Great Blue Heron

Ardea herodias

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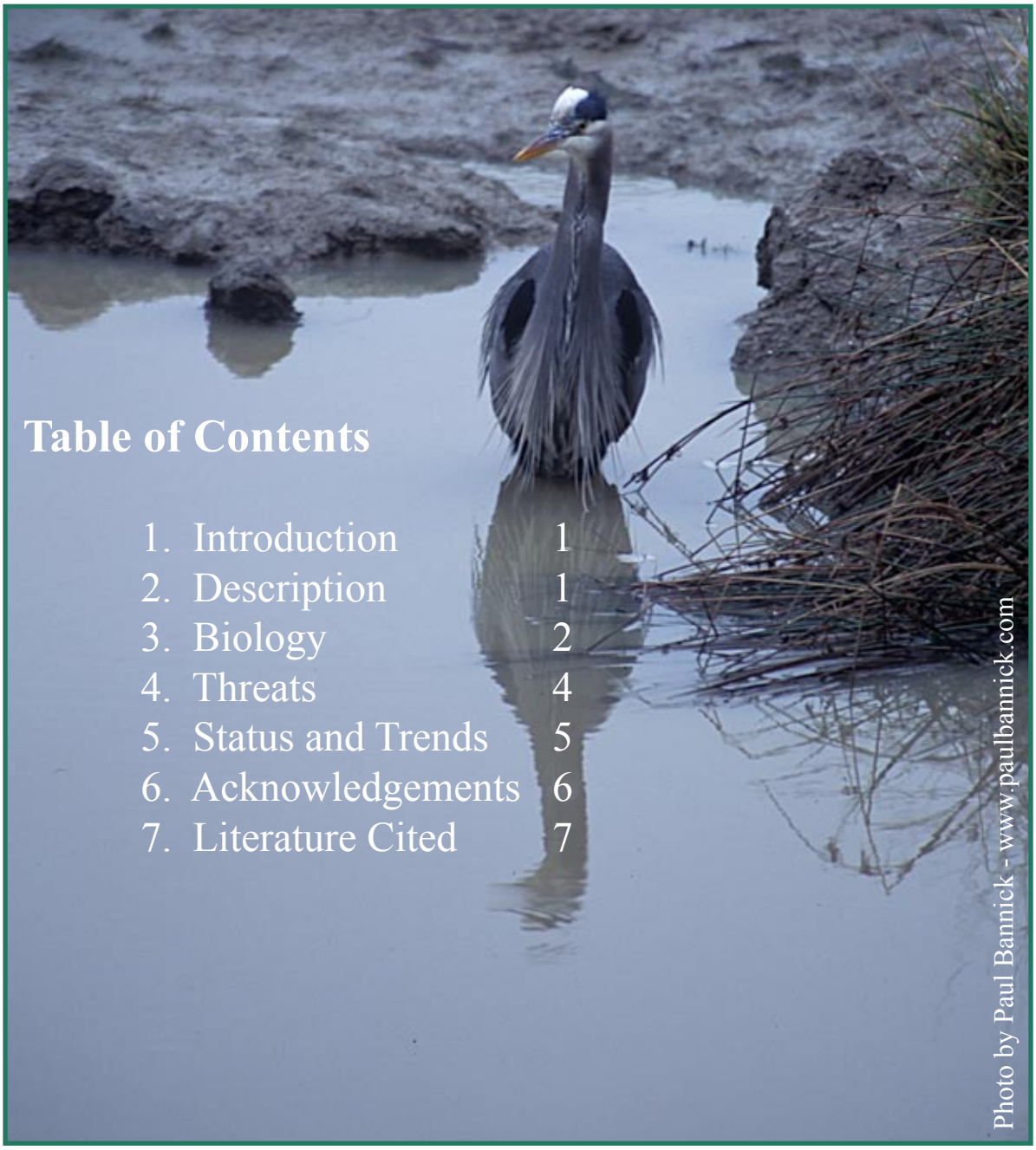

