

# Watershed-scale drivers of temperature and flow of headwater streams in Northern Maine: Year One Update

Dr. Neil Thompson, University of Maine at Fort Kent

Cooperating faculty in the UMaine School of Forest Resources & Graduate School



# Question and Approaches

## **What factors explain the temperature and flow of headwater streams?**

#1: Network of temperature ( $n = 100$ ), flow ( $n = 18$ ) sensors in randomly selected streams

#2: Natural experiments & outliers

#3: Controlled experiment at Smith Brook ( $n = 3$  watersheds, two experiment/one control)

# Objective #1

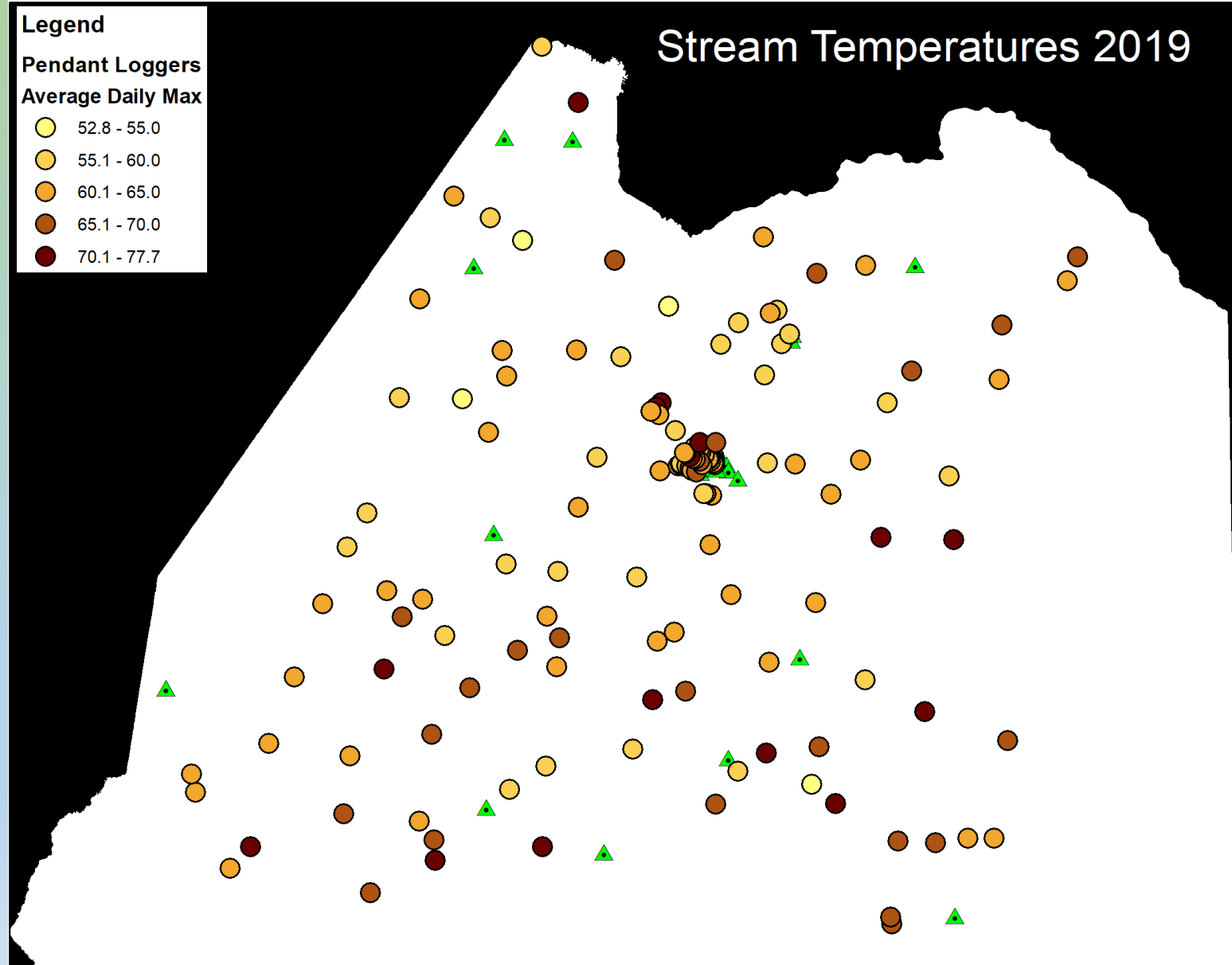
Landscape network: 100+ watersheds

Across ownerships in Northern Maine

Dependent variables:  
temperature metrics

Independent variables:

