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Key Areas for Wintering North American Herons

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Abstract.—Nearly all North American heron populations are migratory, but details of where they winter are little known. Locations where North American herons winter were identified using banding recovery data. North American herons winter from Canada through northern South America but especially in eastern North America south of New York, Florida, California, Louisiana, Texas, Mexico and Cuba, these areas accounting for 63% of winter recoveries. We identified regions where recoveries for various species clustered as “key areas.” These forty-three areas constitute a network of areas that hold sites that likely are important to wintering North American herons. Within each area, we identify specific sites that are potentially important to wintering herons. The relative importance of each area and site within the network must be evaluated by further on the ground inventory. Because of biases inherent in the available data, these hypothesized key areas are indicative rather than exhaustive. As a first cut, this network of areas can serve to inform further inventory activities and can provide an initial basis to begin planning for the year-round conservation of North American heron populations. *Received 2 April 1996, accepted 14 May 1998.*

Key words.—Ardeidae, banding, bitterns, Caribbean, Central America, conservation, egrets, habitat, herons, migration, North America, ringing, South America, wetlands, wildlife.

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Conservation of herons in North America has to date concentrated on protecting nesting sites and associated feeding areas. Preservation and management of these breeding season sites are clearly crucial to the continued maintenance of continental heron populations (Parnell *et al.* 1988). However, less attention has been paid to conservation of wintering sites, even though winter conditions are appreciated to be important to herons elsewhere. For example, population stability of Grey Herons (*Ardea cinerea*) in Great Britain is affected by winter severity and that of Purple Herons (*Ardea purpurea*) in the Netherlands, by conditions at wintering sites in West Africa (North and Morgan 1979; den Held 1981; Cave 1983).

Nearly all North American heron populations are migratory (Hancock and Kushlan

1984). Several studies over a 50 year period have examined aspects of the migration and wintering destination of various species (Coffey 1943, 1948; Dusi 1967; Browder 1973; Byrd 1978; Ryder 1978), as have derivative evaluations such as those by Hancock and Kushlan (1984) and in the Birds of North America series (e.g., Butler 1992; Gibbs *et al.* 1992a, 1992b; Davis 1993; Davis and Kushlan 1994; Telfair 1994). Wintering areas within the United States were evaluated using Christmas Bird Count data (Root 1988). What is not yet accomplished is to identify specific areas and sites within a heron species' total range that support significant numbers or proportions of its population during winter.

In this study, we have attempted to identify key areas for wintering North American

herons using recoveries of birds banded in North America. We hope the results provide a starting point for future species-specific site evaluations, initial guidance for geographic and species conservation plans, and a foundation for a network of conservation reserves specifically recognized as important for North American herons.

METHODS

We used banding recovery data provided by the Bird Banding Laboratory, USGS Patuxent Wildlife Research Center, to determine locations where herons banded in North America were recovered during winter. In most cases (83% of total) birds were banded as nestlings or fledglings. We report on recoveries made during December-January to ensure that they represent locations of wintering birds.

Recovery locations were plotted at the available accuracy level of the nearest 10-minute block of latitude and longitude. Because coordinates for Mexican recoveries were unavailable prior to June 1989, these recoveries were allocated to larger regions, and were plotted at randomly assigned coordinates within their region.

To identify key areas for each species in North America, we clustered points representing 5% or more of all winter recoveries for the species. The lower probability

of reporting in Central America and the Caribbean required that each recovery in the area be given more weight. In these cases, we used a 1% recovery level. Given the biases of the data set, we elected to identify only relatively large key areas rather than specific key sites, although we are able to suggest some potentially important locales within areas based on recovery data and information on the location of significant wetlands. At this level of resolution, clustering of recovery points into key areas proved unambiguous.

RESULTS

Key Areas for Species

We evaluated 851 recoveries from 62 US states and countries. The dispersion confirms that herons winter over most of North America, depending on species, from southern Canada, through coastal and some inland United States, into Central America, the Caribbean, and northern South America. Applying criteria on a species basis, these resolved into 43 key areas (Fig. 1, Table 1).

