

Whale photo-identification: Digital photography techniques, using EXIF data, and photo editing tools

Introduction

When whale photo-identification studies first began in the 1960s and 1970s, researchers used either 35mm slide film or high resolution black and white film to document individual whales. Some photo-ID programs evaluated negatives magnified with dissecting microscope to look for matches and other programs made custom black and white prints in a photo darkroom, carefully enlarging, rotating and adjusting each image to bring out all the fine detail on the negative.

Today's digital photography equivalent of a film negative is the RAW format image file. RAW images are the most accurate photo record that your camera can produce. Because RAW files can't be modified, they are akin to a negative and must be processed to use them effectively (see Appendix I for a description of some common image file types).

JPEG format files should not be used in the field for photo-ID photos. The JPEG format does not capture the reality of the image nearly as well as the RAW format. It does not contain detail that can be edited if the lighting is poor or the animal is distant, and JPEG compression algorithms can tend to add digital artifacts (erroneous markings) that show when the image has been enlarged (see Appendix II).

Recent advances in photo editing tools allow us to work directly (and efficiently) with RAW files rather than having to pre-process RAW files using the digital camera's software tools. Photo editing tools now allow users to view, edit and "Batch Convert File Format" to convert RAW files (7-15 Mbytes on average) to "best compressed" JPEG files (about 300-600 Kbytes on average). These compressed JPEG files show an amazing amount of detail even when enlarged over 200%. And if the quality of the compressed JPEG is not sufficient, the RAW file can be edited and re-converted to compressed JPEG.

The examples in this document are based on tools available in ACDSee Pro (<http://www.acdsee.com>), but there are other photo editing programs that can do similar things.

Here are some guidelines to follow when using digital photography for photo-identification studies:

- Always shoot at the highest resolution of the camera, e.g., RAW. Use fast flash cards (>80x write speed).
- Think of RAW as your original negative and archive the RAW files the same way you'd archive your negatives
- Convert the RAW images to compressed JPEG to use as your working images. If you need to edit your compressed JPEG image, go back and edit the RAW file and then save a new, edited compressed JPEG file.

Researchers working with your image data long after you're retired will thank you for this. In the North Pacific, we are still encountering humpback whales that were first photographed in the early-mid 1970s.

Using EXIF metadata fields to store additional data with each image

Digital cameras automatically store some useful data each time a photograph is taken. This information is called EXIF (Exchangeable Image File) metadata. EXIF metadata includes date, time, camera model, shutter speed, focal length, and exposure settings.

Think of each photo a data record as well as an image and take advantage of the EXIF fields to add descriptive data to each of your photos. Photo tools such as ACDSee let you “Batch Set Information” into the EXIF fields. You can select a number of photos, put in descriptive information, and then import these data directly into a database (see “Protocol for exporting EXIF metadata: <http://nmml.afsc.noaa.gov/pdf/NMMLPhotoMetaDataProtocol.pdf>). Even if you don’t plan to import the data into a database, the EXIF data can be read by anyone you send your photos to who if they have photo software that show EXIF data.

The EXIF fields, “Image Description”, “Artist”, “Copyright” and “User Comment” are useful to store data about our whale encounters. These fields can be individually edited or “Batch Set” all at once.

For my own photo-ID surveys, I “Batch Set Information” including a descriptive encounter number for all images taken with a specific whale or group of whales. In the example shown later, I used the “Image Description” field for my encounter number (7Feb2007_Uganik_Enc4), the “Copyright” field for image type (tail, left or right dorsal), the “Artist” field for the whale’s field nickname and “User Comment” for biopsy info.

Using EXIF data for transmitting photo information when distributing opportunistic data

If you have opportunistic photos that you plan to send to others on an occasional basis, I’d recommend including the latitude/longitude and/or a descriptive place name in one of the editable EXIF fields and your name and affiliation in another. It doesn’t matter which fields you choose to use for your descriptive information as long as you’re consistent. The data will be readable with any EXIF viewer and can be imported into any database and renamed.

Working with RAW files

Batch rename

After copying the RAW files to your computer’s hard drive, you can “Batch rename” the files using some sort of descriptive name. Each research group seems to have their own file naming protocol. Whatever descriptive naming convention you choose, make sure you change the filename of the RAW photos before converting them to compressed JPEG. Because the RAW file is equivalent of a negative, it’s important to ensure that you can connect the RAW file to the JPEG file in case you need examine the RAW image to do any edits to the original file.