- Total solar radiation
- Area in lakes & ponds
- Area in beaver ponds (2018 air photos)
- Harvest footprint (last 7 years)
- Upland & valley wetlands



# Stream Gradient vs. Average Daily Max Temp

- Average stream gradient  $R^2 = 0.36$  (strongest so far)
- Streams >2% average gradient did not exceed 70F in 2019
- Waiting on LiDAR coverage for improved metrics (anticipated soon)

```
. ladder mean_avg_slope
```

Transformation	formula	chi2(2)	P(chi2)
cubic	mean_a~e^3	.	0.000
square	mean_a~e^2	.	0.000
identity	mean_a~e	43.32	0.000
square root	sqrt(mean_a~e)	17.28	0.000
log	log(mean_a~e)	2.14	0.343
1/(square root)	1/sqrt(mean_a~e)	30.88	0.000
inverse	1/mean_a~e	70.70	0.000
1/square	1/(mean_a~e^2)	.	0.000
1/cubic	1/(mean_a~e^3)	.	0.000

```
. gen logslope = log( mean_avg_slope)
(1 missing value generated)

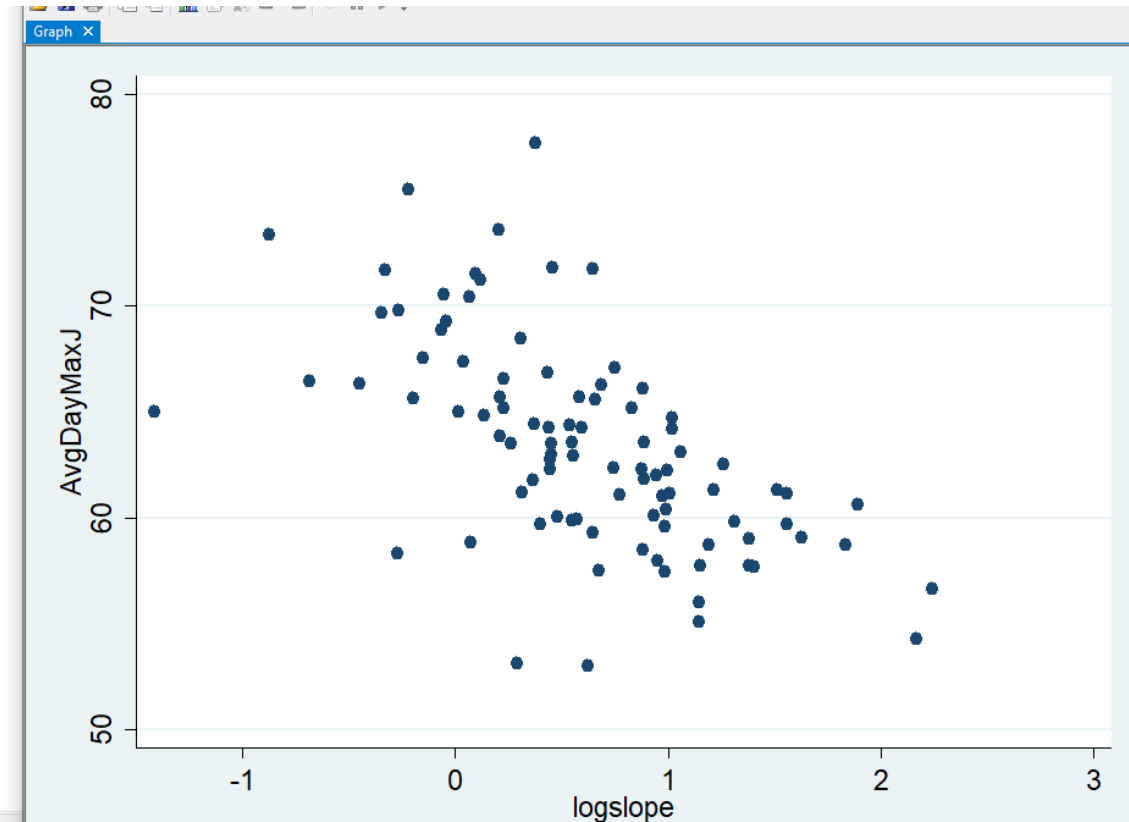
. scatter logslope avgday

. regress logslope avgday
```

