Heron Observation Network of Maine: Five Year Report and Future Plans

Introduction

The great blue heron (*Ardea herodias*) is an icon of North American wetlands, for it is one of the most widespread and adaptable wading birds on the continent. In Maine, great blue herons are also quite common and can be seen foraging in tidal marshes, along riverbanks, and even in open grasslands. In flight, their form is reminiscent of a prehistoric creature: large body, long snake-like neck with a sharp dagger for a bill, all carried about by those ever so graceful wings that when wide open may stretch six feet across. Upon liftoff, their squawk further confirms their prehistoric essence. Though they tend to forage alone, their nesting habits are the complete opposite. Colonies can contain anywhere from a few pairs to several hundred, and often multiple nests occupy the same tree. Colonial nesting and location of a colony is somewhat predator driven, but is also determined by the proximity of quality foraging habitat. In addition, human disturbance can be a real threat to a colony's continued occupancy.

Unlike Endangered or Threatened status, Special Concern is an administrative category established by policy, rather than by regulation, and is used for planning and informational purposes only.

In 2007 the great blue heron was listed as a Special Concern species (a non-regulatory status, used for planning and informational purposes) in Maine prompted by an apparent decline in the number and size of nesting colonies, a significant declining trend indicated by Breeding Bird Surveys, and observations of predation by Maine's increasing eagle population. Periodic censuses have been conducted in the past; the most recent was in 2009. The 2009 census revealed 1,071 nesting pairs at 83 colonies statewide. Between 1983 and 1995, the coastal breeding population experienced a 46.7% decline. The 2009 census revealed 430 pairs on 9 coastal islands which was a 33.3% decline from 1995 and a 64.4% decline from 1983. It is unknown whether that decline is a statewide phenomenon or whether it is restricted to only the coastal colonies. The 2009 census was the most geographically comprehensive survey of Maine's nesting great blue herons ever conducted. Aerial surveys are extremely labor-intensive and expensive, thus they cannot be performed on an annual basis. To ensure that we continue to collect nesting data for great blue herons and other colonial wading birds, the Maine Department of Inland Fisheries & Wildlife (MDIFW) began a volunteer adopt-a-colony program in 2009 called the Heron Observation Network (HERON). While the program focuses on great blue heron colonies, it is designed to also incorporate colonies for other wading bird species if the opportunity arises. All colonies that are known to contain other wading bird species are on coastal islands, which do not lend themselves to easy monitoring by volunteers. The program has grown to 229 members, with nearly 100 actively involved in monitoring current or historic sites across the state.

By "adopting" a colony, volunteers agree to visit the site at least once during the breeding season (May-July) and report back to MDIFW whether or not it was active and the number of active and inactive nests. Observations are made from a distance and only if disturbance to the nesting birds can be

avoided. If the volunteers are willing to commit additional time, they can visit as often as every other week to track individual nests and report the number of young that hatch and fledge. These data can be used to better understand productivity and nest success rates, which may in turn affect the adult breeding population trend over time.

After five years of operation, HERON volunteers have provided data on 143 colonies statewide. Although these data have some limitations, they have helped MDIFW better understand the dynamic nature of great blue heron nesting habits, and have led to additional research aimed at identifying sources of disturbance and developing an optimal way to estimate the statewide population.

Level of Public Involvement Over 5 Years

The level of public interest and involvement in the Heron Observation Network is far more than originally anticipated. The list of individuals interested in participating as a HERON volunteer has grown to 229; many of which do not currently live near a conveniently located or accessible colony. Over the course of five years the number of volunteers adopting colonies has waxed and waned but in general has steadily grown (Table 1). Increased media coverage via press releases, newspaper articles, and radio station interviews, resulted in a jump in interest, particularly in 2011 and 2013. In five years of operation, 123 volunteers provided data for over 143 colonies across the state. An added benefit of using volunteers to monitor great blue heron colonies has been the ability to leverage federal funding by using volunteer time and mileage as a non-federal match source. Volunteers were given the option of tracking their time and mileage, but were not required to. Volunteers were not asked to voluntarily track mileage until 2013.

Table 1. Volunteer involvement with the Heron Observation Network, 2009-2013. Not all volunteers who adopted colonies followed through with collecting data; thus the number of colonies adopted and volunteers adopting colonies was always greater than the number colonies monitored and the number of volunteers collecting data.