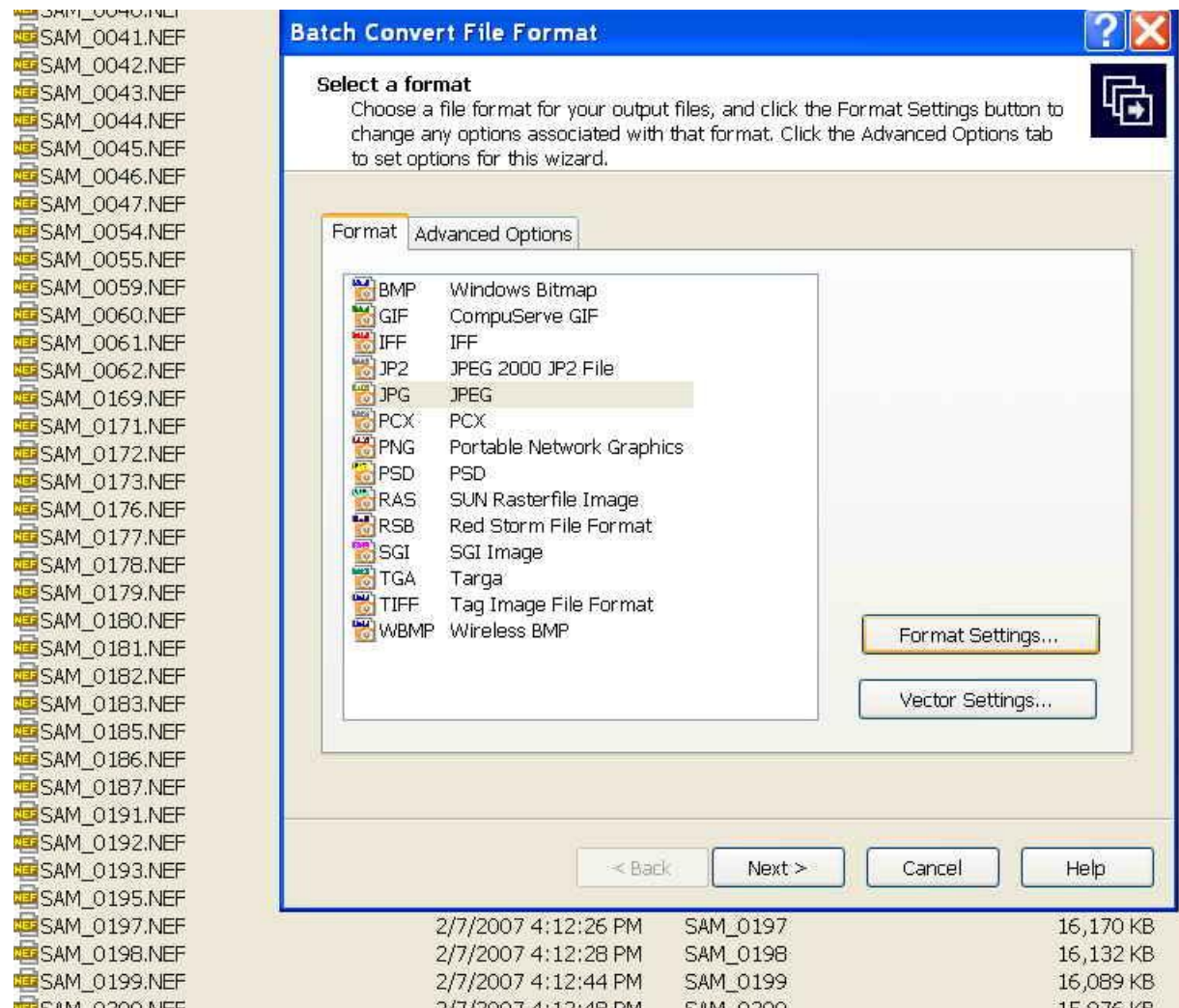
Batch RAW process (if your camera settings were off)

If you've had some sort of camera glitch that affected all your images (wrong meter settings, etc), this is the time to do some "Batch RAW processing" to adjust light levels in the photos to compensate for any camera problems. If your camera has behaved appropriately, you can skip this step.

Batch convert RAW files to compressed JPEG

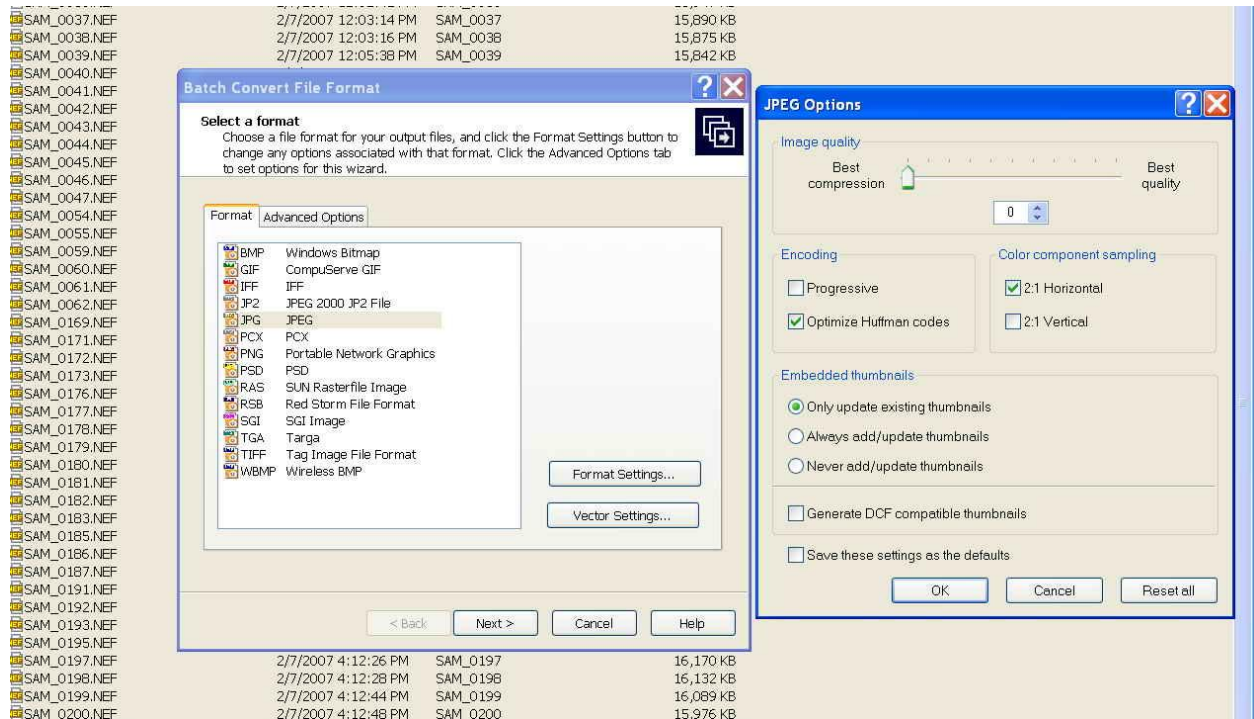
Put all the images you want to batch convert from RAW to JPEG in one folder, then:

