Using statewide data to model the habitat needs of nesting herons and egrets

Ardeid Landscapes

by Emiko Condeso

PHOTO BY INGRID TAYLAR OF GREAT BLUE HERON CARRYING NEST MATERIAL.

At the tail end of the California winter, when the number of rainy days declines and the sun shines more often than not, herons and egrets begin to appear at traditional nesting sites. They can be seen for a few hours at a time, here and there in the tall trees where, in a month or so, they may choose to build their nests. Elsewhere, throughout most of California, herons and egrets are similarly investigating new sites never before occupied by nesting Ardeids. There are many mysteries involved in nest-site selection. How do individuals assess their environment to determine which feeding area will be productive enough to provision nestlings? Which grove of trees will provide reasonable protection from disturbance? What branch will provide the best location to place a nest and advertise for a mate?

Although herons and egrets undoubtedly incorporate many different kinds of environmental cues into their site-selection process, it is becoming increasingly clear that large-scale features of the surrounding landscape, in addition to the more intuitively obvious local characteristics of the colony site, play an important role in determining where birds choose to nest and how successful they are. Several studies have shown that the distribution of waterbird colonies is influenced by habitat qualities in the surrounding landscape. That is, colonies tend to be located in places associated with particular

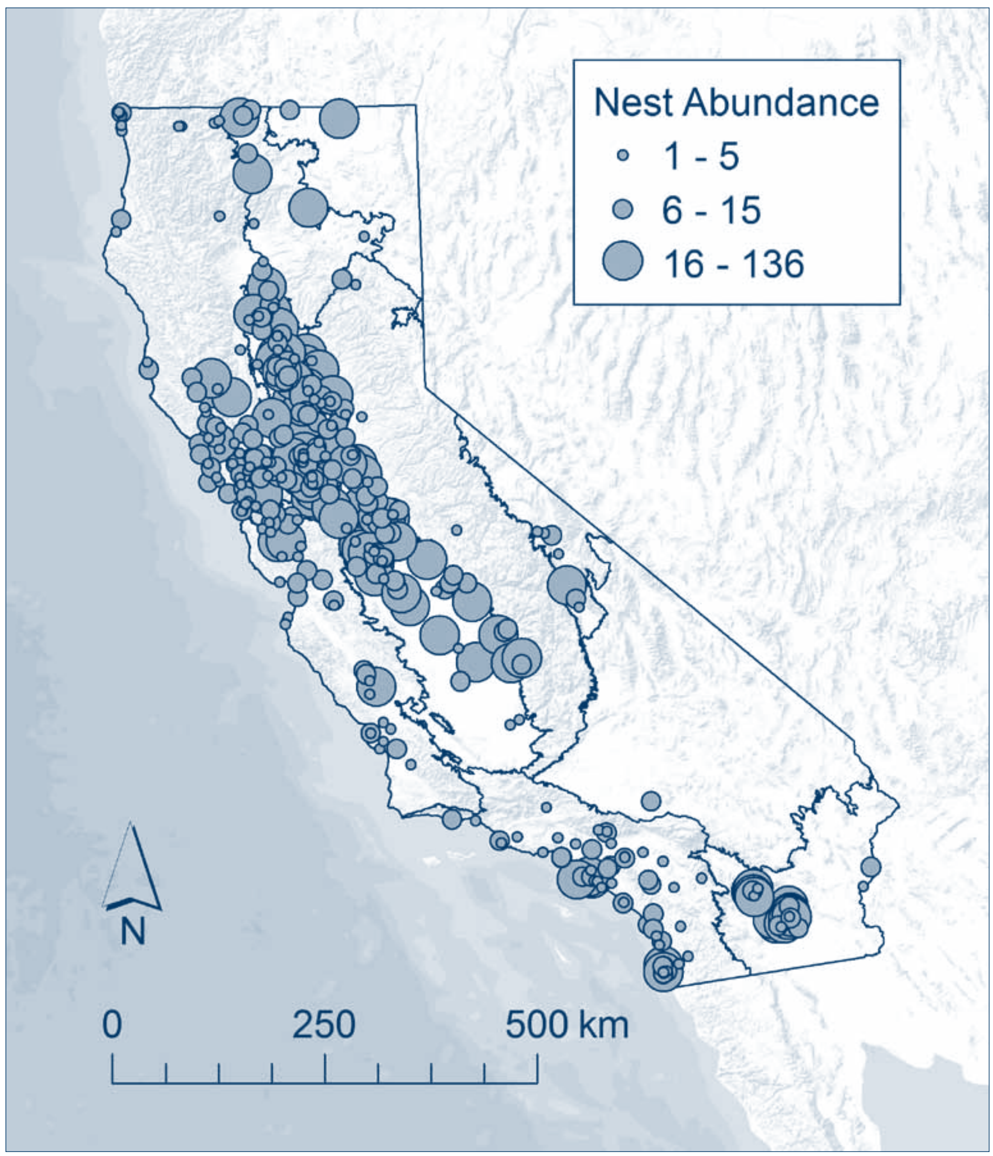

Figure 1. Distribution of Great Blue Heron nesting colony sites in California, 2009–2012 (Shuford, 2014). Symbol size indicates nest abundance, as shown. Solid boundary lines within the state indicate Jepson Ecoregions. Great Blue Herons generally nest in relatively small colonies, near suitable feeding areas in freshwater wetlands and tidal marshes, and along streams and rivers throughout most of the state. (Basemap data sources: ESRI, USGS, NOAA.)

Conservation Keys

- ACR is conducting the first statewide investigation of heron and egret habitat needs in California.
- The impacts of climate change on wetlands in California could dramatically affect the distributions and abundances of nesting herons and egrets.
- This study will be used to make recommendations for regional wetland conservation throughout California with regard to the habitat needs of herons and egrets.

