Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID:**   030-A

An Integrated Population Model for Minnesota Mallards

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 37,013

Proposed Project Time Period for the Funding Requested: 2 years, July 2016 to June 2018

Summary:

An integrated population model for Minnesota mallards that will synthesize survey, banding, and harvest data from all periods of the annual cycle to improve our understanding of mallard management.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Maps showing incomplete survey coverage for mallards in MN. Flow diagram of integrated population model.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

An integrated population model for Minnesota mallards that will synthesize survey, banding, and harvest data from all periods of the annual cycle to improve our understanding of mallard population dynamics.

PROJECT TITLE:
An Integrated Population Model for Minnesota Mallards

I. PROJECT STATEMENT
1. Mallards are one of the most heavily harvested and most intensively managed wildlife species in the state, and a thorough understanding of how annual reproduction and survival (including the effects of hunting on survival) affect population change is integral to effective conservation policies. Integrated population modeling is an innovative new tool that will allow us to combine information from different data sources (e.g., population surveys, banding data, harvest data) collected at different times of the year to determine which parts of the annual cycle have the greatest impact on population change of mallards in Minnesota. Such information will inform the most cost effective techniques for spending conservation dollars.
2. Our objectives are to synthesize survey, banding, and harvest data for mallards in Minnesota to provide:
    a) Improved state-wide population estimates of mallards throughout the <u>entire</u> state (current aerial surveys cover ~40% of the state)
    b) Determine which of the three major vital rates (fecundity, juvenile survival, adult survival) are the main drivers of population change for mallards in Minnesota.
    c) Identify components of the annual population cycle that are most poorly understood so that future research and monitoring can be as efficient and effective as possible.
3. We will use Bayesian modeling techniques to integrate mallard population data from the Minnesota DNR aerial waterfowl survey, the state-wide Breeding Bird Survey, and US Fish and Wildlife Service 4-square mile survey to better estimate historical population trends throughout the entire state (the DNR survey is the most precise survey, but covers only ~40% of the state). We will combine banding and harvest data to obtain annual estimates of fecundity (ratio of young to old mallards at the beginning of hunting season), juvenile survival, and adult survival to better predict the causes of annual population change. From these analyses, we will be able to determine if population change is primarily driven by reproduction (i.e. breeding habitat limitation) or by survival of adult females (i.e., potential for over-harvest by duck hunters).

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: (Data acquisition and summarization)   **Budget: $5,206**

We will acquire necessary data from cooperating agencies (i.e. banding, harvest, and survey data) and organize these data in preparation for formal statistical analysis (250 hours, Research Associate).

Outcome	Completion Date
1. Obtain and summarize harvest and parts collection data (obtained from U.S. Fish and Wildlife Service).	Dec 2016
2. Obtain and summarize banding and recovery data (obtained from U.S. Fish and Wildlife Service Bird Banding Lab).	Dec 2016
3. Obtain and summarize population survey data (MN DNR, USGS Breeding Bird Survey, USFWS 4-square mile surveys).	Dec 2016

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Activity 2: (Development of individual model components)   **Budget: $13,187**

Conduct formal analysis of banding, harvest, and survey data, prepare individual data components for integrated population modeling (250 hours, Research Associate, 30% PI time).

Outcome	Completion Date
1. Estimate annual fecundity from banding and harvest data.	Jun 2017
2. Estimate annual survival and recovery rates from band-recovery data.	Jun 2017

Activity 3: (Development of integrated population model)   **Budget: $18,620**

Use Bayesian modeling methods in program JAGS to develop historical models (1966-2011) of population size, annual fecundity, and annual survival rates for Minnesota mallards (70% of PI time).

