Meeting Notes 9.5 May

Discussion: pilot study to test ADST on sharks, receiver setup not perfect but shows something

Sugarcoating: say what is already known about a species, then mentioning gaps and that you are going to fill them 🡪 Knowledge gaps, lead towards research questions

Finetune story

Rewrite skeleton & send them

Intro: gap in common knowledge on (seasonal) presence of M. asterias in the Scheldt,

Bridging that gap by combining DST logs and acoustic data in the Scheldt

Period of visit of the pupping grounds, we don’t know if female if pregnant or not, or if they go to the same area if she’s not pregnant

Discussion: suggest that based on the acoustic detections both sexes are

Ask Jan or Jolien about geolocation model outputs and how to include them (put in skeleton)

# of detections, #of individuals: heatmap with stations, maybe with map on the side showing receivers

* include 3rd array of receivers in the westerschelde

for the presentation on Friday: what info is the most sexy/relevant (for VLIZ) and understandable

* put some pics of the shark tagging
* make 1 figure of acoustic vs data storage tags

put horizontal distance into the thesis (jan and niels think it’s good)

come back to Jan about July

#### Female (tag 308)

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#### Male (tag 321)

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Description automatically generated

# What story do I want to tell?

1. ADST aspect
   1. Show the case of one adult female detected in 2 consecutive years, e.g. 308, and showing how the acoustic detections and the depthlogs and templogs can help to fill different knowledge gaps while complementing each other
      1. i.e. line plot with detections at stations
      2. case of 308: arriving & departing from birkenfels even though DST logging had stopped
      3. acoustic detections can inform geolocation models, especially in places where geolocation modelling is difficult such as highly mixed areas with relatively constant water depth, such as the BPNS
2. Interesting characteristics about the depthlogs of the sharks would be: firstly, die identification of high vs low vertical activity and secondly, the identification of migration times. Migration and high vertical activity might coincide, but not be exclusively different, i.e., the shark could be vertically active during the winter where it is thought to be somewhat residential.
   1. Vertical activity levels: Pedersen 2008

# What do my results show?

## Acoustic Data

* 1. Figure: heatmap with detections per station (and abacus plot with detections per individual?)
     1. Adult Females are present outside the Westerschelde, increasing the likelihood of the area being important for pupping
        + They come to the area between April and October and are not detected the rest of the year
        + There are sporadic detections inside the Westerschelde, but not further into the river than borssele
     2. Adult males are only sporadically present, both in summer and winter
  + Figure: abacus plot with detections per individual
    1. Both male and Female sharks return to the area
       - Mention the percentage of tags being detected in the year after tagging

## Data Storage Tags

* + **Figure: raw depthlogs f the long term dst logs**
    1. The female shark goes deeper than 68 m, the tag’s recording limit
    2. The vertical behaviour/depth use of both sharks shows seasonal patterns
  + **Figure**: **daily summary statistics**
    1. Same depth use during summer, then suddenly deeper depths (October, f and November, m), and progressively shallower depths
    2. Female: biweekly peaks of daily median depth in winter residency, male: same pattern but less defined, TODO: FFT of winter res with daily median!!, sample freq = 1/24?? = 1 sample per 24 h
  + **Figures**: **FFT of subset**s
    1. here: summer resting periods (with only 12h peak for the female and with 12 & 24 h peak for the male)
       - The male and the female sharks show different behaviours during summer months.
       - Discuss: male might be feeding or this might be courtship behaviour (but the male has a 24h period the whole summer through…so maybe rather feeding than courtship?
    2. winter migration
       - female shows 12 & 24 h peaks so they might both be feeding during night
       - the male only shows 24 h peak: feeding?
    3. Maybe compare summer resting period between 2018 and 2019, especially for the female to see if there is any difference that could lead to the assumption that she was pupping
  + **Figure**: **autocorrelation plots**
    1. both sharks show overall annual patterns, and are anticorrelated, indicating that their depth use is contrary every 6 months, shifting after ~2.5 months and ~8.5 months
  + **Figure: Wavelet plot of daily median**
    1. More large-scale patterns already visually detectable in the daily summary plots are confirmed here, such as the biweekly pattern in the winter residency of both sharks. The biweekly pattern is less visible for the male than the female but clearly shows in the wavelet scalogram, suggesting that both sharks have a biweekly activity cycles
       - 🡪 TODO (DONE): wavelet of daily depth range! Bc the range is smaller when the daily depth decreases in biweekly patterns, and this would signal less vertical acitivity
         1. Biweekly pattern very well seeable, and 5-7 day pattern in the same time period. Could mean that that is the duration of the low/high activity periods

1. Combination of acoustic detections and data storage logs
   * Figure: overlay of 308 summer ’19 depthlog and acoustic detections
     1. Added info with birkenfels entry and leaving in 2019
   * The tagging procedure might have an impact on the shark 🡪 not sure if I should mention this at all!
     1. 10 sharks are not detected at all, 2 only have 1 detection 🡪 does not necessarily mean that they die. But the likelihood is not 0 that they died
     2. From the 8 tags that returned so far, 6 sharks died within a month of tagging.

