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THE SALIX CONSORTIUM

PROGRESS HIGHLIGHTS: Third Quarter 1998

Feedstock Production and Infrastructure (Task 1)

- Willow planted on the Consortium's demonstration plots planted in spring of 1998 have grown well. As anticipated, weed growth presented the single most significant challenge. An effective combination of chemical and mechanical weed control was employed to maintain control. Efforts are ongoing in this area to determine the most economic and biologically effective means of monitoring and controlling weeds.
- Site preparation for the 1999 planting sites continued during this period. Approximately 80 ha (200 ac) were plowed and disked in western New York. This acreage has been secured using revised site selection criteria which includes larger plot sizes. These criteria are aimed at lowering costs and increasing productivity.
- Consortium staff continued site visits for identifying acreage for additional commercial scale plots. Six new potential sites were evaluated and informational packets were sent to eleven interested landowners.

Power Plant Conversion and Testing (Task 2)

- Retrofit activities at Dunkirk continued during this period. Silo storage was ordered and plant staff began rerouting pneumatic transport lines. Biomass sizing equipment has been specified and was ordered. The station is expected to be ready for shakedown tests late in the first quarter of 1999.
- The Vermont gasification project produced gas from wood and corn. Many mechanical modifications were made to improve the systems performance and fuel handling. The Consortium still intends to test willow in the system sometime next year.
- Greenidge station continues to operate at a 10% cofiring rate using biomass residues.

System Optimization and Experimental Studies (Task 3)

- Ten seedlings each from 78 families will be the focus of a new genetic study. The objectives of the study are to obtain basic information on inheritance pattern of various traits and to develop a system for identifying superior willow clones at a young age. The results of this study may reduce crop improvement costs by reducing R&D efforts spent on less promising clones.
- Research efforts on willow root growth continued during this reporting period. In July, minirhizotrons were inserted into the soil in a four-year-old willow trial at Tully. The study focuses on root production and turnover and will continue through the 1999 growing season. The results of this study will be important to answering carbon sequestration questions and confirming estimates of below ground biomass in willow.

- Cornell University's Laboratory of Ornithology released an interim report on its study of avian biodiversity in willow plots. The report is provided in Appendix C. This research is a key component of the Consortium's efforts to evaluate the environmental effects of a large scale willow energy enterprise. The data collected indicated a zero presence of cow birds (a pest species).
- Willow trials were planted on three sites along the Erie Canal in Utica, NY. Other potential trial sites were visited in Pennsylvania (Roaring Branch, Homer City), New Jersey (Bayside Prison), and Maryland (Delmarva Peninsula).
- Tests with a disc mower for first year coppicing operations were unsuccessful. Other types of equipment, such as modified sickle bar mower and corn choppers, are being pursued. An optimized system will be required to minimize coppicing costs and reduce the risk of damage to the willow.

Enterprise Development (Task 4)

- Approximately 40 people attended the Willow Biomass Field Days. Participants at this years event were much more interested in how they could become actively involved in the development of willow biomass crops.
- Preparations are ongoing for October's community meeting. Two sessions are scheduled for October 28th at the Fredonia Masonic Lodge. The Consortium mailed 132 personal invitations.
- Leaders from the Consortium met with U.S. Assistant Secretary Dan Reicher and New York Congressman Sherwood Boehlert in Utica.
- Articles about the project and the upcoming community meetings were published in several newsletters and a magazine. A full length feature article with photos was published in local daily newspapers with a circulation of approximately 45,000. These press releases resulted in a number of new leads for more demonstration acreage and project participation.
- Additional data was collected for the Consortium's business and economics model. When completed, the model will provide valuable information about the value of willow energy crop enterprise.

#

1.0 INTRODUCTION

The project undertaken by the Salix Consortium is a multi-phased, multi-partner endeavor. Phase I focused on initial development and testing of the technology and forging the necessary agreements to demonstrate commercial willow production. The Phase I objectives have been successfully completed: preparing final design plans for two utility pulverized coal boiler for 20 MW of biopower capacity; developing fuel supply plans for the project with a goal of establishing 365 ha (900 ac) of willow; obtaining power production commitments from the power companies for Phase II; obtaining construction and environmental permits; and developing an experimental strategy for crop production and power generation improvements needed to assure commercial success. The R&D effort also addresses environmental issues pertaining to introduction of the willow energy system. Beyond those Phase I requirements, the Consortium has already successfully demonstrated cofiring at Greenidge Station and has initiated development of the required nursery capacity for acreage scale-up. This past spring, 43 ha (105 ac) of willow were planted and another 91 ha (225 ac) were prepared for planting in 1999. Exhibit 1-1 shows the locations of various Consortium activities. Not shown are Consortium activities in Rhinelander Wisconsin.

Exhibit 1-1: Location of Consortium Activities

In Phase II every aspect of willow production and power generation from willow biomass will be demonstrated. The ultimate objective of Phase II is to transition the work performed under the Biomass Power for Rural Development project into a thriving, self-supported energy crop enterprise.

1.1 Project Overview

The Salix Consortium pools the research and investment interests of over 14 corporations, associations, universities and regional government agencies in a well orchestrated program to develop a new energy crop enterprise. More than 37 farmers and landowners representing over 3,000 acres of potential willow production have met with Consortium representatives and expressed interest in the new energy crop. Although some of these landowners/growers are too far away to be considered in this demonstration, 22 landowners representing 770 ha (1,900 ac) of land have been screened for participation in the project (Appendix A). From this pool of acreage combined with utility-owned land and other Consortium experimental plots, the availability of 365 ha (900 ac) of willow for energy production is assured in Phase II. The Consortium continues to add to the prospect list of participating landowners through outreach activities.

Consortium regional representation is focused in the Northeast, stretching from Ontario to Pennsylvania and expanding into the midwest. Cofiring tests have been conducted at both Niagara Mohawk Power Corporation's (NMPC) Dunkirk, New York State Electric and Gas' (NYSEG) Greenidge, and GPU's Seward and Shawville power stations. The basic fuel handling system at Greenidge has demonstrated continuous firing at 10% by heat input. An initial test firing of the willow at Greenidge station has already been performed and has provided insight into the issues to be addressed in Phase II to assure efficient use of the willow energy crop. NMPC recently completed successful tests cofiring biomass in one corner of a boiler at its Dunkirk Station. NMPC is now retrofitting this boilers for full-time cofiring. The focus of the Salix Consortium is on energy crop infrastructure and development first and conversion technology second in the belief that the major tasks ahead are to develop an economical crop production infrastructure for the business. Nonetheless, energy conversion issues are effectively addressed in the program and advanced technologies through gasification are included with a realistic timetable for implementation. All of the preceding efforts contribute to the project team's belief that this

Exhibit 1-2: Dunkirk Sites

Consortium will be the *first in the nation to develop an economically and environmentally sustainable business in energy crops for power generation* and ultimately a variety of high value energy products.

