Standardized Field Sampling Protocol

[version 1.0 - 09/Apr/26]

1. OBJECTIVE

1.1 This protocol aims to describe the standardization of Remote Underwater Video (RUV) sampling (*videoplots*) and to establish the procedures to be followed during field surveys.
1.2 This sampling technique can be applied across a variety of habitats, including coral reefs, rocky reefs, tide pools, mangroves, and sandy substrates.
1.3 The standardized sampling area for the method described below is 2 m².
1.4 Standardized videos (by time and area) allow the extraction of data on species richness, abundance, biomass, feeding rates, benthic cover, and other behavioral traits of fishes and marine organisms.

2. PROCEDURE

2.1 Field preparation

2.1.1 Before starting field activities, the responsible researcher must ensure that all necessary sampling equipment is available. Essential items include:

- Digital camera fully charged for video recording;

- Ballast (lead weight) of 1 or 2 kg to secure the camera to the substrate;

- Articulated base to attach the camera to the weight (Figure 1);

- Cable ties to secure the camera to the weight;

- Memory card with sufficient storage capacity;

- A 2 m graduated rope or measuring tape to delimit the sampling area. Ideally, the rope should have a lead weight attached to at least one end to facilitate fixation to the substrate

during measurements. Markings every 10 cm along its length are recommended to facilitate later video analysis;

- Dive computer to record sampling time, depth, and temperature.

2.1.2 Optional materials include: mesh bag (*samburá*) for carrying cameras during the dive, rope, carabiners (to clip cameras onto the BCD), extra cable ties for adjustments, and pencil and slate for annotations.

2.1.3 A field checklist is provided at the end of this document (Annex I).

2.1.4 *Camera configuration:*

2.1.4.1 Cameras should be checked for battery charge preferably the night before the dive.

2.1.4.2 Ensure that cameras are set to 1080p at 60 fps, with a linear lens or medium field of view. This configuration ensures adequate video quality for analysis and optimizes battery performance.

2.1.4.3 If possible, bring fully charged spare batteries to the field.

Figure 1: Examples of articulated bases used to secure cameras to weights (Photos: Google).

2.2 RUV sampling

2.2.1 The diver must be familiar with the reef structure beforehand (e.g., slope zones, reef–sand interface, sand patches, rhodolith beds) to plan the operation and optimize camera placement.

2.2.2 The selected site must be free of natural (e.g., rocks, corals, large macroalgae) or artificial structures (e.g., anchors, ropes) that may obstruct the camera view.

2.2.3 The diver should select a substrate that allows stable positioning of the weighted camera (Figures 2, 3, 5A). Steep surfaces should be avoided as they may cause the camera to slip or topple.

Figure 2: Example of a properly positioned weighted camera for RUV sampling (Photo: Sergio Floeter).

2.2.4 After positioning, ensure the camera is oriented toward the substrate, not the water column (Figures 2 and 3).

2.2.5 Once positioned, press “record” to start filming. Immediately after recording starts, the diver must present the dive computer in front of the camera to record depth and temperature (Figure 4). This should be done for a few seconds while slightly moving the wrist to improve visibility. These data may also be recorded on a slate.