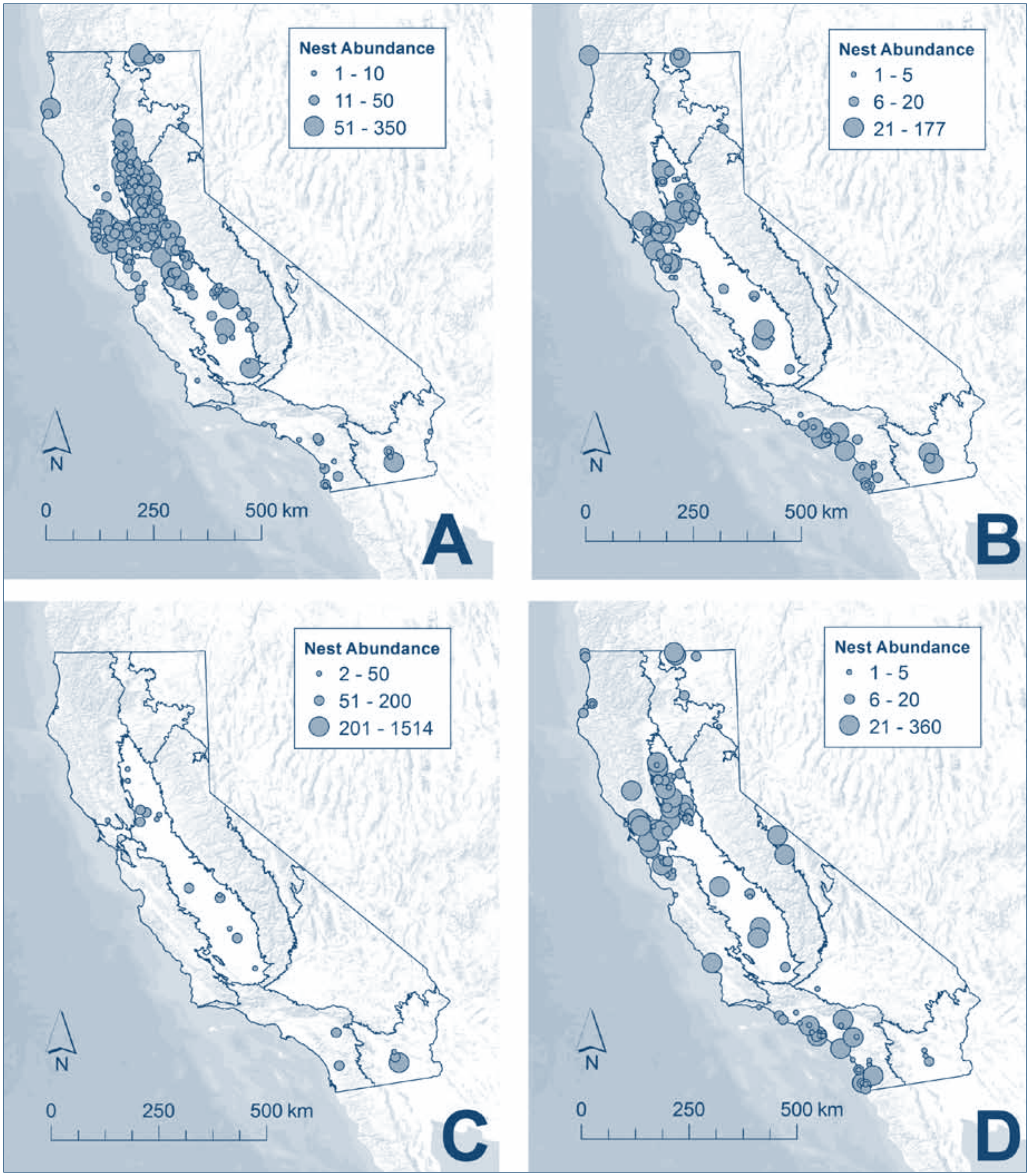

Figure 2. Distribution of (A) Great Egret, (B) Snowy Egret, (C) Cattle Egret, and (D) Black-crowned Night-Heron nesting colony sites in California, 2009–2012 (Shuford, 2014). Symbol size indicates nest abundance, as shown for each map. Solid boundary lines within the state indicate Jepson Ecoregions. (Basemap data sources: ESRI, USGS, NOAA.)

land cover and wetland features measured at scales as great as 10 km away from the actual nests (e.g. Elphick 2008; Kelly et al. 2008).

In 2011, ACR had the opportunity to collaborate with Point Blue Conservation Science on the first comprehensive survey of Ardeid nesting distribution and abundance for the state of California—part of the Western Colonial Waterbird Survey of several breeding species in 11 western states (Condeso and Sterling 2011, Shuford 2014). The wading bird subset of this effort, a statewide "snapshot" capturing the distributions and sizes of heron and egret colonies in California, now provides an ideal foundation for modeling the relationship between nesting abundance and associated landscape features within each county and Ecoregion in the state (Table 1). Great Blue Herons generally nest in smaller, more widely distributed colonies, while other species often form larger colonies and are more restricted in their distributions (Figures 1 and 2; Table 1). This investigation will delve intensively into the landscape conditions that account for current nesting distributions, specifically to determine which features strongly influence nesting abundances in important habitat areas.

Key landscape components, such as the amount of available wetland foraging habitat, the amount of developed land, human population density, and wetland habitat connectivity, will be measured at multiple scales and used to predict nest abundance for each of the five study species (Table 2, Figure 3). The final models will then be used to create a suite of predictive maps, each showing the colony size and nesting abundances expected given the habitat conditions within each county and ecoregion in California.

Conservation targets

Model outputs will be summarized by relevant natural and political boundaries, such as Jepson Ecoregions and counties, for ease of interpretation by local governments and land managers. Comparison of modeled suitability and actual survey data will identify significant matches and mismatches, providing the opportunity to not only improve the model but also to critically examine specific regions in the state that may be important conservation targets. For example, areas of the state that are modeled as highly suitable, but do not currently support many nesting birds, may be brought onto the "radar" of land managers and local governments as potentially valuable resources deserving of protection. Areas of low

Table 1. Estimated average colony size (standard deviation), total number of nesting sites, total nest abundance, and the percent of the statewide nest abundance for five species of Ardeids (2009–2012), summarized by Jepson Ecoregion.

