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**ESS162 Lab5: CA wildland ecology**

**Create and hand in 4 images based on ArcGIS – 1) big view of biomass over shaded relief, 2) big view of WHR over shaded relief, 3) zoom view of biomass over shaded relief, 4) zoom view of WHR over shaded relief.**

Maps of biomass over shaded relief were made in QGIS

Map

Description automatically generated

Map

Description automatically generated

Maps of WHR class over shaded relief were made in ArcGIS

Map

Description automatically generated

Map

Description automatically generated

The map is zoomed in and covers the Bay region and parts of the Central Valley and the Sierra Nevada Mountains.

**Make line plots of the average (or mode) elevation gradients of vegetation type through tree death (5 properties) and include**

**Explain the average (or mode) elevation gradients**

**Chart, scatter chart

Description automatically generated**

Orographic lifting and the resulting rain shadow effect helps to explain the pattern in elevation and precipitation. As moist air that originates from the Pacific Ocean travels to the east, it gets lifted by the Coast Ranges, the Klamath Mountains, and the Sierra Nevadas. During the lifting process, air masses cool and condenses into precipitation, and the further it rises, the more it will cool and the more precipitation is produced. Therefore, precipitation initially increases with elevation. However, this relationship falters at elevations higher than 2000 m. A possible explanation for this is the width of the mountain ranges over which the air masses travel. As air initially travels up the western slopes of the mountain ranges, there is a positive correlation between elevation and precipitation due to the orographic effect. However, when air masses reach summits on the western edge of the mountain ranges, they might then descend and warm adiabatically before encountering another upwards slope further to the east of the same mountain range and is then lifted again. However, because air masses had dropped a significant portion of their precipitation on the western slopes of the mountain ranges, they will drop less precipitation as they travel up these slopes that are further to the east but are part of the same mountain ranges. As a result, the correlation between elevation and precipitation falters at elevations higher than 2000 m.

There is a strong negative correlation between elevation and both minimum and maximum temperatures. This can be explained by the relationship between the pressure, volume, and temperature of gases. Atmospheric pressure decreases with elevation, resulting in the same amount of heat in an air parcel being spread over a larger volume, which leads to lower temperatures.

The relationship between actual evapotranspiration (AET), biomass, and elevation can be explained by both temperatures and biomass. Initially, AET increases with elevation due to increasing vegetation biomass with elevation. As vegetation biomass increases, an ecosystem’s total leaf surface area tends to increase, allowing for increased rates of transpiration that increases AET. This initial increase in vegetation biomass is a function of temperature and precipitation: the initial decrease in temperature allows photosynthesis to increase so that plants can fix more carbon; in addition, the increase in precipitation with elevation allows for plants to have more access to water, decreasing the risk of water stress and allowing plants to have higher rates of transpiration in order to build more biomass.

The trend between AET and elevation reverses at elevations higher than roughly 1000 m. As elevation continues to increases, temperatures drop below the optimum for photosynthesis, resulting in decreased photosynthesis that leads to decreased vegetation biomass and, subsequently, decreased AET. In addition, temperatures continue to drop with elevation, which is a contributing factor in the decrease in AET with elevation.

There seems to be an initial negative correlation between runoff. This initial decreasing trend can be explained by the increase in AET from increasing biomass that outpaces the increase in precipitation with elevation. However, runoff fairly consistently increases with elevation at elevations higher than 1000 m. This increase is initially driven by an increase in precipitation with elevation due to orographic lifting and then by decreasing AET with elevation due to decreasing vegetation biomass and temperatures.

The relationship between tree death and elevation seems to match the relationship between biomass and elevation. Therefore, it would seem that tree death is proportional to vegetation biomass: as vegetation biomass increases, so does the amount of tree death.

**Make the following scatterplots and include: AET vs Biomass, Tmax vs Biomass, Precip vs Biomass**

**Explain the scatter plots**

Graphical user interface, chart, scatter chart

Description automatically generated

This plots on the left were made by plotting raw values that weren’t averaged into elevation bands, while the plot on the right was made by plotting averaged elevation band values.

There is a positive relationship between vegetation biomass and AET, as vegetation biomass is a key control of AET. As vegetation biomass increases, the number of leaves to conduct transpiration also increases, resulting in increased AET.

The positive relationship between vegetation biomass and precipitation, on the other hand, is determined by precipitation rather than vegetation. As precipitation increases, plants have more access to water, allowing for more stomata to be opened, more leaves to be built for more stomata, and longer growing seasons, resulting in higher rates of photosynthesis that leads to higher vegetation biomass.

The relationship between temperature and vegetation biomass can be explained by the effects of temperature on photosynthesis. Photosynthesis tends to have a temperature optimum and is limited at high temperatures due to photorespiration and water stress and limited at low temperatures. Because photosynthesis is the main method by which plants build biomass, vegetation biomass mimics the pattern between temperature and photosynthesis.