# WSVHA Revisions (With CHM Aggregated using MAX function)

## Cabin-GIS

## 15/07/2022 (vV)

## Contents

## Action:

The following report documents code used and revisions made to WSVHA raster estimates for 'All-Species Areas' (nonFd-stands included; </>50%) across all 16 BCTS Operating Areas within the Williams Lake TSA. New WSVHA rasters were derived with approved masks and VRI layers using corrected LiDAR mosaics shared by LQ. Quesnel validation blocks were moved to section 2 at towards end ofreport.

# 1. All-Species Areas: Includes Fd and non-Fd stands

## 1.1. All-Species Areas: Import DEM and CHM

```r
# Merge chunks
filez_be_ahbau = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/BareEarth", full.names =
elev_raster_list_ahbau <- lapply(filez_be_ahbau, raster)
elev_raster_ahbau = do.call(merge, c(elev_raster_list_ahbau, tolerance = 1))
elev_rast_ahbau = terra::rast(elev_raster_ahbau)
terra::crs(elev_rast_ahbau) = "epsg:3005"
elev_rast_ahbau = terra::aggregate(elev_rast_ahbau, fact = 100, fun = mean)
writeRaster(elev_rast_ahbau, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/elev_raster_
elev_raster_ahbau = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/elev_raster_100m_

filez_be_bells = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/BareEarth", full.names =
elev_raster_list_bells <- lapply(filez_be_bells, raster)
elev_raster_bells = do.call(merge, c(elev_raster_list_bells, tolerance = 1))
elev_rast_bells = terra::rast(elev_raster_bells)
terra::crs(elev_rast_bells) = "epsg:3005"
elev_rast_bells = terra::aggregate(elev_rast_bells, fact = 100, fun = mean)
writeRaster(elev_rast_bells, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/elev_raster_
elev_raster_bells = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/elev_raster_100m_

filez_be_big_valley = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_valley/BareEarth", fu
elev_raster_list_big_valley <- lapply(filez_be_big_valley, raster)
elev_raster_big_valley = do.call(merge, c(elev_raster_list_big_valley, tolerance = 1))
elev_rast_big_valley = terra::rast(elev_raster_big_valley)
terra::crs(elev_rast_big_valley) = "epsg:3005"
elev_rast_big_valley = terra::aggregate(elev_rast_big_valley, fact = 100, fun = mean)
writeRaster(elev_rast_big_valley, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_valley/el
elev_raster_big_valley = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_valley/elev_ra

filez_be_cariboo_lake = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cariboo_lake/BareEarth
elev_raster_list_cariboo_lake <- lapply(filez_be_cariboo_lake, raster)
elev_raster_cariboo_lake = do.call(merge, c(elev_raster_list_cariboo_lake, tolerance = 1))
elev_rast_cariboo_lake = terra::rast(elev_raster_cariboo_lake)
terra::crs(elev_rast_cariboo_lake) = "epsg:3005"
elev_rast_cariboo_lake = terra::aggregate(elev_rast_cariboo_lake, fact = 100, fun = mean)
writeRaster(elev_rast_cariboo_lake, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cariboo_lak
elev_raster_cariboo_lake = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cariboo_lake/ele

filez_be_charleson_marvincreek = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/charleson_marv
elev_raster_list_charleson_marvincreek <- lapply(filez_be_charleson_marvincreek, raster)
elev_raster_charleson_marvincreek = do.call(merge, c(elev_raster_list_charleson_marvincreek, tolerance =
elev_rast_charleson_marvincreek = terra::rast(elev_raster_charleson_marvincreek)
terra::crs(elev_rast_charleson_marvincreek) = "epsg:3005"
elev_rast_charleson_marvincreek = terra::aggregate(elev_rast_charleson_marvincreek, fact = 100, fun = me
writeRaster(elev_rast_charleson_marvincreek, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ch
elev_raster_charleson_marvincreek = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/charles

filez_be_dash = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/BareEarth", full.names = T
elev_raster_list_dash <- lapply(filez_be_dash, raster)
elev_raster_dash = do.call(merge, c(elev_raster_list_dash, tolerance = 1))
```

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elev_rast_dash = terra::rast(elev_raster_dash)
terra::crs(elev_rast_dash) = "epsg:3005"
elev_rast_dash = terra::aggregate(elev_rast_dash, fact = 100, fun = mean)
writeRaster(elev_rast_dash, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/elev_raster_1
elev_raster_dash = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/elev_raster_100m_da

filez_be_gaspard = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/BareEarth", full.na
elev_raster_list_gaspard <- lapply(filez_be_gaspard, raster)
elev_raster_gaspard = do.call(merge, c(elev_raster_list_gaspard, tolerance = 1))
elev_rast_gaspard = terra::rast(elev_raster_gaspard)
terra::crs(elev_rast_gaspard) = "epsg:3005"
elev_rast_gaspard = terra::aggregate(elev_rast_gaspard, fact = 100, fun = mean)
writeRaster(elev_rast_gaspard, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/elev_ra
elev_raster_gaspard = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/elev_raster_

filez_be_hawks_creek = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/BareEarth",
elev_raster_list_hawks_creek <- lapply(filez_be_hawks_creek, raster)
elev_raster_hawks_creek = do.call(merge, c(elev_raster_list_hawks_creek, tolerance = 1))
elev_rast_hawks_creek = terra::rast(elev_raster_hawks_creek)
terra::crs(elev_rast_hawks_creek) = "epsg:3005"
elev_rast_hawks_creek = terra::aggregate(elev_rast_hawks_creek, fact = 100, fun = mean)
writeRaster(elev_rast_hawks_creek, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek
elev_raster_hawks_creek = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/elev
terra::plot(elev_rast_hawks_creek)

filez_be_hawks_creek2 = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/Hawks2/32b
elev_raster_list_hawks_creek2 <- lapply(filez_be_hawks_creek2, raster)
elev_raster_hawks_creek2 = do.call(merge, c(elev_raster_list_hawks_creek2, tolerance = 1))
elev_rast_hawks_creek2 = terra::rast(elev_raster_hawks_creek2)
terra::crs(elev_rast_hawks_creek2) = "epsg:3005"
elev_rast_hawks_creek2 = terra::aggregate(elev_rast_hawks_creek2, fact = 100, fun = mean)
writeRaster(elev_rast_hawks_creek2, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_cree
elev_raster_hawks_creek2 = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/ele
terra::plot(elev_rast_hawks_creek2)

filez_be_little_river = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_river/BareEarth
elev_raster_list_little_river <- lapply(filez_be_little_river, raster)
elev_raster_little_river = do.call(merge, c(elev_raster_list_little_river, tolerance = 1))
elev_rast_little_river = terra::rast(elev_raster_little_river)
terra::crs(elev_rast_little_river) = "epsg:3005"
elev_rast_little_river = terra::aggregate(elev_rast_little_river, fact = 100, fun = mean)
writeRaster(elev_rast_little_river, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_riv
elev_raster_little_river = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_river/el

filez_be_little_swift = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_swift/BareEarth
elev_raster_list_little_swift <- lapply(filez_be_little_swift, raster)
elev_raster_little_swift = do.call(merge, c(elev_raster_list_little_swift, tolerance = 1))
elev_rast_little_swift = terra::rast(elev_raster_little_swift)
terra::crs(elev_rast_little_swift) = "epsg:3005"
elev_rast_little_swift = terra::aggregate(elev_rast_little_swift, fact = 100, fun = mean)
writeRaster(elev_rast_little_swift, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_swi
elev_raster_little_swift = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_swift/el
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filez_be_mcintosh = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/BareEarth", full.n
elev_raster_list_mcintosh <- lapply(filez_be_mcintosh, raster)
elev_raster_mcintosh = do.call(merge, c(elev_raster_list_mcintosh, tolerance = 1))
elev_rast_mcintosh = terra::rast(elev_raster_mcintosh)
terra::crs(elev_rast_mcintosh) = "epsg:3005"
elev_rast_mcintosh = terra::aggregate(elev_rast_mcintosh, fact = 100, fun = mean)
writeRaster(elev_rast_mcintosh, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/elev_
elev_raster_mcintosh = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/elev_raster

#filez_be_meldrum = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/BareEarth", full.n
#elev_raster_list_meldrum = lapply(filez_be_meldrum, raster)
#elev_raster_meldrum = do.call(merge, c(elev_raster_list_meldrum, tolerance = 1))
#elev_rast_meldrum = terra::rast(elev_raster_meldrum)
#terra::crs(elev_rast_meldrum) = "epsg:3005"
#elev_rast_meldrum = terra::aggregate(elev_rast_meldrum, fact = 100, fun = mean)
#writeRaster(elev_rast_meldrum, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/elev_ra
elev_raster_meldrum = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/Meldrum DTM/D
elev_rast_meldrum = terra::rast(elev_raster_meldrum)
terra::crs(elev_rast_meldrum) = "epsg:3005"
elev_rast_meldrum = terra::aggregate(elev_rast_meldrum, fact = 100, fun = mean)
writeRaster(elev_rast_meldrum, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/elev_ras
elev_raster_meldrum = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/elev_raster_
terra::plot(elev_rast_meldrum)

filez_be_phillips_anahim_lake = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/phillips_anahi
elev_raster_list_phillips_anahim_lake <- lapply(filez_be_phillips_anahim_lake, raster)
elev_raster_phillips_anahim_lake = do.call(merge, c(elev_raster_list_phillips_anahim_lake, tolerance =
elev_rast_phillips_anahim_lake = terra::rast(elev_raster_phillips_anahim_lake)
terra::crs(elev_rast_phillips_anahim_lake) = "epsg:3005"
elev_rast_phillips_anahim_lake = terra::aggregate(elev_rast_phillips_anahim_lake, fact = 100, fun = mean
writeRaster(elev_rast_phillips_anahim_lake, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ph
elev_raster_phillips_anahim_lake = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/phillips

filez_be_piltz = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/BareEarth", full.names =
elev_raster_list_piltz = lapply(filez_be_piltz, raster)
elev_raster_piltz = do.call(merge, c(elev_raster_list_piltz, tolerance = 1))
elev_rast_piltz = terra::rast(elev_raster_piltz)
terra::crs(elev_rast_piltz) = "epsg:3005"
elev_rast_piltz = terra::aggregate(elev_rast_piltz, fact = 100, fun = mean)
writeRaster(elev_rast_piltz, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/elev_raster_
elev_raster_piltz = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/elev_raster_100m_