Ecoregion / Species	Mean colony size (Std dev)	Number of colony sites	Nest abundance	Percent statewide nest abundance
Cascade Ranges				
Black-crowned Night-Heron	0 —	0	0	0.0
Cattle Egret	0 —	0	0	0.0
Great Blue Heron	9 (4.6)	7	60	1.1
Great Egret	51 (69.2)	2	102	1.3
Snowy Egret	0 —	0	0	0.0
Central Western California				
Black-crowned Night-Heron	21 (23.8)	16	341	13.9
Cattle Egret	0 —	0	0	0.0
Great Blue Heron	7 (5.7)	67	454	8.3
Great Egret	24 (24.3)	27	636	7.9
Snowy Egret	38 (38.0)	16	607	32.2
East of the Sierra Nevada				
Black-crowned Night-Heron	36 (6.4)	2	71	2.8
Cattle Egret	0 —	0	0.0	
Great Blue Heron	6 (5.7)	7	44	0.8
Great Egret	0 —	0	0.0	
Snowy Egret	0 —	0	0.0	
Great Central Valley				
Black-crowned Night-Heron	35 (64.6)	32	1111	45.4
Cattle Egret	58 (54.6)	14	813	30.3
Great Blue Heron	19 (21.0)	158	2959	54.1
Great Egret	56 (71.0)	107	5992	75.2
Snowy Egret	27 (39.3)	25	669	35.4
Modoc Plateau				
Black-crowned Night-Heron	33 (52.1)	5	166	6.8
Cattle Egret	0 —	0	0.0	
Great Blue Heron	23 (13.3)	3	68	1.2
Great Egret	87 (121.8)	6	521	6.5
Snowy Egret	13 (8.3)	3	38	2.0
Mojave Desert				
Black-crowned Night-Heron	3 (<0.1)	1	3	0.1
Cattle Egret	0 —	0	0.0	
Great Blue Heron	8 (<0.1)	1	8	0.1
Great Egret	0 —	0	0.0	
Snowy Egret	0 —	0	0.0	
Northwestern California				
Black-crowned Night-Heron	39 (59.3)	8	308	12.6
Cattle Egret	40 (<0.1)	1	40	1.5
Great Blue Heron	10 (16.1)	41	390	7.1
Great Egret	12 (23.6)	11	213	2.6
Snowy Egret	31 (43.4)	4	125	6.6
Sierra Nevada				
Black-crowned Night-Heron	0 —	0	0	0.0
Cattle Egret	0 —	0	0	0.0
Great Blue Heron	13 (13.9)	22	290	5.3
Great Egret	26 (30.1)	9	230	2.9
Snowy Egret	2 (0.7)	2	3	0.2
Sonoran Desert				
Black-crowned Night-Heron	4 (4.0)	3	13	0.5
Cattle Egret	567 (822.4)	3	1701	63.5
Great Blue Heron	31 (36.6)	23	721	13.2
Great Egret	22 (32.0)	6	129	1.6
Snowy Egret	24 (3.2)	3	71	3.8
Southwestern California				
Black-crowned Night-Heron	12 (13.4)	38	436	17.8
Cattle Egret	65 (1.4)	2	124	4.6
Great Blue Heron	7 (7.6)	67	473	8.7
Great Egret	12 (14.2)	13	150	1.9
Snowy Egret	14 (17.1)	26	375	19.7

modeled suitability may be obvious targets for future wetland restoration efforts.

The predictive maps will also be useful, when combined with other readily available models related to climate change and sea-level rise, for examining future risks to wading birds in California. In previous work, we highlighted one of the potential ways heron and egret populations may be impacted by climate change—their responses to altered patterns of rainfall (Kelly and Condeso 2014). Heavy winter or spring rainfall and increased winter storminess, may cause declines in the annual growth or resilience of heron and egret nest abundances. Additionally, in regions where prey species are particularly sensitive to periods of drought, nest abundances may decline with reduced rainfall.

Predictions of future rainfall in California vary considerably, depending on the climate model and emissions scenario involved. Therefore, to identify areas of conservation concern, it will be useful to compare the current distribution of colonies to predicted patterns of colony site suitability in California, based on various climate futures. In addition, future iterations of the model may take into account predicted ways that wetland foraging habitat, and therefore colony suitability, may change with rising sea level (Figure 4). As the configuration of tidal marshes evolves in California, these models will allow the needs of herons and egrets to be included in climate adaptation planning.