Table of Contents

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1 Introduction

Great Blue Herons (Ardea herodias) are a ubiquitous member of the west coast avifauna. Standing over 60 centimeters tall, their slow gait and bent neck are a familiar sight to people living in the Pacific Northwest. A gradual decline in the heron population in this area over the last two decades is a conservation concern and requires more research into causes and possible solutions to recover population numbers. Nest and colony abandonment are common in herons breeding in Washington State and British Columbia, and potentially accounts for the decreasing trend. The Great Blue Heron is sensitive to disturbance from human activities and, more recently, predation by bald eagles (*Haliaeetus leucocephalus*). Curiously, neither mechanism may be the primary factor responsible for the aforementioned decline (Butler et al. 1995, Kenyon 2005). Heron declines preceded an increase in eagle populations after eagle hunting was banned and the use of certain pesticides decreased (e.g., DDT; Buehler 2000, Elliott and Harris 2001). Human disturbance, a second potential mechanism, is rarely the primary cause of colony abandonment, though the combined effects of human disturbance and eagle predation may have contributed to a reduction in breeding success in the late 1990s in British Columbia (Vennesland and Butler 2004).

Listed in Washington State by the Washington Department of Fish and Wildlife as a "Priority Species" (Quinn and Milner 2004) and as a species of "special concern" by the Committee on the Status of Endangered Wildlife (COSEWIC 2004) in Canada, the Great Blue Heron is a species of interest to Seattle Audubon Society's conservation, research and education programs. Increasing the overall profile of this species and its requirements for breeding and foraging habitat are the aims of this paper.

2 Description

Members of the Family Ardeidae include herons, bitterns and egrets (del Hoyo et al. 1992). The Great Blue Heron is one of 60 heron species in the world and among the largest of dark herons. Common in salt and freshwater habitats that extend from Alaska to Central America, the Great Blue Heron is closely related to the Cocoi herons in South America and the Old World grey herons of Europe and Asia.

Great Blue Herons are sexually dimorphic and typically, males are larger, and with longer bills, than females. Each stage of a heron's life – from fledgling to adult - has subtle differences in the length and coloration of the plumage. Adult Great Blue Herons have a white head with black plumes above the eye, dark underparts, grey upperparts and wings, a dark shoulder patch, and long, body plumes originating near the bottom of their neck. Yearlings (12 to 24 month old; Butler 1997) have transitional or intermediate plumage between adults and juveniles. Yearlings can be easily mistaken for adults because the body plumes are almost as long in both ages but the black shoulder patch is smaller in yearlings. Juvenile herons (0-12 months) are distinguished from yearlings and adults by a chestnut colored edging along the wing coverts, a white crown and the lack of long, body plumes. Fledglings (1-2 months after leaving the nest) differ from juveniles, yearlings and adults because they have a grey crown and characteristic downy feathers protruding from their head.

Based on differences in size, plumage and geographic distribution, there are seven subspecies of Great

Blue Heron recognized in North America, including the great white heron (*A. h. occidentalis*) (AOU 1957, 1963). The great white heron is currently accepted as a white morph of the Great Blue Heron that is restricted to Florida and parts of the Caribbean. A recent study on the taxonomic status of this species, with genetic and mate choice research, found that full species status was warranted and the author suggested a taxonomic review (McGuire 2002). McGuire and Noor (2002) published a DNA library of Ardea herodias while investigating the status of A. h. occidentalis and this may help to clarify the taxonomic status of all subspecies in North America

3 Biology

Great Blue Herons begin breeding in their second year and, at this time, undergo several morphological changes. Mature birds develop body feather plumes and intense color changes in their beaks, eyes and legs in response to reproductive cues (Butler 1997). In the Pacific Northwest, the breeding season begins in January with courtship and nest building, and eggs are laid from early March into mid April, with the peak in late March (Butler 1993). The breeding season typically lasts 14-16 weeks in Washington and British Columbia; however, in more southerly parts of the species range, Great Blue Herons nest until August, with some pairs successfully raising two broods (Moul et al. 2001).

Male herons return to breeding sites to select mates and nest locations from January to March (Stabins 2001, Butler 1992), generally arriving at larger heronries earlier than smaller ones (Werschkul et al. 1977). Courtship begins with an elaborate display of movements, dances and greetings between mated pairs (Mock 1976) and culminates with nest building. Generally speaking, males gather the nest materials while females construct a nest and guard the nest site (Butler 1997). However, both males and females participate in incubation and chick rearing (Butler 1992).