filez_be_punky_clisbako = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punky_clisbako/BareEa
elev_raster_punky_clisbako = do.call(merge, c(elev_raster_list_punky_clisbako, tolerance = 1))
elev_rast_punky_clisbako = terra::rast(elev_raster_punky_clisbako)
terra::crs(elev_rast_punky_clisbako) = "epsg:3005"
elev_rast_punky_clisbako = terra::aggregate(elev_rast_punky_clisbako, fact = 100, fun = mean)
writeRaster(elev_rast_punky_clisbako, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punky_cl
elev_raster_punky_clisbako = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punky_clisbako

filez_be_quesnel = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/BareEarth", full.nam
elev_raster_list_quesnel <- lapply(filez_be_quesnel, raster)
elev_raster_quesnel = do.call(merge, c(elev_raster_list_quesnel, tolerance = 1))
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elev_rast_quesnel = terra::rast(elev_raster_quesnel)
terra::crs(elev_rast_quesnel) = "epsg:3005"
elev_rast_quesnel = terra::aggregate(elev_rast_quesnel, fact = 100, fun = mean)
writeRaster(elev_rast_quesnel, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/elev_ra
elev_raster_quesnel = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/elev_raster_
elev_rast_quesnel = terra::rast(elev_raster_quesnel)


filez_vh_ahbau = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/VegHt", full.names = T,
lead_htop_raster_list_ahbau <- lapply(filez_vh_ahbau, raster)
lead_htop_raster_ahbau = do.call(merge, c(lead_htop_raster_list_ahbau, tolerance = 1))
lead_htop_rast_ahbau = terra::rast(lead_htop_raster_ahbau)
terra::crs(lead_htop_rast_ahbau) = "epsg:3005"
lead_htop_rast_ahbau = terra::aggregate(lead_htop_rast_ahbau, fact = 100, fun = max)
writeRaster(lead_htop_rast_ahbau, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/lead_h
lead_htop_raster_ahbau = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ahbau/lead_htop_ra


filez_vh_bells = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/VegHt", full.names = T,
lead_htop_raster_list_bells <- lapply(filez_vh_bells, raster)
lead_htop_raster_bells = do.call(merge, c(lead_htop_raster_list_bells, tolerance = 1))
lead_htop_rast_bells = terra::rast(lead_htop_raster_bells)
terra::crs(lead_htop_rast_bells) = "epsg:3005"
lead_htop_rast_bells = terra::aggregate(lead_htop_rast_bells, fact = 100, fun = max)
writeRaster(lead_htop_rast_bells, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/lead_h
lead_htop_raster_bells = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/bells/lead_htop_ra


filez_vh_big_valley = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_valley/VegHt", full.n
lead_htop_raster_list_big_valley <- lapply(filez_vh_big_valley, raster)
lead_htop_raster_big_valley = do.call(merge, c(lead_htop_raster_list_big_valley, tolerance = 1))
lead_htop_rast_big_valley = terra::rast(lead_htop_raster_big_valley)
terra::crs(lead_htop_rast_big_valley) = "epsg:3005"
lead_htop_rast_big_valley = terra::aggregate(lead_htop_rast_big_valley, fact = 100, fun = max)
writeRaster(lead_htop_rast_big_valley, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_vall
lead_htop_raster_big_valley = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/big_valley/le


filez_vh_cariboo_lake = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cariboo_lake/VegHt", fu
lead_htop_raster_list_cariboo_lake <- lapply(filez_vh_cariboo_lake, raster)
lead_htop_raster_cariboo_lake = do.call(merge, c(lead_htop_raster_list_cariboo_lake, tolerance = 1))
lead_htop_rast_cariboo_lake = terra::rast(lead_htop_raster_cariboo_lake)
terra::crs(lead_htop_rast_cariboo_lake) = "epsg:3005"
lead_htop_rast_cariboo_lake = terra::aggregate(lead_htop_rast_cariboo_lake, fact = 100, fun = max)
writeRaster(lead_htop_rast_cariboo_lake, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/caribo
lead_htop_raster_cariboo_lake = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cariboo_lak


filez_vh_charleson_marvincreek = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/charleson_marv
lead_htop_raster_list_charleson_marvincreek <- lapply(filez_vh_charleson_marvincreek, raster)
lead_htop_raster_charleson_marvincreek = do.call(merge, c(lead_htop_raster_list_charleson_marvincreek,
lead_htop_rast_charleson_marvincreek = terra::rast(lead_htop_raster_charleson_marvincreek)
terra::crs(lead_htop_rast_charleson_marvincreek) = "epsg:3005"
lead_htop_rast_charleson_marvincreek = terra::aggregate(lead_htop_rast_charleson_marvincreek, fact = 100
writeRaster(lead_htop_rast_charleson_marvincreek, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosai
lead_htop_raster_charleson_marvincreek = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/cl


filez_vh_dash = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/VegHt", full.names = T, al
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lead_htop_raster_list_dash <- lapply(filez_vh_dash, raster)
lead_htop_raster_dash = do.call(merge, c(lead_htop_raster_list_dash, tolerance = 1))
lead_htop_rast_dash = terra::rast(lead_htop_raster_dash)
terra::crs(lead_htop_rast_dash) = "epsg:3005"
lead_htop_rast_dash = terra::aggregate(lead_htop_rast_dash, fact = 100, fun = max)
writeRaster(lead_htop_rast_dash, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/lead_htop
lead_htop_raster_dash = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/dash/lead_htop_rast

filez_vh_gaspard = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/VegHt", full.names =
lead_htop_raster_list_gaspard <- lapply(filez_vh_gaspard, raster)
lead_htop_raster_gaspard = do.call(merge, c(lead_htop_raster_list_gaspard, tolerance = 1))
lead_htop_rast_gaspard = terra::rast(lead_htop_raster_gaspard)
terra::crs(lead_htop_rast_gaspard) = "epsg:3005"
lead_htop_rast_gaspard = terra::aggregate(lead_htop_rast_gaspard, fact = 100, fun = max)
writeRaster(lead_htop_rast_gaspard, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/lea
lead_htop_raster_gaspard = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/gaspard/lead_hto
terra::plot(lead_htop_rast_gaspard)

filez_vh_hawks_creek = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/VegHt", full
lead_htop_raster_list_hawks_creek <- lapply(filez_vh_hawks_creek, raster)
lead_htop_raster_hawks_creek = do.call(merge, c(lead_htop_raster_list_hawks_creek, tolerance = 1))
lead_htop_rast_hawks_creek = terra::rast(lead_htop_raster_hawks_creek)
terra::crs(lead_htop_rast_hawks_creek) = "epsg:3005"
lead_htop_rast_hawks_creek = terra::aggregate(lead_htop_rast_hawks_creek, fact = 100, fun = max)
writeRaster(lead_htop_rast_hawks_creek, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_c
lead_htop_raster_hawks_creek = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/
terra::plot(lead_htop_rast_hawks_creek)

filez_vh_hawks_creek2 = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek/Hawks2/32bi
lead_htop_raster_list_hawks_creek2 <- lapply(filez_vh_hawks_creek2, raster)
lead_htop_raster_hawks_creek2 = do.call(merge, c(lead_htop_raster_list_hawks_creek2, tolerance = 1))
lead_htop_rast_hawks_creek2 = terra::rast(lead_htop_raster_hawks_creek2)
terra::crs(lead_htop_rast_hawks_creek2) = "epsg:3005"
lead_htop_rast_hawks_creek2 = terra::aggregate(lead_htop_rast_hawks_creek2, fact = 100, fun = max)
writeRaster(lead_htop_rast_hawks_creek2, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_
lead_htop_raster_hawks_creek2 = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/hawks_creek
terra::plot(lead_htop_rast_hawks_creek2)

filez_vh_little_river = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_river/VegHt", fu
lead_htop_raster_list_little_river <- lapply(filez_vh_little_river, raster)
lead_htop_raster_little_river = do.call(merge, c(lead_htop_raster_list_little_river, tolerance = 1))
lead_htop_rast_little_river = terra::rast(lead_htop_raster_little_river)
terra::crs(lead_htop_rast_little_river) = "epsg:3005"
lead_htop_rast_little_river = terra::aggregate(lead_htop_rast_little_river, fact = 100, fun = max)
writeRaster(lead_htop_rast_little_river, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/littl
lead_htop_raster_little_river = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_rive

filez_vh_little_swift = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_swift/VegHt", fu
lead_htop_raster_list_little_swift <- lapply(filez_vh_little_swift, raster)
lead_htop_raster_little_swift = do.call(merge, c(lead_htop_raster_list_little_swift, tolerance = 1))
lead_htop_rast_little_swift = terra::rast(lead_htop_raster_little_swift)
terra::crs(lead_htop_rast_little_swift) = "epsg:3005"
lead_htop_rast_little_swift = terra::aggregate(lead_htop_rast_little_swift, fact = 100, fun = max)
```

```r
writeRaster(lead_htop_rast_little_swift, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little
lead_htop_raster_little_swift = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/little_swi

filez_vh_mcintosh = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/VegHt", full.names
lead_htop_raster_list_mcintosh <- lapply(filez_vh_mcintosh, raster)
lead_htop_raster_mcintosh = do.call(merge, c(lead_htop_raster_list_mcintosh, tolerance = 1))
lead_htop_rast_mcintosh = terra::rast(lead_htop_raster_mcintosh)
terra::crs(lead_htop_rast_mcintosh) = "epsg:3005"
lead_htop_rast_mcintosh = terra::aggregate(lead_htop_rast_mcintosh, fact = 100, fun = max)
writeRaster(lead_htop_rast_mcintosh, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/
lead_htop_raster_mcintosh = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/mcintosh/lead_

