Wood Turtle Monitoring and Stewardship in the Annapolis River Watershed

2016-2017 Final Report
Public Version

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This project was made possible thanks to the financial support from the Nova Scotia Habitat Conservation Fund (contributions from hunters and trappers) and the Government of Canada

NOVA SCOTIA HABITAT CONSERVATION FUND
Contributions from Hunters and Trappers

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Canada

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2.0 Acknowledgements

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CARP would like to thank the members of the Nova Scotia Wood Turtle Recovery Team for their ongoing support for this and other projects that aim to ensure the long-term persistence of the wood turtle.

CARP would like to thank the many volunteers who contributed their time to support the field component of this project. Without volunteer support for visual surveys, nesting surveys and nest monitoring, this program would not have been possible.

3.0 Executive Summary

The Wood Turtle Monitoring and Stewardship Project was initiated by the Clean Annapolis River Project (CARP) in collaboration with Acadia University, the Mersey Tobeatic Research Institute (MTRI), and the Nova Scotia Department of Natural Resources (NS DNR) in 2012. It has since completed five successful field seasons.

The goal of the project is to ensure the long-term persistence of the wood turtle and their habitat in the Annapolis River watershed. The project has several components, including monitoring and data collection, public outreach and education, and promotion of stewardship actions.

For the 2016-2017 project year, funding was received from the Nova Scotia Habitat Conservation Fund, and Environment and Climate Change Canada's (ECCC) Habitat Stewardship Program for Species at Risk.

During the 2016 field season survey effort included 30 visual survey events, totalling 177.25 hours of visual survey effort. Turtles were observed on 10 of these events, including 4 new captures. Thirty-six radio-telemetry sessions were conducted, totalling 295 hours of survey effort. A total of 134.74 hours was spent on nesting surveys. While 4 females were observed digging test pits or searching out nest sites, only 1 laying event was observed. This nest was protected and resulted in six out of eight hatchlings successfully developing and emerging. Over the course of the field season 20 individual turtles were observed, including 7 first captures. Since 2012, CARP has observed and notched 41 individual turtles.

Ten new stewardship plans were developed for properties in the Annapolis River watershed. Nine of these properties are located within the Village of Lawrencetown, the result of an effort to promote broader community engagement in recovery initiatives and to promote collaboration across property borders. The other stewardship plan was for a property in Brickton.

Two interpretive panels were produced, to be installed in communities that include areas of wood turtle habitat. Six turtle crossing signs were produced, to be installed in areas where turtles are at risk of mortality or injury from vehicle collisions. Twenty-seven outreach activities were conducted, reaching over 750 individuals.

4.0 Introduction

Wood turtle description and ecology

Figure 1. Wood turtle carapace

The wood turtle (*Glyptemys insculpta*) is a medium-sized, semi-aquatic turtle, ranging in size from 16 to 25 cm in length as adults (COSEWIC 2007; MacGregor & Elderkin, 2003). The carapace is gray-brown in colour (Figure 1) with a sculptured woody appearance, caused by pyramidal circular rings or growth lines. The plastron is yellow with a pattern of black or dark coloured blotches and has no hinge (Figure 2). The skin on the head and upper body of the wood turtle is often dark brown, while the skin on the throat, tail and undersides of the legs is often yellow, orange or red in colour (Figure). They are a long-lived species, reaching sexual maturity between the ages of 11 to 22 (with 16 years being the average). In the wild, wood turtles have an average lifespan of 30 years, compared to 50 years in captivity.

Figure 2. Wood turtle plastron

Figure 3. Adult wood turtle

The wood turtle can be found distributed throughout northeastern North America (MacGregor & Elderkin, 2003). In Canada, the wood turtle can be found in Nova Scotia, New Brunswick, Quebec and Ontario. In the United States (US), the wood turtle can be found in Virginia, New York, Wisconsin, Minnesota and Iowa (MacGregor & Elderkin, 2003; Ernst & Lovich, 2009). In Nova Scotia, wood turtles have been reported in 31 watersheds throughout the province, although little is known about their abundance in many of these areas (MacGregor & Elderkin, 2003). The estimated population in Nova Scotia is between 2000 to 7000 individuals (Environment Canada, 2015). The largest known population of wood turtles in Nova Scotia can be found within the St. Mary's River watershed.

The wood turtle is the most terrestrial of the four freshwater turtle species in Nova Scotia, but still requires water for many of its seasonal activities (COSEWIC 2007; MacGregor & Elderkin, 2003) such as thermoregulation (Dubois et al., 2009), mating (Ernst & Lovich, 2009) and hibernation (Greaves & Litzgus, 2007). In Nova Scotia, the wood turtle requires a stream or river that is clear, meandering and moderately flowing (COSEWIC 2007; MacGregor & Elderkin, 2003). A sandy or sand-gravel area is required for nesting although wood turtles will also make use of artificial nesting sites such as gravel pits, road shoulders and residential sites. Riparian areas and forested habitat are preferred wood turtle habitat;

however they are also found in habitats such as flood plains, meadows, hay and agricultural fields, oxbows and beaver ponds.

Figure 4. Wood turtle range

Wood turtles in Nova Scotia face a variety of natural and anthropogenic threats. Anthropogenic threats include accidental mortality as a result of vehicles or agricultural equipment, habitat loss and degradation, such as residential and commercial development, forestry practices, water management, and changes in ecological dynamics or natural processes, such as subsidized predation (Environment Canada, 2015). Illegal collection as pets or for consumption has also been identified as a potential threat. In the Annapolis River watershed, which includes extensive road networks and a relatively large amount of land in agricultural production, accidental mortality as a result of collisions with vehicles or farming equipment are significant threats to wood turtles (Environment Canada, 2015; MacGregor & Elderkin, 2003).

Species at risk status

In Canada, the wood turtle is currently listed as *threatened* under the Federal Species at Risk Act (SARA). The wood turtle was first added to the SARA Registry in 1996 as a species of special concern, and re-examined and listed as threatened in Schedule 1 of SARA in 2010. Environment Canada (2015) has determined the recovery of the wood turtle in Canada to be both technically and biologically feasible. In 2015 a draft Recovery Strategy for the Wood Turtle (*Glyptemys insculpta)* in Canada was released, and open to public comment until April 1, 2016. Once a final Recovery Strategy has been approved, Wood Turtle Action plans will be posted to the Species at Risk Public Registry. These Action Plans are due for submission by 2020 and will guide conservation actions.

In Nova Scotia, the wood turtle was first listed under the Nova Scotia Endangered species act as *vulnerable* in 2000. After re-examination, this designation was changed to threatened in 2013. These designations are largely imparted because of the wood turtle's sensitivity to human activities and land use practices.

Between 2005 and 2008 NS DNR completed wood turtle surveys within the Annapolis River watershed and 75 wood turtles were recorded. CARP initiated surveys in 2012 to re-assess the population and has developed a monitoring and stewardship program that is ongoing. There are a number of remaining data gaps regarding the local population of wood turtles, including the full extent of their range, and population size and structure.

4.1 Project Goals and Objectives

The overall goal of the Wood Turtle Monitoring and Stewardship project is to ensure the long-term persistence of the wood turtle and its habitat in the Annapolis River watershed. More broadly, the project aims to engage community members in environmental conservation and stewardship activities, using the wood turtle as a focal species.

Project objectives and outcomes as outlined in the contribution agreements for the 2016-2017 project season are outlined in Table 1.

Table 1. Project objectives and associated outcomes 2016-2017

	Funding stream		
Activity Type	**Nova Scotia Habitat Conservation Fund** (Funds from Hunters and Trappers, administered by Nova Scotia Department of Natural Resources)	**Habitat Stewardship Program Species at Risk** (Environment and Climate Change Canada)	Associated Results and Outcomes
Surveys, Inventories and Monitoring	**Visual surveys** • Systematic and repeatable land and water based visual surveys conducted on rivers and tributaries within the Annapolis River watershed • Turtle notching will be conducted based on the protocols developed by DNR • Standardized wood turtle data cards will be used to ensure consistent data collection • Group tracking field sessions organized for volunteers		Threats to SAR and/or their habitat that are caused by human activities are stopped, removed and/or mitigated. Identification of new areas of wood turtle habitat within the Annapolis watershed for future stewardship efforts; identification of high risk threats (e.g. areas of frequent road crossings) for future targeted management and/or stewardship actions.
Surveys, Inventories and Monitoring	**Radio telemetry** • Radio transmitters will be used to track turtles throughout the field season and during overwintering • Standardized wood turtle data cards will be used to ensure consistent data collection • Transmitters will be attached using methods established by the NS DNR, Acadia University and the Wood Turtle Recovery Team for monitoring using radio-telemetry • Group tracking field sessions organized for community members		
Habitat	**Nest protection program coordination and Implementation:**		Important habitat for SAR recovery is

improvement	Nesting surveys • Nesting surveys conducted as per methods established by the Blanding's Turtle Recovery Team (2007) • Data will be recorded using established NS Turtle Nesting and Observation Card Emergence surveys • Emergence surveys conducted as per methods established by the Blanding's Turtle Recovery Team (2007) • Data will be recorded using established NS Turtle Nesting and Observation Card Nest protection program coordination • Screen enclosures placed over nests to prevent predation and monitored during emergence window • Nest enclosure building workshops organized and open for public participation		improved and/or managed to meet their recovery needs. Increased recruitment to local wood turtle subpopulations through reduced nest predation; community capacity developed for continued nest protection activities; implementation of Nova Scotia wood turtle stewardship plan.
Human impact mitigation	Stewardship Plan Development • Development of stewardship plans • Identify priority land parcels using GIS • Work with landowners to develop stewardship plans for their properties; seek commitment to specific actions defined in the plan through signature of a stewardship agreement with landowners • Support provided by CARP staff for implementation of stewardship plans		Threats to SAR and/or their habitat that are caused by human activities are stopped, removed and/or mitigated. Landowners/managers aware of threats to wood turtle on their properties and actively making decisions to remove or mitigate threats; implementation of Nova Scotia wood turtle stewardship plan.
Program planning and development	Data sharing to support provincial recovery initiatives • Data entry and analysis. • Prepare final report including project activities, the results of data analysis, GIS mapping, lessons learned and recommendations • Disseminate report to public stakeholders, funders and project partners • Participate in wood turtle species recovery working group		Threats to SAR and/or their habitat that are caused by human activities are stopped, removed and/or mitigated. Working relationships developed and maintained among key stakeholders allowing for sustained SAR recovery efforts.
Public		Public interpretive panel production and installation	Threats to SAR and/or their habitat that are caused by human activities

outreach		• Produce and install and educational interpretive panel at trailhead on the Fales River, Kingston, Nova Scotia in areas of critical habitat and low public awareness about wood turtle threat status	are stopped, removed and/or mitigated. Awareness raised about local threats to wood turtles and stewardship options among community members residing in areas of critical habitat; implementation of Nova Scotia wood turtle stewardship plan. Community members educated about wood turtles, wood turtle habitat, and conservation/stewardship practices; Increased community support for project and participation in project initiatives.
		Road crossing sign production and installation • Work in collaboration with Department of Transport and other stakeholders to produce and install a turtle crossing sign at known areas of frequent wood turtle sightings (Whitman Rd., Aylesford)	
	Volunteer training • Visual survey and radio-telemetry training workshop • In-field training for community groups and organizations • Nesting and emergence training workshop • Individual field training sessions		Project benefits are sustained over time by engaging Canadians to participate directly in activities that support the recovery of SAR Community participation in voluntary stewardship actions; community capacity to support citizen science programs that target wood turtles
	Youth Leadership Training • Conduct a series of training sessions with youth representatives from schools within the Annapolis River watershed • Involve youth participants in field based project activities • Youth presentations given at respective schools		Project benefits are sustained over time by engaging Canadians to participate directly in activities that support the recovery of SAR Youth leaders knowledgeable about SAR and threats to their habitat, and able to communicate this information among peers and community members; youth leaders actively engaged in SAR conservation activities.

