SMILE
Size Matters: Innovative Length Estimates

Camera Use & Maintenance Guide

REEF| SMILE Camera Use and Maintenance Standard Operating Procedures

Purpose: Citizen science programs, such as the SMILE project, empower the public to generate length and relative abundance monitoring data of ecologically and economically important fishes (e.g. grouper, snapper, hogfish), while promoting active participation in resource management science. Divers are an underutilized source of fisheries data and the SMILE project seeks to address that, while providing quality length data that are important for fisheries managers to understand the health of and changes to important reef fishes. Fish length data traditionally require a fish in-hand to make measurements, and it can be difficult for scientists to collect this information. By leveraging trained REEF citizen scientist divers, this collaboration will provide valuable fish length data for fisheries stock assessments and ecosystem-based management.

This SOP is designed to support opportunistic use of the SMILE camera and will cover the following:

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Camera Set-Up:

A camera commonly used by recreational divers, the **Olympus TG6,** is contained in it's underwater housing. A detachable, wide-angle lens dome port is added to the housing to reduce distortion of the edges of the images to optimize length estimation. Lastly, the cold shoe mount of the housing supports a laser-mount and single laser. The three camera components, the

camera itself, housing, and wide angle lens are all calibrated together as a single unit. These components are each labeled with their camera number and should *never* be combined with any other camera unit's components. Additionally, while the laser itself can be changed out, the *position* of the laser on the housing is fixed. All efforts (e.g. tightening bolts if there's any "wiggle") should be taken to minimize movement of the laser mount.

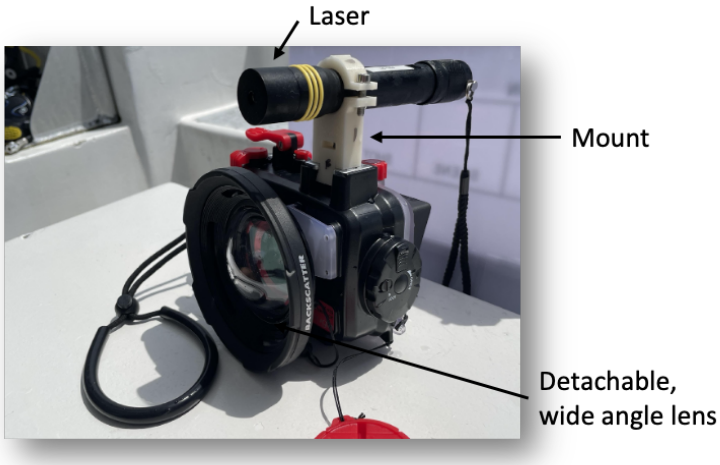


Figure 1. FishSenseLite Camera for the SMILE project, with single laser attached to a cold shoe mount with nut and bolts, underwater camera housing, and detachable dome port/wide angle lens,

If the laser mount breaks, see: Laser Mount Repair

Camera Settings

In addition to camera unit calibration, specific settings on the TG6 are required to produce fish lengths from the images, as follows:

- Program auto (set the wheel to P) - you will see a **P** at the lower left corner.
- Flash off
- ISO-A 1600
- Exposure bias 0
- Burst mode - *camera operators will need to hold the trigger button down for 2-3 seconds to get the burst. If it is a quick "click" of the button, only a single image will be capture. We need >1 to generate reliable length estimations.*
- Underwater shallow white balance
- ESP metering
- Face priority off

- Accessory off
- JPEG mode underwater
- Autofocus
- Aspect ratio 4000 x 3000
- Output format LF + raw
- Still image stabilization on

Date and Time Setting: Settings > Date/Time (use 24 hr clock, if possible). Sometimes they stay from the last check, sometimes they don't. Reset as needed

Camera Use Procedure

Prior to Dive, performed by Diver or Dive Operator Staff:

1) Provide webinar access to the short SMILE webinar for the diver to review dockside or while on the boat, via QR code or some other means (e.g. link). <*link here*>
2) Inspect camera housing and laser mount:
    1. Verify that the laser mount shows no signs of cracking.
    2. Verify that the laser is working properly by turning it on by rotating the back (or front, depending on the laser model) and checking that it functions properly.
    3. Verify that the screws securing the bracket to the base are tight.
    4. Verify that the O-ring in the camera housing has no debris that may interfere with the seal.