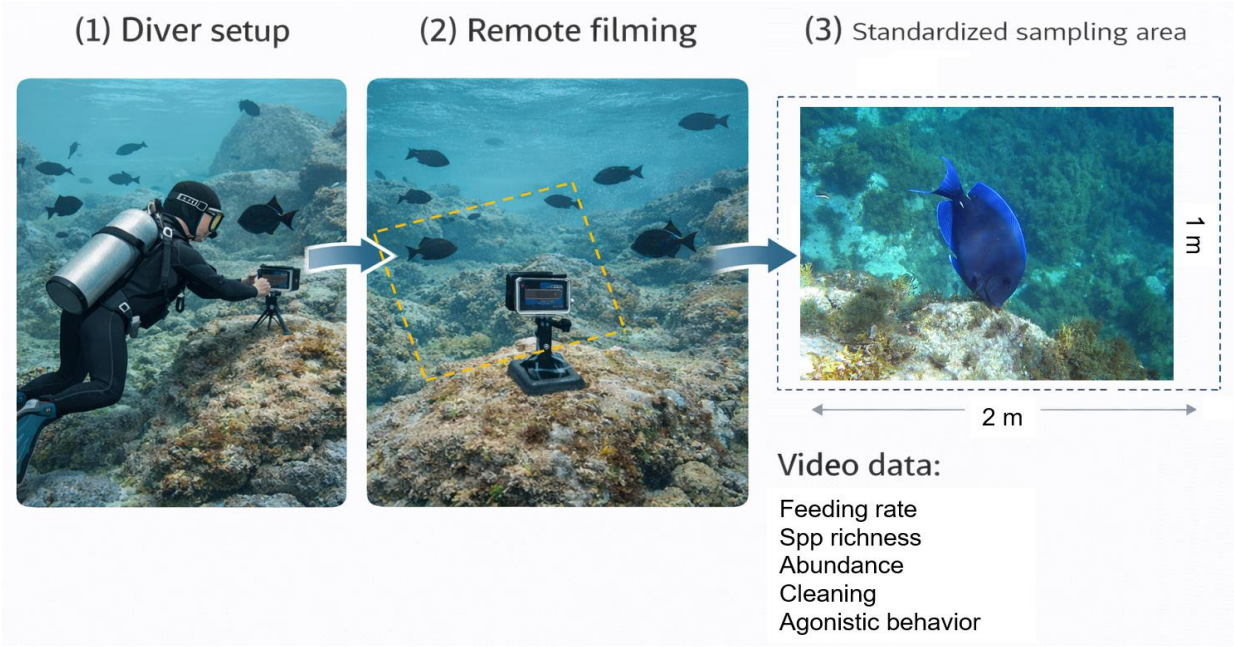

Figure 3: Diagram showing: (1) camera deployment, (2) camera framing, and (3) an example of a fish interaction (fish feeding on benthos).

Figure 4: Diver displaying dive computer showing depth (red circle) and temperature (°C) (yellow). A digital watch may be used to monitor recording time (Photo: Talita Beneli).