#filez_vh_meldrum = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/VegHt", full.names
#lead_htop_raster_list_meldrum = list(filez_vh_meldrum, raster)
#lead_htop_raster_meldrum = do.call(merge, c(lead_htop_raster_list_meldrum, tolerance = 1))
#lead_htop_rast_meldrum = terra::rast(lead_htop_raster_meldrum)
#terra::crs(lead_htop_rast_meldrum) = "epsg:3005"
#lead_htop_rast_meldrum = terra::aggregate(lead_htop_rast_meldrum, fact = 100, fun = mean)
#writeRaster(lead_htop_rast_meldrum, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/l
lead_htop_raster_meldrum = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/Meldrum
lead_htop_rast_meldrum = terra::rast(lead_htop_raster_meldrum)
terra::crs(lead_htop_rast_meldrum) = "epsg:3005"
lead_htop_rast_meldrum = terra::aggregate(lead_htop_rast_meldrum, fact = 100, fun = max)
writeRaster(lead_htop_rast_meldrum, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/lea
lead_htop_raster_meldrum = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/meldrum/lead_hto
terra::plot(lead_htop_rast_meldrum)

filez_vh_phillips_anahim_lake = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/phillips_anahi
lead_htop_raster_list_phillips_anahim_lake <- lapply(filez_vh_phillips_anahim_lake, raster)
lead_htop_raster_phillips_anahim_lake = do.call(merge, c(lead_htop_raster_list_phillips_anahim_lake, tol
lead_htop_rast_phillips_anahim_lake = terra::rast(lead_htop_raster_phillips_anahim_lake)
terra::crs(lead_htop_rast_phillips_anahim_lake) = "epsg:3005"
lead_htop_rast_phillips_anahim_lake = terra::aggregate(lead_htop_rast_phillips_anahim_lake, fact = 100,
writeRaster(lead_htop_rast_phillips_anahim_lake, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaic
lead_htop_raster_phillips_anahim_lake = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/ph

filez_vh_piltz = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/VegHt", full.names = T,
lead_htop_raster_list_piltz <- lapply(filez_vh_piltz, raster)
lead_htop_raster_piltz = do.call(merge, c(lead_htop_raster_list_piltz, tolerance = 1))
lead_htop_rast_piltz = terra::rast(lead_htop_raster_piltz)
terra::crs(lead_htop_rast_piltz) = "epsg:3005"
lead_htop_rast_piltz = terra::aggregate(lead_htop_rast_piltz, fact = 100, fun = max)
writeRaster(lead_htop_rast_piltz, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/lead_h
lead_htop_raster_piltz = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/piltz/lead_htop_ra

filez_vh_punky_clisbako = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punky_clisbako/VegHt
lead_htop_raster_list_punky_clisbako <- lapply(filez_vh_punky_clisbako, raster)
lead_htop_raster_punky_clisbako = do.call(merge, c(lead_htop_raster_list_punky_clisbako, tolerance = 1)
lead_htop_rast_punky_clisbako = terra::rast(lead_htop_raster_punky_clisbako)
terra::crs(lead_htop_rast_punky_clisbako) = "epsg:3005"
lead_htop_rast_punky_clisbako = terra::aggregate(lead_htop_rast_punky_clisbako, fact = 100, fun = max)
writeRaster(lead_htop_rast_punky_clisbako, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punk
lead_htop_raster_punky_clisbako = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/punky_cli
```

```r
filez_vh_quesnel = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/VegHt", full.names =
lead_htop_raster_list_quesnel <- lapply(filez_vh_quesnel, raster)
lead_htop_raster_quesnel = do.call(merge, c(lead_htop_raster_list_quesnel, tolerance = 1))
lead_htop_rast_quesnel = terra::rast(lead_htop_raster_quesnel)
terra::crs(lead_htop_rast_quesnel) = "epsg:3005"
lead_htop_rast_quesnel = terra::aggregate(lead_htop_rast_quesnel, fact = 100, fun = max)
lead_htop_rast_quesnel = terra::resample(lead_htop_rast_quesnel, elev_rast_quesnel)
writeRaster(lead_htop_rast_quesnel, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/lea
lead_htop_raster_quesnel = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/lead_hto
lead_htop_rast_quesnel = terra::rast(lead_htop_raster_quesnel)

# Merge mosaics
elev_raster_allSpeciesAreas_list = list(
  elev_raster_ahbau, elev_raster_bells,
  elev_raster_big_valley, elev_raster_cariboo_lake,
  elev_raster_charleson_marvincreek, elev_raster_dash,
  elev_raster_gaspard, elev_raster_hawks_creek,
  elev_raster_hawks_creek2, elev_raster_little_river,
  elev_raster_little_swift, elev_raster_mcintosh,
  elev_raster_meldrum, elev_raster_phillips_anahim_lake,
  elev_raster_piltz, elev_raster_punky_clisbako,
  elev_raster_quesnel)

elev_raster_allSpeciesAreas = do.call(merge, c(elev_raster_allSpeciesAreas_list, tolerance = 1))
writeRaster(elev_raster_allSpeciesAreas, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/elev_
elev_raster_allSpeciesAreas = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/elev_raster_
elev_rast_allSpeciesAreas = terra::rast(elev_raster_allSpeciesAreas)

lead_htop_raster_allSpeciesAreas_list = list(
  lead_htop_raster_ahbau, lead_htop_raster_bells,
  lead_htop_raster_big_valley, lead_htop_raster_cariboo_lake,
  lead_htop_raster_charleson_marvincreek, lead_htop_raster_dash,
  lead_htop_raster_gaspard, lead_htop_raster_hawks_creek,
  lead_htop_raster_hawks_creek2, lead_htop_raster_little_river,
  lead_htop_raster_little_swift, lead_htop_raster_mcintosh,
  lead_htop_raster_meldrum, lead_htop_raster_phillips_anahim_lake,
  lead_htop_raster_piltz, lead_htop_raster_punky_clisbako,
  lead_htop_raster_quesnel)

lead_htop_raster_allSpeciesAreas = do.call(merge, c(lead_htop_raster_allSpeciesAreas_list, tolerance = 
writeRaster(lead_htop_raster_allSpeciesAreas, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/
lead_htop_raster_allSpeciesAreas = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/lead_hto
lead_htop_rast_allSpeciesAreas = terra::rast(lead_htop_raster_allSpeciesAreas)
```
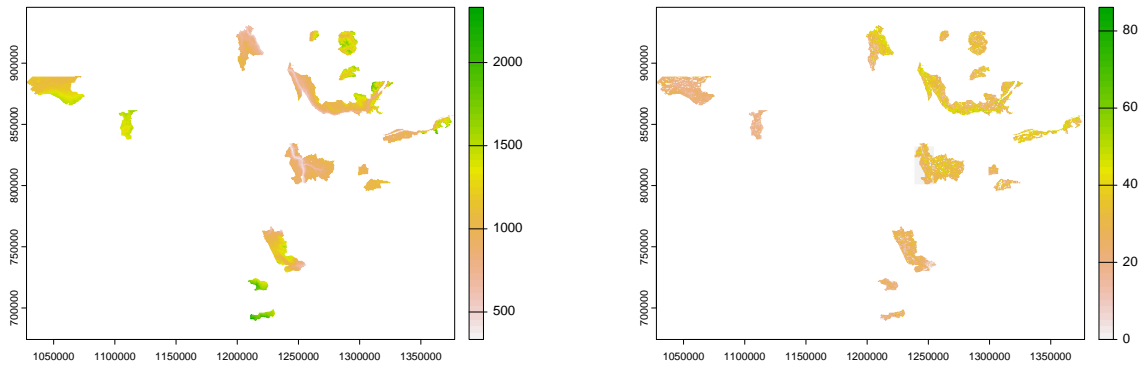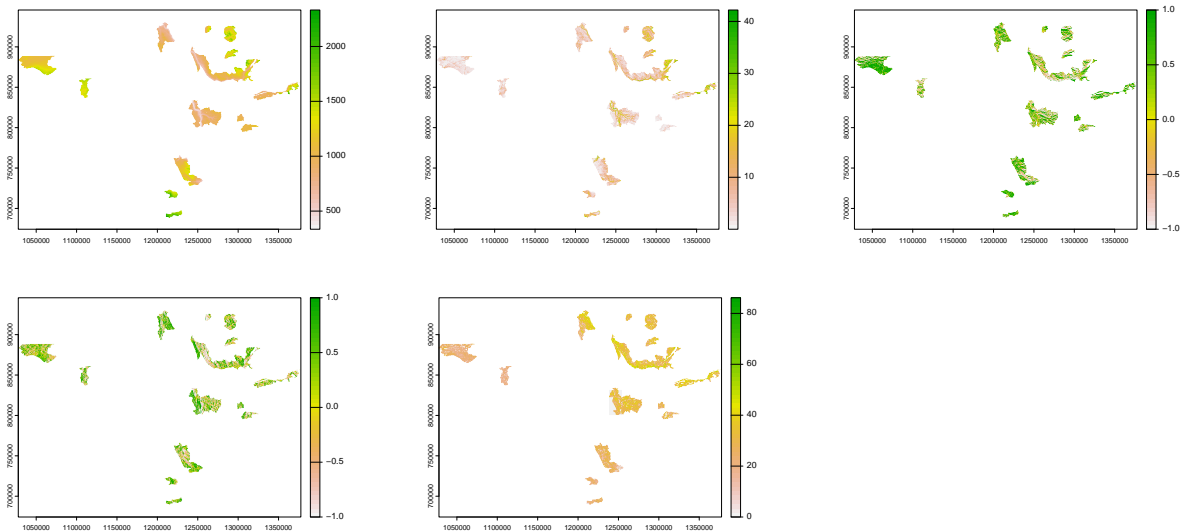
## 1.2. All-Species Areas: Derive Terrain Rasters