Discussion and Outlook

1. What we can do to improve geolocation models of M. asterias
   1. Do behavioural segmentation
      1. Tidal method like Pedersen 2008 and Griffiths 2020
   2. New boundary condition to mirror demersal behaviour: maximum depth of shark at a day == max. seafloor depth at that same day (prevents m. asterias from ‘swimming in the water column”
2. More investigation of adult females in the Western Scheldt in summer:
   1. Ideally: receiver at zoetelande, hormone samples to investigate if sharks are pregnant

* Look up: what’s the easiest way to tell if a shark Is present or not?
* What about abortion of pups if mother is tagged and that induces too much stress? Eg try to fish at the end of season and not directly at pupping grounds, also to avoid behaviour change due to tagging effects

1. Possible implications for species management
   1. Bottom trawling on coast between dishoek and zoetelande in summer months: not good
   2. Alternatively: try to fish some males as well? Avoid only fishing the females since this will destroy the stock in the longterm
      1. We need to know where exactly the males are in summer…Eg fish more out in the BPNS, not only on coastal area of the WS

# What I plan to put in the annex

## Data Storage Tags

### All depth and temperature logs of the retrieved tags

### Wavelet results of daily minimum and maximum depth

MAYBE PUT DEPTH RANGE INSTEAD OF MIN&MAX DEPTH

#### Female shark (tag 308)

Maybe don’t put min and max depth in the annex, and only include median depth and depthrange

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#### Male shark (tag 321)

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### CPD results (what do I do with that?)

A close-up of a graph

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# What I plan to exclude

* + Acoustic data depth use: mention at all?
  + Daily vertical migration behaviour

A screenshot of a graph

Description automatically generated with low confidence

**Master Thesis Structure**

1. Introduction
   1. Problem statement
      1. Relevance of understanding how fish move for economy, conservation & improved management
      2. Challenges involve migratory species
      3. Sharks are especially vulnerable to anthropogenic threats
   2. Aquatic Telemetry (cf. Section *2.1. Acquatic telemetry* in the manuscript*)*
2. Materials and Methods
3. Results
4. Discussion
   1. Data Storage Tags
      1. Potential lunar influences on winter vertical behaviour
         1. Match tidal range and potential location and look at tidal currents there (tidal range 3-4 m for tag 308 in January 2019)
5. Outlook

# Tidal currents

18.1.19

A screenshot of a computer

Description automatically generatedA black and red lines on a white background

Description automatically generated with low confidence

29.12.19

A screenshot of a computer

Description automatically generatedA picture containing sketch, art, drawing, child art

Description automatically generated

29.3.19

A screenshot of a computer

Description automatically generated

A picture containing text, diagram, line, font

Description automatically generated

A picture containing text, line, font, receipt

Description automatically generated

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Description automatically generatedA picture containing screenshot, colorfulness, line, diagram

Description automatically generated

Change point detection code manuscript

<!-- ### Change Point Detection -->

<!-- #### Tag 308 -->

<!-- <!-- A step of 2.5 % of the time vector's length amounts to `r rulsif\_308\_table\_2\_5percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif30825 and in @tbl-tblrulsif30825. -->

--\>

<!-- <!-- ```{r rulsif30825} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: fig-rulsif30825 --> --\>

<!-- <!-- #| layout-ncol: 1 --> --\> <!-- <!-- #| out-width: 95% -->

--\> <!-- <!-- #| fig-height: 1.5 --> --\>

<!-- <!-- #| fig-cap: "Rulsif results for tag 308, step = 2.5 %." -->

--\> <!-- <!-- #| fig-subcap: --> --\>

<!-- <!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

--\>

<!-- <!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

--\> <!-- <!-- #| fig-pos: "H" --> --\>

<!-- <!-- p\_308\_ribbon\_rulsif\_2\_5percent -->

--\>

<!-- <!-- p\_308\_scores\_rulsif\_2\_5percent -->

--\>

<!-- <!-- ``` -->

--\>

<!-- <!-- ```{r table-rulsif30825} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: tbl-tblrulsif30825 --> --\>

