DRAFT Coastal Marten: Areas of Interest Survey Protocol

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Background: Protocol was created by M. Linnell and K. Moriarty in 2015 (published within Moriarty et al. 2016, Northwest Naturalist; Moriarty et al. 2018, Wildlife Society Bulletin), adapted to Olympic marten surveys during 2016-2017 (Moriarty et al. in press). Modified surveys and protocol refinement have been executed by B. Barry (within Barry 2018, MS thesis). J. Golding and J. Tucker are contacts for the proposed National Forest Carnivore Center for Research and Monitoring. An interim, statistically robust protocol will be upcoming through the Forest Carnivore Center.

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Objectives and Justification
This protocol seeks to provide a flexible methodology for opportunistic coastal marten surveys while remaining systematic and standardized within Oregon. Large portions of coastal Oregon have been previously surveyed using systematic surveys dating back to 2014. Nonetheless, these surveys were not designed to specifically address questions of stand scale occurrence, abundance, or inform fine-scale management practices. Humboldt marten (Martes caurina humboldtensis) is a subspecies of the Pacific marten found in coastal northern California and Oregon, and is proposed for listing as federally threatened under the Endangered Species Act. Historically, coastal martens were found throughout coniferous forests in the coastal ranges of
Oregon and California (Grinnell and Dixon 1926, Zielinski et al. 2001). A lack of reliable information on the current distribution and status of coastal marten populations poses a significant challenge to conservation efforts.

We sought to establish a framework that addresses information needs by surveying within an area of interest (e.g., a project area, a region) while providing a platform for combining data into a common repository and allowing for additional monitoring.

**Study Design**

This survey protocol is predicated on identifying presence of marten by deploying cameras or track plate boxes at a scale smaller than an anticipated home range. Marten home ranges within coastal shrub forests of the Oregon Dunes National Recreation Area are small (females= 0.8 km², males 1.5 km²) and the density (1.13 per km²) is the highest reported for North American marten populations (*M. caurina, M. americana*) (Linnell et al. 2018). We sought to deploy cameras at a scale that would, in theory, place multiple sets of paired cameras within an approximate home range (~1km²). This intensive surveying should increase the possibility of detecting marten presence, but would be difficult to execute at large scales. To rectify these discrepancies our sampling approach is dependent on the use of intensive focal sampling within designated Area of Interest (e.g., a project area). These surveys would be best paired with broad surveys spaced greater than a home range apart and more detection devices.

**Regional Surveys for Monitoring**

A design is being developed by the USDA Forest Service National Forest Carnivore Center for Research and Monitoring with collaboration with Region 6, 5, 4, and 1 (USFS), BLM Oregon/Washington, and NCASI. Current proposals include using an EPA identified watershed (HUC-12) as a sampling framework. For surveys in these areas, we strongly urge surveys to include labeled aluminum tree tags to monument camera locations. Such information is invaluable for future monitoring.

**Focal Surveys**

We identified locations within an Areas of Interest to be opportunistically surveyed. These areas may include places where previous surveys did not examine or in places where survey effort was considered to have been low. Areas of Interest are variable in size, ranging from forest stands to management units to small landscapes. Ideally, such surveys could integrate into regional monitoring in the future. To do so, we need some similarities in protocols (e.g., a minimum sample duration), knowledge of survey locations, results (occurrence, non-detection), and raw data. Surveying with a camera or two is valuable – such data can inform future efforts. Nonetheless, if you want confidence in your results - aim to deploy cameras in multiple places, saturating an area within reason given constraints (e.g., >300m between sample units).

Although statistical occupancy modeling suggests detectability increases over time – increased duration is NOT a substitute for space in reality! Increasing the number of stations throughout the survey area is highly beneficial because these carnivores are territorial and strongly associated with specific sites within their range.
Connectivity and distribution (Summer 2019)
An additional goal of these surveys is to establish whether known detections of martens in the southern coast range have evidence of metapopulation connectivity. To achieve this goal, we will be adding glass colored beads (<1mm in diameter) or edible glitter (cellulose-based) to camera bait sets in areas with confirmed detections. Subsequent scent detection dog surveys will locate scat within these known populations and the presence of the colored beads or glitter can help to determine whether dispersal between detection clusters is occurring.

Sample unit placement in the field
We used a random point layer with a minimum of 750m spacing between points within the boundary.

