

Field Notes

Friends of Plant Conservation newsletter

June 2016 / Vol. VIII Issue 1

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SPECIAL FEATURE ARTICLE



Lesley and Rob race a beaver up the road to Tater Hill.

INFLUENCES OF BEAVER ON FORESTED COMMUNITIES IN THE SOUTHEASTERN U.S.

C.E. DeJaco, March 13, 2016

Summary

Beaver were extirpated from the southeast U.S. more than a hundred years ago. Now, due to few predators and little hunting by humans, beaver are re-establishing themselves. Some people are excited by the return of the beaver while others are disturbed by the destruction beavers can impose on the habitats where their impacts have been absent for so long. This short paper is a synopsis of the limited research available to date to describe and explain the known influences of beaver on forested communities in the southeastern U.S.

Introduction

Prior to European colonization of North America, beaver (*Castor canadensis*) were abundant throughout most of the continent, from sub-arctic to sub-tropical habitats, with the only exception being the southwestern deserts (Naiman et al 1998, Rosell et al 2005). Estimates of pre-colonization beaver populations are between 60 million and 200 million individuals, with at least 20 million beaver-built dams. Beaver were, in fact, one of the major sources of natural disturbance in forests, their behaviors resulting in major changes in habitat structure. Colonization by Europeans and their descendants led to massive levels of trapping and hunting of beaver for their fur or meat or to

protect timber and croplands from the impact of beaver (Woodward et al 1985, Metts et al 2001). By the year 1900, beaver had been extirpated from the eastern half of North America and the species was hanging on by small remnant populations in the west (Naiman et al 1988).

Reintroductions of beaver had begun in the southeastern U.S. by the 1940s (Woodward et al 1985). With few predators and laws regulating hunting, beaver populations in North America have rebounded to between 6-12 million (Naiman et al 1988). By 1983, beaver were present in 80 of 100 counties in North Carolina but were still largely absent from the Broad, French Broad, Catawba, and Pasquotank river basins—mainly the Charlotte area and the region directly to the west and north of it (Figure 1; Woodward et al 1985, Arner and Hepp 1989). Beaver have now begun to reoccupy this part of North Carolina (pers. obs.). With the recolonization of beaver, many landowners have become concerned about the damage on the landscape caused by beaver.

The majority of studies

...continued on page 9

From The President



What a wild year we have had, and it continues. From receiving 430 lbs. of dried ginseng (in 5 large barrels) confiscated by USFWS, storing and then selling/auctioning it to licensed NC dealers; raising \$120,000 for matching funds for a grant to add a parcel to Cedar Mountain Bog (with help from Karen Ramsaur and Carolina Mountain Land Conservancy; dedicating Caraway Preserve, which we would not have without the help of so many Friends; having our most successful Annual Meeting yet (Amphibolite Adventure) with the help of Matt Estep, Alan Weakley, Fred Annand, Walter Clark and a number of others; to welcoming new Board members, we have stayed busy in lots of areas.

Saddest to most of us was watching Rob Evans leave NCPCP for a great position with the Virginia Natural Heritage Program. He came back for the dedication of Caraway and was welcomed by the 70+ members and friends present. David Welch tells us that we should have a new Plant Ecologist in a couple of weeks and we look forward to welcoming that new person to the group.

In the meantime, Lesley Starke (Research Specialist), and Jenny Stanley (Field Specialist) have been working overtime to keep things in order. They spent most of the spring conducting burns in the eastern part of the State, but found time to visit and work on Preserves across the State. Our hats off to both of them. Jenny is scheduled for her mandatory one-month unpaid leave, and as many of you know, we will be helping her with expenses during this time—thanks to the donations you have made to Jesse's Fund.

More about Jenny elsewhere in the newsletter.

I can't tell you how much fun it is to watch NCPCP and FoPC grow and prove successful in what they undertake. We don't say "never," as it is amazing what we can accomplish when we put our minds, creativity, and cooperative efforts together. We CAN do it!



The news we present here is just a taste of what is going on, and we invite each and every one of you to find your place working alongside us. Even if that is just participating in Field Trips and events, or spreading the word about the work we do for the imperiled plant species of North Carolina, your efforts are valuable.



