Guidelines for Collecting Ephemeral Data in the Arctic: ROCKY INTERTIDAL HABITATS

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Note: These guidelines are limited data collection aides that do not necessarily consider all possible scenarios under which samples may be collected. Use best professional judgment to modify these guidelines according to area-specific field conditions.

Guideline Objectives

The primary objective of this document is to provide guidelines on collecting rocky intertidal community samples from intertidal or shallow subtidal areas during the early stages of an oil spill in the Arctic to support Natural Resource Damage Assessment (NRDA) exposure and injury evaluations. Arctic rocky shores are very different from rocky shores in other regions. There is very little rocky shore north of the Bering Strait. The predominant areas where there are rocky shores in the Bering Strait and south of the Bering Strait are islands (Saint Lawrence Island, Little Diomede Island, Fairway Rock, Sledge Island, and King Island). With the exception of Saint Lawrence Island, the coasts of these islands are very steep and do not have flat benches. Many rocky areas are made up of large rocks from the size of cobbles to boulders or steep rocky shores. Rocky shorelines are also present along the coast of the Bering Sea, including in Norton Sound, Bristol Bay and the Aleutian Islands. Other related habitats (e.g., gravel beaches) are covered in separate guideline documents.

Sampling Objectives

Characterize oil

- Determine the composition of oil compounds in rocky intertidal habitats compared to background concentrations
- Determine the source of contamination via chemical fingerprinting analysis and characterize oil weathering and fate
- Characterize other sources of oil or hydrocarbons in the environment

Describe habitat

- Estimate the areal extent and degree of oiling in rocky intertidal habitats
- Document the presence/absence and species composition, and estimate the abundance or density of the invertebrate and algal community associated with rocky intertidal habitats
- Support oil environmental transport modeling by documenting where oil stranded onshore

Study exposure

- Support exposure and transport modeling

Quality assurance/quality control

- Ensure the integrity of the sample(s) throughout sampling, transport, and storage
- Ensure the reliability of chemical and biological characterizations

Collaboration

- Support other ongoing ephemeral sampling efforts (see Intertidal and Subtidal Sediment guidelines)
- Collect tissue samples for chemical analysis (see Shellfish Tissue guidelines)

Before Field Sampling

- Assure that all personnel have required safety training and protective equipment for Arctic field work (not described in this guideline).
- Arctic weather conditions (e.g., wind direction and speed) are variable within a short timeframe. Be prepared for changing weather conditions, be aware of your surroundings, and take precautions to ensure the safety of the sampling team.
- Sampling rocky intertidal habitats by boat is not recommended unless the area is sheltered and the water very calm.
- Special precautions are to be taken when sampling rocky intertidal habitats as sampling areas may have steep rocky shores. In areas relatively free of ice scour, the exposed rocky areas will be covered by macro-algae which will make sampling challenging. Modifications to these guideline documents will be needed to adjust for sampling in these areas.

Study design

- It is important to have a defined sampling strategy prior to conducting fieldwork. Rocky intertidal habitats are difficult to sample because of the inherent heterogeneity, steep slopes, and in some cases difficult access.
- The following terminology is used to define general to specific sampling geographies:
  - Area = general area of uniform characteristics, such as degree of oil exposure, physical setting, habitat types present, etc.
  - Location = a specific location that is representative of the area and contains the type of habitat to be sampled, such as intertidal boulders or cobble beaches
  - Transect = a line through a site along which samples are collected or observations are made
  - Site = a specific point at which samples are collected or observations are made
- Plan ahead the number of locations and number of sites per location, taking into account level of effort, potential logistical limitations, weather conditions, and other issues that may compromise sample integrity.
- Review the guideline and resolve any area-specific issues. Area-specific modification of the guideline may be needed based on environmental conditions, geography, access to remote areas, and shipping capabilities.
- Use a computer or conceptual model of the extent of rocky intertidal habitat contamination or an appropriate power analysis to estimate the number of sampling locations and number of samples per site needed to respond to the sampling objectives.
- A stratified random sampling approach, which divides the sampling location into non-overlapping zones (strata) from which random samples are collected, is recommended if no other sampling strategy has been developed. This type of sampling improves the representative quality of samples by reducing sampling error (variability).
- Contact the laboratories that will be receiving field samples for analysis and assure that they have the capacity to receive and analyze samples from the study. Follow relevant guidelines from the laboratory and consult with them about necessary modifications.
- Shoreline visualization tools (e.g., ESI maps, satellite images, ShoreZone) should be used to develop a sampling strategy and estimate distances, number of sampling transects, transect spacing, intertidal zone width, etc. before going into the field.
- The sampling strategy should have flexibility to be adjusted based on conditions in the field. This is particularly the case for rocky intertidal habitats, as sampling strategies may need to be modified to sample each type of rocky shore (steep rocky shores, cobble/boulder rocky shores, irregular rocky shores with crevices, etc.).

