Exploring Beaver Habitats Using a SETS Approach

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The bank downstream is flooding!
Well... Dam it!

The North American Beaver

- The beaver is the second largest rodent in the world and belongs to the Castidore family in the suborder Sciuromorpha of the order Rodentia.
- Beavers prefer to build their dams in small-medium sized streams with low gradient that flow through valleys, and they usually populate the lowest gradient sections first.
- Beavers inhabit areas with vegetation for food and structure. They prefer aspen, cottonwood and willows for food

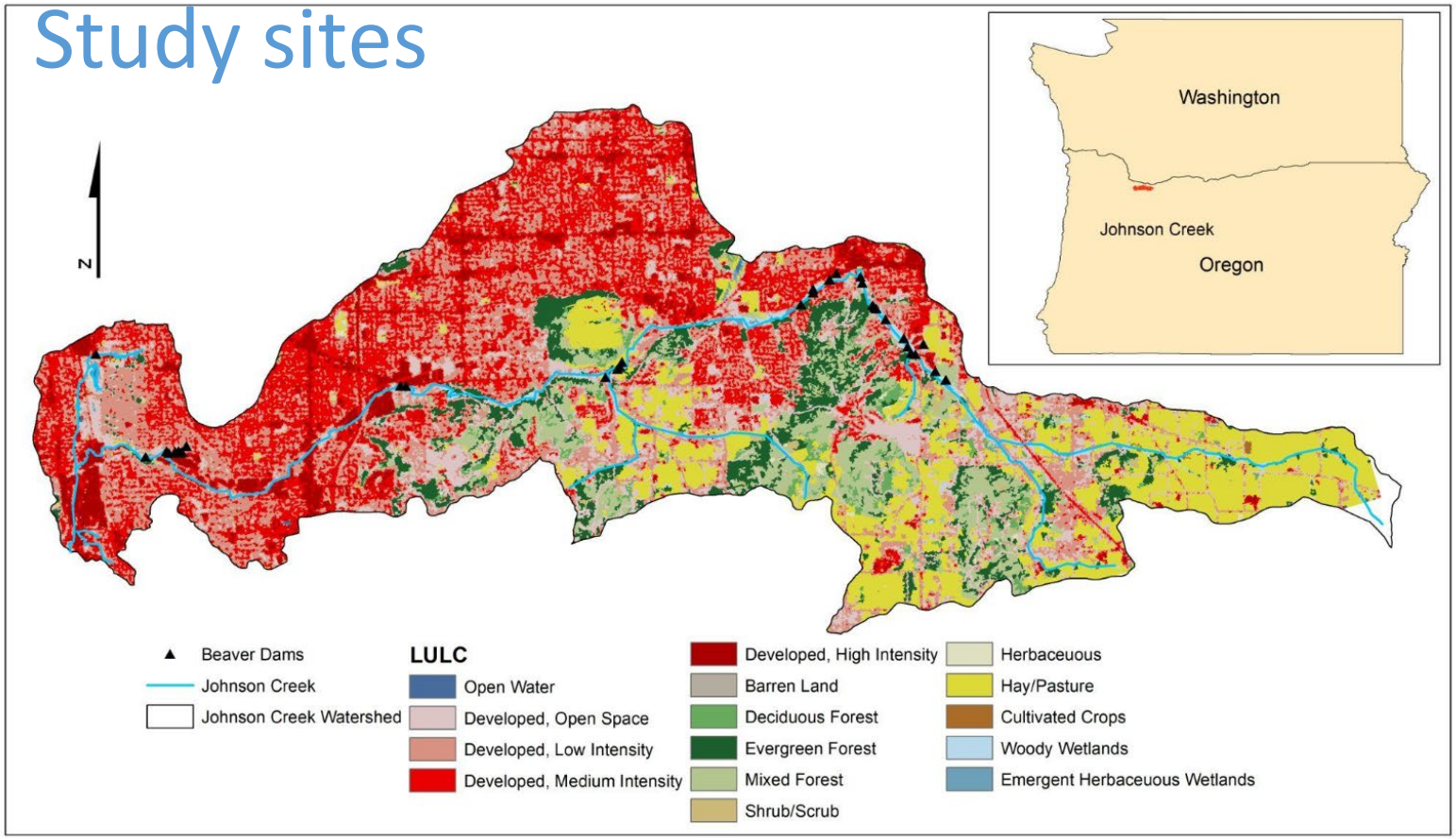
"Do beavers even know what they are doing or do they just see water flowing down a river and think "absolutely not"?

~ Random Meme

Setting

- Beavers are native to Oregon and have played a crucial role in the state's history
- Johnson Creek in Portland is home to a North American Beaver population
- Surrounding areas are continuously being developed, creating more impervious surfaces and runoff

Study sites


N
Washington
Johnson Creek
Oregon
Beaver Dams
Johnson Creek
Johnson Creek Watershed
LULC
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Herbaceuous
Hay/Pasture
Cultivated Crops
Woody Wetlands
Emergent Herbaceuous Wetlands

Impacts of Beaver Populations

- Beaver dams create new wetland areas that are beneficial to fish, invertebrates and plants by retaining groundwater and trapping debris.
- They also cool water temperatures by creating habitat that is suitable for trees that will eventually provide shade. Deep pools behind dams also provide cooler water towards the bottom.
- In Europe, beaver ponds have been shown to increase the self-purification capacity of small, polluted streams (Pollock et al.,2015)

Factors Impacting Beaver Dam Site

- Vegetation and elevation often play a large role in where beavers decide to inhabit
- In high elevation areas, beaver are often found above 11,000 feet in Willow fields. However, elevation likely won't play a role in Johnson Creek
- Deciduous trees are generally used for dam construction, and wood/stumps under 25 cm in diameter were crucial, coupled with soft fast draining soil (Coblentz and Hackler, 1993)

Important Consideration

- One piece of literature pointed out that by observing previously established beaver sites, it may over-emphasize certain characteristics since the land has already been altered to a large extent.
- A study conducted 2015-2017 in the upper Missouri River observed newly colonized beaver segments and compared them to uncolonized sections.
- Newly settled stream segments had relatively low gradients, narrow channels, high channel complexity, high canopy cover of woody riparian vegetation, and low-lying areas adjacent to the stream.
- Thus, a comprehensive social, ecological and technological variable analysis may be helpful in understanding beaver habitats better

Research Questions

Why do beavers return to the same locations to build their habitats?

