

South Florida/Caribbean Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure SL04

Lobster Data Collection and Survey Methods—Version 1.1

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Purpose

This standard operating procedure (SOP) describes the procedures for performing spiny lobster surveys. A minimum of two divers and one captain are needed to complete each survey. At each location, one set of paired 7.5-meter (24.6 foot [ft]) radius circular plots are completed. In each survey, every spiny lobster encountered is recorded and size estimated prior to any attempt at capture. Spotted lobsters are included in the survey and sizes are estimated, but there is no attempt at capture or recording of demographic information. Once visual estimates are obtained, each spiny lobster encountered is captured (if possible), carapace length measured, biological condition (sex, molt condition, presence of eggs, and presence of spermatophore) is recorded, and the lobster is then released. Photos are taken of the eggs and spermatophore if they are present. A brief habitat assessment is also completed for each plot, along with four photos that display the sampled location. These surveys are used to determine average size, assess demographics, and track relative indices of density and frequency of occurrence.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
3/24/2020	Lee Richter	1) Revised Boat Log to match the latest version from the fish protocol 2) Removed Plot % = Habitat metric 3) Spotted lobsters added to survey (estimated size only) 4) Rapid queen conch and long-spined sea urchin counts added to survey 5) Included snare as lobster catching option 6) Removed calipers as necessary tool 7) No listing of specific quadrant on datasheet necessary. Instead denoted lobster grouping by letter. 8) Added Printable Field Sheets	1) Updated to stay consistent with fish monitoring and reduce bookkeeping for topside support 2) Redundant data from abiotic assessment section 3) Opportunistic and informative addition to survey 4) Opportunistic and informative addition to survey 5) Situationally, may be better tool to capture lobster (surveyor preference) 6) Measuring aid on snare/tickle stick is adequate and accurate 7) Determined a better way to track lobster grouping than by quadrant, which was confusing to surveyors. 8) To make this SOP more sharable with partners who do not have access to our server	1.1

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Equipment

- Weighted dive flag
- GPS and dry bag
- Tickle stick and net (to capture lobster)
- Snare (to capture lobster)
- Measurement aid in millimeters (this can be attached to the tickle stick to help with carapace length estimates)
- Gloves
- Several 30 meter (98 ft) transect tapes (at least two per buddy pair)
- Underwater slate and datasheets
- Dive watch
- Underwater camera

Procedures

Locating and Assessing the Sample Site

When determining daily site list assignments, it is important to take into account proximity of sites to one another, weather conditions, geographic location, and how many sites are needed to fill stratum allocation requirements. When more than one boat is operating, this can help prevent repeat sampling of sites and ensure that stratum quotas are met efficiently. Furthermore, if any sites are in potentially problematic or unsafe locations (e.g. too shallow or high wave action areas that prevent a close enough approach by boat), it is prudent to assign alternative sites in case the original sites are not doable.

Sample sites are located using a vessel-mounted or hand-held GPS unit. The centroid of the primary sample units (e.g., grid cells) are provided on a list of latitude-longitude site positions prior to sampling. Upon arrival at the primary sample unit, divers should attempt to determine (e.g., using the sonar or if visibility permits, simply looking over the side of the boat) whether the benthic habitat at the survey location is reef habitat. In the Virgin Islands, where 50×50 -meter (164×164 -ft) cells are used, this means remaining within 25 meters (82 ft) of the centroid to the north, south, east and west or within 35 meters (115 ft) to the northeast, southeast, northwest, and southwest. In Florida, where 100×100 -meter (328×328 -ft) cells are used, this means remaining within 50 meters (164 ft) of the centroid to the north, south, east, and west, or within 71 meters (233 ft) to the northeast, southeast, northwest, and southwest. With updates to existing benthic maps anticipated, the Florida program expects to convert to a 50×50 -meter (164×164 -ft) grid in 2020 (Steve Smith, Research Scientist,

University of Miami pers. comm., August 14, 2018). If the target habitat type cannot be located, the sampling should proceed, with divers recording the new habitat type on the Boat Log. If no hard-bottom habitat can be located or the site is deemed unsafe to sample (e.g. high wave action close to shore), that site should be omitted from sampling and an alternate site selected from the list provided. At each sample site, one set (replicate) of two paired surveys occur (Figure 1).

The recommended approach to sampling is to use live-boating with three to four personnel. A four-person team per boat is preferable for daily operations. When four divers are present, two teams of divers are formed for the day of sampling, where one team is underwater and the second team is topside to pilot the vessel. Duties rotate every other dive. When three divers are present, divers rotate at each sample site in a format such that each diver remains at the surface at every third sample site to pilot the vessel.

Diver Deployment, Descent, and Plot Setup

Once divers are deployed at a site, they descend to the bottom. If divers are not deployed over hard-bottom but it is within view, they swim to the nearest visible hard-bottom within the cell to set up the survey. It is possible that in some situations, divers may unknowingly drift outside of the grid cell. These surveys should still proceed and be included in analyses, but the divers should always attempt to conduct the survey on hard-bottom habitat inside the designated grid cell. If no habitat is visible, the dive is aborted and an alternative site chosen.

When the divers are deployed over hard-bottom habitat, the buddy team will secure their reel (with dive flag and surface GPS) to the substrate. Divers should not bias the survey toward habitat edges or based on habitat quality where more (or less) lobster are expected to be found. The plots however, should occur over as much hard-bottom habitat as possible at the site (i.e. plot center greater than or equal to 7.5 meters [24.6 ft] from the habitat edge if feasible). The first plot is established haphazardly without respect to habitat edge or habitat quality. The second plot is set up adjacent to the first, opposite the dive flag. In situations where a patch reef is not large enough to accommodate the two plots and another patch is visible nearby (less than 20 meters [66 ft] away) and within the cell, the second plot is placed there and sampled. In situations where a patch reef is smaller than two circular plots, the dive reel is placed to maximize the amount of hard bottom surveyed within each cylinder.

