The Spruce Moose

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Taking a Look at Adirondack Park Future

William Porter

by Dr. William Porter, AEC Director

Over the past couple of months, I have been involved in a series of meetings that focus on the future of the Adirondacks. Several common themes are emerging.

Is a new vision for the Adirondacks forming? There is growing interest in developing a shared vision of the inherent values of the Adirondacks. There is increasing recognition among even traditional adversaries that we need to identify and focus on those elements of the Adirondacks that are common ground. Many organizations are realizing that more science is essential.

Can we identify indicators of ecosystem health? The vitality of local and regional economies is essential to the Park, but there is serious concern about the impact of growth and the infrastructure that will be built to support it. There is particular interest in identifying the indicators of social and ecosystem health ("canaries in the coal mine"), and the thresholds of significant change.

What are the risks posed by chronic wasting disease, West Nile virus, Lyme disease and rabies; the bioaccumulation of contaminants; the effects of acid deposition; the effects of road salt; and the impacts of invasive species? Questions are being raised about the monitoring that is being done and what might be needed to make the case in Albany and Washington.

Should we be planning with a landscape context? There is great concern about planning for individual parts of the park and failing to consider the interaction of these parts. How, for instance, does the Siamese Ponds Wilderness Area affect the economy of Indian Lake, and how does the proximity of the community of Indian Lake affect the biological integrity of Siamese Ponds? Do the individual units of the Forest Preserve function as a constellation of wilderness areas to enhance biological integrity of the Adirondacks?

To hear these same questions from local planners, and representatives of industry, environmental organizations and state agencies suggests an important opportunity. We appear to be at a rare moment in time when decisions are on the horizon that will shape the Adirondack Park for the next several decades.

Adirondack Landscapes

by Stacy McNulty, Ecologist

In 2002, the AEC completed a strategic plan that included short and long-term goals for research and education programs and indicated the need for growth of the station's facilities. During the planning process, many questions arose: Who uses the buildings and for what purposes? Should the existing buildings remain the same, be modified, or should some even be removed? Where should new housing or laboratory space be located? Which road and pathway plan allows for the smooth flow of people and vehicles with a minimum of maintenance? How can we serve diverse user groups during all seasons?

During that planning process we realized that to make the best use of current space and future resources we needed to focus on one vision for the facilities. Resolved to get help from the experts, we invited faculty from ESF's Faculty of Landscape Architecture (LA) to explore facility design on Huntington Forest. Maren King, assistant director of the LA Council for Community Design Research (CCDR), responded and a design studio focused on renovation of the Arbutus Area was born.

On a beautiful weekend in early September 2003, Drs. Elen Deming and Tony Miller brought 15 second-year LA graduate students to stay at Huntington Lodge to kick off the month-long project. The visit introduced the students to the area, many of whom had never been to the Adirondacks. The students interviewed HWF staff about program priorities, users, and proposed functions of the buildings of the Arbutus area. The exercise provided the students with a real-world experience using AEC staff as the clients. Dr. Deming reflected that the experience was much deeper for the students than anticipated. They had not expected the variety of programs, user groups, needs, cultural/natural resources, and challenges inherent in running the field station.

The students returned to campus where they gathered more information, prepared site plans, and began to design innovative layouts. Since the 1940s the Arbutus area has changed little, though the cabins have served different purposes as the station grew. The college removed unneeded or unrepairable buildings, recast buildings into housing, and built Marcy cabin. Some students kept the historical cabins and added new facilities in the adjacent space, separating the buildings with vegetation or joining them with

walkways. Others redesigned the entire area, its parking, and views of Arbutus Lake. The studio culminated in the presentation of the projects at a design show in Syracuse. Each design had a different look and feel based on the experience of the student's immersion into the natural surroundings during the autumn visit.

The studio was a great success for everyone involved. The LA students were presented with a real-world problem and an important learning experience in a wilderness setting to which they might not ordinarily be exposed. Dr. Deming said, "Both the students and AEC staff enjoyed sharing ideas. As we further refine our options for preserving and enhancing the Arbutus area, the students' designs provide many points of departure and a range of interesting possibilities to pursue."

We are excited about this new connection between LA and the AEC. This spring Dr. Deming's graduate students investigated the layout and functions of the Rich Lake Dining Center and White Pine bunkhouse facilities. Working with the "pros" will result in creative solutions to our facilities' growth challenges. And ultimately, improved facilities will enhance our ability to fulfill the station's mission of "understanding the Adirondack ecosystem through research."

