The Maine Water Temperature Working Group:

Working collaboratively to identify thermal refugia for cold water species

Graham S. Goulette[1], Merry Gallagher[2]
and Kirstin L. Underwood[3]

[1] NOAA Fisheries Service NEFSC Atlantic Salmon Ecosystems Research Team [2] ME-IFW Division of Fisheries and Hatcheries [3] USFWS Gulf of Maine Coastal Program

Introduction:

Stream temperature is a primary control on the distribution and abundance of aquatic organisms. The Maine Water Temperature Working Group (MWTWG) was established to develop a coordinated stream temperature monitoring network that could be integrated with regional and national efforts to identify watersheds with high climate resiliency. Regional models are useful for characterizing spatial variation, making robust predictions and estimating effects across wide environmental ranges. The MWTWG created the Maine Stream Temperature Monitoring and Modeling Network to deploy sensors statewide that collect temperature data for input into a hierarchical model.

Goals:

- Expand a statewide sensor network and manage a comprehensive, interagency stream temperature database
- Contribute data to an existing online stream temperature model that incorporates climate drivers, riparian conditions, and geomorphic factors
- Use the model to predict historic and future patterns in stream temperatures for fish-bearing streams
- Translate stream temperatures into thermal habitat maps to assess species distributions and climate relationships across Maine
- Provide workshops to teach resource managers, landowners, and NGOs how to participate in the Network and use its products
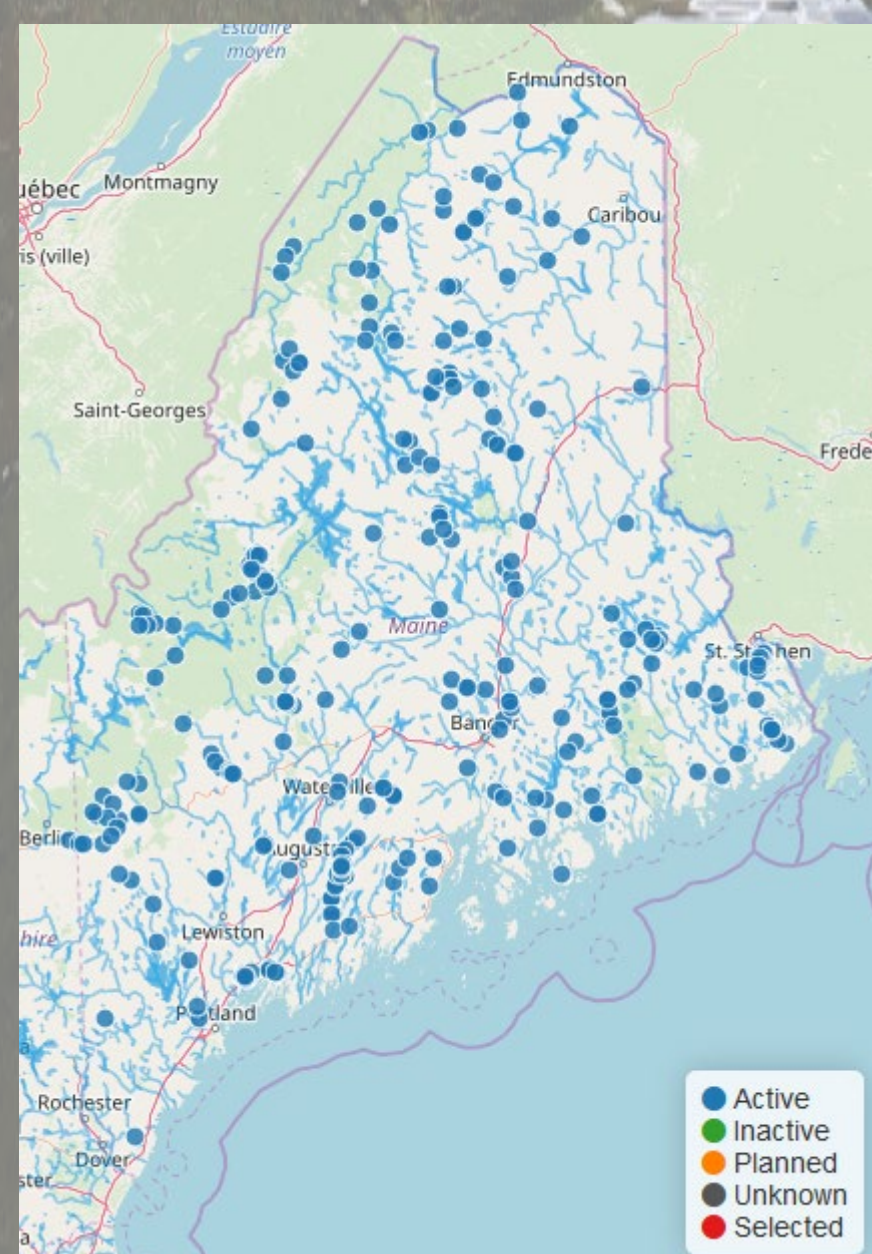