Nests are frequently built 15-30 m above the ground in trees with large diameter trunks. The tree - in particular its height and lateral strength - must be strong enough to withstand and support multiple nests (Stabins 2001) and herons will nest in whatever species are available. On the west coast, the species nests in mature stands containing red alder (*Alnus rubra*), black cottonwood (*Populus balsamifera*) or Douglas-fir (*Pseudotsuga menziesii*) though other species are used as well (Gebauer 2001, Machmer and Steeger 2003).

Both the number of nests per tree and nests per hectare are positively correlated with reproductive success (Werschkul et al. 1977, Forbes et al. 1985, Gibbs et al. 1987, Gebauer and Moul 2001). Colony size is positively correlated with area to foraging habitat (Gibbs et al. 1987) and nests are usually located close (less than 10 km) to foraging areas. However, the feeding territories for male herons may be up to 34 km away (Peifer 1979). There is a lot of variability with respect to the tolerance herons have for nesting near human settlements because herons can habituate to some repeated activities (Vennesland and Butler 2004).

Onset of egg laying differs according to geographic location (i.e., latitude) but begins about nine days after a female's daily food intake crosses an estimated threshold of 1,715 kJ/day (Butler 1993). The large volume eggs (75 g) are laid at 2 day intervals (rarely 3) and both parents begin incubating immediately. The incubation period lasts on average 28 days and subsequent chick rearing 64-91 days,

for an average of 110 days for each breeding effort (Butler 1992) - the longest nestling period among North American herons (Werschkul et al. 1977, Butler 1997).

Clutch size increases with latitude with smaller clutches found in southern populations (Butler 1992). In the Pacific Northwest, *A. h.herodias* lays an average number of 3.6 - 4.0 eggs per clutch (Norman 1995) but more southerly populations may reproduce more frequently (two attempts/year) and thus have a similar reproductive output each year despite smaller clutches (Butler 1997). Chicks are semi-altricial at hatching and take up to 21 days before being able to walk around the nest (Butler 1992). Lifetime reproductive success is unknown in this species but annual success averages 2.3 young/nest or 62 percent (Butler 1992).

Chick mortality factors have been difficult to assess because of the challenges of seeing into active nests but it includes siblicide (siblings killing each other), predation, starvation, and falls from the nest (Butler 1997). Based on band recovery data, mortality has been estimated at 28 percent in the first year, 36 percent in the second and 22 percent each year thereafter (Owen 1959). Survival estimates might be higher than the published estimates because many factors influence the rate of band returns, for example, juvenile dispersal after fledging. While juveniles usually return to the hatching site as adults, the actual return rate is not known, nor where juveniles go during maturation. Additional considerations for the adult survival rate include the possibility that non-migratory Great Blue Herons might live longer than migratory subspecies because they avoid the yearly energy expenditure of migration (Butler 1997). The lifespan of herons is not known but the oldest recorded individual was 23 years-old when it died (Butler 1992).

Great Blue Herons are general and opportunistic predators consuming many different species including marine fish and crustaceans, small terrestrial mammals, rodents, insects, reptiles, amphibians and small birds (Butler 1992). They rarely engage in kleptoparasitism (e.g., stealing prey from ospreys, *Pandion haliaetus*; Squires 1998) and are usually solitary, not social, feeders (Custer et al. 2004). The species feeds mainly in both fresh and saltwater, including grasslands habitats for fish and amphibians. The Great "White" Heron, *A. h. occidentalis*, forages along the shore for fish. In the Galápagos, where another subspecies of Great Blue Heron occurs (*A. h. cognata*) herons consume mainly lizards, iguanas, fish, and hatchling sea turtles (Butler 1997).

The upright "stand and wait" position epitomizes Great Blue Heron hunting behavior for most people that have observed this bird (Meyerrieks 1960, Kushlan 1976). Once prey are detected, a heron will stand motionless for long periods of time waiting for the fish or small mammal to move (Butler 1992); as soon as the prey moves, the heron lowers and thrusts its head forward, grabbing it in its mandibles, only rarely spearing it with the tip of its bill (Peifer 1979). Great Blue Herons rarely engage in the myriad of hunting methods used by other heron species in the family Ardeidae (e.g., dive, swim, plunge, run, hop, wing flick, or hover).