How do ecological and technological factors influence their decision at different scales?

Conceptual Framework

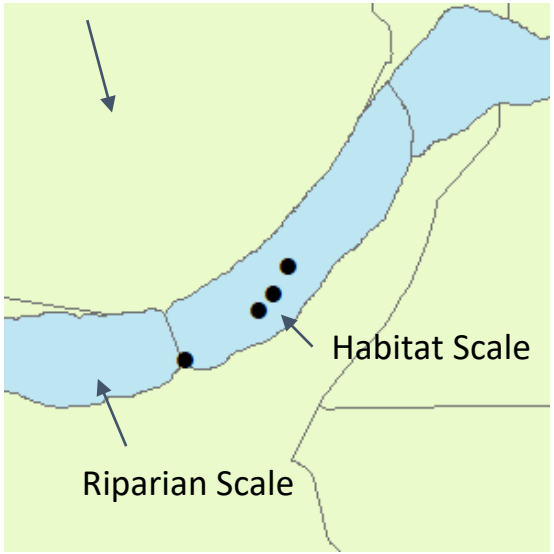
A framework for studying the distribution of Beaver Dams using the intersection of social-ecological-technological systems (SETS)

Adapted from (Chang et al., 2021, Sus City Soc)

Data and Methods

- A set of ecological and technological variables that are likely to determine beaver habitats
- Several types of GIS layers (e.g. NLCD, Canopy, DEM)
- Processed the data on ArcMap (GIS software) and summarized the variables at Beaver habitat-scale, Riparian-scale, and CBG-scale
- This presentation focuses on Habitat-scale

CBG Scale

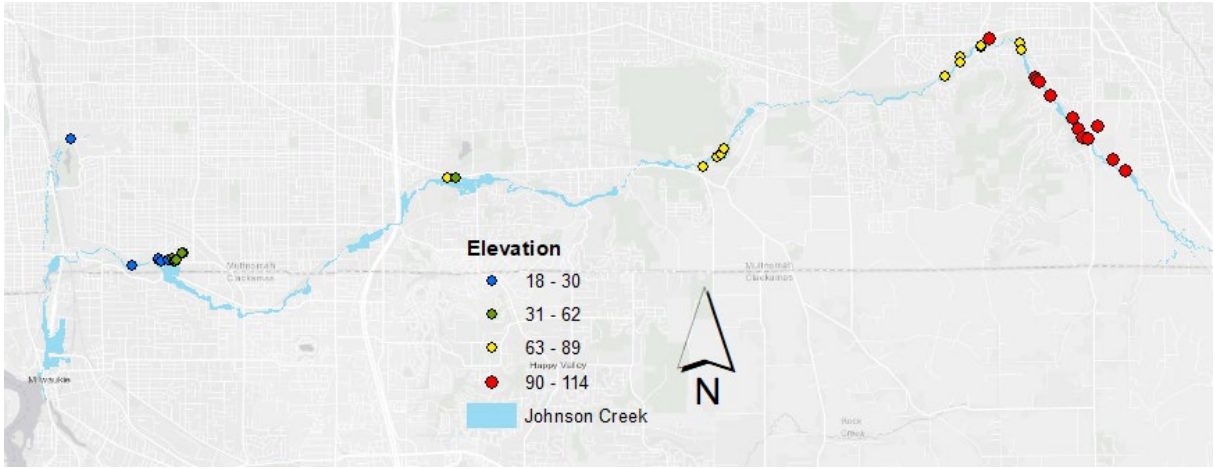


Beaver Habitat Scale

Ecological Variables	Technological Variables
Elevation	Distance to Bridges
Slope	Distance to Storm Pipes
Aspect	Distance to Culverts
Distance from Floodplain	Land Cover within 50 m
Channel Width	Land Cover within 100 m
Canopy	Street Length

Ecological Variables - Results

Elevation (Meters)

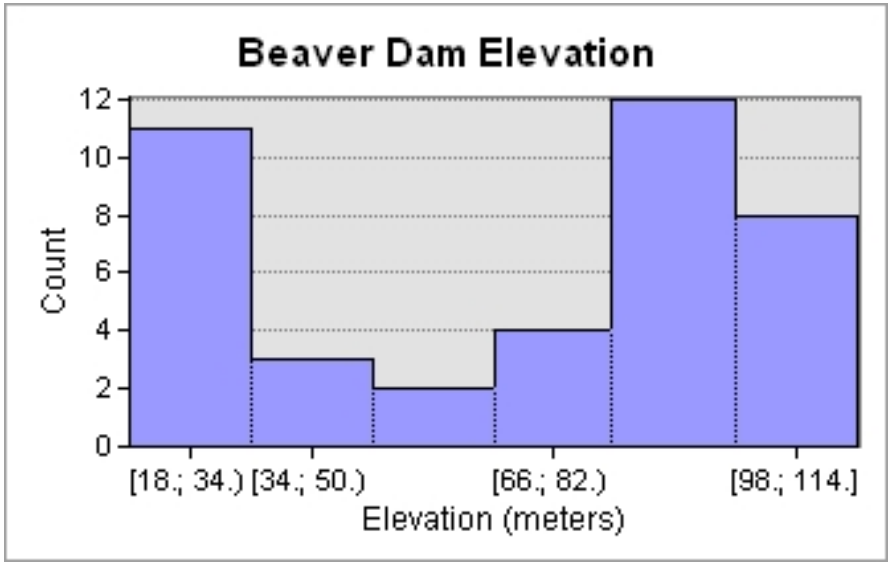


Average: 69

Minimum: 18

Maximum: 114

Standard Dev: 30



Slope (Degrees)