With gratitude for having the opportunity to serve as President,

Kathy

FoPC / NCPCP Field Trip Schedule

June 2016 –
October 2016

DATE, TIME	LOCATION & LEADERS	WHAT TO SEE
Saturday, June 11 th 8:30 AM – 10:30 AM	Hebron Road Preserves DURHAM NC Lesley Starke & Jenny Stanley (NCPCP staff)	PIEDMONT TREASURES Endangered Smooth Coneflowers and a host of other interesting species. See what prescribed burns can do! Easy.
Friday, July 29 th - evening and/or Saturday, July 30 th - morning	INTERNATIONAL BOG DAY Boiling Spring Lakes Preserve Boiling Spring Lakes, Brunswick County Lesley Starke (NCPCP) and a guest leader	HOT FUN IN THE SUMMERTIME... We will bring ICE and BUG SPRAY! You bring your cameras for an incredible display of native orchids and pocosin plant species. To avoid the worst of the hot sun, we will walk in the early evening and again in the morning. THIS IS A SPECIAL EVENT! Easy
Saturday, August 13 th 10:00 AM – 3:00 PM Rain date: Sat., Aug. 27 th	Paddy Mountain Ashe County Lesley Starke and <hr/> We drive part of the way up.	COOL MOUNTAIN BREEZES IN THE SULTRY DOG DAYS OF SUMMER! <i>Liatris helleri</i> on the steep slopes of Paddy Mountain, a pristine NC mountaintop. Also watch for <i>Allium allegheniense</i> , <i>Carex roanensis</i> , <i>Hackelia virginiana</i> , <i>Rhytidium rugosum</i> , <i>Rohlia lescuriana</i> Moderately difficult
Friday, September 16 th 10:00 AM – 3:00 PM	Cedar Cliff Mountain Jackson County	SEARCHIN' FOR SILENE The view is worth the hike (and lots of 60s+ folks make it by taking their time!), and along the way we'll see <i>Celastrus scandens</i> in fruit and watch for <i>Silene ovata</i> which hasn't been for a while. A slow pace may give us the time to spot the elusive plant. Difficult but do-able

JENNY STANLEY: FIELD SPECIALIST EXTRAORDINAIRE!



Don't let this sweet photo fool you...she is sweet, but Jenny is also knowledgeable and she is tough, wielding chain saws, burn equipment, repairing trucks, and standing off snakes! On top of that, she has a great attitude and a wry sense of humor. If you have the chance, be sure to join a Field Trip with her and get to know her.

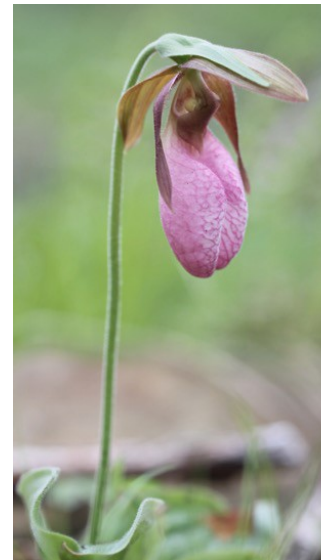
Some of the photos she sends after being out in the field...



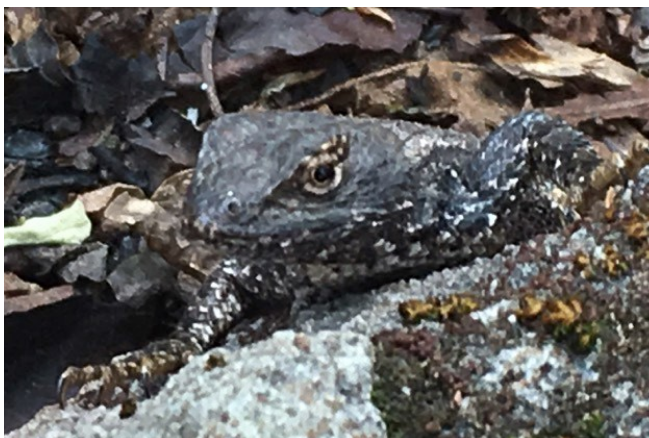
I got pretty excited about this orchid.
It turned out to be showy orchis.
Then I was less excited.



Just for funzies :)



Learning how to do an open face cut.



You can't see me!



No problem. I've had worse.



I stole this little guys log by accident.



Thinning around rare plants at Hebron Road.



American painted lady at Harvest Field



A WISH LIST FROM JENNY....

FoPC, thanks to your generous donations, has supplied Jenny with a blower, a weed eater, sprayers, and gloves this spring (all professional equipment) that NCPCP did not have the money in the budget to purchase. As you see from the previous photos, and more will come in future newsletters, the equipment is well used and saves enormous amounts of time. Even so, Jenny still has a wish list:

- Nomex shirt: size SMALL
- Nomex pants (SIZE 6, regular length): <http://cascadefire.com/strike-teamr-pants-nomexr-for-women.html>
- For the chainsaws: New chains, Sharpen chains, Short wedges
- For the torches for starting prescribed burns: Wicks (at least 6); Rubber O-rings—At least 6 large (for large cap) and at least 6 small (for small chained cap)
- Long aluminum nails (or galvanized long nails) for boundary signs – we have a few left
- Sweedish brush axe handles (x2)
- A 1 or 2 gallon metal fuel container.

I don't even know what some of this stuff is, but it sounds important, and I am sure Jenny would be happy to explain it to you. You can contact her at jennymawhenny@gmail.com If you would like to contribute to an equipment fund, send it to FoPC, c/o NC Plant Conservation Program, NCDA&CS Plant Industry Division, 1060 Mail Service Center, Raleigh, NC 27699-1060.

Long overdue

We don't have to tell you that this newsletter is overdue, but we do owe you an apology. The Friends board has been very busy, as you will see elsewhere in the newsletter, and we have had the usual board changes, including a vacant newsletter editor position.

We are still looking for someone, and would love to welcome YOU to the board. If you are interested in serving at the committee level, we have a spot to fit your interests and time available. Just get in touch -

admin@ncplantfriends.org
or call Kathy 336-708-3852



WWW.NCPLANTFRIENDS.ORG

By the time you receive this, or within a day or two, our new website should be up and running.