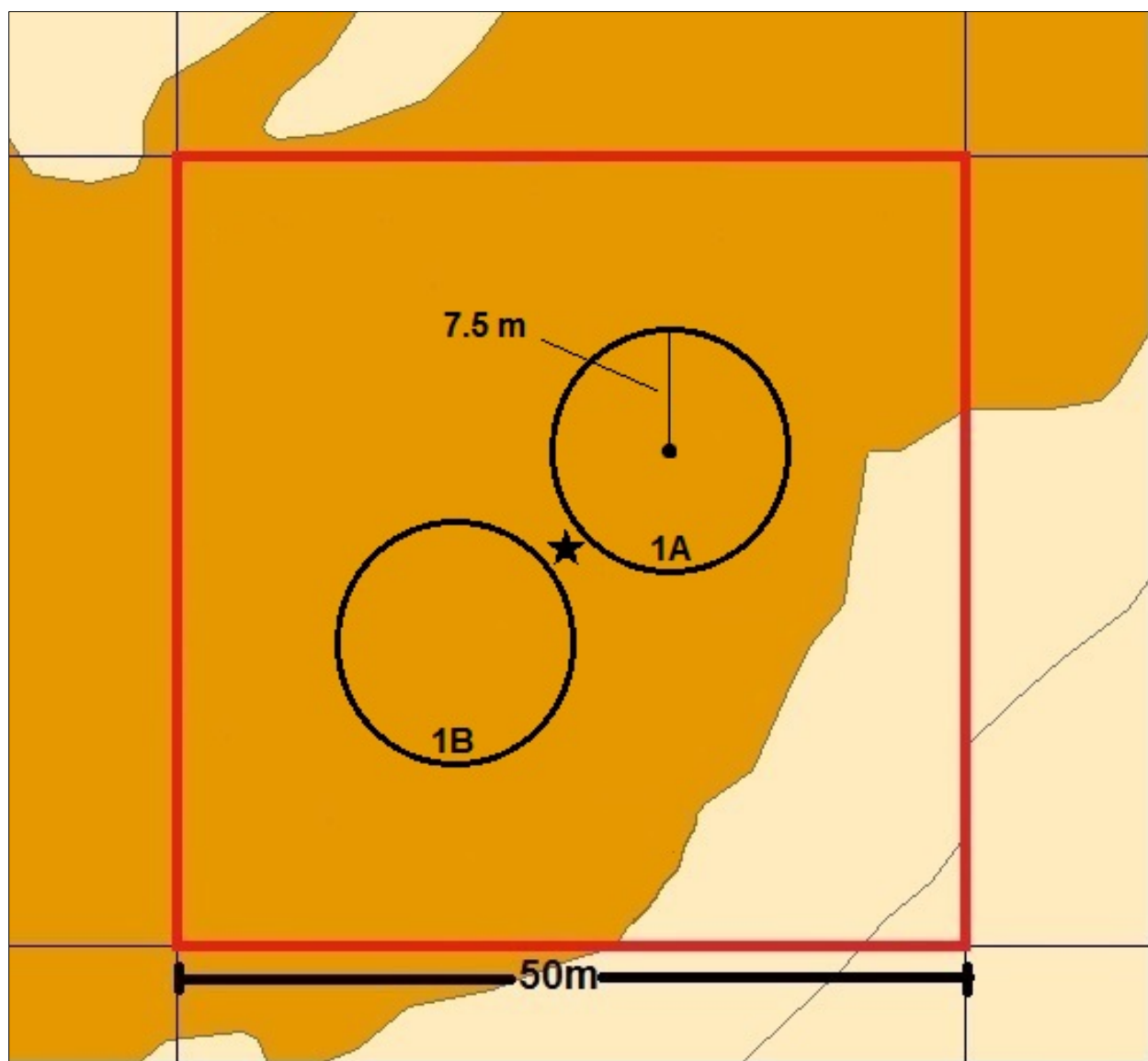


Figure 1. Example of how the two averaged circular plots may be located at a site. Tan is non-target habitat (e.g., sand) and orange is target habitat (e.g., reef). The 50 × 50-meter (164 × 164-ft) grid used in the US Virgin Islands is overlain on the habitat and is outlined in red. Divers descend and attach the dive flag with surface GPS at the star. Two non-overlapping 7.5-meter (24.6-ft) radius circular plots are completed adjacent to one another.

The reel secured to the bottom acts as the edge of both adjacent circular plots. To avoid diver separation, both divers assess one circular plot together, then assess the second. Each plot occurs over hard-bottom habitat. While there are several ways to survey a circular plot thoroughly for lobster, we suggest a quadrant method is most appropriate and efficient.

To set up the first circular plot, a transect tape is attached to the substrate next to the reel and run out 15 meters (49 ft), marking the diameter of the plot. A second transect tape is run by one diver perpendicular to this first transect, beginning at the 7.5-meter (24.6-ft) mark, separating half of the

circular plot into two quadrants (Figure 2). The other diver repeats this on the opposite half of the circular plot. Thus, each diver is responsible for surveying two of the four quadrants in each circular plot.

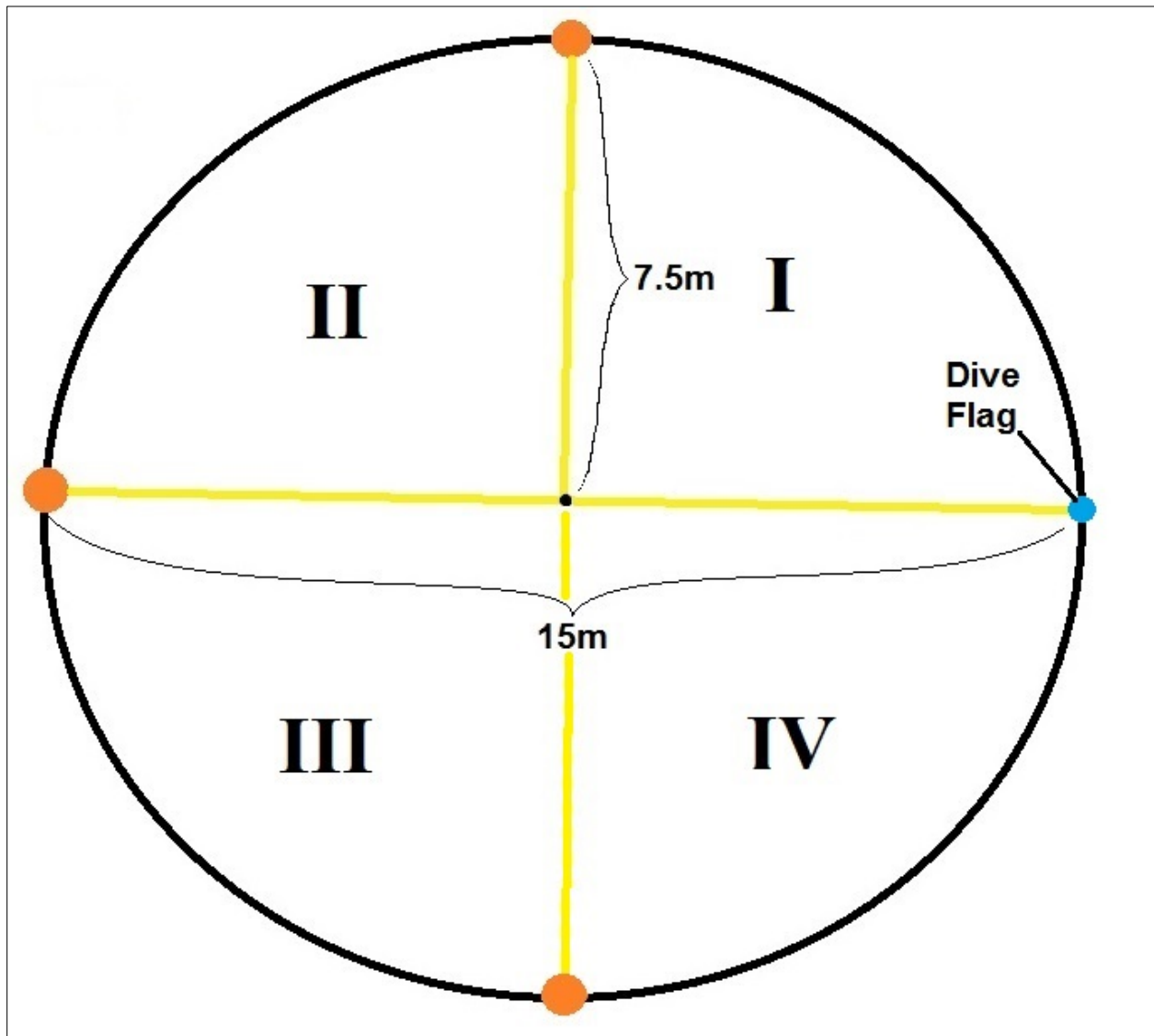


Figure 2. Example of how a circular plot is established. A transect tape is run 15 meters (49 ft) from where the dive flag is tied off to the substrate. A second transect tape is run perpendicular to the first, beginning at 7.5 meters (24.6-ft), separating the top half of the plot into two quadrants. The other diver repeats this on the opposite side of the plot. This separates the entire plot into four quadrants.