- Consult appropriate guidelines for the collection of other environmental media and biota concurrent with rocky intertidal sampling. Tarballs, sheens or other oil residues can be collected opportunistically for chemical analysis and fingerprinting.

Equipment

- Review the list of sampling equipment/containers, make adjustments as needed, and assure that all essential field materials are ready to be taken to the field.
- If not all sampling equipment is available, consult the alternative equipment guidelines or determine if other appropriate options are available.
- Consider area-specific conditions for remote Arctic regions and make adjustments in methodology and equipment as necessary.
- It may be necessary to coordinate with the laboratory that will receive the samples to assure that acceptable materials and conditions are used for sampling and sample storage and shipping.
- Do as much material preparation prior to field deployment, including: labeling sample jars using permanent markers or laboratory labels; solvent rinsing of jars, etc.
- Make sure that all essential equipment is in working order and operational under Arctic field conditions, and that spare equipment and/materials are available.
- Store solvents carefully to prevent spillage. Follow regulations regarding the shipment of chemicals.

Sampling Areas and Timing

- Follow a sampling plan/work plan if one is available.
- If a sampling plan is not available for ephemeral data collection immediately after a spill, data collection should focus on collecting samples from a range of unoiled, likely to be oiled, and already oiled areas.
- It is important to obtain reliable data that account for spatial and temporal variations of oil impacts.
- When sampling in remote areas with limited shipping capabilities, plan ahead to make sure that the integrity of samples is not compromised by ensuring that the processing laboratory receives the samples within their recommended holding time. Remember that it may take multiple days for shipments from remote areas to reach a laboratory facility. This last stage is the most important and requires due diligence until the samples are safely delivered.
- The number of locations and number of sites per location need to be considered accordingly, making sure that there is enough space in the coolers to accommodate all samples without sacrificing their integrity.
- Plan all sampling strategies within daylight hours; sampling in the dark, even with headlamps, is not recommended. This guideline may not apply during winter or much of the fall.
- The challenges of collecting samples in remote areas, particularly during winter, are great and require adequate planning and careful field implementation to attain the data quality required to meet the objectives of the sampling plan.

Area selection

- Rocky intertidal habitats can be: 1) rocky shores composed of steep rock walls and vertical bedrock exposed to moderate to high wave energy (see photograph); 2) platforms consisting of wave-cut or low-lying bedrock exposed to moderate to high wave energy; and 3) rocky shores characterized by vertical rock walls, bedrock outcrops, wide rock platforms and boulders found in sheltered

areas and generally protected from wave exposure.

