

## 7. Herons in North America, Central America and the West Indies

Robert W. Butler, James A. Kushlan and Ian J. Davidson

This chapter discusses heron populations in North America, Bermuda, Central America, and the islands of the West Indies including the Bahamas, Greater Antilles, and the island chain including the Virgin Islands and Lesser Antilles (Fig. 7.1). The region includes the large northern countries of Canada and the United States of America (USA) and more southerly countries differing in size and stage of economic development. Ranges, especially migratory ranges, of many species cover the breadth of the region, crossing political borders and making international cooperation an absolute requirement for heron conservation. Seasonal population movements over wide areas are the rule in the region, with few species being endemic or having restricted ranges.

### The Heron Fauna

The heron fauna comprises 24 species (Table 7.1). Species diversity is greatest in North America. Twelve species nest north of Mexico; and ten nest only from Mexico south. Several species of recent European/African origin and two species of recent Asian origin occur in the area, some of which may be in the process of establishing themselves in the hemisphere. Most species are abundant and widely distributed. For example, the breeding ranges of the Great Blue and Black-crowned Night herons and Least Bittern extend across the inhabitable portion of the continent from high latitude into the tropics. A few species are more restricted: the Reddish Egret and a dimorphic population of the Great Blue Heron (*Ardea herodias occidentalis*) have limited ranges. The American Bittern is the only regional endemic (as a nesting species), although the Bare-throated Tiger Heron is nearly endemic as it barely ranges beyond our limits into South America. Typical South American species, such as Coccoi, Capped, and Agami herons, range into the region in Central America.



Fig. 7.1 Important heron areas in North and Central America and the West Indies.

### Environmental Conditions

Climatic conditions range from arctic to tropical, arid to humid, and continental to coastal. At high latitudes, landscapes are dominated by short season wetlands (tundra), which give way south to boreal forests (taiga), bogs, prairies, and prairie wetlands, then to temperate forests in humid areas and grasslands and desert in the drier continental interior. Western mountain ranges partition the North American continent, and a single river system (the Mississippi) drains most of the continental interior. Salt marshes occur along the seacoast in the north and are replaced by mangrove swamps further south. Tropical lowlands tend to be dry (especially on islands), and tropical uplands range from scrub to rain forest. Herons use most landscapes having available water, other than those of the far north.

Seasonal distribution of herons is influenced largely by food availability as determined by such factors as seasonal temperatures especially in the north, by seasonal hydrological cycles especially in the subtropics and tropics, by tidal cycles along the seacoasts, and cycles of prey availability in most locations. Temperate zone herons move south of frozen waters in the boreal winter (Hancock and Kushlan

**Key to Fig. 7.1** Important heron areas in North and Central America and the West Indies.

- |   |  |
|---|--|
| 1 United States of America—Delaware Bay   | 16 Mexico—Tabasco lagoons  |
| 2 United States of America—Chesapeake Bay   | 17 Mexico—Ria Lagartos   |
| 3 United States of America—Southeastern coastal plain, including the Okefenokee Swamp             | 18 Mexico, Belize, Guatemala, Honduras—Gulf of Honduras coast and coastal islands                                |
| 4 United States of America—Southern Florida, including Florida Bay and the Everglades             | 19 Guatemala—Guatemala Pacific coast and Lago Atitlan  |
| 5 United States of America—Mississippi River valley   | 20 El Salvador, Honduras, Nicaragua—Golfo de Fonseca   |
| 6 United States of America—Mississippi Delta and Louisiana coastal and inland swamps              | 21 Nicaragua—Lago de Managua and Lago de Nicaragua, including Rio San Juan                                       |
| 7 United States of America, Mexico—Coastal lagoons of Texas and Mexico including the Laguna Madre | 22 Costa Rica—Gulf of Nicoya including Laguna Palo Verde   |
| 8 United States of America, Canada—Puget Sound and Strait of Georgia                              | 23 Costa Rica, Panama—Panama coast including Golfo de Montijo  |
| 9 United States of America—San Francisco Bay and Central Valley                                   | 24 Panama—Golfo de Panama including Bahia de Panama  |
| 10 United States of America—Imperial Valley and Salton Sea  | 25 Nicaragua—Mosquito Coast  |
| 11 Mexico—Bahia Magdalena   | 26 Puerto Rico—Puerto Rico coast   |
| 12 Mexico—Sonora and Sinaloa coast  | 27 Dominican Republic—Hispaniola north coast   |
| 13 Mexico—Nayarit coast including Marismas Nacionales   | 28 Dominican Republic—Hispaniola south coast   |
| 14 Mexico—Lago Chapala  | 29 Jamaica—Jamaica north coast   |
| 15 Mexico—Tampico lagoons   | 30 Cuba—Cuba south coast including the Zapata Swamp, Golfo de Batabano, Golfo de Ana Maria, Golfo de Guacanayabo |
|   | 31 Cuba—Cuba north coast including Archipelago de Sabana, Bahia de los Perros, Bahia de Jigüey                   |
|   | 32 Bahamas—Andros Island   |

Table 7.1 Status of herons in North and Central America and the West Indies.

	CpH	GrH	GBH	CoH	GWE	RE	TH	Species	LBH	SnE	LE	SwE
Greenland	+								+		+	
Canada	?	++	++		++				++	++		
USA	?	++	++		75 000-100 000	2500	75 000-100 000		75 000-100 000	12 000-150 000	+	+
Mexico		++	++		25 000-50 000	500	++		++	25 000-50 000		
Belize						++	?		+	+		
Guatemala			+		++	+	++		+	++		
Honduras			+		++	?	++		+	+		
El Salvador			+		++	+	++		+	+		
Nicaragua			+		++	+	++		+	+		
Costa Rica			+		++	+	++		++	++		
Panama	++		+	+	++	+	++		+	+		
Cuba			++		++	++	++		++	++		
Jamaica			+		++	+	++		++	++		
Hispaniola			+		++	++	++		++	++		
Puerto Rico			+		++	+	++		++	++	+	
Bahamas			+		++	++	++		++	++		
Bermuda			+		+	++	+		+	+	+	
Lesser Antilles	+	++	++	++	++	+	++		++	++	++	

++ = nesting population, + = present, not nesting, ? = status uncertain, Number = nesting pairs.

	CE	GbH	AH	YCNH	BCNH	Species	BBH	BTTH	FTH	RTH	LsB	YB	SAB	AmB
Greenland		+												+
Canada	++	++		++	++						++			++
USA	250 000-500 000	++		++	25 000-50 000						++	+		++
Mexico	++	++	++	++	++		++	++		++	++		++	++
Belize	++	++	?	++	++		++	++		++	++		++	?
Guatemala	++	++	++	++	++		++	++		++	++		++	+
Honduras	++	++	+	++	++		++	++		++	++		?	?
El Salvador	++	++	?	++	++		++	++		?	++		++	?
Nicaragua	++	++	?	++	++		++	++		++	++		++	?
Costa Rica	++	++	++	++	++		++	++		++	++		++	+
Panama	++	++	++	++	++		++	+		++	++		++	+
Cuba	++	++	++	++	+			++		++	++			+
Jamaica	++	++	++	++	++					++	++			
Hispaniola	++	++	++	++	++					++	++			
Puerto Rico	++	++	++	++	++					++	++			+
Bahamas	++	++	++	++	++					++	++			+
Bermuda	+	+	+	++	+		+			+	+			+
Lesser Antilles	++	++	++	++	++		++			++	++		++	+

++ = nesting population, + = present, not nesting, ? = status uncertain, Number = nesting pairs.

