# Utilizing ALMANAC model to simulate harvest index in wetland plants to calculate duck energy days.

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## WeARE Research Area

Yield comparison of harvest index simulated by the crop simulation model, ALMANAC to field collected data to assess the potential use of ALMANAC in calculating habitat carrying capacity for waterfowl in wetlands.

## Background

Accurate estimation of energy carrying capacity of wetland habitat is critical for management and conservation of wetland systems. To quantify adequate resources for waterfowl, carrying capacity is calculated in duck energy days (DED) where one DED is equivalent to the amount of food required to feed one average sized duck for one day [1-4]. Calculation duck energy days requires food availability (g[dry]), the true metabolic energy (TME) of seed (kcal/g[dry]), and daily energy requirement (DER)of duck species/type. Quantification of food availability, a limiting factor in assessing habitat carrying capacity, can be both time consuming and time sensitive in collecting mature inflorescences with intact seeds to predict seed mass [3, 5, 6]. Additionally current predictive models utilizing morphological measurements or simple linear regression models relating seed-head area to seed production require extensive field work and are unable to incorporate weather, soil, or land management to simulate output in temporal and spatial scales that may be better suited for wetland management. DED of adjoining cropland used by waterfowl, for example, is not taken into account with simple predictive models but could be simulated with ALMANAC. Preliminary data by Williams *et al*. [9] on wetland plant parameters suggests that ALMANAC (Agricultural Land Management Alternatives with Numerical Assessment Criteria) could be used to realistically simulate yield with appropriate plant parameters of functional groups of key wetland plants such as fraction of intercepted photosynthetically active radiation (FIPAR), leaf area index (LAI), and light extinction coefficient (K) combined with soil, weather and management databases [9]. Additionally process-based models such as ALMANAC have established versatility of reasonably simulating plant species in wide ranges of environmental conditions making it a valuable tool in assessing food availability [7, 8]. Hardstem Bulrush was chosen due to a wide range of growth throughout North America, the stalks (tules) provide nesting and, most importantly, waterfowl feed on the seed.

## Objectives

The objective of this study is to evaluate the efficiency of ALMANAC to simulate food availability or harvest index (HI), specifically moist-soil seed yield, which is used to assess habitat carrying capacity by calculating DED.

1. **Calculate Harvest Index for Hardstem Bulrush from previously collected data.**
2. **Determine the efficiency of ALMANAC in simulating biomass and seed yield of Hardstem Bulrush** using parameters compiled for FIPAR, LAI, and K.

## Methodology

Data was previously collected on Hardstem Bulrush (*Schoenoplectus acutus*) from the Prairie Pothole wetlands near Jamestown, ND. Harvest Index was calculated from previously measured collected data including, weight of fresh sample, dead biomass, inflorescences, and dried sample. Harvest Index, a measure of reproductive efficiency, is the ratio of grain (seed) yield to total dry matter (biomass). ALMANAC parameters were derived for Hardstem Bulrush using FIPAR, LAI, and K from previously collected data. The ALMANAC model was used for all simulations [7].

Fig. 1 *Inflorescences of Hardstem Bulrush used in measuring harvest index*

Fig. 2 *Measuring Fraction of Intercepted Photosynthetically Active Radiation (FIPAR) of Hardstem Bulrush. Photo credit: Amber Williams.*

