Standard Operating Procedures (6.2): Terrestrial Invertebrates

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Standard Operating Procedures: Terrestrial Invertebrates

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate estuarine wetland habitat types (of those evaluated) to implement terrestrial invertebrate protocols is displayed in Table 1. The protocols (especially epigeal – close to the ground) are difficult, if not infeasible, in tidal habitats. A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations of terrestrial invertebrate survey protocols can be found in Appendix 6.2A.

Table 1. Appropriate habitat types for terrestrial invertebrate survey protocols.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Aerial traps			X	X	X	X
Pitfall traps (non-tidal)				X	X	X
Pitfall traps (tidal)		X	X			

Table 2. Categorical assessment of cost/effort and data quality for terrestrial invertebrate survey protocols.

	Evaluation Metric	Aerial traps	Pitfall (non-tidal)	Pitfall (tidal)	Notes
Time / Effort	Office Preparation Time	10-30 minutes	10-30 minutes	10-30 minutes	Need to prepare and label all Sticky Traps, cups, and identify survey locations
	Equipment Construction Time (one time)	0-10 minutes	10-30 minutes	10-30 minutes	Building tomato cages
	Field Time (per transect)	0-10 minutes	10-30 minutes	10-30 minutes	May be less time with 3+ people or unconsolidated soils; protocols may be implemented concurrently
	Laboratory Time (per transect)	> 60 minutes	> 60 minutes	> 60 minutes	Dependent on familiarity with species identifications and quantity of invertebrates; more than an hour if identifying to a low-level taxa (e.g., genus- or species-level)
	Post-Survey Processing / QAQC Time	10-30 minutes	30-60 minutes	30-60 minutes	----
	Minimum Repetition (site-dependent)	Many Repetitions	Many Repetitions	Many Repetitions	Invertebrate communities are highly variable
	Relative Cost (equipment and supplies)	> $15	> $15	> $15	----
Survey / Data Quality	Accuracy (at a survey area level)	Medium	Medium	Medium	----
	Precision (at a survey area level)	Low	Medium	Medium	----
	Qualitative-Quantitative Score	Quantitative	Quantitative	Quantitative	----
	Subjectivity-Objectivity Score	Objective	Objective	Objective	----

Resulting Data Types

The application of terrestrial invertebrate survey protocols will yield quantitative data displayed in biomass or productivity per square meter per transect for flying invertebrates. Data can be extrapolated up to habitat type. Pitfall invertebrate surveys are also quantitative and are useful to identify the

potential species composition, richness, and density of epigeal invertebrates in a given area; they can also be analyzed as biomass or productivity for a given area over time.

Objective

Terrestrial invertebrates are a vital component of wetland food webs and are indicators of the overall health of a system (Zedler 2001). Invertebrate-related ecosystem function has traditionally been measured by enumerating and identifying insects to the species level to calculate compositional biodiversity. In practice, such approaches are exceedingly costly, require extensive periods of sample interrogation, and therefore have resulting processing times on the order of many months to years for monitoring efforts with robust/frequent sampling plans. Logistically, simpler and more rapid measures that more directly describe functions or rates of arthropod productivity may be better indicators of ecosystem health (Anderson 2009). The high diversity of coastal arthropods, a lack of existing, complete baseline inventories, and the growing dearth of qualified invertebrate taxonomists also make traditional high-resolution taxonomically-focused terrestrial invertebrate assessments in this habitat expensive and challenging.

The primary purpose of this sampling method is to document aerial and epigeal (above soil surface) arthropod productivity (as biomass per unit area, or biomass per day) for each habitat or area by extrapolation from enumerated arthropods via length-fresh weight regressions. Taxa should be assessed in the pitfall traps by sorting to a higher taxonomic classification (e.g., order) or recognizable taxonomic units (RTUs) to facilitate the use of student and volunteer (non-professional taxonomic identification) assistance, but they can also be sorted to lower taxa by taxonomists. To meet previously identified concerns of local resource managers, these sampling methods include specific steps/elements to minimize any impacts upon non-target taxa (e.g., birds encountering sticky traps, coyotes ingesting pitfall traps). Sticky traps are routinely surrounded by tomato cages to deter birds from contacting the adhesive trap surface and have no statistical effect on the arthropod biomass accumulated by those sticky traps (Anderson 2010); similarly, plastic covers suspended just above pitfall traps deter ancillary catch of herpetofauna and small mammals in pitfall traps.