```
slope_rast_allSpeciesAreas = terra::terrain(elev_rast_allSpeciesAreas, v="slope", unit="degrees", neighb
aspect_rast_allSpeciesAreas = terra::terrain(elev_rast_allSpeciesAreas, v="aspect", unit="degrees", neig
asp_cos_rast_allSpeciesAreas = cos((aspect_rast_allSpeciesAreas*pi)/180)
asp_sin_rast_allSpeciesAreas = sin((aspect_rast_allSpeciesAreas*pi)/180)
lead_htop_rast_allSpeciesAreas = terra::resample(lead_htop_rast_allSpeciesAreas, elev_rast_allSpeciesAre
writeRaster(elev_rast_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unma
writeRaster(slope_rast_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unm
writeRaster(asp_cos_rast_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/u
writeRaster(asp_sin_rast_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/u
writeRaster(lead_htop_rast_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/input
```
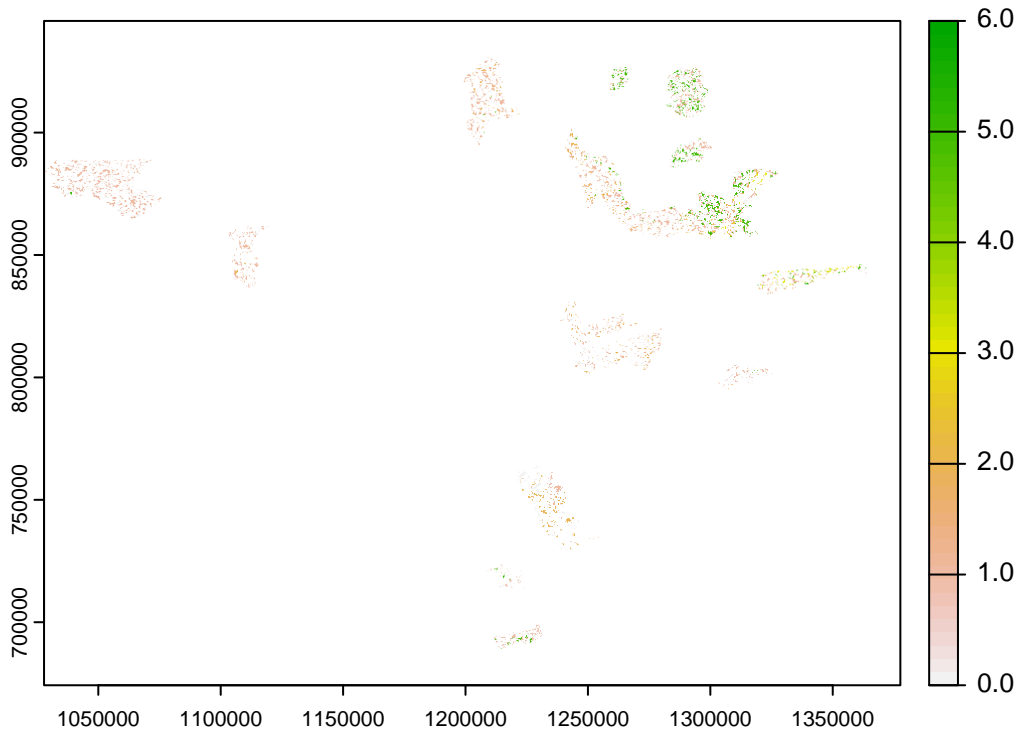


## 1.3. All-Species Areas: Derive Species Raster

```
lead_htop_sv_allSpeciesAreas = as.polygons(lead_htop_rast_allSpeciesAreas)
lead_htop_sf_allSpeciesAreas = sf::st_as_sf(lead_htop_sv_allSpeciesAreas)
#vri_sf_allSpeciesAreas = read_sf("/media/seamus/128GB_WORKD/data/vector/vri/vri_bc_2020_rank1.shp")
vri_sf_allSpeciesAreas = read_sf("/media/seamus/128GB_WORKD/data/vector/vri/vri_tcc_lquan_20220627.shp")
vri_species_allSpeciesAreas = vri_sf_allSpeciesAreas[c("SPECIES_CD", "SPECIES_PC")]
vri_species_aoi_allSpeciesAreas = dplyr::filter(vri_species_allSpeciesAreas,
    SPECIES_CD=='PL' | SPECIES_CD=='PLI' | SPECIES_CD=='FD' | SPECIES_CD=='FDI' |
    SPECIES_CD=='SB' | SPECIES_CD=='SE' | SPECIES_CD=='SW' | SPECIES_CD=='SX' |
    SPECIES_CD=='CW' | SPECIES_CD=='HW' | SPECIES_CD=='BL' | SPECIES_CD=='LW')
vri_species_allSpeciesAreas = vri_species_aoi_allSpeciesAreas
vri_species_allSpeciesAreas$SPECIES_CD = dplyr::recode(vri_species_allSpeciesAreas$SPECIES_CD,
  PL = 0, PLI = 0, SB = 1, SE = 1, SW = 1, SX = 1, FD = 2, FDI = 2, CW = 3, HW = 4, BL = 5, LW = 6)
vri_species_allSpeciesAreas = dplyr::rename(vri_species_allSpeciesAreas, species_class = SPECIES_CD)
vri_species_allSpeciesAreas = vri_species_allSpeciesAreas["species_class"]
vri_species_allSpeciesAreas_sf = sf::st_as_sf(vri_species_allSpeciesAreas)
plot(st_geometry(vri_species_aoi_allSpeciesAreas))
vri_species_aoi_allSpeciesAreas = st_intersection(vri_species_allSpeciesAreas_sf, st_make_valid(lead_ht
species_class_rast_allSpeciesAreas = terra::rasterize(vect(vri_species_aoi_allSpeciesAreas), lead_htop_
species_class_rast_allSpeciesAreas = terra::resample(species_class_rast_allSpeciesAreas, lead_htop_rast_
species_class_raster_allSpeciesAreas = raster::raster(species_class_rast_allSpeciesAreas)
raster::writeRaster(species_class_raster_allSpeciesAreas, filename = "/media/seamus/128GB_WORKD/data/ra
```

## 1.4. All-Species Areas: Derive Mask From Approved Layers & Extents

```r
#mask_burn2017 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity_T
#mask_burn2018 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity_T
#mask_burn2021 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity_T
#mask_burn2017 = mask_burn2017["BurnSev"]
#mask_burn2018 = mask_burn2018["BurnSev"]
#mask_burn2021 = mask_burn2021["BurnSev"]
#mask_burn2017 = dplyr::filter(mask_burn2017, BurnSev == 'High')
#mask_burn2018 = dplyr::filter(mask_burn2018, BurnSev == 'High')
#mask_burn2021 = dplyr::filter(mask_burn2021, BurnSev == 'High')
#mask_roads = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Roads.shp")
#mask_roads = sf::st_zm(mask_roads)
#mask_roads = sf::st_buffer(mask_roads, dist = 15, nQuadSegs = 5, endCapStyle = "ROUND", joinStyle = "R
#mask_roads_ften = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/FTEN_Roads_All.sh
#mask_roads_ften = sf::st_zm(mask_roads_ften)
#mask_roads_ften = sf::st_buffer(mask_roads_ften, dist = 15, nQuadSegs = 5, endCapStyle = "ROUND", join
#mask_clearcut = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/RSLT_CCRES_CLEAR.sh
#mask_blocks = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Blocks_Join.shp")

#extent_sf = read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/Lidar_Extent_Cleaned.shp")
#extent_sfz = st_zm(extent_sf) # drop z dimensions for plotting purposes
#extent_sfz_3005 = sf::st_transform(extent_sfz, 3005)
#ggplot(extent_sfz) + geom_sf(aes(fill = 'red'), show.legend = FALSE)

#mask_burn2017_fullMask_allAreas = sf::st_intersection(sf::st_make_valid(mask_burn2017), extent_sfz_300
#mask_burn2018_fullMask_allAreas = sf::st_intersection(sf::st_make_valid(mask_burn2018), extent_sfz_300
#mask_burn2021_fullMask_allAreas = sf::st_intersection(sf::st_make_valid(mask_burn2021), extent_sfz_300
#masks_df_fullMask_allAreas = full_join(as_tibble(mask_burn2017_fullMask_allAreas), as_tibble(mask_burn
#masks_sf_fullMask_allAreas = st_as_sf(masks_df_fullMask_allAreas)
#mask_clearcut_fullMask_allAreas = sf::st_intersection(mask_clearcut, st_make_valid(extent_sfz_3005)
#masks_df_fullMask_allAreas = full_join(as_tibble(masks_sf_fullMask_allAreas), as_tibble(mask_clearcut_
#masks_sf_fullMask_allAreas = st_as_sf(masks_df_fullMask_allAreas)
#mask_blocks_fullMask_allAreas = sf::st_intersection(mask_blocks, st_make_valid(extent_sfz_3005))
#masks_df_fullMask_allAreas = full_join(as_tibble(masks_sf_fullMask_allAreas), as_tibble(mask_blocks_fu
#masks_sf_fullMask_allAreas = st_as_sf(masks_df_fullMask_allAreas)
#mask_roads_fullMask_allAreas = sf::st_intersection(mask_roads, st_make_valid(extent_sfz_3005))
#mask_roads_ften_fullMask_allAreas = sf::st_intersection(mask_roads_ften, st_make_valid(extent_sfz_3005
#masks_df_fullMask_allAreas = full_join(as_tibble(masks_sf_fullMask_allAreas), as_tibble(mask_roads_ful
#masks_sf_fullMask_allAreas = st_as_sf(masks_df_fullMask_allAreas)
masks_lquan_20220627 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/tcc_masks_lqua
#masks_sf_fullMask_allAreas = sf::st_intersection(masks_lquan_20220627, st_make_valid(lead_htop_sf_allSp
masks_rast_fullMask_allAreas = rasterize(vect(masks_lquan_20220627), lead_htop_rast_allSpeciesAreas, tou
masks_raster_fullMask_allAreas = raster::raster(masks_rast_fullMask_allAreas)
writeRaster(masks_raster_fullMask_allAreas, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputa
#ggplot(masks_sf_fullMask_allAreas) + geom_sf(aes(fill = 'red'), show.legend = FALSE)
```
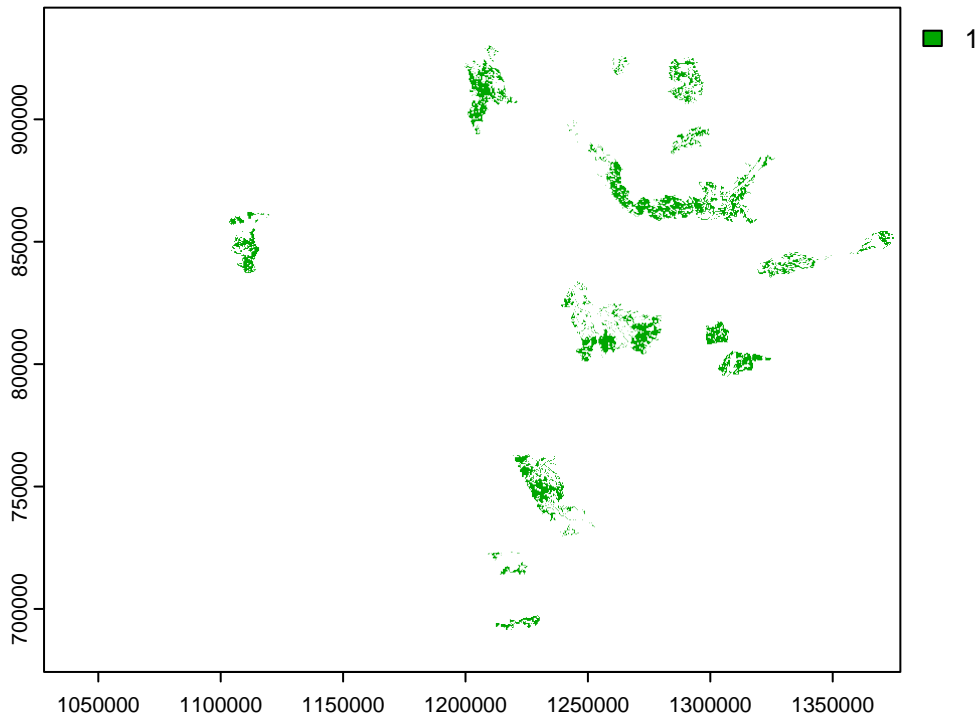
## 1.5. All-Species Areas: Apply Masking