To meet this vision, the Consortium has organized its activities into four distinct tasks:

Task 1 - Feedstock Production and Infrastructure

Task 2 - Power Plant Conversion and Testing

Task 3 - System Optimization and Experimental Studies

Task 4 - Enterprise Development

A brief description of the objectives of each task is provided below.

1.2 Description of Tasks and Goals

1.2.1 Task 1 - Feedstock Production and Infrastructure

Task 1 activities focus on acreage scale-up and willow field production activities. During Phase II, the Consortium will establish 365 ha (900 ac) of willow in New York. To accomplish this, the Consortium will ensure that sufficient planting stock is produced, production sites are prepared, and that planting, monitoring, maintenance, and harvesting activities are developed in a manner consistent with establishing an energy crop enterprise. All planning, land acquisition, and commercial field activity associated with this project are managed under Task 1. A schedule of the Task 1 efforts and corresponding deliverables is provided in Appendix B.

	TASK 1
★	<i>ACREAGE SCALE-UP</i>
★	<i>NURSERY PRODUCTION</i>

1.2.2 Task 2 - Power Plant Conversion and Testing

Task 2 activities focus on resolving issues related to the power plants and conversion of a delivered willow product into electricity. The goals for Task 2 efforts in Phase II include the retrofitting and continuous cofiring of biomass at Dunkirk Station, continued operation and testing of Greenidge Station, and gasification tests using willow at McNeil Station. The Consortium will also collect operational data such as manpower requirements and maintenance costs. However, emissions monitoring and ash testing activities will be managed under Task 3. A schedule of the Task 2 efforts and corresponding deliverables is provided in Appendix B.

	TASK 2
★	<i>PLANT RETROFITS</i>
★	<i>EMISSION MONITORING</i>

1.2.3 Task 3 - System Optimization and Experimental Studies

All research and development activities are managed under Task 3. This includes willow feedstock and production system R&D, environmental and sustainability studies, and power generation optimization efforts.

Specifically, the Consortium will seek to improve willow yields and pest resistance while maintaining site productivity. The Consortium will evaluate willow site preparation techniques, planting and harvesting equipment. A schedule of the Task 3 efforts and corresponding deliverables is provided in Appendix B.

TASK 3	
★	<i>CROP R&D</i>
★	<i>ENVIRONMENTAL STUDIES</i>
★	<i>OPERATION IMPROVEMENTS</i>

1.2.4 Task 4 - Enterprise Development

Task 4 will focus on Business Development and Optimization activities that will lay the foundation for the long term viability of a willow production enterprise. The Consortium will investigate ways to capitalize on existing federal, state, and local government programs to increase

the competitiveness of the crop. Forest management and agricultural tax structures, Conservation Reserve Programs, and eco-enterprise zones are examples of avenues being pursued. These activities plus on-going outreach and technology transfer are aimed at ensuring the successful transition of this project from demonstration to commercialization. A schedule of the Task 4 efforts and corresponding deliverables is provided in Appendix B

TASK 4	
★	<i>BUSINESS DEVELOPMENT</i>
★	<i>OUTREACH</i>

1.3 Work Schedule and Deliverables

A complete work schedule and list of corresponding deliverables for each partner is provided in Appendix B. A summary of that schedule is provided below.

2.0 DETAILED TASK PROGRESS REPORTS

2.1 Task 1 - Feedstock Production and Infrastructure

2.1.1 Nursery Operations

Willow growth at the New York State Department of Environmental Conservation Saratoga Tree Nursery, Saratoga Springs, NY, appeared better than in 1997. Improvements to the irrigation system that were installed during 1998 are a likely reason for this result. Mechanical and chemical weed control was completed in cutting orchards established at Saratoga during 1998. Ammonium nitrate fertilizer will be applied to cutting beds established in previous years at the rate of 100 kg-n/ha. Foliage samples were also collected for nutrient analyses.

2.1.2 Acreage Scale-up Activity Dunkirk/Greenidge

Demonstration Site and Field Trial Updates

Trees in the demonstration planting established at Leon, NY, during spring 1998 grew well. The site required mechanical weed control because the herbicide cap provided only partial control. Nutsedge (*Cyperus spp.*) was the primary problem weed. An arrowhead tine cultivator was used for weed control but, it was ineffective. SUNY-ESF's multi-head rototiller, which has proven effective in central New York, was transported to Leon from Tully to complete the task.

Trees in the demonstration planting at Sheridan, NY, grew well, and there was less weed competition than at Leon. Part of the site (14 ha) was treated with fluazifop-P-butyl (Fusilade 2000) at the 0.45 kg ai ha⁻¹ rate to control quackgrass (*Elytrigia repens* L.). Spot-treatments with Fusilade 2000 were completed on an additional 4 ha. The Leon and Sheridan sites had minor foliage damage by flea beetles (subfamily Alticinae). Tree survival in the willow demonstration planting at Pomfret, NY, appeared low and this site will have to be replanted next spring.

Quackgrass was also observed in the demonstration planting established during spring 1998 at Canastota, NY. Fusilade 2000 herbicide was applied at the 0.45 kg ha⁻¹ rate to control the quackgrass.

Site preparation for plantings scheduled for 1999 continued. In western NY, sites in Dayton, Gerry, and Pomfret totaling 80 ha in size were plowed and disced. Winter rye was planted on the Gerry site to reduce erosion and will be planted at Pomfret during October. In central NY, disking was completed on sites that were plowed during August at Lafayette and Tully. Drainage improvements were made on sites in Pomfret, NY, scheduled for planting during 1999. Culverts were installed to facilitate equipment movement on the Pomfret sites.

SUNY-ESF examined potential sites for willow clone-site trials in Delaware and New Jersey. Staff from the Delaware Department of Agriculture Forest Service located a 2 ha site that is

currently planted with soybeans and will be prepared for planting next spring. Approximately half of this field will be used for a willow bioenergy trial, and the other half will be used for switchgrass trials.