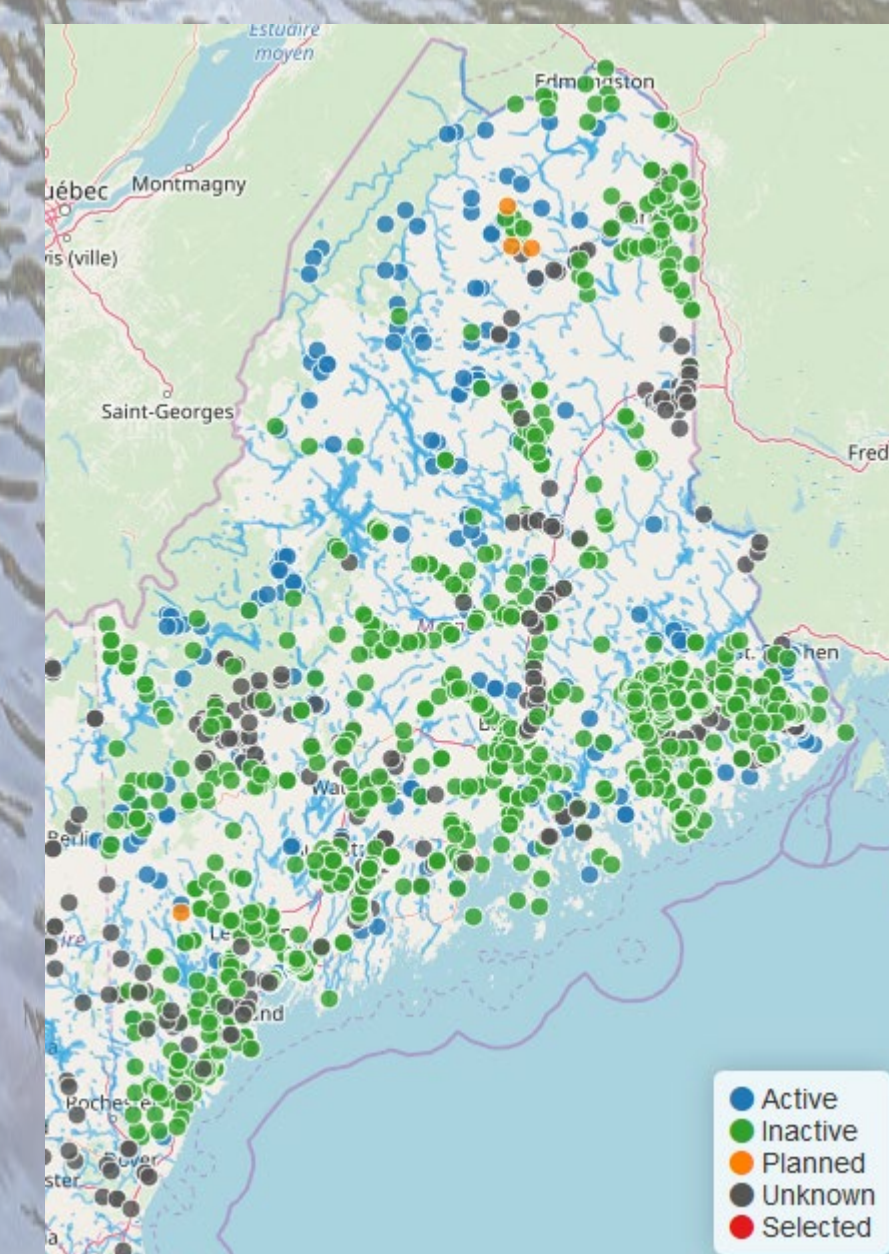Fig 1. Current temperature sensor locations deployed by the MWTWG

