Date: September 21, 1992

INTERAGENCY RIPARIAN/WETLAND PLANT DEVELOPMENT PROJECT

Fourth Quarter FY 1992 Progress Report

PROJECT STAFF

J. Chris Hoag, Wetland Plant Ecologist
Mike Sellers, Wetland Biological Technician
Mike Zierke, Riparian Biological Technician

INTRODUCTION

Degradation of wetlands is widespread over the United States. Numerous opportunities for the restoration, revegetation, improvement, and creation of wetlands exist nationwide. However, availability of wetland plants or seed on a commercial basis is extremely limited. Selected ecotypes of wetland plants with proven performance traits for establishment and production are not available. Cultural techniques for the commercial production of certain species of wetland plants are neither documented nor clearly understood. Methods and procedures to construct and create wetlands to use as nutrient and sediment treatment systems are not fully understood or tested. In response to these needs, the Interagency Riparian/Wetland Plant Development Project was created and funding was sought from state and federal agencies who have identified similar requirements in their own operations.

Wetlands perform several functions important to plant and animal life.

1) Wetlands are significant in food chain production, general habitat, and nesting, spawning, rearing, and resting sites for aquatic and land species.

2) Their destruction or alteration detrimentally affects natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, and water current patterns.

3) They also serve as shields for other adjacent areas that could be damaged by wave action, erosion or storms.

4) They serve as valuable storage areas for storm and flood waters.

5) Wetlands are prime natural recharge areas where surface and ground water are directly interconnected.

6) Wetlands serve as water quality improvement sites that use natural purification functions to remove a variety of chemicals, heavy metals, agricultural products, and other contaminants.

OBJECTIVES OF THE PROJECT

The objectives of the Interagency Riparian/Wetland Plant Development Project are seven-fold.

1) Assemble, collect, evaluate, and select performance tested ecotypes of the following species for commercial production; to provide plant materials for advanced testing and for commercial growers.

Nebraska Sedge, *Carex nebrascensis* (CANE2)
Creeping Spikerush, *Eleocharis palustris* (ELPA3)
Baltic Rush, *Juncus balticus* (JUBA)
Threesquare Bulrush, *Scirpus pungens* (SCPU3)
Alkali Bulrush, *Scirpus maritimus* (SCMA)
Hardstem Bulrush, *Scirpus acutus* (SCAC)
Water Smartweed, *Polygonum amphibium* (POAM8)

2) Develop design criteria for establishing and maintaining native riparian/wetland plant communities.

3) Develop design criteria for establishing and maintaining wetland plants to maximize their performance in constructed wetlands for water quality improvement.

4) Develop and manage a riparian/wetland plant attribute database.

5) Coordinate input into riparian/wetland restoration/development training courses.

6) Coordinate preparation of videos, slide shows, publications, and other means of information exchange.

7) Develop demonstration sites to show plant materials and techniques for the establishment of constructed wetlands.

SEED COLLECTIONS

Seed of the selected wetland species were collected from August through September, 1991 by several collectors who traveled throughout the Aberdeen Plant Materials Center Service Area. This includes southern Idaho, Utah, Nevada, northeastern California, and eastern Oregon (see Appendix A). In all, 106 individual collections were made. The seeds were sent to the Aberdeen PMC, for cleaning and the assignment of an accession number. (See Appendix A for a list of collections and their locations.)

Of the 106 collections made, 2 collections were of the wrong species, 4 collections had no viable seed after cleaning, and 6 collections arrived late and were not cleaned in 1991 (Table 1).

Wetland plant seed was collected according to directions laid out in advance. Collectors generally concentrated their collection efforts on National Wildlife Refuges and Wildlife Management Areas. At each collection location, the owner, manager, or person-in-charge was contacted to obtain permission for the seed collection. This not only informed them of the existence of the Project, but it also provided continuity for the Wetland Plant Ecologist as additional collections needed to be made from the same areas.

Table 1: Number of accessions by species that were collected, grown in the greenhouse, and transplanted out. Live plant collections did not necessarily match greenhouse transplanted

accessions because we did anticipate germination problems and we wanted to look at seed propagated plants verses clonally propagated plants.

Species	Total Acc. Collected	Acc. Planted in Greenhouse*	Transplanted Out**	Live Collections
CANE2	18	18	14	18
ELPA3	16	14	11	14
SCAC	23	22	22	23
SCMA	12	8	8	8
SCVA	1	0	0	0
SCPU3	11	11	8	11
POLYG4	6	6	6	8
JUBA	19	14	14	14
	106	93	84	96

* Some Accessions did not have any viable seed after cleaning. Some accessions arrived too late to be cleaned in time for planting.
** Number of accessions that had at least 20 individual plants survive in the greenhouse as of the transplanting date.

When collecting, the collector was instructed to collect from a dense stand with few other stray species and to pick the best population within the collection area. When harvesting, the collector had to determine the best method for each species since little is known about wetland seed collection techniques. Goal amounts of viable seed were set for each species. When harvesting, the collector had to determine how much bulk material to collect to reach the goal. Collection notes have provided us with an indication of bulk material collection needs for each species and time required for the collection. Each species also has a time period when the seed is ready to collect. Additional notes were made when unusual situations were encountered.

Some pertinent notes taken during the collections include:

Juncus balticus - A dense stand can be mowed to obtain enough seed, but the stems must be kept up right so that the seed doesn't fall out. This species is ranked first in time period for collecting. Shattering date will be affected by elevation. At 2000-3000 ft. elevation, the plants had shattered by the beginning of August.

Scirpus acutus - Less than half an hour is required to make a decent collection. Ranked second in collection priority. Collections are affected by water depth.

Polygonum species- Easiest to collect, but hardest to find. Collectors experienced significant confusion over this species and other perennial or annual species. Most of the collections made were of other species (yet to be firmly identified). Since these species are a favorite of waterfowl, it is ranked third.

Scirpus pungens - A good collection can be made in a short amount of time from a dense stand, using hand clippers. Ranked fourth in collection priority. Collect before September.

Scirpus maritimus - Since the inflorescences are large, a collection can be made quickly with hand clippers. Ranked fifth in collection priority. Plants begin to shatter at the end of September.

Eleocharis palustris - A dense stand can be mowed to obtain seed. If lodged, the stand can be lifted up to remove the seed head, which is held tight. Ranked sixth in collection priority because it lodges and holds the seed tight.

Carex nebrascensis - Fifteen to twenty individuals usually provides enough seed for 1/4 cup of seed. Ranked last in collection priority, it usually has not shattered by the end of September. Grazing can be a problem because it is very palatable.

LIVE PLANT COLLECTIONS

Germination problems have been reported in the literature for *Scirpus pungens*, *Eleocharis palustris*, *Scirpus acutus*, and *Scirpus maritimus*. Consequently, live plant collections of these species specifically needed to be made if we hoped to study them at all. We also wanted to make live plant collections from the same areas as the seed collections so we could study seed propagated plants versus clone propagated plants. Even though no seed was collected from wetland plant populations near the Aberdeen PMC, live plant collections were made from 6 populations because of their close proximity to the PMC. The live plant collection plan was based on obtaining 20 individual plants for each accession.

Transportation of the plants to the Constructed Wetland Ponds at Aberdeen was a major consideration because of the long distances and hot summer temperatures involved. Based on past experiences with various other species of plants (since no information was found in the literature), it was determined that the plants should be transported in a truck with a camper shell to keep the wind off the plants. The target temperature for the plants in the bed was under 24°C (75°F). Sliding windows between the cab and the covered bed were installed to allow the truck air conditioning unit to cool the bed. For additional cooling, the plants were transported in styrofoam coolers. Enough water was added to the coolers to cover the root system. In addition, a small amount of ice was added to the coolers on particularly hot days. During the days, the cooler lids were kept on and ice was added. During the night, the cooler lids were removed to allow the plants to "breathe" and cool down. On the average, the temperature in the coolers ranged between 18.5°- 26.3°C (65°-79°F) even when the outside temperature was 40.3°- 41.4°C (104°-106°F).

It has been reported in the literature that if no more than 1 square foot of plant material is removed from a 3-4 square foot area, the plants will grow back into the hole in one good growing season. So, based on this information, a total of 3 to 4 square feet of plant material, sufficient to give us 20 individual plants with some left over for border rows, was collected from each site. The plants were dug down about 15 cm which was normally below the root mass. Then they were carried to the truck and processed for transportation.