Arbutus Cabin circa 1927.

Silviculture, HWF, and the Great Adventure of Time

by Dr. Ralph D. Nyland, Distinguished Service Professor

Silviculture research at Huntington Wildlife Forest has enhanced teaching, supported outreach and workshops, and influenced hardwood management throughout northeastern North America. Yet things started slowly. When ESF cut 900 acres along the Adjidaumo and Old Military roads in 1947, it simply removed large trees. This was quite different from the ideas of Carl Hammarstrom ('36) and Gould Hoyt ('48), who proposed sustainable forestry. Later research reinforced their belief that silviculture could make a difference.

In 1957, Gene Farnsworth and Jack Barrett started the silviculture along Catlin Lake Road opposite Long Pond. They invited me ('59) to help. Norm Richards found that intensive browsing and understory beech prevented hardwood regeneration. Later, Jim Coufal ('62), Carl Mize ('77), and Dick Lea described ways to select good residual trees and predict the response, and the effects of beech bark disease. Jan Carney ('81) found that after release, well-chosen 200-year-old maples increased in growth from hardly visible to a sustained rate of 2 inches per 10 years.

Bill Tierson ('67) followed by showing benefits of poisoning pole-sized beech at the Electric Fence shelterwood cutting along Shattuck Clearing Road. Then, through the '70s, he and Dick Sage combined mistblowing, shelterwood seed cutting, and deer density control at operational scales along the Loop Road, and through the Sucker Brook drainage. Matthew Kelty ('79) found that thrifty new hardwood stands later covered the sites. Where they kept widely spaced older trees, a new age class regenerated between them. Heather Engelman ('04) now studies how the two age classes grow, and their structural characteristics. We know that these sites have greater songbird diversity than single-cohort stands.

Inventory plots along the grid lines helped Steven Simon ('86) to identify 13 distinct forest community types at Huntington, and that most species grew differently from one community type to another. Yet Thomas Temple ('81) found no significant differences in stand-level volume production, except at extreme conditions. Robert Sommers ('86) added a 14th community type at high elevations. He confirmed that stands with the best nutrient supply, drainage, and available moisture produced the most volume regardless of the soil or vegetation community type. Similarly, David Ray ('97) found little difference among young shelterwood stands growing on Becket soil, allowing him to predict changes in their stem density through time. It reinforced Peter Triandofillou's ('80) findings that site quality did not appreciably affect early even-aged stand development. With Chris Helmes ('99), David also documented the tree height growth and crown size at different ages. Coupled with John Garrett's ('80s) earlier work, this tells us what spacing to use for thinning and other cultural treatments.

John Lareau ('85) understory and overstory responses after thinning, showing that upper canopy trees grow much faster than smaller ones. For the '85 Stone Garage thinning plots that Maria Saurez ('89) helped to document, we used Susan Stout's ('83) methods for controlling stocking, adjusting for short to long thinning intervals. We also added plots at the Catlin Lake Road Switchbacks, upper Wolf Lake Road, and the junction of Deer Pond and N Line Roads. Now we can study the effects on immature trees, and on wildlife habitat.

These studies suggested some important guidelines:

- manage deer populations … to reduce browsing
- herbicide the beech … to minimize interference

THE SPRUCE MOOSE is a semi-annual publication of the Adirondack Ecological Center. Submissions regarding news, research or events associated with the AEC or Huntington Wildlife Forest are welcome. Due to space limitations, *The Spruce Moose* reserves the right to edit, omit or postpone submissions at our discretion. Submissions, comments, and questions can be directed to Ray Masters or Marianne Patinelli-Dubay at *aechwf@esf.edu*.

- manage the light … to promote advance regeneration
- wait patiently … to get a response

With help from Dawn Adams Harkenrider ('01) and Jamie Savage ('90), we used these in new cuttings along the Old Military Road, at the Catlin Lake and Shattuck Clearing Road junction, and on Gooseberry Mountain. Bill Tierson had partially cut the latter area (late 60s) after doing beech understory control. We chose it and the other stands to test low-density selection system strategies in the late 1980s as suggested by Gerald Hansen's ('83) research. According to Paul Quinlan ('96), the plots have stable diameter distributions, similar structures across sites, successful regeneration where we controlled the beech and deer, and high vertical structural diversity. Where deer and beech interfered, regeneration failed, and herb species diversity and abundance declined.

