

A Guide to Northern Bottlenose Whale Photo ID

Version 3.1

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Introduction to Northern Bottlenose Whale Photo-Identification

This guide focuses on using Adobe Lightroom to facilitate the photo identification of northern bottlenose dorsal fins and melons. It was developed in the process of integrating photos from a long-term photo-identification dataset of northern bottlenose whales (NBW) from 1988-2019, which included incorporating previous identifications, matching protocols, quality rating systems for film and digital photographs. This guide documents the protocols used for building the Master Scotian Shelf NBW catalogue and is intended to support ongoing matching and analysis of northern bottlenose whales. The document has been divided into two parts:

Part I: Details the data management and workflows used in the creation of individual annual or regional dorsal catalogues, as well as updating and maintaining Master catalogues. Includes guidance on matching and keywording dorsal fins of individual northern bottlenose whales.

Part II: Describes the process for building a melon catalogue and determining the sex of individual northern bottlenose based on their melon shape.

The Guide to Northern Bottlenose Whale Photo ID is updated on an ongoing basis and the most current version can be found at:
<https://northernbottlenosewhale.weebly.com/our-publications.html>

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Part I: Data Management and Matching

Getting started with the NBW Project catalogue protocols in Lightroom

- We use the photo management program Adobe Lightroom to create digital catalogues to organize, edit, and match the photos of NBWs taken since 1988.
- Lightroom is a database that does not store the photos, but instead stores the metadata about each photo. This information is stored in the catalogue as an .lrcat file.
 - If the photos are moved on the computer, the photos in Lightroom will be greyed out and/or have an exclamation mark on their thumbnails. The location will need to be updated in Lightroom by right-clicking on the parent folder and selecting “Find missing folder”.
 - To see all missing photos in the catalogue, go to Library > Find All Missing Photos. The photos will be placed in a collection (under Catalog) for easy access, until their location is found.
- Lightroom allows the metadata of photos to be edited (filename, GPS, keywords, quality ratings, date, etc.).
 - The metadata can be saved to the photos through Lightroom BUT be careful, as metadata can be overwritten if saving from an outdated catalogue.
- Dorsal fin photos taken since 1988 of quality 3 and 4 have been integrated into the Master Scotian Shelf catalogue. These photos have been matched across years and each individual whale has been given a unique ID number or name. Each ID has a “best of” photo (the best and most recent photo, if possible) that has been given the keyword “Overall Best of”. Any photos that have not been matched are given the title “unk” for unknown. UNK photos are not included in analysis and are largely of low quality, retained for legacy purposes only.
 - The Master catalogue name is: SS1988_20XXDorsalsMASTER ('XX' indicates the most recent year that has been added to the catalogue; see below for instructions for adding annual catalogues to Master).
 - Metadata should be saved regularly from the Master catalogue (or any other working catalogues) to ensure that no work is overwritten or lost (select photo(s), ctrl + S). This may take a while depending on the number of photos selected.
 - Left- and right-sided photos are treated as separate catalogues, such that the same whale may not have the same ID for its left and right sides.
 - The IDs are written in the “title” of the metadata for each photo.
- The Master catalogue (and any other recently edited catalogue) should be backed-up regularly. Each catalogue should be set to prompt a back-up once a week after closing the program.
 - Ensure that the backups are being saved to the correct folder (Click “Browse” to select folder location).
 - If you want to back up a catalogue immediately (i.e. before making big changes), go to Edit > Catalogue Settings > General, and set the drop down bar to “When Lightroom next exits”. Close Lightroom and the backup prompt will appear.

- The file name structure for all photos should be similar to: NBW_date_imagename.jpg. To rename photos (you can do this in bulk), go to Library > Rename Photos, then in the drop-down menu, go to Edit. Here you can customize the file names to have the date, which will be taken automatically from the photo's metadata.
 - Cameras will automatically name photos with a prefix (i.e. IMG_). This prefix can be changed in the camera settings so that the photos are named after the initials of the PI working on the project.
- Only one Lrcat file can be open at a time. If you try to open a second file, Lightroom will automatically close the catalogue you are working on.
- If Lightroom is running slow, you may need to close the program and reopen it, or you can try File > Optimize Catalogue.

File Structure and Backups

- It's extremely important to be diligent and consistent with file naming and structure on the computer/hard drive. Currently, each working catalogue should have a folder for the Lightroom catalogue(s), files, and associated photos, and a folder for datasheets or metadata files.
- All catalogues should be clearly named, and the associated photos, previews and backups should be properly filed to ensure that Lightroom can access the files. If the catalogue file is moved to a new location on the computer, the photos will have to be moved as well, and you may have to point to its new location in Lightroom.
- Any data sheets should be kept in the folder with the associated catalogue. It's also important to ensure that regularly produced datasheets, such as ListViews (see page 28), should have the date it was created in the file name (e.g. LV_SSDorsalMaster_march23), and old versions should be archived or deleted.
- The original catalogues and photos (pre-quality check) from each annual season should be archived on the backup drive, leaving only the working catalogue(s) of quality-rated and keyworded photos. Any old catalogues or files can also be archived to the backup drive and deleted from the main computer.
- Keep track of versions so that data isn't accidentally deleted or overwritten from an outdated file!

Dorsal Catalogues and Matching

Adding new datasets (>50 photos) to any catalogue should follow the guidelines below (see also Figure 1) for creating a new annual catalogue.

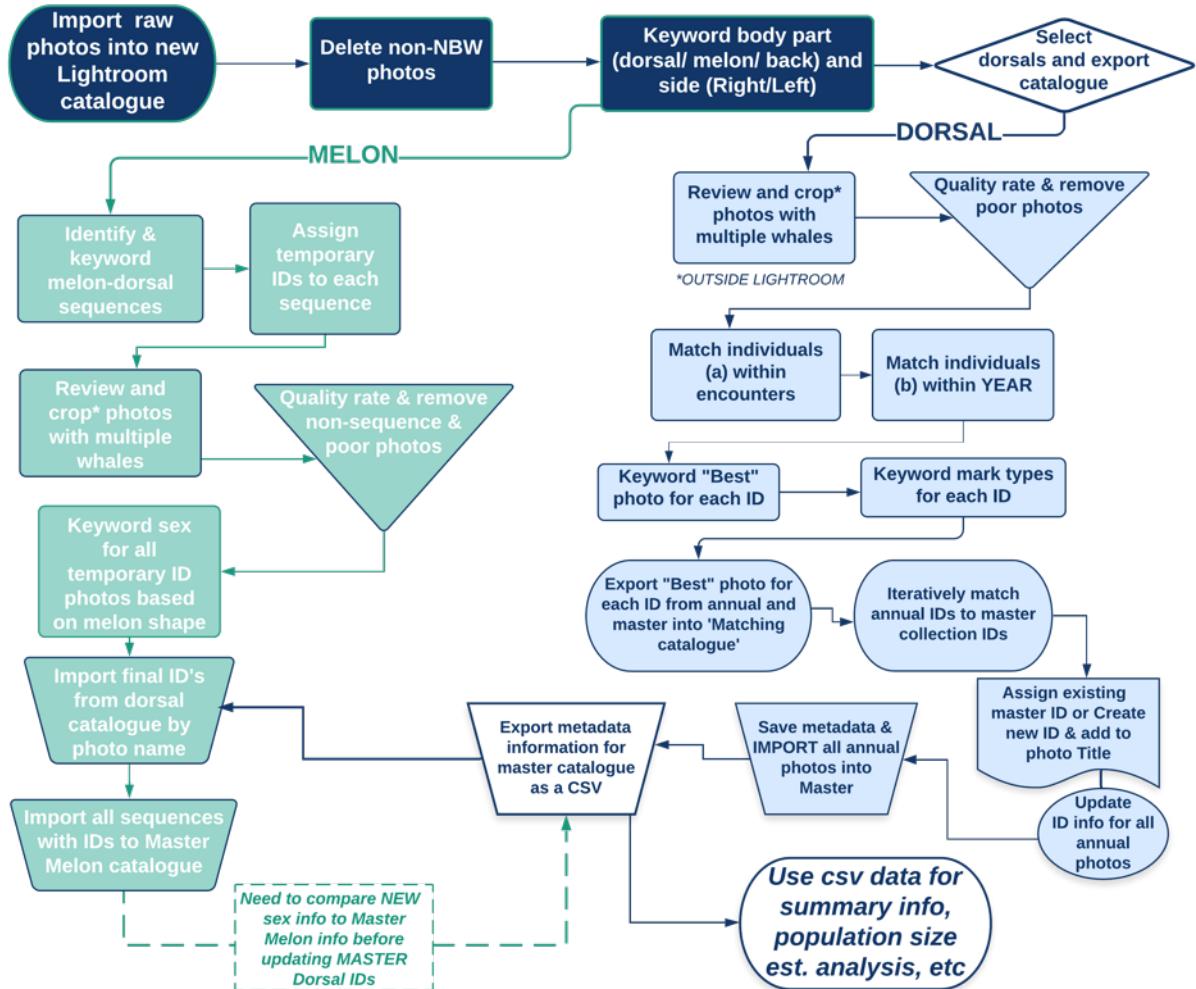


Figure 1. Northern bottlenose whale photo-ID protocol for importing dorsal and melon field data.

