**Exploration of the Great Blue Heron Clutch Size**

**in the Interior British Columbia**

By: Jollee Perrier

T00598587

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Supervisor: Karl Larsen

Bachelor of Natural Resource Science at Thompson Rivers University

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# Executive Summary

The Great Blue Heron subspecies *herodias* (*Adrea herodias herodias*) is found in the Northern and Southern interior forest regions of British Columbia and also, throughout southern Canada and the northern United States (Butler and Vennesland 2015). Evaluating clutch size will provide us a basis of knowledge on this topic as currently there are no wide-ranging colony surveys in the interior region on *A. h. herodias* (Butler and Vennesland 2015). This study will focus on the number of chicks successfully hatched in selected breeding pairs of each colony. The study area will be in southern interior of British Columbia to establish a reference of clutch size. The study will be for 3 consecutive years including a preliminary year allocated for drone testing. Monitoring will start late March at the beginning of their breeding season and until eggs are hatched. Approximately once a week each nest will be surveyed for when the eggs are laid and hatched. This study will further provide information to wildlife managers and ecologists for future studies or education.

# Background Information and Significance of the Study

The Great Blue Heron is the largest wading bird in North America. The subspecies *herodias* is found in the Southern and Northern Interior Forest regions in British Columbia during breeding and migratory periods (Butler and Vennesland 2004). This subspecies is known to migrate south to Mexico and South America but, some are known to overwinter near ice-free waterbodies in southern British Columbia (Butler and Vennesland 2004). This subspecies is on the provincial

*Blue List* and its COSEWIC status have not been accessed in British Columbia (COSEWIC 2008). Great blue herons losing young can be from starvation which can be from lack of prey and predation, therefore clutch sizes are important with population persistent because fledging success is never 100% (Butler et al 1995). Liu et al (2018), explain that avian clutch sizes have patterns across latitudinal gradients which decrease with increasing breeding season length whereas, they increase with increasing breeding season length through elevational gradients.

Great Blue Heron colonies are dynamic because they can relocate nests frequently thus, tracking colonies each breeding season may be difficult (Butler and Vennesland 2015). The Great Blue Heron commonly nest in trees including black cottonwood (*Populas balsamifera*) comprising 56%, and the remaining 46% include coniferous species such as, Douglas-fir (*Pseudotsuga menziesii*), western white pine (*Pinus monticola*), hybrid white spruce (*Picea glauca × engelmannii),* ponderosa pine (Pinus ponderosa), western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) (Butler and Vennesland 2004). They nest in colonies called a rookery, which must be accessible to foraging habitats such as aquatic areas, riverbanks, lakeshores and wetlands; they are a top predator in the aquatic food web (Grau and Parris 1980). Foraging and nesting habitat proximity is correlated with populations size (Butler and Vennesland 2004). The main threats to populations include urbanized areas that disturb nesting and foraging habitat and eagle predation (COSEWIC 2008). These disturbances can cause habitat loss and reduce habitat quality causing colonies to relocate thus, may provoke reproduction timing (COSEWIC 2008). Understanding threats to their population is critical for managing strategies to avoid population declines. In the interior their breeding is initiated in late March, but the breeding duration is not known (Butler and Vennesland 2004). Herons can potentially breed more than once if their first attempt fails early (Butler and Vennesland 2004). Butler and Vennesland 2004, describe *A. h. herodias’* reproduction and breeding as the following. The males arrive before the females by about 1 week to the colony site to establish territories. Several days to a month are allocated for courtship, nest repair or build, and establish monogamous pairs for the season. After mating, the eggs can be laid within a week at about 2-day intervals and then incubation starts and lasts for about 27 days. Breeding sites can be quickly relocated because they can rebuild a nest in 3 days and lay eggs within a week after mating. Clutch sizes range from 1-8 eggs with 3-5 being average. When the chicks hatch, they are reared on the nest for approximately 60 days and the parents feed them mostly fish which are caught near the nest; they first breed after their second winter (Butler and Vennesland 2004). Great Blue Herons require plentiful prey nearby of shallow water fish species within 10km of their breeding location (Butler and Vennesland 2015). They may also rely on non-aquatic foraging habitat but the importance to *A. h. herodias* in the Interior is unknown (Butler and Vennesland 2004).

# Objectives of Proposed Study

Clutch sizes and fledging success are important to stable populations in a species that are listed of species concern. Therefore, studying this subspecies clutch size will aid to the knowledge gap and contribute to baseline data of clutch size and simultaneously determine breeding durations for the Great Blue Heron subspecies herodias (*Adrea herodias herodias*) in the interior British Columbia. The objective of this study is to 1) Gather baseline data of clutch sizes in populations found in the Okanagan, Similkameen, and South Thompson Fraser Canyon during the breeding season, and 2) Determine if this subspecies clutch size and duration vary from the other subspecies (*Adrea herodias fannini*) found in Pacific coast of British Columbia.