Based on these and other stands, Kimberly Bohn ('01) identified a threshold density where understory beech interferes with other regeneration, and where managers should follow Dick Sage's ('83) advice about making a summer application of mistblown glyphosate. After he did it at the Junction site, abundant advance sugar maple developed in the understory. It grew rapidly after the 1989 cutting. Yet when we treated pole-size beech by stem injection, we controlled beech suckering only with herbicides that moved into the root systems. Amy Mallett Bashant's ('02) summer cutting of understory beech using brush saws also limited suckering and sprouting, and promoted sugar maple advance regeneration. Kimberly Bohn and Jodi Forrester observed ('03) that herb species abundance and diversity also increased at those sites. Further, students working with Charlotte Demers found that fencing increased herb diversity and abundance in stands where we cut in the overstory and controlled the beech. Other measures of biodiversity likely increased as well.

With conifers, we saw that white pine planted in small hardwood clearcuts grew much faster than trees in old fields. So with Dick Sage, we planted open areas and skid trails at some shelterwood sites. Pines free of hardwood shading grew well, enriching the habitat for some songbirds and increasing wood volume production. Daniel Goerlich's ('98) studies showed that partial shade, a thin organic layer, and a favorable soil moisture regimen increase hemlock regeneration success. He suggested leaving 40-to 50-foot wide reserve areas between narrow cleared strips. Dan also contributed to our study with Finch-Pruyn Company to see if understory beech removal improved the survival and development of underplanted hemlock.

Members of the Faculty of Forest and Natural Resources Management during a recent retreat.

We now have 28 permanent silviculture research sites at Huntington Wildlife Forest, illustrating many options for managing northern hardwoods. Many unmentioned undergraduate students helped along the way. In the process, we all learned that silviculture can make a difference.

Wetland Hydrological, Biogeochemical Research at the HWF

by Dr. Christopher P. Cirmo, Associate Professor, SUNY Cortland

With increased scientific and public interest in wetlands and questions of their role in a variety of environmental quality indices, it is important to determine their function. Of particular importance is the determination of just how wetlands impact water quality and hydrology within Adirondack systems already impacted by acid deposition, forest management, and shoreline development. A full 15 percent or more of the total area of the Adirondack Park is wetland, a much higher current percentage than most other regions of the state and nation. In addition, the Adirondacks contains large tracts of comparatively pristine landscape, giving scientists an opportunity to study wetlands in a relatively undisturbed state.

Wetlands consist of areas of continuously saturated soils, many times in proximity to lakes and streams, frequently inundated by floodwaters, and supporting vegetation uniquely adapted to such conditions. They are referred to as bogs, swamps, fens, flows, wet meadows, riparian zones, fringes or a multitude of other classification and naming conventions.

Research on the structure and function of wetlands within the Huntington Wildlife Forest (HWF) has a decade-long history beginning with the formal establishment of the Huntington Watershed Study and construction of an automated H-flume on Archer Creek, the major inlet stream to Arbutus Lake. This project was initiated in 1994 by Drs. Myron Mitchell and Jeff McDonnell of ESF, and Dr. Chris Cirmo of SUNY Cortland, as part of a USDA National Research Initiative (NRI) grant. Several significant wetland areas exist near the Archer Creek inlet to Arbutus Lake, consisting of saturated riparian zones, abandoned and active beaver meadows, and a large slope wetland. In addition, many pockets of saturated soils and vernal pools exist throughout the drainage area. Initial studies in the mid-1990s focused on the overall hydrological and biogeochemical function of the Archer Creek watershed and wetlands, and their connections to Arbutus Lake.

Graduate work done by Joe Bischoff and Mike McHale from 1994-1998 established the vegetative structure of these wetlands, their importance as sinks and sources of nitrogen (Bischoff 1997, Bischoff et al. 2001; McHale 1999, McHale et al. 2004). These wetlands were found to contain much larger pools of stored nitrogen than the surrounding forested uplands. There were notable changes in the form of transported nitrogen as water moved through these wetlands, from inorganic to organic forms. Subsequent studies have shown a larger than expected proportion of nitrogen entering Arbutus Lake as dissolved organic nitrogen. These findings allowed a better understanding of overall biogeochemical processing in the watershed.