2.2.6 The next step is area delimitation. The diver must measure 2 m length, 1 m height, and 1 m width (Figures 5B, 5C).

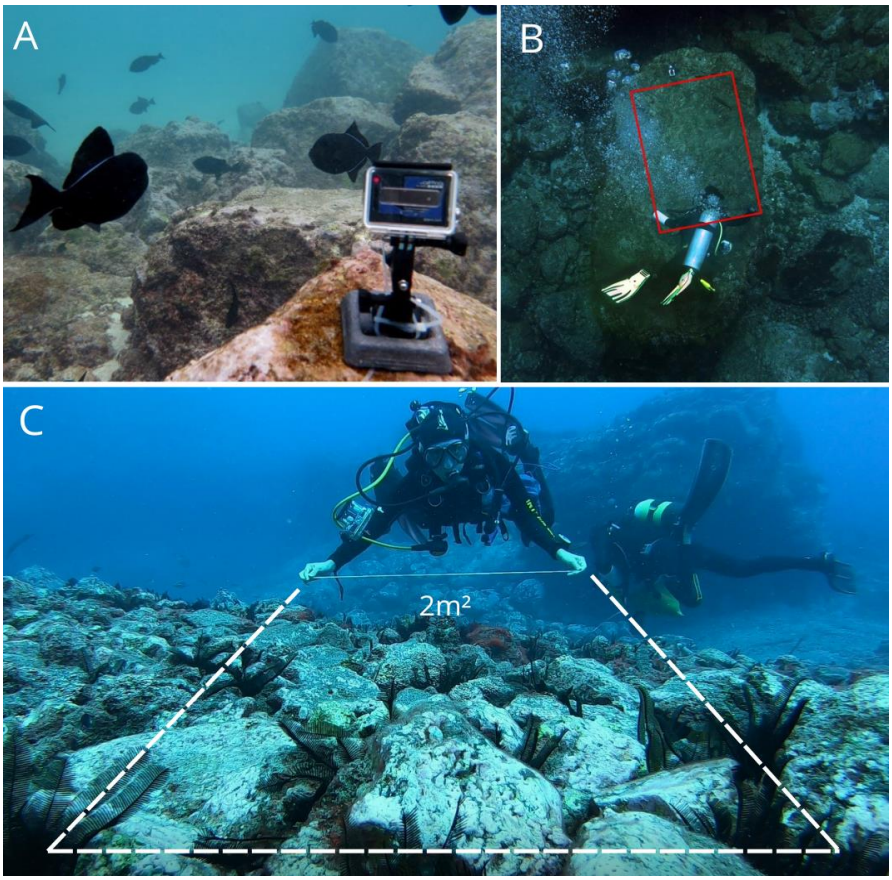

Figure 5. Area delimitation process: (A) unobstructed sampling site; (B) area delimitation; (C) lateral boundary definition (Photos: Sergio Floeter, Lucas Nunes & Debora Ferrari).

2.2.7 Begin by measuring the 2 m length, extending the rope from the camera in a straight line (Figure 6).

2.2.8 Then, fold the rope to 1 m and measure the height, holding it vertically (Figure 7). Clearly display the 1 m mark to the camera.

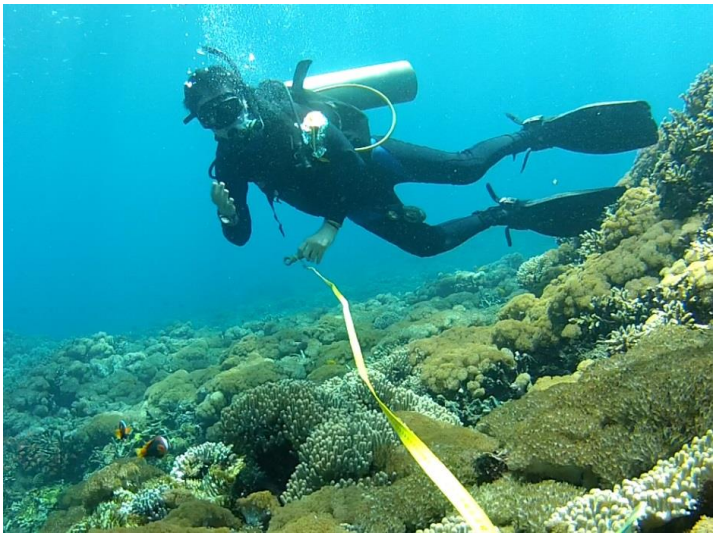

Figure 6: First step: extending the measuring tape/rope 2 m from the camera (Photo: Sergio Floeter).

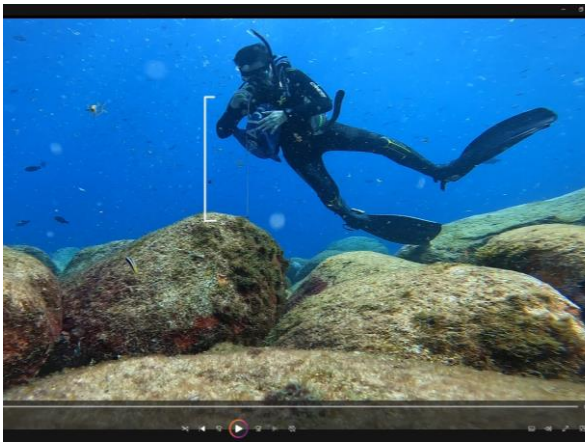

Figure 7: Second step: measuring 1 m height perpendicular to the substrate (Photos: Sergio Floeter & Talita Beneli).