Year	# Colonies Adopted by Volunteers	# Colonies Monitored by Volunteers	# Volunteers Adopting Colonies	# Volunteers Collected Data	Volunteer Hours Documented	Volunteer Miles Documented
2009	56	25	41	18	115.5	-
2010	68	51	56	41	148.5	-
2011	103	66	70	46	224.35	-
2012	88	68	64	50	252.2	-
2013	130	96	94	74	350.35	3,590.6
Total					**1090.9**	**3590.6**

Survey Methods

Colonial wading bird colonies in Maine are surveyed by both ground and aerial survey. HERON volunteers only partake in ground surveys; whereas MDIFW biologists may collect data via ground or air. Each year, volunteers receive a HERON Volunteer Packet which describes the program in detail and

includes the monitoring protocol, data sheets, volunteer forms, and instructions for completing the forms. Volunteers typically sign up to adopt a colony prior to May, however some have signed up later in the season. Volunteers can adopt one or more colonies for a particular season and usually monitor the same colonies each year. Most often volunteers adopt colonies that are convenient for them to monitor (i.e., within a reasonable distance from their homes) or ones that they have observed in the past. If needed, MDIFW will help the volunteer choose an appropriate location from which to observe the colony without causing disturbance to the birds. Nesting herons can be extremely sensitive to human disturbance, and may even abandon a colony as a result of human intrusion. From the onset of courtship behavior through fledging, it is extremely important to keep a distance of 200 m (656 ft) from the colony. For this reason, a good pair of binoculars or a spotting scope can be extremely helpful for a clear view of the colony. Sometimes a closer distance is acceptable, but it depends on the colony and how much human disturbance the birds are used to. More than one point of observation may be needed in order to count and age the young in all colony nests accurately. If the volunteer believes his/her presence is causing birds to leave their nests, scream, or flush from the site, they must leave and choose an alternative location for subsequent observations. Some colonies may be impossible to observe without causing disturbance; in such cases, these colonies will not be monitored by volunteers. It is not worth the risk of causing abandonment of a colony.

Volunteers are encouraged to obtain landowner permission for any land accessed as part of the Heron Observation Network program, and especially land that is posted. This may require visiting a town office to determine the landowner and his/her contact information. Any landowner information for the colony site or land accessed to get to the colony site is provided to MDIFW to keep on record for future monitoring. MDIFW often assists with obtaining landowner permission.

The minimum data needed for a colony in a given year is whether or not it is active and the approximate number of active nests by species; this can be obtained by one visit preferably between mid-May and mid-June. If a volunteer plans to visit the colony only once, they should consider the visibility of the colony when deciding when to observe. For instance, if the colony nest trees are mostly live hardwoods, active nests may be difficult to see once the trees have leafed out; therefore, a one-time visit should take place in early May. Conversely, if the colony nest trees are primarily dead and easy to see throughout the season, a visit closer to early June may get a more accurate count of the peak number of active nests.

MDIFW is also interested in whether or not a colony survives to fledge young, as well as the productivity of individual nests within a colony. If willing and able to visit a colony multiple times throughout the breeding season to collect this type of information, volunteers can begin anytime in mid-May and space out their observations such that they are 1-2 weeks apart, ending in August when most young start to fledge and thus increasingly lose their ties to the colony. Besides the number of active and inactive nests, volunteers can also record the number of young in each nest and the growth stage of the nestlings.

In addition to observations by HERON volunteers, several MDIFW biologists also conduct ground surveys at colonies that are either convenient to other work and have not been adopted by a volunteer. MDIFW

biologists abide by the same monitoring protocol as HERON volunteers, but do not track their time for future funding leverage.

Aerial survey is another method by which biologists may obtain colony activity data, either as a targeted survey or opportunistically during surveys focused on other species such as bald eagles, ospreys, common eiders, moose, or deer. Maine Warden Service pilots also report heron colonies observed during regular flying duty.

Habitat Setting, Distribution and Size of Colonies

Historic great blue heron colonies have been distributed statewide; however most colonies known to be active within the past five years primarily occur in the southern, central, and coastal portions of the state (Map 1). Map 2 shows the locations of all great blue heron colonies active at least one year between 2009 and 2013. Table 2 shows the habitat setting of these 141 colonies. As we found in 2009, the predominant habitat setting used is withina wetland such as a beaver flowage. However, the number of pairs per colony on coastal islands ($\bar{x}$=28.1, *n*=18) and in uplands ($\bar{x}$=14.7, *n*=19) is usually greater than within wetlands ($\bar{x}$=6.1, *n*=101).

Table 2. Habitat setting and average colony size (pairs per colony) for great blue heron colonies active at least one year between 2009 and 2013.

Habitat Setting*	# Colonies	Average # Pairs per Colony (range)**
Coastal Island	18	28.1 (1-120)
Inland:		
Within wetland	101	6.1 (1-43)
Split: upland & within wetland	2	4.5 (4-5)
Upland - island	3	20.2 (1-65)
Upland - waterbody shore	9	17.2 (1-70)
Upland - other	7	9.0 (1-60)
Man-made structure	1	14.0 -
Total Inland	123	7.5 (1-70)
Total	**141**	**10.1 (1-120)**

**Split: upland & within wetland* refers to a colony overlapping a wetland and upland with nests in live and dead trees; *Upland – other* refers to a colony in an upland not adjacent to a lake, stream, or wetland, with nests primarily in live trees. *Man-made structure* refers to a colony on an active railroad trestle.

***Average # Pairs per Colony* is calculated by first averaging the size of each colony across 5 years, then taking the average of these numbers, grouped by habitat setting.