	Outreach and education • Electronic and social media campaign • Press releases in local newspapers and other publications • Project specific articles included in CARP's quarterly newsletter	Threats to SAR and/or their habitat that are caused by human activities are stopped, removed and/or mitigated. Awareness raised about local threats to wood turtles and stewardship options among community members residing in areas of critical habitat; implementation of Nova Scotia wood turtle stewardship plans. Community members educated about wood turtles, wood turtle habitat, and conservation/stewardship practices; Increased community support for project and participation in project initiatives.

5.0 Methodology

5.1 Visual Surveys

Systematic visual surveys of terrestrial and aquatic habitat were conducted in areas of known and suspected wood turtle habitat within the Annapolis River watershed between May and July 2016. Field teams recorded location and effort using Nova Scotia Turtle Daily Effort Cards (Appendix 1Appendix). Data for any individual turtles observed during surveys was recorded using Nova Scotia Turtle Observation cards(Appendix 2). Protocols for data collection and handling of turtles were based on those developed by the Blanding's Turtle Recovery Team (2007).

Data collection for each observed turtle included: notch code, GPS coordinates of location and a location description (position, habitat at capture, perch, etc.), weather conditions, turtle behaviour, and measurements. All survey data was recorded in an internal database and contributed to the central Species at Risk Turtle Database, maintained by Mersey Tobeatic Research Institute (MTRI).

Notch codes were used to mark each individual turtle, and were assigned to CARP by MTRI staff. Notch codes 451 to 500 were assigned to CARP staff. Left and right marginal scutes are assigned specific values (Appendix 3) which when summed, provide an individual turtle ID number. A ½" triangular file was used to file notches on previously un-notched turtles.

5.2 Radio Telemetry

Radio transmitters were attached to the carapace of individual turtles using methods developed by the Blanding's Turtle Recovery Team (2007). Transmitters were glued to the rear marginal scutes of the carapace using epoxy. New turtles identified as candidates for radio telemetry were transported to the CARP office in a 40L plastic bin. After the transmitter was attached, turtles were held for a maximum 24 hours to provide time for the epoxy to set. Turtles were then transported back to and released at location where they were collected.

Two turtles were equipped with radio transmitters prior to the 2016 field season. Three additional transmitters were available for use and were equipped to new individuals during the 2015 field season. One new transmitter was donated in June 2016. Transmitter units have approximately an 18 month lifespan, after which they must be removed in order to avoid having units expire while they are attached to turtles and subsequently lost. Units can then be refurbished for future re-use.

Radio telemetry was conducted semi-weekly at a minimum between May and October, with more frequent sessions focused on reproductive females during the nesting season. Telemetry sessions were conducted through November 2016 to identify overwintering sites and

concluded once turtles were consistently identified in overwintering sites. Individual turtle observations were recorded on Nova Scotia Turtle Observation Cards (Appendix 2) and survey efforts recorded on Nova Scotia Turtle Daily Effort Cards (Appendix 1). Telemetry data was recorded in an internal database and contributed to the central Species at Risk Turtle Database.

5.3 Nest and emergence surveys

Nest surveys were conducted based on methods established by the Blanding's Turtle Recovery Team (2007). Surveys were conducted at sites with previously documented nesting activity, or in areas with known females of reproductive age and suitable nesting habitat. Nesting surveys were conducted throughout June, and effort was recorded using Nova Scotia Turtle Daily Effort Cards (Appendix).

Data about individual turtles observed nesting or attempting to nest was recorded on Nova Scotia Turtle Nesting Observation Cards (Appendix). Morphometric data was collected only after females had completed nesting activity. Protective nest covers were placed on all nests where oviposition was observed, in order to prevent nest predation.

Confirmed nests were monitored daily, beginning 60 days after oviposition. Nest monitoring effort was recorded on Turtle Emergence Effort Cards. In the case of hatchling emergence, data was collected for the nest site on Turtle Emergence Cards, and individual hatchling data was documented on Turtle Hatchling Observation Cards (Appendix 4). Emerged hatchlings were notched and released on site once data collection was complete.

Nests covers were replaced after the first observation of hatchling emergence, and nests monitored for an additional week. After one week, nests were excavated in order to identify eggs or hatchlings that failed to emerge. In the case that emergence was not observed, nests were excavated after 120 days. All data was recorded in an internal database and contributed to the central Species at Risk Database.

5.4 Stewardship Plans

Stewardship plans were developed collaboratively between CARP and private land owners and managers. Potential properties were selected based on known sightings of wood turtles, presence of wood turtle habitat(s), and landowner interest in active participation in the project. An effort was made to engage a number of landowners within the same community, to address stewardship issues at a larger scale than individual properties.

A property assessment form was developed to guide data collection for each property. Information collected included habitat types present on the property, a description of key habitat features, and specific threats to wood turtles on or near the property. Geospatial information was collected using a handheld computer and ArcPad GIS software. Data

collected included boundaries of habitat types and locations of important habitat features. This data was used to produce property specific habitat maps using ArcGIS. Stewardship actions were recommended based on the outcomes of property assessments, taking landowner/manager property goals and objectives for their property into consideration. Recommendations were linked to specific habitat type of features identified on the property maps.

5.5 Public Outreach and Education

A variety of educational and outreach materials were developed for the project. Materials were developed in order to achieve a broad range of objectives, including raising awareness about wood turtles and threats to their population in the Annapolis River watershed, increasing awareness about the Wood Turtle Monitoring and Stewardship Project, engaging landowners in stewardship actions, and engaging members of the public in volunteer actions.

Outreach events targeted public engagement in project activities, including radio-telemetry and visual surveys. Educational events focused on promoting stewardship actions among landowners/managers and raising public knowledge about species at risk, including the wood turtle.

6.0 Results

6.1 Visual Surveys

Visual survey efforts were concentrated from April through June, when conditions were most favourable for observing turtles, with vegetation at its least dense. Thirty visual surveys were completed (Table 2). A total of 177.25 hours were spent on visual surveys, 168.49 hours of which were completed by volunteers (Table 3). Visual survey locations focused on expanding the confirmed range of wood turtles in Aylesford on the South, in Lawrencetown on various tributaries of the Annapolis River, in Kingston along the Annapolis River and in Meadowvale along the Fales River (*maps omitted in this version of the report)*.

Turtles were observed during 10 of these surveys, accounting for nine individuals, 4 of which were first captures (turtles #461,462,463,464) (Table 8). One of the female turtles identified through visual surveys were equipped with radio-transmitter (#461).

Table 2. Visual survey locations, 2016

Date	Section	Section	Turtle observed?	
07-Apr-16	South River	**omitted	NO	
22-Apr-16	South River	**omitted	NO	
29-Apr-16	Fales	**omitted	NO	
01-May-16	South River	**omitted	NO	
01-May-16	South River	**omitted	NO	
02-May-16	South River	**omitted	NO	
10-May-16	South River	**omitted	NO	
10-May-16	South River	**omitted	NO	
10-May-16	South River	**omitted	NO	
11-May-16	Fales	**omitted	YES	unidentified recapture
11-May-16	Fales	**omitted	YES	Sandy *(first capture)*
12-May-16	Fales	**omitted	NO	
15-May-16	Lawrencetown	**omitted	YES	Frederick *(first capture)*
17-May-16	Annapolis	**omitted	YES	Boomer (*recapture)*, Red Rocket (*recapture)*
17-May-16	Annapolis	**omitted	NO	
17-May-16	Lawrencetown	**omitted	NO	
18-May-16	Annapolis	**omitted	YES	Red Rocket (*recapture)*
18-May-16	Annapolis	**omitted	YES	Red Rocket (*recapture)*
18-May-16	South River	**omitted	NO	
19-May-16	South River	**omitted	NO	
19-May-16	South River	**omitted	YES	the Hulk *(recapture)*
20-May-16	Annapolis	**omitted	NO	

20-May-16	Fales	**omitted	NO	
23-May-16	Annapolis	**omitted	YES	Boomer *(recapture)*
25-May-16	Lawrencetown	**omitted	NO	
25-May-16	Lawrencetown	**omitted	NO	
25-May-16	Lawrencetown	**omitted	NO	
26-May-16	South River	**omitted	YES	Sam *(first capture)*
26-May-16	South River	**omitted	YES	Eden *(first capture)*, Linds *(recapture)*
01-Jun-16	Lawrencetown	**omitted	NO	

** *data omitted for public report*

Table 3. Visual survey effort, 2016

Area	Section	Total Effort (hours)	Volunteer Effort (hours)
Annapolis	CFB Greenwood	48	45
	Kingston boat launch	11	11
	Middleton	2.5	2.5
	Palmer Rd	2	2
Fales	Meadowvale	21.9	20.24
	Rocknotch Rd	12.5	12.5
	Tremont Mtn Rd	1.5	1.5
Lawrencetown	Eel Weir Brook	22.25	18.75
	Lawrencetown	2	2
	Leonard Rd	3.5	3.5
South River	Aylesford	9	9
	South River	4	4
	Victoria Rd	6	6
	Whitman Rd	31.1	30.5
TOTAL		*177.25*	*168.49*

6.2 Radio Telemetry

Two turtles (#456,458) were equipped with radio-transmitters prior to overwintering between November 2015 and April 2016. Radio-telemetry for these two individuals commenced on April 29, and both individuals were located. The unit on turtle #458 remained attached through the duration of the field season, and overwintering.

One unit was available for use in spring 2016 and was equipped to a new female turtle (#461) found in the Rocknotch Rd. section of the Fales River area. The transmitter remained equipped through overwintering 2016-2017.

Two units were refurbished during spring 2016, and were available for use once received by the CARP office on June 21, 2016. One of these transmitters was attached to a new male (#467) found in the Victoria Rd. section of the South River area. This turtle was found deceased November 2, 2016 and was subsequently removed. The other unit was exchanged with a transmitter that was anticipated to expire in winter 2016 on a female turtle (#456).

One new transmitter unit was donated to CARP. This unit was attached to a new female (#466) found at Briar Patch Nursery, South Berwick. After 13 days of successful radio tracking the turtle was not able to be located, and only a very weak signal could be detected. The site is located near a major powerline corridor, and interference with the signal may be contribution to this issue. The turtle was not observed beyond July 20, 2016 and the transmitter unit remains attached.

Thirty six telemetry field surveys were conducted throughout the 2016 season (Table 4). Effort was increased during the nesting season (late May-June), to increase chances of observing nesting activity. A total of 295 hours of effort were spent conducting radio-telemetry, 240.65 of which were completed by volunteers (Table 5).

Telemetry sessions concluded in November, after the two turtles equipped with radio-transmitters (456, 458) had moved into over-wintering sites. Telemetry was conducted March 2, 2017 to confirm whether turtles remained in the same overwintering positions. All turtles were determined to be in the same locations. Individual turtle observations resulting from both radio-telemetry and visual surveys are presented in section 4.3.

