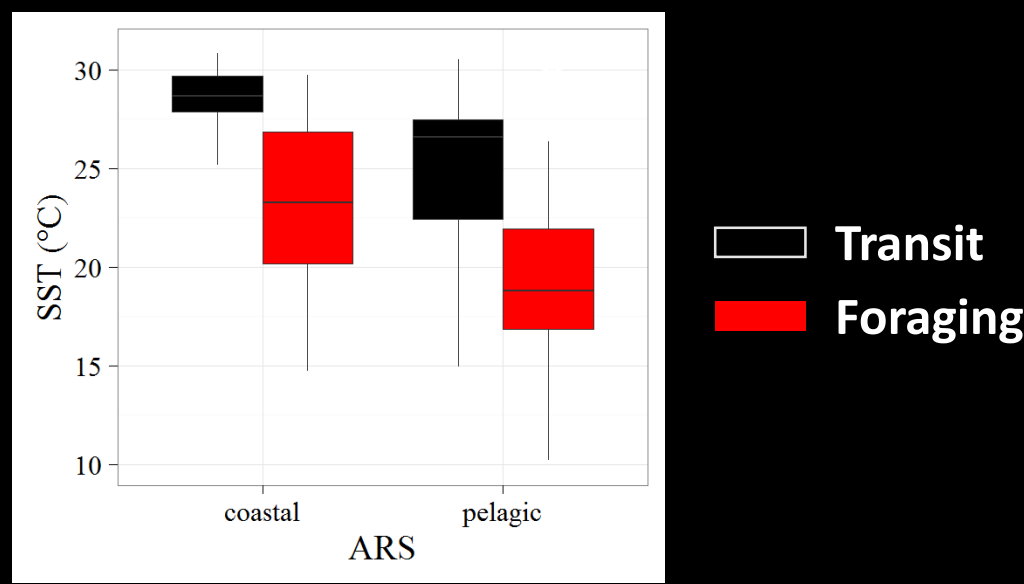
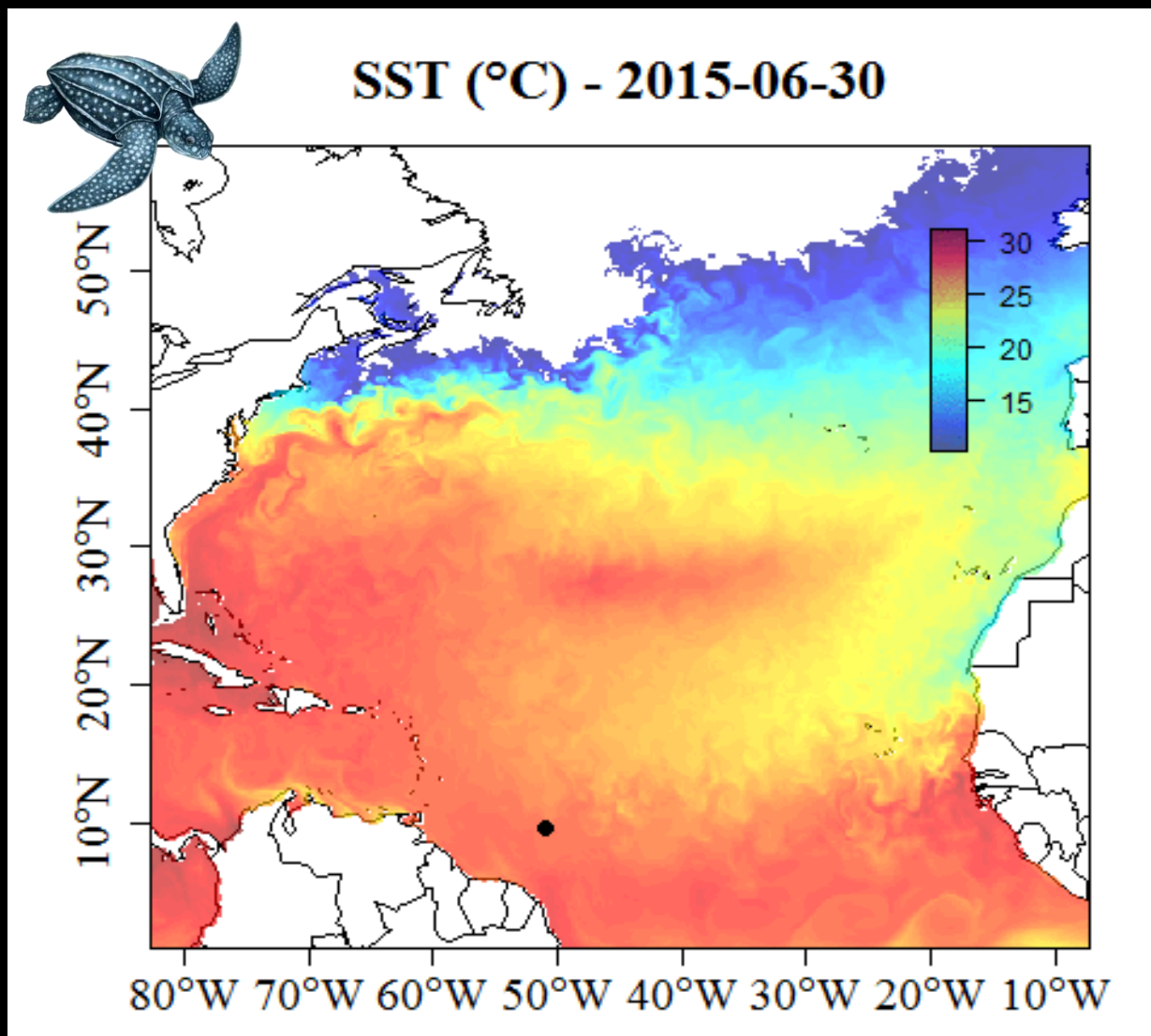