Because herons and egrets select nesting locations in response to the quality of their environment at the regional or landscape scale (Figure 5), it follows that their nesting abundances will also be influenced by land management practices that occur at this scale. For example, changes in the water use practices in the California's Central Valley agricultural fields could have dramatic implications for future heron and egret nesting abundances and distributions (Elphick 2008). These and other changes in the management of California landscapes have the potential to greatly impact the status of wading birds and other wetland-dependent wildlife in the state. A more precise understanding of the relationship between landscape features and nesting distribution and abundance may be a critical component of wetland restoration and climate-change mitigation in California's uncertain future.

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Table 2. Landscape metrics used in modeling statewide nest abundance for five focal wading bird species (Great Blue Heron, Great Egret, Snowy Egret, Black-crowned Night-heron, and Cattle Egret). Estimated rainfall at each colony site (PRISM Climate Group, Oregon State University) and survey year will also be incorporated as predictors into the models.

Metric	Scales of measurement (radius in km)	Predicted influence on nest abundance
Area of wetland foraging habitat Tidal wetland Non-tidal wetland Irrigated/agriculture land Small open water bodies Creeks and streams	1, 10	Increase, at medium and large scales.
Area of suitable nest substrate: Woodland/forest Large woody shrubs	0.1, 1	Increase, at small and medium scales.
Area of developed land	0.1, 1, 10	Decrease, at all scales.
Human population density	0.1, 1	Decrease, at small and medium scales.

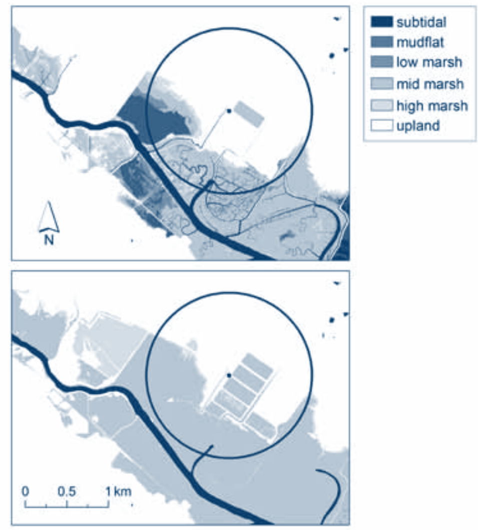

Figure 4. (A) Current (2010) and (B) projected (2110) tidal marsh elevations in the vicinity of an active Great Blue Heron nesting site in Petaluma, Sonoma County (Stralberg et al. 2011). Although this model predicts that, under a scenario of low sedimentation and modest sea-level rise (0.52 m/century), tidal marsh will persist here, the habitat is projected to be of a different character and considerably less complex than what is currently present. Our habitat associations model will help determine the extent to which the current heron and egret nest site distribution in California may change given future changes in coastal wetlands.

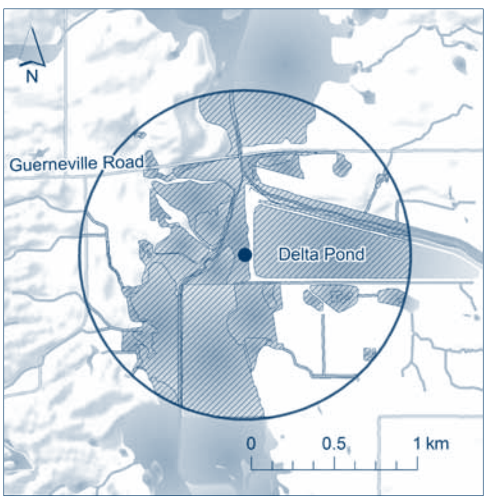

Figure 3. Illustration of foraging habitat calculation. The filled black symbol indicates the center of the colony site at Delta Pond in the Laguna de Santa Rosa, Sebastopol, Sonoma County. Available foraging habitat is estimated by summing the areas of wetland (diagonal fill) within the illustrated 1-km radius around the site center. The lengths of creeks and streams within the circular boundary are also summed as a complementary index of foraging habitat availability.

Figure 5. Great Egrets nesting at ACR's Martin Griffin Preserve, shown here, responded to localized Bald Eagle disturbance by moving to another nearby colony site, where they can continue to provision their nestlings by foraging in the rich feeding areas of Bolinas Lagoon. Photo by Larry Goodwin.

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