Data Collection

Boat Log

Field personnel not diving at a site fill out the field/boat log (Figure 11). The boat log is the same as the log used in the reef fish monitoring protocols. It combines survey information with dive

information to reduce the bookkeeping duties of the topside support. A new boat log sheet is used for each new day of sampling.

1. Park (top of sheet): The four-letter code of the park in which operations are occurring in. This only needs to be filled in once per sheet.
2. Date (top of sheet): The date of dive operations. This only needs to be filled in once per sheet.
3. Boat (top of sheet): The name of the boat that dive operations were occurring from. This only needs to be filled in once per sheet.
4. Dive of day: This is the cumulative site number (e.g., 1, 2, 3...) completed throughout a day.
5. Site ID: This is a code listed on the sample list.
6. Team (A/B): Designates whether the diver is “A” or “B” in the buddy team.
7. Diver: Name of an individual diver who is conducting the survey.
8. O₂%: Designates the percentage of oxygen in the breathing gas if nitrox is used. If air is being used, then put “Air” or “21%”.
9. PSI IN: This is the amount of gas in pounds per square inch that a diver has in their cylinder prior to entering the water.
10. Time IN: This is the time that the divers are deployed on a site and begin their dive.
11. GPS / Flag #: This is the specific GPS and Flag # used for the surveys.
12. Depth: This is the maximum depth a diver records during their dive.
13. BT: This is “bottom time” and should be recorded as the length of time in minutes of the dive from the divers going underwater to returning to the surface.
14. Time OUT: This is the time that divers return to the surface.
15. PSI OUT: This is the amount of gas in pounds per square inch that a diver has in their cylinder once they are back on the boat.
16. Habitat type: This is the divers’ consensus of the habitat type that was sampled. While the divers are targeting a specific habitat based upon the stratification, it is possible that they may complete a survey on a habitat that did not match the stratum initially targeted by the sample allocation.
17. Comments/Waypoint: A waypoint is collected by either a hand-held or boat-mounted GPS to document where the divers were deployed. This is where that waypoint’s name can be recorded. This will be used as a backup GPS location in case the flag-mounted GPS the

divers use fails. This is also a space where additional information judged to be important by the surface collector can be written.

General Site Information

Figures 12 and 13 are examples of the Florida and Virgin Islands datasheets used for general site information, habitat assessment, and lobster encountered within the circular plots. Prior to each dive, the divers enter their name (i.e. observer), name of dive buddy, date, park, and site ID on their datasheet. The site ID is unique to each primary unit and is followed by an underscore and a 1 (designating the dive team) and an A or B (designating the diver within the team). For example, “1088_1A” would represent diver A on team 1 at site 1088.

After reaching the bottom, each diver records the depth of the station, visibility (in feet), and the start and end times for each circular plot survey completed. One of the divers also takes a photo of the datasheet with the site name clearly visible, and then four photos in each of the cardinal directions that represent the habitat where the survey will occur.

Lobster Assessment

Each diver is responsible for surveying two of the four quadrants in each circular plot. Once the quadrants are established, the diver surveys all area within each quadrant, paying attention to crevices, cracks, under ledges, and structures that lobsters use as shelter.

If a spiny lobster is encountered, where any part of the lobster is within the plot, a visual estimate of carapace length to the nearest millimeter is recorded prior to any attempts to capture the lobster. If there are several lobsters clustered together in a den, first record the number of lobsters that are present. While a den can vary in size, lobsters are generally considered grouped when they are less than one meter apart. Each grouping of lobsters is noted on the datasheet by a letter (e.g. group A, group B). Second, try to obtain visual estimates of carapace lengths of all the lobsters. Only after these are recorded should any attempt at capture be made. This is because when capturing a lobster within a group, the water can become silty and the other lobsters may hide, hindering visual assessments of the other lobsters in the cluster. In this manner, at least some information is retained by recording the number of lobsters observed and estimating their carapace lengths prior to an attempt at capture.

Spotted lobsters are also recorded during the survey. Their sizes are only estimated and no attempt at capture is made. Thus, no measured carapace length or demographic information (sex, molt stage, and presence of eggs or spermatophore) is recorded for spotted lobster. They are not the target species of this protocol, but the survey provides an opportunity to collect basic data on their presence and size. The spotted lobster species is designated on the datasheet with “PG” (*Panulirus guttatus*) while spiny lobster is designated as “PA” (*Panulirus argus*). While other lobster species exist, they are rare and unlikely to be encountered in a survey. If other lobster species are found on a survey, their presence may be included in the notes section on the datasheet, but no demographic or size information is collected.

Capturing lobster with a tickle stick and net requires skill and practice to capture lobster effectively without injuring them. A tickle stick is a thin stick about 1 meter (3.3 ft) in length with a bent tip. When a lobster is encountered, the bent tip is gently placed under the tail or body of the lobster to coax it out into the open. If done too aggressively, the lobster will frighten and try to escape by flipping its tail and moving quickly backwards. A flat-bottomed net is placed behind the lobster (in between the lobster and the den), so when the lobster is then startled, it swims backwards into the net (Figure 2 in SFCN SOP SL05 *Training—Version 1.1* [SFCN 2020]). The open side of the net can be placed on the bottom, making it more difficult for the lobster to escape. Once the lobster is inside the net, hold with a gloved hand to measure the actual carapace length and record the biological condition of the lobster. Once a lobster has been captured and assessed, to create the least disturbance, release it back to its original location.

A snare may also be used to capture lobster. The observer decides whether the snare or tickle stick and net is used to attempt a capture. Both tools are brought on a dive so the option to use either exists. The snare consists of a loop on the end of a stick that is tightened around the tail of a lobster to prevent escape. During the 2019 sample season, we found a snare preferable to a tickle stick and net when lobsters were in hard-to-reach places deep inside the reef. However, the snare was less effective at capturing smaller lobsters. Prior to capture, if an observer notices a lobster has eggs, a tickle stick and net should be used rather than a snare in order to lessen the potential of harm to the eggs. It is important to obtain accurate size data for lobsters observed to have eggs, though extra care should be taken when handling these berried lobsters (Tom Matthews, Associate Research Scientist, Florida Fish and Wildlife Conservation Commission, pers. comm. October 21, 2019).