Starting a New Annual Catalogue

With each new year of photos, a separate Lightroom catalogue is created to process and match the photos before adding them to the Master catalogue.

- Once imported into Lightroom, screen the photos that do not contain northern bottlenose whales or are very poor quality (i.e. photos of water or people, very blurry, etc.). These photos can be removed. You can also use keywords (i.e. NBW, other species).
- Add keywords to distinguish the body part visible in each photo (melon, dorsal fin, back). The dorsal fin photos can then be exported into a separate catalogue:

- i. Select desired photos.
 - ii. File > Export as Catalogue > Choose location on computer and name catalogue (ex: SS2013_dorsals) > OK
 - iii. In drop down menu, select “move photos” (this is so the photos associated with this new catalogue are copied to the same location)
3. Keyword any photo with more than one whale with “Multiple Whales”. Any photos with multiple whales of Q3 or higher must be cropped (see instructions below).
4. Keyword the dorsal fin side (Left or Right) and the year for all photos.
5. Quality rate all photos (see below for instructions and examples). If already done, the consistency of the ratings may need to be checked.
6. Match photos within the season and give individual whales a unique ID (you can use any naming scheme you want because this is temporary, and the photos will be given master IDs eventually). Put the ID as the “Title” of the photo.
- i. The easiest way to do this is to start by matching whales for each encounter/day, and then match the whales across the field season.
 - ii. Stacking is a useful tool for keeping track of individuals while you sort through photos. Select desired photos, right click, Stacking > Group into Stack. You can then close the stack in order to have only one photo of that individual visible and can add new photos as needed.
7. Determine the best photo of each ID and keyword it with “best of”
- i. The chosen photo (ideally Q4) should show the most detail of scarring and include as much of the dorsal skirt as possible.
 - ii. I recommend making a “Best of” Smart catalogue for these photos (separate for lefts and rights).
8. Using the “best” photo as a guide, keyword mark types for all photos of each ID (see below for examples of mark types).
9. Export “best of” photos to a new catalogue. Name it something like “year_bestof_matching”. This catalogue will only be used for matching, so any changes to the photos should be made in the original annual catalogue only.
10. From the Master catalogue, export a catalogue of the “Overall best of” photos, then import this catalogue into the catalogue created in step 9.
- i. File > Import from Another Catalogue > Choose the desired .lrcat file > Choose location to move photos > Import
11. Match the annual catalogue to the Master and record the IDs of all matches.
- i. You can make an Excel spreadsheet to track any changes you make and the list of matching IDs between the two catalogues.
 - ii. Any whales that do not match the Master need to be given new IDs. Start from an '00 number (6000, 6100, 6200, etc.) and continue numbering sequentially (6001, 6002, 6003, etc.).
 - iii. Any individual with a very distinguishing notch and has both a left and right side can be combined into 1 ID. Otherwise, keep the left and right IDs separate.
12. From the annual dorsal fin catalogue, export all Q3 and 4 photos to a new catalogue, then change the annual IDs of all photos to match the Master IDs.
13. In the Master catalogue, import the photos from the step above, making sure to move the photos (double-check that the folder location is correct).

- i. You can now delete the matching catalogs from steps 9 and 10, or archive them.
14. Close the Master catalogue and change the names of the .lrcat, Previews, Smart Previews files (if applicable), and photos folder to include the recently added year of photos.
- i. i.e. SS1988_2010DorsalMASTER changes to: SS1988_2011...
15. Update the “Overall Best” photo of each ID with the newly imported photos (only if new photo is of equal or better quality than the current “Overall best” photo).
16. Remember to clean up any extra keywords and collections that may have been imported along with the photos.

Checklist for Adding Annual Catalogues to Master

- Delete non-NBW photos from catalogue
- Keyword body part (dorsal fin, melon)
- Export dorsal fin photos to new catalogue.
- Process photos with multiple whales.
- Keyword year for all photos.
- Keyword left and right side for all photos.
- Quality rate all photos/check consistency of quality ratings.
- Match photos within field season.
- Keyword “best of” for best photo in each ID.
- Keyword mark types for each ID.
- Create matching catalogue of the “best of” from the annual catalogue and the “Overall Best of” from the Master catalogue.
- Match annual photos to Master photos.
- Change IDs of annual catalogue to match Master IDs.
- Import annual catalogue into Master (make sure to move photos).
- Rename Master catalogue and associated files.

Matching Workflow and Tips

For each annual or master catalogue, there should be Smart Collections (separate for lefts and rights) with the best photo of each ID across the entire sampling period. All photos in these collections can be exported into a temporary catalogue for matching, named according to the catalogues being matched (i.e. SS_NFLD_matching, SS_2019_Master_matching, etc.). The Smart Collections will automatically appear in the newly exported catalogue.

- Depending on the analyses, only well marked* individuals will be matched. Well-marked individuals have either a notch, a large fin or body scar, or a back indentation.

*Note this is different than “Reliably marked” IDs which are only those IDs with a notch or back indent, used for scaling mark recapture population estimates.

As an example, the protocol below includes directions for matching one region (NFLD) to another (SS), however, the same protocol can be used to match annual catalogues to the Master.

1. Open the Left NFLD smart collection and lock the first photo to the second monitor (right-click).
2. Open the Left SS smart collection and, if needed, filter photos by mark type keywords. You can also make smart collections of SS photos with or without certain mark types (i.e. notch, no notch).
3. Scroll to the very end (i.e. to the most recent photos), then go backwards through each photo in the collection to compare to the NFLD photo locked to the second monitor.
4. As you go through each NFLD photo, write down its ID and any possible matches (you could also do this in Excel). This is also how to keep track of which photos have been matched.

Important Matching Tips:

- Keep in mind that whales can gain markings over time, so just because a 2017 whale has a notch, it doesn't mean it had a notch in 2016 or earlier! A Smart Collection of whales with "no notch" may come in handy in this situation.
- Diatoms (brownish-orange patches), lice, and sloughed skin (greyish patches of peeling/peeled skin) are marking types that are not used for matching because they can change over days to weeks.
- The shape of a fin can also be helpful for determining matches, but keep in mind that the angle of the fin to the camera may distort its shape as well as the shape of notch.

The Biopsy Catalogue

- The biopsy catalogue includes information for biopsied individuals in all study regions across all field seasons.
- For each biopsy sample, all photos of that individual from that field season are added to the catalogue and keyworded “biopsy”. The biopsy sample code is added to the caption of all photos.
- Biopsy information is found from original field notes and datasheets. For each biopsy attempt, detailed information of the date, time, photo frames, whale reaction, and success of the biopsy is recorded. Using this information, photo(s) from the time of the biopsy can be used to determine the ID that was sampled. Ideally, the photo(s) will have the biopsy dart in the frame or evidence of a biopsy wound on the whale.
- If the photo of the animal taken at the time of the biopsy is not great but can be used to locate a better photo of the same individual during another part of the encounter, both photos should be added to the biopsy catalogue. You may need to look through the original annual catalogue (all Q-ratings) in order to find photos from the time of the biopsy.
- If a biopsied whale is not ID'ed (is “unk” in the master), the relevant photos should still be added to the catalogue and keyworded as usual.
- Once all biopsy photos are keyworded, export a List View of the catalogue then use LR/Transporter to import the biopsy keyword into the Master catalogue using the filename as the guide.

Quality (Q) Ratings for Dorsal Fin Photos

- Each photo in the catalogue must receive a quality (Q) rating based on the:
 - Focus
 - Angle of fin/body
 - Amount of fin visible
 - Exposure
- Q ratings are not determined by how reliably marked a whale is (to reduce bias toward highly marked whales).
- We currently use a 4-point scale to determine quality, with 1 being poor and 4 being excellent.

Q4 – Photos are well-lit and in focus, the fin is parallel to the observer (90°), and the entire fin at least the majority of the body surrounding the fin (one fin-width away) is visible.

- Q4 photos show the most detail and are the most reliable photos for analysis, matching and identification.