SUNY-ESF visited two potential clone-site trial locations in Pennsylvania. Site preparation including herbicide application was initiated at a site near Roarding Branch, PA. The lack of rain and recent mowing of the site raised concerns about the potential effectiveness of the herbicide treatment. A site inspection will be completed in early October by the site co-operator to assess herbicide effectiveness. The site will be plowed this fall and left in that condition over the winter to facilitate drying next spring. The second site was near Homer City, PA. This site will not be planted until 2000 because site preparation could not be completed during fall 1998. The site would have required mowing, raking, and weed re-growth before herbicide application, and it is unlikely that sufficient weed control could have been achieved in time for spring 1999 planting.

SUNY-ESF staff visited four potential sites for willow bioenergy trials at the Bayside Prison in southern New Jersey. Staff from the New Jersey Department of Environmental Protection State Forestry Service discussed the possibility of establishing willow biomass trials with prison staff and arranged the visit. A decision will be made as soon as possible on the best location for the trial.

Staff from SUNY-ESF, NYSEG, and ANTARES visited Delmarva Power Company's Indian River Power Plant to discuss cofiring opportunities and the potential of establishing willow biomass trials in the area. The Consortium will continue to follow up on this lead in 1999.

Land Acquisition Updates

Staff from the SoCNY RC&D, SUNY-ESF, and FORECON inspected four sites planted in the spring of 1998 and evaluated six new potential sites. SoCNY RC&D also sent information packets with land questionnaires to eleven other interested landowners.

2.1.3 Acreage Scale-up Activity Other Sites

Burlington Electric Department trial plots continue to show excellent growth. Additional data will be presented in the next progress report.

2.2 Task 2 - Power Plant Conversion and Testing

2.2.1 Dunkirk Station

Retrofit activities at Dunkirk continued during this period. Silo storage was ordered and plant staff began rerouting pneumatic transport lines. Biomass sizing equipment has been specified and was ordered. The station is expected to be ready for shakedown tests late in the first quarter of 1999.

2.2.2 *Greenidge Station*

Although Greenidge station is preparing to be transferred to new owners, biomass continues to be cofired at the plant. The Consortium expects to seek the participation of the new owners in the project during the first half of 1999.

2.2.3 *McNeil Station*

The VT gasification project produced gas on wood and corn during the summer and fall. Many mechanical modifications were made to improve performance and fuel handling. Wood fuel consists of dried sawmill chips. Pre-parametric tests are scheduled to resume late in December through January.

2.3 **Task 3 - System Optimization and Experimental Studies**

2.3.1 *Willow Feedstock R&D*

Genetic Improvement

Seedling growth rates increased dramatically in response to increased fertilizer application and extended photoperiod. These plants will be brought into dormancy during October. Heights of all willow seedlings produced during 1998 by controlled pollination were measured. These measurements will be used to select 20 exceptionally vigorous seedlings per family that will be planted in pots and provided with optimum growing conditions until mid-fall 1998. The seedlings will then be allowed to proceed into dormancy, followed by propagation during winter 1998-1999 using small hardwood cuttings (2 cm in length) in a greenhouse. Rooted cuttings from these plants will be field planted during spring 1999 in a cutting orchard. This is part of an effort to utilize progeny produced by 1998 controlled breeding efforts as quickly as possible.

Ten seedlings per family will be selected at random from approximately 35 *S. eriocephala* families produced by controlled pollination during February 1998 for a detailed genetics study. The objectives of the study are to obtain basic information on inheritance patterns of various traits and to develop a system for identifying superior willow clones at a young age using molecular markers.

Progress continued towards determining chromosome numbers of willows in the SUNY-ESF collection. Willow chromosomes were observed and photographed. Modifications were made to the protocols for producing root tissue used in the system and the chromosome staining procedure. Chromosome numbers have been estimated for several clones and numbers will be reported after all clones of interest have been tested. The small size of willow chromosomes relative to chromosomes of most other plant species has made this project especially challenging. These efforts will aid and advance the Consortium's understanding of willow genetics and make breeding of desirable willow clones easier.

Native willows collected during 1995 and planted in cutting orchards at Tully, NY, were surveyed for insect and disease pests. A small number of *S. eriocephala* clones had shepherd's crooks. The suspected cause is *Fusicladium spp.*, a fungal pathogen. Foliage damage by a rust fungus was observed on some clones, but damage was minor. Insect feeding damage by at least three beetle species was observed on many clones, but the damage was not considered severe enough to warrant control treatments. These studies are part of the Consortium's ongoing effort to seek native clones that have superior characteristics for use as energy crops.

Growth and light interception measurements continued in the genetic selection trial established at Tully during spring 1997 in cooperation with the USDA Forest Service in Rhinelander, WI. Foliage samples were collected for nutrient analyses and laboratory analyses continued on foliage samples collected during summer 1998. This study will assist in characterizing the ecophysiology of different willow clones. Ultimately this information will be used to breed superior clones.

Nursery Production Improvement

There was no new activity to report this quarter.

Crop Improvement

Measurements scheduled for July 1998 were completed. Sawfly larvae damaged trees for the third time this season and were controlled with carbaryl insecticide. Measurements continued throughout this quarter.

A trial was initiated in 1996 to identify optimum nitrogen fertilization rates for willow bioenergy plantings using existing trials at King Ferry, Somerset, and Tully, NY. Foliage samples were collected for nutrient analyses and weed biomass was measured at each site. These trials will be harvested during winter 1998-1999, enabling verification of biomass estimation equations derived from this study.

SUNY-ESF continued its efforts on a study that was initiated in 1996 to identify organic fertilizers that can be used to increase willow biomass production without causing site quality degradation. Attempts to collect soil water samples using lysimeters in the test plots were unsuccessful during September due to dry soil conditions. Soil water monitoring has been undertaken to determine if leaching of nitrates or phosphates present in the organic amendments occurs. SUNY-ESF will also begin a cooperative effort to mineralization of sewage biosolids and poultry manure study with the USDA Forest Service Northeast Experiment Station in Warren, PA.

Willow trials were planted on three sites along the Erie Canal in Utica, NY. These small trials will assess the potential of using willow for phytoremediation of contaminated soils. Two of the three sites planted in Utica contained dredge spoils from the Erie Canal. The third site was

contaminated early in the century by the coal gas industry. These plantings will be monitored for willow growth and changes in levels of polycyclic aromatic hydrocarbon (PAH) contaminants in the substrate.