    See below for laser mount repair. <link here>
3) Check that there is a battery and SD card in the camera. The camera should be zoomed *out*
4) Dive staff will ensure that the above settings are correct. This can be done by pushing the "OK" button on the housing and arrowing down to each respective setting to confirm it is set to the above criteria.
5) Check that the Date and Time are correct (Settings > Date/Time > adjust accordingly)
6) Dive operator staff will allow the citizen scientist to hold the camera to get familiar with the buttons, lens, and laser.
7) While the citizen scientists is holding the camera, dive operator staff will demonstrate the on/off camera button on the housing, loosening and tightening of the lens, camera trigger, and on/off procedure for the laser. Please also show them how to capture in image in burst mode - hold the trigger to take a photo for 2-3 seconds.
8) Demonstrate how to use the calibration slate
9) Ensure citizen scientist has reviewed the camera use video <*link here*> and species list. Provide a chance to review the species list on the laminated card prior to the dive.

10) Provide a few reminders to the diver, e.g. that the camera remains on during the dive, how to capture images in burst mode, getting laser on the side of the fish
11) Dive operator staff will record on the *Diver Record Sheet* the dive site location, date and time of dive start, name of diver (or at least initials to identify different divers, as applicable), and camera number. If possible, please also indicate any noteworthy dive conditions, such as visibility.

12) If other equipment (dive computer and/or small data logger) *is attached to the camera: Puck dive computer just needs to ensure date/time are correct. If there is a small data logger, please push on the middle of it until a small red light briefly turns on. This will activate the logger. <include picture here>*

Start of the Dive

1) After the diver has entered the water, they will loosen the lens to allow water to flood between the lens and the housing. They will then re-tighten the lens.
2) Diver will ensure camera is ON (the battery saver mode sometimes times the camera out, thus off, if no photos have been taken for ~10 minutes).
3) Diver will turn the laser ON.
4) Calibration Slate: once near the bottom/in a safe location, either the dive operator *guide* or dive buddy of the person operating the camera will hold up the calibration slate for the camera operator to take burst images at 4 different lengths, away from the slate. A diver can start close up and progressively move farther away; or start far and move progressively closer. As long as it is 4 distances.

During the dive

1) Divers will take images of target species they encounter during the course of their dive by getting the laser on the middle, lateral side (i.e. broad side) of the fish, in burst mode by holding down the trigger for 2-3 seconds.
2) At the dive conclusion, divers will repeat the calibration process before the cameras leave the water for that dive.
3) General tips:
    a. Do not use the zoom function on the camera. This changes the focal length, rendering our calibration useless.
    b. Avoid touching or moving the laser directly. Do not use the laser as a handle. The laser must be rigidly attached and unmoved for calibration values to hold true.
    c. The laser must be pointed directly at the fish, as close to its center of body mass as possible.
    d. The camera's optical axis should establish approximately a right angle with the vertical axis of the fish.
    e. Ensure the fish is located within the effective range of 0.5 to 5 meters (~1.5-15 feet).