Key areas in North America are located along much of the Pacific, Gulf of Mexico,

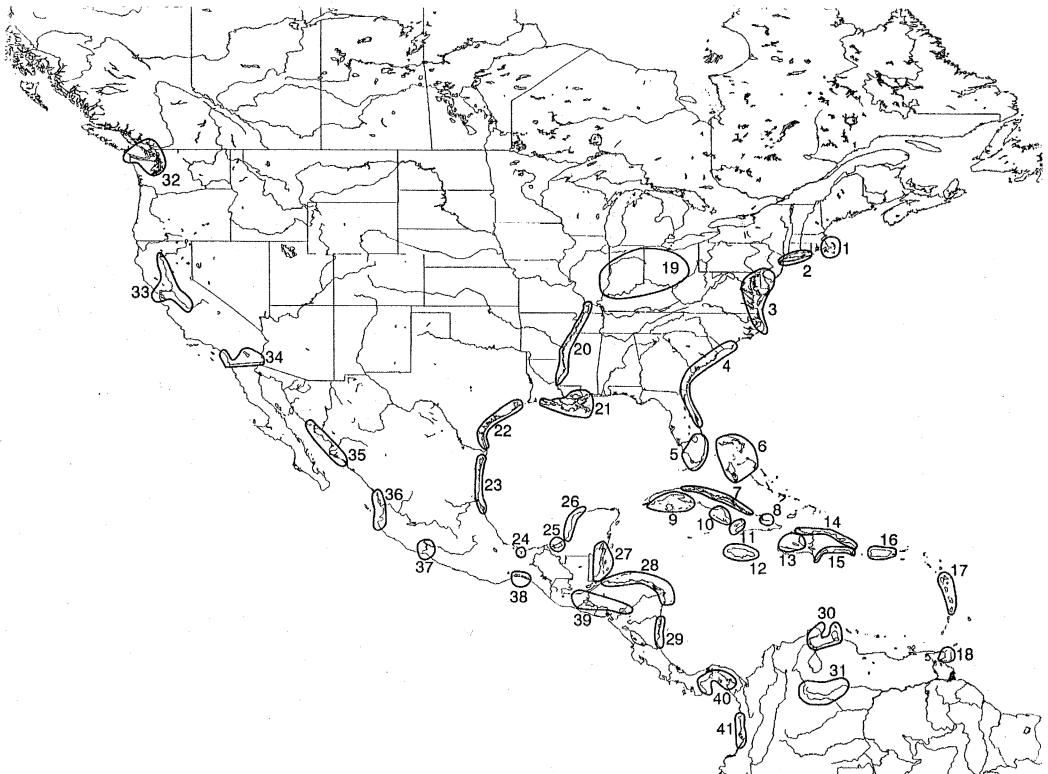


Figure 1. Key areas for wintering North American herons.

Table 1. Key areas for wintering North American herons.

| Area Numbers | Area Names | Great Blue | | Little Blue | | Tricolored Heron | Cattle Egret | Black Crowned Night Heron | |
|--------------|---|------------|-------|-------------|-------|------------------|--------------|---------------------------|-------|
| | | Heron | Egret | Heron | Egret | | | Heron | Egret |
| 1 | USA, S New England | | | | | | | X | |
| 2 | USA, Long Island | | | | | | | X | |
| 3 | USA, Mid-Atlantic Coast | | | X | | X | | X | |
| 4 | USA, SE Atlantic Coast | X | | X | | X | | X | |
| 5 | USA, S Florida | X | | X | | X | | X | |
| 6 | Bahamas | X | | X | | | | | |
| 7 | Cuba, N Coast | X | | X | | | X | | |
| 8 | Cuba, Bahia de Nipe | X | | | | | | | X |
| 9 | Cuba, Golfo de Batabano | X | | X | | X | X | X | X |
| 10 | Cuba, Bahia de Ana Maria | X | | X | | X | | X | X |
| 11 | Cuba, Golfo de Guacanayabo | | X | X | | X | | | X |
| 12 | Jamaica | | | | | | | | |
| 13 | Haiti, Golfe de la Gonave | | | X | | | | | |
| 14 | Hispaniola, N Coast | | | X | | X | | | |
| 15 | Dominican Republic, S Coast | X | | | | X | | | |
| 16 | Puerto Rico | | X | X | | X | | | |
| 17 | Lesser Antilles | | | X | | | | | |
| 18 | Trinidad | | | X | | | | | |
| 19 | USA, Midwest | X | | | | | | | |
| 20 | USA, Lower Mississippi | | X | X | | | | | |
| 21 | USA, Mississippi Delta | | X | | | | | | |
| 22 | USA, Texas Coast | | X | | | | | | |
| 23 | Mexico, Tamaulipas, N Vera Cruz Coast | X | | X | | X | X | X | X |
| 24 | Mexico, S Vera Cruz Coast | | | | | X | X | | |
| 25 | Mexico, Tabasco | | | | | X | X | | |
| 26 | Mexico, Yucatan, Campeche Coast | | | | | X | X | | |
| 27 | Belize | | | | | | | | |
| 28 | Honduras, Nicaragua, Caribbean Coast | X | | | | X | | | |
| 29 | Coast Rica, Caribbean Coast | X | | X | | | | | |
| 30 | Venezuela, Golfo de Venezuela | | | X | | | | | |
| 31 | Venezuela, Llanos de Orinoco | | | X | | | | | |
| 32 | Canada, Strait of Georgia: USA, Puget Sound | X | | | | | | | |
| 33 | USA, Central California | X | | | | | | | X |