A sample unit consists of a two baited camera traps spaced 100-200m apart and sample units are buffered by 300m from both stations as set. This buffer around the actual stations set (not theoretical random) should allow for sample units to be separate (not touching), and would represent an estimated maximum distance for consistent influence by the long-distance olfactory lure. Station 1 is the random point location provided, and Station 2 will be determined by random compass direction and distance (between 100 and 200m) barring terrain, accessibility, and logistical concerns. Do NOT go straight back to the truck – random means random!

Each of the stations may be placed in an area that appears to be “suitable” (or areas with local cover) identified by the surveyor, as long as the location is within 50m of the designated location. All stations should be >100m from campsites and lakes, >50 m from trails, >75m from a road and out of sight from trails, campsites, and the general public (as per wilderness permits and to deter camera theft).

Identify the sample unit to be surveyed using the GIS layer, aerial photographs, and maps depicting recent road and trail operability. Create an access plan to get to the location and have appropriate gear (see Table x).

Every effort should be made to access the sample unit but circumstances may require offsetting stations from their original locations.

Sample unit abandonment:

1) If the sample unit occurs entirely on private property without permission to access or if private property must be crossed without permission to access the sample unit.
2) If the sample unit occurs in extreme terrain, >35° slope, or requires crossing a large river or water body. Do not climb mountainous terrain that would require ropes or other safety equipment.
3) If the closest station to a road or trail is >1.5 km or requires hiking >3km on a road or trail.
4) If coastal tides make the access to and from the station hazardous to the crew.
5) Any other reason where the safety of the crew is a concern or the equipment is at high risk of being stolen, broken, etc.

Moving a station or the sample unit.

The flexible nature of the protocol should limit access issues; nonetheless, problems may arise where a station(s) need to be moved. Note that every location within the random point layer does not need to be surveyed or moved so as to be available to be surveyed. If random point locations fall outside of plausible habitat such as open sand, urban development, or water they may be dropped instead of moved. Moving stations should be done in the following way:

1) Offset station 100m in a random direction. Randomize by spinning the dial of the compass for ~10 seconds. Vary spinning using long and short spins. If that is not sufficient:
2) Offset 201—560 m in a random direction. Again, use a compass to randomize direction. Randomize distance by spinning compass and adding 200 m to randomized compass bearing.
3) If the station is still located in dangerous terrain, abandon the sample unit. Instead sample an alternate unit.

Sampling duration
Each sample unit should be operational for a minimum of 27 days based on initial latency of first detection (Moriarty, unpublished data, 2014-2018; Barry, preliminary analysis). Similarly, an analysis for predicted occupancy was completed in northern California suggesting >21 days (K. Hamm, Green Diamond and T. MacDonald, West, Inc; unpublished data). The deployment period may be longer. Periods >60 days are warranted for obtaining fisher detections (Sweitzer et al. 2016, Barry, unpublished results). Ideally, each camera will be checked at least once, approximately 1-3 weeks following set up of all available camera units. One initial check is desirable to ensure that cameras are operating appropriately, camera sensitivity is not too high or low, and there are no bear issues. With bear issues, extend the survey (as possible) to obtain a minimum of 27 days or we risk not using that station for future analyses. Sample units deployed in more difficult areas may not be checked if there are accessibility or logistical concerns.

If a marten is detected and surveyors are interested in collecting genetic samples, please see the genetic sampling section appendix. Send hair and scat samples to the National Genomics Center for Wildlife and Fish Conservation, USDA Forest Service, Rocky Mountain Research Station. Coordinate with their lab manager before sending samples. Samples must be labeled (location, date, contact information) and kept dry (e.g., dehydrate, use desiccant). Samples may cost $30-$100 for processing depending on the task.

Kristine Pilgrim
National Genomics Center
Detailed station setup

**Suggestions:**

- Test cameras prior to deployment. Make sure the date and time are set, SD card is formatted, and batteries are fresh. All cameras had their gaskets cleaned and lubed with a silicone grease. Cameras were tested with a light water spray to ensure they were water resistant and capable of collecting data during winter months.
- Screen random point locations with satellite imagery or aerial photography to ensure that locations fall within forested or shrub covered areas, and not in open sand, urban development, roads, etc. Identify random point locations that may need to be moved (see Moving a Station or the Sample Unit) or dropped.
- Turn on GPS prior to arriving in dense canopy cover or overhead shrub cover. This will improve accuracy of the GPS and facilitate accurate placement of the station.
- Prepare for camera set up scenarios. Carry metal stakes, tree brackets, and straps to enable set up of camera traps (Table 2).
- Train field personnel to standardize distance measurements with readily available metrics, such as stride length, e.g. measure number of strides to reach 1-2.5 m, the standard suggested distance between camera trap and bait at baited sets.