As part of a National Science Foundation (NSF) study of watershed hydrology and soil biogeochemistry, ESF graduate student Sheila Christopher determined that a large wetland on a slope draining to Archer Creek is a major source of dissolved organic carbon (DOC) to the stream. DOC can affect both stream pH and the ability of stream water to transport other metals and nutrients. It is also a classic indicator of wetland influence.

Additional work within the Archer Creek wetlands complex continues involving studies of wetland soil stratigraphy (layering) and how this affects hydrologic flowpath. This work includes the use of ground penetrating radar (GPR) to visualize subsurface structure, in cooperation with James Doolittle of the USDA. This work includes soil coring for texture analysis and profiling, and the use of natural chemical tracers in wetland groundwater. Amanda Buboltz and Rachel Hutchinson (SUNY Cortland) are investigating alternating layers of paleo (historical) sand and peat layers within these wetlands. Correlation of soil texture depth profiles with pictures obtained by GPR could be used as a new tool to classify the historical development of Adirondack wetlands. These findings are being compared to similar work from Catskills wetlands to determine commonalities useful to better understanding the three-dimensional structure of wetlands.

Other wetlands work at the HWF includes research on nitrogen fixation at several alder shrub wetlands by students of Dr. Dudley J. Raynal (Hurd 2000; Hurd et al. 2001; Gokkaya 2003), and work on plant species dynamics in beaver meadows by Justin Wright working through Cornell University (Wright 2000; Wright et al. 2002, 2003). Current graduate work done by Nancy Karraker under Dr. James Gibbs (SUNY-ESF) involves monitoring amphibian populations and salt impacts on vernal pools at HWF. Determinations of water sources to vernal pools, combined with water quality analysis are being pursued by Karraker and Dr. Cirmo.

Overall, the HWF is poised to become a center for wetland studies in the Adirondacks, and the inherent interdisciplinary nature of wetlands work should be a magnet to attracting new studies and funding to continue this important work.

Check out the Adirondack Ecological Center website at *www.esf.edu/aec* for a full list of wetlands publications.

From the Home of the Blues to a Home in the Blue Line

Jennifer Gagnon

Jennifer Gagnon joins the staff at the AEC as a specialist in geographic information systems. Born and raised in New Orleans, Louisiana. She earned a BA in sculpture from the University of California, Davis, in 1991. After designing and building iron furniture in her New Orleans studio for six years, she returned to school to study the sources of her inspiration.

Jennifer took courses in biology, ecology and geography at the University of New Orleans. Her desire to apply Geographic Information Systems (GIS) techniques to meet conservation goals led her to the Smithsonian National Zoological Park's Conservation and Research Center in Front Royal, Va. There she developed her thesis on "global conservation assessment of temperate forests (elevation and geographic bias in protection)." She also conducted a regional habitat assessment for Asian elephants, produced maps for publication and instructed portions of GIS and remote sensing courses for wildlife managers, researchers and conservation professionals.

Jennifer earned a MA in Geography Techniques (GIS and Remote Sensing) with a minor in ecology in 2003. She is deeply interested in applying GIS technology to help solve real-world conservation problems. She is looking forward to contributing her skills to the natural resource inventory portion of the Unit Management Plan process in the Adirondack Park.

Close Encounters

by Stacy McNulty, Ecologist

It was a gorgeous, sunny Sunday in mid-December, so I decided to hike up to the Cold River. I enjoyed the multitude of tracks crossing the trail. There were three otter slides crossing the road. Deer, red squirrels, snowshoe hare, weasel, marten and fisher all left their marks in the fresh snow.

As the trail neared the river I began to hear flowing water. A different track caught my eye and I headed into the raspberries to see what it was. I stumbled out onto the river bank and saw tracks on the rocks below, so I jumped down to take a look. With my eyes I followed the tracks west, and suddenly their maker came into sight. A coyote stood on the bank above me — wow, was he close! I watched him (if it was a him) watch me take in his features: he was all-over sandy brown, a large eastern coyote typical of this region. He disappeared into the brush but reappeared downstream, trotting through the dead vegetation. About 100 yards away, the coyote splashed into the water, which came up over his ribcage at its deepest. I stood there on the river rocks, reveling in my great encounter.