Table 4. Radio-telemetry sessions, 2016

Area	Date	Turtles observed/located?	Comments
Fales	29-Apr-16	YES	Jenny (456)
Fales	04-May-16	YES	Jenny (456)
South River	04-May-16	YES	Miss Chris (458)
Fales	12-May-16	YES	Jenny (456)
South River	15-May-16	YES	Miss Chris (458)
Fales	18-May-16	YES	Jenny (456); Sandy (461)
South River	19-May-16	YES	Miss Chris (458)
Fales	05-Jun-16	YES	Jenny (456); Sandy (461)
South River	05-Jun-16	YES	Miss Chris (458)
Berwick	09-Jun-16	YES	Raindrop (466)
Berwick	10-Jun-16	YES	Raindrop (466)
Berwick	12-Jun-16	YES	Raindrop (466)
Berwick	14-Jun-16	YES	Raindrop (466)
Berwick	16-Jun-16	YES	Raindrop (466)
Berwick	18-Jun-16	YES	Raindrop (466)
Berwick	20-Jun-16	YES	Raindrop (466)
Berwick	22-Jun-16	NO	
Berwick	04-Jul-16	NO	
South River	04-Jul-16	YES	Miss Chris (458)
Fales	07-Jul-16	YES	Jenny (456); Sandy (461)
South River	07-Jul-16	YES	Miss Chris (458); Ping (467)
Fales	18-Jul-16	YES	Jenny (456); Sandy (461)
South River	22-Jul-16	YES	Miss Chris (458); Ping (467)
Fales	26-Jul-16	YES	Jenny (456); Sandy (461)
South River	18-Aug-16	YES	Miss Chris (458); Ping (467)
Fales	31-Aug-16	YES	Jenny (456); Sandy (461)
South River	31-Aug-16	YES	Miss Chris (458); Ping (467)
South River	15-Sep-16	YES	Miss Chris (458); Ping (467)
Fales	02-Oct-16	YES	Jenny (456)
South River	03-Oct-16	YES	Sandy (461)
South River	03-Oct-16	YES	Miss Chris (458)
Fales	21-Oct-16	YES	Sandy (461)
South River	21-Oct-16	YES	Miss Chris (458)
Fales	02-Nov-16	YES	Jenny (456); Sandy (461)
South River	02-Nov-16	YES	Miss Chris (458); Ping (467)*mortality*
Fales	02-Mar-16	YES	Jenny (456) Sandy (461)

Table 5. Radio telemetry effort, 2016

Area	Section	Total effort (hours)	Volunteer effort (hours)
Berwick	Briar Patch	19	11.5
Fales	Meadowvale	12.5	11.7
	Rocknotch Rd	103.6	85
South	Victoria Rd	6	4
River	Whitman Rd	153.9	128.45
TOTAL		295	240.65

Table 6. Radio transmitter unit data

Serial Number	Date shipped to CARP	Date Attached to turtle	Frequency	Turtle #	Turtle name	Anticipated expiry	Date removed	Date shipped for refurbishing
183540								
		11-May-16	172.992	461	Sandy	May-16	*still attached*	
	23-Oct-14	Oct/Nov 2014	172.992	452	Red Rocket	May-16	09-Aug-15	
	14-May-13	09-Jul-13	172.992	471	Oli	Jan-15	14-Oct-14	*sent for refurbishing*
183539	21-Jun-16	02-Nov-16	172.932	456	Jenny	Dec-17	still attached	
	14-May-13	05-May-15	172.932	458	Ms Chris	Nov-14	24-Jul-15	*sent for refurbishing April 11, 2016*
		03-Jun-13	172.932	500	Annie	Nov-14	25-May-15	
	14-May-13	27-May-13	172.932	548	Jules	Nov-14	03-Jun-13	
74247	23-Oct-14	21-May-15	172.401 (.402)	456	Jenny	Nov-16	*02-Nov-16*	*in office*
		12-Apr-13	172.402	608	Hannley	Oct-14	06-Oct-14	*sent for refurbishing*
74252	21-Jun-16	07-Jul-16	172.520	467	Ping	Mar-18	2-Nov-16 (mortality)	*in office*
	21-Jan-14	ca. 16 September 2014	172.520	608	Hannley	Jun-15	27 July, 2015	*sent for refurbishing April 11, 2016*
		May-14	172.520	455	Jimmy		16-Sep-14	
		29-Apr-13	172.522	566	Little Miss	Jan-14	06-Sep-13	*sent for refurbishing*
		10-Jul-12	172.522	523	Earl	Jan-14	29-Apr-13	
74257	16-Jul-15	24-Jul-15	172.664	458	Ms Chris	Jan-17	*still attached*	*season*
		30-Apr-13	172.665	452	Red Rocket		28-Oct-14	*sent for refurbishing*
		26-Apr-13	172.665	451	Boomer		30-Apr-13	
	donated from MTRI	08-Jun-16	172.639	466	Raindrop	Nov-17	*still attached*	

6.3 Turtle observations

During the 2016 field season a total of 20 individual turtles were observed through visual surveys, nesting surveys, radio-telemetry, or incidental to radio-telemetry (Table 8), seven of these individuals were first captures. Since 2012 CARP has observed and notched a total of

41 individual turtles (Appendix 6). A summary of all observations is presented in Table 9 (maps have been omitted in this version of the report).

Table 7. Survey methods and resulting observations

Sighting method	Individuals observed*	Total Observations	First captures
Visual survey	10	12	5
Radio-telemetry	6	45	0
Incidental to radio-telemetry	4	4	1
Nesting survey	4	10	0
Incidental (other)	4	4	1

*Individual turtles were potentially observed using multiple-methods

Table 8. Individual turtles observed, 2016

Turtle #	Name	Notch Code	Sex	Age Class	Area	Section	Date of first capture/	# observations 2016	Sighting method(s)	Reproductive female?
452	Red Rocket	L11-R2,8,9	F	A	Annapolis	Bridge St	recapture	2	I,V	√
453	Brucie	L11-R2,8,9,11	M	J	Fales	Meadowvale	recapture	1	I	
456*	Jenny*	L11-R2,8,9,10	F	A	Fales RIver	Meadowvale	recapture	12	R	√
457	Lucky Lady	L10-R2,8,9	F	A	Annapolis	Lawrencetown, Paradise Bridge	recapture	2	N, L	√
458*	Miss Chris*	L10, R2,8,9,11	F	A	South River	Whitman Rd.	recapture	17	R,N	√
459	Nina	L10,11-R2,8,9	F	A	South River	Whitman Rd.	recapture	1	N	√
500*	Annie	L0-R2,3	F	A	Annapolis	Lawrencetown	recapture	3	N	√
520	May	L9, R2,3	F	A	South River	Whitman Rd.	recapture	1	I	
522	The Hulk	L9,11-R2,3	M	A	South River	Whitman Rd.	recapture	1	I	
566	Little Miss	L9,11-R2,3,8,10	F	A	South River	Whitman Rd.	recapture	1	V	
451	Boomer	R2,8,9,11	M	A	Annapolis	Bridge St., CFB Greenwood	recapture	3	I,V	
464	Eden	L9-R2,8,10	F	A	South River	Victoria Rd	26-May-16	1	V	
523	Earl	L9,11-R2,3,11	M	A	South River	Whitman Rd	recapture	1	I	
462	Frederick	L2,8-R9,11	M	A	Lawrencetown	Eel Weir Brook	15-May-16	1	V	
545	Linds	R2,3,8,10,11	F	A	South River	Whitman Rd	recapture	2	V	√
467	Ping*	L9,10-R2,8	M	A	South River	Whitman Rd, Victoria Rd	07-Jul-16	4	I,R	
466	Raindrop*	L9,11-R2,8,10	F	A	Berwick	Briar Patch	07-Jun-16	9	I,R	√
606	Randy	L3,11-R2,10	M	A	South River	Victoria Rd	26-May-16	1	V	
463	Sam	L9,11-R2,8,11	U	J	South River	Whitman Rd	26-May-16	1	V	
461	Sandy	L9-R2,8,11	F	A	Fales River	Rocknotch Rd	11-May-16	10	V,R	

*denotes turtles equipped with radio transmitters

Table 9. Summary of annual observations 2012-present

Year	Area	Section	Individuals observed	First Captures	Males	Females	Undetermined Sex	Nesting females	Adults	Juveniles
2016	Total		19	6	6	12	1	3	18	1
2016	Annapolis	*omitted*	2	0	1	1	0	0	2	0
2016	Berwick	*omitted*	1	1	0	1	0	0	1	0
2016	Fales	*omitted*	3	1	1	2	0	0	3	0
2016	Lawrencetown	*omitted*	3	1	1	2	0	2	3	0
2016	South River	*omitted*	10	3	3	6	1	2	9	1
2015	Total		18	4	6	12	0	6	15	3
2015	South River	*omitted*	11	2	4	7	0	2	9	2
2015	Annapolis	*omitted*	1	0	0	1	0	1	1	0
2015	Annapolis	*omitted*	4	0	1	3	0	2	4	0
2015	Fales	*omitted*	2	2	1	1	0	1	1	1
2014	Total		17	9	8	7	2	3	14	3
2014	South River	*omitted*	6	1	3	2	1	0	5	1
2014	Annapolis	*omitted*	6	5	3	3	0	2	6	0
2014	Annapolis	*omitted*	4	2	1	2	1	1	3	1
2014	Black River	*omitted*	1	1	1	0	0	0	1	0
2013	Total		18	9	7	9	3	3	17	1
2013	South River	*omitted*	10	1	5	5	0	2	10	0
2013	Annapolis	*omitted*	5	5	2	3	0	0	5	0
		omitted								
2013	Annapolis	*omitted*	1	0	0	1	1	1	1	0
2013	Black River	*omitted*	2	0	0		2	0	1	1
2012	South River		1	0	1	0	0	0	1	0

Based on data from wood turtle observation cards for all survey methods employed during the 2016 season, individuals were most frequently observed in aquatic habitat (n=20), accounting for 28% of observations and riparian habitats (n=19), accounting for 27% of observations (Figure 1), followed by aquatic habitats and nesting substrate.

It should be noted that certain habitat types are not amenable to observations, and are likely under-represented in the data collected. For example, it is often not possible to visually locate

turtles in aquatic habitats, and agricultural fields are often not surveyed in the late summer until harvest, to avoid causing crop damage. The number of observations for individuals in nesting substrate is biased as a result of the increased effort to observe turtles during nesting events.

The most frequently observed behaviours based on all observations were terrestrial stationary (n=33), accounting for 46% of all observations and aquatic stationary (n=16) accounting for 25% of observations (Figure 2). Again, it should be noted that the number of observed nesting attempts is disproportionately high, as survey efforts targeted turtles that were likely to nest.