During this reporting period, insect, disease, and browse survey data collected at all willow demonstration areas were summarized. Deer browse was the most severe problem encountered during 1998. Damage was severe on some sites and large clonal variation in damage incidence was observed. *Salix eriocephala* clones were damaged more severely than other species, but a strong effect of position in a field was observed. Damage typically increased as distance from a road increased. Deer browse damage was most severe in plantings at Lafayette and Leon, NY. Foliage-feeding insects were a severe problem in demonstration plantings at Tully, NY.

Melampsora rust was observed on several clones, but was not severe on any clone or site. An infestation of sawflies (*Nematus ventralis*) damaged one-year-old willows in the demonstration planting at Tully, NY (planted in 1997). This was the third infestation in this area during 1998. The insects were controlled with carbaryl (Sevin) insecticide. Survival was measured in demonstration areas planted at Tully during 1997 and 1998. These efforts will be important in establishing the optimum mix of clones and placement for maximizing biomass growth and survival.

Foliage sample collection was completed in demonstration plantings that were established during spring 1998 at Lafayette, Leon, Sheridan, Tully, and Wolcott, NY. Analyses of foliar nitrogen, phosphorus, potassium, calcium and magnesium concentrations will be completed on these samples at SUNY-ESF. These data will be combined with similar information obtained in previous years from willow bioenergy trials around New York State and used to develop fertilizer recommendations for willow bioenergy plantings. Laboratory analyses began on soil samples collected during summer 1998 from all of the 1998 demonstration plantings. Mechanical weed control was completed in the demonstration area at Sheridan, NY.

Survival measurements were completed by SUNY-ESF's staff in willow clone-site trials at Somerset (planted in 1995) and Tully, NY (planted in 1993). Mechanical weed control was completed in the willow clone-site trial at Wolcott, NY (planted in 1998) using the multi-head rototiller to control various broadleaf weeds that were beginning to dominate the planting.

Survival measurements began in willow clone site-trials across New York, Pennsylvania, and Vermont. Survival measurements will be completed by the end of November 1998. Foliage was collected for nutrient analyses in all clone-site trials that were planted during 1998 and in those that are scheduled for harvesting during winter 1998-1999. Mechanical weed control was completed in the willow clone site-trial planted in Sheridan, NY during 1998.

A formal effort is being made to standardize operating procedures in the monitoring demonstration plantings and clone-site trials. SUNY-ESF produced and implemented a Standard Operating Procedure (SOP) on foliage sampling. A second SOP was developed and is being tested for sampling survival in large-scale plantings. Other SOPs will be developed as needed, as

part of a critical quality assurance program. A field map was prepared for all willow bioenergy trials established to date. A new laboratory sample tracking system was established to increase the efficiency of sample processing, an increasingly difficult task with the large increase in samples being analyzed.

2.3.2 Production Systems

Planting System Testing, Evaluation, and Optimization

A disc mower was tested as an alternative to sickle-bar mowers for first-year coppicing. Staff from SUNY-ESF and the Department of Agricultural and Biological Engineering at Cornell University attended the demonstration at Tully, NY. Rather than producing clean cuts, the mower shredded some stems and did not cut others. Individuals involved in willow biomass production in the United Kingdom were contacted to determine what machinery they use for first-year coppicing. They indicated that sickle bar mowers produce the best results. Staff from SUNY-ESF and the Department of Agricultural and Biological Engineering at Cornell University will modify and test existing sickle bar mower so that stems are lifted as the machine passes, which is expected to decrease the number of stems that are missed by the mower. This modified equipment will be used to coppice the scale-up acreage planted earlier this year.

Harvesting System Testing, Evaluation, and Optimization

There was no activity on this subtask during this reporting period.

Evaluation of Other Supply Dynamics

There was no activity on this subtask during this reporting period.

2.3.3 Environmental Studies

Cornell University provided an interim report on its study of avian biodiversity in short rotation intensive culture (SRIC) willow plots (refer to Appendix C). These preliminary results listed the bird species observed per plot and per willow age class and provided information on nests found; the study found 80 nests of 7 different species.

A field study was initiated during fall 1997 at the SUNY-ESF research station in Tully, New York, to gain information on willow root growth. During July 1998, 24 minirhizotrons were inserted into the soil in a four-year-old willow trial at Tully to study root production and turnover. The tubes were inserted into plots where composted chicken manure had been applied in 1996 and in control plots that were not fertilized. Root growth monitoring began this reporting period and will continue through the fall and over the 1999 growing season.

2.3.4 Power Generation Optimization

There was no activity on this subtask during this reporting period.

2.4 Task 4 - Enterprise Development

2.4.1 Business Optimization and Analysis

Consortium staff continued their work on development of a willow energy crop economic model. During this period, several new model components were added and they are undergoing review. The Consortium expects to test the model more completely in the first quarter of next year. A flow diagram of the model presented at BioEnergy '98 is provided in Appendix D.

2.4.2 Enterprise Development

Approximately 40 people attended the Willow Biomass Field Day at the SUNY-ESF research station in Tully, NY on September 2nd. Issues discussed included using willow for end products such as large and small-scale energy production, snow-fences, willow baskets and trellises, etc. There was a noticeable shift in the participant's range of interests at this year's event compared with last year. This year, more individuals were interested in becoming actively involved in the development of a willow biomass industry. People expressed interest in producing and supplying plant stock, growing willows for energy, becoming involved in custom planting and harvesting operations, and capturing the multiple environmental benefits associated with willow biomass crops.

The annual Biomass-Bioenergy Advisory Board meeting was held on September 3rd. Items addressed included a program update, presentation and discussion of an economic model that is being developed, review of work highlighting the rural development benefits from the establishment of willow biomass acreage across the region, and discussion of the community meeting planned for October 28th in western NY.

During this reporting period, staff from Niagara Mohawk and SUNY-ESF met with United States Assistant Secretary of Energy Dan Reicher and Congressman Sherwood Boehlert in Utica, NY. Mr. Reicher and Mr. Boehlert were updated on the progress of the Salix Consortium's Biomass Power for Rural Development project. Discussions were held on how the program could be supported to reach its goal of developing a commercially viable business centered on willow biomass crops over the next few years.

