Assessing the Importance of Wetlands on DoD Installations for the Persistence of Wetland-Dependent Birds in North America (Legacy 12-610)

Abstract

Wetlands are among the most imperiled ecosystems in the U.S. As a result, many wetland-dependent bird species have suffered population declines and are considered priority species for management at state, regional, and national levels. To ensure the long-term persistence of these species, we must identify and manage the wetlands on which they depend. The Department of Defense (DoD) should play a key role in managing wetland-dependent bird habitat in the continental U.S. We need to identify the DoD installations that provide optimal remaining habitat to ensure that these issues do not curtail the military mission and reduce military readiness, and to enable the DoD to better manage wetland-dependent bird habitat.

Ridgway's rail (*Rallus obsoletus*)

We integrated survey data collected with the North American Marsh Bird Monitoring Protocol between 1999 and 2012 with spatial data from the National Wetland Inventory (NWI) and Gap Analysis Program (GAP) to examine the influence of wetland characteristics (i.e., water regime, vegetative community, and anthropogenic alteration)and anthropogenic disturbance on the occupancy of 11 species of wetland-dependent birds (Ridgway's rail, clapper rail, king rail, Virginia rail, sora, common moorhen, purple gallinule, American coot, least bittern, American bittern, and pied-billed grebe) at 3 spatial scales (100-m, 225-m, and 500-m radii buffers surrounding survey points) at over 9,400 survey points across the U.S. With these data we developed habitat suitability models that quantify occupancy of each species across the continental U.S. and allow us to rank each DoD installation based on the quantity and quality of the habitat they provide.

We developed an effective hierarchical modeling and variable-selection approach that we have implemented for two species thus far—clapper rail and Ridgway's rail. We have identified a suite of key indicators of occupancy for these species. DoD installations with these features will be ranked favorably for each species. We have validated these models and are currently using the features specified from our models to project occupancy and rank DoD installations.

Project Specifics

Description of geographic setting: This project includes all DoD installations in the continental U.S.

Principal investigators: Dr. Courtney Conway, Unit Leader, U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho

Partners: U.S. Department of Defense (Legacy Program), University of Idaho, U.S. Geological Survey, Nebraska Game and Parks Commission, U.S. Fish and Wildlife Service.

Service branch: This project includes lands used by all DoD service branches.

Project location: This project will assess wetland-dependent bird habitat at all DoD installations in the continental United States.

Installation size: The DoD installations in the continental U.S. range in size from <1km^2 to >8,000,000 km^2.

Installation primary mission: This project will include all DoD installations in the continental U.S, thus the scope of this project pertains to the overall mission of the DoD: to provide the military forces needed to deter war and to protect the security of our country.

Project dates: June 2012 to May 2016.

Project point of contact: Dr. Courtney Conway, Unit Leader, U.S. Geological Survey Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, 875 Perimeter Drive, MS1141, Moscow, ID 83843. Phone: 208-885-6176. Email: cconway@uidaho.edu

Purpose/Need

Wetlands are among the most imperiled ecosystems in the U.S. As a result, many wetland-dependent bird species have suffered population declines and are considered priority species for management at state, regional, and national levels. To ensure the long-term persistence of these species, we must identify and manage the wetlands on which they depend.

The DoD should play a key role in managing wetland-dependent bird habitat in the continental U.S. Wetland complexes on DoD installations tend to be healthier than those on non-DoD lands due to restrictions on DoD land use. Hence, the DoD may manage a disproportionate amount of the remaining quality habitat for wetland-dependent birds in the U.S. The DoD already manages much of the remaining habitat for the federally endangered light-footed Ridgway's rail (*Rallus obsoletus levipes*) in California. DoD installations may be expected to shoulder the administrative burden if more species become federally listed as threatened or endangered. We need to identify the DoD installations that provide optimal remaining habitat to ensure that these issues do not curtail the military mission and reduce military readiness, and to enable the DoD to better manage wetland-dependent bird habitat.

Approach

Marsh bird survey data

We compiled marsh bird survey data from the North American Marsh Bird Monitoring Program (NAMBMP) database. The dataset included survey data collected at many locations throughout North America from 1999–2012. All surveys followed the North American standardized marsh bird survey protocol (Conway 2011). Each survey included both a passive and a call-broadcast segment. The suite of species' calls included in the call-broadcast portion of the survey varied among survey locations because the species expected to breed in those locations varied (e.g., calls were typically not broadcast in areas outside of a species' breeding range). However, we included data from all surveys for each species (whether a species was included in the broadcast sequence or not) because broadcasting calls of one species of marsh bird can elicit responses by sympatric species.

Surveys were conducted along routes—groups of geographically clustered survey points—so that all points on a route could be surveyed during the same morning or evening. For each species, we restricted our analyses to include survey data from routes: 1) that contained at least one survey point within the published breeding range, or 2) where at least one individual was detected. Hence, we included data from all surveys conducted in areas where breeding individuals could potentially occur, while ensuring that we did not exclude areas where individuals were detected during the breeding season even if they were outside of the published breeding range. We included data from surveys conducted over the duration of the breeding seasons of each species: 1 March–15 July. The ability of surveyors to detect bird calls during surveys is often negatively correlated with distance from the bird, thus, we only considered a point occupied if an individual bird was detected within 225 m of the surveyor. If no distance was recorded for a given detection we assumed the detection was within 225 m.