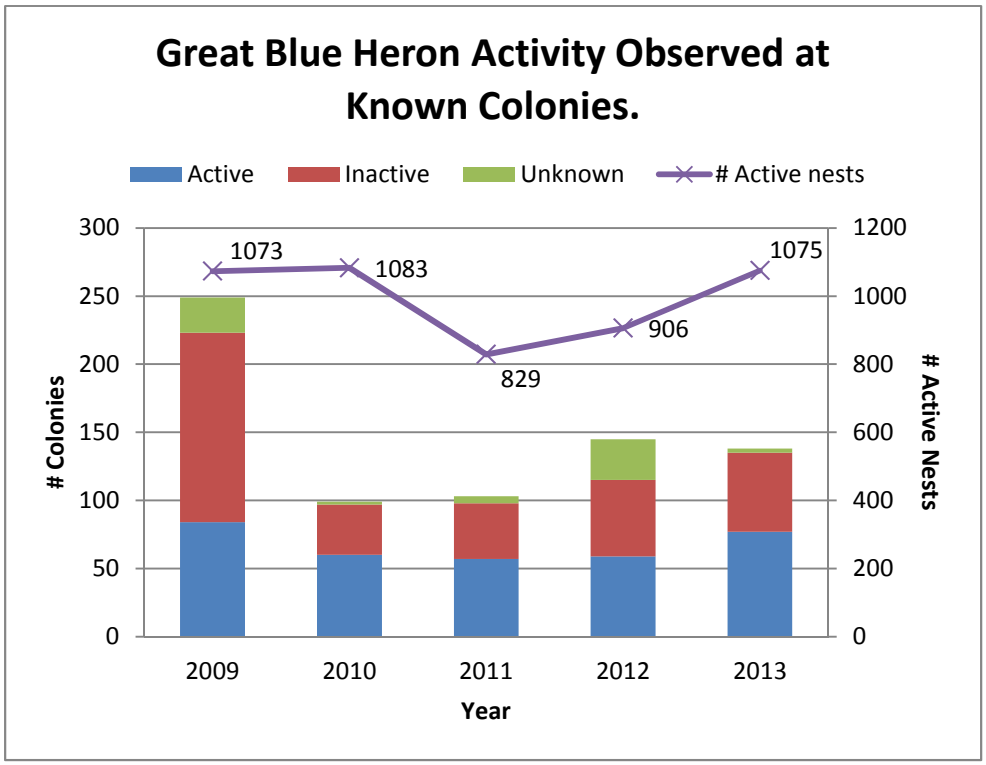
Nesting Activity

Since 2009, MDIFW staff and HERON volunteers have collected use and activity data at great blue heron colonies across the state. Not all historic colonies are monitored each year, and the same colonies are

not monitored each year. Across the five years, 141 individual colonies were active for at least one year (Map 2).

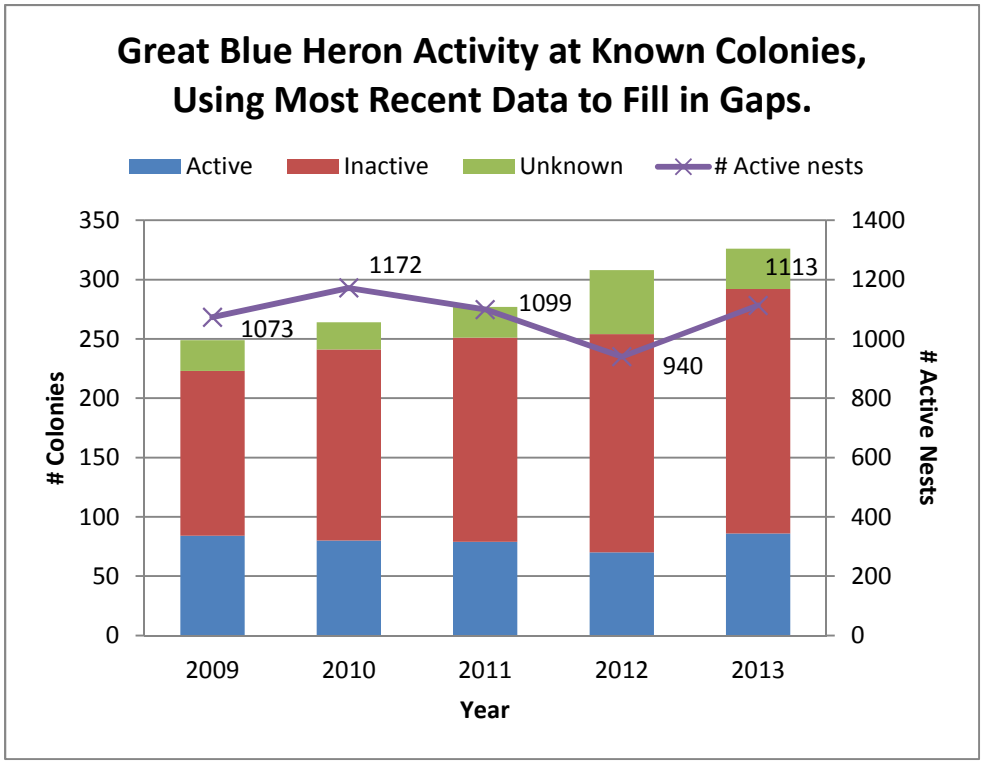
Each year, some colonies that were monitored the year prior are not monitored, and "new" colonies previously unknown to us are monitored. Even though some colonies may become inactive, new colonies are also being added to the list. Despite both additions and subtractions, the number of pairs observed appeared to decrease from 2009 to 2011 and then increase from 2011 to 2013 (Fig. 1). However, this is not a random sample, nor does it represent complete coverage of current and historic colonies.

