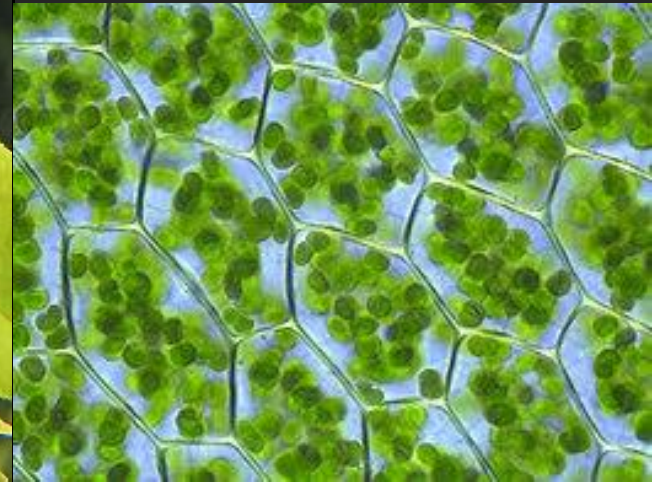
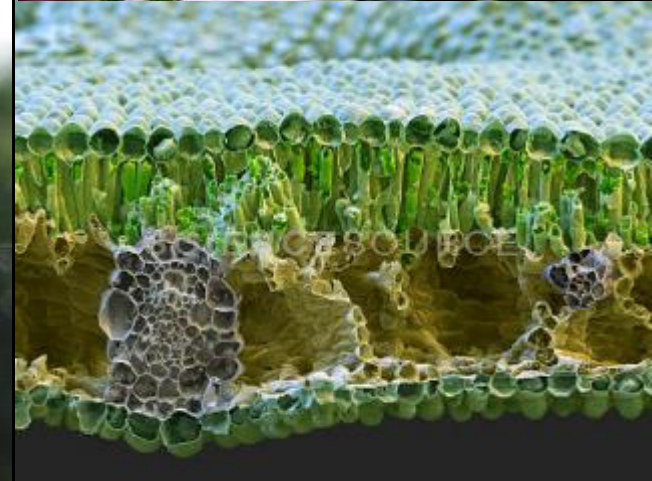


Forests – The Living Filter

UMASS
AMHERST

Paul K. Barten, Ph.D., Professor, Dept. of Environmental Conservation, Nov. 15, 2017©



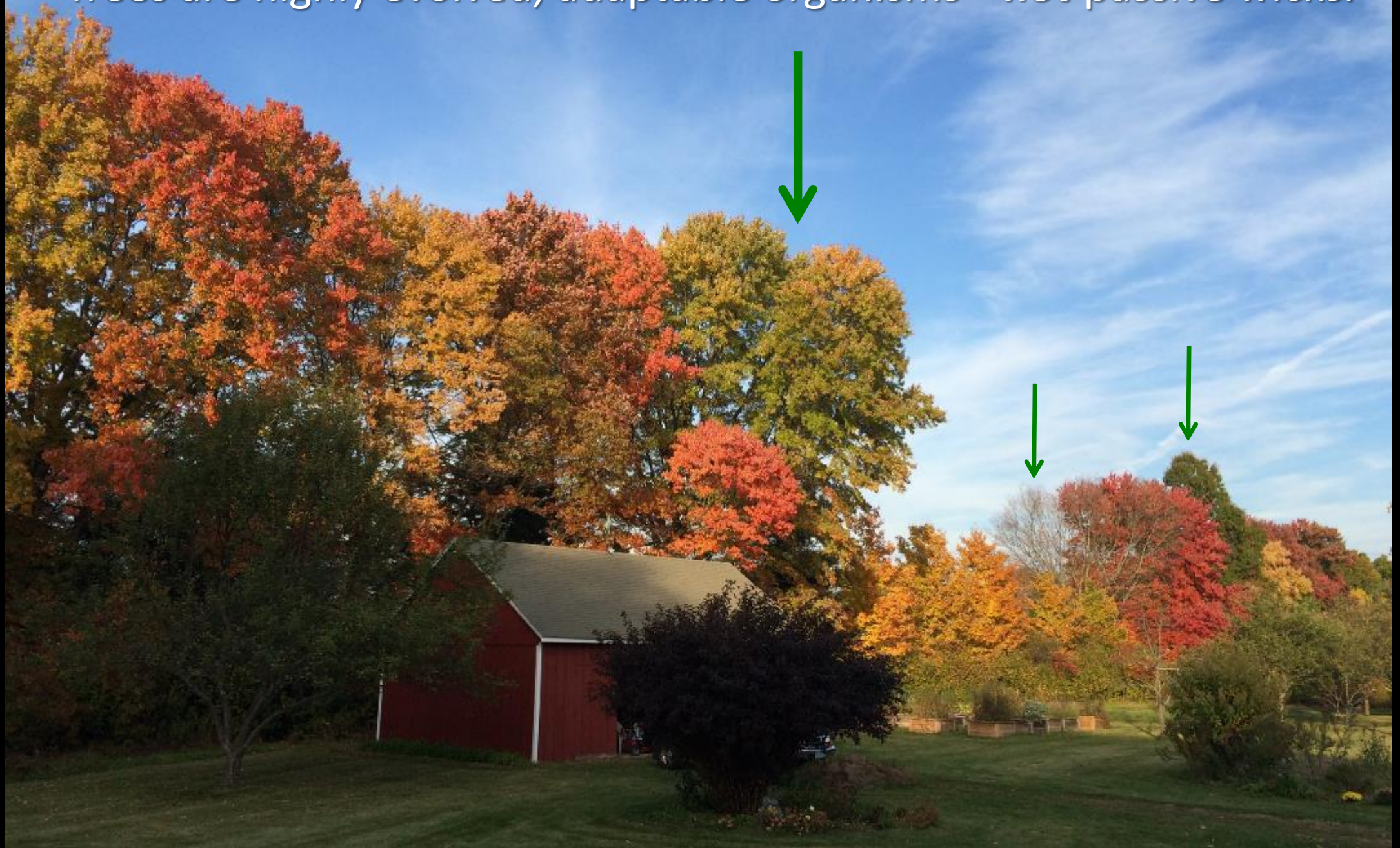








Trees are highly evolved, adaptable organisms—*not* passive wicks.



Civil and Environmental Engineering Department
Syracuse University

The interacting hydrologic responses to changing climate, watershed physical characteristics, river regulation, and land development in the northeastern United States

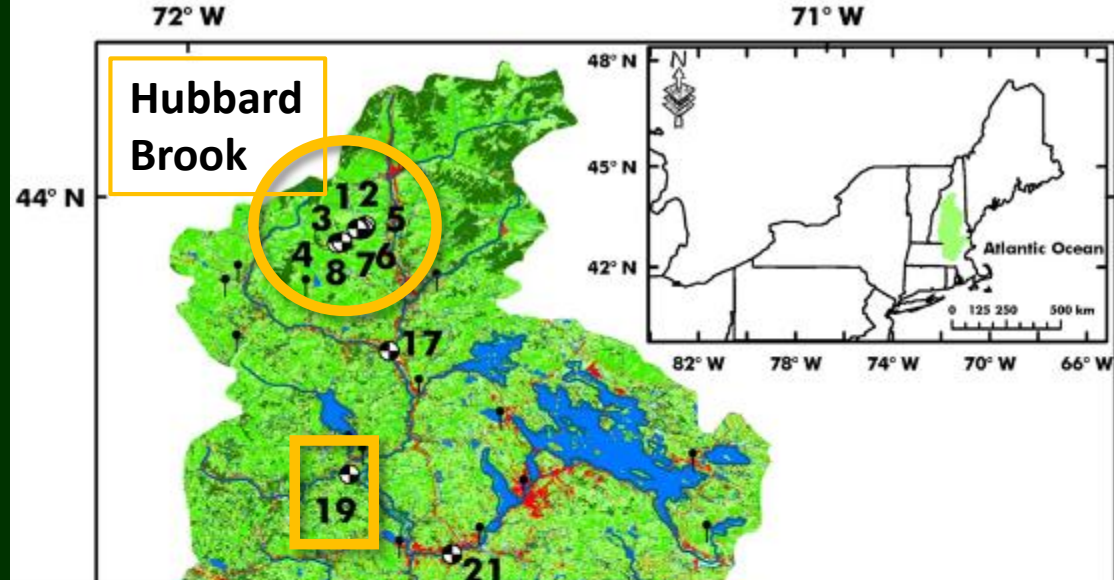
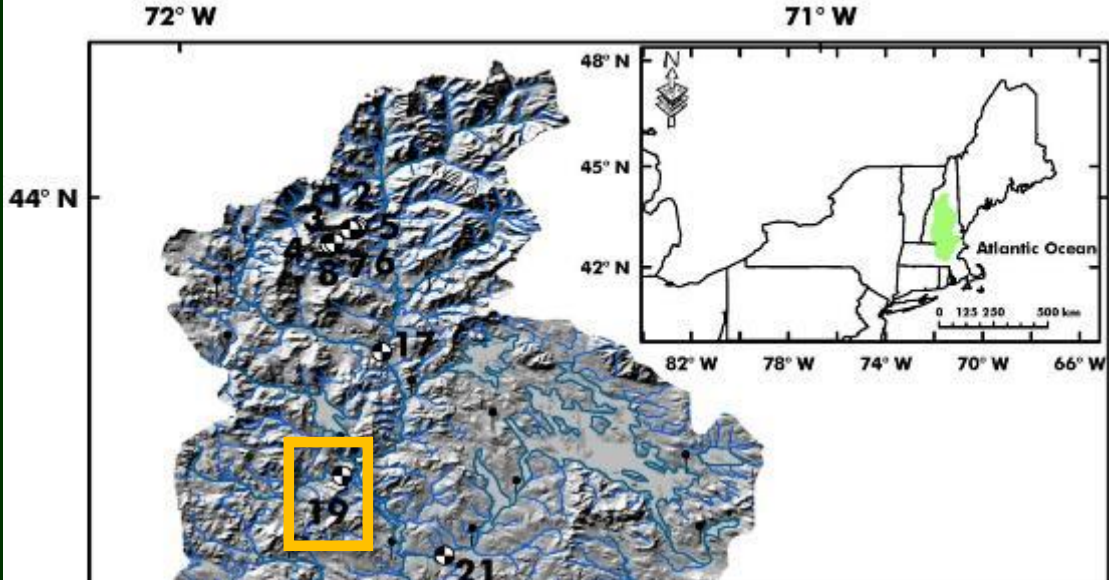