Table 1. (Continued) Key areas for wintering North American herons.

| Area Numbers | Area Names | Great Blue Heron | Great Egret | Snowy Egret | Little Blue Heron | Reddish Egret | Tricolored Heron | Cattle Egret | Black Crowned Night Heron |
|--------------|-------------------------------|------------------|-------------|-------------|-------------------|---------------|------------------|--------------|---------------------------|
| 34 | USA, S California | | | X | | | | | |
| 35 | Mexico, Sonora, Sinaloa Coast | X | X | X | | | | | X |
| 36 | Mexico, Nayarit Coast | X | X | X | | | | | |
| 37 | Mexico, Guerrero Coast | X | | X | | | | | |
| 38 | Mexico, Oaxaca Coast | | | X | | | | | |
| 39 | Guatemala, Honduras | | | | X | | X | | |
| 40 | Panama, Pacific Coast | | X | X | X | | | | |
| 41 | Colombia, Pacific Coast | | | | X | | | | |
| 42 | Mexico, E Inland | | | | | | | X | |
| 43 | Mexico, W Inland | | | | | | | X | |

and Atlantic coasts of Canada and the United States, the lower Mississippi River flood plain, and the interior midwest south of the Great Lakes. Key areas also occur on Caribbean islands, along the coasts of Mexico, Central America, and northern South American coast, and in inland Mexico and Venezuela. Eastern North America, Florida, California, Louisiana, Texas, Mexico and Cuba account for 63% of winter heron recoveries.

Key area use differs among heron species (Table 1). The Great Blue Heron (*Ardea herodias*) has the widest wintering distribution of North American herons, remaining as far north as southern Canada, with key areas occurring in Puget Sound, central California, and the midwest. Few locales in the USA qualify as key areas by our criteria because individual birds tend to be well dispersed. Key areas south of the USA are located along both Mexican coasts and as far south as Hispaniola.

The Great Egret (*Casmerodius albus*) also winters relatively far north, from Oregon to Panama on the Pacific coast, the Mississippi flood plain, and along the Atlantic coast from New Jersey to the Lesser Antilles. Key areas are located along most of this range including the North American Atlantic coast, south to Cuba and the other Greater Antilles, in the continental interior from midwest USA, along the Mississippi, the coasts of Texas and Mexico into Central America.

The Snowy Egret (*Egretta thula*) winters along the Pacific coast from central California to Central America, along the Gulf of Mexico and Caribbean, along Atlantic coastlines from New Jersey south to the Antilles, coastal Venezuela and French Guiana. Key areas are located along the Atlantic coast of the United States, Bahamas, Cuba and the other Greater Antilles, the Gulf coast into Central America, and the Pacific coast from California to Panama.

The Little Blue Heron (*Egretta caerulea*) winter range includes the Atlantic coast from New Jersey south through the Caribbean Basin and Gulf of Mexico. Key areas are located along the Atlantic coast of USA, Bahamas, Greater and Lesser Antilles to Venezuela, the

lower Mississippi, the Gulf coasts of Mexico, and the Pacific coast of Central America.

The Reddish Egret (*Egretta rufescens*) winters from Texas and Florida south to Guatemala and El Salvador. Key areas identified are along the Mexican Gulf coast, reflecting banded birds from Texas.