- Sampling locations should be representative of areas that have been or may be oiled by the spill and unoiled reference areas.
- Use trajectory models, conceptual models, overflight information, SCAT data or other tools to determine what location have been oiled and which ones are likely to be oiled.
- Samples should also be collected from locations known or suspected to be impacted by other natural or anthropogenic sources of contamination (e.g., oil seeps, coal, peat, shipping, mining, combustion engines), as these will be important to differentiate background sources and levels of contamination.
- It may be necessary to prioritize sampling locations. In this case, highest priority samples are to be collected from oiled rocky intertidal areas. Collecting pre-oiled rocky intertidal samples from areas that are likely to be oiled by the spill in the near future is also a priority. Sampling at unoiled "control" areas and sampling other sources of contamination should be prioritized based on the ephemerality of the data and relative importance to developing a NRDA case.
- Steep rock walls that are exposed to wave action and ice scouring will not retain oil and will generally have limited biological productivity. These rocky shores are likely to be challenging to access. Consider prioritizing sampling in other rocky intertidal habitats (cobble, boulder, bedrock platforms or protected rocky habitats), or in other habitat types before attempting to sample steep, exposed rock walls.
- Rocky intertidal samples should be collected pre-oiling, if possible, as soon as practical after oiling and periodically thereafter. Sampling frequency is a function of oil persistence, biological community composition, habitat importance, and resource availability and should be defined in the study design.
- Oiled locations should be selected to represent different degrees of oiling (Heavy, Moderate, Light) that have similar degrees of exposure to ice scour and wave energy because the rocky intertidal communities can vary widely in exposed versus sheltered settings. When sampling oiled areas focus first on the sheltered rocky shores as that is where most of the oil will likely end up for the longest period of time. A pre-survey or detailed walk of the area may be needed to select these areas appropriately. Information about exposure and oil retention potential is also available for many shorelines in ShoreZone.
- The number of locations and number of sites per location should be defined in the study design. A minimum guideline for collecting rocky intertidal samples is at least three samples per intertidal zone per location of relatively uniform oiling exposure. If relevant data are available, a power analysis or other modeling approaches should be used to determine the number of samples needed before going into the field.
- Sample along exposure gradients, starting in the cleanest zone, at regular intervals proportional to the exposure area.

Collaboration

- Rocky intertidal samples can be collected in conjunction with intertidal sediment (if any), stranded oil, and gravel beach sampling.
- Close collaboration and coordination with other ongoing ephemeral sampling efforts is important.

Field Sampling Methods

Sampling Equipment/Containers

Note: The amount of equipment required depends on the sampling plan, desired sample volumes, and logistics. Analytical laboratories may provide required sampling and sample storage and transport materials – contact the receiving lab before preparing to collect samples in the field.

- Coolers – for sample storage and transport
- Ice packs/Collapsible jugs– for storage temperature regulation (if ambient temperature exceeds 4°C)
- Thermometer or temperature logger (1 per cooler)

- Disposable nitrile gloves (preferred), insulated nitrile-coated gloves (less ideal)
- Insulated shoulder-length rubberized gloves preferred for sampling under extreme cold conditions
- 8 oz certified organic-clean jars with Teflon-lined lids and labels – for oil samples
- Surveying supplies – site markers (appropriate for substrate type), surveying flags and tape, quadrats (0.5 m^2 and 1.0 m^2), portable hammer drill with drill bits, stainless steel bolts, marine epoxy (or similar), 30 m fiberglass tape measure marked in cm, hand counter, caliper
- Pencils, waterproof pens, waterproof labels, markers
- Evidence tape (see Chain of Custody guidelines)
- Small containers– for holding motile invertebrates
- Aluminum foil: the dull side should be pre-cleaned with acetone, methanol, or hexane (Capillary GC Pesticide Residue Grade or equivalent) to wrap samples of larger gravel, with the dull side in contact with the sample
- Ziploc or Whirl-Pak bags, and additional sampling jars
- 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal)– preservation; and a stain (such as Rose Bengal) if appropriate
- Field Sample forms (template in Appendix A)
- Chain of Custody forms (see Chain of Custody guideline)
- Rocky intertidal identification field guides/charts (if available), field notebook (waterproof paper), other guidelines as needed (Field Photography, Subtidal and Intertidal Sediment, Stranded Oil guidelines)
- GPS, camera (with spare batteries), and photo scales
- Single or double strobe lighting, quadrapod frame for photoplots
- Tape measure and ruler
- Packaging materials for glass jars (e.g., bubble wrap, sorbent pads, tape) – may be provided by the analytic laboratory
- Suitable disposal bags for oiled PPE and disposable sampling materials