Based on information from our greenhouse experience and literature reviews, two different methods of handling the green stems of the plants were tried. First, the tops were cut off according to the procedures listed below for the different species:

JUBA, CANE2, SCPU3, SCMA, ELPA3 - tops were cut to 6 inches.

SCAC - Cut to 10 inches to prevent the tops from being submerged when transplanted to the ponds at the PMC.

POLYG4 - Based on our experience from the greenhouse with cutting, it was decided not to clip the live collections.

Second, cutting the tops was tested. To test these two procedures, both uncut and cut plants were collected from sites close to the PMC. The uncut plants were placed in border rows adjacent to

test plants that were cut and monitored their establishment. It was quickly apparent that uncut plants tended to take longer to get established, so the tops were cut in all subsequent collections.

The live plant collections were planted on the day following our return to the PMC. This was customarily Friday since the collection trip usually took 4 days. The main emphasis was on planting the collected plants as soon as possible. One square foot samples were taken and split with a shovel into as many individual plants as possible. Generally, the smaller plugs were 6 x 6 cm with healthy rhizomes and tops. Any weeds in the plugs are removed by hand. Every effort was made to keep the soil on the roots. We did look at washing the soil off the roots before planting the plugs. The theory was that washing the soil off the roots would reduce the risk of noxious weed infestation. However, this procedure proved to be too time consuming and actually seemed to stress the plants which in turn increased the establishment time. It was decided to keep the soil on the roots to decrease this stress. We also felt that the natural wetland soil could provide much needed microbial activities that would normally not occur on non-wetland, non-organic mineral soil used to construct wetlands on normal farm ground.

A collection form was filled out for every live collection, giving specifics such as temperature, area description, species condition, plants in association and any other information that would help in future collections.

The 20 individuals of each accession was planted out in a replicated Random Complete Block design of 5 groups of 4 individuals each. All of the accessions for each different species are randomized and planted in a block set aside for each species. The species were not mixed together in the randomization process nor in the planting process because of the lack of information on the effects of root competition between species.

Based on the size of the constructed wetland ponds which were approximately 18 X 21 meters (60 X 70 ft) and the number of accessions for each species, it was determined that the spacing would be 46 cm (18 inches). Additional studies will be done on other spacing distances in the future, but the 46 cm distance will serve as baseline data.

In order to get a consistent 46 cm spacing, the 4 plants in each group were planted in a square we call a "quad". Each quad is 46 cm from its neighbor. Border rows of the same species were planted between each species block so that potential root competition would not negatively affect the test quads. Border rows were also planted around the outside of each block so all of the test plants would be subject to competition on all sides to prevent the "edge effect".

The 7 test species were split up into 2 different water regime:

1) Moist Group-- *Carex nebrascensis* (CANE2), *Eleocharis palustris* (ELPA3), and *Juncus balticus* (JUBA)

2) Standing Water Group-- *Scirpus pungens* (SCPU3), *Scirpus maritimus* (SCMA), *Scirpus acutus* (SCAC), *and Polygonum sp.* (POLYG4).

These groups were based on the water requirements for each plant that one would expect in a "natural" situation. Two ponds lined with a 22 mil impervious liner to prevent water leakage were dedicated to each group, one pond for seed collected-greenhouse grown plants and one pond for live plant collections. The *Polygonum* plants were planted around the edge of the Standing Water ponds so they would be in a more typical (for them) fluctuating water level regime.

EVALUATIONS

All plants are evaluated and the resulting data analyzed with the statistical program MSTATC. The traits being evaluated, have been selected to determine the most vigorous plants that are best adapted to our five state service area. Each accession is evaluated independently of the other accessions. When evaluating a quad, the data is averaged from all four plants. Height is measured in centimeters. Width is also measured in centimeters, but is a two dimensional figure, such as 5cm X 5cm. New shoots originating from the parent plant are measured two ways, the maximum distance from the parent plant and the height of the new shoot, both measured in centimeters. Emergence of seed heads was noted. Until more than 10 seed heads are present on a plant, the number of seed heads will be counted. After the plant has more than 10 seed heads, a subjective scale of 1-9, 1-being the best and 9-the worst will be used. The following traits are also rated with the 1-9 scale:

Vigor - Evaluated based on color with limited or no browning, number of new shoots and growth of cut culms, and overall appearance of the plant. A very subjective trait.

Erect - upright appearance, no lodging.

Seed - number of seed heads present, seed production.

Green - dark green color with no browning or yellowing of culms.

Misc. - observation notes.

GREENHOUSE STRATIFICATION AND GERMINATION STUDIES

Tanks

Eight propagation tanks were constructed for the purpose of propagating wetland plants many of which require standing water. The tanks are of steel construction 4 feet by 8 feet by 1 foot deep. These tanks were designed to hold Rootrainers book planters. Each book planter has 4 cells which are 1.5 inches by 1.75 inches by 8 inches deep. Each tank has a total capacity of 920 individual cells. Each cell is filled with 1 part sand, 1 part vermiculite, 1 part peat, and .1 part time-release fertilizer. Water can be added to the tanks with a regular garden hose up to a depth of 4 inches above the top of the cells. Draining capabilities for the tanks are provided by means of a removable plug at one end of the tank.

Stratification

One priority of this wetland project is to determine stratification methods which will result in successful seed germination. A literature search was made to find any reported stratification techniques. This search found reports on three stratification variables for *Scirpus acutus*, *Scirpus maritimus*, *Scirpus pungens*, *Eleocharis palustris*, and *Polygonum species*. These variables were: cold temperature versus alternating temperature conditions, a wet versus a moist stratification environment, and composition of water found in a natural wetland environment. For *Carex nebrascensis* and *Juncus balticus*, it showed few studies on stratification, but did report good germination with light and warm temperatures. Therefore, *Carex nebrascensis* and *Juncus balticus* seeds were not stratified.

For *Scirpus acutus*, *Scirpus maritimus*, *Scirpus pungens*, *Eleocharis palustris*, and *Polygonum species*, the cold temperature versus alternating temperature conditions were tested by one set of samples being placed at 3°C and maintained for the duration of stratification, and another set of samples placed on a four week rotating period of 3°C and 37°C for the alternating temperature condition.

The wet environment was obtained by placing seeds in a 4 ounce white plastic cup and adding sufficient water to completely cover seeds. The moist environment was obtained by placing soil mixture of 2 parts sand, 2 parts vermiculite, and 1 part peat into the bottom 1/3 of the cup and covering the top of the soil with an absorbant paper. The seeds were then placed on top of the paper material and sufficient water added to the cup so as to saturate the soil mixture.

Two sources of water with drastically different chemical compositions were tested. Distilled water was used for one source and pond water from a wetland area in the Aberdeen area was used for the second source. The pond water samples were collected with a 1 liter bottle in shallow water with the sediment disturbed to obtain maximum amount of natural water and sediment contents.

These three variables were combined to produce eight total stratification trials per each accession. For example, each accession had:

1 cup with seeds in a cold, wet, distilled water
1 cup for alternating temperature, wet, distilled water
1 cup for cold, moist, distilled water
1 cup for alternating temperature, moist, distilled water
1 cup for cold, wet, pond water
1 cup for alternating temperature, wet, pond water
1 cup for cold, moist, pond water
1 cup for alternating temperature, moist, pond water

After our experiences with these tests, we have concluded that more studies need to be made on different stratification conditions. One additional trial would be to follow our original alternating temperature regimes with immediate transplanting of the seed into the propagation tanks. This would negate the problems we encountered with germination in the cups.

Another test that would be beneficial would be to monitor the temperature within the closed cups. A thermistor and Ohm meter would be used to monitor the temperatures within the closed cups while in the cool and warm stratification. This would allow better adjustments in our germination environment.

Germination

From our research into the literature and conversations with other scientists, we did not expect immediate noticeable results from the different stratification methods for *Scirpus acutus*, *Scirpus maritimus*, *Scirpus pungens*, *Eleocharis palustris*, and *Polygonum species*. Our estimate was that it would take at least 2 cycles in the alternating temperatures test before we would get more than a few seeds germinating. However, rapid germination occurred almost immediately after removing the cups from the cooler to the warm temperatures in the greenhouse (30°C to 37°C). We were not prepared for this flush of seeds so they were not transferred from the cups as fast as they should have been and extensive germination occurred in the cups. Success in germination varied greatly among the different accessions of each species. *Scirpus acutus* and *Scirpus pungens* germinated better in the moist stratification than in the wet. *Polygonum species* did not germinate in the wet conditions, but as soon as they were planted in the moist soil, they germinated extensively. We found no significant difference between the wet and moist conditions with *Scirpus maritimus*. However, plants that were stratified in moist conditions established and grew more rapidly once they were planted. *Eleocharis palustris* seeds had a high percent germination under wet conditions, but many seeds seemed to die off rapidly once they were transplanted. (See Appendix B for germination percentages under wet and moist conditions by accession.)