PhD Dissertation

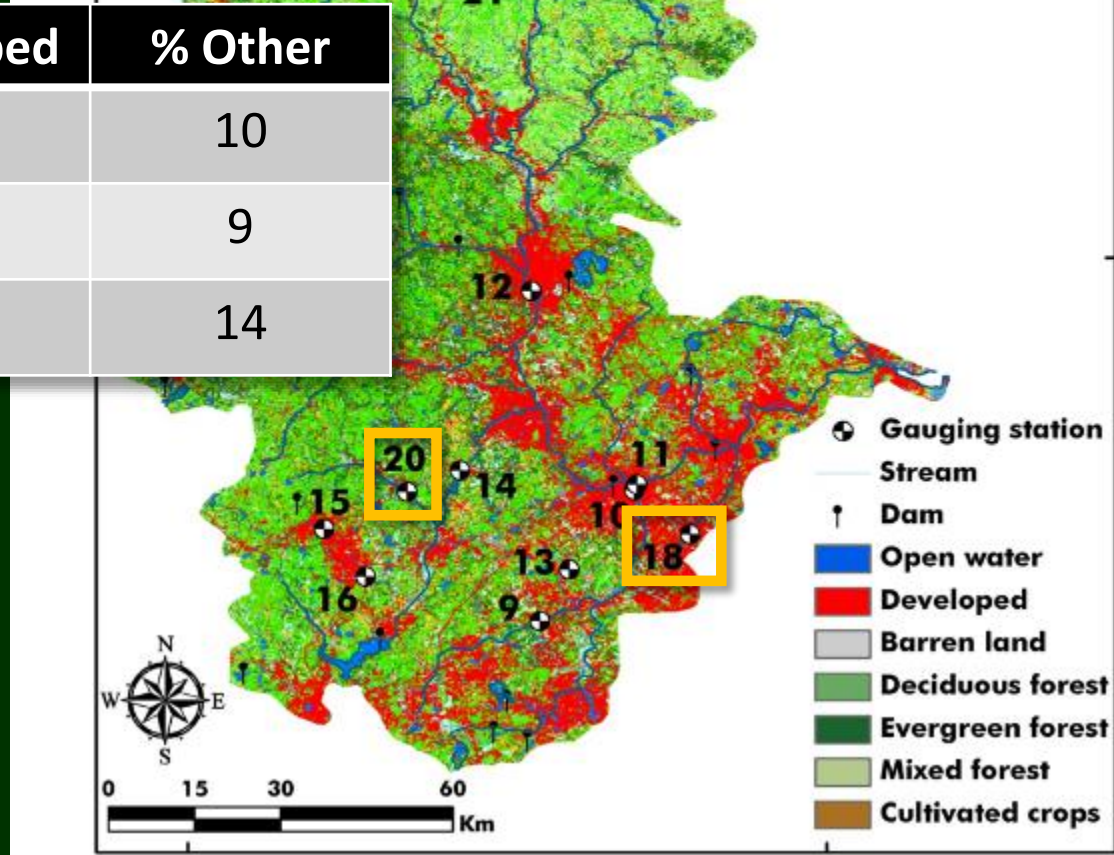
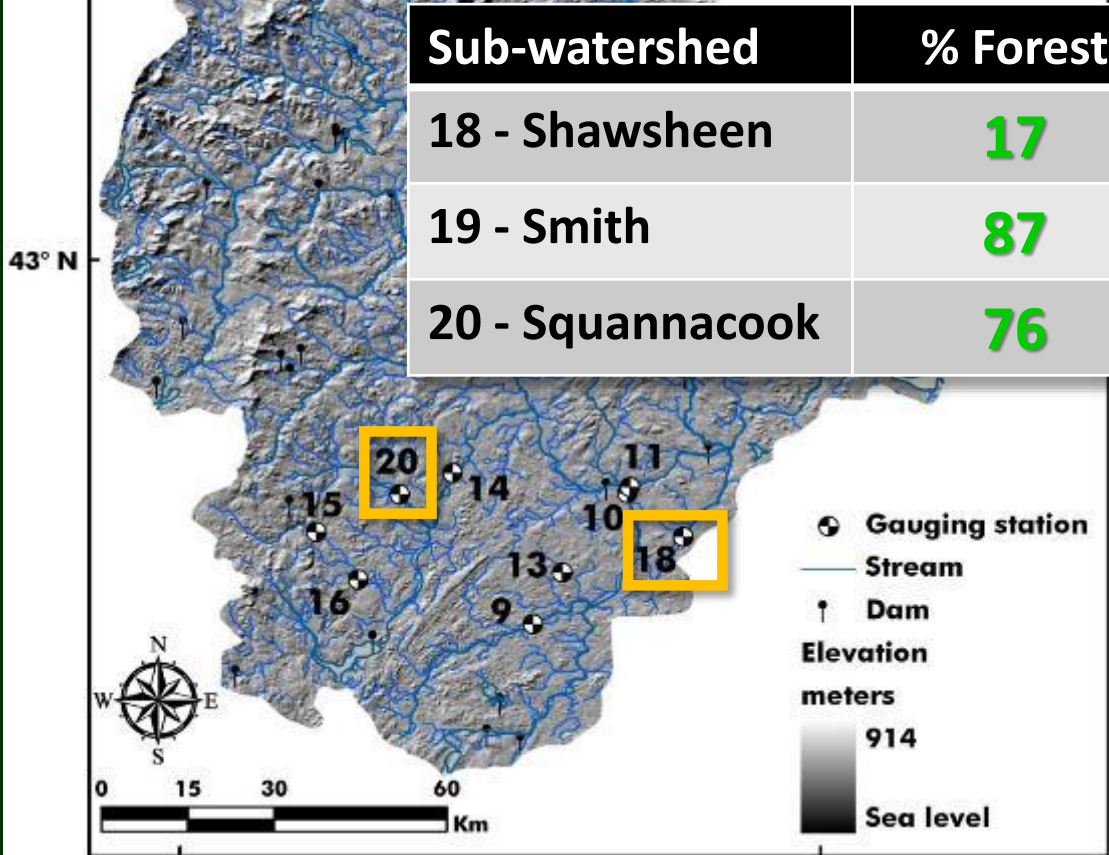
Rouzbeh Berton

