Findings from 111 satellite tags deployed on Indian Ocean billfish during the FLOPPED project

Anne-Elise Nieblas, Serge Bernard, Blandine Brisset, Maxime Bury, Jérémie Chanut, Thomas Chevrier, Rui Coelho, Yann Colas, Hugues Evano, Cyril Faure, et al.
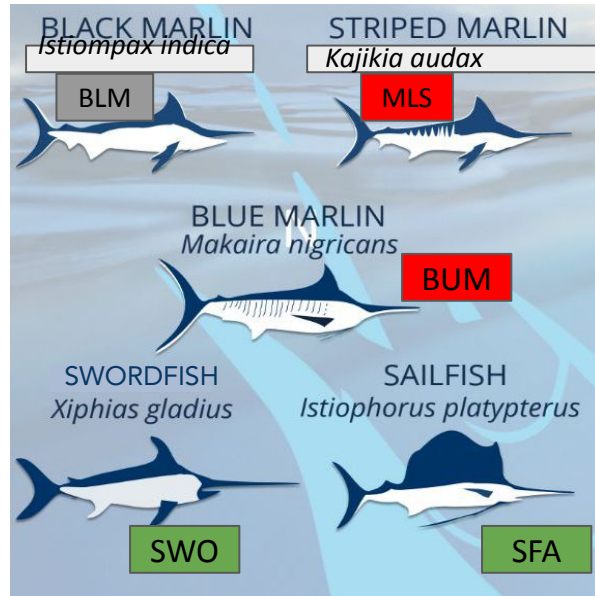
Findings from 111 satellite tags deployed on Indian Ocean billfish during the FLOPPED project (2019-2023)

Anne-Elise NIEBLAS[1], Serge BERNARD[2], Blandine BRISSET[3], Maxime BURY[4], Jérémie CHANUT[1], Thomas CHEVRIER[1], Rui COELHO[5], Yann COLAS[6], Hugues EVANO[3], Cyril FAURE[7], Gaëtan HERVÉ[8], Vincent KEZERHO[2], Amelie NITHARD[3], Ross NEWTON[9], Tracey NEWTON[9], Tristan ROUYER[3], Sean TRACEY[11], J. Worthington[12], Sylvain BONHOMMEAU[3]

