Restoration of Rare Plants

How to reclaim with rare vascular plants in the parkland and Prairies of Western Canada

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Tannas Conservation Services Ltd.

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Importance of Restoring Rare Plants

- Ecological Importance: Rare Vascular Plants represent species of plants that are either globally, regionally, or locally endangered.
  - **Globally endangered species** represent those species at the risk of extinction. Preservation of existing populations is no longer enough to secure these species
  - **Regionally rare species** are those that have secure populations elsewhere, but they are endanger of being lost in portions of their habitat and loss may result in reduced genetic diversity
  - **Locally rare species** are those that are rare in a small jurisdiction, but are secure elsewhere. Preservation is important of diversity

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Importance of Restoring Rare Plants

- Loss of one plant has a magnified impact on genetic diversity
- Rare vascular plants fill unique niches in the landscape
- Rare vascular plants support other rare and endangered species (wildlife and insects)
- Restoration of rare plants can secure populations for the future
- Restoration of rare plants can allow for continued development activities will minimizing environmental impacts

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Importance of Restoring Rare Plants

- In many cases development is chosen over protection of rare plants
  - This is driven by economic needs and societal values being traded off against ecological value of natural ecosystems and specific species
  - We have poor protection for rare plants in many jurisdictions and so avoidance is rarely the chosen option

Plant Specific Assessment

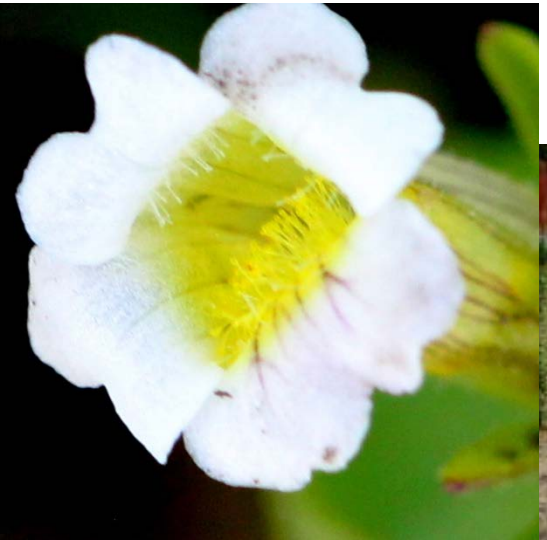
- In order to successfully protect and restore rare vascular plants we must understand their lifecycle and the reason why they are rare.
  - In some cases they are rare due to anthropogenic activities
  - In other cases their own environmental adaptations are poorly suited to the environment they are currently found in.

Plant Specific Assessment

- Some plants their status of being rare will become an impediment to their successful propagation
  - Rare due to:
    - Poor reproductive abilities
    - Poor establishment abilities
    - Narrow window of environmental conditions for successful reproduction
    - Susceptibility to disease and predation
    - Relationship with insects, microbial relationships and wildlife

Plant Specific Assessment

- Some plants their status of being rare has nothing to do with their successful propagation:
  - Rare due to:
    - Loss of disturbance regime
    - Loss of habitat
    - Change in climatic conditions
    - Herbivory and seed predation



Plant Specific Assessment

- In some cases propagation is the easy, but establishment in the wild is challenging.
  - Current environmental conditions do not match with plant needs
  - Disturbance regimes are wrong

Plant Specific Assessment

- Why is the plant Rare?
  - Has it suffered habitat loss?
    - Land use changes can change habitat?
    - Have climatic changes effected its habitat?
  - Does it have specific disturbance requirements?
    - Specific grazing regimes
    - Specific fire return interval requirements
    - Specific Scarification regimes of the ground
    - Specific flood return intervals
    - Specific relationships with other species plants, insects, or animals