1984, R. W. Butler 1992). Seasonal and daily fluctuations of temperature and surface water depths control when and where herons forage, and also when and where they nest (Kushlan et al. 1985, Kushlan 1989a, Butler 1993, 1995). Shallow waters created during semiannual or biannual dry periods in subtropical savannas and swamps concentrate prey and attract large numbers of feeding herons. When savannas and wetlands dry completely, herons migrate to lower lying areas or to coastal areas. Lunar tidal fluctuations dictate where and when coastal herons can feed, setting up daily and longer-cycle movements. Seiches and wind-driven tides influence use of shores.

North America has extensive wetlands (Fig. 7.1) (Kushlan 1993a, Livingston 1993), which support its heron fauna. Notable feeding habitats include the following: dense freshwater reed beds (American and Least bitterns, Green-backed and Tiger herons); wooded stream edge (Green-backed, Tricolored, and Agami herons); shallow, relatively open, fresh or brackish water marshes (Little Blue, Tricolored, Great Blue and Black-crowned Night herons, Snowy and Great White egrets); shallow coastal marine waters (Yellow-crowned Night Heron, Reddish Egret, Great Blue Heron); coastal mangrove swamp (Green-backed, Great Blue, Tricolored, and Boat-billed herons); sea beaches (Great Blue and Yellow-crowned Night herons, Great White Egrets); prairie, pasture, and cultivated fields (Cattle Egret, Great Blue and Rufescent Tiger herons), urban grasslands and lawns (Cattle and Great White egrets, Yellow-crowned Night Heron), aquacultural ponds and raceways (Great White Egret, Great Blue and Black-crowned Night herons); and residential and commercial sites where foods such as human hand-outs or fish scraps are available (Great Blue and Black-crowned Night herons).

Extensive wetlands occur in the prairie pothole region of central USA and southern Canada and along the coastal plain of south-eastern USA. In tropical regions, significant wetlands occur along both coasts of Mexico, particularly in Nayarit and Tabasco, and along the Caribbean coast of Central America (Scott and Carbonell 1986, Lopez-Ornato and Ramo 1992, Davidson and Gauthier 1993, Anderson et al. 1996, Wilson and Ryan 1997). Inland, Lakes Managua and Nicaragua support extensive freshwater wetlands. Large wetlands on Caribbean islands include the Zapata Swamp and other coastal wetlands of Cuba, and the coastal wetlands on the Bahamas, Hispaniola, Jamaica, and the French Antilles.

Wetlands were more extensive throughout the region before European settlement. Over half of the pothole wetlands in the Canadian prairies have been converted to other uses, as have two-thirds of the wetlands in southern Ontario, the salt marshes in Atlantic Canada and estuarine marshes on the Pacific Coast (Government of Canada 1991). In the USA, over 4.75 million acres (54%) of palustrine wetlands were lost between mid 1950s and mid 1970s (Tiner 1984). In Mexico 50% of wetlands have been lost since 1970.

## Changing Status of Herons

### Data available

Although information available on the status of various species of herons is rather extensive, compared to some other parts of the world, only broad conclusions can be

drawn regarding status and trends. No national or continental programme yet exists for censusing colonial herons (Parnell et al. 1988, Erwin et al. 1985, 1993). Some smaller regions, particularly some states, have significant information bases from recurring surveys. In some locales information goes back decades and, although of varying reliability (Frohring et al. 1988), is sufficient to identify long-term trends in parts of North America (Ogden 1978, Powell et al. 1989). Comprehensive surveys were undertaken along coasts of eastern North America starting in the 1970s (Portnoy 1977, Kushlan and White 1977, Erwin 1979, Custer et al. 1980) and a national register was operating for several years (McCrimmon 1978). Spendelow and Patton (1988) did a thorough evaluation of these data. Monitoring has been conducted in some USA states, such as Texas, Florida, Louisiana, South and North Carolina (TCWC 1982, Lange 1995, Runde et al. 1991, Bancroft 1989, Keller et al. 1984, Martin and Lester 1991, Dodd and Murphy 1996, Parnell et al. 1997). An annual North American survey of breeding birds, although focusing on land birds, can be used cautiously to infer trends of some of the more visible herons (Robbins et al. 1986, Peterjohn and Sauer 1993, Fleury and Sherry 1995). In boreal winter, bird counts conducted near Christmas each year provide long-term data on herons in count sites (Root 1988, Fleury and Sherry 1995). Fleury and Sherry (1995) found correspondence between these two census methodologies in evaluating wading bird population changes. In the future, breeding bird atlases, which are being developed in various USA states, will provide additional detail of nesting distributions. Each species is being described in the Birds of North America series.

### Species status

**Capped Heron.** The range of this South American species reaches eastern Panama, where it is considered rare or uncommon but probably regular (Ridgely and Gwynne 1989).

**Grey Heron.** This Old World species has been reported infrequently in Greenland and the West Indies (Barbados, Martinique, Montserrat) (Hancock and Kushlan 1984, Smith and Smith 1990, Raffaele et al. 1998), and outside the region in South America. One bird had been banded in France. These are vagrants, presumably delivered to the New World by favourable winds. The species should be sought also among Great Blue Herons along the east coast of North America.

**Great Blue Heron.** The breeding range of this widespread species is shown by Butler (1992), updating and clarifying that illustrated by Hancock and Kushlan (1984). Its western range extends as far north as south-east Alaska. To the south it has been recorded breeding in Cuba, in the Virgin Islands, and also in the Galapagos Islands off South America. Its breeding status in Central America requires additional documentation. In the core of its North American distribution, all evidence suggests it remains widespread. Nesting is widespread though localised, and often coincides with areas of human activity, so conflict with changing human land use is its primary conservation challenge.

Because the Great Blue Heron nests solitarily or in small colonies over a vast area, range-wide population estimates are unavailable. In the late 1970s about 36 000 birds

were tallied along the east and south North American coast, almost 40% being counted in the Chesapeake Bay and mid-Gulf of Mexico coast (Spendelow and Patton 1988). Few comparable data are available from large inland areas (for instance Findholt and Berner 1988). Available information, however, suggests populations in various portions of North America are stable or maybe even increasing (McCrimmon 1982, Robbins et al. 1986, Butler 1992). For example, the nesting population in Louisiana doubled from 1976 to 1990, now exceeding 10 000 birds (Portnoy 1977, Martin and Lester 1991) and continuing on an upward trend (Fleury and Sherry 1995).