8 Oringa, MYT

FINDING LARGE OCEANIC PELAGIC PREDATORS' ENVIRONMENTAL DISTRIBUTION

5 BILLFISH SPECIES in the Indian Ocean

BLACK MARLIN
Istiompax indica
BLM

STRIPED MARLIN
Kajikia audax
MLS

BLUE MARLIN
Makaira nigricans
BUM

SWORDFISH
Xiphias gladius
SWO

SAILFISH
Istiophorus platypterus
SFA

ADULT STOCKS

LIFE CYCLE

JUVENILES

REPRODUCTION & EGG-LAYING

STATE OF CONCERN FOR 4 SPECIES

GROWTH HABITATS OF YOUNG STAGES (LARVAE & JUVÉNILES) WITH HIGHT NATURAL MORTALITY

BREEDING AREAS & SEASONS

RESEARCH **PRIORITY** OF THE **INDIAN OCEAN TUNA COMMISSION** : ENABLING **SUSTAINABLE EXPLOITATION** OF THESE 5 SPECIES

MULTIDISCIPLINARY APPROACH TO INVESTIGATE THE BREEDING AREAS OF INDIAN OCEAN BILLFISH

IDENTIFY **THE BREEDING AREAS** AND **PERIODS** OF BILLFISH

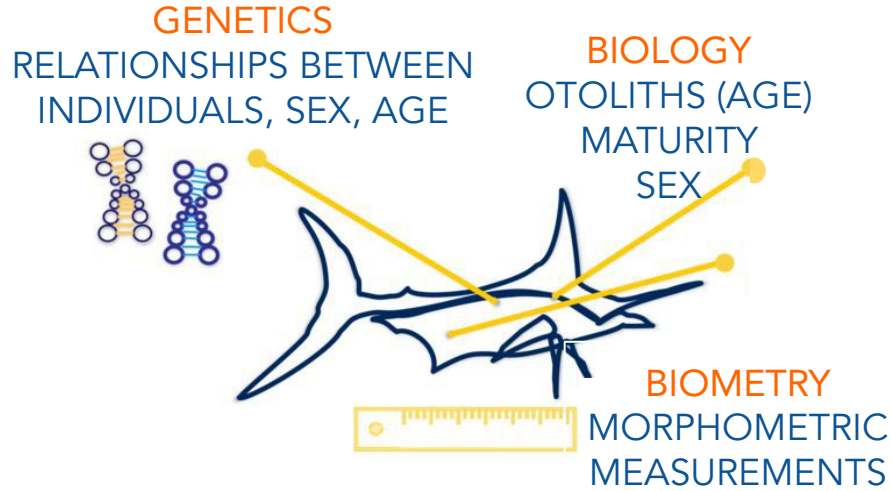DETERMINE THE SIZE OF BREEDING POPULATIONS WITHIN BREEDING AND SPAWNING AREAS

DETERMINE **KINSHIP RELATIONSHIPS** BETWEEN INDIVIDUALS TO ASSESS **LEVELS OF CONNECTIVITY** BETWEEN DIFFERENT BREEDING AREAS
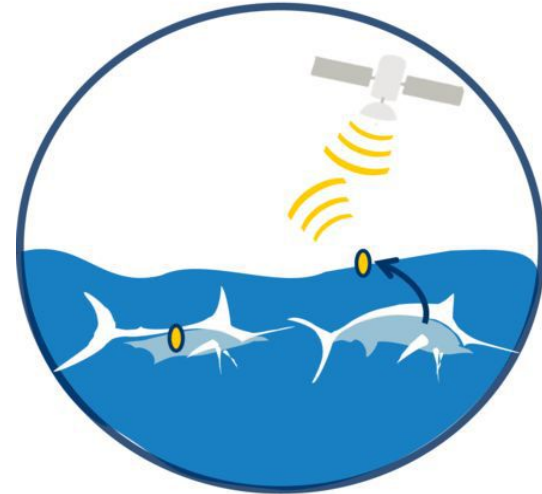
DETERMINE BILLFISH LARVAE **ORIGIN**
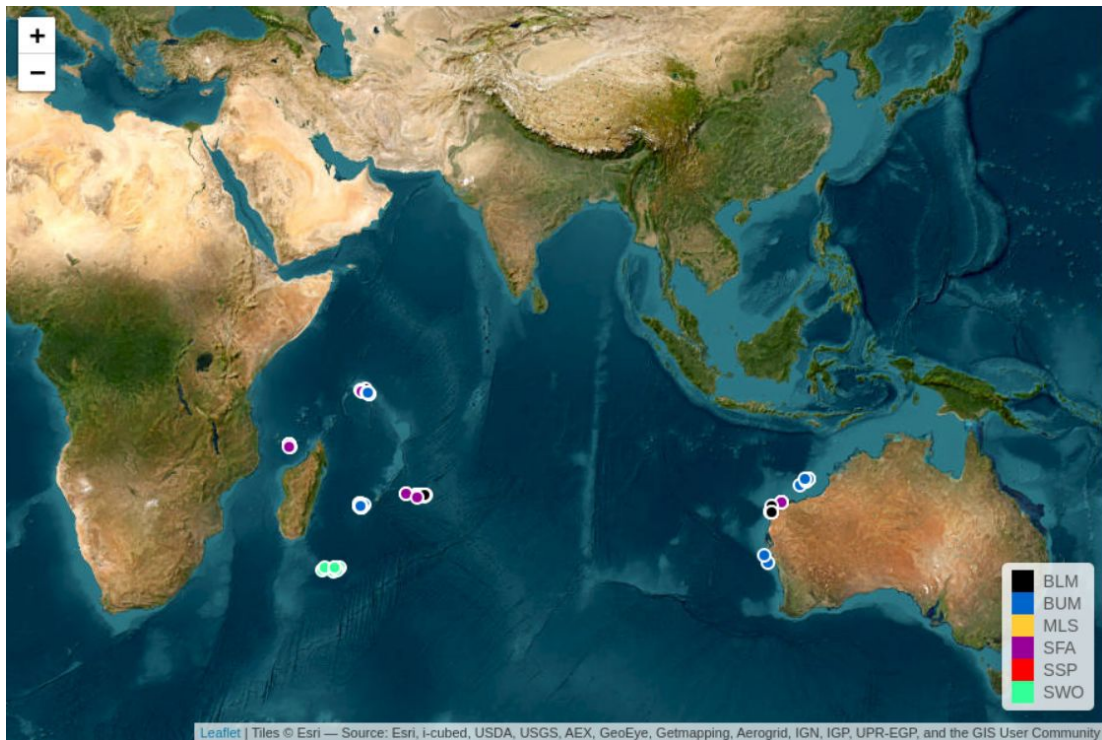
METHODS TO BETTER UNDERSTAND THE 5 BILLFISH SPECIES

GENETICS
RELATIONSHIPS BETWEEN
INDIVIDUALS, SEX, AGE

BIOLOGY
OTOLITHS (AGE)
MATURITY
SEX

BIOMETRY
MORPHOMETRIC
MEASUREMENTS

OCEAN MODELLING

LARVAL ORIGIN AND DRIFT

SATELLITE TAGGING

100 SATELLITE TAGS (20 PER SPECIES)
IDENTIFICATION OF MOVEMENT DURING
BREEDING PERIODS

111 TAGS AROUND THE INDIAN OCEAN


SITES OF TAG DEPLOYMENTS BY SPECIES

Legend:
- BLM (black)
- BUM (blue)
- MLS (yellow)
- SFA (purple)
- SSP (red)
- SWO (green)

TAG DEPLOYMENTS BY:
- COOOL, IFREMER TEAMS
- OBSERVERS and SCIENTISTS
- RECREATIONAL FISHERS

- SEYCHELLES
- AUSTRALIA
- MAYOTTE
- RODRIGUES
- GRAND SUD RÉUNION
- RÉUNION
- INDONESIA
- SRI LANKA
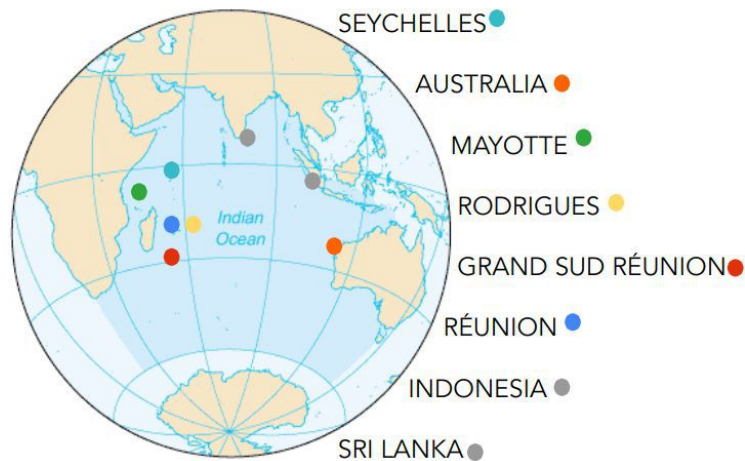
Indian Ocean

111 TAGS AROUND THE INDIAN OCEAN

1) WILDLIFE COMPUTERS PSAT TAG
2) ANCHOR : LARGE DOMEIER
3) FLUOROCARBON LINE 120/100
4) STAINLESS STEEL SLEEVE

Line length	Size of fish
8 cm	50-60 kg
10 cm	>60kg <140 kg
13 cm	>140 kg
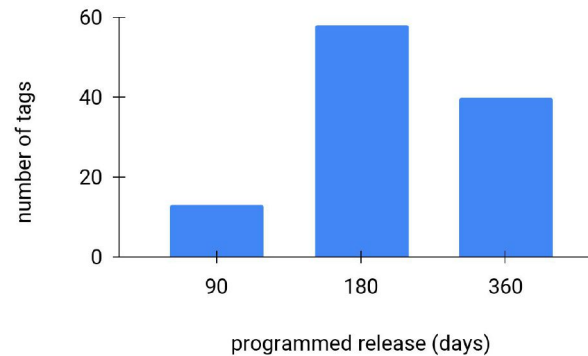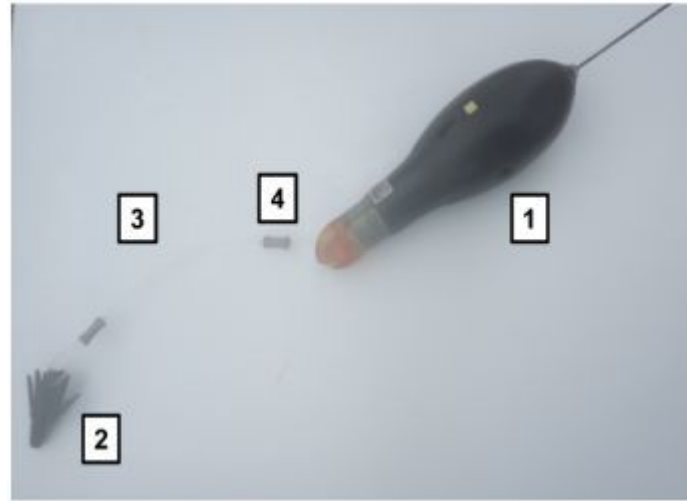
TAGS PROGRAMMED BETWEEN 90-365 DAYS