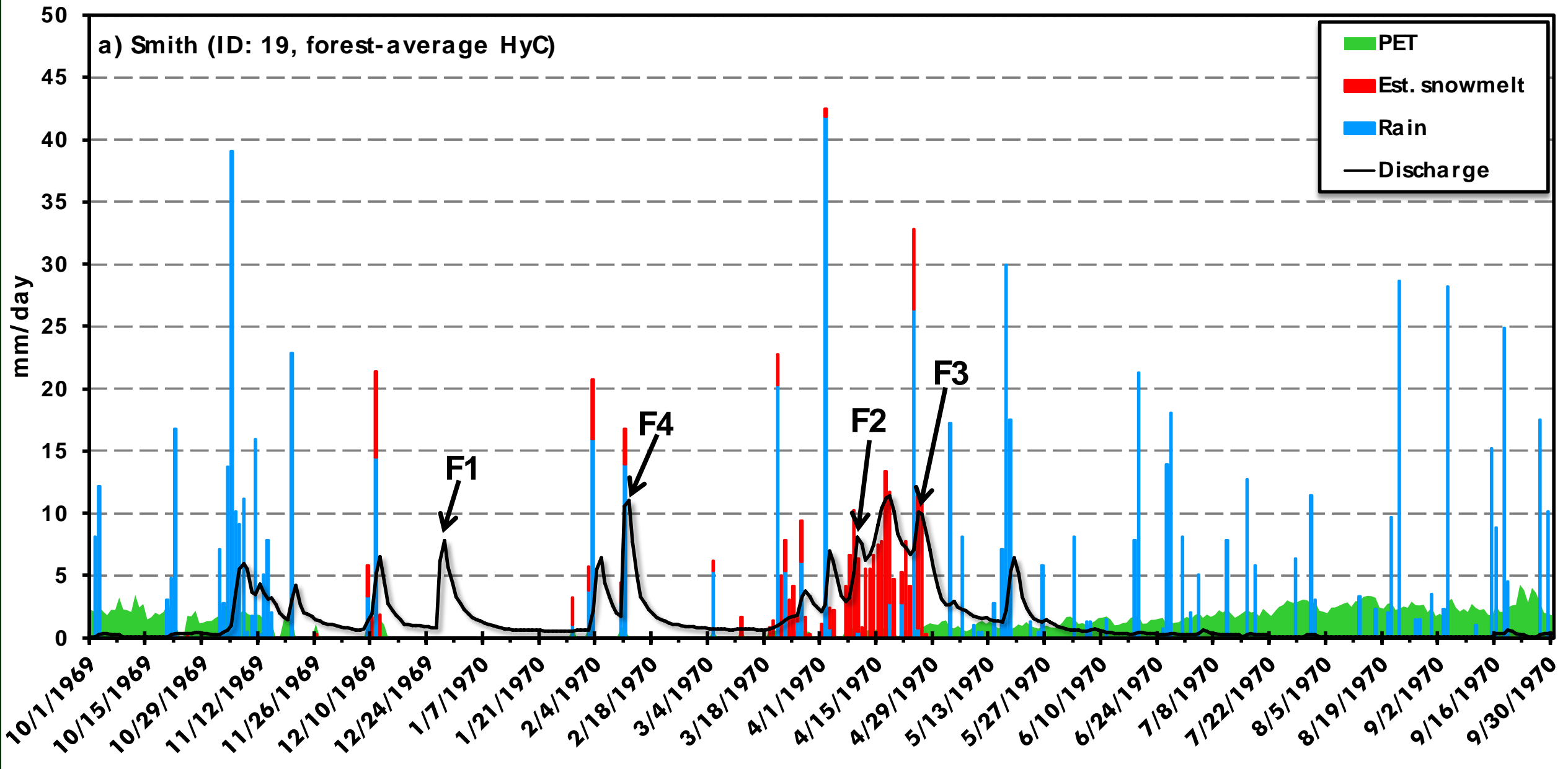
May 2017

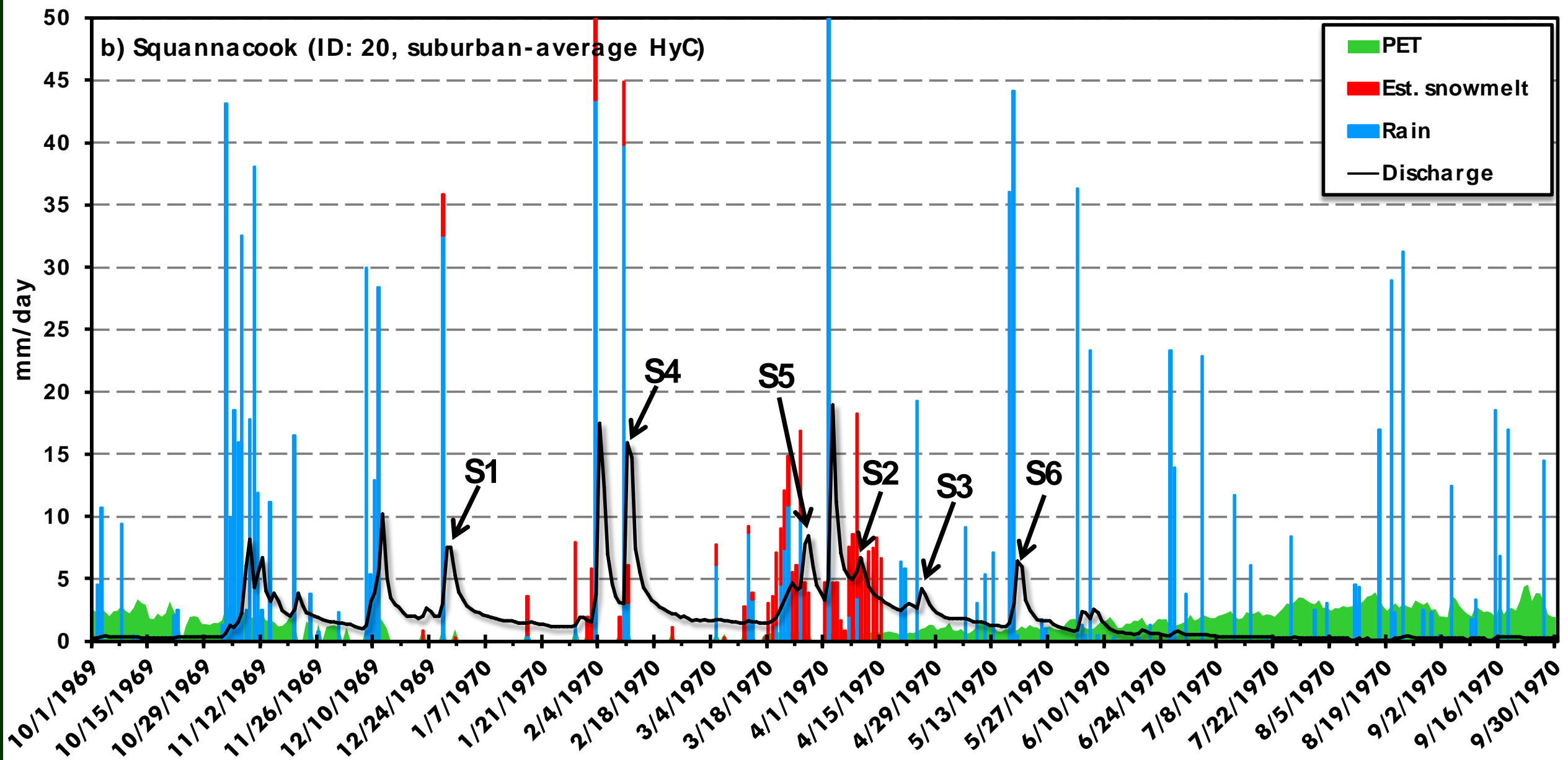
Berton, R., C.T. Driscoll, P.K. Barten, and J.L. Campbell. *(in preparation)*
Climate change and land use effects on streamflow discharge and timing.

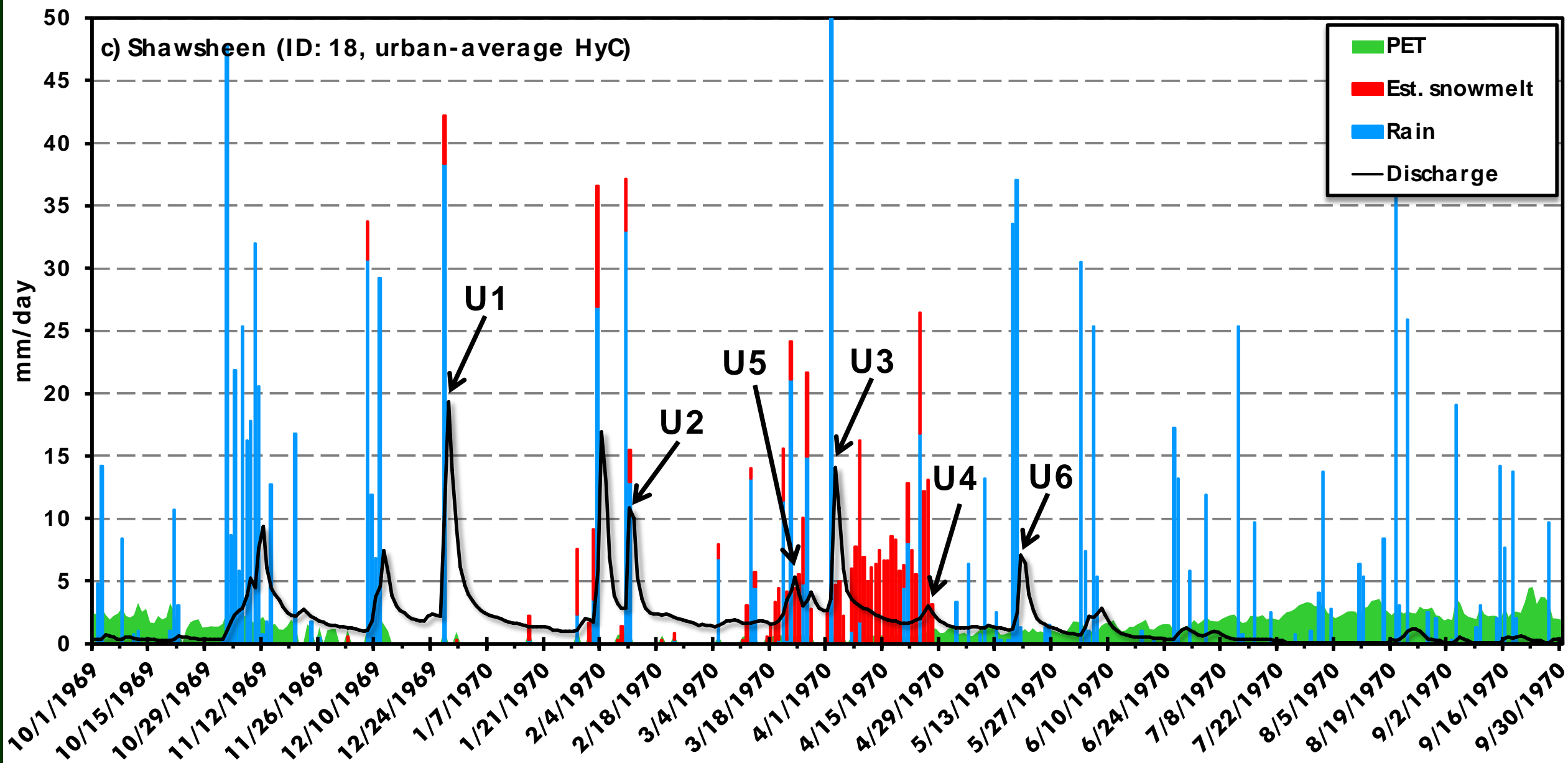


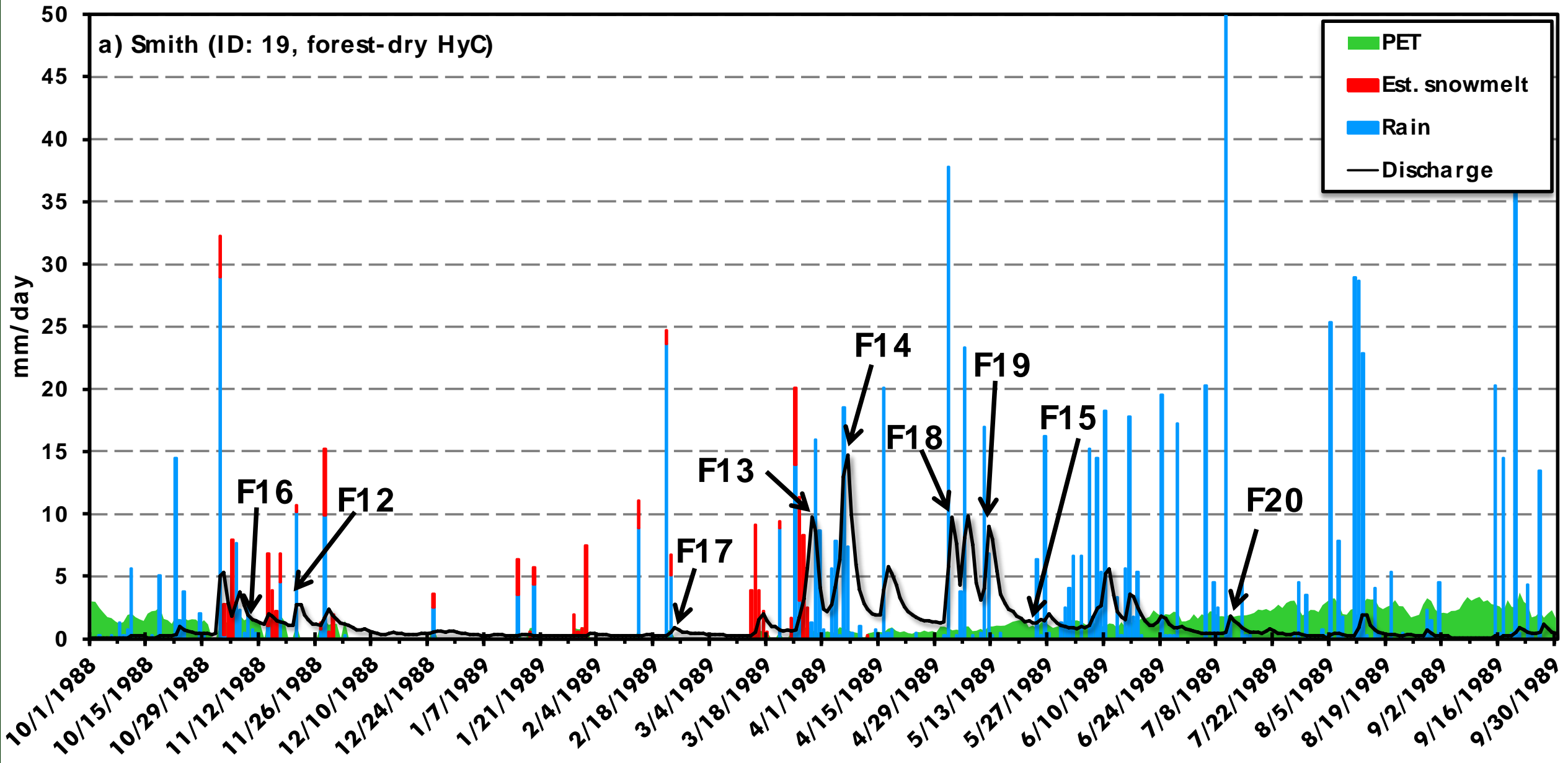
Sub-watershed	% Forest	% Developed	% Other
18 - Shawsheen	17	73	10
19 - Smith	87	4	9
20 - Squannacook	76	10	14