Individuals do winter as far north as southern Canada in some years, but generally they winter south of the  $-6^{\circ}$  January isotherm (Root 1988), especially along coasts and in the southern USA, Mexico, and Central America south to the Greater Antilles, rarely in the Lesser Antilles, and into northern South America (Byrd 1978, Campbell et al. 1990, Mikuska et al. 1998, Raffaele 1983, Raffaele et al. 1998). In the USA, relatively high winter densities occur on the southern Colorado River, Great Salt Lake, the Gulf of Mexico coast, and Florida (Root 1988). Wintering populations appear high and have increased dramatically in recent years in Louisiana (Fleury and Sherry 1995). Post-breeding dispersal of young individuals extends far north of their nesting range.

Two subspecies deserving special conservation consideration are the southern Florida-Caribbean subspecies (*occidentalis*), characterised by a high proportion of white-plumaged morphs, and the north Pacific subspecies (*fannini*), residing year-round along the coasts of Washington, British Columbia and south-east Alaska (Butler 1997). Powell et al. (1989) provided an excellent understanding of the population changes in extreme southern Florida. The *occidentalis* population doubled each decade between 1930 and 1980 to about 1500 birds. About 1500 birds occur elsewhere in Florida (Kale 1978). The white phase appears to be rare in the West Indies, but additional study is desirable in Cuba. Butler (1997) described population changes in Washington and British Columbia. The *fannini* subspecies appears to be in slow decline, likely as a result of frequent disturbances of nesting birds by humans and eagles.

**The Cocoli Heron.** The South American analogue of the Great Blue Heron (Chapter 8), this species extends into the region in eastern Panama, but its status there is little known. It is thought to breed, but this is not confirmed (Ridgely and Gwynne 1993).

**Great White Egret.** Widely dispersed throughout the region, this egret's nesting distribution has not changed much since 1984 (Hancock and Kushlan 1984), but its slow northward range consolidation continues, now including nesting in southern Ontario, Canada.

Coastal USA nesting population in the 1970s was about 114 000 egrets (Spendelow and Patton 1988). The North American nesting population is centred on Louisiana, USA, where over 43 000 were estimated to occur in 11 colony sites in 1990 (Martin and Lester 1991). Florida, USA, supported over 23 000 nesting birds (counted in 1977). A few thousand birds reside in the American states along the mid-Atlantic (Spendelow and Patten 1988), and hundreds live in each of various non-coastal states. Nesting populations are increasing in Louisiana, Texas and California, but may be decreasing in south-western USA (Robbins et al. 1986, Fleury and Sherry

1995). Coastal Mexico is a second population centre, where about 54 000 birds nest in the Tabasco Lagoons (Scott and Carbonell 1986). Its breeding range extends into the West Indies in the Bahamas, Greater Antilles, and northern Lesser Antilles (Raffaele et al. 1998).

In late summer, post-breeding birds disperse into the mid-USA and southern Canada. The wintering range (not depicted clearly in Hancock and Kushlan 1984) includes California, southern Mississippi Valley through Texas, the east and south USA coast, both Mexican coasts, the Caribbean and into northern South America (Mikuska et al. 1998). In the USA, highest wintering abundance is on the Florida Gulf Coast and in Louisiana-Texas; the southern Colorado River and Humboldt Bay in California also support numbers in winter (Root 1988). Wintering Great White Egret populations have been stable from 1960 through 1989 in Florida (McCrimmon pers. comm.) and appear to have increased in Louisiana (Fleury and Sherry 1995). Egrets winter also through the West Indies into the lower Lesser Antilles.

**Reddish Egret.** This coastal egret nests along the Gulf of Mexico, Caribbean and Pacific coasts. In recent decades, it has expanded its USA breeding range into Gulf coastal Alabama and Louisiana. Further south it nests along the Caribbean and Pacific coasts of Mexico south to Costa Rica (race *dickeyi*), the Bahamas and Cuba (Hancock and Kushlan 1984, Paul 1991, Lopez-Ornato and Ramo 1992). Outside the region covered by this chapter it occurs into northern South America (see Chapter 8).

The species is rather irregular away from its nesting grounds but is found as far as the Lesser Antilles. Wandering birds are increasingly being reported far inland.

The world population of the Reddish Egret is about 6–10 000 adults (Paul 1991). It nests most abundantly in Florida and Texas, USA, and is less common in Central America. In Texas, local breeding populations have fluctuated between about 2000 and 4200 birds since the 1970s (Paul 1991). About 600–800 birds nest in Mexico (Lopez-Ornato and Ramo 1992) and about 600–800 in southern Florida. Highest wintering densities in the USA are around Laguna Largo in Texas and in southern Florida (Root 1988). The Florida population was probably extirpated in the early part of this century but has recovered in Florida Bay, since its rediscovery in the 1930s, to about 200–250 adults in the 1970s (Powell et al. 1989). More recent information is needed. Other populations appear to have decreased somewhat in recent years in Texas and Louisiana (Martin and Lester 1991, Lange 1995).

**Tricolored Heron.** This species nests from Maine, USA, through the Gulf of Mexico and the Gulf of California to both coasts of Central America, the West Indies (Bahamas, Greater Antilles, Cayman Islands) and outside the region into South America (Hancock and Kushlan 1984, Frederick 1997). Birds occur in Florida and on the Gulf of Mexico Coast year-round. This species expanded its range northward in North America in the present century, and has benefited from coastal habitat modification creating both nesting and feeding sites. Populations have likely increased in Louisiana but may have decreased in southern Florida.

Spendelov and Patton (1988) tallied about 178 000 birds nesting along the USA coasts in 1976–78. Over 133 000 individuals were counted in Louisiana alone. In 1990, Martin and Lester (1991) tallied about 44 000 individuals in Louisiana, but the methods do not allow for comparison to previous surveys. Summer populations may have decreased in Texas (Fleury and Sherry 1995).



Post-breeding birds disperse into the south-central USA. Northernmost populations migrate southward in winter, into the south-eastern USA, the Greater Antilles, Central America, but also into South America (Mikuska et al. 1998). The largest winter populations occur in southern Louisiana wetlands and Texas, but it is also numerous in winter along both Florida seacoasts (Root 1988). Its populations have increased in winter in Louisiana (Fleury and Sherry 1995).

**Little Blue Heron.** The North American distribution of this species appears to be influenced by proximity to the coast and large lakes and rivers. It nests in the eastern USA south from Maine through Central America, the West Indies, and outside the region through much of South America (Hancock and Kushlan 1984). Recent



Little Blue Heron. Overall nesting populations of the Little Blue Heron are relatively stable in the USA. Photo: Robert Bennetts.

evidence indicates limited nesting in mid-continental sites (AOU 1983), but no important shifts in distribution have occurred in recent years.

The centre of the North American population is on the Gulf Coast of the USA. Coastal populations were estimated to be about 101 000 nesting birds in the 1970s, over 80% in Louisiana (Spendelov and Patton 1988). An additional 34 000 birds were reported from inland colonies in Texas, USA (TCWC 1982). There are indications of decreases in this species in eastern USA (Robbins et al. 1986), but overall nesting populations remain relatively high.

