Casuarina Textiles: Wearing Out an Invasive Species
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Introduction
The Casuarina research team has been working towards creating sustainable, eco-friendly, and renewable textiles from invasive Casuarina (Casuarina equisetifolia) woody biomass. The group has been successful in extracting fibers and creating paper sheets with the Casuarina. The initial goal was to take the Casuarina fibers and use them to create clothing and textiles while collaborating with Querencia Studio, an eco-friendly clothing company based in New York City, which provides clothing for The Island School store. Over time, the group has decided to focus more on making products such as artisan paper and other textiles due to the excess chemical demand of creating wood-based textiles like Rayon. Along with this project came the opportunity to enter the textile industry. The textile industry is one of the world’s biggest polluters, and notorious for its labor exploitation. The industry is not environmentally friendly, and most materials that are used are not renewable. The project gives us potential to take a new path in the industry, using environmentally friendly materials, production methods, and giving workers fair treatment. Casuarina trees can fit into this mission, because they do not need to be cultivated, saving a lot of labor, and are an organic material that can be recycled back into the Earth.

Methods
The experiment design consisted of these steps: Biomass Preparation, Soda Pulping, Washing & Filtration, and Paper Making.

1. **Biomass Preparation**:
   - Image 1: Preparing the wood chip stock for the wood cook.
   - Image 2: Measurements being taken for density and pH of black liquor during the soda cook.
   - Image 3: Pulpy before and after being washed.

2. **Soda Pulping**: The process involves cooking the Casuarina wood chips in White liquor; cook conditions are varied (Fig. 1) to determine maximum pulp yield. Each cook used 30g of woodchips, and a 10:1 liquor-to-wood ratio. The resulting soda pulp is washed with hot distilled water, over a vacuum filter, to remove the black liquor. Next, the paper-making process starts off with blending the washed pulp, and then spreading this pulp onto a dozette where it is then manually pressed to decrease water. Once de-watered, the formed paper is air-dried.

3. **Washing & Filtration**
   - White liquor concentration in terms of reaction time.

4. **Paper Making**:
   - Image 4: Pressing pulp sludge to remove water to create cellulose sheets.
   - Image 5: Separation of wood fibers during soda pulping.
   - Image 6: Separation of wood fibers during soda pulping.

Research Problem
Invasive species are organisms that are found in regions that are outside of their native ranges and spatially compete with other species due to their high reproduction rate. Typically, they have no natural regulators which make them difficult to manage or eradicate. Casuarina leaf litter acidifies soil and blocks sunlight from other species of plants which disrupts important ecosystems. Additionally, they accelerate beach erosion because their shallow root systems topple over during high winds.

Press:
- The Casuarina tree is a sustainable forest product due to its fast growth rate
- Unlike other feedstocks, it doesn’t require irrigation or pesticides
- Manage where it grows to provide economic activity as well as a constant supply of raw materials
- Higher standing biomass density (20 Mton/ha yr) compared to other sources of fibers such as bamboo

Cons:
- Accidental seed dispersal during transportation to processing facilities.
- It is illegal to cultivate Casuarina trees in The Bahamas (Bahamas Plant Protection Act 2015).

Background
The Casuarina research team is looking to harness the Casuarina tree, an invasive species in the Bahamas, in order to create textiles. Casuarina can be used to make paper sheets and other forms of fuel. The tree consists of two fibers (lignocellulose and hemicellulose), and the plant heteropolymer, lignin. The soda pulping pretreatment that is used, separates the cellulose, hemicellulose and lignin.

Future Research
The Casuarina research team hopes to continue soda pulping experiments to improve the cooks and finished paper quality rather than continuing to make textiles for it is not environmentally friendly. The team will continue to research the manufacture of wood-based products such as charcoal, firewood, and artisan paper, as well as using mycelium to create vegan leathers and biobased construction blocks.

Results & Analysis

Cited Literature & Acknowledgements