The following characteristics will be recorded for each spiny lobster (Note: for spotted lobster, only the length will be estimated):

1. Species: This is PA for *Panulirus argus* (spiny lobster) or PG for *Panulirus guttatus* (spotted lobster).
2. Group (letter): A letter (A, B, C) is used to designate the grouping of lobsters. Lobsters are considered within the same group if they occupy the same den and are within one meter of one another. Single lobsters not associated with a group are assigned a letter but are the only lobster in that letter group (e.g. three lobsters are in group A, one lobster in group B).
 - a. At each plot, each diver will start with group letter A. For data storage the diver letter and group letter will be combined to create a unique group name at that site. For example, the first group discovered by diver B will be recorded on the datasheet as A and stored in the database as BA (i.e. diver B, group A).
 - b. If a lobster group crosses the quadrant line and could potentially be counted by both divers, they communicate underwater to ensure that only one diver records the group.
3. Estimated carapace length (millimeters [mm]): An estimate of carapace length in millimeters is made prior to any attempt at capture of any lobster. The carapace length is the distance

from the rigid part between the horns to the rear edge of the top part of the carapace (Figure 3).

4. Actual carapace length (millimeters): Measure carapace length with the measuring aid taped on to the end of a snare or tickle stick. The carapace length is the distance from the rigid part between the horns to the rear edge of the top part of the carapace (Figure 3).

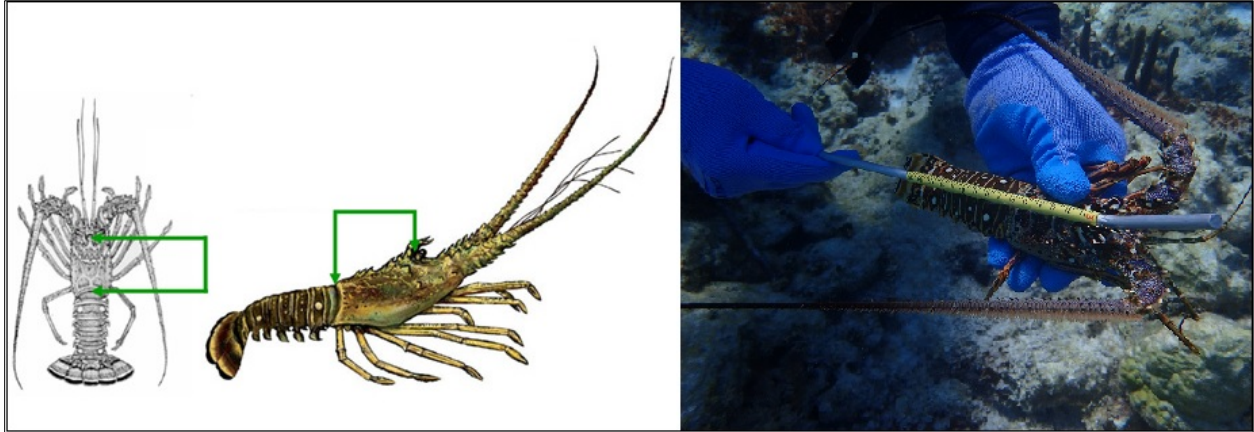


Figure 3. The left image shows where the carapace length is measured from (the rigid part between the horns to the rear edge of the carapace; FWC 2017). The right image shows the carapace being measured with the measuring aid taped on the end of a tickle stick.

5. Sex (male or female): The sex of a spiny lobster is most easily determined by looking at the underside of its abdomen (this is the “tail” that is typically taken by the fishery). Females have two pairs of pleopods, or swimming appendages, per abdominal segment and the pleopods are feathery in appearance (Figure 4). Males have a single pair of pleopods per abdominal segment, which do not appear feathery, and will also have a slightly thinner tail than a similarly sized female.

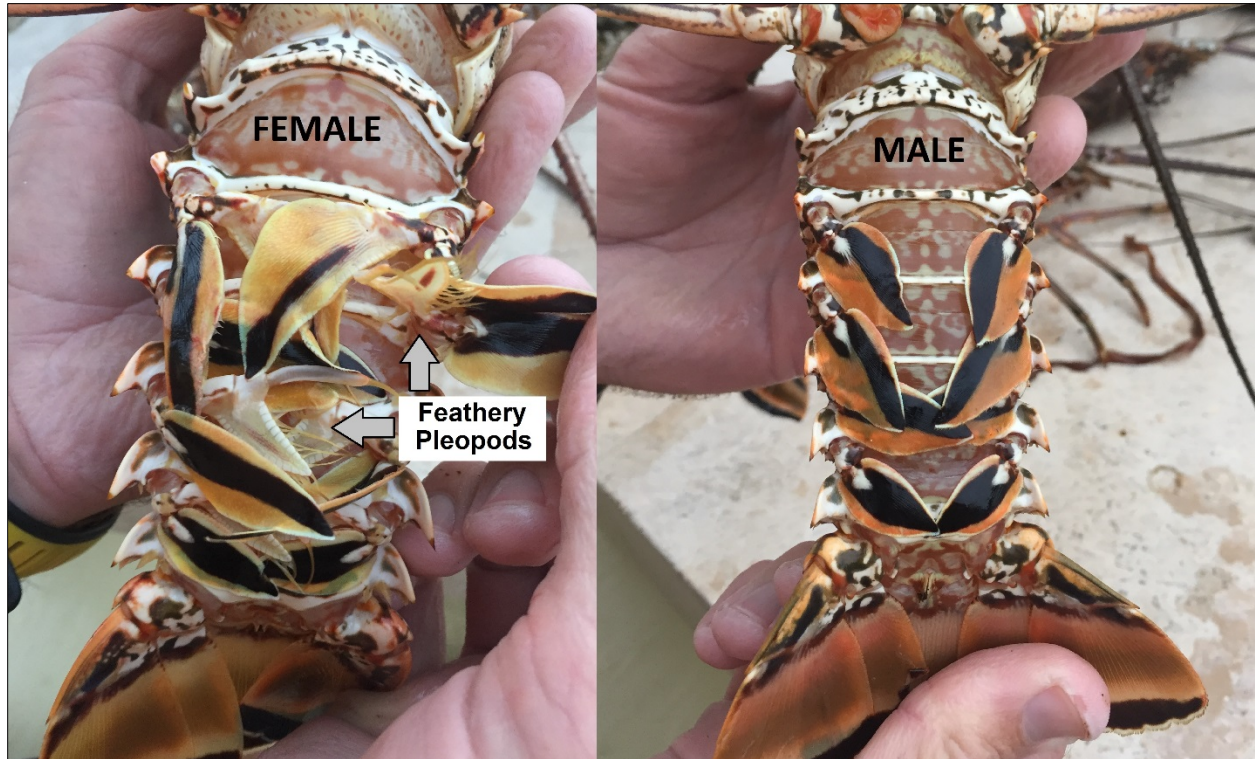


Figure 4. The difference between a female and male lobster can be seen on their abdomen. Females are most easily identifiable by the two pairs of pleopods, or swimming appendages, per abdominal segment, which are feathery in appearance. Males have a single pair of pleopods per abdominal segment and the pleopods are not feathery.

6. Molt condition (pre-molt, post-molt, intermolt): Spiny lobsters molt as they grow. Post-molt lobsters have a soft carapace that has not hardened since a previous molt. Pre-molt lobsters have a resorptive or ecdysial line along the branchiostegites (Figure 5). A few hours prior to molting, the fleshy area between the carapace and tail may appear swollen. The majority of lobsters observed will be in the intermolt phase, where the carapace is hard and no ecdysial line is observed. For more information on the molting cycle of *Panulirus argus*, consult Travis (1954).