Figure 1. Great Blue Heron Activity Observed at Known Colonies.



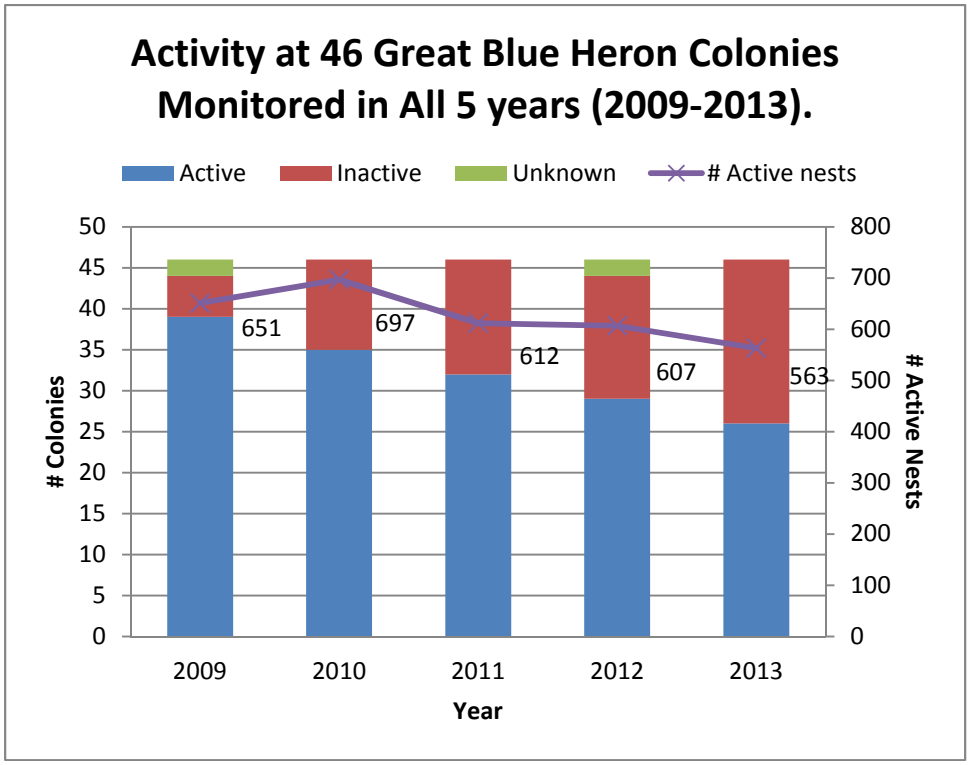
Perhaps a more comprehensive way to look at nesting activity on a statewide basis is to include the most recent survey data for each site (collected 2009 or later). By including these data, we assume the activity remained the same at those sites that did not get surveyed. Figure 2 includes the most recent observations for colonies in each year's column; and shows a pretty steady population with an average of 1,079 nesting pairs each year.

Figure 2. Great blue heron activity at known colonies, using most recent data to fill in gaps.



The 2010-2013 field seasons did not cover all known colonies across the state, thus we cannot determine a statewide population trend at this time. However, there were 46 colonies that were monitored each of the 5 years (2009, 2010, 2011, 2012, and 2013), and colony occupation among the 46 sites declined by 33% (Figure 3). The number of active pairs within these 46 colonies has declined 13%. It is unknown if this decline is simply an artifact of herons changing their colony locations, or if it is an indication of a true decline in nesting activity at a larger scale. This cannot be determined without complete knowledge of all colonies across the state or another method for estimating the nesting population of great blue herons.

Figure 3. Data from 46 colonies surveyed all 5 years.



Productivity Measures

Starting in 2012, volunteers had the option of tracking productivity of individual nests to determine if our fledging rates are similar to other areas, and to provide additional data for a master's student at University of New England (see Research at University of New England section below). On each visit, observers recorded the number of young observed in each nest and the approximate age (1-2, 2-4, 4-6, or 6-8 weeks old, based on nestling illustrations by Donald Gunn (Vennesland and Norman 2006)). For each nest, a maximum number of nestlings in each nest observed prior to 4-6 weeks old was considered the number of hatchlings, or clutch size. The number of nestlings observed to be at least 4-6 weeks old was considered the pre-fledging brood size, and was used as a surrogate for the number of young fledged from successful nests. These methods are used in great blue heron colony monitoring in the San Francisco Bay Area (Kelly et al. 2006).