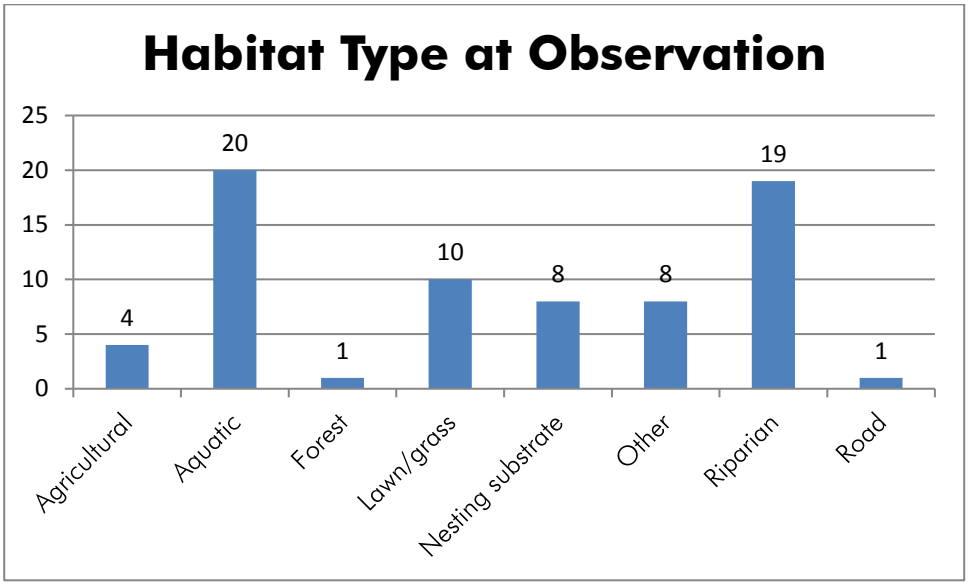

Figure 1. Habitat use during individual observations, 2016

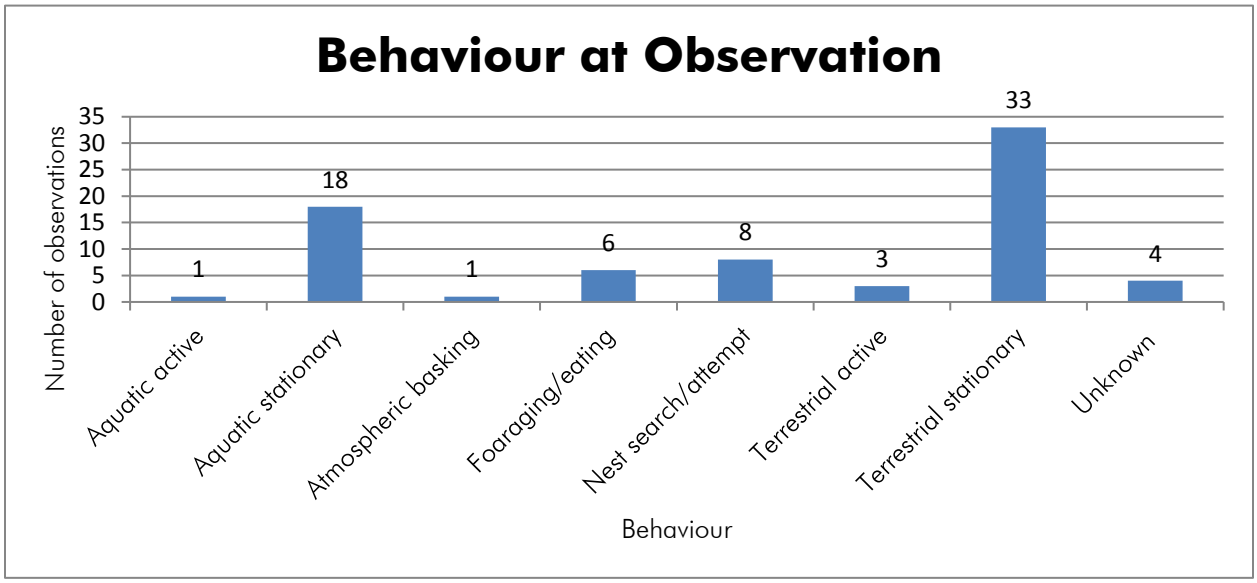

Figure 2. Observed behaviours for all individuals, 2016

Observations for position at observation were grouped into three categories based on air temperature during observation. When temperature was under 10°C turtles are most likely to be found in aquatic habitats, with 80% of individuals founds submerged in the water (Figure 3). 50% of turtles were observed on land when temperatures were between 10 to 20 °C and 84% when temperatures were between 20 to 30 °C. The data also suggests that as temperatures increase, turtles will more frequently be observed covered or partially covered, likely a response to aid in thermoregulation.

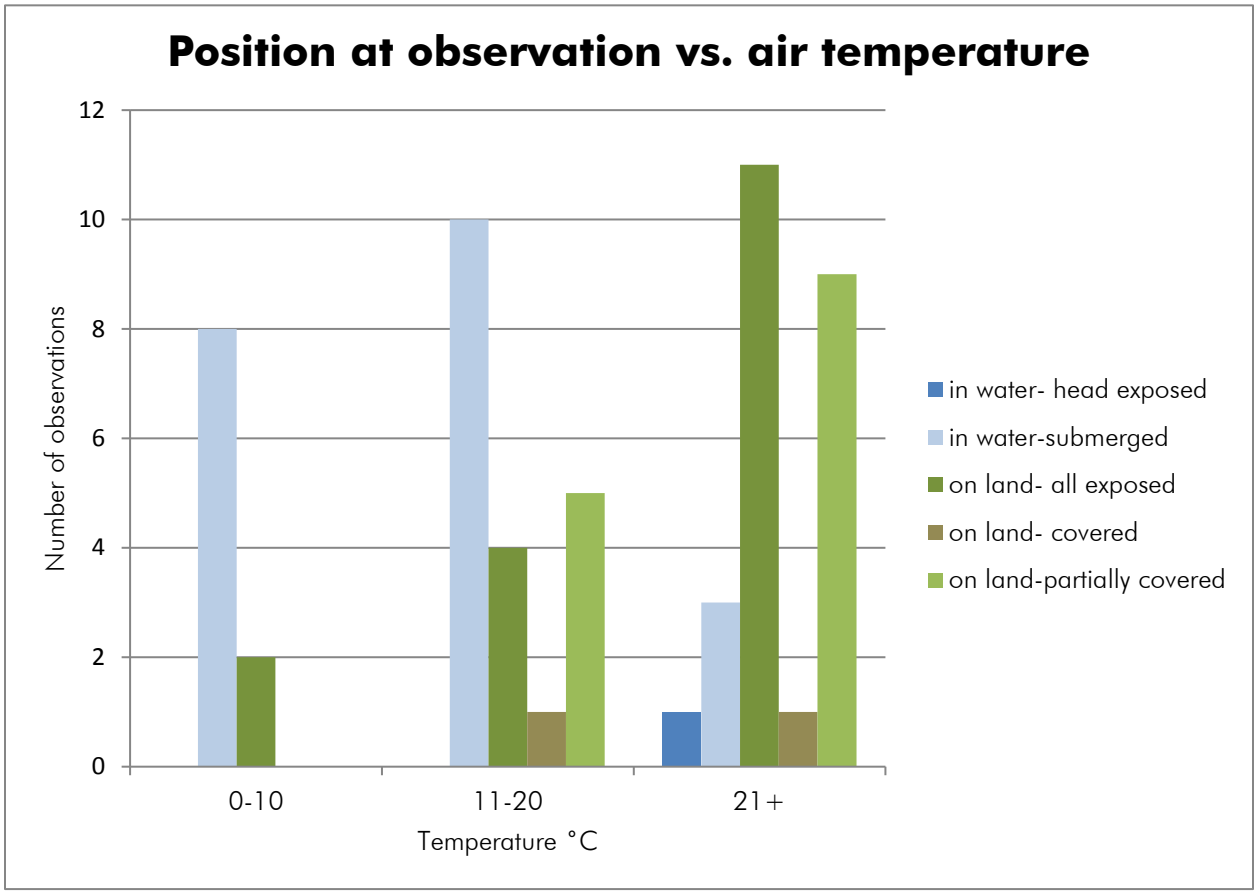

Figure 3. Position at observation vs. air temperature, 2016

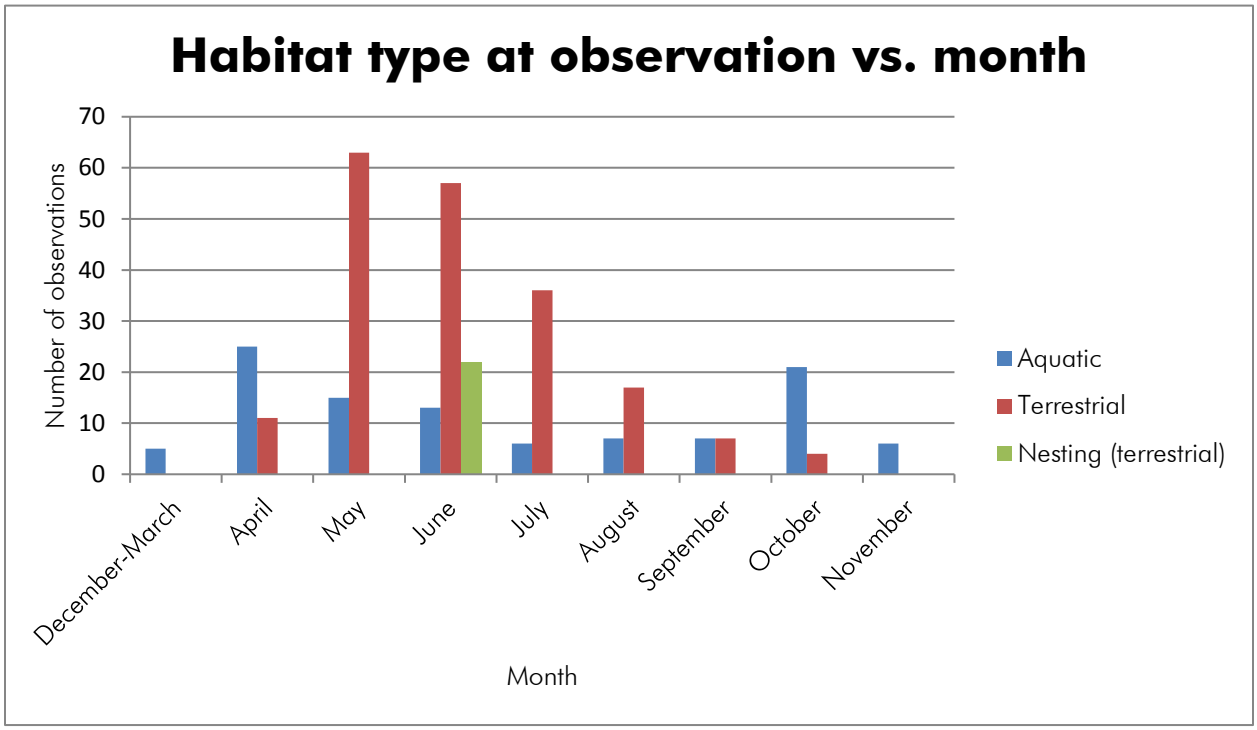

Figure 4. Habitat type vs. month, 2013-2016 observation data

Data from individual observations during the 2013, 2014, 2015 and 2016 field seasons were combined (n=322) in order to analyze habitat use. Observations were classified into three categories based on habitat type: aquatic, terrestrial and nesting (Figure 4). It should be noted that results are heavily biased for a number of reasons; there is disproportionate visual survey effort between months, with effort being concentrated in May and June. Radio-telemetry is the primary survey type conducted from July-March, meaning that only radio-tracking individuals, incidental sightings and public reports are accounted for; additionally there is increased difficulty observing wood turtles when there is dense vegetation in the later summer months. Based on the data presented, wood turtles were most likely to be found in terrestrial habitat between May and August. Between November and March all turtles were observed in aquatic habitat, which is expected as this coincides with the known over-wintering season. This data was also grouped into observed behaviour by month (n=327) (Figure 5).