- Select all images ("Control I" is the keyboard shortcut for this)
- Under Tools, choose Batch Convert File Format
- Select JPEG, then click on Format Settings
- Under JPEG options, slide the compression bar to "best compression" and save this as your default setting
- Choose a file folder
- Finish

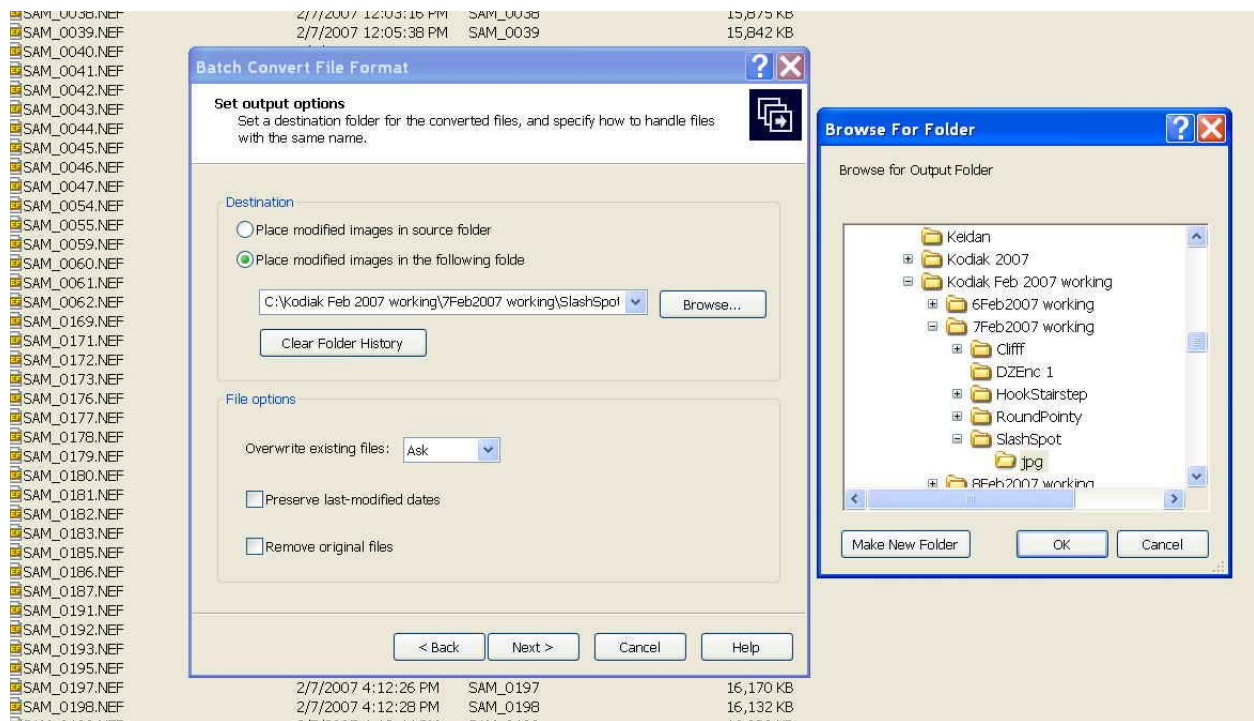


Set the JPEG options to "Best compression". There is no need to save a larger JPEG file. These small

JPEGs enlarge very well, and if you need more detail, it's best to go back to the RAW file.



Select a folder for your JPEG files.



Editing RAW files

If your compressed JPEG working file image is too distant, at an odd angle, or too dark or light, go back and edit the RAW file and save the edited image as a “best compressed” JPEG.

For humpback whale tail photos, if we need to edit the image at all, we typically

- rotate the image, if necessary
- crop it to fill the frame and center the tail flukes
- adjust the exposure using contrast and gamma (see definition below).

We do not adjust brightness, because it lightens the entire image. Gamma adjustments bring out detail in the mid-tones (shadow areas) of the image, and we adjust contrast to fine-tune the appearance of small marks and gray areas.