SoCNY RC&D held a planning meeting in July with ten Agriculture Service Center staff, SUNY-ESF, and FORECON in Jamestown. The meeting provided valuable input on location, choice of date, invitations, and length and time of sessions. SoCNY RC&D booked the Masonic Lodge in Fredonia for two Community Meeting sessions on October 28th to increase attendance by a variety of people with different schedules. It also began coordinating other partners' efforts. SoCNY RC&D also mailed 132 personal invitations to the community meeting to environmental groups, economic development leaders, agricultural groups, and elected officials. These

invitations were individualized and printed on letterhead with the logos of SoCNY RC&D, NMPC, SUNY-ESF, and FORECON, and with the Salix logo. In addition, staff from SUNY-ESF agreed to do radio interviews with WJTN in Jamestown, which will be recorded and aired in October.

Articles about the Willow Biomass Project and the community meeting were published in the following:

- Chautauqua County SWCD Newsletter, which is inserted in Cornell Cooperative Extension's Agriculture News with a total circulation of 1,350.
- Cattaraugus County SWCD Newsletter with a circulation of 800.
- A full-length feature article on the Willow Biomass Project was published in the Post Journal Saturday magazine, Sept. 5th issue, with a circulation of 45,000.
- Several other articles and mentions appeared in publications in early October.

These activities generated additional contacts including other media and individuals interested in participating in the program.

SoCNY RC&D attended the Willow Biomass Display at Empire Farm Days and spoke with fair attendees about the Willow Biomass Project, handed out materials, collected names and addresses of interested people and distributed the community meeting flyer.

At the September Mid-Atlantic RC&D meeting, SUNY-ESF and RC&D staff made a presentation entitled "Willow Biomass Crops: Home Grown Energy". RC&D staff from northern NY and Maryland expressed interest in examining ways to capitalize on willow's environmental and economic development benefits in their regions. The Consortium staff took this opportunity to promote the project and distribute flyers for the upcoming community meeting.

Jud Isebrands from the USDA Forest Service in Rhinelander, WI, visited SUNY-ESF to tour the research station at Tully with a specific focus on the genetic selection trial that is duplicated at the research station in Rhinelander. Plans were discussed for a collaborative effort to screen a range of pre- and post-emergent herbicides for willow biomass crops.

Staff from the Montreal Botanical Gardens visited the Tully research station to learn more about SUNY-ESF's research efforts and to discuss future collaborative efforts. Research with two willow species has been ongoing at the Montreal Botanical Gardens for several years. Opportunities exist to build on the knowledge and experience from SUNY-ESF and the Montreal Botanical Gardens to advance the commercialization of willow biomass crops.

Gerald Tuskan from Oak Ridge National Laboratory (ORNL); Robert Fritz from Vassar College, Poughkeepsie, NY; Bernadette Roche from Loyola College in Maryland, Baltimore, MD; and SUNY-ESF staff met to discuss willow breeding plans and collaborative research opportunities. Vassar College has an active willow breeding program with the objective of learning how genes

for resistance to *Melampsora* rust move through natural populations. Plant materials will be exchanged between SUNY-ESF and Vassar College, and a joint research project may be pursued if funding sources can be identified.

The following papers were submitted for the Bioenergy Conference in Wisconsin in October:

- Downing, M.; Demeter, C.; Braster, M.; Hansen, C.; Larson, G.; and Volk, T. *Agricultural Cooperatives and Marketing Bioenergy Crops: Case Studies of Emerging Co-operative Development for Agriculture and Energy.*
- Lindsey, C. and Volk, T. *Economic and Business Model of a Commercial Willow Enterprise.*
- Tharakan, P.J.; Abrahamson, L.P.; Isebrands, J.G.; and Robison, D.J. *First Year Growth and Development of Willow and Poplar Bioenergy Crops as Related to Foliar Characteristics.*
- White, E.H.; Neuhauser, E.F.; Abrahamson, L.P.; Volk, T.A.; Benjamin, W.H.; Peterson, J.M.; Gray, E.; Demeter, C.; and Lindsey, C. *The Salix Consortium - A Partnership for Bioenergy Commercialization.*

A pamphlet describing the willow bioenergy production system was prepared for distribution to the general public. This pamphlet will be part of the Environmental Information Series of public service brochures produced and distributed by SUNY-ESF.