- Depending on the mixing layer & thermocline
- Depth ↘
- **Transiting:** within the thermocline
- **Foraging:** within the mixing layer depth

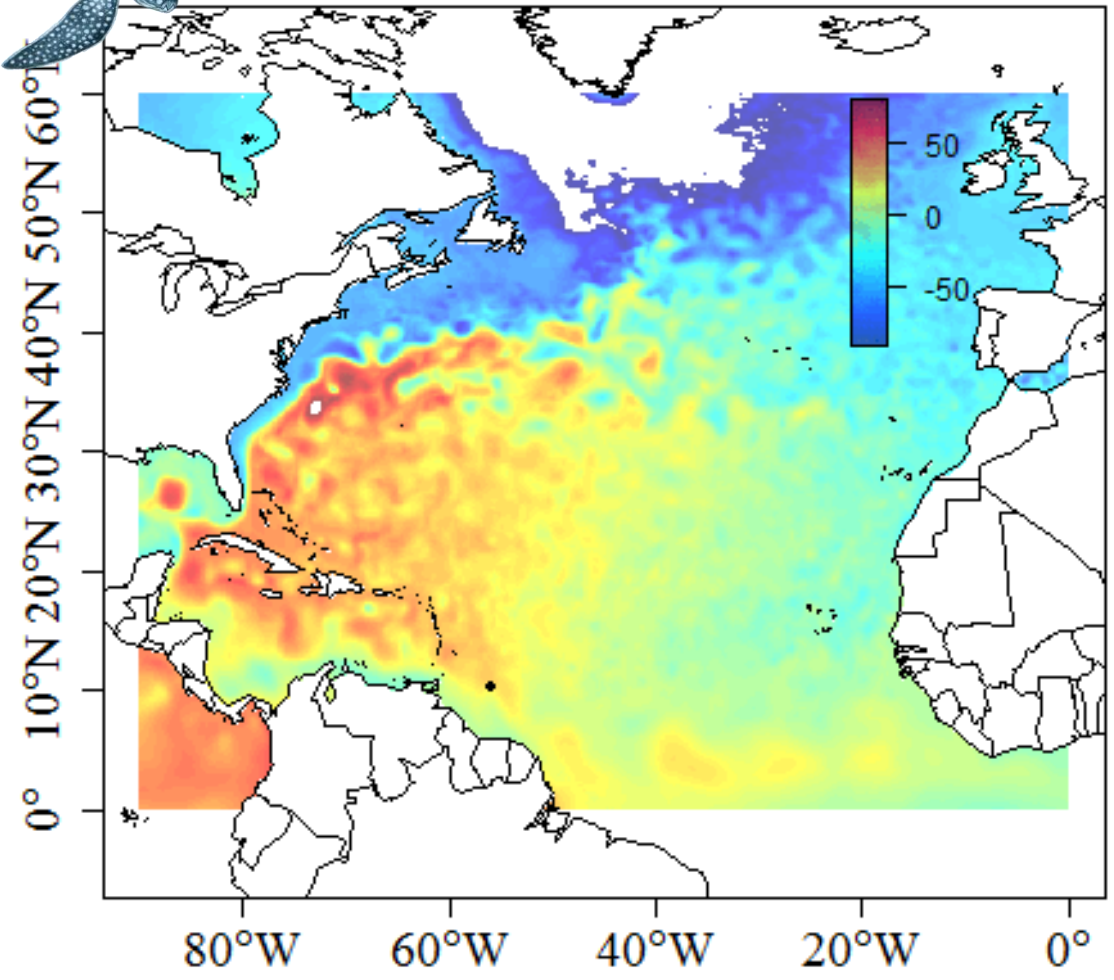
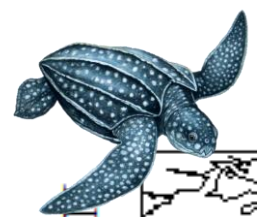