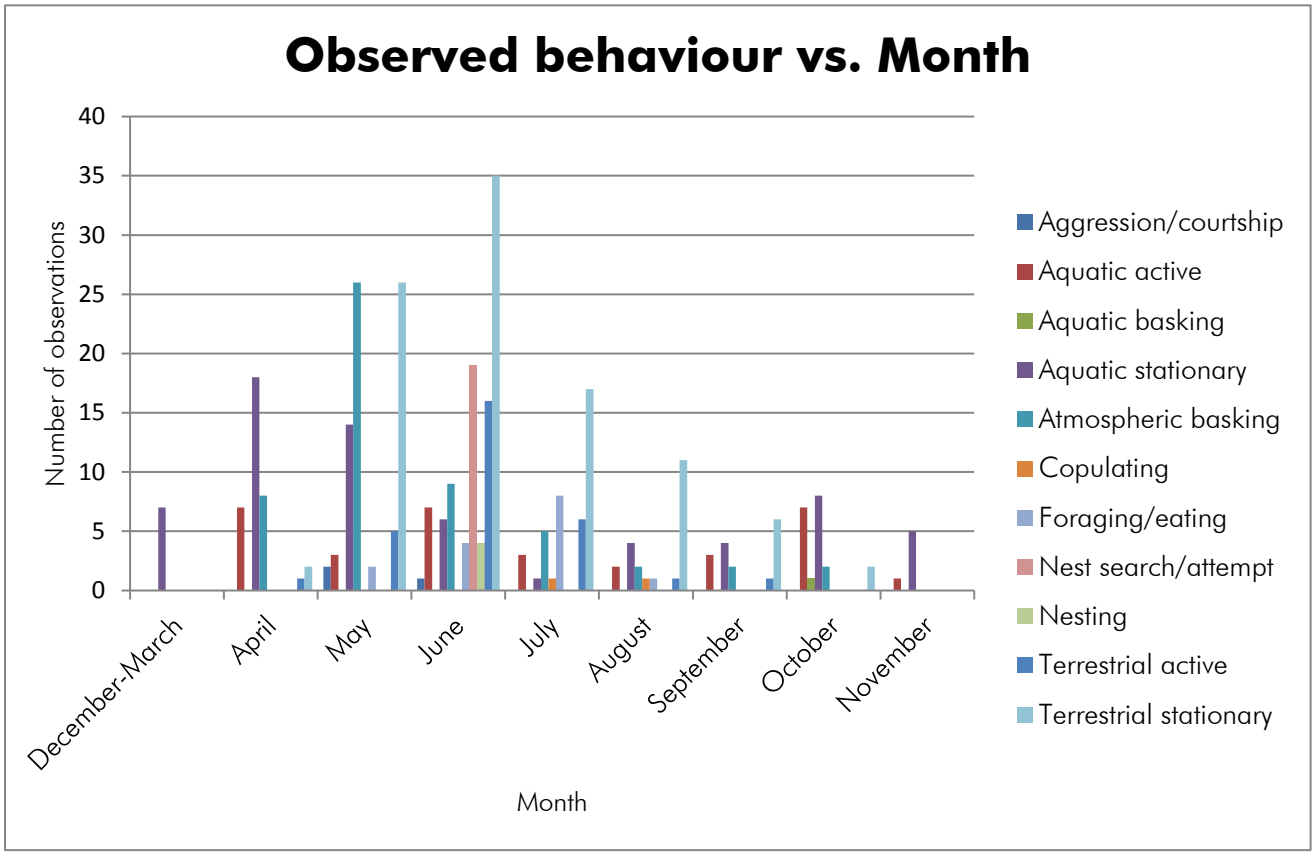

Figure 5. Observed behaviours vs month, based on 2013-2016 data

6.4 Nesting Surveys

Nesting surveys were conducted in areas where past nesting activity has been observed and in areas where females of reproductive age were being radio-tracked. This included sites in the Fales River, Kingston, Lawrencetown, and South River areas (maps have been omitted in this version of the report). A total of 134.74 hours were spent on nesting surveys, with 122.4 of these hours conducted by volunteers.

Four females were observed during nesting surveys, however only 1 turtle was observed laying (Table 10). Observation dates from the 2016 and previous field seasons are presented in Table 11 to inform planning for 2017 nesting surveys.

Two of the females observed making nest attempts have been observed nesting at the Cranberry Bog site in Lawrencetown in past years. Since the 2015 nesting season the cranberry operation has been purchased and was in operation during the 2016 nesting season. It is possible that these turtles nested at this site without being observed by volunteers, but it should also be considered that the increased amount of traffic and disturbance or compaction of substrate from heavy machinery may have displaced nesting females. It is

recommended that if one of these females is observed prior to nesting season in 2017 that a radio-transmitter be equipped to them in case they seek new nesting areas. The cranberry bog site will be targeted for ongoing outreach and stewardship activities.

Table 10. Monitored nest 2016

Mother's #	Mother's Name	Date Laid	Location description/event description	Date emerged/excavated	Section	Incubation time	Clutch Size	Fate of eggs/hatchlings
459	Nina	19-Jun-16	Edge of river, sand, near corn field	19 September 2016- 6 hatchlings emerged	*Omitted*	92 days	8	6 live hatchlings
			Digging start- unknown, first observed 21:30	21 October 2016- 2 unhatched eggs excavated				2 eggs with dead embryos
			Laying start- 23:00					
			Laying finish- 23:30					
			Burying start- 23:35					
			Concealing start- 23:45					
			Nest finish- 01:15 (20/06/16)					

Table 11. Historical nesting observations

Turtle Number	Turtle Name	Section/Area	Past nesting dates	Dates observed 2016
500	Annie	*omitted*	3 June 2013	June 5,6,8
452	Red Rocket	*omitted*	9 June 2015	
457	Lucky Lady	*omitted*	18 June 2014	June 14-24
			24 June 2015	
458	Ms Chris	*omitted*		June 21, 22, 24
459	Nina	*omitted*	16 June 2015	Nested June 19
475	Luna	*omitted*	19 June, 2014	
500	Annie	*omitted*	3 June 2013	June 5,6,8

553	Chip	*omitted*	18 June 2013	
545	Linds	*omitted*	27 June, 2013	

Emergence surveys were conducted by a volunteer living in close proximity to the nest, and commenced after 60 days of incubation. A total of 8 hours of emergence surveys were completed. Hatchling incubation time took 92 days, the same number of days as the eggs from the same mother in 2015. 75 % or six out of eight eggs successfully developed, emerged and were live-released at their nest site. In 2015 the same mother laid a clutch of 9 with no eggs successfully developing and emerging.

6.5 Stewardship Plans

Ten stewardship plans were developed in 2016, in areas of known or suspected wood turtle habitat. In order to promote landscape level stewardship, the community of Lawrencetown was targeted for stewardship plan solicitation. In 2011 the Village of Lawrencetown undertook a pilot project with the Canadian Wildlife Federation resulting in their designation as Canada's first Certified Backyard Habitat Community, making them a prime candidate for engagement in CARP's stewardship initiatives.

Nine stewardship plans were developed for properties within the Village of Lawrencetown. Visual surveys in past years have identified wood turtles in the Lawrencetown area, and visual surveys during spring 2016 led to the observation of one new wood turtle on Eel Weir Brook, and additional historical observation information was collected from local residents, expanding the confirmed range of wood turtles in the Lawrencetown Area.

The properties targeted for stewardship plan development are all located adjacent to Eel Weir Brook, a tributary that acts as a travel corridor for wood turtles, provides habitat for foraging and thermoregulation, and may also provide access to nearby nesting habitat. Eel Weir Brook is surrounded by riparian forest, and stewardship plans created in 2016 emphasized the importance of establishing and/or maintaining a buffer along this watercourse.

ne stewardship plan was developed for a residential property in Brickton. During the initial landowner interview previous sightings of what were believed to be wood turtles were reported. The property is located in an area that was identified through past GIS analysis as potential nesting and foraging/thermoregulation habitat. During an interview with the neighbour on the west side of the property, it was reported that in the past they have observed what they believe to be wood turtles on several occasions. The property owner and neighbour were provided with information to support reporting of future sightings. This property will be targeted for visual surveys in 2017.

6.6 Outreach

Outreach events included a variety of indoor and field-based educational programs, summarized in (Table 11). Over 750 individuals were engaged through outreach and educational events, presentations, field days and training programs during the 2016 field season.

Table 11. Outreach events and presentations, 2016-2017

Event name	Location	Audience	General Description
Fundy Ecology Day, April 1, 2016	Digby	public	Display, dissemination of educational resources. Event included environment related organizations working in the Bay of Fundy area.
Nova Scotia Federation of Anglers and Hunter AGM, April 2, 2016	Truro	Federation of Anglers and Hunters	Project display, wood turtle project presentation, dissemination of educational and outreach materials
Volunteer Training- visual surveys 20 April, 2016 27 April, 2017	 Lawrencetown Kingston	Public, new and/or prospective volunteers	Training on field methodology, project background.
School presentation, May 2, 2016	Middleton Regional High School	Option to opportunities program	Project background and preparation for field days.
Girl guides field day 15 May, 2016	Aylesford	Aylesford and Kingston Guides	Radio-tracking and visual survey
RBC staff field day 15 May, 2016	Lawrencetown	RBC volunteers + families	Visual survey
Scholl field day 19 May, 2016	Aylesford	Middleton Options to Opportunities	Radio-tracking and visual survey
World Turtle Day 23 May, 2016	CFB Greenwood	public	Visual survey
Nest survey Training June 1, 2016 June 6, 2016	 Kingston Lawrencetown	Public, new and/or prospective volunteers	Project background, training in visual survey and emergence survey methodologies
Young Naturalists Club field day 5 June, 2016	Aylesford	Young Naturalists Club + families	Radio-tracking and visual surveys
Annapolis River Watershed Enrichment Week	Multiple locations around Granville Ferry	Champlain Elementary School (all classes)	Multiple scheduled programs, including wildlife and habitat

13-17 June, 2016			
Enrichment program 22 June, 2016	Mickey Hill Provincial Park	Champlain Elementary School	Turtles of Nova Scotia outdoor lesson and activity
Annapolis River Festival July 16, 2016	Jubilee Park, Bridgetown	Public	Project display, educational resources available, volunteer recruitment
Lunch-n-learn, Port Lorne 17 August, 2016	Port Lorne Community Hall	Community members	Project background, dissemination of educational resources
Kids River Walk 27 August, 2016	Paradise	Youth	Outdoor educational programming
Community Wood Turtle Stewardship Presentation 13 September, 2016	Lawrencetown Public Library	Public	Wood turtle stewardship program information, presentations from youth leadership students re: experience with the wood turtle project, dissemination of educational resources.
Class field survey 3 October, 2016	Aylesford	Middleton Options to Opportunities program	Radio-tracking and visual survey
NSCC Sustainability Days 18-20 October, 2016	Middleton, Lawrencetown, Digby NSCC campuses	Students, public	Information display, dissemination of project information and materials, solicitation of volunteers and stewardship program participants
Field survey 21 October, 2016	Fales River	Université St. Anne field biology students	Radio-telemetry training and survey
Lawrencetown Education Center, wood turtle program 21,25,27 October	Lawrencetown Education Center	High school students	Project background presentation, radio-telemetry training, stewardship plan field survey
Annapolis Men's' Group 7 November, 2016	Annapolis Royal	Community members	Project presentation and presentation from youth leadership student about her experience with the wood turtle project
School presentation 2 March, 2017	Middleton Regional High School	Middleton Options to Opportunities program	Project background and preparation for spring field days
Guest speaker: Kings County Wildlife Association 7 march, 2017	Kentville	Kings County Wildlife Association and community members	Project presentation, dissemination of educational resources, solicitation of volunteers and landowners for stewardship program
Turtle Day 11 March, 2017	Mersey Tobeatic Research Institute, Kempt	Public	Displays, presentations and youth programs about turtles
YMCA March Break Camp 15 March 2017	Cornwallis	Youth	Presentation and craft about turtle species at risk
Wester 4-H Tour 15 March 2017	Cornwallis	Youth	Presentation about agri-stewardship and best management practices for wood turtles on agricultural land

A variety of outreach materials were developed and distributed, including:

- Electronic materials
- Project webpage
- Social media posts on Facebook, Twitter and Instagram
- Television, web radio coverage on CBC news
- You-tube video
- Powerpoint presentations
- A blog article by the Annapolis Valley Regional Library

Print materials

- "Wood Turtle Information" English and French versions
- "Wood Turtle Stewardship in Your Backyard" information brochure in English and French
- Posters for all events and volunteer opportunities
- "Have you seen a wood turtle" posters in English and French
- "Have you seen a wood turtle" ID cards in English and French
- Press releases in local newspapers and community publications including the Annapolis Valley Register, and Valley Harvester
- Articles in CARP's Waterstrider newsletter

Public signage

Two interpretive panels were produced (Figure 6), and will be erected in (1) Lawrencetown near Eel Weir Brook and (2) Greenwood near the Fales River, in order to raise community awareness about wood turtles, promote best practices that mitigate threats to wood turtles, and encourage public reporting of sightings.

