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Photo: Steve Hurley

USGS science for a changing world

Estimating species response to environmental change

Goals

Identify resilient populations/regions and effective management strategies under alternate futures

Goal 1:

- Forecast brook trout
  - 1) Occupancy
  - 2) Population growth rates
  - in response to environmental change
    - Climate change, land use, fragmentation, invasives

Goal 2:

- Make model results useful to managers
  - Web site/DSS

Funding

- NALCC, NE CSC, TNC
- USGS Powell Center

Goal 1

- Models for
  - 1) Occupancy
    - p(presence) = f(env drivers,yearly)
      - Untagged fish, presence estimate
  - 2) Population growth rates
    - pop growth = f(env drivers,yearly)
      - Untagged fish, abundance estimate
    - pop growth = f(env drivers,seasonal)
      - Tagged fish, individual histories
  - Environmental drivers
    - Stream temperature
    - Stream flow
    - Other species/invasives
    - Land use
    - Depostition
    - Patch size/fragmentation
    - Geomorphic factors

Environmental drivers

- Current
- Imputation models
  - Stream temperature
    - NECSC model
      - NECSC temperature database
  - Stream flow
    - NALCC model(s)
      - USGS gages
  - Other species/invasives
    - State monitoring data/occupancy models
      - Variable data quality across states
- Data layers
  - Land use
    - Tree cover, road density, impervious surface
      - NLCD after cleaning by NALCC
  - Deposition
    - Sulfur, Nitrogen
      - National Atmospheric Deposition Program
  - Patch size/fragmentation
      - NALCC road crossing model/TNC dam layer

Environmental drivers

- Future
- Forecasts
  - Stream temperature
    - NECSC model – Polebitski/Palmer/O'Neill
      - Air temperature/precip forecasts [NECSC]
  - Stream flow
    - NALCC model(s) - ABCDE, Polebitski/Palmer
      - Precip forecasts [NECSC]
  - Other species/invasives
      - Air temperature/precip/landuse [NECSC,NALCC]
  - Land use
    - NALCC models - McGarigal team
      - 3 demographic/emission scenarios
  - Patch size/fragmentation
    - Road density models?
    - Assume good culverts?
      - Data?


Photo: Steve Hurley

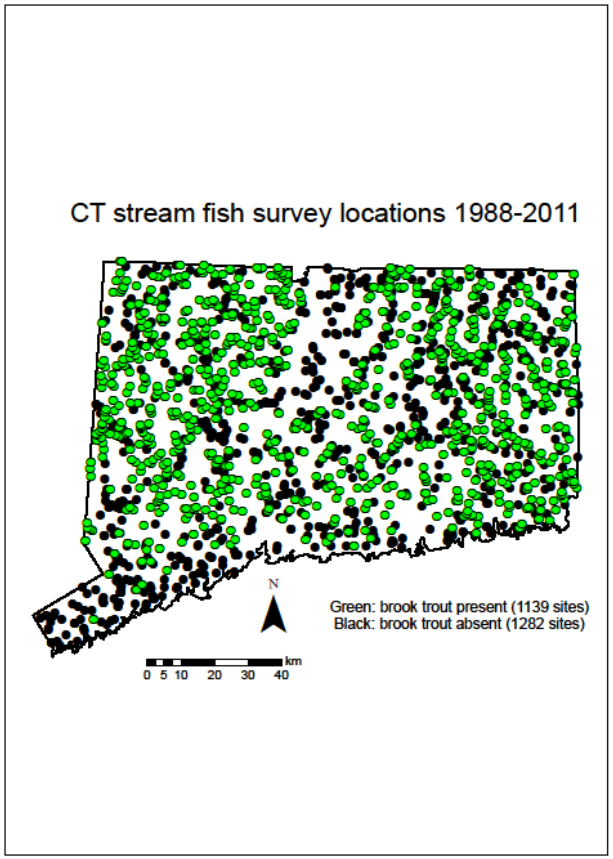
Progress - Goal 1

1) Occupancy

- Collected brook trout/others species database
- Delineated catchments for CT using ARC Hydro – high resolution NHD
- Preliminary occupancy models run