Good Sampling Practices and Decontamination

- Good field practices and the development of a consistent sampling routine will help provide for the integrity of the samples and their validity in environmental assessments.
- Disposable nitrile gloves should be worn when sampling and changed between each sample collected or as necessary to prevent cross contamination.
- Disposable nitrile gloves can be worn over low-profile insulated gloves (e.g., neoprene gloves) in cold conditions and should be changed between samples to prevent cross contamination if they become contaminated or damaged. If nitrile gloves are not available or will not fit over insulated gloves in cold conditions, insulated nitrile-coated gloves may be an alternative, but extra precautions will have to be taken to prevent sample contamination; gloves will need to be cleaned with soap and clean water between samples and should not come in contact with the sample or with the surfaces of glassware or tools that will be in direct contact with the sample. Similar precautions should be taken when using insulated shoulder-length rubberized gloves.
- Take precautions to avoid cross-contamination of the site from oil on personal equipment. Sampling unoiled areas first, then lightly oiled areas and finally heavily oiled areas can minimize cross-contamination. Personal equipment should be exchanged or cleaned between sites if it becomes contaminated.

Study Design Implementation

- Ice scouring and freezing temperatures affect the distribution and abundance of rocky intertidal organisms in the Arctic. Ice scour on flat surfaces likely occurs on a yearly basis in many rocky intertidal locations and, consequently, the biota likely to occur on these rocky shore types are either

ephemeral (e.g., diatomaceous scum) or mobile (e.g., gastropods/crustaceans). Sessile invertebrates and organisms less tolerant to direct cold air exposure are likely to be found in crevices and other areas sheltered from ice scour. Consequently, sampling crevices is an important component of rocky intertidal sampling (see below).

- If recent SCAT data are available, it may not be necessary to conduct and overflight or ground survey. Otherwise, if practical, conduct an overflight of the entire affected area within two hours of low tide (before or after) if possible, to observe the extent of visible contamination. Note that weather, particularly fog, may dictate survey times that may not coincide with tides. Tides may not be a consideration along high Arctic shorelines where tidal range is small and water level is primarily wind driven.
- If an aerial survey is not feasible, survey from the ground. Use topographic maps, nautical charts, vertical aerial photographs, or other detailed maps to record observations. Set a GPS in track mode and take a photograph of the date/time screen so photographs can be geo-referenced later. The use of high definition video is also recommended. If an overflight is not feasible, conduct a pre-walk of the area. Observations should include:
  - Locations and approximate lengths of rocky intertidal habitats in the oiled area
  - Approximate degree of visible oiling of these habitats (if possible)
  - Locations of access points, major landmarks, and potential ground-truth and reference locations (if possible)

Note: Overflights may not be adequate enough to assess characterize rocky intertidal habitat oiling. It is highly advisable to consult with local experts and to select sampling sites based on trajectory modeling or SCAT data.

- Upon return, select locations for ground surveys based on degree of oiling (Heavy, Moderate, Light, No Oil; standard SCAT terminology), degree of rocky shoreline exposure and physical characteristics (e.g., steep shores, cobble/boulder rocky shores).
- If no other sampling strategy has been developed, use a stratified random sampling approach by randomly selecting the first transect starting point and expanding the sampling site (other transects) systematically into a grid from that initial point. Randomly select sampling sites within each intertidal zone intervals.
- Based on the study design and/or sampling strategy outlined before going into the field, establish a minimum of three transects spaced at least 30 m apart (recommended). Transects should be perpendicular to the shoreline and encompass the entire intertidal zone.
  - Record transect location using a GPS, but also accurately plot the transect on a map or aerial photograph
  - Permanently mark transect locations using “front and back” stakes which line up along the transect lines, and consider stake placement carefully to minimize loss to vandalism, erosion, ice-scouring, etc. Label the stakes to clearly identify the site as a NRDA sampling location to avoid possible confusion with the multitude of other survey stakes found across the Arctic
  - Record the transect angle with a compass so it can be re-surveyed at a later date, even if one stake is lost; note whether the angle reading is magnetic or corrected to true north
  - Take photographs of the transect at the beginning, middle and end, including upslope, downslope, and longshore images. This takes little time and establishes a reference for future work
- Divide each transects into sampling intervals based on the intertidal zones: upper intertidal, middle intertidal and lower intertidal.
- On some high-Arctic shorelines, the rocky intertidal zone may be very narrow. If a rocky intertidal transect is too narrow to have three sampling intervals on, consider running the transect from the supratidal or storm surge line (usually demarcated by a line of logs or debris) to the lower intertidal. Alternately, two sampling intervals can be defined on each transect, in the upper (or storm surge) and lower intertidal zone, or just one station if the intertidal zone is very narrow.