111 TAGS AROUND THE INDIAN OCEAN

TAGGING EVENT

PROTOCOL COMMUNICATED

1. VIDEO THE TAGGING EVENT
2. ROD-AND-REEL (BUM,BLM,MLS,SFA), LONGLINE (SWO)
3. FISH BROUGHT ALONGSIDE
4. ASSESS FISH FITNESS
5. CONTROL AND PRESENT BROAD TARGET TO TAG
6. CAREFULLY PLACE TAG AND PUSH FIRMLY IN THE *OPTIMAL TAG ZONE*
7. ESTIMATE LENGTH
8. REMOVE HOOK/CUT LINE
9. REVIVE FISH
10. FILL OUT TAGGING FORM

STEP 5 - TARGET THE OPTIMAL TAGGING ZONE (2)
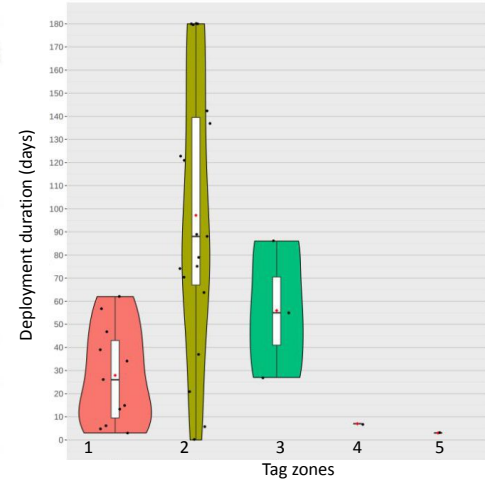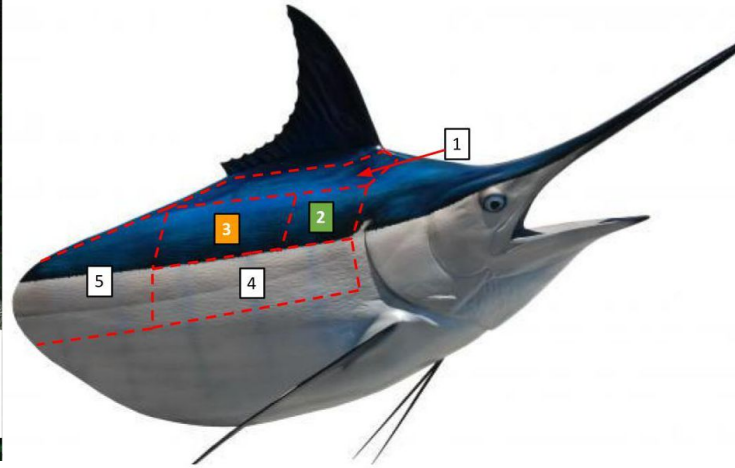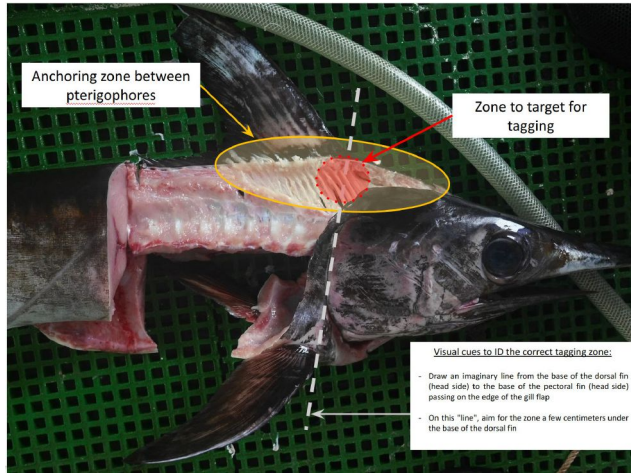
TARGET THE PTERYGIOPHORES
(SWO PICTURED)

OPTIMAL TAGGING ZONES (2 AND 3)
(BUM PICTURED)

DEPLOYMENT DURATION
BY TAGGING ZONE

111 TAGS AROUND THE INDIAN OCEAN
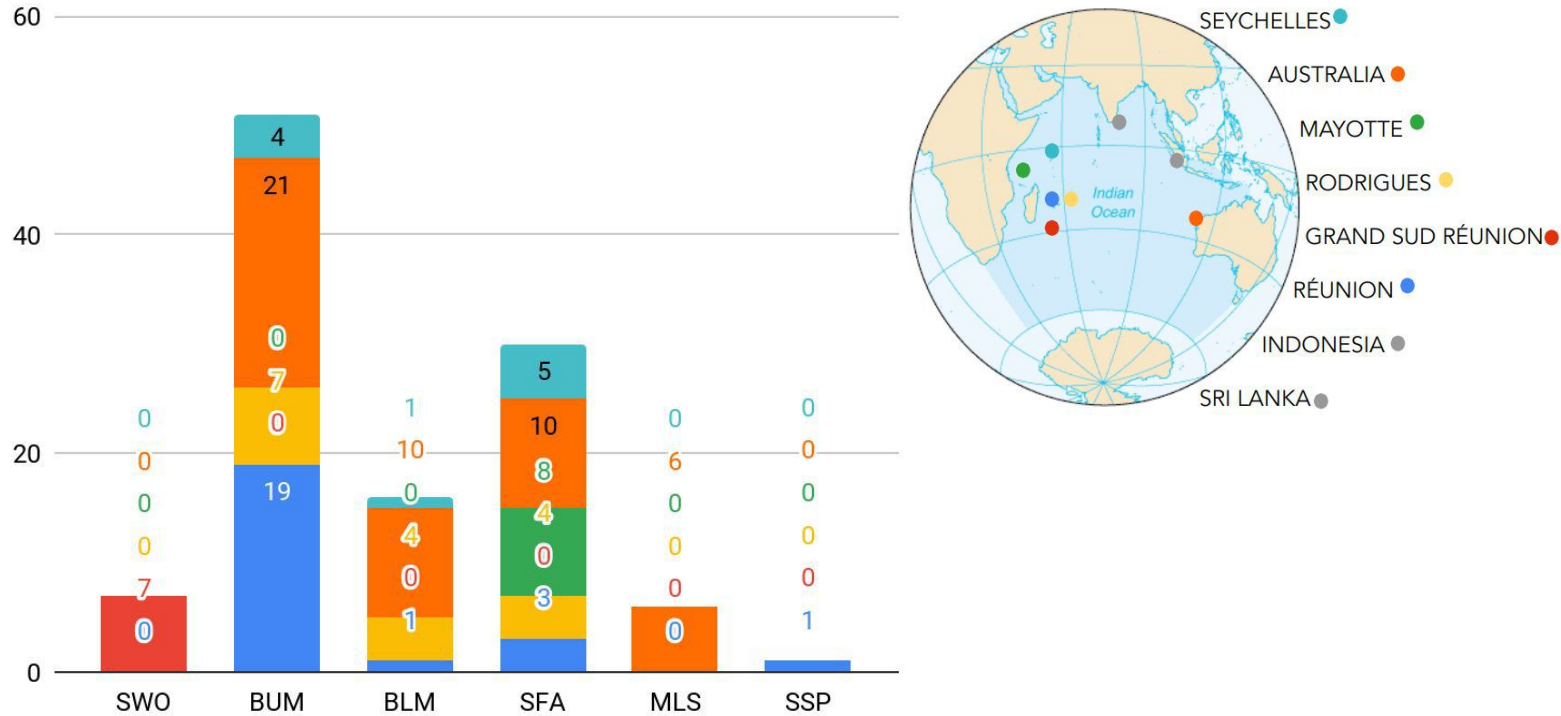
NUMBER OF TAGS DEPLOYED BY SPECIES AND INDIAN OCEAN SITES (N=111 TOTAL)