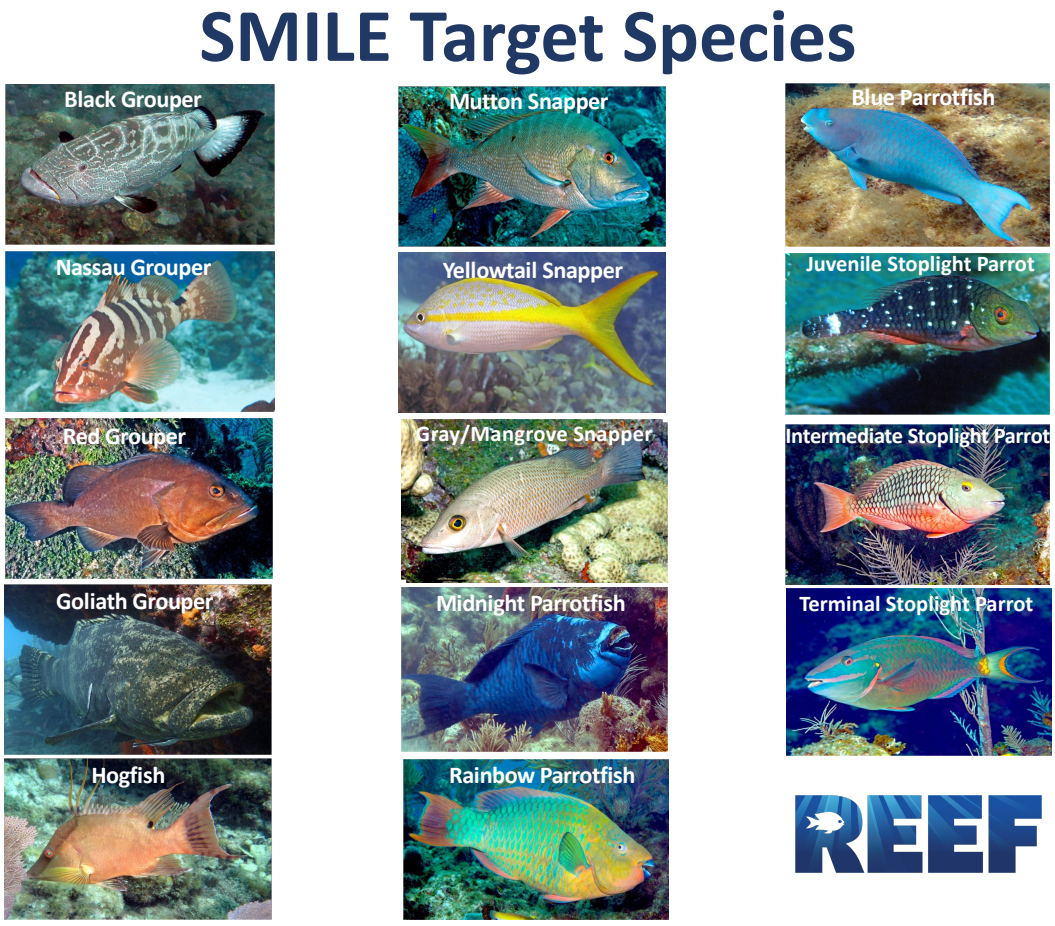
Data Sheet

REEF | SMILE Project | Phone for questions: 305-852-0030

Data Sheet Instructions: Each row represents a dive with a camera unit. If >1 camera unit is used on a dive - they would be on a separate rows. Fillow out each column to the best of your ability. **Date:** mm/dd/yy. **Time:** Time of day (hh:ss). **Site:** Site Name and Mooring Ball Number. Lat/Long coordinates, if possible (espeically if it's not a well-known dive site, and for drift dives) **Diver Name:** First name is fine. **Camera #:** SMILE camera number is written and/or labeled on the camera. **Dive conditions:** general summary of visibility, sea state, weather, water temperature. **Primary Benthic Habitat:** predominant habitat type e.g. hard bottom, live coral, low profile, sea fans. **Notes:** any other notes or camera issues

Date	Time	Site; LatLong	Diver Name	Camera#	Dive Conditions	Primary Benthic Habitat	Notes

Target Species



These predatory species are part of the South Atlantic's snapper-grouper complex of managed reef fishes. Many of them perform ontogenetic shifts, are sequential hermaphrodites, and managed by both state and federal entities.

Mangrove/Gray snapper ***Lutjanus griseus*** This mesopredator conducts an ontogenetic shift from inshore nursery habitat to offshore reefs and experiences harvest pressure in both habitats. This species is a high data collection priority for the SAFMC, as it has yet to have a stock assessment for the region. *Distinguishing characteristics: "drab" appearance, scales are obvious grayish-bronzey color, caudal fin (tail) is flat. Similar species mahogany snapper, but smaller eye and lacks red margin on tail. Behavior*: often in schools, easy to photograph, some individuals may shy away from the laser, others will be attracted to it.

Mutton snapper ***Lutjanus analis*** This long-lived mesopredator also performs ontogenetic habitat shifts and reaches larger sizes than *L. griseus*. It is also considered a high data collection priority for SAFMC, with a SouthEast Data Assessment and Review (SEDAR) stock assessment currently in progress (SEDAR 79). *Distinguishing characteristics: black spot on*

posterior dorsal area, can have faint white bars, smooth, triangular-looking face. Behavior: typically solitary or may be in pairs, pretty curious and easy to photograph at a distance.

Yellowtail snapper Ocyurus chrysurus This common species is the only member of its genus. It has recently undergone an assessment, as such, it provides a sufficient comparison to SMILE data. *Distinguishing characteristics: white body with distinct yellow later line that moves into a yellow forked tail. Yellow spots. Behavior: often in the water column, very attracted to the laser*

Black grouper *Mycteroperca bonaci* Like many groupers, this predator demonstrates strong site fidelity and experiences intense harvest pressure that is managed as a single stock, and is a high priority data collection species for SAFMC. *Distinguishing characteristics: black chain-like blotches, solid black margin on caudal fin (tail), more elongated body than the other groupers. Behavior: very skittish to photograph. Will often dart away, but if you linger in the area, they tend to come back since they favor certain sites.*

Goliath grouper *Epinephelus itajara* This is the largest grouper species in the Atlantic basin, which has undergone recent management changes. Reviewers from the most recent stock assessment indicated that additional indices of abundance, lengths, and spatial information would improve future stock assessments. *Distinguishing characteristics: large size, mottled pattern. Behavior: often observed under ledges where they may be easier to photograph. Some individuals are easily disturbed by divers.*