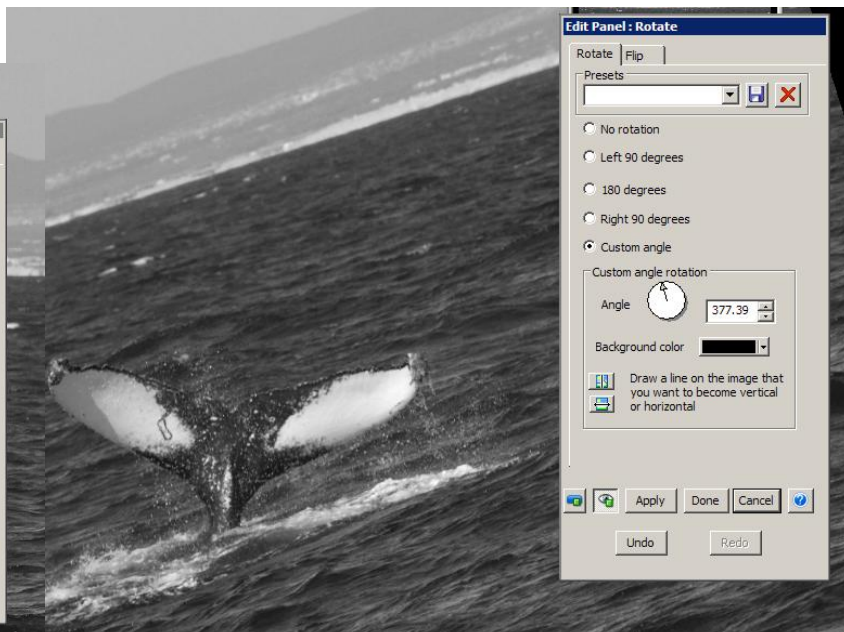
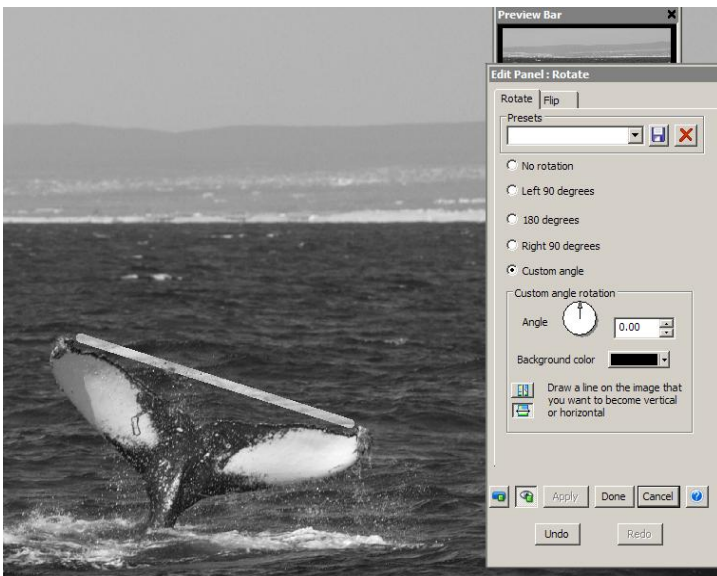
The simple editing capabilities of a program like ACDSee are preferable to some of the more sophisticated (and more expensive) editing packages. For example, after extensive testing we found that “Sharpening” images actually degraded one’s ability to interpret the finest scratches and marks on a digital image. A “sharpened” image looks better from a distance, but when magnified, the pixel edges appear to be fuzzy, not sharp, which makes it hard to interpret the fine marks.

We don’t Resize during editing. If we need to resize or compress the photo into a smaller JPEG format in order to reduce its size for e-mail or web distribution, we use “Convert file format” or “Resize...” for a number of photos at once, using the “Modify” tools. If you need to save file space, you can convert humpback tail photos to 256 grays before editing. Color can be distracting when matching whale tails and takes up more file space than is necessary

Modify, Edit Mode Tools

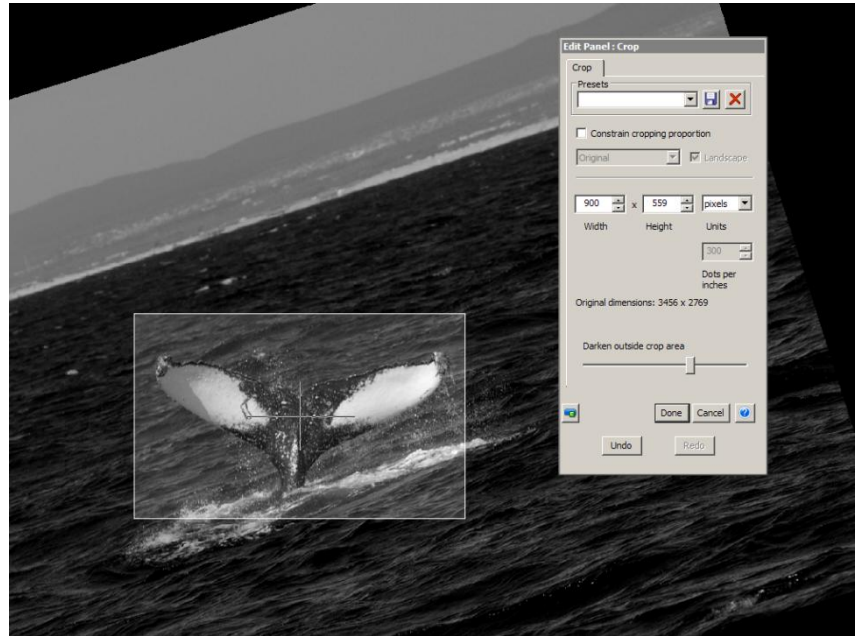
Rotate

We rotate humpback whale tail flukes to a standardized horizontal plane in order to help us have a consistent image for comparing photos while matching. To rotate, select Custom angle, horizontal, and draw a line (drag the mouse) from fluke tip to fluke tip. This will automatically rotate the flukes to the horizontal plane. In this case, the rotational angle was 377.39°