As seeds for all the species germinated, they were transplanted to the cells in the propagation tanks. Transplanting the germinated seeds took from 2 to 5 days, depending upon the number of accessions in a species. To insure a strong viable plant, 20-25 seeds were planted in each cell.

For *Carex nebrascensis* and *Juncus balticus*, the seeds of each accession were soaked in tap water for 48 hours before planting. They were then placed directly on the soil surface of the book planters. The seeds were left uncovered so grow-lights would directly illuminate the seeds. The water level was maintained at 6 inches which was enough to allow the soil surface to be moist throughout the growing period.

Table 2: The number of weeks in stratification, the number of days before initial emergence of the cotyledon, and the estimated percent germination for both the wet and moist stratification media by species of the wetland plants tested in the greenhouse.

SPECIES	WEEKS IN STRAT.	DAYS BEFORE GERM	AVE WET GERM	AVE MOIST GERM	AVERAGE GERM
CANE2	0	8	n/a	n/a	32%
JUBA	0	7	n/a	n/a	89%
ELPA3	4	2	73%+/-*	69%+/-*	71%
SCAC	4	2	71%+/-*	76%+/-*	74%
SCMA	4	5	71%+/-*	71%+/-*	71%
SCPU3	4	7	65%+/-*	67%+/-*	66%
POLYG4	4	1	94%+/-*	94%+/-*	94%

* Percent germination is estimated at less than 100% even though there were no seeds left in the cups. Some seeds that had not germinated were transplanted with the germinated seeds and it is unknown if they germinated.

Under the current conditions stratification, germination, and a one to three week initial growing period occurred within the cups. The germination data indicates that the moist soil stratification, germination and growing conditions provide more successful results then the wet conditions for the Scirpus acutus and Scirpus pungens species. The Polygonum species seeds did not germinate in the wet condition but once transferred to moist conditions they germinated as successfully as the seeds which were stratified in moist conditions. The Scirpus maritimus experienced an average equal germination between wet and moist conditions, but the plants which were in the moist conditions established and grew more rapidly in the propagation tanks. The Eleocharis palustris seeds in the wet conditions had a higher percentage of germination, but some of these germinated seeds did not survive the transplanting into the propagation tanks.

Greenhouse Temperature and Lighting

From February to March, we tried to keep the temperature in the greenhouse at about 24°C. For February and most of March the average daily low and high in the greenhouse was 22°C to 26°C. On March 19, the cooling fan broke. This caused the greenhouse temperatures to soar to over 38°C. It took 2 days for the fan to be fixed. We were very worried about the plants and were constantly monitoring their condition. As a result of this continuous monitoring, we noted that the seeds and plants responded to the high temperature with increased germination and growth. From that time on, we tried to keep the greenhouse temperatures between 30°C and 37°C. During the summer months when the greenhouse boilers were turned off, the temperatures occasionally reached 40°C (in August) and occasionally dropped to 20°C (in September).

Our greenhouse is equipped with mercury vapor lights over each tank. These lights are on 24 hours a day, every day.

Algae Growth in Greenhouse Tan

From the start of our greenhouse work, we were concerned about the build up of algae in the water and fungus on the soil surface of the propagation tanks. The algae grew and spread quite rapidly because of the standing water, warm temperatures, and constant light. The fungus is constantly growing when moist soil surface conditions are present.

To control the algae, we considered several options from a small aquarium circulation pump for recycling the water in the tanks to constantly cycling in new water. However, we found that by draining the tanks biweekly, we could keep the water relatively clean. As the plants matured, they used the water fast enough so that the algae in the water was not a problem.

The fungus on the soil surface was not a problem after the seeds had germinated and reached the 2 leaf stage. Before this time, it could spread over the entire cell surface and prevent the seeds from germinating and growing. We found that by draining the tanks biweekly and leaving them for 1 to 2 days without water, the soil surface would dry out just enough to slow the fungus spread, but not enough to cause the seeds to die off.

Greenhouse Plant Trimming

Carex nebrascensis and *Juncus balticus* were trimmed when they became tall enough to begin falling over or when they came close to reaching the overhead lights. Initially, an average 23 cm were cut off all the plants of both species which made them 20 cm tall. One month later, the *Carex nebrascensis* plants had grown back to an average height of 146 cm. This time, they were cut down to 15 cm because they had responded so well to the first cutting, we felt that cutting them lower would not hurt them and would save on the number of times they would need to be cut (the same reasoning applies to the Juncus trimming). The *Carex nebrascensis* were not trimmed again before they were transplanted into the ponds. The *Juncus balticus*, however, grew to an average height of 43 cm in 1.5 weeks. It was trimmed to 15 cm. Approximately, 3 weeks later they had regrown to about 54 cm. They were trimmed again to 10 cm. They were then transplanted into the ponds. Over the course of the greenhouse growing period, the best accessions of *Carex nebrascensis* had grown an average of 180 cm and the best accessions of *Juncus balticus* had grown to an average of 115 cm.

The *Polygonum species* were also trimmed because the rapid growth rate allowed older plants to overshadow the younger plants which germinated later. They were trimmed down to 12.7 cm. Growth was so rapid and massive that no accurate measurement of the amount removed was possible. A major problem was identified after the plants were trimmed. It took 4 days for the plants to start greening up again. It took significantly longer for the plants to resume the same speed of growth they had prior to cutting. We concluded that trimming the *Polygonum species* was detrimental to their rapid and healthy establishment.

Greenhouse Insect Control

One significant greenhouse problem was an insect infestation. Many types of insects, spiders, and caterpillars were found on and around the plants, but they caused no significant damage. However, at the end of July, we noticed a large swarm of Aphids on the wetland plants. *Eleocharis palustris* and *Juncus balticus* were hit particularly hard by *Rhopalosiphum cerasifoliae*, an aphid that is commonly found on Chokecherry bushes (*Prunus virginiana*). After discussions with the University Of Idaho Entomologist, the plants were sprayed with Lorsban. Effective control of the aphids was achieved the next day. Both plant species recovered, but it took several weeks.

Nutrient Supplementation

Other than the time release fertilizer that was included in the soil mixture, no additional fertilizer was added to the plants. As part of our greenhouse procedures, we constantly monitored the plants for disease and nutrient problems.

In our previous greenhouse work on other species, we experienced problems with iron chlorosis because of the very high Ph of our greenhouse water. We originally felt that because the wetland plant species we were working with naturally grew in high Ph conditions that we would not have a problem with iron chlorosis in the greenhouse. However, through our monitoring procedures, we did identify an iron deficiency problem. *Juncus balticus* and especially *Carex nebrascensis* started to exhibit chlorotic symptoms in the 2-3 leaf stage. Those accessions that exhibited symptoms were supplemented with iron chelate. The iron chelate was applied over top of the plants as frequently as it appeared necessary.

SPECIAL TESTS

Scirpus acutus Submersion Test

A common wetland management technique for controlling *Scirpus acutus* is to cut the stems and totally submerge them. This has been reported as a good method of killing the plants. Since we are transporting live plants for long distances, we needed to cut the stems off so the transplanting would be less stressful on the plants. In addition, the coolers we were transporting the plants in are only 8 inches tall. We were concerned that if we cut the plants too short and maintained the water level in the ponds at 6 inches to 1 foot, we might kill off the transplants. So, we initiated a study to find out how total submergence of the cut stems would affect *Scirpus acutus*.

Three samples of *Scirpus acutus* were obtained from a healthy stand of the species. Sample #1 was trimmed to 4 inches above the soil surface. Sample #2 was trimmed to 4 inches on 1/2 of the stems and 8 inches on the other 1/2. Sample #3 was trimmed to 4 inches. Each sample was placed in a five gallon bucket and water was added to specific levels. Sample #1 was maintained at a water level of 6 inches (2 inches above the cut stems). Sample #2 was maintained at a water level of 6 inches so that half of the cut stems were submerged and the other half were above the water level. Sample #3 was maintained at a water level of 2 to 3 inches so that none of the cut stems are submerged.

