

SEAN Sea otter monitoring SOP 5: Field protocol for aerial surveys in Glacier Bay

Revision History Log:

Previous SOP version	Effective Date	Revised By	Changes Made	New SOP version
-	September 2018	Jamie Womble	Initial version	1.0

Summary

Sea otters are surveyed in Glacier Bay using fixed-wing single engine aircraft. This SOP details the procedures needed to carry out the aerial surveys, specific equipment and equipment settings, duties for the observers, and procedures for ensuring data integrity during field operations.

The plane is flown at ~215 m (700ft) and about 90-95 knots along pre-defined transects. The transects need to be programmed into the aircraft's navigation system (Chelton Flight System) which creates a 3-D image of each transect that the pilot can use for navigation along the transect line. Programming of the Chelton Flight Navigation system requires the aviator to have specialized knowledge and experience. Transects are optimized to capture the distribution of sea otters throughout Glacier Bay while taking into account personnel safety and budget considerations. Digital photos are taken of the area directly under the aircraft along each transect using a digital camera (Nikon D810) with a Zeiss 85 mm lens. The camera is aimed vertically attached to a tripod head mounted on a plywood platform secured in the belly porthole of the aircraft. The digital camera captures an image every 1 second, using a digital timer (Nikon MC36) that is attached to the camera and operated by the observer.

Detailed steps

1. Equipment and settings
 1. Nikon D810 Camera



Figure SOP5.1. The above image shows the Nikon D810 digital camera menu screen and controls.



Figure SOP5.2. The above image shows the Nikon D810 digital camera with Zeiss 85mm lens attached and the focus taped to infinity. The attachment port for the cord connecting the remote timer is also shown.

1. Camera Battery: Should be fully charged before every aerial survey flight. A backup battery should also be fully charged and taken on each aerial survey flight.

2. Camera Memory: A 256GB Extreme Compact Flash memory card is used in the Nikon D810. The card should be formatted before each aerial survey to ensure data integrity.
 3. Date & Time: Should be synchronized with GPS time at beginning of every flight. If this is not done correctly then it will be difficult to georeference photos. This step is very important and is described in detail in SOP 4.
 4. Custom settings: see Appendix SOP5.1 for a short checklist of essential settings required for the camera. See Appendix SOP5.2 for more detailed custom settings that should be programmed into the camera once and used for all subsequent aerial surveys.
2. Zeiss 85mm lens
 1. Set focus to manual, turn focus to infinity, and tape in place to hold.



Figure SOP5.3. Nikon D810 digital camera with Zeiss 85mm lens attached. The lens focus is adjusted to infinity and taped in place. Also shown is the attachment port for the cord connecting the remote timer.

3. Nikon MC-36 Timer



Figure SOP5.4. Nikon MC-36 remote timer programmed to trigger the digital camera once every two seconds.

1. The timer uses 2 AAA batteries. Install fresh batteries before heading into the field.
2. Set timer to 1-second intervals as shown in Figure SOP5.4.
3. Attach timer to camera (port is on front left side of camera).