APPENDIX A

List of Potential Acreage Scale-up Sites

SUMMARY OF DUNKIRK AREA ACREAGE

NAME	COUNTY	SITE VISIT	TOTAL ACRES	PLANTED ACRES	COMMENTS
HOPKINS, ANGELA	CHAUTAUQUA	YES	47	34	PLANTED APPROX 34 ACRES (1998). PAID THROUGH MARCH 31, 1999
SMITH, CHUCK	CHAUTAUQUA	YES	20	16	PLANTED APPROX 16 ACRES (1998). PAID THROUGH MARCH 31, 1999
KLOSINSKI, DAN	CATTARAGUS	YES	37	20	PLANTED APPROX 20 ACRES (1998). PAID THROUGH MARCH 31, 1999
GREEN, KATHLEEN	CHAUTAUQUA	YES	50	25	PLANTED APPROX 25 ACRES (1998). PLANTING FAILED. WILL REPLANT IN 1999. PAID THROUGH MARCH 31, 1999
CONTI, SAM	CHAUTAUQUA	YES	55	16	CONTRACT SIGNED FOR 16 ACRES (1999 PLANTING)
BROWN, ALBERT	CHAUTAUQUA	YES	42	20	CONTRACT SIGNED FOR 20 ACRES (1999 PLANTING)
DUCK, RICKY & STACY	CATTARAGUS	YES	160	100	CONTRACT SIGNED FOR 100 ACRES (1999 PLANTING)
GERNATT, DAN	CATTARAGUS	YES	100	66	CONTRACT SIGNED FOR 66 ACRES (1999 PLANTING)
Available / Planted			511	297	
LESCH	CHAUTAUQUA	YES	120		LAND IN ESTATE. NOT LIKELY TO HAVE LAND SECURED FOR 1999
MALVESTUTO, BOB	CHAUTAUQUA	YES	400		RENTED FOR 1999. NEGOTIATING FOR 2000.
PHILLIPS, JUDY	CHAUTAUQUA	YES	60		LANDOWNER DECIDED TO CONTINUE RENTING TO AREA FARMER
PULCI, ANN	CHAUTAUQUA	YES	60		HUSBAND DIED. WAS IN TOMATOES. NOT PLANTED IN 1998.
PANNELLA, GEO.	CHAUTAUQUA	YES	300		OFFERED TO RENT 30 ACRES. OWNER DECLINED OFFER. WOULD RECONSIDER IF WE TOOK A LARGER ACREAGE.
BROWN, RANDY	CHAUTAUQUA	NO	20		THINKING OF BUILDING A GOLF COURSE
REISCH, RICHARD	CHAUTAUQUA	YES	50		MOWED IN 1997. IN LOW BRUSH PREVIOUSLY
HANBY, DON	CHAUTAUQUA	NO	50		SOME STEEP AREAS. NEAR STOCKTON.
ZINK	CHAUTAUQUA	YES	135		CRP. WEIGHT LIMITS?? SLOPE??
SAM, CHARLES	CHAUTAUQUA	NO	75		UNSUITABLE BECAUSE OF WEIGHT LIMITS ON ROAD.
NEWCOMB, BARB	CATTARAGUS	NO	10		HERBICIDES MAY BE A PROBLEM.
LORE, DEBORAH	CHAUTAUQUA	YES			UNSUITABLE. MOST IS BADLY OVERGROWN.
ROMANOWSKI, J.		NO	10		NO INFO ON THIS GUY. STACY SHOULD KNOW MORE.
CHERRY, NORM	CHAUTAUQUA	YES	59		UNSUITABLE. BADLY OVERGROWN.
FIELDS, PAUL	CHAUTAUQUA	YES	8		ODD SHAPED FIELD.
FRALLICK, JIM	CATTARAGUS	YES	55		TAKING A WAIT AND SEE ATTITUDE.
SCHALLMO	CATTARAGUS	YES	40		LAND LOOKS OK. LONG WAY FROM DUNKIRK. WEIGHT LIMITS??
HITE, RONALD	CATTARAGUS	NO	60		FALLOW LAND. LONG WAY TO POWER PLANT.
ROSATI	CHAUTAUQUA	YES	40		UNSUITABLE. SLOPE PROBLEMS
KACZMAREK, CHRIS	CHAUTAUQUA	NO	35		~10 MILES TO PLANT
EADES, TIM	CHAUTAUQUA	NO	53		~30 MILES TO PLANT
MURDOCH, DAVID	CATTARAGUS	NO	10		30 MILES TO PLANT
WIESNER, RUDY	CHAUTAUQUA	YES	25		2 FIELDS TOTALING 15 ACRES LOOK USABLE. THIS IS QUITE DISTANT FROM ANY OTHER OF OUR SITES.
THIEL, DAVID	CATTARAGUS	NO	45		~40 MILES TO PLANT. INTERESTED IN BEING A GROWER
MITCHELL, MARG.	CHAUTAUQUA	YES	90		ACCESS DRIVEWAY IS VERY STEEP.
CACKENER, JOHN	CHAUTAUQUA	YES	38		TOOK A QUICK LOOK FROM THE ROAD. NEED MEET WITH OWNER ON A FUTURE TRIP.
NOBLES, SCOTT	CATTARAGUS	NO			LITTLE INFO ON THIS PERSON
WHITE, BILL	CATTARAGUS	NO			BETWEEN RANDOLPH & CONEWANGO
SMITH, RICHARD	CHAUTAUQUA	NO			LITTLE INFO ON THIS PERSON
REID, ANN	CATTARAGUS	YES	100		SOME FIELDS APPEAR USABLE. NEED TO CHECK ROAD WEIGHT LIMITS
SNYDER, WILLIAM	?	NO	18		TOWN OF IRVING
RICE, JAMES	?	NO	20		NEAR FREWSBURG
Total Prospective			1,985		
Total Acreage			2,496	297	

APPENDIX B

Schedule of Task Deliverables

BIOMASS POWER FOR RURAL DEVELOPMENT Salix Consortium Project Schedule

ID	Task Name
51	Future Demo Plots
52	Future Demo Plots
53	COPPING SCHEDULE
54	Copping - 1998
55	Kosinski (20 ac)
56	Smith (16 ac)
57	Green (25 ac)
58	Hopkins (24 ac)
59	Copping - 1999
60	Comb (16 ac)
61	Brown (20)
62	Duck (100 ac)
63	Gerhart (66 ac)
64	Green (25 ac)
65	Copping - 2000
66	Future Demo Plot1
67	Future Demon Plot2
68	Future Demo Plot3
69	Future Demo Plot4
70	Copping - 2001
71	Future Demo Plots
72	Future Demo Plots
73	HARVESTING SCHEDULE
74	Harvesting Operations - 2001
75	Shp Harvester to NY
76	Obtain Chip Wagons, Trucks
77	Kosinski (20 ac)
78	Smith (16 ac)
79	Green (25 ac)
80	Hopkins (24 ac)
81	Harvesting Operations - 2002
82	Shp Harvester to NY
83	Obtain Chip Wagons, Trucks
84	Comb (16 ac)
85	Brown (20)
86	Duck (100 ac)
87	Gerhart (66 ac)
88	Green (25 ac)
89	TRANSFER TO ENTERPRISE
90	Task II
91	Dunk Copping
92	Copping Return
93	Shakedown Testing
94	Operation
95	Greenidge Copping
96	Operation - 1 Shm
97	AES Decision Point
98	Final Modifications
99	Operation - 24 hr
100	GPU Copping

Task	Summary	Progress	Milestone	Split
Task II				
TRANSFER TO ENTERPRISE				
Green (25 ac)				
Gerhart (66 ac)				
Duck (100 ac)				
Brown (20)				
Comb (16 ac)				
Obtain Chip Wagons, Trucks				
Shp Harvester to NY				
Harvesting Operations - 2002				
Hopkins (24 ac)				
Green (25 ac)				
Smith (16 ac)				
Kosinski (20 ac)				
Obtain Chip Wagons, Trucks				
Shp Harvester to NY				
Harvesting Operations - 2001				
Future Demo Plots				
Future Demo Plots				
Copping - 2001				
Future Demo Plot4				
Future Demo Plot3				
Future Demon Plot2				
Future Demo Plot1				
Copping - 2000				
Green (25 ac)				
Gerhart (66 ac)				
Duck (100 ac)				
Brown (20)				
Comb (16 ac)				
Copping - 1999				
Hopkins (24 ac)				
Green (25 ac)				
Smith (16 ac)				
Kosinski (20 ac)				
Copping - 1998				
COPPING SCHEDULE				
Future Demo Plots				
Future Demo Plots