Samples #2 and #3 produced visible new growth within 6 to 8 days, respectively. New growth has continued to increase. Sample #3 has consistently had 30% to 50% more new growth stems than sample #2. Sample #1 produced visible new growth after 27 days. After 45 days, sample #1 had four stems of visible new growth, sample #2 had eleven stems of visible new growth, and sample #3 had twenty stems of visible new growth. Tentative conclusion would be that submerging the cut stems will not kill the plants, but it will definitely slow their reestablishment.

CONSTRUCTED WETLAND PONDS

In the winter of 1991, 11 wetland ponds were constructed on the Aberdeen PMC Home Farm. Out of the 11 ponds, 6 were lined with an impervious layer of plastic and the other 5 were left unlined. The ponds are watered with irrigation water purchased from the Aberdeen/Springfield Canal Company. The water is delivered from the Home Farm headgate on the High Line Canal through part of the farm's gated pipe system down to a buried pipe that feeds risers located in each pond. These ponds are approximately 18 X 21 meters (60 X 70 feet). They were built to hold at least 35 cm of water (1 foot).

Plants that were grown in the greenhouse from seed were planted in 2 lined ponds. Plants that were collected in the live plant collection phase of the project were planted in 2 adjacent lined ponds. Each group is being evaluated separately. To this point in the project, 4 lined ponds are

being used. One more lined pond is scheduled for a spacing trial next spring. The unlined ponds will be used to test the wetland plants drought tolerance.

These ponds are meant to resemble constructed wetlands that a farmer might build in the Aberdeen PMC Service Area where the total annual precipitation is 6 to 12 inches. This area generally relies very heavily on irrigation for its crop production. Farmers might have to incorporate liners in their ponds if they are to hold water long enough for the plants to survive and grow.

NATURAL WETLAND AREAS FOR PLANT TESTING

On the Idaho Fish and Game land just east of the Aberdeen PMC Fish and Game Farm, we have installed water depth gauges to monitor the water level above and below the ground surface. This area will be the future location for wetland plant test site. The site will be used to test our wetland plants in a natural wetland area versus a constructed wetland site with no wetland soils. Plants that do not grow well in a constructed wetland pond, may perform very well in a natural wetland revegetation project and visa versa. Appendix C lists water depths measured over the course of the 1992 summer.

SUMMARY OF EVALUATIONS TO DATE

Evaluations have been made over the course of the summer after the plants were replanted into the ponds. Appendix D lists some of the outstanding accessions to the present date. Note that in Appendix, the best accessions from the greenhouse and the best accessions form the live plant collection are listed. In several instances, the same accession appears in both sections.

SUMMARY OF SPECIES ATTRIBUTES TO DATE

Data collections and observations of species in the ponds and in the greenhouse have been summarized in Appendix E. Examples of some of the information contained in Appendix E include:

- Cut stem performance
- Spread from Rhizomes
- Insect damage
- Growth performance in standing water or moist soil
- Difficulty of seed collection

GREENHOUSE INFORMATION SHEETS BY SPECIES

Literature search of greenhouse information for each species is listed in Appendix F. Greenhouse procedural notes are listed in chronological order by species in Appendix F.

APPENDIX A

INTERAGENCY RIPARIAN/WETLAND PLANT DEVELOPMENT PROJECT

WETLAND PLANT COLLECTIONS BY ACCESSION NUMBER AND LOCATION

Date 9/15/92

Acc. No.	Greenhouse No.	Species	State	Location	Legal descrip. SEC TWN RG	Date planted
9057598	8	CANE2	ID	Hagerman WMA	35 7S 13E	***no plants
9057599	2	CANE2	ID	Centennial Marsh WMA	11 2S 12E	8/18/92
9057605	18	CANE2	ID	Fairbr. rd.	16 17N 3E	no plants
9057606	6	CANE2	OR	Malheur NWR	29 26S 29E	8/6/92
9057612	7	CANE2	CA	Modoc NWR	19 42N 13E	7/23/92
9057619	11	CANE2	ID	Grays Lake NWR	17 5S 43E	7/2/92
9057623	13	CANE2	ID	Bear Lake NWR	22 14S 44E	7/15/92
9057627	15	CANE2	ID	Chesterfield Resv.		7/22/92
9067412	14	CANE2	UT	Lone peak nursery		8/6/92
9067406	8	CANE2	ID	F&G by our tubes	13 5S 31E	8/26/92
9067407	16	CANE2	ID	Johnson Segment	13 5S 31E	8/26/92
9057631	10	CANE2	NV	Kirch WMA		no plants
9057639	9	CANE2	NV	Rubylake NWR	18 27N 58E	8/14/92
9057647	3	CANE2	ID	Market Lake WMA	7 5N 37E	8/18/92
9057650	12	CANE2	UT	Willard Bay Park	22 8n 2w	7/30/92
9057592	17	CANE2	UT	Heiners Creek	25 4N 5E	8/6/92
9057652	1	CANE2	UT	G.Blackburn Ranch	25 4N 5E	I/6/92
9057655	16	CANE2	UT	G.Blackburn ranch	25 4N 5E	no plants
9067382	5	CANE2	NV	Trout Cr.OATS	34 46N 65E	8/5/92
9067371	4	CANE2	ID	Lower Salmon Dam	2 7S 13E	
9057581	6	ELPA3	ID	Squaw river	8 7N 1E	8/26/92
9057585	4	ELPA3	ID	Bruneau River	23 6S 5E	7/31/92
9057600	11	ELPA3	ID	Centennial Marsh WMA	11 2S 12E	8/18/92
9057601	9	ELPA3	ID	Ponderosa St. Park	34 19N 3E	8/27/92
9057604	3	ELPA3	ID	upper Cow Lake	27 28S 44E	8/6/92
9057607	12	ELPA3	OR	Malheur NWR	29 26S 29E	8/6/92
9067391	13	ELPA3	ID	Grays Lake NWR	19 3S 43E	7/2/92
9067386	7	ELPA3	ID	Sublett Reservoir		7/15/92
9067388	10	ELPA3	NV	Kirch WMA		8/14/92
9067387	1	ELPA3	NV	Ruby Lake NWR	18 27N 58E	8/14/92
9067389	8	ELPA3	ID	North Lake WMA	31 7N 35E	8/20/92
9067390	2	ELPA3	UT	Willard Bay Park	22 8N 2W	replaced
9057588	5	ELPA3	UT	D.Hinckley Ranch	19 1N 1W	8/6/92
9067385	14	ELPA3	NV	Trout Cr.OATS	34 46N 65E	8/5/92
9057595		ELPA3	UT	Deb Kawaguchi farm	6 4N 5E	wrong spp.
9067410	2	ELPA3	ID	Orth Segment	13 5S 31E	7/29/92
9057576		JUBA	ID	Quarry park, Boise	13 3N 2E	*no seed
9057580	13	JUBA	ID	Rosewell WMA	25 5N 6W	7/31/92
9057583	11	JUBA	ID	Bruneau River	23 6S 5E	7/31/92
9057602	1	JUBA	ID	N of Maki Ln.	10 17W 3E	8/27/92
9057603		JUBA	ID	upper Cow Lake	27 28S 44E	no seed
9057609	8	JUBA	OR	Malheur MWR	29 26S 29E	8/6/92
9057613	2	JUBA	CA	Modoc NWR	19 42N 13E	7/23/92
9057617	6	JUBA	ID	Minidoka NWR		7/15/92
9057621	7	JUBA	ID	BF. Reservior	31 4S 41E	7/15/92
9057626	9	JUBA	ID	Ft Hall Rerservation		7/22/92
9057630	3	JUBA	NV	Kirch WMA		8/14/92