<!-- <!-- #| out-width: 40% --> --\>

<!-- <!-- #| tbl-cap-location: top --> --\>

<!-- <!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 2.5 % for tag 308 (f)." -->

--\>

<!-- <!-- knitr::kable(rulsif\_308\_table\_2\_5percent %>% dplyr::select(!c(CP\_period, step)), -->

--\> <!-- <!-- booktabs = T, escape = F, --> --\>

<!-- <!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

--\>

<!-- <!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

--\> <!-- <!-- ``` --> --\>

<!-- <!-- A step of 5 % of the time vector's length amounts to `r rulsif\_308\_table\_5percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif3085 and in @tbl-tblrulsif3085. -->

--\>

<!-- <!-- ```{r rulsif3085} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: fig-rulsif3085 --> --\>

<!-- <!-- #| layout-ncol: 1 --> --\> <!-- <!-- #| out-width: 95% -->

--\> <!-- <!-- #| fig-height: 1.5 --> --\>

<!-- <!-- #| fig-cap: "Rulsif results for tag 308, step = 5 %." --> --\>

<!-- <!-- #| fig-subcap: --> --\>

<!-- <!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

--\>

<!-- <!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

--\> <!-- <!-- #| fig-pos: "H" --> --\>

<!-- <!-- p\_308\_ribbon\_rulsif\_5percent -->

--\>

<!-- <!-- p\_308\_scores\_rulsif\_5percent -->

--\>

<!-- <!-- ``` -->

--\>

<!-- <!-- ```{r table-rulsif3085} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: tbl-tblrulsif3085 --> --\>

<!-- <!-- #| out-width: 40% --> --\>

<!-- <!-- #| tbl-cap-location: top --> --\>

<!-- <!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 5 % for tag 308 (f)." -->

--\>

<!-- <!-- knitr::kable(rulsif\_308\_table\_5percent %>% dplyr::select(!c(CP\_period, step)), -->

--\> <!-- <!-- booktabs = T, escape = F, --> --\>

<!-- <!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

--\>

<!-- <!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

--\> <!-- <!-- ``` --> --\>

<!-- A step of 10 % of the time vector's length amounts to `r rulsif\_308\_table\_10percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif30810 and @tbl-tblrulsif30810. -->

<!-- ```{r rulsif30810} -->

<!-- #| include: true -->

<!-- #| label: fig-rulsif30810 -->

<!-- #| layout-ncol: 1 -->

<!-- #| out-width: 95% -->

<!-- #| fig-height: 1.5 -->

<!-- #| fig-cap: "Rulsif results for tag 308, step = 10 %." -->

<!-- #| fig-subcap: -->

<!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

<!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

<!-- #| fig-pos: "H" -->

<!-- p\_308\_ribbon\_rulsif\_10percent -->

<!-- p\_308\_scores\_rulsif\_10percent -->

<!-- ``` -->

<!-- ```{r table-rulsif30810} -->

<!-- #| include: true -->

<!-- #| label: tbl-tblrulsif30810 -->

<!-- #| out-width: 40% -->

<!-- #| tbl-cap-location: top -->

<!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 10 % for tag 308 (f)." -->

<!-- knitr::kable(rulsif\_308\_table\_10percent %>% dplyr::select(!c(CP\_period, step)), -->

<!-- booktabs = T, escape = F, -->

<!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

<!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

<!-- ``` -->

<!-- <!-- ```{r} -->

--\> <!-- <!-- #| layout-ncol: 2 --> --\>

<!-- <!-- #| layout-valign: bottom --> --\>

<!-- <!-- #| cap-location: bottom --> --\>

<!-- <!-- #| fig-cap: "A plot" --> --\>

<!-- <!-- #| tbl-cap: "A table" --> --\>

<!-- <!-- library(knitr) -->

--\>

<!-- <!-- # plot on the left -->

--\> <!-- <!-- plot(cars) --> --\>

<!-- <!-- # table on the right -->

--\> <!-- <!-- kable(head(cars)) --> --\> <!-- <!-- ``` --> --\>

<!-- #### Tag 321 -->

<!-- <!-- A step of 2.5 % of the time vector's length amounts to `r rulsif\_321\_table\_2\_5percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif32125 and in @tbl-tblrulsif32125. -->

--\>

<!-- <!-- ```{r rulsif32125} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: fig-rulsif32125 --> --\>

