

# Modelling Uncertainty: Developing an Adaptive Harvest Management Strategy for the American Black Duck *Anas rubripes*

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## Introduction

This research entails the development and evaluation of predictive models for the population dynamics of the American Black Duck *Anas rubripes*. These models will characterize the effect of two phenomena which are thought to influence Black Duck populations and are subject to some degree of management control: (i) hunting mortality, and (ii) competitive interactions between Black Ducks and Mallards *Anas platyrhynchos*. Wintering and breeding habitat effects will be incorporated based upon historical analyses. The goal of this research is to develop reliable estimates of the population response to management activity, in the context of implementing an adaptive management strategy for this resource. Given that the scale and complexity of this system prohibits the application of meaningful manipulative experiments, a classical hypothetico-deductive framework will not be applied. Rather, the relative importance of each factor (or combinations of factors) will be compared using Bayesian inference. This approach complements an adaptive management strategy,



## Optimization and Bayesian Updating

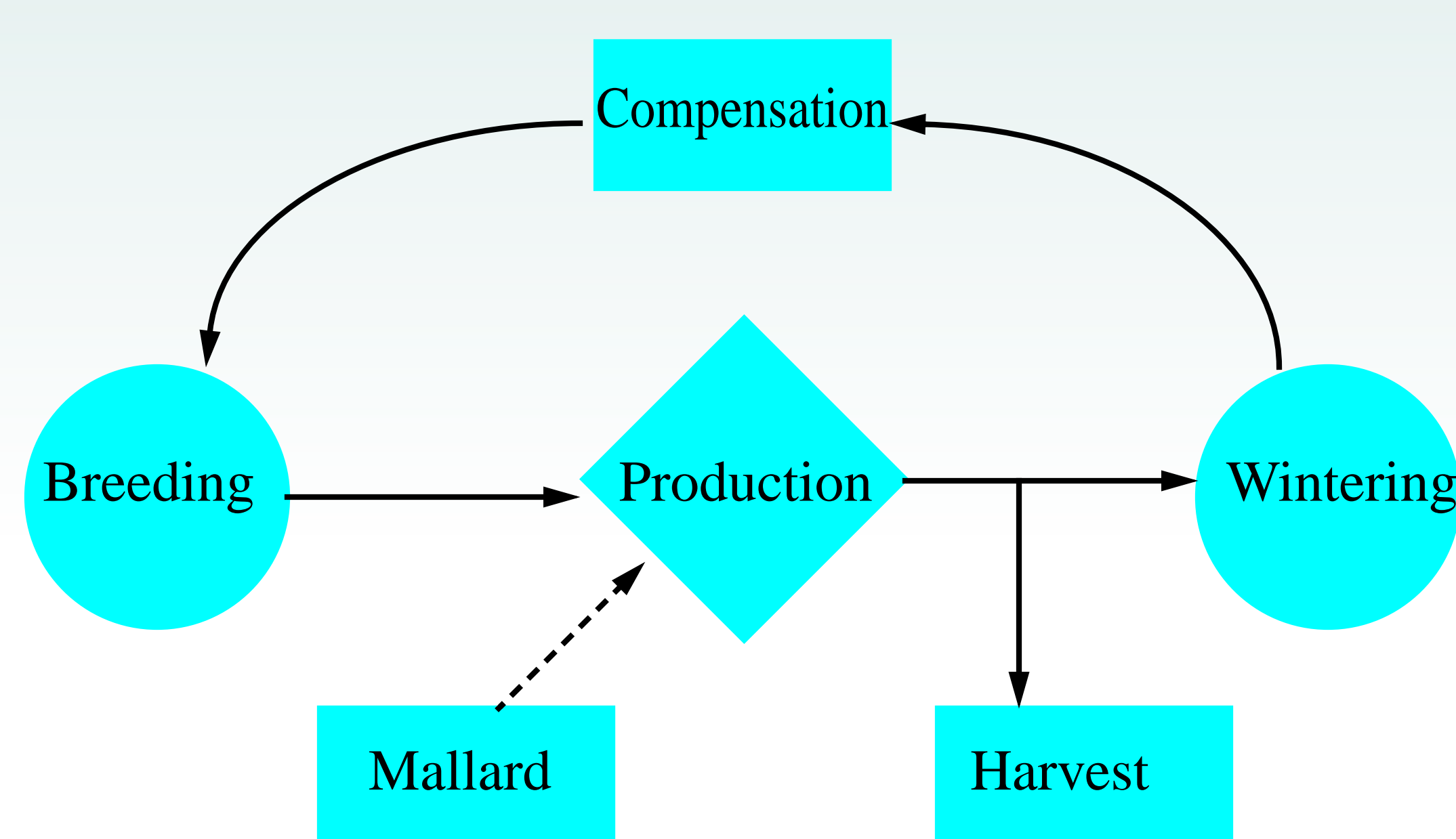
- Initially using program ASDP (Adaptive Stochastic Dynamic Programming) to provide optimal harvest decisions for combinations of black duck and mallard abundances
- Decision making under structural uncertainty captured by establishing model belief weights and obtaining a weighted average (expected) outcome under each alternative decision
- Spatial stratification will necessitate exploration of other methods such as genetic algorithms to derive optimal harvest decisions subdivided by geopolitical strata
- Establish initial model belief weights
- Make optimal decision based on these weights
- Make predictions of next years breeding population under each of the alternative models
- Compare observed population abundance to predictions and compute a likelihood for each model
- Adjust weights using Bayes' theorem:

$$P_j(t+1) = \frac{P_j(t) L_j(t)}{\sum_i P_i(t) L_i(t)}$$

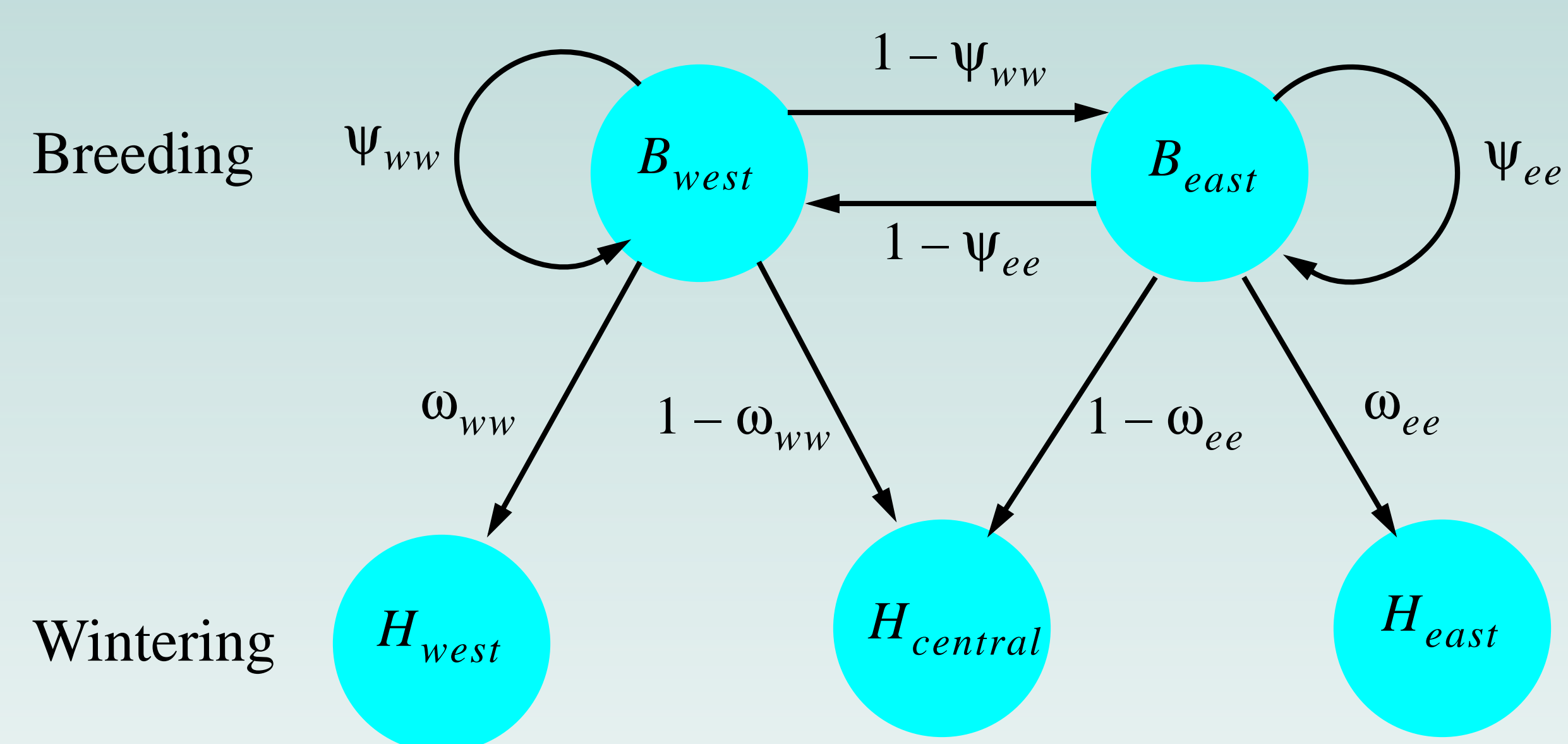
## Adaptive Harvest Management

- Quantifiable objective: *maximum long-term harvest*
- Defined set of decision alternatives: *regulation packages*
- Model describing population dynamics and impact of environmental conditions and harvest
- Explicit consideration of structural uncertainty: *compensation, competition*