Check in once in a while to keep up
with events.

We are also on Facebook:

[Friends of plant conservation](#)

MEET THE BOARD OF DIRECTORS

We asked a few to say a word or two about serving on the Board. We'll hear from more later.

President: Katherine Schlosser

Vice President: Judge Ola Lewis

Secretary: Catherine Luckenbaugh— The past year has been full of exciting trips and learning experiences for me! Among the year's highlights was "Adventure in the Amphibolites," a wonderful weekend of learning at Appalachian State University with accompanying field trips to PCP's Tater Hill and The Nature Conservancy's Bluff Mountain, not to mention a truly memorable dinner at Walter Clark's Old Orchard Creek Farm. It was wonderful to have my family along for the weekend – we're still appreciative of the opportunity to explore some of North Carolina's protected natural places. The Pondberry visit and picnic at Bruce Williams farm was another great family day—music with a history, food, and friendship. I was also fortunate to be able to assist with the ginseng auction at the NC State Fairgrounds, another unique experience. The Caraway dedication in May to protect the lovely *Shortia galacifolia* var. *brevistyla* was a special day for me, as it brought to fruition the protection of this special place for the late Kim Caraway and his family. Finally, a visit to Mineral Springs Barrens in Union County brought me full circle as I visited a place where I first learned to look at plants and their communities with a scientific perspective as a graduate student at UNC Charlotte in the late 1990's. Serving on the board for FoPC this past year has been truly my pleasure!



Treasurer: Mimi Westervelt

Alvin Braswell

Walter Clark

Crystal Cockman—My work with The Land Trust for Central North Carolina brings me into contact with rare plants on a regular basis. We work to try to preserve important properties with natural, cultural, historical and farmland significance. We have worked to transfer property to PCP in the past. There are still more projects that need to happen to preserve the plant diversity of the Uwharries Region, and we are excited to partner with PCP whenever possible to protect these rare plants.

Carrie DeJaco—I am new to the FoPC Board this year. I am a community ecologist with particular interest in interactions such as pollination, seed dispersal, and competition among organisms; of great concern currently are the declining abundances of pollinators and the increasing abundances of invasive species. At last October's "Adventure in the Amphibolite Mountains", I enjoyed the collegiality of the group and how people with different knowledge sets all shared with and learned from one another. I look forward to being more involved with the FoPC in the coming years.



Julie Moore: As a new member of the Board, as yet I have only been involve in a few activities of the organization. Sorting through the confiscated ginseng roots was a very curious experience, I couldn't help thinking how expansive an area it would take to support those roots if alive and replanted. I tried to envision the many forests where they had been collected. I worked for the NC Natural Heritage Program for 12 years, leaving the state in 1990 and returning in 2014. I am delighted that several of my favorite sites for rare plants are now state preserves and look forward to more interactions with the preserves the PCP owns and manages. Coastal plain and piedmont species and their unusual habitats continue to be of particular interest to me.

Bob Shepherd

B Townes

Gary Wein

Charlie Williams

Andy Wood

Past Presidents:

Bruce Williams—Preservation of native plant species is a lynch pin in the ecosystem. When habitat fails, species disappear. I hope to bring attention to disappearing plants habitats and to better educate citizens for an improved understanding of the "co-existence" between nature and agriculture. Much of my time is spent in volunteer efforts with USAID in developing countries in Africa and Central Asia. When not traveling, I run a small consulting business and farm/timber operation in southeastern North Carolina.

Paul Hosier

2015 FoPC Award Winners



PLANT CONSERVATION LEADERSHIP AWARD

This year Bob Shepherd presented **Rob Evans**, Plant Ecologist at PCP since 2006, with our highest award. Rob steadily, patiently, and persistently took PCP into an era of building Preserves for the conservation of NCs imperiled species, moving from none to 23 preserves. His guiding principal has been a “Noah’s Ark Approach” to have each of our 421 species held on 2 preserves in their natural habitat. We have a long way to go, and an excellent model to follow.



2015 DISTINGUISHED MEMBER

The Distinguished Member of the Year Award recognizes a member who has made exemplary contributions to the Friends of Plant Conservation, NCPCP, and plant conservation.

Pat Amyx has consistently rendered outstanding service to the Friends of Plant Conservation, working on preserves, especially with *Echinacea laevigata*, leading guided tours, mentoring new stewards, helping with annual meetings, and always maintaining an inspiring positive attitude about anything in which she is involved.



2015 DISTINGUISHED MEMBER

The Distinguished Member of the Year Award recognizes a member who has made exemplary contributions to the Friends of Plant Conservation, NCPCP, and plant conservation.

Herb Amyx has also consistently rendered outstanding service to the Friends of Plant Conservation, to NCPCP, and especially to Rob Evans. He worked with Rob on preserves, especially with *Echinacea laevigata*, leading guided tours, mentoring new stewards, and in any other way that he could. He is always available for workdays, and has the mind of a scientist.