Acc. No.	Greenhouse No.	Species	State	Location	Legal descrip. SEC TWN RG	Date planted
9057632	4	JUBA	NV	Stillwater NWR	17 19N 31E	8/14/92
9057641	10	JUBA	NV	Railroad Valley WMA		8/13/92
9067384		JUBA	UT	Willard Bay Park	22 8N 2w	no seed
9067383	5	JUBA	UT	Locomotive Springs WMA	2 11N 10W	7/30/92
9057589	14	JUBA	UT	D.Hinckley Ranch	19 1N 1W	8/6/92
9057591	15	JUBA	UT	Echo canyon	17 3N 5E	8/6/92
9067411	9	JUBA	ID	F&G by our tubes	13 5S 31E	8/26/92
9067370		JUBA	UT	G.Blackburn ranch	25 4N 5E	not clean
9057577	16	SCAC	ID	Fort Boise WMA	36 6N 6W	7/13/92
9057582	22	SCAC	ID	Bruneau River	14 6S 5E	7/31/92
9057597	6	SCAC	ID	Hagerman WMA	35 7S 13E	7/31/92
9057608	5	SCAC	OR	Malheur NWR	29 26S 29E	8/6/92
9057614	19	SCAC	CA	Modoc NWR	25 42N 12E	7/23/92
9057616	14	SCAC	ID	Minidoka NWR		7/15/92
9057620	7	SCAC	ID	Grays Lake NWR	8 5S 43E	7/2/92
9057622		SCAC	ID	Bear Lake NWR	8 14S 44E	+poor germ
9057625	2	SCAC	ID	Ft Hall Reservation		7/22/92
9057628		SCAC	UT	Bricknell Bottoms WMA		++replaced
9057629	21	SCAC	NV	Kirch WMA		8/14/92
9057634	1	SCAC	NV	Stillwater NWR	18 19N 31E	8/14/92
9057636	20	SCAC	NV	Weeks on Alt. Hwy.95		8/14/92
9057640	12	SCAC	NV	Ruby Lake NWR	18 27N 58E	8/14/92
9057643	3	SCAC	ID	Camas NWR	18 7N 36E	8/20/92
9057646	8	SCAC	ID	Market Lake WMA	7 5N 37E	8/18/92
9067394	4	SCAC	ID	Carey Lake WMA	23 15 21E	8/18/92
9067395	11	SCAC	UT	Bear River MBR	3 8N 4W	7/30/92
9067393	18	SCAC	UT	Ogden Bay WMA	10 5N 3W	7/30/92
9067396	10	SCAC	UT	Locomotive Springs WMA	2 11N 10W	7/30/92
9057587		SCAC	UT	D.Hinckley Ranch	19 1N 1W	not clean
9057651	9	SCAC	UT	Deb Kawaguchi farm	6 4N 5E	8/6/92
9067392	13	SCAC	UT	D.Hinckley ranch	1 1N 1W	8/6/92
9067413	15	SCAC	ID	Johnson Segment	13 5S 31E	8/26/92
9067409	17	SCAC	ID	Orth Segment	13 5S 31E	7/29/92
9067414	23	SCAC	ID	F&G by our tubes	13 5S 31E	8/26/92
9057578	10	SCPU3	ID	Fort Boise WMA	36 6N 6W	7/31/92
9057596	3	SCPU3	ID	Bruneau Dunes Park	13 6S 6E	7/13/92
9057610	9	SCPU3	OR	Malheur NWR	29 26S 29E	8/6/92
9057615	8	SCPU3	CA	Modoc NWR	19 42N 13E	7/23/92
9057635	2	SCPU3	NV	W. of Fallon		8/14/92
9057638	6	SCPU3	NV	Rosewood Lakes		8/14/92
9057642	1	SCPU3	NV	Railroad Valley WMA		8/13/92
9057644	11	SCPU3	ID	Camas NWR	7 7N 36E	8/20/92
9067408	4	SCPU3	ID	American Game Seg.	13 5S 31E	8/26/92
9057648	5	SCPU3	ID	Market Lake WMA	7 5N 37E	8/18/92
9057654	7	SCPU3	UT	Deb Kawaguchi farm	6 4N 2W	8/6/92
9057593	4	SCPU3	UT	Deb Kawaguchi farm	6 4N 5E	poor germ
9057579		SCMA	ID		na	**not clean
9057584		SCMA	ID	Burneau River	23 6S 5E	not clean
9067376	3	SCMA	NV	Kirch WMA		8/14/92
9067380	1	SCMA	ID	Bear Lake NWR	16 14S 44E	7/15/92
9067375	7	SCMA	NV	Rosewood Lakes		8/14/92
9067377	5	SCMA	UT	Salt Creek WMA	35 11N 4W	7/30/92
9067374	6	SCMA	UT	Bear River MBR	3 8N 4W	7/30/92
9057590					wrong spp.	

Acc. No.	Greenhouse No.	Species	State	Location	Legal descrip. SEC TWN RG	Date planted
9067381	8	SCMA	UT	Ogden Bay WMA	10 5N 3W	7/30/92
9057594		SCMA	UT	Deb Kawaguchi farm	6 4N 5E	not clean
9067378	2	SCMA	UT	Deb Kawaguchi farm	6 4N 2W	8/6/92
9067379	4	SCMA	UT	Horseshoe Springs		8/6/92
9057586		SCMA	ID	Canyon County		not clean
9057645		SCVA	ID	Mud Lake	31 7N 35E	not planted
9057611	1	POLYG4	CA	Modoc NWR	19 42N 13E	7/23/92
9057618	2	POLYG4	ID	Yale road	35 10S 27E	7/16/92
9057624	3	POLYG4	ID	Bear Lake NWR	17 14S 44E	7/16/92
9057633	4	POLYG4	NV	Stillwater NWR	18 19N 31E	8/14/92
9057637	6	POLYG4	NV	Weeks on Alt. Hwy.95		not found
9057649	5	POLYG4	ID	Market Lake WMA	1 5N 36E	8/18/92
9067415	6	POLYG4	ID	Mud Lake	31 7N 35E	8/20/92
9067416	7	POLYG4	ID	Deer Flats	7 2N 2W	7/31/92
9067417	8	POLYG4	ID	Malheur	7 31S 32.5E	8/6/92

LEGEND:

*no seed in packet
**arrived late not cleaned
*** no plants from green house
+poor germination
++replaced with F&G plants because of poor germ

Appendix B

September 21, 1992

SEED GERMINATION PERCENTAGES ALTERNATING TEMPERATURE

(Seeds began stratifying 5/19/92)

Species Access. #	Wet Strat. First cycle*	Wet Strat. Second cycle	Moist Strat. First cycle	Moist Strat. Second cycle
POLYG4				
9057611	95% +/-	--	95% +/-	--
9057618	95% +/-	--	95% +/-	--
9057624	95% +/-	--	95% +/-	--
9057633	95% +/-	--	95% +/-	--
9057649	90% +/-	--	90% +/-	--
9057637	95% +/-	--	95% +/-	--
ELPA3				
9067387	5%	10%	30%	30%
9067390	60%	60%	30%	30%
9057604	90% +/-	--	60%	65%
9057585	90% +/-	--	90% +/-	--
9057588	90% +/-	--	65%	70%
9057581	90% +/-	--	90% +/-	--
9067386	60%	70%	70%	75%
9067389	65%	75%	75%	80%
9057601	90% +/-	--	90% +/-	--
9067388	10%	10%	15%	20%
9057600	90% +/-	--	80%	80%
9057607	90% +/-	--	90% +/-	--
9067391	65%	80%	90% +/-	--
9067385	90% +/-	--	60%	60%
SCAC				
9057634	15%	55%	70%	75%
9057625	35%	60%	25%	55%
9057645	45%	85%	40%	70%
9067394	40%	70%	80%	85%
9057608	20%	30%	40%	50%
9057597	65%	85%	45%	85%
9057620	40%	70%	45%	75%
9057646	30%	70%	30%	75%
9057651	75%	85%	90% +/-	--
9067396	65%	70%	90% +/-	--
9067395	50%	50%	90% +/-	--
9057640	25%	75%	25%	80%
9067392	15%	65%	70%	85%
9057616	20%	70%	25%	55%
9057628	30%	85%	30%	85%
9057577	40%	85%	90% +/-	--
9057622	10%	75%	10%	20%
9067393	10%	50%	55%	85%
9057614	55%	85%	65%	85%
9057636	20%	70%	70%	85%
9057629	40%	80%	70%	85%
9057582	10%	80%	20%	80%
SCPU3				
9057642	30%	40%	30%	50%

Species Access. #	Wet Strat. First cycle	Wet Strat. Second cycle	Moist Strat. First cycle	Moist Strat. Second cycle
9057635	45%	85%	35%	65%
9057596	90% +/-	--	80%	90% +/-
9057593	65%	80%	60%	70%
9057648	55%	55%	45%	45%
9057638	90% +/-	--	80%	90% +/-
9057654	65%	75%	60%	70%
9057615	25%	30%	30%	35%
9057610	35%	60%	30%	45%
9057578	15%	15%	60%	85%
9057644	70%	90%	75%	90%
SCMA (Species did not begin stratifying until 7/9/92 and has not completed the second cycle.)				
9067380	80%	n/a	75%	n/a
9067378	55%	n/a	55%	n/a
9067376	70%	n/a	75%	n/a
9067379	80%	n/a	90% +/-	n/a
9067377	75%	n/a	80%	n/a
9067374	75%	n/a	65%	n/a
9067375	75%	n/a	70%	n/a
9067381	60%	n/a	55%	n/a

Species Access. #	Total Germination
CANE2	
9057652	75%
9057599	20%
9057647	15%
9067371	80%
9067382	45%
9057606	90%
9057612	70%
9057598	1%
9057639	20%
9057631	5%
9057619	1%
9057650	15%
9057623	20%
9057653	40%
9057627	5%
9057655	1%
9057592	55%
9057605	10%

Species Access. #	Total Germination
JUBA	
9057602	85%
9057613	95%
9057630	90%
9057632	90%
9067383	95%
9057617	95%
9057621	95%
9057609	95%
9057626	65%
9057641	85%
9057583	80%
9057580	90%
9057589	95%
9057591	95%

+/- This number was estimated because some unsprouted seeds were removed as the sprouted seeds were transplanted and it is unknown whether they germinated or not.