Outcome	Completion Date
1. Develop integrated population model combining surveys, harvest, and survival.	Dec 2017
2. Conduct simulations to verify model predictions and performance.	Dec 2017
3. Prepare final report; disseminate formal results to waterfowl management community	Jun 2018

III. PROJECT STRATEGY
A. Project Team/Partners
University of Minnesota, ENRTF funds: $37,013

      Todd Arnold, Ph.D.   Role: data analysis, model building and simulations, writing
      Cristina de Sobrino, M.Sc   Role: data summary, organization, and analysis

B. Project Impact and Long-Term Strategy
Our project will help identify portions of the annual cycle that are most limiting to population growth of Minnesota mallards. Insights from other studies of mallards outside of their core breeding range in the Prairie Pothole Region have revealed that mallards in the Great Lakes States behave very differently than their prairie counterparts. An integrated population model for Minnesota mallards would allow us to obtain more reliable estimates of annual population size and ask better questions about factors that influence annual population change, such as the effect of annual harvest on adult female survival rate, or the effect of precipitation and habitat loss on annual fecundity.

C. Timeline Requirements
The project will begin with the acquisition of relevant data sets from cooperating partners (e.g., harvest data from USFWS). Organization and preliminary data analyses will be completed by December 2016. Formal data analysis and model development will be completed by June 2017. Final analyses and model evaluations will be completed by Jun 2018.

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2016 Detailed Project Budget

Project Title: An Integrated Population Model for Minnesota Mallards
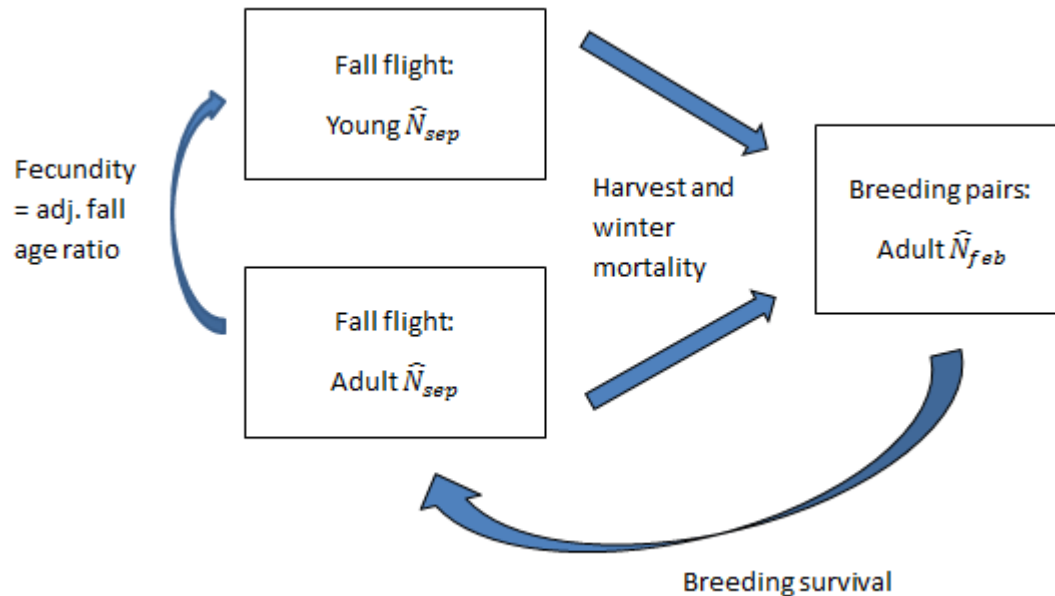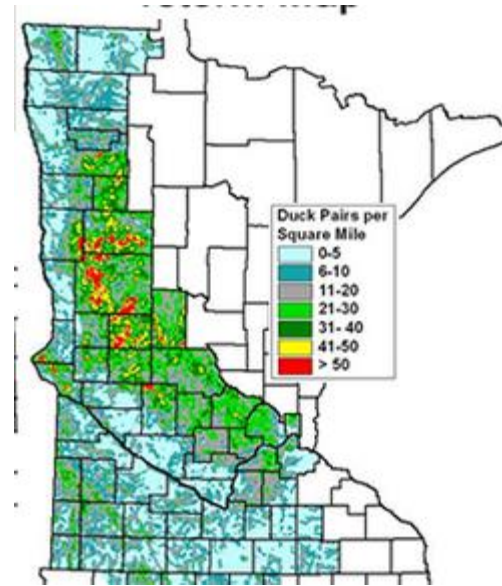
IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM	AMOUNT
Personnel:	
Principle investigator (2 months summer salary @ 10,000/month)	$ 20,000
PI fringe benefits @ 33%	$ 6,600
Research Associate (500 hours @17.50)	$ 8,750
Research Associate fringe benefits @19%)	$ 1,663
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 37,013