Six public road signs (Figure 7) were produced; pairs of these signs will be erected in areas where high frequency road crossings are suspected, and/or where turtles are known to nest on the shoulder of roads. These sites include: Bridge St., Kingston, Whitman Rd., Aylesford, and one additional site to be determined. Signs will warn the public that they are in an area of wood turtle habitat, and will increase drivers' awareness about the presence of turtles in the area, and reduced the chance of collisions.

Figure 6. Wood turtle interpretive panel

Figure 7. Wood turtle habitat road sign

7.0 Discussion and Recommendations

7.1 Visual surveys

Collecting morphometric data during a visual survey

Any future visual survey effort should continue to be planned for late April through the end of May, when vegetation is at its least dense. It was noted by staff and project volunteers that as early as the first week of June vegetation severely impeded ability to make visual observations. Continued volunteer training is a good option for reducing the amount of field time required by project staff. It is important that in future years that the project leader(s) continue reiterating the importance of completing effort cards to volunteers, even when turtles are not observed. The development of an online app to record survey effort on phones or tablets in the field may help reduce the number of cases that data is not recorded and/or submitted and the time required following up with volunteers about data card submission.

The development of a standard transect protocol for visual surveys that could be shared by all groups in Nova Scotia would be valuable, as it would allow for data to be compared. This point has been raised during Recovery Team meetings, and is on the agenda to be addressed in 2017. Protocols have been developed for use in the United States (Brown, Cochrane & Moen, 2017).

Future visual survey efforts should be focused on expanding the known range of wood turtles in the Annapolis watershed by targeting areas with little or no past survey effort. It would also be beneficial to document specific threats to individual turtles and their habitat in these areas, in order to inform future outreach and stewardship initiatives, such as candidate sites for interpretive signs or road signs.

The habitat suitability maps developed for CARP in 2014, in combination with public reports and confirmed observations have been used to develop recommendations for areas to target during visual surveys in future years. Sites recommended for targeted survey efforts in 2017 include:

(1) Eel Weir Brook, the Lawrencetown Sewage Treatment facility and adjacent area; One wood turtle was observed along Eel Weir Brook in 2016, and it is likely that there are additional individuals using this area. Four emerged turtle nests were identified at the Sewage Treatment facility, and staff reported observations that match the description of wood turtles, making this a likely nesting area. Any reproductive aged females in

this area would be good candidates for future radio-telemetry, in order to identify travel corridors between foraging and nesting habitat.

(2) McEwan Brook and surrounding area in Brickton; this area is the location of several unconfirmed reports of wood turtles and would expand the confirmed range of wood turtles in the watershed.

(3) Black River, Torbrook; 3 individuals have been previously observed on the Black River, in addition to several unconfirmed reports. One visual survey was conducted in this area in 2016, yielding no observations, but it was noted that the area provides excellent habitat. This area may have good potential for future stewardship plan development.

Youth leadership students radio tracking in Aylesford

7.2 Radio-telemetry

Radio-tracking on a semi-weekly basis was sufficient for gathering general data about habitat use, without losing the approximate location of individuals. Priority for radio-tracking was given to sexually mature females, in order to increase the chances of observing nesting activity. It is recommended that as the project continues, once nesting territories have been identified that transmitters are removed, so that they are available to be equipped to newly identified females. Turtle #456 was observed to be gravid, but not observed nesting. Continued radio-tracking in 2017 may lead to the identification of her nesting habitat.

In 2016 the cranberry bog site in Lawrencetown came under new ownership and resumed commercial operation. This site is known to support 3 nesting females, and while 2 of these females were observed digging test pits, they were not observed nesting at the site. While it is possible that nesting was missed by volunteers, it is also possible that increased commercial activity at the bog made substrate unsuitable for nesting (i.e. compaction from machines) or the increase in activity deterred them from nesting. Radio-tracking one of these females may provide additional information about habitat use patterns, and create the opportunity to more easily identify their nesting area in 2017, particularly if they have been dislocated from their historical nesting area. Additional visual survey effort in the Lawrencetown area is recommended to identify potential individuals for radio-tracking.

In addition to radio-tracking, the addition of GPS tracking of wood turtles would be useful in gathering data about habitat needs and use, as it is not possible to radio-track turtles on a frequent enough basis to gather this information. Two commercial GPS units (i-got-U model

120) have been ordered and will be trialed in May 2017. The units will be modified based on a method presented by Allan et al. (2013), in their study of the brushtail possum. While this method includes the creation of a waterproof coating using marine epoxy, additional considerations may need to be made given the semi-aquatic nature of wood turtles.

A recently emerged hatchling

7.3 Nest and emergence surveys

Nest monitoring and emergence surveys are a relatively simple way to increase recruitment to the local population of wood turtles. Several areas known to support nesting activity have been identified, and should be the focus for nesting surveys in future years. These areas include: the cranberry bog in Lawrencetown; the Sewage Treatment Plant, Lawrencetown; Bridge St., Kingston; the road shoulder along Whitman Road near the South River Bridge; the Whitman Rd./Victoria Rd. survey sections. It is also likely that the private residence on Rocknotch Rd., where turtle #456 was frequently observed, supports nesting activity.

It is often difficult to recruit nest and emergence survey volunteers. These activities take a great deal of time, and rarely result in turtle observations, which may be a deterrent to long-term volunteer participation. Increased effort to emphasize the importance of these volunteer roles in supporting recovery of the species should be made in future years of the program. Targeted recruitment of nest monitoring volunteers who live in close proximity to nesting sites may help address issues with time commitment.

7.4 Stewardship plans

Stewardship plans are an excellent tool for guiding stewardship actions and promoting the implementation of best management practices on private lands. Soliciting new landowners to participate in plan development can be challenging; continued effort to develop relationships with key stakeholder groups, such as agricultural landowners/managers, is required to facilitate future recruitment of landowners.

It is recommended that CARP continue to work collaboratively with the Nova Scotia Federation of Agriculture's Species at Risk Program for Agricultural Lands (SARPAL) wood turtle programme in 2017-2018 to target agricultural landowners in stewardship plan development. This program offers financial incentives of $15,000 for the implementation of best management practices that benefit wood turtles and their habitat.

7.5 Public outreach and education

Youth leadership students assisting with data collection

While CARP's outreach programs have been well attended and the project has received coverage from a variety of local media sources, there is an ongoing need to raise awareness about wood turtles and the threats placing them at risk. It is recommended that active outreach programs such as events, guest presentations, and field days are continued in future years of the project. Continued effort to develop volunteer capacity and recruit new volunteers is another approach that can be used to raise local awareness and encourage participation in stewardship actions.

Including the wood turtle project as a component of CARP's Youth Leading Environmental Change program was an excellent way to engage members of the public in project activities, increase public awareness about the program, and develop local volunteer capacity. It is recommended that a youth leadership component be included in future years of the project. In the Fall of 2016 CARP developed a funding proposal in partnership with St. Mary's Elementary School in Aylesford for the creation of a wood turtle education program that would include both classroom based learning and field activities. Funding was awarded, and this program will be implemented in Spring 2017, and may prove to be an effective method for achieving multiple project deliverables, including increased public education and awareness, increased volunteer commitment, and increased survey effort.

8.0 Project alignment with the Recovery Strategy for the Wood Turtle (*Glyptemys insculpta)* in Canada

In order to support National efforts to recover the wood turtle CARP has aimed to align project activities to the proposed Recovery Strategy for Wood Turtles in Canada. CARP's wood turtle project currently addresses each of the six broad recovery strategies identified. Table 12 provides an outline of the area where CARP's current project aligns with the national *Recovery Strategy*. Once the final version of the Recovery Strategy and subsequent Action Plans are released, CARP should ensure that project objectives and activities continue to align with these documents.

With five years of experience delivering the Wood Turtle Monitoring and Stewardship Project, CARP is in an excellent position to act as a model for other watershed and community based organizations that are interested in becoming involved in the recovery of wood turtles. CARP has developed a broad variety of educational and outreach materials that can be used or adapted to facilitate these types of initiatives. CARP is also in an excellent position to field test new methodologies and tools, such as MTRI's proposed data collection app and the standard transect monitoring protocol being developed by members of the Recovery Team.

Table 12. Recovery Strategy for Wood Turtles in Canada, Adapted from Canada's Recovery Strategy (Environment Canada, 2015)

Broad Strategy for Recovery*	Priority*	General Description of Research and Management Approaches*	CARP Project Alignment
Reduction of adult mortality, injury and illegal collection	Urgent	- Protect Wood Turtle individuals through legislation and regulation tools. - Continue to develop and implement reduction and mitigation techniques (e.g., best management practices) to address threats to individuals. - Develop a federal/provincial strategy to address illegal collection as pets and for consumption.	-development and installation of public signage (e.g. interpretive panels, turtle crossing signs) -development of and implementation support for stewardship plans -collaboration with key stakeholder groups to promote uptake of BMP's

Conservation, management and restoration of habitat	Urgent	- Conserve or manage Wood Turtle habitat through legislation, regulation, administrative and stewardship tools. - Continue to develop and implement reduction and mitigation techniques (e.g., best management practices) to address threats to habitat where required and at a relevant scale. - Promote an integrated habitat management approach at the watershed scale. - Determine habitat restoration needs in streams where Wood Turtle habitat is declining.	-development of and implementation support for stewardship plans - engagement of private landowners and managers in stewardship actions -identification of restoration opportunities on public and private lands, and implementation of restoration activities (e.g. riparian zone restoration)
Communication and outreach	Necessary	- Develop and implement communication strategies appropriate to reduce adult mortality, reduce threats and conserve habitat. - Encourage the transfer and archiving of information and tools, including Traditional Ecological Knowledge (TEK). - Improve and maintain cooperation between stakeholders. - Promote research initiatives on the species.	- development and implementation of a multi-faceted public outreach and education program, including events/presentations, print/electronic educational materials, etc. -contribution to provincial database and data sharing with partner organizations -collaboration with relevant stakeholder groups -creation of opportunities for public engagement in stewardship activities
Improvement of recruitment where needed	Necessary	- Document recruitment needs in streams where the Wood Turtle is declining or where viability is deemed to be compromised. - Improve recruitment (where needed) in streams where the Wood Turtle is declining or where viability is deemed to be compromised.	- nest activity monitoring and documentation across the Annapolis River watershed -nest protection and monitoring to increase recruitment
Surveying and monitoring	Necessary	- Develop and implement provincial monitoring plans. - Develop and promote the appropriate use of standardized protocols (e.g., data collection, handling, marking) and databases.	-monitoring and data collection across the Annapolis River watershed (visual survey, radio-telemetry) -sharing of data through provincial database and with provincial species recovery team -data collection expanding the

		- Improve the knowledge on local populations (e.g., abundance, suitable habitat size, threats, key habitats).	confirmed range of the wood turtle in the Annapolis -collection of data required by ECCC for the identification of critical habitat
Research	Necessary	- Verify the extent of local populations and most appropriate recovery scale. - Determine minimal habitat and population requirements to ensure local population viability (e.g., suitable habitat size, number of mature individuals). - Determine the full range of adverse effects (e.g., indirect effects, knowledge gaps) from identified threats as well as potential threats (including at the watershed scale). - Refine knowledge of habitat needs (e.g., females foraging habitat, brackish water) in order to develop a better understanding of spatial and temporal use.	- identification and documentation of range of wood turtle sub-population(s) in the Annapolis River watershed -identification of specific threats to wood turtles and their habitat -documentation of habitat use and behaviour in the Annapolis River watershed (visual surveys and radio-telemetry)