Equipment

General equipment and supplies needed for any terrestrial invertebrate surveys include:

- Plastic wrap
- Permanent ink pen (e.g., Sharpie) and duct or lab tape (for labeling the cups on the pitfall surveys)
- Bucket to hold supplies and pulled traps
- Datasheet(s) (Appendices 6.2B & C)
- GPS

Additional equipment and supplies for the aerial arthropod surveys includes:

Figure 1. Deployed and labeled aerial arthropod sticky trap.

- Sticky Strip yellow plastic insect traps ("Stiky Traps®" Tanglefoot-covered, Bioquip catalog #2873). Traps are supplied in 6 x 12 inch sheets and should be cut in half to produce 6 x 6 in sheets (or approximately 15 x 15 cm) with an area of 0.021 m^2 (Figure 1).
- Razor blade, box cutter, or utility knife to cut Sticky Traps in half. *Helpful Hint*: *use a dedicated, sharp blade. The Tanglefoot will get onto your blade and limit the value of that cutter for other uses. Cutting traps in half is also facilitated with a hard, straight edge such as a wooden ruler to guide the cutting blade. As with the blades, a dedicated guide capable of becoming contaminated with Tanglefoot is suggested. While scissors will work to cut a single trap, use of scissors is not recommended, as they rapidly clog with Tanglefoot and cease to function, leading to imprecise trap cutting*.
- Galvanized wire hoop Sticky Trap holders (Bioquip catalog #2874)
- Tomato cages, prepared in advance with ½ inch wide metalized bird-deterring mylar tape (e.g., TheTape Depot catalog #71858SLO001) attached (tied or stapled to itself) approximately every decimeter around the circumference of the cage (Figure 2).

Equipment and supplies for the epigeal pitfall surveys include:

- Marine-friendly, less-toxic antifreeze
- Plastic cups (preferred model; Solo Product# TP9-9oz.) with a 9cm diameter rim. *Helpful Hint*: *while the depth of the cup can be variable, the Solo TP-9oz. cups with a depth of 7.2 cm are preferred for consistency*. While deeper cups may be used, they require additional soil disturbance and do not yield any significant improvement in performance. These larger cups also entice field technicians to put excessive amounts of antifreeze into each cup, necessitating additional coolant use.
- Small plastic plates big enough to extend over the edge of the cups. *Helpful Hint*: *While any style/color plate will work, opaque colored plates which obscure the antifreeze-containing traps and reduce the attractiveness to curious carnivores are preferred*.
- *Alternative to plastic cups and plates*: 50 mL centrifuge vials with leak-proof screw cap lids. Note: the opening will be much narrower with less likelihood of consistent invertebrate capture. This method is one of the alternate tidal survey options ("Method 2").
- Rubber bands
- Hand gardening trawl

Figure 2. Deployed tomato cage with metallic ribbon and green wire.

- Nails, screws, or coated wire (14 gauge, in ~20 cm segments)
- Fabric and garden staples (optional with alternate "Method 1" and "Method 2")

Laboratory equipment and supplies:

- 500 μm Geological Sieve (= ASTM Sieve Size 35; = Tyler Mesh Size 32) or 300 μm for intertidal
- Tweezers, scoops, small spatulas and/or additional laboratory utensils
- Dissecting scope and light source
- Invertebrate identification books and/or manual (e.g., PIRatE and TBF Coastal Salt Marsh and Coastal Strand Pitfall Invertebrate Key V3.0, 2014)
- Small ruler or calipers
- Hand counter (optional)
- Petri dish(es)
- Squirt bottle filled with 70% ethanol and funnel (optional)
- Glass vials or jars and Parafilm (Model# PM-996) for storage. *Helpful Hint*: the smallest size container for long-term sample preservation is desirable. This will vary depending upon your site, but a safe initial purchase will be 4 oz. wide-mouth glass jars (for larger individuals or abundant captures) and 20 mL vials (for depauperate captures)
- Laboratory labeling tape (colored – optional)
- Magnifying glass or hand lens