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period:	NA	
Funding History:	NA	
Remaining $ From Current ENRTF Appropriation:	NA	
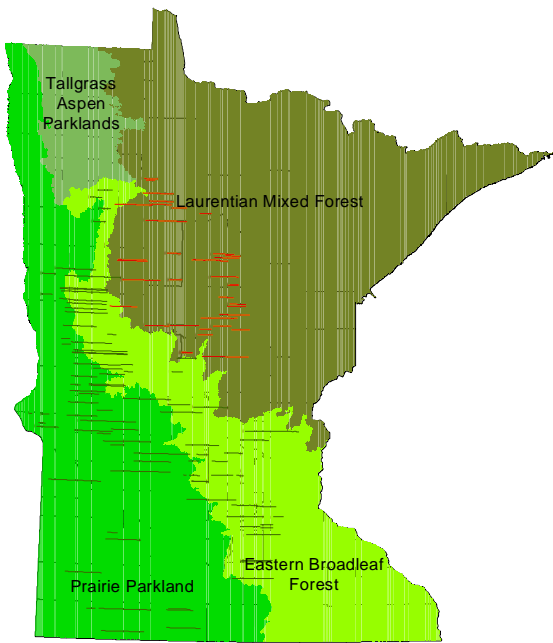
Maps showing incomplete coverage of DNR waterfowl surveys and USFWS breeding duck projections

Duck Pairs per Square Mile
- 0-5
- 6-10
- 11-20
- 21-30
- 31-40
- 41-50
- > 50

Tallgrass Aspen Parklands

Laurentian Mixed Forest

Prairie Parkland

Eastern Broadleaf Forest

Fecundity = adj. fall age ratio

Fall flight: Young $\widehat{N}_{sep}$

Fall flight: Adult $\widehat{N}_{sep}$

Harvest and winter mortality

Breeding pairs: Adult $\widehat{N}_{feb}$

Breeding survival

Conceptual diagram of integrated population model for mallards: breeding survey data provide estimates of breeding pairs. Harvest and banding data provide estimates of fecundity and fall flight size. Band recovery data provides estimates of harvest and natural mortality rates.

Project Manager Qualifications

Todd Arnold (Ph.D., Zoology, University of Western Ontario, 1990) is a Professor in the Department of Fisheries, Wildlife & Conservation Biology at the University of Minnesota. Prior to that, he was Senior Scientist at Ducks Unlimited Canada (1999-2002) and Scientific Director at Delta Waterfowl Foundation (1997-1999). He has published more than 80 papers in professional journals, including several recent papers on population ecology of mallards.

Cristina de Sobrino (M.Sc., Zoology, University of British Columbia, 1994) is a part-time Research Associate in the Department of Fisheries, Wildlife & Conservation Biology, where she has assisted on data summarization and analysis for research projects involving harvest derivation of mallards and American black ducks and survival of webless migratory gamebirds (e.g. summarizing banding and recovery data for American woodcock, sandhill cranes, American coots; analyzing banding data using Brownie and Seber models in Program MARK).

Organization Description:

The Department of Fisheries, Wildlife and Conservation Biology (FWCB) is one of 14 departments in the University of Minnesota's College of Food, Agricultural and Natural Resource Sciences. The mission of FWCB is to foster a high quality natural environment by contributing to the management, protection, and sustainable use of fisheries and wildlife resources through teaching, research, and outreach.

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