Nassau grouper *Epinephelus striatus* This predator is considered federally threatened, and critically endangered throughout its range (IUCN), thus harvest of this species is prohibited. Length data provide better insight on population status and management efficacy in this region. *Distinguishing characteristics: black spot on the "saddle," or caudal-peduncle, red bars with ones on the forehead forming a 'Y'. Similar species: red grouper. Behavior: can be docile and easy to photograph, but somewhat shy.*

Red grouper *Epinephelus morio* This data-limited predator is considered overfished and is managed as two stocks (Gulf and Atlantic; Atlantic SEDAR 53; 2017). Reviewers from recent stock assessments indicated that additional indices of abundance, lengths, and spatial information would improve future stock assessments. *Distinguishing characteristics: reddish and can be blotchy-read. Deeper bodied than Nassau. Behavior: extremely docile and easy to photograph. Similar species: Nassau grouper*

Hogfish *Lachnolaimus maximus* This benthic carnivore experiences intense harvest pressure and are data-limited. The Hogfish stock off the FL Keys is overfished and undergoing overfishing based on the most recent assessment (SEDAR 37). Management measures were enacted in 2018 which restricted harvest which will limit the amount of data available for future assessments. Data from this project provide an opportunity to contribute to the next Hogfish assessment has begun. *Distinguishing characteristics: black spot on dorsal area, can be mottled in color or distinct bicolor or drab/muted colors that match the sand, elongated frills on*

dorsal fin. Hog-like snout to rout in the sand. Behavior: Tends to not mind the laser, but some individuals are very skittish of it.

Parrotfish These species provide a good representative for a lower trophic level, in addition to being an ecosystem indicator. These species are also frequently encountered on dives in the Keys and provide a good size range that may not be captured with the predator species, thus making suitable subjects for citizen scientists. Parrotfish are not federally managed in the U.S. South Atlantic, but information on these species would be a valuable component of future ecosystem analyses.

Stoplight parrot *Sparisoma viride*: This species is a true, strict herbivore and thus provides a good indicator of reef health. This species presents distinct color phases that correspond with size, age, and population sex structure. This species is restricted to the Tropical Western Atlantic. *Distinguishing characteristics: Juvenile phase look like intermediate phase but with distinct white spots. Intermediate phase: reddish color with distinct scales. Terminal phase: blueish color with yellow spot at its operculum (i.e. gills) and yellow splotch on its caudal peducle (i.e. area before the tail; between tail and body). Behavior: very common, terminal phase individuals are very "zippy" on the reef.*

Rainbow parrot *Scarus guacamaia* The IUCN lists this large herbivorous parrotfish as "near threatened," as it is dependent upon both mangrove shorelines and coral reef habitats. *Distinguishing characteristics: orange and green color with disctinct parrotfish "beak", can grow large Behavior: can be in schools or small groups, easy to photograph*

Midnight parrot *Scarus coelestinus* This species is considered data deficient (IUCN), but can exhibit local site abundance, often foraging in groups on algae and opportunistically on small invertebrates. *Distinguishing characteristics: Dark navy blue color with cerulean, bring blue splotches. Distinct parrotfish "beak" Behavior:*

Blue parrot *Scarus coeruleus* This species also often forages in groups, primarily on algae covering corals. *Distinguishing characteristics: light powder blue, with young individuals having a yellow, or pale pink splotch near the face, broad, squarish forehead. Behavior: can be solitary or in small groups, easy to photograph.*

After the dive | Camera Maintenance

1) Turn off the laser and camera to save battery.
2) Rinse Cameras: push down on each of the buttons/turn the button wheel(s), loosen the lens to ensure fresh water gets to all components of the camera housing, laser
3) Leave out to dry.
4) Periodically check the camera housing o-ring for any debris. Re-lubricate as needed.

5) Remove the olympus camera. Remove the battery and put on a charger. Replace with a fresh battery.
6) Change SD card. Handle the used SD card according to step 10 below.
7) Open up laser compartment completely to remove battery. Leave open to air out with the other camera unit components.
8) Charge laser battery. *Laser batteries typically last 2-3 dives.*
9) Twist on/off laser o-rings should be checked at least weekly (~every 3-6 dives) to remove salt, check for corrosion, and re-lubricate. These are more fragile, thus prone to flooding and corrosion.
10) Provide used SD card and diver record sheet to REEF. *Used SD cards need to be marked in some way with what camera it came from and when used* Suggestion - put in a ziplock bag with a piece of paper labeling camera number, date(s) used and sites - theoretically this should match the diver record sheet. At *minimum* we *need* to know what camera # it is.
    a) E.g. “FSL02, 7/12/2025, 1) Conch Reef, ball 2 (2) Molasses hole in the wall”

Laser Mount Repair

There are 3 segments to the laser mount. 1) flange: holds the laser mount into the camera cold shoe mount.. A bolt goes through middle of this flange when you are looking down at it. The bolt is not accessible, when the laser is attached. This is the most likely source for laser breakage. (2) lower laser bracket: this has a semicircle shape and supports the laser. (3) upper laser bracket: attaches the laser to the rest of the mount. A bolt on each side holds the top mount to the bottom mount.