Field Preparation

The tomato cages should be prepared in advance by using the small gardening wire to wrap strategically through the largest holes (if present) to reduce the possibility of a bird flying into the tomato cage. Distance between the wires should be approximately 15 cm (6 inches) or less. Additionally, several small pieces of the metallic ribbon should be tied or stapled to itself around both the top and middle of the tomato cage (Figure 2). These will also act as bird deterrents. The direct from factory Sticky Traps should be cut in half prior to field deployment, and both Sticky Traps and pitfall trap cups should be labeled in advance with location (e.g., site name and transect number), deployment date, and replicate (e.g., 1-3 for each transect).

Equipment described should be collected prior to the field shift. Batteries for all electronic devices should be checked and replaced as needed, and relevant data sheets should be printed.

Field Methods: Aerial Arthropod Traps

Aerial arthropod traps for any given vegetation transect should be deployed in replicate. Specific transect selection should follow the same randomly allocated vegetation transects within each of the marsh habitat types (see Vegetation Cover SOP 3.2 for details on randomly allocating transect locations). Traps should be placed in conjunction with the pitfall traps (within 1 m, see Figure 3, below).

1. Label each trap using a permanent ink pen with the individual transect number, date deployed, and replicate (i.e., 1, 2, or 3) along the transect (Figure 1).

2. Deploy three sticky traps equidistant along 30 m transects, which extend 2.5 meters past the start and end of the 25 m vegetation transects (Figure 3). Note: when conditions are particularly windy (i.e., >40 KPH or 25 MPH) for extended periods of time, the plastic Sticky Traps may crack at the wire holder. It is best to avoid deploying traps under these conditions. But if trap deployment cannot be forestalled, deploy an additional replicate (n=4) may be deployed to assure that the sample size is not limited by wind impacts to the traps.
    a. Each Sticky Trap should be placed so the lower edge of the sheet is approximately 5-10 cm above the uppermost surface of the substrate (e.g., the soil surface of unvegetated salt pans) or vegetation canopy (Figure 1). In cases of short or sparse vegetation, the insect trap should be set approximately 10 cm above the bare ground to avoid potential inundation or entanglement with blowing plant stems (Ambrose et al. 2006, Anderson 2009). Traps should never be placed such that the lower trap edge is suspended more than 15 cm above the highest surface. Placing traps too high will significantly reduce the diversity and abundance of the capture and artificially lower productivity estimates. Assure that any stray plant stems are trimmed such that wind gusts will not blow vegetation onto the Sticky Trap surface.

Figure 3. Deployed invertebrate transect. Grey PVC pole is the end of a vegetation transect.

    b. If birds are present in the sampling area, place a tomato cage with reflective tape over the deployed sticky trap to deter bird activity. As with plant stems, assure that the reflective tape will not contact the trap surface before concluding deployment.
3. Leave traps out for four days (deployment times of 3-6 days produce statistically indistinguishable results when standardized for days of deployment; Anderson 2009). While four days is the default deployment time, the ultimate goal is to accrue maximum saturation of the trap surface area by arthropods. Using an *a priori* assumption or previous field survey site knowledge, deployment should tend towards three days where arthropods fairly are abundant. In situations where arthropods are scarce, deployment should tend towards six days.
4. Upon collection, wrap the traps with clear plastic film (i.e., "Saran™ Wrap") and return them to the lab for processing. Care should be taken to stretch the plastic film taut and maintain a smooth surface over both faces of the trap (a wrinkle-free plastic covering will greatly speed the subsequent lab processing of the traps). This clear film prevents additional items or sediment from getting stuck upon the trap surface, allows traps to be stacked without sticking to one

another, and allows rapid processing in the laboratory.

5. Traps should normally be processed within 10 days of collection (see Laboratory Methods section), however if the trap surface was wet (e.g., collected in heavy fog or dew) when collected and filmed, processing should occur immediately (within three days). Wet traps/arthropods will decay rapidly, particularly during warm summertime conditions.

Figure 4. Deployed pitfall trap with antifreeze (top) and covered by a plastic plate (bottom).