Habitat model development

We integrated marsh bird survey data with spatial data from the National Wetland Inventory (NWI) and the USGS National Gap Analysis Program (GAP) Land Cover dataset, Version 2, to examine the influence of wetland characteristics (i.e., water regime, vegetative community, and anthropogenic alteration) and anthropogenic disturbance on the occupancy of 11 species of wetland-dependent birds (Ridgway's rail, clapper rail, king rail, Virginia rail, sora, common moorhen, purple gallinule, American coot, least bittern, American bittern, and pied-billed grebe) at 3 spatial scales (100-m, 225-m, and 500-m radii buffers surrounding survey points). For each species, we split data into training and validation datasets (using a 70:30 split). We then created single-season and dynamic occupancy models (depending on the migratory patterns of each species) in the R package *unmarked*. Prior to assessing the influence of habitat variables on occupancy, we examined the influence of survey-specific variables on detection probability (e.g., time of day, date, broadcast length) while holding occupancy probability constant.

We then used a step-wise, hierarchical modelling approach to examine the influence of NWI and GAP variables on the occupancy of each marsh bird species. We began with variables representing the most general wetland features and then included variables

from more specific wetland features. Once these wetland variables were examined, we included GAP land cover variables into our models. For each type of wetland feature (or disturbance variable), we examined single-variable occupancy models, and then included all significant variables in multiple regression occupancy models. Upon completion of the modelling process, we assessed the predictive performance of the models by examining the Area Under the Curve (AUC) of a Receiver Operating Characteristic (ROC) plot. We compared AUC values across scales to determine the scale (100 m, 224 m, or 500 m) that best predicted occupancy. We used model coefficients from the model at that scale to project occupancy at each DoD installation.

Results

We have completed the modeling procedure outlined above for clapper rail and Ridgway's rail. For clapper rail, the model at the 224-m scale had the greatest predictive performance, with an AUC value of 0.835. This indicated good predictive performance of our model. Positive wetland (NWI) predictors of clapper rail occupancy at this scale included estuarine subtidal and intertidal wetlands, emergent vegetation, excavated wetlands, and tidal water regimes with water covering the surface throughout most the day and most of the growing season. Negative predictors of clapper rail occupancy were scrub-shrub and forested wetlands, and among the anthropogenic disturbance variables—agriculture and all levels of development.

The Ridgway's rail model at 224 m had the greatest predictive performance, with an AUC value of 0.826. Positive wetland predictors of Ridgway's rail occupancy at this scale included palustrine wetlands, riverine wetlands where water flows quickly throughout the year, and the seasonally flooded water regime. Anthropogenic disturbance variables with a positive association with Ridgway's rail occupancy included agriculture and low-intensity development. Negative predictors of Ridgway's rail occupancy included riverine wetlands where water flows slowly throughout the year or where flowing water is present for only part of the year, and the permanently flooded water regime. The disturbance variable, high-intensity development, was negatively associated with Ridgway's rail occupancy.

Having developed these models, we projected predicted occupancy probability of these two species across the U.S., focusing on the areas within and adjacent to DoD installations. Maps of predicted occupancy will allow us to examine and rank all DoD installations in terms of habitat quality and quantity for each marsh bird species.

Benefit

Failing to manage habitat for wetland-dependent birds has the potential to ultimately curtail the military's mission and reduce military readiness at many DoD installations if actions are not taken to protect important patches of habitat that sustain species of concern. Moreover, many emergent wetlands are not occupied by any wetland-dependent birds of management concern and identifying which wetlands have these priority birds present and which do not will help DoD carry out the military mission with minimal roadblocks. Furthermore, changes to wetlands on adjacent non-DoD lands may affect the species present on, and the conservation value of, DoD-managed wetlands. Hence, our findings will improve military readiness, improve range sustainment, and reduce the conflict between military needs and the needs of rare and endangered

wetland-dependent birds on DoD lands. By identifying the DoD installations that are most valuable to wetland-dependent birds, the DoD will be able to make proactive and scientifically sound decisions to reduce their impact on this imperiled natural resource. Furthermore, those DoD installations with wetlands that are most valuable to wetland-dependent birds (those that rank high in our modeling effort) will be able to incorporate this explicit information into their integrated natural resource management plans, therefore increasing their military readiness.

Recommendations/Lessons learned

Dealing with large datasets and many variables can pose a challenge to modeling efforts, but also poses an opportunity to develop unique and effective strategies to manage these data. We recommend taking time to develop means to assess the utility of the data intended for modelling purposes and to explore modelling approaches that allow the incorporation of all variables of interest. Our step-wise, hierarchical modelling approach was effective in eliminating uninformative variables, while ensuring that important wetland and anthropogenic disturbance variables were included in our models.

Communications

Findings from the first year of this project have been presented as an oral presentation at the Idaho Chapter of the Wildlife Society meeting in Pocatello Idaho, March 10-12, and as a research article in the journal, Wetlands: "Range-wide Wetland Associations of the King Rail" (issue 35: 577-587).