**Station Setup**

Navigate to station UTM using map, compass, and GPS.

Place the camera and baits low to the ground and in micro-sites with cover. Low sets may increase effectiveness, presumably because smaller carnivores may disproportionately use dense cover. Sets may be placed along a game trail or log, in an area with high local ground cover (>50%). Think about being a National Geographic photographer while setting cameras. What would the public see from your image? Does it capture the area? A log? Take a moment to look through Jonny Armstrong’s portfolio (OSU professor and camera trap extraordinaire) as an example to be inspired.

**Macro-sites placement**

- Navigate to as close to the theoretical UTM as possible. Select a camera set location within 50 m of the theoretical point in an appropriate area as described below. Look specifically for areas that would increase marten detections (e.g., dense cover, logs).
• Stations should be located >100m from campsites and lakes, >50 m from trails, >75m from any road, including un-maintained roads. Ensure that the camera, flagging, and any other material at the station is not visible from roads, trails, campsites, or to the general public.
• Where possible, stations should be placed in the shade. Avoid placing the camera in full sun, or a mix of full sun/shade. Strong contrasts in lighting can be challenging for cameras and may cause false triggers.
• Avoid placing stations in areas with little to no airflow (tight draws, slot canyons, etc.) or move olfactory lure both next to the camera and higher on the ridge. The smell of the bait/lure may be attracting animals, but it’s ideal to set near the intended location.
• Monument the camera tree with a tree tag, installed near the base of the tree ~2—3 feet from the ground avoiding obstructions.
• Record a GPS coordinate at the camera tree. Preferred GSP coordinate system is WGS84.

Micro-site placement and camera set up
• Identify a group of trees or thick shrubs with a potential bait tree or large shrub and a camera tree or large shrub. The grouping should allow the camera to face generally north (aspect of ~330 to 30 degrees) to reduce false triggers and backlit photos.
• Snags should be avoided when possible for safety reasons.
• Use either a strong tie attached to a log (log must fresh and not rotten or soft) or tree with the camera attached. Cameras (e.g. Reconyx, Moultrie, Browning, Bushnell) should be placed 1.5-3.0 m (~4.5-9.0 feet) from the bait and be placed 0.5—1m above ground level. Ensure the photo captures some of the ground at the base of the tree, if it doesn’t try to move the bait to a different set of trees.
• Make an effort to keep all smells off the cameras such as bait or lure. If working in teams have one partner work at the camera station and one at the bait station; maintain these roles throughout the day. If working solo, set up the bait station first and wear gloves when setting the camera, making sure not to touch the bait/lure and then the camera.
• Optional: Attach a piece of Coroplast (15cm x 30cm) above or to the top of the camera to act as a roof and reduce the amount of rainfall directly to the camera. Ensure that this does not make the camera inoperable over time by making sure the height is well above the frame so if the A-frame or platform collapses with snow, it does not change camera view.
• Identify tree adjacent to a features that increase marten detections (e.g., dense cover, logs) to place the bait on. If there is no tree, identify a shrub and try to find a gap with a small animal run through it, make sure the gap is >20cm. Place the bait 0.5m above ground height (about knee cap height) such that a marten can reach it but smaller mammals cannot without climbing, ideally on the side of the log or tree.
If placed on a shrub stem, use bailing wire to wrap around the narrow end of the chicken drumstick and cat food can. Place signage and a measure strip as possible within the camera frame.

- Do your best to ensure the ground is captured in the frame in addition to the sign, measuring strip, and some of the adjacent area (Fig. 3). If a marten walks by – ensure your set can detect it!
- Sets will be baited with a combination of catfood (wet, fish flavored) and an olfactory lure (Gusto, Minnesota Trapline Company) mixed with glycerine (1:1 ratio).
- Take “station photos”. Station photos should be taken from next to the bait tree and in the four cardinal directions using the digital camera. Move your body position so that the camera tree does not take up an entire photograph. The last photo should be facing straight up and can be used to inform canopy cover later. These are helpful for others to find the station and for examining conditions on the ground.
- Final step: After camera and bait are both set, test camera sensitivity and orientation to bait. Turn camera to ON, move to immediately adjacent to bait. Move your hand and forearm (hinge at the elbow) up and down at moderate speed in the area 30 cm above and below the bait. Repeat for 30 seconds. Check images recorded during the 30 second period. If functioning properly, the camera should have triggered 2 times, resulting in 6 images (2 triggers, 3 photos each). All images should have been triggered by the motion of the hand and forearm and not by any other body movement. Move the camera as close as 1.5m from the bait tree if no images were recorded. Repeat camera testing. If no images record, replace the camera.
Figure x. Example of baited set, including measurement strip. Note the bait is low to the ground, the ground is visible, and the camera is facing an area that allows a full spectrum if a marten walks by but does not investigate the bait.