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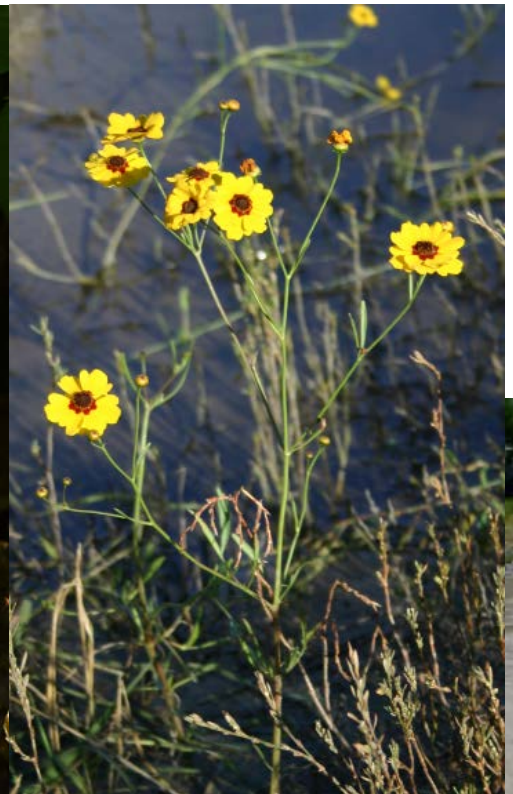
Plant Specific Assessment

- Why is the plant Rare?
  - Is it at the edge of its ecological range?
    - If at the edge of its range it may not be adapted to the environment
  - Are the reasons it is rare unknown?



Plant Specific Assessment

- What is the plants life history?
  - Longevity
    - Annual, Biennial, short lived perennial (2-5 years), long lived perennial 5-50 years, very long lived perennial (>50 years)
  - Reproductive Strategy
    - Reproductive method
      - Asexual, Sexual, or Asexual and Sexual reproductive strategies
    - Pollination requirements
      - Wind pollinated, self pollinated, insect pollination, wildlife pollination
    - Dispersion of Propagules
      - Vegetative propagules (creeping, spreading in water…)
      - Seed and Spores dispersion technique (wind, animal, water, none)
      - Distance of average dispersion (one meter to hundreds of kilometers)





Plant Specific Assessment

- What is the plants life history?
  - Reproductive Strategy
    - Storage and Longevity of Propagules
      - Chemical or physical inhibitors to germination
      - Storage ranges from a few days to centuries
      - What conditions are required for storage
        - Some seeds have secondary dormancy triggers (temperature, moisture conditions…
        - Moisture Levels (some wetland plants cannot have dry seed)
        - Temperatures for safe storage
      - What conditions are required to break dormancy
        - Light, moisture, chemical scarification, physical scarification, age, heat…
    - Establishment requirements
      - Light (what spectrum of light and day length are required to initiation germination)
      - Storage ranges from a few days to centuries

Plant Specific Assessment

- What is the plants life history?
  - Reproductive Strategy
    - Germination requirements
      - Light (what spectrum of light and day length are required to initiation germination)
      - Soil moisture (what levels of soil moisture initiate germination
      - Temperature
    - Establishment requirements
      - Depth of seed
      - Access to light
      - Soil moisture
      - Competition
      - Propagule age

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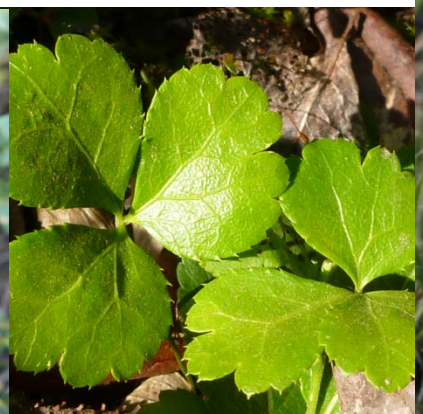
Plant Specific Assessment

- What is the plants life history?
  - Long term Habitat requirements
    - Light
    - Temperature
    - Soil moisture
    - Competition
    - Nutrients
    - Symbiotic relationships
    - Parasitic relationships
    - Disease
    - Predation and herbivory