-- Germination percentage is not recorded because no seed remained in cup after previous transplanting.

* A cycle is an eight week period of time consisting of four weeks at 3°C. and four weeks at 37°C. The germination percent is a sum of the germination during each cycle.

APPENDIX C

Date: September 21, 1992

GROUNDWATER TUBE MEASUREMENTS

All measurements taken from the ground surface.

DATE	Tube A1	Tube A2	Tube A3	Tube A4
4/30/92	-2'8"	-2'2.5"	-2'1"	-0'8.5"
5/8/92	-2'7"	-2'2"	-2'2"	-1'3.5"
5/21/92	-2'0.5"	-1'7"	-1'6"	-0'3"
5/29/92	-2'2.5"	-1'8.5"	-1'7"	-0'3.5"
6/8/92	-2'0"	-1'7.5"	-1'6"	-0'5"
6/19/92	-2'4"	-1'11"	-1'10"	-0'8"
6/26/92	-1'7"	-1'1"	-0'11.5"	+0'2"
7/6/92	-2'1"	-1'7.5"	-1'5"	-0'1"
7/17/92	-1'10"	-1'5"	-1'2.5"	0'0"
8/7/92	-3'3"	-2'8"	-2'7"	-1'3"
8/17/92	-3'7"	-3'1"	-3'1"	-2'3.5"
8/28/92	-3'11"	-3'4"	-3'4"	-2'8"
9/17/92	-3'5"	-3'0"	-3'0"	-2'3"
	Tube B1	**Tube B2**	**Tube B3**	**Tube B4**
4/30/92	-1'5"	-1'1"	-1'0"	-0'7.5"
5/8/92	-1'4"	-1'1"	-1'0"	-0'1"
5/21/92	-0'10.5"	-0'6.5"	-0'5"	+0'5.5"
5/29/92	-1'0"	-0'8"	-0'7"	+0'5"
6/8/92	-0'10.5"	-0'6"	-0'5"	+0'3.5"
6/19/92	-1'2"	-0'10"	-0'9"	+0'3"
6/26/92	-0'4"	-0'1"	+0'0.5"	+0'9"
7/6/92	-1'0"	-0'7"	-0'5"	+0'7"
7/17/92	-0'8"	-0'4"	-0'3"	+0'7"
8/7/92	-2'1"	-1'9"	-1'7"	-0'3"
8/17/92	-2'4"	-2'1.5"	-2'0"	-1'1.5"
8/28/92	-2'9"	-2'5"	-2'4"	-1'10"
9/17/92	-2'2"	-1'10.5"	-1'10"	-1'6.5"
	Tube C1	**Tube C2**	**Tube C3**	**Tube C4**
4/30/92	-1'7"	-0'2.5"	-0'7"	+0'2"
5/8/92	-1'2"	-0'2"	-0'7"	-0'1.5"
5/21/92	-0'10"	+0'4"	-0'0.5"	+0'4"
5/29/92	-1'0"	+0'2.5"	-0'3.5"	+0'3"
6/8/92	-0'9.5"	+0'2.5"	-0'1"	+0'2"
6/19/92	-1'3"	+0'1"	-0'5"	-0'3.5"
6/26/92	-0'4"	+0'10"	+0'4"	+0'5.5"
7/6/92	-1'0"	+0'3"	-0'2"	+0'3"
7/17/92	-0'8"	+0'5.5"	+0'0.5"	+0'5.5"
8/7/92	-2'2"	-0'10.5"	-1'5"	-0'6"
8/17/92	-2'6"	-1'3"	-1'10"	-1'11"
8/28/92	-2'9"	-1'6"	-2'1"	-2'7"
9/17/92	-2'0.5"	-1'0"	-1'6"	-1'10"

- Water below soil surface
+ Water above soil surface

APPENDIX D

OUTSTANDING ACCESSIONS FROM POND EVALUATIONS:

Listed below are accessions for each species that scored high when evaluated for the following traits: height, width, rhizome, vigor, erect, seed, and greeness.

ACC. #	LOCATION	DATE PLANTED	DATE EVAL.	
Carex nebrascensis:	**GREENHOUSE PLANTS**			
9057650	Willard Bay, UT	7/1/92	7/20/92	
	9057623 Bear Lake, ID	7/1/92	7/20/92	
9057647	Market Lake, ID	7/1/92	7/20/92	
	9067382 Trout Creek, NV		7/1/92	7/20/92
	LIVE COLLECTIONS			
9057650	Willard Bay, UT	7/30/92	8/21/92	
9057623	Bear Lake, ID	7/15/92	8/21/92	
9057619	Grays Lake, ID	7/2/92	8/21/92	
Eleocharis palustris:				
	GREENHOUSE PLANTS			
not planted yet				
	LIVE COLLECTIONS			
9057604	Cow Lakes, ID	8/6/92	8/21/92	
9067391	Grays Lake, ID	7/2/92	8/21/92	
9067386	Sublett Res., ID	7/15/92	8/21/92	
9057607	Malheur, OR	8/6/92	8/21/92	
Juncus balticus:				
	GREENHOUSE PLANTS			
9057632	Stillwater, NV	7/1/92	7/16/92	
9057583	Bruneau, ID	7/1/92	7/16/92	
9057621	Wilson flat, ID	7/1/92	7/16/92	
9057591	Echo Canyon, UT	7/1/92	7/16/92	
	LIVE COLLECTIONS			
9057626	Fort Hall, ID	7/22/92	8/21/92	
9057591	Echo Canyon, UT	8/6/92	8/21/92	
9057621	Wilson flat, ID	7/15/92	8/21/92	

ACC. #	LOCATION	DATE PLANTED	DATE EVAL.

Scirpus acutus:

GREENHOUSE PLANTS

9057597	Hagerman, ID	8/18/92	9/15/92
9057634	Stillwater, NV	8/18/92	9/15/92
9057577	Fort Boise, ID	8/18/92	9/15/92

LIVE COLLECTIONS

9057597	Hagerman, ID	7/31/92	9/9/92
9057616	Minidoka, ID	7/15/92	9/9/92
9057577	Fort Boise, ID	7/13/92	9/9/92

Scirpus maritimus:

GREENHOUSE PLANTS

not planted yet

LIVE COLLECTIONS

9067381	Ogden Bay, UT	7/30/92	9/9/92
9067374	Bear River, UT	7/30/92	9/9/92
9067379	Horseshoe Sp., UT	8/6/92	9/9/92

Scirpus pungens:

GREENHOUSE PLANTS

planted on Sept. 18, 1992, not evaluated

LIVE COLLECTIONS

9057644	Camas, ID	8/20/92	9/9/92
9057615	Modoc, CA 7/23/92	9/9/92	
9057610	Malheur, OR	8/6/92	9/9/92

APPENDIX E

INTERAGENCY RIPARIAN/WETLAND PLANT DEVELOPMENT PROJECT

SPECIES REVIEW

Carex nebrascensis (Nebraska sedge)

*cut stems continue to grow from center
*outside sheath turns brown and makes the plant look dead
*plants out of standing water sent up new shoots sooner
*uncut tops in border row, weak for long time
*plants out of standing water darker green
*growth is more dense on plants out of standing water
*good growth from rhizome, spreads