In 2012 and 2013, volunteers and staff recorded productivity data at 12 and 10 colonies, respectively (5 sites were followed both years). We tracked 113 (1-28 nests per colony) nest attempts in 2012, and 56 (1-17 nests per colony) in 2013. In both years, we observed two total colony failures, but these were small colonies and combined accounted for four nest attempts each year. The average clutch sizes for 2012 and 2013 were 2.7 (SD = 1.1) and 2.3 (SD = 1.4) young per nest, respectively (Table 3). It is not possible to see into the nests during incubation to count the number of eggs. Therefore, these numbers represent only the number of young hatched and that were visible; and they are likely an underestimate of the average number of eggs laid.

Based on the number of young observed at 4-6 weeks old or older, the average number of young fledged per nest attempt in 2012 was 1.9 (SD = 1.1) and in 2013 was 2.1 (SD = 1.3). Past studies of great blue heron fledging rates have shown an average of 2.3 (16 studies, reported in Butler 1992) and 2.0 (n=2,193 nests, reported in Kelly et al. 2007) young per nest; however, these figures were based on the number of young fledged per successful nest, rather than per nest attempt. By including all nest attempts including nests that fail, we would expect a lower fledging rate per nest than what has been reported in the literature. When we exclude nest failures, our fledging rate per successful nest in 2012 is 2.5 (SD = 0.7, n=83 nests at 10 colonies) and in 2013 is 3.0 (SD = 0.5, n=45 nests at 8 colonies), both higher than reported by other studies.

The average reproductive success (mean number of chicks fledged per successful nest/mean clutch size) in 2012 was 77.3% (SD = 14.5%), and in 2013 was 94.1% (SD = 7.2%). Past studies have reported lower reproductive success: 62.5% (8 studies, reported in Butler 1992); however this figure may not be comparable to our data. The productivity data collected by volunteers thus far has its limitations. Volunteers typically do not visit colonies very regularly throughout the season. Often it is just 2 or 3 visits a season, so inevitably they may miss the opportunity to observe the starting number of hatchlings and/or the number of young at 6-8 weeks of age for some or all nests in a colony. The colonies for which I included summary statistics in 2012 and 2103 above, appeared to have good counts of nestlings before 4 weeks of age and after 6 weeks of age; however, if brood reduction occurs early on before nestlings are large enough to be visible from a distance, then we likely are missing some initial losses and our figures for productivity and reproductive success are overestimates.

If we choose to look at productivity measures, it will be important to focus efforts on getting complete counts of nestlings early in the season and close to fledging age. This will likely require visiting colonies at least every 2 weeks in order to get this information for each visible nest in a colony. It is not practical to expect all volunteers to be able to commit this level of effort; therefore future efforts to look at productivity measures will need to rely on permanent and seasonal staff, as well as a few very dedicated volunteers. In addition, a random sample of colonies should be chosen for which such observations will be made.

Table 3. Productivity of nesting great blue herons at colonies monitored by staff and Heron Observation Network volunteers, 2009-2013. Top portion includes all nest attempts; whereas bottom portion excludes complete nest failures and only includes nests that fledged at least 1 young.

PRODUCTIVITY FOR ALL NEST ATTEMPTS

Year	# of Colonies	Total Nest Attempts*	Max Young Observed*	Max Pre-fledge Brood Size Observed*	Average # Hatchlings /Nest**	Survival Rate of Young to Fledging Age**	Average # Young Fledged /Nest**
2012	12	113 (1-28)	325 (0-75)	218 (0-49)	2.7 ± 1.1	61.5 ± 32.6%	1.9 ± 1.1
2013	10	56 (1-17)	142 (0-47)	124 (0-41)	2.3 ± 1.4	72.8 ± 39.8%	2.1 ± 1.3
Combined	**22**	**169**	**467**	**342**	**2.5 ± 1.2**	**66.6 ± 35.6 %**	**2.0 ± 1.2**

PRODUCTIVITY FOR NESTS THAT FLEDGED AT LEAST 1 YOUNG

Year	# of Colonies	Total Successful Nests*	Max Young Observed*	Max Pre-fledge Brood Size Observed*	Average # Hatchlings /Nest**	Survival Rate of Young to Fledging Age**	Average # Young Fledged /Nest**
2012	10	83 (1-17)	273 (2-55)	207 (2-49)	3.3 ± 0.6	77.3 ± 14.5%	2.5 ± 0.7
2013	8	45 (1-16)	133 (3-44)	124 (3-41)	3.2 ± 0.4	94.1 ± 7.2%	3.0 ± 0.5
Combined	**18**	**128**	**406**	**331**	**3.2 ± 0.6**	**84.8 ± 14.3%**	**2.7 ± 0.6**

*Range per colony shown in ().
**SD shown in ().

Challenges and Limitations

HERON relies heavily on volunteers to collect colony use data. The volunteers are quite diverse in their background, experience, and abilities. Some are interested in doing the maximum desired, and others have a hard time fulfilling the minimum asked of them; but all have good intentions. Some are willing to complete hard copy datasheets, while others would rather call or email their observations, or submit their data online. These individual differences result in data that are submitted in a variety of ways, and have varying levels of quality and detail. This creates a challenge when it comes time to summarize and analyze the data.