111 TAGS AROUND THE INDIAN OCEAN

Tags programmed to pop after 3-12 months
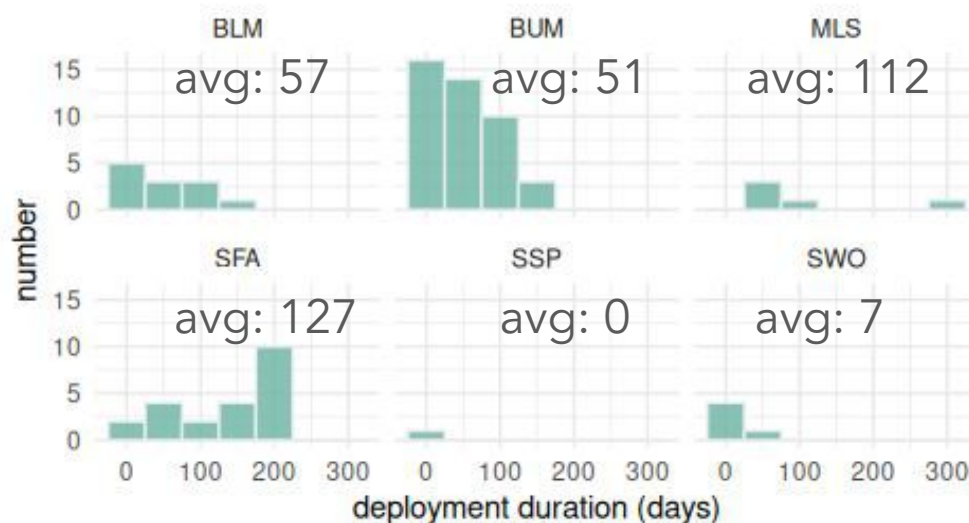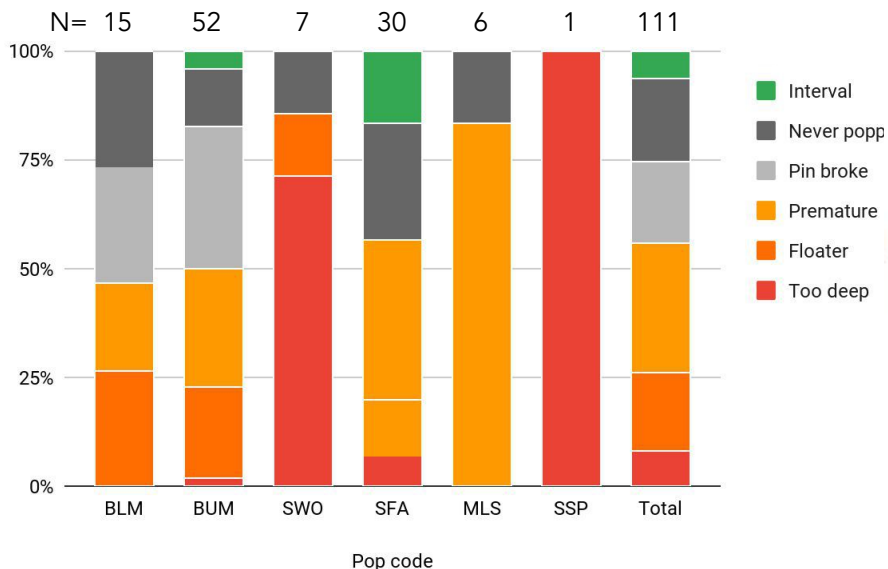
POP CODES OF TAGS DEPLOYED BY SPECIES.
TOO DEEP = LIKELY MORTALITY,
FLOATER/PREMATURE = LIKELY MORTALITY/ANCHORING ISSUE
PIN BROKE & NO INFORMATION = MANUFACTURING ERROR
INTERVAL = RELEASED AS PROGRAMMED

HISTOGRAM of PROGRAMMED AND ACHIEVED
DEPLOYMENT DURATION
MAX DEPLOYMENT: 300 DAYS
AVERAGE DEPLOYMENT: 67 DAYS
AVERAGE OF PROPORTION OF PROGRAMMED TIME: 36%
TOTAL NUMBER OF DAYS AT SEA: 6415.5
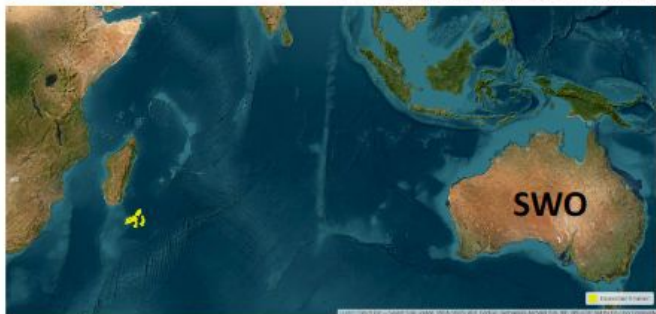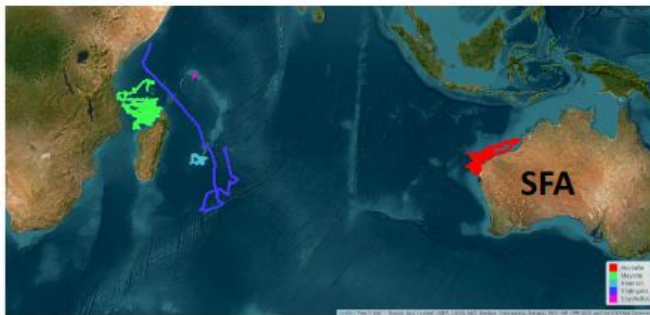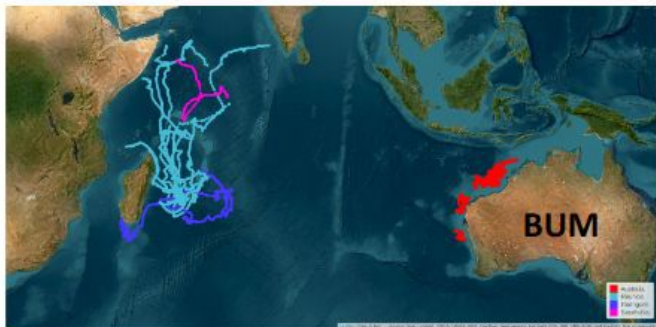
TRAJECTORIES SHOW DIFFERENT BEHAVIOURS BETWEEN EAST AND WEST