Q3 – Photos are good but lack one or two key criteria from Q4 photos (too dark, water splashes, out of focus, blurry, poor angle, fin not entirely in frame, etc.).

- Q3 photos show some detail but may not be as useful for matching/identification.

Q2 – Photos are generally poor, but whales may still be identifiable, however fine details are lost.

- Photos are often very blurry and/or out of focus, the fin is almost entirely covered in water, the angle is poor (i.e. whale is swimming towards or away from camera)

Q1 – Photos are very poor, and whales are usually completely unidentifiable. May include only a tip of a fin, be completely out of focus or the whale is too far away.

***Photos of Q1 and 2 are removed from the Master catalogue, so distinguishing between the two is not as important as for Q3 and 4 photos.

Q-Rating	Example	Reasoning
1		<ul style="list-style-type: none"> – Completely out of focus and blurry – Not enough of body showing
2		<ul style="list-style-type: none"> – Too far away, grainy image – Water covering part of body – Backlit, reduces visibility of markings
3		<ul style="list-style-type: none"> – Image slightly soft in focus – Water covering part of body within 1 fin width from dorsal – Whale perpendicular to observer – Good lighting
4		<ul style="list-style-type: none"> – Image in focus – Radius of 1 fin width (approx) from dorsal is in frame – Whale perpendicular to observer – Good lighting

Figure 2. Dorsal fin Q-rating examples

Mark Type Keywords

- Mark type keywords are given to each ID in each year separately. This is to account for mark change or gain over time. The “best of” photo is used as a guide to add keywords to all other photos of that ID for that year.
- Markings must be within one fin width from the base of the dorsal fin, called the “dorsal skirt”, to be counted and keyworded (Figure 1).
- A single marking can be counted in multiple categories (i.e. circle + LCCS; linear + tooth rake + large body scar; etc.)
- Some markings are more reliable for photo ID and will persist for years, such as notches and back indentations (Feyrer et al., 2021; Gowans and Whitehead, 2001). Whales with these mark types are considered “reliably marked” and may be prioritized for analysis and identification.
- Diatoms (see below) and other short-lived markings are only useful for within-year or even within-month identification and matching.

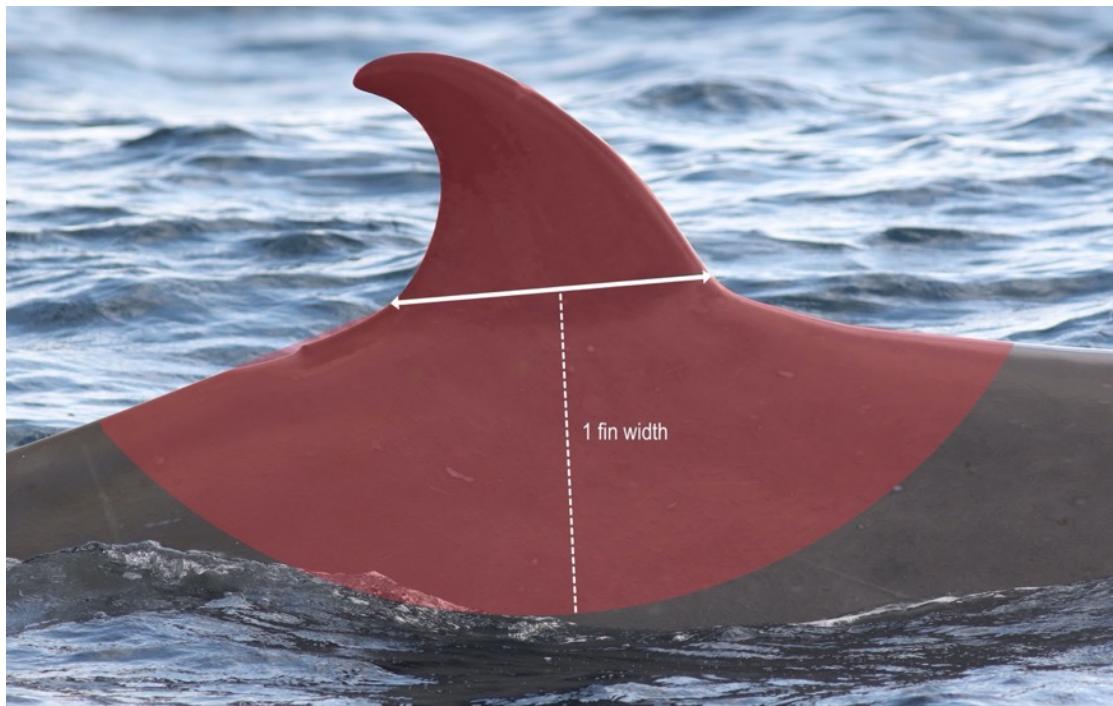


Figure 3. Dorsal skirt surrounding the dorsal fin, where markings are considered for analysis

Reliable Markings

- These mark types are permanent or will persist over long timescales.
Identification of whales with these markings is easier and more reliable.

Back indentation – Indentation or notch along the spine of the whale; Can be posterior or anterior (rare) to dorsal fin; Depth of the indentation may vary from small nicks to large gashes.

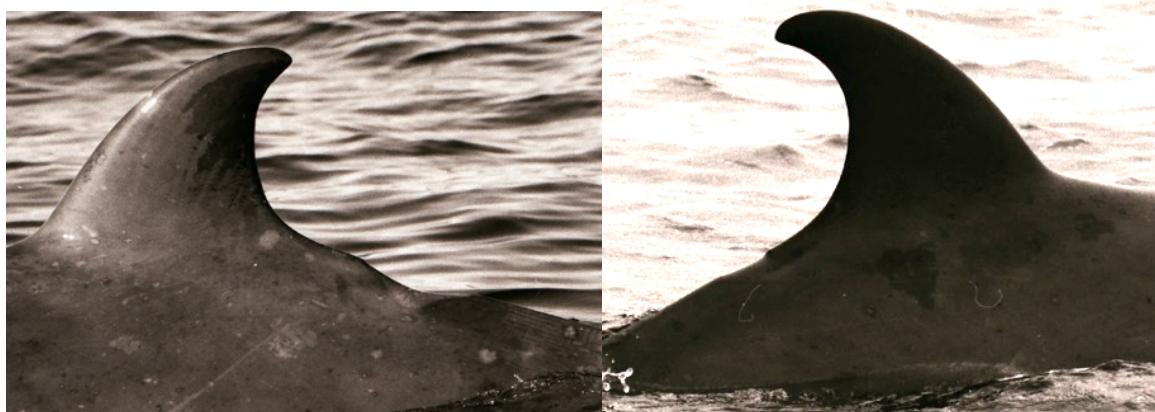


Figure 4. Back indentation

Notch – Any dorsal fin notch or where a chunk of fin has been removed; includes very small nicks as well as severe fin mutilation; White scarring may occur around edges; Notches are permanent and will not grow back.



Figure 5. Notch

To distinguish between back indentations (BI) and notches:

- *Where the fin stops curving and the spine continues straight, all injuries above this are considered notches and below are back indentations (applies to the posterior and anterior dorsal).*
- *If an injury spans this area, then it is considered both a notch and a back indentation.*

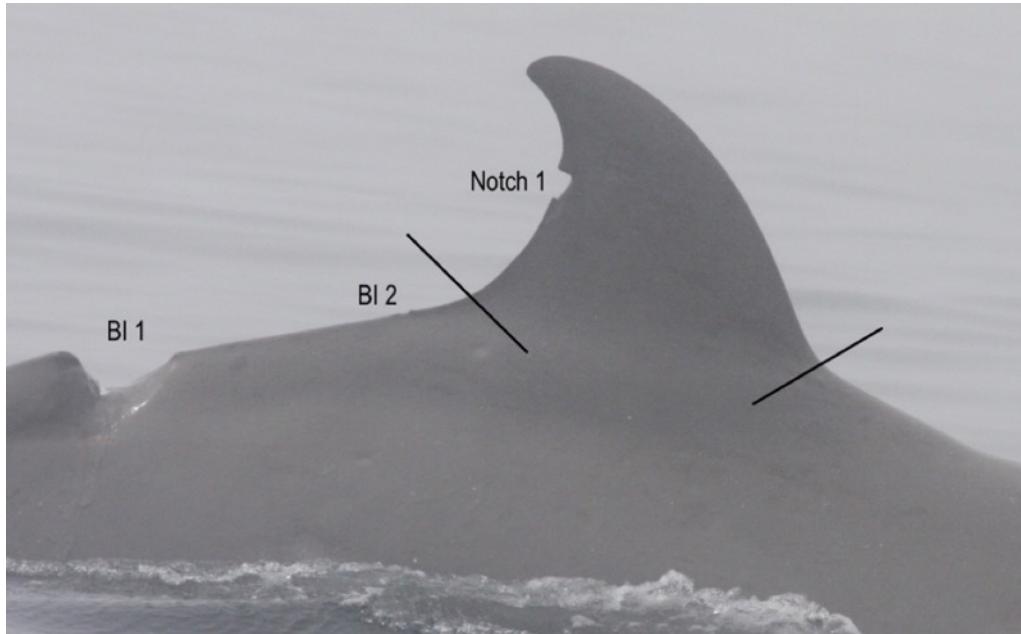


Figure 6. Distinguishing between back indentations (BI) and notches.