Despite efforts to get volunteers to adopt nearly all colonies in the state, not all colonies are surveyed each year, nor is the same subset of colonies surveyed each year. Each year, an updated Volunteer Packet is provided with detailed guidance for timing of visits and data collection procedures; however, the timing of volunteer visits is not always ideal to capture the peak number of active nests, the number of young at early stages, or the number of young about to fledge. Some sites do not get surveyed despite being adopted by a volunteer; and staff typically do not find out until after the breeding season.

The inconsistencies among the data have made it difficult to calculate a trend for the breeding population of great blue herons, which is a primary goal for MDIFW. However, we plan to conduct a dual frame sampling survey that will make good use of the data collected by volunteers, while also providing a breeding population estimate for the state. This survey method could then be repeated every 3-5 years to determine a population trend.

Data collection is only one aspect of the Heron Observation Network. Effective communication with volunteers is essential to its success. Volunteers should be shown that their efforts are needed and appreciated. This has been done primarily through email communications and a weblog devoted to the HERON project. The purpose of the blog is to provide program information and resources, interesting informational articles relevant to the program, and data summaries reflecting the work of the volunteers. It has also provided an additional benefit of educating the general public and recruiting new volunteers. In addition, HERON has its own Facebook page to help with disseminating information, keeping volunteers engaged, and informing non-volunteers of the great work HERON does.

The biggest challenge regarding communications has been during March, April, and May when volunteers are being assigned colonies. This is primarily done through email communication, and due to the large volume of communication happening at once and the startup of the survey season, it is a challenge to keep up with it. New volunteers need to be provided with guidance on how the program works, maps of colonies, and landowner and access information. It is also preferred to have staff go out with the volunteer the first time to ensure the colony can be found and a good observation location is chosen. With only one staff person dedicated to the program, it is sometimes difficult to accommodate all potential volunteers and some end up not signing up for a colony. In years when survey information is critical, or a specific research project is occurring, it is recommended to at least have one seasonal contract worker who can help fulfill some of these duties.

Disturbance and Predation

In addition to a population estimate and trend for breeding great blue herons in Maine, a better understanding of limiting factors is also needed. In 2013, of 70 active great blue heron colonies, ten were observed to have failed mid-season well in advance of expected fledging dates. The causes of these abandonments are unknown, but disturbance by one or more of the following predators is suspected: bald eagle, great horned owl, Northern goshawk, and raccoon. Bald eagles have been observed taking chicks, fledglings, and even adults in several areas within the state; and in 2012 volunteers observed an adult bald eagle attack and drown an adult heron at a colony. Many historic great blue heron colonies on Maine's coastal islands are no longer active; most of these islands now host nesting bald eagles. Great horned owls have been observed using great blue heron nests, both in colonies with and without actively nesting herons. A Northern goshawk was known to nest very close to a great blue heron colony and is one possibility for causing 19 of 21 nests to completely fail in 2013. A raccoon was observed raiding heron nests during the day at this same colony in 2012.

Maine's burgeoning bald eagle population and increased reports of bald eagles attacking great blue herons leads us to suspect that bald eagles are a leading cause of disturbance and abandonment of

colonies. Colonies located closer to bald eagle nests may be more susceptible to predation by bald eagles, or may benefit from the resident pair of bald eagles keeping other predators (including other eagles) out of their territory and any nearby heron colonies, offering indirect predator protection. Alternatively, the presence of an osprey nest within or near a heron colony may indirectly help protect nesting herons from other predators including bald eagles and other raptors.

Surveillance for predators or other sources of disturbance can be accomplished through the use of time-lapse cameras that capture images at set intervals. In addition, the use of a sound recorder can further confirm the presence of a predator and the amount of stress the disturbance has caused the nesting herons. The presence of bald eagle and osprey nests within a 15 km radius may influence what predators can successfully invade a heron colony. In 2014, we plan to conduct a pilot study to identify causes for disturbance that may cause colony failure and abandonment through the use of time-lapse cameras and sound recorders, and determine whether nesting bald eagles or osprey in the vicinity of heron colonies influence the types of predators that can successfully invade a heron colony.

Research at University of New England

In 2012, Margaret M. Meserve, a graduate student at University of New England, conducted a study designed to assess factors affecting nest survival by examining the behavioral traits of individuals in a coastal versus inland colony. With a total of 411 hours of colony monitoring and 123 observed brood provisioning rates, her study provides the most thorough examination of parental care and nestling behavior of great blue herons in the northeastern United States (Meserve 2013).

Due to declines in our coastal breeding population, she expected to see lower nest survival at the coastal colony; however no difference was found. Daily nest survival was positively associated with an increasing number of nestlings, earlier hatch dates, and increased brood provisioning rates for 1-2 week old chicks (Meserve 2013). These results suggest that the number of nestlings seen early on could be used as a proxy for nest success, and that the 1-2 week old period is an important time for feeding and for human observers to avoid entering colonies and limiting disturbance.