Potential Habitat Assessm

- What range of environmental conditions are require
  - Soil moisture
  - Light
  - Temperature
  - Nutrient conditions
  - Soil types
  - Disturbance regimes
  - Symbiotic, parasitic and mutualistic relationships
  - Competition it can and cannot withstand

Restoration Options

- Once the Habitat requirements are assessed and the plant has been assessed it is possible to determine the best method for Restoration
  - If a plant is a weak competitor but can be propagated easily then propagation is recommended to compensate for high establishment mortality
  - If a plant requires very challenging to replicate conditions to survive propagation may pose more risks than direct transplantation
  - If habitat is not available propagation and storage can buy time

Restoration Options

- Direct transplantation
  - Only plants salvaged will be installed and so mortality results in direct population losses
  - Very good option for plants that can be safely removed without damage although expensive and time consuming

Restoration Options

- Direct transplantation
  - Is a waste of effort if plants are easily propagated in a greenhouse or field system and can be installed by planting or by seed
  - Best technique for plants with symbiotic or parasitic relationships if those relationships can be transplanted as well
  - Relies on finding the perfect environment to transplant too

Restoration Options

- Seed collection and dispersal
  - Good technique for disturbance based species that are prolific seed producers
  - Relies on finding the appropriate site for establishment
  - Best technique for most annuals, biennials and short lived perennials as they typically are colonizers
  - The appropriate disturbance regime must be in place to ensure germination and establishment (short and long term)
  - Seed scarification may be required prior to seeding

Restoration Options

- Seed collection, propagation and seed dispersal
  - For plants where few seeds are available but they establish well from seed propagation in breeder plots or in the greenhouse may allow for significant increases in seed to occur effectively reducing the risk of failure to establish a population
  - This is a great method to reduce risk of loss as the breeder plants remain and multiple generations of seed can be harvested and sent out to establish the new population.
  - This is only suitable for plants that can be effectively propagated under controlled conditions and produce seed efficiently

Restoration Options

- Seed collection, propagation and live plant installation
  - This technique works well for slow growing plants that are poor initial competitors and have poor germination and establishment rates
  - Use of controlled conditions can maximize survival and health overcoming initial week points in the plants life cycle
  - Works very well for climax species
  - Relies on a suitable seed source in the wild or ability to establish a breeder plot of the plant for long term seed collection

Restoration Options

- Vegetative propagation and relocation
  - For plants with poor seed production (low germination, few seeds, or heavy predation of seeds)
  - Works well on species with vegetative reproduction strategies as well as on tillering species
  - May be completed on almost all species through germ-plasm and cuttings
  - This method is more expensive as there is a significant labor component to the techniques used

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Monitoring Requirements

- Monitoring requirements will vary, but will generally be a minimum of 5 years to ensure the population reaches maturity and reproduction is occurring naturally in the environment. For some species that are slow growing (trees) it may take longer to determine success.
- Monitoring should measure:
  - Plant health, growth rates, reproduction success, and potential impediments to population security and growth (i.e. disturbance, predation, herbivory…)

Success and Failures to Date

- Eastern Slopes Rangeland Seeds
  - 30 years of Native Plant propagation
  - Production of over 300 species of native plants
  - Grass, Shrubs, Trees, Flowers…
  - Upland and Wetland
  - Prairie to Alpine
  - ~15,000 square feet of space
  - Addition of ~5,000 square feet 2017

Success and Failures to Date

- Pale Blue Eyed Grass
  - Successfully propagated in the greenhouse
  - Around 50 have been grown out through vegetative splitting
  - Not competitive and must be carefully monitored

  - Field establishment has been challenging to date with competition from grass becoming a challenge