Eleocharis palustris (creeping spikerush)

*cut stems continue to grow
*few accessions really spreading out from rhizome
*culms size can vary from small to large
*rhizomes and seed head differeniate from other perennial
*no seed yet
*seed has been difficult to collect, favorite of water fowl
*susceptible to aphid damage

Juncus balticus

*greenhouse plants put up seed heads after transplanting
*grows from cut top
*new shoots from rhizome look like a fence (in a row)
this differeniates balitcus from other perennial
*seed shatters early at high elevations
*growth from rhizome visible soon after planting
*susceptible to aphid damage

Scirpus acutus

*cut stems do not grow
*all new growth from rhizome
*submersion test-shows plants will grow if inundated
only at a slower rate
*plants with uncut tops in border rows, took longer to establish but now have lots of new shoots.
*most difficult to dig, due to big rhizome

Scirpus maritimus (alkali bulrush)

*first evaluation shows lots of dead plants in live collections
*plants do not grow from cut stems
*all new growth is from the rhisome, and far from parent plant
*new shoots off live collections are few
*plants were inundated--we are going to do tests to see if this affected the plants growth from the cut tops.
*test not cutting tops--in greenhouse with live collections from PMC area

Scirpus pungens (threesquare bulrush)

*cut tops do grow
*growth from rhizome is closer to the parent plant than the SCMA, and is more abundant
*culm size has varied a lot, larger culms-more mature plants-, small culms-young plants ?
*seed heads already out on some accessions
*we are going to do submersion tests

Polygonum species

*most of the collections have been annuals, with a small tap root
*plants seemed to die off after planting, but now have a few new green leaves
*some plants are rooting from the nod
*some plants have a reddish dark spot on the leaves others don't
*the live collections were not cut, so they were difficult to transport, since some of the plants were 4ft tall.
*plants in standing water aren't doing as well as ones on the bank
*plants in the greenhouse have hard seed

APPENDIX F

GREENHOUSE INFORMATION SHEETS BY SPECIES

This Appendix lists liturature search of greenhouse information by species, seed treatment information, aand a list of chronological events and procedures in the greenhouse.

Species include:

Carex nebrascensis (Nebraska Sedge)
Juncus balticus (Baltic Rush)
Eleocharis palustris (Creeping Spikerush)
Scirpus acutus (Hardstem Bulrush)
Scirpus pungens (Threesquare Bulrush)
Scirpus maritimus (Alkali Bulrush)
Polygonum amphibian (Water Smartweed)

CAREX NEBRASCENSIS (Nebraska Sedge)

INFORMATION SHEET

Literature Search Information

SEED TREATMENT

Clean seed stored air dry at about 3 degree Celsius.

CHRONOLOGICAL EVENTS

2/24/92 Began stratifying seeds.

3/2/92 Began planting seeds in tanks #1,#2.

3/3/92 Finished planting seeds in tanks #1,#2.

4/15/92 Watered plants with an Iron/water mixture.

4/28/92 Trimmed plants in tank #1 down to twenty centimeters. Watered plants with an Iron/water mixture.

4/29/92 Watered plants with an Iron/water mixture.

5/4/92 Watered plants with an Iron/water mixture.

5/5/92 Watered plants with an Iron/water mixture.

5/27/92 Trimmed plants in tank #2 down to fifteen centimeters. Accessions #8,#10,#11,#15,#16,#18 had less then twenty cells with plants to transplant into the constructed ponds. Cells with plants in accessions #10,#18 were separated and transplanted to obtain a total of twenty cells with plants for both accessions.

5/28/92 Trimmed plants in tank #1 to fifteen centimeters.

5/29/92 Plants have grown up to 3.5 centimeters since being trimmed.

6/4/92 Transplanted plants from the fourteen accessions with the minimum twenty cells with plants into constructed pond #5. Returned excess plants to greenhouse.

JUNCUS BALTICUS (Baltic Rush)

INFORMATION SHEET

Literature Search Information

SEED TREATMENT

Clean seed stored air dry at about 3 degrees Celsius.

CHRONOLOGICAL EVENTS

2/24/92	Began stratifying seeds.
3/3/92	Began planting seeds in tanks #3,#4.
3/4/92	Finished planting seeds in tanks #3,#4.
4/15/92	Water plants with an Iron/water mixture.
4/28/92	Seed forming on accessions #4,#8,#10,#11. Trimmed plants to twenty centimeters.
5/5/92	Watered plants with an Iron/water mixture.
5/7/92	Trimmed plants to fifteen centimeters.
5/26/92	Trimmed plants to ten centimeters.
5/29/92	Plants have grown 5 to 7.5 centimeters since trimming.
6/4/92	Accession #12 was identified as not a Juncus and so was removed from tank and test.
6/5/92	Transplanted plants to constructed pond #5, except accession #12. Returned excess plants to greenhouse.
7/31/92	An insect infestation has been noticed during the last week. The insects are identified as aphids. Treatment prescribed is to spray is to spray all greenhouse plants with Lorsban. The most affected species are Eleocharis palustris, and Juncus balticus.
8/3/92	Sprayed all greenhouse plants with Lorsban.
8/5/92	The aphids appear to have been killed of. The aphid damage is most noticeable in accessions #5,#6,#7.
9/10/92	Recovery is very slow. Little if any new growth is visible in damaged areas.

ELEOCHARIS PALUSTRIS (Creeping spikerush)

INFORMATION SHEET

Literature Search Information

- Store in water at 2 degrees Celsius.
- Stratification - wet/moist, water level 2" above to 2" below soil surface.
- Germination - 20 to 30 degrees Celsius, water level 2" above to 2" below soil surface.

SEED TREATMENT

- Clean seed stored air dry at about 3 degrees Celsius.

CHRONOLOGICAL EVENTS

5/19/92 - Began stratifying seeds.

6/9/92 - Transferred all alternating temperature cups to greenhouse.

6/10/92 - Removed lids from cups for 4 to 5 days and attempted to keep seeds wet or moist without lids. This was found to be too time consuming so lids were replaced. Lids remained in place at all times except to check for germination, and to add water if needed.

6/11/92 - Germination visible beginning.

6/15/92 - Much germination visible.

6/19/92 - Began transplanting germinated seed from cups to books in tank #6.

6/22/92 - Finished transplanting germinated seed from cups to books in tank #6.

Based on amount of germination, the rating of ELPA3 accessions from best on down are: #6, #12, #13, #4, #3, #9, #8, #7.

-Filled water level in tank up to, or slightly below, the soil surface.

7/8/92 - Transferred all remaining alternating temperature cups from the greenhouse, back to the cooler.

7/10/92 - The accessions that seem to be doing the best based on amount of germination and success in growing are: #3 and #6, then #12, #13, #4, then #7, #8, #9.

The accessions that are doing the worst are: #10, #5, #2, and #11.

7/31/92 - An insect infestation has been noticed during the last week. Today it was noticed that the plants are beginning to be damaged. The insects are identified as aphids. Treatment prescribed is to spray all greenhouse plants with Lorsban. The most affected/damaged species are Eleocharis palustris and Juncus balticus.

8/3/92 - Sprayed all greenhouse plants with Lorsban. Also noticed a small population of lady bugs on ELPA3 and SCAC.

8/5/92 - The aphids appear to have been killed off. Transferred all alternating temperature cups from cooler to greenhouse. A little germination has occurred in #3 PM2 while in the cooler.

8/7/92 - The aphid damage is most noticeable in greenhouse numbers #3, #4, #5, #6, #7, #10, and #12.

8/10/92 - Additional germination occurring in alternating temperature cups.

8/11/92 - Counted cells and measured plants growing in tanks.

Greenhouse Number	# of Cells with Plants	Avg. Height of Accession (cm)	% of Plants Damaged by Aphids
1	14	8	0%
2	6	14	0%
3	29	30	50%
4	36	20	30%
5	18	8	25%
6	34	30	75%
7	28	20	25%
8	28	18	0%
9	39	27	0%
10	6	10	15%
11	18	5	10%
12	40	6	50%
13	40	10	10%
14	10	5	60%

8/14/92 - Accessions beginning to recover from aphid infestation.

8/28/92 - Transplanted germinated seeds from cups to books in accession #1, #2, #5, #6, #10, #11, #14 for the purpose of having all or as many as possible accessions with at least 20 plants for planting out.

9/2/92 - Transferred alternating temperature cups from greenhouse to cooler.