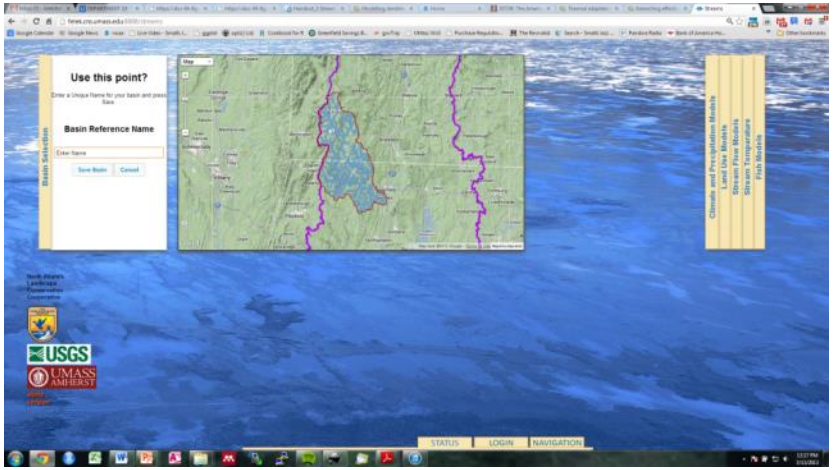
2) Population growth rates

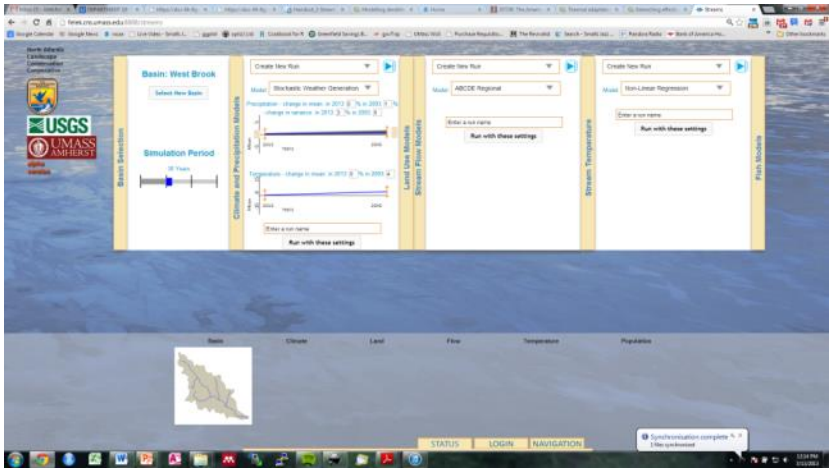
- Untagged fish, abundance estimate
  - Collected brook trout database
  - Evaluated simulation results to identify minimum data needs
- Tagged fish, individual histories
  - Developed Integral Projection Model based integrated survival/body growth/movement model
  - Response and resilience surface



Goal 2

- Goal 2: Make model results useful to managers
  - Interactive web site
  - Test scenarios in a linked system of alternate futures
    - Basin delineation
    - Climate models
    - Land use models
    - Environmental models
    - Fish models
      - Sensitivity
      - Occupancy/population growth forecasts
  - Could show data beyond delineated basin (maps)
    - Environmental driver data
      - NECSC climate forecasts
      - Temperature data, Forest Service website
      - Landuse maps, NALCC project
    - Occupancy/population dynamics
    - Etc.





3) What are your primary science and data needs or most important technical challenges?

- Imputation
  - Incomplete data across space and time
  - Random effects/spatial autocorrelation models
    - Mo' data, mo' betta
  - Can provide very clear recommendations for data collection
    - How often and where

- Stream temperature model
  - More sites
  - Ground water effects
    - Short- and long-term
    - Need data or proxies