Other Markings/Keywords Used for Identification

Large Body Scar – Highly identifiable scar or distinct marking on the body (within the dorsal skirt); to be considered “large”, the size of the mark (or group of markings, collectively) must be equal to at least 25% of the dorsal fin area

Large Dorsal Scar – Highly identifiable scar or distinct marking on the dorsal fin or near the base of the dorsal fin; to be considered “large”, the mark (or group of markings, collectively) must span at least 25% of the fin



Figure 7. Large Scar

* Large scars will vary in shape, type and cause; generally white to grey in colour

Circle – Any circular marking(s) (very common)

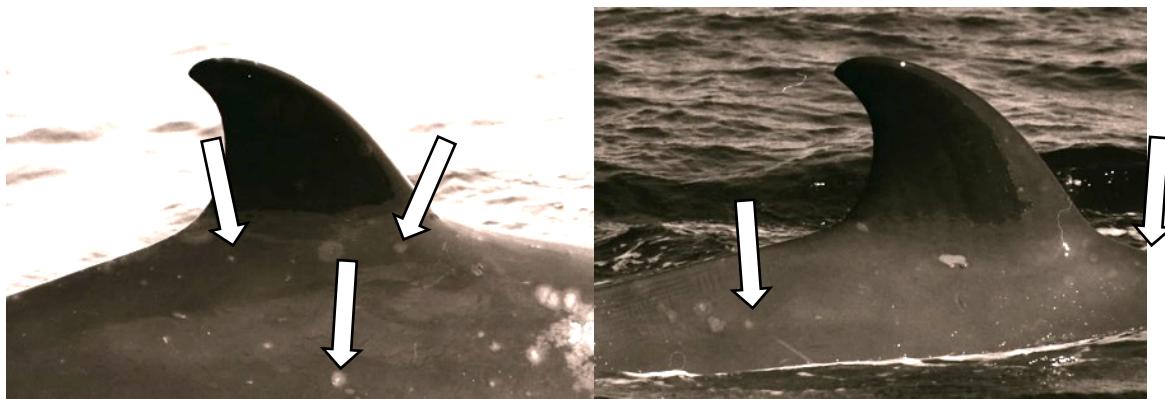


Figure 8. Circle scars

LCCS – Scar caused by lamprey or cookie cutter shark; usually circular donut shape with small teeth marks

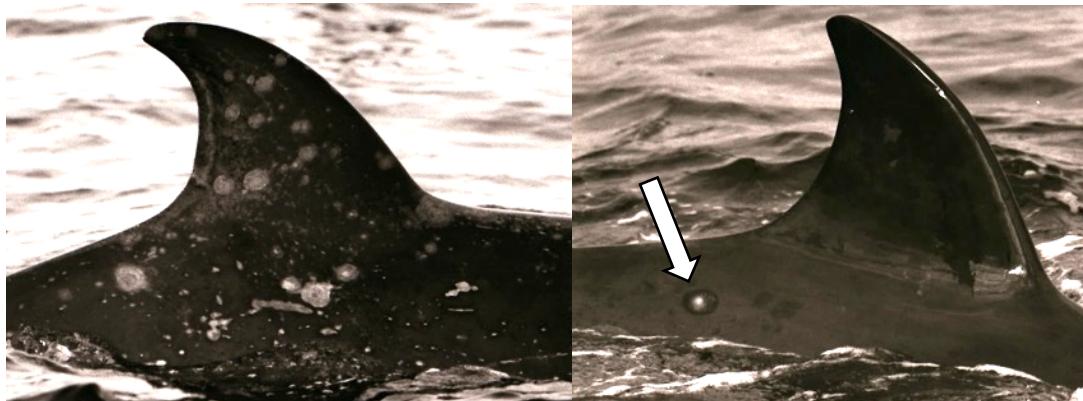


Figure 9. Lamprey Cookie-cutter Shark (LCCS)

Linear – Any linear scars; white to grey in colour; will vary in length and thickness



Figure 10. Linear Scars

Patch – Large blotchy white patches of various shapes, usually on the body of the whale; similar to a birth mark. *Not to be confused with sloughed skin, which are irregular in shape and change rapidly



Figure 11. Patches

Tooth rake – Two or more parallel, thin linear scars caused by the teeth of other animals; likely caused by other species of beaked whale, rather than other NBWs

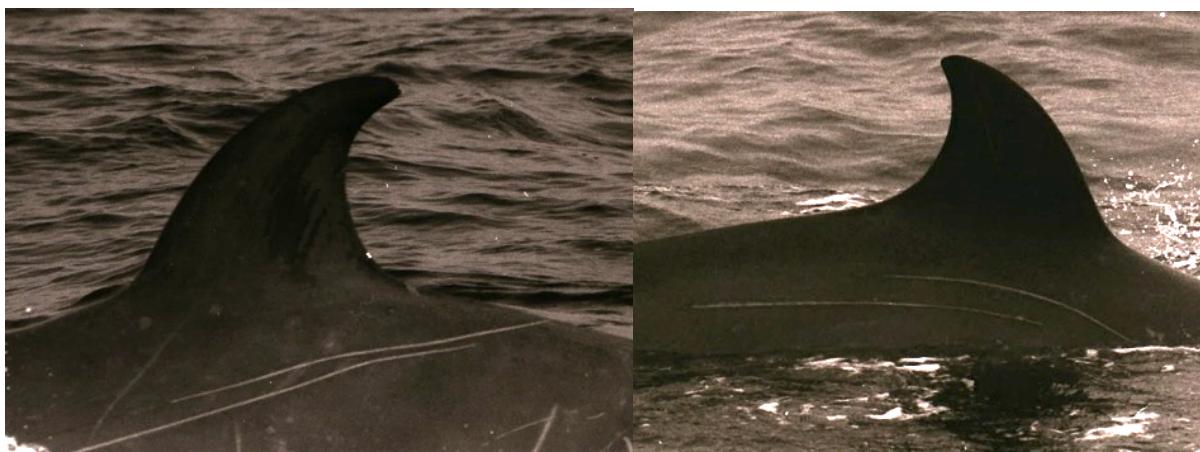


Figure 12. Tooth rakes

Unusual mark – Markings or scars that are very unique and difficult to classify



Figure 13. Unusual and unique markings

Anthropogenic-Caused Markings

- These keywords characterize a scar or grouping of scars that are assumed to be caused by interactions with vessels or fishing gear. Some severe marks (e.g. mutilations, amputations, back indents) may be difficult to distinguish as being caused by one or the other source.
- Anthropogenic injuries on NBW have been characterised based on studies of other cetacean species and from analysis of photographs of other entangled beaked whales in the Gully (i.e. Sowerby's). See Feyrer et al. 2021 for references and details.

Entanglement – Usually thick, linear furrows that appear to wrap around the body or fin and may crisscross; may also have a back indentation, fin notch or protruding scar tissue in same location; can have breaks in linear pattern due to the whale's body curvature, knotted lines.



Figure 14. Entanglement Scars

Propeller vessel-strike – Various injuries or scars assumed to be caused by a propeller or vessel strike, including large gashes, mutilated dorsal fins, and deep back indentations.



Figure 15. Propeller-vessel strike scars

Markings/Keywords Not Used for Identification

- These mark types can change rapidly within a season and cannot be used to identify individuals long-term. They may be useful for matching within encounters.

Clean – Given to any whale lacking any distinguishing or large markings (i.e. may only have small circle and/or superficial linear scars)



Figure 16. Example of a "clean" whale

Diatoms – Brown patches caused by diatoms; Change shape rapidly



Figure 17. Diatoms

Fetal Folds – Creases on the skin of calves; will fade over time as the juvenile ages



Figure 18. Fetal folds

Mites/lice – Small, white crustaceans usually found near the tip of the dorsal fin



Figure 19. Lice

Skinny – Whales that appear thin, with prominent ribs and/or back bone, scalloped spine and shadows on the body



Figure 20. Skinny

Sloughed skin – peeling skin on the body or fin; changes rapidly, not used for identification. *Not to be confused with patches, which are permanent and blotchy or mottled



Figure 21. Slough skin

Photos with Multiple Whales

- Photos with multiple whales must be cropped outside Lightroom so that each whale has a separate photo. Only whales of Q3 and higher need to be cropped.
- The original photo is kept in the catalogue after the crops are imported.
- Before beginning, make sure all photos with multiple whales (even without dorsal fins) are keyworded with “multiple whales”.
- Recommended to make a collection of photos that need to be cropped for easy access while you work.