The Tricolored Heron (*Egretta tricolor*) wintering range extends along the USA Atlantic coast from New Jersey, Greater Antilles, the Mississippi Delta, and coast of Gulf of Mexico through Central America as far as Ecuador. Key areas are located along the US Atlantic coast, the Mississippi delta, Gulf of Mexico coast of Texas and Mexico to Central America, and the Greater Antilles.

The Cattle Egret (*Bubulcus ibis*) winters primarily south of the USA in Mexico, Central America, the Greater Antilles, and into South America. Key areas are located primarily in Cuba and coastal and inland Mexico.

The Black-crowned Night-heron (*Nycticorax nycticorax*) winters relatively far north, typically along the Atlantic coast from Massachusetts south through the Greater Antilles to the Lesser Antilles, on the Pacific coast from California to Panama, and along the Gulf of Mexico coast. Key areas are located along the US Atlantic coast to Cuba, Jamaica, and Gulf coastal Mexico. On the Pacific, key areas are located in Central California and Mexico.

Several species had too few recoveries to be able to apply the selection criteria for identifying key areas. The three winter recoveries for the American Bittern (*Botaurus lentiginosus*) are in Delaware and Alabama. Green Heron (*Butorides virescens*) recoveries included the west and Gulf coast of Mexico. The Yellow-crowned Night-heron (*Nyctanassa violacea*) recoveries included coastal Louisiana, South Carolina and the Gulf coast of Mexico. The single winter recovery of the Least Bittern (*Ixobrychus exilis*) away from the nesting area was a Michigan banded bird recovered in South Carolina.

Potentially Important Sites

Due to the limited number of banding recoveries for use in identifying wintering lo-

cales, we confined our evaluation to relatively large areas, our goal being to define important areas for each species as a basis for further, more site specific, inventories. Nonetheless consideration of specific recovery locations and knowledge of habitats and sites encompassed within key areas allow identifying more precise locations that may be among those supporting wintering populations within the key area. As is the case with key areas, these sites should be considered hypothetical and worthy of more intensive inventory.

In the Mid-Atlantic Coast area, sites used included the New Jersey coast near Wildwood and Atlantic City, Delaware River, Delaware Bay, Chesapeake Bay, Assateague Island, and coastal wetlands from Virginia Beach south to the Virginia border. The Southeastern Atlantic coast encompasses extensive areas of potential habitat including James Island south of Charleston, coastal wetlands near Savannah, Okefenokee swamp, St. Johns Marshes, Florida coastal wetlands south of Daytona Beach and along the Indian River lagoon, and many other scattered swamps. The southern Florida key area includes the Everglades, Big Cypress Swamp, Florida Bay, and Biscayne Bay, much of the area being national parks and other conservation reserves.

Many Bahamas islands are used by wintering or migrating herons, particularly Andros and wetlands near Nassau, the northern coast of Grand Bahama, and the Marls on Great Abaco island. Other sites include the Bluff wetlands on Eleuthera Island, Bennett's Harbour Creek on Cat Island and Inagua National Park and Lake Rosa on the Great Inagua Island.

The Greater Antilles provide wintering sites for North American herons. Several potential key areas occur in Cuba, along both the northern and southern coasts. Potentially important sites include the coast of the Golfo de Batabano and the Zapata Swamp, Jibaro wetlands, and Golfo de Ana Maria. Along the north coast are potentially important coastal lagoons, bays, and wetlands from San Antonio de los Banos and Havana, through the coastal wetlands of the Bahia de

Cardenas, Archipiélago de Sabana and Archipiélago de Camaguey. In Jamaica, the key area includes Luana Swamp and Black River Lower. In Haiti, recoveries near Cap Haitien suggest that Baie de Forte Liberte is an important wintering locale in that region. In the Dominican Republic, wetlands along the north coast are Luguna Limon, Laguna Redonda, and Rio Yuna. Along the south coast are Parque Nacional del Este, the estuaries of the Rio Higuamo and Rio Soco and Cayos Siete Hermanos. In Puerto Rico, both north and south coasts include sites. Cibuco Swamp is on the north coast; the La Parguera wetland and Bahia de Jobos are on the south coast.

In the Lesser Antilles, wetlands occur scattered on a number of the islands, including St. Thomas, Baie de Fort-de-France and southern tip of Martinique, and Grand Cul-de Sac Marin mangrove swamps on Guadeloupe. Recoveries also exist from Saint Lucia, Dominica, and Trinidad.