Task Name	1998	1999	2000	2001	2002
101	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
102	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
103	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
104	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
105	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
106	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
107	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
108	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
109	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
110	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
111	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
112	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
113	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
114	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
115	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
116	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
117	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
118	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
119	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
120	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
121	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
122	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
123	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
124	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
125	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
126	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
127	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
128	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
129	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
130	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
131	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
132	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
133	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
134	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
135	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
136	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
137	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
138	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
139	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
140	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
141	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
142	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
143	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
144	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
145	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
146	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
147	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
148	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
149	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
150	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1

BIOMASS POWER FOR RURAL DEVELOPMENT Salix Consortium Project Schedule

BIOMASS POWER FOR RURAL DEVELOPMENT Salix Consortium Project Schedule

APPENDIX C

Cornell University Laboratory of Ornithology Interim Report

BIOMASS FOR RURAL DEVELOPMENT – PHASE II

A STUDY OF AVIAN BIODIVERSITY IN SHORT ROTATION
INTENSIVE CULTURE WILLOW PLOTS

INTERIM REPORT SEPTEMBER 1998

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Abstract: Birds were censused in fifteen SRIC-plots located in six sites in NY State July through September 1998. These plots were planted with willow clones one to three growing seasons old. Different clones or groups of clones were planted in each plot. A total of forty-eight bird species were censused. We found 80 nests of 7 different species.

In this first interim report we present preliminary results on the avian biodiversity in the 1998 season. We list the bird species observed per plot and per willow age class. We also provide information on nests found. In subsequent reports we will quantify these results in more detail and specifically address the questions that this study was designed to answer.

Area of study and methods

This study was conducted in fifteen plots located in the following sites in NY State: King Ferry, Tully, Lafayette, Canastota, Leon, and Sheridan. Table 1 summarizes available information for each plot, including site, field, area, planting date, age of plants, and number of different clones. Tully – Area 4 was planted in 1987 and harvested annually from 1987 to 1992 and again in March 1996. Its 300 clones includes many hybrids. Sheridan, in the western NY is the largest site with 67 acres subdivided in four plots. In the Western Field in Sheridan the planting was not completed. This year there were still only a small number of plots in which willows were in their second or third growth season.

Table 1. Plots studied

Site	Field	Area (ac)	Planting Date	Age (years)	# Clones
King Ferry	Barn Site	5.5	1996	2	8
	Weather St.	3.7	1996	2	7
	Site Trial	2.7	1995	3	14
Tully	Area 4	0.1	1987	2	300
	Area 12	2.7	1995	3	8
Lafayette	Lafayette Rd.	7.0	1997	1	5
	Upper Field	2.0	1998	1	6
	Lower Field	2.0	1998	1	3
Canastota	Canastota	20.0	1998	1	7
Leon	Western Field	17.0	1998	1	2
	Field by Gas Well	16.0	1998	1	5
Sheridan	Smith	67	1998	1	5
	A. Hopkins		1998	1	4
	Western Field		1998	1	1
	Eastern Field		1998	1	4
age 1 – all	10 sites	131			
age 2 – all	3 sites	9.3			
age 3 – all	2 sites	5.4			

Visits only started in July 1998 because funding was not available earlier. We continued until late September, because we found that migrants also forage in the willow plantations. In fact, willow plantations might become an important resource during stopovers of migratory birds in the fall.

Each plot in King Ferry, Tully, and Lafayette was visited six times at intervals of at least one week. Because of the very small size of the plots in Canastota, Sheridan, and Leon, only two visits were made to each plot in these three areas.

We used spot-mapping techniques to census birds during each visit (Robbins et al. 1970 and Bibby et al. 1992). Different techniques were used depending on the age of the plot. For first year plots, we walked transects through the plots, mapping the locations of each bird that was seen or heard in or near the plot. For the second and third-year plots, we walked the perimeter of the plot mapping any birds detected and afterwards we walked transects through the plot. This procedure was adopted to minimize as much as possible disturbances due to walking through dense and tall vegetation.

The species detected in or near plots were divided into three categories: breeding species, visitors to the plot, and neighbors or potential visitors. For all birds species listed as *Breeding* nests were found. *Visitors* are species actually seen or heard inside the plot but not meeting the previous definition. Among the *Visitors* we have two groups: territorial birds, that are possible breeders, and transients, that use the plots for feeding, but were only observed after the breeding season was over. In a later analysis of the data we will try to quantify the number of territories of each species and estimate density. *Neighbors* are species that are detected near, or flying over, the plot and not previously listed.

Each nest found was identified to species and recorded on field maps. We believe that because we walked through the plots repeatedly, and because the plots were relatively small that we found most of the nests built above the ground.

Results

We present our observations of the bird species grouped by the age of the willows growing in each plot (Tables 2-4). Results on nests found are presented both by plot (Table 5) and by clone (Table 6).

First Willow Growth Season. (Table 2).

The only species found breeding in the willows in their first growing season was the American Goldfinch. Although it might be surprising that such a species would nest during the first growing season, this can be understood by the fact that goldfinches only start breeding very late, and that by that time the fast growing willows had reached a sufficient size for goldfinches to nest in. Furthermore the NM6 clone, in which this nest was found, grows very rapidly. Killdeer are probable breeders earlier in the season, but the observations only started after their breeding season was over. 10 species were observed as Visitors, and another 27 species were recorded as Neighbors.

Second and Third Willow Growth Season (Tables 3 and 4)

Nests of seven species were found in the 2nd and 3rd growth seasons. These seven species are therefore confirmed breeders. An additional 11 species were recorded as Visitors in second-year plots, but only six in third year plots. A further 3 species, all warblers, were observed as Transient Visitors. 32 species were recorded as Neighbors around second-year plots, and 26 around third-year plots.

Nesting (Table 5)

Details about the numbers of nests per plot are given in Table 5. With the exception of one American Goldfinch nest found in Lafayette Road, all nests were in 2- or 3-year old willows. Nests of seven species, including American Goldfinch, American Robin, Cedar Waxwing, Gray Catbird, Red-winged Blackbird, Willow Flycatcher, and Yellow Warbler were found in both second and third year plots.