<!-- <!-- #| layout-ncol: 1 --> --\> <!-- <!-- #| out-width: 95% -->

--\> <!-- <!-- #| fig-height: 1.5 --> --\>

<!-- <!-- #| fig-cap: "Rulsif results for tag 321, step = 2.5 %." -->

--\> <!-- <!-- #| fig-subcap: --> --\>

<!-- <!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

--\>

<!-- <!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

--\> <!-- <!-- #| fig-pos: "H" --> --\>

<!-- <!-- p\_321\_ribbon\_rulsif\_2\_5percent -->

--\>

<!-- <!-- p\_321\_scores\_rulsif\_2\_5percent -->

--\>

<!-- <!-- ``` -->

--\>

<!-- <!-- ```{r table-rulsif32125} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: tbl-tblrulsif32125 --> --\>

<!-- <!-- #| out-width: 40% --> --\>

<!-- <!-- #| tbl-cap-location: top --> --\>

<!-- <!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 2.5 % for tag 321 (f)." -->

--\>

<!-- <!-- knitr::kable(rulsif\_321\_table\_2\_5percent %>% dplyr::select(!c(CP\_period, step)), -->

--\> <!-- <!-- booktabs = T, escape = F, --> --\>

<!-- <!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

--\>

<!-- <!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

--\> <!-- <!-- ``` --> --\>

<!-- <!-- A step of 5 % of the time vector's length amounts to `r rulsif\_321\_table\_5percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif3215 and in @tbl-tblrulsif3215. -->

--\>

<!-- <!-- ```{r rulsif3215} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: fig-rulsif3215 --> --\>

<!-- <!-- #| layout-ncol: 1 --> --\> <!-- <!-- #| out-width: 95% -->

--\> <!-- <!-- #| fig-height: 1.5 --> --\>

<!-- <!-- #| fig-cap: "Rulsif results for tag 321, step = 5 %." --> --\>

<!-- <!-- #| fig-subcap: --> --\>

<!-- <!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

--\>

<!-- <!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

--\> <!-- <!-- #| fig-pos: "H" --> --\>

<!-- <!-- p\_321\_ribbon\_rulsif\_5percent -->

--\>

<!-- <!-- p\_321\_scores\_rulsif\_5percent -->

--\>

<!-- <!-- ``` -->

--\>

<!-- <!-- ```{r table-rulsif3215} -->

--\> <!-- <!-- #| include: true --> --\>

<!-- <!-- #| label: tbl-tblrulsif3215 --> --\>

<!-- <!-- #| out-width: 40% --> --\>

<!-- <!-- #| tbl-cap-location: top --> --\>

<!-- <!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 5 % for tag 321 (f)." -->

--\>

<!-- <!-- knitr::kable(rulsif\_321\_table\_5percent %>% dplyr::select(!c(CP\_period, step)), -->

--\> <!-- <!-- booktabs = T, escape = F, --> --\>

<!-- <!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

--\>

<!-- <!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

--\> <!-- <!-- ``` --> --\>

<!-- A step of 10 % of the time vector's length amounts to `r rulsif\_321\_table\_10percent$step %>% unique()` days. The identified change periods (CP) are shown in @fig-rulsif32110 and @tbl-tblrulsif32110. -->

<!-- ```{r rulsif32110} -->

<!-- #| include: true -->

<!-- #| label: fig-rulsif32110 -->

<!-- #| layout-ncol: 1 -->

<!-- #| out-width: 95% -->

<!-- #| fig-height: 1.5 -->

<!-- #| fig-cap: "Rulsif results for tag 321, step = 10 %." -->

<!-- #| fig-subcap: -->

<!-- #| - "Identified Change Periods (CP) together with daily median, maximum and minimum depth.." -->

<!-- #| - "Scores of the dissimilarity measure, relative Pearson Divergence (rPE). Region of classification for a change point marked in yellow." -->

<!-- #| fig-pos: "H" -->

<!-- p\_321\_ribbon\_rulsif\_10percent -->

<!-- p\_321\_scores\_rulsif\_10percent -->

<!-- ``` -->

<!-- ```{r table-rulsif32110} -->

<!-- #| include: true -->

<!-- #| label: tbl-tblrulsif32110 -->

<!-- #| out-width: 40% -->

<!-- #| tbl-cap-location: top -->

<!-- #| tbl-cap: "Identified Change Periods (CP) with a step of 10 % for tag 321 (f)." -->

<!-- knitr::kable(rulsif\_321\_table\_10percent %>% dplyr::select(!c(CP\_period, step)), -->

<!-- booktabs = T, escape = F, -->

<!-- col.names = linebreak(c("Change\nPeriod (CP)", "start date", "end date", "CP duration\nin days"), align = "c")) %>% -->

<!-- kableExtra::kable\_styling(position = "center", latex\_options = "HOLD\_position") -->

<!-- ``` -->