# Methodology

In this study we will determine nest locations, breeding pairs and clutch sizes in Great Blue Heron subspecies herodias (*Adrea herodias herodias)*. The study will be conducted for 3 years with a 1-year preliminary test located within Southern interior region of British Columbia in the Okanagan, Similkameen, and South Thompson Fraser Canyon. One rookery in each region will be surveyed. A breeding pair is considered if egg or chicks are found in their nest. We will then use simple random sampling by using a computer to randomly assign a sample size of nests for which we will survey in each rookery. This will allow for a non-bias sampling method. Each following year the same method will be used with replacement. Preliminary drone test will be conducted the year before the study starts to see if drone counts cause more disturbance than ground surveys. Disturbance will be estimated by 1) length of time that heron alarm displays during the drone/researcher present and, 2) the maximum fleeing distance from the nest observed by at least one heron pair. If drone survey disturbance is greater, then ground surveys will be used but if not, drone and ground surveys will be used in combination. Using both ground and arial survey will decrease error in counts. The preliminary test will also determine a drone’s count optimal proximity, speed, altitude, and duration at the nest. The drone survey will be performed by using system and operational factors that minimize negative impacts on the herons. A recent study on Eurasian waders by Valle and Scarton (2019), show that drone surveys cause less disturbance than traditional ground surveys and that time proximity at the nest can be reduced to 90% when compared to ground surveys. Steps to minimize the amount of disturbance during drone surveys include 1) the drone will be launched at least 100m from the colony, 2) time restricting drone flights to less than 1 minute and 3) examine for potential predators close by in case of possible predation events inflicted by our disturbance, and if the case, flights will be suspended and rescheduled. We will use a small drone (DJI Mavic Pro), at an approximate cost of US$1370 with the following parameters: weight 734 g, maximum speed 60 km/h, sensor 1/2.3ʺ, lens 28 mm (35 mm format equivalent), f/2.2, field of view 78.8°, distortion < 1.5 %, focus from 0.5 m to ∞, video recording modes C4K (4096 × 2160 24p), 4K (3840 × 2160 24/25/30p), and noise 70.0 dB(A). The drone will allow for GPS points and pinpointing nests that will be used for random sampling and mapping coordinates. Each drone count will be followed by a ground count. This ground count will be determined by a future chosen time frame that depends on heron arrival after drone disturbance that was accessed in the preliminary test. Counts will be made into recorded videos and viewed on a personal computer by observers. For monitoring each breeding season the steps include 1) during the end of march start monitoring predicted breeding sites for confirmed site use 2) continue monitoring for monogamous pairs establishment once a week 3) once pairs are established continue monitoring once a week to see when the first egg is laid to predict approximately how long until hatching occurs by using incubation timing, and 4) during incubation we will pause monitoring to decrease disturbance when the eggs are most vulnerable. When the predicted hatching shall occur, we will attain number of hatched chicks for each pair. In the case what we cannot use drones, field sampling will follow the above steps and parameters but use cameras on an extendable pole to capture recordings of the eggs and chicks in the nest. The camera will the GoPro hero 9 at an approximate cost of US405$ with the following features: weight 158 g 1080p live streaming, HyperSmooth 3.0 Video Stabilization, Wifi and Bluetooth, GPS Enabled, 5 lens options, and Rugged + Waterproof to 33ft (10m). It will be mounted on the end of extendable pole that can extend up to heights where it can capture nest activity. At the end of each breeding season clutch sizes in each colony will be recorded for each breeding pair. At the end of the 3-year study our results will compare the averages of each colonies clutch size to the average heron clutch size of 3-5.

# Significance of Results

The Great Blue Heron being the top predator in the aquatic food web and competing with other large birds contribute to the evolutionary fitness of heron populations. The Great blue Heron contributes to the biodiversity and are a symbol of wetland conservation and environmental quality (COSEWIC 2008). As urbanization is continually increasing, wildlife habitat is threatened by human encroachment (COSEWIC 2008). The Great Blue Heron requires foraging habitats 10km within their breeding sites, therefore these sites are a limiting factor to their population (Butler and Vennesland 2004). Habitat destruction and habitat isolation are threats to the Great Blue Heron and offspring. Eagle depredation on heron nests has increased in urbanized areas (COSEWIC 2008). Therefore, we must be aware of the potential threat of eagle depredation on colonies we are surveying because, we may induce eagle predation from our disturbance causing temporary fleeing leaving their nests subject to depredation. These 2 factors may cause herons to relocate their nest and potentially cause unsuccessful reproduction for that season (COSEWIC 2008). These threats caused by humans and eagles may cause a decrease in breeding productivity, colony abandonments, and egg loss. Clutch sizes are critical for stabilizing the heron population. By using the subspecies *Adrea herodias fannini* as a reference clutch size, we can then compare clutch sizes. If we have a less than the average clutch size, then our results may suggest that these populations are subject to threats affecting their clutch sizes to be less than the average. If our results show a positive correlation to average clutch sizes, then our results may support that these populations are relatively healthy and have average clutch sizes. Less than 25% of juveniles survive to their second year after which survival increases to about 75% per year for adults (Butler and Vennesland 2004). Therefore, due to juvenile mortality rates, heron clutch sizes are critical in maintaining populations. By monitoring clutch sizes, we can provide a reference to further research which may support future predictions and management strategies for this blue-listed subspecies which habitats are threatened by urbanization and pollution impacts. This aids future research and management strategies because clutch sizes provide important references of population health which relates to population persistent and stability.

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