Field Methods: Pitfall Traps

Epigeal pitfall traps should be placed along the same randomly allocated vegetation transects within each of the marsh habitat types (see Vegetation Cover SOP for details on randomly allocating transect locations). Pitfall traps should be placed in conjunction with the aerial Sticky Traps (within 1m, see above). Generally, the pitfall traps using the cup method should not be deployed in the lower marsh/intertidal zone (see "centrifuge method", below for intertidal deployment strategies). These two methods can be extrapolated up by area for analyses but may not provide complimentary data.

1. Label the side of each trap (cup) using a permanent ink pen on a strip of duct tape with the individual transect number, date deployed, and replicate (i.e., 1, 2, or 3) along the transect.
2. Deploy three to four pitfall traps equidistantly spaced along 30 m transects, which extend 2.5 meters past the start and end of the 25 m vegetation transects. Be consistent across all transects and normalize to survey area based on the number of traps.

a. Dig a small hole in the surface of the sediment to the depth of and slightly wider than the rim of the cup using a hand trowel. Place excavated soil to the side for use momentarily.
b. Sink the cup into the excavated hole. The rim should rest 1-3 millimeters lower than the surrounding soil surface but avoid spilling sediment into the trap itself. Should any sediment fall into the cup, remove the cup, empty the soil, and repeat the deployment.
c. Pack the extra (removed) sediment into the space between the edge of the excavated hole and the cup's rim to create an unbroken soil surface such that invertebrates will experience no gaps/cracks before the encounter the rim of the cup itself (Figure 4). *Helpful hint*: stack two cups and insert them together into the hole, adjust the sediment, then pull the top cup out, leaving the bottom cup clean (devoid of sediment) and flush with the soil surface.
d. Pour 1-2 cm of antifreeze into the base of the cup to act as a euthanizing medium which will not evaporate under excessive summertime/direct sunlight conditions.
e. Cover the cup with the plastic plate suspended 2-4 cm above the soil surface by pushing

the nails/screws/wire through the plate and into the sediment until the appropriate height is reached, allowing invertebrates access but deterring larger animal tampering.

3. Leave traps out for four days (deployment times of 3-6 days produce statistically indistinguishable results when standardized for days of deployment; see notes for Sticky Trap deployment duration; Anderson 2009).
4. Upon collection, pull the cups out of the soil, replace the soil, cover the traps with Parafilm or a clear plastic film secured with a rubber band, and return to the lab for processing. Care should be taken to avoid spilling the samples or the antifreeze.
5. Traps should be processed within 3-5 days of collection (see Laboratory Methods).

Field Methods: Pitfall Traps in Intertidal Zones (Alternate Deployment Method)

As indicated in the previous pitfall deployment methods, it is difficult or infeasible to use the aforementioned procedure in the lower marsh areas and intertidal zones. These pitfall traps would be completely inundated with water from the incoming and outgoing tides, spilling the contents into the marsh. Due to the difficulty of collecting data, this zone is often overlooked. There are two potential methods to collect quantitative data of terrestrial invertebrates in the intertidal zones.

The first method (see "Method 1: Cup Removal," below) is very similar to the non-tidal habitat pitfall trap deployment but requires much more significant effort regarding timing around the tides (pulling and placing daily or semi-daily). Care should be taken to account for the exact deployment times to allow for cross-habitat evaluations of biomass or productivity. Only the revisions to the standard deployment method are included below and should be combined with the pitfall trap deployment methods found above.

The second method (see "Method 2: Vial Deployment," below) is essentially a combination of the two deployment methods previously discussed for pitfall traps but uses a different trap and smaller holes. It also requires an extra deployment step. Similarly to "Method 1," only the revisions to the standard deployment methods are included below.

Method 1: Cup Removal

Revisions to 2a: Begin to deploy traps while the tides are falling (deploy highest elevation areas first and follow tides down the elevation gradient). To maximize deployed time, begin trap placement as soon as the soil is no longer completely submerged. Place each cup using the same strategies as the non-tidal pitfall methods. Dig a small hole in the surface of the sediment to the depth of and slightly wider than the rim of the cup rim using a hand trowel. Place excavated soil to the side for use momentarily.