Great Blue Herons are territorial at their foraging grounds, especially during the chick-rearing period. Adults will leave their foraging area to defecate but return to the same spot promptly. Non-breeding birds are generally not territorial and will defecate within their foraging territory and fly to a new area afterwards (Bayer 1980). Most Great Blue Herons are quite active, occurring in pairs and large colo-

nies, though in the Galápagos, it is more sedentary and found mostly only in pairs (Butler 1997).

Compared to adult herons, juvenile birds are unskilled foragers. In the Pacific Northwest, juveniles cannot meet their energetic requirements on the eelgrass beds used by adults near the nest and thus must move. In the late summer and fall, juveniles cannot find enough food during low tide and need to move to upland meadows and grasslands to forage on small mammals. Adults, who are more efficient foragers, remain in the eelgrass beds through November (Butler 1991, 1997).

With the onset of winter, the daily tide cycle significantly influences how much food all herons can consume in marine habitats because the number of minutes of low tide during the day decreases and the tides are not very low (Butler 1993). Herons of all ages are unable to find enough food during the one low tide of the day and need to switch to foraging for small rodents and other species in upland habitats (Butler 1997), highlighting the importance of multiple habitat types to support a heron population. Upland grasslands become very important to adult and juvenile herons of *A. h. herodias* in the winter months where they hunt for small rodents and mammals, such as Townsend's voles (Microtis townsendii) (Gebauer 2001).

4 Threats

There are at least four main threats to Great Blue Herons in the Pacific Northwest: predation or disturbance by eagles, disturbance from human activities, habitat loss or alteration, and chemical poisoning (toxins). Predation by eagles on adult and post-fledgling herons may be an important factor for heron populations in Washington State and southwestern British Columbia (Forbes 1987) but the extent of the mortality is unknown. Great Blue Heron nestlings, juveniles and adults all fall prey to eagles (and occasionally hawks and mammals) and after repeated attacks at the colony, herons may abandon their nest site (Caldwell 1986) or redistribute into smaller, more widely scattered colonies (Kenyon 2005). In British Columbia, some heron colonies are smaller now that eagle populations are rebounding in the last two decades. Interestingly, in British Columbia some Great Blue Herons have responded to an increase in eagle predation and disturbance by adopting either the strategy to increase colony fragmentation or increasing colony density adjacent to active eagle nests (R. Butler, pers. comm.).

Herons are sensitive to disturbance from human activities though they may habituate to non-threatening activities that are repeated (Webb and Forbes 1982). The extent and severity of nest abandonment from human activities is not well understood and more work is needed in these areas. Skagen et al. (2001) noted that several factors (including interactions with other species and environmental change) could either mask or intensify the effects of human activities. However, because there is some evidence that disturbance during the breeding season can cause reproductive failures and displacement from nesting and foraging areas, the Washington Department of Fish and Wildlife (WDFW) has suggested 300 m (84 feet) buffer zones around active colonies to screen and isolate nesting herons during this critical life history stage (WDFW 1997, Quinn and Milner 2004). Additional buffer zones may be needed around important foraging areas if they are surrounded by intense human activities.

Habitat destruction or change in the form of logging, residential or commercial development, parks, and wildlife-viewing areas is a third threat to Great Blue Herons and has potentially added to the

problem of nest abandonment. Since herons require large diameter trees for nesting, and the proximity of nesting habitat to suitable foraging habitat is important (Butler 1997), WDFW recommended that forest stands of 4 hectares, containing trees not less than 17 m in height, be left near existing heron colonies to ameliorate the loss or degradation of heron nesting habitat in the future (Quinn and Milner 2004).