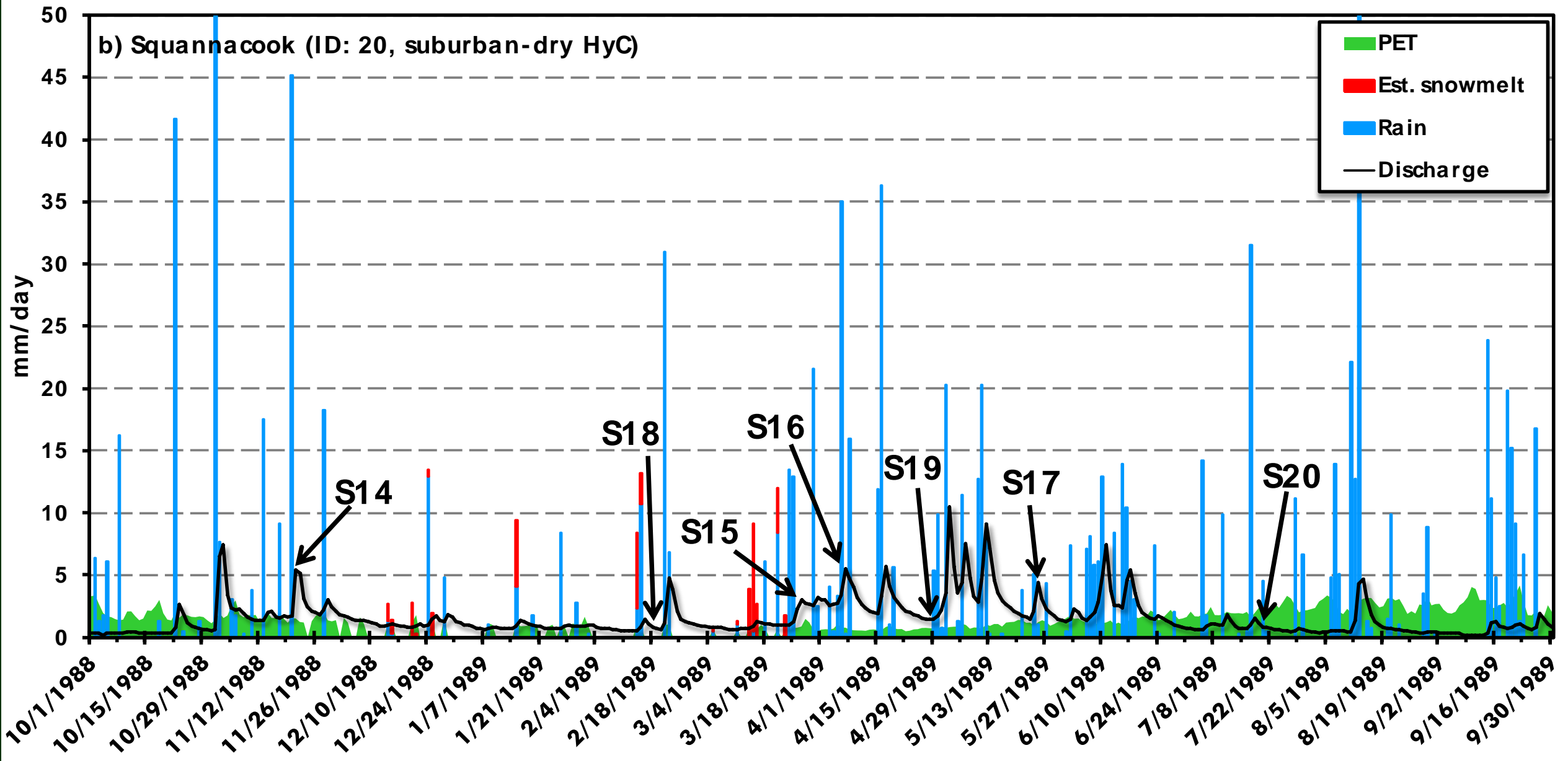


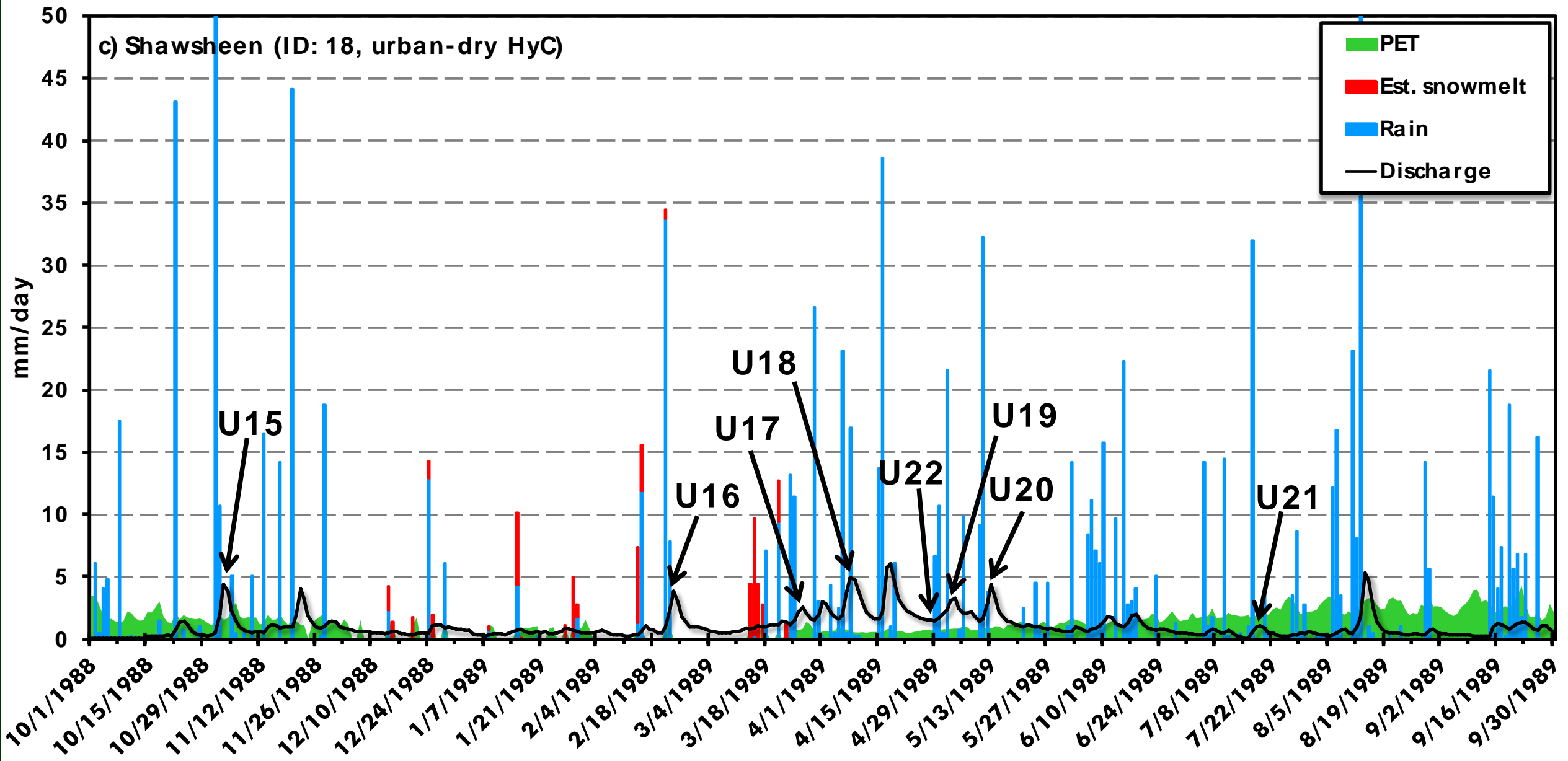


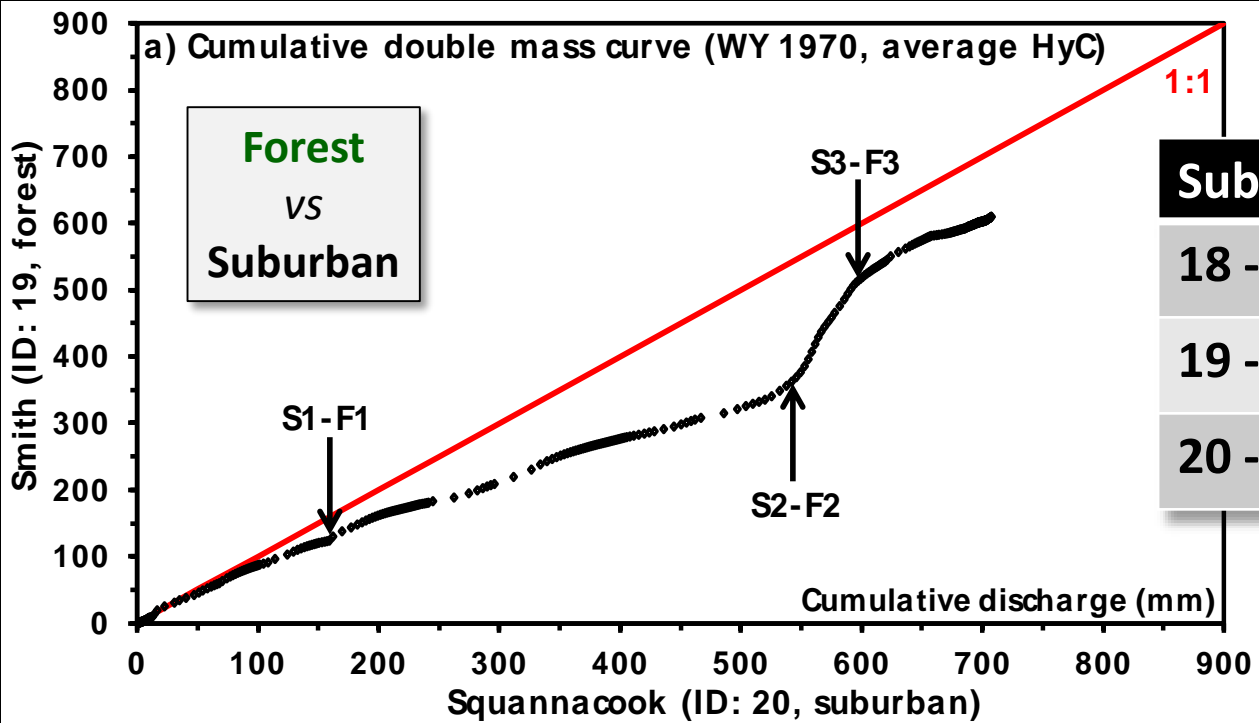




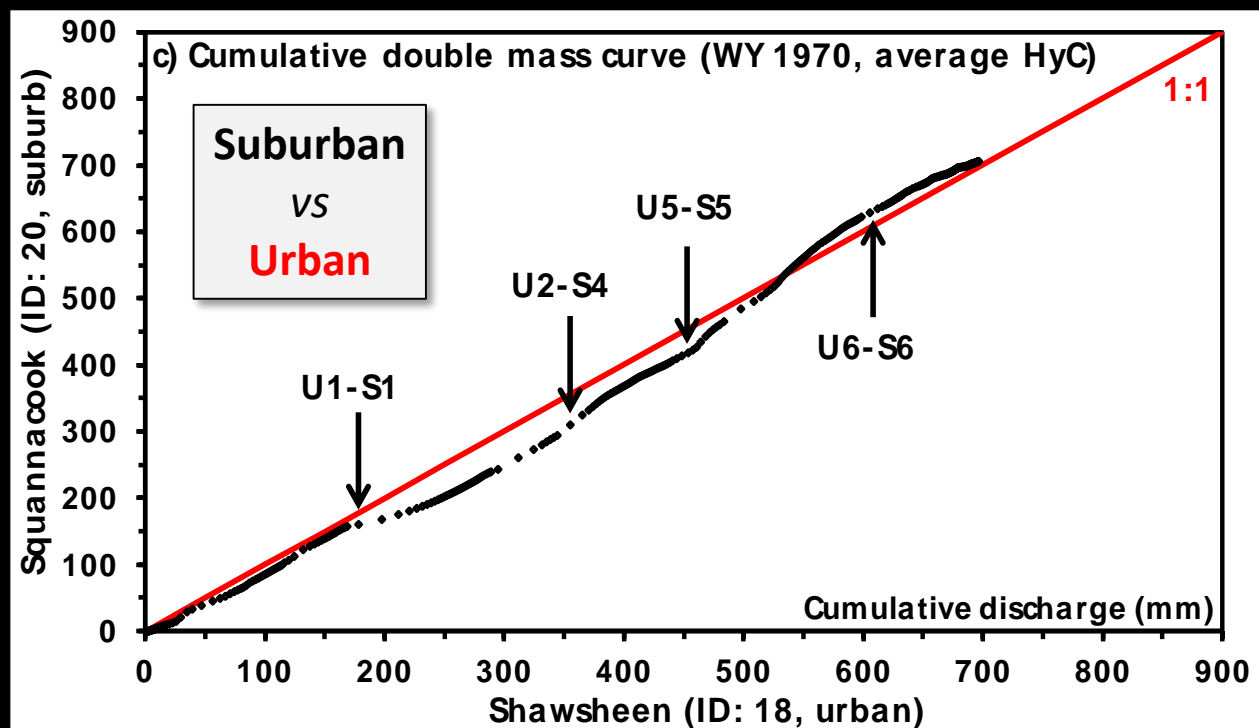