1. In file explorer, go into the photos folder for the annual catalogue, then create a new folder and name it “crops” (or “multiples”).
2. In Lightroom, right-click on a photo and select “Show in Explorer”.
3. Copy then paste the photo in the new folder you created.
4. Rename this newly pasted photo with an “a” after the file name (i.e. NBW_IMG1234a).
5. Double-click on the photo to open, then click “Edit & Create” and “Edit”.
6. Click on “Crop and rotate” and crop around the first whale.
 - i. Whales are numbered (a, b, c, ...) from left to right or from front to back, depending on the photo.
7. Click “Done” then “Save” (NOT “Save as a copy”).
8. Repeat the process until all whales in the photo of Q3+ have been cropped.
9. Once all photos with multiple whales have been cropped, the folder containing the photos must be synchronized in Lightroom (right-click > Synchronize folder). This will then prompt you to import the photos.
10. After importing, select all the cropped photos and keyword them “crops”.
11. Give a purple label to the original photos with multiple whales and give them the title “see crops”.



Figure 22. Identifying and labelling photos with multiple whales

Lightroom Tips and Troubleshooting

- Using a second monitor can be very useful for matching photos. Right click on a photo, then select “Lock to Second Monitor”. You can then toggle the second monitor on/off by using the icon in the bottom left corner. If you don’t have a second monitor, you can also compare 2 photos side-by-side on one screen, using Compare View (XY icon in bottom toolbar).
- Right-click on a photo then select “Show in Explorer” to open the photo from its location on the computer.
- Lightroom filtering (top toolbar) allows you to search for photos based on certain metadata, such as rating, keywords, label colour, title/ID, date, etc.
 - In addition to searching for specific photos, this can be helpful for matching, checking consistency of quality ratings, ensuring completeness of metadata, etc.
- Try to focus your efforts on the Q4 photos first, as they are usually the only photos used in population analyses.
- Use control + A to select all photos. You can also invert your selection under Edit>Invert Selection. Use control + D to deselect photos.
- Collections, Quick Collections and Smart Collections are powerful tools to sort photos for editing or matching:
 - **Collections:** Select desired photos then click the “+” in the Collections toolbar. You can also drag desired photos into the collection.
 - **Quick collections:** Located in the Catalog toolbar; to add a photo, simply click the open circle on the top right of its thumbnail. The circle will turn grey when the photo is added to the Quick Collection. Only one Quick Collection can be made at a time, however, it can be saved as a Collection or cleared by right-clicking.
 - **Smart Collections:** Smart Collections use rules to automatically add photos based on chosen criteria. Click the “+” in the Collections toolbar, click Create Smart Collection, then add rules in the pop-up box. Rules can sort for Keywords (under “Other Metadata”), Date, Rating, etc., and can either include or exclude these criteria. Double-click on an already made Smart Collection to edit the rules. Smart Collections have been made for every ID in the catalogue.
- If a photo is too dark/bright, you can change the exposure in Quick Develop (right sidebar). If needed, click the black triangle to drop down more options for photo editing, such as contrast, highlights, shadows, etc. These adjustments are non-destructive so they will not change anything on the original file.
- If Lightroom turns black and the photos seem to be “floating”, press L to return to regular mode.

Dealing with Photo ID Errors

- You may encounter errors in the photo identification catalogue, which may be caused by data entry errors or by poor matching. Often, two or more dorsal fins can look very similar (i.e. same sized notch in same place), so make sure to zoom in on photos and carefully scan the whole fin/body area to compare markings.
- Any errors must be recorded in the Master Error Log Excel spreadsheet (or if in an annual catalogue, in the error log for that year). The subsequent correction(s), date corrected, number of photos affected, and any other information should also be recorded.
- Photos with errors must be labelled red in Lightroom.
- There are 3 main types of errors:
 - a) Photos in the wrong ID – Any photo(s) that do not match the rest of the photos in the ID. Label the photos in red (to indicate an error) and match to the correct ID. If the photo(s) don't match any other IDs, a new one will have to be created (starting in the 9000s to reduce confusion).
 - b) Duplicate IDs – Individual whales with more than 1 ID. Photos must be moved to the oldest or original ID (i.e. lowest number). After moving the photos, make sure there is only 1 “Overall best of” photo in the original ID.
 - c) Multiple whales in same ID – If an ID has more than one whale ID'ed to it (usually happens when two whales look very similar), the original individual will have to be determined. It may not always be obvious which whale is the original, so you may need to dig through old negatives and metadata files. All other individuals should be moved to the proper ID(s).
- Corrections of Q4 errors should be prioritized, then Q3, and errors of Q1 and 2 can be ignored.

Plug-Ins: List View and Transporter

We use 2 plug-ins to bulk import and export metadata between Lightroom and Excel.

- If plug-ins are not installed, follow these steps:
 1. Download from these links:
<https://www.photographers-toolbox.com/products/jbeardsworth/listview/>
<https://www.photographers-toolbox.com/products/lrtransporter.php>
 2. Move the downloaded plug-in(s) to a folder of your choosing (but don't delete them even after enabling the plug-ins in Lightroom).
 3. In Lightroom, go to File > Plug-in Manager
 4. Click "Add" and find the plug-in download.
 5. Enter the registration code (ask your supervisor for this), then click "Enable".

List View

Exports data from Lightroom and provides a metadata summary in Excel for all or selected photos. Used to export metadata for analysis, for error checking or checking for missing metadata.

1. Select desired photos or set a filter.
2. In Lightroom, go to Library > Plug-in Extras > List View, Standard View (this may take a few seconds to load, depending on how many photos you choose).
3. Choose desired metadata to export by clicking on the triangle of each column.
4. Click the green icon . This will open an Excel document with your metadata (may take a few seconds).
5. Save as an Excel document and name accordingly.

Ensure that the date each List View was created is written in the file name, so that older sheets of the same type can be archived or deleted.

LR/Transporter

Allows metadata to be imported to photos in Lightroom from an Excel sheet (CSV).

1. Save a copy of your desired Excel sheet as a CSV file.
2. In Lightroom, go to Library > Plug-in Extras > LR/Transporter, Import Metadata
3. In Browse, choose the CSV file to extract metadata from.
4. In Record Mapping, choose the field in Lightroom that the Transporter will look for (usually filename) and choose the corresponding metadata field from your CSV file.
 - a. Check if your CSV file has the .jpg at the end of the filename or not. If it doesn't, make sure to select filename w/o extension as the Lightroom field.
5. In Fields Mapping, choose the metadata that you would like to import and the name of the field in Lightroom it will be sent to. Choose "overwrites if data source isn't empty" in drop down menu.
6. If desired, click the "+" to add more metadata fields to import.
7. Click OK.

As an example, if you wanted to import GPS (both lat and long), you would set up Transporter with the following settings:

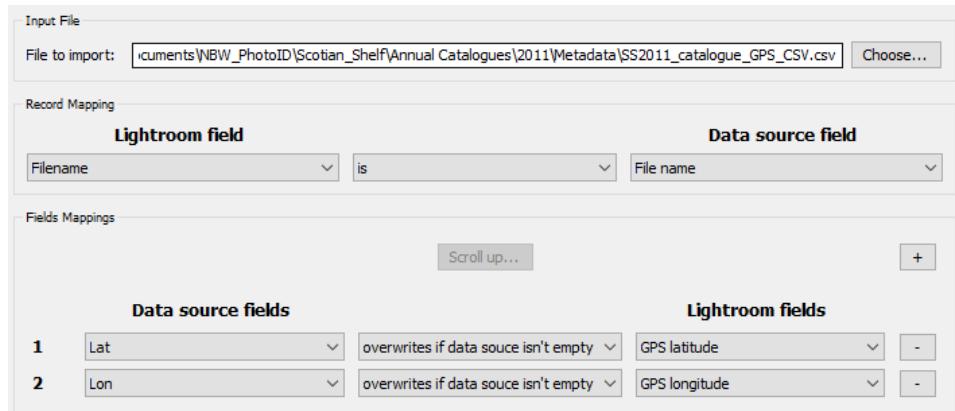


Figure 23. Adding or altering GPS coordinates using a plugin

**Note: GPS information cannot be imported if the GPS field is blank. You must fill in a temporary GPS first (i.e. something easy to distinguish, like 55° 55' 55 N) then import with Transporter.