- Ground-based ephemeral data collection on steep rocky cliffs may not be feasible or necessary; visual surveys from vessels or aircraft may be the preferred method for assessing this habitat. If ground-based surveys are conducted, some of the guidelines for studying intertidal rocky shorelines may not be applicable to steep cliffs or will need to be adapted for safety and feasibility. On steep rocky shorelines, transects will be vertical or near vertical and tidal zones will be defined by biota bands or height above the water. As with less steep shorelines in the high Arctic, the tidal zone may be too narrow to divide into multiple sections.
- When establishing ground transects:
  - Record transect location using a GPS, but also accurately plot the transect on a map or aerial photograph (if available)
  - Permanently mark transect locations using "front and back" stakes which line up along the transect lines, and consider stake placement carefully to minimize loss to vandalism, erosion, ice-scouring, etc. Label the stakes to clearly identify the site as a NRDA sampling location. If marking transects with stakes is not possible or unpractical, the following alternate approaches may be used:
    - Use a small amount of epoxy to mark rocks at the transect ends. This can be done by pressing a blob of well-mixed epoxy onto a clean rock surface (important to ensure adhesion) to form a mound approximately 4 cm in diameter
    - Use water resistant paint to mark rocks at the transect ends. Strong colors (red, orange) are preferred
    - Use a hand drill to drill small holes on the rock, and use epoxide to permanently put bolts in place. Consider their placement to make sure these markers are not a tripping hazard. Use the primary bolt marking the site from which other lines can be found. Note that bolts may not be appropriate in ice scouring areas
  - Record the transect angle with a compass so it can be re-surveyed at a later date, even if one stake is lost; note whether the angle reading is magnetic or corrected to true north
  - Take photographs of the transect at the beginning, middle and end, including upslope, downslope, and longshore images. This takes little time and establishes a reference for future work
- For each transect, record:
  - Date, time, weather conditions (e.g., wind direction and speed), and tide level
  - Physical setting (shoreline orientation, exposure, etc.)
  - Substrate type and grain-size (if applicable) (e.g., mud, sand, granule, pebble, cobble, boulder)
  - Length of the transect (in meters) (if applicable) and of the sampling zone
  - Extent and degree of visible shoreline oiling (use SCAT guidelines for a more detailed assessment of shoreline oiling if needed)
  - Extent and degree of shoreline cleanup, if already performed (particularly note sediment disturbance or removal, flushing of oil and/or sediments into down-slope areas, etc.)
  - Presence of snow or ice along shoreline
  - Presence of biological resources or other relevant information
  - Presence, condition, and/or altered behavior of visible biota such as amphipods, gastropods, crabs, etc.
- Collect samples from each rocky intertidal zone (described below) and record the distance along the transect and GPS coordinates of each sampling site.
- Take pictures of the transect before and after sampling and pictures of each sampling site.

Sample Collection Methods

- Use field data forms included in the work plan, if one is available. Otherwise, use forms in Appendix A. Coordinate data form development/modification with the data management group.