HONORARY LIFE MEMBER

In recognition of her invaluable service to the Friends of Plant Conservation, and untiring commitment to our mission, Kathy Schlosser presented **Nancy Stewart**, Information Technologist and Ginseng Coordinator with PCP, with an Honorary Life Membership. She is the first recipient of such an honor, and it is well-deserved.

on beaver in North America have been conducted in the northern states and Canada. Larger scale effects found by these studies may be applicable here in the south, but many of the species-specific observations are irrelevant due to the difference in plant species between the northern and southern latitudes. This review of the literature on the impacts of beaver includes the handful of studies conducted in the southeastern U.S.; larger scale patterns observed at northern latitudes will also be discussed, but species-level observations from northern studies will only be included if they are relevant to the southeastern U.S.; larger scale patterns observed at northern latitudes will also be discussed, but species-level observations from northern studies will only be included if they are relevant to the southeastern U.S..

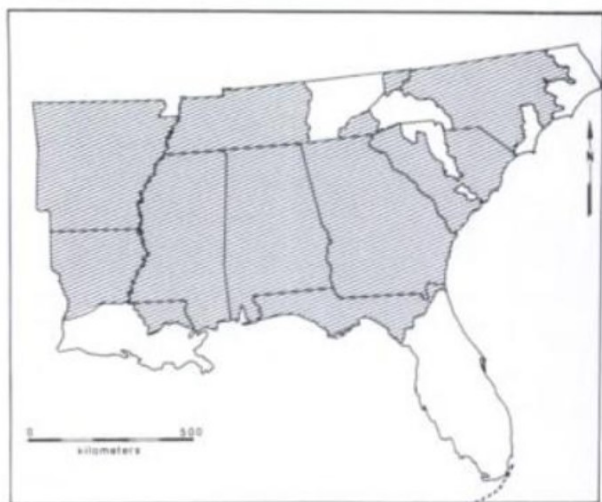


Figure 1. Map showing distribution of beaver in the southeastern U.S., taken from Arner and Hepp (1989).

Review of literature

Beaver use twigs and branches to construct dams that block running water. The dam causes flooding of the immediate area upstream, creating a pond. The beaver then build a lodge for themselves in the center of the pond using more twigs and branches; this location prevents them from most unwanted intruders. The entrances to a beaver lodge are typically underwater which prevents potential predators from seeing where the beaver go once they duck under the water.

The trees in the riparian area that are flooded by the dam built by the beaver are typically not adapted to living with their roots in consistently waterlogged soil, and they die. Standing dead trees are attractive for many types of birds as perches from which to signal territorial boundaries, to proclaim their availability to mate, or to hunt. The trees also provide nesting opportunities for woodpeckers, and then the holes excavated by the woodpeckers are used in subsequent years as nesting habitat for other birds such as wood ducks, owls, tree swallows, and flycatchers (Rosell et al 2005) and, if there are other trees near enough to use for transit, mice, squirrels, and



Lesley reported this bedraggled fellow started to attack the truck tires!

chipmunks may nest there as well. Standing trees in flooded areas also provide protected areas for bats to roost (Menzel et al 2001).

The reduced rate of water flow in beaver-impounded areas and the raised water level increase water retention in the landscape. Neff (1957) found that areas in the Rocky Mountains that had been abandoned by beaver had significantly less water storage capacity than areas where beaver were still active. The slower water current also reduces erosion and increases retention of nutrients and sediment (Kuenxler 1989, McArthur 1989, Rosell et al 2005).

The flooded beaver pond provides a three-dimensional habitat with numerous niches for a variety of organisms that may otherwise be absent from the area. The increase in water availability enables more rapid breakdown of dead organic matter by fungi and bacteria which are then a food source for small zooplankton and invertebrates (McArthur 1989). The slow-moving water also allows for colonization by aquatic plants and algae which provide additional sources of food for small invertebrates. Those small aquatic invertebrates provide food for macroinvertebrates which, in turn, become food for fish, salamanders, and birds. Naiman et al (1988) reported that the amount of biomass in a beaver pond may be five times greater than that of the unimpounded stream that would otherwise exist.

The aquatic vegetation and invertebrates provide a food source for waterfowl (Edwards and Otis 1995), but waterfowl alone do not account for the increase in avian diversity found in areas with beaver impoundments. Jones et al (2011) reported 90 bird species using beaver-created wetlands and, of those, 25 were never observed in wetlands where there was no beaver activity. In fact, beaver wetlands supported significantly greater abundance and diversity of birds than riparian forest sites in both seasons surveyed (winter and spring). These patterns corroborated those found by other researchers. Piscivorous birds, like herons and kingfishers, and woodpeckers are more common in wetlands where beaver are active than in similar areas without beaver (Lochmiller 1979, Grover and Baldassarre 1995, Rosell et al. 2005).

At the Clemson University Experimental Forest in the piedmont of South Carolina, Russell et al (1999) compared amphibian and reptile communities in 2 young and 2 older beaver ponds (< 5 years and >10 years old, respectively) and 2 unimpounded streams. All 6 habitats were in similar closed-canopy mixed hardwood forest and had similar topography. Amphibian and reptile communities were assessed each month for a year via trapping. Amphibian community composition and species richness were similar for all 3 habitat types, but there were significant differences among the reptile communities. There were four times as many reptiles at old ponds than at new ponds or unimpounded streams. The diversity of reptile communities was greater at old ponds than at new ponds, which was greater than that of the unimpounded streams. The old ponds had almost twice as many species as the new ponds and three times as many as the unimpounded streams (15, 8, and 5 species, respectively). Overall, there was less than 50% similarity among the reptile communities of the three habitat types.