BUM
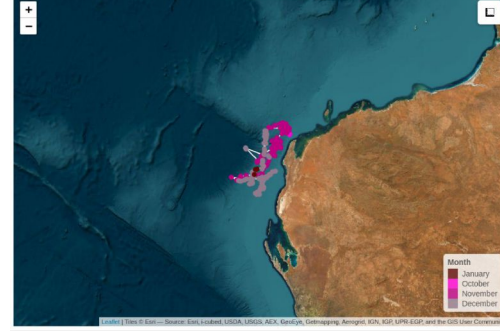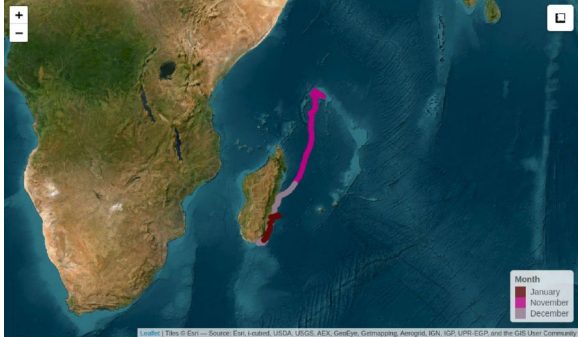
E-W DIVIDE IN BEHAVIOURS

WEST SIDE VARIABLE, MAJORITY S>N DURING PRESUMED SPAWNING PERIOD, BUT SOME RESIDENCY, N>S
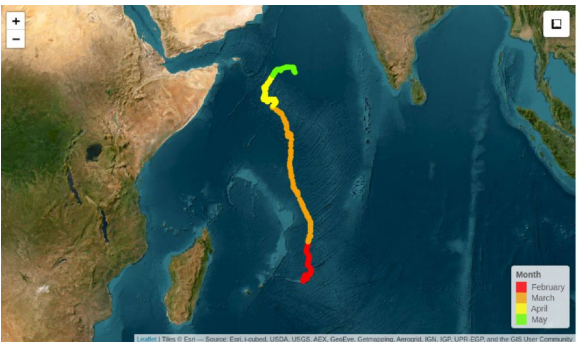
EAST SIDE HIGHER RESIDENCY
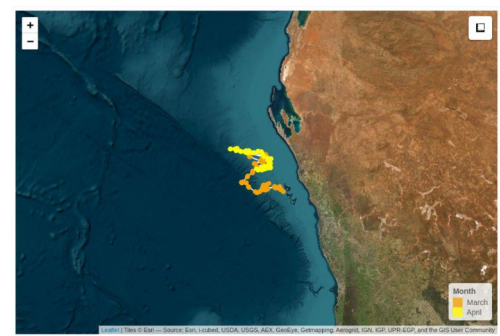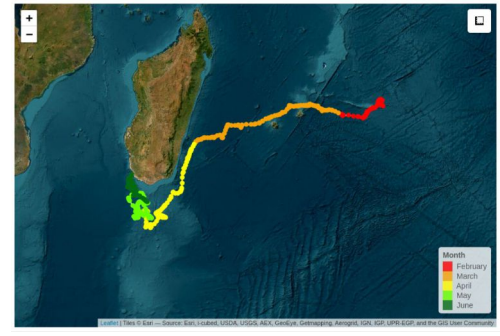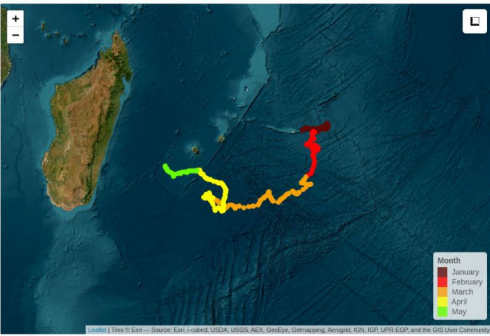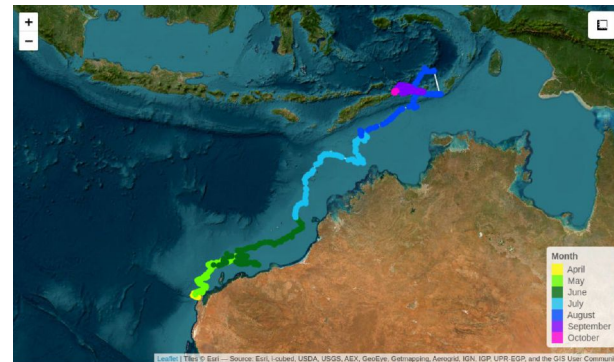
N > S
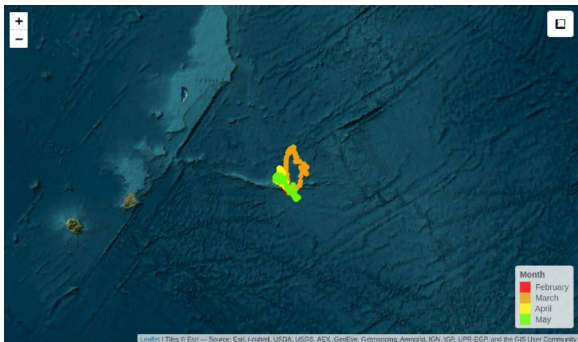
LITTLE DISPLACEMENT