Post-nesting herons disperse into the eastern USA before migrating south. Populations east of the Mississippi River migrate into the Caribbean and South America (Byrd 1978). Birds breeding west of the Mississippi River migrate to the south-eastern USA, Mexico, Cuba, Bahamas, Hispaniola, Puerto Rico, Jamaica, Central America, and northern South America (Mikuska et al. 1998). Important winter sites include the eastern North American coast, lower Mississippi River in Louisiana, southern Florida, and coastal lagoons of western and eastern Mexico and Honduras, Cuba, Hispaniola, Puerto Rico (Root 1988, Fleury and Sherry 1995, Mikuska et al. 1998). Florida wintering populations show evidence of a decrease from 1960 to 1989 (McCrimmon pers. comm.).

**Snowy Egret.** This species nests from Maine, USA, south along the Atlantic and Gulf coasts, and from California south through coastal Mexico, into the West Indies (Bahamas, Greater Antilles, northern Lesser Antilles to St. Martin) (Hancock and Kushlan 1984, Raffaele et al. 1998). Disjunct populations occur in western American states. Its nesting range expanded between the end of the plume hunting era and the 1970s (Hancock and Kushlan 1984). Populations are increasing in the West Indies (Raffaele et al. 1998). It breeds most abundantly along the coast. Estimates from the 1970s indicated a coastal USA nesting population of about 159 000 birds (Spendelov and Patton 1988). Its population is centred on the Gulf of Mexico coast, where the nesting population in Louisiana may approach 100 000 birds and that of the coastal lagoons of Tabasco may approach 60 000 (Scott and Carbonell 1986). Florida supports the next largest nesting concentration, about 20 000 individuals.

Few data exist on breeding population changes. It is probable that populations decreased into the early 1900s due to the plumage trade, but credible numerical estimates are lacking. In recent decades, summer populations have increased in California (Fleury and Sherry 1995). In southern Florida, USA, between the 1970s and 1980s numbers plummeted from about 5000 pairs in 1976 to about 500 pairs in 1989 (Bancroft 1989). However, for Florida as a whole and range-wide, there is no evidence of significant decrease (Robbins et al. 1986, McCrimmon pers. comm.). Post-breeding dispersal results in a net northward movement through most of the continental USA. North American populations winter in the eastern and south-eastern USA, southern Florida, the Pacific coast from San Francisco through western Mexico, the southern end of the Colorado River, eastern coastal Mexico, the Caribbean, Greater and Lesser Antilles, into South America in coastal Colombia, Venezuela, and French Guiana (Mikuska et al. 1998). Wintering populations have increased significantly in Louisiana (Fleury and Sherry 1995).

**Little Egret.** Hancock and Kushlan (1984) reported sightings from Newfoundland, Trinidad and Martinique, of which two birds had been banded in Spain. These were

evidence of stragglers from the Old World to the New World. Since then the species has become a part of the nesting heron fauna of the Americas (Murphy 1992, Raffaele et al. 1998), an extremely exciting example of recent heron population expansion. Two forms have been reported. The Little Egret (*E. garzetta garzetta*) is now resident on Barbados, with nesting of up to 40 individuals, and St. Lucia and (so far) a nonbreeding resident or vagrant on Puerto Rico, Martinique, and Guadeloupe (Raffaele et al. 1998). The Western Reef Heron (*E. g. gularis*, *sensu* Hancock and Kushlan 1984) is also reported from the West Indies (Puerto Rico, St. Lucia, Barbados) (Raffaele et al. 1998). Its breeding is to be looked for.

**Swinhoe's Egret.** No North American records were reported by Hancock and Kushlan (1984), but a single North American record does exist, an adult female from Agattu Island, Alaska, 16 June 1974 and now in the University of Alaska Museum (UAM 2805) (Byrd et al. 1978).

**Cattle Egret.** This species invaded from Africa to become the most abundant heron in North America within a space of 60 years. Evidence exists that trans-Atlantic colonisation continues (Telfair 1994). Its range now covers much of the landscape of North America from southern Canada, Central America and the Caribbean. Telfair (1994) provides an excellent evaluation of its changing status (also Telfair 1983, Arendt 1988, Campbell et al. 1990).

Spendelov and Patton (1988) found coastal nesting populations in the 1970s numbered about 439 000 individuals, with over 248 000 birds along the Florida coast. These totals do not include extensive inland populations. Populations have continued to grow over recent decades; expansion continues along the range periphery, such as in California (Fleury and Sherry 1995). However, in most places the rate of population increase has slowed, suggesting that population growth is levelling off continent-wide (Telfair 1994).

Northern populations migrate south in the winter. Densest wintering populations occur in Florida, the Salton Sea in California, the coastal plain in Texas, and Mississippi River swamps in Louisiana (Root 1988). Wintering areas include Mexico and the Greater Antilles, and Central America, into northern South America (Mikuska et al. 1998).

**Green-backed Heron.** This species is widely distributed in North and Central America and the West Indies (Davis and Kushlan 1994). Hancock and Kushlan (1984) showed the northernmost range as Washington State, USA, but small numbers now reside year-round in British Columbia, Canada, and it is extending slowly northward along the Pacific coast of Canada.

Population size data are few because of its widely dispersed nesting habits. Breeding bird surveys (Robbins et al. 1986, Fleury and Sherry 1995) suggest that populations are largest in Florida and Louisiana and that continent-wide increases are occurring. It is an abundant resident in Central America, particularly Nicaragua and Costa Rica where it is the most abundant heron species.

In winter, northern populations move southward into Florida and Mexico, and perhaps into South America (Chapter 8). Highest wintering densities in the USA were in southern Florida and in southern California (Root 1988).



The Green-backed Heron. This species normally nests solitarily or in small colonies. Consequently population sizes are poorly known. Photo: Robert Bennetts.

**Agami Heron.** This tropical bird of pools and streams in dense forests nests in Mexico and Costa Rica, and outside the region in South America (Marin 1989). Little is known about its requirements, and deforestation might threaten its survival. As a result it is considered to be near threatened (IUCN 1996).

**Yellow-crowned Night Heron.** This species nests through most of eastern North America, Central America, and the Caribbean, and outside the region in South America and the Galapagos (Chapter 8). Its North America nesting distribution, unclearly presented in Hancock and Kushlan (1984), is from Kansas, Nebraska, Iowa, Wisconsin, Michigan, Ontario, Ohio and Pennsylvania to Massachusetts, southward along the Atlantic Coast and into the mid continent in Texas, Colorado, and Oklahoma. It also nests along both coasts of Mexico and Guatemala, through the Bahamas, Greater Antilles, Virgin Islands, and northern Greater Antilles. Also outside this region, it occurs on the Galapagos and coastal South America, the southern birds being recognised as the race *bancrofti*. The species was reintroduced to Bermuda in the late 1970s (Wingate 1982).

Northern populations migrate south to western and southern Florida, with smaller numbers along the Gulf and Atlantic coasts (Root 1988), and some into the West Indies.

The population size of this dispersed species is poorly known. Spindelow and



The Yellow-crowned Night Heron. This species is widespread in North America. Some West Indian populations seem to be threatened by increasing pressure from human activities. Photo: James A. Kushlan.

Patton (1988) tallied about 1800 birds in coastal USA in the 1970s but this is an underestimate because the censuses they analysed clearly overlooked many birds. Breeding Bird Survey data indicate increases in summer in Louisiana (Robbins et al. 1986). There is no evidence of breeding population decreases in North America.