*as identified in the Recovery Strategy for the Wood Turtle (*Glyptemys insculpta)* in Canada

References

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9.0 Appendices

Appendix 1. Nova Scotia Turtle Daily Effort Card

NOVA SCOTIA TURTLE DAILY EFFORT CARD

Population : _____
Area: _____
Date: _____
Project: _____
Target spp: ☐ Blanding's ☐ Painted ☐ Snapper ☐ Wood

Observers	Vol. Effort*	Observers	Vol. Effort*

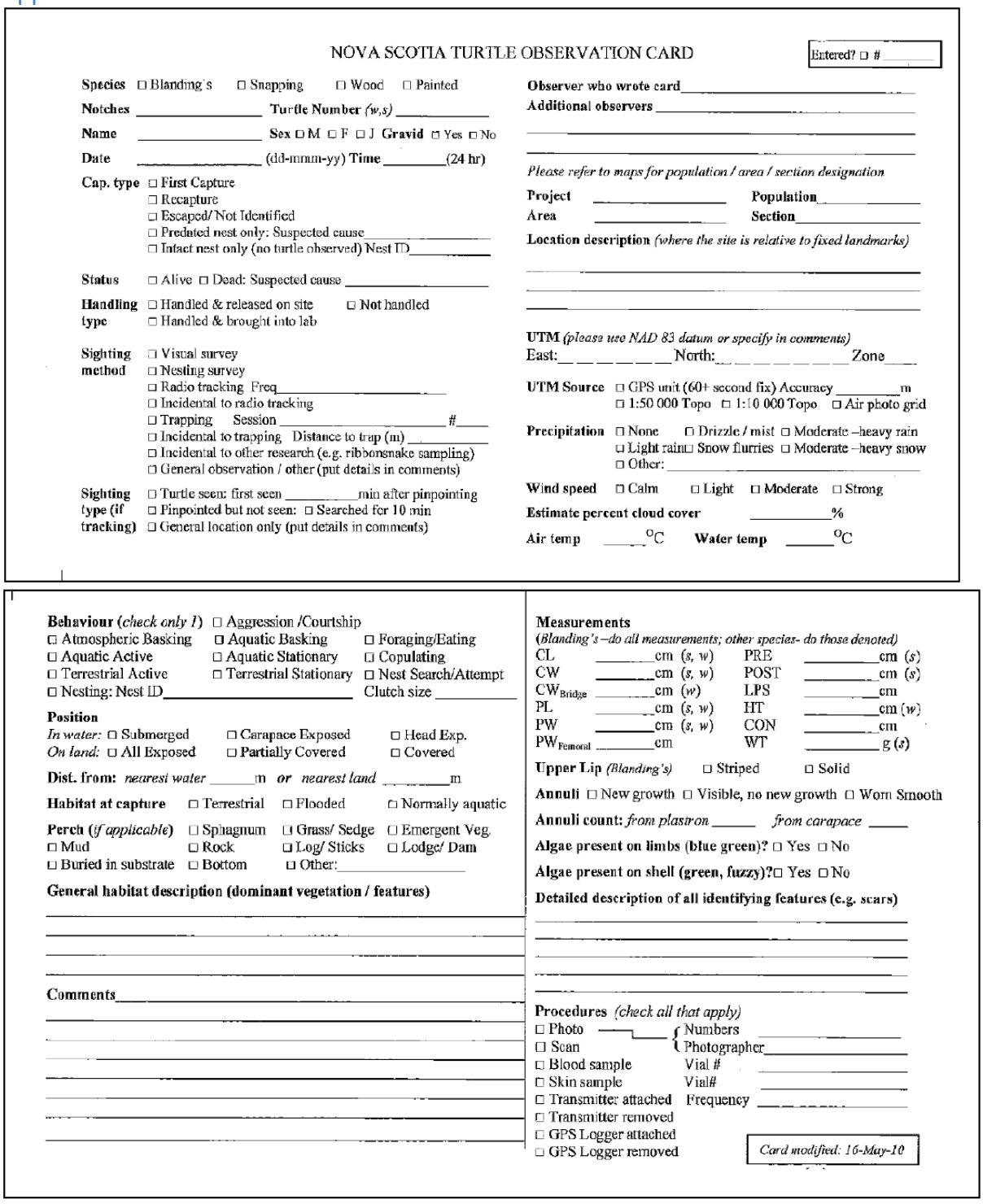
*Total volunteer effort includes on site time, preparation time and travel time

Effort and activities					Weather at start of survey					Trapping details	# Observations				# Nests			
Section Name / Nest Site	Activity **	# Observers	On site time: Time Start (24 hr)	On site time: Time end (24 hr)	Precip **	% Cloud Cover	Wind Speed **	Air Temp	Water Temp	Trap Session ID	Blanding's	Snappers	Painted	Wood	Blanding's	Snappers	Painted	Wood

**Refer to back for activity, precipitation and wind speed codes. Please fill out one observation card for each observation of a Blanding's turtle or wood turtle.

Comments: _____

Appendix 2. Nova Scotia Turtle Observation Card



NOVA SCOTIA TURTLE OBSERVATION CARD

Entered? ☐ #_____

Species ☐ Blanding's ☐ Snapping ☐ Wood ☐ Painted

Notches _____ **Turtle Number** *(w,s)* _____

Name _____ **Sex** ☐ M ☐ F ☐ J **Gravid** ☐ Yes ☐ No

Date _____ (dd-mmm-yy) **Time** _____(24 hr)

Cap. type ☐ First Capture
☐ Recapture
☐ Escaped/ Not Identified
☐ Predated nest only: Suspected cause_____
☐ Intact nest only (no turtle observed) Nest ID_____

Status ☐ Alive ☐ Dead: Suspected cause _____

Handling type ☐ Handled & released on site ☐ Not handled
☐ Handled & brought into lab

Sighting method ☐ Visual survey
☐ Nesting survey
☐ Radio tracking Freq_____
☐ Incidental to radio tracking
☐ Trapping Session _____ #____
☐ Incidental to trapping Distance to trap (m) _____
☐ Incidental to other research (e.g. ribbonsnake sampling)
☐ General observation / other (put details in comments)

Sighting type (if tracking) ☐ Turtle seen: first seen _____min after pinpointing
☐ Pinpointed but not seen: ☐ Searched for 10 min
☐ General location only (put details in comments)

Observer who wrote card_____
Additional observers _____

Please refer to maps for population / area / section designation

Project _____ **Population**_____
Area _____ **Section**_____

Location description *(where the site is relative to fixed landmarks)*

UTM *(please use NAD 83 datum or specify in comments)*
East:__ __ __ __ __ __ North:__ __ __ __ __ __ __ Zone____

UTM Source ☐ GPS unit (60+ second fix) Accuracy _____m
☐ 1:50 000 Topo ☐ 1:10 000 Topo ☐ Air photo grid

Precipitation ☐ None ☐ Drizzle / mist ☐ Moderate –heavy rain
☐ Light rain ☐ Snow flurries ☐ Moderate –heavy snow
☐ Other: _____

Wind speed ☐ Calm ☐ Light ☐ Moderate ☐ Strong

Estimate percent cloud cover _____%

Air temp _____°C **Water temp** _____°C

Behaviour *(check only 1)* ☐ Aggression /Courtship
☐ Atmospheric Basking ☐ Aquatic Basking ☐ Foraging/Eating
☐ Aquatic Active ☐ Aquatic Stationary ☐ Copulating
☐ Terrestrial Active ☐ Terrestrial Stationary ☐ Nest Search/Attempt
☐ Nesting: Nest ID_____ Clutch size _____

Position
In water: ☐ Submerged ☐ Carapace Exposed ☐ Head Exp.
On land: ☐ All Exposed ☐ Partially Covered ☐ Covered

Dist. from: *nearest water* _____m *or nearest land* _____m

Habitat at capture ☐ Terrestrial ☐ Flooded ☐ Normally aquatic

Perch *(if applicable)* ☐ Sphagnum ☐ Grass/ Sedge ☐ Emergent Veg.
☐ Mud ☐ Rock ☐ Log/ Sticks ☐ Lodge/ Dam
☐ Buried in substrate ☐ Bottom ☐ Other:_____

General habitat description (dominant vegetation / features)

Comments_____

Measurements
(Blanding's –do all measurements; other species- do those denoted)

CL	_____cm	*(s, w)*	PRE	_____cm	*(s)*
CW	_____cm	*(s, w)*	POST	_____cm	*(s)*
CW_{Bridge}	_____cm	*(w)*	LPS	_____cm	
PL	_____cm	*(s, w)*	HT	_____cm	*(w)*
PW	_____cm	*(s, w)*	CON	_____cm	
$PW_{Femoral}$	_____cm		WT	_____g	*(s)*

Upper Lip *(Blanding's)* ☐ Striped ☐ Solid

Annuli ☐ New growth ☐ Visible, no new growth ☐ Worn Smooth

Annuli count: *from plastron* _____ *from carapace* _____

Algae present on limbs (blue green)? ☐ Yes ☐ No

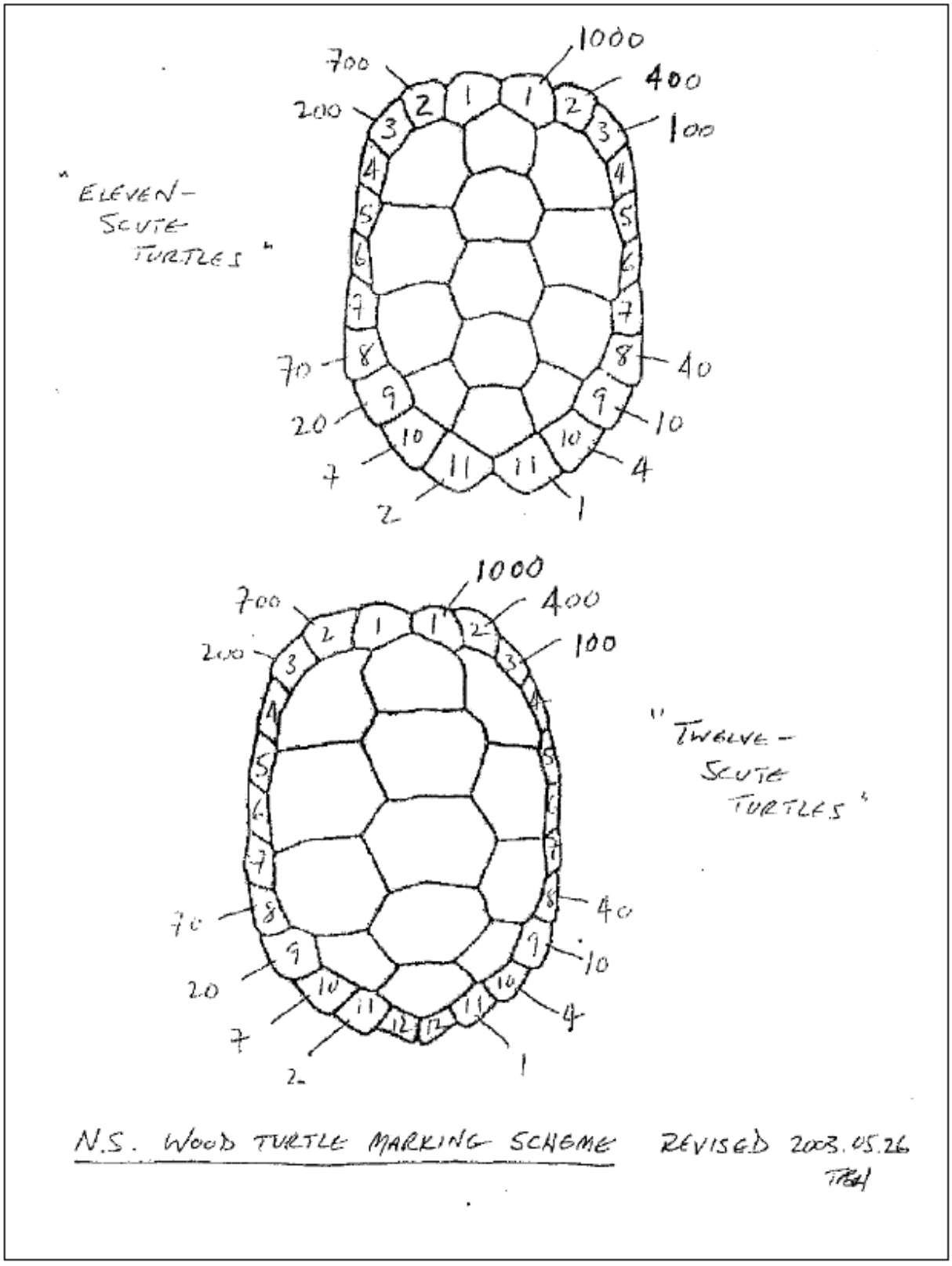
Algae present on shell (green, fuzzy)? ☐ Yes ☐ No