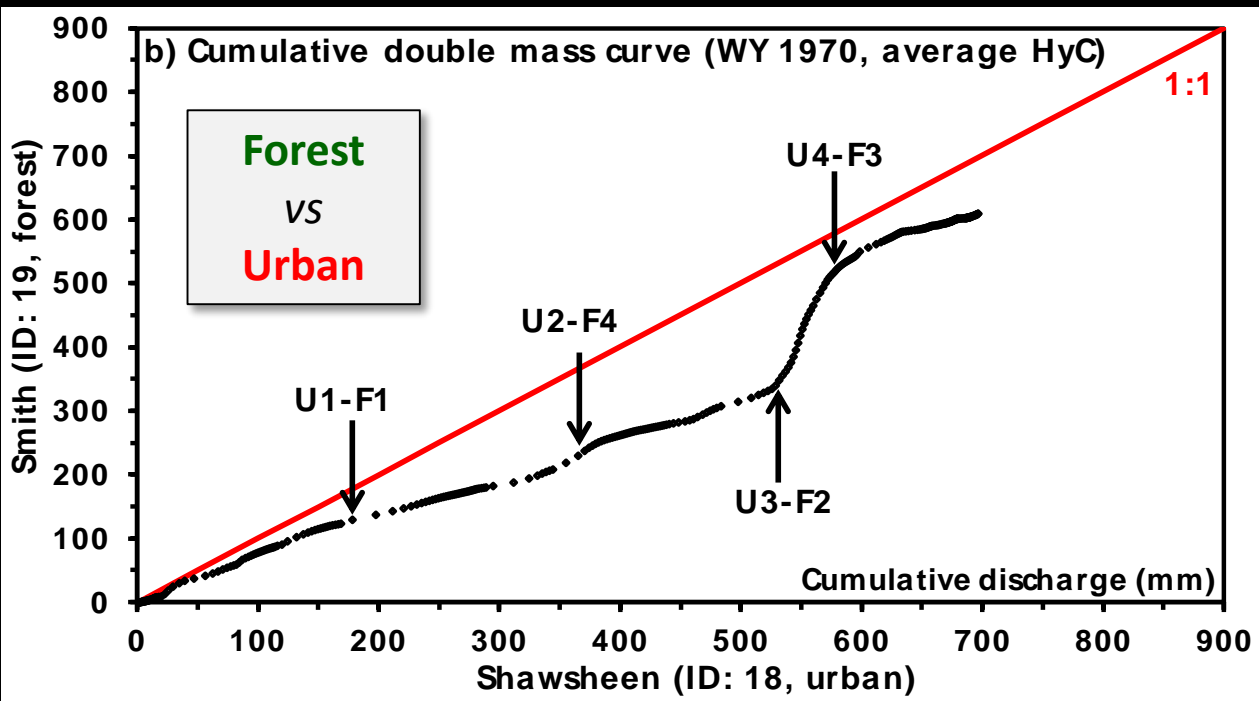




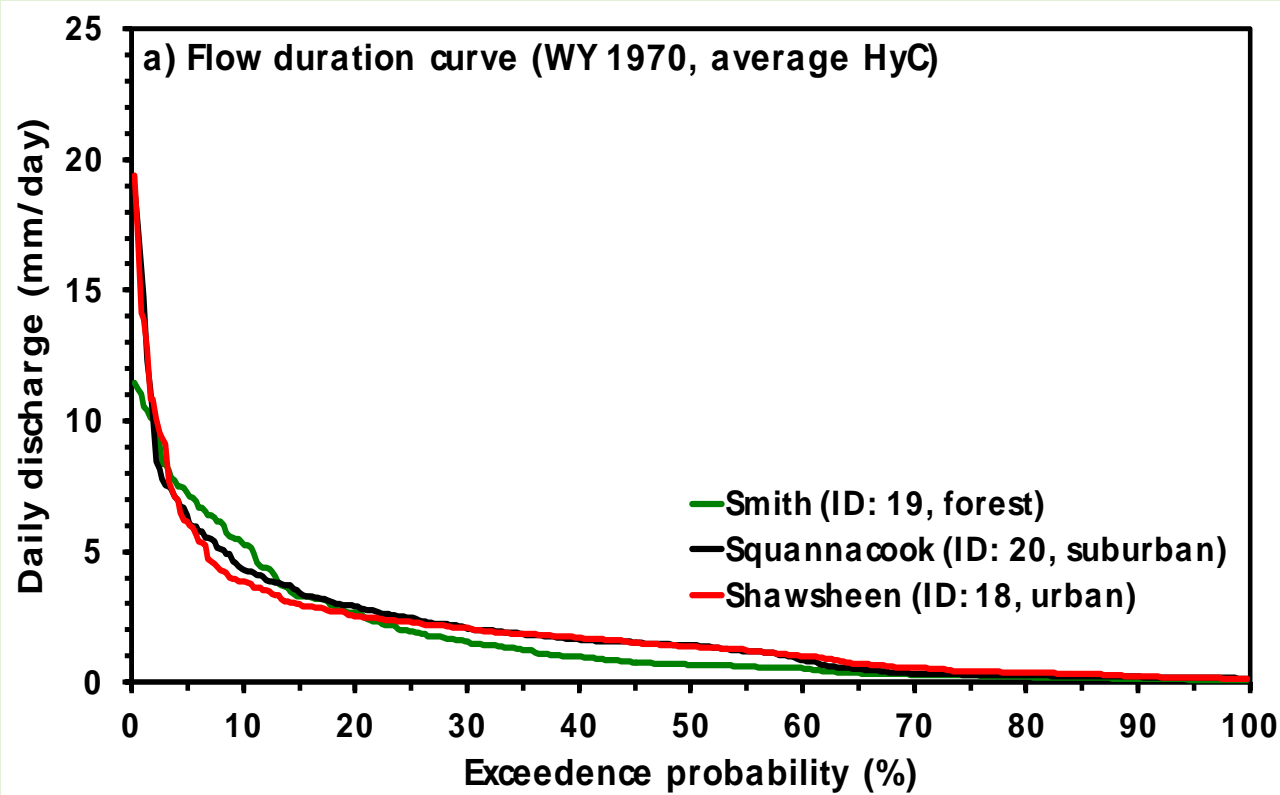




Sub-watershed	% Forest	% Developed	% Other
18 - Shawsheen	17	73	10
19 - Smith	87	4	9
20 - Squannacook	76	10	14