→ MLD : productive layer rich in prey

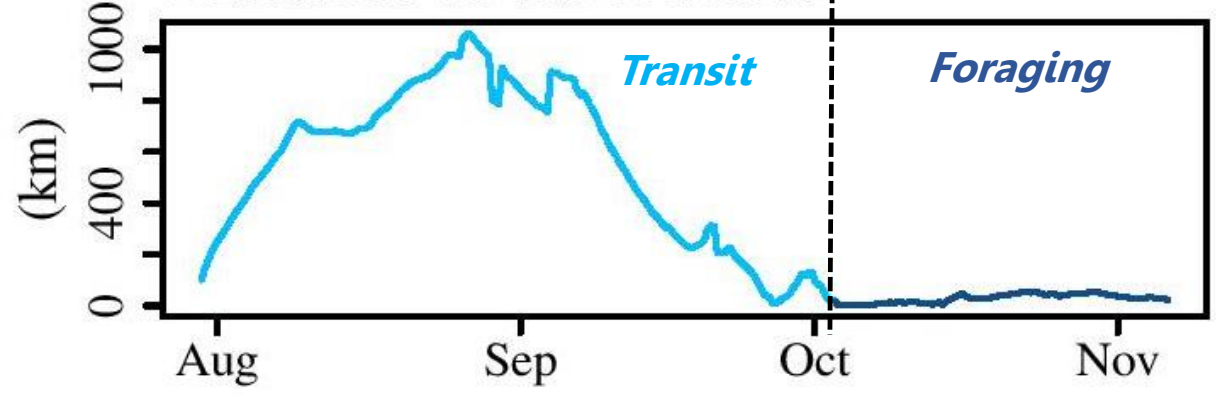


➤ Target cold temperatures during foraging