The Mississippi River and adjacent flood plain appear to provide substantial wintering habitat, especially along the lower Mississippi Alluvial Valley and near its delta in Louisiana including marshes along West Cote Blanche, Cameron, Baratria Bay, and the Atchafalaya basin.

Further west along the Gulf of Mexico, herons winter along the coastal lagoons from Texas through Mexico. Potentially important sites include Galveston Bay, the Laguna Madre, the Tampico lagoons including Laguna de Tamiahua and the deltas of Rio Panuco and Rio Tamesi. Further south are the Tabasco lagoons from Laguna Camparonera and Laguna Alvarado through the delta of Rio Usumacinta to Laguna de Terminos. Although a surprising few recoveries appeared from the Tabasco lagoons, these freshwater marshes, mangrove swamps, seasonally inundated wetlands, and brackish lagoons are likely of importance to wintering North American herons. On Yucatan, recoveries occur around Ria Largatos, Bahia del Espiritu Santo and Sianka'an.

In Central America, herons use the coastal and inland wetlands lagoons of Belize, Honduras, Guatemala, and Nicaragua. Po-

tentially important sites of Belize include the New River, Shipstern Lagoon, Bahia Chetumal, Farbers Lagoon, and Punta Ycacos Lagoon. Potentially important sites continue into Honduras including Laguna de Los Micos and the Rio Ulua Delta, Laguna de Guaymoreto and the Rio Aguan Delta and Laguna de Caratasca; in Guatemala, Bahia de Amatique and Rio Dulce, to Lago de Izabal; in Nicaragua, Laguna de Bismuna through the Matagalpa Delta.

A few recoveries are widely distributed in northern South America. In Venezuela, important sites appear to occur along the Caribbean coast particularly around Peninsula de Paraguana and along Lago de Maracaibo including the marsh complex of Ciénegas de Juan Manuel, Aguas Blancas, and Aguas Negras. In Colombia, herons occur from Laguna Fuquene through Ciénega de Guajaro and inland to Ciénega de Ayapel, as well as in the llanos seasonal wetlands of the Orinoco River basin.

In western North America, herons winter relatively far north including Puget Sound, San Francisco Bay and the San Joaquin—Sacramento valleys. In southern California herons winter from the Pacific coast to the Colorado River including the Imperial Valley, the Brasos River, lower Colorado River, and Salton Sea.

Along the Mexican Pacific coast, important locales appear to be the coastal lagoons of Sonora and Sinaloa including Bahia de Lobos, Rio Yaqui delta, Cocoraquito Lagoon, Bahia de Santa Barbara, Agiabampo Lagoons, Bahia de San Estaban, Topolobambo Lagoons, Bahia de Santa Maria, and Boca de la Barra. To the south along the Nayarit coast, possibly important sites include coastal lagoons between El Dorado and Dimas, Laguna Caimanero and the Marismas Nacionales. Along the Jalisco/Colima coast are Lago Chapala and the Rio Lerma Delta, Lago de Atotonilico, Laguna de Sayula, and Laguna de Cuyutlan.

This pattern continues further south along the Pacific coast in Central America. In Guatemala the key area includes coastal and inland wetlands from the Manchon Lagoon to Lago de Atitlan. On the Pacific coast

of Honduras herons occur along the Gulf of Fonseca. Recoveries in El Salvador come especially from around the Gulf of Fonseca and nearby Punta San Juan lagoons but also in Lago de Coatepeque and in the northwest part of the country around Lempa River. In Costa Rica, potentially important wintering sites on the Pacific coast include the Golfo de Nicoya, including Palo Verde, Laguna Mata Redonda, Estero Madrigal, Estero Piedras, and Estero Mata de Limon. Riparian wetlands along the Sarpiqui, Sabogal and Grande de Terraba rivers appear also to be potentially important.