Some West Indian populations may be a matter of concern. For example the nesting population on Tobago is reported from only three wetlands there. Boccoo Reef is a state-owned reserve, while Kilgwyn and Bon Accord Swamps are private. All face pressures from livestock grazing, fishing, crab-collection, and garbage dumping, and there is the probable construction of large tourist resorts, which would eliminate habitat (see also Chapter 8). More information is needed on the status of this species in the West Indies.

**Black-crowned Night Heron.** This bird nests throughout much of North America, in the west from southern British Columbia and east of the mountains from southern Saskatchewan, Manitoba, Ontario and Quebec, and outside the region through much of the world (Hancock and Kushlan 1984). The northern edge of the North American breeding range has not changed from the 1960s (Palmer 1962) to the 1980s

(Godfrey 1986), and there is no evidence of other changes in overall nesting distribution.

Nesting population estimates are tenuous because of difficulty in counting these cryptic, nocturnal birds in their many small colony sites. Along the North American Atlantic coast, over 48 000 individuals were tallied in the 1970s with the greatest concentrations being on the mid-Atlantic and Louisiana coasts (Spendelow and Patton 1988). These numbers are undoubtedly underestimates, and do not include inland colonies. Local changes in numbers have been suggested, including possible decreases in the central North America plains and mid-Atlantic but also increases in the north-eastern states (Robbins et al. 1986, Williams et al. 1990, Erwin and Spendelow 1991, Davis 1993).

Birds breeding in Oregon and Idaho colonies migrate to the central coast of Mexico. Night-herons breeding in Nevada winter in southern California, southern Arizona and southern Texas (Henny and Blus 1986). Largest numbers occur in the USA along the Oregon-California border, in California, on the California-Arizona border, the Texas coast, and the west coast of Florida (Root 1988). Other birds migrate into the southern West Indies.

Contaminant levels in some Pacific North-west colonies had been sufficiently high to threaten productivity (Henny et al. 1984) but have generally declined in recent years (Custer et al. 1983a, Henny et al. 1985, Chapter 12).

***Boat-billed Heron.*** The range of this species includes South America, Central America and Mexico, where four subspecies are recognised, and outside this chapter's region in South America (Chapter 8). Few data exist on nesting populations anywhere within its range. It appears common where it is found and its populations stable, but habitat loss may affect it in the future.

***Bare-throated Tiger Heron.*** Although known as a bird of mangrove swamps and coastal lagoons, it does occur inland along rivers. It is nearly restricted to Central America, breeding from southern Mexico into Colombia (Hancock and Kushlan 1984, Lopez-Ornato and Ramo 1992). Nothing is known about population sizes or trends.

***Fasciated Tiger Heron.*** This primarily South American species (Chapter 8) occurs in the south of the region in Panama and Costa Rica. Nothing is known of its population size or trend there. Because of its limited distribution it is considered near threatened (IUCN 1996).

***Rufescent Tiger Heron.*** This primarily South American species (Chapter 8) occurs south of Chiapas, Mexico. Little is known of its population size or change, but it is widely distributed in Central America and is a common species found along rivers, lakes and even grasslands.

***Least Bittern.*** The nesting range of this species includes eastern USA, eastern Mexico and the West Indies (Greater Antilles, northern Lesser Antilles), and localised areas in western North America, Mexico, and Central America (Hancock and Kushlan 1984, Gibbs et al. 1992a), and outside our region into South America (Chapter 8). There is no known recent change in breeding range.



The secretive Least Bittern. Photo: Robert Bennetts.

It is secretive and often overlooked on surveys, so estimates of population trends are scant. Birders reported the species as being reduced over much of its range (Tate 1986), but there is some evidence of increases in the north-eastern part of its range (Robbins et al. 1986).

Northern populations migrate to the south-eastern USA and Mexico. There is weak indication of decreases in wintering populations in Louisiana (Fleury and Sherry 1995). In North America, preservation of wetlands >10 ha appears to be its most urgent conservation need (Gibbs et al. 1992a).

**South American Bittern.** This bittern breeds in freshwater swamps and rice and sugarcane fields of southern Mexico, Costa Rica, Nicaragua and Guatemala, as well as outside the region in South America (Chapter 8). Nothing is known about its population sizes or trends in the region.

**American Bittern.** This secretive species is widespread in North and Central America (Gibbs et al. 1992b). Breeding populations have been recorded from Texas, the Great Basin, California, and Florida, USA (unclearly labeled in Hancock and Kushlan 1984).

Population data are few. An analysis of breeding bird surveys for the north central states suggested decreases in numbers (Hands et al. 1989). Loss of wetland and wet grassland habitats is the most likely cause for any declines (Hands et al. 1989).

This bittern winters from the southern USA through Mexico and the West Indies to Panama. Centres of winter abundance in the USA are southern Florida and the San Joaquin River in California, with smaller numbers reported from marshes along the North Carolina coast, the Okefenokee Swamp between Georgia and Florida, and the swamps along the Louisiana coast (Root 1988). Winter populations in Louisiana may be declining (Fleury and Sherry 1995).

Hands et al. (1989) recommended that conservation should focus on wetlands >10 ha and adjacent grasslands. They suggested that under natural conditions, the species could move among sites as plant succession proceeded, but today it might be necessary to maintain a complex of protected wetlands in different stages of succession for populations to grow in the long term.

### Overall status

No heron species in the region is globally threatened (Groombridge 1993, IUCN 1996). No species has suffered a critical range decrease; most have expanded their range: at least two have newly established breeding populations in the New World in this century. The several quantitative data sets that are available (comparative censuses, Christmas Counts, and Breeding Bird Surveys) suggest that no continent-wide population decreases can be documented. It is likely that continent-wide Great Blue Herons, Cattle Egrets, and Green-backed Herons have increased in abundance in recent years. Some data suggest localised decreases, but for such highly mobile species, localised decreases may be offset by increases elsewhere. The most apparent example of compensatory change in abundance is the decrease of some species in south Florida, stability elsewhere in Florida, and increases in Louisiana (Bancroft 1989, Fleury and Sherry 1995).

However, population data for even the best-known species can only provide some sense of large-scale trends, and data for rare or highly dispersed species are scant to non-existent. Even the best available data cannot detect small changes in numbers of any species. Thus, much needs to be done to develop appropriate monitoring programmes for these species. It is essential that a continent-wide programme of population monitoring of both breeding and wintering populations be developed (Erwin et al. 1993, Kushlan J. and Steinkamp M., pers. comm.).

A few populations that have small ranges in the region or specific habitat requirements deserve conservation attention for those reasons. The white morph and North Pacific Coast populations of Great Blue Herons, Reddish Egrets, and newly established Little Egrets have restricted ranges. Bare-throated Tiger Herons, Fasciated Tiger Herons, and Agami Herons may be likely candidates to become at risk if their limited habitats are altered; the Fasciated Tiger Heron and Agami Heron are considered to be near threatened (IUCN 1996).