Source	SS	df	MS	Number of obs	=	94
Model	13.5610371	1	13.5610371	F(1, 92)	=	51.54
Residual	24.2069613	92	.263119144	Prob > F	=	0.0000
				R-squared	=	0.3591
				Adj R-squared	=	0.3521
Total	37.7679984	93	.406107509	Root MSE	=	.51295

logslope	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
avgdaymaxj	-.0768709	.0107076	-7.18	0.000	-.0981371 -.0556047
_cons	5.477436	.6809831	8.04	0.000	4.124944 6.829927

```
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```





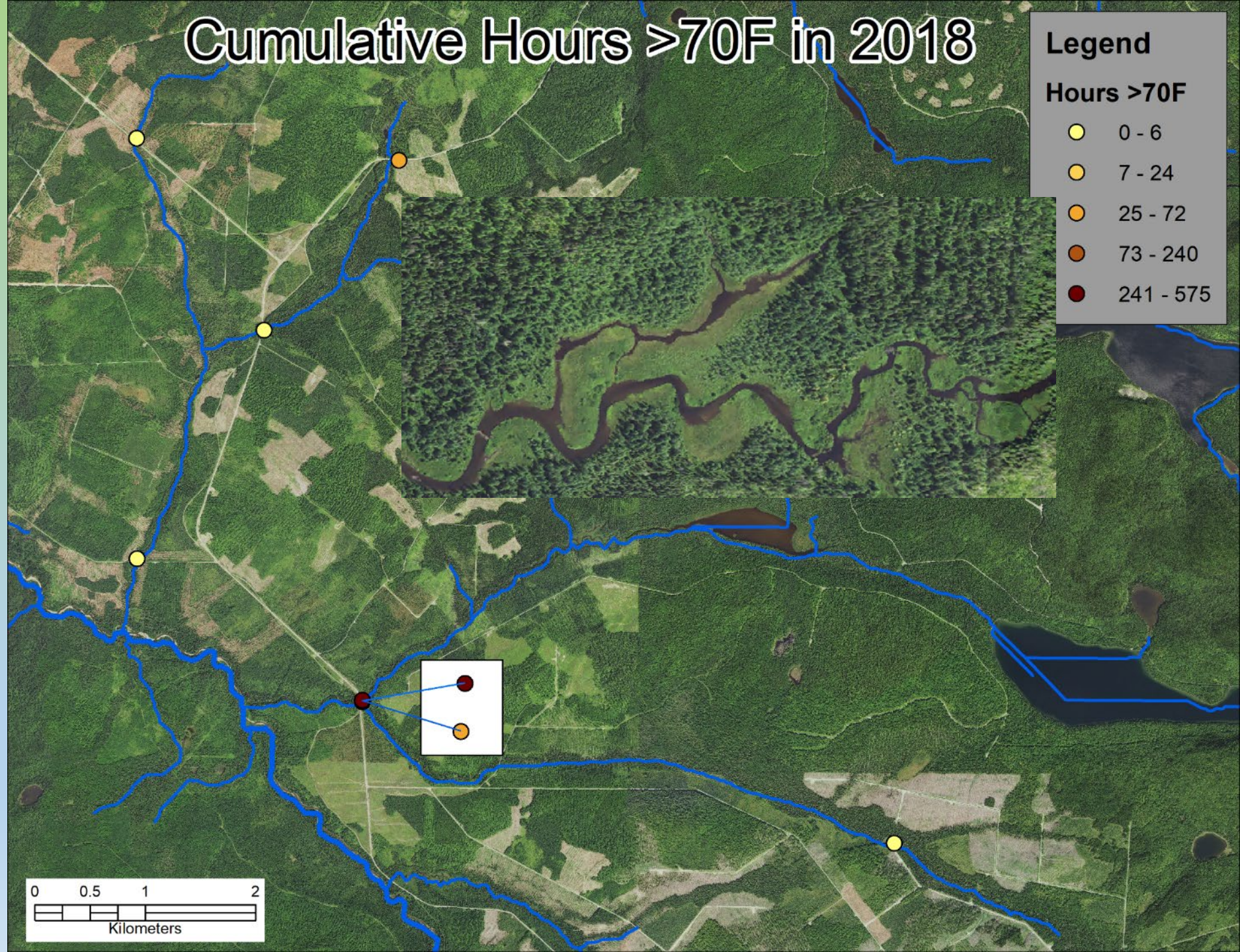
# Objective #2

Investigate outliers

Some exceeded 80F  
This kills trout in tests

Why this warm?

Others extremely cool





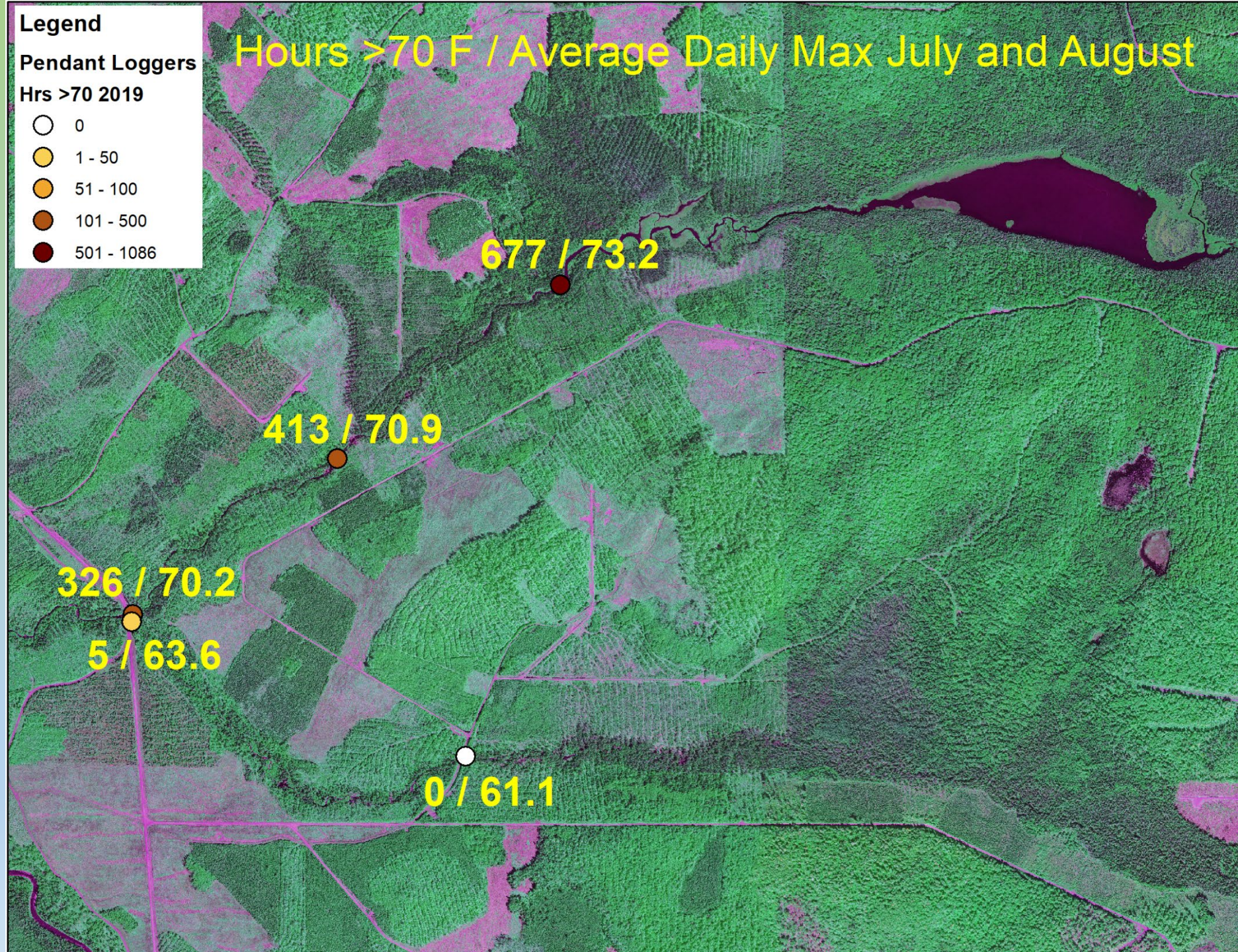
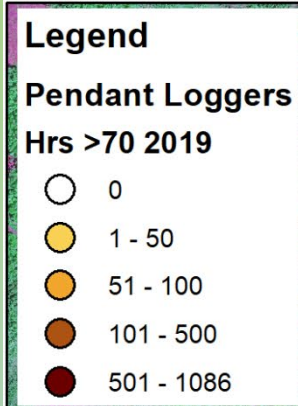
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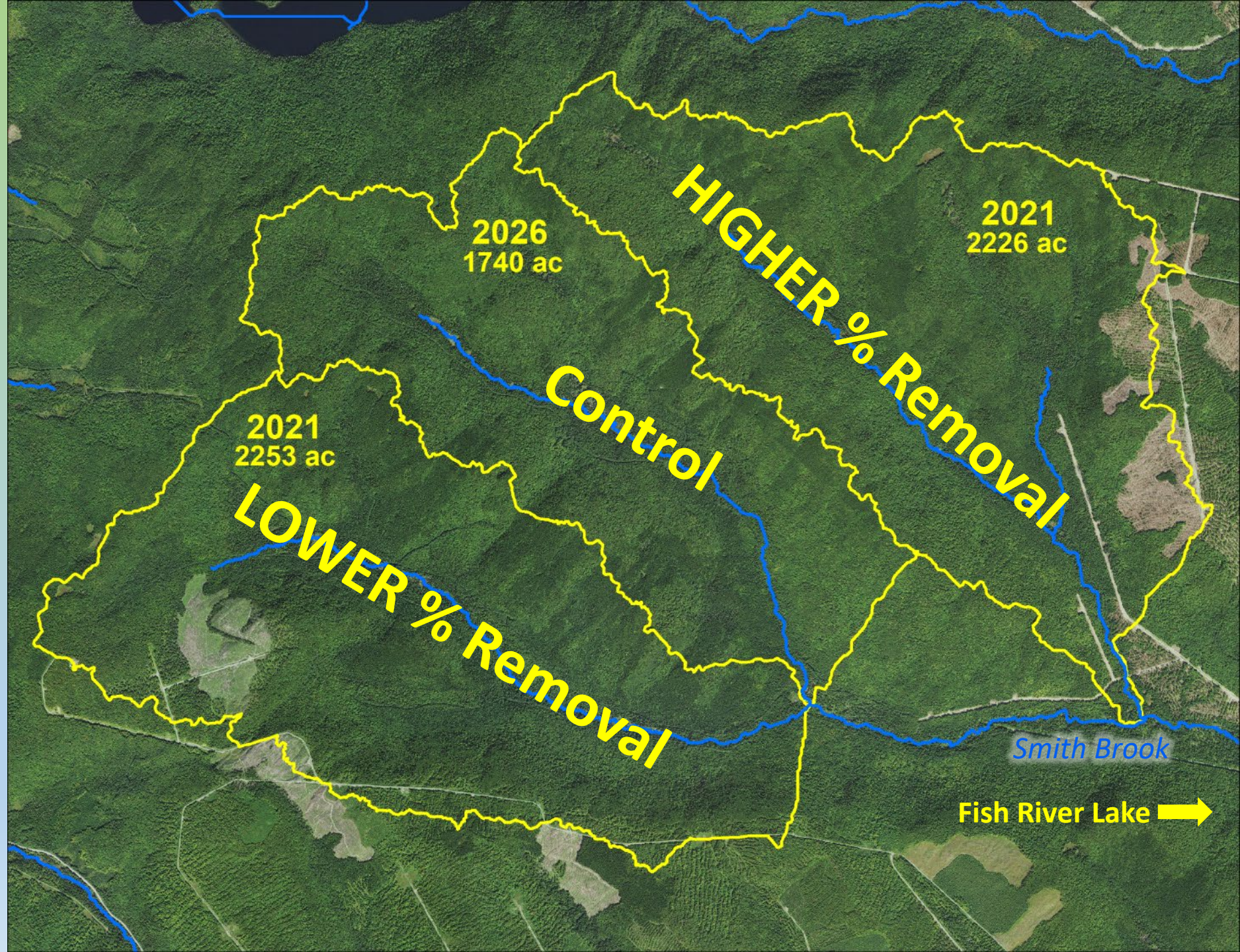


