Impacts of Forestry Practices on Manoomin/Psiŋ (Wild Rice) Watersheds in a Changing Climate: Exploring Tribal-University Knowledge Co-Production in Hydrologic Modeling

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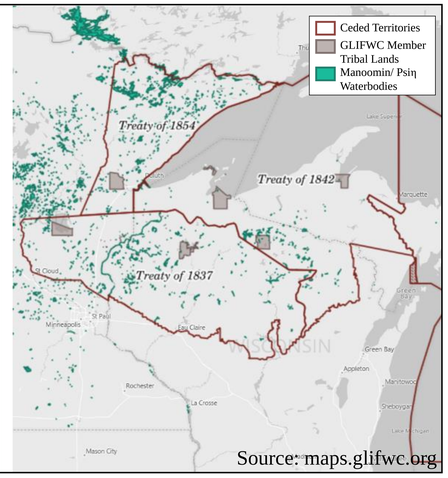
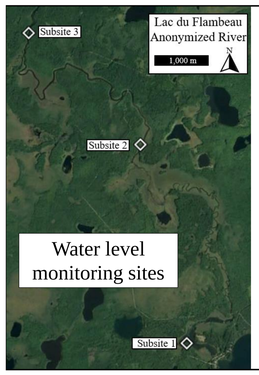
Overview

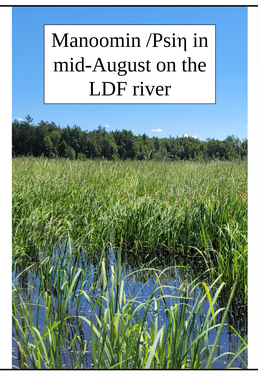
- Manoomin/Psiŋ (Ojibwe/Dakota) or wild rice is an aquatic grass native to the Great Lakes Region[1]
- Manoomin/Psiŋ is a culturally and spiritually significant relative for Indigenous peoples in the region[2] and serves crucial ecosystem purposes[3]
- Significant decline since onset of Euro-American colonization is linked to environmental stressors (land cover/use[4], toxins[5], invasive species[1], etc.) with 32% decline since 1900s[6]
- However, specific causes of impairment are often highly uncertain at a site[6], thus motivating our research
- Manoomin /Psiŋ requires a specific range of hydrologic conditions[3] → Tribes are concerned how upland forest changes will impact rivers/lakes



Source: maps.glifwc.org

How do forest distributions in watersheds impact seasonal water levels? How can Manoomin /Psiŋ be conserved and protected through forestry practices?



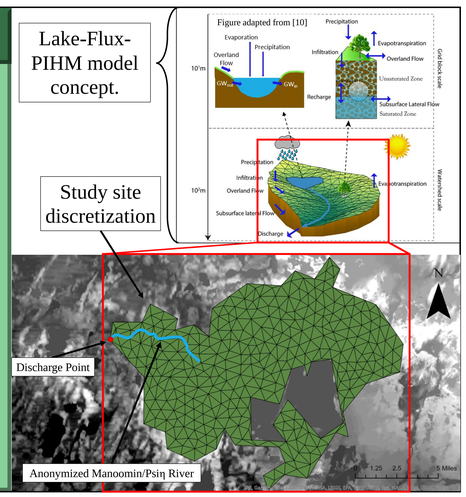


Background

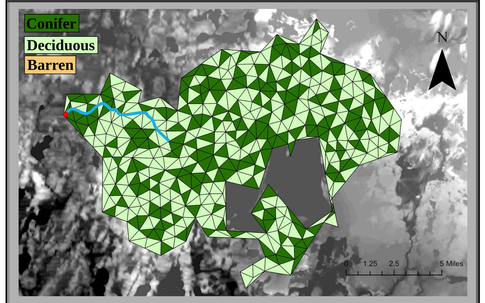
- Manoomin /Psiŋ river, Lac du Flambeau Band of Lake Superior Chippewa (LDF) reservation in northern WI
- Historically abundant rice has declined at some subsites, especially near an upstream dam, while rice has remained abundant in other reaches
- Our Tribal-university collaborative's central aim is to **prioritize Tribal questions and sovereignty** while restoring and protecting Manoomin /Psiŋ[7]

Methods

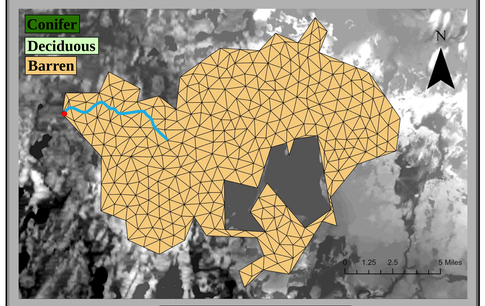
- Newly integrated watershed model Lake-Flux-PIHM which combines Flux-PIHM[8] and PIHM-Lake[9]
- Lake-Flux-PIHM simulates spatially heterogeneous surface and subsurface hydrology and atmospheric fluxes
- Scenario choices were informed by the priorities of Tribal research managers at LDF
- Meteorological inputs
  - NCEP North American regional reanalysis
- LAI inputs
  - ORNL DAAC
- Forest composition inputs
  - Based on tree survey completed in 2021 by McKaylee Duquain