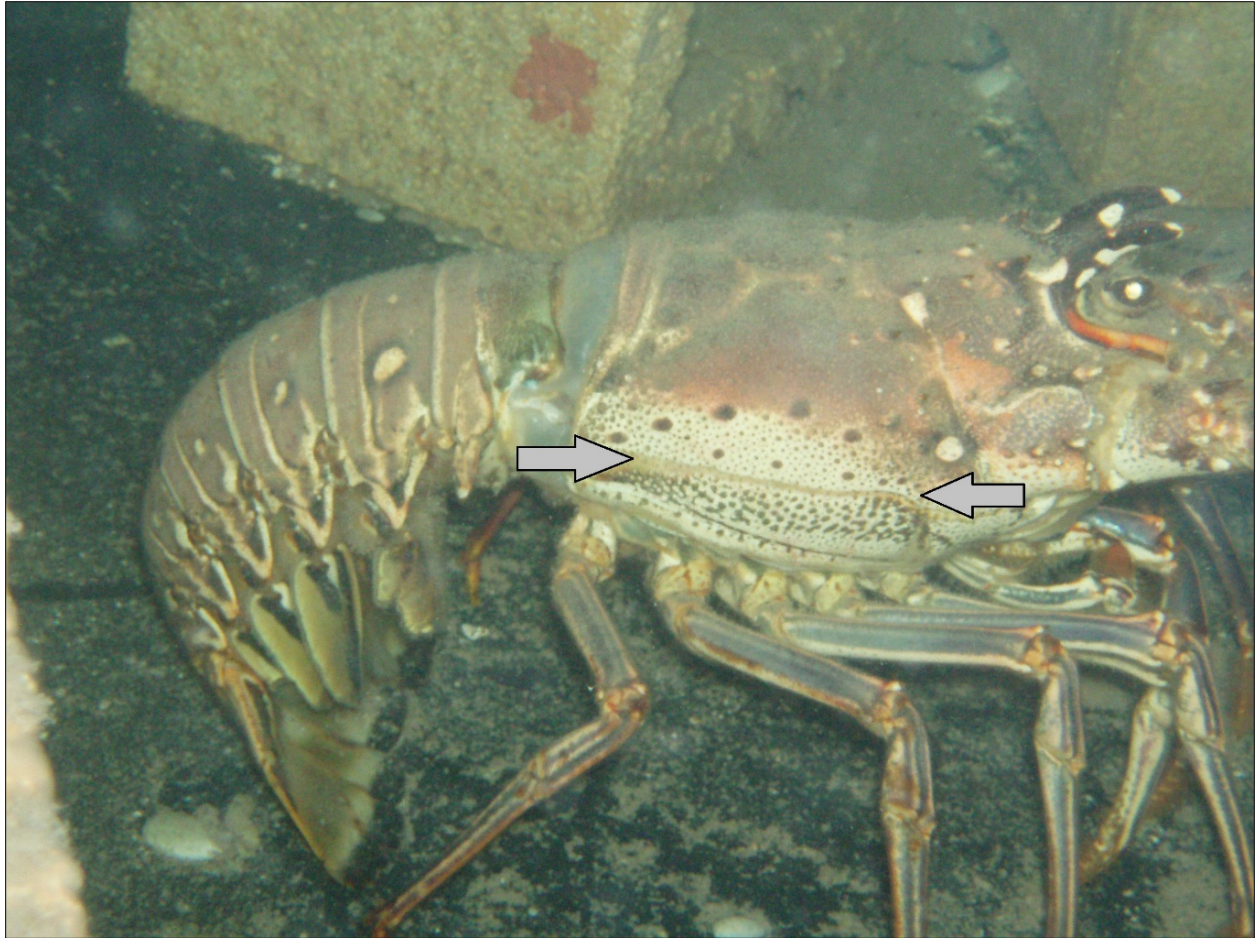


Figure 5. Photo of a pre-molt lobster a few hours prior to molting. The arrows point to the resorptive or ecdysial line. The fleshy area between the carapace and tail appears swollen (photo used with permission by FWC/Tom Matthews 2017).

7. Eggs (orange or brown): If a female lobster is carrying eggs, the eggs will be more orange in color if they are new (Figure 6), or brown if they are close to hatching (Figure 7). If eggs are present, a photo is taken of the datasheet showing the data for that particular lobster and a second photo of the eggs, ideally with the measurement aid in the frame for scale.
8. Spermatophore (eroded or fresh): Male lobsters deposit a spermatophore or “tar patch” on the underside of female lobster during reproduction. The spermatophore is black and has a tar-like consistency (Figure 6). To fertilize the eggs, the female lobster will scratch at the tar patch with her legs. Figure 7 shows an example of an eroded spermatophore. A female with no eggs and an eroded tar patch has recently reproduced. If a spermatophore is present, a photo is taken of the datasheet showing the data for that lobster and a second photo of the spermatophore, ideally with the measurement aid in the frame for scale.

