

Protocol: Experimental Design for Invasive Alien Species (IAS) Management – *Cestrum aurantiacum*

Objective

To evaluate the effectiveness of different interventions for managing *Cestrum aurantiacum* by assessing vegetation responses across varying levels of invasion intensity, based on mapped data and field surveys using transects and plots

1. Plot Categorization

Based on field observations, plots are categorized by the density of *C. aurantiacum* individuals as follows:

- **Low:** 0 mature individuals, but with presence of seedlings/saplings
- **Medium:** 1–10 individuals
- **High:** 11–30 individuals
- **Very High:** >30 individuals

Note: The “High” and “Very High” categories are distinguished to ensure adequate attention to areas with denser infestations that may otherwise be grouped too broadly.

2. Plot Selection Criteria

- Existing plot categories and corresponding mapped polygons will be revised accordingly.
- Plots for experimental interventions will be selected across different polygons representing each invasion category.
- Selection will not be restricted to original transect alignments to allow for spatial flexibility and representation.

3. Experimental Setup

Each *invasion category* will include two replicate sets, each located in separate polygons. Each replicate set will consist of three treatment plots, each measuring 10 × 10 meters, and spaced at least 5 meters apart to avoid treatment interference. Baseline data are collected in these plots before the treatment to allow for comparison and evaluation of intervention outcomes.

Plot Treatments per Set:

1. Control Plot – No intervention
2. Removal Plot – Manual removal of *C. aurantiacum*
3. Removal + Planting Plot – Manual removal of *C. aurantiacum* followed by planting of native species

4. Removal and Planting Protocol

Cestrum Removal

- Tools used: Knife, shovel, pickaxe, and other locally available implements.
- Method: Stems and stumps of *C. aurantiacum* are fully uprooted.
- Disposal: Uprooted biomass is removed from the site and dumped outside the plot boundary to prevent regrowth.

Planting Intervention

- Replacement Strategy: The number of *Cestrum* stems removed determines the number of native species planted.
- Species Composition:
 - Pioneer and understorey tree species
 - Shrub species
 - Native grass species
- Tree saplings: Protected using tree guards made of PVC mesh supported by locally sourced wooden posts.
- Grass species: Entire plot is fenced using chicken mesh to protect against herbivory and trampling.

5. Timelines

Activity	Timeline
Plot Selection & Baseline Data Collection	Month 1
Removal & Planting Interventions	Month 2
First Monitoring Round	Month 4
Second Monitoring Round	Month 7

Activity	Timeline
Third Monitoring Round	Month 12
Annual Monitoring Thereafter	Years 2 and 3

6. Monitoring Methods

- Vegetation Surveys:
 - Species richness, abundance, and composition (woody-stemmed species)
 - Regrowth of *C. aurantiacum* (if any)
- Soil Parameters:
 - Temperature, pH, and moisture content
- Photo Monitoring:
 - Fixed-point photography from pre-marked corners of each plot

7. Indicators for Assessment

Parameter	Indicator
Invasive Recovery	% regrowth of <i>C. auranticum</i> individuals
Resilience	Survival and growth rate of planted native species
Biodiversity Gains	Increase in species richness
Ground Cover	% cover of grasses
Recruitment	Regeneration or recruitment of planted native species

This protocol enables systematic evaluation of IAS management strategies for *C. auranticum* while integrating ecological restoration best practices. It provides a replicable and adaptive framework suitable for community-based interventions and long-term forest recovery in invaded landscapes.