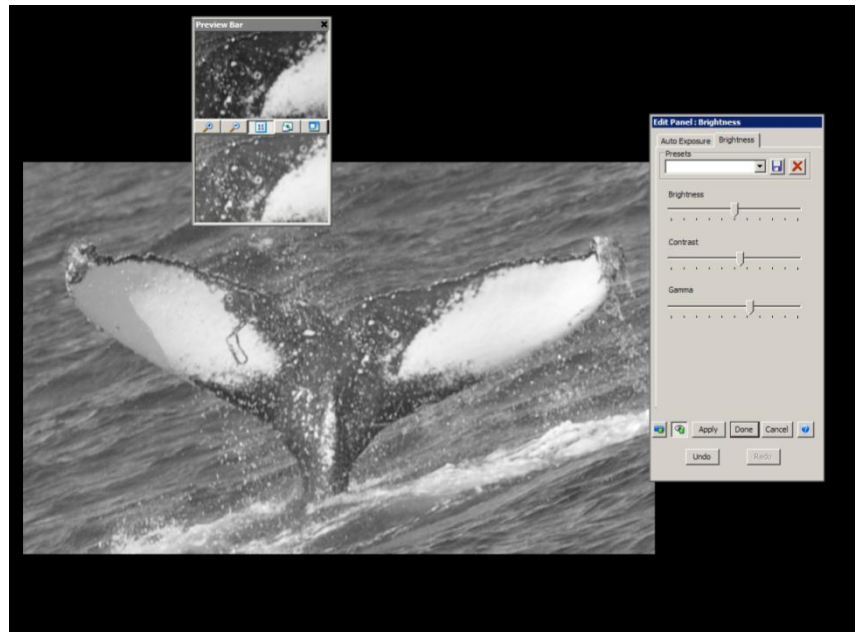
Crop

We crop to fill the entire frame with the centered flukes photograph. We adjust the crop size by eye using the “handles” on the crop frame. The crop tool can remember a preset crop or can be set by exact pixel height and width if desired.



Exposure

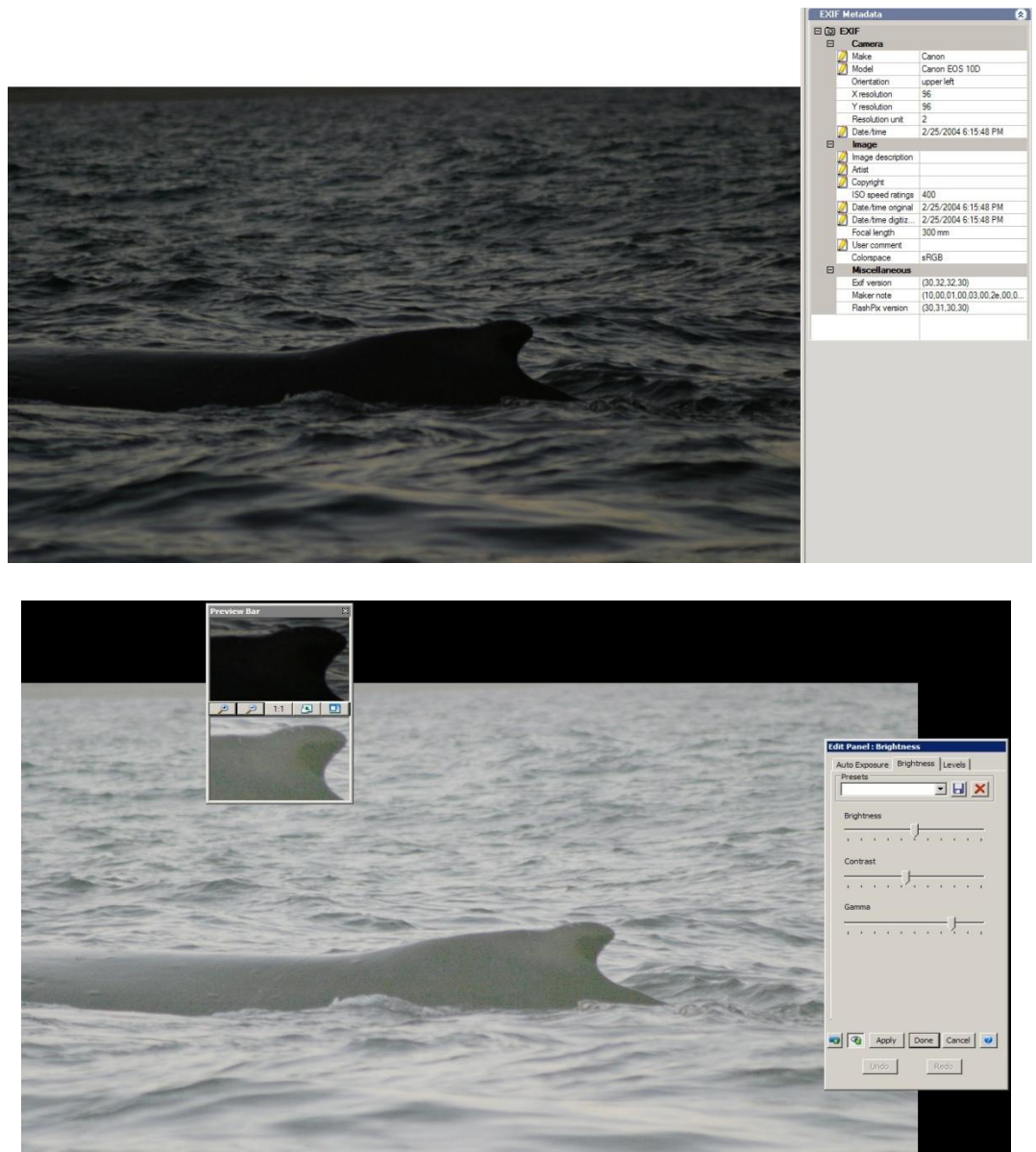
We adjust only the gamma and contrast. The brightness control lightens across all the tones of the image, and will cause the fine marks to be washed out. The preview bar (the small magnified box above the image) allows you to magnify selected portions of the image to evaluate fine changes in densities. This photo had a minor adjustment to gamma and an even smaller adjustment to the contrast (the slide bars are near the center of the scale).