Camera Station Set Up
Camera Settings: For initial set up, we have used the following settings:

- CAMERA MODE: set to camera, not video
- IMAGE SIZE: 8MP. Yes, some cameras have lots of megapixels but the sensor is likely still small. Keep <14 MP unless you want >8x10 printed. If you have an animal that reoccurs in a wonderful spot, then you can increase the resolution.
- TIME STAMP: should be ON and checked every visit to ensure date/time stamp accuracy.
- SENSOR SENSITIVITY: set to “NORMAL”; set to “HIGH” if camera does not trigger during test.
- CAMERA DELAY: set to 10 seconds
- LED CONTROL: set to either “LOW” or “MEDIUM”; check for washed out photos
- PHOTOS PER EVENT: 3 photos per triggered event. Set to 1 photo if this option is not available or if you anticipate many photographs of non-targets based on previous surveys.

Measuring strip – Martens are sexually dimorphic and males can be distinguished from females by measuring total body length. In camera trap photos, marten body length can
be measured using a measurement strip placed vertically adjacent to the bait. The measuring strip is a 1cm wide piece of yellow polystrapping that is 60-100cm long and has alternating reflective and sharpie bands every 20cm such that it is divided into 10cm increments. Use square U nails or staples to secure the polystrap, covering sharpie lies.

**Signage** -- Use a piece of polyboard and sharpie to write the station label: County (4-letter code) – Sample Unit ID – Station Number. Also include the setup date below (e.g., COOS-5539-2 02Feb15). Place this <20cm above the bait, and make sure it is *in the photo frame!* Note the data is written differently than our suggested label.

**Bait** – Use at least a 5.5 ounce can of fish flavored cat food (we have used Friskies savory shreds: “Whitefish and sardines” or “Ocean whitefish and tuna”). Bait needs to be secured to ensure it cannot be easily removed. One can will have 4-6 holes nailed into it and then nailed to the tree with the top of the can facing the tree. If desired, a second can will be opened (and for 2019, have colored beads added and mixed in), then secured by nailing to the base of the tree. Similarly, chicken, a broad mix (peanut butter, apple, oats, etc) could be used for a bait reward. During our 2015-2018 surveys throughout Oregon, bait type did not influence marten or fisher detections. Bobcats were slightly more likely to be detected at stations with chicken. Canids and mountain lions were detected slightly more on unbaited, unlured trail cameras.

**Lure** – We use gusto (Commercial trapping lure GUSTO™, Minnesota Trapline Products, Pennock, MN, http://www.minntrapprod.com/) at baited stations. The gusto is mixed with glycerin in a 1:1 ratio to help prevent desiccation or freezing OR mixed with lanolin OR on a sponge/rag tied to a branch OR a combination. Approximately 1/2oz of lure should be placed on a tree branch near the bait set up at an *elevated location* at each station during set up – think about wind, wind direction, and maximizing distance the scent could extend. Ideally still within the photo frame. Lure should be refreshed during each check.

Data collected during typical set up:

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<td></td>
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</table>
To do

Figure 4. Film canister filled with lure and holes drilled.

Camera Trap Station Check
If time is available camera stations should be checked 2-3 weeks after deployment. A short check after initial deployment is preferable to adjust camera settings as needed, check for false triggers, replenish bait, and generally ensure functionality for the duration of the survey period. Stations should be set for a minimum of a week before checking. Make an effort to keep bait scent off the cameras. If working in teams have one partner work at the camera station and one at the bait station; maintain these roles throughout the day. If working solo, check the camera first and wear gloves at the bait station.

More checks could be optimal depending on the situation, but are likely unnecessary more than once every 7 days. For instance, increase visits as possible:
- during summer, when bait becomes dry
- in areas and periods with bear disturbance
- when aiming to collect genetic samples (heat, moisture, and UV exposure reduce genetic integrity)

Check data collected during Moriarty/Barry et al. surveys:

Start with the Camera Tree

1. Go towards bait and attempt to trigger the camera to determine if it is still functional.
2. Verify that you triggered the camera. Depending on the camera type you may be able to see this on the LCD display screen or you will have to view the last photo recorded.
3. Fill out a Station Check form (bait status, cam status, images, etc.). If you do not have one, we can provide an example.
4. Review images for potential marten photos, and either replace card with a new one or download photos to clear the field SD card and then replace.
5. In your field notebook the essential station check info as a backup.