Revisions to 2c: If the cups begin to rise due to the soil still being saturated with water, use small stakes to hold them into the ground (Fabric and Garden Staples work well).

Revisions to 3: Try to leave the traps out for 4-6 hours in the same tidal period or until the tide rises to the elevation of the transect, then cover and remove. Replace as described in "revisions to 2a," above.

Repeat daily or semi-daily matching the tide pattern; try to achieve a similar deployment time as the 3-6 day time frame of the standard pitfall deployment method. It is helpful to have an in-depth understanding of the local field conditions regarding inundation times within the survey area.

Method 2: Vial Deployment

Revisions to 1: Additionally, on the first deployment day, fill each vial to the rim with water to minimize the air in the container; then, screw the lid on tightly.

Revisions to 2c: Additionally, use stakes (Fabric and Garden Staples) to help hold the vials down in the ground and to prevent the traps from rising with the incoming tide. Leave the traps deployed (closed and full of water) until the following day. This minimizes the disturbance from creating the holes.

Revisions to 3: Once the tide has fallen below the elevation of the transect, return to the survey area, remove the stakes and water from the vial, and replace the vial in the ground with antifreeze (uncovered). If the vials rise from soil saturation, use the stakes to hold them down. Try to leave the traps out for 4-6 hours in the same tidal period or until the tide rises to the elevation of the transect, then cover and remove. Replace as described in "revisions to 2a," above. Repeat daily or semi-daily matching the tide pattern; try to achieve a similar deployment time as the 3-6 day time frame of the standard pitfall deployment method. It is helpful to have an in-depth understanding of the local field conditions regarding inundation times within the survey area.

Laboratory Methods: Aerial Arthropod Traps

Processing of the aerial traps (Figure 5) follows methods developed by Dr. Sean Anderson, California State University Channel Islands / Pacific Institute for RestorATion Ecology (PIRatE Lab):

1. All individual invertebrates should be counted and classed by size (anterior-posterior length) into one of five operationally-determined categories: <0.5 mm, 0.5-2 mm, 2-5 mm, 5-10 mm, or >10 mm and recorded on the appropriate datasheet (Appendix 6.2B). *Helpful hint:* for traps with high numbers of individuals, use a permanent ink pen to divide up the trap into quarters or other convenient subdivisions and count each subdivision separately. It may be beneficial to use a magnifying glass to count the smaller invertebrates.

Figure 5. Aerial sticky trap ready for processing.

2. Aerial arthropod biomass is estimated by extrapolation based on weight and number of individuals per size class, according to the following formula and length-fresh weight regressions by size class (S. Anderson, pers. comm. 2009):

   (# of arthropods in size class Y) x (fresh weight regression multiplier for size class Y in g) x (trap area in m^2) x (duration in days) = productivity of size class Y

3. Multiply the number of arthropods in a given size category by the average fresh weights and sum to produce total productivity in the form of grams of arthropods per m^2 per day.
4. Each Sticky Trap (front and back together) is considered a single trap (i.e., a single spatial plane through which insects passed).
5. Multipliers for estimating arthropod productivity:
   a. <0.5mm: mean individual fresh weight = 0.0000079g
   b. 0.5-2mm: mean individual fresh weight = 0.0002738g
   c. 2-5mm: mean individual fresh weight = 0.0009839g
   d. 5-10mm: mean individual fresh weight = 0.0081993g
   e. >10mm: mean individual fresh weight = 0.097621g

Laboratory Methods: Pitfall Traps

Processing of the pitfall traps (Figure 6) follows methods developed by Dr. Sean Anderson, California State University Channel Islands / PIRatE lab and The Bay Foundation:

1. Separate all individual invertebrates from the antifreeze by pouring all material out of the sampling cup through a 500 μm sieve. If analyzing terrestrial invertebrates from the intertidal habitats, use the 300 μm sieve. *Helpful hint:* if done using a funnel, the first pour of the antifreeze can be reused to reduce waste. Antifreeze may be reused for an extended period if care is taken to avoid excessive accumulation of dirt and other contaminants.
2. Repeatedly rinse remaining sample with distilled water until only debris (too large to fit through the sieve) and invertebrates remain in the sieve. Keep in mind, the water that comes through the sieve is considered biological waste and should be disposed of according to individual laboratory hazardous waste disposal protocols. As such, care should be taken to minimize excessive rinsing.
3. If ancillary catch is present in the sample (e.g., juvenile lizard), it should be stored as a voucher specimen for the site or disposed of at the discretion of the

