**Sperm Whale Measurement and Photo-ID Protocol**

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My initial goal is to measure ~ 100 whales, which roughly translates to 7 *different* whales per day. I randomly inspected flights rated Q ≤ 4, until I could get good photos of whales. Within each video, I tried to capture a broad range of sizes.

## 1. Video selection

### a. Video quality Rating *Adapted from David Gaspard’s Northern Bottlenose Whale (Hyperoodon ampullatus) – Data Analysis Workflow*

Each recording file is assigned a Quality Rating from 0 – 8 based on the following criteria. These traits might vary within the video, so assign the value corresponding to most of the recorded time. The total Quality is the sum of the criteria listed below.

a. Glare: (0 – 2) Consider the coverage and intensity of the glare throughout the footage. Glare refers to the reflection or shine that makes it hard to distinguish individual whales and their activities.

A collage of different types of water

Description automatically generated

* 0 = Glare is absent or covers < 25% of the frame
* 1 = Medium intensity glare covering > 25% of the frame
* 2 = Intense glare covering >25% of the glare. The intensity of the glare makes whales too hard to distinguish.

*b. Sea state:* (Not Beaufort scale!) This refers to the texture of the water surface that can interact with glare and distort the whale’s appearance.

A collage of whales in the ocean

Description automatically generated

* 0 = Flat calm. Swell and undulations are visible, but no ripples in the water.
* 1 = Small ripples are visible, but the sea surface is not significantly disturbed.
* 2 = Large ripples and waves

*c. Focus:* Whether the individuals are in focus or not (e.g., can you see clear edges or do they look cloudy/fuzzy?)

Several different types of boats in the ocean

Description automatically generated

* 0 = most of the footage is in focus, edges are sharp and details are visible in a whale.
* 1 = most of the footage is slightly out of focus. Some detail is visible (like peeling skin, blowhole) but edges are fuzzy.
* 2 = most of the footage is blurry and whales are difficult to distinguish, marks are not visible in the whales.

*d. Exposure*: Refers to how much light is being captured by the image. Over-exposure happens when image looks very white or burnt, and underexposure refers to when the image is very dark.

A collage of dolphins swimming in the ocean

Description automatically generated

* 0 = exposure is good over the video and does not require any adjustments to easily detect individuals and their behaviours.
* 1 = exposure is a bit high or low, but it can be fixed by modifying parameters in BORIS.
* 2 = most of the video is under/over exposed in a way that can’t be fixed using BORIS adjustments.

### b. Video inspection

For each video, determine whether there are nadir times (<87 degrees). If there are, inspect the output time interval in Boris. Otherwise, skip. Launch the R Shiny App – shiny\_app\_find\_nadir\_range.R

## 2. Snapshot extraction

Launch BORIS

A good photo had – photo quality rating has to do with body position

* Whale lying flat at the surface (Glarou et al. 2022)
* Flippers visible – if possible!
* At Nadir

### Quality rating

Using a modified version of (Christiansen et al. 2018) to account for the measurability of HF and HD, but omitting body width (not interested!)

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute** | 1 (good) | 2 (medium) | 3 (poor) |
| Camera focus | Picture is sharp, contour of body clearly visible | Blurry but still able to make out contour of whale’s body | Picture too blurry to make out the contour of the whale’s body |
| Body straightness | Body axis midline crosses peduncle near the center. | Body axis midline crosses near the edges of peduncle | Body axis midline crosses outside peduncle. |
| Body roll | Snout peak is aligned with the midline of the body | Snout peak deviates slightly (<1/3 of head width) | Snout peak deviates slightly (>1/3 of head width) |
| Body arch | No visible arching – lying flat in the water | Head or peduncle slightly lifted or dropped. | Head or peduncle significantly lifted or dropped |
| Body pitch | Axis of whale is not angled vertically. | Axis of whale is angle slightly up or down. | Axis f whale is angled significantly up or down. |
| Body length measurability | Both tip of rostrum and the notch of tail fluke are clearly visible. | The tip of the rostrum or the notch of the tail fluke is partly obscured but can be approximated. | The tip of the rostrum or the notch of the tail fluke are not visible due to spray, water distortion, another animal, etc. |
| HD measurability | Dorsal fin edge is clearly distinguishable. | Dorsal fin edge is generally distinguishable but is slightly slopy. | Dorsal fin edge is not distinguishable due to shape or obstruction. |
| HF measurability | Both flippers are clearly visible. | One or both flippers are partly visible or can be approximated. | Flippers are hardly visible. |

## 3. Measuring Whales

### a. Extracting Pixel Lengths in MorphoMetriX V2

1. Launch the MorphoMetriX V2 app (installed from .exe file - <https://github.com/MMI-CODEX/MorphoMetriX-V2/releases>).
2. Select an image from the folder C:\Users\balae\Documents\SpermWhale\_SexAge\_Drone\drone\_snapshots
3. Set the measurement to ‘Piece-Wise’
4. Enter drone height
5. In the notes, enter the suspected age/sex class: M (mature male), NB (newborn), C (calf), AJ (adult female/juvenile).
6. Select ‘Measure Length’ and get the following measurements:
   * fref = draw a line from the anterior base of one flipper to the other (if it is visible). This will just be a reference point and not a measurement.
   * TL = Total Length – from the tip of the snout (s), passing through the base of the dorsal fin (d), fluke stalk (t), to the fluke notch (n).
   * HF = Head-Fin – from the tip of the snout (s) to the point where fref line crosses the snout to dorsal fin line (f). If flippers are not visible, omit this measurement.
   * HD = Head-Dorsal – from the tip of the snout (s) to the anterior base of the dorsal fin (d).

A whale swimming in the water

Description automatically generated

d

f

n

t

s

1. If there are several whales you’re trying to measure in a video, use the Image ID option to denote whales within a video:
   * Start with the left-most whale and move towards the right.
   * In the Image ID option, write the whale number for that video (e.g., 001).
   * Obtain the relevant measurements, and when exporting the files, add “\_00n” to the file name.
   * If the next whale is in the same frame, click “undo” to remove all the existing measurements, and replace Image ID with the corresponding option (e.g., 002). Obtain relevant measurements and add the corresponding whale ID number to the file.
   * If the next whale is in a different frame, open the new image, modify Image ID with the correct whale number, extract the corresponding measurements, and export with the corresponding whale ID (e.g., \_003).

## 4. Aerial photo-identification

In lightroom

## 5. Inspecting peduncle dives

* For all videos that have at least 2 whales, checked if any of the **measured individuals** were observed performing or receiving a peduncle dive.
* Videos that were inspected (including those with just one whale) were saved to the "E:\Gal2023\_Drone\Measured\_Videos\_for\_pd\_analysis" (n = 95)
* To determine the number of minutes inspected, open a BORIS project to annotate the start & end of visual contact with whales.
* Minutes inspected = minutese of whale contact (>1 whale visible in video)
* Processing carried out in R script "C:\Users\balae\Documents\SpermWhale\_SexAge\_Drone\_VSC\Scripts\scrap\_book\summarize\_pd\_analyses.R"