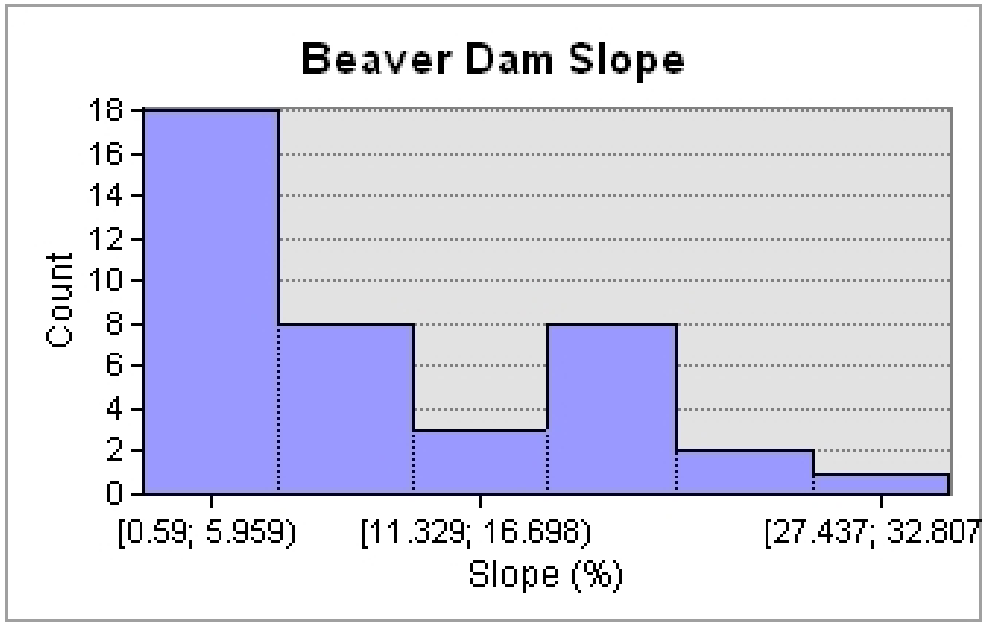
Average: 10

Minimum: 0.5

Maximum: 33

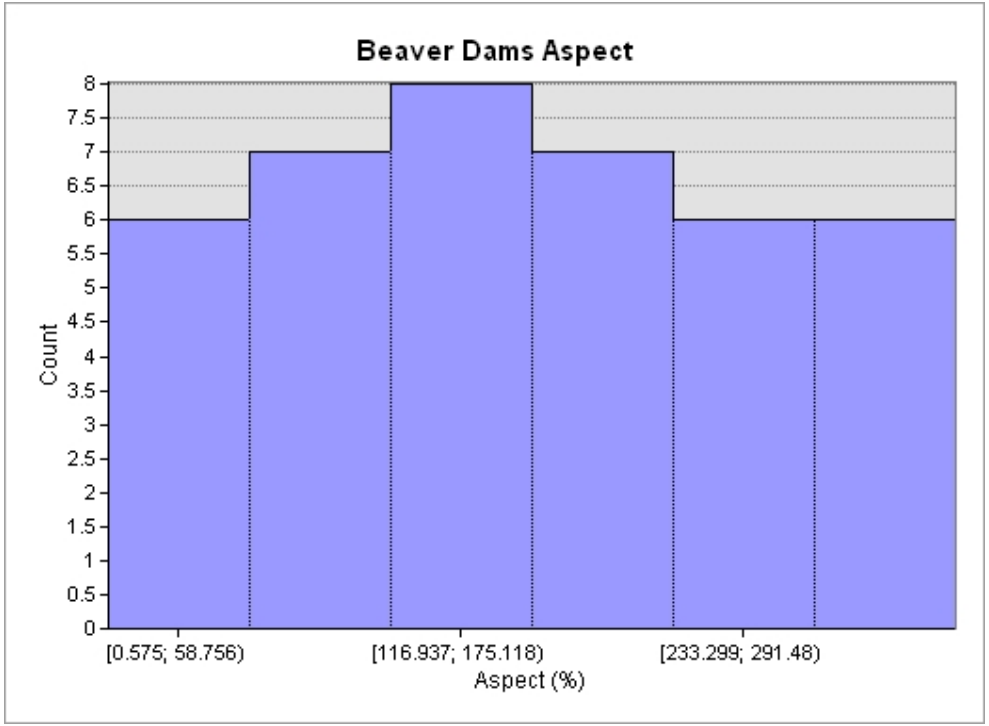
Standard Dev: 8

Observation: Beavers prefer flatter surfaces



Aspect (%)

Mean: 169
Minimum: 0.5
Maximum: 350
Standard Dev: 101



Observation: Beavers typically build their dams facing all directions except west

Canopy (50 m radius)

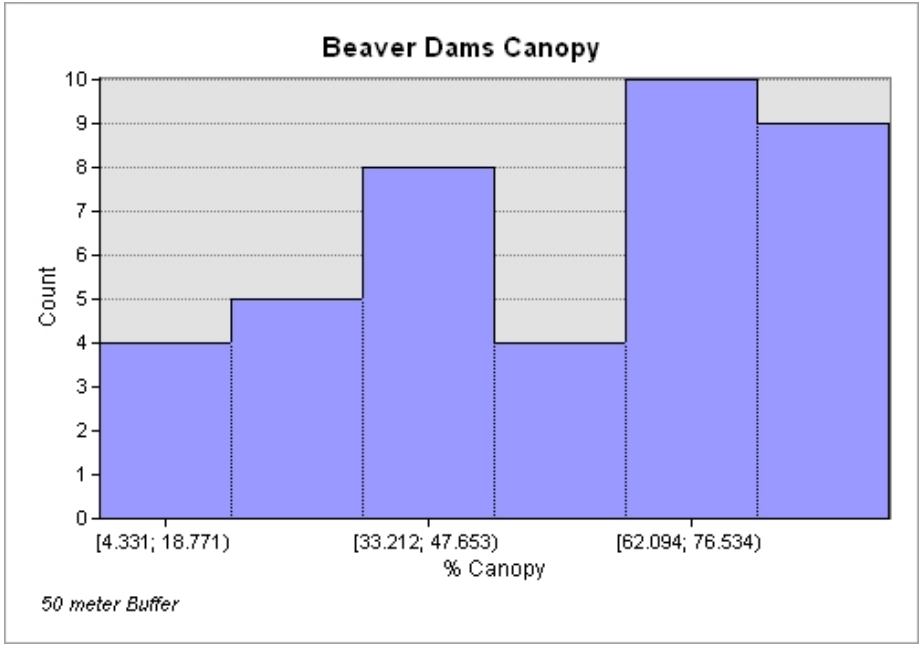
Average: 54%

Minimum: 4%

Maximum: 91%

Standard Dev: 25%

Observation:
Beavers need plenty of canopy



Canopy (100 m radius)

