Thank you for signing in early

The webinar will begin promptly at 12:00 pm ET, 9:00 am PT
SERDP and ESTCP Webinar Series

- The webinar will begin promptly at 12:00 pm ET, 9:00 am PT

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    - (669) 900-6833 or (929) 205-6099
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- For questions or technical issues, please email serdp-estcp@noblis.org or call 571-372-6565
Variation in Phenological Shifts: How do Annual Cycles and Genetic Diversity Constrain or Enable Responses to Climate Change?

October 3, 2019
Welcome and Introductions

Rula A. Deeb, Ph.D.
Webinar Coordinator
Webinar Agenda

- Webinar Logistics
  Dr. Rula Deeb, Geosyntec Consultants (5 minutes)

- Overview of SERDP and ESTCP
  Dr. Kurt Preston, SERDP and ESTCP (5 minutes)

- Partnerships Enhance Scope and Scale of Phenology
  Research
  Dr. Julie Heath, Boise State University (25 minutes + Q&A)

- Full Annual Cycle Framework for Forecasting Species
  Response to Climate Change
  Mr. Jason Winiarski, Boise State University (25 minutes + Q&A)

- Final Q&A session
In Case of Technical Difficulties

- Use a compatible browser (Firefox, IE or Edge)
- If material is not showing on your screen or if screen freezes
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How to Ask Questions

- Find the Q&A button on your control bar and type in your question(s)
- Make sure to add your organization name at the end of your question so that we can identify you during the Q&A sessions
SERDP and ESTCP Overview

Kurt Preston, Ph.D.
Resource Conservation and Resiliency Program Manager
SERDP

- Strategic Environmental Research and Development Program
- Established by Congress in FY 1991
  - DoD, DOE and EPA partnership
- SERDP is a requirements driven program which identifies high-priority environmental science and technology investment opportunities that address DoD requirements
  - Advanced technology development to address near term needs
  - Fundamental research to impact real world environmental management
ESTCP

- Environmental Security Technology Certification Program
- Demonstrate innovative cost-effective environmental and energy technologies
  - Capitalize on past investments
  - Transition technology out of the lab
- Promote implementation
  - Facilitate regulatory acceptance
Program Areas

1. Environmental Restoration
2. Installation Energy and Water
3. Munitions Response
4. Resource Conservation and Resiliency
5. Weapons Systems and Platforms
Resource Conservation and Resiliency

- **Natural resources**
  - Ecological forestry
  - Arid lands ecology and management
  - Cold regions ecology and management
  - Pacific island ecology and management
  - Coastal and estuarine ecology and management
  - Living marine resources ecology and management
  - Species ecology and management
  - Watershed processes and management

- **Resilience**
  - Vulnerability and impact assessment
  - Adaptation science
  - Land use and carbon management

- **Air quality**
  - Wildland fire dynamics
  - Fugitive dust
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For upcoming webinars, please visit

Save the Date!

A three-day symposium showcasing the latest technologies that enhance DoD’s mission through improved environmental and energy performance

December 3-5, 2019
Washington Marriott Wardman Park

Registration is open
Partnerships Enhance Scope and Scale of Phenology Research

Julie Heath, Ph.D.
Boise State University
Agenda

- Why build research partnerships?
- Full Cycle Phenology project
- Approach for network development
- Results and product demonstration
- Conclusions
- Benefits to DoD
Migratory Birds and DoD Lands

- INRMPs supports training and testing mission
- DoD PIF expertise
- >70 migratory birds of conservation concern
- Found on >300 installations
- Proactive conservation precludes listing of additional birds as T&E

Notes:
INRMPs = Integrated Natural Resources Management Plans
PIF = Partners in Flight
T&E = threatened and endangered

Source: Bart et al. 2012, Coordinated Bird Monitoring
Phenology Mismatch
Climate Change and Vulnerability

Strong Climate and Life History Relationships

Great-Crested Flycatcher

Arrival Date

Temperature (°C)

Year

Indigo Bunting

Arrival Date

Temperature (°C)

Year

Shift in mean arrival date (days/°C)

Source: Hurlbert and Liang 2012
Breeding habitat quality + winter climate → reproductive success

Spring climate → migration rate; limits number of birds reaching breeding grounds

Migration stop-over sites → energy on way to wintering grounds

Winter climate and habitat quality → probability of spring migration survival into next breeding season

Events occurring during one period influence individuals and populations during subsequent periods

Source: Small-Lorenz et al. 2013
Research Locations

Large Spatio-temporal Scale

Fort Drum, New York
Full Cycle Phenology Project

- How do genetics and annual cycles of migratory birds affect phenological responses to climate change?
American Kestrels and Climate Change

- Generalist predator
- Diverse migration strategies
- Widespread, experiencing differential climate change
Approach: Full Annual Cycle Biology
Network Development

Multiple Outreach Methods
DoD Sites within Network

- **Flyway**
  - Central
  - Eastern
  - Western

The map shows various DoD sites across the United States, with different colors indicating the flyway regions.
Results: Monitoring

Source
- Citizen Scientist
- Department of Defense
- Non-profit Org.
- University