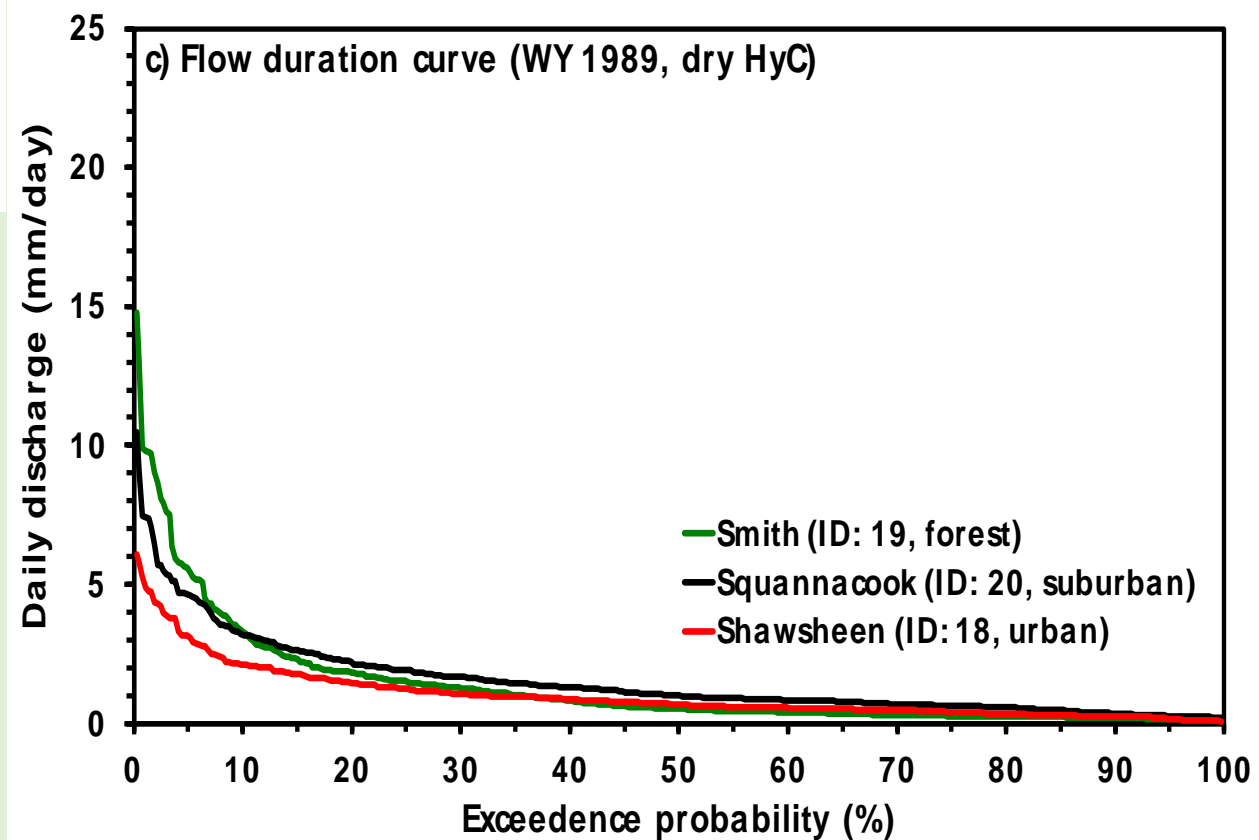


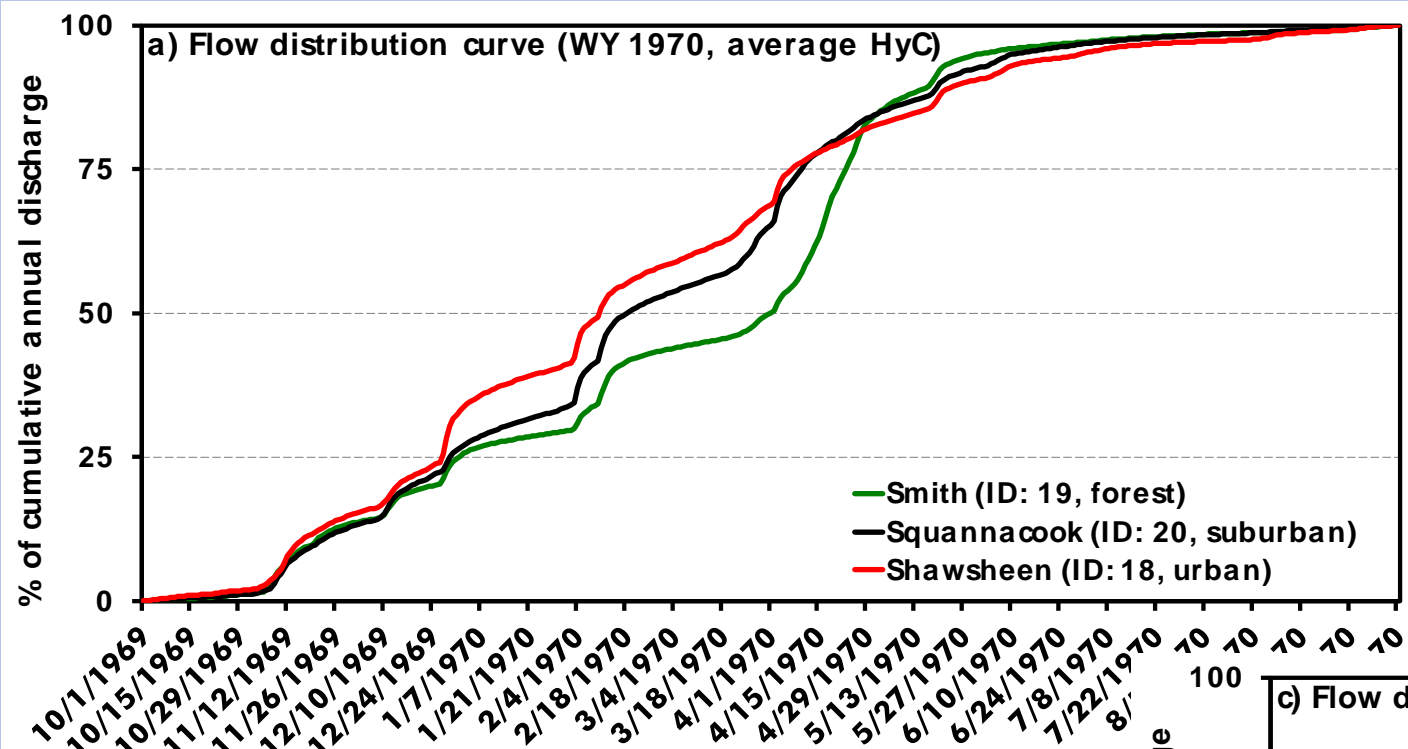
Flow regime changes when impervious surfaces >5 to 10%.



On average, as urbanization progresses: ***high flows get higher and low flows get lower.***

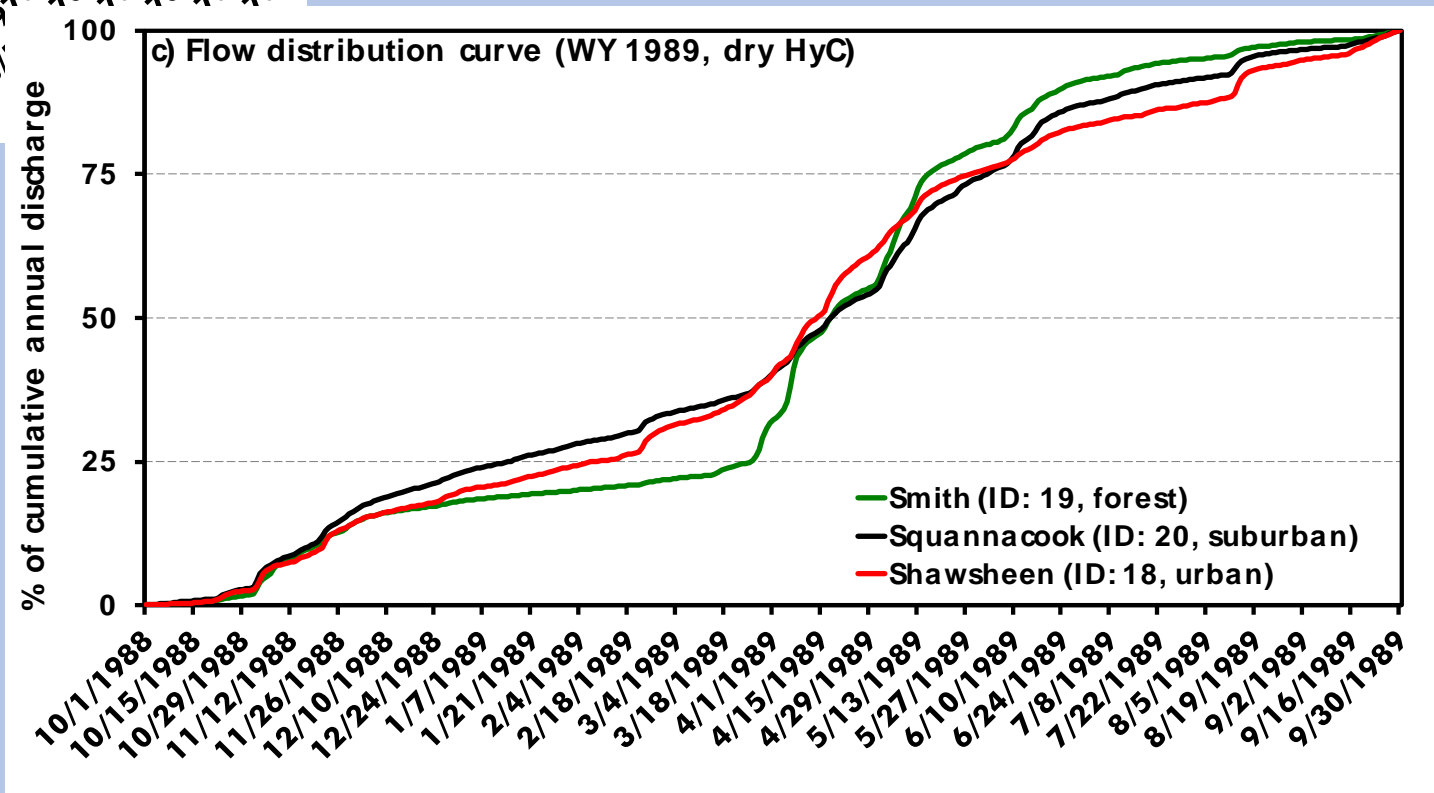
Forests help to sustain streamflow during dry years via infiltration, subsurface flow, and deeper groundwater flow paths.

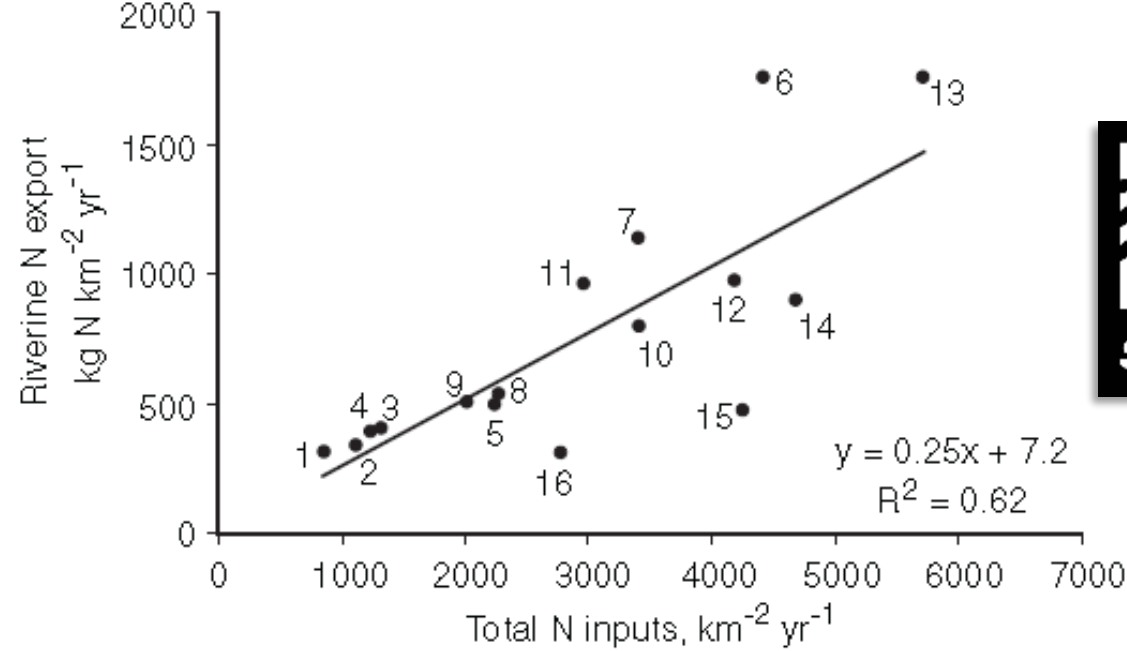
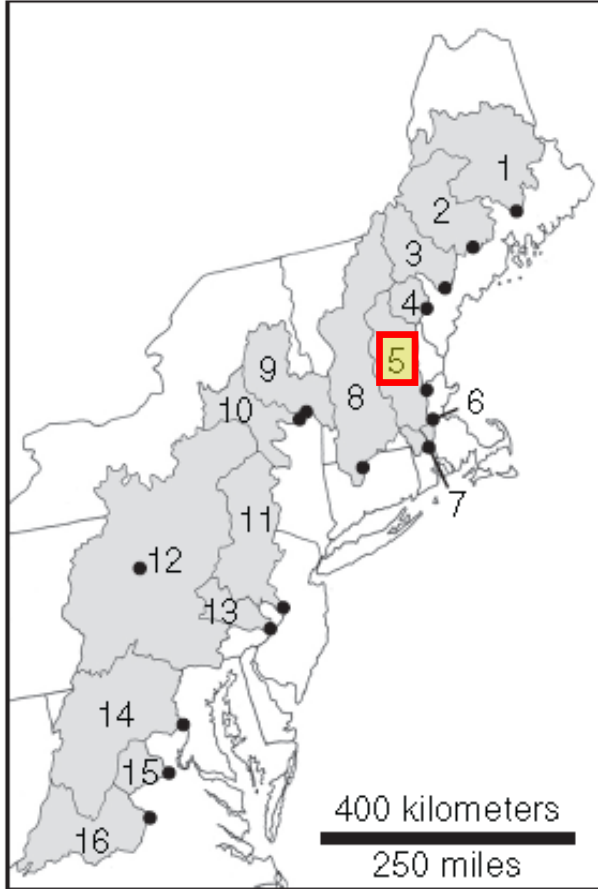




Forests delay and de-synchronize snowmelt.