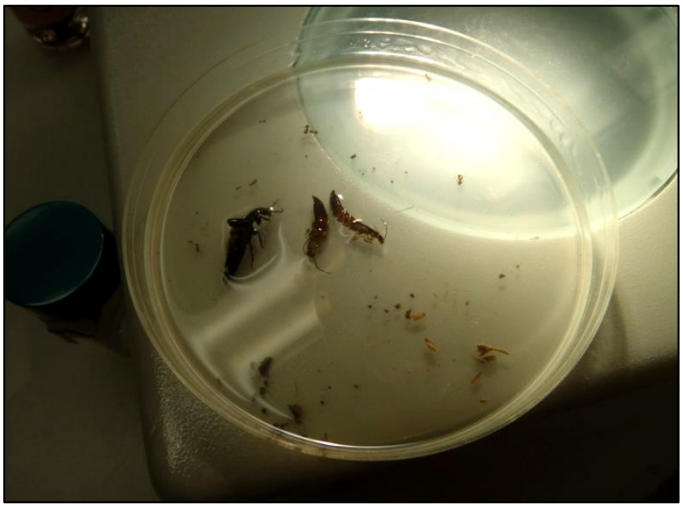

Figure 6. Representative pitfall sample in ethanol.

project manager (after first being measured, photographed, and identified). Such ancillary catch may require a formalin preservation in contrast to the normal ethanol-based archiving.

4. Using tweezers, scoops, small spatulas and other laboratory utensils, separate invertebrates from debris, rocks, and remaining sediment. *Helpful hint:* remove the largest debris first, check for attached invertebrates, and dispose of properly before pulling inverts off the sieve mesh.
5. Place invertebrates into label glass vials and cover completely with 70% ethanol. Seal vial with a layer of parafilm.

Identification of the invertebrates:

6. All individual invertebrates should be placed in petri dishes (Figure 6) and grouped into the lowest possible taxa (to a minimum of Order, but higher resolution if possible) using invertebrate identification books, manuals (e.g., PIRatE Coastal Salt Marsh and Coastal Strand Pitfall Invertebrate Key V2.0, 2013), and online identification resources (e.g., www.bugguide.net). Dissecting scopes (or higher power scopes) and light sources are recommended to identify minute anatomical features of each taxonomic group (Figures 7 and 8). Larger specimens may be identified using a small magnifying glass.

Figure 7. Charles Piechowski using a dissecting scope to identify and measure pitfall invertebrates.

7. The number of individuals in each taxon should be counted. In addition, a representative size class estimate (approximate mean) and a maximum size should be recorded for each group (see Appendix 6.2C for a copy of the datasheet).

Figure 8. Photo of a scavenger beetle taken under a dissecting scope (Photo: Maria Wong).

8. Completed samples are placed back into a glass vial, covered with 70% ethanol, and labeled as complete along with sampler technician's name and completion date.
9. Epigeal invertebrate biomass is estimated by extrapolation based on weight and number of individuals per size class, according to the following formula and length-fresh weight regressions by size class (S. Anderson, pers. comm. 2009):

(# of arthropods in size class Y) x (fresh weight regression multiplier for size class Y) x (area) x (duration) = productivity of size class Y

10. Multiply the number of arthropods in a given size category by the average fresh weights and sum to produce total productivity in the form of grams of arthropods per m^2 per day.

Data Entry and QAQC Procedures

Data should be entered in the laboratory using the appropriate data sheet (Appendices 6.2B and 6.2C). All required fields should be completed in full, and the data recorder should assign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server nightly. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets, Chain-of-Custody forms, and field notes are filed appropriately with electronic back-up copies available. QAQC should verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified.

Extensive QAQC should be conducted on every twentieth completed pitfall and flying arthropod sample to ensure accuracy of taxonomic identifications and size class estimates. The sample should be reprocessed, discrepancies corrected, and the initial technician notified. Additional QAQC of samples sorted by that technician should be repeated at the discretion of the QA Officer, and the technician may be required to go through the laboratory training again.