S > N

BLM

VARIABLE BEHAVIOR DURING PRESUMED SPAWNING PERIOD (NOV-MAR) IN WEST
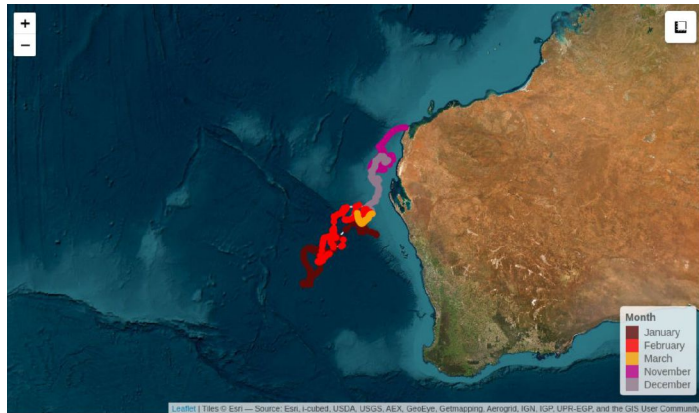
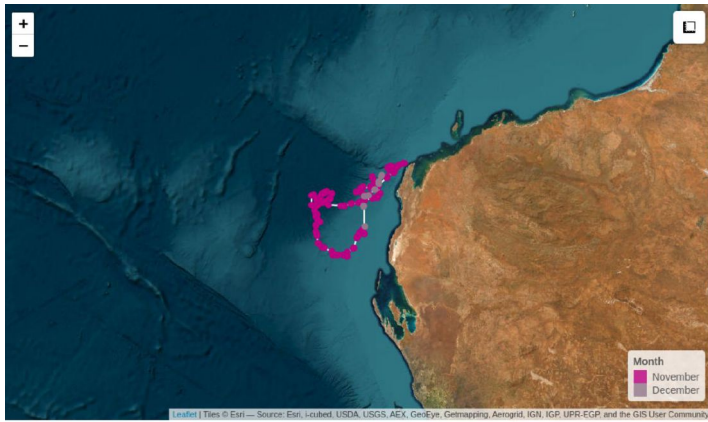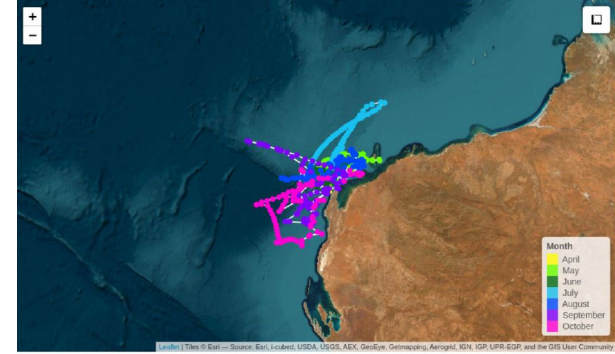MIGRATION THRU INDONESIA IN EAST

MLS

ALL TAGS IN EAST BASIN
REMAIN ON/NEAR SHELF

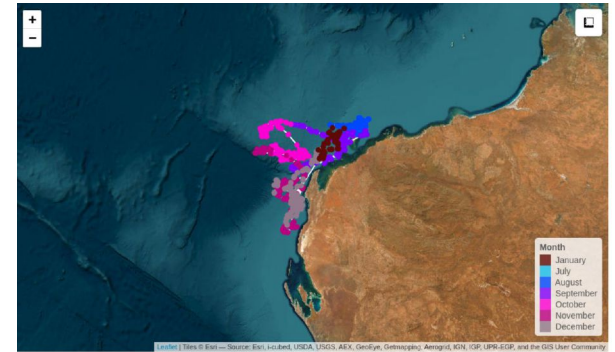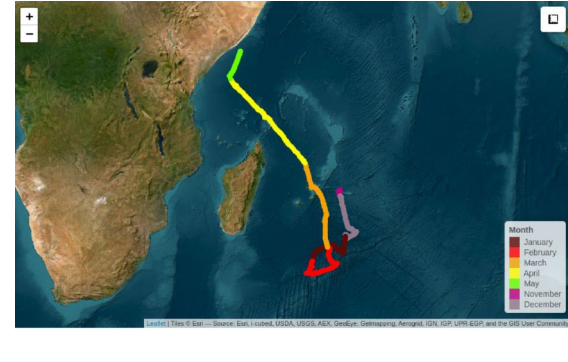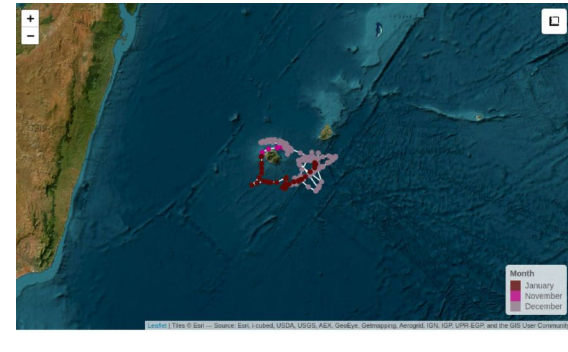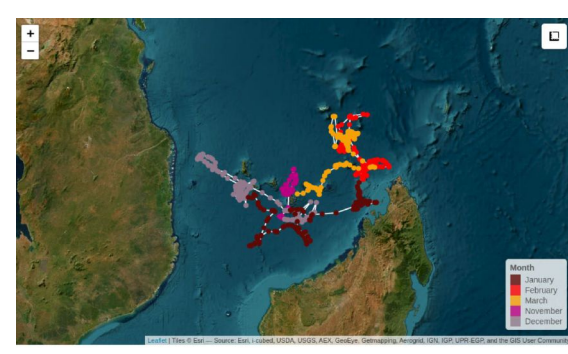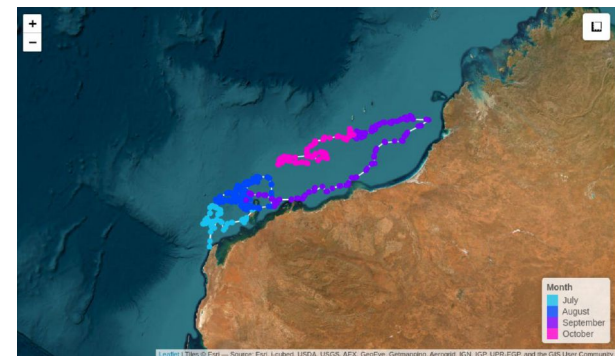AND ONE POP AFTER 1 YEAR WITHOUT
DATA TRANSMISSION OFFSHELF

SFA

HIGH RESIDENCY
AROUND
MAYOTTE/COMOROS

REUNION

ALL TAGS IN EAST
BASIN REMAIN
ON/NEAR SHELF

LARGE
DISPLACEMENTS
OBSERVED

HOUR OF THE DAY
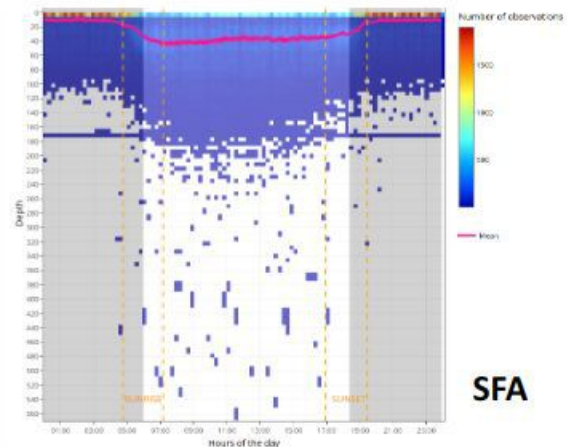
DEPTH (M)

