The ecology and genetics of alkali bulrush (*Schoenoplectus maritimus*): management implications

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This report describes the results of Amanda Sweetman's Masters research at Utah State University. Some of the research findings are described in more detail in the following publication:

Sweetman, A.C., K.M. Kettenring, and K.E. Mock. **2013**. The pattern and structure of genetic diversity of *Schoenoplectus maritimus*: implications for wetland revegetation. Aquatic Botany, *in press*.

We thank the many wetland managers who provided site access and logistical support to make this research possible: Annette de Knijf, Howard Browers, Bridget Olson, and Brian Allen from the U.S. Fish and Wildlife Service; and Randy Berger, Val Bachman, and Rich Hansen from the Utah Division of Wildlife Resources.

This report should be cited as:
Sweetman, A.C., K.M. Kettenring, and K.E. Mock. **2012**. The ecology and genetics of alkali bulrush (*Schoenoplectus maritimus*): management implications. Final report to Great Salt Lake wetland managers.

Project description: Alkali bulrush (*Schoenoplectus maritimus*) is an important wetland plant species, in the Intermountain West. However, there is a lack of knowledge on how best to source seeds of this species for restoration and how environmental factors influence its productivity. We looked at the interaction of three factors important for wetland management and restoration: (1) hydrology; (2) plant materials used in restoration (source and diversity of seeds); and (3) plant success (reproduction, establishment, and productivity).



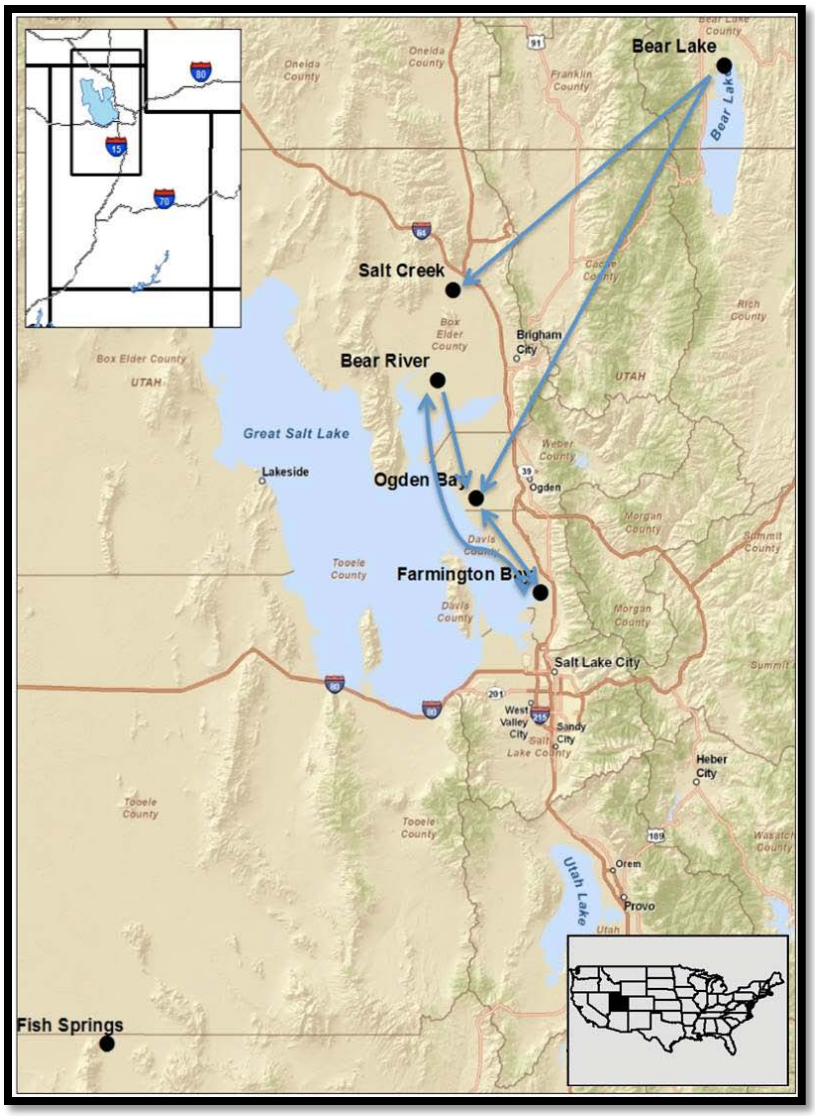
Background information: Selecting the appropriate source of plant materials for restoration or management projects is important for long-term success and for the conservation of biodiversity. Factors such as genetic diversity within and among populations and drivers of productivity are important to understand when deciding where to obtain seeds and how to manage restored populations (see explanations below).