4. Belly-port in aircraft

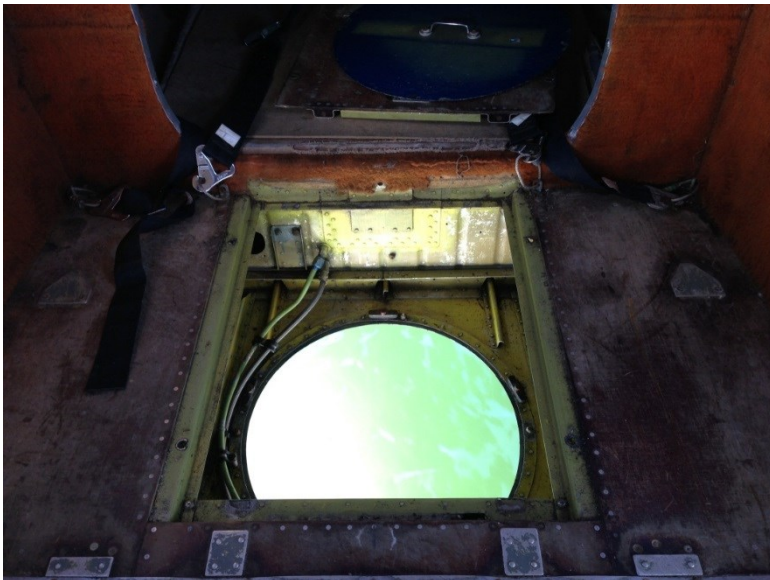


Figure SOP5.5. The above image shows the bellyport in the De Havilland Canada DHC-2 Beaver aircraft where the custom camera platform is placed.

5. Camera Tripod on Plywood Mounting Board in Aircraft



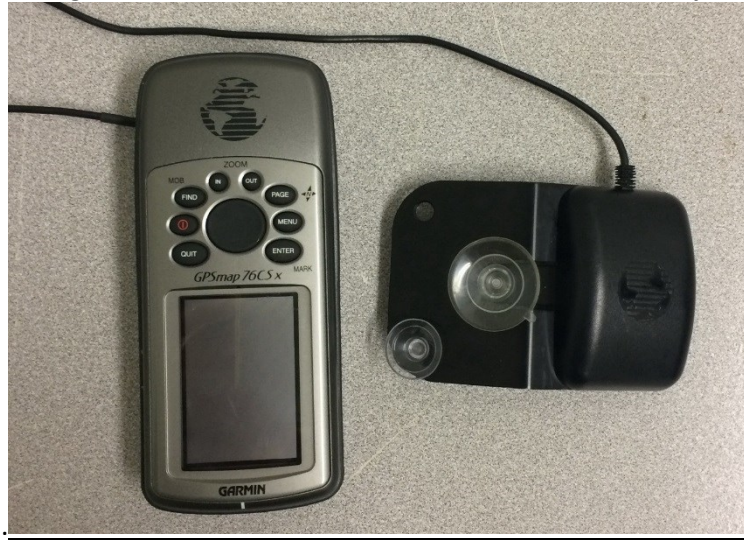
Figure SOP5.6. The above image illustrates the attachment of the digital camera to the tripod affixed to the custom platform that fits the belly port of the aircraft. The digital camera is aimed vertically, adjusted with a portable level in flight, and controlled with the attached remote timer.

6. Garmin GPS 76 CSX with external antenna

1. Set GPS to record a tracklog with points every one second. The GPS holds a maximum of 10,000 points in a tracklog. If one anticipates the aerial survey will exceed two and a half hours, wait until near the first transect to start recording a tracklog.
2. A second GPS (or newer high-capacity model) may be used in case the tracklog time is exceeded. A redundant GPS unit would also provide backup in case the primary unit fails in the field.
3. Be sure GPS is recording using the WGS84 datum.

The GPS 76CSX unit employs a barometric altimeter. Accurate altitude is essential for calculating the area covered by each individual photograph. The GPS must be calibrated using a local barometer at the time of survey. The nearest point barometric pressure is measured is at the Gustavus airport. Just prior to commencing transects the pilot obtains the corrected pressure and adjusts the plane's altimeter using it. The pilot then flies

at a specified level altitude using his calibrated altimeter and our GPS unit is then adjusted so its altitude



matches that of the plane.

Figure SOP5.7. Garmin GPS 76CSx with antenna.

7. Chelton Navigation System in Aircraft

1. The Chelton Flight Navigation System is important for enabling the pilot to accurately follow the specified transect lines while maintaining a steady speed and altitude. The transects need to be pre-programmed into the aircraft's navigation system which creates a 3-D image of each transect that the pilot can use for navigation along the transect line. Programming the Chelton system requires the assistance of an aviator with specialized training and experience.



Figure SOP5.8. Chelton Navigation System.