2.2.9 Finally, measure the width by swimming back toward the camera with the rope still folded (Figure 8). This step is crucial because it will define the lateral boundaries of the area analyzed in the video and facilitate future measurements of the size of the observed individuals.

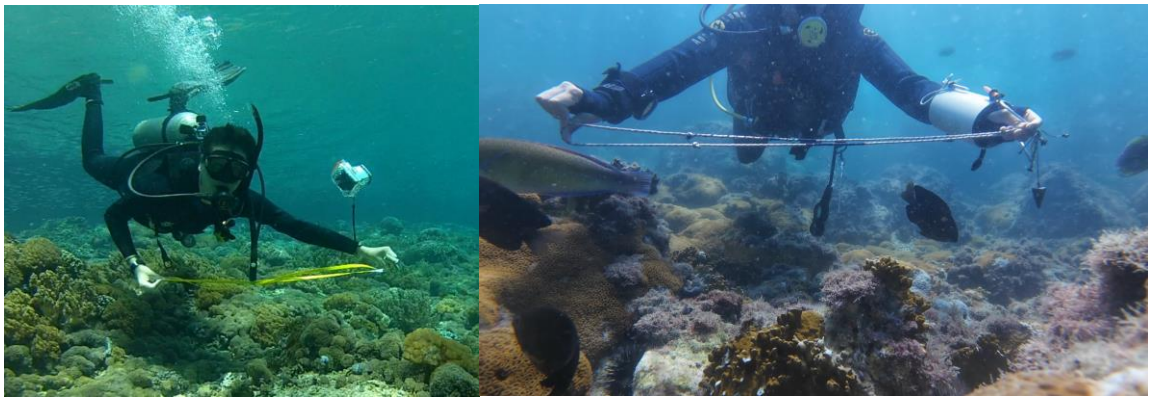

Figura 8: Final step in delimiting the area: the diver keeps the measuring tape/rope folded and swims in a straight line towards the camera to measure the width (Photos: Sergio Floeter and Talita Beneli).

2.2.10 The camera should record for at least 15 minutes. Only the central 10 minutes will be used for analysis (see “Standardized Protocol for RUV Data Extraction” file for more information).

2.2.11 After recording, retrieve the camera and move to the next site. Sampling units must be at least 3 m apart.

NOTE 1: The measured height does not restrict analysis to a fixed volume but helps evaluate vertical interactions relative to the substrate.

2.3 Benthic sampling (photoquadrats)

2.3.1 Since fish–benthos interactions are central to the RUV method, benthic characterization is essential. It is recommended to collect five 25 × 25 cm photoquadrats per videoplot.

2.3.2 A dedicated camera should be used for photoquadrats to avoid operational errors.

2.3.3 A 25 × 25 cm PVC quadrat frame is recommended for standardization (Aued et al. 2018; Figure 9). It must not be positively buoyant.

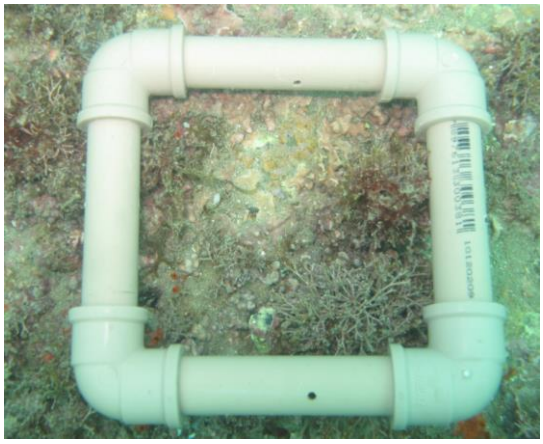

Figure 9: Example of PVC photoquadrat frame (25 × 25 cm). Small holes in the pipe prevent the structure from floating.

2.3.4 Before filming, photograph the dive computer and the deployed camera to allow pairing with videoplots.

2.3.5 After filming, randomly select five points within the 2 m² area and take one photoquadrat per point.

2.3.6 Photos must be taken perpendicular to the substrate (Figure 10), avoiding oblique angles.

2.3.7 Ensure images are in focus; take additional photos if needed.

Figure 10: Diver performing a photoquadrat, with the camera positioned perpendicular to the substrate.