SSH (cm) 2015 - Day 7

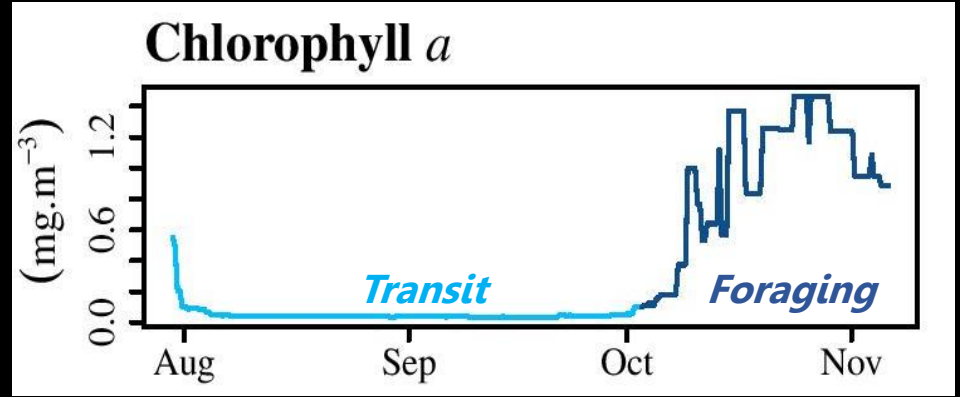
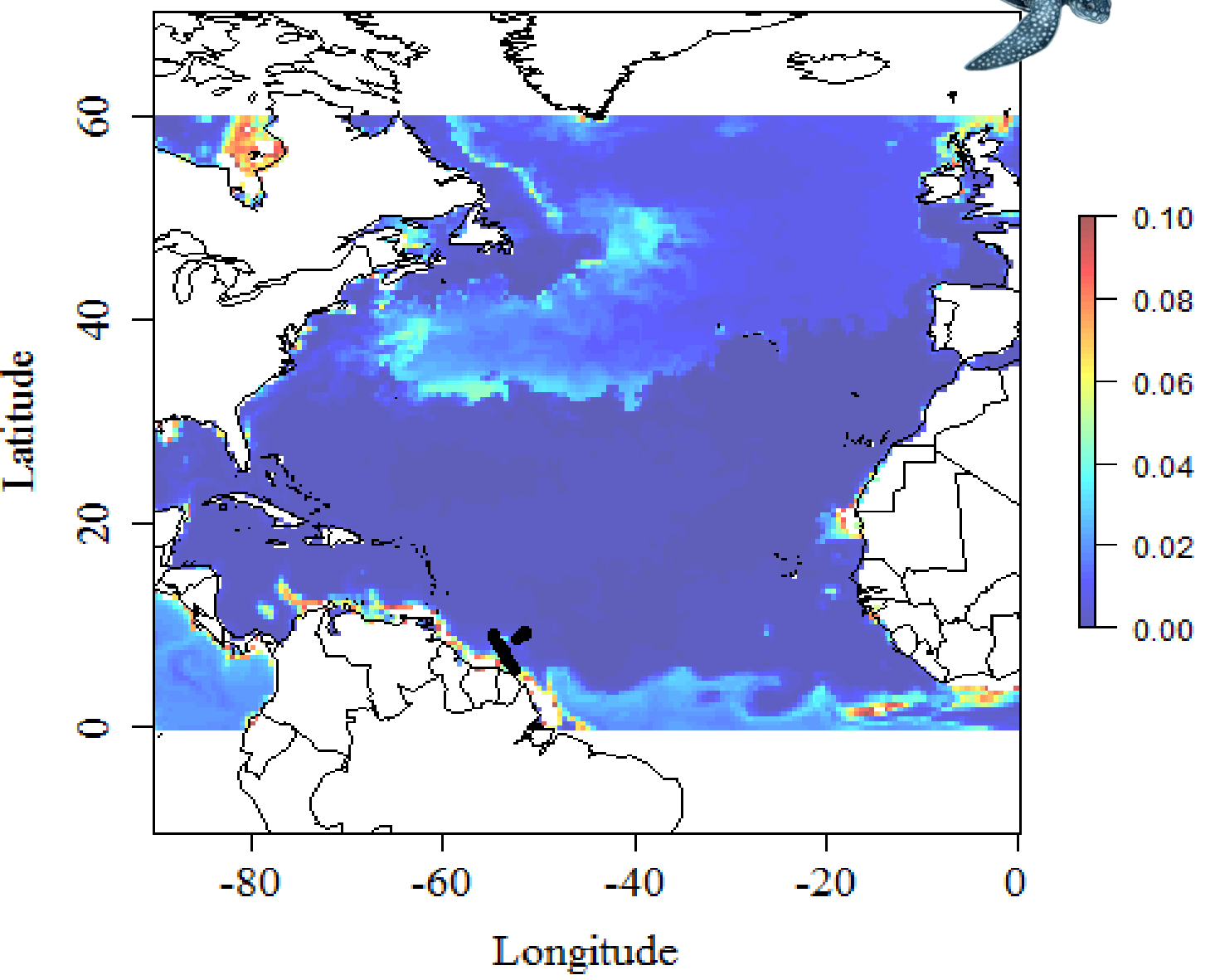
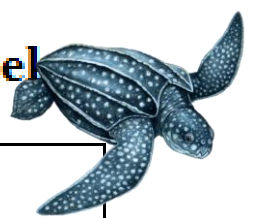