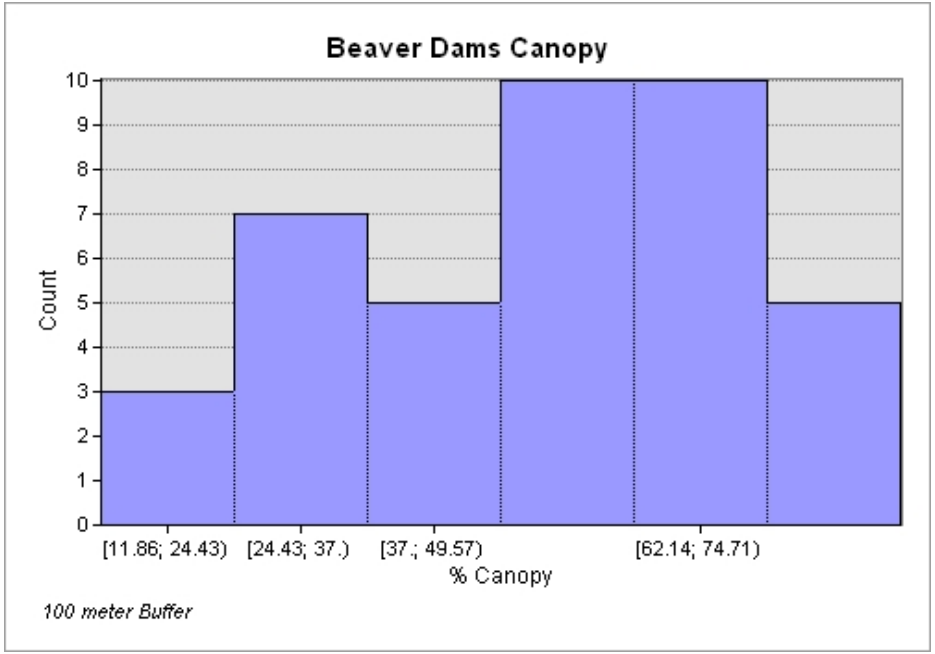
Average: 53%

Minimum: 12%

Maximum: 87%

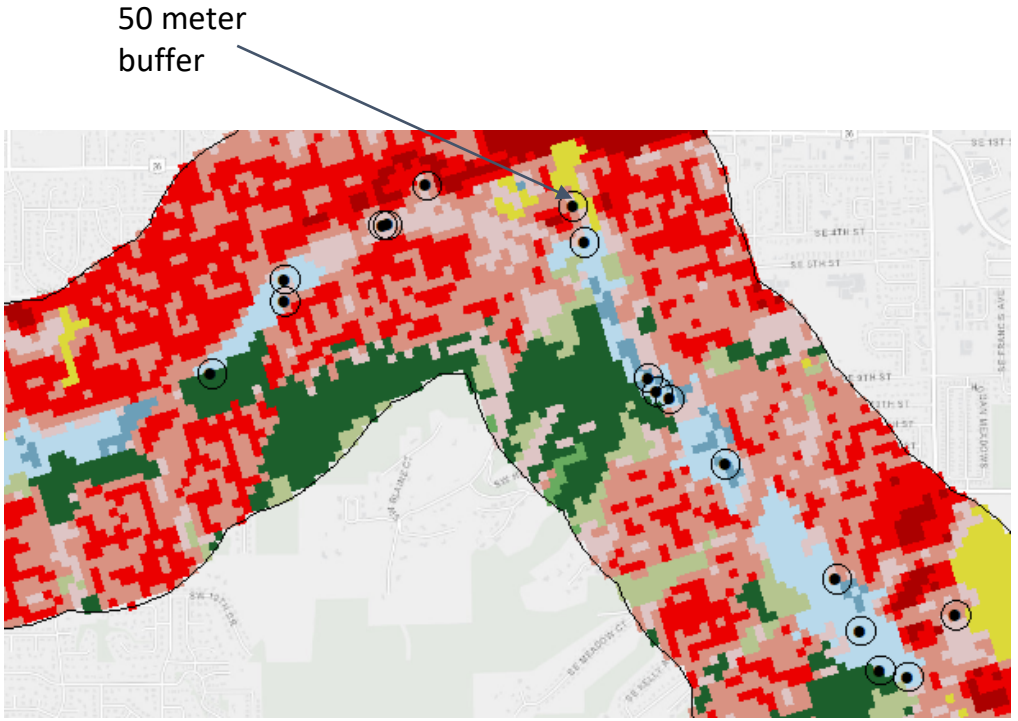
Standard Dev: 20%

Observation:
Beavers need plenty of canopy



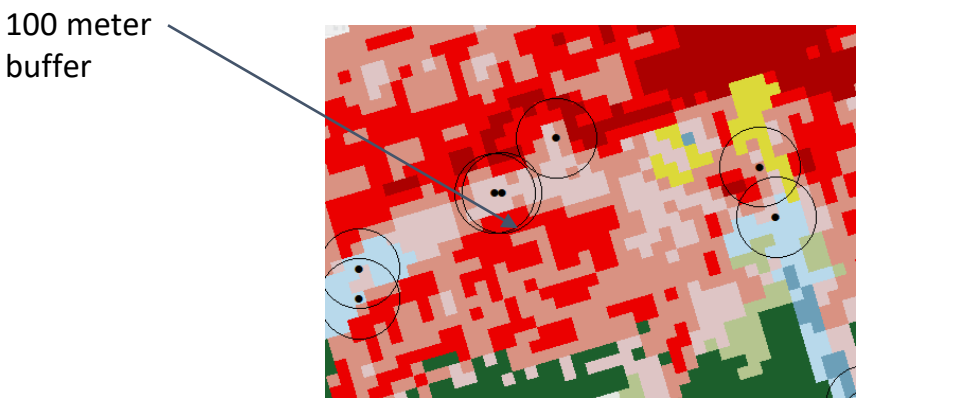
Dominant land cover class at the 50 meter buffer scale