Fig 2. Temperature sensor locations in SHEDS database managed by the MWTWG
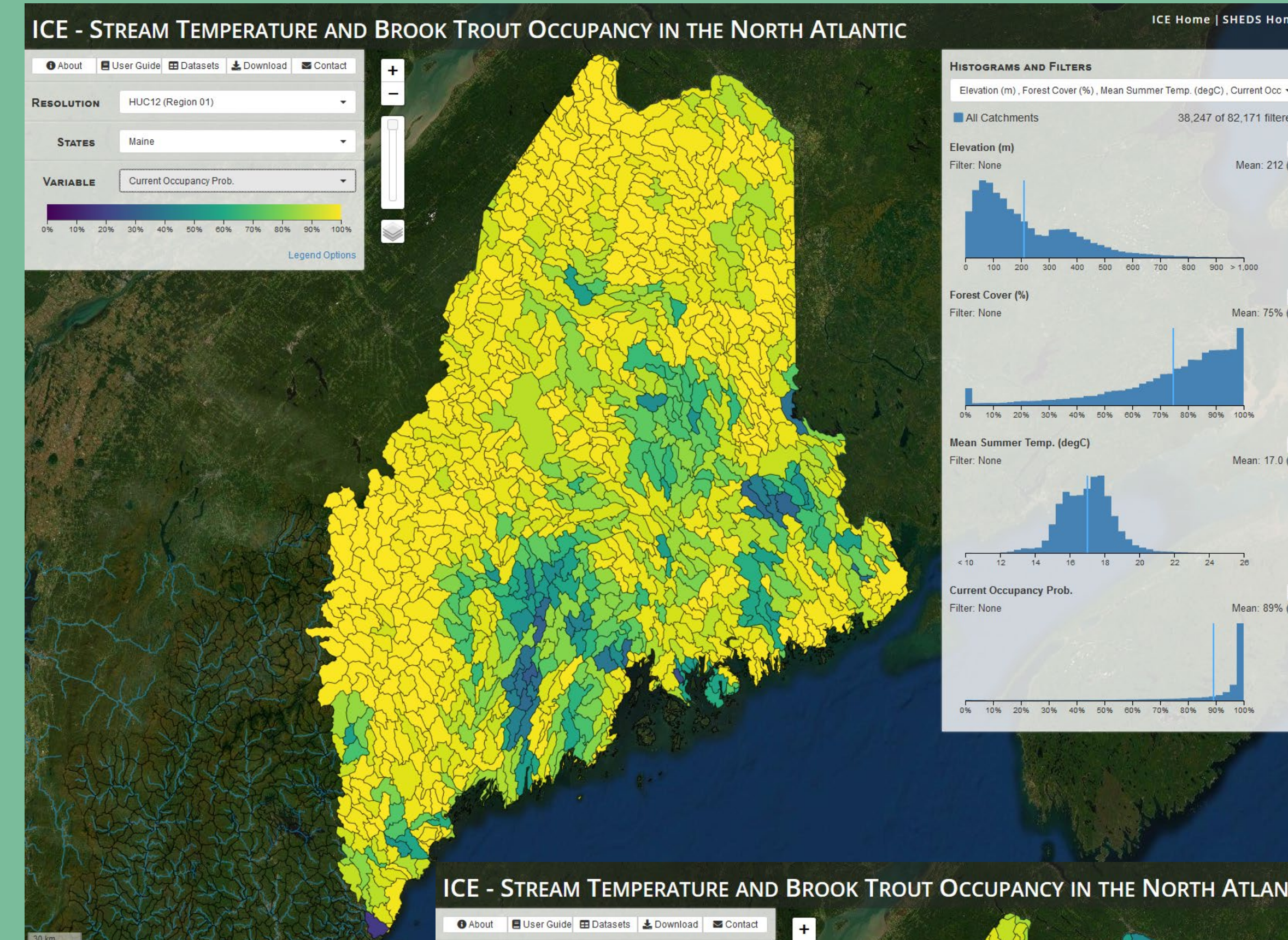