### **Critical Conservation and Regional Management Issues**

Conservation of herons and other water birds in the northern New World requires multifaceted approaches (Parnell et al. 1988, Bildstein et al. 1991, Custer et al. 1991, Erwin et al. 1993 and Kushlan 1992, 1993b). Overriding concerns throughout the region include habitat (especially wetland) loss and alteration, human competition, and contaminants. Conservation of herons in North America requires habitat protection, legislation, and management action at local to international levels, and wise use of their wetland habitats (Bildstein et al. 1991). Conservation needs to be undertaken at the local scale as guided by continental scale goals set out through regionwide conservation planning.

#### **Bermuda**

We have included Bermuda in our region for biogeographic reasons, as it derives its heron fauna from North America. Several North American herons occur there in migration (Wingate 1973). Bermuda is the site of one of the great success stories in heron conservation—the establishment of Yellow-crowned Night Herons by David Wingate (Wingate 1982). But the small size of this population requires continued vigilance.

#### **Mexico and Central America**

Mexico and Central America support many nesting and wintering herons, including species not found elsewhere in the region. The major conservation issues for herons in Mexico and Central America are habitat loss and degradation, especially along the coast. Davidson and Guthrie (1993) summarised the direct and indirect causes of wetland loss in Central America, finding the following to be critical: deforestation, removal of mangrove bark, clearing for shrimp and salt production, agricultural clearing, uncontrolled forest fires, uncontrolled tourism development, hunting and poaching, agro-chemical contamination, raw sewage and industrial waste dumping, dams and irrigation channels, and other wetland development.

Large numbers of wading birds reside and migrate to coastal wetlands and mudflats in Mexico and Panama (Wilson and Ryan 1997, Morrison et al. 1998). Conversion of mangroves to salt ponds and aquaculture is a particularly major concern, given their importance for resident and wintering herons (Butler et al. 1992). However, some aquaculture ponds also provide additional feeding sites. Oil exploration along the coast may also become a factor in the quality of local habitats for herons.

Conversion of inland forests affects not only downstream wetlands, because of increased sedimentation, but also more directly the habitat of forest and stream-edge heron species. Further loss of remnant inland forests in El Salvador (now 2% of original) and Costa Rica (5% of original) and rapid acceleration of the agricultural frontier along Caribbean coasts undoubtedly threaten forest-dependent species. Information on these species is urgently needed.

#### **Atlantic flyway**

The migration flyway along the eastern coast of North America encompasses nesting, migration, and wintering habitats of herons breeding from eastern Canada

and north-eastern USA southward into Florida, the Bahamas and the Caribbean (Custer et al. 1980, Spendelov and Patton 1988).

The Atlantic coast supports substantial nesting populations, with Florida being one of the three most important areas in North America (Bancroft 1989). Although nesting and wintering populations remain high in most areas of this state, nesting numbers have decreased in extreme southern Florida, despite the persistence of huge areas of wetland, owing to changes in water management practices affecting food availability (Kushlan and White 1977, Bancroft 1989, Ogden 1994). On the other hand, appropriate habitat conditions have increased for some species along the Atlantic coast. In New York and Ontario, reforestation of abandoned agricultural lands has positively affected Great Blue Heron populations (McCrimmon 1982).

Hérons nesting in north-eastern North America migrate along the Atlantic coast, coastal plain, and Appalachian Mountains. Herons nesting in the south shift further southward in winter. Wintering areas include Florida, the Gulf of Mexico coast east of the Mississippi Delta, Cuba, Jamaica, Dominican Republic, the Lesser Antilles to Trinidad and coastal northern South America (Byrd 1978, Hancock and Kushlan 1984, Mikuska et al. 1998).

The Atlantic Flyway has the greatest human population densities in the USA (Southworth 1989). Conservation threats to herons involve competition with humans for the herons' nesting and feeding sites and various threats from contaminants. Herons do continue to nest as part of developed landscapes in parks and along watercourses near even the largest cities. It is expected, although not assured, that future wetland habitat losses in the USA and Canada will be ameliorated by continued enforcement of strict wetland protection legislation. In the Caribbean, losses of scarce wetland habitat continue through drainage and conversion (K. Shephard, pers. comm.).

Several Ramsar sites are located in this flyway (Jones 1993). Delaware Bay, Chesapeake Bay, and the Okefenokee Swamp support nesting, migratory and/or wintering populations of herons. Trinidad's Nariva Swamp supports many nesting and wintering herons.

Coastal wetlands and lagoons along the Atlantic Flyway are of special concern because of their importance to all species of herons, but especially white morph Great Blue Herons and Reddish Egrets. The drainage of coastal wetlands for agriculture and development, other alterations of hydrology, and pollution are especially disconcerting given the narrow habitat requirements and ranges of these species. Powell and Powell (1986) showed that the white morph Great Blue Heron population of extreme southern Florida was under food stress, probably owing to changes in food availability. Disturbance also becomes a factor in such restricted populations. Kale (1978) recommended prevention of unauthorised landings by boaters at nesting sites to protect coastal Great Blue Herons. Increased access to heron feeding areas, by increases in various watercraft including jet-propelled personal watercraft, should be examined for effects on feeding birds.

### Mississippi flyway

The Mississippi River, its tributaries, and associated wetlands are major features affecting North American herons, serving as nesting grounds, a migration corridor, and winter destinations. The river and its tributaries serve as conduits for migrant

herons breeding as far as central Canada, the Midwest and southern USA states east of the Rocky Mountains. Herons originating in Canada, Wisconsin, Illinois, and Minnesota follow the Mississippi drainage to the Gulf Coast, eastern Mexico and Central America (Byrd 1978). Inland and coastal wetlands of Louisiana are the most important heron habitats in North America (Portnoy 1977, Spindelov and Patton 1988, Root 1988, Martin and Lester 1991). The coastal lagoons of Texas and Mexico support the largest North American nesting populations of the Reddish Egret. The wetlands of Tabasco and Campeche, Mexico, are one of the three most important nesting areas for herons in the region.

The Louisiana wetlands are the most important destination for migrating and wintering herons in North America (Fleury and Sherry 1995). Further south, the coastal lagoons of Texas and Mexico form a chain of stopover and wintering sites (Anderson et al. 1996, Mikuska et al. 1998). This beadwork of coastal lagoons includes the Laguna Madre, Laguna Tamiagua, Usumacinta Delta, Laguna de Terminos, and the Rio Lagartos (a Ramsar site). Less known areas include the extensive coastal wetlands of Central America, where herons appear to be widespread. The Bay of Panama supports large numbers of herons (Butler et al. 1992). In the West Indies, it is likely that the Zapata Swamp and other parts of coastal Cuba, the western Bahamas especially Andros and the Caicos (including a Ramsar site) may be important wintering grounds (Mikuska et al. 1998). Ramsar sites in the Netherlands Antilles and Aruba (Het Lac, Het Pekelmeer, De Slagbaai) support several heron species.

Habitat protection is the most critical issue in this region. In North America, this means wetland conservation. Conservation and management of Louisiana wetlands, Laguna Madre of Texas–Mexico, the many shallow, isolated wetlands of the Mississippi watershed, and Mexican wetlands are of prime importance (Paul 1991, Gibbs et al. 1992a, Wilson and Ryan 1997). In the Louisiana wetlands, there is strong evidence that heron populations have grown in response to seasonal food supplies from aquaculture (Fleury and Sherry 1995).