- Because GPS units will be used to record locations and times, make sure that all units are using the same coordinate system, datum, reporting units, and correct time. Follow the recommended GPS datum of the study plan, if one is available. Alternatively, set the default to WGS84.
- Record GPS coordinates for each sample site.
- Photograph the sampling site prior to sample collection to document the site conditions, as well as the sample collected. Make sure each photograph or series can be later associated with the corresponding sampling locations (e.g., through use of GPS Photo link software or by keeping a detailed photo log with waypoints and/or lat/long). Do not delete or alter any photographs. The numbering sequence of photographs uploaded from your camera must not have any gaps (see Field Photography guideline).
- If time allows, a calibration exercise is needed to ensure that all field teams consistently perform sampling.
- At each selected sampling site, conduct a preliminary visual survey of the shoreline and draw a field sketch showing:
  - Shoreline orientation, type, grain size, etc.
  - Extent and degree of shoreline oiling (use shoreline oil terminology codes and % cover charts)
  - Type or degree of shoreline cleanup, if already performed (particularly note substrate disturbance or removal, flushing of oil and/or sediments into down-slope areas, etc.)
  - Location of transects
- Sampling is conducted to document the presence, composition, and general abundance of organisms including barnacles (e.g., *Chthamalus* and *Balanus*), mussels, and serpulid worms, among others. If highly quantitative density estimates are needed, or detailed comparisons of oiled vs. un-oiled sites are planned, an experienced rocky intertidal ecologist and statistician should be consulted to plan more detailed studies. For surveys of selected shoreline transects or habitat areas:
  - Record the distance along the transect and GPS coordinates of each collection site
  - For species presence/absence, composition, or density estimates use quadrats (0.5 m^2 or 1.0 m^2). Randomly place the quadrat 1 and 2 m to the left and right of each transect by tidal zone (high, middle, low), for a n=4 per tidal elevation. If possible record a visual estimate of percent oiling by key species. ***Note***: A 2-dimensional quadrat frame may not be as effective when sampling a rocky shore with complex profiles, high scour rocky intertidal areas, and rock crevices. Under some situations, string quadrats may be more appropriate
  - Take high-resolution vertical photographs of each quadrat, if possible using a tripod or quadrapod, and record GPS coordinates. When taking photographs:
    - Take photographs of the quadrat to document motile and sessile organisms
    - When documenting coverage of sessile organisms, prior to taking photographs remove from the quadrats any large or abundant motile invertebrates blocking the view of sessile invertebrates and algae. Carefully remove these organisms without disturbing the sessile/less motile organisms. Make sure to document the removal of organisms in the field sample form from photoplots prior to photo/scoring
    - High-resolution photographs must include all four sides of the quadrat as these will be used to digitally count individuals and measure their coverage on a computer screen
    - When photographing highly dense quadrats, quadrat frames can be split into 2-sided frames to facilitate computer-based analyses
    - Photographs need to be relatively flat so that the entire quadrat falls within a similar focal plane, with minimal shadowing from crevices or projections. Photographs should be directly perpendicular to the quadrat
    - If possible, use a quadrapod apparatus to support the camera at a constant height (1 m with a 35 mm lens) from the quadrat, and positioned to capture all four corners of the quadrat:
      - A quadrapod, consists of a gray PVC or gray Schedule 80 PVC pipe frame with a photoplot-size bottom (0.5 m^2 or 1.0 m^2 internal dimensions) connected by 4 poles to the frame supporting the digital camera