Fig 3. ICE showing current brook trout occupancy projections for all HUC 12 sub watersheds across the state of Maine
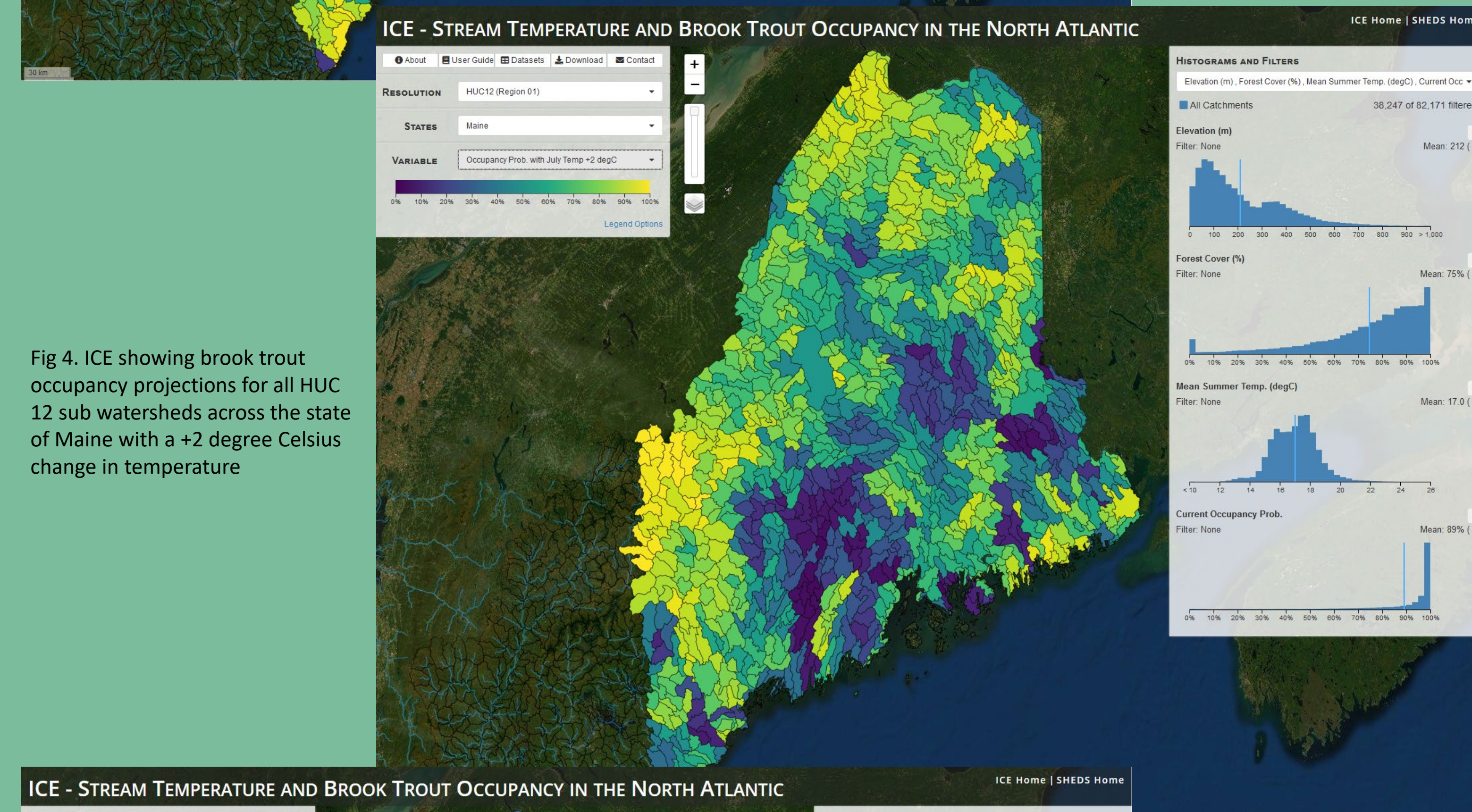