```r
# align
lead_htop_rast_allSpeciesAreas = terra::resample(lead_htop_rast_allSpeciesAreas, elev_rast_allSpeciesAr
masks_rast_fullMask_allAreas = terra::resample(masks_rast_fullMask_allAreas, elev_rast_allSpeciesAreas)
species_class_rast_allSpeciesAreas = terra::resample(species_class_rast_allSpeciesAreas, elev_rast_allSp
# mask by mask
lead_htop_rast_allSpeciesAreas_masked = mask(lead_htop_rast_allSpeciesAreas, masks_rast_fullMask_allArea
elev_rast_allSpeciesAreas_masked = mask(elev_rast_allSpeciesAreas, masks_rast_fullMask_allAreas, invers
slope_rast_allSpeciesAreas_masked = mask(slope_rast_allSpeciesAreas, masks_rast_fullMask_allAreas, inve
asp_cos_rast_allSpeciesAreas_masked = mask(asp_cos_rast_allSpeciesAreas, masks_rast_fullMask_allAreas,
asp_sin_rast_allSpeciesAreas_masked = mask(asp_sin_rast_allSpeciesAreas, masks_rast_fullMask_allAreas,
species_class_rast_allSpeciesAreas_masked = mask(species_class_rast_allSpeciesAreas, masks_rast_fullMask
# mask by species
lead_htop_rast_allSpeciesAreas_masked = mask(lead_htop_rast_allSpeciesAreas_masked, species_class_rast_
elev_rast_allSpeciesAreas_masked = mask(elev_rast_allSpeciesAreas_masked, species_class_rast_allSpecies
slope_rast_allSpeciesAreas_masked = mask(slope_rast_allSpeciesAreas_masked, species_class_rast_allSpeci
asp_cos_rast_allSpeciesAreas_masked = mask(asp_cos_rast_allSpeciesAreas_masked, species_class_rast_allSp
asp_sin_rast_allSpeciesAreas_masked = mask(asp_sin_rast_allSpeciesAreas_masked, species_class_rast_allSp
species_class_raster_allSpeciesAreas_masked = raster::raster(species_class_rast_allSpeciesAreas_masked)
writeRaster(lead_htop_rast_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tc
writeRaster(elev_rast_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inp
writeRaster(slope_rast_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/in
writeRaster(asp_cos_rast_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/
```

```
writeRaster(asp_sin_rast_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/
writeRaster(species_class_raster_allSpeciesAreas_masked, filename = "/media/seamus/128GB_WORKD/data/ras
```

**1.6. All-Species Areas: Stack and Tidy Covariates**

```r
# Rename rasters
names(lead_htop_rast_allSpeciesAreas_masked) = "lead_htop"
names(elev_rast_allSpeciesAreas_masked) = "elev"
names(slope_rast_allSpeciesAreas_masked) = "slope"
names(asp_cos_rast_allSpeciesAreas_masked) = "asp_cos"
names(asp_sin_rast_allSpeciesAreas_masked) = "asp_sin"
names(species_class_rast_allSpeciesAreas_masked) = "species_class"
# transform spatRaster to raster
lead_htop_raster_allSpeciesAreas_masked = raster::raster(lead_htop_rast_allSpeciesAreas_masked)
elev_raster_allSpeciesAreas_masked = raster::raster(elev_rast_allSpeciesAreas_masked)
slope_raster_allSpeciesAreas_masked = raster::raster(slope_rast_allSpeciesAreas_masked)
asp_cos_raster_allSpeciesAreas_masked = raster::raster(asp_cos_rast_allSpeciesAreas_masked)
asp_sin_raster_allSpeciesAreas_masked = raster::raster(asp_sin_rast_allSpeciesAreas_masked)
species_class_raster_allSpeciesAreas_masked = raster::raster(species_class_rast_allSpeciesAreas_masked)
# stack rasters
covs_m1_allSpeciesAreas = raster::stack(
  lead_htop_raster_allSpeciesAreas_masked,
  elev_raster_allSpeciesAreas_masked,
  slope_raster_allSpeciesAreas_masked,
  asp_cos_raster_allSpeciesAreas_masked,
  asp_sin_raster_allSpeciesAreas_masked,
  species_class_raster_allSpeciesAreas_masked)
# visualize
rasterVis::levelplot(covs_m1_allSpeciesAreas)
```
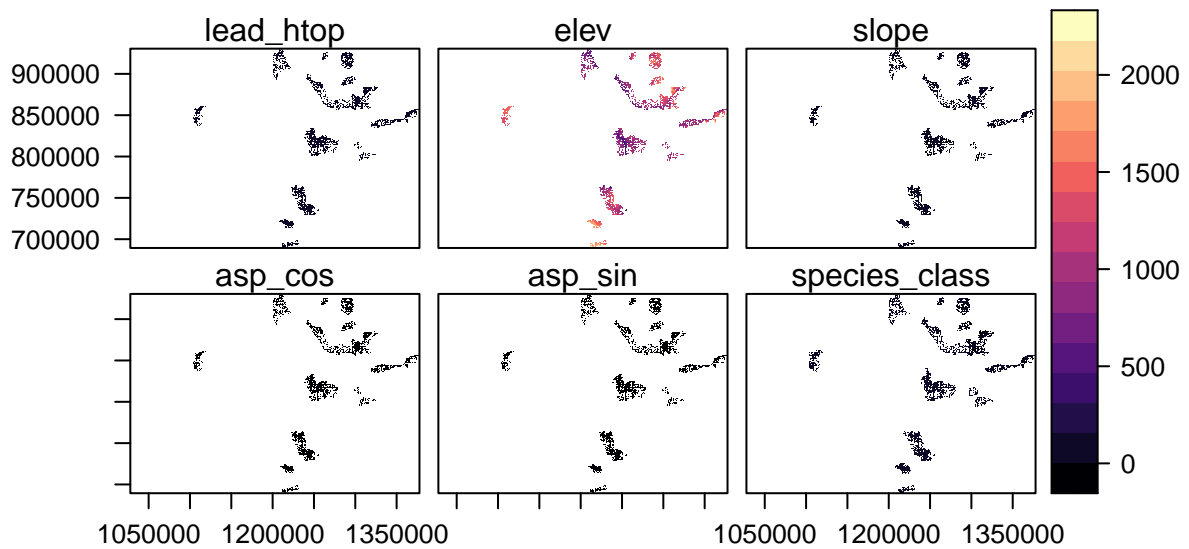
## 1.7. All Species Areas: Bootstrapping and training/test splits

```r
# Data cleaning
faib_psp <- read.csv("/media/seamus/128GB_WORKD/EFI-TCC/0_Caret_Predict_to_writeRasterOutput/Data/FAIB_
faib_psp = subset(faib_psp, util == '12.5')
faib_psp$spc_live1 = as.factor(faib_psp$spc_live1)
faib_psp =  subset(
  faib_psp, spc_live1=='PL' | spc_live1=='PLI' | spc_live1=='FD'| spc_live1=='FDI' |
    spc_live1=='SB' | spc_live1=='SE' | spc_live1=='SW' | spc_live1=='SX' |
    spc_live1=='CW' | spc_live1=='HW' | spc_live1=='BL' | spc_live1=='LW')
faib_psp$species_class = dplyr::recode(
  faib_psp$spc_live1, PL = 1, PLI = 1, SB = 2, SE = 2, SX = 2,
  FD = 3, FDI = 3, CW = 3, HW = 4, BL = 5, LW = 6)
faib_psp$asp_cos = cos((faib_psp$aspect * pi) / 180)
faib_psp$asp_sin = sin((faib_psp$aspect * pi) / 180)
faib_psp$elev[faib_psp$elev <= 0] = NA
faib_psp$slope[faib_psp$slope <= 0] = NA
faib_psp$lead_htop[faib_psp$lead_htop < 2] = NA
faib_psp$stemsha_L[faib_psp$stemsha_L <= 0] = NA
faib_psp$wsvha_L[faib_psp$wsvha_L <= 0] = NA
faib_psp = subset(faib_psp, stemsha_L < 864)
faib_psp$elev = as.numeric(faib_psp$elev)
faib_psp$slope = as.numeric(faib_psp$slope)
faib_psp$asp_cos = as.numeric(faib_psp$asp_cos)
```

```r
faib_psp$asp_sin = as.numeric(faib_psp$asp_sin)
faib_psp$lead_htop = as.numeric(faib_psp$lead_htop)
faib_psp$species_class = as.numeric(faib_psp$species_class)
faib_psp$wsvha_L = as.numeric(faib_psp$wsvha_L)
faib_vri_true_m1_df = faib_psp[c("elev", "slope", "asp_cos", "asp_sin", "lead_htop", "species_class", "
faib_vri_true_m1_df = na.omit(faib_vri_true_m1_df)
# Bootstrapping: Weighting done by full 16-area raster payload
lead_htop_raster_all_masked = raster::raster("/media/seamus/128GB_WORKD/data/raster/tcc/inputs/masked-c
lead_htop_df_all = as.data.frame(rasterToPoints(lead_htop_raster_all_masked))
dens.fun = approxfun(density(lead_htop_df_all$lead_htop_rast_allSpeciesAreas_masked_20220715vV, adjust=(
B = 1000
n = 4
faib_vri_true_m1_df_boot = dplyr::sample_n(faib_vri_true_m1_df, B * n, weight_by = dens.fun(faib_vri_tr
faib_vri_true_m1_df_boot = na.omit(faib_vri_true_m1_df_boot)
truehist(faib_vri_true_m1_df$lead_htop, main="CHM (un-Bootstrapped FAIB)")
truehist(faib_vri_true_m1_df_boot$lead_htop, main="CHM (Bootstrapped FAIB)")

faib_vri_true_m1_df_boot_split = createDataPartition(faib_vri_true_m1_df_boot$wsvha_L, p=0.80, list=F)
faib_vri_true_m1_df_split = createDataPartition(faib_vri_true_m1_df$wsvha_L, p=0.80, list=F)

train_m1_boot = faib_vri_true_m1_df_boot[faib_vri_true_m1_df_boot_split, ]
test_m1_boot = faib_vri_true_m1_df_boot[-faib_vri_true_m1_df_boot_split, ]
train_m1 = faib_vri_true_m1_df[faib_vri_true_m1_df_split, ]
test_m1 = faib_vri_true_m1_df[-faib_vri_true_m1_df_split, ]