Another use for these plug-ins is to help fill in missing metadata in bulk. For example, any photos with blank IDs need to be given "unk" (unknown) as the title. Since blank titles cannot be searched for in Lightroom, using the plug-ins is more efficient than searching manually through the catalogue.

1. Export a List View of desired photos (i.e. an entire catalogue).
2. Fill in any blanks in Excel.
3. Convert the Excel sheet to CSV then reimport the metadata using Transporter.

Part II: Guide for Melon Analysis

Screening Photos and Creating an Annual Catalogue

Screening melon photos can occur while screening dorsal photos, as it is more efficient for overall catalogue development. However, the dorsal catalogue is sometimes prioritized for analysis and including additional keywording of melon photos will require more time at the screening stage, so the starting point for compiling the melon catalogue may differ based on project priorities. The first steps for compiling a melon catalogue are outlined below. Melon catalogue development beyond screening depends on the completion and analysis of the dorsal catalogue for the year.

1. Sort photos by filename so that the sequences are in order (especially if more than one camera was used in a field season)
2. Review original field season catalogue (all Q-ratings) and keyword all melon photos and possible dorsal sequence links as 'melon'. Dorsal link photos include all consecutive photos of the back and dorsal fin that follow the melon photo(s) of the individual, and should be in the same orientation and occur within a 30sec time window.
3. Using the caption field, assign a temporary melon ID (e.g. Melon_1, Melon_2) to each melon-dorsal sequence. Temporary IDs should be added to the caption for ALL linked photos (melon, back and dorsal fin).
4. Extract all melon photos and linked sequence/dorsal photos into a separate MELON_YYYY catalogue.
5. Once all melons and linked dorsals are imported to a new catalogue, make sure the keywords for body part (melon, dorsal, back) and side (left/right) are complete for all photos.

Linking Melons to Dorsal IDs

Once Dorsal IDs for the annual catalogue are established, the relevant information from the dorsal master catalogue can be imported into the Melon catalogue so that only the melons with links to high quality dorsal IDs are further processed.

1. Use a ListView .csv export of the dorsal catalogue to import the Q-rating information and unique Dorsal IDs in the Title field for the dorsal photos based on filename.
2. Assign Dorsal IDs to all linked melon photos based on the temporary melon IDs and dorsal links. This can be done a few ways, but one method is to:
 - Export a ListView .csv of the melon catalogue.
 - Using Excel, filter the Caption field for each melon link ID, copy and fill the Dorsal ID for all melon linked photos in the Title field.
 - Import the updated Title field back into the melon catalogue using the Transporter plug-in in Lightroom.
3. Keyword all photos with dorsal IDs with 'master' so that they can be filtered later.

Q-Ratings for Melon Photos

Melon Q-rating is independent of the Q-rating of the dorsal fin or sex and is based primarily on proportion of melon that is visible. Unlike the Dorsal Master catalogue, photos of all Q ratings (as long as they are part of a sequence) will be included in the Melon Master catalogue.

Melon Q-rating scale:

- **4 stars:** the entire melon is visible; water line is no higher than just above the beak
- **3 stars:** at least half the melon is visible
- **2 stars:** most of the melon is obscured but the rounded edge of the melon is still visible
- **1 star:** the melon is not visible (back photo, etc.)

When the orientation of the whale is not perpendicular (90°) to the observer, it can significantly affect sex analysis. After visibility the Q-rating should be adjusted to account for orientation so that:

- one star is deducted when the photo is between 45° - 70° to the body of the animal
- two stars are deducted when the photo is at an angle $< 45^\circ$

Q-rating

1

Example



2



3



4



Figure 24. Melon Q-rating and example photos

Introduction to Northern Bottlenose Whale Melon Sex-Age Classification

Sex analysis described in detail below should be conducted on every melon photo linked to an identifiable dorsal with an ID. Gowans et al. (2000) was the first to formalize the method for sexing of northern bottlenose whales by photographic analysis based on qualitative descriptions for a dataset of 20 whales over 9 years. They relied on a subjective assessment of the relative “roundness” of the melon to classify a whale into one of three age/sex classes: female/juvenile, subadult male, or mature male. They tested this method using genetic determinations from 10 biopsied whales and found 100% agreement with their classifications. However, Gowans (2000) did not have a genetic comparison for their subadult whale category. As a result of inconsistencies in the sub-adult male classification (see Yeung 2019 Honor’s thesis for further details), the protocol for sexing northern bottlenose whales has been revised and is based on two primary classifications: either: Mature Male (MM) or Female/Juvenile (FJ). Potentially the subtleties of this category could still be applied to the analysis of a chronology of individual males with multiple years of photos.

The current methods established for sex analysis are described in the step-by-step decision tree protocol. Using keywords in Lightroom, the sex classifications are summarized annually by ID (*Sex_Sum*), then summarized over the entire study period by ID (*MelonMasterSex*), and finally validated to biopsy sex, if applicable (*Sex.Final*).

Melon Sex-Age Classification Protocol

1. Is the melon round or flat?
 - a. Very flat: **Mature Male**



- a. Very flat: **Mature Male**
- b. Very round: **Female-Juvenile**

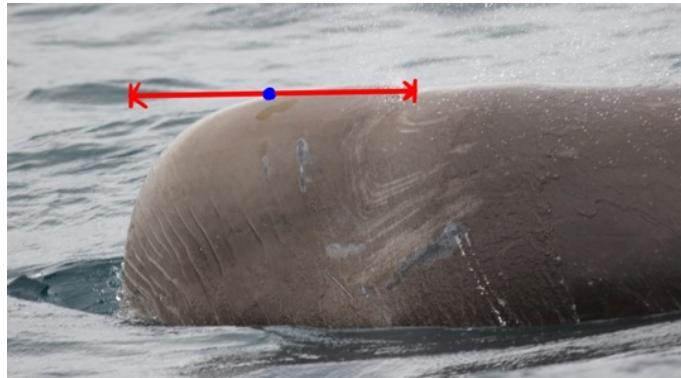


- a. Very flat: **Mature Male**
 - b. Very round: **Female-Juvenile**
- b. Difficult to tell: **Go to Step 2**

2. Where does the melon begin to round or flatten out?

- a. Halfway between the blowhole and the front of the melon or closer to the front:

Mature Male



- b. Closer to the blowhole than the front of the melon:

Female-Juvenile

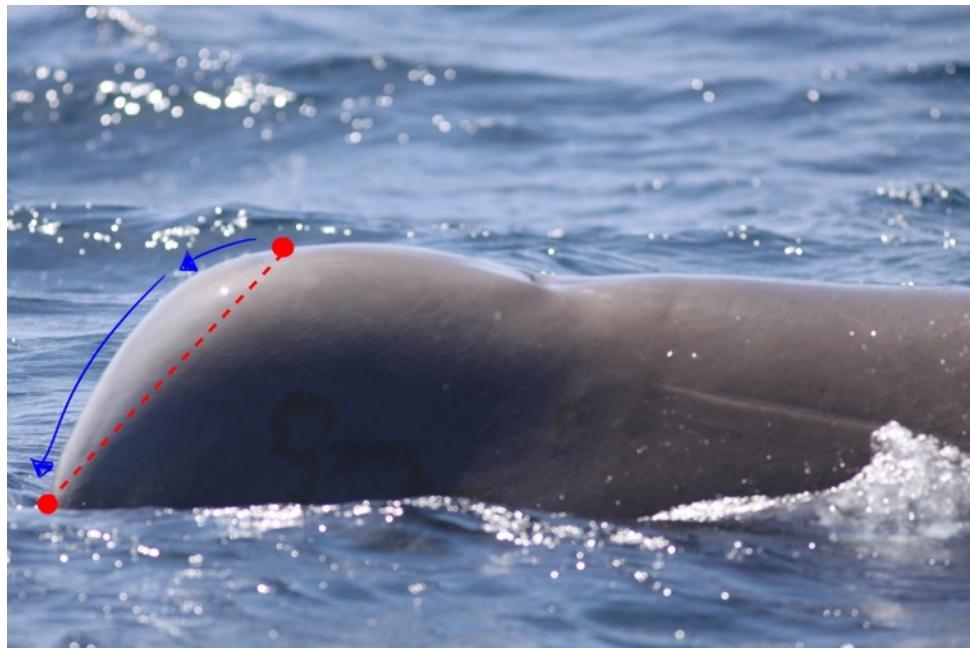


- c. Difficult to tell: Go to Step 3

3. Draw a line from the point where the melon begins to round out to where the melon meets the beak (if visible), or the waterline. What does the melon contour look like?