Fig 4. ICE showing brook trout occupancy projections for all HUC 12 sub watersheds across the state of Maine with a +2 degree Celsius change in temperature
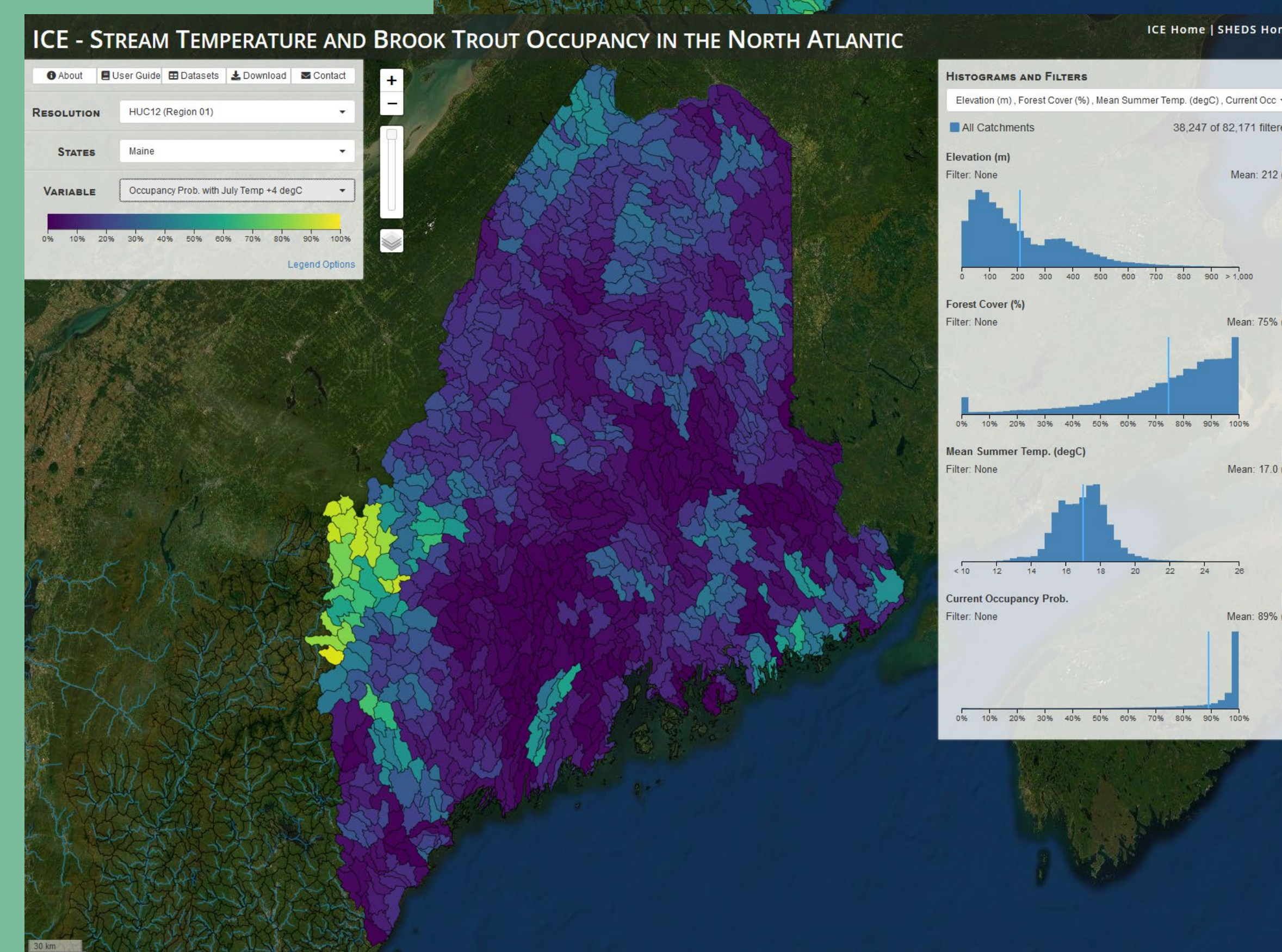

Fig 5. ICE showing brook trout occupancy projections for all HUC 12 sub watersheds across the state of Maine with a +4 degree Celsius change in temperature

Project Outcomes:

- Through numerous meetings, conference calls, and workshops the MWTWG has developed a protocol for deploying temperature loggers and collecting data

- Building out the network has brought the total number of MWTWG members to 25

  - Academia   3
  - Federal Partners 2
  - NGOs   11
  - State Partners   6
  - Tribal Partners   3

- Historical temperature data collected and uploaded from more than 1900 locations providing over 4000 temperature time series containing more than 170 million records into the Stream Temperature database housed on the SHEDS (Spatial Hydro-Ecological Decision Systems) website
- Development of models and visualization platforms: Stream Temperature model, Brook Trout Occupancy model, Interactive Catchment Explorer (ICE)

Stream Temperature Model

The stream temperature model is a nested, hierarchical, Bayesian model that predicts daily stream temperature based on catchment characteristics and weather conditions.
Documentation: http://ecosheds.org/models/stream-temperature/latest/

Northeast Brook Trout Occupancy Model

The Northeast Brook Trout Occupancy Model is a logistic mixed effects model that includes the effects of landscape, land-use, and climate variables on the probability of Brook Trout occupancy in stream reaches across the Northeast U.S.
Documentation: http://ecosheds.org/models/brook-trout-occupancy/latest/

Interactive Catchment Explorer

The Interactive Catchment Explorer is a dynamic visualization tool for exploring catchment characteristics and model predictions, as well as for identifying priority catchments across the Northeast region of the United States.
http://ice.ecosheds.org

Publications

A hierarchical model of daily stream temperature using air-water temperature synchronization, autocorrelation, and time lags

Letcher BH, Hocking DJ, O'Neil K, Whiteley AR, Nislow KH, O'Donnell MJ. 2016. A hierarchical model of daily stream temperature using air-water temperature synchronization, autocorrelation, and time lags. PeerJ 4:e1727
https://doi.org/10.7717/peerj.1727

https://ecosheds.org/