

## **The Legacy of Collaborative Watershed Research Between the Rocky Mountain Forest and Range Experiment Station and Colorado State University**

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### **Introduction**

The U.S. Forest Service established the Rocky Mountain Forest and Range Experiment Station (RMFRES) in 1935 and the Fraser Experimental Forest in 1937. There was a synergy between the Station and Colorado State University (CSU) from the very start that has continued for 70 years. Dr. Chuck Troendle, whom we honor here today, has been an important part of this legacy for the past twenty-eight years.

This paper gives only a brief overview of watershed research collaboration between the two institutions. People are mentioned to illustrate specific points. Many more people at both institutions were involved but are not included because of limitations of space and time. Reference is made to several publications that give a more exhaustive accounting.

### **Early Years**

The newly formed RMFRES came to Fort Collins in 1935 because of the presence of CSU and the centrality of the location for the region the Station served. Its first location was on campus in the top floor of the administration building. The Station headquarters moved to the new (now old) Forestry building in 1937. It remained there and expanded offices to several other buildings on campus until it built its new building on CSU-leased land in 1967 on West Prospect Street. Thus, from the very beginning, there was strong institutional support and mutual benefit. Among the first tasks of the new station was a “survey of soil erosion on National Forests, influence of vegetative cover on runoff and erosion, and use of water by vegetation.” The Station budget for the initial year included \$25,000 each for Watershed, Timber and Range (Price, 1976).

The Manitou Experimental Forest was established in 1936 and the Fraser Experimental Forest in 1937. Each of these research areas has been the site of collaboration between RMFRES and CSU for field studies of water resources. CSU has benefited by having field laboratories and logistical support for its students and the RMFRES has gained added hands and minds for its research programs. Gary (1985) reported these studies at Manitou by three CSU students. CSU alums that worked as research scientists on soil and water studies there included Herbert Berndt, Buchard

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Heede, and Stan Ponce (CSU faculty). There have been several water related studies since that time and recently Manitou is being revitalized as a research site for a wide variety of natural resource studies. The classic bunchgrass runoff plots that measured runoff and erosion under different levels of grazing from 1937-1952 still are an important data source for our understanding and teaching of range/watershed relationships (Love and Johnson, 1952).

At the Fraser Experimental Forest the famous Lodgepole Pine plots were established in 1938 and stream gages were installed on Fool Creek and East St. Louis Creek in the early 1940's. The full description of these and other studies established at Fraser through the mid-80's is presented in the proceedings of the 50<sup>th</sup> anniversary technical conference (USDA, 1987) and in the report by Alexander et al (1985). What is significant for this paper is that of the 32 dissertations and theses listed by Alexander et al, 18 are in water related studies and 17 of these 18 are by CSU students. In addition to the students, at least 6 of the watershed researchers who have worked at Fraser were graduates of CSU.

H.G. Wilm, who was in charge of watershed research in 1947 at RMFRES taught the first formal course in watershed management (rather than "Forest Influences" taught at several forestry colleges) at CSU. Among the students in that course was Robert Dils, later to become the leader of the Cooperative Watershed Unit at CSU. It is probably safe to assume that there were many other interactions between faculty and RMFRES researchers during these early years, but they are difficult to document. Two documented examples of collaboration involved Dr. Dave Harris of the Dept of Geology who was contracted in 1949 to evaluate geologic factors in erosion on National Forests and Bert Goodell's work in the hydraulics lab with Max Parshall to evaluate a trapezoidal flume (Goodell, 1950).

A tradition at Fraser has been the joint snow survey efforts each spring. Since at least the early 1960's watershed faculty and students would join with Station researchers, and often folks from National Forests and other agencies, to conduct the annual snow surveys in early April. These were good opportunities for practical field experience and scientific interchange. On one occasion Charles Lovelace, Director of the Station in the 1980's, joined the group.

Walter Garska, an employee of the US Bureau of Reclamation, played an important role in the RMFRES-CSU relationship. The classic paper relating snowmelt and streamflow (Garska et al, 1958) integrated results from the Fraser Experimental Forest. Later, he would serve as visiting professor at CSU. He was also instrumental in bringing funding for watershed research to CSU.

In 1958 the Cooperative Watershed Management Unit was formed at CSU. Instrumental in the formation of this new program were Ray Price, Director of RMFRES and Clinton Wasser, Dean of the College of Forestry and Range Management. Through his personal acquaintance with Arthur Pack of Tucson, Arizona, Dr. Price obtained a \$75,000 grant from the

Charles Lathrop Pack Foundation to develop undergraduate and graduate programs in watershed management (Dils and Meiman, 1995). Dr. Robert Dils was hired to lead the new unit and Director Price assigned Bert Goodell from RMFRES to work with Bob Dils. Bert, a mainstay in the fledgling program, received a PhD from CSU in Watershed Management in 1963, and served as major professor for at least 6 students and on the graduate committees of many others.

Among other RMFRES staff that gave strong support to the unit during those foundation years were Marvin Hoover and Mario (Pete) Martinelli, well-known researchers in watershed and snow/avalanche studies respectively. Chuck Leaf would join this list a little later in the 1960's.