# Objective #3

Isolate the variable

Two levels, % removal

Background: 1950s  
harvest, Tibetan  
workers for Great  
Northern Paper





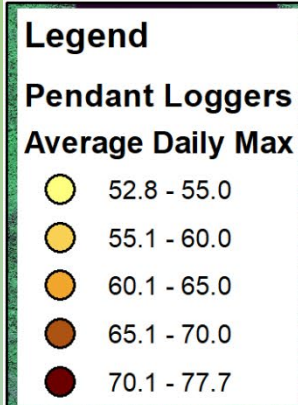
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Isolate the variable

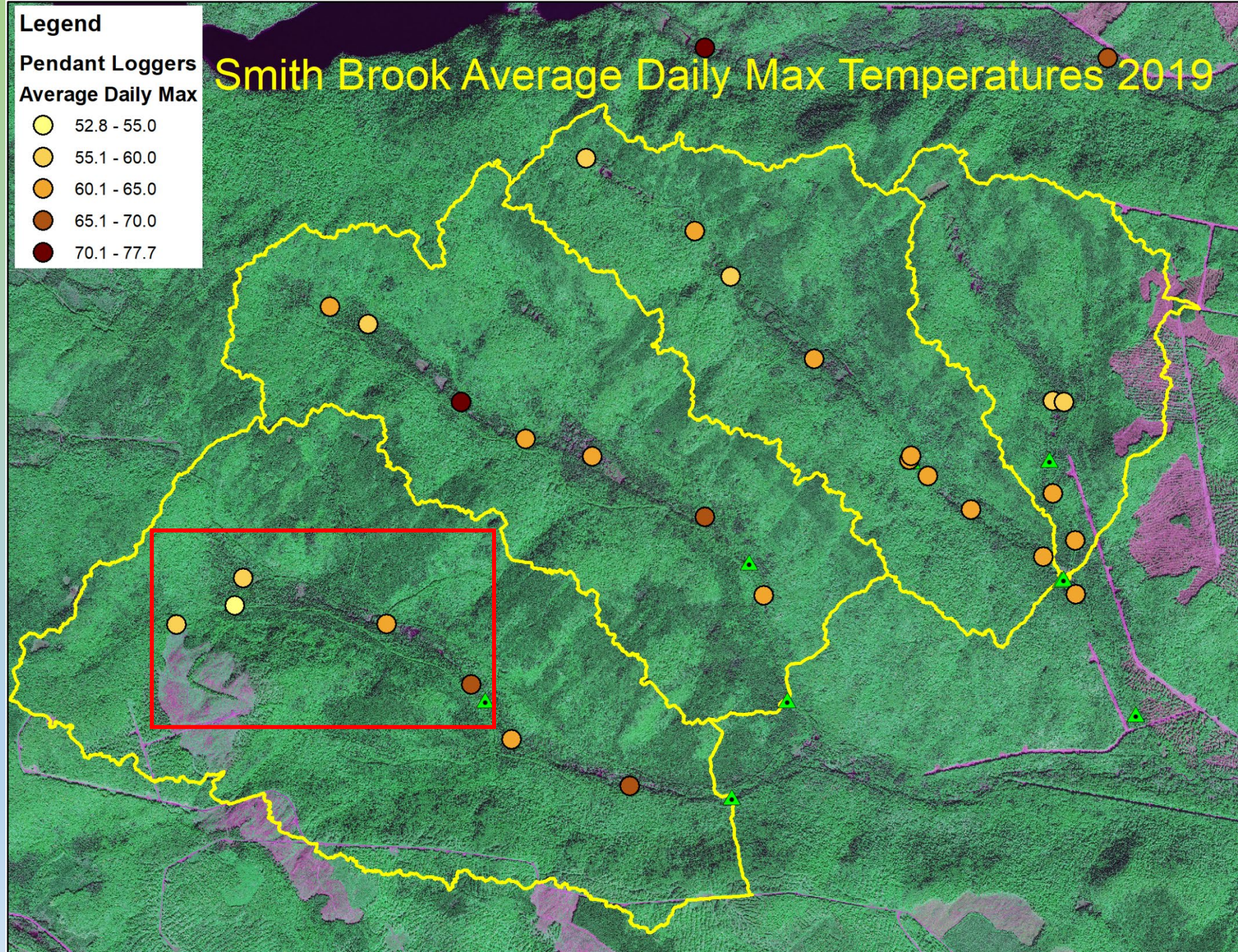
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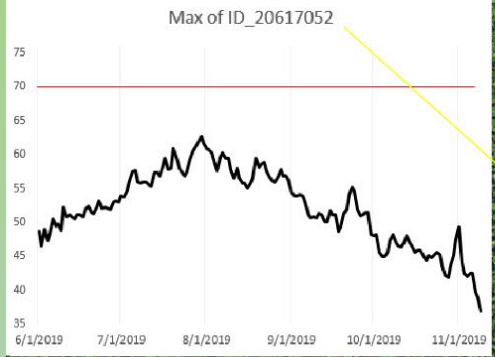