Example

Gamma adjustments are very useful to bring out small details in very dark underexposed photographs. This photograph was shot just after sunset using a Canon 10D camera set at the Canon RAW high resolution setting. If we had been shooting at the JPEG setting, there would have been no fine detail at all, because the compression algorithm would have “decided” that the whale was completely black.

Even though the photograph looked very dark to the eye, after adjusting the gamma, we were able to see many fine marks on the dorsal fin. We were able to confirm the marks the next day when we approached and photographed the same mother and calf.



Batch set EXIF metadata fields

Once the files have been converted to JPEG, you can edit data into the EXIF metadata fields. In this example we are inputting the encounter number information for our whales “Hook” and “Stairstep”, photographed in Uganik Bay, Kodiak in February 2007. I used the “Image Description” field for my encounter number (7Feb2007_Uganik_Enc4

The screenshot shows a file explorer window with a list of files and a 'Batch Set Information' dialog box. The file list has the following columns: Filename, Image Type, Date/time original, Artist, Copyright, Image description, and User comment.

Filename	Image Type	Date/time original	Artist	Copyright	Image description	User comment
SAM_0124.jpg	JPEG	2/7/2007 1:45:02 PM	Hook	RD	Uganik_7Feb2007_Enc4	
SAM_0125.jpg	JPEG	2/7/2007 1:47:27 PM	Hook?	Tall	Uganik_7Feb2007_Enc4	
SAM_0126.jpg	JPEG	2/7/2007 1:47:28 PM	Stairstep	Tall	Uganik_7Feb2007_Enc4	
SAM_0131.jpg	JPEG	2/7/2007 1:52:43 PM	Stairstep	RD	Uganik_7Feb2007_Enc4	
SAM_0132.jpg	JPEG	2/7/2007 1:52:44 PM	Stairstep	RD	Uganik_7Feb2007_Enc4	

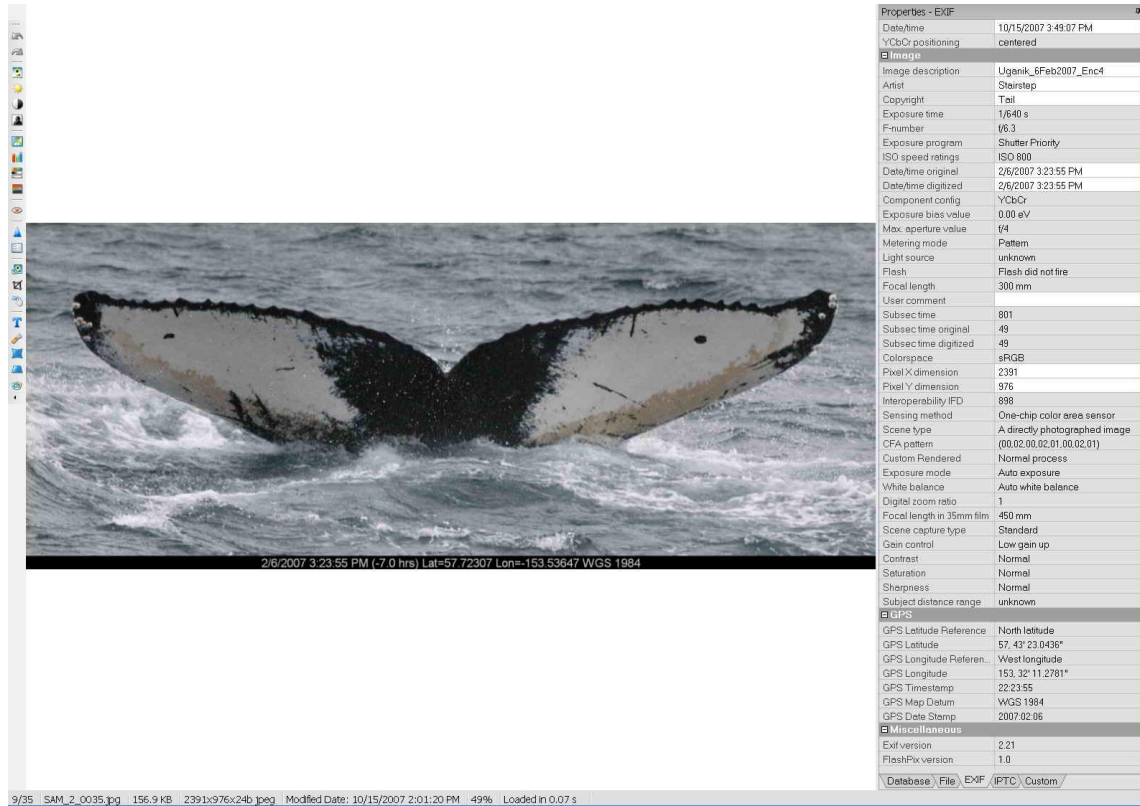
The 'Batch Set Information' dialog box is open, showing the 'EXIF' tab. The 'Image description' field is set to 'Uganik_7Feb2007_Enc4'. Other fields like Artist, Copyright, and User comment are set to an asterisk (*). The 'Preview' section shows a list of files and their new values.