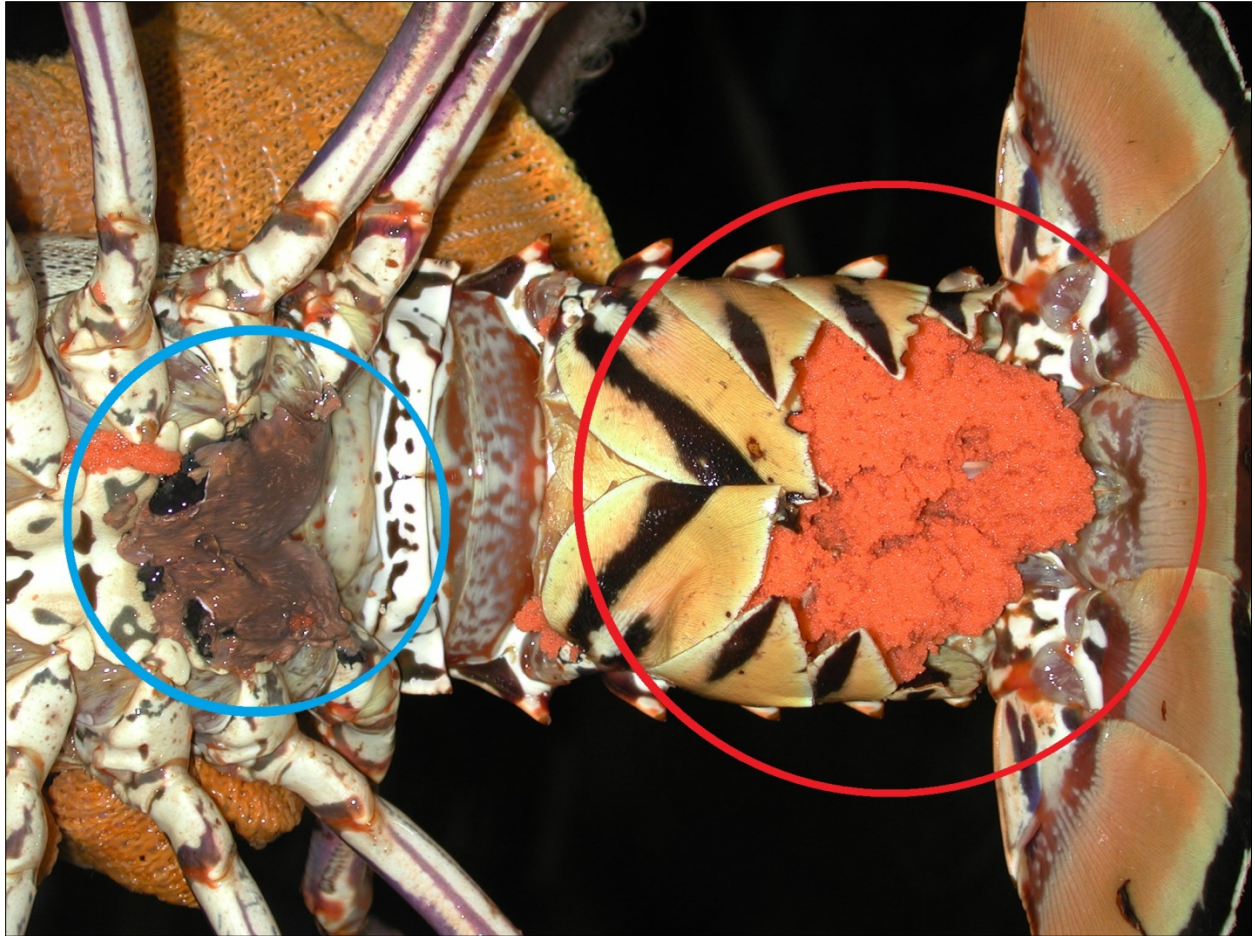


Figure 6. Figure shows a female lobster with orange eggs under tail (red circle) and a fresh, non-eroded spermatophore (blue circle) under her belly (photo used with permission from FWC/Tom Matthews 2017).

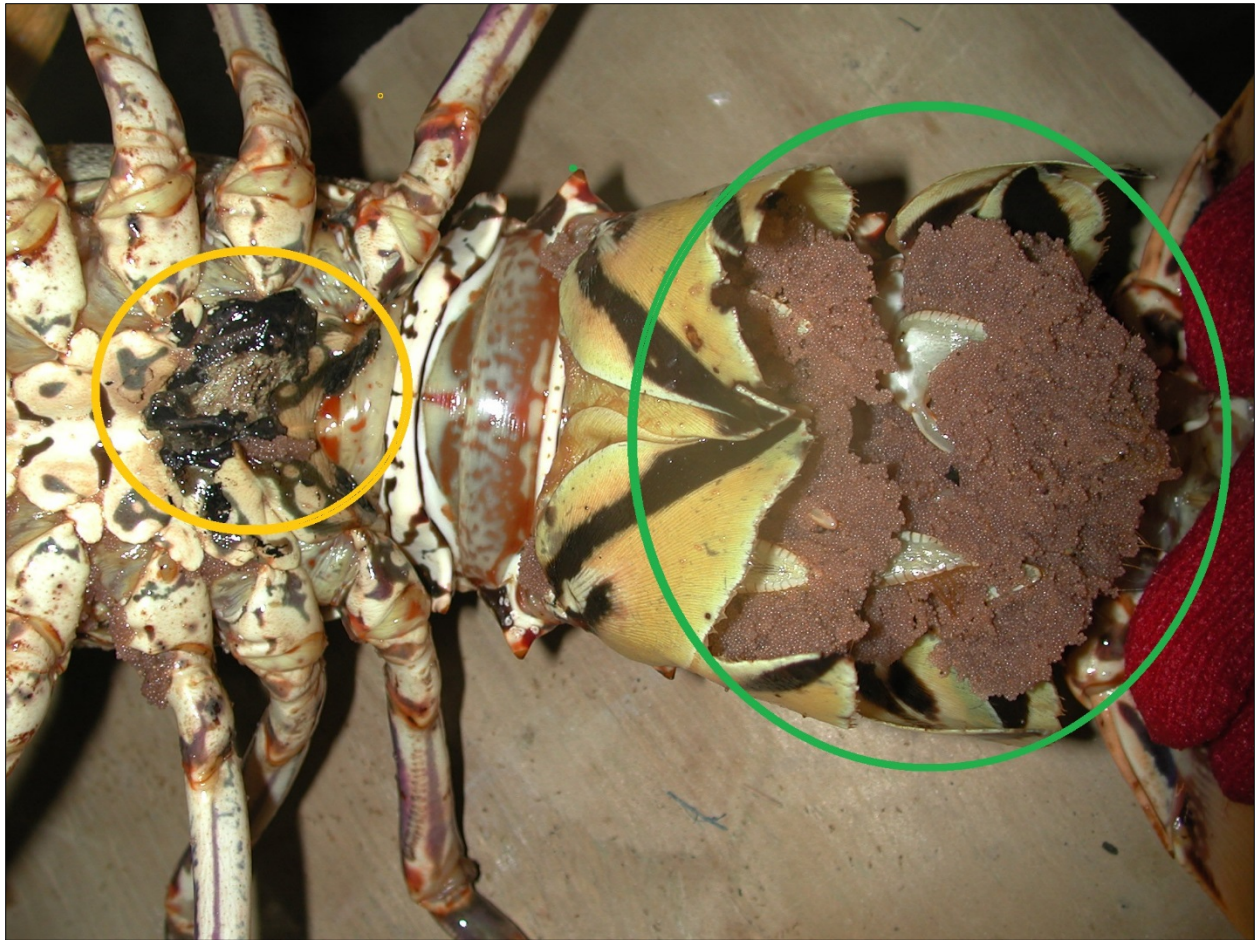


Figure 7. Figure shows a female lobster with brown eggs under tail (green circle) and an eroded spermatophore (orange circle) under her belly (photo used with permission by FWC/Tom Matthews 2017).

9. Distance to edge (meters): Here, an edge is defined as a soft bottom-hard bottom interface. When a lobster is encountered, the observer estimates, in meters, how far the lobster is from an edge if one is visible. This distance can extend outside the circular plot. If an edge is not within sight, then “n/a” is recorded.

Prior to surfacing, the divers mark the time that they complete the survey and make sure all fields are filled out on their data sheet. Upon finishing the plots, the divers will reconvene, end their dive, surface, and get picked up by the boat before travelling to the next location.

Habitat Assessment

Only one diver needs to take habitat photos for a site. They take a photo of the datasheet so the site name is clearly visible and then take four photos in each of the cardinal directions that show the habitat where the survey will occur. Both divers will make a basic habitat assessment (Figure 8) for each circular plot.

The assessment of habitat type, abiotic footprint, and surface relief coverage categories match that of the reef fish monitoring protocol, presented in SOP C *Field Data Collection* of Brandt et al. (2009). It is kept the same for consistency so that habitat characteristics may be directly comparable. Following data collection, the divers should discuss these values. While the estimates may vary slightly, the divers should achieve a consensus on the type of habitat the plot(s) were completed on. If no consensus is achieved, the habitat type designation will default to the more experienced of the two observers. All discrepancies in habitat designation will be assessed by the lobster project lead or marine ecologist by referring to the habitat photos for verification.