M. Meserve also looked at data collected by HERON volunteers for 32 inland nests from seven sites that had complete nest histories (number and stage of hatchlings, and fate per nest). There was a significant difference in the survival of nests with at least three hatchlings versus nests with at most two hatchlings (X^2=5.35, p=0.0207, df=1, n=32), which is consistent with her independent findings. There was no correlation between mean hatch date and latitude (R^2=-0.195, df=8, p=0.589, n=10) however there was a significant correlation between colony size and mean hatch date (R^2=0.129, df=9, p=0.046, n=11) where hatch date decreases as colony size increases.

It appears that successful nests are initiated earlier, have larger clutch sizes, and are within larger colonies. Additional studies should look at the age of adults and timing of food abundance. We might predict that older, more experienced adults choose to nest in larger colonies, initiate nesting earlier, lay larger clutches, and are better at finding high quality food for their young. The timing of

food abundance may coincide with earlier nest initiation and would likely be needed for producing larger clutches.

Future Research and Monitoring

In the spring and summer of 2014, we plan to conduct a pilot study to document predation and other sources of disturbance through the use of PlotWatcher Pro Time-Lapse HD Video Cameras (Day6 Outdoors) at up to six colonies; and Song Meter (Wildlife Acoustics) autonomous sound recorders at up to four of these six colonies. The song meters are to be borrowed from Maine Coastal Islands NWR and will only be in use until mid-May before they need to be returned; whereas the time-lapse cameras can be in use until all birds have fledged or left the colony. Cameras and sound recorders will be deployed as soon as sites are safely accessible and as long as there is no disturbance caused to nesting herons. Ideally we will have the cameras and sound recorders in place before the birds return from their wintering grounds, but if access is not safe or feasible (due to ice, snow or mud conditions) we will wait until birds are incubating to avoid disturbing them during territory establishment and courtship. Batteries and memory cards will be checked every 2-3 weeks, and changed out as needed.

MDIFW staff and HERON volunteers will monitor productivity of individual nests every two weeks at these six sites as well as at six additional sites to be chosen at random from the statewide population of colonies that are active and have had no known apparent predator or disturbance problems in the past 2 years. Aerial surveys will be conducted in mid-May within a 15-kilometer radius of all 12 sites to determine nearest nesting activity by bald eagles and ospreys, including distances from active nests to the heron colonies.

Through the use of time-lapse cameras and sound recorders we will document predation or other disturbance events at heron colonies that have experienced high failure rates in recent years. We will explore the relationship between proximity of active bald eagle and osprey nests with nest success and fledging rates at nests within colonies. This pilot study will identify sources of disturbance that may cause full colony abandonments and individual nest failures, and may help inform future investigations into limiting factors for great blue herons in Maine.

In addition, over the course of the next year we plan to collaborate with Mark Otto with the U.S. Fish and Wildlife Service on the design of a dual frame sampling strategy for estimating the breeding population of great blue herons in Maine. The survey is planned for spring and summer of 2015. The dual-frame sampling method, used for monitoring nesting bald eagles, is a technique that would translate well to monitoring great blue heron colonies in Maine (Haines and Pollock 1998, USFWS 2009). Heron colonies are highly visible from the air and tend to be stable over many years (i.e., nesting pairs return year after year). Dual frame sampling combines sampling from both a List Frame and an Area Frame to obtain an estimate of occupied colonies across the state. Both frames are sampled via aerial survey. The List Frame will include known locations of recently active great blue heron colonies across the state. This List Frame has been compiled over the past five years by MDIFW staff and HERON volunteers and will continue to be updated in 2014 with ground surveys by staff and volunteers during the nesting season. The Area Frame is comprised of randomly selected plots (approx. 10km x 10km in

size) within which great blue heron nesting habitat is carefully surveyed for occupied colonies. It is the comparison of the List Frame to the Area Frame survey results that produces a highly accurate estimate for the entire area. This estimate can also be repeated at future intervals (e.g. every 5 years) to obtain a population trend.

Acknowledgements

I express my most sincere thanks to the many individuals that contributed to this effort over the past five years. First and foremost, none of this could have happened without support from within MDIFW: my supervisor, Brad Allen; the entire MDIFW Bird Group; and the RAS supervisors, Information & Education staff, and Wildlife Division Directors that spanned the past five years.

I also thank the pilots from the Maine Warden Service (Charlie Later, Dan Dufault, and Daryl Gordon) and the Maine Forest Service (Chris Blackie and Shawn Rogers) for making themselves readily available for the project, being flexible with scheduling and flight plans, and enduring some very long days. Dan Dufault went above and beyond by reporting many new colony sites he encountered during his regular duty flying, adding significantly to our knowledge of inland colony locations.