Now on the opposite shore, the coyote began to trot back toward me. I lost sight of him when he stepped behind a little bend, but kept my binoculars trained on the area. After about 15 seconds, I noticed a flash of white fur and something jumping out of the brush. I saw another brown lunge and white tail and realized the coyote had pounced on a bedded deer! The deer twisted away and jumped down into the shallow water. The deer frantically crashed through patches of new ice, plunging into the water, hooves scrambling. The coyote didn't pursue, but instead was watching to see where the deer would go. I was probably 50 yards from the two and neither was paying any attention to me, despite my exposed position. My camera? At home on the shelf.

The deer swam closer, and I saw she was a fairly small female. The deer swam into the middle of the river toward me as the coyote swam away and crossed again over to the near shore, disappearing over the rise. The deer didn't act injured, so the coyote must not have gotten a good hold on her. The deer had been sunning herself on a grassy southern exposure when the coyote pounced. Standing on that rock with the deer shivering in the icy water, not knowing whether the coyote would reappear, I experienced a fraction of what

it was like to be hunted. I watched for another 15 minutes as she took a few steps toward one shore, ears swiveling, then turned and started downstream, unsure which way to go.

I stayed as still as I could, hoping my presence was not impacting the outcome, until it was clear the coyote was not going to return. I shouted at the deer and waved my arms to get her to move. She eventually jumped back up on the opposite shore, whereupon she had the audacity to turn and stomp her hoof to get *me* to move. Another display from me sent her crashing into the forest. I climbed the near shore and tried to determine where the coyote had gone, but there were too many fresh tracks going in opposite directions.

As I headed home, I thought about the perception of the coyote as a pack animal. While that perception is rooted in fact, this encounter revealed to me the ability of both predator and prey to react to a unique situation. We can continue to learn and be amazed, if we are willing to spend time observing the natural world and are occasionally in the right place at the right time. Marlon Perkins, eat your heart out.

Roosevelt in the Adirondacks

by Paul B. Hai

On Sept. 15, 1901, Adirondack school children were learning the name of an unexpected new president, Theodore Roosevelt. Now, a little over a century later, Adirondack students are again learning the name Roosevelt in an unexpected context. However, they are not learning about him in relation to his Sept. 14 midnight ride to North Creek, where he learned fate had elevated him to president of the United States after William McKinley's assassination.

The Roosevelt Wild Life Station (RWLS), with the AEC, has initiated a dynamic Adirondack program as part of our statewide conservation education initiative. In keeping with the educational mission of the RWLS, the Adirondack components use natural history and the local environment to teach students the process of science.

We currently are pursuing funding for Interpretive Peaks, our first Adirondack program. When completed it will deliver three comprehensive conservation units examining water quality for all sixth-, seventh- and eighth-grade science classes in five Adirondack school districts.

However, RWLS is already entering schools across the Adirondacks with a variety of smaller experiences. Recently, the RWLS sponsored a five-week project with high school science students from Minerva and Indian Lake school districts. The project culminated in the two schools coming together for a "town hall meeting" where students presented their findings on the feasibility of reintroducing wolves in the Adirondacks to a panel of two current town supervisors and a retired DEC wildlife manager.

Upcoming programs include Crown Point's 12th grade Spanish students who are using Adirondack summer breeding birds to examine habitat fragmentation and development in Central and South America, and environmental science students from Moriah who will conduct macro-invertebrate surveys to learn about watershed hydrology and stream quality in the Adirondacks.

Ricky Sage, pictured left, received the 2003 New York Society of American Foresters Forestry/Environmental Education Award on behalf of his father, the late Richard W. Sage, Jr. from Mike Gooden. The award is given "to recognize outstanding accomplishments in forestry education, aimed at any audience, which increases understanding and appreciation of forest resources, forest management, and the full spectrum of forest values and benefits."

Spring-boarding from these initial efforts, the RWLS is excited about developing a breadth of programs and experiences using the Adirondacks to integrate conservation themes and sound science not only into Adirondack classrooms, but also into classrooms in districts throughout the state. All in the name of an unexpected President, leading conservationist, and fellow Adirondacker.

Forest Workshop

The AEC will host the Forest, Trees, Wood and Craft: A Hands-On Introduction From a Woodworking Perspective Oct. 1-3. This workshop will examine the link between fine wood craftwork and the forest. Woodworkers Barry Gordon and Ken Pierson will team up with ESF forest ecologist Greg McGee to lead a three-day class at Huntington Lodge and in the Stone Garage woodshop.