1. **Habitat type:** On the datasheet, the habitat choices will differ depending on whether the surveys are completed in Florida or the Virgin Islands, because the habitat maps used in stratification for the two regions are different. For surveys in Florida, the following habitats may be chosen: contiguous reef (spur and groove), contiguous reef (other), isolated reef structure, rubble, seagrass/rubble/sand matrix, or sand. For surveys in the Virgin Islands, the following habitats may be chosen: bedrock, linear reef, patch reef, pavement, or scattered coral/rock. Matrix and sand habitat types (in parentheses on the datasheet) are not target habitats and are not sampled. If surveyors are deployed on these habitats without any target hard-bottom habitat in sight nearby, the survey will be aborted.
2. **Abiotic footprint:** This is an estimate of percent cover of sand, rubble, and hard-bottom in the entire circular plot. Each category is estimated to the nearest 10%, and the percentages must sum to 100%. Sand is defined as coarse biogenic or oolitic sand (grain sizes typically between 0.5–2 millimeters [0.01–0.07 inches {in}]) and finer silt sized particles (less than 0.2 millimeters [0.007 in]). Sand is considered the substratum when sediment depth is 2–3 centimeters (0.7–1.1 in) in depth or greater. It excludes a surface “dusting” of sediment particles overlying a consolidated substratum. Rubble ranges from coarse gravel (greater than 5 millimeters [0.19 in]) to unconsolidated and moveable rocks (e.g., dislodged and moveable coral fragments). This category differs from consolidated hard-bottom because of its loose and moveable nature. Consolidated hard-bottom includes solid, consolidated lithogenic or biogenic substratum, including living and dead coral, and non-coral hard-bottom. Areas covered by seagrass are coded as sand, since the biotic “grass” is growing in the abiotic sand substrate.
3. **Slope:** This is the maximum and minimum depths of the substrate slope within the sample circular plot. These values refer to the maximum and minimum depths on the imaginary plane underlying the sample cylinder. If there is a slope, these depths will be different; if the minimum depth = maximum depth there is no slope.
4. **Surface relief coverage:** This is recorded by estimating the percentage, to the nearest 10%, of the circular plot that falls within five different categories of surface relief (less than 0.2 meters [0.6 ft], 0.2–0.5 meters [0.6–1.6 ft], 0.5–1.0 meters [1.6–3.2 ft], 1.0–1.5 meters [3.2–4.9 ft], and greater than 1.5 meters [4.9 ft]). The percentages must sum to 100%. Surface relief is described here as the height of hard features (not soft corals or sponges) measured perpendicular from the plane of the benthos.

Habitat type (circle one)			
Contiguous S&G		Rubble	
Contiguous Other		(Matrix)	
Isolated		(Sand)	
Abiotic Footprint (%)		Surface Relief Coverage (%)	
SAND	%	<0.2 m	%
RUBBLE	%	0.2-0.5 m	%
HARD-B	%	0.5-1.0 m	%
Total	100%	1.0-1.5 m	%
Slope (ft)		>1.5 m	%
Min___ Max___		Total	100%

Habitat type (circle one)			
Bedrock		Pavement	
Linear Reef		Scat'd coral/rock	
Patch Reef		(Sand)	
Abiotic Footprint (%)		Surface Relief Coverage (%)	
SAND	%	<0.2 m	%
RUBBLE	%	0.2-0.5 m	%
HARD-B	%	0.5-1.0 m	%
Total	100%	1.0-1.5 m	%
Slope (ft)		>1.5 m	%
Min___ Max___		Total	100%

Figure 8. Habitat assessment portion of the lobster survey datasheet for Florida (left) and the Virgin Islands (right). Habitat type, abiotic footprint, slope and surface relief coverage are all recorded here.

Rapid Queen Conch and Urchin Assessment

After the first sampling event in 2019, we decided to add an opportunistic rapid queen conch and urchin assessment to the sample (Figure 9). Individuals are only counted and not measured. While other species of conch exist, only the queen conch (*Lobatus gigas*) is quantified in this survey. Similarly, only the long-spined sea urchin species (*Diadema antillarum*) is quantified. A section was added to the datasheet where the number of adult queen conch, juvenile queen conch, and *Diadema* urchins can be quantified within each plot. These data are considered secondary and should not detract from the quality of the lobster survey.

Adult conch: _____
Juv conch: _____
Diadema: _____

Figure 9. Queen conch and *Diadema* portion of the lobster survey datasheet.

The diver will indicate the number of *Diadema* urchins, adult queen conch (*Lobatus gigas*) and juvenile queen conch are present within the plot. Adult queen conch have a flared, thick shell lip that differentiates them from juveniles and can be identified quickly (Figure 10).

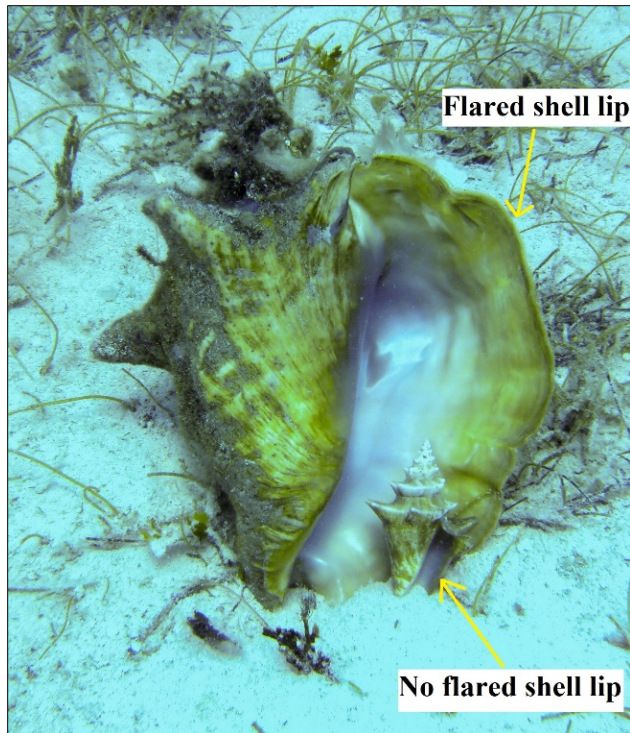


Figure 10. This image shows an adult queen conch with a flared shell lip. This lip thickens as the conch ages. For comparison, a much smaller juvenile queen conch is also pictured, but lacks a flared shell lip.

Florida Lobster Survey Datasheet

Observer: _____ **A / B** **Date:** _____ **Site ID:** _____ **Sample Start:** _____ **Visibility (ft):** _____

Buddy: _____ **A / B** **Park:** _____ **Depth (ft):** _____ **Sample End:** _____

Plot	Species (PA/PG)										Habitat type (circle one)				
	Group (letter)										Contiguous S&G		Rubble		
	Estimate of CL (mm)										Contiguous Other		(Matrix)		
	Measured CL (mm)										Isolated		(Sand)		
	Sex (M/F)										Abiotic Footprint (%)		Surface Relief Coverage (%)		
	Molt (PR/PO/INT)										SAND		%	<0.2 m	%
	Eggs (O/B)										RUBBLE		%	0.2-0.5 m	%
	Spermat (E/F)										HARD-B		%	0.5-1.0 m	%
	Dist. to edge (m)										Total		100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft) Min ____ Max ____		>1.5 m		%
Total							100%	Total		100%					
Slope (ft)							Min ____ Max ____		Total		100%				

Plot	Species (PA/PG)										Habitat type (circle one)				
	Group (letter)										Contiguous S&G		Rubble		
	Estimate of CL (mm)										Contiguous Other		(Matrix)		
	Measured CL (mm)										Isolated		(Sand)		
	Sex (M/F)										Abiotic Footprint (%)		Surface Relief Coverage (%)		
	Molt (PR/PO/INT)										SAND		%	<0.2 m	%
	Eggs (O/B)										RUBBLE		%	0.2-0.5 m	%
	Spermat (E/F)										HARD-B		%	0.5-1.0 m	%
	Dist. to edge (m)										Total		100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft) Min ____ Max ____		>1.5 m		%
Total							100%	Total		100%					
Slope (ft)							Min ____ Max ____		Total		100%				

Species: **PA** = *P. argus*, **PG** = *P. guttatus* / Sex: **M** = Male, **F** = Female / Spermat: **E** = Eroded, **F** = Fresh

Eggs: **O** = Orange (new), **B** = Brown (near hatching) / Molt condition: **PR** = pre, **PO** = post, **INT** = intermediate

Figure 12. Example of Florida lobster survey datasheet.