X_train_m1_boot = train_m1_boot[,-7]
y_train_m1_boot = train_m1_boot[, 7]
X_test_m1_boot = test_m1_boot[,-7]
y_test_m1_boot = test_m1_boot[, 7]
X_m1_boot = faib_vri_true_m1_df_boot[,-7]
y_m1_boot = faib_vri_true_m1_df_boot[, 7]

X_train_m1 = train_m1[,-7]
y_train_m1 = train_m1[, 7]
X_test_m1 = test_m1[,-7]
y_test_m1 = test_m1[, 7]
X_m1 = faib_vri_true_m1_df[,-7]
y_m1 = faib_vri_true_m1_df[, 7]
```

**1.8. All-Species Areas: Modeling WSVHA Estimates with Random Forest Regression**

```r
tuneResult_rf_m1_full <- tune.randomForest(
  X_m1_boot, y_m1_boot,
  mtry = c(2:10), ntree = 50,
  tunecontrol = tune.control(sampling = "cross", cross = 10),
  preProcess = c('YeoJohnson', 'scale', 'center', 'corr'))

tuneResult_rf_m1_train <- tune.randomForest(
  X_train_m1_boot, y_train_m1_boot,
  mtry = c(2:10), ntree = 50,
  tunecontrol = tune.control(sampling = "cross", cross = 10),
```

```
   preProcess = c('YeoJohnson', 'scale', 'center', 'corr'))
tunedModel_rf_m1_full <- tuneResult_rf_m1_full$best.model
tunedModel_rf_m1_train <- tuneResult_rf_m1_train$best.model
tunedModel_rf_m1 = predict(tunedModel_rf_m1_full, newdata=faib_vri_true_m1_df, type = "response")
tunedModel_rf_m1_test = predict(tunedModel_rf_m1_train, newdata=test_m1, type = "response")
save(tunedModel_rf_m1_full, file = "/media/seamus/128GB_WORKD/data/models/tcc-wsvha/wsvha_model1_randoml
tuneResult_rf_m1_full
R2(tunedModel_rf_m1, faib_vri_true_m1_df$wsvha_L)
MAE(tunedModel_rf_m1, faib_vri_true_m1_df$wsvha_L)
RMSE(tunedModel_rf_m1, faib_vri_true_m1_df$wsvha_L)
MAE(tunedModel_rf_m1_test, test_m1$wsvha_L)
RMSE(tunedModel_rf_m1_test, test_m1$wsvha_L)

wsvha_model1_randomForest_bootstrapped_demBased_100m_allSpeciesAreas <- raster::predict(covs_m1_allSpeci
wsvha_model1_randomForest_bootstrapped_demBased_100m_allSpeciesAreas$layer[wsvha_model1_randomForest_boo
writeRaster(wsvha_model1_randomForest_bootstrapped_demBased_100m_allSpeciesAreas, overwrite=TRUE,
  filename = "/media/seamus/128GB_WORKD/data/raster/tcc/outputs/wsvha/bootstrapped/wsvha_model1_randomFc
plot(wsvha_model1_randomForest_bootstrapped_demBased_100m_allSpeciesAreas, main="WSVHA for all-Species (
hist(wsvha_model1_randomForest_bootstrapped_demBased_100m_allSpeciesAreas, main="WSVHA for all-Species (
```
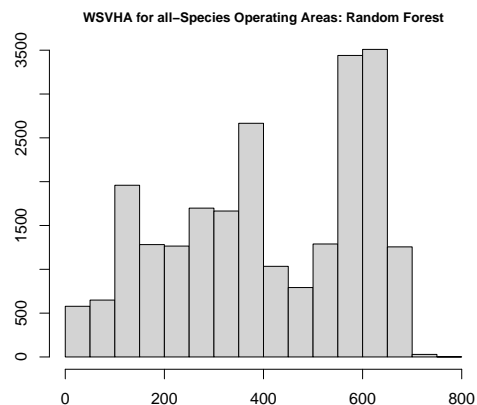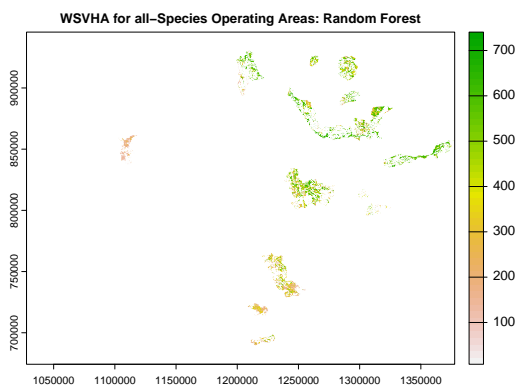


## 2. Quesnel Lake: Includes areas for all species (Fd and non-Fd stands), and developed cutblocks for validation purposes

### 2.1. Quesnel Lake: Import DEM & CHM

```
filez_be_quesnel = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/BareEarth", full.nam
elev_raster_list_quesnel <- lapply(filez_be_quesnel, raster)
elev_raster_quesnel = do.call(merge, c(elev_raster_list_quesnel, tolerance = 1))
elev_rast_quesnel = terra::rast(elev_raster_quesnel)
terra::crs(elev_rast_quesnel) = "epsg:3005"
elev_rast_quesnel = terra::aggregate(elev_rast_quesnel, fact = 100, fun = mean)
writeRaster(elev_rast_quesnel, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/elev_ras
elev_raster_quesnel = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/elev_raster_l
elev_rast_quesnel = terra::rast(elev_raster_quesnel)

filez_vh_quesnel = list.files("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/VegHt", full.names =
```
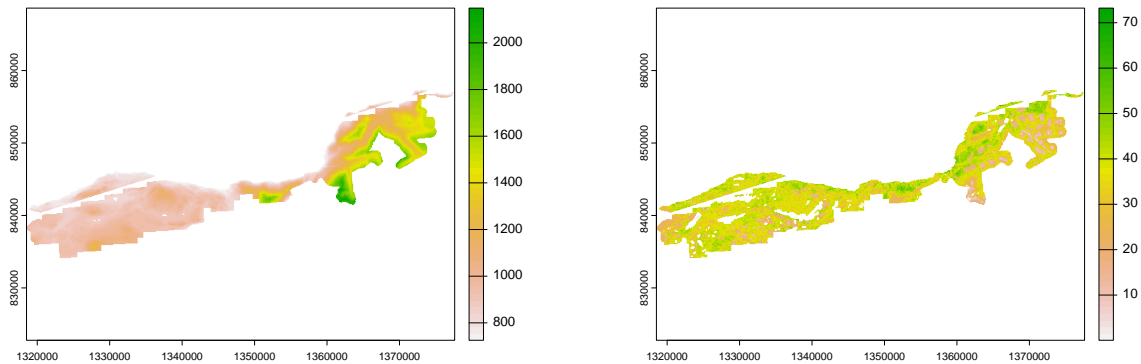
```
lead_htop_raster_list_quesnel <- lapply(filez_vh_quesnel, raster)
lead_htop_raster_quesnel = do.call(merge, c(lead_htop_raster_list_quesnel, tolerance = 1))
lead_htop_rast_quesnel = terra::rast(lead_htop_raster_quesnel)
terra::crs(lead_htop_rast_quesnel) = "epsg:3005"
lead_htop_rast_quesnel = terra::aggregate(lead_htop_rast_quesnel, fact = 100, fun = max)
lead_htop_rast_quesnel = terra::resample(lead_htop_rast_quesnel, elev_rast_quesnel)
writeRaster(lead_htop_rast_quesnel, filename = "/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/lea
lead_htop_raster_quesnel = raster::raster("/media/seamus/Ubuntu 22_04 LTS amd64/mosaics/quesnel/lead_hto
lead_htop_rast_quesnel = terra::rast(lead_htop_raster_quesnel)
```



## 2.2. Quesnel Lake: Derive Terrain Rasters

```
slope_rast_quesnel = terra::terrain(elev_rast_quesnel, v="slope", unit="degrees", neighbors=8)
aspect_rast_quesnel = terra::terrain(elev_rast_quesnel, v="aspect", unit="degrees", neighbors=8)
asp_cos_rast_quesnel = cos((aspect_rast_quesnel*pi)/180)
asp_sin_rast_quesnel = sin((aspect_rast_quesnel*pi)/180)
writeRaster(elev_rast_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unmasked-cov
writeRaster(slope_rast_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unmasked-co
writeRaster(asp_cos_rast_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unmasked-
writeRaster(asp_sin_rast_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unmasked-
writeRaster(lead_htop_rast_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/unmaske
```
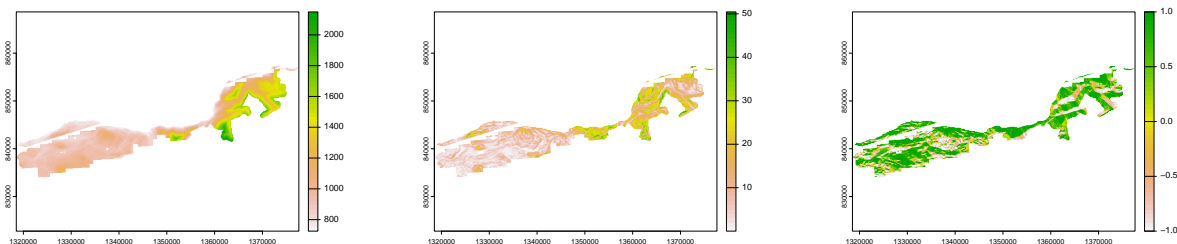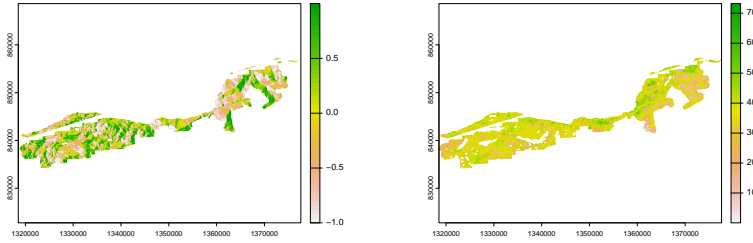
## 2.3. Quesnel Lake: Derive Species Raster