The fourth, but by no means last, threat to herons is the presence of toxins in the environment. Herons are at the top of the food chain and thus can be used as indicators of ecosystem health. Their success, or failure, can be tied or linked back to chemicals or pollutants in the environment and in their prey. For example, changing pulp and paper practices in British Columbia caused a reduction in the use of pesticides and improvements in the reproductive success of herons, and other species, followed (Elliott et al. 1996). Insecticides and herbicides used near waterways may have low toxicity to herons but can be highly toxic to the fish they consume (Grue et al. 1986). Chemical compounds, like dioxin, can enter waterways and accumulate at multiple trophic levels (Elliott et al. 1989). High levels of PCBs continue to occur at the Commencement Bay and Lower Duwamish (Norman 1998b), with some samples of eggs collected at the west Seattle heron colony in 1998 still containing high levels of PCBs (pers comm Donald Norman). The WDFW recommends pesticide-free buffer zones of at least 300 m and 4 km for heron colonies and foraging grounds, respectively, depending on meteorological factors and other conditions present at the time of pesticide application (Quinn and Milner 2004).

5 Status and Trends

Long-term population trends for the Great Blue Heron in North American are limited because of the different methods used for census and research (Machmer and Steeger 2003). Across most of the United States, heron populations are thought to be stable or increasing, potentially in response to buffer zones added to nesting habitats and the prohibition or elimination of some pesticides and chemicals in the environment (e.g., DDT) (Stabins 2001). The North American Breeding Bird Survey population estimates for Great Blue Herons in Washington, from 1966-1999, show variability in annual rates of change from -6.11 to +13.4 percent per year (Sauer et al. 2000, US Geological Survey 2006). Additional studies suggest that population levels in King County, WA were higher in 2000 than in 1985 (Stabins 2001) and that there is adequate habitat to support herons breeding in the Puget Sound (Norman 1995). In Canada, heron populations in the Pacific Maritime Region of British Columbia have been declining since 1969 (Downes 2002). The productivity of the colonies in this region is the lowest in North American, and has been declining since 1971 (Vennesland 2000, Kenyon 2005).

Surveys in the Columbia Basin, WA indicate little change in the number of adults and chicks per nest when comparing counts made in 1982 and 2002, although the average colony size has declined (Machmer and Steeger 2003).

In Puget Sound, limited work has been done to characterize the foraging habitat available to Great Blue Herons, especially during the winter months. People for Puget Sound, a non-profit citizen's group working to protect and restore the health of Puget Sound, WA, surveyed beaches in 2002 and found that 42 percent of a 9.3 km stretch of shoreline contained at least one potential foraging area for

herons (i.e., an area with fish spawning gravel) (Bloch et al. 2002).

A recent approach to addressing the shifting colonies and incomplete coverage of colonies in western Washington was an aerial survey of the marine foraging grounds which occurred as a special flight of the Puget Sound Ambient Monitoring Program (PSAMP) of WDFW. This report (Norman 2001) was expanded to fly the entire inland and outer coastal waters of western Washington during a low tide during the breeding season to obtain an estimate of the number of birds foraging (Hayes 2006). Several new colonies were located with this method and the flights will be done regularly to track populations.

In 2001, government and non-government groups and individuals from Washington State joined the Heron Stewardship Program in British Columbia and now serve on the Heron Working Group (www.heronworkinggroup.org). The Working Group is a consortium of individuals from many different organizations that seeks to ensure the survival of the Great Blue Heron throughout its range. Seattle Audubon Society has completed the first stage in creating a predictive geospatial model of Great Blue Heron nesting and foraging habitat through Snohomish, King and Pierce Counties (A. Morgan, pers. comm. 2006). The importance of identifying key habitats during the nesting period is the primary focus of the project because of the need for adults to locate good foraging grounds near the nest site when they are raising their chicks.

The largest colony in King, Snohomish and Pierce Counties is found in the Black River Riparian Forest, Renton, WA. Herons Forever (www.heronsforever.org) is a local non-profit organization dedicated to protecting the Black River heron colony and works to purchase and secure private land with public funds. The Black River Forest is one of the few remaining lowland riparian forests in Puget Sound, WA and the colony supports approximately 130 active nests, making it one of the largest in the State

In conclusion, a coordinated effort by agencies, academics and non-profit organizations is needed to identify and prioritize knowledge gaps and concentrate efforts on locating and identifying nesting areas, foraging grounds during the summer and winter months, and minimizing or removing human activities and other threats adjacent to nest sites to reduce the probability of nest abandonment or nest failure. Additionally, management plans developed to protect and manage heron nesting colonies should incorporate measures to address the health of and pressures exerted upon adjacent foraging areas.

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