DIEL VERTICAL MIGRATION
OBSERVED FOR ALL SPECIES

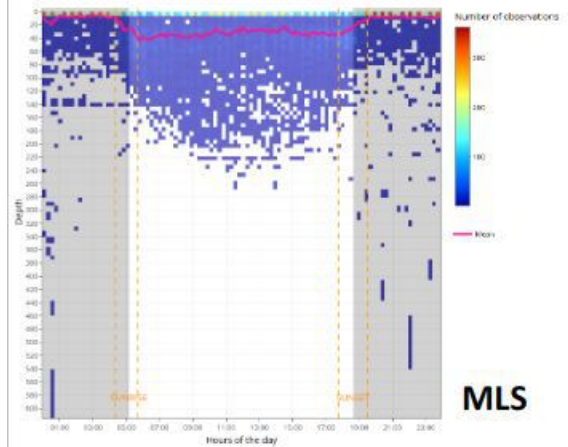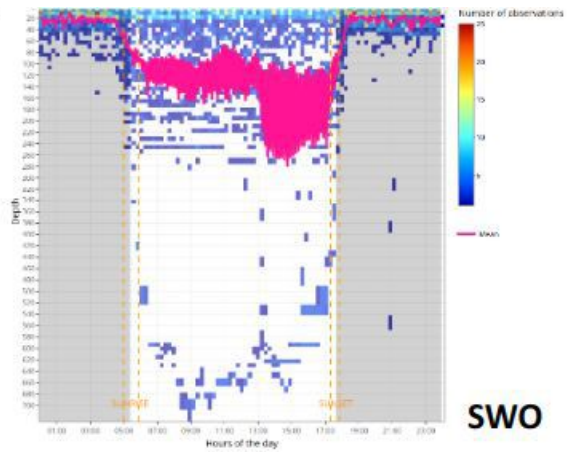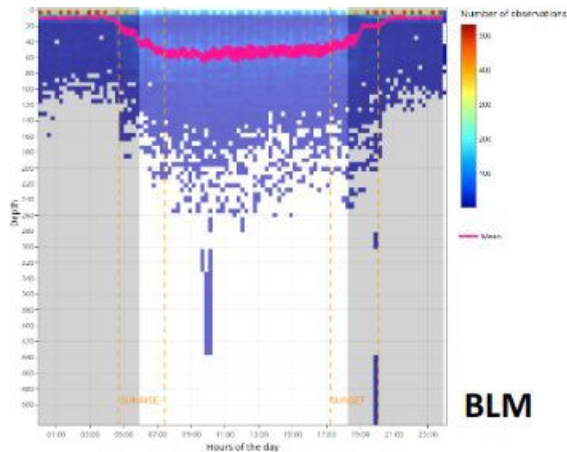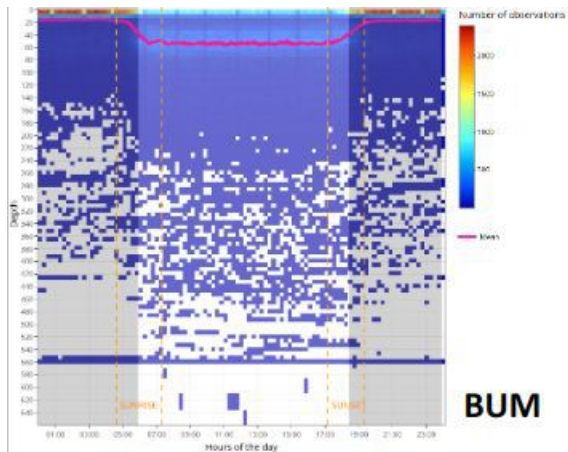| SPECIES	DAYTIME DEPTH (M)	NIGHTTIME DEPTH (M)
SWO	100-250	20-40
BUM, BLM	60	10-20
MLS, SFA	40	10-20

BUM · BLM · SWO · MLS · SFA

NIGHT · SUNRISE · DAY · SUNSET · NIGHT

Depth (m)

Mean depth per hour by month
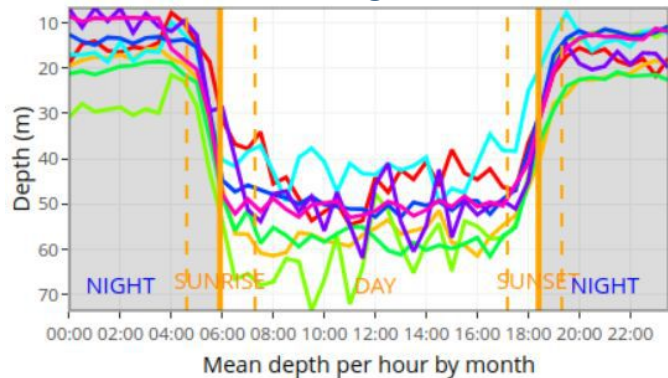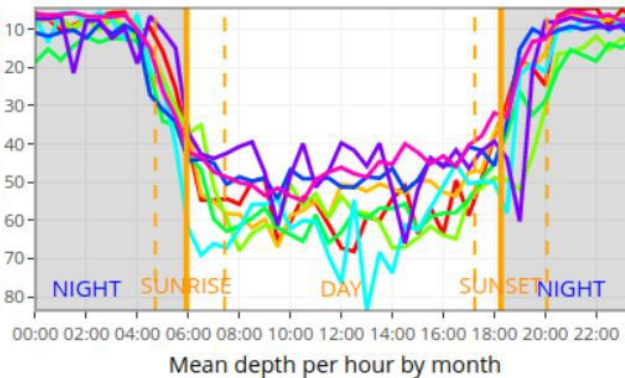
Legend:
- New Moon
- Waxing Crescent
- First Quarter
- Waxing Gibbous
- Full Moon
- Waning Gibbous
- Last Quarter