SCIRPUS ACUTUS (Hardstem bulrush)

INFORMATION SHEET

Literature Search Information

- Store air dry 5 degrees Celsius in the dark in sealed plastic containers for 5 days.
- Stratification - Wet and moist, distilled and pond water at 0 - 3 degrees Celsius and alternating 30 degrees Celsius.
- Germination - Seeds sprinkled on soil compartment, flooded, then allowed to drain, 20 - 30 degrees Celsius, water level 2" above to 2" below soil surface.

SEED TREATMENT

CHRONOLOGICAL EVENTS

5/20/92 -	Began stratifying seeds.
6/9/92 -	Transferred alternating temperature cups from cooler to greenhouse.
6/10/92 -	Removed lids from cups for 3 to 4 days to keep seeds wet or moist without lids. This was found to be too time consuming so lids were replaced. Lids remained in place at all times except to check for germination and add water if needed.
6/11/92 -	Very little and scattered germination became visible.
6/16/92 -	Very definite and strong germination.
7/6/92 -	Began transplanting germinated seeds from cups to books in tank #7.
7/7/92 -	Finished transplanting germinated seeds from cups to books in tank #7 - Filled water in tank to soil surface.
7/8/92 -	Transferred alternating temperature cups back to cooler.
7/10/92 -	Water level in tank slightly (2 to 3 mm) above soil surface. A thick green algae will form and completely cover and/or coat smaller plants. The accession that seem to be doing the best based on percent germination and a general vigor and height comparison are from best to worst: #9,16,10,11,4,6,18. The accession that seem to be doing the worst are: #2,12,14,17,22 in no particular order.
8/5/92 -	Transferred alternating temperature cups back to the greenhouse.
8/10/92 -	Additional germination occurring in alternating temperature cups.
8/11/92 -	Counted cells and measured plants growing in tank #7.

Greenhouse Number	# of Cells with Plants	Avg. Height of Accession (cm)
1	19	85
2	8	80
3	23	70
4	25	75
5	14	70
6	32	75
7	22	65
8	8	70
9	40	60
10	27	70
11	20	75
12	7	65
13	21	70
14	9	30
15	11	60
16	38	60
17	3	30
18	23	60
19	33	65
20	26	65
21	18	55
22	10	65

8/12/92 - Started transplanting plants from greenhouse to pond #6.

8/13/92 - Finished transplanting plants from greenhouse to pond #6.

15 of the 22 accessions had sufficient plant to fill up 5 quadrants or at least 20 plants. Greenhouse #1,3,4,5,6,7,9,10,11,13,16,18,19,20,21.

Returned excess plants to greenhouse tank.

Root mass generally extended down to and filled entire cell. A few of the rhizomes were up to 1/4 inch in diameter.

8/18/92 - Transplanted germinated seed from cups to books in Accessions #2,8,12,14,15,17, and 22, for the purpose of having at least 20 plants in these accessions so that they can also be transplanted to pond #6.

9/3/92 - Transferred alternating temperature cups from greenhouse to cooler.

SCIRPUS PUNGENS (Three square bulrush)

INFORMATION SHEET

Literature Search Information

- Store air dry 22 degrees Celsius 5 days at 5 degrees Celsius in dark in sealed plastic containers.
- Stratification - Wet & moist, distilled & pond water, 0 to 3 degrees Celsius to 30 degrees Celsius alternating.
- Germination - Seeds sprinkled on soil, compartment flooded then allowed to drain, 20 - 30 degrees Celsius, water level 2" above to 2" below soil surface.

SEED TREATMENT

Clean seeds stored air dry at about 3 degrees Celsius.

CHRONOLOGICAL EVENTS

5/14/92 -	Began stratifying seeds.
6/9/92 -	Transferred all alternating temperature cups from cooler to greenhouse.
6/10/92 -	Removed lids from cups for 3 to 4 days and attempted to keep seeds wet or moist without lids. This was found to be too time consuming, so lids were replaced. Lids remained in place at all times except to check for germination, and add water if needed.
6/16/92 -	Little germination visible.
7/8/92 -	Transplanted germinated seed from cups to books in tank #8. Transferred alternating temperature cups back to cooler.
7/10/92 -	The accessions that seem to be doing the best based on amount of germination and growing success are #3,6,7,11, and then 10 and 4. The accessions that are doing the worst are #8,9, and 1.
8/5/92 -	Transferred all alternating temperature cups from cooler to greenhouse.
8/10/92 -	Additional germination in alternating temperature cups.
8/11/92 -	Counted cells and measured plants growing in tanks.

Greenhouse Number	# of Cells with Plants	Avg. Height of Accession (cm)
1	8	28
2	23	30
3	39	30

4	16	4
5	11	30
6	40	45
7	10	15
8	5	20
9	6	30
10	21	15
11	40	25

8/18/92 - Transplanted germinated seeds from cups to books in accession #1,2,4,7,8,9 for the purpose of having all or as many as possible accessions with at least 20 plants for planting out.

9/2/92 - Transferred alternating temperature cups from greenhouse to cooler.

SCIRPUS MARITIMUS (Alkali Bulrush)

INFORMATION SHEET

Literature Search Information

SEED TREATMENT

Clean seed stored air dry at about 3 degrees Celcius.

CHRONOLOGICAL EVENTS

7/9/92	Began stratifying seeds.
8/5/92	Transferred all alternating temperature cups to greenhouse.
8/10/92	Germination visible. The greatest amount of germination occurred in #4,#5,#6.
8/14/92	Very good germination continuing. Transplanted germinated seeds from cups to books in tank #8.
09/2/92	Transferred alternating temperature cups to cooler.

POLYGONUM SPP. (Water Smartweed)

INFORMATION SHEET

Literature Search Information

- Store in water at 2 degrees Celsius.
- Stratification - Wet and moist, distilled and pond water, 0 - 3 degrees Celsius and alternating 30 degrees Celsius.
- Germination - 20 - 30 degrees Celsius, varying water level.

SEED TREATMENT

- Clean seed stored air dry at about 3 degrees Celsius.

CHRONOLOGICAL EVENTS

4/16/92 -	Seed placed in distilled water in glass containers and stored in 3 - 6 degrees Celsius, mostly dark conditions.
4/28/92 -	Some type of mold found growing on top of the seeds that are floating on top of the water. Accessions #1 through #5 have a portion of the seed floating on top of the water and a portion sunken and submerged in the water. Additional distilled water was added and the seeds were then mixed every other day to prevent additional mold growth.
5/12/92 & 5/13/92 -	Began stratifying seeds. Pond water was collected from a wetland area in the Johnson segment. Pond water samples were collected in shallow water with sediment disturbed to obtain maximum amount of natural water contents.
6/9/92 -	Transferred alternating temperature cups from cooler to greenhouse.
6/10/92 -	Removed lids from cups. Polygonum seeds have begun germinating. Accession #6 has the most germination; #3 is second in germination.
6/10/92 to 6/15/92 -	Transplanted germinated Polygonum seeds.
7/2/92 -	Trimmed 12 cells of accession #6 to determine if plants would survive being trimmed. Plants were trimmed to 3 inches. One of the cuttings (about 6 inches in length) was planted in an empty cell.
7/6/92 -	Trimmed plants appeared to have survived cutting.

Trimmed all remaining Polygonum plants to 5 inches. Purpose for trimming plants was because the plants which were planted first grew over and began to cover the younger/smaller plants. Trimming plants allowed more light and space for the smaller plants.

Also was noticed that as plants bent over, and came within about 1/2 inch of the soil, the nodes sprouted roots.

7/10/92 - The Polygonum plants appear to be recovering from the trimming. For the first 2 days after trimming, they seemed or appeared very dry and yellow. I then raised the water level from about 5 inches below soil surface to about 1 inch below soil surface. Also turned off the overhead lamps in case they were causing any drying or burning.

The cutting that was planted turned brown, then after about 4 or 5 days, green started to appear. Now the entire cutting is green and seems to be doing very well.

The smaller plants that were covered over appeared to have dried up and died. As of yesterday and today, some of them are coming back.

8/10/92 - Plants recovered very well. New growth on trimmed plants occurs from the node just below the cutting point.

Seed heads visible and well developed.

Began transplanting from greenhouse to the banks of pond #5.

8/11/92 - Finished transplanting from greenhouse to pond #5.

Root structure extended in cells about 4 to 5 inches vertically and 3 to 4 cells would be bound together by the roots horizontally.

Excess plants were returned to greenhouse and placed in tank.