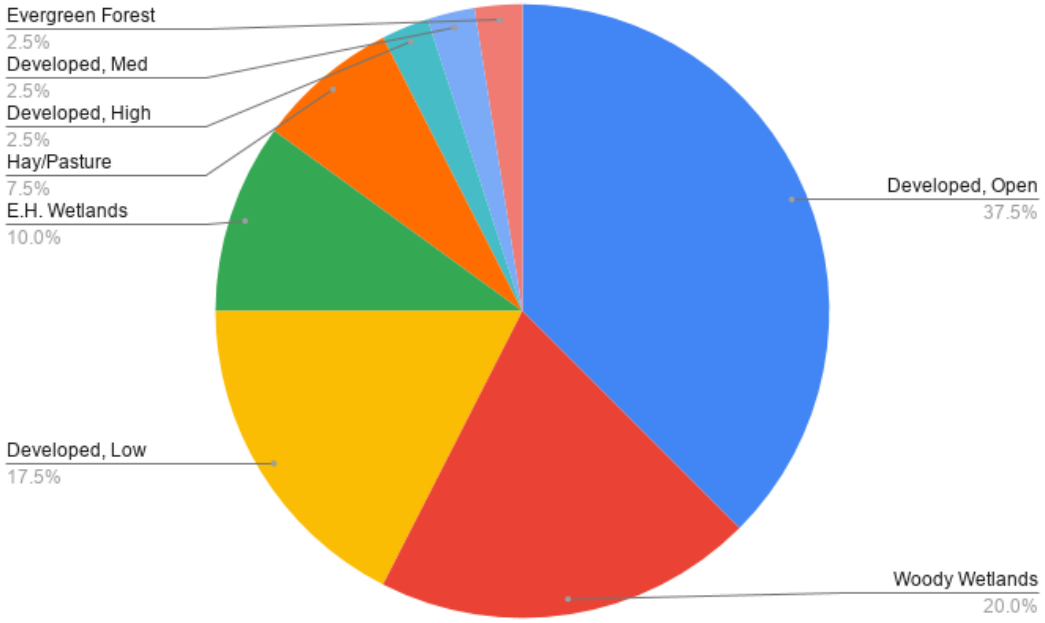
Developed	Developed, Open Space - 10
	Developed, Low Intensity- 7
	Developed, High Intensity - 1
Wetland	E.H. Wetlands - 8
	Woody Wetlands - 8
Agriculture	Hay/Pasture - 3
	Shrub/Scrub - 2
	Herbaceous - 1



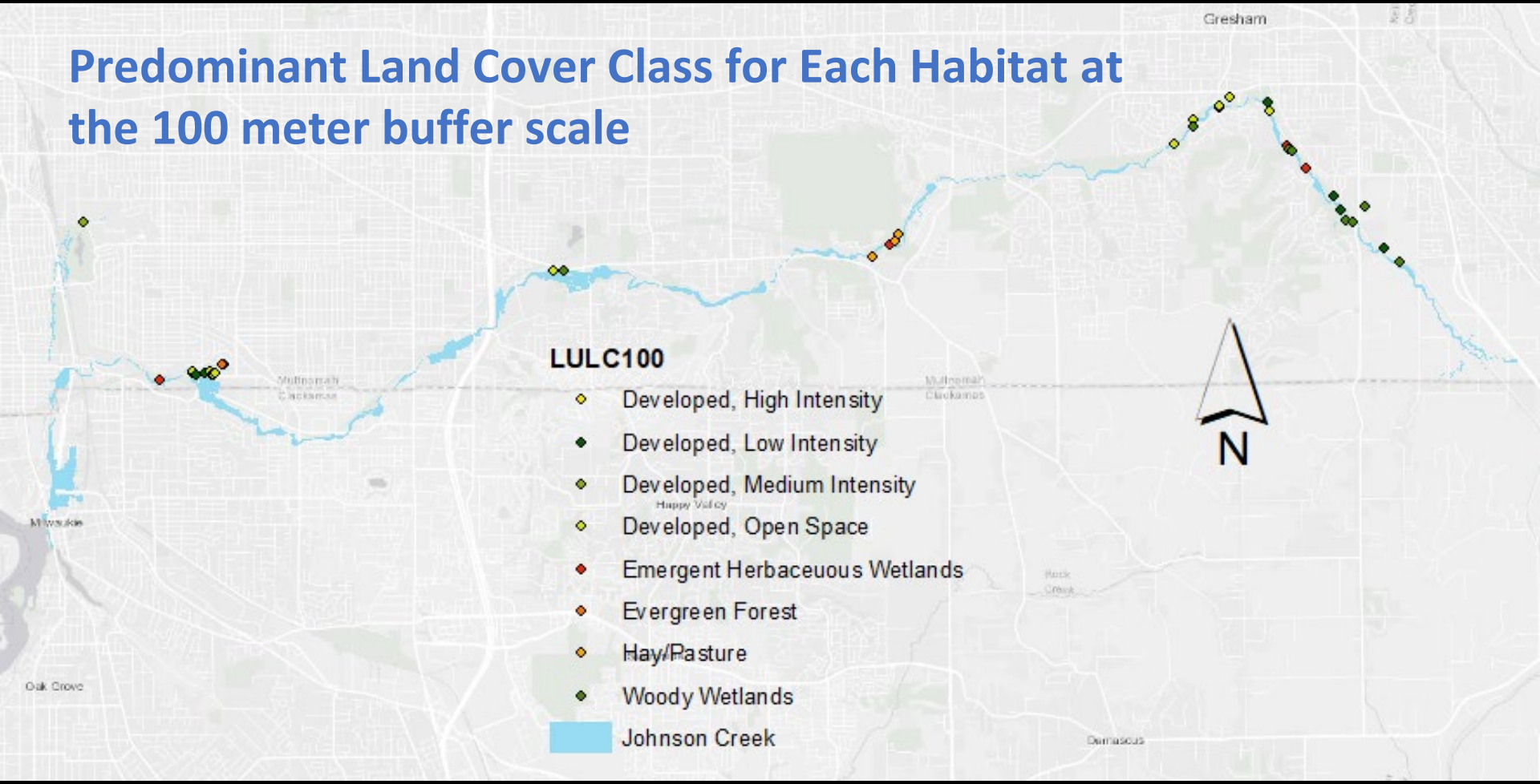
Dominant land cover class at the 100 meter buffer scale

Developed	Developed, Open Space - 15 Developed, Low Intensity- 7 Developed, High Intensity - 1 Developed, Med Intensity - 1
Wetlands	Woody Wetlands - 8 E.H. Wetlands - 4
Agriculture	Hay/Pasture - 3