Distance to SSH front



➤ **Target front areas during foraging**

Primary productivity (g/m³/day) - Week



➤ Synchronization with phytoplanktonic bloom

Feeding

Local habitat conditions



✓ Deployment of camera-loggers

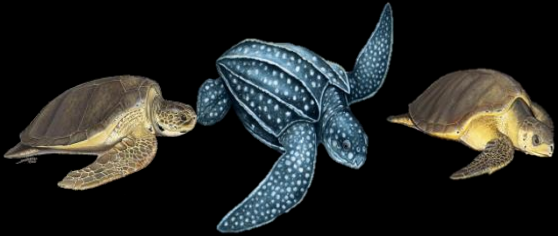
Camera loggers

3D Accelerometer, Magnetometer, Gyroscope, Hydrophone, Pressure, Temperature, GPS



Feeding

Local habitat conditions



- ✓ Deployment of camera-loggers

Reproductive strategies?

Capital breeder

Income breeder

?

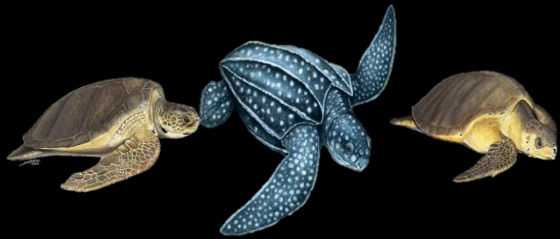


- ✓ *Isotopic analyzes*
- ✓ *Stomach contents*
- ✓ *Weighed*



Feeding

Local habitat conditions



- ✓ Deployment of camera-loggers

Reproductive strategy ?


Capital breeder *Income breeder*

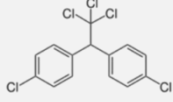
?

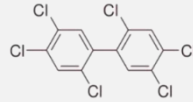


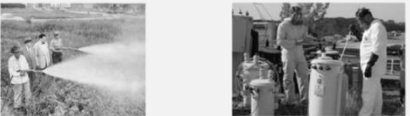
- ✓ *Isotopic analyzes*
- ✓ *Stomach contents*
- ✓ *Weighed*

Contaminants ?

Polluants Organiques Persistants (POPs) historiques 

Pesticides 

Polychlorobiphényles (PCBs) 