```r
lead_htop_sv_quesnel = as.polygons(lead_htop_rast_quesnel)
lead_htop_sf_quesnel = sf::st_as_sf(lead_htop_sv_quesnel)
vri_sf = read_sf("/media/seamus/128GB_WORKD/data/vector/vri/vri_tcc_lquan_20220627.shp")
#vri_species = vri_sf[c("SPECIES_CD", "SPECIES_PC")]
vri_species =  dplyr::filter(vri_sf,
    SPECIES_CD=='PL' | SPECIES_CD=='PLI' | SPECIES_CD=='FD' | SPECIES_CD=='FDI' |
    SPECIES_CD=='SB' | SPECIES_CD=='SE' | SPECIES_CD=='SW' | SPECIES_CD=='SX' |
    SPECIES_CD=='CW' | SPECIES_CD=='HW' | SPECIES_CD=='BL' | SPECIES_CD=='LW')
vri_species_allspecies = vri_species
vri_species_allspecies$SPECIES_CD = dplyr::recode(vri_species$SPECIES_CD,
  PL = 0, PLI = 0, SB = 1, SE = 1, SW = 1, SX = 1, FD = 2, FDI = 2, CW = 3, HW = 4, BL = 5, LW = 6)
vri_species_allspecies = dplyr::rename(vri_species_allspecies, species_class = SPECIES_CD)
vri_species_allspecies = vri_species_allspecies["species_class"]
vri_species_allspecies_sf = sf::st_as_sf(vri_species_allspecies)
vri_species_aoi_quesnel = st_intersection(vri_species_allspecies_sf, st_make_valid(lead_htop_sf_quesnel)
species_class_rast_quesnel = terra::rasterize(vect(vri_species_aoi_quesnel), lead_htop_rast_quesnel, fie
species_class_rast_quesnel = terra::resample(species_class_rast_quesnel, lead_htop_rast_quesnel)
species_class_raster_quesnel = raster::raster(species_class_rast_quesnel)
raster::writeRaster(species_class_raster_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc,
```
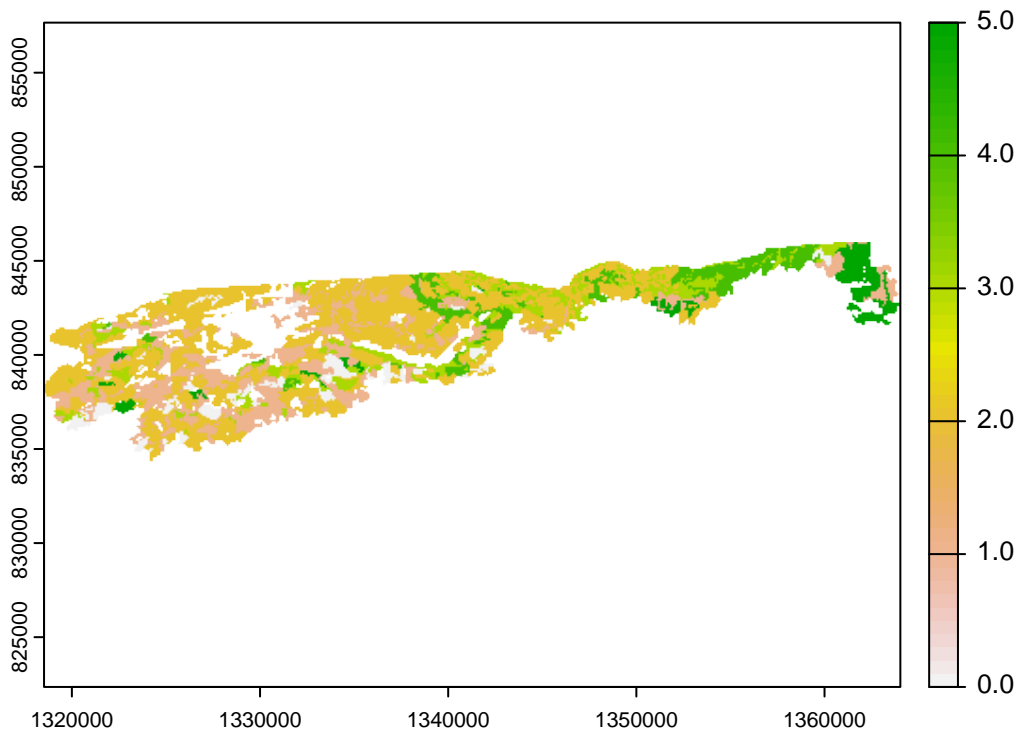
## 2.4. Quesnel Lake: Derive Mask to Include Estimates of "RESULTS, TCC_Blocks" Areas

```
#mask_burn2017 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity T
#mask_burn2018 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity T
#mask_burn2021 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Burn_Severity T
#mask_burn2017 = mask_burn2017["BurnSev"]
#mask_burn2018 = mask_burn2018["BurnSev"]
#mask_burn2021 = mask_burn2021["BurnSev"]
#mask_burn2017 = dplyr::filter(mask_burn2017, BurnSev == 'High')
#mask_burn2018 = dplyr::filter(mask_burn2018, BurnSev == 'High')
#mask_burn2021 = dplyr::filter(mask_burn2021, BurnSev == 'High')
#mask_roads = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Roads.shp")
#mask_roads = sf::st_zm(mask_roads)
#mask_roads = sf::st_buffer(mask_roads, dist = 15, nQuadSegs = 5, endCapStyle = "ROUND", joinStyle = "R
#mask_roads_ften = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/FTEN_Roads_All.sh
#mask_roads_ften = sf::st_zm(mask_roads_ften)
#mask_roads_ften = sf::st_buffer(mask_roads_ften, dist = 15, nQuadSegs = 5, endCapStyle = "ROUND", join
#mask_clearcut = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/RSLT_CCRES_CLEAR.sh
#mask_blocks = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/TCC_Blocks_Join.shp")

#mask_burn2017_devBlocks_quesnel = sf::st_intersection(sf::st_make_valid(mask_burn2017), lead_htop_sf_q
#mask_burn2018_devBlocks_quesnel = sf::st_intersection(sf::st_make_valid(mask_burn2018), lead_htop_sf_q
#mask_burn2021_devBlocks_quesnel = sf::st_intersection(sf::st_make_valid(mask_burn2021), lead_htop_sf_q
#masks_df_devBlocks_quesnel = full_join(as_tibble(mask_burn2017_devBlocks_quesnel), as_tibble(mask_burn
```

```r
#masks_sf_devBlocks_quesnel = st_as_sf(masks_df_devBlocks_quesnel)
#mask_roads_devBlocks_quesnel = sf::st_intersection(mask_roads, st_make_valid(lead_htop_sf_quesnel))
#mask_roads_ften_devBlocks_quesnel = sf::st_intersection(mask_roads_ften, st_make_valid(lead_htop_sf_qu
#masks_df_devBlocks_quesnel = full_join(as_tibble(masks_sf_devBlocks_quesnel), as_tibble(mask_roads_dev
#masks_sf_devBlocks_quesnel = st_as_sf(masks_df_devBlocks_quesnel)
#masks_lquan_20220627 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/tcc_masks_lqu
masks_lquan_20220627 = sf::read_sf("/media/seamus/128GB_WORKD/data/vector/tcc_mask_layers/tcc_masks_lqua
st_crs(masks_lquan_20220627) = 3005
#masks_sf_devBlocks_quesnel = sf::st_intersection(masks_lquan_20220627, st_make_valid(lead_htop_sf_quest
masks_rast_devBlocks_quesnel = rasterize(vect(masks_lquan_20220627), lead_htop_rast_quesnel, touches = T
masks_raster_devBlocks_quesnel = raster::raster(masks_rast_devBlocks_quesnel)
writeRaster(masks_raster_devBlocks_quesnel, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/input
ggplot(masks_sf_devBlocks_quesnel) + geom_sf(aes(fill = 'red'), show.legend = FALSE)
```
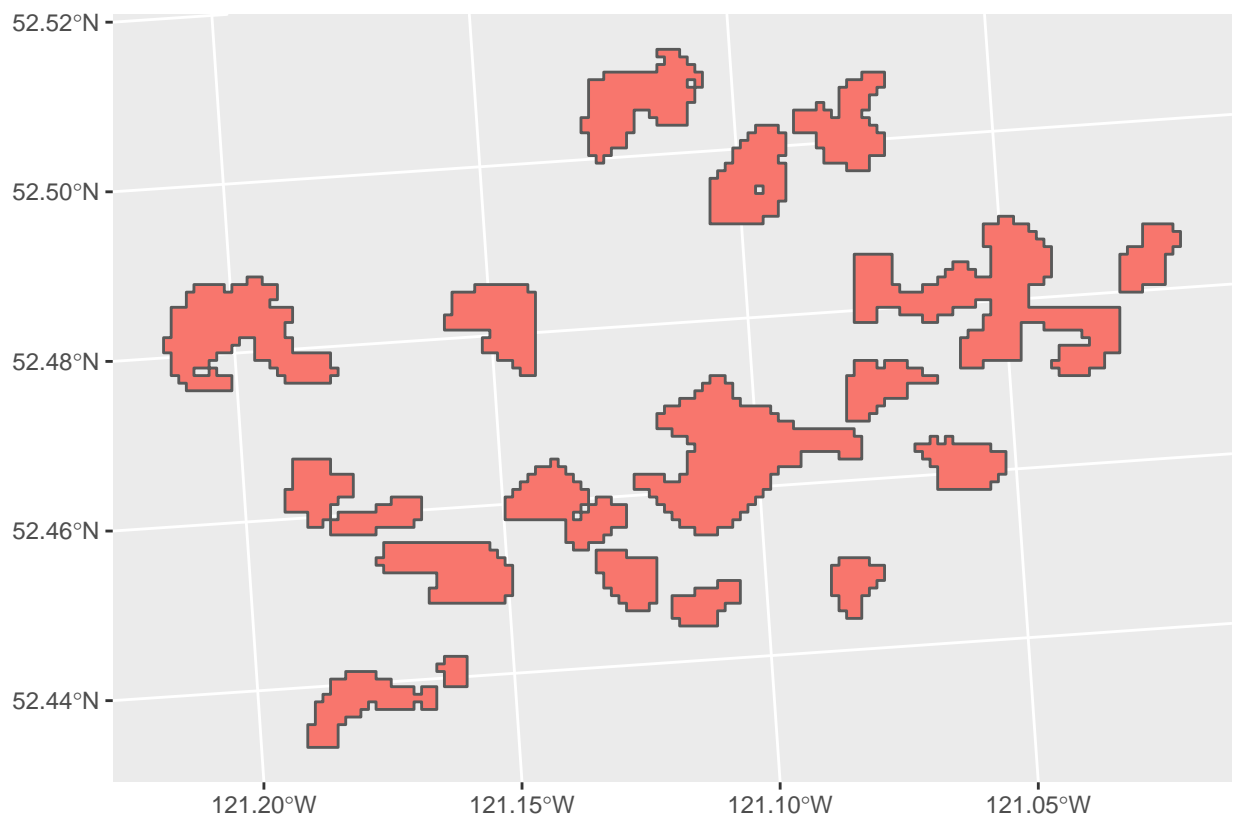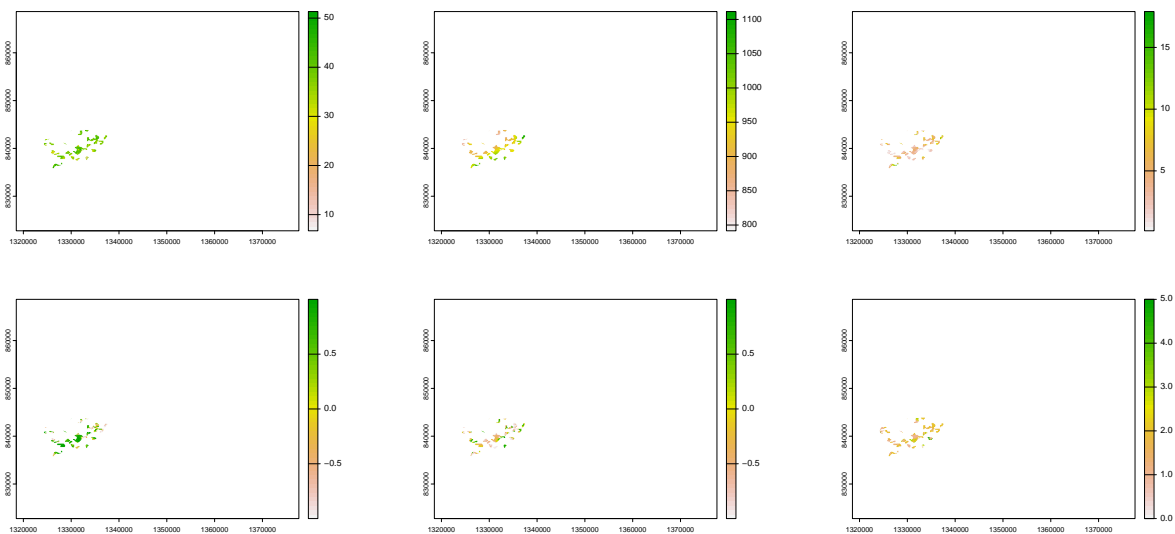


## 2.5. Quesnel Lake: Apply Masking