2. Field Methods

1. Before commencing fieldwork, obtain the items required as described in the Appendix SOP5.3 checklist.
2. The survey plane, currently a de Havilland Canada DHC-2 Beaver single-engine high-winged aircraft, is flown at ~213 meters above the surface and about 90-95 knots along established transects.
3. A handheld GPS unit (currently Garmin 76 CSX), with an external antenna, is used to record the tracklog and position of the plane (latitude, longitude, altitude) at 1-second intervals. The latitude, longitude, and altitude from the tracklog will be downloaded after the aerial survey and later used to georeference each digital image (SOP 7).
4. Digital photos are taken of the area directly under the aircraft along each transect using a digital camera (Nikon D810, 36.3 megapixel) with 85 mm lens (Zeiss F/1.4 ZF.2). The camera is attached to a tripod head and then vertically aimed and mounted on a plywood platform that is secured in the belly porthole of the aircraft (figure SOP5.6). The digital camera captures an image every 1 second, using a digital timer (Nikon MC36) that was attached to the camera and operated by the observer (Figure 5.4).
5. Digital images are recorded on a 256 GB compact flash memory card (SanDisk Extreme PRO). Each digital image (7,360 X 4,912 pixel JPEG) covers approximately 90 X 60 m at the surface of the water with ~1.64 cm pixel resolution.
6. Immediately after the flight, review the quality of the day's data.
 1. Extract and back up the tracklog from the GPS as explained in SOP 6.
 2. Download all photos to a suitable field computer as explained in SOP 6.

3. Spot check photo images to verify they are being legibly recorded.
4. Attempt a test georeference cycle (see SOP 7) to be certain the trackpoints properly reconcile with the photos. This is for quality control purposes only: the formal georeferencing will be performed in the office at a later date once all aerial surveys are complete.
5. Retain all used memory cards in a safe place on the ground; they are the source of images when the formal image deliverables are created at the office once all field work is complete. The field quality control computer images are not rigorously managed, so it is essential to retain the complete set of original memory cards intact: they will be the basis for the monitoring program's final data and information products.



Figure SOP 5.9. Example of a digital photograph of sea otters taken with the digital camera mounted vertically in the belly port of the aircraft.

Appendix SOP5.1: Essential camera settings

Summary: The following describe the custom settings for best shooting aerial images of sea otters with the Nikon D810 digital camera and Zeiss 1.4/85 mm ZF.2 lens. Because conditions may change during surveys such as light and glare it is important to monitor conditions in the event the settings need to be modified in flight.

- **Date & Time:** Set the date and time under Menu, Setup Menu, Date and Time. The date and time should be set to match the GPS at the beginning of every survey. This step is very important and is described in detail in SOP 4.
- **Exposure Mode:** Set the exposure mode to S for shutter priority. The mode button is on top of the camera next to the shutter release button.
- **Release Mode:** Set the release mode to S for single frame. The release mode dial is on the top left of the camera.
- **ISO:** Set ISO to 200 or 400 depending on lighting (use 200 for bright days if needed). Under Menu, Shooting Menu, ISO Sensitivity Settings, select Auto ISO sensitivity control and make sure it is ON.
- **Image Quality:** Under Menu, Shooting Menu, Image Quality select FINE.
- **Image Area:** Under Menu, Shooting Menu, Image Area, select FX for full frame, the largest image area.
- **Autofocus Mode:** Select manual focus mode with the toggle on the front of the camera, right of the lens.
- **Auto Image Rotation:** Under Menu, Setup Menu, select Auto image rotation and make sure it is OFF.

Appendix SOP5.2: Detailed digital camera settings



Figure SOP5.2-1. Nikon D810 camera.