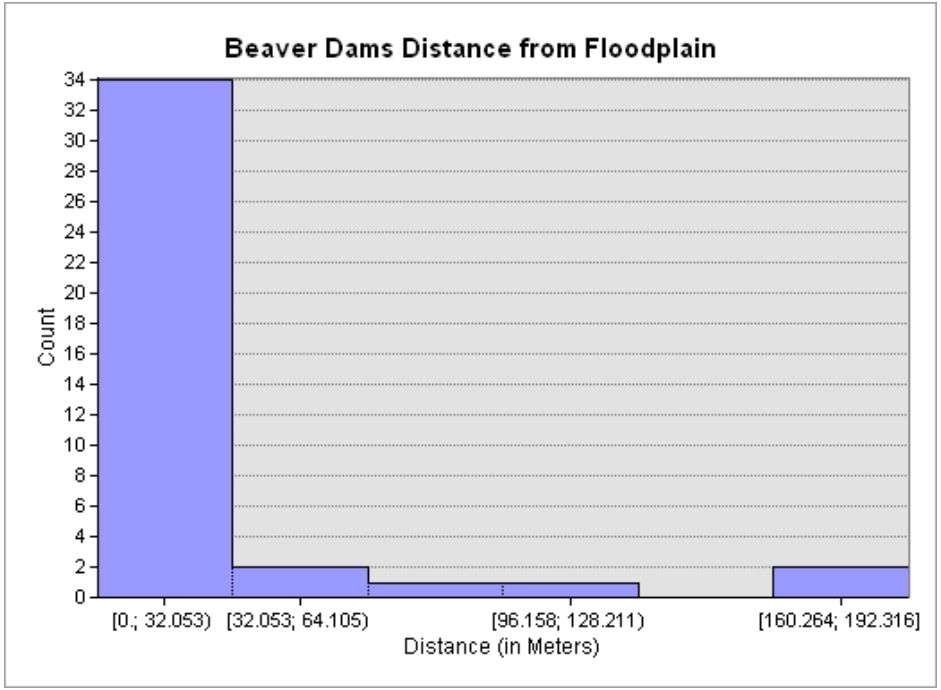


Predominant Land Cover Class for Each Habitat at the 100 meter buffer scale



Distance from Floodplain (meters)

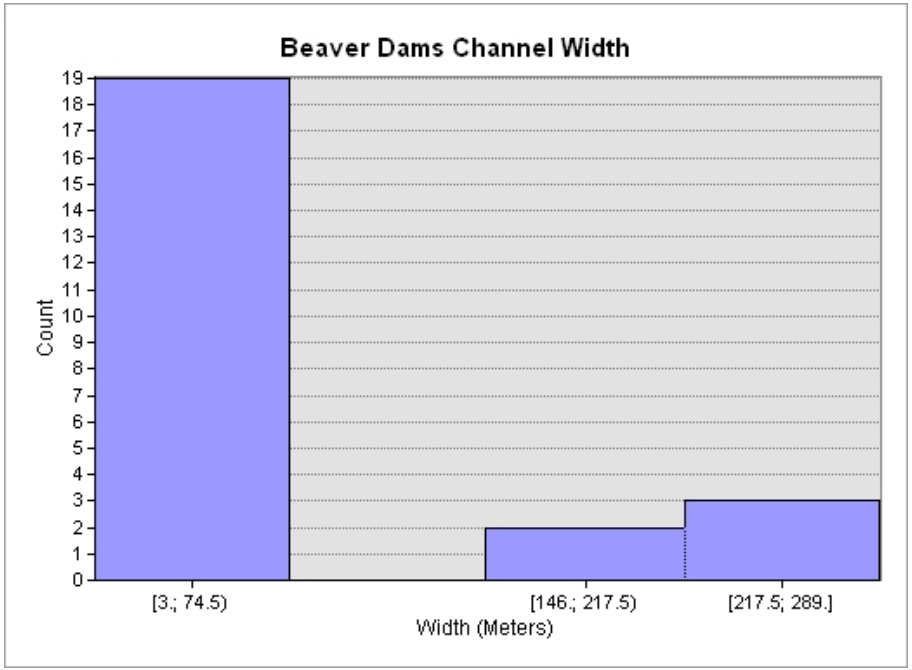
Mean: 18
Min: 0
Max: 192
Std: 46



Observation:

Beavers live close to water or floodplain than away from it

Channel Width (meters)



Mean: 73
Min: 3
Max: 289
Std: 84

Observation:

Beavers generally prefer smaller width as it is easier to build dams across

Technological Variables - Results

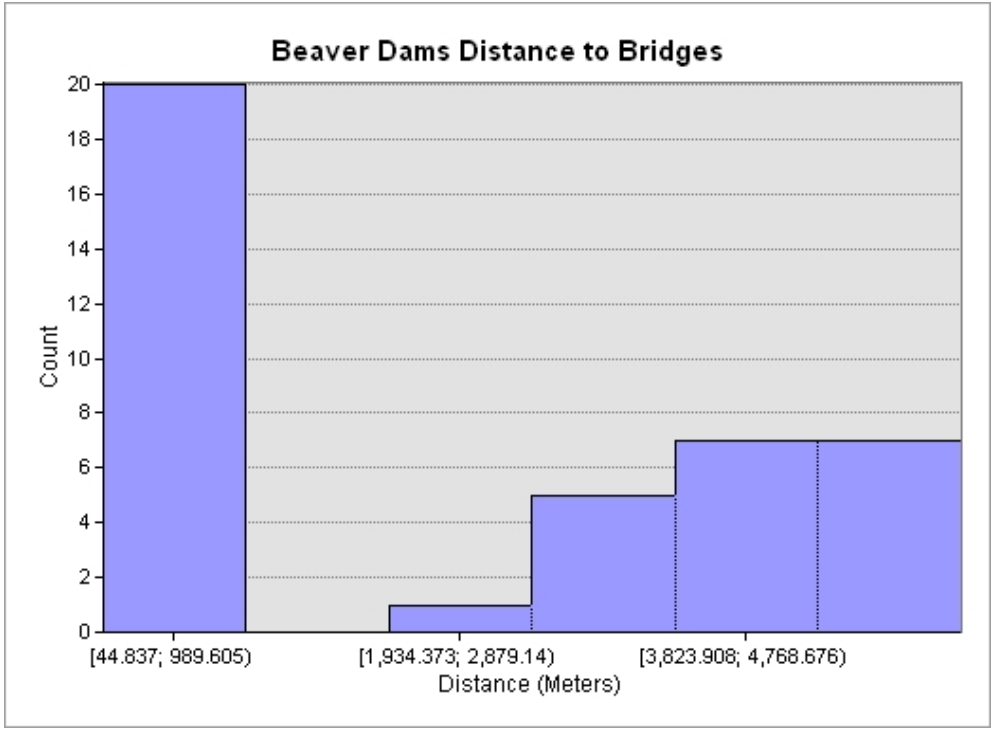
Distance to Bridges (meters)