Annual cycle phase
- Breeding
- Migration
- Non-breeding
Results: Monitoring

A network approach creates a dataset at a unique spatial and temporal scale
Demonstration: Breeding Phenology

Timing of nesting correlated with start of growing seasons

Note: DOY = day of year; LCL = lower confidence limit; UCL = upper confidence limit
Results: Sampling

Source
- Citizen Scientist
- Department of Defense
- Nat. Resource Agency
- Non-profit Org.
- University
Results: Sampling

The network contributes biological samples at a unique spatial and temporal scale
Demonstration: Genoscape

- Spatially-explicit map of genetic structure in American kestrels

Note: K = genetically distinct group
Network Maintenance

- Important to have personnel to:
  - Manage permit applications and reports
  - Maintain personal communication and social media
Conclusions

- Full annual cycle research necessary to understand climate change effects
  - Challenging for migratory animals
- One approach: Large-scale network of partners
  - Demonstrated contributions to monitoring and sampling across the annual cycle of American Kestrels
Benefits to DoD

- Address research needs on appropriate scale and scope
  - Informs models for forecasting (next presentation)
- Support the objectives of the DoD Coordinated Bird Monitoring Plan
- Leverage other projects to inform species management on DoD lands
- Build relationship for collaboration on other projects
For additional information, please visit

Speaker Contact Information
julieheath@boisestate.edu; 208-426-3208
Full Annual Cycle Framework for Forecasting Species Responses to Climate Change

Jason Winiarski
Boise State University
Agenda

- Need for phenology model framework
- Project objectives
- Demonstration of a full cycle model
- Overview of the SCOPE model
- Conclusions
- Benefits to DoD

Note: SCOPE = Simulation of Carry-Over Effects on Phenology
Migratory Birds

Adaptations to Climate Change

Climate influences biology year-round; effects carry-over to different seasons

Source: Rockwell et al., 2012
Challenges to Annual Cycle Approach

- Data from single-season studies
- Many species difficult to track across:
  - Seasons
  - Vast geographic areas
- Events beyond installation boundaries
- Unable to manipulate field conditions
Challenge of Integration

- Response to climate change also likely depends on:
  - Genetic variation
    - Population-level changes over generations
  - Phenotypic plasticity
    - Individual-level response over lifetime
Current Approaches
Species Distribution Models

Mechanisms shaping responses often lacking
Ignore seasonal interactions

Figure credit: New York Invasive Species Research Institute
What is an Individual-Based Model?

- Simulated individuals interact with one another and virtual environment
- Decisions made to maximize fitness
- Basic ecological rules lead to emergent, complex patterns
- Allow for manipulative ‘experiments’

Note: IBM – Individual-Based Model
IBM Applications

Annual Productivity (Fledglings per female)

- 1.9
- 1

2010-2020
2090-2100
Project Objectives

- Develop full annual cycle IBM for the American kestrel
- Test mechanisms underlying phenological shifts
- Forecast future climate change impacts
- Apply IBM to DoD species of conservation concern
Case Study

Kestrels in Southwest Idaho

Neil Paprocki
Advancing Laydates and Winter Warming?

Note: °C = degrees Celsius
Testing Mechanisms Underlying Shifts

- Lay date inheritance
- Date available?
- Winter warming
- Pairing
- Breeding starts
- Breeding success
- Seasonal fitness decline
- Migrate?
Kestrel IBM in NetLogo

- **Other Data**
  - Date of non-migrators
  - Migration distance
  - Hatch date
  - Nest date
  - Origin mating proportion
  - Strategy mating proportion
  - Etc…
**Results**

*Warming winters release former constraints that drive advancement in laydate*

Note: hh = high heritability
Scaling up our Full Cycle IBM

Note: Red circles represent DoD study sites
Overview of SCOPE

Climate

Start-of-spring date

SCOPE

Testing and calibration

Phenology/climate/start-of-spring relationships

Test hypotheses

Forecasting
Next Steps

- Simulating populations across flyways
Conclusions

- Tools to realistically forecast population responses to climate change
  - Benefit to DoD managers
- Individual-based models
  - Help identify mechanisms underlying phenology shifts and forecast changes
- Better understand which species and populations can shift their timing
Benefits to DoD

- Forecasting tool for DoD Mission-sensitive Species
- Identify species with potential to constrain military training and readiness
- IBMs can inform more cost-efficient and effective management
Acknowledgments

- Dr. Ben Pauli
  - St. Mary’s University of Minnesota
- Anjolene Hunt, Katie Callery, Hanna McCaslin
  - Boise State University
- HawkWatch International, The Peregrine Fund, UCLA, Environmental Laboratory
  - US Army Corps of Engineers
- DoD Natural Resources Managers!
- DoD Partners in Flight
- Images - Creative Commons license (unless otherwise noted)
For additional information, please visit

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Q&A Session 2
The next webinar is on October 17, 2019

Managing Aqueous Film Forming Foam (AFFF) Impacts to Subsurface Environments and Assessment of Commercially Available Fluorine-Free Foams
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