Detailed description of all identifying features (e.g. scars)

Procedures *(check all that apply)*
☐ Photo { Numbers _____
☐ Scan { Photographer_____
☐ Blood sample Vial # _____
☐ Skin sample Vial# _____
☐ Transmitter attached Frequency _____
☐ Transmitter removed
☐ GPS Logger attached
☐ GPS Logger removed

Card modified: 16-May-10

Appendix 3. Nova Scotia wood turtle notch code scheme



Appendix 4. Turtle Nesting Observation Card

Turtle Nesting Observation Card

Species ☐ Blanding's turtle ☐ Snapping turtle ☐ Wood turtle ☐ Painted turtle

Turtle ID ____________________

Turtle Name ____________________

Date ____________________

Population ____________________

Area ____________________

Section ____________________

Observers ____________________

____

____

Capture type
☐ New turtle (no prior notches)
☐ Previously notched turtle
☐ Turtle not identified
☐ Predated nest only
☐ Intact nest only (no turtle seen)

Handling type
☐ Not handled
☐ Handled and released on site
☐ Handled and brought into lab
If handled, was the turtle gravid?
☐Yes ☐No

Method
☐ Nesting survey
☐ Incidental to tracking
☐ Radio tracking (Freq________________)
☐ Other (*please put details in comments*)
If tracking, how closely did you track the turtle?
☐ Turtle Seen ☐ Pinpointed ☐ General area

Weather at first sighting
Precip ☐ None ☐ Light rain ☐ Drizzle/mist ☐ Heavy rain
Wind ☐ Calm ☐Light ☐ Moderate ☐Strong
Cloud cover __________ %

Activities: IF THE TURTLE NESTED, PLEASE FILL OUT DETAILS ON BACK. **UTM source:** ☐GPS unit ☐Air photo with grid ☐Other

Time	UTM East	UTM North	Activity	Air	Location (where on the site was the turtle) and comments
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________
______	3_ _ _ _ _ _	4_ _ _ _ _ _ _	______	______	____________________

Activity key FP: Face ploughing; D: Digging; L: Laying; B: Burying; C: Concealing; TB: Terrestrial basking; AB: Aquatic basking; NS: Nest search; AA: Aquatic active; TA: Terrestrial active; TS: Terrestrial stationary; AS: Aquatic stationary; ML: Move onto land; RW: Return to water; G: Gone

Nest Details
Don't forget to fill out the turtle ID on the front of the card!

Nest ID ____________________ # Eggs _______
☐ Nest Protected ☐ Eggs collected for laboratory incubation
☐ Nest Predated ☐ Nest Moved

UTM of nest (NAD 83 datum):
Easting _ _ _ _ _ _ Northing _ _ _ _ _ _ _
UTM source : ☐ GPS unit Accuracy _________m
☐ Air photo in kit ☐ Other________________

Digging Start: __________ Laying Start: __________
Laying Finish: __________ Burying Start: __________
Concealing Start: __________ Nest Finish: __________

Egg#	Time	Egg#	Time
____	________	____	________
____	________	____	________
____	________	____	________
____	________	____	________
____	________	____	________
____	________	____	________
____	________	____	________

Dist. to water: ________m Dist. to veg: ________m
Height above water: ________m
Temperature loggers: ____________________

Identifying features -*Check the turtle list to confirm features*

____

____

____

____

Measurements

CL ________cm
CW ________cm
CW_{Bridge} ________cm
PL ________cm
PW ________cm
$PW_{Femoral}$ ________cm
PRE ________cm
POST ________cm
LPS ________cm
HT ________cm
CON ________cm
WT ________g

Procedures *(check all that apply)*

☐ Photo Numbers ________________
Taken by________________
☐ Scan
☐ Blood sample Vial __________
☐ Skin sample Vial __________
☐ Transmitter attached Freq. __________
☐ Transmitter removed
☐ GPS Logger attached
☐ GPS Logger removed

Comments

____

____

____

____

____

____

____

Card modified 17-May-2011

Appendix 5. Turtle Emergence Card

Blanding's Turtle Emergence Card

Nest description

Nest ID: _____
Mother's ID: _____
Date laid: _____
Clutch est. at laying: _____
Population: _____
Area: _____
Section: _____

UTM (*NAD 83*) East:3_____ North:4_____
UTM Source ☐ GPS unit (60+ second fix) Accuracy _____m
☐ 1:50 000 Topo ☐ 1:10 000 Topo ☐ Air photo with grid
Location description_____

Nest Status ☐ Full emergence ☐ Partial emergence ☐ No emergence
Cause of failure ☐ Nest flooded ☐ Nest predated ☐ Unknown ☐ Other_____

Summary

Total emerged hatchlings: _____
Total excavated live hatchlings: _____
Total excavated dead hatchlings: _____
Total excavated eggs: _____
Estimated number of escapees: _____
Clutch size estimate at emergence: _____

Total incubated eggs: _____
Incubated eggs that emerged: _____
Total captive reared: _____
Total tracked after emergence: _____
Date excavated: _____
Nest depth (cm): _____

Comments (include excavation details)

_____

Card modified 05-Sep-2007

Hatchling and Egg Measurements (mm)

Hatchling notch code_____

#	CL / egg length	CW / egg width	PL	PW	Weight turtle/ egg (g)	Date (dd-mmm-yy)	Status	Fate	Vial	Deformities and comments (include individual hatchling ID and frequency, if given)

Status: 1. Live hatchling that emerged from nest
2. Live hatchling that was excavated from nest
3. Dead hatchling that emerged prior to death
4. Dead hatchling found in nest cavity
5. Undeveloped egg
6. Egg with dead embryo
7. Egg with live embryo

Fate: 1. Hatchling released at nest site
2. Hatchling released away from nest (put details in comments)
3. Hatchling brought in to lab (put date died or released in comments)
4. Egg incubated
5. Egg opened and discarded
6. Egg or hatchling reburied

Add a T after fate if the hatchling had a transmitter attached

Appendix 6. Notched individuals

Notched Individuals, Annapolis River Watershed

Turtle #	Name	Notch Code	Sex	Age Class	Area	Section	Date of first capture	Reproductive age?
205	Hank	L3-1 R10,11	M	A	South River	*omitted*	May 20, 2015	
451	Boomer	R2,8,9,11	M	A	Annapolis	*omitted*	April 26, 2013	
452*	Red Rocket*	L11-R2,8,9	F	A	Annapolis	*omitted*	30 April, 2013	√
453	Brucie	L11-R2,8,9,11	M	J	Fales	*omitted*	21-May-15	
453	Stubs	L11-R2,8,9,11	M	A	South River	*omitted*	7 May, 2013	
454	Nick Jr.	R2,8,9,10	M	A	Annapolis	*omitted*	recapture	
454	Little C	R2,8,9,10	U	J	Black River	*omitted*	May 8, 2013	
455	Jimmy	R2,8,9,10,11	M	A	Annapolis	*omitted*	April 30, 2014	
456*	Jenny*	L11-R2,8,9,10	F	A	Fales	*omitted*	21-May-15	√
457	Lucky Lady	L10-R2,8,9	F	A	Lawrencetown	*omitted*	12 June 2014	√
458*	Miss Chris*	L10, R2,8,9,11	F	A	South River	*omitted*	28-May-15	
459	Nina	L10,11-R2,8,9	F	A	South River	*omitted*	14-Jun-15	√
460	Sarah	L9-R2,8	F	A	Greenwood	*omitted*	18 June, 2014	
461	Sandy	L9, R2,8,11	F	J	South River	*omitted*	May 11, 2016	
462	Frederick	L2,8-R9,11	M	A	Lawrencetown	*omitted*	May 15, 2016	
463	Sam	L9,11-R2,8,11	U	J	South River	*omitted*	May 26, 2016	
464	Eden	L9-R2,8,10	M	A	South River	*omitted*	May 26, 2016	
466	Raindrop	L9,11-R2,8,10	F	A	Berwick	*omitted*	June 7, 2016	√
467	Ping	L9,10-R2,8	M	A	South River	*omitted*	July 7, 2016	
470	Princess	L8-R2	F		Annapolis	*omitted*	May 10, 2013	
471	Oli	L8-R2,11	M		Annapolis	*omitted*	10 May 2013	
472	Baby Ben	L8,11-R2	U	J	South River	*omitted*	8 May, 2014	
475	Luna	L8-R2,10,11	F	A	Annapolis	*omitted*	13 June, 2014	√
480	Mapleton	L8-R2,9	M	A	Annapolis	*omitted*	29 July, 2014	
490	Mr. Squishy	L8,9-R2	M	A	Black River	*omitted*	3 August, 2014	
497	Mikjik'jij	L8,9,10-R2	U	J	Annapolis	*omitted*	2 September 2014	
500*	Annie*	L0-R2,3	F	A	Annapolis	*omitted*	2 June 2013	
520	May	L9, R2,3	F	A	South River	*omitted*	14 May 2006	
522	The Hulk	L9,11-R2,3	M	A	South River	*omitted*	6 May 2013	
523	Earl	L9,11-R2,3,11	M	A	South River	*omitted*	July 12, 2012	
545	Linds	R2,3,8,10,11	F	A	South River	*omitted*	22 June, 2013	√
548	Jules	L10-R2,3,8,11			South River	*omitted*	27 May, 2013	
552	Big Foot	L11-R2,3,8,11			South River	*omitted*	7 May, 2013	

553	Chip	L11-R2,3,8,9,11	F	A	South River	*omitted*	18 June 2013	√
565	Moe	L9-R2,3,8,10,11	M	A	South River	*omitted*	recapture	
566	Little Miss	L9,11-R2,3,8,10	F	A	South River	*omitted*	29 April, 2013	
568	Rudy	L9,10-R2,3,10	M	A	South River	*omitted*	29 April, 2013	√
572	Myrtle	L9,11- R2,3,8,10	F	J	South River	*omitted*	20 May, 2015	
605	Jeanie	L3-R2,10,11	F	J	South River	*omitted*	26 April, 2009	
608*	Hannley*	L3,10-R2,11	M	A	South River	*omitted*	4 April, 2010	