DISCUSSION

What Key Areas Represent

We used banding recoveries to discern areas that might be potentially important to wintering North American herons. We restricted evaluations to only two months, relinquishing many recoveries but also avoiding confounding wintering sites with the protracted migratory movements common in these species. Thus the study is based on the relatively small data set and further constrained by the several well appreciated limitations of banding data. Among these are that recoveries are scattered over large geographic areas and over many decades. Species differences and geographic differences in banding effort and recovery probability affect the thoroughness of evaluation. Recovery data are likely to have some bias toward identifying wintering sites used by those populations that experienced heavy banding effort and those sites that enjoy a relatively higher probability of reporting. Species with small populations (like Reddish Egrets), or “hard-to-find” solitary species (like bitterns) are not banded in large numbers and have a smaller number of recoveries to evaluate.

None of these biases seriously undermines the value of the present list of key areas provided its is understood to be a minimal initial listing. Other important areas certainly exist that did not happen to supply recoveries of banded birds. A more complete evaluation

of other data sources may reveal additional candidate sites. Nor is the distribution of key areas intended to provide a complete depiction of winter range. North America species are known to occur in many additional areas beyond those identified here as key areas.

Ideally and perhaps eventually, key areas should be identified as those supporting a significant proportion of a species' population. Identification of wetlands of international importance under the Ramsar Convention, for example, uses a 1% population criterion. But limited knowledge of overall population sizes or of the numbers of birds using most potentially key sites renders use of such criteria problematical except at those very few sites known to support many thousands of wintering birds. Using criteria of 5% or 1% of recovery records provides an available approach to key site identification, but these data should not be taken as reflecting population proportions.

Dispersion of Key Areas

The dispersion of key wintering areas for North American herons identified in this study (Fig. 1) demonstrates the importance of habitats in the southeastern United States and of coastal habitats scattered along the Atlantic and Pacific oceans, Gulf of Mexico and Caribbean basin. Areas in the eastern, southern and western coastal United States are heavily used by wintering herons (see also Root 1988). However, the data also suggest importance of areas south of the USA, especially in Mexico, Central America, and Cuba. Many areas are key for more than one species (Table 1). Without population data it is inconclusive to judge the relative importance of sites. However, based on current information, the sites likely to be of most crucial importance may be those situated along the eastern and southern coast of the United States, in southern California, along both coasts of Mexico and Cuba.

Conservation of Key Areas

Upon further resolution, key areas and key sites will constitute a network of localities that together support an important portion

of the total wintering population of herons nesting in North America. Identification of such key bird areas is typically based on pragmatic criteria (that is, constrained by available data), the degree of threat to a species (leading to more expansive identifications for species at risk), and appreciated ecological values of certain areas (Wege and Long 1995). To be of maximum conservation value, key areas should have the potential to become a spatially explicit network underpinning hemispheric conservation planning. To function in this context, network sites should have some practical means for conservation and management, be reasonably self-sufficient in sustaining the birds' needs while in residence, feasible to delineate, and potentially persistent (Grimmet and Jones 1989). Site identification is crucial should national and international programs of habitat conservation be undertaken. For herons, winter habitat conservation primarily means protection and management of wetlands or other feeding and roosting habitats.

Conservation of key areas will require international, national, and local engagement. Fortunately, and not unexpectedly, several of the key sites noted in this study are also Ramsar sites, identified by their countries as wetlands of international importance (Jones 1993). These include Delaware Bay, Chesapeake Bay, Okefenokee, and Everglades in the United States, Ria Lagartos in Mexico, Laguna del Tigre in Guatemala, Palo Verde in Costa Rica, and Golfo de Montijo in Panama. Conservation and appropriate management of these preserves have been committed by their respective national governments. Their importance to migratory heron populations can be factored into management plans. Other areas used by herons include national parks, wildlife refuges, Western Hemisphere Shorebird Reserves, and North American Waterfowl and Wetlands Plan joint venture sites. In each of these conservation reserves, management could take the needs of wintering herons into account in devising local management practices.

Conservation of key heron wintering sites requires, fundamentally, a recognition of their importance. A final list of key sites, to-

gether with a similar list of sites important to nesting heron populations constitute a geographically explicit network of locales that together support a large proportion of North American herons through the year. Monitoring and advocacy for sites within the network by conservation organizations will bring attention to the need for their conservation and management. To the extent that these sites also support other waterbird species, including other wading birds, waterfowl, and shorebirds, site-specific conservation interests could be unified.

