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Genetic Variation in Riparian Restoration as a Tool for Climate Change Adaptation

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When selecting plant species in restoration projects, the accepted standard is to use local species sources with a regional genetic memory to ensure species site adaptability (McKay et al. 2005). More broadly defined, "local" is understood as plants from similar environmental and climatic conditions (McKay et al. 2005). However, forward-thinking restoration that aims for long-term success in a changing environment may find it more appropriate to select species adapted to anticipated environmental conditions (Choi et al. 2008, Seavy et al. 2009). Gene pool variability can allow adaption to changing climate conditions without losing a population's genetic memory (Seavy et al. 2009). Because riparian ecosystems have a natural resilience (Seavy et al. 2009) and are able to adapt to changing conditions (Naiman and Décamps 1997), they offer a perfect opportunity for "pushing the envelope" of species climate adaptability.

Young Oregon Ash (Fraxinus latifolia).
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One way to nudge riparian species genetic variability towards evolutionary change is to introduce plant species that are at the edges of a population's hydrological conditions (Seavy et al. 2009). For example, flood-adapted early colonizers can help shift variability to adapt to changes in seasonal flooding. Species adapted to dry periods can adjust a population towards periods between flood events (Seavy et al. 2009).

One of the challenges of adapting genetic resilience to climate change is bridging the gap between species seasonality and warming conditions (Seavy et al. 2009). For example, in California, the Oregon ash has bloom period variations of almost two month's difference between the northern Sacramento Valley and the lower San Joaquin River riparian zone (Seavy et al. 2009). Introducing species from the valley to riparian sites may help the ash adapt to drier conditions.

Genetic diversification in response to climate change can also be enhanced by introducing species from the warmer edge of a population's environment (Grady et al. 2011). Grady et al. (2011) found that aboveground net primary productivity at the warmer edge of a species distribution was enhanced by augmenting local populations with species from warmer climates. Species with small ranges may be unable to migrate in response to warmer, drier conditions (Catford et al. 2013). Introducing genetic variability may assist their successful migration (Grady et al. 2011).

Salicaceae species have high genetic variability due to high levels of gene flow among populations (Karrenberg et al. 2002). Future studies could consider using Salicaceae species as a testing ground for some of the previously mentioned strategies.

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Techniques for enhancing species genetic variation may not be as critical in urban areas. Urban riparian zones have been modified to such a high degree through hydrologic changes, warming trends, loss of indigenous species, introduction of non-native species, etc. that their new status already resembles climate change conditions. Thus climate change may not have much of impact on these ecosystems (Catford et al. 2013).

While “local” species genetic memory is important, restoration must account for diversifying species adaptability. Anticipated changing environmental conditions suggest restoration techniques should consider “pushing the envelope” of species genetic variability by introducing a gene pool that will help species adjust to climate change.

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