        - Strobes mounted laterally and away from the camera can enhance lighting of the quadrats and reduce shadows
      - The best quality photographs are obtained by optimizing the ISO, aperture, and shutter speed. Most digital cameras take acceptable photographs when set to "auto", but make manual adjustments if needed
      - Remember that all quadrat images must be of sufficient quality to allow a positive identification and enumeration of the species in the quadrats
    - Estimate the percent cover of sessile species and algae within each quadrat. If sessile species are present in the form of layers, measure the thickness of the layer from the substrate to the top of the layer, and document the relative dimensions of the layers if these are present as distinct aggregations or patches
    - If time allows, identify (to the lowest taxonomic level practical), count and/or measure the size of mobile organisms (crabs and snails) captured either on the surface or under the rocks, and release them live; alternatively, place samples in plastic bags or jars and store in coolers. Preserve for identification in 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal) as soon as practical, and stain (such as Rose Bengal) if appropriate
- Sessile invertebrates and organisms less tolerant to direct cold air exposure, ice scour and wave action are likely to be found in crevices, which depending on their configuration, have the potential to retain oil. Sampling crevices can be challenging and is best accomplished by counting the number of organisms or the percent cover of sessile organisms within fixed plots. Since this type of sampling may be obstructed in deep or narrow crevices, assessments are to be made based on what is visible to the sampler.
- At some locations where localized impacts are obvious, it may be necessary to sample intertidal pools, which are operationally defined as depressions with persistent water >5 cm deep. Sampling the biota of intertidal pools is challenging because of the three-dimensional nature and highly variable size of pools. When sampling intertidal pools:
  - Treat individual tidal pools as the sampling unit and assess the composition (abundance and percent cover; as describe above) of the entire community within each intertidal pool
  - If a intertidal pool is too large to sample the entire pool, randomly place quadrats within each pool (the number of quadrats will depend on the size of the pool; 1-3 quadrats, preferred), and collect quadrat information as described above
  - Take photographs of individual pools from different angles using a photo scale as a reference
- It is important to remember that sampling boulder rocky shores requires a modification of standard rocky intertidal sampling procedures because the three-dimension scales of these habitats make quantifying algae and sessile invertebrates challenging. One approach to sampling boulder rocky shores is to treat individual boulders as the sampling unit and assess the composition (abundance and percent cover; as describe above) of the entire community within each boulder. Within boulders of similar size, randomly select a minimum of 3 boulders to be sampled.
- If tissue analyses are planned for mollusks, follow the Shellfish Tissue guideline. Briefly:
  - Wrap each individual specimen in pre-cleaned aluminum foil, and freeze the sample as soon as practical
  - Take care to avoid cross contamination during sampling and handling
  - Clean sampling equipment, such as shovels, between collections
  - Ship biological and sediment samples on ice overnight to the laboratory conducting the analyses, or as soon as practical
- Take oil samples, particularly in areas where rocky intertidal impacts are visibly obvious (see Stranded Oil guideline).

Sample Labeling and Record Keeping

- Verify that all samples are properly labeled, and that field sample forms are properly filled out.

- Follow chain of custody procedures for securing samples and complete chain of custody forms (See Chain of Custody guidelines).
- Complete the Chain of Custody form, noting where each rocky intertidal sample was collected, sampling equipment used, time/date of collection, size and container type, and sampler name.
- Make special notation on the Chain of Custody form about any problems or observations during sampling.
- Maintain strict chain of custody during sample storage and transportation.
- Record the sample number on both the sample jar label and lid. Record the following on the field sample form:
  - Sample collection site (NRDA sample grid ID and GPS coordinates)
  - Sample matrix (biota, tissue)
  - Sample #, date/time
  - Sampling method (quadrat)
  - Oiling conditions (using standard shoreline assessment terminology), tidal elevation, weather conditions, presence of biota, vegetation or debris, odors and other relevant information on the field data sheet
  - Grain size characteristics: grain size, texture
- All sample numbers must be unique. Use the sample number convention provided by data management if available. Otherwise, the sample number should consist of a sample team ID and sequential numbers. For example AKA-0001, AKA-0002, etc.
- Documenting oil distribution in rocky intertidal areas is best accomplished with photography, video, and good field notes and sketches using standard shoreline assessment methods. These data may be collected by SCAT teams and available to support environmental assessments. Samples may be needed for fingerprinting or monitoring weathering, to correlate a degree of oiling term with oil loading, to confirm the presence of oil, or for bioassay purposes.
- Make a quick sketch in a field logbook or sketch form showing the sampling locations in enough detail that the location could be re-occupied by someone else.
- Keep a detailed photo log so that each photograph can be labeled.
- Note any deviations from the recommended guidelines in the field book.

Sample Preservation, Recommended Holding Times and Shipping

- Follow chain of custody procedures for sample storage and shipping.
- Ship highly oil-contaminated samples separate from non-contaminated or low-contaminated samples to reduce risk of cross contamination.
- Immediately place all samples in cooler and keep at 4°C. DO NOT FREEZE samples preserved in formalin. Tissue samples for chemical analysis can be frozen.
- Freeze samples for chemical analysis as soon as practical or by the end of each day if samples are not going to be analyzed within 7 days of collection.
- Tape lids on sample bottles so that they do not accidentally come off.
- If possible, store samples from unoiled locations in one set of coolers, with oiled samples in a separate set of coolers.
- Use packing material, such as bubble wrap or sorbent pads, around glass jars to prevent breakage during transport and shipping.
- Ship samples directly to the laboratory as soon as practical with complete chain of custody forms. If necessary, samples can be stored under specified conditions and with complete chain of custody until they can be shipped. Assure that samples are packaged to protect them from breakage, shipping containers are sealed and use ice packs or dry ice to maintain storage temperatures during shipment to the lab.
- Ship any samples preserved in formalin or other chemicals as hazardous goods.