Virgin Islands Lobster Survey Datasheet

Observer: _____ A / B Date: _____ Site ID: _____ Sample Start: _____ Visibility (ft): _____

Buddy: _____ A / B Park: _____ Depth (ft): _____ Sample End: _____

Plot	Species (PA/PG)										Habitat type (circle one)				
	Group (letter)											Bedrock	Pavement		
	Estimate of CL (mm)											Linear Reef	Scat'd Coral/Rock		
	Measured CL (mm)											Patch Reef	(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)	
	Molt (PR/PO/INT)											SAND	%	<0.2 m	%
	Eggs (O/B)											RUBBLE	%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B	%	0.5-1.0 m	%
	Dist. to edge (m)											Total	100%	1.0-1.5 m	%
	Notes	Check if NO lobster observed: ☐					# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft)		>1.5 m		%		
Min__ Max__															
Total									100%		Total		100%		

Plot	Species (PA/PG)										Habitat type (circle one)				
	Group (letter)											Bedrock	Pavement		
	Estimate of CL (mm)											Linear Reef	Scat'd Coral/Rock		
	Measured CL (mm)											Patch Reef	(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)	
	Molt (PR/PO/INT)											SAND	%	<0.2 m	%
	Eggs (O/B)											RUBBLE	%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B	%	0.5-1.0 m	%
	Dist. to edge (m)											Total	100%	1.0-1.5 m	%
	Notes	Check if NO lobster observed: ☐					# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft)		>1.5 m		%		
Min__ Max__															
Total									100%		Total		100%		

Species: **PA** = *P. argus*, **PG** = *P. guttatus* / Sex: **M** = Male, **F** = Female / Spermat: **E** = Eroded, **F** = Fresh
 Eggs: **O** = Orange (new), **B** = Brown (near hatching) / Molt condition: **PR** = pre, **PO** = post, **INT** = intermediate

Figure 13. Example of Virgin Islands lobster survey datasheet.

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Appendix A. Printable Data Sheets

The following pages are data sheets formatted so that they can be printed directly onto sheets of underwater paper for use in the field. For this reason, no page numbers or headings are included.

1st page: Field/Boat/Dive Log form

2nd page: Florida Lobster Data Sheet

3rd page: US Virgin Islands Lobster Data Sheet

Lobster Survey Boat Log Park _____ Date _____ Boat _____ Page ____ of ____

Park _____ Date _____ Boat _____

Page ____ of ____

[illegible]

Florida Lobster Survey Datasheet

Observer: _____ A / B Date: _____ Site ID: _____ Sample Start: _____ Visibility (ft): _____

Buddy: _____ A / B Park: _____ Depth (ft): _____ Sample End: _____

Plot	Species (PA/PG)											Habitat type (circle one)				
	Group (letter)											Contiguous S&G		Rubble		
	Estimate of CL (mm)											Contiguous Other		(Matrix)		
	Measured CL (mm)											Isolated		(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)		
	Molt (PR/PO/INT)											SAND		%	<0.2 m	%
	Eggs (O/B)											RUBBLE		%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B		%	0.5-1.0 m	%
	Dist. to edge (m)											Total		100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft)		>1.5 m		%	
											Min___ Max___		Total		100%	

Plot	Species (PA/PG)											Habitat type (circle one)				
	Group (letter)											Contiguous S&G		Rubble		
	Estimate of CL (mm)											Contiguous Other		(Matrix)		
	Measured CL (mm)											Isolated		(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)		
	Molt (PR/PO/INT)											SAND		%	<0.2 m	%
	Eggs (O/B)											RUBBLE		%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B		%	0.5-1.0 m	%
	Dist. to edge (m)											Total		100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft)		>1.5 m		%	
											Min___ Max___		Total		100%	

Species: **PA** = *P. argus*, **PG** = *P. guttatus* / Sex: **M** = Male, **F** = Female / Spermat: **E** = Eroded, **F** = Fresh
 Eggs: **O** = Orange (new), **B** = Brown (near hatching) / Molt condition: **PR** = pre, **PO** = post, **INT** = intermediate

Virgin Islands Lobster Survey Datasheet

Observer: _____ **A / B** **Date:** _____ **Site ID:** _____ **Sample Start:** _____ **Visibility (ft):** _____
Buddy: _____ **A / B** **Park:** _____ **Depth (ft):** _____ **Sample End:** _____

Plot	Species (PA/PG)											Habitat type (circle one)			
	Group (letter)											Bedrock	Pavement		
	Estimate of CL (mm)											Linear Reef	Scat'd Coral/Rock		
	Measured CL (mm)											Patch Reef	(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)	
	Molt (PR/PO/INT)											SAND	%	<0.2 m	%
	Eggs (O/B)											RUBBLE	%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B	%	0.5-1.0 m	%
	Dist. to edge (m)											Total	100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft) Min___ Max___		>1.5 m	%	
Total							100%	Total		100%					
Slope (ft)							Min___ Max___		Total		100%				

Plot	Species (PA/PG)											Habitat type (circle one)			
	Group (letter)											Bedrock	Pavement		
	Estimate of CL (mm)											Linear Reef	Scat'd Coral/Rock		
	Measured CL (mm)											Patch Reef	(Sand)		
	Sex (M/F)											Abiotic Footprint (%)		Surface Relief Coverage (%)	
	Molt (PR/PO/INT)											SAND	%	<0.2 m	%
	Eggs (O/B)											RUBBLE	%	0.2-0.5 m	%
	Spermat (E/F)											HARD-B	%	0.5-1.0 m	%
	Dist. to edge (m)											Total	100%	1.0-1.5 m	%
	Notes						Check if NO lobster observed: ☐		# Adult conch: _____ # Juv conch: _____ # Diadema: _____		Slope (ft) Min___ Max___		>1.5 m	%	
Total							100%	Total		100%					
Slope (ft)							Min___ Max___		Total		100%				

Species: **PA** = *P. argus*, **PG** = *P. guttatus* / Sex: **M** = Male, **F** = Female / Spermat: **E** = Eroded, **F** = Fresh
 Eggs: **O** = Orange (new), **B** = Brown (near hatching) / Molt condition: **PR** = pre, **PO** = post, **INT** = intermediate