External Camera Settings [general location on camera]

- Focus-Mode selector [front left] – M (Manual)
- Mode dial [top left] – press/release Mode dial lock to select S (Single-frame) or C (Continuous, 3 fps)
- Diopter adjustment knob [top center-right] – adjust focus to your eye, then lock
- Metering selector [top center-right] – in most cases, select 3D Color Matrix (center option); Spot metering (left option) can be useful when very bright objects (e.g., water glare or icebergs) cannot be excluded from view
- Exposure MODE button [top right] – hold down and use Command dial to select S (Shutter-priority, shown in top control panel), adjust Shutter speed with changing light conditions using the Command dial:

- In bright conditions, set ISO to ≈ 200 and Shutter speed to $\approx 1/1600$ sec
- In overcast conditions, set ISO to ≈ 400 and Shutter speed to $\approx 1/1250$ sec
- In dark conditions, set ISO to ≈ 800 and Shutter speed to $\approx 1/640$ sec

Internal Menu Settings

- PLAYBACK MENU (Right-Arrow Icon)
 - All Playback settings should be left at their default values
- SHOOTING MENU (Camera Icon)
 - Image Quality = Jpeg FINE, Color, and Large
 - White Balance = A (Auto)
 - ISO = 200 - 800, adjust with changing light conditions (see 'Exposure Mode')
 - Assign FUNC = QUAL (allows you to adjust Image Quality using FUNC button and Command dial)
 - AF Area Mode = doesn't matter, we're not using Auto-Focus
 - File No. Seq. = OFF (image file numbering restarts at 0001 after downloading or formatting CF card)
 - Command Lock = OFF
- CSM (CUSTOM) MENU (Pencil Icon)
 - #1- Image Review = OFF (unless you want images to be displayed automatically, then = ON). Images can also be reviewed manually by pressing the Monitor button at any time and using the Multi-selector to navigate
 - All other Custom settings should be left at their default values unless you know what you're doing!
- SET UP MENU (Wrench Icon)
 - Format = use to format your CF card; or, hold down MODE and DEL (delete) buttons for 3 secs and wait for "For" to stop flashing
 - Language = E (English)
 - Video Output = NTSC
 - Date = reset Date/Time immediately before each survey following the exact method specified in SOP 4.
 - GPS Input = OFF (unless connected to a GPS, then = GPS)
 - LCD Brightness = user preference
 - Monitor Off (timer) = user preference

Please consult the Nikon D810 User's Manual (booklet or PDF) for more detailed information.

Appendix SOP5.3: Field equipment checklist

Electronics:

- Nikon D810 digital camera
- Six 256GB Sandisk Extreme PRO compact flash memory cards (three for photos, three spare)
- Nikon camera battery and backup, fully charged
- Zeiss 1,4/85 mm ZF.2 lens (lens focus should be taped to infinity during surveys)
- Nikon MC-36 Timer
- Two AAA batteries, fully charged and two more for backup
- Garmin GPSMap 76CSx handheld GPS (n = 2)
- Two AA batteries, fully charged and two more for backup
- GA 27C external GPS antennae with connecting cable
- Tripod and custom mounting board
- Aviation headset
- Extra AA, AAA, and 9V batteries.

Tools:

- Ratchet straps for securing mounting board in aircraft
- Electrical tape
- Leatherman tool

Safety Equipment:

- Nomex flight suit, if applicable
- Aviation life vest with safety gear (e.g., knife, whistle, matches, strobe, streamer, food, etc.)
- Mustang immersion suit for each passenger
- E-PIRB (Sarsat Beacon)
- Non-synthetic clothing
- Leather ankle-length boots
- Sunglasses

- Binoculars

Communication Equipment:

- Spidertracks S3 for flight following
- Hyperjuice 60Wh external battery for Spidertracks S3
- Satellite phone with activated account (~200 minutes) with antennae
- Satellite phone device for connecting to aviation headset
- Garmin In-Reach Device
- 2 VHF radios
- VHF radio in plane
- Mobile phone
- Intercom

Computer Equipment and Software:

- Laptop or desktop computer for QC testing of downloading, renaming, and geo-referencing
- 1 USB thumb drive for retaining tracklog files
- BaseCamp software with BluCharts for Glacier Bay and Icy Strait survey area
- RoboGEO software for geo-referencing images
- ACDSee Pro software for renaming images
- Adobe Reader
- Tides software for survey planning
- Microsoft Excel

Miscellaneous data files

- This survey manual
- Printed maps in booklet (to use during surveys)
- If available, big-print-out region maps (route-planning)
- Field data form in PDF
- Software install files (backup)