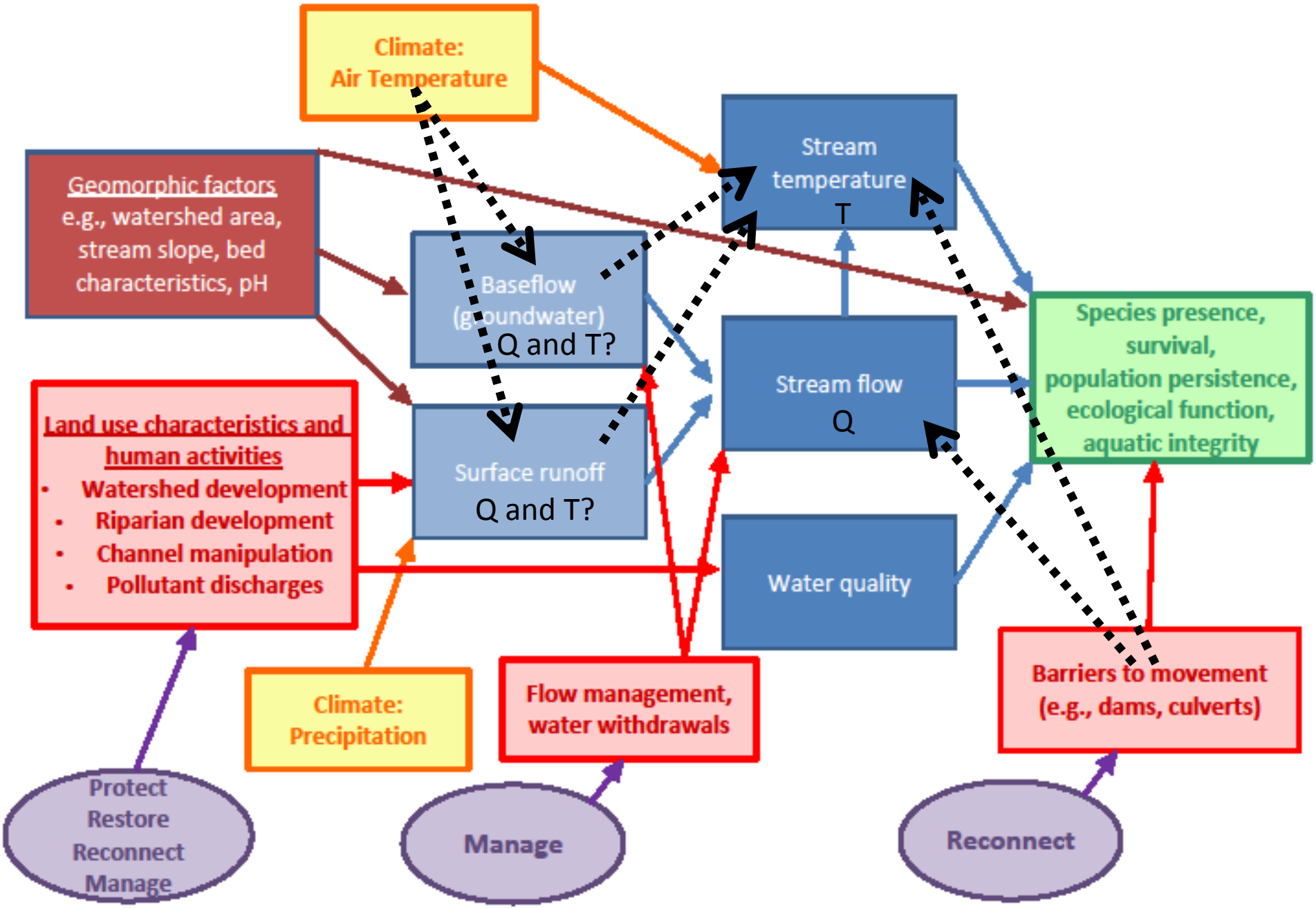
- Stream flow model
  - Models for headwater streams
    - Not so many gages
  - Need barrier [density] forecasting model

- Climate model
  - Which approach?
    - Forecasts
      - Physical models - GCMs/RCMs
      - Statistical models - Weather generator
    - Sensitivity
      - Response and resilience surfaces
  - How limit options? Allow anything, user beware?

➔ 4) Who are your target audiences (users) and how are you engaging them?

- Land trusts, Local governments, NGOs, State and Federal managers/policy makers
- Web site
- User meetings/workshops

Conceptual model – aquatic relationships at regional scales



- 1) What are your primary data sources (model inputs) and how can data be shared across project teams?
- Discuss stream projects matrix (Handout 2)

- 2) What opportunities do you see for collaboration and model integration?
- Aquatic relationships conceptual model as a framework for discussion (Handout 3)

- 3) What are your primary science and data needs or most important technical challenges?

- 4) Who are your target audiences (users) and how are you engaging them?