## Preliminary Results

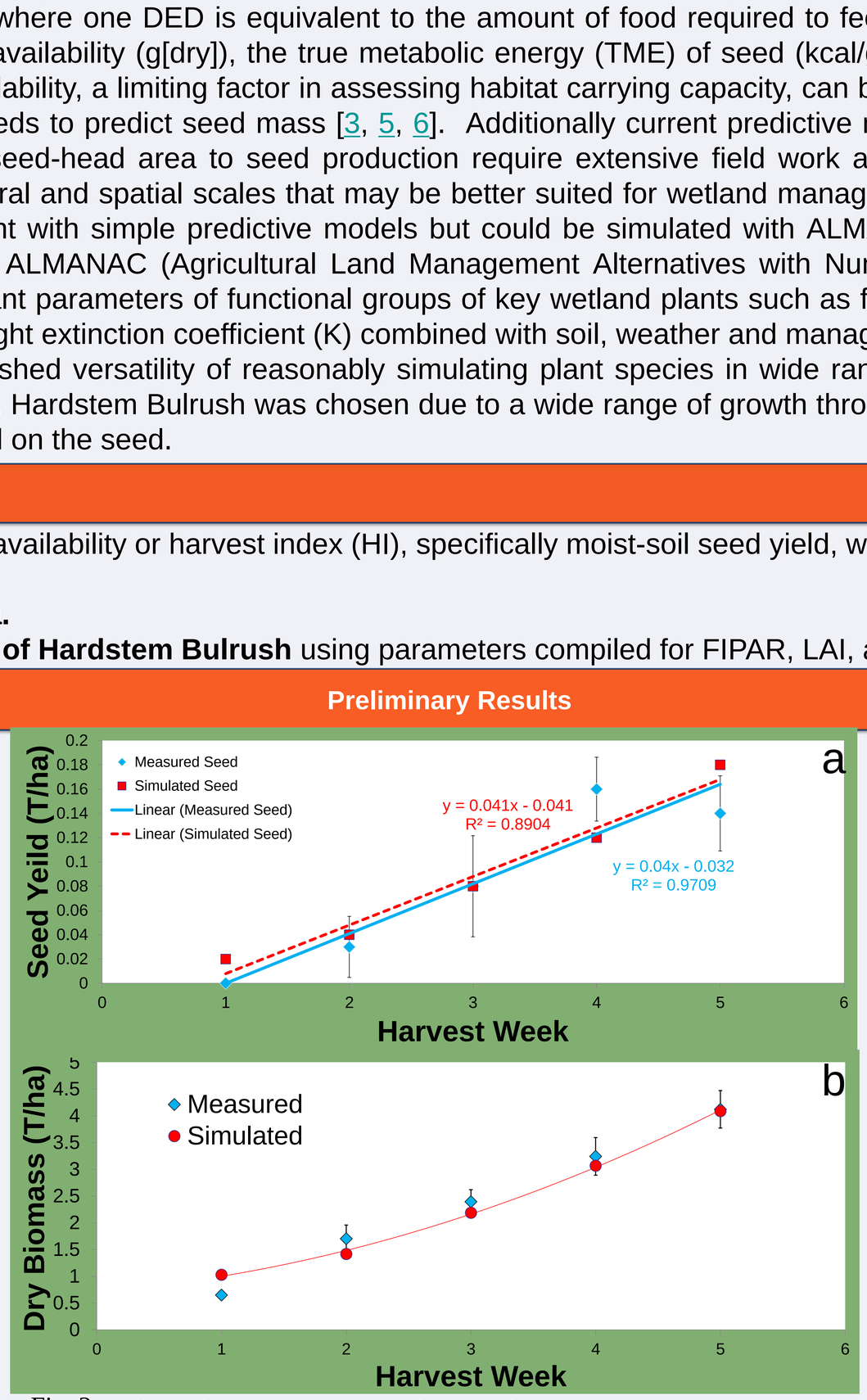


Fig. 3 *Simulated and measured a) seed yield (T/ha) and b) dry biomass (T/ha) in Prairie Pothole region, North Dakota*

Both dry biomass and seed yield comparisons between simulated and measured means demonstrates that **ALMANAC derived parameters were appropriate to adequately simulate Hardstem Bulrush in the Prairie Pothole wetland region.**

## Future Plans

The results show promise in utilizing ALMANAC to simulate seed yield for wetland species. In order to sufficiently validate model for seed availability for DED in wetland systems, future plans need to include data for Hardstem Bulrush and other key species in this and other regions.

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