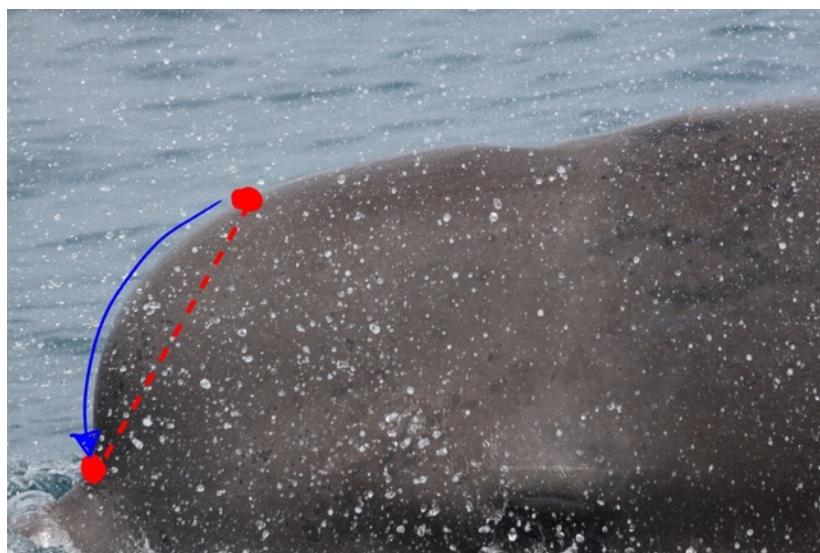
- a. A sharper contour where the peak is closer to the top of the melon:

Mature Male



- b. A smooth parabolic contour where the peak is near the midpoint or closer to the beak:

Female/Juvenile



Entering Sex Classification into Lightroom

- Sex classification/rating codes are: Mature Male (MM), Female/Juvenile (FJ), or Unknown (UNK)
- The sex classification is associated with a reviewer confidence rating: 2- not confident, 3- fairly confident, 4- very confident. This results in a combined confidence classification such as MM2 for a male whale that has low certainty or F4 for a female-juvenile with high certainty.
- The sex classification-confidence rating for each photo is identified using the following keyword hierarchy (see below for example photos):
 - i. **Female-Juvenile**
 - a. Calf
 - b. F2
 - c. F3
 - d. F4
 - ii. **Male**
 - a. MM2
 - b. MM3
 - c. MM4
 - iii. **Unknown – UNK**

**Sex Confidence
Rating**

Example

Calf



F2



F3



**Sex Confidence
Rating**

Example

F4



MM2



Sex Confidence Rating	Example
MM3	 A photograph showing the dorsal fin and the back of a whale's head above the water surface. The whale is dark grey or black.
MM4	 A photograph showing the dorsal fin and the back of a whale's head above the water surface. The whale is dark grey or black.

Figure 25. Photos of melon sex analyses classification and confidence ratings

Annual Sex Summary by ID

After all melon photos in the annual catalogue have been analysed, the sex classifications are summarised by ID for the year. This is done by filtering the catalogue by Dorsal ID and assessing all melon photos of the individual from that year to identify the most likely overall sex classification based on best quality photos and/or the majority of consistent photos.

The sex summaries can then be added to all photos in the annual melon catalogue as keywords using the following hierarchy:

- Sex_Sum**
 - a. Sum_M
 - b. Sum_F
 - c. Sum_Unk

The following decision tree can help when summarizing sex for an ID:

- a. One or more photos MM3 or MM4 → Sum_M
One or more photos FJ3 or FJ4 → Sum_F
- b. All photos MM2 or Unk AND Q3 or 4 → Sum_M
All photos FJ2 or Unk AND Q3 or 4 → Sum_F
- c. All photos MM2 or Unk AND Q1 or 2 → Sum_Unk
All photos FJ2 or Unk AND Q1 or 2 → Sum_Unk
- d. All photos Unk → Sum_Unk
- e. Mix of MM and FJ photos → Re-analyse

The Melon Master Catalogue

The melon master catalogue contains all the sex designations based on previous melon analyses and will be updated based on information from each new annual melon catalogue. Importing the information from the annual catalogue into the master should only be done when the annual catalogue has been fully analysed, all metadata has been saved to the photos, and the catalogue is considered final. The following steps are suggested to help streamline the incorporation of annual melon analyses into the Melon Master and dorsal catalogues.

1. Select all photos in the annual catalogue and save metadata.
2. Filter annual melon catalogue by the keyword “master” to identify all melons with a dorsal link and export as the annual [YYYY]_Master catalogue, saving a copy with photos in a new location.
3. Open the Melon Master Catalogue in Lightroom and import the annual melon master from another catalogue - *Import* > navigate to the [YYYY]_Master catalogue

4. File Handling: Copy new photos to a new location and import
5. Rename photos folder to [YYYY]
6. Export a list view CSV of the Melon Master catalogue.

Master Melon Sex Summary by ID

After importing the newest annual catalogue, the master sex for each ID in the master melon catalogue needs to be re-evaluated based on the new sex classifications. The following steps have been used to do this:

1. Using the CSV of the annual master melon catalogue, recode the sex summary for the IDs in the caption variable:
 - a. For all new dorsal IDs:
 - Master Melon Sex will be equal to the summary from the annual sex classification.
 - b. For IDs with previous sex summaries:
 - If the annual sex classification matches previous master sex, then stays the same
 - If the annual sex classification does NOT match previous master sex, evaluate:
 - i. If biologically possible? (i.e. FJ transitioning to MM)
 - YES: recode master sex for ALL YEARS to the new sex classification
 - ii. If there is photo quality or other issues?
 - Evaluate possible dorsal link or classification errors, record the issue, reassess, and reclassify the sex in the annual Melon and Master Melon catalogues
2. Use Transporter to import updated sex CSV for all melon photos back into Master Melon catalogue.

Incorporating the Melon Sex Summary into the Master Dorsal Catalogue

Once the melon master catalogue has been finalized, the updated sex information needs to be imported into the dorsal catalogue.

1. Export a CSV of the Melon Master catalogue
2. Summarize the master sex for each ID (in Excel or R)
3. Remove all previous melon sex keywords from photos in the dorsal catalogue
4. Use Transporter plug-in to import the new Melon Master Sex keywords into the dorsal catalogue by appending the FJ, MM, or UNK variable as keywords.
5. Update the Sex.Final keyword with the new melon sex
 - a. If genetic sex ('Male', 'Female') is present for an ID it should be prioritized over melon sex in analyses.

Checklist for Annual Melon Analysis:

- Keyword 'melon' for all melon photos + dorsal sequences
- Assign temporary IDs to each sequence
- Export annual melon catalogue
- Check keywords for side and body part
- Import dorsal IDs and Q-ratings to dorsal photos in annual melon catalogue
- Assign dorsal IDs to linked melons for each sequence
- Keyword 'master' to all photos given a dorsal ID
- Q-rate all photos of melons
- Assign sex-age class and confidence rating to each ID'ed melon
- Summarize sex for each ID within the year
- Import annual catalogue into Melon Master catalogue
- Summarize sex across all years
- Import melon sex keywords into Master Dorsal catalogue
- Update Sex.final keyword

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Appendix 1 Scotian Shelf Catalogue Binder Metadata Codes by Year

YEAR	PHOTO TYPE	FILM ROLL/PHOTO CODE(S)	# PHOTOS IN MASTER LRCAT
1988	FILM	A	27
1989	FILM	GU	683
1990	FILM	ID, SP	1768
1991	FILM	D	3
1993	FILM	UG	317
1994	FILM	GX	206
1995	FILM	BW	48
1996	FILM	AA, AB	1150
1997	FILM	SA	1013
1998	FILM	BA, GBW	1781
1999	FILM	JA	1081
2001	FILM	WM, WMS	316
2002	FILM, DIGITAL	TW	974
2003	FILM, DIGITAL	MD, LB	188
2005	FILM	GULLY	2
2006	FILM	MPA	309
2007	DIGITAL	BAL	58
2008	DIGITAL	TEM	17
2009	DIGITAL	NED	2
2010	DIGITAL	/	1136
2011	DIGITAL	/	2546
2013	DIGITAL	/	1031
2015	DIGITAL	/	3499
2016	DIGITAL	/	9496
2017	DIGITAL	/	717
2019	DIGITAL	/	2796

Appendix 2 List of Key Terms

Dorsal – the fin on the whale’s back; used for identifying individual whales

Lightroom Catalogue – file that organizes photos and allows non-destructive changes to metadata

List View – a spreadsheet exported from the Lightroom catalogue (using the Listview plug-in), listing every photo’s filename, title (ID), caption, keywords, date, time, GPS coordinates, and any additional metadata necessary

Melon – the head of the whale, the shape of which is used for sex analysis

Q-rating – “Quality Rating” of a photo used to determine which photos are used for analysis; dorsal and melon photos have different q-rating criteria

Smart collection – a function in Lightroom that selects photos based on criteria, such as rating, keywords, title, date, etc.