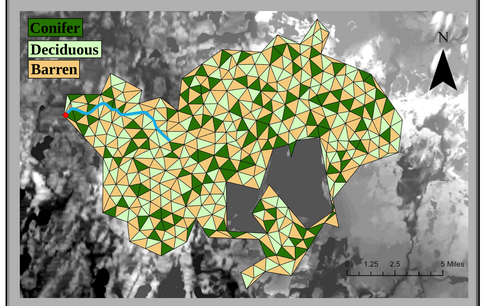
Forestry Scenarios



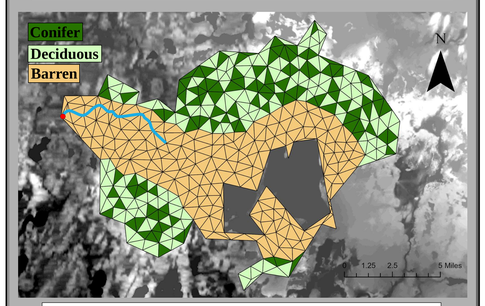
Scenario 1: Base Case, 60% Deciduous, 40% Conifer



Scenario 2: Clear-cut



Scenario 3: Significant (50%) Random Harvesting



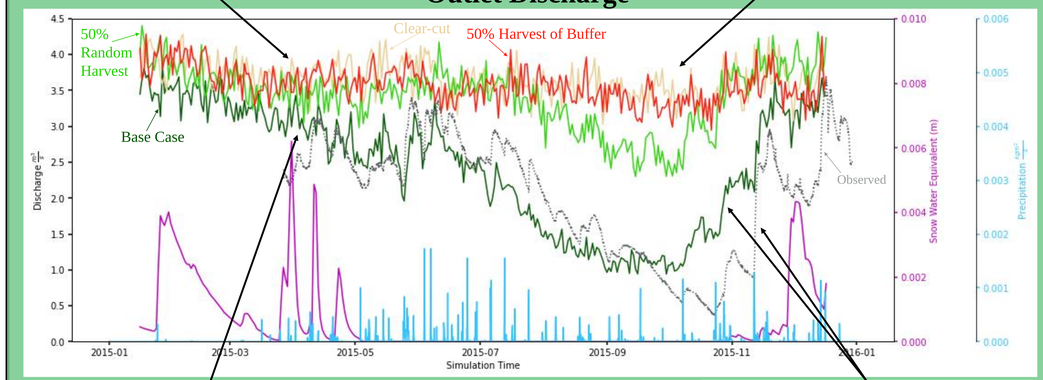
Scenario 4: Significant (50%) Harvesting of Buffer Zone

Preliminary Results & Discussion

4. For 50% random harvesting and 50% harvesting in the buffer zone, the springtime discharge remains high

3. 50% harvest in buffer around water bodies has similar discharge impact as clear-cut

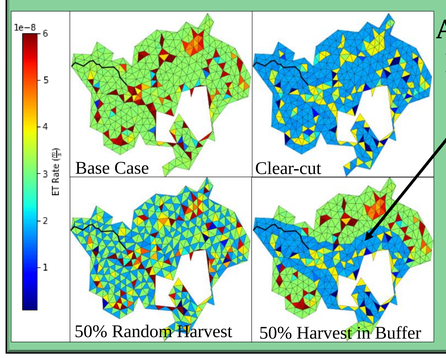
Outlet Discharge



5. Base case discharge decreases in late spring despite snowmelt, unlike in other scenarios- critical for Manoomin/Psiŋ's sensitive early growth stage

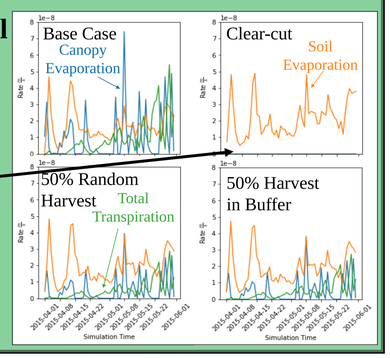
2. Magnitude and timing of discharge response to large rainfall events is variable across all scenarios

1. Preliminary calibration with model parameter adjustments (vertical and horizontal K, macropore and rooting depth, vegetation fraction)



Avg. April-May Total Evapotranspiration

Lower total ET in clear-cut buffer zone due to lack of total transpiration and canopy evaporation → excess water moves quickly to stream resulting in higher discharge than 50% random harvest scenario



Preliminary Takeaways

1. Significant quantities of forest cover are important for drawing down springtime discharge
2. Proximity of land cover change to Manoomin/Psiŋ water bodies is incredibly important in this watershed
3. Collaboration with Tribes allows for ethical research on critical ecohydrological problems

Next Steps

- Address uncertainty in present Lake-Flux-PIHM watershed model (mesh, improved calibration, water balance)
- Iterative scenario planning in close collaboration with LDF members through Tribal community workshops
- How does selective cutting reducing percentage canopy coverage or changing species composition impact water levels?
- What buffer zone size is needed to protect Manoomin/Psiŋ?

References

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Acknowledgements

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