File Name:	New Value:
SAM_0124.jpg	Uganik_7Feb2007_Enc4
SAM_0125.jpg	Uganik_7Feb2007_Enc4
SAM_0126.jpg	Uganik_7Feb2007_Enc4
SAM_0131.jpg	Uganik_7Feb2007_Enc4
SAM_0132.jpg	Uganik_7Feb2007_Enc4
SAM_0133.jpg	Uganik_7Feb2007_Enc4
SAM_0134.jpg	Uganik_7Feb2007_Enc4
SAM_0135.jpg	Uganik_7Feb2007_Enc4
SAM_0136.jpg	Uganik_7Feb2007_Enc4
SAM_0137.jpg	Uganik_7Feb2007_Enc4
SAM_0139.jpg	Uganik_7Feb2007_Enc4
SAM_0140.jpg	Uganik_7Feb2007_Enc4
SAM_0141.jpg	Uganik_7Feb2007_Enc4
SAM_0142.jpg	Uganik_7Feb2007_Enc4
SAM_0143.jpg	Uganik_7Feb2007_Enc4
SAM_0144.jpg	Uganik_7Feb2007_Enc4
SAM_0145.jpg	Uganik_7Feb2007_Enc4
SAM_0146.jpg	Uganik_7Feb2007_Enc4
SAM_0147.jpg	Uganik_7Feb2007_Enc4
SAM_0148.jpg	Uganik_7Feb2007_Enc4
SAM_0150.jpg	Uganik_7Feb2007_Enc4
SAM_0151.jpg	Uganik_7Feb2007_Enc4
SAM_0153.jpg	Uganik_7Feb2007_Enc4
SAM_0154.jpg	Uganik_7Feb2007_Enc4
SAM_0156.jpg	Uganik_7Feb2007_Enc4
SAM_0157.jpg	Uganik_7Feb2007_Enc4
SAM_0158.jpg	Uganik_7Feb2007_Enc4
SAM_0159.jpg	Uganik_7Feb2007_Enc4
SAM_0160.jpg	Uganik_7Feb2007_Enc4

In the example below, you can see that I used the “Artist” field for our field nickname for each whale, the “Copyright” field for photo type (RD (right dorsal), LD (left dorsal) and Tail), and the “User comment” field to record the biopsy sample number with the photo taken at the moment of the biopsy.

Filename	Modified Date	Size (KB)	Artist	Date/time original	Copyright	Image description	User comment
SAM_0124.jpg	2/7/2007 1:45:02 PM	569 KB	Hook	2/7/2007 1:45:02 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0125.jpg	2/7/2007 1:47:27 PM	587 KB	Hook?	2/7/2007 1:47:27 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0126.jpg	2/7/2007 1:47:28 PM	613 KB	Stairstep	2/7/2007 1:47:28 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0131.jpg	2/7/2007 1:52:43 PM	641 KB	Stairstep	2/7/2007 1:52:43 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0132.jpg	2/7/2007 1:52:44 PM	651 KB	Stairstep	2/7/2007 1:52:44 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0133.jpg	2/7/2007 1:52:47 PM	720 KB	Stairstep	2/7/2007 1:52:47 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0134.jpg	2/7/2007 1:55:40 PM	505 KB	Hook	2/7/2007 1:55:40 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0135.jpg	2/7/2007 1:55:41 PM	392 KB	Hook	2/7/2007 1:55:41 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0136.jpg	2/7/2007 1:57:09 PM	275 KB	Stairstep	2/7/2007 1:57:09 PM	Tail	Uganik_8Feb2007_Enc4	
SAM_0137.jpg	2/7/2007 1:58:38 PM	597 KB	Stairstep	2/7/2007 1:58:38 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0139.jpg	2/7/2007 1:59:55 PM	692 KB	Hook	2/7/2007 1:59:55 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0140.jpg	2/7/2007 1:59:57 PM	658 KB	Stairstep	2/7/2007 1:59:57 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0141.jpg	2/7/2007 1:59:59 PM	653 KB	Stairstep	2/7/2007 1:59:59 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0142.jpg	2/7/2007 2:00:46 PM	663 KB	Hook	2/7/2007 2:00:46 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0143.jpg	2/7/2007 2:01:27 PM	708 KB	Stairstep	2/7/2007 2:01:27 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0144.jpg	2/7/2007 2:01:32 PM	749 KB	Stairstep	2/7/2007 2:01:32 PM	Tail	Uganik_7Feb2007_Enc4	Biopsy 2007-KO-Mn4 reaction
SAM_0145.jpg	2/7/2007 2:03:03 PM	804 KB	Stairstep	2/7/2007 2:03:03 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0146.jpg	2/7/2007 2:08:33 PM	586 KB	Stairstep	2/7/2007 2:08:33 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0147.jpg	2/7/2007 2:08:35 PM	578 KB	Hook	2/7/2007 2:08:35 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0148.jpg	2/7/2007 2:08:36 PM	560 KB	Hook	2/7/2007 2:08:36 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0150.jpg	2/7/2007 2:10:49 PM	627 KB	Hook	2/7/2007 2:10:49 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0151.jpg	2/7/2007 2:10:50 PM	609 KB	Stairstep	2/7/2007 2:10:50 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0153.jpg	2/7/2007 2:14:18 PM	602 KB	Stairstep	2/7/2007 2:14:18 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0154.jpg	2/7/2007 2:15:12 PM	588 KB	Stairstep	2/7/2007 2:15:12 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0156.jpg	2/7/2007 2:17:13 PM	516 KB	Hook	2/7/2007 2:17:13 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0157.jpg	2/7/2007 2:17:13 PM	544 KB	Hook	2/7/2007 2:17:13 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0158.jpg	2/7/2007 2:17:15 PM	528 KB	Hook	2/7/2007 2:17:15 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0159.jpg	2/7/2007 2:18:30 PM	633 KB	Hook	2/7/2007 2:18:30 PM	LD	Uganik_7Feb2007_Enc4	
SAM_0160.jpg	2/7/2007 2:20:13 PM	677 KB	Hook front Stairstep back	2/7/2007 2:20:13 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0161.jpg	2/7/2007 2:20:13 PM	722 KB	Stairstep	2/7/2007 2:20:13 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0162.jpg	2/7/2007 2:20:14 PM	707 KB	Stairstep	2/7/2007 2:20:14 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0163.jpg	2/7/2007 2:20:15 PM	704 KB	Stairstep	2/7/2007 2:20:15 PM	Tail	Uganik_7Feb2007_Enc4	
SAM_0164.jpg	2/7/2007 2:20:40 PM	688 KB	Hook	2/7/2007 2:20:40 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0165.jpg	2/7/2007 2:20:45 PM	705 KB	Stairstep	2/7/2007 2:20:45 PM	RD	Uganik_7Feb2007_Enc4	
SAM_0166.jpg	2/7/2007 2:21:43 PM	717 KB	Hook	2/7/2007 2:21:43 PM	Blowhole	Uganik_7Feb2007_Enc4	
SAM_0167.jpg	2/7/2007 2:21:43 PM	689 KB	Stairstep	2/7/2007 2:21:43 PM	RD	Uganik_7Feb2007_Enc4	