Mean: 2234

Minimum: 45

Maximum: 5713

Standard Deviation: 2093



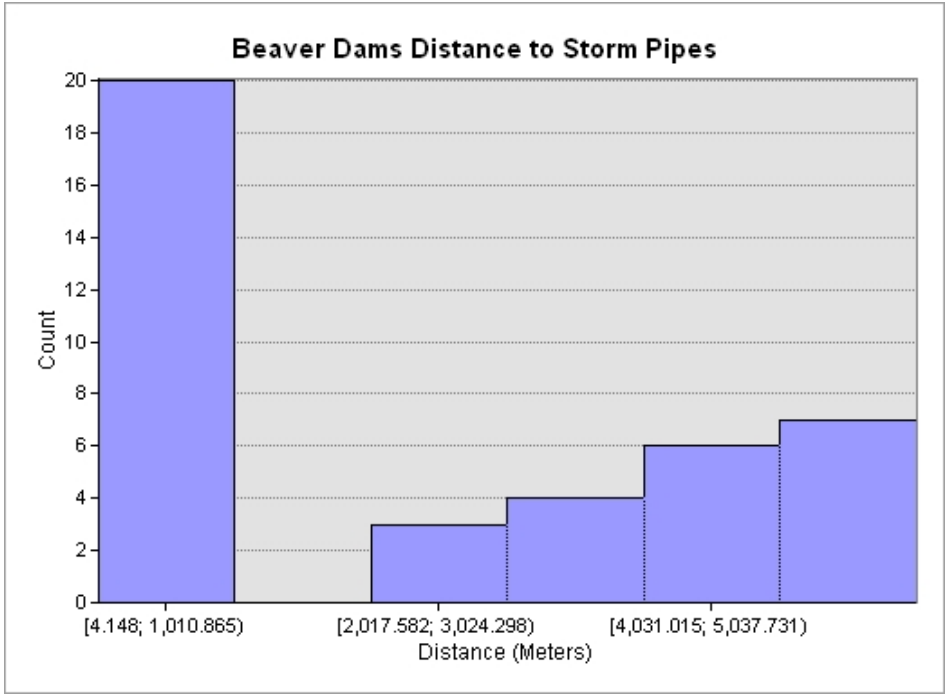
Distance to Storm Pipes (meters)

Mean: 2255

Minimum: 4

Maximum: 6044

Standard Deviation: 2300



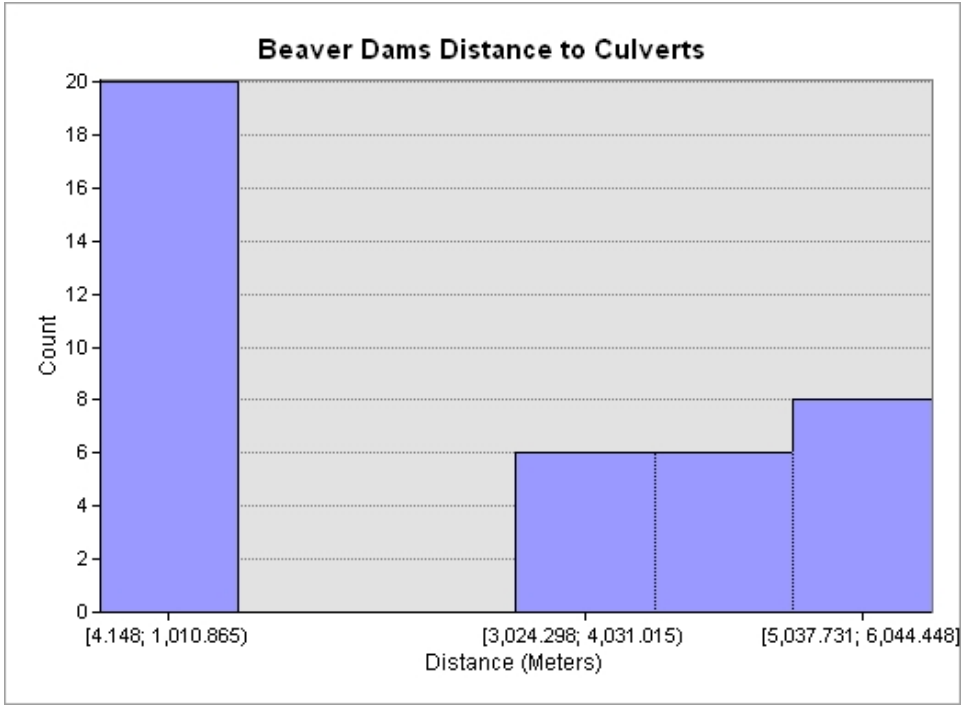
Distance to Culverts (meters)

Mean: 2404

Minimum: 4

Maximum: 6044

Standard Deviation: 2387



Street Length (50m radius)

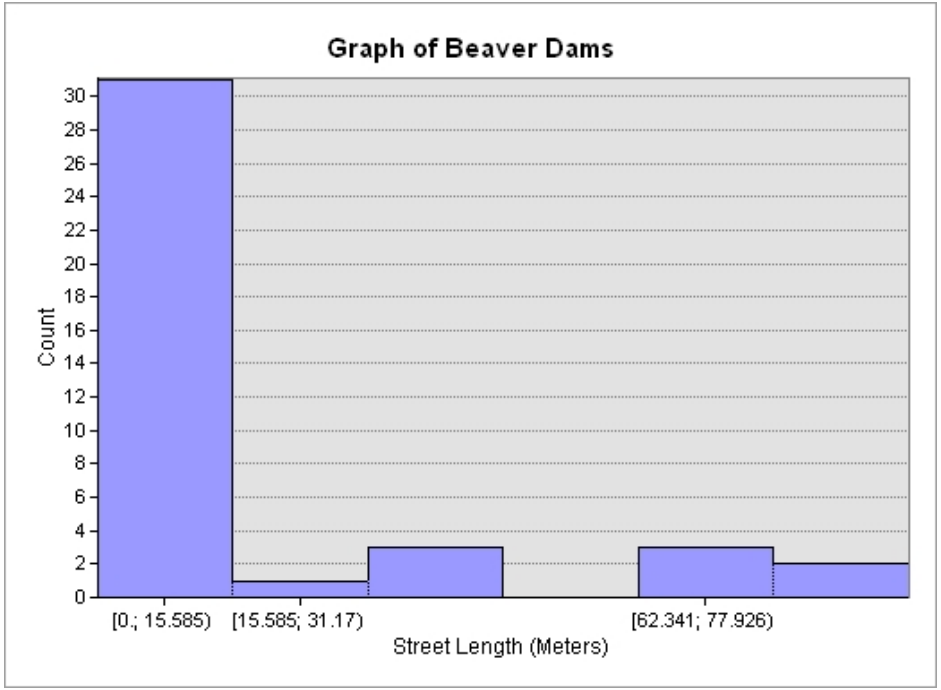
Mean: 14

Minimum: 0

Maximum: 94

Standard Deviation: 27

Not significant



Street Length (100m radius)