Genetic diversity <u>within</u> populations	**Genetic diversity <u>among</u> populations**	**Drivers of productivity within <u>and</u> among populations**
How genetically different are alkali bulrush plants within the same population? *Importance:* using seeds from sources with low genetic diversity can: • Increase the risk of inbreeding • Decrease plant productivity • Decrease seed production • Decrease the ability of a population to react to changes in the environment (=adaptive potential)	*How genetically different are populations of alkali bulrush from one another?* *Importance*: transferring seeds from one genetically distinct population to another can: • Decrease the long-term success of populations by introducing individuals not adapted to local conditions • Decrease survival and reproduction of offspring between local and non-local (poorly adapted) plants	*What environmental factors influence alkali bulrush biomass, stem density, and height?* *Importance*: understanding the environmental variables that influence productivity can: • Increase establishment and growth of plants, which, for example, can reduce erosion and reduce the risk of invasive species colonizing • Increase production of food and habitat for wildlife

Methods, Results, & Implications

Genetics:

We evaluated genetic diversity *between* six sites of alkali bulrush in southern Idaho and Utah (Bear Lake, Salt Creek, Bear River, Ogden Bay, Farmington Bay, and Fish Springs; see map below). We found shallow, yet significant, genetic differences between all sites. **Stands of alkali bulrush are sufficiently genetically differentiated such that there should be limited translocation of plant materials between populations to conserve historic lineages.**



However, populations that were closer together were more closely related and sites along the Great Salt Lake showed evidence of some mixing between sites. Thus, if it is necessary to use seeds from outside of a restoration area, **it would be best to use source populations that are geographically close to the restoration site. It would also be acceptable to move seeds between sites on the Great Salt Lake.** Genetic diversity patterns indicated some movement of alkali bulrush seeds among sites (see blue arrows on map that illustrate the direction of mixing, likely due to bird dispersal of seeds). Therefore, **when moving seeds consider natural patterns of dispersal. That is, do not move seeds out of or into isolated sites such as Fish Springs.**

We also sampled genetic diversity *within* six sites. Genetic diversity was high within populations at most sites and positively related to seed production. **If you collect broadly within source populations, you are likely to capture high levels of genetic diversity, which may increase seed production of your restored population(s).**

Drivers of productivity:

In a greenhouse experiment and field survey, we looked at the productivity of alkali bulrush under different water levels. We found that both high water levels and drought decreased productivity. **Intermediate water levels (~5cm deep) promoted the greatest growth of alkali bulrush.**

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<u>Interaction of productivity and diversity</u>:
In a greenhouse experiment, we grew alkali bulrush seeds from different sources under different water levels. We found that seed source population (where the seeds came from) impacted seedling establishment (seeds from Timpie Springs sprouted faster than seeds from other sites), while higher numbers of seed sources used (*i.e.,* the diversity) had a positive impact on sensitivity to drought. No population was more productive overall—**which supports the use of seeds from the population closest to the restoration site. Using genetically diverse seed sources (*i.e.,* seeds collected broadly from nearby a restoration site) might increase resilience of local populations as they face environmental challenges in the future (e.g., drought).**