The example photo below has the latitude and longitude information embedded both on the image (optional) and also available in the EXIF metadata.



The screenshot displays a photo viewer interface. The central image shows a whale's tail fluke emerging from the water. At the bottom of the image, the following text is overlaid: "2/6/2007 3:23:55 PM (-7.0 hrs) Lat=57.72307 Lon=-153.53847 WGS 1984". To the right of the image is a "Proprietes - EXIF" window with the following data:

Property	Value
Date/Time	10/15/2007 3:43:07 PM
YCbCr positioning	centered
Image Description	
Image description	Ugenik_EFeb2007_Enc4
Artist	Steirstep
Copyright	Tail
Exposure time	1/640 s
F-number	f6.3
Exposure program	Shutter Priority
ISO speed ratings	ISO 800
Date/Time original	2/6/2007 3:23:55 PM
Date/Time digitized	2/6/2007 3:23:55 PM
Component config	YCbCr
Exposure bias value	0.00 eV
Max. aperture value	f4
Metering mode	Pattern
Light source	unknown
Flash	Flash did not fire
Focal length	300 mm
User comment	
Subsec time	801
Subsec time original	49
Subsec time digitized	49
Colorspace	sRGB
Pixel X dimension	2391
Pixel Y dimension	976
Interoperability IFD	898
Sensing method	One-chip color area sensor
Scene type	A directly photographed image
CFA pattern	(00.02.00.02.01.00.02.01)
Custom Rendere	Normal process
Exposure mode	Auto exposure
White balance	Auto white balance
Digital zoom ratio	1
Focal length in 35mm film	450 mm
Scene capture type	Standard
Gain control	Low gain up
Contrast	Normal
Saturation	Normal
Sharpness	Normal
Subject distance range	unknown
GPS	
GPS Latitude Reference	North latitude
GPS Latitude	57.43° 23.0436"
GPS Longitude Referen...	West longitude
GPS Longitude	153.32° 11.2781"
GPS Timestamp	22:23:55
GPS Map Datum	WGS 1984
GPS Date Stamp	2007:02:06
Miscellaneous	
Exif version	2.21
FlashPix version	1.0

At the bottom of the photo viewer, the status bar shows: "9/35 SAM_2_0035.jpg 156.9 KB 2391x976x24b jpeg Modified Date: 10/15/2007 2:01:20 PM 49% Loaded in 0.07 s".

Exporting photo metadata into a database

Once we've edited all the information into the metadata, we can then select specific EXIF and file information and import it directly into our Access database (see Protocol for Exporting EXIF Metadata into an MS Access Database, developed by Christy Sims and Sally Mizroch, <http://nmml.afsc.noaa.gov/pdf/NMMLPhotoMetaDataProtocol.pdf>)

Appendix I: Digital Photo File formats

RAW

- Highest resolution of a digital camera
- Can be converted JPEG using batch conversion software
- Usually stores in smaller file on compact flash card than TIFF

JPEG (Joint Photo Experts Group)

- Compressed, small files
- “Lossy” format, “guesses” or predicts patterns, so can give false information (see example in Appendix II)
- Each time JPEG file is saved, it’s compressed again and loses additional information.
- If you need to edit original JPEG files, save the edited version as a TIFF file, then compress back to JPEG from TIFF.

TIFF (Tag Image File Format)

- Uncompressed, large files
- Good as intermediate step when editing files that were originally JPEGs

Appendix II: Disadvantages of JPEG for photo-ID

- Accurate matching requires accurate presentation of fine marks and scars.
- JPEG files don't show fine marks well if the image is too dark or too light
- JPEG files can show pixel edges when enlarged
- JPEG images can be totally inaccurate! (see below)

False Mark in JPEG photo

