An Introduction to LWD and Fluvial Geomorphology

I. Basics of River Morphology

- Normal stream conditions:
  - Rivers organized into pool and riffle sequences
    - Pool: smooth area of water
    - Riffle: agitated water, appears uneven on surface
  - Pool-riffle sequences dependent on twistiness of river and environmental conditions like bank slope, grain size, bed material, and weather conditions
  - River functions as a steady-state under typical conditions
    - "Typical conditions": no heavy flow change, measurements cannot be taken during periods of heavy rainfall, serious bank collapse, or extensive ice melting
    - changes occur so slowly that for our purposes they can be approximated as not happening during the time we test

II. Classifications of LWD

- definition: dead woody material of specified diameter or comparable cross-sectional area
- three main types of DWD (dead woody debris):
  - Large/coarse woody debris (LWD/CWD)
    - Diameter greater than 10 cm, typically ≈1m in length
    - Medium LWD has a 20 cm diameter, large LWD has a 50 cm diamater
  - Fine woody debris (FWD)
    - Diameter between 1 and 10 cm
  - Litterfall/detritus
    - Diameter smaller than 1 cm
- Secondary classifications A-E based on length of debris and angle of extensions
- Also classified based on state of decay

III. Functions of LWD

- LWD does not generally move down the river. After initially entering the river, pieces of LWD tend to become lodged on the bank, other pieces of LWD, or woody extensions into stream flow
- Ecological functions:
  - Provide organic matter that decomposer species consume (makes them one of the bases of the food chain)
  - Carbon sinks; decaying trees store carbon
  - Help to cycle nutrients through environment
- Biological functions:
  - Provide habitat for many animals and seedbed for plants

        - Particularly important for fish, especially salmon, who need calm and protected water environments to survive during winters
        - Maintain biological diversity by expanding available range of habitats
    - Geomorphology
        - Makes bank slope more stable
        - Creates pools in water
            - Not as prevalent in New England rivers
            - The larger the river basin the more likely LWD is to orient itself parallel to the river flow
        - Reduces erosion from bank
            - Natural erosion still occurs at "elbows" of river: sediment is picked up from the inner curve of one elbow and deposited on the outer curve of the next
        - Helps control storm runoff (reduces degradation of bank during heavy rainfall and flow periods)
    - LWD is found mostly in rivers running through deciduous forests

IV Implications for our work

- In this view, our study on LWD is very nontraditional since we are studying moving pieces roughly the same size of LWD rather than stationary pieces of debris; in other words, I have no idea what we should expect
- It will be interesting to see if any ducks become lodged in the sides of the bank or woody extensions into stream
    - Look at:
        - Current around stuck ducks (visually, use food dye?)
        - Any additional objects that become stuck on or near ducks
        - Distribution of ducks that become stopped
- Testing questions
    - The validity of data obtained right when the ice melts may be questionable since the data may not be typical of normal river flow conditions
    - How will we release LWD ducks? Usually twenty pieces of LWD don't get set loose at the same time in the river
        - Release in waves? Release at numerous points across river width?
    - Do we want to explicitly study the current flow or the movement of LWD?
        - May need to come up with a procedure for moving/not moving ducks that get stuck depending on that question

References:

A View of the River, Luna Leopold *in this book you can find a formula that approximates the curvature and current flow of the river as a function of length

Mechanics in Fluvial Geomorphology, Luna Leopold

Hydraulic and Geomorphic Effects of Large Woody Debris Additions in the Narraguagus River Watershed, Coastal Maine, Elizabeth A. Johnson

"Effects of experimental removal of woody debris on the channel morphology of a forest gravel-bed stream" R.D. Smith, et al.

"The geomorphic function and characteristics of large woody debris in low gradient rivers, coastal Maine, USA" F.J. Magilligan et al.

"Concept and Classification of Coarse Woody Debris in Forest Ecosystem" Yan Enrong et al.

"Distorted Froude-scaled Flume Analysis of Large Woody Debris" Nicholas P. Wallerstein et al.