Data Analyses

After data have been entered, corrections made, and QAQC procedure completed, data can be used in multiple analyses. Examples include graphs of biomass or productivity by habitat or assessments of individual transect or area biomass and productivity. Each pitfall trap should be analyzed independently.

Health and Safety Precautions

Extreme caution should be taken to ensure no anti-freeze is spilled on wetland soils or disposed of improperly in the laboratory.

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APPENDIX 6.2A

	Evaluation Metric	Aerial traps	Pitfall traps (non-tidal)	Pitfall traps (tidal)	Notes
	Correlation to L2 CRAM	Not Applicable	Not Applicable	Not Applicable	Loosely tied to biotic metrics
Personnel Requirements	Specialty Equipment or Clothing Required	Few Specialty Items	Many Specialty Items	Many Specialty Items	Sticky traps, microscope, tomato cages, antifreeze
	Ease of Transport (amount or weight of supplies)	Many or Heavy Items / Difficult	Many or Heavy Items / Difficult	Many or Heavy Items / Difficult	Primarily for the tomato cages and collection of the processed samples, which can be bulky
	Ease of Implementation	Easy	Easy	Difficult	Tidal requires frequent checks
	Expertise / Skill Level	Some Technical Knowledge	High Technical Knowledge	High Technical Knowledge	No technical knowledge required for field implementation; Familiarity with species identifications is required for laboratory processing
	Number of Personnel	2	2+	2+	Two personnel are fine, more increases speed
	Training Requirements	Some	Some	Some	Familiarity with taxonomic identifications as required; may be necessary for laboratory processing
	Seasonality of Survey Time	During peak productivity	During peak productivity	During peak productivity	May be performed in conjunction with vegetation surveys to capture site conditions concurrently
	Suggested Frequency	Annual	Annual	Annual	Or semi-annual; project-dependent
Survey / Data Quality	Type of Output	Numerical	Numerical	Numerical	----
	Active or Passive Monitoring Style	Active	Active	Active	----
	Specialty Computer Software Required	No	No	No	----
	Availability of Online / External Resources	Some	Some	Some	----
Potential Limitations	Wetland Type Applicability	All	All	All	----
	Images or Multi-Media Required	Images Suggested	Images Required	Images Required	Voucher photographs recommended
	Degree of Impact / Disturbance	Low Disturbance	Moderate Disturbance	Moderate Disturbance	Soil disturbance will be required
	Vegetation Height Limitation	Overhead	None	None	Must be able to place the sticky trap above highest vegetation
	Appropriate for Tidal / Wet Habitats	Yes	No	Yes	See tide height for aerial surveys
	Tide Height	< 2 feet	Not Applicable	Full	High tide level must be below sticky trap
	Regional or Broad Implementation *	Infrequently Used	Infrequently Used	Infrequently Used	** based on monitoring literature review*
	Potential for Hazards / Risk	Medium Risk	Medium Risk	Medium Risk	Tanglefoot and antifreeze
	Restrictions	Special Status Species	Special Status Species	Special Status Species	----

APPENDIX 6.2B

FLYING INVERT DATASHEET

Sampling Program Information		
DATE:	STAFF:	**FID:**
TIME (start):	(end):	**SAMPLE DATE:**

TRAP 1 (front)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

TRAP 1 (back)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

Morphic Species

TRAP 2 (front)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

TRAP 2 (back)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

Morphic Species

TRAP 3 (front)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

TRAP 3 (back)

SIZE CLASS	COUNT	SPECIES:	COUNT:
(~0.5 mm):		SPECIES:	COUNT:
<2 mm:		SPECIES:	COUNT:
2-5mm:		SPECIES:	COUNT:
5-10mm:		SPECIES:	COUNT:
>10 mm:		SPECIES:	COUNT:

Morphic Species

APPENDIX 6.2C

Terrestrial Invertebrate Pitfall Trap

<u>Staff:</u> <u>Date:</u> <u>Time</u>

Start: End:

Date Collected	FID	Taxonomy					Max Length	Average Length (mm)	Count	Notes	Voucher #
		Order	Superfamily	Family	Genus	Species					