Note the two sites in  
the north as well



## Smith Brook Average Daily Max Temperatures 2019







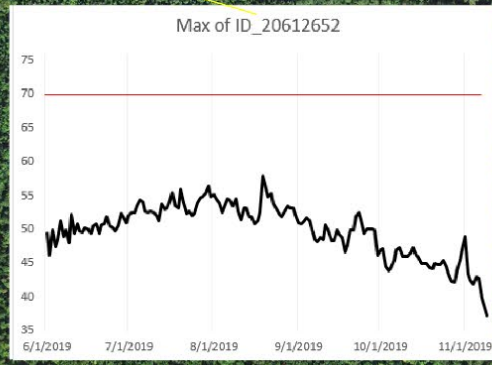
20617052



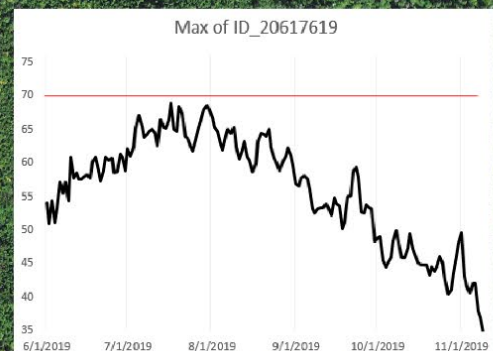
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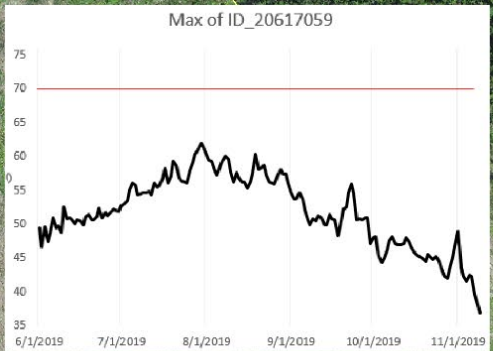
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20617619

20617023  
Buried in sediment?

20617059



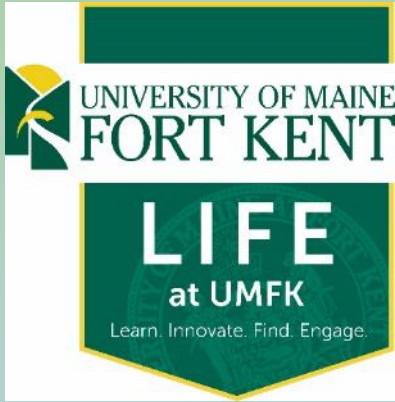


# Plans for 2020

- Double sample size of landscape network
- Year-round temperature loggers in Smith Brook
- Fly portions of Smith Brook with hyperspectral drone
- Flow calibrations & rain gauges
- Data analysis with forthcoming LiDAR data



# Collaboration



Neil Thompson



Antoin O'Sullivan



Hamish Greig



Jeremiah Wood