- Method for reducing uncertainty through time: *Bayes' updating*

## Population Models



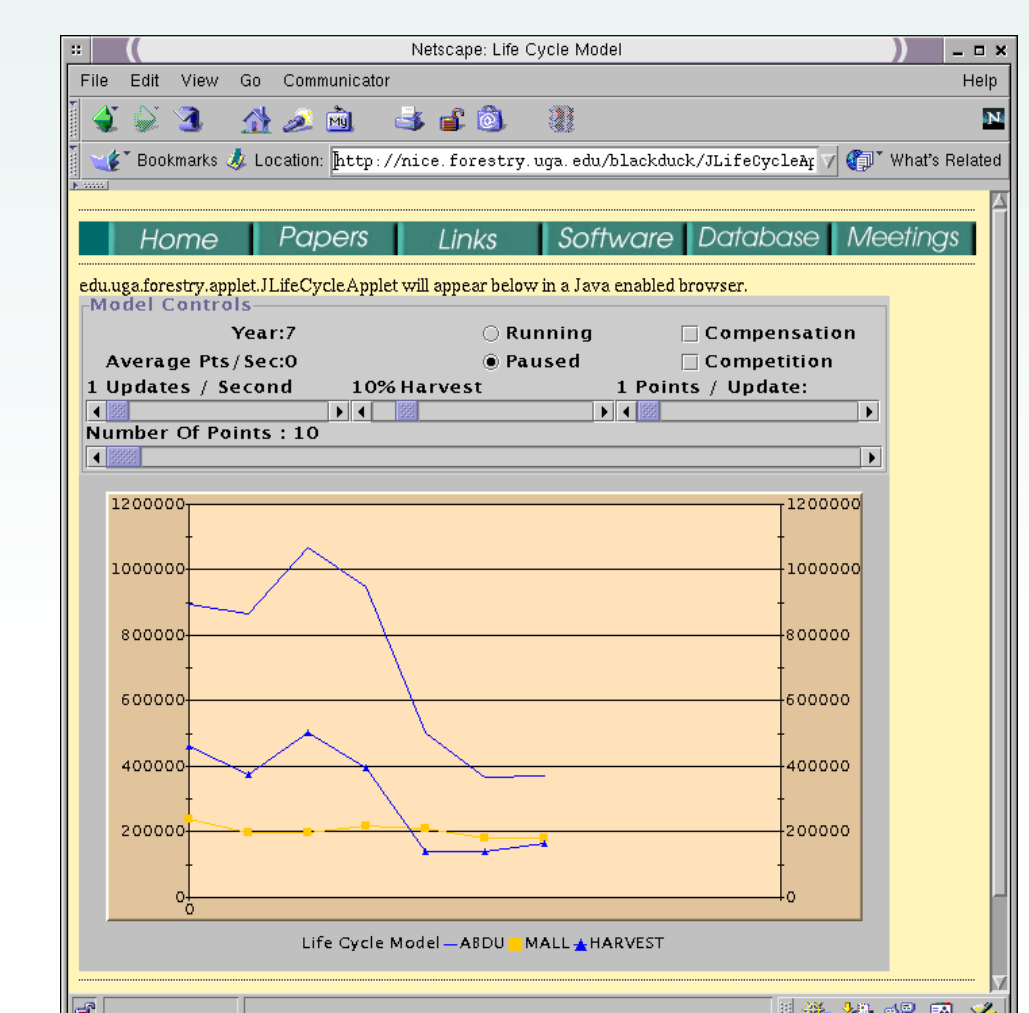
## Spatial Stratification of Models



## Project Website

Visit <http://fisher.forestry.uga.edu/blackduck> for project details and demos:

- Project overview
- Relational database
- Java applet demos
- Research papers



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