Although the sample size is small, the data suggest that the density of nests is higher in 3rd-growing season plots (7.4 nests per acre) than in 2nd season plot (4.2 nests per acre)

The American Goldfinch nest found in the first year plot was in an NM6 clone (planted in 1997) at Lafayette. NM6 in this particular plot is the tallest plant, and probably the only one for which the branching patterns could provide nesting site. Birds as Gray Catbird, American Robin and Red-winged Blackbird used NM6 for nesting.

American Goldfinch nests were found in 11 different clones. Most of the nests of the other species listed above were found in clone S365 (no American Robin or Gray Catbird), and in clone SV1 (no Willow Flycatcher or Yellow Warbler). SV1 is a very wide spread clone.

Our visits were too late in the season to catch early nest birds.

Conclusions

The results for the 1998 breeding season produced results roughly similar to these obtained in similar habitat in 1997, although many more nests were found in 1998. None of the species found breeding were unexpected. One surprising result, however, was that no brown-headed cowbirds were observed.

This preliminary analysis of the 1998 breeding season shows that in the willow plantations nest density, and hence presumably breeding density, increases with the age of the willows. In their 3rd growth season the nest density of 18.5 nests per hectare are comparable to those expected in riparian habitats. More data will be needed to determine to what extent plot size has an effect on bird density.

References

Bibby, C.J., N.D. Burgess, and D.A. Hill. 1992. Bird census techniques. Academic Press, San Diego, California.

Robbins, C.S., and International Bird Census Committee. 1970. Recommendations for an international standard for a mapping method in bird census work. Audubon. Field Notes 24:723-726.

Table 2. Bird species observed in plots in their 1st year of growth. Visitors marked with an asterisk are "transient" visitors.

Breeding	Visitors	Neighbors
American Goldfinch	American Robin	American Crow
	Barn Swallow*	American Kestrel
	Chipping Sparrow	Black-capped Chickadee
	Common Yellowthroat	Blue Jay
	House Finch	Bobolink
	Killdeer	Cedar Waxwing
	Mourning Dove	Common Grackle
	Savannah Sparrow	Downy Woodpecker
	Song Sparrow	Eastern Wood-Pewee
	Wild Turkey	European Starling
		Field Sparrow
		Gray Catbird
		House Wren
		Indigo Bunting
		Northern Cardinal
		Northern Flicker
		Pileated Woodpecker
		Red-eyed Vireo
		Red-tailed Hawk
		Red-winged Blackbird
		Ring-billed Gull
		Ruby-throated Hummingbird
		Scarlet Tanager
		Sharp-shinned Hawk
		Tree Swallow
		Turkey Vulture
		White breasted Nuthatch

Table 3. Bird species observed in plots in their 2nd year of growth. Visitors marked with an asterisk are "transient" visitors.

Breeding	Visitors	Neighbors
American Goldfinch	American Redstart *	American Crow
American Robin	Baltimore Oriole	American Kestrel
Cedar Waxwing	Black-capped Chickadee	Barn Swallow
Gray Catbird	Blue-winged Warbler*	Blue Jay
Red-winged Blackbird	Chipping Sparrow	Bobolink
Willow Flycatcher	Common Yellowthroat	Canada Goose
Yellow Warbler	Eastern Phoebe	Chimney Swift
	Indigo Bunting	Common Grackle
	Mourning Dove	Coopers Hawk
	Northern Flicker	Downy Woodpecker
	Palm Warbler*	Eastern Wood-Pewee
	Red-eyed Vireo	European Starling
	Song Sparrow	Field Sparrow
	Yellow-rumped Warbler	Herring Gull
		House Wren
		Killdeer
		Northern Cardinal
		Northern Flicker
		Pileated Woodpecker
		Purple Martin
		Red-bellied Woodpecker
		Red-tailed Hawk
		Ring-billed Gull
		Rock Dove
		Rose-breasted Grosbeak
		Sandpiper spp.
		Savanna Sparrow
		Scarlet Tanager
		Tree Swallow
		Turkey Vulture
		Warbling Vireo
		Wood Thrush

Table 4. Bird species observed in plots in their 3rd year of growth

Breeding	Visitors	Neighbors
American Goldfinch	Chipping Sparrow	American Crow
American Robin	Eastern Phoebe	American Kestrel
Cedar Waxwing	Eastern Wood-Pewee	Barn Swallow
Gray Catbird	Indigo Bunting	Blue Jay
Red-winged Blackbird	Red-eyed Vireo	Bobolink
Willow Flycatcher	Song Sparrow	Canada Goose
Yellow Warbler		Chimney Swift
		Common Grackle
		Downy Woodpecker
		European Starling
		Field Sparrow
		Herring Gull
		House Wren
		Killdeer
		Northern Flicker
		Purple Martin
		Red-bellied Woodpecker
		Red-tailed Hawk
		Ring-billed Gull
		Rock Dove
		Rose-breasted Grosbeak
		Sandpiper spp.
		Savannah Sparrow
		Turkey Vulture
		Warbling Vireo
		Wood Thrush

Table 5. Number of nests by plot.

<i>Plot</i>	Lafayette rd	Barn Site	Weather Station	Area 4	Site Trial	Area 12	Total
<i>Willow growth season</i>	1 st	2 nd	2 nd	2 nd	3 rd	3 rd	
<i>Plot size (ac)</i>	7.0	5.5	3.7	0.1	2.7	2.7	
<i>Bird Species</i>							
American Goldfinch	1	5	5		12	2	25
American Robin		3	1		1	7	12
Cedar Waxwing		9	1	3	2	1	16
Gray Catbird		2	1		1	3	7
Red winged Blackbird			1		5		6
Willow Flycatcher		5	2		4	1	12
Yellow Warbler			1		1		2
Total	1	24	12	3	26	14	80
<i>Nests/ac</i>	<i>0.14</i>	<i>4.4</i>	<i>3.2</i>		<i>9.6</i>	<i>5.4</i>	

Table 6. Clones in which nests were found, (all plots).

	S646	S185	SH3	S546	S365	SV1	SA2	S25	S301	S287	S19	S566	NM6
American Goldfinch	*		*	*	*	*	*	*	*		*	*	*
American Robin		*				*		*	*				
Cedar Waxwing		*			*	*							*
Gray Catbird						*		*					*
Red winged Blackbird					*	*				*			*
Willow Flycatcher		*	*		*		*					*	
Yellow Warbler		*			*					*			