The first 9 undergraduates of this new academic program all went to work for the US Forest Service and 3 became researchers for RMFRES – Bob Swanson, Ron Tabler and R.A. Schmidt. Other graduates who went to work for RMFRES included Herb Berndt, Ernest Frank, Arden Haeffner, Burchard Heede, Boyd Hutchinson and Charles Leaf.

Dr. Charles Leaf received his PhD in Watershed at CSU in 1969. He worked for the USFS with Marvin Hoover at Fraser during the 60's and 70's and developed a process-oriented hydrologic simulation model integrating much of the work at Fraser. (Leaf and Brink, 1973) He also produced "status of our knowledge" papers on watershed management (Leaf, 1975).

### **1977 – Present**

Dr. Charles (Chuck) Troendle arrived at RMFRES in 1977 and added considerably to the synergy between the two institutions. Dr. Troendle not only continued the historic studies at Fraser involving forest/snow interactions but added stream channel, subsurface and soil water flow and road erosion studies. Each of these additions involved graduate students from CSU. Some of these more recent studies included several on stream channels at Fraser by students of Dr. Ellen Wohl of the Department of Geosciences and another by Bunte and Abt (2001) from the Department of Civil Engineering. In addition to the emphasis on hydrologic process studies, he also worked hard on integrating and transferring to land managers our understanding of watershed hydrology. Two examples are his contributions to WRENS (Troendle and Leaf, 1980) and, very recently, his report on the impact of forest activities on water yield in the North Platte Basin (Troendle et al, 2003).

Dr. Troendle was an enthusiastic contributor to seminars and classes at CSU. He served as an Affiliate Faculty member on graduate committees and supported graduate students in their work at Fraser. He was also host to many university field tours at Fraser and elsewhere including the annual "Watershed Practicum".

Dr. Troendle expanded investigation related to the influence of forests on snow emphasizing more process studies in addition to the more traditional plot and watershed-scale ones. The common hypothesis at the time was that the additional snow in the forest openings was a "redistribution effect" more

so than an interception loss effect. This redistribution included both the differential input during snowfall as well as the relocation of intercepted snow in the forested areas to openings after snowfall in the interstorm intervals. The reasons for this hypothesis and the change in interpretation based on additional data and studies are given by Meiman (1987). Additional studies were built upon those by Troendle and Meiman (1984; 1986). Kent Wheeler (1987), a graduate student of Hal Boyne at CSU, conducted plot studies of increased intensity that confirmed that there was no significant redistribution of snow from forest to openings in the intervals between storms at Fraser. The clinching evidence for the importance of interception loss over redistribution was the study by Troendle et al (1988) where no difference was found in the above-canopy snowfall and the snowfall above an adjacent opening.

Dr. Kelly Elder replaced Dr. Troendle in 2001 as research hydrologist at RMFRES. Dr. Elder had been a faculty member in the watershed program at CSU and had already been working with Dr. Troendle with his graduate students at Fraser. One of these students, Gus Goodbody, is presenting a paper at one of these Hydrology Days sessions. Dr. Elder is currently working with four other students from CSU – two from Geosciences, one from civil engineering, and one from Watershed Sciences. Dr. Elder has expanded the work at Fraser even further to link it with regional and global studies of cold land processes (Cline et al, 2002). Dr. Hal Boyne, Professor Emeritus, who replaced Dr. Jim Meiman as leader of the snow hydrology program at CSU in 1975, is now working with Dr. Elder on this study. Dr. Elder replaced Dr. Boyne as leader of the CSU snow hydrology program in 1995. So the collaborative interchange between RMFRES and CSU is alive and healthy! Also, the recent syntheses by Stednick and Troendle (2004) and by MacDonald and Stednick (2003) draw heavily on the Fraser experience.

### **The Legacy**

What then is the legacy of the cooperation between these two institutions over the past 70 years? The answer can be divided into three parts: 1) a history of synergistic collaboration by people and institutions; 2) a vast body of knowledge on the relationship of land use to watershed hydrology and erosion; and 3) a large pool of trained personnel in watershed management.

*Collaboration:* People are the key to collaboration. The 70-year record illustrates that scientists and the institutions they represent have been able to produce far more knowledge and training than they ever could have by working alone. This mutual effort has involved not only scientific research but also the support thereof by sharing facilities, logistical support, funding and the related political support.

*Knowledge:* A combination of theoretical and field-verified understanding of watershed hydrology resulting from multi-scale studies

ranging from process to plot to watershed to regional including the development of models for application of this knowledge by land managers. Related to the acquisition of this knowledge has been the development of a research approach that, in the best sense of scientific endeavor, has continually reformulated ideas, hypotheses, and paradigms.

*Trained People:* Approximately 1000 people have earned degrees in watershed since the founding of the Cooperative Watershed Unit in 1958, 525 of these at the graduate level. Many of these people went to work for the US Forest Service. Through the leveraging of PhD graduates who go on to teach at other universities, perhaps thousands of others have been influenced by the formation of this Unit.

The challenge ahead is to continue to build this legacy. This will require the continued close association and dedication of the people involved at all levels -graduate students, research scientists and research administrators.

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