Infiltration, subsurface flow, and groundwater flow paths also increase travel times to streams, rivers, lakes, and reservoirs.



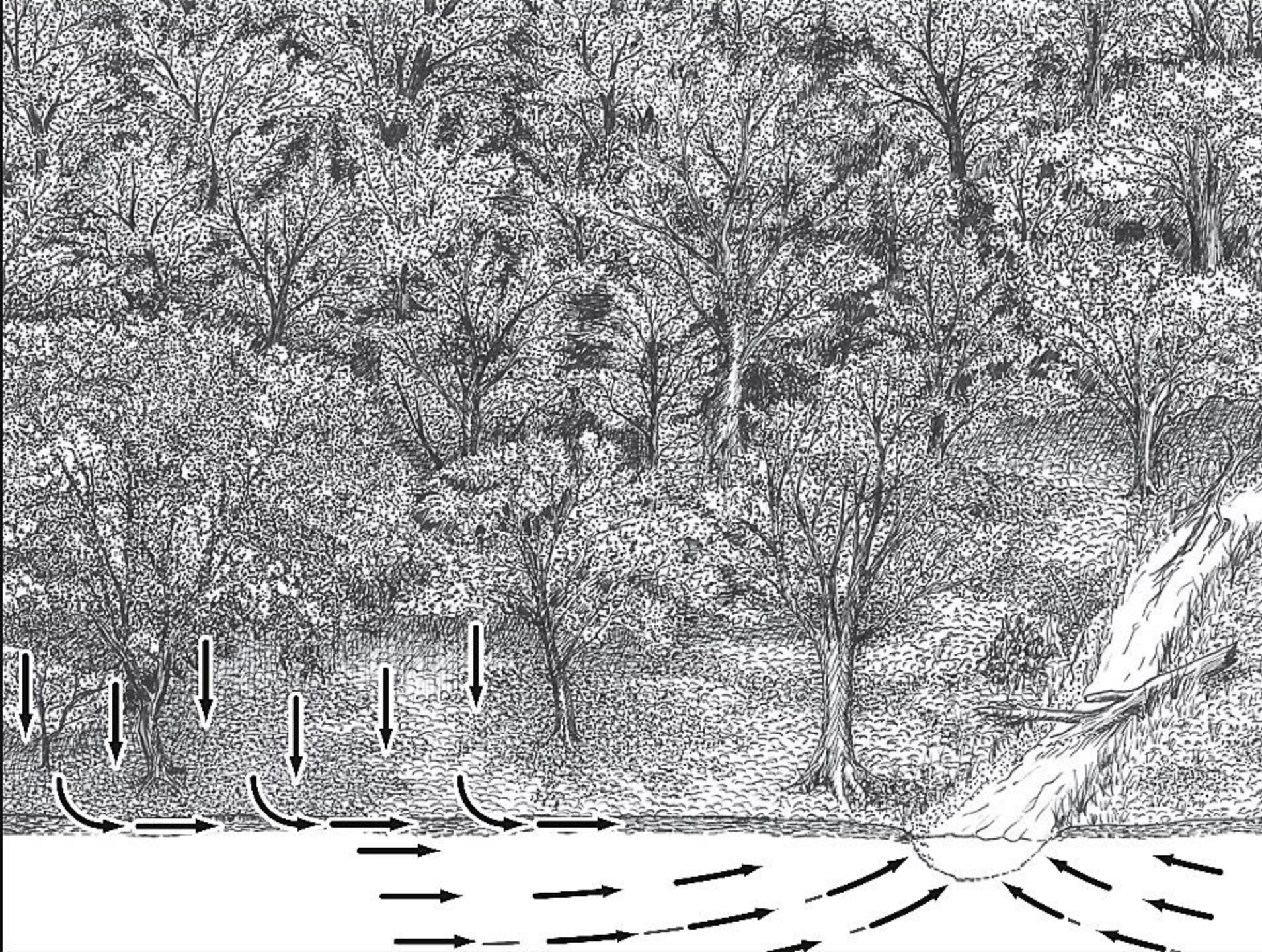


Nitrogen Loading Correlations:

- +0.70 with % agricultural land
- +0.96 with % agri + % urban
- **-0.77 with % forest**

(Presence of forests = absence of people ...and human activity)

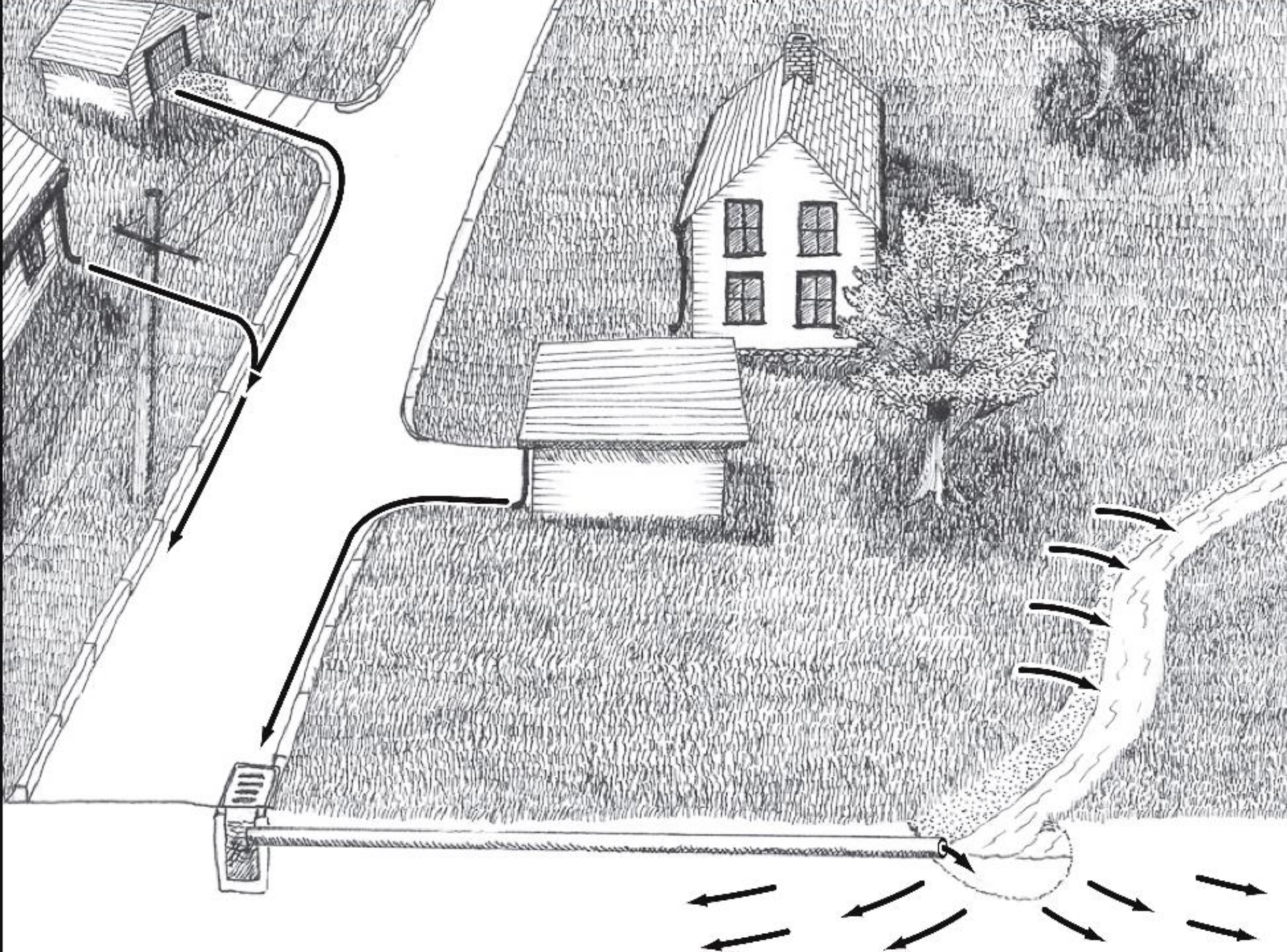
FIGURE 9.1 (Left) Nitrogen budgets were constructed for 16 major East Coast watersheds: 1. Kennebec (ME); 2. Kennebec (ME); 3. Androscoggin (ME); 4. Saco (ME); 5. Merrimack (NH); 6. Merrimack (NH); 7. Blackstone (MA and RI); 8. Connecticut (VT, NH, MA, and CT); 9. Hudson (NY); 10. Hudson (NY); 11. Delaware (NY, NJ, PA); 12. Schuylkill; 13. Susquehanna (PA); 14. Potomac; 15. James; 16. James. (Slightly modified from Boyer et al., 2002; reprinted from *Biogeochemistry* with the permission of Springer Science and Business Media.) (Right) Riverine exports plotted against total nitrogen inputs for 16 East Coast watersheds. Exports were highest in the two watersheds with the highest total nitrogen inputs, the Charles River watershed in Massachusetts and the Schuylkill River watershed in Pennsylvania. (Slightly modified from Boyer et al., 2002; reprinted from *Biogeochemistry* with the permission of Springer Science and Business Media.)