Further south, harvest of mangroves, development of shrimp farming, and increasing drainage for agriculture, especially banana plantations, threaten wetlands used by herons. Butler et al. (1997, 1998) showed that the highest densities of wading birds in Panama were associated with mangrove ecosystems near regions with ocean upwelling.

### **Pacific flyway**

In western North America, some herons disperse in winter to nearby habitats along the coast and mountain valleys (Gill and Mewaldt 1979, Butler 1992) while others migrate south to Arizona, Texas and western Mexico (Byrd 1978, Henny and Blus 1986). Therefore the relatively coastal wetlands of the Pacific coast assume critical importance. These include the lagoons of Huizache–Caimanero, Nayarit, and Jalisco, in Mexico, and other coastal lagoons south to Palo Verde, Costa Rica, a Ramsar site that supports nesting and seasonal heron populations. Conservation issues in the region involve disturbance, habitat loss, and contaminants.

Increasing human populations in the area have intensified competition with herons for nesting sites, although the long-term effects are not yet clear (Vos et al. 1985, Werschkul et al. 1977, Butler 1997). In recent years, growing numbers of Bald

Eagles (*Haliaeetus leucocephalus*) along the coast of Washington, USA, and British Columbia, Canada, have become important predators of chicks, immature and adult herons (Norman et al. 1989, Butler 1995, 1997).

Habitat protection is critical, as over two-thirds of the coastal wetlands between southern British Columbia and California have been lost in the last 100 years (Speth 1979, Butler and Campbell 1987). Protection of wetlands along the Central American coast is similarly essential to heron conservation (Morrison et al. 1998).

Through much of this flyway, contaminants have been found in heron eggs and tissues (for example Blus et al. 1980, 1985, Henny et al. 1984, 1985, Ohlendorf et al. 1988, Elliott et al. 1989, Ohlendorf and Marois 1990, Chapter 12). Some herons may be accumulating pesticides on their wintering grounds in the USA and Mexico. Sudden declines of Great Blue Heron and Great White Egret populations and disappearance of breeding populations of Cattle Egrets and Snowy Egrets in the Salton Sea area (W. Radke, pers. comm.) are cause for alarm.

### Habitat conservation

The loss of wetland habitat in North and Central America is one of the principal conservation concerns for herons in the region. Wetland conversion, mostly for agriculture or residential development, was national policy in both the USA and Canada for many years. Incentives were provided for reclaiming the "waste land" (Alderman 1965). Even lacking definitive information of effects on herons, it can be expected that wetland conversions over the past centuries have had effects on heron populations, at least locally.

Today, however, legislation and executive policy in both the USA and Canada mandate some level of wetland protection. In Mexico, Central America, and the West Indies wetland loss to drainage, conversion to aquaculture, and tree harvest continues. Adoption of the Ramsar Convention by every nation in North and Central America as well as several nations of the West Indies including the Netherlands (for Netherlands Antilles and Aruba), United Kingdom (for Turks and Caicos) has raised attention to the value of wetlands for herons and other birds. Important heron sites need to be protected and managed to conserve their sustained viability as heron habitat (Mikuska et al. 1998).

Wetland conservation has become national policy for governments in Canada and the USA (Government of Canada 1991). Policies of "no net loss" recognise wetlands as important components of national and global landscapes and economies. However, only about 29% of Canada's wetlands are on federally-owned lands and many are north of the range of herons. Most wetlands within the range of herons in southern Canada are within the jurisdiction of provincial governments, and policies differ among provinces. In the USA, federal initiatives in wetland protection are enforced at the federal level through requirements over issue of permits, and are being adopted by many states and some local governments. The federal government protects many wetlands in parks and wildlife refuges that support many herons. It is likely that, overall, the loss of wetland area has been halted in Canada and the United States.

However, the downward trend in wetland viability continues in many parts of North America. Despite protection of wetland area, functional alterations continue and the role as suitable heron habitat of restored and created wetlands (built as

replacement for lost wetland area) is not yet understood. Protection of heron habitat needs to be extended throughout the range of herons including Mexico (Wilson and Ryan 1997), Central America, and the Caribbean. However, as wetland conservation increasingly conflicts with development and agricultural interests, the resolve of government to protect these habitats may be weakening and the outcome remains in doubt.

Barriers to accomplishing wetland conservation involve economic and social factors because wetland protection carries significant costs in loss of immediate economic opportunity. Issues of the appropriate balance between governmental regulation and private ownership rights remain to be resolved in the United States, as do the relative roles of federal, state/provincial, and local governments. In developing countries, human population increases have exacerbated stress on wetlands. In both developed and less-developed economic zones of the region, the need for integrating policies that promote wise use of wetlands is paramount.

Heron habitats need also to be viewed at larger spatial and temporal scales. Changes in habitat may be due to long-term changes such as climate change, sea level rise, and landscape fragmentation. Heron habitat needs to be conserved and managed within the context of these larger-scale processes, particularly those operating at the landscape or watershed scale.

### **Habitat quality**

As noted above, habitat quality is as important as habitat area in conserving herons. Important approaches to maintaining habitat quality are those that seek to retain habitat diversity, natural functioning, food supplies, and sustainable human use of wetland ecosystems (Boyd and Pirot 1989). Preserving habitat quality specifically for herons includes maintenance of vegetation at colony sites, prey base and suitable hydrology. Despite their flexibility, herons require the presence of species-appropriate nesting sites. In that herons can damage sites, making them unsuitable, a succession of sites needs to be available in most areas. Most studies in the region show that maintenance and accessibility of a suitable prey base is essential to maintaining heron populations. Given the importance of water depths to wading birds, hydrological management is often a crucial consideration. The example of wading bird declines in the southern Florida Everglades owing to hydrological alteration and changes in prey availability are testament to the result of declining habitat quality (Bancroft 1989). In this regard, on wetland preserves, management for game species (waterfowl) may not coincide with optimal management for herons, and such potentially conflicting conservation concerns need to be optimised at each locality.

### **International conservation**

The importance of international cooperation in protecting heron populations in the region becomes clear when their breeding and winter distributions are examined. For example, six species that nest in Canada (American and Least bitterns, Cattle Egret, Green, Great Blue, and Black-crowned Night herons) (Godfrey 1986) spend the winter from southern USA and southward. Some individuals of most of the 12 species that breed in the United States winter in the West Indies, Mexico, or Central and even South America, so important areas for wintering North American herons

extend well south of the USA border (Mikuska et al. 1998). Two restricted populations that might especially benefit from an international approach to conservation are the white morph Great Blue Herons in Florida, Bahamas and Cuba and Reddish Egrets in Mexico and USA. Throughout the region, laws, treaties, policies, and conservation programmes to arrest wetland losses hold promise of protecting heron habitat.