Metts et al (2001) used the same trapping techniques as Russell et al (1999) at the Clemson University Experimental Forest seventeen years later, comparing the amphibian and reptile communities around 3 beaver-impounded streams to those of 3 unimpounded streams. Results from this study were similar to those of the previous one—there were no differences in salamander abundances but significantly more turtles, lizards, and frogs were found at the beaver-impounded streams than at the unimpounded streams.

In regard to direct impacts on vegetation outside of the flooded area, studies have found no differences in abundance, species richness, or diversity of woody plants, herbaceous riparian vegetation, or vines among beaver-impacted and unimpacted riparian forest sites in the piedmont of South Carolina or in Georgia (Metts et al 2001, Brzyski 2005). These studies also found no differences in basal area of overstory trees, saplings, or the amount of woody debris (Metts et al 2001, Brzyski 2005). In some cases, although species richness may remain the same, the plant species composition of the communities impacted and not impacted by beaver differ (Collen and Gibson 2001, Metts et al 2001, Rossell et al 2014). In South Carolina, height and percent cover of herbaceous plants around beaver ponds was significantly higher than alongside streams (Metts et al 2001).

Beaver are generalist opportunistic herbivores, feeding on a good deal of wood, but also consuming leaves of woody species, acorns, grasses, sedges, ferns, and herbaceous plants (Roberts et al 1984, Rosell et al 2005). Beaver damage to trees is typically within 100 m of the pond, and usually within 35 m or so of the edge (Johnson and Naiman 1987). Trees with stump diameters between 2 and 8 cm are most often used, though beaver have been known to cut down trees more than 100 cm in diameter (Collen and Gibson 2001, Rosell et al 2005, Raffel et al 2009). Being a generalist opportunist, however, does not mean beaver do not have preferred species of plants; several studies have reported some species are, indeed, preferred by beaver over other species (Table 1). Cutting of larger trees or those further from the pond is likely to be

restricted to preferred species since doing so requires greater expenditure of energy (Roberts et al 1984, Rosell et al 2005).

Herbivory frequently causes plants to increase the proportion of secondary metabolite chemical in their tissues. These chemicals have many varied effects on consumers; they can cause the plants to taste bad, may cause digestive problems, and can even inhibit DNA replication (Bryant and Kuropat 1980, Paré and Tumlinson 1999). The presence of such chemicals in plant tissues frequently deters herbivores. In some plants, these chemicals are persistently present but, in others, the production of these chemicals is stimulated by tissue damage by herbivory (Karban and Myers 1989). Rossell et al (2014) postulated that beaver use of plants such as yellowroot, doghobble, and rhododendron was low due to high levels of secondary compounds in these plants.

Another common effect of herbivory is more vigorous sprouting of axillary branches below where the stems have been cut. Many trees, when their trunk is severed, sprout multiple stems from the base of the stump in an effort to compensate (Del Tredici 2001). This pattern was observed of Chinese privet that had been cut by beaver in North Carolina (Rossell et al 2014) and is likely true of many other species affected by beaver.

It is common for invasive plants to become established in areas that have been disturbed and especially along stream because the seeds are frequently dispersed by the water (Crawley et al 1986, Lodge 1993). However, Brzyski (2005) found that, in Georgia, beaver-modified sites did not have more non-native plant species than sites unmodified by beaver. In both Brzyski's study and that of Metts et al (2001) in South Carolina, beaver activity did not result in reduced canopy cover, one element of disturbance commonly recognized as an invitation for colonization by invasive species (Crawley et al 1986, Eschtruth and Battles 2009).

PLANTS	AUTHORS (STATE REPORTED)
bitternut hickory	Raffel et al 2009 (OH)
black cherry	Busher 1996 (MA), Raffel et al 2009
black oak	Raffel et al 2009
black willow	Chabreck 1956 (LA)
buttonbush	Chabreck 1956
Chinese privet	Davis and Guynn 1993 (SC), Rossell et al 2014 (NC)
dogwood (silky or flowering)	Davis and Guynn 1993, Raffel et al 2009, Rossell et al 2014
hackberry	Raffel et al 2009
hophornbeam	Raffel et al 2009
kudzu	Davis and Guynn 1993
loblolly pine	Chabreck 1956
musclewood	Rossell et al 2014
red maple	Busher 1996
red oak	Busher 1996, Raffel et al 2009
redbud	Davis and Guynn 1993
sassafras	Raffel et al 2009
shingle oak	Raffel et al 2009
southern red oak	Chabreck 1956
spicebush	Rossell et al 2014
sweetgum	Chabreck 1956, Davis and Guynn 1993
winged sumac	Chabreck 1956
witch hazel	Busher 1996, Raffel et al 2009, Rossell et al 2014

Table 1. Plants reported to be preferred by beaver.