NOTE 2: When using multiple cameras, maintain consistent positioning order to facilitate pairing between videoplots and photoquadrats. The cameras can be positioned simultaneously, provided that a minimum distance of 3 m is maintained between them, and they must be repositioned in the same order for each new round.

2.4 TURF sampling

2.4.1 Turf (filamentous algae that cover the consolidated substrate and retain sediments) sampling is optional but highly recommended due to its ecological relevance and low cost.

2.4.2 Turf height should be measured using a caliper depth probe (Figure 11).

2.4.3 Turf should be measured after filming the videoplot and taking the five photoquadrats. Within the previously delimited area (2 m^2) for filming, the diver should randomly select five points, obtaining one measurement per point (totaling five measurements per videoplot).

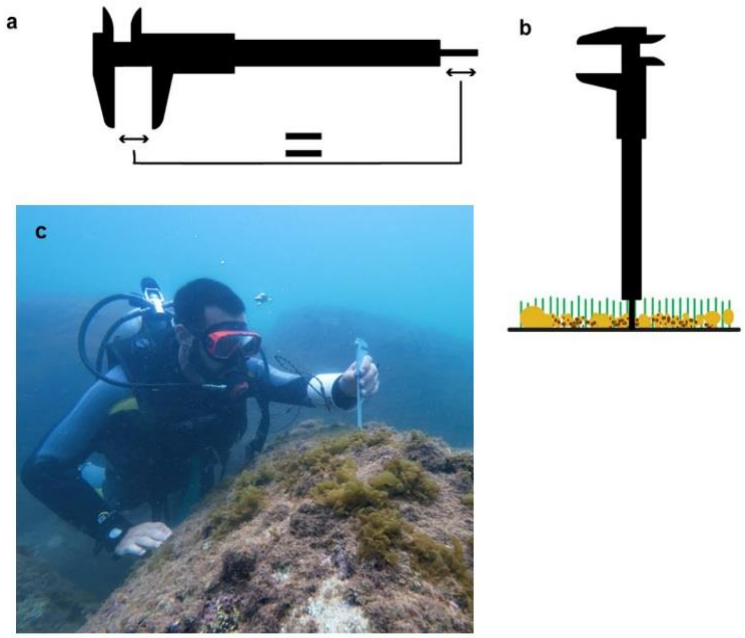

Figure 11: Diagram of the use of a caliper in measuring turf: (a) the depth rod corresponds to the same distance between the ends; (b) this rod can be used to measure the length of the turf fibers; (c) diver measuring the turf in relation to the substrate (Adapted from Tebbett & Bellwood, 2019; Photo: Talita Beneli).

2.4.4 In each measurement, the diver should position the caliper perpendicular to the substrate (Figure 11c) and allow the rod to slide until it comes into contact with the substrate. Then, they should record, in millimeters, the distance indicated between the tips of the instrument (Figure 11a) on a recording board.

2.4.5 The diver must ensure that the turf measurement notes can be subsequently paired with each videoplot.

2.4.6 When a point selected for sampling is not represented by turf (e.g., sand, zoanthids), the measurement should be recorded as “NA”, which refers to the absence of turf.

3. REFERENCES

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ANNEX I – FIELD CHECKLIST

RUVs

☐ Charged digital camera
☐ Articulated base
☐ 1–2 kg weight
☐ Memory card
☐ Cable ties
☐ 2 m graduated rope/tape with weight
☐ Carabiners
☐ Mesh bag
☐ Dive computer
☐ Digital watch

PHOTOQUADRATS

☐ Camera
☐ Memory card
☐ PVC quadrat (25 × 25 cm)
☐ Pencil
☐ Slate

TURF

☐ Calipers
☐ Slate
☐ Pencil
☐ Attachment cord