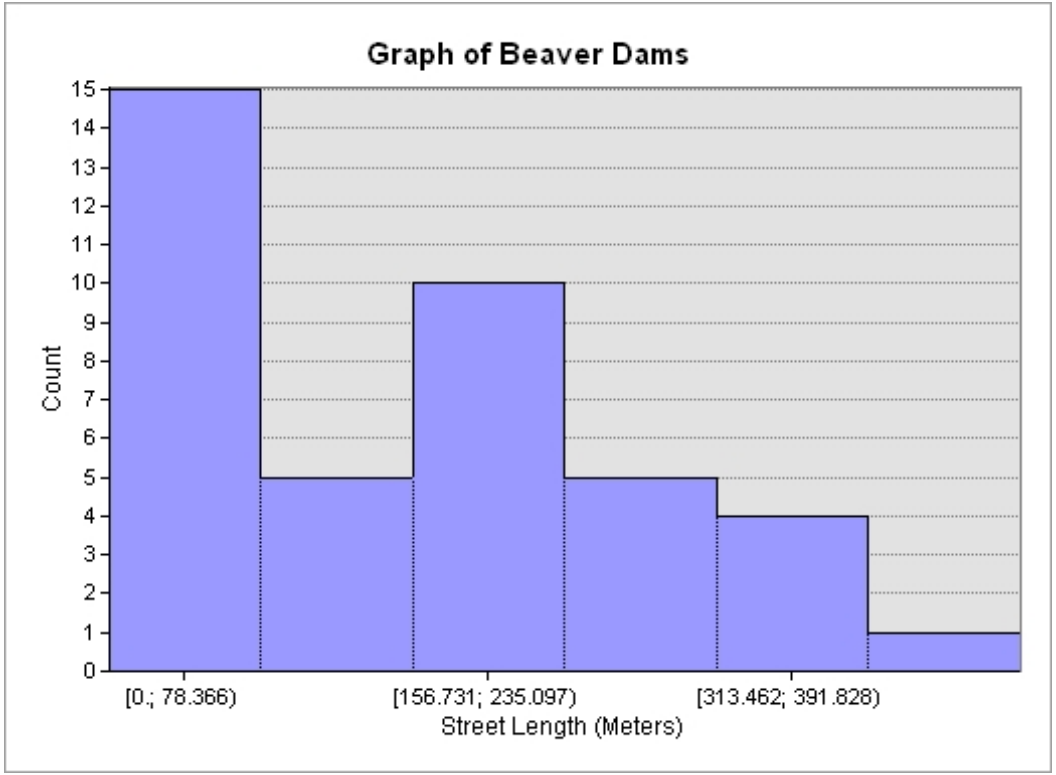
Mean: 145

Minimum: 0

Maximum: 470

Standard Deviation: 127

Not significant

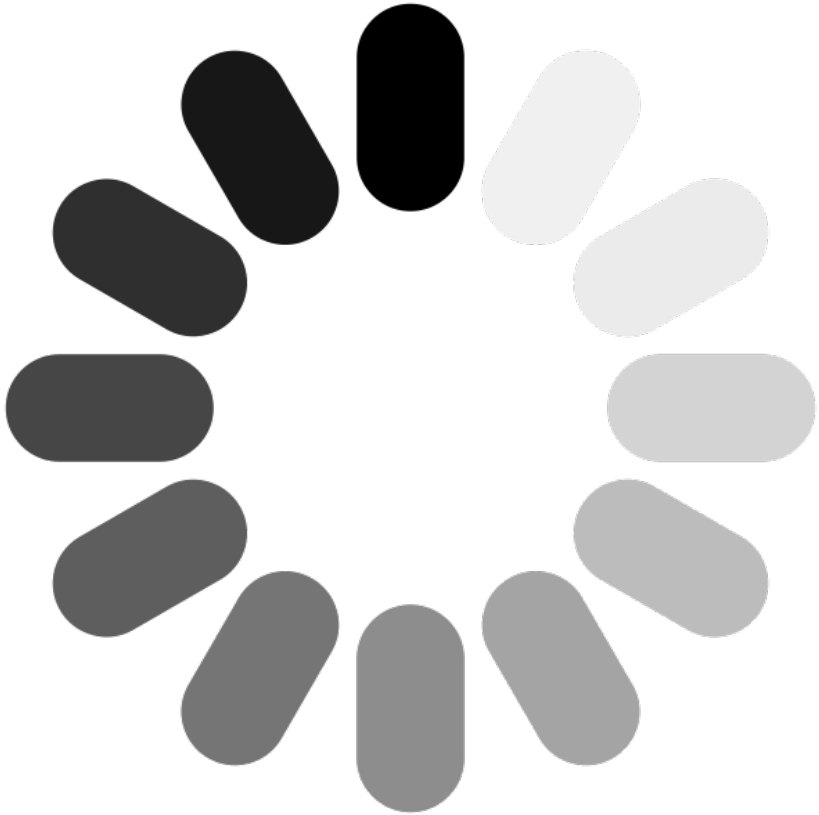


Conclusions

- A SETS approach to understanding beavers habitat is necessary for understanding why beavers return to the same locations
- A temporal analysis will provide insight into trends, if any
- The primary requirements for Beaver habitats seem to be surrounding, slope, vegetation and stream size / width
- Further analysis is needed to understand whether our results are location-specific or universal
- Conservation programs will benefit from this study

Future Work

- SETS relationship at Riparian Scale and CBG Scale using logistic regression and spatial regression methods is ongoing
- Better sample set will make results more accurate
- Results are expected to provide better insight into surrounding environments



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