LITTLE EFFECT OF MOONPHASE

111 TAGS AROUND THE INDIAN OCEAN

VARIABLE BEHAVIOURS BETWEEN SPECIES, BASINS

WEST BASIN SHOWS HIGHER VARIABILITY IN HORIZONTAL DISPLACEMENTS
- NORTHWARD MIGRATION TO PRESUMED SPAWNING AREA OFF SOMALIA
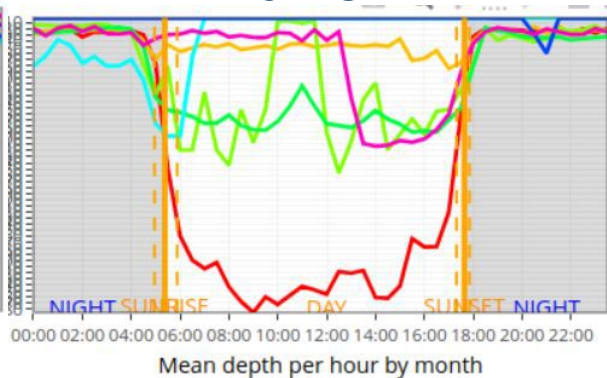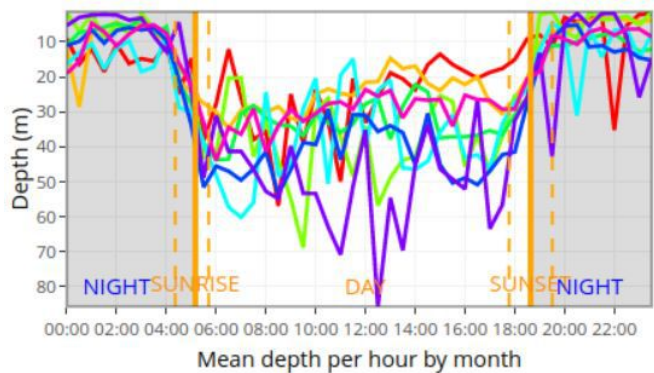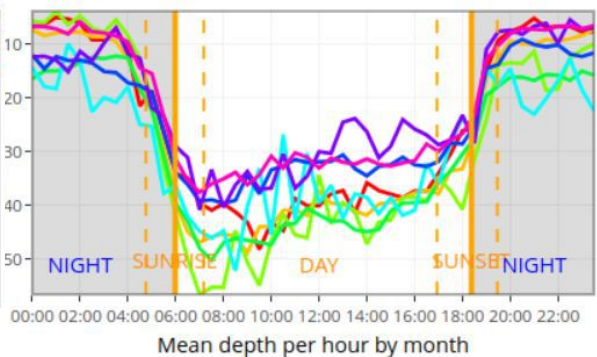   - MOST OBSERVED IN BUM
- SOUTHWARD MIGRATIONS TOWARDS FEEDING GROUNDS
    - BUM, BLM
- RESIDENT BEHAVIOR, SMALL HORIZONTAL DISPLACEMENTS
    - ALL SPECIES, PARTICULARLY SFA

EAST BASIN TAGS STAY PRIMARILY ON/NEAR CONTINENTAL SHELF
- POTENTIALLY MIGRATION THRU INDONESIA (BLM)

DIEL VERTICAL MIGRATION SIMILAR TO OTHER STUDIES

NO CLEAR EFFECT OF MOONPHASE

111 TAGS AROUND THE INDIAN OCEAN

CONCLUSIONS

EXPENSIVE, HIGH EFFORT, and CAPACITY INVESTMENT

MANY TAG FAILURES (battery issues, no reporting)

FEW DATA FOR STOCK ASSESSMENT PURPOSES (but indication of movement between regions)

MORE DATA REQUIRED (e.g. longer trajectories)

COMPLEMENTARY METHODS REQUIRED (e.g. genetic studies)

111 TAGS AROUND THE INDIAN OCEAN
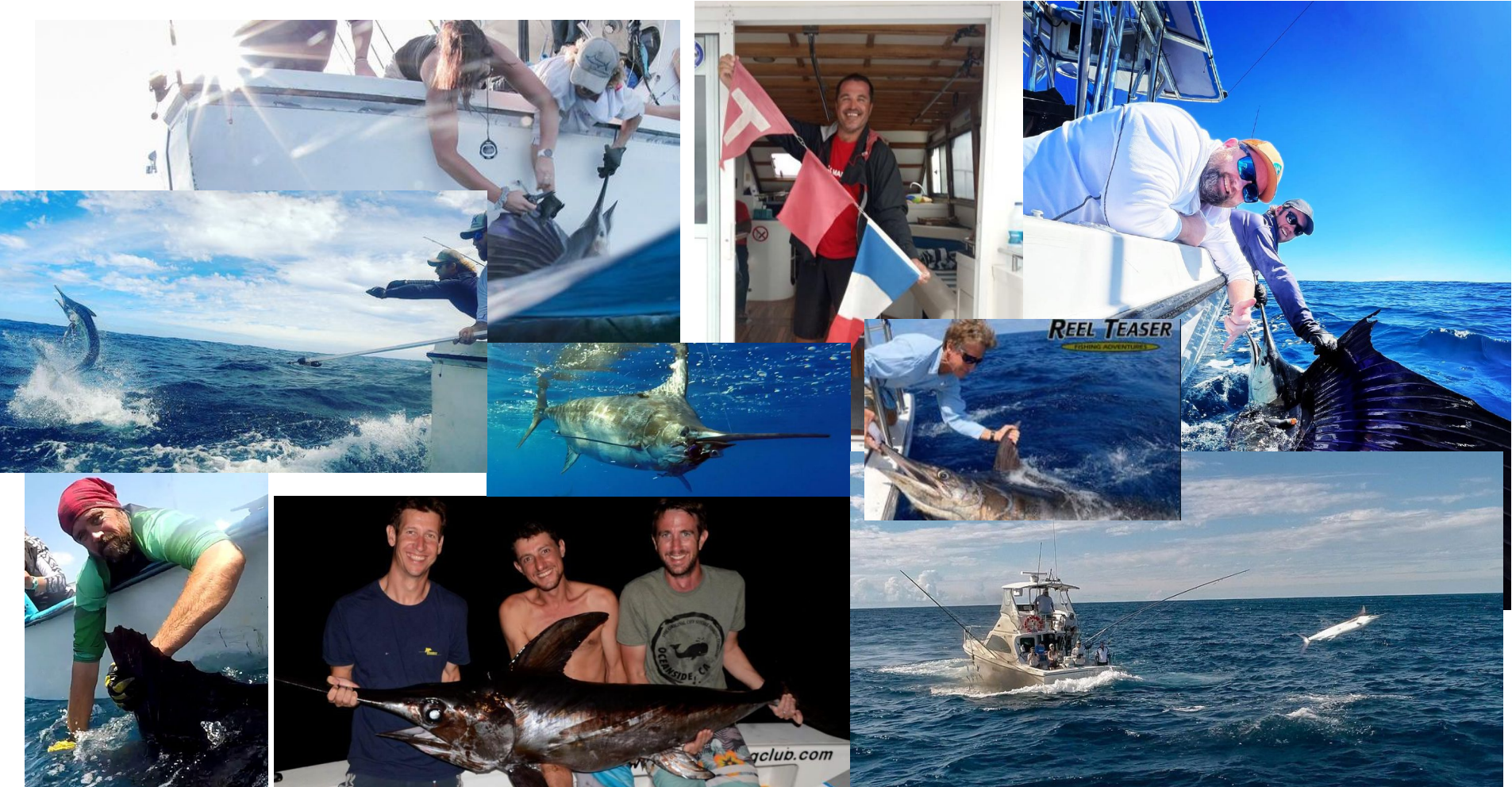
CURRENT AND NEXT STEPS

IN-DEPTH ANALYSES (ECOLOGY, HABITAT, BEHAVIOUR)

POST-RELEASE MORTALITY INDICATOR

STANDARDISED TAGGING DATABASE (e.g. NIEBLAS et al. 2019; LAM et al 2011)

DATA PAPER - SUBMIT DATA FOR OPEN USE

THANK YOU TO OUR PARTNERS AND COLLABORATORS

THANK YOU TO SYMPOSIUM COORDINATORS