Type Specimen / Best of – the “best” photo of a particular ID, can be determined by year and by entire study period

Appendix 3 Distinguishing Patches from Slough Skin

Since Gowans et al. (2001) it has become clear that the marking keyword for mottled patches was vaguely described, resulting in incorrect keywording of other marking types. The most common of these incorrect markings was sloughed skin, which is the peeling of dead skin, which can be seen in other cetacean species, such as sperm whales. Mottled patches are characterized by a white and blotchy appearance, usually on the body of the whale, and are usually large in size (Figure 26). Conversely, sloughed skin is greyish in colour and can be found anywhere on the body or fin of the whale. It is found in irregular shapes and can range in size (Figure 27). Digital resolution and colour images allow for easier distinction between these two marking types.



Figure 26. Northern bottlenose whale with patch



Figure 27. Northern bottlenose whale with sloughed skin

An important difference between mottled patches and sloughed skin is that patches persist over time, allowing identifications across sampling years, whereas sloughed skin can rapidly change within a sampling season and even between days as the skin heals. Along with all mark type keywords, the patch keyword has been checked for mistakes, and the sloughed skin keyword has been introduced. Table 1 summarizes the number of IDs with the patch and sloughed skin keywords before and after the corrections.

Table 1. Number of IDs for left and right sides of the Scotian Shelf catalogue before and after rectifying the marking type keyword for patch in Lightroom.

	Number of IDs	
	Left	Right
Original with Patch	113	110
Updated with Patch	74	92
Updated with Sloughed Skin	56	41

Appendix 4 Large Scar Reclassification

Previous northern bottlenose whale photo-identification work by Gowans & Whitehead (2001) characterized large scars as white, irregular shapes of >10 cm in size. This classification does not clearly define how the 10cm was measured or standardized across all photographs. Scars were reviewed and reclassified to better account for differences in fin size (juvenile vs. adult) and distance from camera, such that a scar or group of scars were considered large if spanning at least 25% of dorsal fin area. For keywording in Lightroom, large scars were classified separately for the dorsal fin and body (i.e. “Large Body Scar”, Large Dorsal Scar”). All photos with the keywords used for the original large scar classification were reviewed iteratively by ID and year, and the new keywords were added where appropriate. The ID summary for large scar keywords before and after re-classification is outlined in Table 2.

Table 2. Number of unique IDs with each associated keyword. IDs counted separately for the left and right side photographs of whales.

Large scar classification	Dorsal scar	Body scar
Adapted from Gowans and Whitehead (2001)	L: 172 R: 177	L: 315 R: 281
Reclassification (2020)	L: 58 R: 61	L: 241 R: 240

Appendix 5 Protocols used in the compilation of the master catalogue

A. Film/Negatives and Scanning

- Most photos from field seasons before 2006 were taken on film and have since been scanned as digital copies. The old film negatives are stored in large binders in the lab, and each photo is numbered according to the initials of the field technician of that year, the roll number and the photo's position in the roll. For example, JA01_18 (from 1999, roll 1, photo 18).
- The film negatives are very delicate and must be handled with care to protect the images, which can be rubbed off. Wear cotton editing gloves when handling and only hold by the edges of the strip.
- Use the light table and magnifying eye piece to view negatives up close. If needed, negatives can be scanned into digital copies using the following instructions (adapted from protocol by Hillary Moors, September 2011):
 1. Plug in the CanoScan 8800F scanner into the computer and ensure the software is installed.
 2. Carefully place the film strip(s) in the scanning holder (shiny side down), making sure the film is dust free.
 - The film holder has space for 2 film strips, and reads from bottom to top, so place the first strip in the bottom row. The film will be read from right to left, so make sure the first photo is on the right. Ensure that there is no gap between the film strip's edge on the right and the holder
 3. Close the holder and place in scanner. The white insert in the scanner must be removed.
 4. Turn on the scanner, and press PHOTO/FILM to open program automatically, or open the image scanning program “MP Navigator”.
 5. Make sure the program has the following settings:
 - Document type: negatives
 - Colour mode: colour
 - Document size: 35mm film
 - Resolution: 1200 dpi (you may need to increase the resolution, however the photos will be larger and take longer to scan).
 - Save images as type: JPEG/Exif (do not save over the file, as Jpeg files compress when they are saved)
 - Set up automatic naming system: NBWphotos_year_imagename
 6. Select folder to save files.
 7. If desired, preview the photos to ensure orientation and to remove any unwanted negatives from being scanned (i.e. water, people, etc.)
 8. Scan. This may take a few minutes depending on the number of photos and the resolution.
 9. Remove film from scanner and carefully place in correct row in plastic sheet in binder.
 10. Check the save location of the photos and if the file structure is organized properly (i.e. by year and photo set).

B. Converting CR2 Files to JPEGs

1. Make sure metadata is saved to photos.
2. Select photos, then go to File > Export.
3. On the left sidebar of the pop-up window, select ‘Burn Full-Sized JPEGs’, then in the drop-down menu at the top, select Hard Drive.
4. Use the following settings:
 - a. Export Location
 - i. Export to ‘Same folder as original photo’
 - ii. Check “Put in subfolder” and name the folder “jpgs”
 - iii. Existing files: Ask what to do
 - b. File naming
 - i. Do not rename photos
 - c. Metadata
 - i. Include: ‘All metadata’
 - ii. Uncheck ‘Remove person info’ and Remove location info’
 - iii. Check ‘Write keywords as Lightroom hierarchy’
5. Click Export.
6. Synchronize parent folder to import the new jpgs.
7. Check that the metadata is correct for the jpgs.
8. On computer, delete or move the CR2 (and xmp sidecar files).
9. Remove the CR2 files in Lightroom.
10. In Lightroom, move the jpg photos to the parent folder and delete the ‘jpg’ subfolder.

C. Changing Capture Date/Time

- If the date/time of a photo is incorrect, you can go to Metadata > Edit Capture Time. This can only be done for 1 photo at a time or for photos with the same date/time.
- For bulk edits of the date/time, you will need to use a program called EXIF Date Changer (<https://www.relliksoftware.com/exifdatechanger/>) in conjunction with the List View and Transporter plug-ins (described above). This protocol is a work around, so it must be followed exactly so metadata isn't lost.
- The program does not work on CR2 files, so these photos will need to be converted into JPEGs (see above).
- You will need an Excel sheet with the original capture date and time for the photos. The date and time must be in the following format: YYYY-MM-DD HH:MM:SS. Also, ensure that the file name matches what is in Lightroom or the process will not work.
 1. Make sure the metadata is saved to the photos.
 2. Export a List View of desired photos, then convert to CSV.
 3. In the filename column, find and replace the .jpg of all photos with nothing, then Save.
 4. From the List View CSV, use Transporter to import the filename of the photo into the Creator field. This will be used later to change the file name back to the original name.
 - a. You will need to choose "filename w/o extension" as the Lightroom field.
 5. From the sheet with the original capture date/time, use Transporter to import the date/time to the Caption of the photo.
 6. Make sure that all photos were successfully modified by Transporter in steps 3 and 4 before proceeding. Then save the metadata to the photos.
 7. Select photos, and go to Library > Rename Photo, then rename as follows: NBW_{Sequence # (1)}_{Caption}
 8. In EXIF Date Changer, select source folder with desired photos (or select specific photos). The program will automatically create a destination folder within the source folder for the adjusted photos.
 9. Check the box for Set date/time from, then select Date in Filename.
 10. Under Options, check the boxes for "Set file created date to taken date" and "Use file created date if no date taken".
 11. Check the "rename files to" box and write "adj-%f". This will append to the beginning of the filename and will help to keep track of the adjusted photos.
 12. Click Process Photos. When done, click Open Folder the right-click and select Properties to check if the date/time was changed correctly.
 13. Import adjusted photos into Lightroom by Synchronizing the parent folder containing the adjusted photos. You can also rename the adjusted folder (i.e. adj-crops).
 14. Ensure that all metadata has transferred over to adjusted photos, including the new information in the Creator field.
 15. Rename photos to have the Creator (i.e. the original filename).
 16. Remove originals from the catalogue.