Discussion

“Southern forested wetlands of the United States represent an “endangered ecosystem.””

The creation of dams and subsequent flooding of riparian areas by beaver clearly have an impact on the landscape. More than half of all wetland habitat in the U.S. is in the southeast part of the country which is said to have had “notable wetland loss” dating back to the 1600s. Reportedly, 89% of wetlands in the southeast were lost between the 1950s and 1980s (Ernst and Brown 1989, Dahl and Allord 1997, Edwards and Otis 1999). In North Carolina, about half of the original wetlands have been converted to agriculture and managed forests or drained, cleared, and filled for development (Arner and Hepp 1989, USGS 1997). Alluvial floodplain forests in the southeast have also been greatly modified by the construction of man-made dams for hydroelectric power,

thermal cooling of power plants, or water reservoirs. The recolonization of the river basins and streams by beaver may help ameliorate some of the consequences of this loss on the ecosystem function and biodiversity.

A beaver impoundment enhances water retention in the catchment. The dam raises the groundwater level and increases soil moisture in areas near the beaver ponds. This augmented water availability may provide the forests and the animals that live there with more of a buffer in times of drought than they would otherwise have. The ponds of slow-moving water also reduce the velocity of streams which is helpful in reducing the amount of erosion and sediment that washes into streams and rivers after heavy rainfall events, the frequency of which is increasing with our changing climate.

The pond itself provides a type of habitat that otherwise would not be present in these forests. The numerous new niches made available enable entirely new communities in the forest of aquatic plants and invertebrates, fish, and the

numerous kinds of larger animals that eat them. The standing dead trees in the pond provide safe roosting and nesting habitat for many species of bats and birds. Fallen dead trees in and around the pond provide new structures on which turtles, snakes, and lizards may sun themselves and under which they can hide from predators, nest, or hibernate.

The trees within a few dozen meters of the pond may be heavily hit by beaver, but this too is creating heterogeneity in the landscape, increasing biodiversity of the forest. Many species of grasses, sedges, and herbaceous plants otherwise not found in the forest may be able to grow around the pond in the cleared areas. In south central North Carolina, Bartel et al (2010) found that wetlands created by beaver activity were home to plant species that were not found in other nearby habitat, specifically, plants required for completion of the life cycle of the endangered St. Francis' satyr butterfly. It is certainly possible that there are many species of plants and animals whose preferred wetland habitats have been available in only tiny pockets of the landscape but are now increasing with the return of beaver activity and the associated wetland areas.

According to Williams and Dodd (1978), around 95% of the 3200 plant species in need of protection, as listed for submission in 1974 to the U.S. Congress, were aquatic or wetland-dependent. Also on that list were 22 wetland-dependent bird species. Currently in North Carolina, 27 animal species (not counting sea turtles) are federally listed as threatened or endangered (USFWS 2015). The North Carolina Plant Conservation Board lists 419 plant species as currently endangered, threatened, or of special concern, 25 of which are federally listed (NCPCB 2010); an unknown percentage of these plant species are wetland-dependent.

With the recolonization of beaver in the southeastern U.S., many landowners have become concerned about the effects of beaver on the landscape. Emphasis is often placed on the damage caused by beaver while the positive contributions of beaver to ecosystem function and diversity are unrecognized. The forests we recognize as natural and undisturbed today are, in fact, in their current state due to past disturbances like the disappearance of the American chestnut tree, said to have been a dominant forest species that contributed greatly to the forest food web (Liebhold et al 1995), and the absence of the once common beaver, extirpated by hunting and trapping (Naiman et al 1988).

If the recent return of beaver activity negatively affects a landowner's livelihood, the presence of the beaver and its influence on the landscape may need to be addressed. If the land is in somewhat of a natural state and the goal is to protect the land and its biodiversity, the forest conditions prior to the extirpation of beaver may be more appropriately considered the historically natural conditions. Beaver do contribute positively to ecosystem function through their ponds' retention of water, sediment, and nutrients. Biodiversity of flora and fauna in the forest ecosystem increases with the development of new niches and greater food availability that result from beaver impoundments. Many plant and animal species in the altered habitat created by beaver activity have had shrinking amounts of

suitable habitat over the past decades and centuries. The return of beaver to an area may provide new footholds for such wetland-dependent species.

Remaining thoughts

Because of the paucity of studies of beaver impacts in the Carolina piedmont, it is difficult to predict which species may be most affected, negatively or positively, by the return of beaver to the area. We could make predictions based on the handful of studies conducted in North Carolina, South Carolina, Georgia, and Louisiana, but the species palettes for the coastal plain and the mountain regions are not directly comparable to ours here in the piedmont.

