**Conceptual Models for how marten select habitat on Haida Gwaii**

Below is a list of conceptual models used as the basis for logistic regression models in STATA. There is one non-spatial model (run time), and 12 spatial models. I grouped the 12 spatial models into two scales: home range (1km radius) and stand (100m radius). There are four categories of spatial models: trapping bias, structural, topographic, and human disturbance. I wrote each model with the variable name and how it was measured, followed by a short hypothesis statement. Refer to ‘habitat\_attributes\_24Sept2018’, ‘1.lit\_review’ for references. Fixed effects were run time, average temperature, cluster, and year. Random effect was grid cell.

**Non-spatial (trapping bias):**

1. Run time (number of 14-day intervals since site installation) + average temperature + cluster + year

Marten activity changes with season, therefore as run time increases and temperature and daylight hours change, so will patterns in marten detections at cameras. The probability of detection will be greater for sites that occur within the same grid cell (clusters) as opposed to sites that occur in separate grid cells. Some aspects of sampling design increased detection probability between years, therefore there will be more detections in 2018 as opposed to 2017.

**Home range scale (1km radius):**

**Trapping bias:**

1. Trap density (camera sites per km^2)

The number of sites within a home range (1km buffer) will be positively correlated with the number of marten detections, because an area with more bait and lure will be more appealing than an area with less bait and lure. More sites within a home range will also give the animal more opportunities to become comfortable using the site.

**Structural**

1. Proportion of area with average height of trees > 20 m + proportion of area with average height of trees between 10-20 m

Marten select annual home ranges where all life history requirements can be met. Tree height serves as a proxy for developmental stage, with greater values corresponding to taller, older trees. Old growth forests, represented by average height of trees > 20 m, provide habitat for foraging, resting, denning, and mate access, as well as protection from predators. Second growth, represented by proportion of area with average height of trees between 10-20m, may also serve as suitable habitat for marten on Haida Gwaii.

1. Proportion of area with canopy cover (from VRI) > 45%

At the coarsest scale of habitat selection, marten select forested, as opposed to open, areas. Therefore, areas with greater percent canopy cover will receive more use than areas with less canopy cover.

1. Proportion of area with canopy cover (from VRI) > 45% + proportion area with tree height (average height of first returns) 10-20 m\* + Proportion area with age > 250 years from VRI

This model combines the above hypotheses about cover and developmental stage. Marten select home ranges with mostly old-growth or late-mature forests. These forests contain the rich complexity in structure that marten require to satisfy all life history requirements throughout their lifetime. The greater the percent canopy cover and greater the proportion of area in older developmental stages, the more frequently marten will be detected.

\*needed to use 10-20m because height > 20 m was excessively multicollinear with age > 250

1. Shrub and CWD cover (LiDAR percent cover of returns between 0-1m height)

Marten have been shown to select home ranges in areas of high structural complexity, regardless of forest age or composition. Much of my study area is made up of second growth, Sitka spruce forest. These stands are even-aged and lack the large diameter, tall trees of uncut old-growth stands. However, they may contain sufficient near-ground structural complexity to provide marten with access to prey, cover from predators, as well as resting and denning sites. There may also be sufficient near-ground structure in clearcuts to provide marten with foraging and denning opportunities.

**Human Disturbance**

1. Quadratic % cut blocks < 30 years old (proportion of area cut within 30 years of sampling) + quadratic road density ((line density of roads per km^2) ^2)

Marten benefit from some clearcutting, which increases availability of some prey species. Marten select home ranges with greater proportions of regenerating clearcuts up to a point when the over-abundance of cut-blocks will reduce foraging and denning opportunities. Maintained roads provide access to hunter-killed deer carcasses, which benefit marten. Marten select home ranges with greater road density, up to a certain threshold, beyond which they are negatively impacted by increased road density.

1. Maintained road density (line density of driveable roads per km^2) + quadratic abandoned road density ((line density of alder roads per km^2)^2) + quadratic edge\* density ((line density of edge from VRI tree heights per km^2)^2)

Marten generally avoid open areas and areas of high human disturbance. Therefore, marten select home ranges with low density of maintained roads. Abandoned roads provide easier pathways for movement than complex forest floors, with more cover from aerial predators than openings. Marten may select home ranges containing greater densities of abandoned roads. Forest edges are an important habitat for early-seral prey species, such as deer, and provide seasonally-available berries important for marten diet. Marten may be adapted to select home ranges with greater amounts of edge habitat.

\*Edge measured as intercept between VRI height of leading tree species below and above 3m height.

**Stand scale (100m radius):**

**Structural + Topographic**

1. Average age of leading tree species (VRI)

Old growth forest structure is the most important factor determining where marten spend time foraging and resting within their home range. They are more likely to be detected in older stands than in younger stands.

1. Stand height (average height of first returns) + shrub cover (LiDAR percent cover of returns between 0-1m height) + canopy cover (LiDAR percent cover of first returns)

Within their home range, marten are more likely to be found in stands of oldest developmental stage, represented by greater average tree height. Within their home range, marten are found in stands with extensive, dense shrub cover. These structures allow access to subnivean prey, resting sites, protection from predators, and den sites. Marten will likely spend the most time in stands with greatest percent canopy cover to avoid aerial predation.

1. Quadratic distance to marine shoreline (mean distance to marine shoreline ^2)

Marten are more likely to spend time foraging in areas close to marine shoreline. This relationship will become less important at great distances from marine coastlines.

1. Quadratic distance to riparian area (mean distance to riparian ^2)

Marten are more likely to forage near riparian areas due to increased prey density. This relationship will become less important at great distances from riparian areas.

**Human Disturbance**

1. Quadratic edge density ((line density of edge from LiDAR per km^2) ^2) + Regenerating clearcuts < 30 years old (proportion of area cut within 30 years of sampling) + quadratic road density ((line density of roads per km^2) ^2)

Marten are more likely to be found in areas of greater edge density due to greater prey availability and facilitation of daily movements. Marten will avoid areas with greater proportions of regenerating clearcuts, to avoid predation, and maximize use of interior uncut forests. Marten will avoid areas of high road density due to pulse stressor of vehicle traffic and low canopy cover.

1. Quadratic abandoned road density ((line density of alder roads per km^2) ^2) + maintained road density (line density of driveable roads per km^2)

Marten will avoid areas with high density of maintained roads, however, they will occur more frequently in areas with limited amounts of abandoned roads.