Check the Bait Station

1. Look in the vicinity of the base of the tree for suspected scats. Collect suspected scats in a labeled sample vial with desiccant and paper bag. Label with the following: 4-letter location-SurvNumLoc-Station-SCAT, Collection date (DDMMYY) and observer’s 3 initials; example:
   AGNE-0006-1-SCAT 11NOV15 CNM
2. Add or replenish bait and lure during every visit. Bait present from the last visit should be removed from the study area (store in sealable baggies or trash bag) and disposed of out of the field.

Digital Photo Storage and Management:
Management of digital photos is suggested using a hierarchical file structure to maintain linkage of photos to each year’s survey effort, survey unit, and station. Dates for digital storage are in the format YearMonthDay (YYMMDD). However, there may be a local or remote database already established that managers may want to utilize. The following is just a suggestion.

There will be thousands of photos and possibly terabytes of data. If you label EXACTLY, then we can use programs to extract the data and upload the labeled data into a database (e.g., excel).

We suggest the overall hierarchical file structure of:

MACA_Survey_Photographs (folder)
   RemoteCamera_RawPhotographs (folder)
      AGNE-0548-2-150531-CHECK1 (folder)
         Location – Sample unit – station – date checked – check
         Contains: Unedited photographs from the first check, at sample unit 0548 in Agness area at the 2nd station collected 31May2015.
      AGNE-0548-1-150603-CHECK2 (folder)
         Contains: Unedited photographs from the second check, at sample unit 0548 in Agness area at the 1st station collected 03June2015.
   RemoteCamera_MartenPhotos (folder)
      Contains: Labeled photographs with a marten or suspected marten. Copying these into a separate folder is helpful to quickly identify marten locations. Photos
copied, and not relabeled, from the RemoteCameraPhotographs CURR-0548-2-140603-CHECK1 (order). This way we can go back to the RemoteCameraPhotographs and RawPhotographs to see visits before and after.

StationPhotographs(folder)
Contains: **Labeled photographs** of station photographs (cardinal directions)
*Label = AGNS-0548-1-140603-SetUp (order)*

FieldPhotos(folder), contains the following subfolders: Animals, Crew, Scat, Landscape, etc. Contains: **Labeled photographs** taken in the field that you want to share for powerpoints.

These are quite important for later. Please take pictures of the crew, setting up stations, and some of the cool things you see. Then, for the really good photos, please copy them into the Favorites folder.

Favorites (folder)
Contains special photos that are so incredibly awesome that they need to be shared.

**Data Storage:**

It is important that redundancy be built into the data storage system. Please ensure data is in three places (geographically/cloud/hard drive). We have been using external hard drives to store data as a back up as well as clouds with unlimited data (e.g., Box). If multiple hard drives are used for data backup at least 2 should be stored at different physical locations.

**Literature Cited**


Table x. Station Set Up and Check Equipment Checklists

**General Equipment Needed for Station Set Up:**
- GPS Unit and Station Coordinates/Shapefile
- Field Maps & Air Photos
- Compass
- Digital camera (viewing test shots, station habitat photos)
- Card viewer (charged; optional if above is not available or working with camera format)
- Bait: 21 5 oz can of wet fish based catfood/station
- Lure: Pre-made Gusto/Glycerine mixture
- Flagging
- Sharpies
- Multi-tool
- 1mm diameter colored beads OR cellulose-based glitter

**Personal Equipment**
- First Aid
- Radio/Cell Phone/SPOT/InReach
- Latex Gloves
- Hand Sanitizer
- Water, Electrolites, Food, Clothes

**Equipment Needed for Camera Trap Station Set Up:**
- Camera materials (camera unit, bear box, cable lock)
  - 4-8 AA batteries per camera
  - 1-SD card per camera (min. 4GB)
- Optional: Scent Blocker Spray (e.g., White Lighting)
- Camera & Snare Mounting Screws & Washers
- Electric drill, bit, screws OR hammer, nails
- Measurement strips (yellow with bands)
- Bailing wire for bait attachment

**General Equipment Needed for Camera Station Checks:**
- Extra trail camera (in case one fails)
- Field notebook
- Digital camera for viewing
- Bait: 1 can of wet fish based catfood/station
- Lure: Pre-made Gusto/Glycerine mixture, pre-punched
- Cleared SD cards for swapping into cameras
- Bailing Wire
- Extra AA Batteries
- Keys/codes for Cable Locks
- Drill, Bits, Screws OR Hammer, Nails
- Vial with desiccant for scats (or paper bags for drying)