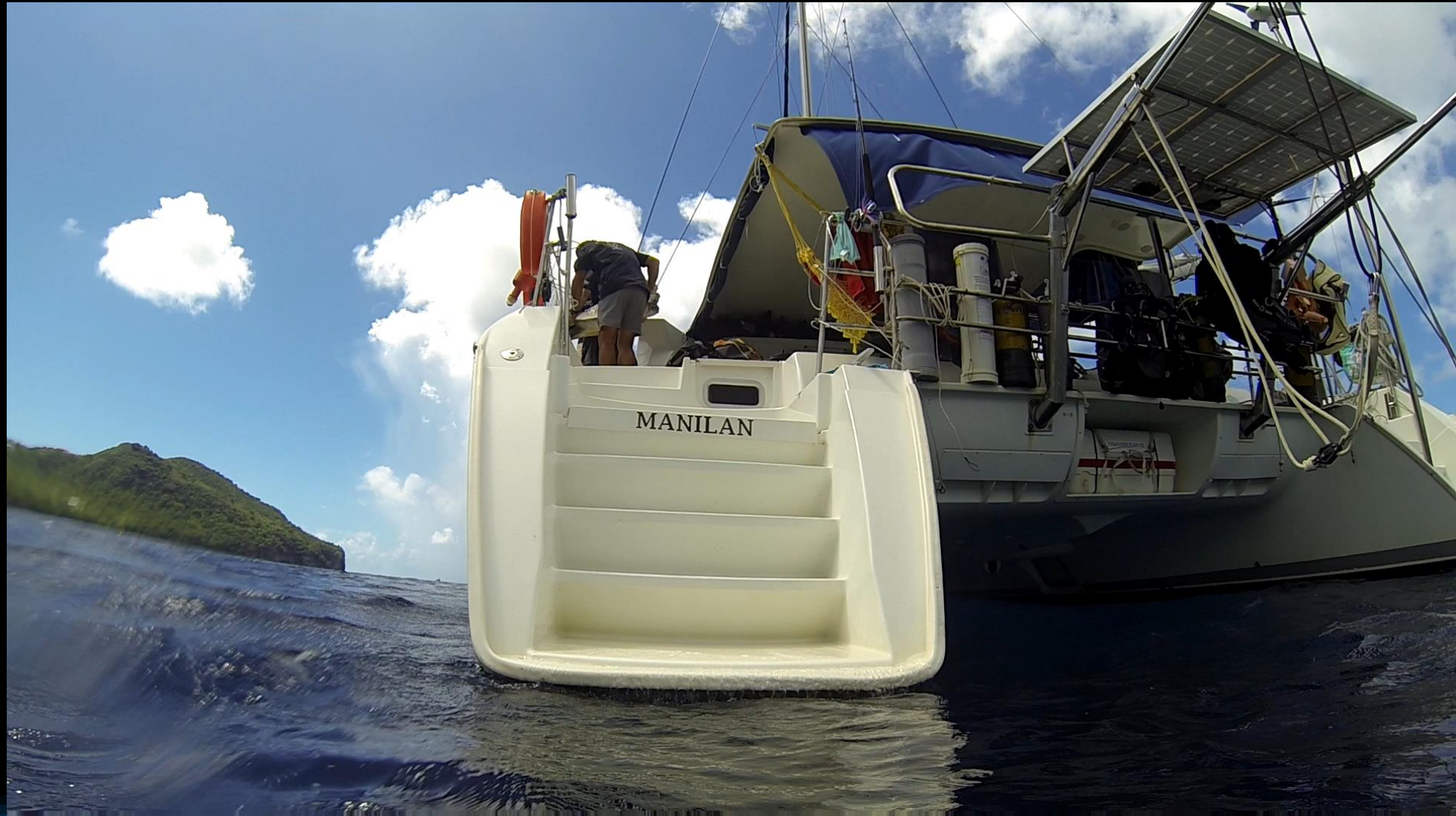
- ✓ Concentration in POP, Heavy metals

Sea turtles Monitoring



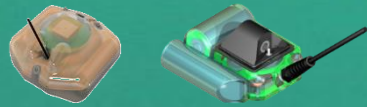
- ✓ *Extensive monitoring CMR*
- ✓ *Monitoring nest counting*

Thank you for your attention
and sorry for my beautiful accent



ANNEXE

Données *in situ* à partir des balises



- Température
- Salinité
- *Fluorescence*

Données satellitales & Modèles de simulation



Courants
SST
SSS
SSH
Chl *a*
MLD



Filaments
Fronts

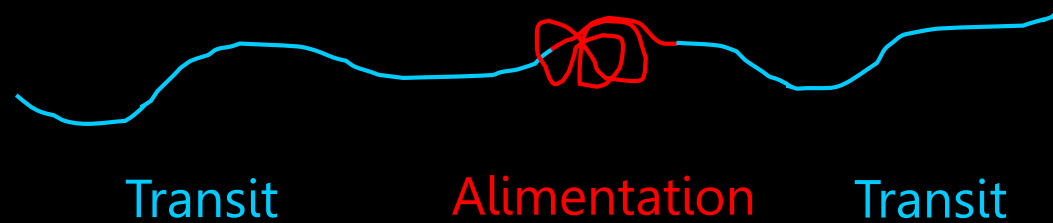


SEAPODYM

Micronekton
Euphotic
Profondeur

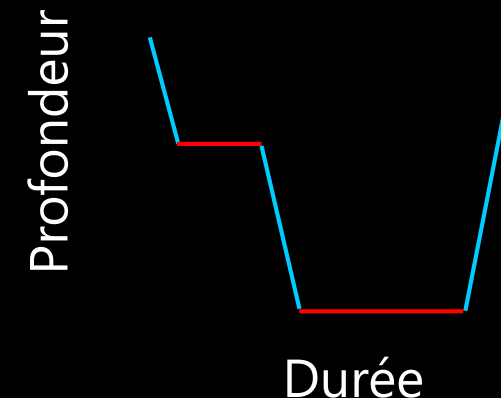


- **Food prospecting activity in the horizontal dimension**¹ (Residence time analysis)



- **Food prospecting activity in the vertical dimension** (Allocation at Depth (TAD) index)

- Hunting time index (Hunting time ²)
- Vertical speed threshold
- 2 modes: **Transit** vs. **Food**
- Hunting time (min) & hunting depth (m)



¹ Barraquand & Benhamou (2008), ² Heerah et al. (2014 & 2015)