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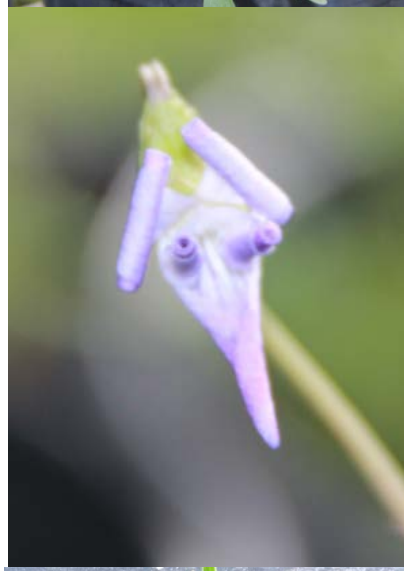
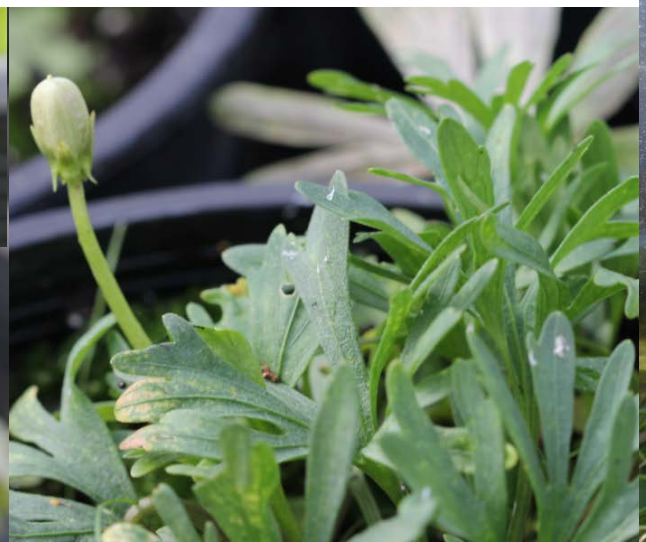
Success and Failures to Date

- Liatris Scariosus
  - Edge of range in Alberta
  - Common species in the East
  - Establishes easily from seed and one plant has been turned into hundreds

Success and Failures to Date



- Viola peditafida – Crowfoot Violet (S2-Tracked)
  - 50 plants initially collected and placed in 1 gallon pots
  - Plants flower and set seed on average 3 times a year
  - Numerous seedlings have established in pots
  - Plants are being multiplied effectively over a 1 year period
  - A secure location is still being searched for



Success and Failures to Date

- Limber Pine
  - Easily germinated
  - Establishes a seedling quickly, and grows fast in controlled conditions
  - Much slower establishing outside in the ground
  - Over 400 have been sent out for restoration work

Success and Failures to Date

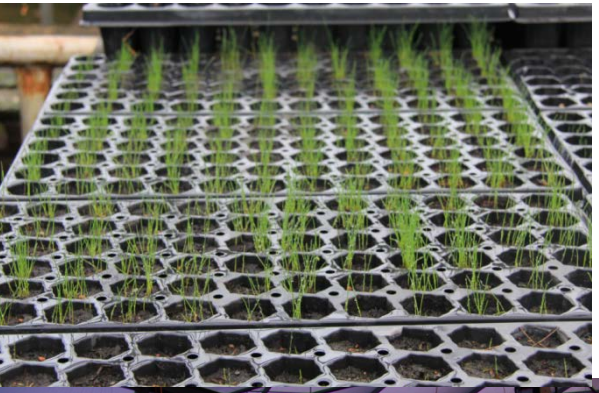
- Lupinus nootkatensis
  - Seed germinated successfully and propagated successfully
  - Hundreds of plants have been grown
  - Expanding population for Alpine Mine Reclamation
  - Goal to use as an early colonizer in the near future

Success and Failures to Date

- *Carex adusta*
  - Established a breeder plot successfully in 2014
  - Seed sets annually
  - Expected to use the species in reclamation in the future as an early colonizer of sandy locations in the boreal forest

Success and Failures to Date

- Plains Rough Fescue Communities
  - Established from plugs successfully, but is slow growing and takes time to successfully create the rare community types



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Success and Failures to Date

- Artemisia tridentata
  - Sold as an ornamental this species is very easy to propagate for restoration projects,
  - Established successfully around Calgary and southern Alberta
  - Establishes from seed and cuttings

Questions?

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