1. A survey of plant species and abundance in lowland and riparian areas with and without beaver activity in the Carolina piedmont, repeated every few years, would be useful for ecologists, conservationists, and land managers. Such information would provide answers to many questions such as:
 - a) What plant species are preferred or avoided by beaver?
 - b) Are there differences in the abundances or sizes of beaver-preferred plant species between areas with and without beaver activity?
 - c) Are there plant species present in beaver-impacted areas that are not in unimpacted areas, and vice versa?
2. Invasive species are frequently more of a problem in disturbed areas. Are invasive species more of a problem exist with the type of disturbance caused by beaver?
3. Among invasive species, Chinese privet is very problematic, especially in riparian areas. Both beaver and deer have recently been observed cutting privet. Cutting of Chinese privet stems results in greater numbers of stems produced. But any plant contains a finite amount of energy. The regrowth of new stems following the removal of stems necessitates the plant's using stored energy—energy that otherwise may have been used to produce fruits that would enable a greater distribution of privet plants. Do plants that have resprouted produce fewer fruits? Or do they attempt to compensate for the loss by producing more fruits post-cutting with the remaining stored energy?
4. It would be nice to have evidence (via surveys) that bird and reptile communities in our area are augmented (or not) by the presence of beaver ponds.

And, in conclusion,

“If one values all forms of life and not just the life of one’s own species, then one must be concerned with the genetic pool, the total potential of all living things to produce descendants of various shapes, sizes, colors The Columbian exchange has left us with not a richer but a more impoverished genetic pool.” A.W. Crosby (1972)

References and Literature Cited

- Arner, D.H. and G.R. Hepp. 1989. Beaver pond wetlands: a southern perspective *in* Habitat Management for Migrating and Wintering Waterfowl in North America, eds. L.M. Smith, R.L. Pederson, and R.M. Kaminski, Texas Tech. Univ. Press, pp. 117-128.
- Bartel, R.A. N.M. Haddad and J.P. Wright. 2010. Ecosystem engineers maintain a rare species of butterfly and increase plant diversity. *Oikos* 119: 883-890.
- Bryant, J.P., and P.J. Kuropat. 1980. Selection of winter forage by subarctic browsing vertebrates: The role of plant chemistry. *Annual Review of Ecology and Systematics* 11:261–285.
- Brzyski, J.R.. 2005. Beaver (*Castor canadensis*) impacts on herbaceous and woody vegetation in southeastern Georgia. MS Thesis, Georgia Southern University, Electronic Theses & Dissertations, Paper 707.
- Burchsted, D, M. Daniels, R. Thorson, and J. Vokoun. 2010. The River Discontinuum: applying beaver modifications to baseline conditions for restoration of forested headwaters. *BioScience* 60(11): 908-922.
- Busher, P.E. 1996. Food caching behavior of beavers (*Castor canadensis*): selection and use of woody species. *American Midland Naturalist* 135: 343-348.
- Chabreck, R.H. 1958. Beaver–forest relationships in St. Tammany Parish, Louisiana. *Journal of Wildlife Management* 22: 179–183.
- Collen, P. and R.J. Gibson. 2001. The general ecology of beavers (*Castor spp.*) as related to their influences on stream ecosystems and riparian habitats, and the subsequent effects on fish—a review. *Reviews in Fish Biology and Fisheries* 10: 439-461.
- Crawley, M.J., H. Kornberg, J.H. Lawton, M.B. Usher, R. Southwood, R.J. O'Connor, and A. Gibbs. 1986. The population biology of invaders. *Philosophical Transactions of the Royal Society of London B* 314: 711–731.
- Crosby, A.W.. 1972. *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Greenwood Press. Westport, CT.
- Dahl, T.E. and G.J. Allord. 1997. History of wetlands in the conterminous United States. Technical Aspects of Wetlands, National Water Summary, U.S. Geological Survey Water Supply Paper 2425.
- Davis, J.R. and D.C. Guynn, Jr. 1993. Activity and habitat utilization of beaver colonies in South Carolina. *Proceedings of the Annual Conf. Southeast. Assoc. Fish and Wildlife Agencies* 47: 299-310.
- Del Tredici, P. 2001. Sprouting in temperate trees: a morphological and ecological review. *The Botanical Review* 67(2): 121-140.
- Edwards, N.T. and D.L. Otis. 1999. Avian communities and habitat relationships in South Carolina piedmont beaver ponds. *American Midland Naturalist* 141(1): 158-171.
- Ernst, J.P. and V. Brown. 1989. Conserving endangered species on southern forested wetlands. *Proceedings of the Symposium: The Forested Wetlands of the Southern United States*, Technical Report SE-50: 135-145.
- Eschtruth, A.K. and J.J. Battles. 2009. Assessing the relative importance of disturbance, herbivory, diversity, and propagule pressure in exotic plant invasion. *Ecological Monographs* 79(2): 265-280.
- Grover, A.M. and G.A. Baldassarre. 1995. Bird species richness within beaver ponds in south-central New York. *Wetlands* 15: 108–118.
- Harris, L.D.. 1989. The faunal significance of fragmentation of southeastern bottomland forests.