- NEVER discard any samples even if these have exceeded their recommended holding times or storage temperatures.

Analytical Methods

- Refer to those under Shellfish Tissue, Subtidal, and Intertidal Sediment guidelines

Key References

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Appendix A
Supporting Documentation – Field Data Form Examples

Unique field data forms may be included in the work plan if one has been developed, otherwise, use the attached form.

- Adapt the form as needed prior to use.
- Print the form on water-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with waterproof pen or permanent marker. Do not use pencil, or biro (erasable) ink.
- Make any additional notes that do not fit on the form in a field notebook and indicate the presence of associated additional notes on the field data form.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not erase or black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- Electronic versions of field data forms are available. Coordinate data entry with NRDA data management personnel.

Attached Forms:

- Beach Survey Field Data Form – 2 parts: Survey set-up, Surface quadrat

Rocky Intertidal Habitat Survey Field Data Sheet – Set-up (one per transect)

1 Date: ___ Time: ____ Site ID: _____ Team ID: _____

2 Data Recorder / Affiliation: _____

3 Other team members / Affiliations: _____

4 Transect ID: _____

Total Transect Length (m): _____

5 Front Stake/Mark Way Pt. # ____ Latitude (DD) _____ Longitude (DD) _____

Back Stake/Mark Way Pt. # ____ Latitude (DD) _____ Longitude (DD) _____

6 Distance from high-tide line to the midpoint of plots in each zone (m):

Supratidal ____ Middle Intertidal _____

Upper Intertidal ____ Low Intertidal _____

7 Photos

Front stake/mark looking inland: ____ Back stake/mark looking shoreward: _____

Front stake/mark looking right: ____ Front stake/mark looking left: _____

Offshore looking inland: ____

8 Plot-wide Substrate and Topography

Primary substrate type: _____ Secondary substrate type: _____

Maximum vertical relief (cm) _____

9 Oiling Impact Extent

Substrate surface oiling coverage (%): _____

Surface oil thickness (circle one): Thick Cover Coat Stain N/A

Surface oil character (circle one): Fresh Mousse Surface residue Tar Asphalt N/A

10 Transect sketch

Bearing to back stake/mark: _____

Drawing Legend	
FS	Front Stake
BS	Back Stake
----------	Transect
~~	Water line
□	Surface Quadrat
■	Subsurface Quadrat
○	Core Sample
X	Other sample

Note presence, condition, and/or altered behavior of visible biota such as chitons, bivalves, crabs, etc.

Rocky Intertidal Habitat Survey Field Data Sheet – Surface Quadrat (one per quadrat)

1 Date: ____ Time: ____ Site ID: _____ Team ID:

2 Data Recorder / Affiliation: _____

3 Other team members / Affiliations: _____

4 Transect ID: _____ Quadrat ID: _____

Quadrat Location: Supratidal/ High/ Middle/ Low Intertidal/ Quadrat Size (m^2): _____

Quadrat Photo: _____

Direction off transect (look landward): Left / Right Distance from Transect: ____

(looking from water towards shoreline)

5 Substrate type:

Primary: _____ Secondary: _____

6 Oiling Impact Extent

Substrate surface oiling coverage (%): _____

Surface oil thickness (circle one): Thick Cover Coat Stain N/A

Surface oil character (circle one): Fresh Mousse Surface residue Tar Asphalt N/A

7 Quadrat Flora Information

Photo Only Yes / No Photo file numbers: _____

Total vegetative cover (%): Total dead vegetative cover (%):

Species Name	Live cover (%)	Dead cover (%)	Additional Information:

8 Quadrat Fauna Information

Photo Only Yes / No Photos:

Species Name	Number, cover (%)	Species Name	Number, cover (%)	Additional Information:

Note presence, condition, and/or altered behavior of visible biota such as chitons, bivalves, crabs, etc.