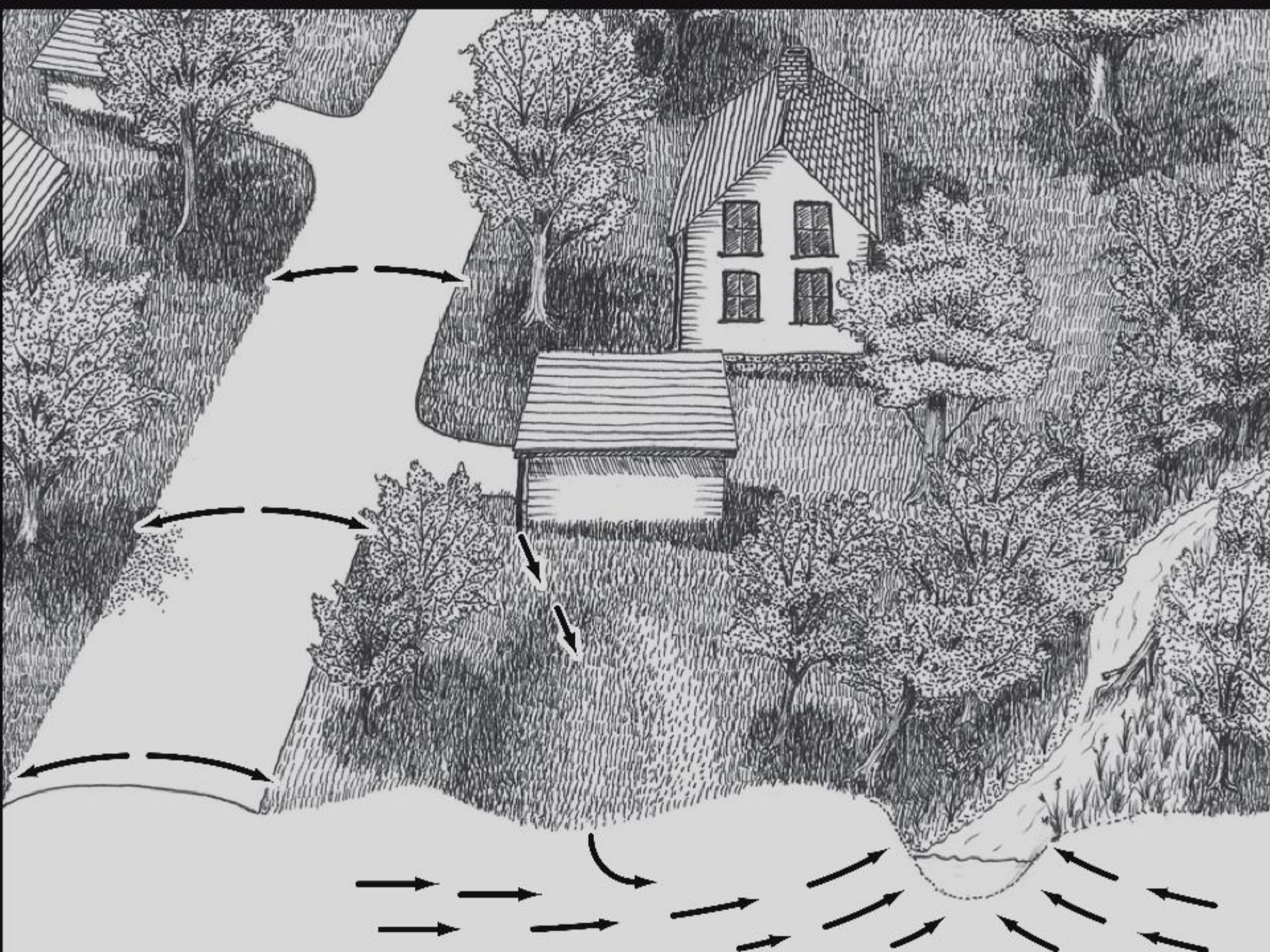
1. Rain tumbles through the canopy
2. Rain lands on the leaf litter.
3. Flows into the soil
4. Some is returned to the atmosphere.
5. Some flows laterally to streams.
6. Some flows vertically to aquifers.
7. Nutrients are resources for plants.
8. Leaf fall, root growth, and biotic activity slowly improve the site.

...The Living Filter

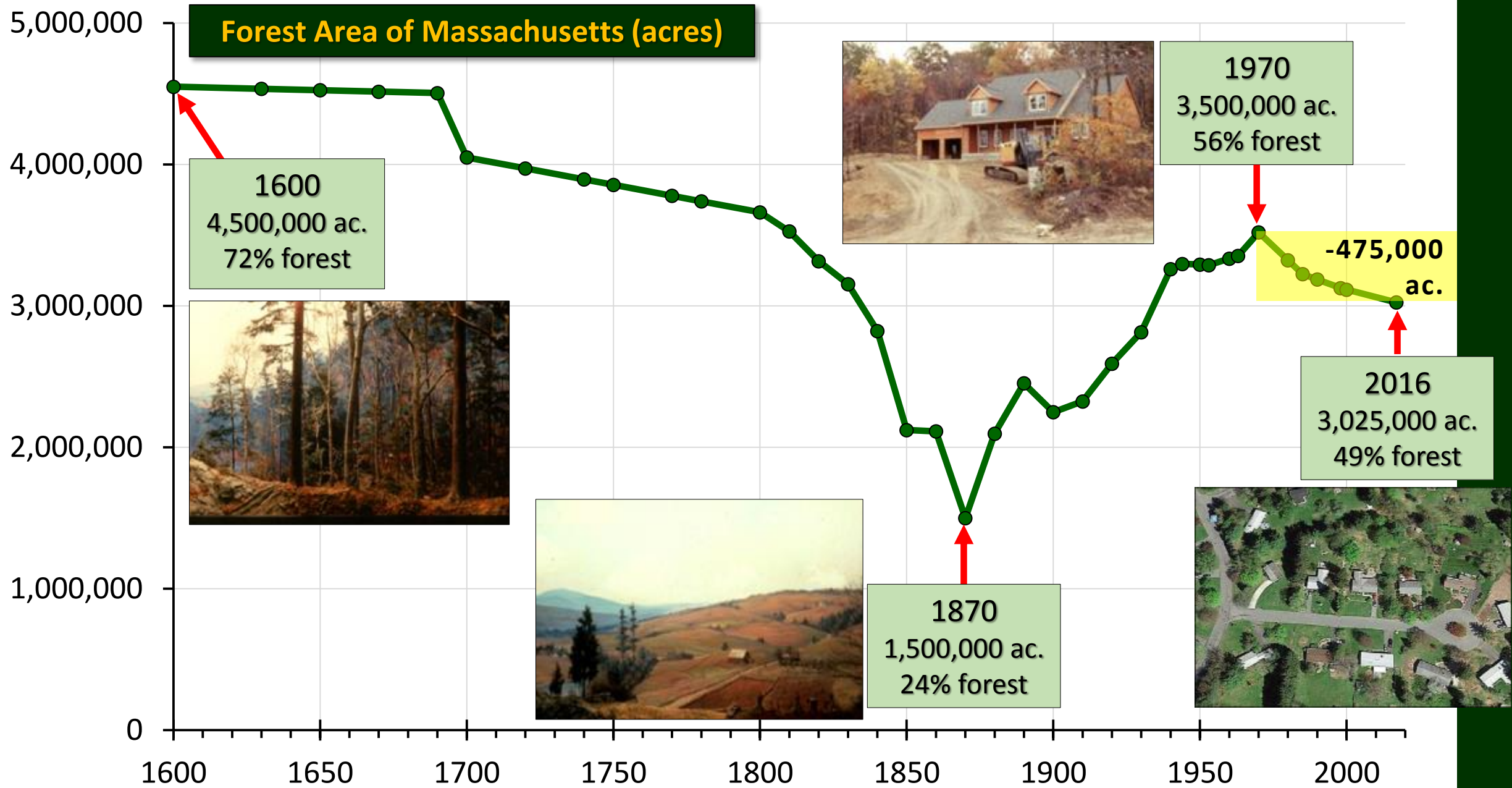
de la Crétaz and Barten
2007:248, Figure 8.8



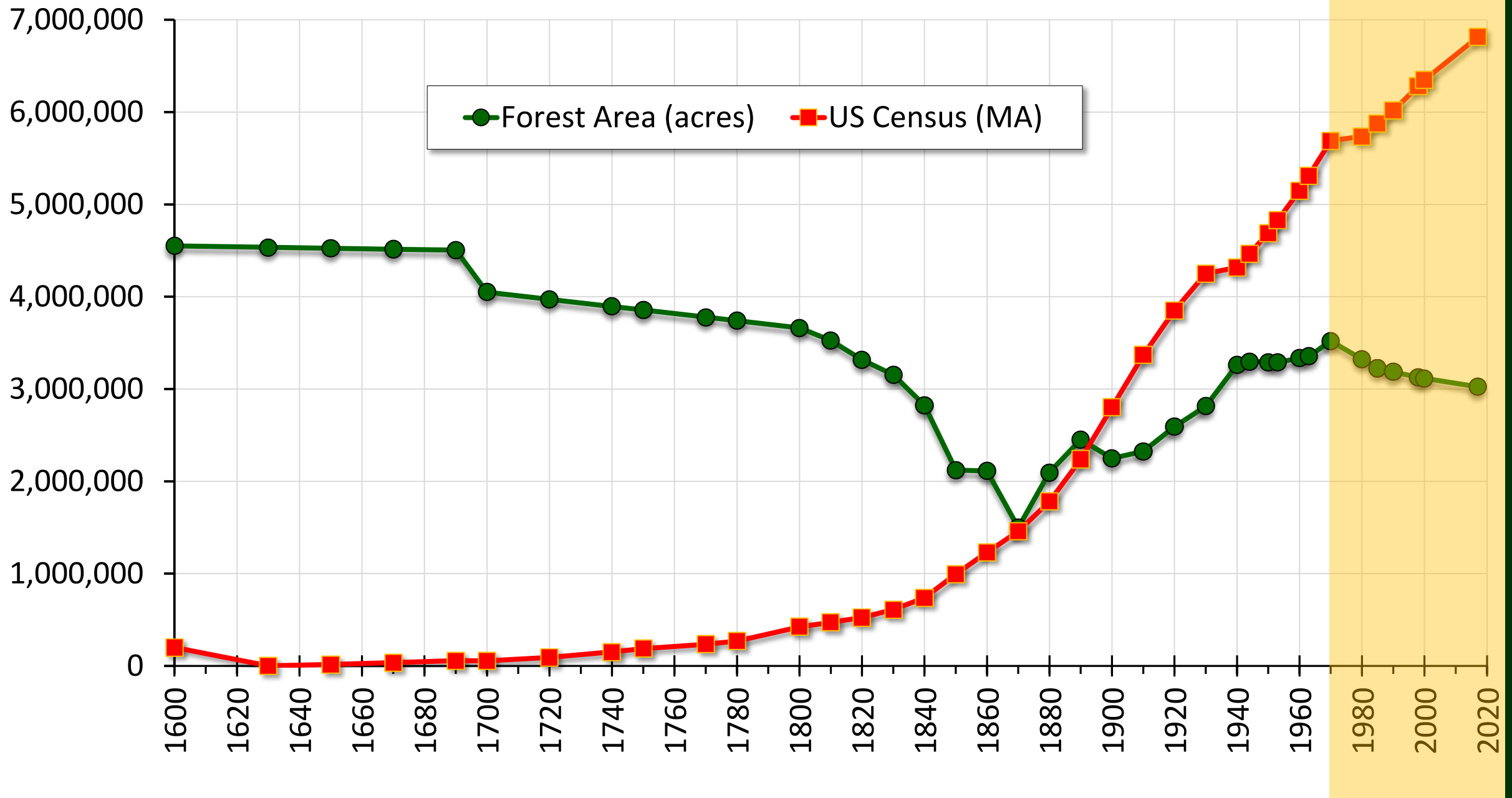
de la Crétaz and Barten
2007:248, Figure 8.8



de la Crétaz and Barten
2007:248, Figure 8.8



Data Sources: USDA Forest Service, Harvard Forest (HF-013)



Data Sources: USDA Forest Service, Harvard Forest (HF-013), US Census Bureau