Information about trees, the wood inside trees and means of directly obtaining that wood will be presented through lectures, field trips and hands-on woodworking. The instructors will focus on tree biology and the structure and properties of wood. Methods for drying wood will be addressed as well. As part of a discussion of small sawmills, a local sawyer will demonstrate converting a hardwood log into useful lumber. Participants will identify species suitable for walking sticks and kitchen utensils and will make one of each.

No experience is required. The workshop is limited to 15 people. For more information, including registration and fees, call: 315-638-4749 or e-mail: *bbgordon@att.net*

Joint ESF-UVM Seminar Explores the Duality of the Adirondacks

by Dr. William Porter, Director

Imagine sitting around the fire in the Trophy Room of Huntington Lodge amidst the snow of February. This was the setting for a graduate student seminar convened by Jon Erickson of

the University of Vermont and myself. The students spent two weekends (and quite a few nights in between) studying the Adirondack Park as an experiment in conservation. Through long conversation around the fire, a group of 14 graduate students sought to understand the duality of our relationship with the wilderness: the influence of nature on culture and culture on nature.

The course itself was an experiment in learning. While most courses contain students from a single curriculum, the graduate students came into this course from ecology, economics, recreation, planning and policy. An array of Adirondack experts added further dimension. Ross Whaley, chairman of the Adirondack Park Agency, and David Gibson, executive director of the Association for the Protection of the Adirondacks, stimulated debate on the philosophical basis for land use regulation. Ray Masters of the AEC added the historical perspective. The class then explored the State Land Master Plan by visiting those people responsible for implementing it. A Saturday packed with meetings allowed students to see the regulations through the eyes of George Canon, Newcomb town supervisor, Jay Rand, general manager of Whiteface Mountain Ski Center; Tom Martin of the NYS Department of Environmental Conservation; and Rick Weber of the Adirondack Park Agency.

Such a class would not be complete without trips into the field to see the beauty of fresh snow on trail to Santanoni, or be awed by the 90-meter ski jump at the Olympic complex in Lake Placid. It's hard to imagine a more delightful educational experience.

SPOTLIGHT ON RESEARCH

Recent publications related to HWF:

Please send citations for all new publications related to AEC-HWF to Marianne Patinelli-Dubay at aechwf@esf.edu for inclusion in our next issue.

Brant, S. V., and **G. Orti.** 2003. Evidence for gene flow in parasitic nematodes between two host species of shrews. Molecular Ecology 12, 2853-2859.

Brant, Sara V., and **G. Orti.** 2003. Phylogeography of the Northern short-tailed shrew, Blarina brevicauda (Insectivora: Soricidae): past fragmentation and postglacial recolonization. Molecular Ecology 12, 1435-1449.

Didier, K.A., and **W.F. Porter.** 2003. Relating spatial patterns of sugar maple reproductive success and relative deer density in northern New York State. Forest Ecology and Management 181:253-266.

Ito, M., M.J. Mitchell, C.T. Driscoll and **K.M. Roy.** 2004. Nitrogen input-output budgets for lake-watersheds in the Adirondack region of New York. Biochemistry (In Revision).

McHale, M.R., C.P. Cirmo, M.J. Mitchell and **J.J. McDonnell.** 2003. Wetland nitrogen dynamics in an Adirondack forested watershed. Hydrological Process. (In press).

Park, J., M.J. Mitchell, P.J. McHale, S.F. Christopher and **T.P. Myers**. 2003. Changing biogeochemistry of N and S in a forested watershed of the Adirondack Mountains, New York: significance of dry deposition and organic solutes. Ecosystems (In Review).

Piatek, K.B., M.J. Mitchell, S.R. Silva and **C. Kendall.** 2004. Sources of nitrate in Adirondack surface water during dissimilar snowmelt events. Biogeochemistry (In Review).

Sage, R.W., Jr., B.C. Patten, and **P.A. Salmon.** 2003. Institutionalized Model-Making and ecosystem-based management of exploited resource populations: a comparison with instrument flight. Ecological Modelling. Pages 107-128.

Wright, J.P., C.G. Jones, and **A.S. Flecker.** 2003. Local VS. Landscape Controls on Plant Species Richness in Beaver Meadows. Ecology 84 (12), pp. 3162-3173.