I am grateful to our backseat observers Charlie Todd, Brad Allen, Mark Caron, Rich Bard, Judy Camuso, Cheryl Daigle, and Robby Lambert, who all endured less than perfect comfort for hours on end while helping with nest counts and navigation. Special thanks go to Charlie Todd whose expansive knowledge and experience with aerial surveys added tremendously to the quality of work that was accomplished.

My 2009 seasonal worker, Michael Merchant went to many places no man would dare to go during black fly and mosquito seasons, just so we could verify GPS locations on the ground.

The Heron Observation Network, consisting of 229 people from all walks of life, has really stepped up to the plate to help make this program a success. We look forward to working with each and every volunteer in the future. Thank you for your patience and dedication, and for providing continued motivation and inspiration to improve HERON each year.

Lastly, the project would not have been possible without important funding sources such as State Wildlife Grants and the Oil Spill Recovery Fund. Planned research will also rely on State Wildlife Grants, Maine Birder Band funds, and revenue from the sale of HERON stickers designed and produced at a reduced cost by Lauren Gilpatrick of Burly Bird.

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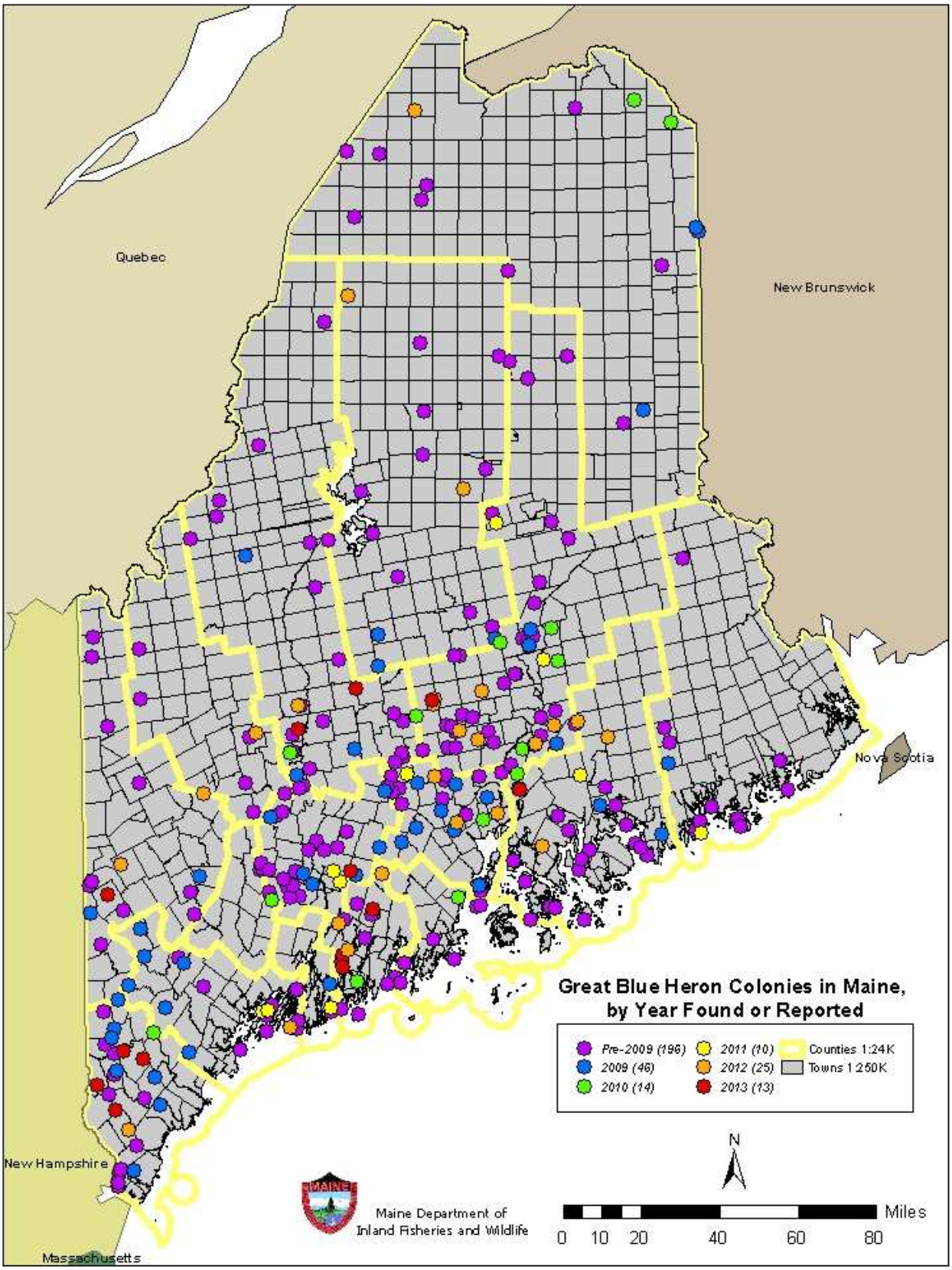
Map 1. Great blue heron colonies in Maine, by year found or reported.



Map 2. Great blue heron colonies in Maine, active at least one year between 2009 and 2013.