```r
# mask by mask
lead_htop_rast_quesnel = terra::resample(lead_htop_rast_quesnel, elev_rast_quesnel)
masks_rast_devBlocks_quesnel = terra::resample(masks_rast_devBlocks_quesnel, elev_rast_quesnel)
species_class_rast_quesnel = terra::resample(species_class_rast_quesnel, elev_rast_quesnel)
lead_htop_rast_quesnel_masked = mask(lead_htop_rast_quesnel, masks_rast_devBlocks_quesnel, inverse=FALSE
elev_rast_quesnel_masked = mask(elev_rast_quesnel, masks_rast_devBlocks_quesnel, inverse=FALSE)
slope_rast_quesnel_masked = mask(slope_rast_quesnel, masks_rast_devBlocks_quesnel, inverse=FALSE)
```

```
asp_cos_rast_quesnel_masked = mask(asp_cos_rast_quesnel, masks_rast_devBlocks_quesnel, inverse=FALSE)
asp_sin_rast_quesnel_masked = mask(asp_sin_rast_quesnel, masks_rast_devBlocks_quesnel, inverse=FALSE)
species_class_rast_quesnel_masked = mask(species_class_rast_quesnel, masks_rast_devBlocks_quesnel, inver
# mask by species
lead_htop_rast_quesnel_masked = mask(lead_htop_rast_quesnel_masked, species_class_rast_quesnel_masked,
elev_rast_quesnel_masked = mask(elev_rast_quesnel_masked, species_class_rast_quesnel_masked, inverse=FAL
slope_rast_quesnel_masked = mask(slope_rast_quesnel_masked, species_class_rast_quesnel_masked, inverse=F
asp_cos_rast_quesnel_masked = mask(asp_cos_rast_quesnel_masked, species_class_rast_quesnel_masked, inver
asp_sin_rast_quesnel_masked = mask(asp_sin_rast_quesnel_masked, species_class_rast_quesnel_masked, inver
# save outputs
writeRaster(lead_htop_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs,
writeRaster(elev_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/mask
writeRaster(slope_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/mas
writeRaster(asp_cos_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/ma
writeRaster(asp_sin_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inputs/ma
writeRaster(species_class_rast_quesnel_masked, filename = "/media/seamus/128GB_WORKD/data/raster/tcc/inp
```



## 2.6. Quesnel Lake: Stack and Tidy Covariates

```
# Rename rasters
names(lead_htop_rast_quesnel_masked) = "lead_htop"
names(elev_rast_quesnel_masked) = "elev"
names(slope_rast_quesnel_masked) = "slope"
names(asp_cos_rast_quesnel_masked) = "asp_cos"
names(asp_sin_rast_quesnel_masked) = "asp_sin"
names(species_class_rast_quesnel_masked) = "species_class"
# transform spatRaster to raster
lead_htop_raster_quesnel_masked = raster::raster(lead_htop_rast_quesnel_masked)
elev_raster_quesnel_masked = raster::raster(elev_rast_quesnel_masked)
slope_raster_quesnel_masked = raster::raster(slope_rast_quesnel_masked)
asp_cos_raster_quesnel_masked = raster::raster(asp_cos_rast_quesnel_masked)
asp_sin_raster_quesnel_masked = raster::raster(asp_sin_rast_quesnel_masked)
```

```
species_class_raster_quesnel_masked = raster::raster(species_class_rast_quesnel_masked)
# stack rasters
covs_m1_quesnel = raster::stack(
  lead_htop_raster_quesnel_masked,
  elev_raster_quesnel_masked,
  slope_raster_quesnel_masked,
  asp_cos_raster_quesnel_masked,
  asp_sin_raster_quesnel_masked,
  species_class_raster_quesnel_masked)
# visualize
rasterVis::levelplot(covs_m1_quesnel)
```
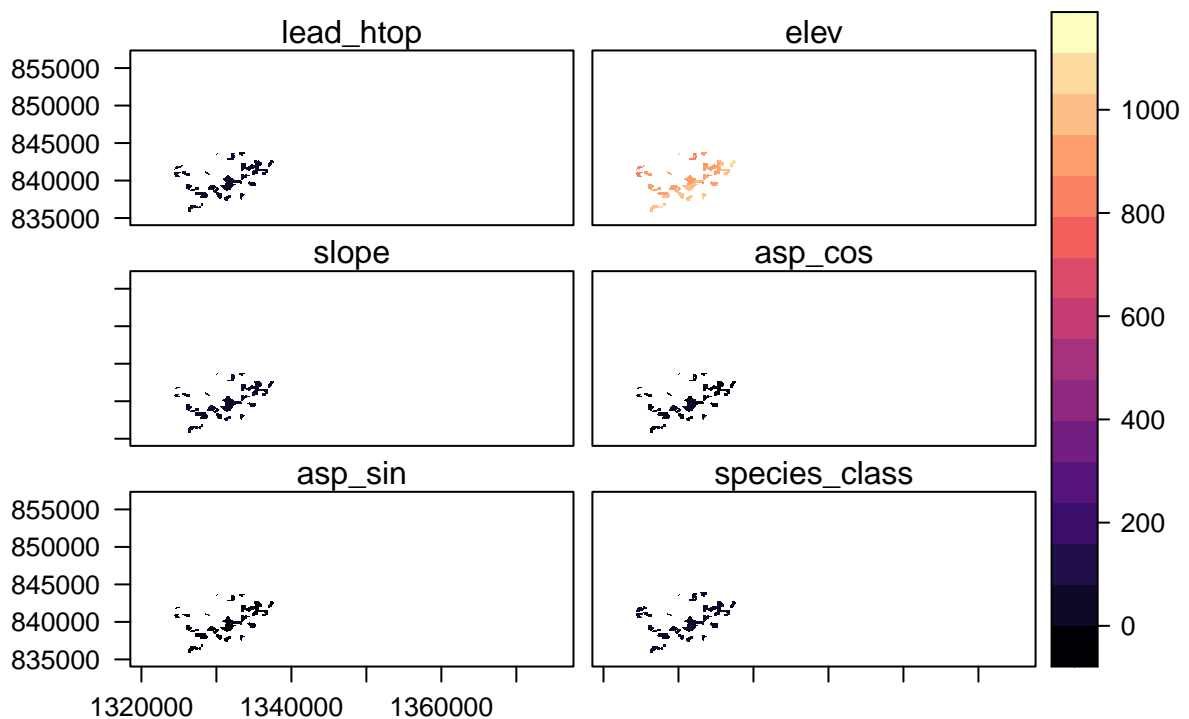


## 2.7. Quesnel Lake: Modeling WSVHA Estimates with Random Forest Regression

```
wsvha_model1_randomForest_bootstrapped_demBased_100m_quesnelANDdevBlocks <- raster::predict(covs_m1_que
wsvha_model1_randomForest_bootstrapped_demBased_100m_quesnelANDdevBlocks$layer[wsvha_model1_randomFores
writeRaster(wsvha_model1_randomForest_bootstrapped_demBased_100m_quesnelANDdevBlocks, overwrite=TRUE,
  filename = "/media/seamus/128GB_WORKD/data/raster/tcc/outputs/wsvha/bootstrapped/wsvha_model1_randomF
plot(wsvha_model1_randomForest_bootstrapped_demBased_100m_quesnelANDdevBlocks, main="Quesnel WSVHA: Ran
hist(wsvha_model1_randomForest_bootstrapped_demBased_100m_quesnelANDdevBlocks, main="Quesnel WSVHA: Ran
```

**Quesnel Developed Blocks WSVHA**

**Quesnel Developed Blocks WSVHA**