- Proceedings of the Symposium: The Forested Wetlands of the Southern United States, Technical Report SE-50: 126-134.
- Johnston, C.A. and R.J. Naiman. 1987. Boundary dynamics at the aquatic-terrestrial interface: the influence of beaver and geomorphology. *Landscape Ecology* 1(1): 47-57.
- Jones, J.C., K.E. Edwards J.H. Fogarty, and K. Shelton. 2011. Bird communities of beaver wetlands and forested riparian slopes along first- and second-order streams in central Mississippi. *Proceedings of the Annual Conference of the Southeastern Assoc. Fish and Wildl. Agencies* 65: 62-70.
- Karban, R. and J.H. Myers. 1989. Induced plant responses to herbivory. *Annual Review of Ecology and Systematics* 20: 331-348.
- Kuenxler, E.J. 1989. Value of forested wetlands as filters for sediments and nutrients. *Proceedings of the Symposium: The Forested Wetlands of the Southern United States, Technical Report SE-50: 85-96.*
- Law, A., F. McLean, and N.J. Willby. 2016. Habitat engineering by beaver benefits aquatic biodiversity and ecosystem processes in agricultural streams. *Freshwater Biology* doi:10.1111/fwb.12721
- Liebhold, A.M., W.L. Macdonald, D. Bergdahl, and V.C. Mastro. 1995. Invasion by exotic forest pests: a threat to forest ecosystems. *Forest Science Monographs* 30: 2-58.
- Lochmiller, R.L. 1979. Use of beaver ponds by southeastern woodpeckers in winter. *Journal of Wildlife Management* 43(1): 263-266.
- Lodge, D.M. 1993. Biological invasions: lessons for ecology. *TREE* 8(4): 133-136.
- McArthur, J.V. 1989. Aquatic and terrestrial linkages: floodplain functions. *Proceedings of the Symposium: The Forested Wetlands of the Southern United States, Technical Report SE-50: 107-116.*
- Menzel, M.A., T.C. Carter, W.M. Ford, and B.R. Chapman. 2001. Tree-roost characteristics of subadult and female adult evening bats (*Nycticeius humeralis*) in the Upper Coastal Plain of South Carolina. *American Midland Naturalist* 145: 112-119.
- Metts, B.S., J.D. Lanham, and K.R. Russell. 2001. Evaluation of herpetofaunal communities on upland streams and beaver-impounded streams in the upper piedmont of South Carolina. *American Midland Naturalist* 145(1): 54-65.
- Naiman, J.T., C.A. Johnston, and J.C. Kelley. 1988. Alteration of North American streams by beaver. *BioScience* 38(11): 753-762.
- Neff, D.J. 1957. Ecological effects of beaver habitat abandonment in the Colorado Rockies. *Journal of Wildlife Management* 21: 80-84.
- North Carolina Plant Conservation Board (NCPCB). 2010. Protected Plant Species List, accessed on March 12, 2016 at <http://www.ncagr.gov/plantindustry/plant/plantconserve/plist.htm>
- Paré, P.W. and J.H. Tumlinson. 1999. Plant volatiles as a defense against insect herbivores. *Plant Physiology* 121: 325-332.
- Parker, M., F.J. Wood, Jr., B.H. Smith, and R.G. Elder. 1985. Erosional downcutting in lower order riparian ecosystems: have historical changes been caused by removal of beaver? *Proceedings of the First North American Riparian Conference*: 35-38.
- Raffel, T.R., N. Smith, C. Cortwright, and A.J. Gatz. 2009. Central place foraging by beavers (*Castor canadensis*) in a complex lake habitat. *American Midland Naturalist* 162: 62-73.
- Roberts, T.H. and D.H. Arner. 1984. Food habits of beaver in east-central Mississippi. *Journal of Wildlife Management* 48(4): 1414-1419.
- Rosell, F., O. Bozser, P. Collen, and H. Parker. 2005. Ecological impact of beavers *Castor fibre* and *Castor canadensis* and their ability to modify ecosystems. *Mammal Rev.* 35: 248-276.
- Rossell, C.R. Jr., S. Arico, H.D. Clarke, J. L. Horton, J.R. Ward, and S.C. Patch. 2014. Forage selection of native and nonnative woody plants by beaver in a rare-shrub community in the Appalachian mountains of North Carolina. *Southeastern Naturalist* 13(4): 649-662.
- Russell, K.R., C.E. Moorman, J.K. Edwards, B.S. Metts, and D.C. Guynn, Jr. 1999. Amphibian and reptile communities associated with beaver (*Castor canadensis*) ponds and unimpounded streams in the piedmont of South Carolina. *Journal of Freshwater Ecology* 14(2): 149-158.

- U.S. Fish and Wildlife Service (USFWS). 2015. Listed species believed to or known to occur in North Carolina. accessed on March 12, 2016 at http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=NC&status=listed
- U.S. Geological Survey (USGS). 1997. "State Summary Highlights", National Water Summary on Wetland Resources, Water Supply Paper 2425. accessed March 8, 2016 at http://pubs.usgs.gov/wsp2425/state_highlights_summary.html
- Williams, J.D. and C.K. Dodd, Jr.. 1978. Importance of wetlands to endangered and threatened species. Wetland Functions and Values: the State of Our Understanding, American Water Resources Association Technical Paper, pp. 565-575.
- Woodward, D.K., R.B. Hazel, and B.P. Gaffney. 1985. Economic and environmental impacts of beavers in North Carolina. Second Eastern Wildlife Damage Control Conference.
- Wright, J.P., C.G. Jones, and A.S. Flecker. 2002. An ecosystem engineer, the beaver, increases species richness at the landscape scale. *Oecologia* 132: 96-101.

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