- To replace the flange, it requires dismantling the top laser bracket from the bottom and removing the laser.

  Tightening or loosening bolts: use a wrench, or pliers or some sort of tool that will keep the washer in place, to hold the washer in place (near the bottom bolts). Use an allen wrench to loosen (“lefty loos-y”!) or tighten (“righty-tighty”) the bolt.
  Accessing the flange bolt: remove the upper laser mount and laser, set aside.
  Tighten the flange bolt: turn righty-tighty with an allen wrench. Ensure the flange is snug tight (i.e. doesn’t wiggle), but *do not overtighten* to where it will crack.
  Replacing the flange: remove the lower laser bracket, after bolt is loosened.
    - Switch out the cracked flange for a fresh, new one.
    - Re-attach the bottom laser mount to the flange using the bolt. Tighten the bolt
    - Sit laser onto the bottom laser mount
    - Fix the top laser mount above the laser
    - Place the laser mount bolts through the whole
    - Attach the washer to the bottom of one side and begin to tighten according to the method described above (i.e. hold washer with plier/wrench, while tightening witht the allen wrench). DO NOT TIGHTEN

COMPLETELY AT THIS STAGE - you will want to get the laser as even as possible in regards to the upper and lower mounts positioned evenly

- Attah the washer to the bolt on the opposite side and begin to tighten, as above.
- Move back and forth between the two bolts until the laser is evenly nestled into the mouth and is snug.

5) You're done!

Figure 2. Close up of the laser and mount. #1 is the flange that attaches the metal mount to the camera housing - this piece is made of plastic and will be the most likely source of breakage, if any. #2 is the lower mount. #3 is the upper mount.

Figure 3. Additional Close-Up shots of the laser mounting (the upper and lower mounts are a bit crooked here, you should aim to get this more even, thus centered, around the laser

Figure 4. Clockwise from Left, A) tools needed for mount repair require a 3mm allen wrench, and either a 7mm wrench or some other tool (e.g.) pliers to grip the bottom nut to hold still while tightening/loosening the bolt

Downloading Data

SMILE (TG6 & TG7) Cameras
-Remove camera from housing – 1 camera at a time!
-Remove battery and place on charger

1) Remove SD card and put in computer. Or connect with a cable if computer does not have this feature.
2) Plug in the SMILE TG6 Harddrive(s)

3) Open folders (e.g. DCIM and OLYMP) until you get to all the photos
4) Hit shift and select all the photos from Dive 1 and put in it's own folder. You can tell they're individual dives based on the time stamp.

Mac – Right click, select "new folder". Once it moves these photos there, you can name it.

PC – you have to click "new folder" first and then move the selected photos into it.

5) Name the folder: **Date(mmddyy)_Site_Camera#** For example:092623_Alligator4_FSL01
Camera numbers are directly on the camera. This is why we only open up one camera at a time to download – so that you can keep track of what camera the images are from.
6) Repeat this process for dive 2, and dive 3 (as applicable).
7) Move these 2 (or 3) dive photo folders into a new folder titled "Date_Dive Area_Camera#". For example, 092623_Alligator*(with no ball #)*_FSL01
8) Move this folder over to the harddrive(s*).

It can take up to 20-30 minutes, based on how many files are there.

9)*Once everything is moved over to the primary harddrive, you can copy it from the primary drive to the back-up harddrive, if applicable (these harddrives at REEF are labeled with Bigger Text handwriting).
10) When the folders with photo images are completely done moving over to the primary harddrive, and you've initiated the backup harddrive from the primary drive, you will restore the SD card – See Below.

Restoring the SD Cards
This procedure is the same for TG6 and GoPro SD cards:

Mac – go to Disk Utility > select the appropriate hardware – the SD card you wish ro restore (left side) > click erase (upper right) >click OK for it to erase the disk > select "ExFAT" as the format > click done > eject the hardware.

Make sure you're doing this on the SD card and not your harddrive! Since one is above the other!

PC – right click on the SD card > Restore > select "ExFAT" as the format > click "done" > eject the hardware