Inventories and Banding

The list of key areas is based on banding recovery data. The advantage is that recovery of a band proves use by North American herons. A disadvantage is that the number of recoveries is at best only vaguely related to the proportion of a bird's population using the site. Information is needed on a site by site basis on the number of herons of each species using the site in winter, the habitats used, and conservation issues related to the management of the site. The network of key wintering areas does provide a starting point in identifying locales appropriate for additional study.

The utility of using band recoveries for this purpose also suggests the continued value of banding as a means of obtaining information on dispersal and distribution. Such value further suggests the desirability of encouraging large scale banding efforts for herons throughout their range.

The proposed network of key areas is hypothetical, depending for its final resolution on follow-up inventory, census, and monitoring. Such inventory should focus on potentially important sites within each area and should determine the numbers of various heron species present during winter, and perhaps at other times during the year. As a baseline of census information accumulates it should become clearer which of the areas and sites are indeed proportionally more important to wintering herons.

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LITERATURE CITED

- Browder, J. A. 1973. Long-distance movements of Cattle Egrets. *Bird Banding* 44: 158-170.
- Butler, R. W. 1992. Great Blue Heron. *The Birds of North America*, No. 25 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.; The American Ornithologists' Union.
- Byrd, M. A. 1978. Dispersal and movements of six North American Ciconiiformes. pages 161-185 in *Wading Birds* (Sprunt, A. IV, J. C. Ogden and S. Winckler, Eds.). National Audubon Society Research Report No. 7; New York.
- Cave, A. J. 1983. Purple Heron survival and drought in tropical West Africa. *Ardea* 71: 217-224.
- Coffey, B. B. Jr. 1943. Post-juvenile migration of herons. *Bird Banding* 14: 34-39.
- Coffey, B. B. Jr. 1948. Southward migration of herons. *Bird Banding* 19: 1-5.
- Davis, W. E. Jr. 1993. Black-crowned Night-Heron. In *The Birds of North America*, No. 74 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia and The American Ornithologists' Union Washington, D.C.
- Davis, W. E. and J. A. Kushlan. 1994. Green Heron. *The Birds of North America*, No. 129 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia and The American Ornithologists' Union Washington, D.C.
- Dusi, J. L. 1967. Migration in the Little Blue Heron. *Wilson Bulletin* 79: 223-235.
- Gibbs, J. P., S. Melvin and F. A. Reid. 1992a. American Bittern. *The Birds of North America*, No. 18 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia and The American Ornithologists' Union Washington, D.C.
- Gibbs, J. P., F. A. Reid and S. Melvin. 1992b. Least Bittern. *The Birds of North America*, No. 17 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia and The American Ornithologists' Union Washington, D.C.
- Grimmett, R. F. A. and T. A. Jones. 1989. Important bird areas in Europe. International Council for Bird Preservation, Cambridge, U.K.
- Hancock, J. and J. Kushlan. 1984. *The herons handbook*. Harper & Row, New York.
- Held den, J. J. 1981. Population changes in the Purple Heron in relation to drought in the wintering area. *Ardea* 69: 185-191.
- Jones, T. 1993. Directory of wetlands of international importance. Part four: Neotropics and North America. Ramsar Convention Bureau, Gland, Switzerland.
- North, P. M. and B. J. T. Morgan. 1979. Modeling heron survival using weather data. *Biometrics* 35: 667-681.
- Parnell, J. F., D. G. Ainley, H. Blokpoel, B. Cain, T. W. Custer, J. L. Dusi, S. Kress, J. A. Kushlan, W. E. South-

- ern, L. E. Stenzel and B. C. Thompson. 1988. Colonial waterbird management in North America. *Colonial Waterbirds* 11: 129-169.
- Root, T. L. 1988. Atlas of wintering North American birds. An analysis of Christmas Bird Count Data. The University of Chicago Press, Chicago, IL.
- Ryder, R. A. 1978. Breeding distribution, movements and mortality of Snowy Egrets in North America. Pages 197-205 *in* *Wading Birds*. National Audubon Society Research Report No. 7. (Sprunt, A., IV, J. C. Ogden and S. Winckler, Eds.). New York.
- Telfair, R. C., II. 1994. Cattle Egret. *The Birds of North America*, No. 113 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia and The American Ornithologists' Union Washington, D.C.
- Wege, D. C. and A. J. Long. 1995. Key areas for threatened birds in the Neotropics. *BirdLife Conservation Series* No. 5. BirdLife International. Cambridge, U.K.