In North America, bilateral and trilateral migratory bird treaties have played important roles in the conservation of habitats of value to herons. The most critical treaties are between the United States, Canada, and Mexico, along with Russia and Japan. The North American Waterfowl Management Plan by Canada, the USA, and Mexico is designed to protect wetlands for waterfowl especially. This has more recently been supplemented by environmental sub-agreements associated with the North American Free Trade Agreement. International cooperation occurs at operational levels, with over half the funds derived from the USA Wetland Conservation Act being directed to wetland conservation in Canada and Mexico. Habitat planning and restoration activities under the North American Waterfowl Management Plan will help conserve wetland-dependent herons, especially the American Bittern, Least Bittern, Great Blue Heron and Black-crowned Night Heron. Trilateral planning for bird conservation recently began under the auspices of the trilateral council for the North America Bird Conservation Initiative (NABCI). A component of NABCI is a recent initiative for planning the conservation of colonial water birds in North America (Kushlan and Steinkamp in prep.).

In Central America, there are a number of pertinent international conservation initiatives under way (Davidson and Guthrie 1993). Costa Rica and Nicaragua have created a bilateral programme to protect areas, including wetlands, along their border. The Central American biological Corridor Project proposes to link protected areas from Guatemala to Panama, many of which will conserve heron habitat.

All North and Central American nations have become signatories to the Ramsar Convention, which requires them to make "wise use" of wetlands of international importance (Boyd and Pirot 1989, RCB 1998). Nearly all Ramsar sites sport herons. Thirty-five sites have been designated as Ramsar sites in Canada, 15 in the USA, seven in Costa Rica, six in Mexico, and three in Guatemala, Honduras, and Panama.

Conservation of herons in the region requires increasing hemispheric planning and international cooperation and coordination. This involves developing a multinational conservation planning effort and the establishment of reserve networks similar to those developed to protect sites used by shore birds (Myers et al. 1987, Boyd and Pirot 1989, Erwin et al. 1993). In North America, heron conservation will be a part of the North American Colonial Waterbird Conservation Plan and similar efforts for non-colonial marsh birds. This plan will coordinate with continental planning efforts for other groups of birds to be enacted on a coordinated regional basis. We also envision a network of sites from Canada to South America that are identified as important to heron populations (Mikuska et al. 1998), able to attract and maintain conservation activities.

### **Contaminants**

Contamination of eggs and tissues of herons by pollutants is widespread in North America and probably Mexico and Central America, but currently effects on

regional heron populations appear to be minimal (Custer et al. 1991, Rattner et al. 1993). Local conditions do appear to be deleterious in places such as the Salton Sea in California, parts of Mexico, and parts of the Gulf Coast (Mora 1991 and Chapter 12). Herons have been used as sentinels and indicators of contamination (Kushlan 1993b and Chapter 15).

### Hunting

Throughout the region, herons are killed by people for various reasons, but mostly for food or in response to their apparent or real depredations on aquacultural crops. Dramatic decreases in some heron populations occurred around the turn of the 1900s when adults were hunted for their plumage at colony sites (reviewed by Butler 1994). Herons are now protected as migratory species by treaties between Canada, the USA, and Mexico. They are, however, considered pests to aquaculture. In the United States permits are issued for aquaculturalists to kill thousands of herons annually (Fleury and Sherry 1995). Available studies suggest that herons, unlike some other bird species, have little adverse impact on aquaculture (Chapter 13), and killing is seldom justified. Almost nothing is known about the potential population impact of depredation reduction programmes, especially given the constraints of relatively crude population monitoring techniques in use, which can detect only large population changes.

### Colony site protection

There is no evidence that heron populations are limited at present by shortage of nesting sites in North America (Butler 1994), and in some areas nesting habitat is increasing due to forest development, wetland conservation and construction, and dredge spoil island construction (see for example Parnell et al. 1988). However, nesting sites are frequently affected and destroyed by urban, agricultural or recreational developments or other human disturbance (David 1994, Butler 1997). Many suitable colony sites exist in the vast swamps of the south-eastern USA, but they are more restricted near populated areas. Many colonies are located on artificial lakes and artificial dredge spoil islands, created by channel dredging. In such areas, policies for spoil disposal and competing uses of colony sites pose challenges. Protecting of existing and potential nesting sites will be essential for the future well being of heron populations in an increasingly developed North American landscape.

To date, herons have proven resilient in using urban and suburban environments for nesting and feeding (Erwin et al. 1991, for example). Extensive use is made of zoos, parks and suburban green spaces for colonies and winter roosts. Some colony sites have been around for decades, but others are considered nuisances. Additional study is needed of how heron colonies can be compatible in developed areas.

Colony abandonment rates in most areas are relatively low, indicating long-term site stability (McCrimmon and Parnell 1983). Turnover is greater where many alternative sites occur (Bancroft et al. 1988). Perhaps the greatest threat of colony site destruction is to Great Blue Herons, which nest in many scattered sites, often in forests, often near people. Developments frequently encroach on heron colony sites, either destroying them, disturbing them with construction activities, changing nearby foraging sites, or encouraging other forms of disturbance. Some of these

activities require permits, a restriction through which the needs of herons can be provided for. Given how widespread such conflicts are, much additional study is needed to determine appropriate approaches for sustainable development near sites containing heron colonies.

It is not clear what long-term effect disturbance of colonies has on breeding populations, although in the short term it can cause abandonment and reduced fecundity of individuals (Werschkul et al. 1977, Vos et al. 1985). Large colony sites should be provided with the strongest protection, such as by purchase, posting, easements and perhaps guarding. In developed areas, fencing may be needed. State and province-wide programmes of identifying and securing heron colony sites are required.

### **Aquaculture**

Aquaculture appears to have important effects, both positive and negative, on North American herons. The most important wintering area for most species of North American herons in southern USA coincides with large-scale pond aquaculture. Increases of aquaculture in Louisiana, especially the areal extent of crayfish ponds, correlate strongly with an increase in heron numbers in the region (Fleury and Sherry 1995). Thus it is possible that aquaculture may be responsible for the present stability and increase in some heron populations in North America.

However, the aquaculture industry regards herons as pests, even though the birds may take only a small proportion of the available stock (Fleury and Sherry 1995 and Chapter 13). Great Blue Herons were found to consume two catfish per hour and Great White Egrets 1.3 per hour, which extrapolates to as many as 24 catfish per day for Great Blue Herons (P.G. Ross and J. Armstrong pers. comm.). Although small compared with the standing stock of fish in a location, such consumption inevitably will lead to damage control and continued conflicts between herons and aquaculture in North America.

Less is known about the effects of conversions of mangroves to aquaculture in the tropics. Natural habitat is lost, but artificially enhanced feeding sites are provided. Controls on killing offending herons are minimal, so much needs to be learned about these sites.

### **Species of concern**

The Reddish Egret is adapted to hypersaline coastal shallows, mostly around the Gulf of Mexico, which are threatened by housing and industrial developments. In addition, the reproductive rate of these egrets appears to be low (Paul 1991).

The white morph of the Great Blue Heron is confined to mostly estuarine habitats of southern Florida and the Caribbean. The special needs of these species are summarised by Kale (1978).

The Pacific coast subspecies of Great Blue Heron is restricted to the coastal strip along the north-east Pacific coast of North America (Butler 1997).

Bitterns are adapted to marshes and nearby grassland habitats, which have been greatly diminished in the USA and Canada. Protection of even small wetland patches would benefit these species in the middle USA, and artificial wetlands may benefit Least Bitterns (Hands et al. 1989, Gibbs et al. 1992b).